FINAL
Integrated Water Quality Assessment for Florida: 2016 Sections 303(d), 305(b), and 314 Report and Listing Update

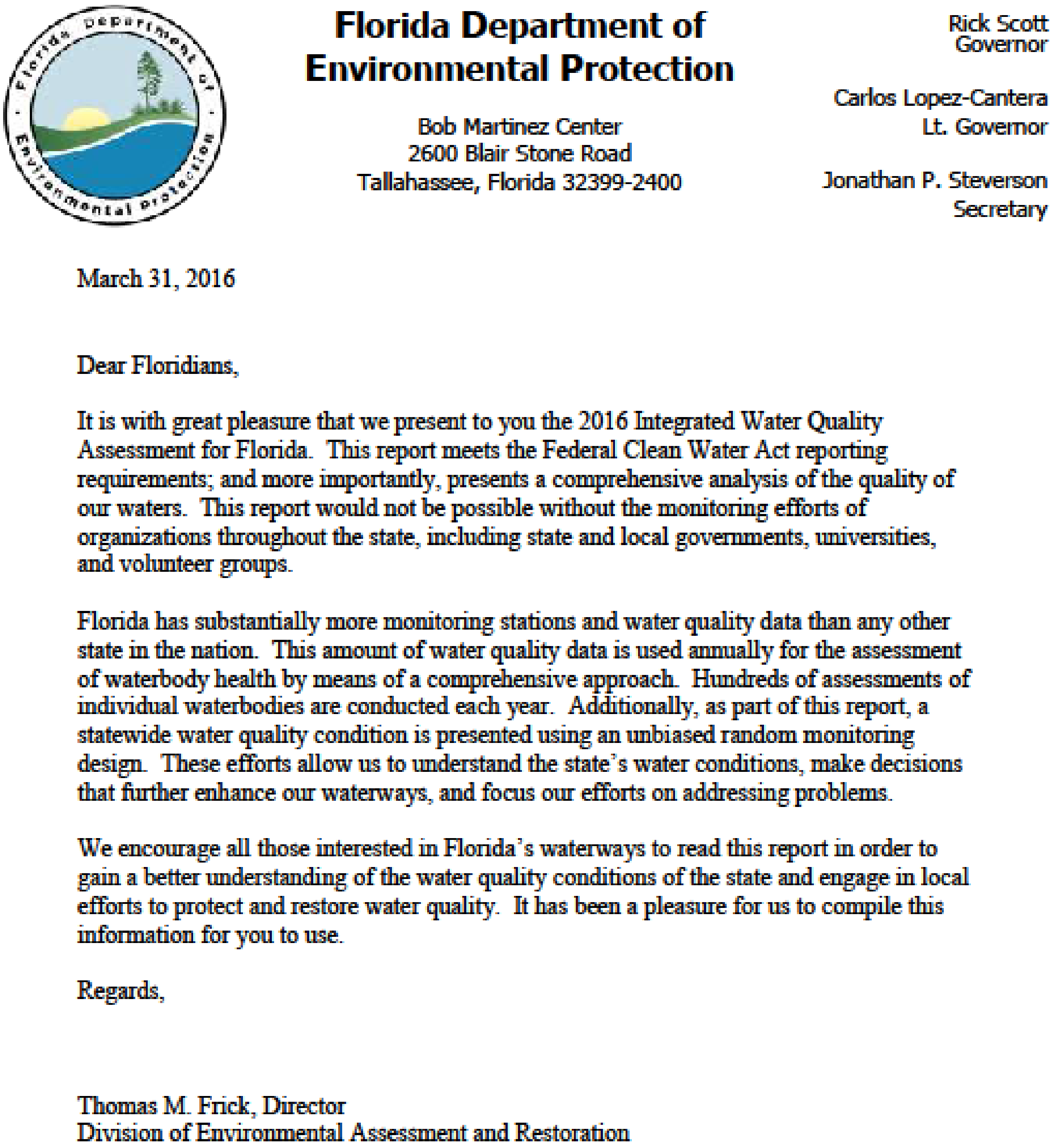
Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

June 2016

2600 Blair Stone Rd.
Tallahassee, FL 32399-2400

This Page Intentionally Blank.

Letter to Floridians



Florida Department of
Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Rick Scott
Governor

Carlos Lopez-Cantera
Lt. Governor

Jonathan P. Steverson
Secretary

March 31, 2016

Dear Floridians,

It is with great pleasure that we present to you the 2016 Integrated Water Quality Assessment for Florida. This report meets the Federal Clean Water Act reporting requirements; and more importantly, 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. This amount of water quality data is used annually for the assessment of waterbody health by means of a comprehensive approach. Hundreds of assessments of individual waterbodies are conducted each year. Additionally, as part of this report, a statewide water quality condition is presented using an unbiased random monitoring design. 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 in order to gain a better understanding of the water quality conditions of the state and engage in local efforts to protect and restore water quality. It has been a pleasure for us to compile this information for you to use.

