Final

Integrated Water Quality Assessment for Florida: 2018 Sections 303(d), 305(b), and 314 Report and Listing Update

Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

June 2018

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Letter to Floridians

Florida Department of Environmental Protection

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June 11, 2018

Dear Floridians:

It is with great pleasure that we present to you the 2018 Integrated Water Quality Assessment for Florida. This report meets the Federal Clean Water Act reporting requirements; more importantly, it presents a comprehensive analysis of the quality of our waters. This report would not be possible without the monitoring efforts of organizations throughout the state, including state and local governments, universities, and volunteer groups.

Florida has substantially more monitoring stations and water quality data than any other state in the nation. Monitoring organizations conduct hundreds of individual waterbody assessments each year. Annually, the department uses these data to evaluate waterbody health. These efforts allow us to understand the state's water conditions, make decisions that further enhance our waterways, and focus our efforts on addressing problems.

We encourage all those interested in Florida' s waterways to read this report, gain a better understanding of Florida's water quality conditions, and engage in local efforts to protect and restore water quality. It has been a pleasure for us to compile this information for your use.

Regards,

Thomas M. Frick, Director
Division of Environmental Assessment and Restoration

Acknowledgments

This document was prepared by staff in the following offices of the Florida Department of Environmental Protection:

Division of Environmental Assessment and Restoration

- ***Bureau of Laboratories:***
  - Biology Section.
- ***Water Quality Standards Program:***
  - Standards Development Section.
  - Aquatic Ecology and Quality Assurance Section.
- ***Water Quality Assessment Program:***
  - Watershed Assessment Section.
  - Watershed Monitoring Section.
- ***Water Quality Evaluation and Total Maximum Daily Loads (TMDL) Program:***
  - Groundwater Management Section.
  - Watershed Evaluation and TMDL Section.
- ***Water Quality Restoration Program:***
  - Watershed Planning and Coordination Section.

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µg/L	Micrograms Per Liter
µS/cm	MicroSiemens Per Centimeter
AEQA	Aquatic Ecology and Quality Assurance
ATAC	Allocation Technical Advisory Committee
BACTAC	Bacteria Technical Advisory Committee
BioRecon	Biological Reconnaissance
BMAP	Basin Management Action Plan
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BRL	Banana River Lagoon
C&SF	Central and Southern Florida
$CaCO_3$	Calcium Carbonate
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
cm	Centimeter
CWA	Clean Water Act
dbHydro	Database Hydrologic (South Florida Water Management District Database)
DEAR	Division of Environmental Assessment and Restoration
DEP	Florida Department of Environmental Protection
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
EC	Emerging Contaminant
E. coli	Escherichia coli
EPA	U.S. Environmental Protection Agency
ERC	Environmental Regulation Commission
F.A.C.	Florida Administrative Code
FC	Fecal Coliform
FDACS	Florida Department of Agriculture and Consumer Services
FDOH	Florida Department of Health
FGS	Florida Geological Survey
F.S.	Florida Statutes
FWC	Florida Fish and Wildlife Conservation Commission
FWRA	Florida Watershed Restoration Act
FWRI	Fish and Wildlife Research Institute
FWRMC	Florida Water Resources Monitoring Council
FY	Fiscal Year
GIS	Geographic Information System
HA	Habitat Assessment
HAB	Harmful Algal Bloom

HAL	Health Advisory Levels
HDG	Human Disturbance Gradient
HUC	Hydrologic Unit Code
IRL	Indian River Lagoon
ISD	Insufficient Data
IWR	Impaired Surface Waters Rule
LVS	Linear Vegetation Survey
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
mg/kg	Milligrams Per Kilogram
mg/L	Milligrams Per Liter
mL	Milliliter
MST	Microbial Source Tracking
N	Nitrogen
N/A	Not Available or Not Applicable
NEEPP	Northern Everglades and Estuaries Protection Program
NELAC	National Environmental Laboratory Accreditation Conference
NHD	National Hydrography Dataset
NMS	National Marine Sanctuary
NNC	Numeric Nutrient Criteria
NO_3	Nitrate
NSILT	Nitrogen Source Inventory and Loading Tool
OAWP	FDACS Office of Agricultural Water Policy
OFS	Outstanding Florida Spring
OPO_4	Ortho-Phosphate
OSTDS	Onsite Sewage Treatment and Disposal System
P	Phosphorus, Dissolved (as P)
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCU	Platinum Cobalt Unit
PEC	Probable Effects Concentration
PLRG	Pollutant Load Reduction Goal
POR	Period of Record
ppb	Parts Per Billion
PQL	Practical Quantitation Limit
PRP	Potentially Responsible Parties
PWS	Public Water System
QA	Quality Assurance
QC	Quality Control
qPCR	Quantitative Polymerase Chain Reaction

RAP	Reasonable Assurance Plan
ROC	Regional Operation Center
RPS	Rapid Periphyton Survey
SCI	Stream Condition Index
SFWMD	South Florida Water Management District
SEAS	Shellfish Environmental Assessment Section
SMP	Strategic Monitoring Plan
SOC	Synthetic Organic Chemical
SOP	Standard Operating Procedure
STCM	Storage Tank Contamination Monitoring
STORET	Storage and Retrieval (Database)
SWAPP	Source Water Assessment and Protection Program
SWIM	Surface Water Improvement and Management (Program)
TEC	Threshold Effects Concentration
Th-232	Thorium-232
THMs	Trihalomethanes
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSI	Trophic State Index
U-238	Uranium-238
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
Water-CAT	Florida Water Resource Monitoring Catalog
WBID	Waterbody Identification (Number)
WIN	Florida Water Information Network
WMD	Water Management District
ZOD	Zone of Discharge

Executive Summary

Contents

- The **Introduction** describes the federal assessment and reporting requirements met by this report.
- **Chapter 1** summarizes current issues of environmental interest and ongoing water quality initiatives.
- **Chapter 2** summarizes the Status Monitoring Network results from 2014 through 2016 and describes long-term trends in surface water and groundwater quality.
- **Chapter 3** summarizes significant surface water quality findings for Strategic Monitoring, including the attainment of designated uses.
- **Chapter 4** discusses the state's total maximum daily load (TMDL) program and priorities.
- **Chapter 5** discusses the state's basin management action plan (BMAP) program.
- **Chapter 6** presents significant groundwater quality findings, summarizes groundwater contaminant sources, and characterizes groundwater–surface water interaction.
- The **Appendices** contain important background information and supporting data.

Purpose

This report provides an overview of the status and overall condition of Florida's surface water and groundwater quality. It also addresses the 305(b) and 303(d) reporting requirements of the federal Clean Water Act. Section 305(b) requires each state to report every two years to the U.S. Environmental Protection Agency (EPA) on the condition of its surface waters, and Section 303(d) requires each state to report on its impaired waterbodies (those not meeting water quality standards). Using the information from all the states, EPA provides the U.S. Congress with a national inventory of water quality conditions and develops priorities for future federal actions to protect and restore aquatic resources.

Issues of Environmental Interest and Water Quality Initiatives

Chapter 1 discusses current issues of environmental interest and ongoing water quality initiatives, including:

- The continued use of chemical wastewater tracers such as sucralose to identify pollutant sources and trends in the environment, and to differentiate between natural and man-made sources.
- The estimation of the extent of Florida's fresh waters potentially affected by wastewaters and pesticides.
- The implementation of a pilot project designed to examine the presence of priority emerging contaminants (ECs).

- The advancement of high-quality, integrated water resource monitoring statewide through projects being carried out by three Florida Water Resources Monitoring Council workgroups.

- The continued implementation of microbial source tracking (MST) to investigate and identify potential sources of elevated fecal indicator bacteria in waterbodies.

- The continued monitoring of saltwater and freshwater harmful algal blooms (HABs).

- The implementation of numeric nutrient criteria (NNC) to address the nutrient enrichment of surface water from sources such as septic tanks, nonpoint source runoff, livestock waste, and increased fertilizer use on farm and urban landscapes.

- The development of a Nitrogen Source Inventory and Loading Tool (NSILT) to identify and quantify the major sources contributing nitrogen to impaired springs and spring runs.

- An ongoing, comprehensive South Florida canal study to improve the understanding of aquatic life in canals and to develop better assessment tools.

- The adoption of several new water quality criteria and reclassifications of some estuarine waters to provide additional protection for shellfish harvesting, as part of a Triennial Review of Florida's water quality standards.

- Improved water quality modeling coordination between the Florida Department of Environmental Protection (DEP) and the water management districts (WMDs).

Statewide Probabilistic and Trend Monitoring Results

Chapter 2 summarizes results generated from the Status Monitoring Network from 2014 through 2016 and from the Trend Monitoring Network from 1999 through 2014. Of note, the state's surface water and groundwater resources are predominantly in good condition, based on the indicators assessed. The results indicate areas that may need further assessment but also areas that can be slated for protection rather than remediation.

The Status Monitoring Network uses an EPA-designed probabilistic strategy to estimate, with known confidence, the water quality of the fresh waters in Florida. These waters include rivers, streams, canals, lakes, and groundwater resources. DEP collects standard physical/chemical and biological metrics in these waters, as applicable, and assesses the entire state each year. The nutrient thresholds used in these analyses are numeric values and are used only for comparison. They are not applied according to the applicable rules to identify compliance or impairment.

Probabilistic analyses of the state's lake and flowing water resources indicate that nutrient enrichment is most prevalent in lakes and canals. An evaluation of the chlorophyll *a* thresholds indicates that roughly 40 % of the state's lake area is expected to sustain healthy aquatic life. For flowing waters, about 60 % of the state’s canal miles and 70 % of the state's river/stream miles can sustain healthy aquatic life based on the total nitrogen (TN) threshold. Using the total phosphorus (TP) threshold, about 50% of the state’s canal miles and 80 % of the state's river/stream miles can sustain healthy aquatic life. **Appendix A** contains the tables for the 2014–16 Status Network regional results.

The Trend Monitoring Network consists of 76 surface water stations (e.g., rivers and streams) and 49 groundwater wells located throughout Florida that are sampled either monthly or quarterly. For surface water stations showing nutrient trends, more stations have increasing than decreasing trends. For 1) nitrate + nitrite as N there are increasing in trends about 37% of stations, decreasing trends in about 16% of stations, and no change in about 47% of stations; for 2) Kjeldahl nitrogen (TKN) there are increasing trends in about 30% of stations, decreasing trends in about 23% of stations, and no change in about 47% of stations; and for 3) Chlorophyll *a* there are increasing trends in about 45% of stations, decreasing trends in about 26% of stations, and no change in about 29% of stations. For groundwater, of those wells having trends, a number show increasing trends for saltwater encroachment indicators (calcium, sodium, chloride, and potassium) and for rock-matrix indicators (calcium, magnesium, potassium, and alkalinity) with an associated decreasing trend in pH.

Designated Use Support in Surface Waters

Chapter 3 summarizes the state's designated use support determinations and results based on surface water quality assessments performed under the Impaired Surface Waters Rule (IWR). **Appendix B** lists the state's water quality classifications.

This report summarizes results for those assessments performed through 2012, which include the second cycle for Basin Groups 2 through 5 and the third cycle for Basin Group 1. The assesments do not reflect water quality criteria changes for nutrients, recreational bacteria, and dissolved oxygen (DO) (as percent saturation).

Based on the assessments performed, DEP assessed 4,393 waterbody segments and found 2,440 were impaired. Of these impairments, 1,893 segments required a TMDL. The most frequently identified causes of impairment include DO, fecal coliform, and nutrients.

TMDL Program and Priorities

TMDLs, discussed in **Chapter 4**, must be developed for waterbody segments placed on DEP's Verified List of Impaired Waters. They establish the maximum amount of a pollutant that a waterbody can assimilate without causing exceedances of water quality standards. In Florida, nutrient TMDLs are adopted as site-specific Hierarchy 1 water quality criteria, as defined in the NNC implementation document.

To date, DEP has adopted a total of 409 TMDLs. Of these, 224 were developed for DO, nutrients, and/or un-ionized ammonia, 179 were developed for bacteria, and 5 were for other parameters such as iron, lead, and turbidity. In addition, the state has adopted a statewide TMDL for mercury, based on fish consumption advisories affecting over 1,100 waterbody segments.

BMAP Program

Chapter 5 provides information on adopted BMAPs. A BMAP is the "blueprint" for restoring impaired waters by reducing pollutant loadings to meet the allowable loadings established in a TMDL. It represents a comprehensive set of strategies, including permit limits on wastewater facilities, urban and agricultural best management practices (BMPs), conservation programs, financial assistance, and revenue-generating activities designed to implement the pollutant reductions established by the TMDLs. These broad-based plans are developed in collaboration with local stakeholders and rely on local input and local commitment for development and successful implementation. They are adopted by DEP Secretarial Order to be enforceable. To date, DEP has adopted 25 BMAPs and is developing or updating numerous BMAPs statewide.

Appendix D contains important background information, including an overview of the Florida Watershed Restoration Act (FWRA), Impaired Surface Waters Rule (IWR), and the statewide cyclical watershed management approach through which DEP develops and implements TMDLs and BMAPs. **Appendix E** describes the IWR methodology for evaluating impairment.

Groundwater Monitoring and Assessment

Chapter 6 summarizes groundwater monitoring results from 2015 through 2016. Overall, the water quality of the evaluated potable aquifers was good for parameters monitored by DEP. Monitoring showed total coliform bacteria and sodium (a salinity indicator) achieved standards less frequently (81 % and 85 % of the samples statewide, respectively). Metals and nitrate achieved standards in almost all samples (99 % statewide median).

DEP evaluated groundwater contaminants of concern using recent sampling data from public water system (PWS) wells. More exceedances were detected in PWS samples compared with those reported in the 2016 Integrated Report. Data from August 2015 through July 2017 showed that radionuclides (a natural condition), salinity (as sodium), and primary metals (mostly arsenic and lead) exceeded primary drinking water standards most often in untreated water (but not the water that is delivered to customers, which meets drinking water standards). Nitrate remains the biggest issue in surface waters that receive significant inputs of groundwater, since it can cause excessive algal growth and can impair clear water systems, particularly springs.

Introduction

This report provides an overview of the status and overall condition of Florida's surface water and groundwater quality. Under the federal Clean Water Act (CWA), the U.S. Environmental Protection Agency (EPA) and its state partners have developed an integrated assessment to address water quality monitoring strategies, data quality and quantity needs, and data interpretation methodologies. Florida uses this Integrated Report to document whether water quality standards are being attained, document the availability of data for each waterbody segment, identify water quality trends, and provide management information for setting priorities to protect and restore Florida's aquatic resources. The report must be submitted to EPA every two years and meet the following requirements:

- Section 305(b) of the CWA requires states and other jurisdictions to submit water quality reports to the EPA. These 305(b) reports describe surface water and groundwater quality and trends, the extent to which these waters are attaining their designated uses (such as drinking water and recreation), and any major impacts to these water resources.

- Section 303(d) of the CWA also requires states to identify waters that are not supporting their designated uses, submit to EPA a list of these impaired waters (referred to as the 303[d] list), and develop total maximum daily loads (TMDLs) for them. A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet its designated uses.

- Section 314 of the CWA requires states to report on the status and trends of significant publicly owned lakes.

Federal guidance and requirements state that the following information should be provided:

- The extent to which the water quality of the state's waters provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows for recreational activities in and on the water.

- An estimate of the extent to which CWA control programs have improved or will improve water quality and recommendations for future actions.

- An estimate of the environmental, economic, and social costs and benefits needed to achieve CWA objectives and an estimate of the date for such achievements.

- A description of the nature and extent of nonpoint source pollution and recommendations needed to control each category of nonpoint sources.

- An assessment of the water quality of all publicly owned lakes, including lake trends, pollution control measures, and publicly owned lakes with impaired uses.

DEP's 2016 document, *Elements of Florida's Water Monitoring and Assessment Programs*, contains background information on Florida's water resources, monitoring and assessment approach, and water resource management programs.

Chapter 1: Issues of Environmental Interest and Water Quality Initiatives

The Florida Department of Environmental Protection (DEP) works with many different programs and agencies throughout the state to address issues and problems affecting surface water and groundwater quality and quantity. These responsibilities are implemented through a variety of activities, including planning, regulation, watershed management, the assessment and application of water quality standards, nonpoint source pollution management, ambient water quality monitoring, groundwater protection, educational programs and land management. This chapter describes some major issues of environmental interest and ongoing water quality initiatives being undertaken primarily by DEP.

Monitoring Emerging Contaminants (ECs) and Pesticides

There is public concern that unregulated contaminants, and their degradants, may be causing human health and ecological impacts as low levels of these compounds increasingly are being detected in water resources throughout the world. Commonly are referred to as ECs, they include food additives, pharmaceuticals, personal care products, hormones, pesticides, detergents, plasticizers, flame retardants, and polycyclic aromatic hydrocarbons (PAHs). Some are being introduced into the aquatic environment through treated wastewater, as standard wastewater treatment technologies do not remove many of these types of contaminants.

Based on recommendations from an internal workgroup, in 2009 DEP began developing lab methodologies for ultra-trace level analyses of compounds to be used as indicators for wastewater and pesticides. Compounds include the artificial sweetener sucralose; the pharmaceuticals acetaminophen, carbamazepine, and primidone; and the pesticide imidacloprid. These compounds are hydrophilic, or attracted to water, and therefore may be highly mobile in the freshwater environment.

DEP's Division of Environmental Assessment and Restoration (DEAR) added wastewater tracers and imidacloprid to its Status and Trends Monitoring Networks (discussed in **Chapter 2**) to investigate the levels of ECs in Florida's fresh waters. DEAR sampled statewide for sucralose from both monitoring networks in 2012, and for sucralose, acetaminophen, carbamazepine, primidone, and imidacloprid from the Status Monitoring Network in 2015.

Analyses of the 2015 samples from 528 sites showed sucralose in more than 50 % of the canal, river, stream, and large lake resources. Acetaminophen, carbamazepine, and primidone were most prevalent in rivers, with 30 % of river kilometers containing at least one of these compounds. Imidacloprid was found in 50 % or more of the canal and river resources, and was the only compound found to exceed published toxicity or environmental effects standards.

Geospatial analysis showed that the presence of sucralose and imidacloprid were significantly related to the percentage of urban land use, and to the percentage of urban and agricultural land use in watersheds, respectively.

In 2013 a DEP workgroup recommended a study to determine the potential biological effects of ECs on aquatic organisms by employing screening assays to detect ecological effects, such as estrogenic activity. The priority ECs were selected based on factors such as global presence, exposure to humans and wildlife, bioaccumulative and toxic effects, persistence in the environment, and suspected endocrine disruption. The main objective of the pilot study, initiated in 2017 and still under way, is to evaluate the efficiency and effectiveness of methods using specific biomarkers to assess waterbody biological health. Site selection was determined based on the frequency and magnitude of sucralose detections at DEAR's Surface Water Trends Monitoring Sites. A total of four sites were selected, three in rivers flowing south into Florida from Georgia. The study employs a whole water chemical screening monitoring design, coupled with bioassays, to detect genotoxic and estrogenic activity. The results are pending.

DEAR also sampled the Status Monitoring Network unconfined aquifers in 2015, flowing waters in 2016, and lakes in 2017 for a full suite of organo-nitrogen and organo-phosphorus pesticides, in addition to wastewater indicators. Ultra-trace concentrations of at least one pesticide compound were commonly found (59 of 120 wells, 222 of 240 flowing surface water sites, and 157 of 168 lake sites). The most frequently detected pesticide compounds were (1) the herbicides atrazine, metolachlor, hexazinone, fluridone, bromacil, simazine, metibuzin, and ametryn; (2) the fungicide metalaxyl; and (3) the insecticides imidacloprid and fipronil. While none of the compounds exceeded published acute toxicity standards for aquatic organisms, or human drinking water standards, imidacloprid was found in concentrations known to impact the mayfly family Baetidae.

Using Chemical Wastewater Tracers to Identify Pollutant Sources

Monitoring for chemical tracers in the environment is a powerful tool for characterizing potential anthropogenic pollutants and helping to identify sources. As instrument technology and the scientific understanding of chemical tracers continue to improve, it is now possible in many situations to use laboratory techniques to help detect unique chemical tracers present in certain types of waste streams. Based on a weight-of-evidence approach, these tracers can help identify or eliminate potential pollutant sources and thus provide a "toolbox" for developing a preponderance of evidence for environmental investigations.

DEP currently uses a number of chemical tracers with uniquely desirable characteristics for identifying sources of industrial, agricultural, pharmaceutical, hydraulic fracturing, and other ECs. By analyzing samples for tracer compounds and other known environmental pollutants, the combined information has proven extremely useful in identifying specific sources and pollution trends. Commonly used human wastewater tracers include artificial sweeteners (sucralose), drugs (carbamazepine and rimadone), pain relievers (acetaminophen), and fragrances (tonalide).

The compound sucralose (trade name Splenda) is almost ideal as a tracer. It is present in virtually every domestic wastewater discharge at detectable levels (10 to 40 parts per billion [ppb]), does not occur naturally, has low toxicity, is highly soluble in water, is not effectively metabolized or removed by wastewater treatment processes, and persists in the environment (with a 1- to 2-year environmental half-life). DEP's monitoring of sucralose has helped identify sites for more intensive study, track contaminant migration routes in surface water and groundwater, and distinguish between abatable and nonabatable sites based on the impacts of human activities.

To obtain the greatest value from chemical tracer data, it is important to collect samples over time and, preferably, before a potential polluting event to obtain a baseline measurement. Multiple samples collected over time can help establish trends and help correct sampling site or process variability. The usefulness of chemical tracers can be amplified by monitoring for more than one tracer simultaneously—e.g., where investigators take advantage of half-life, treatment survivability, or other unique qualities of multiple tracer compounds. The presence of short-lived tracer compounds may provide temporal information, while the presence of tracer compounds known to be destroyed by wastewater treatment may indicate a raw wastewater source. Ultimately, all the chemical tracer data can be used together to render a decision based on the weight of evidence.

Although sucralose has proven to be a useful tracer of human wastewater, it also has limitations in some applications. For lakes with low water turnover rates, for example, sucralose's long environmental half-life means that concentrations can build up over time, making it difficult to identify specific areas of wastewater inputs. Additionally, because sucralose survives wastewater treatment processes, it is not useful for differentiating treated municipal wastewater from untreated wastewater derived from leaking sewer lines or even aggregate septic tank leachate. In such cases, acetaminophen and/or carbamazepine have proven useful. Both have shorter environmental half-lives and may be effectively removed by treatment processes. Using tracers with different characteristics in conjunction with one another has allowed for better differentiation among sources.

In most cases chemical tracers are used as broad aggregate wastewater indicators rather than as an individual source identification tool. However, by using multiple tracers and trend data, coupled with microbial source tracking (MST) tools, it may be feasible to identify specific sources. More generally, employing chemical tracers allows environmental investigators to better focus attention on specific areas of interest, without committing finite resources to remediate naturally occurring conditions.

Supporting Florida Water Resources Monitoring Council Projects

To ensure maximum coordination and efficient resource use, DEP sponsors the Florida Water Resources Monitoring Council (FWRMC), a coordinating body of 20 federal, state, local, and volunteer monitoring organizations. The council promotes information sharing among stakeholders that monitor and manage marine waters, fresh surface waters, and groundwater in Florida. Its activities include the following:

- Coordinate water resource data collection to reduce redundant data.
- Improve data sharing by increasing data comparability among member agencies, affiliates, and stakeholders.
- Provide input into developing the Florida Water Information Network (WIN) data repository.
- Improve the scientific and legal defensibility of collected data.
- Compile and disseminate data concerning the hydrological, chemical, physical, and biological properties of Florida's waters.
- Ensure that water managers have the best science available for decision making.

The council accomplishes its goals through projects by its workgroups. Between 2014 and 2017, the council had three active workgroups:

- The Catalog Workgroup collaborates with the University of South Florida Water Institute on refining and populating the Florida Water Resource Monitoring Catalog (Water-CAT). Released in 2014, Water-CAT is an interactive, searchable, web-enabled database of state, federal, local, private sector, and volunteer organizations that monitor water resources in Florida. It serves as the "first cut" in locating ongoing monitoring efforts for water resource managers, policy makers, and the public. Currently, Water-CAT contains metadata on over 1,300 active projects managed by over 100 organizations.

- The Salinity Monitoring Network Workgroup focuses on the encroachment of saline water into Florida's freshwater resources. Over the past several decades, salinity concentrations have increased both locally and regionally. Two major causes of these increases are below-normal rainfall during the late 1990s and groundwater pumping from aquifers. The workgroup's current objectives are as follows:

- Periodically produce May and September groundwater level percentile ranking maps.
- Develop a Coastal Salinity Monitoring Network.
- Develop a salinity groundwater quality index.
- Develop special sampling protocols for monitoring wells that are completed close to the freshwater/saltwater interface.

- The Continuous Monitoring Workgroup concluded in mid-2017. It assisted DEP's Continuous Monitoring Workgroup in completing a statewide survey of continuous monitoring equipment users, equipment/operational information, sampling procedures, and data availability. The survey results can be found on the Florida Lake Management Society website, under Resources.

Monitoring Harmful Algal Blooms (HABs)

A HAB is a rapidly forming, dense concentration of algae, diatoms, or cyanobacteria (blue-green algae) that may pose a risk to human health through direct exposure, the ingestion of contaminated drinking water, or the consumption of contaminated fish or shellfish. Cyanoacteria pose a potential risk to aquatic ecosystems when present in large quantities, as their decomposition contributes to oxygen depletion, or hypoxia, which can lead to increased mortality in local populations. In addition, some toxins may be harmful to domestic animals, wildlife, and fishes. Even nontoxic blooms can create low oxygen levels in the water column and/or reduce the amount of light reaching submerged plants.

It is currently impossible to predict when a bloom will occur and whether it will be toxic, making response, monitoring, and communication about a bloom complicated. There are federal guidelines for cyanobacteria toxins in recreational waters, but blooms can change quickly, making the guideline thresholds difficult to use for bloom management decisions. By the time toxin results are available, they may no longer be representative of the current bloom conditions in the waterbody. Therefore, public outreach regarding cyanobacteria blooms uses a precautionary approach that minimizes risk by taking the most conservative action early, rather than waiting for more detailed information. For example, if the water is green or otherwise highly discolored, assume it is unsafe; keep people, pets and livestock out of the water; and do not use bloom water for spray irrigation. While this approach may result in some unnecessary loss in recreational opportunities, the department believes it is better to err on the side of protecting the public from adverse health impacts rather than basing action levels on results that may no longer be representative of the actual risk.

Some HAB species are condensed by wind and current to form a thick layer of surface scum along the shoreline. Other species fill the entire water column rather than floating at the surface. Still others move throughout the water column to take advantage of varying levels of nutrients and light. Changes in the weather can cause blooms either to drop lower into the water column and out of sight, or rise to the surface.

Although it is well known that elevated nutrients can cause HAB's, there are other factors that may exacerbate or mitigate the effects of those nutrients on algal growth. For instance, warm temperatures, reduced flow, wind-driven mixing of the water column and sediments, the absence of animals that eat algae, aquatic resource management practices (e.g. vegetation control on canal banks), and previous occurrences of blooms in an area may help to promote HAB's where the nutrients alone would not cause a bloom. Likewise, factors such as strong flow and heavy shading can prevent an algal bloom from occurring even where nutrients are elevated. Therefore, it is difficult to determine one single cause of all HAB's.

Because most freshwater HABs are ephemeral and unpredictable, the state does not have a long-term freshwater HAB monitoring program that routinely samples fixed stations. Instead, DEP, the five water management districts (WMDs), Florida Department of Health (FDOH), Florida Fish and Wildlife Conservation Commission (FWC), and Florida Department of Agriculture and Consumer Services (FDACS) respond to HABs as soon as they are reported or observed.

HAB response is coordinated in a manner that is complementary rather than duplicative. Each agency has identified staff to act as HAB contacts and as agency resources on issues related to bloom events. These contacts are referred to collectively as the Algal Bloom Response Team. When a bloom event is reported or observed, the Algal Bloom Response Team coordinate their response through email, phone calls, DEP's Algal Bloom Reporting Hotline (1-855-305-3903), DEP's online Algal Bloom Reporting Form, FWC's Fish Kill Hotline, and FDOH's Harmful Algal Bloom Tracking webtool, Caspio. The Fish Kill Hotline and Database is used for all types of fish kills but can identify when an algal bloom is suspected to be the cause. FDOH's Caspio web tool acts as a response documentation tool during and following an event. It allows responders to track the same event and update response activities, photos, analytical results, and bloom conditions. Personal health information in Caspio related to cyanobacteria bloom events is restricted because of federal law, and so this information is only accessible by appropriate FDOH staff.

DEP and WMD staff are aware of the need to detect and respond to HAB events in a timely manner. When blooms are reported online or in person to staff, or are observed during normal fieldwork, staff get in touch with one or more of the HAB contacts by email or phone to coordinate the appropriate follow-up actions. DEP has implemented standard operating procedures (SOPs) for sampling cyanobacteria blooms and standardized forms for recording important information when investigating the bloom.

FWC predominantly documents and, when possible, determines the cause(s) of fish and wildlife deaths. The agency focuses on managing the living resources. It also maintains a red tide monitoring program that provides weekly updates on current red tide conditions in Florida's coastal waters. FWC and FDACS share responsibilities for the management of shellfish harvesting waters.

DEP focuses on managing the state's aquatic resources. DEP laboratory staff can quickly identify the bloom species and determine whether they have the potential to produce algal toxins. DEP relays information on species composition, and sometimes the level of toxins being produced, to other state and federal agencies, local governments, and the public. The bloom location and associated results are posted online allowing the public to track where blooms have been observed and sampled, along with the results of any samples collected. Waters with reoccurring or persistent HAB issues are assessed for nutrient impairment, and those deemed impaired are restored through the implementation of TMDLs and BMAPs.

Because FDOH focuses on protecting public health, it takes a lead role when reported health incidents are associated with a bloom. When blooms affect waters permitted as public bathing beaches or other areas where there is the risk of human exposure, the agency may post the waterbody with warning signs. These actions are typically directed out of the local county health department, most often after consultation with staff from FDOH's Aquatic Toxins Program. FDOH also follows up on reports of sick or dead pets that may have been exposed to a bloom, since these events may predict potential human health threats. FDOH administers the Caspio Harmful Algal Bloom Tracking Module used by state and local government agency staff to track a bloom. In 2009, the FWC Florida Wildlife Research Institute (FWRI) and FDOH published a *Resource Guide for Public Health Response to Harmful Algal Blooms in Florida*, which provides recommendations on the materials needed to develop plans for local public health response to HABs.

Implementing and Expanding MST

MST is a set of techniques used to investigate and identify potential sources of elevated levels of fecal indicator bacteria in a waterbody. Indicator bacteria such as fecal coliforms, *Escherichia coli (E. coli)*, and *Enterococci* are commonly found in the feces of humans and warm-blooded animals but can also grow freely in the environment. Standard microbiological culture–based methods cannot discriminate between enteric bacteria (from the gut of a host animal) and environmental bacteria (free-living and not associated with fecal waste or elevated health risks).

Listing a waterbody as impaired on the 303(d) list when there is no increased risk to human health creates significant economic burdens for the TMDL Program and other programs, as well as for the public and industries that rely on clean waters for recreation and tourism. Knowing the potential source of contamination and origin of the bacteria allows DEP to focus its resources on solving the right problem more quickly.

To do that, DEP has devised a multipronged approach that fully uses the latest technologies available. These include the Biology Program's development of a Molecular Biology Laboratory and the Chemistry Program's development and validation of methods for detection of chemical tracers. The Molecular Biology Laboratory now offers real-time, quantitative polymerase chain reaction (qPCR) source markers based assays for human, dog, shorebird, general bird, and ruminants. In addition, the laboratory implemented a method to distinguish DNA that came from live bacteria versus dead bacteria in a water sample. DEP will continue to refine new tracer methods and validate and implement methods for dogs, cows, and a second human-specific molecular marker.

Using the Nitrogen Source Inventory and Loading Tool (NSILT) for Nutrient-Impaired Springs

DEP developed the NSILT to identify and quantify the major sources contributing nitrogen to groundwater. This tool is currently being used in the development of BMAPs designated to restore water quality in impaired springs and springs runs. NSILT is an Arc geographic information system (GIS) and spreadsheet-based system that provides current spatial estimates of nitrogen inputs from nonpoint and point sources in a BMAP area, including farm and nonfarm fertilizers; livestock wastes; septic systems; atmospheric deposition; and the land application of treated wastewater, reclaimed water, and biosolids.

NSILT results provide a detailed inventory of nitrogen inputs to the land surface from each source based on current land use data, nitrogen transport and transformation studies, and information from meetings with stakeholders (including agricultural producers, city utility managers, golf course superintendents, and others). The amount of nitrogen leaching to groundwater is estimated by accounting for nitrogen attenuation processes (biochemical and hydrogeological) that remove or impede the movement of nitrogen through the soil and geologic strata that overlie the Upper Floridan aquifer. NSILT results are used to focus efforts on projects designed to reduce nitrogen loads to groundwater in BMAP areas.

Implementing NNC to Address Nutrient Enrichment

Significant progress has been made in reducing nutrient loads to state waters (see **Chapter 5**). Efforts are under way to reduce nutrient loading from nonpoint sources to groundwater. Nitrogen sources include farm and urban fertilizers, onsite sewage treatment and disposal systems (OSTDS) (septic tanks), atmospheric deposition, livestock wastes, and the land application of treated municipal wastewater. In most spring basins, elevated nitrogen concentrations are present in the groundwater discharging to springs.

To comprehensively address nutrient enrichment in aquatic environments, the state has collected and assessed large amounts of data related to nutrients. DEP convened an NNC Technical Advisory Committee that met 23 times between 2003 and 2010. DEP began rulemaking for the establishment of NNC in lakes and streams in 2009 but suspended its rulemaking efforts when EPA signed a settlement agreement that included a detailed schedule for EPA to promulgate nutrient criteria. DEP provided its data to EPA, which promulgated criteria in 2010, with a 15-month delayed implementation date.

Subsequently, DEP established NNC for streams, lakes, springs, and the majority of the state's estuaries that were approved by the Florida Environmental Regulation Commission (ERC), with ratification waived by the Florida Legislature. While the rules were challenged, they were upheld in state court and approved by EPA on November 30, 2012. In October 2013, EPA approved additional NNC provisions, including NNC for the remaining estuaries and coastal waters and incorporation by reference of a document titled *Implementation of Florida's Numeric Nutrient Standards* (or *Implementation Document*), into Chapter 62-302, Florida Administrative Code (F.A.C.).

The *Implementation Document* describes how DEP implements numeric nutrient standards in Chapter 62-302, F.A.C. (Water Quality Standards), and Chapter 62-303, F.A.C. (Identification of Impaired Surface Waters). The major topics include the hierarchical approach used to interpret the narrative nutrient criterion on a site-specific basis; a summary of the criteria for lakes, spring vents, streams, and estuaries; floral measures and the weight-of-evidence approach in streams; examples of how the criteria will be implemented in the 303(d) assessment process; and a description of the water quality–based effluent limitation process used to implement nutrient standards in wastewater permitting. Finally, because of the complexity associated with assessing the effects of nutrient enrichment in streams, a summary of the evaluation involving flora, fauna, and nutrient thresholds is provided.

During the adoption of Florida's NNC, it was recognized that several waterbody types did not fit the definition of streams. Consequently, the streams definition in Paragraphs 62-302.200(36)(a) and (b), F.A.C., was revised to identify certain waterbody types, such as nonperennial water segments, wetlands, lakelike waters, and tidally influenced segments that fluctuate between fresh and marine, to which only the narrative nutrient criterion would apply. The definition also identified channelized or physically altered ditches, canals, and other conveyances primarily used for water management purposes, such as flood protection, stormwater management, irrigation, or water supply, and have marginal or poor stream habitat or habitat components because of channelization and maintenance for water conveyance purposes, to which only the narrative nutrient criterion would apply.

While EPA approved DEP's NNC in October 2013, the NNC for lakes, streams, spring vents, and many estuaries did not initially go into effect because a provision in the nutrient standards required EPA to formally withdraw its promulgated NNC for lakes and springs before the criteria could be implemented. EPA officially withdrew the federally promulgated NNC for lakes and springs in September 2014, and DEP's NNC went into effect on October 27, 2014.[1]

In November 2014, DEP subsequently adopted by rule estuarine NNC for estuaries that were previously included in the August 1, 2013 *Report to the Governor and Legislature* (portions of the Big Bend from Alligator Harbor to the Suwannee Sound, Cedar Key, St. Mary's River Estuary, Southern Indian River Lagoon (IRL), Mosquito Lagoon, and several portions of the Intracoastal Waterway). While EPA approved the NNC in the August 1, 2013 report on September 24, 2013, DEP subsequently adopted the NNC by rule and the NNC for some of the estuaries during rule development based on additional information. EPA approved the revised NNC in a separate action on Ocober 19, 2017.

Additional information is available on the DEP NNC Development website.

Testing for Pesticides in Surface Waters

A part of a project jointly implemented by DEP and FDACS, 22 surface waterbodies were selected for pesticide sampling in 2016 based on land use criteria and a list of WBIDs impaired for nutrients. As with previous years there were frequent detections of numerous pesticides, but very few that approach EPA aquatic life benchmarks. Like the 2013, 2014, and 2015 findings, herbicides (atrazine, atrazine desethyl, bentazon, bromoacyl, hexazinone, and metolachlors) dominate the detections, with 50 % or more of the samples. The insecticides detected include dieldrin (3 % of samples), fipronil and its degradates (30 % of samples), imidacloprid (49 % of samples), chlorpyrifos ethyl (11 % of the samples), diazinon (4 % of samples) and terbufos (1 % of samples). Metalaxyl was the only fungicide detected. Results breakdown to 22 herbicides or their degradates, 9 insecticides or their degradates, and 1 fungicide. Forty-nine of the 81 analytes included in the lab testing methods were not detected. Of the samples collected, 98 % contained detectable concentrations of the herbicide atrazine. This indicates that atrazine is a widely used herbicide and residues from its use are often found in the environment, albeit at low levels. Insecticides detected included fipronil (12 % of the samples), imidacloprid (70 %), malathion (49 %), and chlorpyrifos (56 %).

Conducting the South Florida Canal Aquatic Life Study

The South Florida landscape was dramatically changed by the development of the Central and Southern Florida (C&SF) Project, initiated in the 1940s to provide water supply, flood control, navigation, water management, and recreational benefits to South Florida. Because of the construction of the C&SF Project, flowing waters in South Florida now consist primarily of man-made canals constructed from uplands, wetlands, or existing transverse glades. The current C&SF Project, operated by the South Florida Water Management District (SFWMD), includes

[1] The NNC for Southwest Florida estuaries went into effect in 2012 and the NNC for Panhandle estuaries went into effect in 2013.

2,600 miles of canals, over 1,300 water control structures, and 64 pump stations. Because of the physical design and construction of the canals, as well as the influence of their highly managed hydrology and vegetation maintenance activities, their water quality and aquatic life cannot be expected to be the same as that of natural flowing waters (streams).

The South Florida Canal Aquatic Life Study was initiated in January 2012 to perform a comprehensive assessment of South Florida canals and the aquatic life associated with those canals. The objectives of the study were to (1) assess aquatic life in South Florida freshwater canals; (2) evaluate the physical, management, and biogeochemical differences among canals; (3) determine the interrelationships between aquatic life in canals and other physical, hydrologic, and chemical variables; and (4) collect information to guide management decisions. The study included monthly water quality sampling, quarterly vertical profile sampling and sonde deployments for metered parameters, and quarterly biological sampling. Information on routine canal maintenance activities, including water-level manipulations and aquatic vegetation removal or herbicide applications, was also collected so that its influence could be quantitatively assessed.

The data collection phase of the study concluded at the end of 2016, and preliminary results indicate significant differences in water quality among canals. As expected, very few canal sites passed the Stream Condition Index (SCI) developed to assess the biological health of natural streams in peninsular Florida. Because the SCI does not provide an accurate assessment of the limited biological communities found in man-made South Florida canals, DEP is working to better define reasonable aquatic life expectations for the canals and develop more appropriate assessment tools.

Triennial Review of Florida's Water Quality Standards

With unanimous approval by the ERC on December 9, 2015, DEP successfully completed the rulemaking phase for the 2015 Triennial Review of Florida's Water Quality Standards. DEP submitted the Triennial Review to EPA Region 4 on June 7, 2016, and EPA approved the recisions[2] on July 24, 2017.[2]

The rulemaking adopted several new water quality criteria, including the following:

- New criteria for bacteriological quality for both fresh (*E. coli*) and marine waters (*Enterococci*) will replace the fecal coliform criteria in Class I and III waters and better protect swimming and other recreational uses in Florida's waters.

[2] EPA did not act on the marine criteria for nonylphenol and several delisting provisions in Chapter 62-303, F.A.C., that are still under review.

- New freshwater total ammonia criteria will replace the old un-ionized ammonia criterion and better protect sensitive mussels.
- New water quality criteria for four compounds—nonylphenol, carbaryl, chlorpyrifos, and diazinon—will provide additional protection for aquatic organisms.

The new criteria for bacteriological quality are based on EPA 2012 national recreational water quality criteria. The national recommendations were reviewed by the Bacteria Technical Advisory Committee (BACTAC), a group of experts in bacteriology formed in 2013. BACTAC recommended that DEP adopt EPA criteria.

As part of the Triennial Review, the ERC also approved reclassifications from Class III to Class II (shellfish propagation or harvesting) for portions of the estuarine waters in Brevard, Citrus, Dixie, Franklin, Hillsborough, Indian River, Levy, St. Lucie, Volusia, and Walton Counties. The reclassified waters have some level of existing shellfish harvesting for human consumption, and the reclassifications provide further protection for this sensitive use. The maps of the reclassified areas were adopted by reference as Rule 62-302-400, F.A.C.

In addition, the rulemaking included revisions to the IWR to address the new and revised water quality standards and provide clarification to the state's water quality assessment program.