Regards,

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

Acknowledgments

This document was prepared by staff in the following divisions and offices of the Florida Department of Environmental Protection (DEP):

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:***
    - Ground Water Management Section
    - Watershed Evaluation and TMDL Section
- ***Water Quality Restoration Program:***
    - Nonpoint Source Management Section
    - Watershed Planning and Coordination Section

Division of Water Resource Management

- ***Domestic Wastewater Program***
- ***Industrial Wastewater Program***
- ***State Revolving Fund Program***
- ***Engineering, Hydrology, and Geology Program***
- ***Submerged Lands and Environmental Resources Coordination Program***
- ***Water Compliance Assurance Program***

Office of Water Policy

Office of Intergovernmental Programs

In addition, DEP thanks staff at the Florida Fish and Wildlife Conservation Commission, Florida Department of Health, and Florida Department of Agriculture and Consumer Services for their valuable help in updating sections of this report, and the Southwest, Suwannee River, and St. Johns River Water Management Districts for reviewing the report.

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

β-BHC	Beta Benzenehexachloride
μg	Microgram
μg/L	Micrograms Per Liter
μg STX/100g	Micrograms Saxitoxin Per 100 Grams
μS	MicroSiemen
μS/cm	MicroSiemens Per Centimeter
ALK	Alkalinity, Dissolved (as calcium carbonate [$CaCO_3$])
As	Arsenic
ASR	Aquifer Storage and Recovery
ATAC	Allocation Technical Advisory Committee
BACTAC	Bacteria Technical Advisory Committee
BGD	Billion Gallons Per Day
BioRecon	Biological Reconnaissance
BLYES	Bioluminescent Yeast Estrogen Screen
BMAP	Basin Management Action Plan
BMP	Best Management Practice
Ca	Calcium, Dissolved
$CaCO_3$	Calcium Carbonate
CARL	Conservation and Recreation Lands
CBI	Compliance Biomonitoring Inspection
CBIR	Community Budget Initiative Request
CCMP	Comprehensive Conservation and Management Plan
CEI	Compliance Evaluation Inspection
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CERP	Comprehensive Everglades Restoration Plan
CEU	Continuing Education Unit
cfs	Cubic Feet Per Second
cfu/100mL	Colony-Forming Units Per 100 Milliliters of Water
Cl	Chloride, Dissolved
cm	Centimeter
CSI	Compliance Sampling Inspection
CSMN	Coastal Salinity Monitoring Network
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CWNS	Clean Watersheds Needs Survey
CWSRF	Clean Water State Revolving Fund
dbHydro	Database Hydrologic (South Florida Water Management District environmental database)
DBP	Disinfection Byproduct
DDT	Dichlorodiphenyltrichloroethane
DEAR	Division of Environmental Assessment and Restoration

DEP	Florida Department of Environmental Protection
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
DSCP	Drycleaning Solvent Cleanup Program
DWMP	District Water Management Plan
EAS	Environmental Assessment Section
EDB	Ethylene Dibromide
e.g.	Exempli Gratia
ELRA	Environmental Litigation Reform Act
EPA	U.S. Environmental Protection Agency
ERC	Environmental Regulation Commission
ERLA	Environmental Litigation Reform Act
ERP	Environmental Resource Permit
ESOC	Emerging Substances of Concern
et al.	Et Alii, Et Aliae, or Et Alia
et seq.	Et Sequentes or Et Sequentia
F.A.C.	Florida Administrative Code
FAR	Florida Administrative Register
FC	Fecal Coliform
FDACS	Florida Department of Agriculture and Consumer Services
FDEO	Florida Department of Economic Opportunity
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FFL	Florida-Friendly Landscaping
FGS	Florida Geological Survey
FL STORET	Florida Storage and Retrieval (Database)
FMRI	Florida Marine Research Institute
F.S.	Florida Statutes
FWC	Florida Fish and Wildlife Conservation Commission
FWPCA	Federal Water Pollution Control Act
FWRA	Florida Watershed Restoration Act
FWRI	Fish and Wildlife Research Institute
FWRMC	Florida Water Resources Monitoring Council
FWVSS	Foodborne, Waterborne, and Vectorborne Disease Surveillance System
FY	Fiscal Year
FYI	Fifth-Year Inspection
GIS	Geographic Information System
GOMA	Gulf of Mexico Alliance
GRTS	Generalized Random Tessellation Stratified
GWTV	Ground Water Temporal Variability
HAB	Harmful Algal Bloom
HAL	Health Advisory Limit

HB	House Bill
HDG	Human Disturbance Gradient
HUC	Hydrologic Unit Code
IBI	Impact Bioassessment Inspection
i.e.	Id Est
IMC	International Minerals and Chemicals Corporation (IMC Agrico)
IRL	Indian River Lagoon
ISD	Insufficient Data
IWR	Impaired Surface Waters Rule
IWRM	Integrated Water Resources Monitoring
K	Potassium, Dissolved
kg	Kilogram
kg/yr	Kilograms Per Year
L	Liter
lbs/yr	Pounds Per Year
LCMS	Liquid Chromatography-Mass Spectrometry
LC/MS-MS	Liquid Chromatography-Tandem Mass Spectrometry
LID	Low-Impact Development
LSJR	Lower St. Johns River
LVI	Lake Vegetation Index
LVS	Linear Vegetation Survey
MAPS	Managed Aquatic Plant System
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MF	Membrane Filter
mg	Milligram
Mg	Magnesium, Dissolved
mgd	Million Gallons Per Day
mg/kg	Milligrams Per Kilogram
mg/L	Milligrams Per Liter
mL	Milliliter
MMS	U.S. Department of the Interior Minerals Management Service
MS4	Municipal Separate Storm Sewer System
MSMA	Monosodium Methanearsonate
N	Nitrogen
Na	Sodium, Dissolved
N/A	Not Available or Not Applicable
ND	No Data
NEEPP	Northern Everglades and Estuaries Protection Program
NELAC	National Environmental Laboratory Accreditation Conference
NEP	National Estuary Program
NHD	National Hydrography Dataset