Improving Water Quality Modeling Coordination between DEP and the WMDs

Modeling is an important part of TMDL development. Empirical and mechanistic models can be used to quantify pollutant loads from different sources, examine pollutant dynamics in receiving waters, establish the relationships between pollutant loads and biological responses, and help determine the target pollutant concentration and loads for individual waterbodies. In Florida, many TMDLs are developed using watershed and receiving water models. An important advantage of using models to develop TMDLs is that they provide information on the spatial distribution of pollutants in watersheds containing impaired waters and therefore are useful tools for identifying pollutant hot spots and establishing more effective restoration plans.

Different models can be used in TMDL development, depending on the complexity of the impaired systems, parameters, and length of time within which the pollutant targets are needed. In most cases, modeling is resource intensive and requires sophisticated technical capabilities, especially for systems with complicated hydrology and hydrodynamic characteristics, multiple pollutant sources with different natures, and parameters that require short intervals for TMDL development. It is thus important, when conducting TMDL modeling, to integrate technical expertise, existing models and model-required input information and data, and site-specific knowledge of the impaired waters from different entities, so that modeling resources can be used more efficiently to address critical water quality issues.

In addition to DEP, the WMDs are among the most important entities conducting modeling on Florida waterways. Historically, modeling efforts by the WMDs primarily focused on water quantity, including administering flood protection, evaluating the availability of water resources, addressing water shortages in times of drought, and acquiring and managing lands for water management. These mandates are carried out through regulatory programs such as consumptive water use, aquifer recharge, well construction, and surface water management. In 1987, the Florida Legislature created the Surface Water Improvement and Management (SWIM) Program, which requires the WMDs to identify and manage priority waterbodies in each district's jurisdiction as integrated ecosystems. Protecting the water quality of these waterbodies ranks among the most critical aspects of the SWIM Program.

Developing pollutant load reduction goals (PLRGs) is a critical mechanism through which the WMDs establish restoration or protection goals for their priority waters. These goals are often consistent with the restoration goals of TMDLs. Since 2003, many modeling efforts by the WMDs have been referenced and used in DEP's TMDL development. TMDLs that benefited from the WMDs' PLRG modeling include the nutrient and DO TMDLs for the Chain of Lakes in the Upper Ocklawaha River Basin; seagrass TMDLs for the IRL and Banana River Lagoon (BRL); nutrient and DO TMDLs for the Lower, Middle, and Upper St. Johns River; and spring nutrient TMDLs for the Wekiva River and Rock Springs Run.

DEP recently coordinated with the St. Johns River Water Management District (SJRWMD) in modeling the Lake George nutrient TMDLs and refining the watershed and receiving water models for the Upper St. Johns River segments. DEP has also been working closely with the SFWMD in developing nutrient and DO TMDLs for several impaired waterbodies in the Caloosahatchee River Basin. Model refinements to facilitate TMDL implementation have also been conducted through joint efforts between DEP and the SFWMD for the Lake Okeechobee and St. Lucie Estuaries.

DEP—in conjunction with the WMDs, Florida Geological Survey (FGS), U.S. Geological Survey (USGS), counties, and other stakeholders—strives to enhance joint modeling efforts. DEP has had email exchanges, teleconferences, and webinars to better identify areas where modeling efforts are overlapping or complementary, prioritize modeling needs, and coordinate interagency modeling efforts by establishing formal technical support requests, awarding general service contracts, exploring possible funding sources for the common research goals of modeling, and providing staff training.

Joint efforts have also been made to evaluate the feasibility of developing a comprehensive online GIS tracking database system for critical modeling efforts conducted by DEP and the WMDs, so that the modeling products and input data completed by one party can benefit the needs of the entire group. The common goal of DEP and the WMDs is to integrate multiagency financial, technical, and intellectual resources to streamline water quality modeling efforts so that precious Florida water resources are protected and restored.

Chapter 2: Statewide Probabilistic and Trend Assessments, 2014–16

Background

Initiated in 2000, DEP's probabilistic Status Monitoring Network (Status Network) provides an unbiased, cost-effective sampling of the state's water resources. Florida has adopted a probabilistic design so that the condition of the state's surface water and groundwater resources can be estimated with known statistical confidence. Data produced by the Status Network fulfill CWA 305(b) reporting needs and complement CWA 303(d) reporting.

In addition, DEP has designed a Trend Monitoring Network (Trend Network) to monitor water quality changes over time in rivers, streams, and aquifers (via wells). To achieve this goal, fixed locations are sampled at fixed intervals (monthly or quarterly). The Trend Network complements the Status Network by providing spatial and temporal information about water resources and potential changes from anthropogenic or natural influences, including extreme events (e.g., droughts and hurricanes).

Taking guidance from the EPA document *Elements of a State Monitoring and Assessment Program* (2003), DEP developed and annually updates the *Florida Watershed Monitoring Status and Trend Program Design Document* (2016) (or *Design Document*), which provides details of both monitoring networks.

Water Resources Monitored

The Status and/or Trend Monitoring Networks include the following four water resources categories (see the *Design Document* for additional details on each resource):

- **Groundwater (confined and unconfined aquifers):** Groundwater includes those portions of Florida's aquifers with the potential for supplying potable water or affecting the quality of current potable water supplies. However, this does not include groundwater that lies directly within or beneath a permitted facility's zone of discharge (ZOD) and water influenced by deep well injection.

- **Rivers and streams:** Rivers and streams include linear waterbodies with perennial flow, defined as waters of the state under Chapters 373 and 403, Florida Statutes (F.S.).

- **Canals (excluding drainage and irrigation ditches as defined below):** Canals include man-made linear waterbodies that are waters of the state.

Chapter 312.020, F.A.C., provides the following definitions: A canal is a trench, the bottom of which is normally covered by water, with the upper edges of its two sides normally above water. A channel is a trench, the bottom of which is normally covered entirely by water, with the upper edges of its sides normally below water. Drainage and irrigation ditches are man-made trenches created to drain water from the land or to transport water across land, and typically are not built for navigational purposes.

- **Lakes (Status Monitoring Network only):** Lakes include natural bodies of standing water and reservoirs that are waters of the state and are designated as lakes and ponds on the USGS National Hydrography Dataset (NHD). This category does not include many types of artificially created waterbodies, or streams/rivers impounded for agricultural use or private water supply.

DEP does not use the Status or Trend Monitoring Networks to monitor estuaries, wetlands, or marine waters.

Summary of Status Network Surface Water Results

Scope of Assessment

DEP samples the Status Network to report on the condition of surface water resources for the entire state. This section summarizes the results of the combined 2014 through 2016 assessments. Three years of data allow for regional assessments by water resource (see **Appendix A**), in addition to the statewide assessment.

DEP used the Status Network to assess rivers, streams, canals, large lakes, and small lakes. **Table 2.1** summarizes the miles of rivers, streams and canals, and acres and numbers of large and small lakes for the waters assessed. The measurements for these resources are specific to the Status Network and may vary from those identified in other sections of this report. From 2014 through 2016, samplers collected approximately 15 samples annually from each resource in each region.

Table 2.1. Summary of surface water resources assessed by the Status Network probabilistic monitoring, 2014–16

Note: The estimates in the table do not include coastal or estuarine waters. These calculations are from the 1:24,000 NHD.

Waterbody Type	Assessed
Rivers	2,676 miles/4,307 kilometers
Streams	16,096 miles/25,904 kilometers
Canals	2,521 miles/4,057 kilometers
Large Lakes	1,740 lakes (965,348 acres/390,662 hectares)
Small Lakes	1,881 lakes (28,950 acres/11,716 hectares)

The indicators selected for surface water reporting include fecal coliform bacteria, DO, un-ionized ammonia, total nitrogen (TN), and total phosphorus (TP). Chlorophyll *a* is also included in reporting for rivers, streams, and canals. **Tables 2.2a** through **2.2e** summarize the indicators and their threshold values. The *Design Document* provides a complete list of indicators used in the Status Monitoring Network.

The main source of information for these indicators is Chapter 62-302, F.A.C., which contains the surface water quality standards for Florida. DEP derived the water quality thresholds from the following:

- Rule 62-302.530, F.A.C., Criteria for Surface Water Classifications.
- Chapter 62-550, F.A.C., Drinking Water Standards.
- Implementation of Florida's Numeric Nutrient Standards.
- Technical Support Document: Derivation of Dissolved Oxygen Criteria to Protect Aquatic Life in Florida's Fresh and Marine Waters.
- Chapter 62-303, F.A.C., Identification of Impaired Surface Waters.
- Rule 62-520.420, F.A.C., Standards for Class G-I and Class G-II Groundwater.

It is important to note that the diversity of Florida's aquatic ecosystems results from a large natural variation in some water quality parameters. For example, surface waters that are dominated by groundwater inflows or flows from wetland areas may naturally have lower DO levels (see **Chapter 6**).

Table 2.2a. Nutrient indicators used to assess river, stream, and canal resources

mg/L = Milligrams per liter
[1] Not applied as criteria, but rather as a threshold used to estimate the nonattainment of water quality standards in state waters. These thresholds are used in the analysis of Status Monitoring Network data, based on single samples. The analysis and representation of these data are not intended to infer verified impairment, as defined in Chapter 62-303, F.A.C.
[2] The nutrient thresholds for rivers, streams, and canals depend on the specific nutrient region where a waterbody is located (**Figure 2.1**).
[3] Not applicable; no numeric threshold. The narrative criterion in Paragraph 62-302.530(47)(b), F.A.C., applies.

Nutrient Region[2]	TP Threshold[1] (mg/L)	TN Threshold[1] (mg/L)	Designated Use
Panhandle West	≤ 0.06	≤ 0.67	Aquatic Life
Panhandle East	≤ 0.18	≤ 1.03	Aquatic Life
North Central	≤ 0.30	≤ 1.87	Aquatic Life
Peninsula	≤ 0.12	≤ 1.54	Aquatic Life
West Central	≤ 0.49	≤ 1.65	Aquatic Life
South Florida	N/A[3]	N/A[3]	Aquatic Life

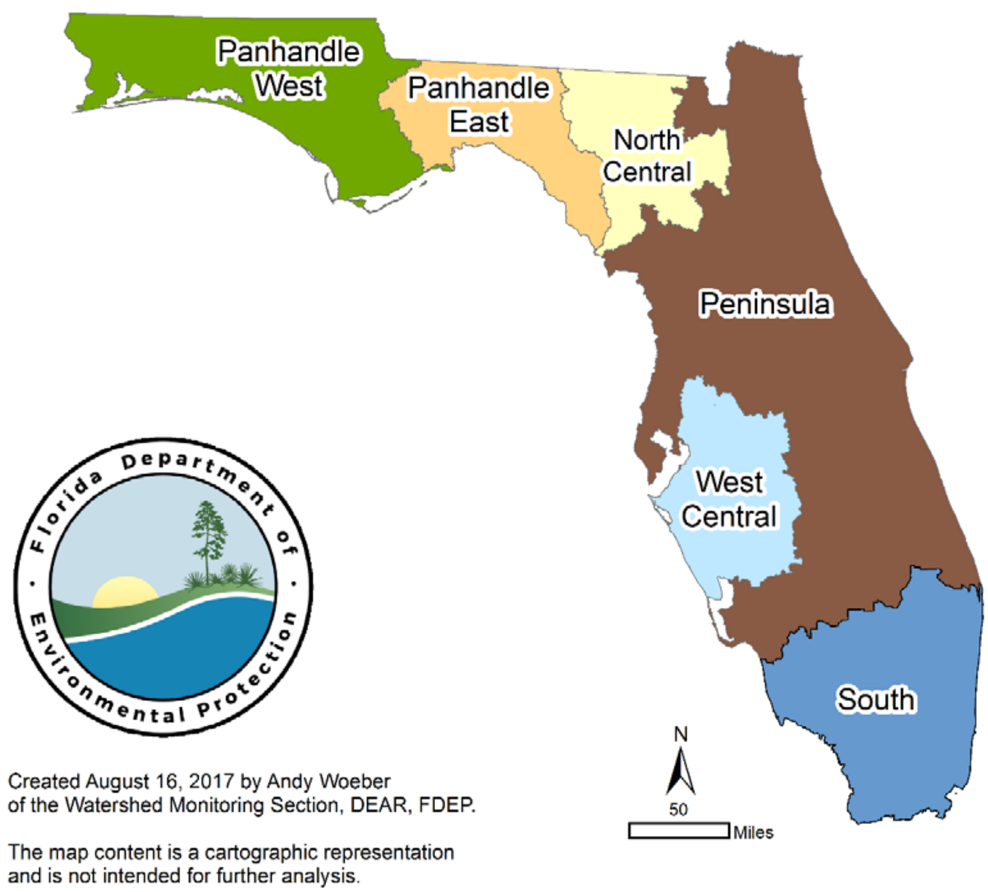


Figure 2.1. Nutrient regions for river, stream, and canal resources

Table 2.2b. Nutrient indicators used to assess lake resources

PCU = Platinum cobalt unit; $CaCO_3$ = Calcium carbonate; µg/L = Micrograms per liter; mg/L = Milligrams per liter
[1]Not applied as criteria, but rather as a threshold used to estimate the nonattainment of water quality standards in state waters. These thresholds are used in the analysis of Status Monitoring Network data, based on single samples. The analysis and representation of these data are not intended to infer verified impairment, as defined in Rule 62-303, F.A.C.
[2] For lakes with color > 40 PCU in the West Central Nutrient Region (**Figure 2.1**), the TP threshold is 0.49 mg/L, regardless of the chlorophyll concentration.

Lake Color and Alkalinity	Chlorophyll *a* Threshold[1] (µg/L)	TP Threshold[1] (mg/L)	TN Threshold[1] (mg/L)	Designated Use
Color > 40 PCU	≤ 20	≤ 0.16[2] if meets chlorophyll *threshold*; ≤ 0.05[2] if not	≤ 2.23 if meets chlorophyll *threshold*; ≤ 1.27 if not	Aquatic Life
Color ≤ 40 PCU and Alkalinity > 20 mg/L $CaCO_3$	≤ 20	≤ 0.09 if meets chlorophyll *threshold*; ≤ 0.03 if not	≤ 1.91 if meets chlorophyll *threshold*; ≤ 1.05 if not	Aquatic Life
Color ≤ 40 PCU and Alkalinity ≤ 20 mg/L $CaCO_3$	≤ 6	≤ 0.03 if meets chlorophyll *threshold*; ≤ 0.01 if not	≤ 0.93 if meets chlorophyll *threshold*; ≤ 0.51 if not	Aquatic Life

Table 2.2c. DO thresholds used to assess surface water resources

[1] Not applied as criteria, but rather as a threshold used to estimate the nonattainment of water quality standards in state waters. These thresholds are used in the analysis of Status Monitoring Network data, based on single samples. The analysis and representation of these data are not intended to infer verified impairment, as defined in Chapter 62-303, F.A.C.
[2] The DO threshold for lakes, rivers, and streams depends on the specific bioregion where a waterbody is located (**Figure 2.2)**. The DO threshold for the protection of aquatic life in canals in all bioregions is ≥ 5.0 mg/L.

Bioregion[2]	DO Threshold[1] (% saturation)	Designated Use
Panhandle	≥ 67	Aquatic Life
Big Bend	≥ 34	Aquatic Life
Northeast	≥ 34	Aquatic Life
Peninsula	≥ 38	Aquatic Life
Everglades	≥ 38	Aquatic Life

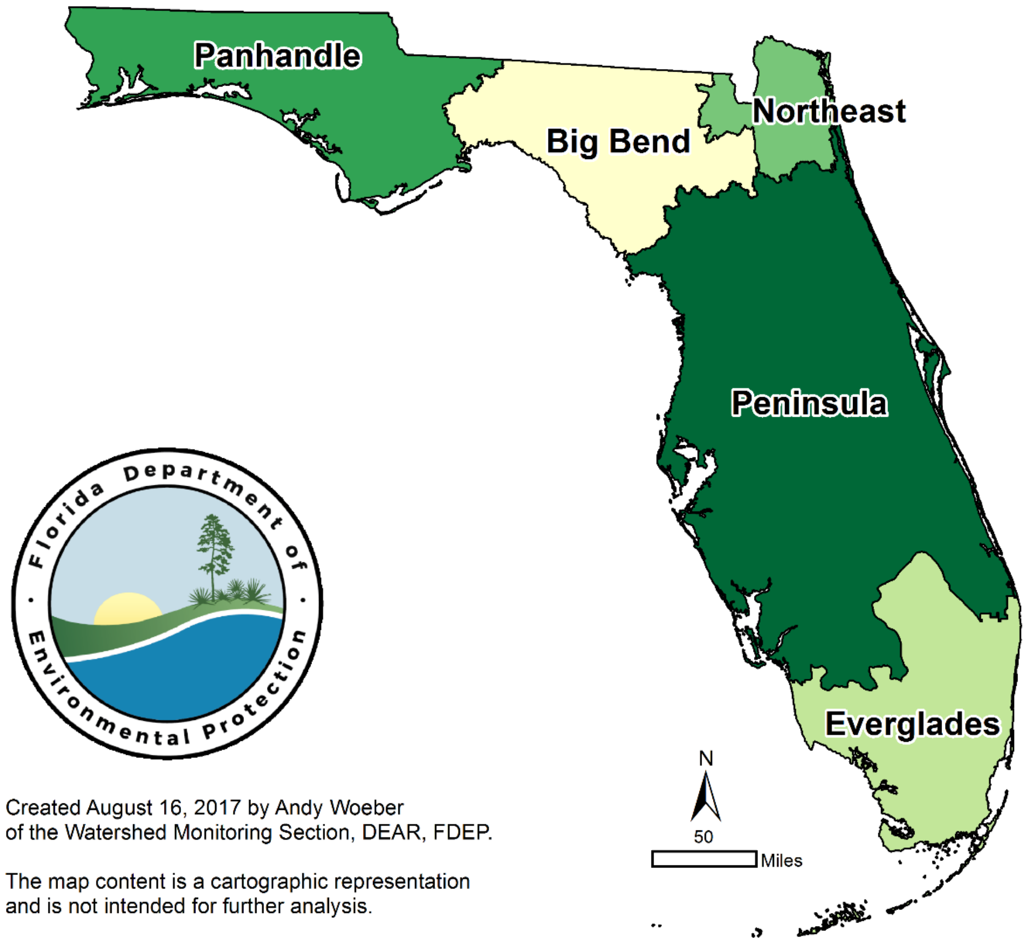


Figure 2.2. Bioregions for lake, river, and stream resources

Table 2.2d. Status Network physical/other indicators for aquatic life use with water quality thresholds

[1] Not criteria, but rather a threshold used to estimate the nonattainment of water quality standards in state waters. These thresholds are used in the analysis of Status Monitoring Network data, based on single samples. The analysis and representation of these data are not intended to infer verified impairment, as defined in Chapter 62-303, F.A.C. These chlorophyll thresholds apply to rivers, streams, and canals only. **Table 2.2b** lists chlorophyll criteria for lakes.

Physical/Other Indicators/ Index for Aquatic Life Use (Surface Water)	Threshold
Un-Ionized Ammonia	≤ 0.02 mg/L
Chlorophyll *a*[1]	≤ 20 µg/L

Table 2.2e. Status Network microbiological indicators for recreational use with water quality thresholds

Microbiological Indicator/ Index for Recreational Use (Surface Water)	Threshold
Fecal Coliform Bacteria	< 400 colonies/100 milliliters (mL)

Results for Rivers, Streams, Canals, Large Lakes, and Small Lakes

The following pages summarize the surface water Status Network results for rivers, streams, large lakes, and small lakes. For each resource, there is a map showing the sample site locations (**Figures 2.3, 2.5, 2.7, 2.9,** and **2.11**), a figure with a summary of the statewide results (**Figures 2.4, 2.6, 2.8, 2.10**, and **2.12**), and a table of the statewide results for each indicator for a particular resource (**Tables 2.3b** through **2.3e**). **Table 2.3a** explains the terms used in the statewide summary tables.

Table 2.3a. Explanation of terms used in Tables 2.3b through 2.3e

Term	Explanation
Analyte	Indicators chosen to assess condition of waters of the state.
Target Population	Estimate of actual extent of resource from which threshold results were calculated. Excludes % of waters determined to not fit definition of resource type.
Number of Samples	Number of samples used for statistical analysis
% Meeting Threshold	% estimate of target population that meets specific threshold value.
95% Confidence Bounds (% Meeting Threshold)	Upper and lower bounds for 95 % confidence of % meeting specific threshold value.
% Not Meeting Threshold	% estimate of target population that does not meet specific threshold value.
Assessment Period	Duration of probabilistic survey sampling event.

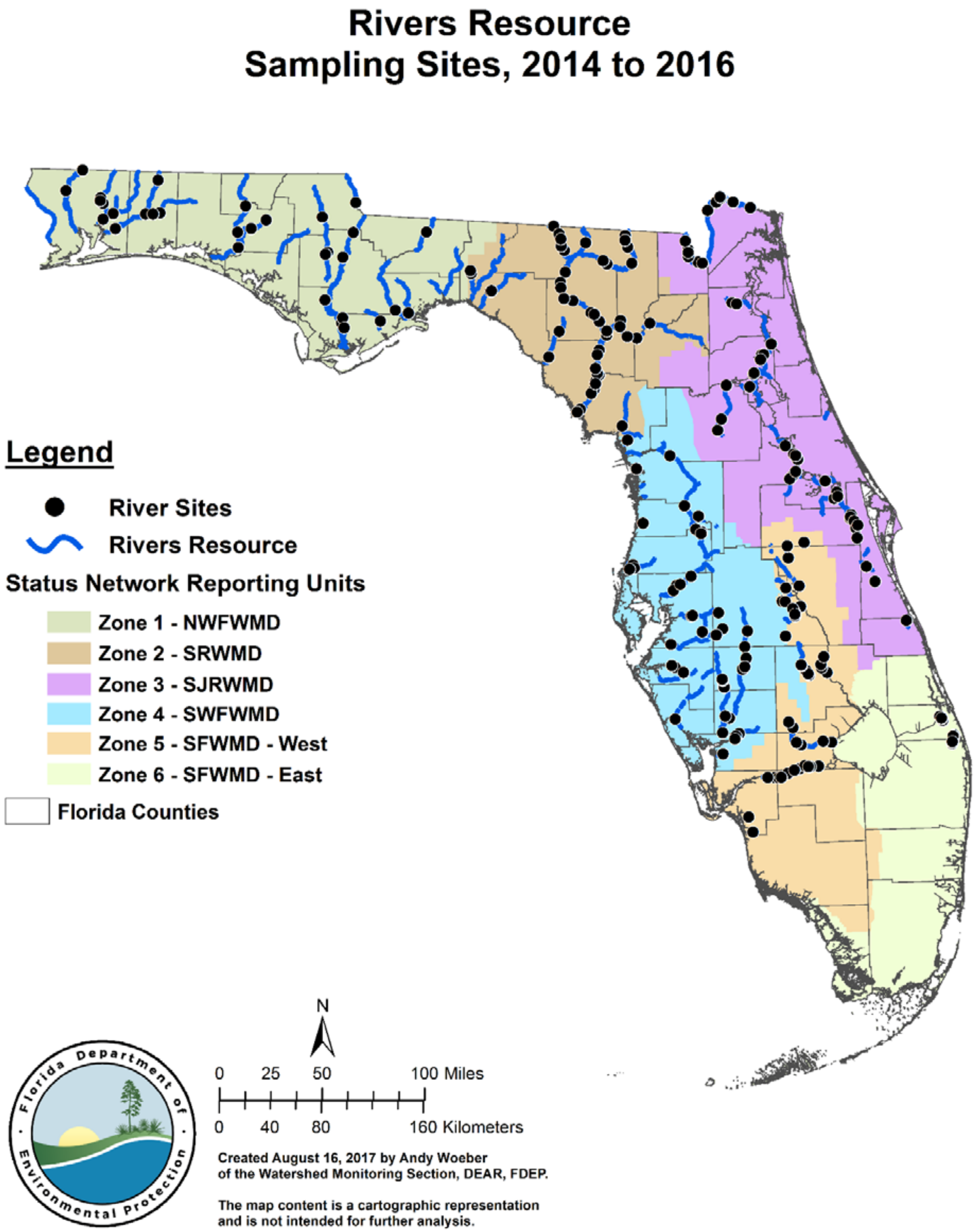


Figure 2.3. Statewide Status Network river sample locations

Table 2.3b. Statewide percentage of rivers meeting threshold values for indicators calculated using probabilistic monitoring design

Status Network | **Designated Use: Recreation and Aquatic Life** | **Units: Miles**

Analyte	Target Population (miles)	Number of Samples	% Meeting Threshold	95 % Confidence Bounds (% meeting threshold)	% Not Meeting Threshold	Assessment Period
TN	2,676	264	72.9	76.8–69.0	27.1	2014–16
TP	2,676	265	85.9	89.1–82.7	14.1	2014–16
Chlorophyll *a*	2,676	265	88.8	91.5–86.2	11.2	2014–16
Un-Ionized Ammonia	2,676	265	100.0	100.0	0.0	2014–16
Fecal Coliform Bacteria	2,676	262	95.4	98.1–92.6	4.6	2014–16
DO	2,676	266	93.1	95.7–90.4	6.9	2014–16

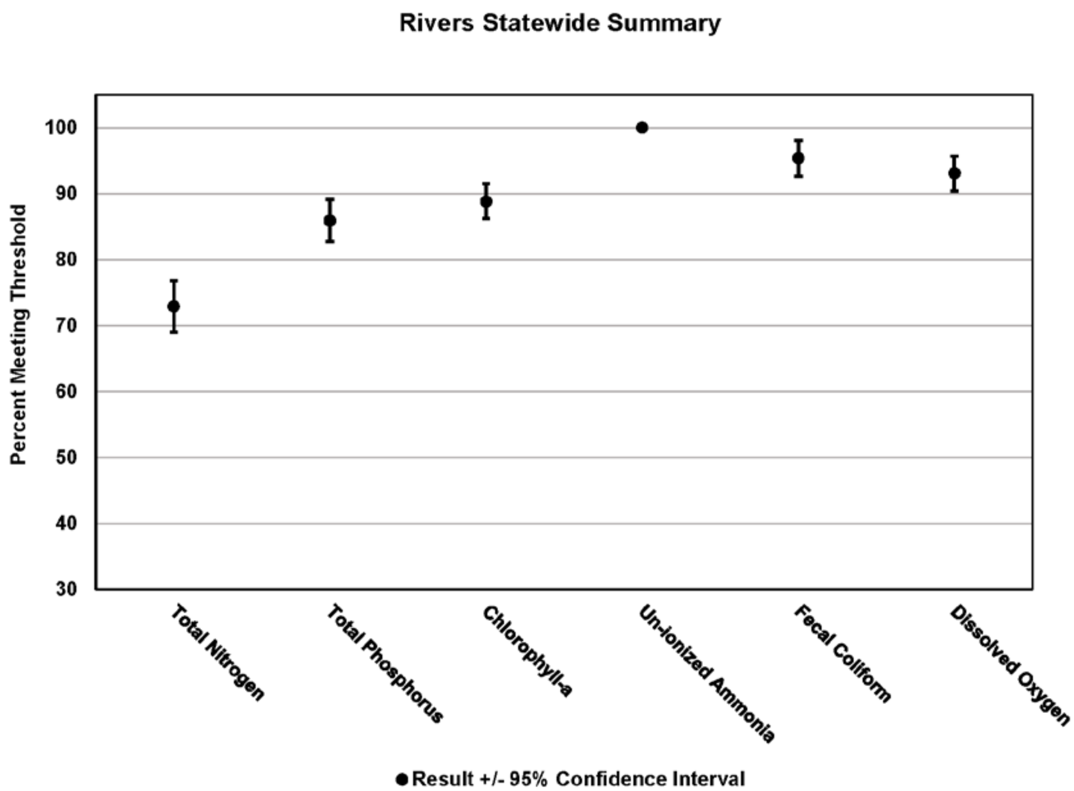


Figure 2.4. Statewide summary of Status Network river results

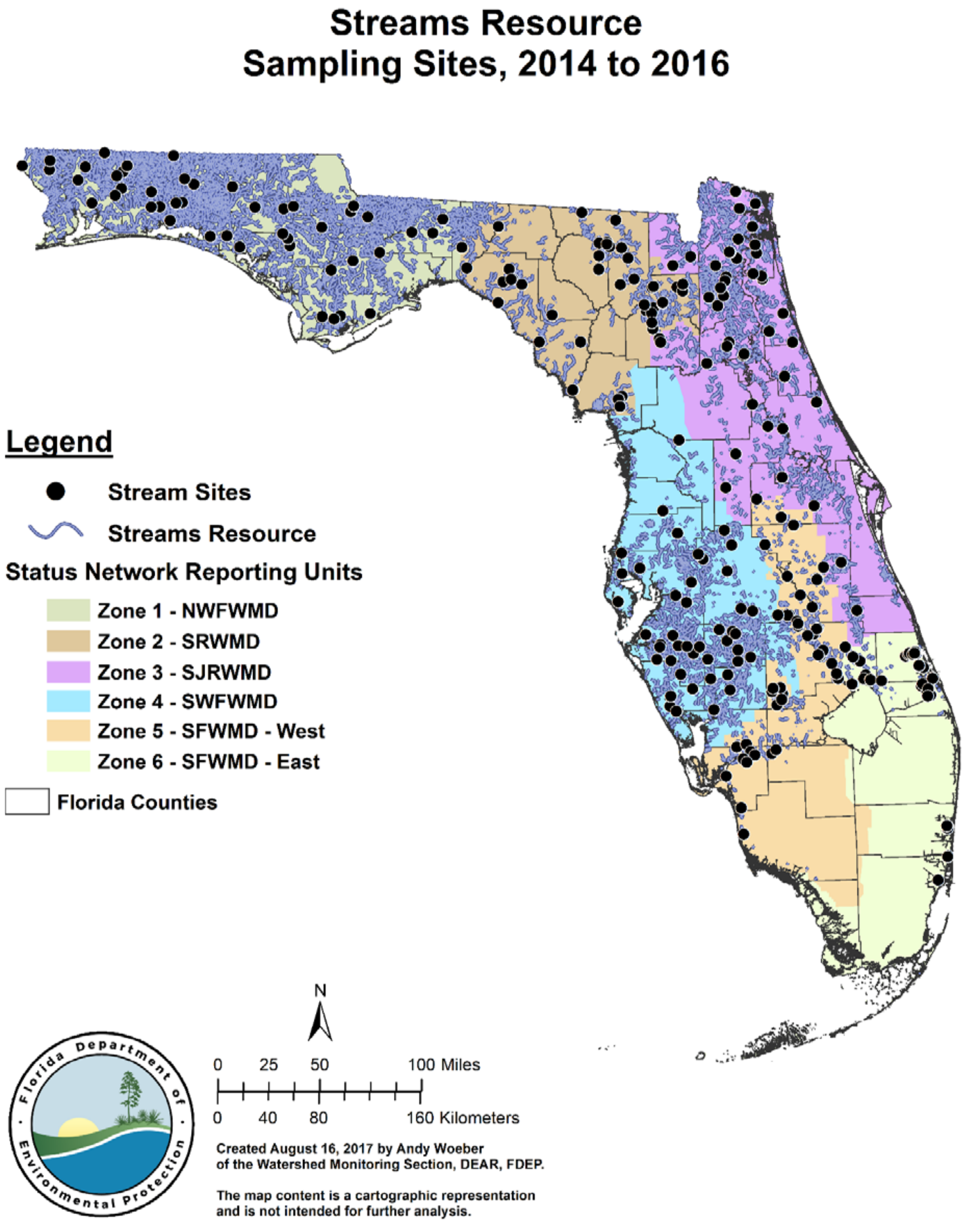


Figure 2.5. Statewide Status Network stream sample locations

Table 2.3c. Statewide percentage of streams meeting threshold values for indicators calculated using probabilistic monitoring design

Status Network **Designated Use: Recreation and Aquatic Life** **Units: Miles**

Analyte	Target Population (miles)	Number of Samples	% Meeting Threshold	95 % Confidence Bounds (% meeting threshold)	% Not Meeting Threshold	Assessment Period
TN	16,096	263	73.7	79.7–67.7	26.3	2014–16
TP	16,096	263	78.9	83.3–74.6	21.1	2014–16
Chlorophyll *a*	16,096	266	94.4	96.9–91.9	5.6	2014–16
Un-Ionized Ammonia	16,096	269	100	100.0	0.0	2014–16
Fecal Coliform Bacteria	16,096	268	70.1	76.4–63.7	29.9	2014–16
DO	16,096	268	78.1	83.7–72.6	21.9	2014–16

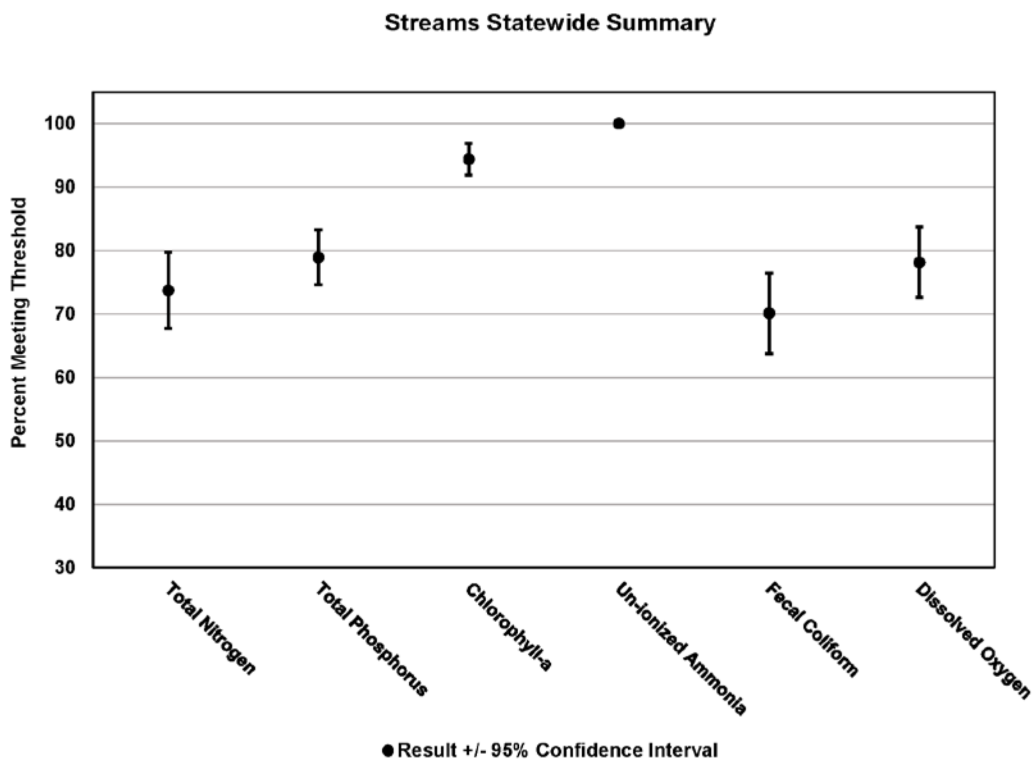


Figure 2.6. Statewide summary of Status Network stream results

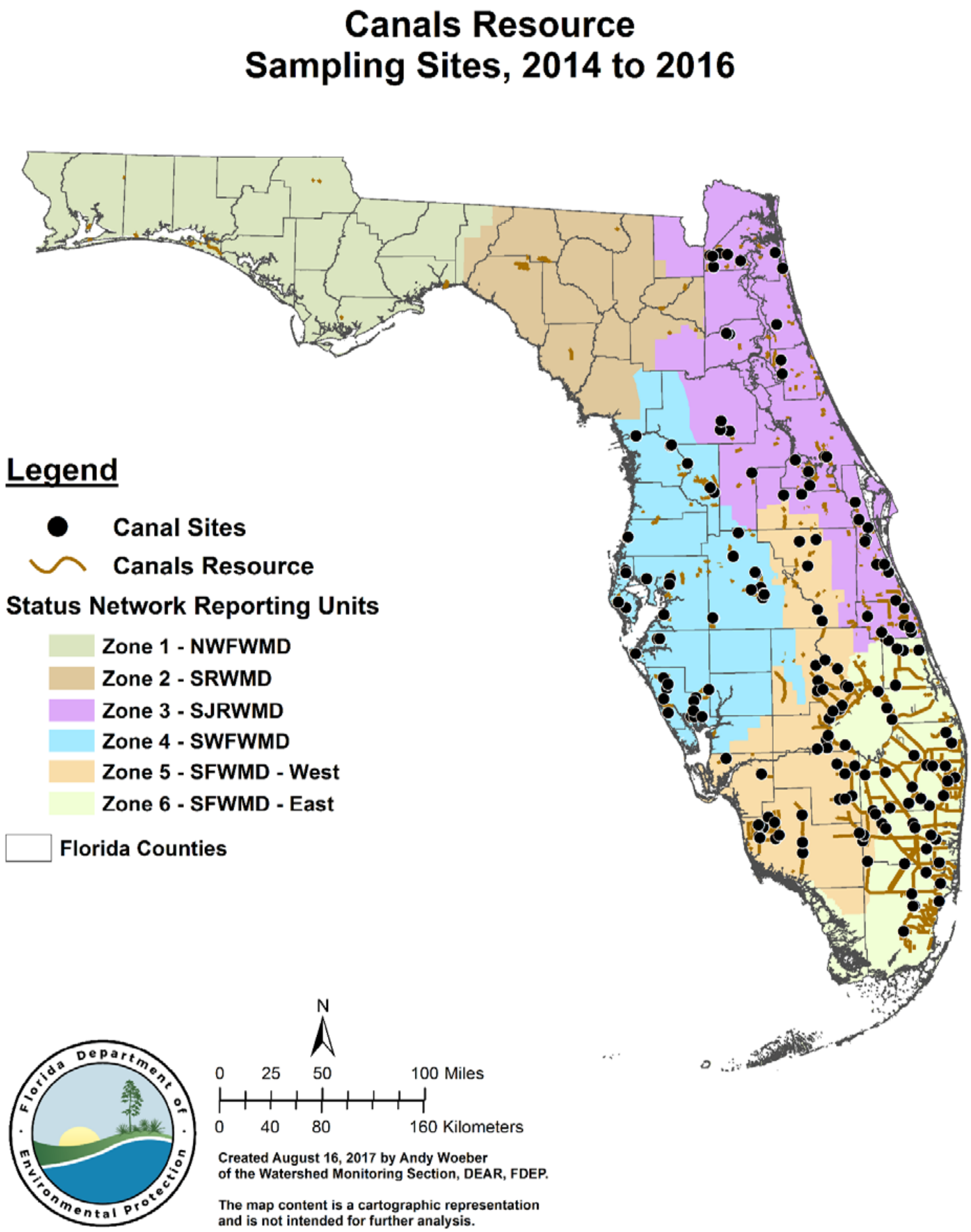


Figure 2.7. Statewide Status Network canal sample locations

Table 2.3d. Statewide percentage of canals meeting threshold values for indicators calculated using probabilistic monitoring design

Status Network	Designated Use: Recreation and Aquatic Life				Units: Miles	
Analyte	**Target Population (miles)**	**Number of Samples**	**% Meeting Threshold**	**95 % Confidence Bounds (% meeting threshold)**	**% Not Meeting Threshold**	**Assessment Period**
TN	2,521	142	56.4	64.4–48.5	43.6	2014–16
TP	2,521	142	49.2	58.5–40.0	50.8	2014–16
Chlorophyll *a*	2,521	180	84.6	89.5–79.6	15.4	2014–16
Un-Ionized Ammonia	2,521	180	98.7	100–96.4	1.3	2014–16
Fecal Coliform Bacteria	2,521	180	95.3	97.2–93.4	4.7	2014–16
DO	2,521	180	89.2	93.5–84.9	10.8	2014–16

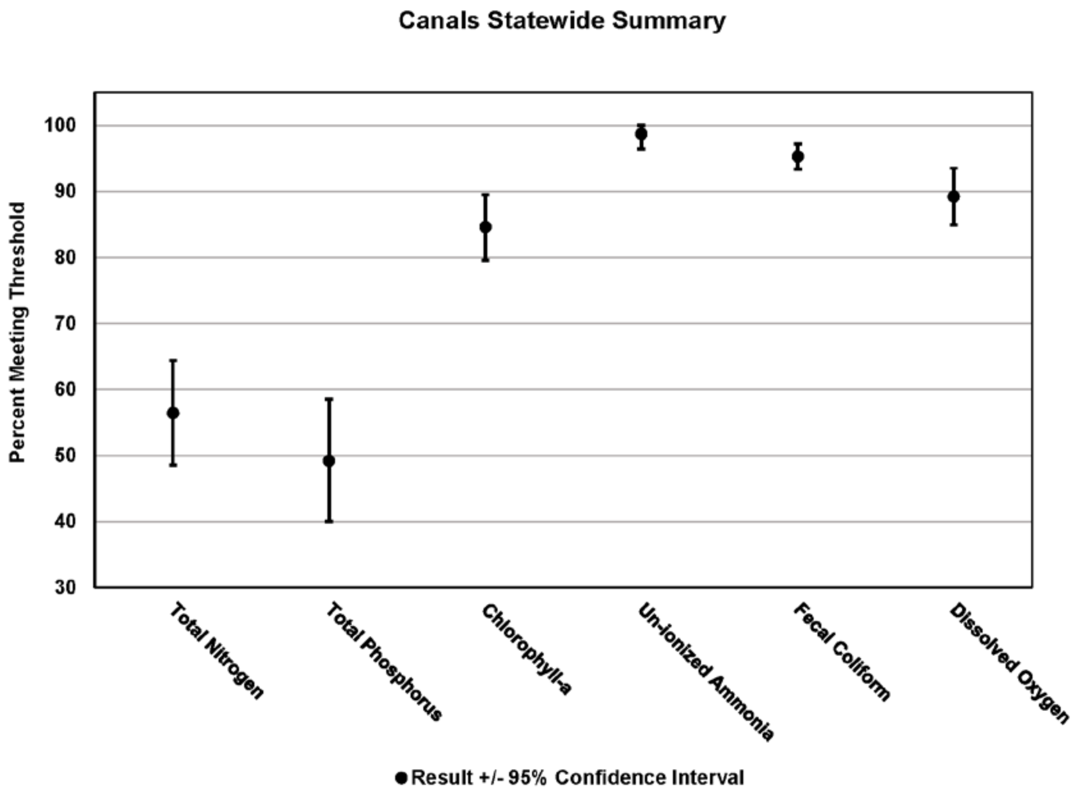


Figure 2.8. Statewide summary of Status Network canal results

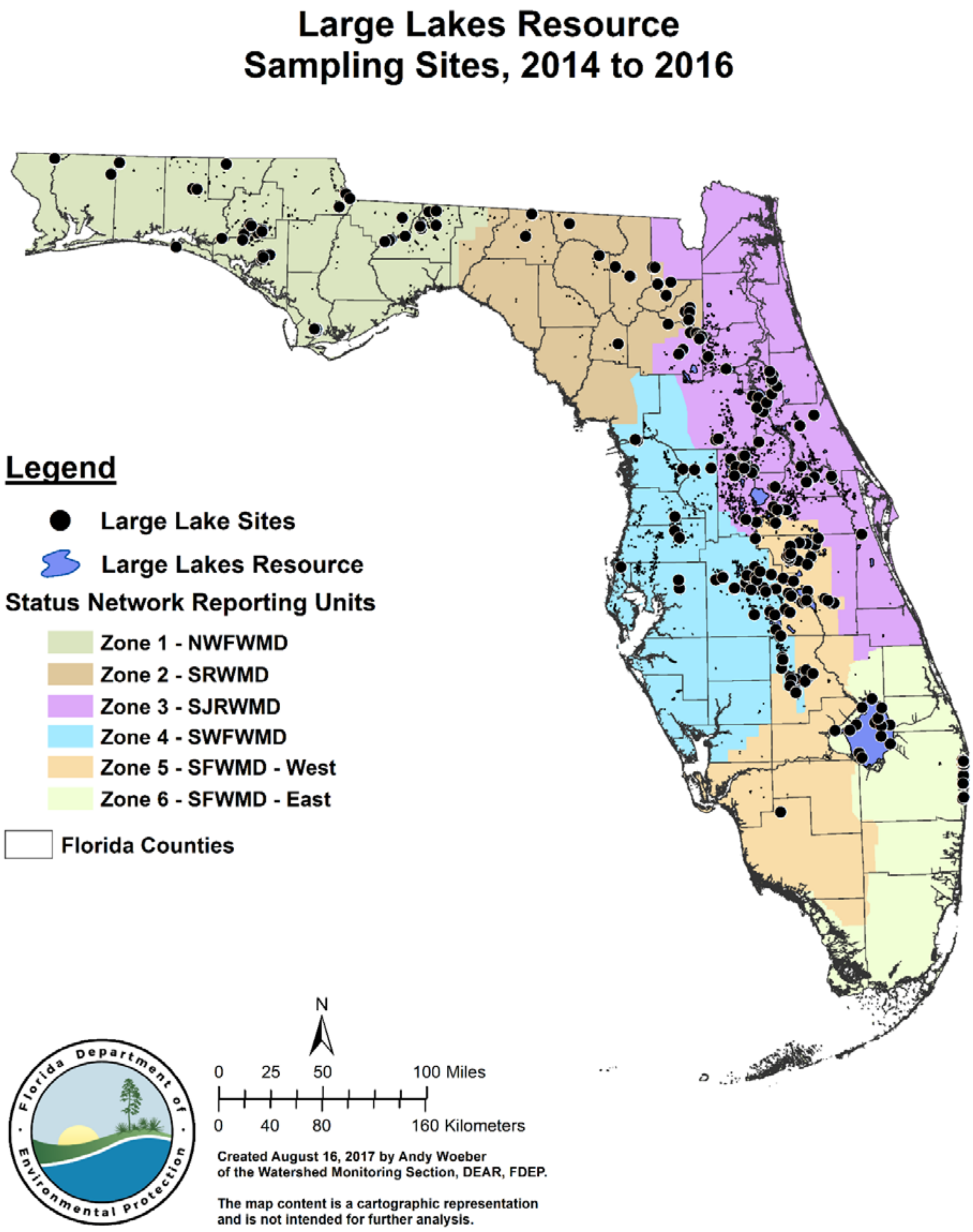


Figure 2.9. Statewide Status Network large lake sample locations

Table 2.3e. Statewide percentage of large lakes meeting threshold values for indicators calculated using probabilistic monitoring design

Status Network **Designated Use: Recreation and Aquatic Life** **Units: Acres**

* The percent of samples for fecal coliform bacteria that do not meet the threshold is reported as a percentage of the weighted areal resource (area of lakes).