NNC	Numeric Nutrient Criteria
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOV	Notice of Violation
NO_x	Nitrate-Nitrite, Dissolved (as N)
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRCS	Natural Resources Conservation Service
NSP	Neurotoxic Shellfish Poisoning
NWFWMD	Northwest Florida Water Management District
O&M	Operations and Maintenance
OAWP	Office of Agricultural Water Policy
OFW	Outstanding Florida Water
OSTDS	Onsite Sewage Treatment and Disposal System
P	Phosphorus, Dissolved (as P)
P-2000	Preservation 2000
PAM	Polyacrylamides
Pb	Lead
PBS	Performance-Based Systems
PCBs	Polychlorinated Biphenyls
PCE	Perchloroethylene (Tetrachloroethylene)
PCU	Platinum Cobalt Unit
PEC	Probable Effects Concentration
PLRG	Pollutant Load Reduction Goal
POR	Period of Record
ppb	Parts per Billion
ppm	Parts per Million
PQL	Practical Quantitation Limit
PSP	Paralytic Shellfish Poisoning
psu	Practical Salinity Unit
PWS	Public Water System
PWS ID#	Public Water System Identification Number
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
q-PCR	Quantitative Polymerase Chain Reaction
QPS	Qualitative Periphyton Survey
RFA	Restoration Focus Area
RPS	Rapid Periphyton Survey
SB	Senate Bill
SBIO	Statewide Biological Database
SC	Specific Conductance
SCI	Stream Condition Index

SERCC	Southeast Regional Climate Center
SFWMD	South Florida Water Management District
SJRWMD	St. Johns River Water Management District
SK	Seasonal Kendall
SKTT	Seasonal Kendall Test for Trend (Trend Test)
SM	Standard Methods
SMP	Strategic Monitoring Plan
SNW	Salinity Monitoring Network
SO_4	Sulfate, Dissolved
SOC	Synthetic Organic Chemical or Save Our Coasts
SOP	Standard Operating Procedure
SOR	Save Our Rivers
SPFP	Saxitoxin Puffer Fish Poisoning
SRF	State Revolving Fund
SRWMD	Suwannee River Water Management District
SS	Sen Slope (Estimator)
SSAC	Site-Specific Alternative Criteria
STA	Stormwater Treatment Area
STAG	State and Tribal Assistance Grant
STCM	Storage Tank Contamination Monitoring
STORET	Storage and Retrieval (Database)
STX	Saxitoxin
SWAPP	Source Water Assessment and Protection Program
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement and Management
TAC	Technical Advisory Committee
TAPP	Think About Personal Pollution
TC	Total Coliform
TCE	Trichloroethylene
TDS	Total Dissolved Solids
TEC	Threshold Effects Concentration
Temp	Temperature
Th-232	Thorium-232
THMs	Trihalomethanes
TIGER	Topologically Integrated Geographic Encoding and Referencing
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
TSI	Trophic State Index
TSS	Total Suspended Solids

TV	Temporal Variability
U-238	Uranium-238
UF	University of Florida
UF–IFAS	University of Florida–Institute of Food and Agricultural Sciences
UMAM	Uniform Mitigation Assessment Method
USACOE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VISA	Very Intense Study Area
VOC	Volatile Organic Compound
WBID	Waterbody Identifier
WHO	World Health Organization
WL	Water Level
WMD	Water Management District
WMS	Watershed Monitoring Section
WQ	Water Quality
WQBEL	Water Quality–Based Effluent Limitations
WQI	Water Quality Inspection
WQS	Water Quality Standard
WQX	Water Quality Exchange
WRP	Wetland Resource Permit
WRRDA	Water Resources Reform and Development Act
WSRP	Water Supply Restoration Program
WWTF	Wastewater Treatment Facility
XSI	Toxic Sampling Inspection

Executive Summary

Purpose and Contents

This report provides an overview of the status and overall condition of Florida's surface and ground water quality from 2012 to 2014. It also addresses the reporting requirements of Sections 305(b) and 303(d) of the Federal Water Pollution Control Act (also known as the Clean Water Act, or CWA). 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, the 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.

In preparing this report, the Florida Department of Environmental Protection (DEP) assessed an abundance of recently collected information on water quality, including data from the DEP Ambient Monitoring Networks (the "Status" and "Trend" networks), ambient data from data providers statewide, and data collected in support of the Total Maximum Daily Loads (TMDL) Program. The Florida Storage and Retrieval (STORET) Database stores tens of millions of data records, and more data are uploaded every year. DEP uses these data to identify impaired waters, develop numeric criteria, and analyze other water quality issues. Several agency programs also track ground water data, both because of the close connection between surface and ground water in the state, and the impact that human land uses are having on ground water quality and quantity.