Analyte	Target Population (acres)	Number of Samples	% Meeting Threshold	95 % Confidence Bounds (% meeting threshold)	% Not Meeting Threshold	Assessment Period
TN	965,348	257	86.9	93.4–80.4	13.1	2014–16
TP	965,348	257	78.3	85.7–71.0	21.7	2014-16
Chlorophyll *a*	965,348	257	57.3	65.0–49.5	42.7	2014-16
Un-Ionized Ammonia	965,348	269	99.3	100.0–98.1	0.7	2014–16
Fecal Coliform Bacteria	965,348	173	100	100	0.0*	2014–16
DO	965,348	257	97.9	99.1–96.7	2.1	2014–16

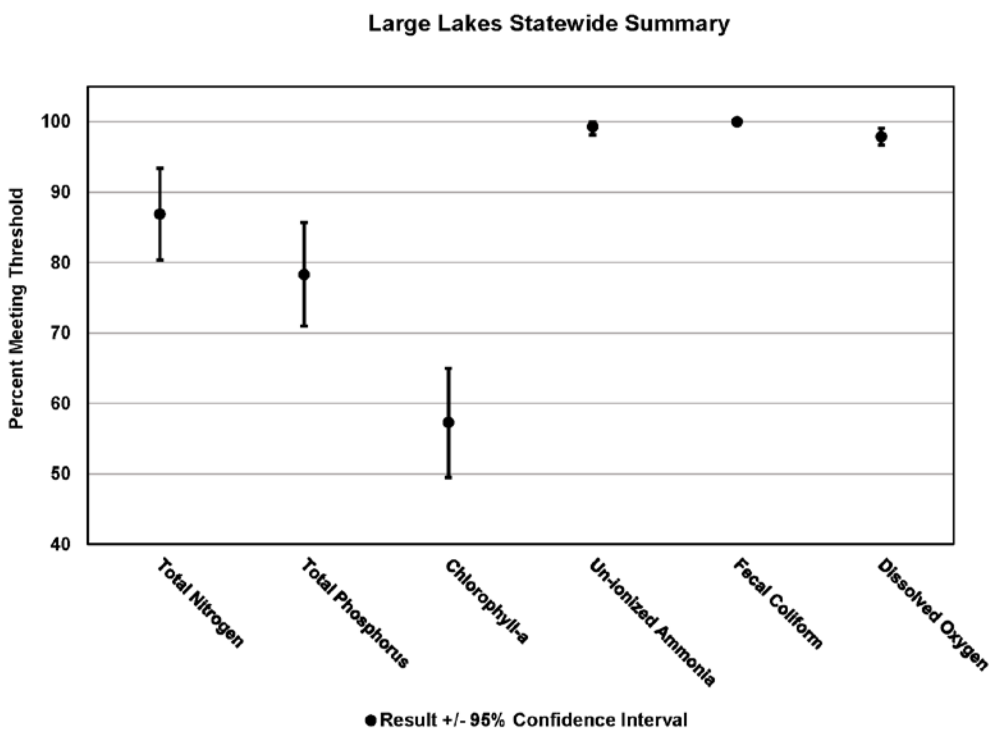


Figure 2.10. Statewide summary of Status Network large lake results

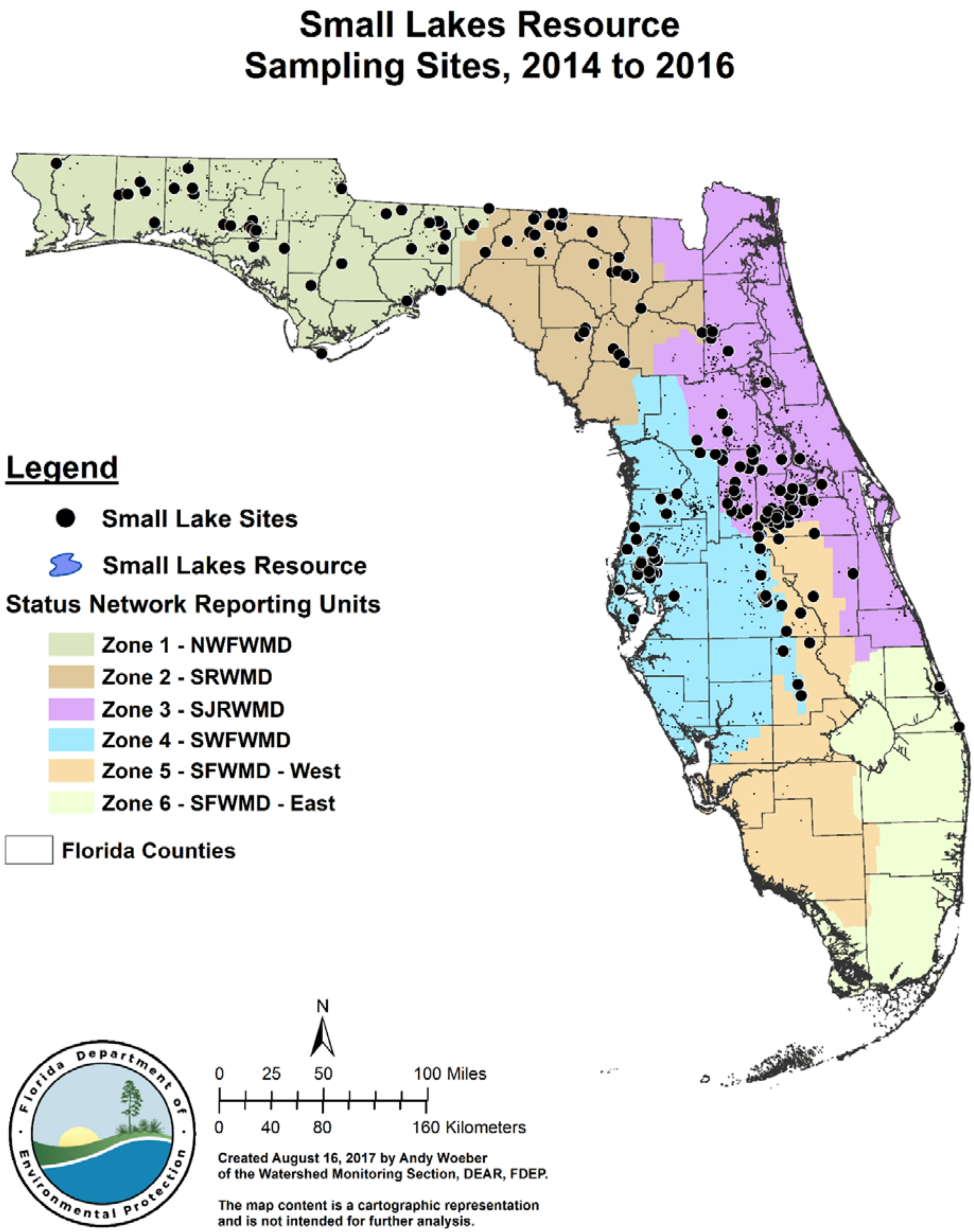


Figure 2.11. Statewide Status Network small lake sample locations

Table 2.3f. Statewide percentage of small lakes meeting threshold values for indicators calculated using probabilistic monitoring design

Status Network	Designated Use: Recreation and Aquatic Life				Units: Lakes	
Analyte	**Target Population (lakes)**	**Number of Samples**	**% Meeting Threshold**	**95 % Confidence Bounds (% meeting threshold)**	**% Not Meeting Threshold**	**Assessment Period**
TN	1,881	233	94.5	97.5–91.4	5.5	2014–16
TP	1,881	232	93.2	96.2–90.3	6.8	2014-16
Chlorophyll *a*	1,881	232	65.9	72.3–59.4	34.1	2014-16
Un-Ionized Ammonia	1,881	233	100.0	100.0	0.0	2014–16
Fecal Coliform Bacteria	1,881	230	98.7	100.0–96.9	1.3	2014–16
DO	1,881	233	85.0	89.0–80.9	15.0	2014–16

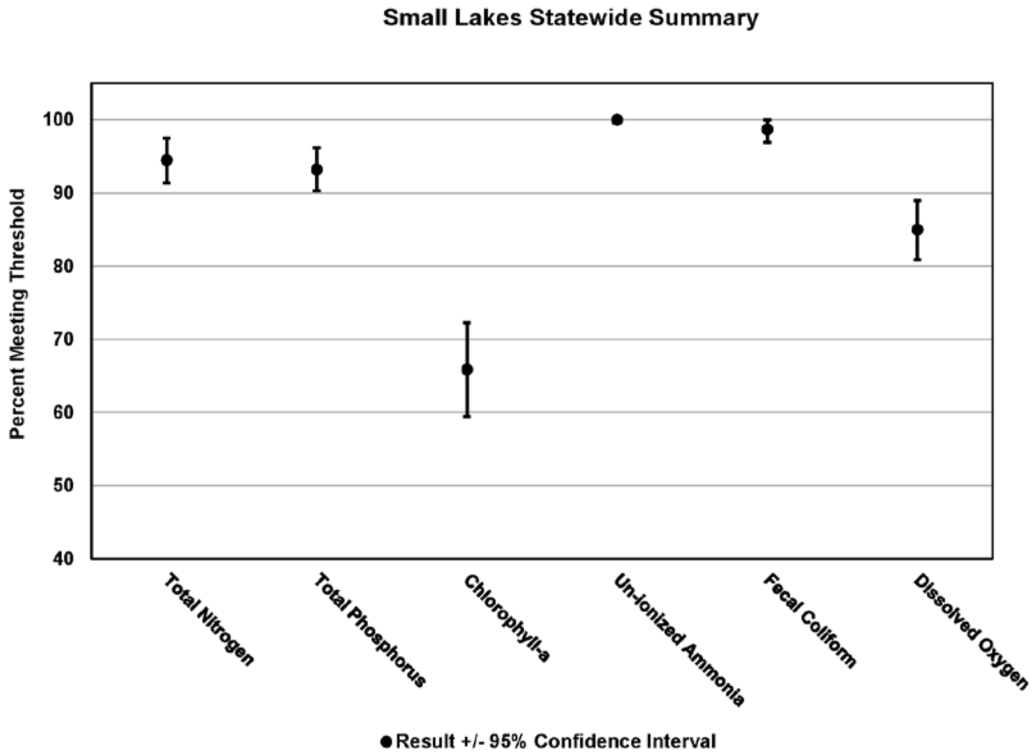


Figure 2.12. Statewide summary of Status Network small lake results

Sediment Quality Evaluation

Background

In aquatic environments, sediments provide many essential ecological functions but, at the same time, may be a source of contamination and recycled nutrients. Sediment contaminants, such as trace metals, organic pesticides, and excess nutrients, accumulate over time from upland discharges, the decomposition of organic material, and even atmospheric deposition. Periodic water quality monitoring alone cannot be used to fully evaluate aquatic ecosystems. A site's sediment quality is an important variable for environmental managers to evaluate in restoration and dredging projects. DEP has no sediment standards (criteria), and no statutory authority to establish these criteria. Therefore, it is important to use scientifically defensible thresholds to estimate the condition of sediments.

The interpretation of marine and freshwater sediment trace metals data, which can vary by two orders of magnitude in Florida, is not straightforward because metallic elements are natural sediment constituents. For sediment metals data analysis, DEP uses two interpretive tools, available in two publications: *A Guide to the Interpretation of Metals Concentrations in Estuarine Sediments* (Schropp and Windom 1988) and *Development of an Interpretive Tool for the Assessment of Metal Enrichment in Florida Freshwater Sediment* (Carvalho and Schropp 2002). These tools use a statistical normalization technique to predict background concentrations of metals in sediments, regardless of their composition.

During the 1990s, several state and federal agencies developed concentration-based sediment guidelines to evaluate biological effects from sediment contaminants. DEP selected the weight-of-evidence approach derived from studies containing paired chemistry and associated biological responses to develop its sediment guidelines. For interpreting sediment contaminant data, DEP uses the guidelines in *Approach to the Assessment of Sediment Quality in Florida Coastal Waters* (MacDonald 1994) and *Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters* (MacDonald Environmental Sciences et al. 2003).

Rather than traditional pass/fail criteria, DEP's weight-of-evidence approach created two guidelines for each sediment contaminant: the lower guideline is the threshold effects concentration (TEC), and the higher guideline, the probable effects concentration (PEC). A value below the TEC indicates a low probability of harm to sediment-dwelling organisms. Conversely, sediment values above the PEC have a high probability of biological harm.

Sediment Evaluation for Small and Large Lakes

Of the Status Network surface water resource categories, DEP selected large and small lakes for sediment contaminant evaluation, since lakes integrate runoff within watersheds. Staff collected a total of 497 samples from the state's 2 lake resources in 2014 through 2016: 231 from small lakes and 266 from large lakes. Samples were analyzed for major elements (aluminum and iron), a suite of trace metals, and 3 sediment nutrients (nitrogen, phosphorus, and total carbon). To ensure accurate metals data, samples were prepared for chemical analysis using EPA Method 3051 (total digestion) rather than EPA 200.2 method (referred to as the total recoverable method). DEP used the geochemical metals tool and the freshwater biological effects guidance values (MacDonald Environmental Sciences et al. 2003) in tandem to evaluate lake sediment chemistry data (**Table 2.4a**).

When the concentration of a metal exceeded the TEC and was less than or equal to the PEC, staff evaluated the metal concentration using the sediment statistical normalization tool. If the metal concentration was still within the predicted naturally occurring range, staff classified the sediment sample as not exceeding the TEC because of natural metal concentrations. When a metal concentration exceeded the predicted naturally occurring range, staff classified the sediment sample as exceeding Florida's sediment guidelines. **Figures 2.13** and **2.14**, along with **Tables 2.4b** and **2.4c**, provide the results.

Most sites that appear to exceed the TEC in fact exhibit expected sediment metal concentrations. Copper (still widely employed as an aquatic herbicide), lead, and zinc have the most elevated concentrations in the dataset. Elevated lead and zinc concentrations often are caused by stormwater input. Arsenic, cadmium, chromium, mercury, and silver rarely exceed the sediment guidelines. Not surprisingly, sediment metals are highest in lakes in urbanized areas. The largest number of lake sites with elevated metals occurs in peninsular Florida.

Table 2.4a. DEP freshwater lake sediment contaminant thresholds for metals

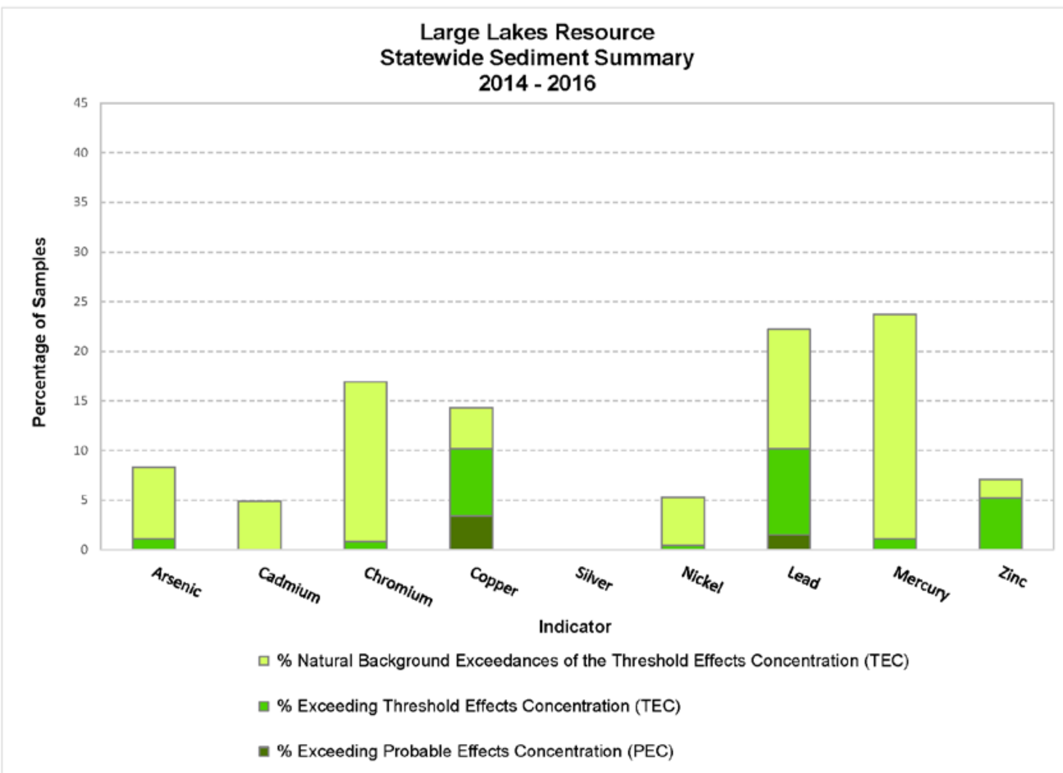
mg/kg = Milligrams per kilogram

Metal	TEC (mg/kg)	PEC (mg/kg)
Arsenic	9.8	33
Cadmium	1.00	5
Chromium	43.4	111
Copper	32	149
Lead	36	128
Mercury	0.18	1.06
Nickel	23	48
Zinc	121	459
Silver	1	2.2

Table 2.4b. Statewide percentage of large lakes meeting sediment contaminant threshold values

Note: All table values reflect results after applying metals normalization analysis.

Metal	% Meeting TEC Threshold	% Not Meeting TEC Threshold	% Not Meeting PEC Threshold	% of Stations > TEC Because of Natural Metal Concentrations
Arsenic	91.7	1.1	0.0	7.2
Cadmium	95.1	0.0	0.0	4.9
Chromium	83.1	0.8	0.0	16.1
Copper	85.7	6.8	3.4	4.1
Silver	100.0	0.0	0.0	0.0
Nickel	94.7	0.4	0.0	4.9
Lead	77.8	8.7	1.5	12.0
Mercury	76.3	1.1	0.0	22.6
Zinc	92.9	5.2	0.0	1.9



Note: There were no exceedances for silver. All samples (100 %) met the TEC threshold for this indicator.

Figure 2.13. Statewide summary of large lake sediment results

Table 2.4c. Statewide percentage of small lakes meeting sediment contaminant threshold values

Note: All table values reflect results after applying metals normalization analysis.

Metal	% Meeting TEC Threshold	% Not Meeting TEC Threshold	% Not Meeting PEC Threshold	% of Stations > TEC Because of Natural Metal Concentrations
Arsenic	87.0	1.3	0.0	11.7
Cadmium	87.0	0.4	0.0	12.6
Chromium	74.0	0.0	0.0	26.0
Copper	67.5	16.1	8.2	8.2
Silver	98.7	1.3	0.0	0.0
Nickel	93.9	0.4	0.0	5.7
Lead	53.6	26.9	7.4	12.1
Mercury	57.6	6.9	0.0	35.5
Zinc	77.1	10.0	5.6	7.3

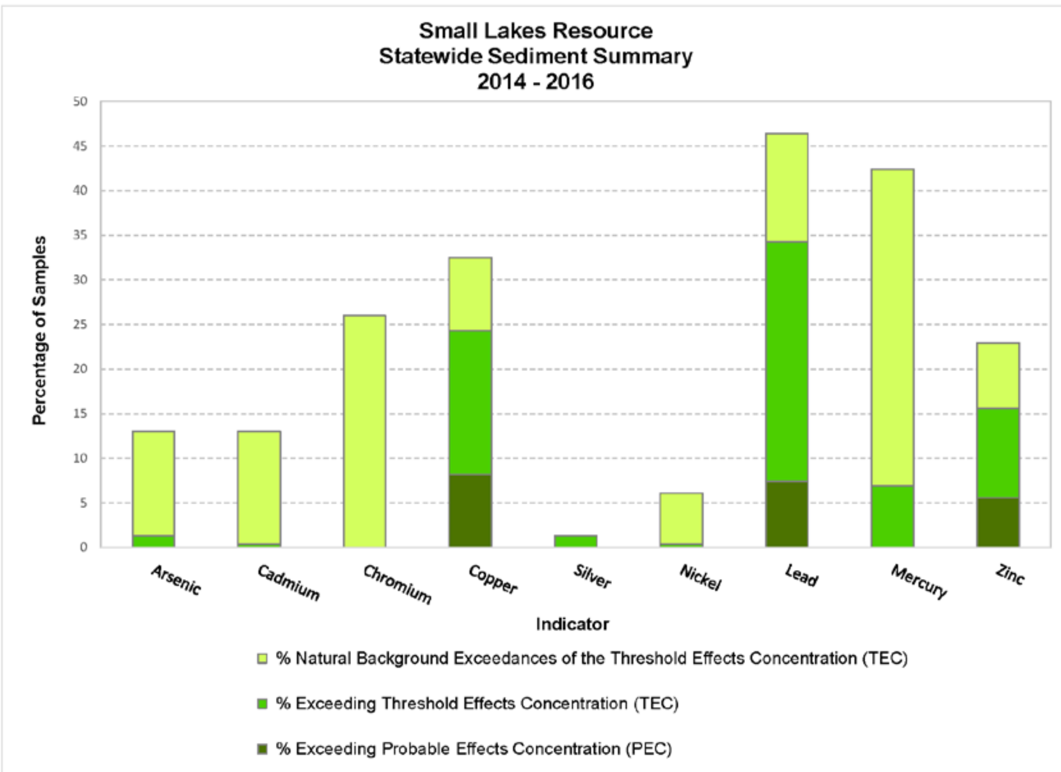


Figure 2.14. Statewide summary of small lake sediment results

Discussion of Rivers, Streams, Canals, Large Lakes, and Small Lakes

The water quality results indicate that, for recreational use and aquatic life support, Florida's flowing waters and lakes are in relatively good health. However, an inspection of the indicators shown in **Figures 2.4, 2.6, 2.8, 2.10,** and **2.12** reveals the following. Canals show the lowest percentage of passing values for TP and TN (< 60 %), while lakes show the lowest percentage of passing values (< 70 %) for the nutrient response indicator, chlorophyll *a*. DEP has developed numerous TMDLs, BMAPs, and restoration areas to address both TN and TP inputs (see **Chapters 4** and **5**).

The sediment results for lakes indicate that, for aquatic life support, the sediment quality of Florida's lakes is generally good. However, **Figures 2.13** and **2.14** show generally lower sediment contamination levels in large lakes compared with small lakes. The sediment metals copper, lead, and zinc in both large and small lakes have the highest exceedances of the TEC and PEC. It is not surprising that small lakes have worse sediment quality than large lakes, as small lakes may be affected more by sedimentation simply because of the lake-shore-to-lake-area ratio.

Summary of Status Network Groundwater Results

DEP has monitored groundwater quality since 1986 in both confined and unconfined aquifers. The Status Network groundwater monitoring program uses a probabilistic monitoring design to estimate confined and unconfined aquifer water quality across the state, based on the sampling of wells representing each. The wells used in this evaluation include private, public, monitoring, and agricultural irrigation wells.

The assessment period for this report is January 2014 through December 2016. **Table 2.5** describes the groundwater indicators used in the analysis and lists drinking water standards (thresholds). Some of the more important analytes include total coliform bacteria, nitrate-nitrite, trace metals such as arsenic and lead, and sodium (salinity), all of which are threats to drinking water quality.

For each Status Network groundwater resource (confined aquifers and unconfined aquifers), there is a map showing the sample site locations (**Figures 2.15** and **2.17)**, a figure summarizing the statewide results (**Figures 2.16** and **2.18**), and a table containing the statewide results for each indicator by aquifer resource (**Tables 2.6b** and **2.6c**). **Table 2.6a** provides the legend for the terms used in **Tables 2.6b** and **2.6c**. **Tables 2.6b** and **2.6c** estimate the quality of Florida's confined and unconfined aquifers by listing the percentage of the resource that meets a potable water threshold.

Discussion of Confined and Unconfined Aquifers

Water quality results indicate that Florida's potable groundwater generally is in good condition, with greater than 90 % of each resource showing passing values for all drinking water indicators.

Florida's groundwater and surface water connectivity is significant. Therefore, groundwater entering surface water systems may trigger failures of aquatic life support indicators, especially for DO and the nutrients TN and TP. DEP has developed TMDLs, BMAPs, and restoration areas to address these issues, discussed in more detail in **Chapter 5**. The section summarizing the Trend Network Analysis contains an additional discussion of groundwater concerns for Florida.

Table 2.5. Status Network physical/other indicators for potable water supply for groundwater with water quality thresholds

Indicator	Threshold for Potable Water Supply (Groundwater)
Fluoride	≤ 4 mg/L
Arsenic	≤ 10 µg/L
Cadmium	≤5 µg/L
Chromium	≤ 100 µg/L
Lead	≤ 15 µg/L
Nitrate-Nitrite	≤ 10 mg/L as N
Sodium	≤ 160 mg/L
Fecal Coliform Bacteria	< 2 counts/100mL
Total Coliform Bacteria	≤ 4 counts/100mL

Table 2.6a. Legend for terms used in Tables 2.6b and 2.6c

Term	Explanation
Analyte	Indicators chosen to base assessment of condition of waters of the state.
Target Population	Number of wells from which inferences were calculated. Excludes % of wells that were determined to not fit definition of resource.
Number of Samples	Number of samples used for statistical analysis
% Meeting Threshold	% estimate of target population that meets specific threshold value.
95 % Confidence Bounds (% meeting threshold)	Upper and lower bounds for 95 % confidence of % meeting specific threshold value.
% Not Meeting Threshold	% estimate of target population that does not meet specific threshold value.
Assessment Period	Duration of probabilistic survey sampling event.

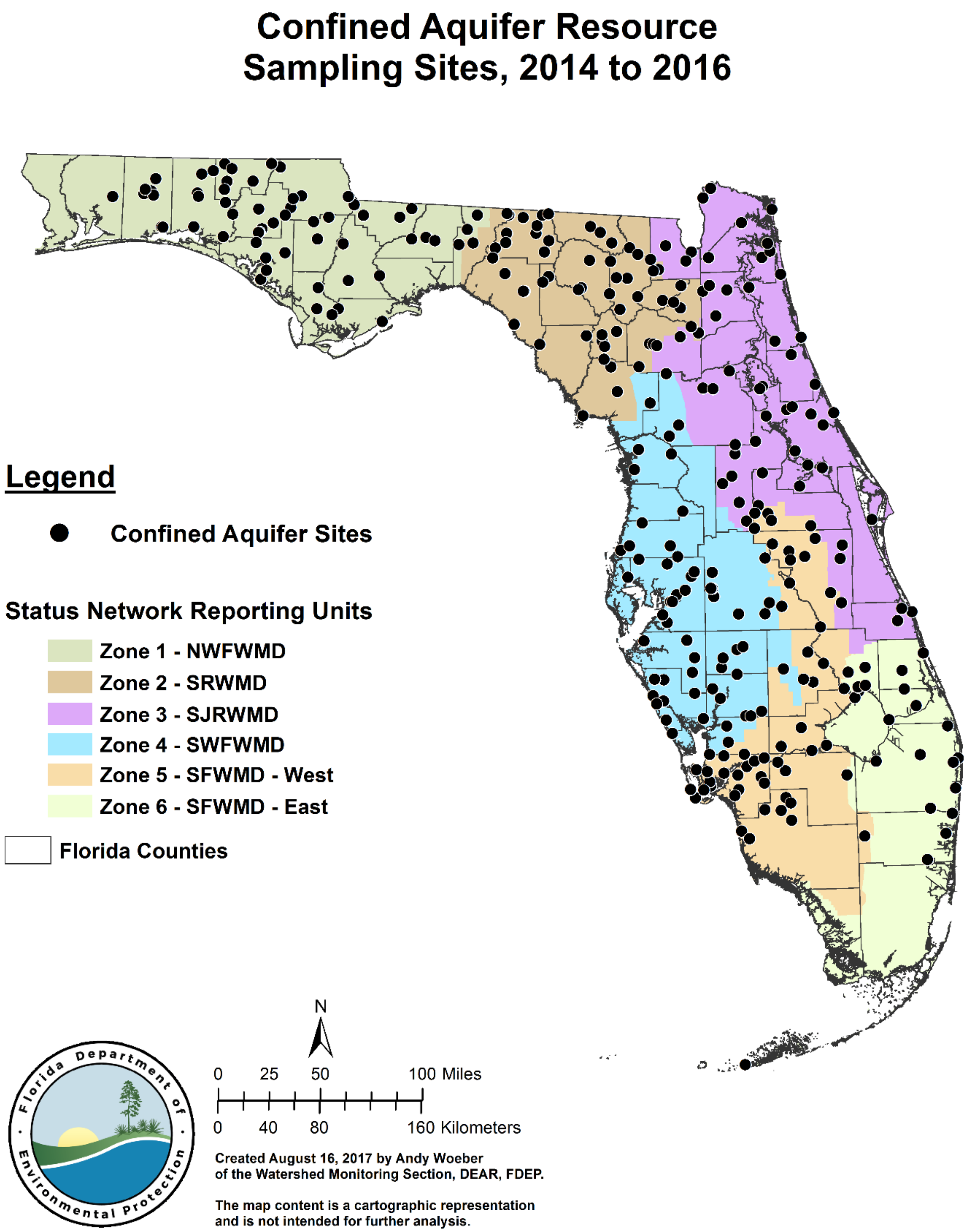


Figure 2.15. Statewide Status Network confined aquifer well locations

Table 2.6b. Statewide percentage of confined aquifers meeting threshold values for indicators calculated using probabilistic monitoring design

Designated Use: Primary Drinking Water Standards **Units: Number of wells**

Analyte	Target Population (wells)	Number of Samples	% Meeting Threshold	95 % Confidence Bounds (% meeting)	% Not Meeting Threshold	Assessment Period
Arsenic	13,302	357	100.0	100.0	0.0	2014–16
Cadmium	13,302	357	100.0	100.0	0.0	2014–16
Chromium	13,302	357	100.0	100.0	0.0	2014–16
Lead	13,302	357	99.9	100.0–99.6	0.1	2014–16
Nitrate-Nitrite	13,302	357	99.0	99.7–98.2	1.0	2014–16
Sodium	13,302	357	95.5	96.5–94.4	4.5	2014–16
Fluoride	13,302	357	100.0	100.0	0.0	2014–16
Fecal Coliform Bacteria	13,302	356	99.4	99.9–98.9	0.6	2014–16
Total Coliform Bacteria	13,302	356	92.1	96.8–87.3	7.9	2014–16

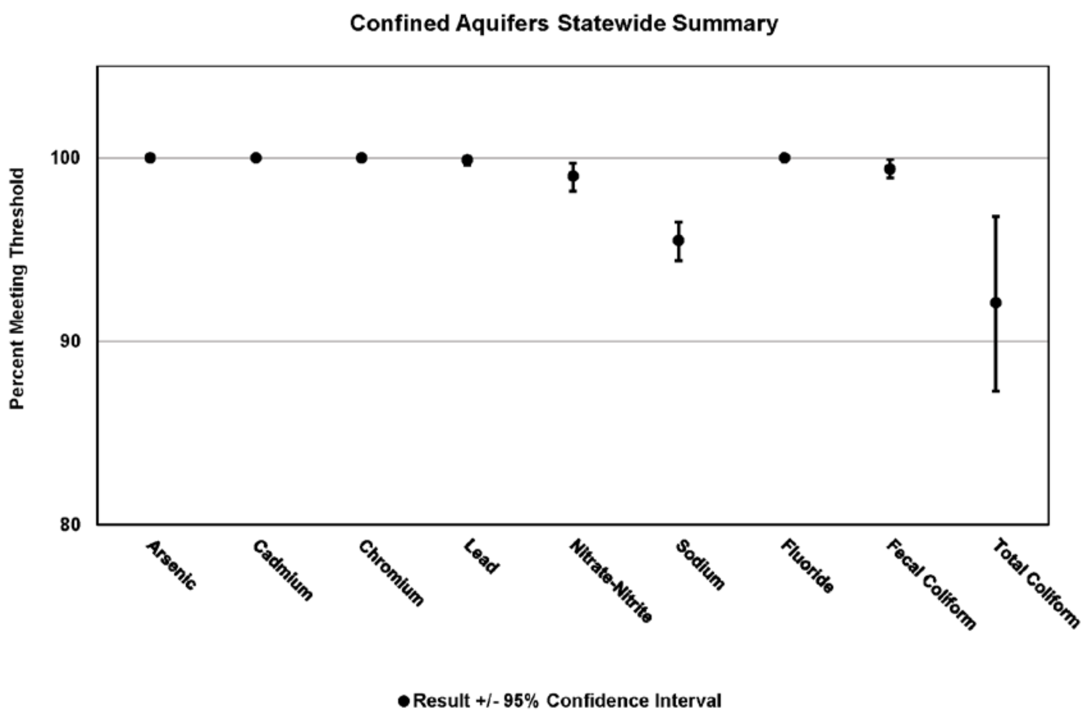


Figure 2.16. Statewide summary of Status Network confined aquifer results

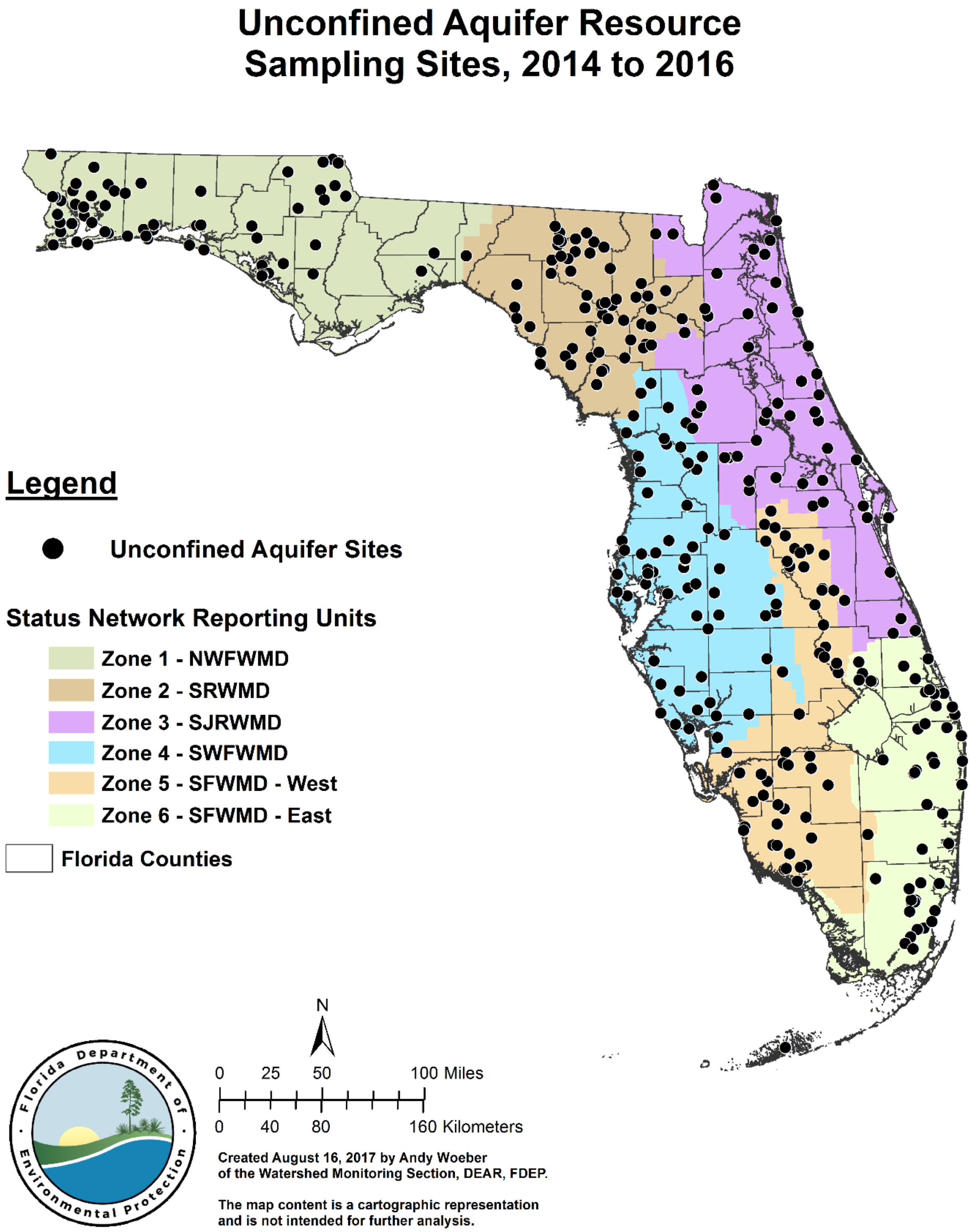


Figure 2.17. Statewide Status Network unconfined aquifer well locations

Table 2.6c. Statewide percentage of unconfined aquifers meeting threshold values for indicators calculated using probabilistic monitoring design

Status Network Designated Use: Primary Drinking Water Standards Units: Number of wells in list frame

Analyte	Target Population (wells in list frame)	Number of Samples	% Meeting Threshold	95 % Confidence Bounds (% meeting)	% Not Meeting Threshold	Assessment Period
Arsenic	15,973	349	96.1	100.0–92.0	3.9	2014–16
Cadmium	15,973	349	100.0	100.0	0.0	2014–16
Chromium	15,973	349	100.0	100.0	0.0	2014–16
Lead	15,973	349	98.1	100.0–95.1	1.9	2014–16
Nitrate-Nitrite	15,973	349	99.7	100.0–99.3	0.3	2014–16
Sodium	15,973	349	96.9	100.0–93.8	3.1	2014–16
Fluoride	15,973	349	100.0	100.0	0.0	2014–16
Fecal Coliform Bacteria	15,973	336	98.9	99.5–98.3	1.1	2014–16
Total Coliform Bacteria	15,973	336	91.9	93.8–89.9	8.1	2014–16

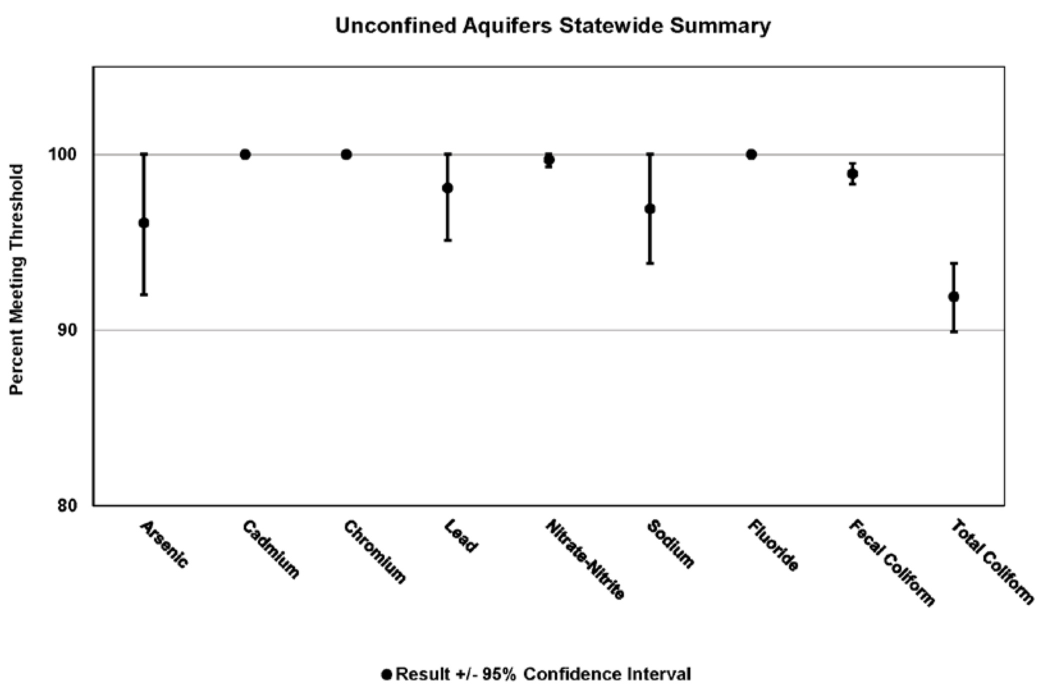


Figure 2.18. Statewide summary of Status Network unconfined aquifer results

Summary of Surface Water and Groundwater Trend Network Results

Overview

In flowing surface waters, flow rate is highly variable and can complicate data analyses if not taken into consideration. Where available, data on flow rates from associated USGS gauging stations were collected at the same time as surface water samples. DEP adjusted surface water quality data for flow before Seasonal Kendall trend analysis. In contrast, groundwater flow rates generally are much slower, and DEP did not need to make flow adjustments prior to performing the Seasonal Kendall analyses for groundwater.