Florida encompasses an area of more than 45 million acres. Its water resources include 27,561 linear miles of rivers and streams; 47,708 linear miles of canals and ditches; over 1.6 million acres of lakes, reservoirs, and ponds; over 1.7 million acres of estuaries and coastal waters; and more than 1,000 springs (**Table 2.1**). Additionally, thousands of wells provide fresh drinking and irrigation water.

Monitoring and characterizing the state's waters is an enormous undertaking. The sheer number and geographic extent of these waters require several monitoring approaches (or "tiers") to adequately report on water quality conditions. Each tier plays a critical role. The first is a big-picture, statewide statistical estimate of condition. The second tier identifies waterbodies and reaches that are impaired, thus requiring remediation. The third tier carries out site-specific, cause-and-effect monitoring. Because of differences in the methods used for data screening, data analysis, study period, study design, geographic location, and other factors, the results presented here may not be the same as those in other reports.

Summary of Statewide Status and Trend Monitoring Results for Surface and Ground Water

Chapter 5 summarizes results generated from the Status Monitoring Network from 2012 through 2014 and from the Trend Monitoring Network from 1999 through 2014. Of note, the state's surface and ground water resources are predominantly in good condition, based on the indicators assessed. The results provide data indicating areas that may need further assessment, but also indicate areas that can be slated for protection rather than remediation.

The Status Monitoring Network uses an EPA-designed probabilistic design to estimate, with known confidence, the water quality of 100% of the fresh waters in Florida that can be sampled. These waters include rivers, streams, canals, lakes, and ground water resources. DEP collects standard physical/chemical and biological metrics in these waters, as applicable. The entire state is assessed each year.

Using the recently approved numeric nutrient and dissolved oxygen (DO) criteria for surface waters, percentages of surface water resources inferred to pass these thresholds are presented for the first time in this 2016 report. The nutrient thresholds used in these analyses are the numeric values and were 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 extensive in these resources. An evaluation of the chlorophyll *a* thresholds indicate that roughly 50% of the state's lake area may have elevated levels. Roughly 70% of the state's river/streams miles can sustain healthy aquatic life based on a comparison of the total nitrogen (TN) threshold, and 80% of the state's river/stream miles based on a comparison of the total phosphorus (TP) threshold.

The Trend Monitoring Network consists of 76 surface water stations (*e.g.,* rivers and streams) and 49 ground water wells located throughout Florida that are sampled either monthly or quarterly. In surface waters, the data indicate statistically significant increasing trends for nitrate + nitrite as N (about 37% of stations), total Kjeldahl nitrogen (about 30% of stations), and chlorophyll *a* (about 45% of stations). For ground water, of those wells having trends, a number of them 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.

Summary of Water Quality Standards Attainment for Assessed Rivers/Streams, Lakes, Estuaries, Coastal Waters, and Beaches

The use support determinations and summary results presented in **Chapter 7** are based on surface water quality assessments performed under the IWR for the most recently completed set of group-specific assessments in the basin rotation and include listings adopted by the state for waters in Groups 2 through 5 in Cycle 2 of the basin rotation that have been submitted to and approved by the EPA as updates to the 303(d) list, as well as those listings in Group 1, Cycle 3, of the basin rotation that have been adopted by the state and also submitted to, and currently under review by, the EPA. The waters assessed for these determinations encompass some 17,554 miles of rivers and streams, 38,536 miles of canals, 1,324,690 acres of lakes, 1,671,159 acres of estuaries, 1875 miles of coastal waters, 293 individual springs, and 353 beaches in the state and include assessments on multiple parameters for 1,430 rivers and stream segments, 891 lake segments, 588 estuary segments, 138 segments for coastal waters, 107 spring segments, and 353 beach segments.

Based on the assessments performed, as shown in **Table ES.1**, using the IWR methodology, impairments were identified for 9,642 miles of rivers and streams and 33,655 miles of canals; as well as 1,065,265 acres of lakes; 993,581 acres of estuaries; 589 miles of coastal waters; and 620 springs. Impairments were also identified for 87 beaches.

Table ES.1. Total water size for each type of measure associated with assessment and TMDL activities by water feature type

Note: Waters in EPA Category 3a (no data and/or information are available to determine if any designated use is supported) are not included in the calculations for waters that were assessed.

Feature	Total Acres (Assessed)	Total Miles (Assessed)	Count (Assessed)	Number of Waterbody Segments (Assessed)	Total Acres (Impaired)	Total Miles (Impaired)	Count (Impaired)	Total Acres (TMDL)	Total Miles (TMDL)	Count (TMDL)
Streams/ Rivers		17,554		1,430		9,642			2,057	
Coastline		1,875		138		589			11	
Canals		38,536				33,655			6,678	
Lakes	1,324,690			891	1,065,265			555,302		
Estuaries	1,671,159			588	993,581			231,161		
Springs			865	107			620			326
Total	**2,995,849**	**57,965**	**865**	**3,154**	**2,058,846**	**43,886**	**620**	**786,463**	**8,746**	**326**

Summary of Ground Water Monitoring Results

Ground water, which provides more than 90% of Florida's drinking water (Marella 2014), is highly vulnerable to contamination in much of the state. Overall, the water quality of the evaluated potable aquifers was good for the parameters evaluated by the DEP monitoring networks (**Table 9.1**). From 2012 to 2014, DEP monitoring showed that total coliform bacteria and sodium (a salinity indicator) were the parameters that achieved standards less frequently (85% and 86% of the samples statewide, respectively). Metals and nitrate achieved standards in almost all samples (100% statewide median).

Ground water contaminants of concern were evaluated using recent sampling data from public water systems served by wells (**Figure 9.1** and **Table 9.2**). Fewer exceedances were detected in public water system samples compared with those reported in the 2014 Integrated Report. However, data from 2012 to 2014 showed that radionuclides (a natural condition) and salinity (as sodium) exceeded primary drinking water standards most often in untreated water (but not the water that is delivered to customers, which meets standards). Nitrate remains the biggest issue in surface waters that receive significant inputs of ground water, since it can cause excessive growth of algae and can impair clear-water systems, particularly springs.

Ongoing and New Issues and Initiatives

DEP continues to make tremendous progress statewide in identifying and addressing surface and ground water contamination. However, much more work remains to be done, especially in the face of the state's continued population growth and increased tourism. In cooperation with other agencies and stakeholders, DEP continues to implement numerous programs and activities to protect, manage, and restore the state's surface water quality, aquatic habitats, aquatic life, and potable water supplies.

Over the last several years, DEP has continued to investigate issues of environmental interest and to develop and implement a number of water quality initiatives (see **Chapter 3**), including the following:

- The continued monitoring and investigation of increased nitrate concentrations in springs that can result in the overgrowth of aquatic plants, including blue-green algae, which can produce toxins that affect humans and wildlife.

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

- The promotion of low-impact development and practices such as green roofs, pervious pavements, and stormwater harvesting.
- The implementation of microbial source tracking to investigate and identify potential sources of elevated fecal indicator bacteria in waterbodies.
- The continued monitoring of saltwater and freshwater harmful algal blooms.
- The implementation of numeric nutrient criteria 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 to identify and quantify the major sources contributing nitrogen to impaired springs and spring runs.
- The continuation of testing for pesticide residues in surface waters and springs.
- The reduction of potential fertilizer impacts through practices such as Florida-friendly landscaping and the required adoption of a Florida-Friendly Model Landscape Ordinance by local governments in watersheds with impaired waters.
- 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 DEP and the water management districts.

Chapter 1: Introduction

Contents

- **Chapter 1** provides background information on the federal assessment and reporting requirements, how they are integrated into Florida's watershed management approach, and the implementation of the EPA's new long-term 303(d) vision.
- **Chapter 2** contains background information on the state's population, surface water and ground water resources, climate, and hydrogeology.
- **Chapter 3** summarizes current issues of environmental interest and water quality initiatives.
- **Chapter 4** describes Florida's water resource management programs to monitor and protect surface water resources.
- **Chapter 5** summarizes the results of the Status Monitoring Network from 2012 through 2014, as well as long-term trends in surface and ground water quality.
- **Chapter 6** describes the surface water Strategic Monitoring design and assessment methodology.
- **Chapter 7** summarizes the significant surface water quality findings for Strategic Monitoring and the attainment of designated uses for rivers and streams, lakes, estuaries, and coastal waters.
- **Chapter 8** discusses the state's total maximum daily load (TMDL) priorities.
- **Chapter 9** describes the state's basin management action plan (BMAP) program.
- **Chapter 10** describes Florida's ground water monitoring programs.
- **Chapter 11** presents significant ground water quality findings, summarizes ground water contaminant sources, and characterizes ground water–surface water interactions.
- The **Appendices** contain background information and supporting data.

Purpose

This report provides an overview of Florida's surface water and ground water quality as of 2015. Referred to as the Integrated Report because it fulfills the reporting requirements under Sections 305(b) and 303(d) of the federal Clean Water Act (CWA), the report must be submitted to the U.S. Environmental Protection Agency (EPA) every two years.

Federal Assessment and Reporting Requirements

Section 305(b) of the CWA requires states and other jurisdictions to submit biennial water quality reports to the EPA. These reports, referred to as 305(b) reports, describe surface water and ground water quality and trends, the extent to which waters are attaining their designated uses (such as drinking water, recreation, and shellfish harvesting), and major impacts to surface water and ground water.

Under Section 303(d) of the CWA, states are also required to identify waters that are not attaining their designated uses, submit to the 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.

Water quality monitoring and data analysis are the foundation of water resource management decisions. The EPA and its state partners have worked together to develop an integrated 305(b) and 303(d) assessment approach to address water quality monitoring strategies, data quality and data quantity needs, and data interpretation methodologies. This 2016 Integrated Report continues the consolidation and alignment of the 305(b) and 303(d) assessment and reporting requirements. It also includes Section 314 reporting on the status and trends of significant publicly owned lakes.

Florida uses the Integrated Report to document whether water quality standards are being attained, document the availability of data and information for each waterbody segment, identify water quality trends, and provide information to managers in setting priorities for future actions to protect and restore the health of the state's aquatic resources. This comprehensive approach to assessment enhances Florida's ability to track the important programmatic and environmental goals of the CWA and, ideally, speeds up the pace of achieving these goals.