If a trend existed for either flow-adjusted or nonflow-adjusted data, DEP determined the corresponding slope by using the Sen Slope estimator (Gilbert 1987), which measures the median difference between successive observations over the time series. This was used only to measure the direction of the slope, not as a hypothesis test. Therefore, reporting the trend as increasing, decreasing, or no trend indicates the direction of the slope and does not indicate impairment or improvement of the analyte being measured. For a detailed explanation of the information goals of the Trend Monitoring Network, including data sufficiency and analysis methods, see Appendix C of the *Design Document*

Surface Water Trends

The Surface Water Trend Network consists of 76 fixed sites sampled monthly (**Figure 2.19**); however, as of December 2014, only 74 stations had sufficient data for analysis. Thirty-six surface water stations were adjusted for flow, while the remaining 38 stations were not flow adjusted. Caution should be used when describing changes in water quality, especially on a statewide scale. To verify the changes, more detailed evaluations are needed. Nevertheless, a general overview of the potential changes that may be occurring is helpful.

The 2016 trend analysis revealed apparent changes in several indicators between 1999 and 2014. To select these indicators, DEP first combined flow-adjusted and nonflow-adjusted sites into one category (surface water) and excluded all sites **not** displaying significant trends. Next, for each analyte, DEP compared the percentage of sites with increasing trends with the percentage of sites with decreasing trends and noted the greater percentage. Then, DEP divided the number of sites with the greater percentage by the total number of sites displaying trends and set a subjective cutoff at 67 %. If the percentage of sites with trends in the strong direction was less than 67 %, the analyte was eliminated from further analyses. Based on this process, DEP found that the concentrations of nitrate-nitrite and DO are increasing and the concentration of TP is decreasing. The number of sites used for each indicator displaying evidence of change ranged from 39 to 40 sites.

Figure 2.19. Surface Water Trend Network sites with sufficient period of record (POR)

The nitrate-nitrite concentration appears to have increased at a large percentage of sites. These nutrients are essential for living organisms. However, an overabundance of nutrients in surface water can cause adverse health and ecological effects, including excessive plant and algal growth. Sources for these nutrients include animal waste, decaying plant debris, fertilizers, and urban drainage. Although many management and restoration efforts are under way to reduce the concentrations of nitrate and nitrite entering surface waters, most of these efforts are relatively new, and improvements that may be occurring are not yet apparent at the scale of this analysis.

The DO concentration appears to have increased at a large percentage of sites. Natural conditions, such as increased photosynthesis from algae and plants, can raise DO levels in waterbodies. Increased photosynthesis may be fueled by the greater availability of nutrients, discussed above. Decreased water inflow from springs and swamps/wetlands during droughts also may contribute to higher DO in surface waters. A higher DO concentration indicates water quality is improving for the species living in these waters.

The TP concentration appears to have decreased at a large percentage of sites, possibly because drought conditions have reduced the flow into and of many surface waterbodies. It could also indicate that the amount of phosphorus entering Florida's surface waters is being reduced through the successful implementation of best management practices (BMPs) and restoration plans.

Surface water trend results are available through an interactive ArcGIS Online web application, Surface Water Trend Report Card Map.

Groundwater Trends

The Groundwater Trend Network consists of 49 fixed sites used to obtain chemistry and field data in confined and unconfined aquifers. From 1999 through 2014, only 48 stations had sufficient data for analysis (**Figure 2.20**). Groundwater trend analyses were performed in the same manner as the surface water trend analyses. As stated previously, reporting the trend as increasing, decreasing, or no trend indicates the direction of the slope and does not indicate impairment or improvement of analyte concentrations in the waters. Of the wells, 23 tap confined aquifers, while 25 tap unconfined aquifers. At some locations, there are multiple wells tapping different areas of the aquifers. These are shown in **Figure 2.20** as bubble groupings.

Caution should be used when describing changes in water quality, especially on a statewide scale. It is important to note that to verify the changes, more detailed evaluations are necessary. Nevertheless, as with surface water, a general overview of the potential changes that may be occurring is helpful.

The 2016 trend analysis revealed apparent changes in several indicators between 1999 and 2014. To select indicators that appear to have changed, DEP first combined the confined and unconfined aquifers into one category (groundwater) and excluded all sites **not** displaying significant trends. Next, for each analyte, the percentage of sites with increasing trends was compared with the percentage of sites with decreasing trends, and the greater percentage was noted. Then, DEP divided the number of sites with the greater percentage by the total number of sites displaying trends and set a subjective cutoff at 67 %. If the percentage of sites with trends in the strong direction was less than 67 %, the analyte was eliminated from further analyses. Based on this process, DEP found the concentrations of calcium, magnesium, alkalinity, specific conductance, sodium, chloride, potassium, total Kjeldahl nitrogen (TKN), and DO are increasing, and temperature and pH are decreasing. The number of sites used for each indicator displaying evidence of change ranged from 13 to 35 sites.

Groundwater trend results are available through an interactive ArcGIS Online web application, Groundwater Trend Report Card Map.

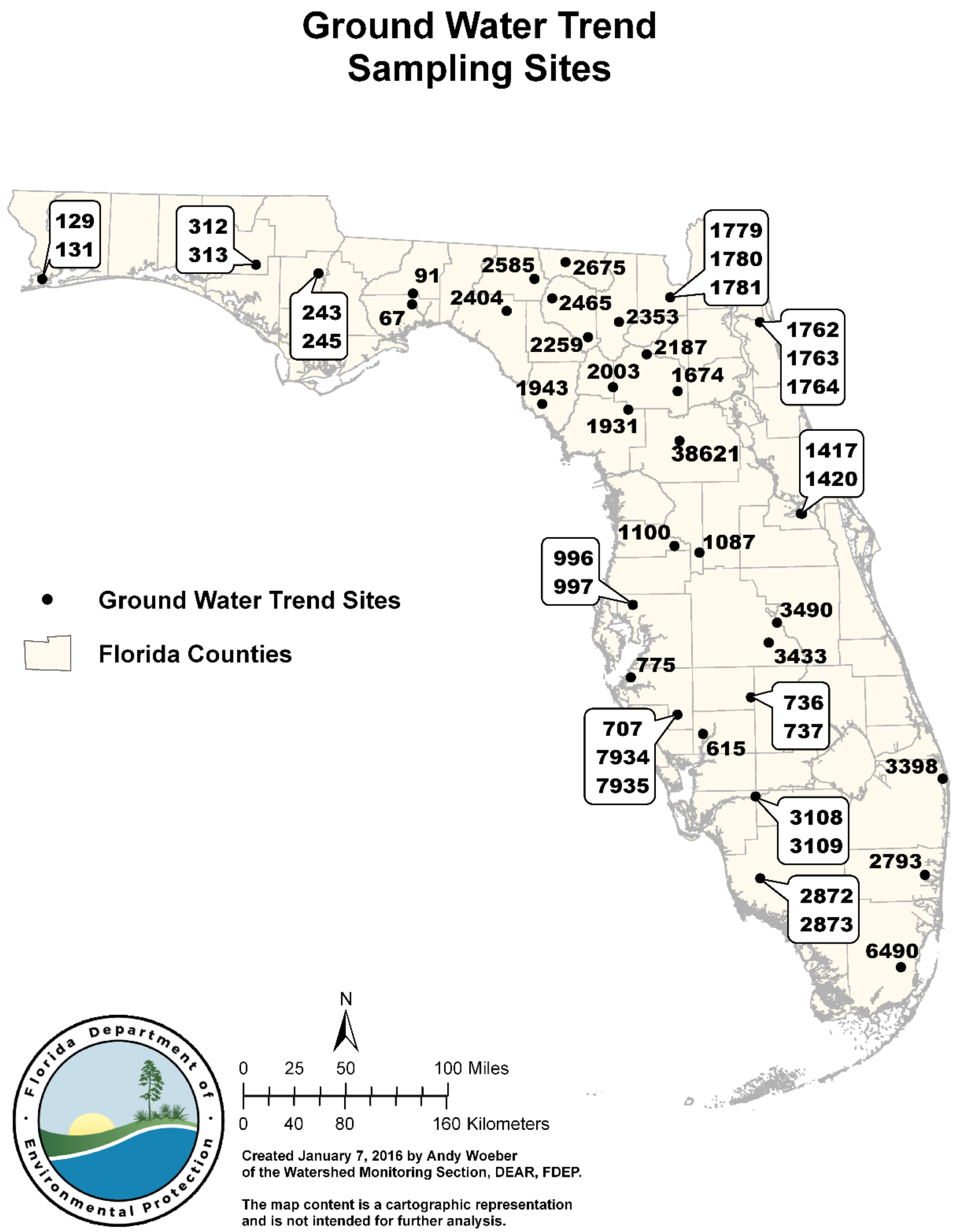


Figure 2.20. Groundwater Trend Network sites with sufficient POR

Chapter 3: Designated Use Support in Surface Waters

Background

Florida's surface waters are protected for the designated use classifications listed in **Appendix B**. DEP's Watershed Assessment Section assesses the health of surface waters through the implementation of the IWR (Chapter 62-303, F.A.C.). The rule provides a legislatively authorized methodology for DEP to assess water quality and determine whether individual surface waters are impaired (i.e., do not attain water quality standards) under ambient conditions. The IWR is used in conjunction with Water Quality Standards (Chapter 62-302, F.A.C.) and the Quality Assurance Rule (Chapter 62-160, F.A.C.), which governs sample collection and analysis procedures.

The IWR is implemented using DEP's watershed management approach. Under this approach, which is based on a 5-year basin rotation, Florida's 52 hydrologic unit code (HUC) basins (51 HUCs plus the Florida Keys) are distributed among 29 basin groups. These basin groups are located in the 6 DEP statewide districts, with 5 groups in each of the Northwest, Central, Southwest, South, and Southeast Districts, and 4 groups in the Northeast District. One group in each district is assessed each year (except for the Northeast). This report summarizes the results of the assessments performed through 2012, including the second cycle for Basin Groups 2 through 5 and the third cycle for Basin Group 1. The assessments do not reflect water quality criteria changes for nutrients, recreational bacteria, and DO (as percent saturation).

As part of the assessment process, DEP uses all available data in Florida's Storage and Retrieval (STORET) Database, which contains data from more than 75 data providers, including data collected under the Strategic Monitoring Program (SMP). The goal of the SMP is to ensure that segments with waterbody identification (WBID) numbers have sufficient data to verify whether potentially impaired waters are in fact impaired and, to the extent possible, determine the causative pollutant for waters listed as not meeting the applicable criteria for DO or biological health. Monitoring under the SMP typically occurs over multiple years and includes the collection of chemistry and biological data. These data are combined with any other available data at the time of assessment. Because of limited resources, monitoring is prioritized based on the EPA's Integrated Report assessment categories, listed in **Table 3.1a**.

Table 3.1a. Distribution of assessment results by waterbody type and assessment category (number of WBIDs)

Note: There are no waters in EPA Category 1 (attaining all designated uses) because DEP does not sample for all uses. Category 2 comprises waters attaining all the uses that are sampled for.

The EPA Integrated Report categories are as follows:
1—Attains all designated uses.
2—Attains some designated uses.
3a—No data and information are available to determine if any designated use is attained.
3b—Some data and information are available, but they are insufficient for determining if any designated use is attained.
3c—Meets Planning List criteria and is potentially impaired for one or more designated uses.
4a—Impaired for one or more designated uses and a TMDL has been completed.
4b—Impaired for one or more designated uses, but no TMDL is required because an existing or proposed pollutant control mechanism provides reasonable assurance that the water will attain standards in the future.
4c—Impaired for one or more designated uses but no TMDL is required because the impairment is not caused by a pollutant.
4d—No causative pollutant has been identified.
4e—Impaired, but recently completed or ongoing restoration activities should restore the designated uses of the waterbody.
5—Water quality standards are not attained and a TMDL is required.

Waterbody Type	EPA Cat. 2	EPA Cat. 3b	EPA Cat. 3c	EPA Cat. 4a	EPA Cat. 4b	EPA Cat. 4c	EPA Cat. 4d	EPA Cat. 4e	EPA Cat. 5	Number of Waterbody Segments Assessed
Beach	241	9	9						87	346
Coastal				12			1		142	155
Estuary	4	5	5	69	3		4		571	661
Lake	152	294	304	49	1		63	3	345	1,211
Spring	4	2	11	28		10	17		37	109
Stream	147	420	346	53		17	214	3	711	1,911
Total	**548**	**730**	**675**	**211**	**4**	**27**	**299**	**6**	**1,893**	**4,393**

303(d) Listed Waters

Only those WBID/analyte combinations placed in EPA Category 5 as a result of IWR assessments are included on the state's Verified List of Impaired Waters adopted by Secretarial Order. For these listings, water quality standards are not being met, and the development of a TMDL is required. These waters are subsequently submitted to EPA as the annual update to Florida's 303(d) list.

Although water quality standards are not met for EPA Category 4, these waterbodies are not included on the state's Verified List because a TMDL currently is not required. Nevertheless, for Subcategories 4d or 4e, TMDLs may be required later, and these listings are included on the 303(d) list.

Assessment Results

Lakes are a particular focus of EPA's Integrated Report guidance, under Section 314 of the CWA. Table 3.3b lists the acres of lakes identified as impaired and the cause of the impairment. Appendix C lists almost 400 publicly owned lakes that have been identified as impaired, for which a TMDL will be needed. Many of these have mercury in fish tissue impairments which are covered by the statewide TMDL. Currently, DEP has 63 of these lakes on its priority list for TMDL development through 2022. Twenty of these lakes already have a TMDL or TMDL alternative adopted into state rule.

In Florida, the most frequently identified causes of impairment for rivers and streams, as well as for lakes and estuarine segments, include DO, fecal coliform, mercury (in fish tissue), and nutrients. **Table 3.1b** lists the 10 most frequently identified impairments by waterbody type.

Table 3.1b. 10 most frequently identified causes of impairment by waterbody type

Note: Counts exclude assessments in Category 4c.

Identified Cause	Lake	Stream	Coastal	Estuary	Spring	Beach	Total Impairments Identified
DO	130	677	14	167	36		1,024
Mercury (in fish tissue)	93	155	133	473	9		863
Fecal Coliform	11	343	5	115			474
Chlorophyll		159	2	100	1		262
Trophic State Index (TSI)	223						223
Bacteria (DEP Shellfish Environmental Assessment Section [SEAS] classification)		9	11	96			116
Beach Advisory						87	87
Historic Chlorophyll		51		32			83
Nutrients	1	20		2	32		55
Biology		47			1		48

Tables 3.2a and **3.2b** and **Figures 3.1a and 3.1b** present the distribution of the impairment-specific subgroup summary assessments for pathogens and nutrients by waterbody type and EPA reporting category.

Table 3.2a. Assessment results for pathogens by waterbody type and assessment category (number of WBIDs)

Note: There are no waters in EPA Category 1 (attaining all designated uses) because DEP does not sample for all uses. Category 2 comprises waters attaining all the uses that are sampled for.

The EPA Integrated Report categories are as follows:
1—Attains all designated uses.
2—Attains some designated uses.
3a—No data and information are available to determine if any designated use is attained (not displayed)
3b—Some data and information are available, but they are insufficient for determining if any designated use is attained.
3c—Meets Planning List criteria and is potentially impaired for one or more designated uses.
4a—Impaired for one or more designated uses and a TMDL has been completed.
4b—Impaired for one or more designated uses, but no TMDL is required because an existing or proposed pollutant control mechanism provides reasonable assurance that the water will attain standards in the future.
4c—Impaired for one or more designated uses but no TMDL is required because the impairment is not caused by a pollutant.
4d—No causative pollutant has been identified.
4e—Impaired, but recently completed or ongoing restoration activities should restore the designated uses of the waterbody.
5—Water quality standards are not attained and a TMDL is required.

Waterbody Type	EPA Cat. 2	EPA Cat. 3b	EPA Cat. 3c	EPA Cat. 4a	EPA Cat. 4b	EPA Cat. 4c	EPA Cat. 4d	EPA Cat. 4e	EPA Cat. 5	Total Number of Assessments
Coastal	92	7							13	112
Estuary	246	45	18	17					182	508
Lake	370	519	16						11	916
Spring	50	42	1							93
Stream	363	683	98	43				1	347	1,535
Total	**1,362**	**1,305**	**142**	**60**	**0**	**0**	**0**	**1**	**640**	**3,510**

Table 3.2b. Assessment results for nutrients by waterbody type and assessment category (number of WBIDs)

Note: There are no waters in EPA Category 1 (attaining all designated uses) because DEP does not sample for all uses. Category 2 comprises waters attaining all the uses that are sampled for.

The EPA Integrated Report categories are as follows:
1—Attains all designated uses.
2—Attains some designated uses.
3a—No data and information are available to determine if any designated use is attained (not displayed)
3b—Some data and information are available, but they are insufficient for determining if any designated use is attained.
3c—Meets Planning List criteria and is potentially impaired for one or more designated uses.
4a—Impaired for one or more designated uses and a TMDL has been completed.
4b—Impaired for one or more designated uses, but no TMDL is required because an existing or proposed pollutant control mechanism provides reasonable assurance that the water will attain standards in the future.
4c—Impaired for one or more designated uses but no TMDL is required because the impairment is not caused by a pollutant.
4d—No causative pollutant has been identified.
4e—Impaired, but recently completed or ongoing restoration activities should restore the designated uses of the waterbody.
5—Water quality standards are not attained and a TMDL is required.

Waterbody Type	EPA Cat. 2	EPA Cat. 3b	EPA Cat. 3c	EPA Cat. 4a	EPA Cat. 4b	EPA Cat. 4c	EPA Cat. 4d	EPA Cat. 4e	EPA Cat. 5	Total Number of Assessments
Estuary	55	280	30	29	5			2	113	514
Lake	315	480	60	49	1			3	244	1,152
Spring	4	68	3						1	76
Stream	286	960	93	17				4	179	1,539
Total	**672**	**1,878**	**187**	**95**	**6**	**0**	**0**	**9**	**539**	**3,386**

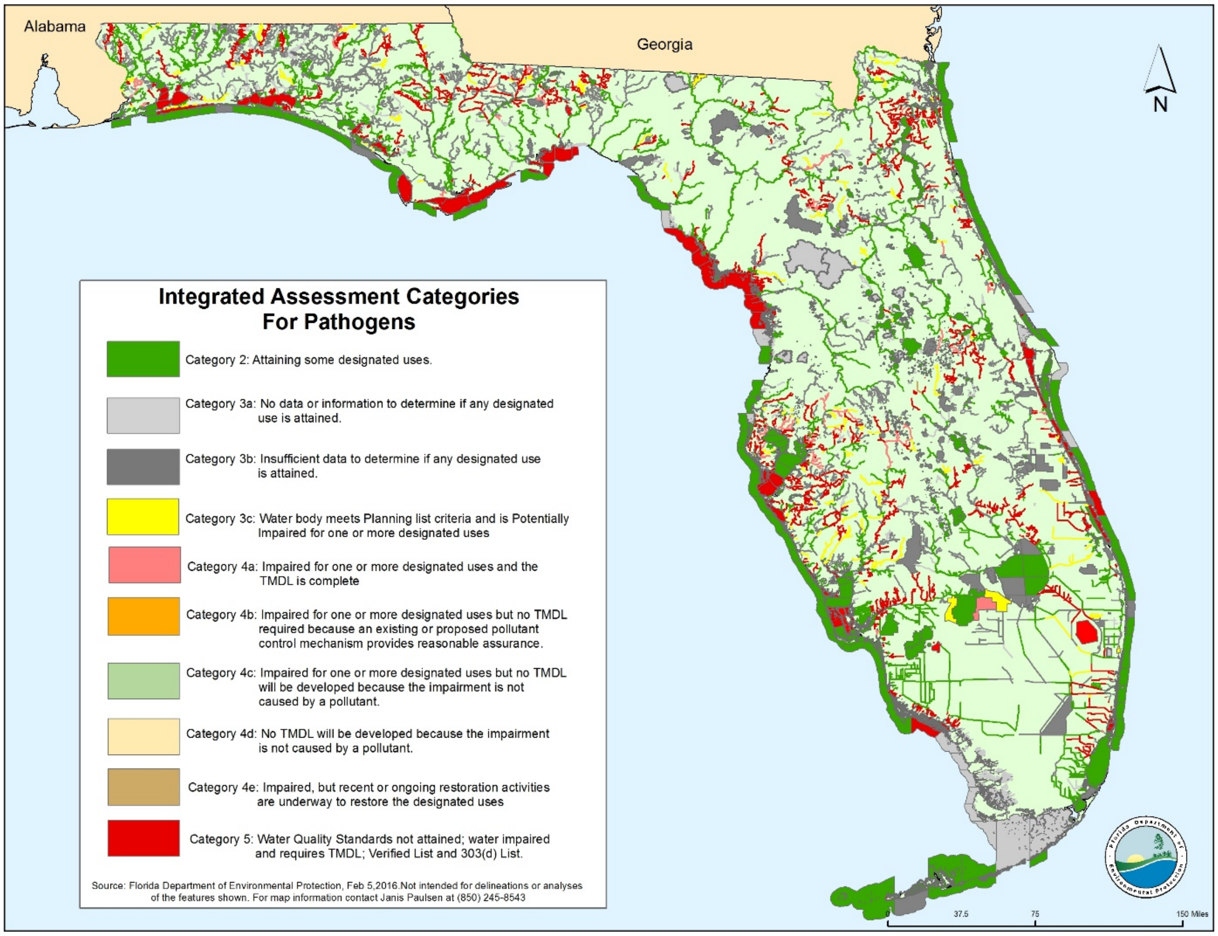


Figure 3.1a. Results of Florida's surface water quality assessment: EPA assessment categories for pathogens

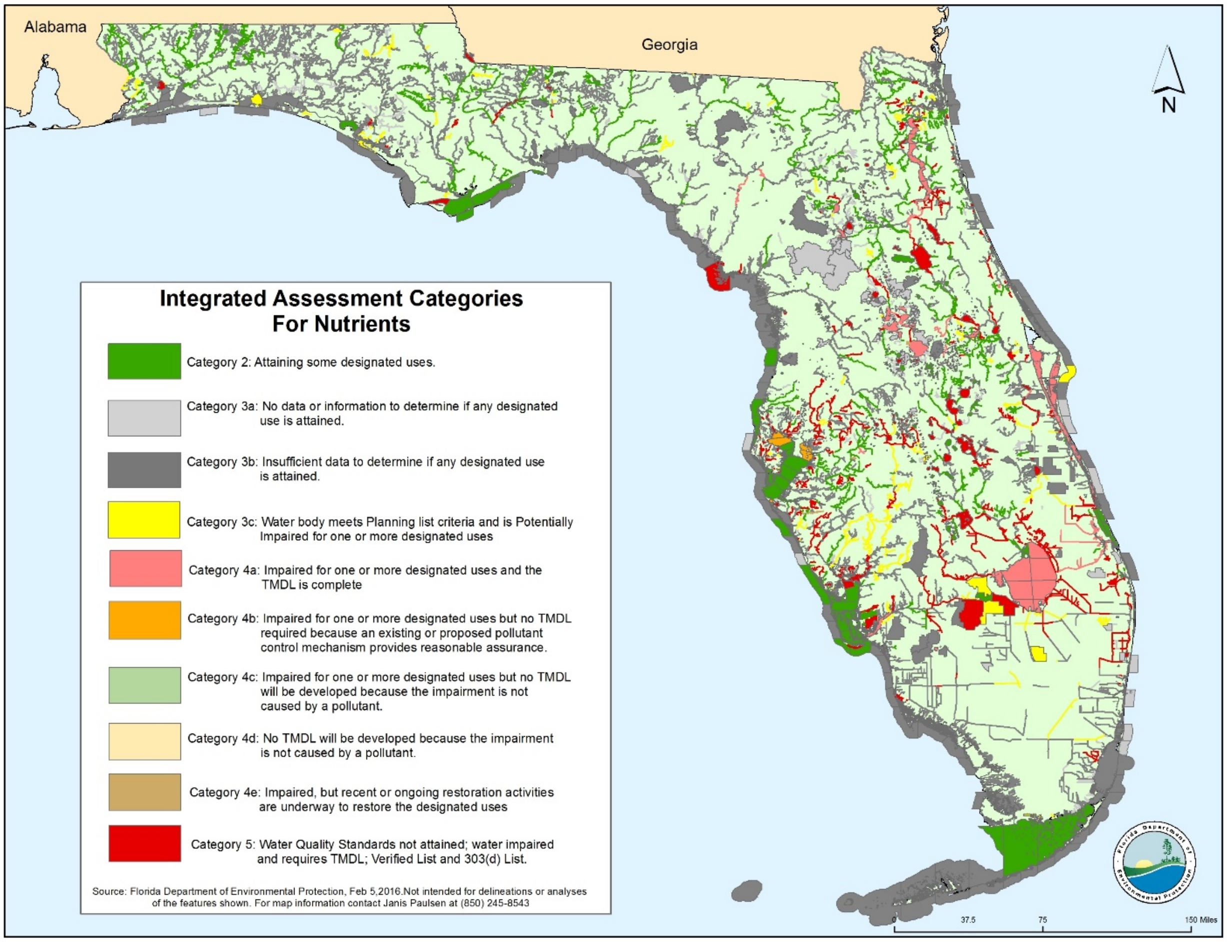


Figure 3.1b. Results of Florida's surface water quality assessment: EPA assessment categories for nutrients

Impairment Summary

Tables 3.3a through **3.3d** summarize the number and size of waterbody segments/analyte combinations identified as impaired for which a TMDL may be required (i.e., in Subcategories 4d, 4e, or 5) by the specific impairment identified. **Chapter 4** has more information on developing Total Maximum Daily Loads in Florida. Since a single WBID may be impaired for multiple analytes, the totals presented do not necessarily reflect the total size of waterbodies identified as impaired, but rather the total of all waterbody segment/analyte combinations. The number of acres identified as impaired for lakes includes and is largely influenced by the assessment results for Lake Okeechobee. Covering 320,331 acres, Lake Okeechobee is by far the largest lake in the state and is included among the Category 5 waters.

In addition, all estuaries and coastal waters have been assessed for mercury (based on analyses of mercury in fish tissue) and are included among the Category 5 waters. Furthermore, although all fresh waters listed as impaired for mercury, and marine waters that were listed as impaired for mercury prior to 2013, were addressed by a statewide TMDL completed in 2012, only those segments in the currently assessed basins in the rotation cycle have been delisted (and placed in EPA Category 4a). It is anticipated that by the conclusion of the current cycle, all segments will have been delisted for mercury impairments.

Table 3.3a. Miles of rivers/streams impaired by cause

Note: Some stream WBIDs were previously classified as lakes and were assessed for nutrients based on the TSI. These will be revised during the appropriate assessment cycle.

Identified Cause	Waterbody Type	Units	Number of Stream Segments Identified as Impaired	Total Water Size for Stream Segments Identified as Impaired (without canals)	Total Water Size for Stream Segments Identified as Impaired (with canals)
DO	Stream	Miles	678	6,293	33,828
Fecal Coliform	Stream	Miles	344	3,511	11,770
Nutrients (chlorophyll *a*)	Stream	Miles	160	927	10,716
Mercury (in fish tissue)	Stream	Miles	157	2,771	5,611
Nutrients (historic TSI)	Stream	Miles	51	488	3,413
Biology	Stream	Miles	47	629	3,605
Nutrients (other)	Stream	Miles	20	83	333
Iron	Stream	Miles	15	217	1,719
Lead	Stream	Miles	12	129	258
Bacteria (SEAS Classification)	Stream	Miles	11	133	260
Un-Ionized Ammonia	Stream	Miles	7	58	647
Turbidity	Stream	Miles	6	19	1,018
Dissolved Solids	Stream	Miles	5	92	838
Chloride	Stream	Miles	3	28	412
Specific Conductance	Stream	Miles	3	46	404
Copper	Stream	Miles	2	4	21
Silver	Stream	Miles	1	6	6
Chlorine	Stream	Miles	1	33	36
Dioxins and Furans	Stream	Miles	1	4	4
Total			**1,524**	**15,470**	**74,898**

Table 3.3b. Acres of lakes impaired by cause

Identified Cause	Waterbody Type	Units	Number of Lake Segments Identified as Impaired	Total Water Size for Lake Segments Identified as Impaired
Trophic Status	Lake	Acres	224	255,016
DO	Lake	Acres	131	103,749
Mercury (in fish tissue)	Lake	Acres	91	260,596
Historic TSI	Lake	Acres	43	79,086
TSI Trend	Lake	Acres	15	73,327
Fecal Coliform	Lake	Acres	11	1,533
Iron	Lake	Acres	8	283,473
Lead	Lake	Acres	5	3,276
Copper	Lake	Acres	2	539
Turbidity	Lake	Acres	2	393
Unionized Ammonia	Lake	Acres	2	934
Silver	Lake	Acres	1	64
Nutrients (other)	Lake	Acres	1	240
pH	Lake	Acres	1	671
Thallium	Lake	Acres	1	66
Total			**538**	**1,062,963**

Table 3.3c. Acres of estuaries impaired by cause

Identified Cause	Waterbody Type	Units	Number of Estuary Segments Identified as Impaired	Total Water Size for Estuary Segments Identified as Impaired (without Canals)	Total Water Size for Estuary Segments Identified as Impaired (with Canals)
Mercury (in fish tissue)	Estuary	Acres	473	1,331,200	1,331,200
DO	Estuary	Acres	166	180,420	180,420
Fecal Coliform	Estuary	Acres	113	198,185	198,185
Nutrients (chlorophyll *a*)	Estuary	Acres	104	135,203	135,203
Bacteria (SEAS classification)	Estuary	Acres	95	641,566	641,566
Nutrients (historic TSI)	Estuary	Acres	33	25,640	25,640
Copper	Estuary	Acres	29	41,955	41,955
Iron	Estuary	Acres	22	34,274	34,274
Lead	Estuary	Acres	3	4,880	4,880
Nutrients (other)	Estuary	Acres	2	944	944
Dioxin (in fish tissue)	Estuary	Acres	1	2	2
Nickel	Estuary	Acres	1	2,808	2,808
Turbidity	Estuary	Acres	1	878	878
Total			**1,043**	**2,597,957**	**2,597,957**

Table 3.3d. Miles of coastal waters impaired by cause

Identified Cause	Waterbody Type	Units	Number of Coastal Segments Identified as Impaired	Total Water Size for Coastal Segments Identified as Impaired	Total Water Size for Coastal Segments Identified as Impaired
Mercury (in fish tissue)	Coastal	Miles	132	1,841	1,841
DO	Coastal	Miles	14	232	232
Copper	Coastal	Miles	10	170	170
Bacteria (shellfish harvesting downgrade)	Coastal	Miles	10	321	321
Fecal Coliform	Coastal	Miles	5	107	107
Nutrients (chlorophyll *a*)	Coastal	Miles	2	46	46
Total			**173**	**2,718**	**2,718**

Biological Assessment

Under the IWR, biological assessments can provide the basis for impairment determinations, or can support assessment determinations made for other parameters (as is the case for some waterbodies with naturally low DO concentrations where it may be possible to demonstrate that aquatic life use is fully supported by using biological information). **Appendices D** and **E** contain more information on biological assessment methodologies.

Biological assessment tools used in conjunction with assessments reported in the 2018 Integrated Report consist primarily of the SCI and Biological Reconnaissance (BioRecon). **Table 3.4** lists the distribution of biological assessments results by bioassessment type. The BioRecon results are version specific. However, since the underlying measures used in the 2007 SCI are the same as those used in the 2012 recalibration, the 2007 SCI results have been recalculated consistent with the calculation performed for the 2012 SCI (the 1992 SCI has not been recalculated). Although the most recent revisions to the biological assessments performed in conjunction with the IWR make direct use of raw scores for both the BioRecons and SCIs, these revisions were not in effect when the assessments for this report were performed.

Since 1992, DEP has processed 4,369 SCI and 1,141 BioRecon samples. Of the BioRecons conducted statewide since then, 33 % have required additional follow-up SCI sampling to determine aquatic life use support. During the same period, 20 % of the SCI values were below the minimum score of 40 associated with a healthy, well-balanced aquatic community (however, 2 temporally independent SCI results with an average less than 40 would be required for an impairment determination).

Table 3.4. Distribution of biological assessment results by bioassessment method and aquatic life use support

BioRecon

Biological Assessment Method and Date	Result	Meets Aquatic Life Use Support	Number of Results Not Meeting Aquatic Life Use Support	Total Number of Results
Biorecon_1992	Healthy	Yes	-	344
Biorecon_1992	Suspect	Yes	-	326
Biorecon_1992	Impaired	Requires follow-up sampling	281	281
Biorecon_2004	Pass	Yes	-	78
Biorecon_2004	Fail	Requires follow-up sampling	76	76
Biorecon_2008	Category 1	Yes	-	17
Biorecon_2008	Category 2	Yes	-	10
Biorecon_2008	Category 3	Requires follow-up sampling	9	9
Total BioRecon			**366**	**1,141**

SCI

Biological Assessment Method and Date	Assessment Result	Meets Aquatic Life Use Support	Number of Results Not Meeting Aquatic Life Use Support	Total Number of Results
SCI_1992	Excellent	Yes	-	1,229
SCI_1992	Good	Yes	-	470
SCI_1992	Poor	No, if two independent samples are collected in segment	210	210
SCI_1992	Very Poor	No, if two independent samples are collected in segment	58	58
SCI_2012	=>40	Yes	-	1,795
SCI_2012	<40	No, if two independent samples are collected in segment	607	607
Total SCI			875	4,369

Total number of bioassessment results for BioRecon and SCI = 6,651
Total number of bioassessment results not meeting aquatic life use support = 1,607

Delisting

Appendix E discusses the delisting process.

Drinking Water Use Support

While earlier sections of this chapter summarized all assessment results, this section focuses on assessment results for waterbodies designated as Class I (potable water supply). Of Florida's public drinking water systems, 13 % receive some or all of their water from a surface water source.

For Class I waters, the nonattainment of criteria that do not relate specifically to drinking water use support does not necessarily affect a waterbody's suitability as a potable water supply. In fact, those impairments for Class I waters that have been identified in assessments performed under the IWR have been for uses other than those associated with providing safe drinking water. **Table 3.5** lists the miles of rivers/streams and acres of lakes/reservoirs designated for drinking water use in each of EPA's five reporting categories. Note that Lake Okeechobee is a Class I waterbody and comprises 320,331 acres of the 337,520 total acres of Class I lakes.

Table 3.5. Waterbodies designated for drinking water use by assessment category (results for assessments including criteria for all use support)

Note: The EPA Integrated Report categories are as follows:
1—Attains all designated uses.
2—Attains some designated uses.
3a—No data and information are available to determine if any designated use is attained.
3b—Some data and information are available, but they are insufficient for determining if any designated use is attained.
3c—Meets Planning List criteria and is potentially impaired for one or more designated uses.
4a—Impaired for one or more designated uses and a TMDL has been completed.
4b—Impaired for one or more designated uses, but no TMDL is required because an existing or proposed pollutant control mechanism provides reasonable assurance that the water will attain standards in the future.
4c—Impaired for one or more designated uses but no TMDL is required because the impairment is not caused by a pollutant.
4d—No causative pollutant has been identified.
4e—Impaired, but recently completed or ongoing restoration activities should restore the designated uses of the waterbody.
5—Water quality standards are not attained and a TMDL is required.

* These impairments are not related to criteria specifically designed to protect drinking water supplies.

Rivers/Streams

Waterbody Type	Assessment Category	Assessment Status	Number of WBIDs	Miles/Analyte Combinations (for Streams)
Rivers/Streams	2	Not Impaired	1	77
Rivers/Streams	3a	No Data	17	34
Rivers/Streams	3b	Insufficient Data	12	67
Rivers/Streams	3c	Planning List	13	180
Rivers/Streams	4a	TMDL Complete	0	0
Rivers/Streams	4b	Reasonable Assurance	0	0
Rivers/Streams	4c	Natural Condition	0	0
Rivers/Streams	4d	No Causative Pollutant	10	279
Rivers/Streams	4e	Ongoing Restoration	0	0
Rivers/Streams	5*	Impaired	34	215

Lakes/Reservoirs

Waterbody Type	Assessment Category	Assessment Status	Number of WBIDs	Acres/Analyte Combinations (for Lakes)
Lakes/Reservoirs	2	Not Impaired	0	593
Lakes/Reservoirs	3a	No Data	1	882
Lakes/Reservoirs	3b	Insufficient Data	0	0
Lakes/Reservoirs	3c	Planning List	0	0
Lakes/Reservoirs	4a	TMDL Complete	2	37,845
Lakes/Reservoirs	4b	Reasonable Assurance	0	0
Lakes/Reservoirs	4c	Natural Condition	0	0
Lakes/Reservoirs	4d	No Causative Pollutant	1	214
Lakes/Reservoirs	5*	Impaired	17	297,588

Springs

Waterbody Type	Assessment Category	Assessment Status	Number of WBIDs	Counts of Individual Springs in WBIDs
Springs	2	Not Impaired	2	3
Springs	3a	No Data	0	0
Springs	3b	Insufficient Data	0	0
Springs	3c	Planning List	0	0
Springs	4a	TMDL Complete	0	0
Springs	4b	Reasonable Assurance	0	0
Springs	4c	Natural Condition	2	9
Springs	4d	No Causative Pollutant	0	0
Springs	5*	Impaired	0	0

Overlap of Source Water Areas and Impaired Surface Waters

In 2015, there were 5,275 public drinking water systems statewide, 17 of which obtain their supplies from surface water. An additional 58 systems wholly or partially purchase water from these 17 systems. Because it is expensive to operate a drinking water system supplied by surface water (given that filtration and advanced disinfection are costly).

DEP compared the adopted Verified List of Impaired Waters with the coverage of the source water assessment areas generated for the Source Water Assessment and Protection Program (SWAPP). The modeled source water assessment area coverage for community drinking water systems used a 3-day travel time to the intake within surface waters and their 100-year floodplains. **Table 3.6** lists the river/stream miles (including springs) and square miles of lakes/reservoirs that overlap source water areas for community water systems impaired for fecal coliform.

Table 3.6. Summary of river/stream miles and lake/reservoir acres identified as impaired for fecal coliforms overlapping source water areas of community water systems

Surface Water Type	Length or Area of Impaired Surface Waters Overlapping Source Water Areas in Basin Groups 1–5
Streams/Rivers	250 miles
Lakes/Reservoirs	4,400 acres

Chapter 4: TMDL Program and Priorities

DEP must develop TMDLs for waterbody segments added to DEP's Verified List of Impaired Waters per requirements of the federal Clean Water Act (CWA) and Florida Watershed Restoration Act (403.067 F.S.). A TMDL establishes the maximum amount of a pollutant that a waterbody can receive without causing exceedances of water quality standards. As such, TMDL development is an important step toward restoring the state's waters to their designated uses. BMAPs and permits issued for point sources all use TMDLs as the basis for their water quality goals. In Florida, DEP adopts nutrient TMDLs as site-specific Hierarchy I water quality criteria as defined in the *Implementation of Florida's Numeric Nutrient Standards* (2013) document. This aligns TMDLs and water quality standards so that two overlapping, but different criteria do not apply to waterbodies. DEP's TMDL Program website contains more detailed information on this program.