Florida's Integrated Approach to Monitoring and Assessment

The state's monitoring approach consists of three tiers, as follows:

- The Status Network component of the ambient monitoring program is a probabilistic assessment used to develop statistical estimates of water quality across the entire state, based on a stratified random sample design. This monitoring network produces an unbiased picture of water quality conditions statewide and provides a cost-effective benchmark for measuring the success of Florida's water quality programs. The results also can provide information on whether it would be useful to target certain waters for further assessment, or if limited resources for water quality assessment can be used more effectively in other ways. DEP also implements a Trend Monitoring Network consisting of 76 surface water and 49 ground water stations. Trend analyses for surface and ground water resources are used to examine changes in water quality over time. Florida's statewide Status and Trend monitoring networks (the first tier) enable DEP to satisfy some of the reporting requirements for Sections 106 and 305(b) of the CWA.

- For the second-tier monitoring, or Strategic Monitoring, a variety of basin- and waterbody-specific assessments are conducted. The primary focus is to collect sufficient data to verify waters are impaired and, to the extent possible, determine the causative pollutant for waters listed for dissolved oxygen (DO) or biological assessment (bioassessment) failures. However, DEP also conducts other types of strategic monitoring to better evaluate specific water resources (*e.g.*, springs).

- Site-specific monitoring (the third tier) includes intensive surveys for TMDLs, monitoring for the development of water quality standards and site-specific alternative criteria (SSAC), as well as fifth-year inspections for permit renewals for facilities that discharge to surface waters. Special monitoring programs are used to address other program-specific needs, such as monitoring to develop predictive models, including the TMDL for Lake Jesup and the surrounding six lakes that is being developed for Florida.

DEP considers all readily available ambient water quality data, regardless of the monitoring tier, in the 303(d) assessment for the determination of impaired waters. Each assessment is placed into one of five assessment categories, based on available data. According to the EPA, this approach allows the states to document the attainment of applicable water quality standards and develop monitoring strategies that effectively respond to the needs identified in the assessment, while ensuring that the attainment status of each water quality standard applicable to a particular waterbody segment is addressed. The five broad categories are as follows:

- Category 1: All designated uses are supported; no use is threatened.

- Category 2: Available data and/or information indicate that some, but not all, of the designated uses are supported.

- Category 3: There are insufficient available data and/or information to make a use support determination.

- Category 4: Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed.

- Category 5: Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

In addition to using these broad categories, the EPA allows states to develop and use individual subcategories to fit unique or specialized sets of circumstances. These subcategories (see **Chapter 6**) must be consistent with the purpose of the more general category and must be approved by the EPA during its review of each state's methodology for developing lists of impaired waters.

Integrating the Federal Requirements into Florida's Watershed Management Approach

For the 2016 Integrated Report, DEP has continued to move towards a comprehensive assessment by integrating federal assessment and reporting requirements into its watershed management approach. Federal 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.

The 1999 Florida Watershed Restoration Act (FWRA) (Section 403.067, Florida Statutes [F.S.]) directed DEP to implement a comprehensive, integrated watershed approach for evaluating and managing cumulative impacts to the state's waters. The act clarified the purpose of the TMDL Program and directed DEP to develop an assessment methodology that allows for the consideration of whether water quality standards are being met based on credible data, studies, and reports. Those waters determined not to meet water quality standards are then included on the state's 303(d) list of impaired waters, or those waters needing a TMDL, and the appropriate TMDLs are developed (see **Chapter 6** for more information). These objectives are carried out through coordination with the water management districts (WMDs), the Florida Department of Agriculture and Consumer Services (FDACS), the Soil and Water Conservation Districts, environmental groups, regulated parties, and local stakeholders during all phases of the TMDL process.

In 2000, DEP implemented the watershed management approach by dividing Florida's 52 basins into 29 groups distributed among DEP's 6 districts: 5 basins each in the Northwest, Central, Southwest, South, and Southeast Districts, and 4 basins in the Northeast District. One basin is assessed in each district every year. Using a rotating basin management cycle, which ensures that each basin is assessed every 5 years, DEP and local stakeholders assess individual basins, identify impaired waters requiring the development of TMDLs, and develop basin management action plans (see **Chapter 6**) and reasonable assurance (RA) plans to restore water quality. Ideally, in any given year, DEP is at one point of the water quality restoration process in each group—for example, monitoring the Group 5 basins while assessing the Group 4 basins, developing TMDLs for the Group 3 basins, creating BMAPs for the Group 2 basins, and implementing restoration activities for the Group 1 basins.

As part of its watershed management approach, which consists of multiple phases carried out on a rotating cycle, DEP began developing Verified Lists of impaired waters for the Group 1 through 5 basins beginning in 2002. Cycle 2, initiated in 2007, was completed in January 2012. Cycle 3 is currently under way, and Verified Lists are currently being developed for the Group 3 basins as part of that cycle. As required by Subsection 403.067(4), F.S., the lists are adopted by DEP Secretarial Order. The resulting Verified Lists of impaired waters and waters to be delisted in those basins amend the 1998 303(d) list of impaired Florida waters maintained by the EPA. DEP intends to continue to submit annual amendments to its 303(d) list as part of the watershed management approach.

The EPA Consent Decree

From 1999 to 2013, the ultimate driver for TMDL development in Florida was a schedule associated with a federal lawsuit. In 1999, the EPA entered into a consent decree to settle a lawsuit brought by Earthjustice, an environmental advocacy group. The consent decree prescribed a schedule for DEP to adopt TMDLs for a list of impaired Florida waterbodies. If DEP was unable to adopt a TMDL by the consent decree date, the EPA would be required by the consent decree to develop a federal TMDL or demonstrate that a TMDL was not needed. Although Florida was not a party to the lawsuit, DEP participated in the development of the consent decree schedule, which was tailored to follow Florida's rotating basin approach.

For 14 years, DEP prioritized its workload in concert with the federal consent decree schedule. It established TMDLs for a majority of the waterbodies on the consent decree list. The Florida Statutes, however, only allow state TMDL development for waterbodies that are verified as impaired under the Impaired Surface Waters Rule (IWR). Because some consent decree–listed waterbodies were never verified as impaired using this methodology, DEP was unable to develop state TMDLs for every waterbody. Thus there is currently a mix of state and federal TMDLs in Florida; some waterbodies have one, some the other, and a few have both.

In 2013, with the development of TMDLs for nutrient impairments for five lakes in the Kissimmee River Basin, DEP completed all of the necessary TMDLs in the consent decree. All of the waters listed in the consent decree have either a state TMDL, or a federal TMDL, or both a state and a federal TMDL, or a federal determination that a TMDL is not needed. The EPA has taken the final necessary steps to approve Florida's TMDLs and close out the consent decree, which was granted on October 9, 2015.

The New EPA 303(d) Long-Term Vision

In December 2013, the EPA announced a new collaborative framework for implementing the CWA Section 303(d) Program to identify and restore impaired waters. The EPA document, *A Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program*, provides additional details about the framework, which resulted from a collaborative process between state and EPA program managers initiated in August 2011.

The vision is not a rule or regulation. It does not impose any binding legal requirements on the EPA, the states, or other stakeholders. Nor does it alter CWA 303(d) regulatory obligations to identify impaired or threatened waters and to develop TMDLs for such waters. The EPA expects states to develop tailored strategies to implement their CWA 303(d) Program responsibilities in the context of their overall water quality goals and individual state priorities.

Future Prioritization, 2016 to 2022

Consistent with the vision, Florida has established its long-term CWA 303(d) Program priorities through Fiscal Year (FY) 2022 in the context of the state’s broader overall water quality goals. This process will focus on identifying watersheds or individual waters for priority restoration and protection activities, taking into consideration how CWA 303(d)–related activities could collectively help achieve a state's broader overall water quality goals. Florida's CWA 303(d) prioritization provides a framework to focus the location and timing of the development of TMDLs, and alternative restoration and protection plans, in relation to other planning and implementation activities that may already exist in the priority watersheds or waters. As such, it provides a foundation to guide how Florida implements CWA 303(d) Program responsibilities and requirements, which remain unchanged. Regardless of the way a state defines its priorities—by geographic units such as segments with waterbody identification (WBID) numbers, watersheds, ecoregions, or basins; by pollutants; or by designated uses—these priorities must be articulated in a manner that allows them to be linked to specific assessment units.

Setting long-term CWA 303(d) priorities from FY 2016 to FY 2022 provides states an opportunity to strategically focus their efforts and demonstrate progress over time in achieving environmental results. As such, the long-term priorities are not expected to substantially change from FY 2016 to FY 2022. However, the EPA recognizes that some adjustments may be needed because of unforeseen circumstances or planning processes. In addition, although the new vision calls for states to identify their priorities through FY 2022, some states may choose to establish a framework that allows them to identify priorities beyond FY 2022.

Additionally, CWA 303(d) prioritization affords the state an opportunity to integrate CWA 303(d) Program priorities with other water quality programs to achieve overall water quality goals. These include programs for state water quality standards (WQS), monitoring, CWA Section 319, National Pollutant Discharge Elimination System (NPDES), source water protection, and conservation. Having CWA 303(d) Program priorities informed by data and information from other relevant programs will help achieve and demonstrate environmental results over time. For example, integration with water quality monitoring programs can lay the groundwork for gathering needed data to assess baseline conditions in priority waters, to develop TMDLs or other restoration and protection plans, or to determine progress in restoring or protecting priority waters. Integration with other programs can also inform the selection of the approaches that afford the best opportunity to restore or protect water quality, as well as facilitate implementing the pollutant reduction or protection goals of those selected approaches.

Consistent with the new vision, **Chapter 6** of this report includes a discussion of the rationale used to establish Florida's long-term priorities.

Implementation of Numeric Nutrient Criteria (NNC)

The implementation of the state’s NNC, discussed in more detail in **Chapter 6**, requires two to three years of data to assess a waterbody rather than a single year of data as under previous rules. As a result of this data sufficiency requirement, in most years, each DEP district will monitor in multiple basins. However, this monitoring shift will not require any changes in schedules for uploading data to the STOrage and RETrieval (STORET) Database.