In 2014, DEP provided EPA with a priority framework document addressing how its 303(d) and TMDL Programs achieve a long-term vision for implementing Section 303(d) of the CWA. The document focused on Florida's transition away from a pace-driven TMDL development schedule and towards a new approach based on recovery potential screening. In 2015 DEP updated the approach by (1) explaining the significant changes to the its priority-setting process since summer 2014, and (2) expanding the planning horizon for TMDL development through 2022, in keeping with the 303(d)long-term vision.

One important change from previous TMDL priority-setting efforts is a new focus on waters where the TMDL and BMAP (**Chapter 5**) approach is the best of the available options for restoration. The resultant list of priorities is therefore best interpreted as "those impaired waters where [DEP] expects to develop a site-specific TMDL."

This process is used to select impaired waters where site-specific TMDLs are appropriate and the most effective path to successful restoration. While annual and two-year plans will need to be developed, DEP does not intend to reprioritize every year. Instead, two check-in periods will allow time to incorporate future IWR Database runs and assessment lists, reprioritize the workload, complete any TMDLs behind schedule, and prepare a new plan for 2023 and beyond (see **Table 4.1**).

The current list of waters prioritized for TMDLs is available online. It includes the waterbodies and the type of TMDL that will be developed between now and 2022.

The first reprioritization event, scheduled for the period from October 2018 to May 2019, is approaching. DEP anticipates updating the original methodology based on the most recent 303(d) list, and on minor changes to the overall methodology and updates to geospatial layers.

Table 4.1. Overall timeline for long-term vision priorities (Fiscal Year [FY] 16 through FY 22)

State Fiscal Year (SFY)	Federal FY	Calendar Quarter	Comments
SFY 15–16	FY 15	July to Sept 2015	Establish plan
SFY 15–16	FY 16	Oct to Dec 2015	Beginning of plan
SFY 15–16	FY 16	Jan to Mar 2016	
SFY 15–16	FY 16	Apr to Jun 2016	
SFY 16–17	FY 16	July to Sept 2016	Annual planning
SFY 16–17	FY 17	Oct to Dec 2016	
SFY 16–17	FY 17	Jan to Mar 2017	
SFY 16–17	FY 17	Apr to Jun 2017	
SFY 17–18	FY 17	July to Sept 2017	Annual planning
SFY 17–18	FY 18	Oct to Dec 2017	
SFY 17–18	FY 18	Jan to Mar 2018	
SFY 17–18	FY 18	Apr to Jun 2018	
SFY 18–19	FY 18	July to Sept 2018	Annual planning
SFY 18–19	FY 19	Oct to Dec 2018	Check-in period 1 (reprioritize)
SFY 18–19	FY 19	Jan to Mar 2019	
SFY 18–19	FY 19	Apr to Jun 2019	
SFY 19–20	FY 19	July to Sept 2019	Annual planning
SFY 19–20	FY 20	Oct to Dec 2019	
SFY 19–20	FY 20	Jan to Mar 2020	
SFY 19–20	FY 20	Apr to Jun 2020	
SFY 20–21	FY 20	July to Sept 2020	Annual planning
SFY 20–21	FY 21	Oct to Dec 2020	
SFY 20–21	FY 21	Jan to Mar 2021	
SFY 20–21	FY 21	Apr to Jun 2021	
SFY 21–22	FY 21	July to Sept 2021	Annual planning
SFY 21–22	FY 22	Oct to Dec 2021	
SFY 21–22	FY 22	Jan to Mar 2022	
SFY 21-–22	FY 22	Apr to Jun 2022	Check-in period 2 (reprioritize)
SFY 22–23	FY 22	July to Sept 2022	
SFY 22–23	FY 23	Oct to Dec 2022	New plan begins

To date, DEP has adopted a total of 416 TMDLs. Of these, 231 were developed for DO, nutrients, and/or un-ionized ammonia; 179 were developed for bacteria; and 5 were for other parameters such as iron, lead, and turbidity. In addition, DEP adopted a statewide TMDL for mercury, based on fish consumption advisories affecting over 1,100 waterbody segments. These TMDLs represent areas in all basin groups and cover many of the largest watersheds in the state (e.g., St. Johns River, St. Lucie Estuary). DEP has many more TMDLs in various stages of development.

Chapter 5: BMAP Program

Florida's primary mechanism for implementing TMDLs adopted through Section 403.067, F.S., is the Basin Management Action Plan (BMAP). Once the decision is made to initiate and ultimately develop a BMAP, the effort cannot be completed without significant input from all stakeholders, collaboration with local entities, and stakeholder commitment to implement BMAP restoration projects. While a BMAP is developed for a specific basin and is unique based on the basin and impairment, at a minimum all BMAPs include restoration projects and management strategies, implementation schedules and milestones, allocations or reduction requirements, funding strategies, and tracking mechanisms.

BMAP implementation uses an adaptive management approach that continually solicits cooperation and agreement from stakeholders on the reduction assignments. The foundation of all BMAPs is the water quality restoration projects that state and local entities commit to developing and completing. DEP, in cooperation with local stakeholders, annually reviews, updates, and assesses these projects to ensure the progression toward the established milestones. During the collaborative review process, stakeholders may update and revise projects, and DEP may require additional restoration projects if deemed necessary. Because BMAPs are adopted by Secretarial Order, they are enforceable and DEP has the statutory authority to take enforcement actions if necessary.

To date, DEP has adopted 25 BMAPs and is working on developing or updating numerous BMAPs statewide. **Table 5.1** summarizes the status of all BMAPs. While the majority address nutrient impairments, DEP also has adopted BMAPs that target fecal indicator bacteria contamination. To address these sources, DEP developed a guidance manual based on experiences in collaborating with local stakeholders around the state, *Implementation Guidance for the Fecal Coliform Total Daily Maximum Loads* (2011). The manual, updated in October 2016, provides local stakeholders with useful information for identifying sources of fecal indicator bacteria in their watersheds and examples of management actions to address these sources. **Figure 5.1** shows the BMAP acres adopted over time, and **Figure 5.2** shows the locations of BMAPs.

In January 2016, the state legislature proposed and later adopted legislation that directed DEP to develop or update BMAPs addressing impaired Outstanding Florida Springs (OFS) and impaired waters that are part of the Northern Everglades and Estuaries Protection Program (NEEPP). Revisions to Chapter 373, F.S., outlined specific updates and actions for OFS and NEEPP BMAPs. Revisions to Chapter 403, F.S., outlined specific updates and actions for all BMAPs, along with the schedules for those updates and actions. DEP, in cooperation with all stakeholders, is working diligently to develop and update BMAPs to ensure these milestones are met.

Table 5.1. Summary of BMAPs

FC = Fecal coliform; BOD = Biochemical oxygen demand; NO_3 = Nitrate; OPO_4 = Ortho-phosphate
*Second phase of BMAP; acres are not counted twice.

BMAP	BMAP Status	BMAP Acres	Parameter(s) Addressed	Implementation Status
Upper Oklawaha River Basin	Adopted August 2017	561,999	TP	The BMAP was updated in 2014.
Orange Creek	Adopted May 2008	385,271	TN/TP/FC	The BMAP was updated in 2014.
Long Branch	Adopted May 2008	3,628	FC/DO	The BMAP, adopted in 2008, is currently being reviewed for any necessary updates as restoration efforts continue.
Lower St. Johns River Basin Main Stem	Adopted October 2008	1,807,397	TN/TP	The BMAP, adopted in 2008, is currently being reviewed for any necessary updates as restoration efforts continue.
Hillsborough River	Adopted September 2009	50,743	FC	The BMAP, adopted in 2009, is currently being reviewed for any necessary updates as source identification efforts continue.
Lower St. Johns River Basin Tributaries I	Adopted December 2009	16,543	FC	The BMAP, adopted in 2011, is currently being reviewed for any necessary updates as source identification efforts continue.
Lake Jesup	Adopted May 2010	95,718	TN/TP/Un-ionized ammonia	The BMAP, adopted in 2010, is currently being reviewed for updates, with hopes of adopting new implementation components by the end of 2017.
Lower St. Johns River Basin Tributaries II	Adopted August 2010	50,925	FC	The BMAP, adopted in 2010, is currently being reviewed for any necessary updates as source identification efforts continue.
Bayou Chico (Pensacola Basin)	Adopted October 2011	6,906	FC	The BMAP, adopted in 2011, is currently being reviewed for any necessary updates as source identification efforts continue.
Santa Fe River Basin	Adopted February 2012	1,076,656	NO_3/DO	The BMAP, adopted in 2012, is currently being revised and updated to meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.
Lake Harney, Lake Monroe, Middle St. Johns River, and Smith Canal	Adopted August 2012	241,928	TN/TP	The BMAP, adopted in 2012, is currently being reviewed for updates, with hopes of adopting new implementation components by the end of 2017.

BMAP	BMAP Status	BMAP Acres	Parameter(s) Addressed	Implementation Status
Caloosahatchee Estuary Basin	Adopted November 2012	277,408	TN	The NEEPP BMAP, adopted in 2012, covers the Tidal Caloosahatchee Watershed. A formal 5-Year Review of the BMAP was submitted to the Florida Legislature and Governor in November 2017 and includes recommendations for future revisions to the BMAP.
Everglades West Coast	Adopted November 2012	55,469	TN/DO	The BMAP, adopted in 2012, covers the impaired waterbodies Hendry Creek and Imperial River. It is being reviewed to identify whether any updates are necessary as the end of the first phase of implementation nears.
BRL	Adopted February 2013	97,139	TN/TP	The BMAP was adopted in 2013, in conjunction with the Central IRL and North IRL BMAPs. All three BMAPs are being reviewed to identify whether any updates are necessary as the end of the first phase of implementation nears.
Central IRL	Adopted February 2013	476,469	TN/TP	The BMAP was adopted in 2013, in conjunction with the North IRL and BRL BMAPs. All three BMAPs are being reviewed to identify whether any updates are necessary as the end of the first phase of implementation nears.
North IRL	Adopted February 2013	211,398	TN/TP	The BMAP was adopted in 2013, in conjunction with the Central IRL and BRL BMAPs. All three BMAPs are being reviewed to identify whether any updates are necessary as the end of the first phase of implementation nears.
St. Lucie River and Estuary Basin	Adopted June 2013	521,170	TN/TP/BOD	The NEEPP BMAP, adopted in 2013, covers the watershed that contributes to the St. Lucie Estuary. A formal 5-Year Review of the BMAP will be submitted to the Florida Legislature and Governor in June 2018 and may include recommendations for future revisions to the BMAP.
Alafia River Basin	Adopted March 2014	47,199	FC/TN/TP/DO	The BMAP, adopted in 2014 and in its third year of implementation, is currently being reviewed for any necessary updates.
Manatee River Basin	Adopted March 2014	16,028	FC/TN/TP/DO	The BMAP, adopted in 2014 and in its third year of implementation, is currently being reviewed for any necessary updates.
Orange Creek – Phase 2	Adopted July 2014	561,999*	TN/TP/FC	The Phase II BMAP, adopted in 2014, is currently being reviewed for updates, with hopes of adopting new implementation components by the end of 2017.

BMAP	BMAP Status	BMAP Acres	Parameter(s) Addressed	Implementation Status
Upper Oklawaha River Basin – Phase 2	Adopted July 2014	385,271*	TP	The Phase II BMAP, adopted in 2014, is currently being reviewed for updates, with hopes of adopting new implementation components by the end of 2017.
Lake Okeechobee Basin	Adopted December 2014	3,898,203	TP	The NEEPP BMAP, adopted in 2014, covers the nine subwatersheds that comprise the Lake Okeechobee Watershed. A formal 5-Year Review of the BMAP is due to the Florida Legislature and Governor in December 2019 and may include recommendations for future revisions to the BMAP.
Silver Springs Group and Silver River	Adopted October 2015	632,810	NO_3	The BMAP, adopted in 2015, is currently being revised and updated to meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.
Upper Wakulla River and Wakulla Springs	Adopted October 2015	848,484	NO_3	The BMAP, adopted in 2015, is currently being revised and updated to meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.
Wekiva River, Rock Springs Run, and Little Wekiva Canal	Adopted October 2015	328,613	NO_3/TP/DO	The BMAP, adopted in 2015, is currently being revised and updated to meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.
Rainbow Springs and Rainbow Run	Adopted December 2015	434,806	NO_3	The BMAP, adopted in 2015, is currently being revised and updated to meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.
Jackson Blue Spring	Adopted July 2016	90,132	NO_3	The BMAP, adopted in 2016, is currently being revised and updated to meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.
Volusia Blue Springs	Pending	66,793	NO_3	The BMAP, which is currently under development, will meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.
Kings Bay/Crystal River	Pending	178,753	TN/TP/NO_3/OPO_4	The BMAP, which is currently under development, will meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.

BMAP	BMAP Status	BMAP Acres	Parameter(s) Addressed	Implementation Status
Weeki Wachee Spring and Spring Run	Pending	162,714	NO_3	The BMAP, which is currently under development, will meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.
Middle and Lower Suwannee River Basin	Pending	1,078,651	TN	The BMAP, which is currently under development, will meet the requirements of new legislation passed in 2016. These updates must be incorporated and adopted by July 1, 2018.

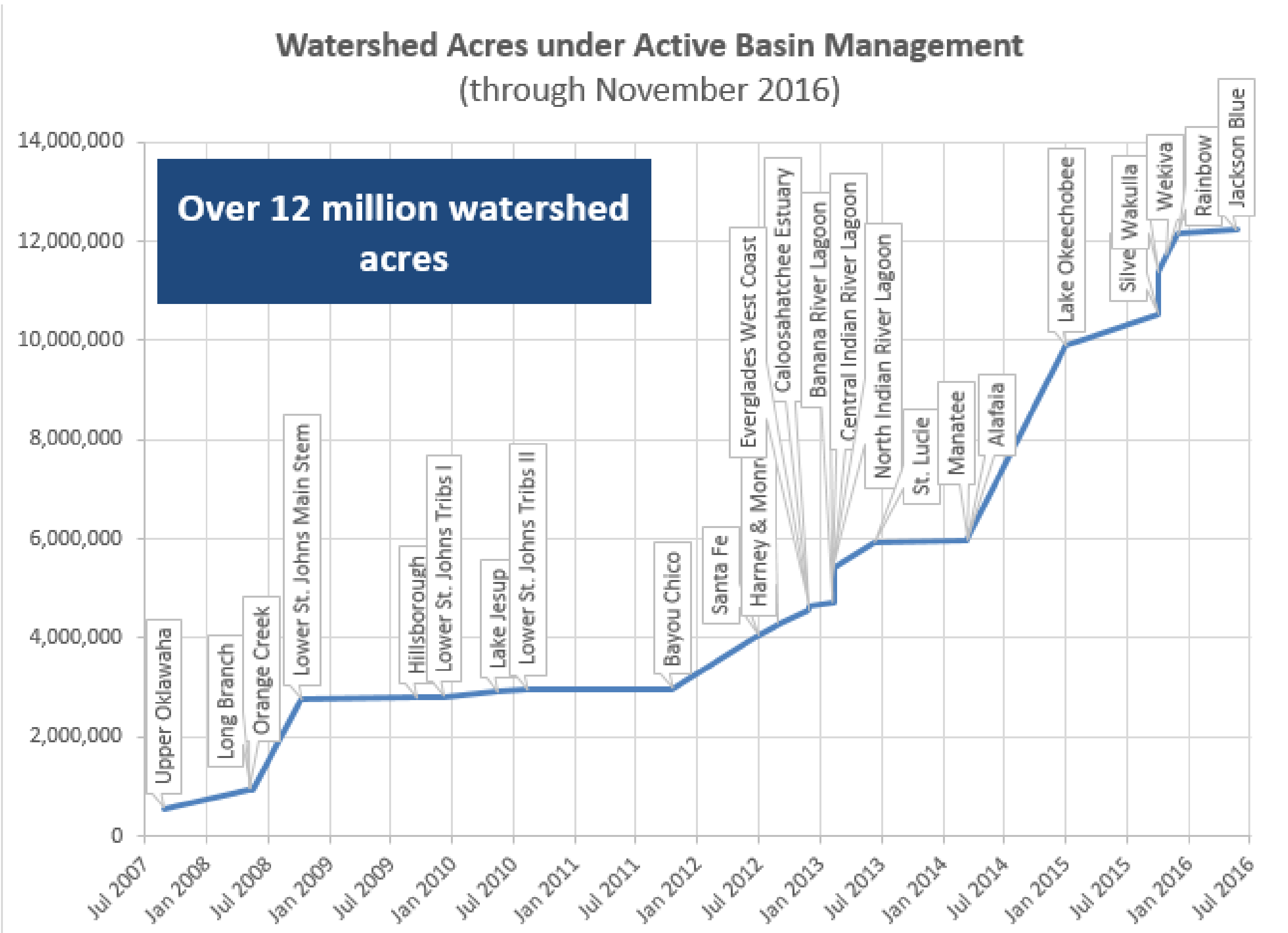
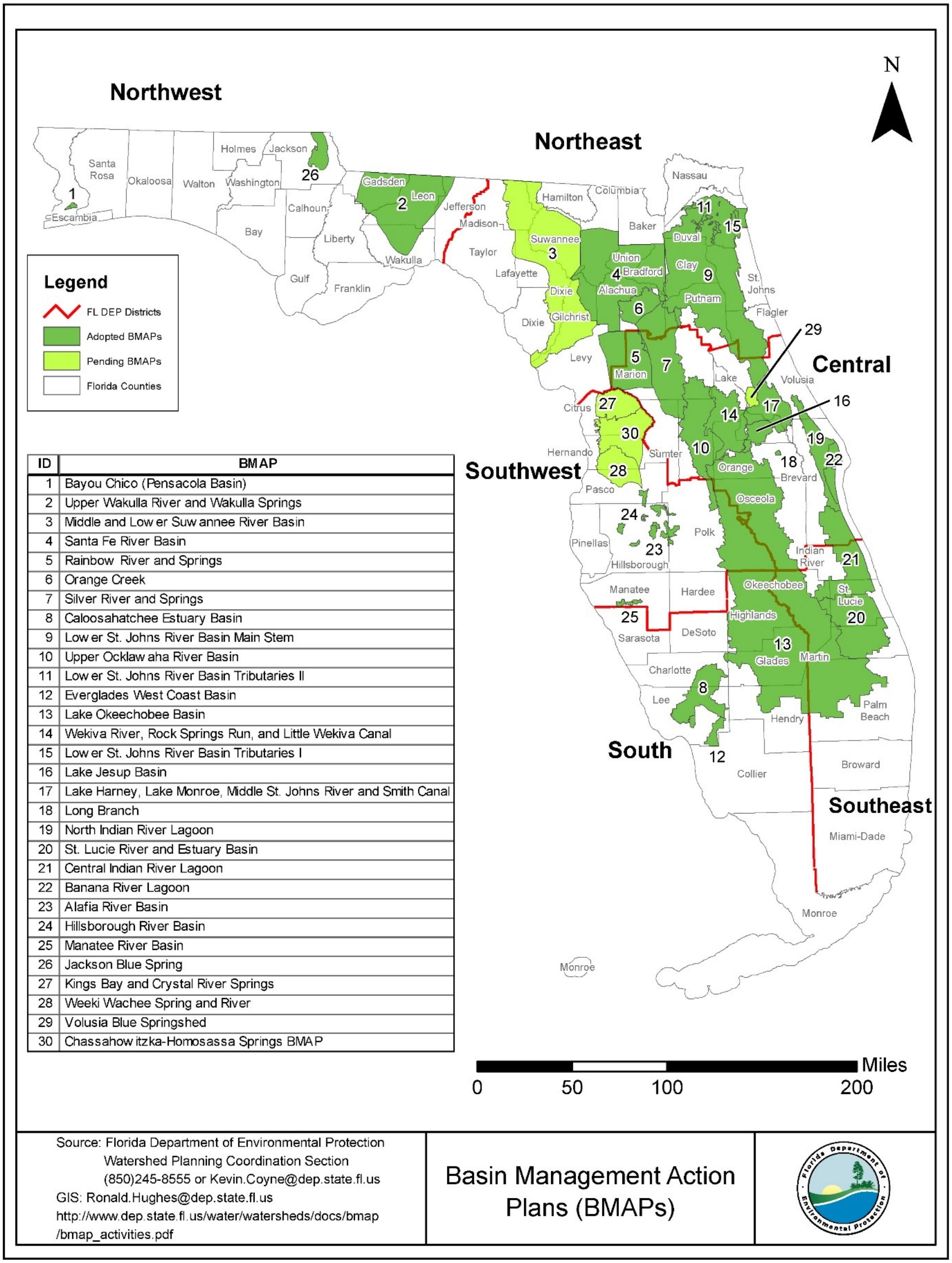


Figure 5.1. Number of acres covered by BMAPs



ID	BMAP
1	Bayou Chico (Pensacola Basin)
2	Upper Wakulla River and Wakulla Springs
3	Middle and Lower Suwannee River Basin
4	Santa Fe River Basin
5	Rainbow River and Springs
6	Orange Creek
7	Silver River and Springs
8	Caloosahatchee Estuary Basin
9	Lower St. Johns River Basin Main Stem
10	Upper Ocklawaha River Basin
11	Lower St. Johns River Basin Tributaries II
12	Everglades West Coast Basin
13	Lake Okeechobee Basin
14	Wekiva River, Rock Springs Run, and Little Wekiva Canal
15	Lower St. Johns River Basin Tributaries I
16	Lake Jesup Basin
17	Lake Harney, Lake Monroe, Middle St. Johns River and Smith Canal
18	Long Branch
19	North Indian River Lagoon
20	St. Lucie River and Estuary Basin
21	Central Indian River Lagoon
22	Banana River Lagoon
23	Alafia River Basin
24	Hillsborough River Basin
25	Manatee River Basin
26	Jackson Blue Spring
27	Kings Bay and Crystal River Springs
28	Weeki Wachee Spring and River
29	Volusia Blue Springshed
30	Chassahowitzka-Homosassa Springs BMAP

Figure 5.2. Status of BMAPs and other water quality restoration activities

Chapter 6: Groundwater Monitoring and Assessment

Overall Groundwater Quality

DEP used data from its groundwater monitoring program to evaluate the state's overall groundwater quality, based on several categories of primary groundwater maximum contaminant levels (MCLs) and health advisory levels (HALs). Florida's drinking water standards apply to groundwater (Chapter 62-520, F.A.C.).

DEP sorted the data into analyte groups and selected an "indicator" analyte to represent groundwater quality. The wells sampled consisted of a mixture of drinking water, irrigation, production, and monitoring wells. They were randomly selected, and no attempt was made to target specific localized groundwater problem areas. Thus, for the purposes of these analyses, the water quality in these wells represents overall groundwater conditions.

Table 6.1 lists the basins with the highest and lowest percentages of groundwater samples achieving MCLs, broken down to show the results from previous years as reported in the 2012 and 2014 Integrated Reports. Overall, bacteria (as total coliform) and salinity (as sodium) were the analyte groups with the highest percentage of MCL exceedances in groundwater samples.

Coliform bacteria can occur in well casing and water distribution systems, and their detection in water samples from wells may not always indicate a groundwater contamination problem. For that reason, coliform bacteria data should always be scrutinized carefully. The next section on **Groundwater Issues and Contaminants of Concern** discusses the occurrence of coliform bacteria in groundwater in greater detail.

Table 6.1. Summary of percent groundwater samples achieving primary groundwater standards for selected analytes by basin

Notes: Data are from DEP's Status and Trends Network. For some basins, datasets are limited. Values for basins with five or fewer samples are indicated by an asterisk and **boldface** type.
[1] Metals assessments were conducted for arsenic and lead, the two primary metals most commonly exceeding their MCL.
N/A = Not available

Basin	Metals, Arsenic[1] 2011–12 / 2013–14 / 2015-16	Metals, Lead[1] 2011–12 / 2013–14 / 2015-16	Coliform Bacteria, Total 2011–12 / 2013–14 / 2015-16	Nitrate-Nitrite (as N) 2011–12 / 2013–14 / 2015-16	Sodium, Total 2011–12 / 2013–14 / 2015-16
Apalachicola–Chipola	100% - 95% - 100%	100% - 100% - 100%	83% - 95% - 80%	95% - 100% - 100%	100% - 100% - 100%
Caloosahatchee	94% - 100% - 100%	100% - 100%- 100%	76% - 69%- 93%	100% - 100%- 100%	65% - 81%- 56%
Charlotte Harbor	100% -90% - 100%	100% - 100% - 100%	78% - 100% - 100%	100% - 100% - 100%	60% - 40% - 33%
Choctawhatchee–St. Andrew	100% - 100% - 100%	100% - 100% - 100%	90% - 97% - 96%	100% - 100% - 100%	100% - 100% - 100%
Everglades	**100%*** - 100% - 100%	**100%*** - 100% - 100%	**100%*** - 89% - 83%	**100%*** - 100% - 100%	**100%*** - 67% - 50%
Everglades West Coast	100% - 100% - 100%	100% - 92% - 96%	74% - 80% - 76%	100% - 100% - 100%	74% - 68% - 71%
Fisheating Creek	**100%*- 100%* - 100%***	**100%*- 100%*- 100%***	**100%*- 100%*- 100%***	**100%*- 100%*- 100%***	**100%*- 100%*- 100%***
Florida Keys	**100%*- 100%* - 100%***	**100%*-100%* - 100%***	**100%*- 100%* - 100%***	**100%*- 100%* - 100%***	**100%*- 100%* - 0%***
Indian River Lagoon	**100%***- 100% - **100%***	**100%***- 100% - **100%***	**100%*** - 90% - **67%***	**100%*** - 100% - **100%***	**33%*** - 70% - **100%***
Kissimmee River	100% - 98% - 100%	94% - 93% - 100%	82% - 86% - 71%	88% - 95% - 97%	94% - 98% - 97%
Lake Okeechobee	100% -100% - 100%	100% - 100% - 100%	100% - 100% - 92%	100% - 100% - 100%	57% - 67% - 69%
Lake Worth Lagoon–Palm Beach Coast	**100%***- 100% - 100%	**100%***-100% - 94%	**80%*** - 92% - 72%	**100%*** - 100% - 100%	**30%*** - 23% - 50%
Lower St. Johns	100% - 100% - 100%	90% - 100% - 100%	75% - 55% - 81%	100% - 100% - 100%	100% - 100% - 87%
Middle St. Johns	100% - 100% - 100%	100% - 94% - 100%	76% - 88% - 56%	100% - 94% - 100%	86% - 81% - 60%
Nassau–St. Marys	100% - 100% - 100%	100% - 100% - 100%	67% - 62% - 73%	100% - 100% - 100%	93% - 85% - 100%
Ochlockonee–St. Marks	100% - 100% - 100%	100% - 100% - 100%	70% - 86% - 89%	100% - 100% - 100%	100% - 100% - 100%
Oklawaha	100% - 100% - 100%	100% - 100% - 100%	71% - 87% - 83%	100% - 100% - 100%	100% - 100% - 100%
Pensacola	100% - 100% - 94%	100% - 95% - 100%	93% - 95% - 100%	100% - 100% - 100%	100% - 100% - 94%
Perdido	**100%*- 100%* - 100%***	**100%*- 100%* - 100%***	**100%*- 50%* - 100%***	**100%*- 100%* - 100%***	**100%* - 100%* - 100%***
Sarasota Bay–Peace–Myakka	100% - 100% - 97%	95% - 100% - 97%	74% - 68% - 69%	100% - 100% - 100%	91% - 85% - 90%
Southeast Coast–Biscayne Bay	100% - 100% - 100%	93% - 100% - 100%	43% - 67% - 60%	100% - 100% - 100%	87% - 61% - 87%
Springs Coast	100% - 100% - 87%	100% - 100% - 87%	100% - 75% - 100%	100% - 100% - 100%	67% - 50% - 87%
St. Lucie–Loxahatchee	100% - 100% - 100%	90% - 88% - 95%	90% - 81% - 89%	100% - 100% - 100%	30% - 37% - 63%
Suwannee	97% - 96% - 99%	100% - 99% - 100%	89% - 85% - 84%	99% - 97% - 94%	100% - 98% - 100%
Tampa Bay	**100%*** - 92% - 100%	100% - 100% - 100%	80% - 50% - 64%	100% - 100% - 100%	100% - 100% - 64%
Tampa Bay Tributaries	100% - 100% - 100%	93% - 100% - 100%	93% - 74% - 82%	100% - 100% - 100%	100% - 100% - 94%
Upper East Coast	**100%***- 100% - 100%	**100%*** - 100% - 100%	**75%*** - 75% - 100%	**100%*** - 100% - 100%	**50%*** - 83% - 57%
Upper St. Johns	89% - 86% - **100%***	100% - 100% - **100%***	88% - 86% - **80%***	100% - 100% - **100%***	67% - 43% - **100%***
Withlacoochee	100% - 100% - 100%	100% - 100% - 100%	75% - 62% - 60%	**100%*** - 100% - 100%	100% - 100% - 100%
Statewide Median	**99% -100% - 99%**	**98% - 100% - 99%**	**83% - 86% - 81%**	**99% - 100% - 99%**	**81% - 85% - 85%**

The statewide assessment shows that data from the past 2 years were similar to the previous years in the number of samples achieving the MCL (83 % compared with 86 % and 81 % of the samples in 2011–12 and 2013–14, respectively). **Table 6.1** shows that Middle St. Johns, Southeast Coast–Biscayne Bay, and Withlacoochee had the lowest percentage of wells achieving the total coliform bacteria MCL in the recent 2-year period. As previously noted, some of the reported exceedances may not all be attributable to actual aquifer conditions.

Sodium can be used as an indicator of saline groundwater influence on freshwater aquifers. Higher salinity can be related to increased groundwater usage that creates the upward seepage of mineralized groundwater from deeper aquifers or the lateral intrusion of seawater if wells are in coastal areas. Saline water was a potential issue in several basins based on their percentage of samples meeting the sodium MCL. The Florida Keys had a limited number of wells sampled, and **Table 6.1** shows that none met the sodium standard. In addition, fewer than 60 % of wells met the sodium standard in Charlotte Harbor, Everglades, Lake Worth Lagoon, Caloosahatchee, and Upper East Coast. The statewide assessment shows that data from the past 2 years were similar to previous assessment periods in the percentages of samples achieving the MCL (85 % compared with 81 % and 85 % of the samples in 2011–12 and 2013–14, respectively).

Statewide, one or more metals exceeding a primary groundwater MCL occurred in only about 1 % of the samples. Similarly, an equal number of basins had exceedances for lead and arsenic. During the recent 2-year period, the Springs Coast Basin had the lowest percentage of wells meeting both the arsenic and lead MCLs (87 %). Elevated lead concentrations in samples sometimes are related to well casing or plumbing material. However, when arsenic is found, it most likely is associated with an actual condition in the aquifer.

For groundwater in the aquifer, nitrate-nitrogen is a conservative contaminant, meaning that it does not change over time because of chemical, physical, or biological reactions, and thus concentrations typically are not biased by well materials or sampling technique. The compound nitrite-nitrogen seldom is detected in groundwater and, if present, occurs in only minute concentrations. Therefore, when concentrations of nitrate-nitrite nitrogen are reported together, as they are in **Table 6.1**, it can be safely assumed that the value represents the nitrate concentration. Elevated nitrate levels reflect the presence of nutrient sources such as fertilizers, animal waste, or domestic wastewater.

According to the statewide assessment, nitrate above the MCL is a concern in only 1 % of the samples analyzed. **Table 6.1** indicates that groundwater samples from the Suwannee and Kissimmee Basins exceeded the MCL.

These regional data analyses show that groundwater quality in the state is good overall, when considering these parameters. However, they also indicate some groundwater quality issues in some basins. Depending on the contaminant, these can be very significant on a localized or regional scale. The following section describes the contaminants of concern in Florida and their observed occurrences in potable groundwater.

Groundwater Quality Issues and Contaminants of Concern, Including Potable Water Issues

DEP used public water system (PWS) sampling data (including both treated and raw water samples) to summarize the parameter categories most frequently exceeding primary MCLs in Florida's potable supply aquifers. PWS data are from systems that operate their own wells but are not restricted to wells only. Some parameter results are for other entry points into a system or from composite samples. While individual sample results collected for this report may exceed an action level or MCL, that exceedance does not necessarily translate directly into a violation of water delivered to the consumer (1) because of the compositing or blending of water mentioned above, or (2) because averaging with subsequent samples was below the action level or MCL.

The data evaluated covered a two-year POR extending back to August 2015. The number and distribution of samples exceeding specific groundwater MCLs during this period help identify current issues and contaminants of concern. The reporting of these exceedances in wells and water systems does not imply that well owners or public water customers are consuming contaminated groundwater.

Figure 6.1 summarizes statewide findings by contaminant category. **Table 6.2** summarizes contaminant categories in each of the state's 29 major basins, showing the numbers of exceedances reported for PWS from August 2015 through July 2017. The contaminant of concern categories are volatile organic compounds (VOCs), other synthetic organic chemicals (SOCs) (such as pesticides), nitrate, primary metals, salinity, and radionuclides. This evaluation is limited to contaminants with potable groundwater primary MCLs. Although not included in the summary tables, trihalomethanes (THMs) and bacteria also are significant contaminants that could be present in treated or raw water supplies and are discussed in this section.

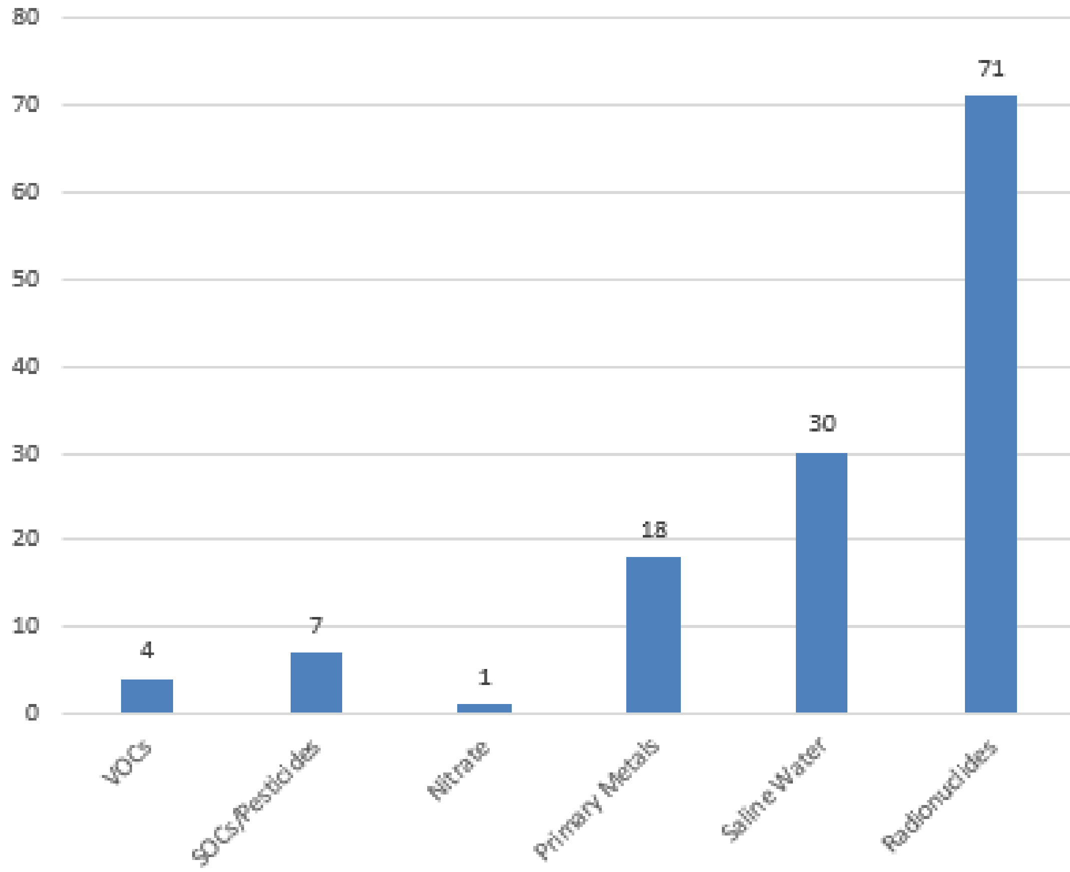


Figure 6.1. Statewide summary of PWS with primary MCL exceedances reported in the recent two-year period

Table 6.2. Summary of recent exceedances of primary groundwater standards in untreated samples from groundwater-based PWS

Contaminant Categories and Number of Water Systems with Samples Exceeding Primary Standards (POR August 2015–July 2017)

Basin–Aquifer	VOCs in PWS	SOCs / Pesticides in PWS	Nitrate in PWS	Primary Metals in PWS	Saline Water in PWS	Radionuclides in PWS
Apalachicola–Chipola–Floridan Aquifer System	0	0	0	2	0	0
Caloosahatchee–Surficial Aquifer	0	0	0	0	5	3
Charlotte Harbor–Floridan Aquifer System (SW)	0	1	0	0	1	2
Choctawhatchee–St. Andrew–Floridan Aquifer System	0	0	0	1	0	0
Everglades–Surficial Aquifer (SW)	0	0	0	0	1	2
Everglades West Coast–Surficial Aquifer	0	0	0	0	2	0
Fisheating Creek–Surficial Aquifer	0	0	0	0	0	0
Florida Keys–None	0	0	0	0	0	0
Indian River Lagoon–Floridan and Surficial Aquifers	0	0	0	0	1	1
Kissimmee River–Floridan, Intermediate, and Surficial Aquifers	0	1	0	1	0	1
Lake Okeechobee–Surficial Aquifer (SW)	0	0	0	0	2	0
Lake Worth Lagoon–Palm Beach Coast–Surficial Aquifer	0	0	0	1	1	0
Lower St. Johns–Floridan Aquifer System	1	2	0	0	1	0
Middle St. Johns–Floridan Aquifer System	1	0	0	2	0	3
Nassau–St. Mary's–Floridan Aquifer System	0	0	0	0	0	0
Ochlockonee–St. Marks–Floridan Aquifer System	0	0	0	0	0	0
Oklawaha–Floridan Aquifer System	0	0	0	1	0	3
Pensacola–Sand-and-Gravel Aquifer	0	2	0	0	1	3
Perdido–Sand-and-Gravel Aquifer	0	0	0	0	0	0
Sarasota Bay–Peace–Myakka–Floridan and Surficial Aquifers	0	0	0	1	3	21
Southeast Coast–Biscayne Bay–Biscayne Aquifer	0	0	0	0	0	1
Springs Coast–Floridan Aquifer System	0	1	0	1	0	0
St. Lucie–Loxahatchee–Surficial Aquifer	0	0	0	0	2	0
Suwannee–Floridan Aquifer System	1	0	0	1	0	2
Tampa Bay–Floridan Aquifer System	0	0	0	0	3	3
Tampa Bay Tributaries–Floridan Aquifer System	1	0	0	6	3	23
Upper East Coast–Floridan Aquifer System and Surficial Aquifer	0	0	0	0	2	0
Upper St. Johns–Floridan Aquifer System and Surficial Aquifer	0	0	0	0	2	1
Withlacoochee–Floridan Aquifer System	0	0	1	1	0	2
Statewide Summary—Nov. 2015 – Jul. 2017	**4**	**7**	**1**	**18**	**30**	**71**
Statewide Summary—2016 Integrated Report	**3**	**4**	**9**	**12**	**17**	**41**

VOCs

Volatile organics can be highly mobile and persistent in groundwater, and incidences of groundwater contamination by VOCs historically have been fairly widespread in mainly urban areas. **Table 6.2** summarizes the numbers of water systems with VOCs exceeding primary drinking water MCLs. Only four PWS had VOC exceedances during the current two-year reporting period. The contaminants exceeding their MCLs were carbon tetrachloride, 1-1-dichloroethene, tetrachloroethylene, and vinyl chloride. By comparison, only three PWS had VOC exceedances during the previous two-year reporting period.

SOCs

Over the past two years, seven PWS had SOC exceedances. Ethylene dibromide and polychlorinated biphenyls (PCBs) were each detected above the MCL in one system. Five systems had exceedances for bis-2-ethyl-hexyl-phthalate. The detection of this ubiquitous phthalate ester is frequently an artifact of sampling or analytical procedures, but without quality assurance (QA) documentation it is impossible to determine if it was actually present in the groundwater.

Nitrate

Elevated nitrate concentrations in groundwater are associated with inorganic fertilizers, animal waste, and domestic wastewater and residuals. Nitrate has occasionally been found at concentrations greater than the MCL of 10 mg/L in PWS. Over the past 2 years, samples from only 1 system using groundwater reported nitrate detections above the MCL. This was a significant decrease since the last reporting period, when nitrate was detected in 9 systems. FDACS works with growers to implement agricultural BMPs in many areas of the state to reduce nitrogen losses to groundwater from agricultural operations.

Primary Metals

Metals have been detected at concentrations above their MCL in PWS. In the past 2 years, 18 PWS across 11 basins had metals exceedances. The Tampa Bay Tributaries Basin had the greatest number of PWS with primary metals exceedances (6). Statewide, the most frequently exceeded MCLs were for lead (5 times) and arsenic (7 times). Thallium, antimony, barium, and nickel also were detected at concentrations above their MCLs.

At times, these detections have occurred because of the materials containing and conveying the water, rather than actual concentrations in groundwater. Metal well casings, piping, storage tanks, and plumbing fixtures, in addition to sampling techniques, often cause bias in the analyses of groundwater samples for metals. Historically, lead has been found at concentrations above the MCL in samples from PWS; very frequently these detections are associated with impurities in water distribution and storage systems. Galvanized coatings on metal surfaces, paint, and lead solder are documented sources of metals contamination in water systems.

The USEPA recently has identified arsenic as a metal of concern in PWS and private wells. Arsenic in groundwater may be naturally occurring, of anthropogenic origin from human-induced geochemical changes in groundwater, or a true contaminant released as a result of human activities. Throughout Florida, arsenic is a stable element associated with the minor minerals pyrite and powellite in the geologic material. It can be made soluble and released from the rock matrix into groundwater by human disturbances that introduce oxygen-enriched water. Activities such as mining, well drilling, stormwater discharge into drainage wells, and aquifer recharge through storage and recovery wells (Arthur et al. 2002; Price and Pichler 2006) potentially can release previously stable arsenic into groundwater. In addition, a lack of recharge and increased groundwater pumping during periods of low rainfall can lower the water table, allowing air to permeate the previously saturated material in the upper aquifer matrix and release arsenic compounds.

Arsenic also can be associated with the past use of arsenic-based herbicides applied to cotton fields; citrus groves; road, railroad, and power line rights-of way; golf courses; and cattle-dipping vats (which were used in Florida from about 1915 to 1960). Arsenical herbicides have been banned almost entirely from use in Florida for several years and have been replaced by other products.

Saline Water

Saltwater intrusion is a well-documented occurrence in some coastal areas of the state where a wedge of salt water is drawn inland by drought, well pumpage, and wetland dewatering (Harrington et al. 2010). In several areas of the state, not necessarily on the coast, the upward seepage of brackish water from deeper zones has also been an issue. In this assessment, an exceedance of the MCL for sodium was used as an indicator of possible saline water impacts.

Based on studies and evaluation of data, DEP has found sodium to be a more reliable indicator of saline water than chloride. Chlorides can also be associated with anthropogenic sources such as wastewater and fertilizer. Over the recent 2-year period, 30 PWS scattered among 15 basins reported sodium exceedances. In the previous reporting period, only 17 PWS had sodium exceedances. Basins with the greatest number of exceedances during the recent 2-year period were Caloosahatchee (5) and Sarasota–Peace–Myakka, Tampa Bay, and Tampa Bay Tributaries (3 each).

Public drinking water supplies with the highest number of sodium exceedances are typically in areas of the state where consumptive use has caused saline water to migrate into potable aquifers. Protracted drought conditions, increased groundwater consumption, and sea-level change are potential contributing causes of these exceedances. Florida's WMDs have been working on alternative water supplies in areas of the state where this is a problem.

Radionuclides

In Florida, most elevated radionuclide levels are caused by natural conditions, but these conditions still may result in MCL exceedances and potential health concerns. Natural radionuclides occur as trace elements in bedrock and soil from radioactive decay series, including uranium-238 (U-238) and thorium-232 (Th-232). Elevated radionuclide levels in Florida occur most frequently in phosphate mineral deposits that are common in some areas of the state. Radionuclide categories with MCL exceedances in groundwater samples from PWS include gross alpha, radium-226, radium-228, and combined uranium. Of these, radium-226 was the most frequently detected at above-MCL concentrations (58 systems). **Table 6.2** summarizes radionuclide MCL exceedances in water from PWS.

Historically, PWS in the west–central area of the state most frequently had MCL exceedances for radionuclides. Over the 2-year period, groundwater samples from 71 PWS exceeded MCLs for radionuclides, an increase from the previous measurement period. Most were from systems in the Tampa Bay Tributaries and Sarasota Bay–Peace–Myakka Basins, where natural phosphate is abundant. These basins contain one of the three largest phosphate-mining areas in the world, encompassing large areas of Manatee, Sarasota, Hardee, DeSoto, Polk, and Hillsborough Counties.

THMs

Some THMs are disinfection byproducts resulting from the addition of halogens (including chlorine, bromine, and iodine) to source water that contains organic matter. THMs are not normally an issue with the actual groundwater resource. Unlike some states, Florida requires PWS to provide disinfection, and thus halogenation is used as a disinfection treatment to kill potentially harmful bacteria. Chloroform, dibromochloromethane, bromodichloromethane, and bromoform are the most common THMs found in treated water. Some PWS are using alternative disinfection methods (such as the use of chloramine) to reduce or eliminate the creation of THMs.

Bacteria (Coliform)

Bacteria are not typically a concern to PWS, because the water is disinfected before distribution. However, the bacterial contamination of private drinking water wells is a common issue addressed by FDOH. Unfortunately, information on the number of bacterial exceedances in private wells is documented poorly and is not maintained in a central database. Of all water quality issues evaluated, bacterial contamination, as indicated by elevated total coliform bacteria counts, is one of the most prevalent issues in groundwater samples collected from monitoring wells (**Table 6.1**).

However, the significance of bacteria in water samples as it relates to the groundwater resource still must be determined. The presence of bacteria may be a result of improper well construction, poor hygiene at the wellhead, animal waste or septic tank issues, flooding, and the surface water infiltration of a water system. These considerations highlight the fact that individual well assessments are necessary and, in many cases, that bacterial contamination is localized and may not be an issue outside of the individual wells themselves.

Summary of Groundwater Contaminant Sources

EPA's Source Water Assessment guidance lists a range of potential groundwater contaminant sources that states may evaluate in their source water assessments. DEP's 2004 Florida Source Water Assessment identified the top five potential sources of contamination in Florida as (1) underground storage tanks (not leaking), (2) gasoline service stations (including historical gas stations), (3) municipal sanitary waste treatment and disposal (commercial, domestic, and industrial waste), (4) known contamination sites/plumes (equivalent to DEP's delineated areas), and (5) drycleaning facilities. Several of these commonly have been the focus of waste cleanup and monitoring activities in Florida.

However, there are also instances where groundwater has been degraded as the result of nonpoint activities. This section discusses the most significant groundwater degradation sources, based on waste cleanup, monitoring, and restoration actions undertaken by DEP and other agencies concerned with groundwater quality.

Petroleum Facilities

DEP's Storage Tank Contamination Monitoring (STCM) Database contains information on all storage tank facilities registered with DEP and tracks information about active storage tanks, storage tank history, and petroleum cleanup activity. Currently, the database lists approximately 37,000 registered petroleum storage tank facilities in Florida that have reported contaminant discharges. DEP has addressed almost half (18,000) of these to date. Petroleum sites and petroleum problems are concentrated in the most populated areas of the state and along major transportation corridors. The main petroleum constituents found in groundwater are benzene, toluene, ethylbenzene, xylenes, and methyl tert-butyl ether.

Florida's Petroleum Cleanup Program carries out the technical oversight, management, and administrative activities necessary to prioritize, assess, and cleanup sites contaminated by petroleum and petroleum product discharges from stationary petroleum storage systems. Sites include those eligible for state-funded cleanup, as well as nonprogram or voluntary cleanup sites funded by responsible parties.

Drycleaning Solvent Facilities

Approximately 1,400 drycleaning facilities (mainly retail) have signed up for eligibility for contaminant cleanup under DEP's Drycleaning Solvent Cleanup Program because of evidence of contamination. Of those, 236 sites are being assessed actively and may be under remedial action, while 194 sites have been cleaned up. The remaining sites await funding. Drycleaning solvent constituents (tetrachloroethene, trichloroethene, dichloroethenes, and vinyl chloride) are among the most mobile and persistent contaminants in the environment.

The Florida Legislature established a state-funded program, administered by DEP, to clean up properties contaminated by drycleaning facility or wholesale supply facility operations (Chapter 376, F.S.). The drycleaning industry sponsored the statute to address environmental, economic, and liability issues resulting from drycleaning solvent contamination. The program limits the liability of the owner, operator, and real property owner of drycleaning or wholesale supply facilities for cleaning up drycleaning solvent contamination, if the parties meet the eligibility conditions stated in the law.

Waste Cleanup and Monitoring Sites

DEP's Waste Cleanup Program maintains lists of contamination sites for various programs. These include the Federal Superfund Program (authorized under the Comprehensive Environmental Response Compensation and Liability Act [CERCLA]), state-funded cleanup sites, and contaminated sites that undergo cleanup by potentially responsible parties (PRP). There are currently 103 active federal and state waste cleanup sites, including landfills, dumps, wood preserving waste, industrial solvent disposal, electroplaters, petroleum, pesticides, waste oil disposal, and drycleaners. There are approximately 1,700 sites on DEP's list of currently open PRP sites. Many of the sites have documented groundwater contamination.

Nonpoint Sources

Sometimes, degraded groundwater quality is associated with multiple sources or land use practices in an area rather than a single contaminant source. The cumulative effect of human activities through leaching from nonpoint pollution sources can create groundwater quality problems. In urban areas, groundwater may receive contaminants from a variety of sources, including residential septic systems, leaking sewer lines, urban stormwater, residential fertilizers, pesticide applications, and pet waste. In more rural areas, significant nonpoint sources can include fertilizers and pesticides used on agricultural fields, animal wastes from pastures and confined animal feeding operations, wastewater application sites, and road and utility rights-of-way. The magnitude of the impacts depends on the vulnerability of the groundwater resource. Groundwater is particularly vulnerable in karst (limestone) areas, where discharges can have a direct, unfiltered pathway to the drinking water resource via sinkholes.

Nitrate-nitrogen is the most common nonpoint source contaminant found in Florida's groundwater at concentrations exceeding the MCL. Most nitrate exceedances occur in rural agricultural areas. Agricultural BMPs promoted to agricultural producers by the FDACS Office of Agricultural Water Policy (OAWP) can help reduce nitrogen losses and groundwater contamination from these activities. FDACS currently has BMP manuals for citrus, row/field crop, cow/calf, sod, poultry, dairy, and speciality fruit and nut crops. The Florida Forest Service promotes the BMP manual for silviculture production activities.

Groundwater–Surface Water Interaction

Setting and Pathways

Florida's surface waters depend on groundwater contributions. For example, in many areas surface water flows into groundwater through sinkholes or reversing springs. As mentioned previously, spring-fed stream systems can depend almost entirely on groundwater discharge. Canals also can contain mostly groundwater. Other streams and lakes may receive over half of their total inflows via groundwater seepage, and natural estuaries rely on groundwater seepage as a significant source of fresh water. In areas where the Floridan aquifer system is near the surface, and in the southern parts of the state where porous limestone is present near the surface, conduit systems in the limestone material efficiently deliver groundwater to streams and canals at high rates. In other areas of the state, groundwater discharge occurs as seepage from the surficial aquifer system.

Groundwater Influence on Impaired Surface Waters

Nutrients, DO, and iron are the groundwater parameters most likely to influence water quality in impaired or potentially impaired surface waters. **Table 6.3** summarizes the median concentrations of these parameters in unconfined aquifers of the state's 29 major basins and compares them with typical values for Florida's streams.

In contrast, nutrients and salinity are the most significant water quality concerns facing Florida's springs. **Table 6.4** lists routinely monitored springs and recent results for some key water quality parameters.

Nutrients

Excessive nutrient enrichment causes the impairment of many surface waters, including springs. Nitrogen (N) and phosphorus (P) are the two major nutrient groups monitored. Both are essential for plant life, including the growth of algae.

Table 6.3. Median concentrations of groundwater–surface water constituents in unconfined aquifers (2000–13)

Notes: Groundwater data provided from DEP's Status and Trends Network, all representing unconfined aquifers with the potential to interact with surface water. For some basins, datasets are limited.
* Values shown with an asterisk indicate concentrations higher (or in the case of DO, lower) than median values for typical streams in Florida (Hand et al. 2009).
µS/cm = MicroSiemens per centimeter

Basin	Nitrate-Nitrite (as N) (mg/L)	TP (mg/L)	DO (mg/L)	Iron (µg/L)	Specific Conductance (µS/cm)
Apalachicola–Chipola	1.15*	0.011	5.51*	15	255*
Caloosahatchee	0.002	0.058	1.06*	1,140*	870*
Charlotte Harbor	0.006	0.175*	1.29*	1,725*	832*
Choctawhatchee–St. Andrew	0.092*	0.008	3.49*	149	103
Everglades	0.006	0.028	1.52*	31	1177*
Everglades West Coast	0.004	0.040	0.88*	1,150*	729*
Fisheating Creek	0.092*	0.008	3.49*	149	103
Florida Keys	0.005	0.021	2.78*	57.5	14,889*
Indian River Lagoon	0.010	0.180*	0.70*	270	1,008*
Kissimmee River	0.007	0.057	1.01*	460*	258*
Lake Okeechobee	0.004	0.170*	0.81*	725*	623*
Lake Worth Lagoon–Palm Beach Coast	0.002	0.066	0.37*	289	706*
Lower St. Johns	0.002	0.088*	1.27*	1,990*	265*
Middle St. Johns	0.009	0.049	0.91*	655*	176
Nassau–St. Marys	0.007	0.065	1.03*	479*	275*
Ochlockonee–St. Marks	0.100*	0.028	2.44*	250	343*
Ocklawaha	0.800*	0.078*	3.00*	94	373*
Pensacola	0.480*	0.002	7.93	15	42
Perdido	0.560*	0.002	6.53	49	44
Sarasota Bay–Peace–Myakka	0.010	0.200*	1.54*	1,360*	401*
Southeast Coast–Biscayne Bay	0.010	0.013	1.69*	496*	599*
Springs Coast	0.024*	0.036	1.52*	480*	400*
St. Lucie–Loxahatchee	0.002	0.120*	0.69*	800*	685*
Suwannee	0.26*	0.048	3.19*	190	400*
Tampa Bay	0.009	0.051	1.36*	680*	457*
Tampa Bay Tributaries	0.010	0.091*	1.60*	1,460*	373*
Upper East Coast	0.010	0.260*	0.70*	850*	754*
Upper St. Johns	0.002	0.098*	1.06*	744*	604*
Withlacoochee	0.020	0.056	1.41*	539*	418*
Statewide (median of all stations)	**0.010**	**0.056**	**1.41***	**480***	**401***
Typical Value for Streams in Florida	**0.051**	**0.076**	**5.8**	**367**	**251**

Table 6.4. Median concentrations of selected parameters in frequently monitored springs (2013–14)

Notes: Nitrate concentrations shown with an asterisk and in boldface type exceed DEP's proposed nitrate criterion for spring vents; phosphorus concentrations shown with an asterisk and in boldface type are higher than the lowest algal growth–based threshold from research (Stevenson et al. 2007).

Basin	Spring Name	Associated Spring Group	Nitrate (mg/L)	TP (mg/L)	DO (mg/L)	Specific Conductance (µS/cm)	Sodium (mg/L)
Apalachicola–Chipola	Jackson Blue Spring		**3.6***	0.021	7.30	272	2.0
Choctawhatchee–St. Andrew	Cypress Spring	Holmes Creek	**0.38***	0.025	4.72	223	3.55
Choctawhatchee–St. Andrew	Gainer Spring #1C	Gainer	0.18	0.013	1.57	146	1.9
Choctawhatchee–St. Andrew	Morrison Spring		0.19	0.024	3.50	230	2.0
Middle St. Johns	Alexander Spring		0.034	**0.051***	2.3	1,134	147
Middle St. Johns	Apopka Spring		**3.60***	**0.044***	3.08	279	6.9
Middle St. Johns	DeLeon Spring		**0.64***	**0.064***	1.12	777	82
Middle St. Johns	Fern Hammock Springs		0.10	**0.026***	6.98	116	2.7
Middle St. Johns	Juniper Spring		0.09	**0.027***	6.81	119	2.7
Middle St. Johns	Rock Spring		**1.29***	**0.087***	0.76	276	5.9
Middle St. Johns	Salt Spring (Marion)		0.10	0.014	3.61	5,165	830
Middle St. Johns	Silver Glen Springs		0.05	**0.026***	3.40	1,926	272
Middle St. Johns	Volusia Blue Spring		**0.55***	**0.085***	0.89	2,144	313
Middle St. Johns	Wekiwa Spring		**1.02***	**0.120***	0.475	366	11.50
Ochlockonee–St. Marks	Wakulla Spring		**0.45***	**0.031***	1.90	310	5.5
Ocklawaha	Silver Spring Main	Silver	**1.28***	**0.049***	2.27	502	7.0
Springs Coast	Chassahowitzka Spring Main	Chassa-howitzka	**0.57***	0.020	4.48	2,609	371
Springs Coast	Homosassa Spring #1	Homosassa	**0.68***	0.016	3.82	3,026	434
Springs Coast	Hunter Spring	Kings Bay	**0.60***	0.024	5.12	433	37
Springs Coast	Tarpon Hole Spring	Kings Bay	0.22	**0.035***	2.08	3,715	531
Springs Coast	Weeki Wachee Main Spring	Weeki Wachee	**0.88***	0.005	1.61	342	5.8
Suwannee	Devil's Eye Spring (Gilchrist)	Ginnie-Devil's	**1.8***	**0.042***	3.90	410	4.1
Suwannee	Falmouth Spring		**1.2***	**0.051***	1.24	378	3.0
Suwannee	Fanning Springs		**5.5***	**0.069***	2.51	516	5.7

Basin	Spring Name	Associated Spring Group	Nitrate (mg/L)	TP (mg/L)	DO (mg/L)	Specific Conductance (µS/cm)	Sodium (mg/L)
Suwannee	Ichetucknee Head	Ichetucknee	**0.79***	**0.032***	3.83	337	2.4
Suwannee	Lafayette Blue Spring		**3.0***	**0.052***	1.00	456	5.5
Suwannee	Madison Blue Spring		**1.69***	**0.057***	1.91	293	3.6
Suwannee	Manatee Spring		**2.24***	**0.031***	1.58	514	4.5
Suwannee	Troy Spring		**2.50***	**0.039***	1.09	390	3.2
Suwannee	Wacissa Spring #2	Wacissa	**0.45***	**0.039***	2.88	276	3.4
Tampa Bay Tributaries	Lithia Springs Major		**2.50***	**0.060***	2.14	564	18.2
Withlacoochee	Rainbow Spring #1	Rainbow	**2.50***	**0.026***	6.92	170	2.8

Nitrogen

Nitrogen occurs in several forms and is ubiquitous in the environment. Nitrate is the form of nitrogen occurring in the highest concentrations in groundwater and springs. While nitrate and nitrite are frequently analyzed and reported together as one concentration (nitrate-nitrite nitrogen), the nitrite contribution is always insignificant. The majority of nitrate in groundwater and springs comes from anthropogenic sources such as inorganic fertilizer, domestic wastewater, and animal waste. Elevated nitrogen concentrations are of greatest concern to clear surface water systems, such as springs and some rivers and estuaries, where phytoplankton in the water column and attached algae can cause biological imbalances.

Historically, nitrogen was only a minor constituent of spring water, and typical nitrate concentrations in Florida were less than 0.2 mg/L until the early 1970s. Since then, nitrate concentrations greater than 1 mg/L have been found in many springs. With sufficient phosphorus in the water column, seemingly low nitrogen concentrations can lead to the degradation of biological systems caused by the overgrowth of algae and sometimes aquatic plants.

Research into the relationship of nutrients to algal growth in springs has provided some science-based values that can serve as thresholds. In a DEP-funded study, Michigan State University researchers found that species reductions occurred at nitrogen concentrations below 0.591 mg/L for the algal genus *Vaucheria* spp. and below 0.250 mg/L for the more prevalent *Lyngbya wollei* (Stevenson et al. 2007). DEP's spring run–related TMDLs for the Wekiva River and Rock Springs Run identified a reference threshold of 0.286 mg/L to reduce overall periphyton biomass concentration to an acceptable level. The TMDL developed for the Suwannee River and several springs provided a statistical analysis of the range of nitrate concentrations over which periphyton growth would occur.

Based on this combined body of research, DEP adopted a surface water standard for nitrogen in spring vents of 0.35 mg/L that applies to both nitrate and nitrate-nitrite. Most of Florida's routinely monitored springs have nitrate concentrations greater than this. More than 72 % (23 out of 32) of the springs listed in **Table 6.4** have nitrate concentrations greater than the threshold. The springs in **Table 6.4** with the highest nitrate concentrations are located in agricultural areas of the Suwannee, Middle St. Johns, Apalachicola, and Withlacoochee Basins. The lowest concentrations in springs are found in conservation lands and forestlands of the Upper Middle St. Johns Basin and the Choctawhatchee–St. Andrew Basin, where there are few sources of nitrate.

Phosphorus

Phosphorus, the other essential nutrient governing algal growth in aquatic systems, can originate from natural or anthropogenic sources. In many parts of the state, naturally occurring phosphorus is a significant source of phosphate in both surface water and groundwater. Anthropogenic sources of phosphorus include fertilizer, animal waste, human wastewater and biosolids, and industrial wastewater effluent. Because phosphorus originates from multiple sources, it is difficult to discern whether the phosphorus found in groundwater and springs is naturally occurring or comes from human activities.

Phosphorus has a critical concentration that is much lower than the nitrogen threshold. Stevenson et al. (2007) found that when nitrogen was present at elevated concentrations, the phosphorus thresholds for *Vaucheria* spp. and *Lyngbya wollei* were 0.026 and 0.033 mg/L, respectively. Ambient phosphorus concentrations in groundwater in springshed recharge areas are frequently higher than the algae-based thresholds offered by Stevenson et al. Approximately 68 % (20 out of 32) of the springs listed in **Table 6.4** have phosphorus concentrations greater than the lower algal-based threshold identified in Stevenson's work (0.026 mg/L). The springs in **Table 6.4** with the highest phosphorus concentrations are in the Middle St. Johns and Suwannee Basins.

DO

Low DO is a normal characteristic of groundwater. This is because the primary source of oxygen in waters is from dissolution from the atmosphere, and groundwater is not in prolonged contact with air. In instances where groundwater contributions to surface waterbodies are significant, low DO is a typical consequence, and many DO exceedances in Florida waters are attributable to groundwater discharge.

Springs receive their water from the Upper Floridan aquifer which is recharged mainly by precipitation. Springs with relatively shallow flow systems respond rapidly to precipitation events, and these springs have chemical characteristics that are more similar to rainwater than to deeper springs, whose discharge water has had a longer residence time in the aquifer material. Thus, DO concentration provides useful information about the relative age of water coming from springs. Rainwater and "newer" groundwater typically have higher DO levels, and springs with high DO levels are most vulnerable to surface water quality impacts from nearby sources.

In **Table 6.4**, springs with the highest DO concentrations include Jackson Blue Spring, Rainbow Spring #1, Fern Hammock Spring, and Juniper Spring. These all have contributing conduit systems that are shallow and capable of rapidly assimilating rainfall. Jackson Blue Spring and Rainbow Spring #1 are both located in agricultural areas and have among the highest nitrate concentrations of all springs being monitored. Fern Hammock and Juniper Spring are situated in a large conservation area, which is why their nitrate concentrations are lower.

Conversely, the springs with lower DO obtain a large portion of their flow from "older," potentially deeper groundwater with potentially longer flow pathways from groundwater recharge areas. Springs with the lowest DO in **Table 6.4** include Volusia Blue, Wekiwa, and Rock Springs in the Middle St. Johns Basin and Lafayette Blue and Troy Spring in the Suwannee Basin.

Iron

Iron is another groundwater constituent that occurs naturally at high concentrations because of the leaching of ferric iron from iron-rich clay soils and sediment. Iron in the environment also has an affinity for organic materials. Streams with high iron concentrations typically have a high to moderate groundwater component, low DO, and high dissolved organic carbon (DOC) content. Many of the iron exceedances in surface waters in Florida are caused by this set of natural conditions.

Specific Conductance

Specific conductance can be an indicator of groundwater discharge to surface waters. In some basins, the specific conductance of groundwater discharging to surface water (quite often via springs) is higher than 1,000 µS/cm and may exceed the specific conductance standard (50 % above background, or 1,275 µS/cm, whichever is higher) for fresh surface waters.

Salinity

Although most springs in Florida are considered fresh waters, springs can be characterized by their salinity analyte levels and mineral content. Salinity analytes evaluated in this assessment include specific conductance and sodium. In some cases, changes in concentrations of these indicators may indicate drought, sea-level rise, and/or anthropogenic influences. Increasing salinity trends also can be caused by a lack of recharge during low-rainfall periods, overpumping the aquifer, or a combination of the two. Coastal springs cannot be easily evaluated for short-term salinity trends because of the tidal cycle. However, long-term increasing trends for salinity indicators in coastal springs could indicate saltwater intrusion.

Salinity trends have increased in many Florida springs. The more saline springs listed in **Table 6.4**, from recent data, include Silver Glen Spring, Salt Spring (Marion), Homosassa Spring #1, Chassahowitzka Spring Main, Volusia Blue Spring, Tarpon Hole Spring, and Alexander Spring. Of these, Silver Glen, Salt, Volusia Blue, and Alexander Springs are located in a region of the Middle St. Johns Basin where a geologic fault zone along the St. Johns River provides a pathway for saline water from the Lower Floridan aquifer to migrate vertically upward (upwell) to zones intersecting these springs. In densely populated areas, groundwater withdrawals enhance this upwelling.

Along the Springs Coast, where Homosassa, Chassahowitzka, and Tarpon Hole Springs are located, salinity in springs is related to the proximity of the Gulf of Mexico. Here, salinity increases can occur during drought conditions where the aquifer gradients are lower, and the influence of groundwater withdrawals is more pronounced. The landward movement of the saline water wedge along the coastline also may be influenced by slight increases in sea level. Increases in spring salinity also influence their receiving waters.

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Appendices

Appendix A: Tables for the 2014–16 Status Network Regional Assessment Results

Surface Water

The Status Network design focuses on the following five surface water resource types:

- Rivers are major rivers of the state.
- Streams are the remaining perennial streams.
- Canals are primary canals.
- Large Lakes are 25 acres or greater (> 10 hectares in size).
- Small Lakes are 10 to less than 25 acres in size (≥ four hectares, but less than 10 hectares)

This appendix contains regional information (**Figures 2.3, 2.5, 2.7, 2.9,** and **2.11,** and **Tables A.1** through **A.5)** on the following surface water indicators for the Status Network:

- DO.
- Fecal coliform bacteria.
- Un-ionized ammonia (calculated).
- Chlorophyll *a*.
- TN.
- TP.

The Status and Trend Program *Design Document* (2016) provides additional information on the water resource definitions and whether the thresholds listed in the tables in this appendix are water quality standards or screening levels.

Table A.1. 2014–16 Statewide and regional percentages of rivers meeting threshold values for selected indicators

Status Network **Designated Use: Recreation and Aquatic Life** **Units: Miles**

Resource Rivers	DO	Fecal Coliform Bacteria	Chlorophyll a	Un-Ionized Ammonia	TN	TP
Statewide Number of Sites	266	262	265	265	264	265
Statewide % Meeting Threshold	93.1	95.4	88.8	100	72.9	85.9
Statewide % Not Meeting Threshold	6.9	4.6	11.2	0	27.1	14.1
Zone 1 Number of Sites	44	42	43	43	43	43
Zone 1 % Meeting Threshold	86.4	90.5	100	100	51.2	90.7
Zone 1 % Not Meeting Threshold	13.6	9.5	0	0	48.8	9.3
Zone 2 Number of Sites	45	45	45	45	45	45
Zone 2 % Meeting Threshold	100	100	95.6	100	97.8	97.8
Zone 2 % Not Meeting Threshold	0	0	4.4	0	2.2	2.2
Zone 3 Number of Sites	42	42	42	42	42	42
Zone 3 % Meeting Threshold	95.2	95.2	71.4	100	73.8	95.2
Zone 3 % Not Meeting Threshold	4.8	4.8	28.6	0	26.2	4.8
Zone 4 Number of Sites	45	45	45	45	45	45
Zone 4 % Meeting Threshold	97.8	100	84.4	100	82.2	66.7
Zone 4 % Not Meeting Threshold	2.2	0	15.6	0	17.8	33.3
Zone 5 Number of Sites	45	43	45	45	44	45
Zone 5 % Meeting Threshold	86.7	93.1	73.3	100	77.3	71.2
Zone 5 % Not Meeting Threshold	13.3	6.9	26.7	0	22.7	28.8
Zone 6 Number of Sites	45	45	45	45	45	45
Zone 6 % Meeting Threshold	97.7	83.0	90.7	100	98.0	78.0
Zone 6 % Not Meeting Threshold	2.3	17.0	9.3	0	2.0	22.0

Table A.2. 2014–16 Statewide and regional percentages of streams meeting threshold values for selected indicators

Status Network **Designated Use: Recreation and Aquatic Life** **Units: Miles**

Resource Streams	DO	Fecal Coliform Bacteria	Chlorophyll *a*	Un-Ionized Ammonia	TN	TP
Statewide Number of Sites	268	268	266	269	263	263
Statewide % Meeting Threshold	78.1	70.1	94.4	100	73.7	78.9
Statewide % Not Meeting Threshold	21.9	29.9	5.6	0	26.3	21.1
Zone 1 Number of Sites	45	45	45	45	45	45
Zone 1 % Meeting Threshold	73.3	77.9	97.8	100	73.4	93.3
Zone 1 % Not Meeting Threshold	26.7	22.1	2.2	0	26.6	6.7
Zone 2 Number of Sites	45	45	43	45	45	45
Zone 2 % Meeting Threshold	89.0	77.7	97.6	100	73.5	62.1
Zone 2 % Not Meeting Threshold	11.0	22.3	2.4	0	26.5	37.9
Zone 3 Number of Sites	44	44	45	45	45	45
Zone 3 % Meeting Threshold	77.2	55.7	91.1	100	95.6	64.2
Zone 3 % Not Meeting Threshold	22.8	44.3	8.9	0	4.4	35.8
Zone 4 Number of Sites	44	44	44	44	44	44
Zone 4 % Meeting Threshold	84.1	56.8	93.2	100	56.8	68.2
Zone 4 % Not Meeting Threshold	15.9	43.2	6.8	0	43.2	31.8
Zone 5 Number of Sites	45	45	44	45	44	44
Zone 5 % Meeting Threshold	88.9	77.1	70.5	100	54.5	63.6
Zone 5 % Not Meeting Threshold	11.1	22.9	29.5	0	45.5	36.4
Zone 6 Number of Sites	45	45	45	45	40	40
Zone 6 % Meeting Threshold	82.6	66.7	80.2	100	77.9	26.7
Zone 6 % Not Meeting Threshold	17.4	33.3	19.8	0	22.1	73.3

Table A.3. 2014–16 Statewide and regional percentages of canals meeting threshold values for selected indicators

Status Network **Designated Use: Recreation and Aquatic Life** **Units: Miles**

ISD = Insufficient data for analysis
Note: The Status Network monitoring design does not include sampling of the canals resource in Zone 1 or Zone 2.

Resource Canals	DO	Fecal Coliform Bacteria	Chlorophyll *a*	Un-Ionized Ammonia	TN	TP
Statewide Number of Sites	180	180	180	180	142	142
Statewide % Meeting Threshold	89.2	95.3	84.6	98.7	56.4	49.2
Statewide % Not Meeting Threshold	10.8	4.7	15.4	1.3	43.6	50.8
Zone 3 Number of Sites	45	45	45	45	45	45
Zone 3 % Meeting Threshold	84.4	84.4	91.1	100	68.9	71.2
Zone 3 % Not Meeting Threshold	15.6	15.6	8.9	0	31.1	28.8
Zone 4 Number of Sites	45	45	45	45	45	45
Zone 4 % Meeting Threshold	91.0	84.4	82.1	100	73.3	84.4
Zone 4 % Not Meeting Threshold	9.0	15.6	17.9	0	26.7	15.6
Zone 5 Number of Sites	45	45	45	45	31	31
Zone 5 % Meeting Threshold	91.1	97.8	80.0	100	58.0	67.7
Zone 5 % Not Meeting Threshold	8.9	2.2	20.0	0	42.0	32.3
Zone 6 Number of Sites	45	45	45	45	21	21
Zone 6 % Meeting Threshold	89.3	100	85.3	97.3	ISD	ISD
Zone 6 % Not Meeting Threshold	10.7	0	14.7	2.7	ISD	ISD

Table A.4. 2014–16 Statewide and regional percentages of large lakes meeting threshold values for selected indicators

Status Network | **Designated Use: Recreation and Aquatic Life** | **Units: Hectares**

Resource Large Lakes	DO	Fecal Coliform Bacteria	Chlorophyll *a*	Un-Ionized Ammonia	TN	TP
Statewide Number of Sites	257	173	257	269	257	257
Statewide % Meeting Threshold	97.9	100	57.3	99.3	86.9	78.3
Statewide % Not Meeting Threshold	2.1	0	42.7	0.7	13.1	21.7
Zone 1 Number of Sites	45	30	45	45	45	45
Zone 1 % Meeting Threshold	88.4	100	79.2	100	100	93.5
Zone 1 % Not Meeting Threshold	11.6	0	20.8	0	0	6.5
Zone 2 Number of Sites	41	26	41	45	41	41
Zone 2 % Meeting Threshold	100	100	89.2	100	97.6	92.7
Zone 2 % Not Meeting Threshold	0	0	10.8	0	2.4	7.3
Zone 3 Number of Sites	45	35	45	45	45	45
Zone 3 % Meeting Threshold	100	100	52.2	97.7	85.3	95.1
Zone 3 % Not Meeting Threshold	0	0	47.8	2.3	14.7	4.9
Zone 4 Number of Sites	40	25	40	45	40	40
Zone 4 % Meeting Threshold	92.6	100	46.5	100	72.8	90.0
Zone 4 % Not Meeting Threshold	7.4	0	53.5	0	27.2	10.0
Zone 5 Number of Sites	45	30	45	45	45	45
Zone 5 % Meeting Threshold	96.3	100	36.4	100	89.1	89.5
Zone 5 % Not Meeting Threshold	3.7	0	63.6	0	10.9	10.5
Zone 6 Number of Sites	41	27	41	44	41	41
Zone 6 % Meeting Threshold	100	100	70.6	100	89.4	49.6
Zone 6 % Not Meeting Threshold	0	0	29.4	0	10.6	50.4

Table A.5. 2014–16 Statewide and regional percentages of small lakes meeting threshold values for selected indicators

Status Network **Designated Use: Recreation and Aquatic Life** **Units: Individual lakes**

ISD = Insufficient data for analysis

Resource Small Lakes	DO	Fecal Coliform Bacteria	Chlorophyll *a*	Un-Ionized Ammonia	TN	TP
Statewide Number of Sites	233	230	232	233	233	232
Statewide % Meeting Threshold	85.0	98.7	65.9	100	94.5	93.2
Statewide % Not Meeting Threshold	15.0	1.3	34.1	0	5.5	6.8
Zone 1 Number of Sites	44	44	44	44	44	44
Zone 1 % Meeting Threshold	75.1	100	75.0	100	93.2	81.8
Zone 1 % Not Meeting Threshold	24.9	0	25.0	0	6.8	18.2
Zone 2 Number of Sites	45	43	44	45	45	45
Zone 2 % Meeting Threshold	71.0	100	48.2	100	95.7	91.2
Zone 2 % Not Meeting Threshold	29.0	0	51.8	0	4.3	8.8
Zone 3 Number of Sites	45	45	45	45	45	45
Zone 3 % Meeting Threshold	91.1	97.7	71.3	100	95.6	97.8
Zone 3 % Not Meeting Threshold	8.9	2.3	28.7	0	4.4	2.2
Zone 4 Number of Sites	45	45	45	45	45	45
Zone 4 % Meeting Threshold	82.3	100	53.2	100	93.3	93.3
Zone 4 % Not Meeting Threshold	17.7	0	46.8	0	6.7	6.7
Zone 5 Number of Sites	46	45	46	46	46	45
Zone 5 % Meeting Threshold	95.7	95.0	77.4	100	97.2	97.2
Zone 5 % Not Meeting Threshold	4.3	5.0	22.6	0	2.8	2.8
Zone 6 Number of Sites	8	8	8	8	8	8
Zone 6 % Meeting Threshold	ISD	ISD	ISD	ISD	ISD	ISD
Zone 6 % Not Meeting Threshold	ISD	ISD	ISD	ISD	ISD	ISD

Groundwater

The Status Network design focuses on the following two groundwater resource types:

- Confined Aquifers.
- Unconfined Aquifers.

This appendix contains regional information (**Figures 2.15** and **2.17** and **Tables A.6** through **A.7**) on the following groundwater indicators for the Status Network:

- Arsenic.
- Cadmium.
- Chromium.
- Fluoride.
- Lead.
- Nitrate-nitrite.
- Sodium.
- Fecal coliform bacteria.
- Total coliform bacteria.

The Status and Trend Program *Design Document* (2016) provides additional information on water resource definitions and threshold interpretations.

Table A.6. 2014–16 Statewide and regional percentages of confined aquifers meeting threshold values for selected indicators

Status Network **Designated Use: Recreation and Aquatic Life** **Units: Individual Wells**

Resource Confined Aquifer	Arsenic	Cadmium	Chromium	Lead	Nitrate-Nitrite	Sodium	Fluoride	Fecal Coliform Bacteria	Total Coliform Bacteria
Statewide Number of Sites	357	357	357	357	357	357	357	356	356
Statewide % Meeting Threshold	100	100	100	99.9	99.0	95.5	100	99.4	92.1
Statewide % Not Meeting Threshold	0	0	0	0.1	1.0	4.5	0	0.6	7.9
Zone 1 Number of Sites	58	58	58	58	58	58	58	58	58
Zone 1 % Meeting Threshold	100	100	100	100	100	100	100	100	93.5
Zone 1 % Not Meeting Threshold	0	0	0	0	0	0	0	0	6.5
Zone 2 Number of Sites	59	59	59	59	59	59	59	59	59
Zone 2 % Meeting Threshold	100	100	100	100	94.1	100	100	98.7	87.9
Zone 2 % Not Meeting Threshold	0	0	0	0	5.9	0	0	1.3	12.1
Zone 3 Number of Sites	60	60	60	60	60	60	60	60	60
Zone 3 % Meeting Threshold	100	100	100	100	100	78.6	100	100	96.2
Zone 3 % Not Meeting Threshold	0	0	0	0	0	21.4	0	0	3.8
Zone 4 Number of Sites	60	60	60	60	60	60	60	60	60
Zone 4 % Meeting Threshold	100	100	100	98.5	100	79.2	100	95.8	85.9
Zone 4 % Not Meeting Threshold	0	0	0	1.5	0	20.8	0	4.2	14.1
Zone 5 Number of Sites	60	60	60	60	60	60	60	59	59
Zone 5 % Meeting Threshold	100	100	100	98.1	100	66.6	100	95.6	89.2
Zone 5 % Not Meeting Threshold	0	0	0	1.9	0	33.4	0	4.4	10.8
Zone 6 Number of Sites	60	60	60	60	60	60	60	60	60
Zone 6 % Meeting Threshold	100	100	100	100	100	10.0	100	100	91.6
Zone 6 % Not Meeting Threshold	0	0	0	0	0	90.0	0	0	8.4

Table A.7. 2014–16 Statewide and regional percentages of unconfined aquifers meeting threshold values for selected indicators

Status Network **Designated Use: Recreation and Aquatic Life** **Units: Individual Wells**

Resource Unconfined Aquifer	Arsenic	Cadmium	Chromium	Lead	Nitrate-Nitrite	Sodium	Fluoride	Fecal Coliform Bacteria	Total Coliform Bacteria
Statewide Number of Sites	349	349	349	349	349	349	349	336	336
Statewide % Meeting Threshold	96.1	100	100	98.1	99.7	96.9	100	98.9	91.9
Statewide % Not Meeting Threshold	3.9	0	0	1.9	0.3	3.1	0	1.1	8.1
Zone 1 Number of Sites	59	59	59	59	59	59	59	58	58
Zone 1 % Meeting Threshold	94.3	100	100	97.2	100	97.0	100	100	98.9
Zone 1 % Not Meeting Threshold	5.7	0	0	2.8	0	3.0	0	0	1.1
Zone 2 Number of Sites	59	59	59	59	59	59	59	59	59
Zone 2 % Meeting Threshold	100	100	100	100	98.9	98.9	100	100	91.9
Zone 2 % Not Meeting Threshold	0	0	0	0	1.1	1.1	0	0	8.1
Zone 3 Number of Sites	59	59	59	59	59	59	59	55	55
Zone 3 % Meeting Threshold	96.5	100	100	100	98.3	93.9	100	98.3	73.4
Zone 3 % Not Meeting Threshold	3.5	0	0	0	1.7	6.1	0	1.7	26.6
Zone 4 Number of Sites	60	60	60	60	60	60	60	59	59
Zone 4 % Meeting Threshold	96.1	100	100	100	98.9	89.7	100	97.9	74.0
Zone 4 % Not Meeting Threshold	3.9	0	0	0	1.1	10.3	0	2.1	26.0
Zone 5 Number of Sites	58	58	58	58	58	58	58	51	51
Zone 5 % Meeting Threshold	100	100	100	98.3	100	94.9	100	95.3	68.6
Zone 5 % Not Meeting Threshold	0	0	0	1.7	0	5.1	0	4.7	31.4
Zone 6 Number of Sites	54	54	54	54	54	54	54	54	54
Zone 6 % Meeting Threshold	100	100	100	98.5	100	98.6	100	89.8	66.7
Zone 6 % Not Meeting Threshold	0	0	0	1.5	0	1.4	0	10.2	33.3

Appendix B: Water Quality Classifications

All surface waters of the state are classified as follows:

Rule 62-302.400, F.A.C., Classification of Surface Waters, Usage, Reclassification, Classified Waters.

(1) All surface waters of the State have been classified according to designated uses as follows:

Class I	**Potable water supplies**
Class II	**Shellfish propagation or harvesting**
Class III	**Fish consumption; recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife**
Class III-Limited	**Fish consumption; recreation or limited recreation; and/or propagation and maintenance of a limited population of fish and wildlife**
Class IV	**Agricultural water supplies**
Class V	**Navigation, utility and industrial use**

(2) Classification of a waterbody according to a particular designated use or uses does not preclude use of the water for other purposes.

Water quality classifications are arranged in order of the degree of protection required, with Class I waters having generally the most stringent water quality criteria and Class V waters the least. However, Class I, II, and III surface waters share water quality criteria established to protect recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. All waters of the state are considered to be Class III, except for those specifically identified in Rule 62-302.600, F.A.C., and must meet the "Minimum Criteria for Surface Waters," identified in Rule 62-302.500, F.A.C.

Class III-Limited surface waters also share most of the same water quality criteria as Class I, II, and III surface waters. The designated use for Class III-Limited surface waters is intended primarily for some wholly artificial and altered waters, in acknowledgment that many of these waters have physical or habitat limitations that preclude support of the same type of aquatic ecosystem as a natural stream or lake. **Appendix D** discusses the relationship between the state and EPA designated use classifications.

Appendix C: Section 314 (CWA) Impaired Lakes in Florida, Group 1–5 Basins

Lake Trends for Nutrients

Although assessments performed to identify impaired lake segments evaluate current nutrient status, the IWR incorporates additional methodologies to evaluate lake nutrient enrichment trends over time. The nutrient criteria in effect when the assessments in this report were performed were narrative and were recently replaced with numeric criteria. While the earlier criteria relied on TSI scores to identify trends in water quality over time, the numeric criteria retain the same methodology but rely instead on the direct evaluation of trends in the nutrient parameters (i.e., TN and TP), as well as trends in the nutrient response variable (chlorophyll *a*), in identifying nutrient trends over time. Subsection 62-303.352(3), F.A.C., provides details of the current methodology to identify both long- and short-term trends indicative of declining lake water quality.

The results presented in this report (**Table C.1**) were developed under the earlier narrative criteria that relied on the TSI and addressed both long- and short- term trends, as follows:

- To identify long-term trends in nutrient status, segment-specific baseline ("historical minimum") TSI values are determined. Baseline values are then used to develop segment-specific threshold values that are calculated as a 10-unit increase in the TSI. Subject to data sufficiency requirements, for each lake-segment and year in the current assessment period, annual average TSI values are calculated and compared with segment-specific threshold values. Annual average TSI values from the current assessment period that exceed threshold values are interpreted as an indication that lake water quality has deteriorated over time.

- The identification of short-term trends is limited to analyses of trends in the annual average TSI values from the current assessment period. This methodology uses Mann's one-sided, upper-tail test for trend, as described in *Nonparametric Statistical Methods* by M. Hollander and D. Wolfe (1999 ed.), pp. 376 and 724, incorporated by reference in Subsection 62-303.352(3), F.A.C.

Since the IWR methodology focuses on the identification of impaired waters of the state, DEP's trend evaluation uses a one-sided statistical test. This means the methodology is not designed to identify water quality improvement trends over time. However, water quality improvement for a lake segment may be suggested if the average TSI from the current assessment period is less than the historical baseline TSI.

Methodology Used to Establish Lake Segment–Specific Baseline TSI Values

For the assessment results included in this report, the methodology described below was used to establish lake segment–specific baseline TSI values:

- Individual TSI values used in the calculation of seasonal averages for the entire POR up to, but not including, the current assessment period are calculated using an adaptation of the TSI described in the state's *1996 305(b) report*.

- For each sampling location, individual TSI values are used to calculate four-day station median TSIs.

- For each lake segment and for each year, seasonal average TSI values are calculated as the average of all four-day station median TSI values for the season over all sampling locations within the lake segment.

- Subject to data sufficiency requirements, for each lake segment and for each year, annual average TSI values are calculated as the average of the four seasonal TSIs.

- Using the annual averages from the entire POR (up to, but not including, the current assessment period, and subject to additional data sufficiency requirements), five-year moving average TSI values are calculated.

- The five-year moving average TSI values are used to establish a baseline TSI value, defined as the minimum of the five-year moving average TSIs over the entire POR (up to, but not including, the current assessment period).

Approaches to Controlling Lake Pollution and Lake Water Quality

BMAPs developed for impaired waterbody segments include specific management activities and BMPs for reducing pollution. Each BMAP also provides interim and final targets for evaluating water quality improvements, a mechanism for tracking management action implementation and progress, data management and quality assurance/quality control (QA/QC) procedures, a strategy and schedule for periodically reporting results to the public, and procedures to determine whether additional corrective actions are needed and whether plan components need to be revised.

Table C.1. Impaired lakes of Florida

Note: The most up-to-date Verified List of Impaired Waters, by basin group, is available on DEP's Watershed Assessment Program (WAS) website.

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
3	1009A	Choctawhatchee–St. Andrew	Western Lake	DO
3	1027A	Choctawhatchee–St. Andrew	Camp Creek Lake	DO (Nutrients)
3	1037	Choctawhatchee–St. Andrew	Eastern Lake	DO
3	1055A	Choctawhatchee–St. Andrew	Lake Powell	DO
4	10EA	Pensacola	Woodbine Springs Lake	Mercury (in fish tissue)
1	1297C	Ochlockonee–St. Marks	Lake Talquin at Dam	DO (BOD); Nutrients (Historic TSI); Nutrients (TSI)
1	1297D	Ochlockonee–St. Marks	Lake Talquin	DO; Nutrients (Historic TSI); Nutrients (TSI)
4	1329B	Withlacoochee	Lake Rousseau	DO; Mercury (in fish tissue)
4	1329H	Withlacoochee	Lake Lindsey	DO
4	1340A	Withlacoochee	Davis Lake	DO; Nutrients (TSI)
4	1340B	Withlacoochee	Fort Cooper Lake	DO
4	1340C	Withlacoochee	Magnolia Lake	DO
4	1340D	Withlacoochee	Hampton Lake	DO
4	1340E	Withlacoochee	Little Lake Consuella	Nutrients (TSI)
4	1340K	Withlacoochee	Cato Lake– Open Water	DO
4	1340L	Withlacoochee	Cooter Lake	DO; Nutrients (TSI)
4	1340M	Withlacoochee	Little Henderson Lake	DO
4	1340P	Withlacoochee	Spivey Lake	DO
4	1340Q	Withlacoochee	Tussock Lake	DO
4	1340R	Withlacoochee	Tsala Apopka Lake (Floral City Arm)	DO
4	1347	Withlacoochee	Lake Okahumpka	Mercury (in fish tissue)
4	1351B	Withlacoochee	Lake Panasoffkee	DO; Nutrients (TSI)
5	1382E	Springs Coast	Highland Lake	DO
5	1392B	Springs Coast	Lake Hancock	DO
5	1432A	Springs Coast	Lake Worrell	DO
4	1436A	Kissimmee River	Lake Davenport	DO (BOD)
2	1440D	Tampa Bay Tributaries	Twin Lake– Open Water	Nutrients (TSI)
2	1443E1	Tampa Bay Tributaries	Hillsborough Reservoir	DO; Mercury (in fish tissue); Nutrients (TSI)
4	1449A	Withlacoochee	Lake Deeson	Nutrients (TSI)
4	145	Pensacola	Lake Karick	DO

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
2	1451B	Tampa Bay Tributaries	Keene Lake	Nutrients (TSI)
2	1451G	Tampa Bay Tributaries	King Lake–Open Water	Nutrients (TSI)
2	1451W	Tampa Bay Tributaries	Saxon Lake	Nutrients (TSI)
1	1463M	Tampa Bay	Little Lake Wilson	Fecal Coliform; Nutrients (TSI)
1	1464A	Tampa Bay	Black Lake	DO (BOD); Nutrients (TSI)
1	1464V	Tampa Bay	Lake Hiawatha	Nutrients (TSI)
4	1467	Withlacoochee	Mud Lake	Nutrients (TSI Trend); Nutrients (TSI)
4	1472B	Kissimmee River	Lake Hatchineha	Mercury (in fish tissue); Nutrients (Historic TSI); Nutrients (TSI Trend); Nutrients (TSI)
1	1473A	Tampa Bay	Keystone Lake	DO
1	1473W	Tampa Bay	Lake Juanita	DO; Nutrients (Historic TSI); Nutrients (TSI)
1	1473X	Tampa Bay	Mound Lake	Nutrients (Historic TSI)
1	1473Y	Tampa Bay	Calm Lake	Nutrients (Historic TSI)
1	1474V	Tampa Bay	Crescent Lake	Nutrients (TSI)
1	1474W	Tampa Bay	Lake Dead Lady	DO; Nutrients (TSI)
1	1478H	Tampa Bay	Lake Reinheimer	DO
4	1480	Kissimmee River	Lake Marion	Mercury (in fish tissue); Nutrients (TSI)
4	1484A	Withlacoochee	Lake Tennessee	Nutrients (TSI)
4	1484B	Withlacoochee	Lake Juliana	Nutrients (TSI)
1	1486A	Tampa Bay	Lake Tarpon	DO (BOD); Nutrients (Historic TSI); Nutrients (TSI)
3	1488A	Sarasota Bay–Peace–Myakka	Lake Smart	Nutrients (TSI)
3	1488B	Sarasota Bay–Peace–Myakka	Lake Rochelle	Nutrients (TSI)
3	1488C	Sarasota Bay–Peace–Myakka	Lake Haines	Nutrients (TSI)
3	1488D	Sarasota Bay–Peace–Myakka	Lake Alfred	Nutrients (TSI)
3	1488G	Sarasota Bay–Peace–Myakka	Silver Lake (Polk County)	Nutrients (TSI)
3	1488P	Sarasota Bay–Peace–Myakka	Lake Martha	Nutrients (TSI)
3	1488Q	Sarasota Bay–Peace–Myakka	Lake Maude	Nutrients (TSI)
3	1488S	Sarasota Bay–Peace–Myakka	Lake Buckeye	Nutrients (TSI)
3	1488U	Sarasota Bay–Peace–Myakka	Lake Conine	Nutrients (TSI)
3	1488V	Sarasota Bay–Peace–Myakka	Lake Swoope	Nutrients (TSI)
3	1488Y	Sarasota Bay–Peace–Myakka	Lake Pansy	Nutrients (TSI)
3	1488Z	Sarasota Bay–Peace–Myakka	Lake Echo	Nutrients (TSI)
3	14921	Sarasota Bay–Peace–Myakka	Lake Tracy	Nutrients (TSI)
1	1493E	Tampa Bay	Buck Lake	DO;

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
				Nutrients (TSI)
1	1494B	Tampa Bay	Brant Lake	Nutrients (TSI)
3	1497A	Sarasota Bay–Peace–Myakka	Crystal Lake	Nutrients (TSI)
3	1497B	Sarasota Bay–Peace–Myakka	Lake Parker	Nutrients (TSI)
3	1497C	Sarasota Bay–Peace–Myakka	Lake Tenoroc	Nutrients (TSI)
3	1497D	Sarasota Bay–Peace–Myakka	Lake Gibson	Nutrients (TSI)
3	1497E	Sarasota Bay–Peace–Myakka	Lake Bonny	Nutrients (TSI)
1	1498A	Tampa Bay	Starvation Lake	DO
1	1498Z	Tampa Bay	Dosson Lake	DO (BOD); Nutrients (TSI)
3	15001	Sarasota Bay–Peace–Myakka	Little Lake Hamilton	Nutrients (TSI)
3	15003	Sarasota Bay–Peace–Myakka	Lake Confusion	Nutrients (TSI)
3	1501	Sarasota Bay–Peace–Myakka	Lake Lena	Nutrients (TSI)
3	1501B	Sarasota Bay–Peace–Myakka	Lake Arianna (North)	Nutrients (TSI)
3	1501W	Sarasota Bay–Peace–Myakka	Sears Lake	Nutrients (TSI)
1	1502C	Tampa Bay	Chapman Lake	Nutrients (TSI)
3	15041	Sarasota Bay–Peace–Myakka	Lake Hamilton	Mercury (in fish tissue)
3	15101	Sarasota Bay–Peace–Myakka	Lake Eva	Nutrients (TSI)
1	1515	Tampa Bay	Horse Lake	DO
1	1516E	Tampa Bay	Lake Ellen	Nutrients (TSI)
1	1519D	Tampa Bay	Pretty Lake	DO; Nutrients (TSI Trend)
3	1521B	Sarasota Bay–Peace–Myakka	Lake Eloise	Nutrients (TSI)
3	1521L	Sarasota Bay–Peace–Myakka	Lake Marianna	Nutrients (TSI)
3	1521P	Sarasota Bay–Peace–Myakka	Deer Lake	Nutrients (TSI)
3	1521Q	Sarasota Bay–Peace–Myakka	Lake Blue	Nutrients (TSI)
2	1522B	Tampa Bay Tributaries	Lake Thonotosassa	DO; Nutrients (Historic TSI); Nutrients (TSI); Un-Ionized Ammonia
2	1523C	Tampa Bay Tributaries	Cedar Lake (East)	Nutrients (TSI)
2	1523D	Tampa Bay Tributaries	Lake Eckles	Nutrients (TSI)
1	1529A	Tampa Bay	Saint George Lake	Nutrients (Historic TSI); Nutrients (TSI)
1	1530A	Tampa Bay	Moccasin Creek	DO (Nutrients and BOD); Fecal Coliform; Nutrients (TSI)
4	1532A	Kissimmee River	Lake Pierce	Nutrients (TSI)
4	1532B	Kissimmee River	Lake Marie	Nutrients (TSI)
2	1537	Tampa Bay Tributaries	Lake Wire	Lead; Nutrients (TSI)
3	1539C	Sarasota Bay–Peace–Myakka	Lake Annie	Nutrients (TSI)
3	1539P	Sarasota Bay–Peace–Myakka	Lake Dexter	Mercury (in fish tissue)
3	1539Q	Sarasota Bay–Peace–Myakka	Lake Ned	Nutrients (TSI)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
3	1539R	Sarasota Bay–Peace–Myakka	Lake Daisy	Nutrients (TSI)
3	1539Z	Sarasota Bay–Peace–Myakka	Lake Menzie	Nutrients (TSI)
2	1547A	Tampa Bay Tributaries	Lake Valrico	Nutrients (TSI)
2	1547C	Tampa Bay Tributaries	Lake Weeks	Nutrients (TSI)
3	1548	Sarasota Bay–Peace–Myakka	Lake Elbert	Nutrients (TSI)
3	1549B	Sarasota Bay–Peace–Myakka	Banana Lake	Nutrients (TSI)
3	1549B1	Sarasota Bay–Peace–Myakka	Lake Stahl	DO (Nutrients); Nutrients (TSI)
3	1549X	Sarasota Bay–Peace–Myakka	Hollingsworth Lake	Nutrients (TSI)
1	1570Y	Tampa Bay	Egypt Lake	Nutrients (TSI)
4	1573A	Kissimmee River	Tiger Lake	Mercury (in fish tissue)
4	1573E	Kissimmee River	Lake Weohyakapka	Nutrients (Historic TSI); Nutrients (TSI)
1	1574A	Tampa Bay	Alligator Lake	DO (Nutrients and BOD); Nutrients (TSI)
1	1579A	Tampa Bay	Bellows Lake (East Lake)	Nutrients (TSI)
3	1588A	Sarasota Bay–Peace–Myakka	Lake Mcleod	Nutrients (TSI)
1	1603C	Tampa Bay	Beckett Lake	DO; Nutrients (TSI)
3	1617A	Sarasota Bay–Peace–Myakka	Lake Effie	DO (Nutrients)
4	1619A	Kissimmee River	Lake Wales	Nutrients (TSI)
3	1623L	Sarasota Bay–Peace–Myakka	Lake Hancock	DO (Nutrients); Nutrients (TSI)
3	1623M	Sarasota Bay–Peace–Myakka	Eagle Lake	Nutrients (TSI)
3	1623M1	Sarasota Bay–Peace–Myakka	Grassy Lake	Nutrients (TSI)
4	1663	Kissimmee River	Crooked Lake	Mercury (in fish tissue)
3	1677C	Sarasota Bay–Peace–Myakka	Lake Buffum	Mercury (in fish tissue)
4	1685A	Kissimmee River	Lake Arbuckle	Mercury (in fish tissue)
4	1685D	Kissimmee River	Reedy Lake	Nutrients (TSI)
1	1700A	Tampa Bay	Crescent Lake	DO; Nutrients (TSI)
4	1706	Kissimmee River	Lake Clinch	Mercury (in fish tissue); Nutrients (TSI)
4	1730	Kissimmee River	Lake Hickory (Center Segment)	Nutrients (TSI)
4	1730B	Kissimmee River	Livingston Lake	Mercury (in fish tissue)
4	1730E	Kissimmee River	Pabor Lake	DO
1	1731A	Tampa Bay	Lake Maggiore	Nutrients (TSI)
4	1761H	Kissimmee River	Lake Lucas	DO
4	179A	Pensacola	Bear Lake	DO
2	1807B	Tampa Bay Tributaries	Lake Manatee Reservoir	DO; Fecal Coliform; Nutrients (TSI)
2	180A	Apalachicola–Chipola	Merritts Mill Pond	Nutrients (Algal Mats)
4	1813E	Kissimmee River	Bonnet Lake	Nutrients (TSI)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
4	1813F	Kissimmee River	Lake Angelo	Nutrients (TSI)
4	1813G	Kissimmee River	Little Bonnet Lake	Nutrients (TSI)
4	1813L	Kissimmee River	Lake Glenada	Nutrients (TSI)
4	1842	Kissimmee River	Lake Sebring	Mercury (in fish tissue)
4	1856B	Kissimmee River	Lake Istokpoga	Mercury (in fish tissue); Nutrients (Historic TSI); Nutrients (TSI)
4	1860B	Kissimmee River	Lake Josephine	Mercury (in fish tissue)
4	1893	Kissimmee River	Huckleberry Lake	Nutrients (TSI)
4	1938A	Kissimmee River	Lake June in Winter	Mercury (in fish tissue)
4	1938C	Kissimmee River	Lake Placid	Mercury (in fish tissue)
4	1938H	Kissimmee River	Lake Annie	DO; Mercury (in fish tissue)
3	1971	Sarasota Bay–Peace–Myakka	Clark Lake	Nutrients (TSI)
3	1981	Sarasota Bay–Peace–Myakka	Lake Myakka (Lower Segment)	Mercury (in fish tissue)
3	1981C	Sarasota Bay–Peace–Myakka	Lake Myakka (Upper Segment)	Mercury (in fish tissue); Nutrients (TSI)
3	2041B	Sarasota Bay–Peace–Myakka	Shell Creek Reservoir (Hamilton Reservoir)	DO
4	2105A	Nassau–St. Marys	Hampton Lake	DO
3	210A	Choctawhatchee–St. Andrew	Double Pond	Mercury (in fish tissue)
2	2213G	Lower St. Johns	St Johns River Above Doctors Lake	Mercury (in fish tissue); Thallium
2	2213H	Lower St. Johns	St Johns River Above Julington Creek	Mercury (in fish tissue)
2	2213I	Lower St. Johns	St Johns River Above Black Creek	Mercury (in fish tissue); Silver
2	2213J	Lower St. Johns	St Johns River Above Palmo Creek	Mercury (in fish tissue)
2	2213K	Lower St. Johns	St Johns River Above Tocoi	Mercury (in fish tissue)
2	2213L	Lower St. Johns	St Johns River Above Federal Point	DO; Mercury (in fish tissue)
2	2308	Lower St. Johns	Eagle Run	DO; Fecal Coliform
5	2320F	Upper East Coast	Lake Vedra–Guana River (Freshwater Portion)	DO (BOD)
4	2339	Nassau–St. Marys	Ocean Pond	Mercury (in fish tissue)
2	2389	Lower St. Johns	Doctors Lake	Nutrients (TSI)
2	2476B	Lower St. Johns	Kingsley Lake	DO; Nutrients (Historic TSI); Nutrients (TSI Trend)
2	2509	Lower St. Johns	Lake Geneva	Lead; Nutrients (Historic TSI)
2	2509H	Lower St. Johns	Lily Lake	Lead
2	2528B	Lower St. Johns	Lake Sheelar	DO; Nutrients (Historic TSI)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
2	2541	Lower St. Johns	Georges Lake	Mercury (in fish tissue); Nutrients (Historic TSI); Nutrients (TSI Trend)
2	2543F	Lower St. Johns	Lake Ross	Lead; Nutrients (TSI)
2	2575	Lower St. Johns	Cue Lake	Mercury (in fish tissue)
2	2593A	Lower St. Johns	Davis Lake	DO
2	2606B	Lower St. Johns	Crescent Lake	Mercury (in fish tissue); Nutrients (TSI)
2	2615A	Lower St. Johns	Dead Lake	Mercury (in fish tissue)
2	2617A	Lower St. Johns	Lake Broward	Mercury (in fish tissue)
2	2630B	Lower St. Johns	Lake Disston	Lead; Mercury (in fish tissue)
2	2659A	Lower St. Johns	Lake Winona	Nutrients (Historic TSI); Nutrients (TSI Trend)
2	2667A	Lower St. Johns	Lake Dias	Nutrients (TSI)
2	2671A	Lower St. Johns	Lake Daugharty	Mercury (in fish tissue)
2	2680A	Lower St. Johns	Lake Molly	Nutrients (TSI)
1	2705B	Ocklawaha	Newnans Lake	DO (Nutrients)
1	2717	Ocklawaha	Kanapaha Lake	DO (Nutrients and BOD)
1	2718B	Ocklawaha	Bivans Arm	Nutrients (Historic TSI); Nutrients (TSI); Turbidity
2	272	Apalachicola–Chipola	Thompson Pond	Nutrients (TSI)
1	2720A	Ocklawaha	Alachua Sink	DO; Fecal Coliform
1	2738A	Ocklawaha	Lochloosa Lake	Nutrients (Historic TSI); Nutrients (TSI Trend); Nutrients (TSI)
1	2740B	Ocklawaha	Lake Ocklawaha	DO
1	2742A	Ocklawaha	Star Lake	Nutrients (TSI)
1	2749A	Ocklawaha	Orange Lake	DO (Nutrients)
1	2771A	Ocklawaha	Lake Eaton	DO (Nutrients)
1	2782C	Ocklawaha	Lake Bryant	Nutrients (TSI)
1	2790A	Ocklawaha	Lake Weir	Nutrients (Historic TSI); Nutrients (TSI)
1	2790B	Ocklawaha	Little Lake Weir	Nutrients (TSI)
1	2797A	Ocklawaha	Ella Lake	DO
1	2803A	Ocklawaha	Holly Lake	DO
1	2806A	Ocklawaha	Lake Umatilla	Nutrients (TSI)
1	2811	Ocklawaha	West Emeralda Marsh Conservation Area	DO; Nutrients (TSI)
1	2819A	Ocklawaha	Trout Lake	DO (Nutrients and BOD)
1	2821B	Ocklawaha	Lake Joanna	Nutrients (Historic TSI)
1	2825A	Ocklawaha	Silver Lake	Nutrients (TSI)
1	2829A	Ocklawaha	Lake Lorraine	DO

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
3	283	Choctawhatchee–St. Andrew	Lake Juniper	Mercury (in fish tissue)
1	2832A	Ocklawaha	Lake Denham	Nutrients (TSI)
1	2839C	Ocklawaha	Lake Wilson	Nutrients (Historic TSI)
1	2839D	Ocklawaha	Lake Cherry	Nutrients (Historic TSI)
1	2839M	Ocklawaha	Lake Louisa	DO (Nutrients)
1	2839N	Ocklawaha	Lake Minnehaha	Nutrients (Historic TSI)
1	2839X	Ocklawaha	Lake Winona	Nutrients (TSI)
1	2839Y	Ocklawaha	Lake Susan	Nutrients (Historic TSI)
1	2854A	Ocklawaha	Marshall Lake	Nutrients (TSI)
1	2865A	Ocklawaha	Lake Florence	Nutrients (TSI)
1	2872A	Ocklawaha	Lake Roberts	Nutrients (TSI)
1	2872B	Ocklawaha	Lake Pearl	Nutrients (TSI)
1	2872C	Ocklawaha	Lake Lily	DO; Nutrients (TSI)
1	2873C	Ocklawaha	Johns Lake	DO; Nutrients (Historic TSI); Nutrients (TSI)
1	2875B	Ocklawaha	Lake Tilden	DO (Nutrients)
1	2875C	Ocklawaha	Lake Roper	Nutrients (TSI)
1	2890A	Ocklawaha	Lake Lowery	Nutrients (TSI)
2	2892	Middle St. Johns	Lake Margaret	Mercury (in fish tissue)
3	28931	Upper St. Johns	Sawgrass Lake	DO (Nutrients); Mercury (in fish tissue); Nutrients (Historic TSI); Nutrients (TSI)
3	28932	Upper St. Johns	Lake Cone At Seminole	Mercury (in fish tissue)
2	2893A	Middle St. Johns	Lake George	Mercury (in fish tissue); Nutrients (TSI)
2	2893D	Middle St. Johns	Lake Monroe	DO; Mercury (in fish tissue); Nutrients (TSI)
2	2893H	Middle St. Johns	Mullet Lake	Mercury (in fish tissue)
2	2893J	Middle St. Johns	Mud Lake	Mercury (in fish tissue)
3	2893K	Upper St. Johns	Lake Poinsett	DO (Nutrients); Mercury (in fish tissue); Nutrients (Historic TSI)
3	2893O	Upper St. Johns	Lake Washington	DO (Nutrients); Mercury (in fish tissue); Nutrients (Historic TSI)
3	2893Q	Upper St. Johns	Lake Helen Blazes	Mercury (in fish tissue)
2	2893U	Middle St. Johns	Lake Beresford	Nutrients (TSI)
3	2893V	Upper St. Johns	Blue Cypress Lake	Mercury (in fish tissue); Nutrients (TSI Trend)
3	2893Y	Upper St. Johns	Lake Winder	DO (Nutrients); Mercury (in fish tissue); Nutrients (TSI)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
2	2894	Middle St. Johns	Lake Delancey	Mercury (in fish tissue)
2	2899B	Middle St. Johns	Lake Kerr	Mercury (in fish tissue); Nutrients (TSI Trend)
2	2905C	Middle St. Johns	Wildcat Lake	Mercury (in fish tissue)
2	2912A	Middle St. Johns	Lake Emporia	Nutrients (Historic TSI); Nutrients (TSI)
2	2916B	Middle St. Johns	South Grasshopper Lake	Mercury (in fish tissue)
2	2917	Middle St. Johns	Boyd Lake	Mercury (in fish tissue)
2	2921	Middle St. Johns	Lake Woodruff	Mercury (in fish tissue)
2	2921C	Middle St. Johns	Lake Dexter	Mercury (in fish tissue)
2	2925A	Middle St. Johns	Lake Ashby	Mercury (in fish tissue); Nutrients (TSI Trend)
2	2929B	Middle St. Johns	Lake Norris	Mercury (in fish tissue)
2	2929C	Middle St. Johns	Lake Dorr	Mercury (in fish tissue)
2	2931	Middle St. Johns	Lake Winnemissett	Nutrients (Historic TSI); Nutrients (TSI Trend)
2	2953A	Middle St. Johns	Broken Arrow Lake	Nutrients (Historic TSI)
2	2954	Middle St. Johns	Konomac Lake Reservoir	Mercury (in fish tissue)
2	2956A1	Middle St. Johns	Linden Lake	DO
2	2961	Middle St. Johns	Lake Sylvan	Mercury (in fish tissue)
2	2964A	Middle St. Johns	Lake Harney	DO; Mercury (in fish tissue); Nutrients (TSI)
3	2964B	Upper St. Johns	Puzzle Lake	DO; Mercury (in fish tissue)
3	2964C	Upper St. Johns	Ruth Lake	Mercury (in fish tissue); Nutrients (TSI)
3	2966A	Upper St. Johns	Buck Lake	Mercury (in fish tissue)
2	2986B	Middle St. Johns	Lake Myrtle	DO
2	2986D	Middle St. Johns	Lake Alma	Nutrients (TSI)
2	2986E	Middle St. Johns	Lake Searcy	Nutrients (TSI)
2	2991B	Middle St. Johns	Buck Lake	Nutrients (TSI)
2	2991D	Middle St. Johns	Horseshoe Lake	DO
2	2994C	Middle St. Johns	Fairy Lake	Nutrients (TSI)
2	2994E	Middle St. Johns	Red Bug Lake	Nutrients (TSI)
2	2994X	Middle St. Johns	Little Lake Howell	Nutrients (TSI)
2	2994Y	Middle St. Johns	Fruitwood Lake	Nutrients (Historic TSI); Nutrients (TSI)
2	2994Y1	Middle St. Johns	Lake Tony	Nutrients (TSI)
2	29971	Middle St. Johns	Leftover Lake Ivanhoe	Nutrients (TSI)
2	29975	Middle St. Johns	Lake Sybelia	Nutrients (TSI)
2	29977	Middle St. Johns	Lake In The Woods	Nutrients (TSI)
2	2997B	Middle St. Johns	Howell Lake	Nutrients (Historic TSI); Nutrients (TSI)
2	2997B1	Middle St. Johns	Lake Ann	Nutrients (TSI Trend);

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
				Nutrients (TSI)
2	2997D	Middle St. Johns	Lake Minnehaha	Nutrients (TSI)
2	2997I	Middle St. Johns	Lake Sue	Nutrients (TSI)
2	2997J	Middle St. Johns	Lake Rowena	Nutrients (TSI)
2	2997K	Middle St. Johns	Lake Estelle	Nutrients (TSI)
2	2997M	Middle St. Johns	Lake Formosa	Nutrients (TSI)
2	2997O	Middle St. Johns	Park Lake	Nutrients (TSI)
2	2997Q	Middle St. Johns	Lake Dot	Fecal Coliform; Nutrients (Historic TSI); Nutrients (TSI)
2	2997R	Middle St. Johns	Lake Adair	Nutrients (TSI)
2	2997S	Middle St. Johns	Lake Spring	Nutrients (TSI)
2	2997U	Middle St. Johns	Lake Park	Nutrients (TSI)
2	2997X	Middle St. Johns	Lake Killarney	Nutrients (TSI)
2	2999A	Middle St. Johns	Lake Hayes	Nutrients (TSI)
2	3000	Middle St. Johns	Lake Pearl	Nutrients (TSI)
2	3000A	Middle St. Johns	Lake Harriet	DO; Fecal Coliform
2	3002D	Middle St. Johns	Starke Lake	Nutrients (TSI)
2	3002E	Middle St. Johns	Lake Primavista	Nutrients (TSI)
2	3002G	Middle St. Johns	Lake Lotta	Nutrients (TSI)
2	3002J	Middle St. Johns	Lake Hiawassee	Nutrients (TSI)
2	3002N	Middle St. Johns	Prairie Lake	Nutrients (TSI)
2	3004A	Middle St. Johns	Bear Lake	Mercury (in fish tissue); Nutrients (TSI)
2	3004B	Middle St. Johns	Lake Fairview	Nutrients (TSI)
2	3004E	Middle St. Johns	Lake Daniel	Nutrients (TSI)
2	3004F	Middle St. Johns	Lake Sarah	Nutrients (TSI)
2	3004J	Middle St. Johns	Lake Gandy	Nutrients (Historic TSI); Nutrients (TSI)
2	3004K	Middle St. Johns	Lake Wekiva (Orlando)	Nutrients (TSI)
2	3004N	Middle St. Johns	Lake Fairview Lake	Nutrients (TSI)
2	3004O	Middle St. Johns	Asher Lake	Nutrients (TSI)
2	3004P	Middle St. Johns	Cub Lake	Nutrients (TSI)
3	3008A	Upper St. Johns	Fox Lake	DO; Mercury (in fish tissue)
3	3008B	Upper St. Johns	South Lake	Mercury (in fish tissue)
2	3009	Middle St. Johns	Bear Gulley Lake	Nutrients (TSI)
2	3009C	Middle St. Johns	Lake Burkett	Nutrients (TSI)
2	3009E	Middle St. Johns	Lake Georgia	Nutrients (Historic TSI); Nutrients (TSI)
2	3011A	Middle St. Johns	Lake Weston	Nutrients (TSI)
2	3011B	Middle St. Johns	Lake Shadow	Nutrients (TSI)
2	3011C	Middle St. Johns	Lake Lucien	Mercury (in fish tissue)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
2	3023C	Middle St. Johns	Lake Susannah	Nutrients (TSI Trend)
2	3023D	Middle St. Johns	Lake Gear	Nutrients (TSI)
2	3023E	Middle St. Johns	Lake Barton	Nutrients (TSI)
2	3036	Middle St. Johns	Lake Frederica	Mercury (in fish tissue)
4	3168C	Kissimmee River	Lake Jessamine	Nutrients (TSI)
4	3168D	Kissimmee River	Lake Gatlin	Nutrients (TSI)
4	3168H	Kissimmee River	Lake Holden	Nutrients (TSI)
4	3168I	Kissimmee River	Pineloch	Nutrients (Historic TSI); Nutrients (TSI)
4	3168J	Kissimmee River	Jennie Jewel Lake	Nutrients (TSI)
4	3168Q	Kissimmee River	Lake Warren (Lake Mare Prarie)	Nutrients (TSI)
4	3168W1	Kissimmee River	Lake Mary Gem	Nutrients (TSI)
4	3168W2	Kissimmee River	Druid Lake	Nutrients (TSI)
4	3168W3	Kissimmee River	Lake Wade	Nutrients (TSI)
4	3168W5	Kissimmee River	Lake Tyner	DO
4	3168W6	Kissimmee River	Lake Warren	DO
4	3168W7	Kissimmee River	Lake Bumby	Nutrients (TSI)
4	3168X1	Kissimmee River	Lake Tennessee (Orange County)	Nutrients (Historic TSI); Nutrients (TSI)
4	3168X5	Kissimmee River	Lake Condel	Fecal Coliform
4	3168X8	Kissimmee River	Lake Angel	Nutrients (TSI)
4	3168Y2	Kissimmee River	Lake Como (Orange County)	DO
4	3168Y3	Kissimmee River	Lake Greenwood	DO
4	3168Y4	Kissimmee River	Lake Davis	Nutrients (TSI)
4	3168Y7	Kissimmee River	Lake Theresa	DO
4	3168Z1	Kissimmee River	Lake Lucerne (West)	Nutrients (TSI)
4	3168Z9	Kissimmee River	Lake Lawsona	Nutrients (Historic TSI); Nutrients (TSI)
4	3169C	Kissimmee River	Big Sand Lake	Mercury (in fish tissue)
4	3169G	Kissimmee River	Clear Lake	Nutrients (TSI)
4	3169G4	Kissimmee River	Lake Kozart	Nutrients (TSI)
4	3169G5	Kissimmee River	Lake Walker	Nutrients (TSI)
4	3169G6	Kissimmee River	Lake Richmond	Nutrients (TSI)
4	3169G8	Kissimmee River	Lake Beardall	Nutrients (Historic TSI)
4	3169I	Kissimmee River	Lake Mann	Nutrients (TSI)
4	3169P	Kissimmee River	Lake Catherine	DO (Nutrients); Nutrients (TSI)
4	3169Q	Kissimmee River	Rock Lake	Nutrients (Historic TSI)
4	3169S	Kissimmee River	Christie Lake	Nutrients (TSI)
4	3170B	Kissimmee River	Lake Russell	Mercury (in fish tissue)
4	3170FE	Kissimmee River	Lake Britt	DO

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4	3170H	Kissimmee River	Lake Sheen	Mercury (in fish tissue)
4	3170J3	Kissimmee River	Cypress Lake (Orange County)	Nutrients (TSI)
4	3170Q	Kissimmee River	Lake Butler	Mercury (in fish tissue)
4	3170S	Kissimmee River	Down Lake	Mercury (in fish tissue)
4	3170T	Kissimmee River	Lake Bessie	Mercury (in fish tissue)
4	3170W	Kissimmee River	Lake Louise	Mercury (in fish tissue)
4	3170X	Kissimmee River	Lake Ilseworth	Nutrients (TSI)
4	3170Y	Kissimmee River	Lake Tibet Butler	Mercury (in fish tissue)
4	3171	Kissimmee River	Lake Hart	Mercury (in fish tissue)
4	3171A	Kissimmee River	Lake Mary Jane	Iron; Mercury (in fish tissue)
4	3171C	Kissimmee River	Red Lake	Copper
4	3172	Kissimmee River	East Lake Tohopekaliga	Mercury (in fish tissue); N utrients (TSI)
4	3173A	Kissimmee River	Lake Tohopekaliga	Mercury (in fish tissue); Nutrients (TSI Trend)
4	3176	Kissimmee River	Alligator Lake	Mercury (in fish tissue)
4	3177	Kissimmee River	Lake Gentry	Mercury (in fish tissue)
4	3177A	Kissimmee River	Brick Lake	Mercury (in fish tissue)
4	3180A	Kissimmee River	Lake Cypress	Mercury (in fish tissue); Nutrients (TSI)
4	3183B	Kissimmee River	Lake Kissimmee	Mercury (in fish tissue); Nutrients (TSI Trend); Nutrients (TSI)
4	3183G	Kissimmee River	Lake Jackson (Osceola County)	DO; Nutrients (TSI)
4	3184	Kissimmee River	Lake Marian	Nutrients (TSI)
2	3194C	St. Lucie–Loxahatchee	Savannas	Copper; DO
1	3212A	Lake Okeechobee	Lake Okeechobee	Iron
1	3212C	Lake Okeechobee	Lake Okeechobee	Iron
1	3212D	Lake Okeechobee	Lake Okeechobee	Iron
1	3212E	Lake Okeechobee	Lake Okeechobee	Iron
1	3212F	Lake Okeechobee	Lake Okeechobee	Iron
1	3212G	Lake Okeechobee	Lake Okeechobee	Iron
1	3212H	Lake Okeechobee	Lake Okeechobee	Iron
3	3237C	Caloosahatchee	Lake Hicpochee	DO (Nutrients)
3	3245B	Lake Worth Lagoon–Palm Beach Coast	Lake Clarke	DO; Fecal Coliform
3	3245C2	Lake Worth Lagoon–Palm Beach Coast	Clear Lake	Nutrients (TSI)
3	3245C4	Lake Worth Lagoon–Palm Beach Coast	Pine Lake	DO; Fecal Coliform; Nutrients (TSI)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
3	3256A	Lake Worth Lagoon–Palm Beach Coast	Lake Osborne	DO
3	3262A	Lake Worth Lagoon–Palm Beach Coast	Lake Ida	Nutrients (TSI)
1	3366A	Suwannee	Lake Francis	Nutrients (TSI)
1	3438A	Suwannee	Peacock Lake	DO (BOD)
2	344	Apalachicola–Chipola	Ocheesee Pond	DO
1	3472	Suwannee	Tenmile Pond	DO
1	3496A	Suwannee	Low Lake	DO
1	3593A	Suwannee	Lake Crosby	Nutrients (TSI)
1	3648A	Suwannee	Sunshine Lake	DO
1	3703A	Suwannee	Watermelon Pond	DO
1	3731A	Suwannee	Lake Marion	DO
1	3738A	Suwannee	Little Bonable Lake	DO
1	442	Ochlockonee–St. Marks	Lake Iamonia	DO
2	51A	Apalachicola–Chipola	Dead Lake	Mercury (in fish tissue)
1	540A	Ochlockonee–St. Marks	Tallavanna Lake	Fecal Coliform; Nutrients (TSI)
1	546C	Ochlockonee–St. Marks	Lake Monkey Business	Nutrients (TSI)
3	553A	Choctawhatchee–St. Andrew	Deerpoint Lake	Mercury (in fish tissue)
1	582B	Ochlockonee–St. Marks	Lake Jackson	DO; Nutrients (TSI)
1	582C	Ochlockonee–St. Marks	Carr Lake	DO
2	60	Apalachicola–Chipola	Lake Seminole	Nutrients (TSI)
3	61A	Choctawhatchee–St. Andrew	Sand Hammock Pond	Mercury (in fish tissue)
1	647C	Ochlockonee–St. Marks	Lake Killarney	Nutrients (TSI); Un-Ionized Ammonia
1	647E	Ochlockonee–St. Marks	Lake Mcbride	DO
1	647F	Ochlockonee–St. Marks	Lake Kanturk	DO; Nutrients (TSI)
1	647G	Ochlockonee–St. Marks	Alford Arm	DO
1	689A	Ochlockonee–St. Marks	Lake Overstreet	DO
1	689B	Ochlockonee–St. Marks	Lake Hall	DO
1	756B	Ochlockonee–St. Marks	Lake Piney Z	DO (Nutrients); Nutrients (Historic TSI); Nutrients (TSI)
1	756C	Ochlockonee–St. Marks	Lake Lafayette (Lower Segment)	DO (Nutrients); Nutrients (TSI)
1	756F	Ochlockonee–St. Marks	Lake Lafayette (Upper Segment)	DO; Nutrients (Historic TSI); Nutrients (TSI)
5	784	Perdido	Tee And Wicker Lakes	Mercury (in fish tissue)
1	791N	Ochlockonee–St. Marks	Lake Miccosukee	DO
1	807C	Ochlockonee–St. Marks	Lake Munson	DO (BOD); Nutrients (TSI); Turbidity

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
4	83A	Pensacola	Hurricane Lake	DO
1	878C	Ochlockonee–St. Marks	Lake Hiawatha	DO
1	878D	Ochlockonee–St. Marks	Cascade Lake	DO
1	878E	Ochlockonee–St. Marks	Grassy Lake	DO
2	926A1	Apalachicola–Chipola	Lake Mystic	Mercury (in fish tissue)
3	959	Choctawhatchee–St. Andrew	Morris Lake	DO
3	959D	Choctawhatchee–St. Andrew	Draper Lake	DO
3	959E	Choctawhatchee–St. Andrew	Alligator Lake	DO
3	959G	Choctawhatchee–St. Andrew	Fuller Lake	DO
3	959I	Choctawhatchee–St. Andrew	Big Redfish Lake	DO
3	959J	Choctawhatchee–St. Andrew	Little Redfish Lake	DO
1	971B	Ochlockonee–St. Marks	Lake Weeks	DO (Nutrients)
1	971C	Ochlockonee–St. Marks	Eagle Lake	DO

Appendix D: Strategic Monitoring and Assessment Methodology for Surface Water

FWRA

The 1999 FWRA (Section 403.067 et seq., F.S.) clarified the statutory authority of DEP to establish TMDLs, required DEP to develop a scientifically sound methodology for identifying impaired waters, specified that DEP could develop TMDLs only for waters identified as impaired using this new methodology, and directed DEP to establish an Allocation Technical Advisory Committee (ATAC) to assure the equitable allocation of load reductions when implementing TMDLs.

The 2005 FWRA amendments included provisions that removed the need for the ATAC and added the development and implementation of BMAPs to guide TMDL activities and reduce urban and agricultural nonpoint sources of pollution. Nevertheless, BMAPs are not mandatory for the implementation of TMDLs. The Legislature established a long-term funding source that provided $20 million per year for urban stormwater retrofitting projects to reduce pollutant loadings to impaired waters. However, over the years the level of funding has been inconsistent.

The FWRA also requires FDACS and DEP to adopt rules for BMPs. As Florida already had an urban stormwater regulatory program, this new authority was particularly important in strengthening Florida's agricultural nonpoint source management program. The law requires DEP to verify the effectiveness of BMPs in reducing pollutant loads. The BMP rules and associated BMP manuals are available from the FDACS OAWP website. DEP can take enforcement action against permittees that do not implement the BMPs they agreed to implement in the BMAP.

IWR

DEP uses the methodology in Florida's IWR (Chapter 62-303, F.A.C.) to evaluate water quality data and identify impaired waters. The rule also addresses data sufficiency, data quality, and delisting requirements. **Appendix E** contains detailed information on the IWR.

Watershed Management Approach

DEP's statewide method for water resource management, called the watershed management approach, is the framework for developing and implementing the provisions of Section 303(d) of the federal CWA as required by federal and state laws. This approach manages water resources on the basis of hydrologic units—which are natural boundaries such as river basins—rather than arbitrary political or regulatory boundaries. DEP assesses each basin as an entire functioning system and evaluates aquatic resources from a basinwide perspective that considers the cumulative effects of human activities. From that framework, DEP addresses causes of pollution.

Rather than relying on single solutions to water resource issues, the watershed management approach is intended to improve the health of surface water and groundwater resources by strengthening coordination among such activities as monitoring, stormwater management, wastewater treatment, wetland restoration, agricultural BMPs, land acquisition, and public involvement. Stakeholder involvement (including federal, state, regional, tribal, and local governments and individual citizens) is an important feature to cooperatively define, prioritize, and resolve water quality problems. Coordination among the many existing water quality programs helps manage basin resources and reduce duplication of effort.

DEP implements the watershed management approach by using a 5-year basin rotation cycle. Under this approach, DEP groups Florida's 52 HUC basins (51 HUCs plus the Florida Keys) into 29 distinct basins distributed among each of DEP's 6 districts. Within each district, DEP assesses 1 basin group each year (except for the Northeast) and assesses each basin every 5 years. **Table D.1** lists the basin groups included in each of the basin rotations by DEP district. **Table D.2** lists the specific assessment periods for the Planning and Verified Lists for each of the 5 basin groups for the first 3 cycles of the basin rotation.

Table D.1. Basin groups for the implementation of the watershed management approach, by DEP district

- = No basin assessed

DEP District	Group 1 Basins	Group 2 Basins	Group 3 Basins	Group 4 Basins	Group 5 Basins
Northwest	Ochlockonee–St. Marks	Apalachicola–Chipola	Choctawhatchee–St. Andrew	Pensacola	Perdido
Northeast	Suwannee	Lower St. Johns	-	Nassau–St. Marys	Upper East Coast
Central	Ocklawaha	Middle St. Johns	Upper St. Johns	Kissimmee River	Indian River Lagoon
Southwest	Tampa Bay	Tampa Bay Tributaries	Sarasota Bay–Peace–Myakka	Withlacoochee	Springs Coast
South	Everglades West Coast	Charlotte Harbor	Caloosahatchee	Fisheating Creek	Florida Keys
Southeast	Lake Okeechobee	St. Lucie–Loxahatchee	Lake Worth Lagoon–Palm Beach Coast	Southeast Coast–Biscayne Bay	Everglades

Table D.2. Periods for the development of the Planning and Verified Lists by cycle and basin group

Cycle Rotation	Basin Group	Planning Period	Verified Period
1	1	1989–1998	1/1/1995–6/30/2002
1	2	1991–2000	1/1/1996–6/30/2003
1	3	1992–2001	1/1/1997–6/30/2004
1	4	1993–2002	1/1/1998–6/30/2005
1	5	1994–2003	1/1/1999–6/30/2006
2	1	1995–2004	1/1/2000–6/30/2007
2	2	1996–2005	1/1/2001–6/30/2008
2	3	1997–2006	1/1/2002–6/30/2009
2	4	1998–2007	1/1/2003–6/30/2010
2	5	1999–2008	1/1/2004–6/30/2011
3	1	2000–2009	1/1/2005–6/30/2012
3	2	2002–2011	1/1/2007–6/30/2014
3	3	2003–2012	1/1/2008–6/30/2015
3	4	2004–2013	1/1/2009–6/30/2016
3	5	2005–2014	1/1/20010–6/30/2017

The watershed management approach is implemented through a coordinated process that involves multiple programs within DEP. DEP prepares a monitoring plan in collaboration with stakeholders to determine when and where additional monitoring is needed to assess potentially impaired waters. This effort culminates in the preparation of a Strategic Monitoring Plan.

DEP then executes the Strategic Monitoring Plan primarily using DEP staff in the Regional Operation Centers (ROCs). The data from this effort are used to produce a Verified List of Impaired Waters, developed by applying the surface water quality standards in Chapter 62-302, F.A.C., and the IWR methodology in Chapter 62-303, F.A.C. DEP provides draft lists to stakeholders for comment and finalizes the lists based on these comments and any additional information received throughout the process. As required by Subsection 403.067(4), F.S., DEP adopts the Verified List for each basin by Secretarial Order.

The TMDL Program uses the Verified List and additional considerations to set priorities for TMDL development. A TMDL assigns preliminary allocations to point and nonpoint sources. DEP adopts all TMDLs by rule. Depending on the circumstance, a Basin Working Group may be formed to develop a BMAP that will guide TMDL implementation activities. DEP works closely with watershed stakeholders to ensure that they understand and support the approaches being undertaken to develop and implement the TMDLs.

The Basin Working Group and other stakeholders—especially other state agencies, WMDs, and representatives of county and municipal governments—develop the BMAP. The BMAP may address some or all of the watersheds and basins that flow into the impaired waterbody. This process may take 12 to 18 months and culminates in the formal adoption of the BMAP by DEP's Secretary.

The most important BMAP component is the list of management strategies to reduce pollutant sources. Local entities (e.g., wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, and individual property owners) usually implement these efforts. The management strategies may improve the treatment of pollution (e.g., wastewater treatment facility upgrades or retrofitting an urban area to enhance stormwater treatment), or the activities may improve source control.

Watershed plans that implement TMDLs are, by definition, BMAPs. There are opportunities, however, to develop plans to address impairments and improve water quality prior to the development and adoption of a TMDL. While these types of plans are not BMAPs, they can promote improved water quality and begin the restoration process without waiting for a TMDL to be established. There are two types of plans that address impairments: (1) 4b reasonable assurance plans (RAPs), and (2) 4e water quality restoration plans. Once a restoration plan—whether BMAP or stakeholder driven—is in place, activities and projects are completed on a schedule to ensure progress towards water quality restoration.

Tracking Improvements Through Time

One of the key benefits afforded by the iterative nature of the watershed management approach is the ability to evaluate and track the effectiveness of management activities (i.e., BMAP and TMDL implementation, the extent to which water quality objectives are being met, and whether individual waters are no longer impaired) using the results of monitoring conducted in subsequent cycles of the basin rotation.

For example, each adopted BMAP includes a monitoring component for evaluating water quality improvements in conjunction with pollutant load reduction projects. Monitoring data can be used in water quality assessments conducted during the subsequent basin rotation cycles, and these results can be compared with previous assessment results to document water quality change.

Determination of Use Support

Section 303(c) of the CWA requires that water quality standards established by the states and tribes include appropriate uses to be achieved and protected for jurisdictional waters. The CWA also establishes the national goal of "fishable and swimmable" for all waters wherever that goal is attainable. **Table D.3** lists the use support categories evaluated by assessments performed under the IWR. These categories correspond hierarchically to the surface water classifications provided in **Appendix B**.

Table D.3. Designated use support categories for surface waters in Florida

Designated Use Category Evaluated by Assessments Performed under the IWR	Applies to Waters Having This Surface Water Classification
Aquatic Life Use	Class I, II, III
Primary Contact and Recreation	Class I, II, III
Fish and Shellfish Consumption	Class I, II, III
Drinking Water	Class I
Protection of Human Health	Class I, II, III

Although the IWR establishes the assessment methodology for identifying impaired waters, for the purpose of reporting use support status to EPA, DEP uses a classification system based on the EPA multi-category, integrated reporting guidance. **Table C.4** lists the categories for waterbodies or waterbody segments in the *2016 Integrated Report*.

Table D.4. Categories for waterbodies or waterbody segments in the *2016 Integrated Report*

Note: The TMDLs are established only for impairments caused by pollutants (a TMDL quantifies how much of a given pollutant a waterbody can receive and still meet its designated uses). For purposes of the TMDL Program, pollutants are chemical and biological constituents, introduced by humans into a waterbody, that may result in pollution (water quality impairment). Other causes of pollution, such as the physical alteration of a waterbody (e.g., canals, dams, and ditches) are not linked to specific pollutants.

Category	Description	Comments
1	Indicates that all designated uses are attained.	Not currently used by DEP.
2	Indicates that sufficient data are available to determine that at least one designated use is attained and insufficient data or no information are available to determine if remaining uses are attained.	If attainment is verified for some designated uses of a waterbody or segment, DEP will propose partial delisting for those uses that are attained. Future monitoring will be recommended to acquire sufficient data and/or information to determine if the remaining designated uses are attained.
3a	Indicates that no data and/or information are available to determine if any designated use is attained.	Future monitoring will be recommended to acquire sufficient data and/or information to determine if designated uses are attained.
3b	Indicates that although some data and/or information are available, available data are insufficient to determine if the designated use is attained.	Future monitoring will be recommended to acquire sufficient data and/or information to determine if designated uses are attained.
3c	Indicates that sufficient data are available to determine that at least one designated use is not attained using the Planning List methodology in the IWR.	These waters are placed on the Planning List and will be prioritized for future monitoring to acquire sufficient data and/or information to determine if designated uses are attained.
4a	Indicates a segment that has been identified as not attaining one or more designated uses, but TMDL development is not needed because a TMDL has already been completed.	After EPA approves a TMDL for the impaired waterbody or segment, it will be included in a restoration plan or BMAP to reduce pollutant loading toward attainment of designated use(s).
4b	Indicates a segment that has been identified as not attaining one or more designated uses, but does not require TMDL development because the water will attain water quality standards because of existing or proposed pollution control measures.	Pollutant control mechanisms designed to attain applicable water quality standards within a reasonable time have either already been proposed or are already in place.

Category	Description	Comments
4c	Indicates a segment that has been identified as not attaining one or more designated uses, but the impairment is not caused by a pollutant and therefore TMDL development is not needed.[1]	This category includes segments that do not meet their water quality standards because of naturally occurring conditions or pollution; such circumstances more frequently appear linked to impairments for low DO or elevated iron concentrations. In these cases, the impairment observed is not caused by specific pollutants but is believed to represent a naturally occurring condition, or to be caused by pollution.
4d	Indicates a segment that has been identified as not attaining one or more designated uses, but DEP does not have sufficient information to determine a causative pollutant; or current data show a potentially adverse trend in nutrients or nutrient response variables; or there are exceedances of stream nutrient thresholds, but DEP does not have enough information to fully assess nonattainment of the stream nutrient standard.	This category includes segments that do not meet their water quality standards, but no causative pollutant has been identified or where there are adverse trends in nutrients, nutrient response variables, or DO.
4e	Indicates a segment that has been identified as not attaining one or more designated uses, and pollution control mechanisms or restoration activities are in progress or planned to address nonattainment of water quality standards, but DEP does not have enough information to fully evaluate whether proposed pollution mechanisms will result in attainment of water quality standards.	Restoration activities for waterbodies in this category have been completed, are planned, or ongoing such that once the activities are completed or the waterbody has had a chance to stabilize, in the opinion of DEP staff it will meet its designated uses.
5	Indicates a segment that has been identified as not attaining one or more designated uses and a TMDL is required.	Waterbodies or segments in this category have been identified impaired for one or more designated uses by a pollutant or pollutants. Waters in this category are included on the basin-specific Verified List adopted by Secretarial Order and submitted to EPA as Florida's 303(d) list of impaired waters at the end of Phase 2.

Assessments and subsequent listing decisions performed using the IWR methodology relate only to the current assessment periods. For segments that cannot be fully assessed using only data from the current assessment periods, EPA has encouraged Florida to incorporate a complete review of all water quality data for the entire POR. Consequently, DEP extended the assessment methodology to include the POR data when such additional data are available and these data meet DEP QA requirements (often the quality and/or the reliability of older data cannot be established). **Figure D.1** illustrates the POR evaluation process.

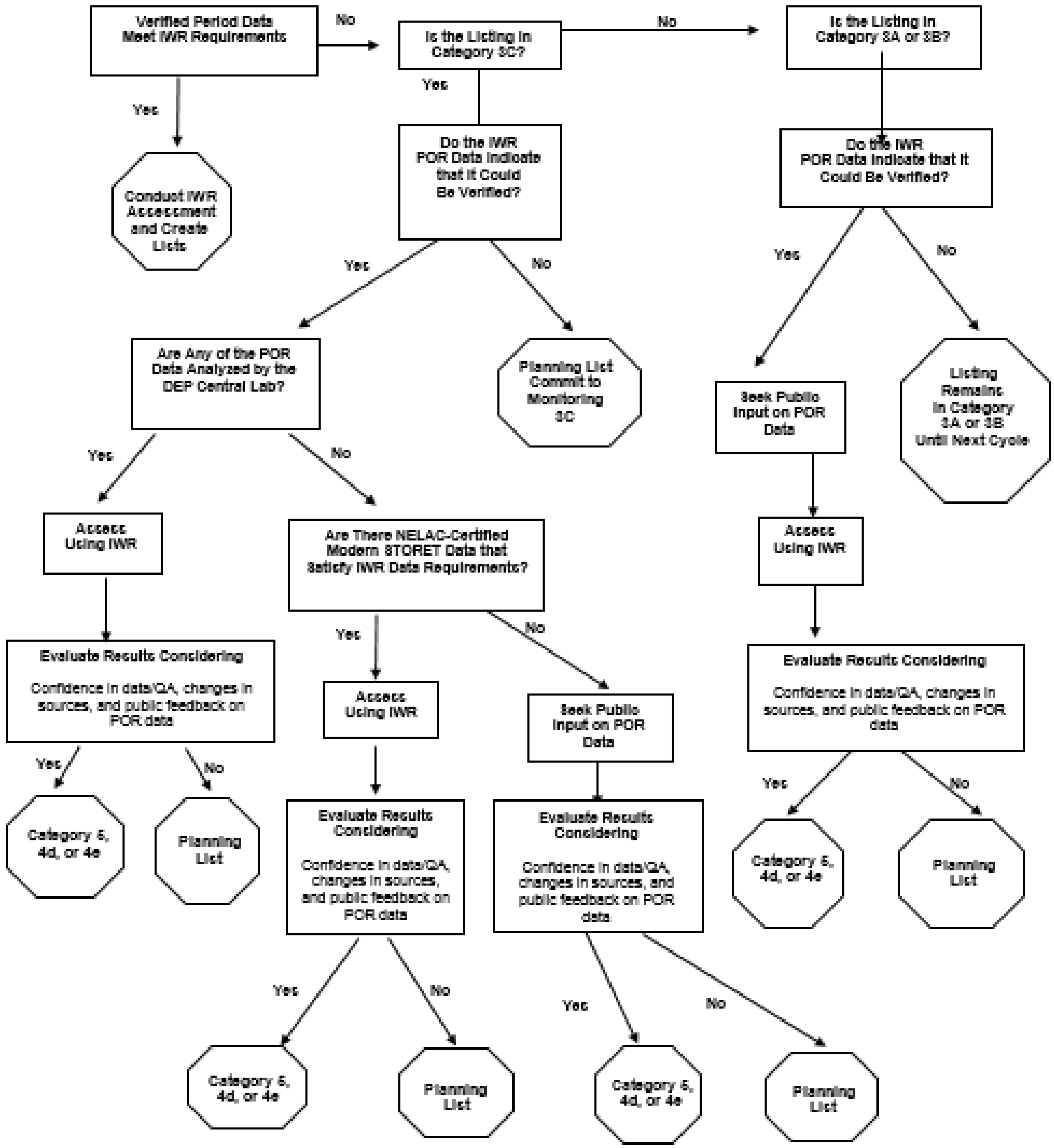

Figure D.1. POR assessment flow chart

Data Management

Sources

Florida STORET (or its successor database) is the primary source for assessment data. While the vast majority of IWR assessments rely almost entirely on data from Florida STORET, these data are supplemented as required with data obtained from other sources. For assessments performed for the current assessment period, nearly 80 % of the data used came from Florida STORET and 20 % came from other sources. **Table D.5** lists the agencies and organizations that have provided IWR assessment data.

Table D.5. Agencies and organizations providing data used in the IWR assessments

- Alachua County Environmental Protection Dept.
- Apalachicola National Estuarine Research Reserve
- Avon Park Air Force Range
- Babcock Ranch
- Biological Research Associates
- Bream Fishermen Association
- Brevard County Stormwater Utility Dept.
- Broward County Environmental Protection Dept.
- Century Reality/ Schreuder, Inc.
- Charlotte County Dept. of Health
- Charlotte County Stormwater Division
- Charlotte Harbor National Estuary Program
- Choctawhatchee Basin Alliance
- City of Atlantic Beach
- City of Cape Coral
- City of Deltona
- City of Jacksonville
- City of Jacksonville Beach
- City of Key West
- City of Lakeland
- City of Naples
- City of Neptune Beach
- City of Orlando–Streets and Stormwater Division
- City of Port St. Joe Wastewater Treatment Plant
- City of Port St. Lucie
- City of Punta Gorda
- City of Sanibel, Natural Resources Dept.
- City of Tallahassee Stormwater
- City of Tampa Bay Study Group
- City of West Palm Beach
- Collier County Coastal Zone Management Dept.
- Collier County Pollution Control
- Dade County Environmental Resource Management
- DEP
- DEP–Central District
- DEP–Charlotte Harbor Aquatic/Buffer Preserves
- DEP–Northeast District
- DEP–Northwest District
- DEP–Rookery Bay National Estuarine Research Reserve
- DEP–South District
- DEP–Southeast District
- DEP, Southwest District
- DEP–Water Quality Standards and Special Projects
- DEP–Watershed Assessment Section
- DEP–Watershed Evaluation and TMDL Section
- Environmental Protection Commission of Hillsborough County
- Environmental Research and Design, Inc.
- FDACS
- FDOH–Division of Environmental Health, Bureau of Water Programs
- FWC
- FWRI
- Florida Keys National Marine Sanctuary (NMS)
- Florida Keys NMS–Seagrass Monitoring Program
- Florida Keys NMS–Water Quality Monitoring Program
- Florida LakeWatch
- Georgia Environmental Protection Division
- Guana Tolomato Matanzas National Estuarine Research Reserve–Florida)
- Gulf Power Company
- Harbor Branch Oceanographic Institution
- IMC Agrico
- Jacksonville Electric Authority
- Lake County Water Resource Management
- Lee County Environmental Lab
- Lee County Hyacinth Control District
- Leon County Public Works
- Loxahatchee River District
- Manatee County Environmental Management Dept.

- Marine Resources Council of East Florida
- McGlynn Laboratories, Inc.
- National Health and Environmental Effect Research Laboratory
- National Park Service Water Resources Division
- Naval Station Mayport
- Northwest Florida WMD
- Orange County Environmental Protection Division
- Palm Beach County Environmental Resources Management Dept.
- Pasco County Stormwater Management Division
- Peace River Manasota Regional Water Supply Authority
- Pinellas County Dept. of Engineering and Environmental Services
- Polk County Natural Resources Division
- Reedy Creek Improvement District–Environmental Services
- Sanibel Captiva Conservation Foundation
- Sarasota County Environmental Services
- Seminole County
- SMR Communities, Inc.
- South Florida WMD
- Southwest Florida WMD
- Southwest Florida WMD–Project Coast
- St. Johns River WMD
- Suwannee River WMD
- Tampa Bay Water
- The Nature Conservancy of the Florida Keys
- Volusia County Environmental Health Lab

QA/QC Criteria

The IWR addresses QA/QC by requiring all data providers to use established SOPs and National Environmental Laboratory Accreditation Conference (NELAC)–certified laboratories to generate results intended for use in IWR assessments. All data must meet DEP QA rule requirements (Chapter 62-160, F.A.C.). To further ensure that the QA/QC objectives of the program are being met, DEP's Aquatic Ecology and Quality Assurance (AEQA) Section, on request, audits data providers (or laboratories used by data providers) on behalf of the program.

Rationales for Exclusion of Existing Data

In assessing surface water quality under the IWR, DEP attempts to assemble and use all readily available ambient surface water quality data. DEP excludes measurements or observations that are known to not be representative of ambient waters (e.g., results for samples collected from discharges or in approved mixing zones) from IWR assessments. In addition, data from observations or samples collected at locations or during periods that are unrepresentative of the general condition of the waterbody (e.g., samples collected during or immediately after a hurricane or samples linked to a short-term event such as a sewage spill) are subject to additional review before inclusion in the IWR assessment process.

If QA/QC audits identify specific data deficiencies, corresponding data subsets may be excluded from the assessment process. In these situations, the AEQA Section will provide recommendations to the appropriate data providers. Similarly, if a review of water quality assessment data identifies specific discrepancies or anomalies, these data also may be precluded from use for assessment purposes. Typically, such discrepancies include systematic issues such as errors in the conversion of units, errors caused by using an incorrect fraction to characterize an analyte, or other data-handling errors that may have occurred in conjunction with the data-loading process. In these cases, DEP staff will work with the data provider to resolve the underlying issue. Upon resolution, corrected data are (re)loaded to Florida STORET and made available for subsequent IWR assessments.

Table D.6 provides additional details about the specific types of data that have been excluded from assessments performed under the IWR.

Use and Interpretation of Biological Results

The biological assessment tools used in conjunction with IWR assessments consist primarily of the SCI and BioRecon. Because BioRecon is primarily a screening tool, DEP does not use low BioRecon scores alone as the basis for impairment decisions. Instead, it requires follow-up sampling with the SCI to provide a more comprehensive measure of aquatic life use support. In addition, a single SCI with a score less than the acceptable value is not sufficient to support an impairment, or delisting decision. When SCIs are used as the basis for impairment decisions, DEP requires a minimum of at least two temporally independent SCIs.

Table D.6. Data excluded from IWR assessments

Data Excluded	Comment
Results reported in Florida STORET that did not include units or included units that were inappropriate for the particular analyte.	The result values could not accurately be quantified or relied on for assessment purposes under the IWR.
Results reported as negative values	It was concluded that, except in cases where documentation was presented that indicated otherwise, any results reporting a negative value for the substance analyzed represent reporting errors. Credible data could not have any values less than the detection limit (in all cases a positive value) reported, and therefore results reported as negative values could not be relied on for assessment purposes under the IWR.
Results reported as "888" "8888" "88888" "888888" "8888888" and "999" "9999" "99999" "999999" "9999999"	Upon investigation, all data reported using these values were found to be provided by a particular WMD. The district intentionally coded the values in this manner to flag the fact that they should not be used, as the values reported from the lab were suspect. The data coded in this manner were generally older.
J-qualified results from the same WMD	These were excluded from the assessments after the district brought to DEP's attention that its intent in using the J-qualifier was not consistent with DEP's use of the J-qualifier.
Extremely old USGS data (from the beginning of the previous century)	These results did not have complete date information available, and accurate date information is required to be able to assess results under the IWR. The USGS data using USGS parameter codes 32230 or 32231 were also excluded from assessments performed under the IWR, based on information in a memo sent from the USGS.
Results for iron that were confirmed to be entered into dbHydro (SFWMD's environmental database) using an incorrect Legacy STORET parameter code	These results were limited to a subset of the results reported by a particular WMD.

Data Excluded	Comment
Results reported associated with "K," "U," "W," and "T" qualifier codes (all of which suggest that the result was below the method detection limit [MDL]) when the reported value of the MDL was greater than the criterion, or the MDL was not provided	To be able to compare a nondetect result with a criterion value, it is necessary to know that it was possible to measure as low as the numeric value of the criterion.
Results reported using an "I" qualifier code (meaning that the result value was between the MDL and the practical quantitation limit [PQL]) if the MDL was not provided, or where the MDL and PQL were inconsistent with the rest of the data record	
Results reported for metals using an "I" qualifier code if the applicable criterion was expressed as a function of hardness, and the numeric value of the metal criteria corresponding to the reported hardness value was between the MDL and PQL	
Results reported using an "L" qualifier code (meaning that the actual value was known to be greater than the reported value) where the reported value for the upper quantification limit was less than the criterion	The reasoning for excluding these data follows a similar logic as the cases discussed above for results reported as below the MDL.
Results reported with a "Z" qualifier code (indicating that the results were too numerous to count)	These results were excluded because there was no consistency among data providers in how data using this qualifier code were reported. Some data providers entered numeric estimates of bacteria counts, while others entered the dilution factor. As a result, the meaningful interpretation of data reported using this qualifier was not uniformly possible.
Results reported with an "F" qualifier code (which indicates female species)	Since the IWR does not assess any analytes for which this qualifier code would be appropriate, the intended meaning of the use of this code is unknown. The reported result is therefore rendered uninterpretable (although there are very few instances of the use of this qualifier code in the IWR dataset, and some agencies may use this to indicate a field measurement).
Results reported with an "O" qualifier code (which indicates that the sample was collected but that the analysis was lost or not performed)	The exclusion of results reported using this qualifier code is self-explanatory.
Results reported with an "N" qualifier code (which indicates a presumption of evidence of the presence of the analyte)	Comparing concentrations of analytes with water quality criteria requires a numeric result value. Presence or absence, for the purposes of assessments performed under the IWR, is not sufficient information on which to base an impairment decision.
Results reported with a "V" or "Y" qualifier code (which indicates the presence of an analyte in both the environmental sample and the blank, or a laboratory analysis that was from an unpreserved or improperly preserved sample)	Such data may not be accurate. The use of these codes indicates that the reported result was not reliable enough to be used in IWR assessments.

Data Excluded	Comment
Results reported with a "Q" qualifier code (which indicates that the holding time was exceeded)	These data were reviewed to validate whether the appropriate holding times were used, and if so, whether the holding times were exceeded. When appropriate, such data were excluded from the assessments. These reviews were performed manually, not as part of the automated processing of the IWR data.
Results reported for mercury not collected and analyzed using clean techniques, as required by the IWR	The use of clean techniques removes the chance for contamination of samples collected and analyzed for mercury. Mercury concentrations obtained from contaminated samples would not be representative of the true mercury concentrations in the target waterbody segments.
Results recommended for exclusion from DEP's EAS as a result of lab audits performed on behalf of the Watershed Assessment Section	The data excluded based on lab audits were generally analyte specific and referred to a specific period. While the data issues encountered were variable, the lack of acceptable, or verifiable, records was a common issue.
Certain DO measurements collected using a field kit (as opposed to a sonde)	

Appendix E: IWR Methodology for Evaluating Impairment

DEP evaluates the quality of waters of the state by using the science-based assessment methodology described in Chapter 62-303, F.A.C. The methodology provides a detailed process for determining the attainment of applicable water quality standards. Two distinct steps aim at identifying impaired waters: (1) using a statistical methodology to identify waterbody segments that exceed water quality criteria ("potentially impaired waters"); and (2) subjecting these segments to further review. If an exceedance for a potentially impaired segment is caused by a pollutant and later is verified, the segment is placed on the Verified List. The methodology described in the IWR provides a prespecified level of confidence that assessment results accurately reflect the actual water quality conditions of waters of the state.

In addition to providing assessment and listing thresholds, the IWR also (1) describes data sufficiency requirements; (2) addresses data quality objectives; and (3) describes the requirements for delisting segments that were previously included on the Verified List. Although the water quality criteria for DO and nutrients were recently revised, these revisions became effective after the period encompassed by this report; therefore, the assessment results presented here reflect the criteria that were in effect at the time these waters were most recently assessed.

The particular type of data and/or information required to determine use support varies by designated use (see **Appendix B**) and—in addition to physical and chemical analytical results characterizing the water column—includes biological data, fish consumption advisories, and beach closure and advisory information, as well as changes in the classification of shellfish-harvesting areas. At times, DEP also uses field survey and recon information to help identify impairments.

Evaluation of Aquatic Life–Based Use Support

Aquatic life–based use support refers to the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. To determine aquatic life–based use support, the IWR methodology uses three distinct types of data (Rule 62-303.310, F.A.C.):

1. Comparisons of discrete water quality measurements with specific class-specific numeric criteria from the Florida Standards (and other, similarly worded numeric threshold values, as described in Rule 62-303.320, F.A.C.).

2. Comparisons of results calculated for multimetric biological indices with waterbody type–specific biological assessment thresholds (as described in Rule 62-303.330, F.A.C).

3. Comparisons of annual summary statistics with numeric values based on an interpretation of narrative criteria from the Florida Standards (as described in Rule 62-303.350, F.A.C.).

Evaluations performed under the IWR rely primarily on discrete sample data obtained primarily from STORET. Subject to data sufficiency and data quality requirements, exceedances of applicable criteria and/or threshold values indicate that aquatic life–based use support is not achieved.

Evaluation of Primary Contact and Recreation Use Support

The IWR methodology determines primary contact and recreation use attainment by evaluating the following (Rule 62-303.360, F.A.C.):

1. Comparisons of discrete water quality measurements with specific numeric criteria values for bacteria, consisting of comparisons with the relevant class-specific numeric criteria from the Florida Standards (and other, similarly worded numeric threshold values, as described in Rule 62-303.360, F.A.C.).

2. Evaluation of beach closure, or beach advisories or warning information; this information must be based on bacteriological data, issued by the appropriate governmental agency, as described in Rule 62-303.360, F.A.C.

3. Comparison of summary measures of bacteriological data with threshold values described in Rule 62-303.360, F.A.C.

For the purpose of assessments using bacteria counts, FDOH reports the bacteriological results used as the basis for beach advisories, warnings, and closures to Florida STORET. DEP combines these data with bacteriological results from other data providers statewide. Subject to data sufficiency and data quality requirements, exceedances of applicable criteria and/or threshold values indicate that primary contact and recreational use support is not achieved.

Evaluation of Fish and Shellfish Consumption Use Support

The evaluation of fish and shellfish consumption use support relies on the evaluation of both quantitative and qualitative information, as follows (as described in Rule 62-303.370, F.A.C.):

1. Comparisons of discrete water quality measurements with specific numeric criteria values for bacteria, consisting of comparisons with the relevant class-specific numeric criteria from the Florida Standards (and other, similarly worded numeric threshold values, as outlined in Rule 62-303.320, F.A.C.).

2. Evaluation of fish advisory information issued by FDOH or other authorized governmental entity.

3. Evaluation of shellfish-harvesting actions taken by FDACS, provided those actions were based on bacteriological contamination or water quality data.

When a Class I, II, or III waterbody fails to meet its applicable Class II water quality criteria for bacteriological quality, the waterbody is assessed as impaired under the IWR. Subject to data sufficiency and data quality requirements, exceedances of applicable thresholds indicate that aquatic life–based use attainment is not met.

In addition, if FDOH has issued a fish consumption advisory, or if FDACS has classified a Class II waterbody segment as anything other than approved for shellfish harvesting or propagation, that segment is verified as impaired, and determined not to meet its designated use.

Evaluation of Drinking Water Use Attainment

The evaluation of drinking water use attainment is based on the following type of information (Rule 62-303.380, F.A.C.):

1. Comparisons of discrete water quality measurements with threshold values consisting of comparisons with class-specific numeric criteria from the Florida Standards (and other, similarly worded numeric threshold values, as outlined in Rule 62-303.320, F.A.C.).

Evaluation and Determination of Use Attainment

Exceedances of Numeric Criteria from the Florida Standards

Table E.1 lists analytes for which numeric criteria in the Florida Standards exist and counts of sample results available for assessments performed under the IWR.

Table E.1. Sample counts for analytes having numeric criteria in the Florida Standards

Analyte	Number of Observations
2,4-Dichlorophenoxyacetic acid (2,4-D)	42
2,4-Dichlorophenol	182
2,4-Dinitrophenol	178
Acenaphthene	190
Aldrin	812
Alkalinity	83,108
Alpha, Gross	29
Aluminum	944
Ammonia, Un-Ionized	93,290
Anthracene	228
Antimony	6,928
Arsenic	31,737
Barium	1,329
Beta Benzenehexachloride (β-BHC)	210
Cadmium	4,666
Chlordane	804
Chloride	8,107
Chlorine	46
Chlorophenols	56
Chromium VI	23
Conductance, Specific	226,540
Copper	7,673
Cyanide	121
Copper	7,673
Demeton	609
Detergents	19
Dichlorodiphenyltrichloroethane (DDT)	724
Dieldrin	835
DO	390,051
Dissolved Solids	4,785
Endosulfan	833
Endrin	800
Fecal Coliform	267,900
Fluoranthene	227
Fluorene	191
Fluoride	39,535
Guthion®	190
Heptachlor	818
Iron	34,767

Analyte	Number of Observations
Lead	5,964
Lindane	885
Malathion	766
Manganese	205
Mercury	3,153
Methoxychlor	702
Mirex	195
Nickel	1,922
Nitrate	1,503
Oil/Grease	282
Parathion	7
Pentachlorophenol	220
Phenol	975
Polychlorinated Biphenyls (PCBs)	26
Pyrene	227
Radium	29
Selenium	18,104
Silver	22,718
Silvex	12
Thallium	6,444
Toxaphene	819
Turbidity	172,601
Zinc	5,433

Since the numeric water quality criteria from Chapter 62-302, F.A.C., are class and waterbody-type specific, DEP classifies segments first by their appropriate waterbody class and as one of four waterbody types—stream (including springs), lake, estuary, or coastal. For each analyte having a criterion in the Florida Standards, DEP calculates four-day station median concentrations (or, in some instances, daily values) and compares these values with the applicable class-specific criterion values in the Florida Standards, rather than the four-day station median).

For waters assessed under Subsection 62-303.320(1), F.A.C., for each segment and analyte combination, DEP counts the number of samples and exceedances of the applicable criterion and compares the exceedance count with the listing threshold value for the corresponding sample size. The listing thresholds represent the minimum number of samples not meeting the applicable water quality criterion necessary to obtain the required confidence levels. Comparisons performed for acute toxicity–based exceedances, or exceedances of synthetic organics and pesticides, have a lower listing threshold of more than a single exceedance in any consecutive three-year period.

Subject to data sufficiency requirements, DEP places a waterbody segment assessed under Subsection 62-303.320(1), F.A.C., on the Planning List if there are a sufficient number of samples to attain at least 80 % confidence that the actual criterion exceedance rate was greater than or equal to 10 %. Waters placed on the Planning List are subject to additional data collection and subsequent review.

To place a waterbody segment assessed under Subsection 62-303.420(2), F.A.C., on the Verified List, the number of samples must be sufficient to attain at least a 90 % confidence that the actual criterion exceedance rate was greater than or equal to 10 %.

Interpretation of Narrative Nutrient Criterion

The results in this report include those assessments performed through 2012 and do not include water quality criteria that have been adopted since, which includes numeric nutrient criteria, recreational bacteria criteria, and DO (as percent saturation). The Florida Standards include a narrative nutrient criterion, which 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." In Rule 62-303.350, F.A.C., the IWR provides a working interpretation of the criterion. Under this interpretation, annual mean chlorophyll *a* concentrations (for segments that are not lakes) and annual mean TSI (for lake segments) were the primary means for assessing whether a waterbody should be further assessed for nutrient impairment under the rule in effect in 2012.

Exceedances of Biological Thresholds

Biota inhabiting a waterbody function as continual natural monitors of environmental quality, capable of detecting the effects of both episodic, as well as cumulative, alterations in water quality, hydrology, and habitat. A biological assessment uses the response of resident aquatic biological communities to various stressors as a method of evaluating ecosystem health. Because these communities can manifest long-term water quality conditions, they can provide a direct measure of whether the designated use of a "well-balanced population of fish and wildlife" is being attained (Rule 62.302-400, F.A.C.) better than characterization by discrete chemical or physical measurements alone. In addition, bioassessment often can provide insights into appropriate restoration strategies.

Metrics Used

Bioassessment tools used with the IWR assessments incorporate multimetric methods to quantify biological community structure or function. When multimetric methods are used, the results of individual metrics (e.g., number of long-lived taxa, number of sensitive taxa, percent filter feeders, percent clingers) are combined into a single dimensionless, multimetric index. Such indices offer potential advantages over the use of individual metrics in that they can integrate multiple nonredundant measures into a single score that reflects a wider range of biological information. The SCI and BioRecon are two examples of multimetric indices used to quantify the health of rivers and streams based on the biological health of macroinvertebrates.

Recalibrations of the SCI and the BioRecon methods completed in 2007 involved the use of the Human Disturbance Gradient (HDG), which ranks sites based on independent assessments of habitat quality, degree of hydrologic disturbance, water quality, and human land use intensity. The SCI and BioRecon scores calculated before August 2007 used a smaller, similar set of input metrics. Since both sets of scores represent valid biological assessments performed during discrete periods, both are used in assessments of biological health performed under the IWR.

Additional efforts to develop multimetric indices for periphyton (attached algae) and phytoplankton (drifting algae) that incorporate the HDG also have been attempted, but significant relationships between human disturbance and biological response in these communities have not been established. DEP has since developed and implemented an RPS method to evaluate periphyton communities and continues to use chlorophyll *a* concentrations to quantify imbalances in phytoplankton communities.

Bioassessment Data Used

The IWR bioassessments used only macroinvertebrate data from ambient sites located in surface waters of the state. DEP excluded data from effluent outfall sites and monitoring sites not clearly established to collect ambient water quality data.

Site-specific habitat and physicochemical assessment (e.g., percent suitable macroinvertebrate habitat, water velocities, extent of sand or silt smothering, and width of riparian buffer zones) provides information important for identifying stressors responsible for a failed bioassessment. This information also can be extremely useful in determining biological impairment, since biological communities sometimes respond to factors other than water quality, such as habitat disruption and hydrologic disturbances. Waterbody segments adversely affected only by pollution (e.g., a lack of habitat or hydrologic disruption) but not by a pollutant (a water quality exceedance) are not placed on the Verified List.

DEP's SOPs provide definitions and specific methods for the generation and analysis of bioassessment data. Because these bioassessment procedures require specific training and expertise, the IWR additionally requires that persons conducting the bioassessments must comply with the QA requirements of Chapter 62-160, F.A.C., attend at least eight hours of DEP-sanctioned field training, and pass a DEP-sanctioned field audit verifying that the sampler follows the applicable SOPs in Chapter 62-160, F.A.C., before collecting bioassessment data used in IWR assessments.

SCI

The total SCI score is the average of 10 metric scores: total number of taxa, total number of taxa belonging to the order Ephemeroptera, total taxa of the order Trichoptera, percent filter feeders, percent long-lived taxa, clinger taxa, percent dominant taxa, percent taxa in the Tanytarsini, percent sensitive taxa, and percent very tolerant taxa (see **Table E.2** for calculations). A total score with a poor or very poor (or Category 3) rating constitutes a failed bioassessment.

Table E.2. SCI metrics for the Northeast, Panhandle, and Peninsula regions of Florida

SCI Metric	Northeast	Panhandle	Peninsula
Total taxa	10 * (X–16)/26	10 * (X–16)/33	10 * (X–16)/25
Ephemeroptera taxa	10 * X /3.5	10 * X /6	10 * X /5
Trichoptera taxa	10 * X /6.5	10 * X /7	10 * X /7
% filterer	10 * (X–1)/41	10 * (X–1)/44	10 * (X–1)/39
Long-lived taxa	10 * X /3	10 * X /5	10 * X /4
Clinger taxa	10 * X /9	10 * X /15.5	10 * X /8
% dominance	10 – (10 * [(X–10)/44])	10 – (10 * [(X–10)/33])	10 – (10 * [(X–10)/44])
% Tanytarsini	10 * [ln(X + 1) /3.3]	10 * [ln(X + 1) /3.3]	10 * [ln(X + 1) /3.3]
Sensitive taxa	10 * X /11	10 * X /19	10 * X /9
% Very tolerant	10 – (10 * [ln(X + 1)/4.4])	10 – (10 * [ln(X + 1)/3.6])	10 – (10 * [ln(X + 1)/4.1])

BioRecon

A BioRecon data impairment rating uses the six metrics as calculated in **Table E.3** and the index thresholds in **Table E.4**.

Table E.3. BioRecon metrics for the Northeast, Panhandle, and Peninsula regions of Florida

BioRecon Metric	Northeast	Panhandle	Peninsula
Total taxa	(X–14)/23	(X–16)/33	(X–11)/25
Ephemeroptera taxa	X /3.5	X /12	X /5
Trichoptera taxa	X /6.5	X /7	X /7
Long–lived taxa	X /6	X /10	X /7
Clinger taxa	X /7	X /15.5	X /8
Sensitive taxa	X /11	X /19	X /9

Table E.4. BioRecon sample size and index range

BioRecon	Index Range
1 sample: Pass	(6–10)
1 sample: Fail	(0–6)
2 samples: Good	(7–10)
2 samples: Fair	(4–7)
2 samples: Poor	(0–4)

Delisting

A waterbody segment on the 303(d) list or the Verified List may be proposed for delisting when it is demonstrated that water quality criteria are currently being met. Waterbody segments may also be proposed for delisting for other reasons, including if the original listing is in error, or if a water quality exceedance is from natural causes, or not caused by a pollutant.

Although the IWR has specific requirements for delisting decisions, determining the ultimate assessment category (or subcategory; see **Appendix D**) for delisted segments is not necessarily straightforward. For example, EPA has provided guidance that a waterbody previously identified as impaired for nutrients based on chlorophyll *a* or TSI assessments can be delisted if the waterbody does not exceed the IWR threshold values. However, until sufficient site-specific information is available to demonstrate use attainment, these waterbody segments cannot be placed in Category 2, and rather are placed in Category 3b. The required site-specific information to place the waterbody segment in Category 2 can include, but is not limited to, measures of biological response such as the SCI and macrophyte or algal surveys.