Probabilistic Monitoring

The DEP Status and Trend Monitoring results are a component of the CWA Section 106 monitoring work plan. The results of these monitoring programs are reported internally through statewide assessments, published by the Watershed Monitoring Section (WMS) on the DEP Watershed Monitoring website. This report presents the results of statewide monitoring conducted from 2012 through 2014.

An additional requirement for CWA Section 106 is the submittal of DEP’s monitoring strategy, which addresses the suite of monitoring programs in this document, using the EPA March 2003 Elements of a State Water Monitoring and Assessment Program guidance. As part of the report, the *Design Document* for the DEP Watershed Monitoring Program is updated as any changes are made to the design of the monitoring program or strategy.

Chapter 2: Background Information

Overview

Florida's 71,341 square miles (or 45,658,240 acres) support abundant, diverse natural resources (DEP 2011).[1] Some of these resources—such as the Everglades—are found nowhere else. Florida also contains the only coral reef in the continental U.S. The state ranks third in the country in inland water area with almost 40% of its area covered by water; it also has large supplies of fresh water in its underground aquifers. Florida depends on water resources in many ways—for example, for its multibillion-dollar fishing and tourism industries.

The pressures of population growth, its accompanying development, and visits by more than 98 million tourists a year (as of 2014) (Visit Florida website 2015) can have impacts on the state's freshwater, ground water, and saltwater resources. Although the state ranks 22nd in the country in total area, it currently ranks third in population, and that population continues to grow. Most Floridians live in coastal areas where less fresh water is available, and about three-fourths of new residents choose coastal locations for their new homes. As development continues, different users compete for water resources. Major challenges include maintaining overall water quality and supplies, protecting public health, satisfying competing and rapidly increasing demands for finite quantities of fresh water, minimizing damage to future water reserves, and ensuring healthy populations of fish and wildlife.

Despite the fact that water is plentiful in many areas, water quantity and quality are critical issues. In 1950, Florida's population of 2.8 million used about 1.5 billion gallons per day (bgd) of fresh ground water and surface water. In 2005, that number had risen to 6.9 bgd (62% ground water; 38% surface water) (Marella 2009), and consumption is projected to rise to 9.3 bgd by 2020 (Morris and Morris 2009). Surface water and ground water quality has been impacted by industrial, residential, and agricultural land uses in areas throughout the state. While many point sources of pollution such as sewage treatment plant discharges have been eliminated, addressing pollutant loading from widespread, diffuse nonpoint sources such as urban development and agriculture remains a challenge.

This chapter provides background information about Florida's population, water resources, climate, and physical features. **Table 2.1** summarizes basic information on the state and its surface water resources.

---

[1] The U.S. Census Bureau uses its TIGER (Topologically Integrated Geographic Encoding and Referencing) files for calculating the area of states/territories seaward to three nautical miles (nm); this does not include the additional territorial waters out to nine nm for Texas, Puerto Rico, or Gulf Coastal Florida. When that area is included, Florida's total area of sovereignty increases to approximately 71,341 square miles.

Table 2.1. Florida atlas

[a] U.S. Census Bureau. Accessed July 30, 2015. *State and county quickfacts: Florida.*
[b] Division of State Lands, Bureau of Survey and Mapping. 2011. Total surface area: Outer boundaries pursuant to the Submerged Land Act, Code, 43 U.S. Code (U.S.C.) 1301-1315 and U.S. vs. Florida, U.S. Supreme Court, 425 US 791, 48 L Ed 2d 388, 96 S Ct 1840, and based on Geographic Information System (GIS) data provided by the Florida Fish and Wildlife Conservation Commission Fish and Wildlife Research Institute (FWC–FWRI) and federal Mineral Management Services (MMS) (renamed the Bureau of Ocean Energy Management, Regulation, and Enforcement [BOEMRE] in 2010). State boundaries between Florida, Georgia, and Alabama determined from the U.S. Census Bureau's TIGER files.
[c] Shafer, M.D., R.E. Dickinson, J.P. Heaney, and W.C. Huber. 1986. *Gazetteer of Florida Lakes.* Publication No. 96. Water Research Program Engineering and Industrial Experiment Station. Gainesville, FL: University of Florida and U.S. Geological Survey (USGS).
[d] Governor's Office. October 22, 2014. *Florida's Award-Winning State Parks and Trails Continue Record-Breaking Success.* News Release. Tallahassee, FL.

Statistic	Number
2014 estimated population (U.S. Census Bureau)[a]	**19,893,297 people**
Ranking by population among 50 states	3rd largest
% change, 2010–12	+ 2.7%
Total surface area (as of 2011)[b]	**45,658,240 acres**
Total water area (as of 2011)	**11,434,880 acres**
Number of counties	**67**
Number of USGS hydrologic units (*i.e.*, watersheds with hydrologic unit codes [HUCs])	**52**
Total number of rivers and streams	**More than 1,700**
Total number of river and stream miles	**27,561 linear miles**
Total river miles bordering other states	238 miles
Chattahoochee River	*26 miles*
Perdido River	*63 miles*
St. Marys River	*139 miles*
Longest river (entirely in Florida)	**St. Johns River** (273 miles)
Largest discharge	**Apalachicola River** (average flow of 25,374 cubic feet per second [cfs])
Total number of ditch and canal miles	**47,708 linear miles**
Number of lakes, reservoirs, and ponds[c]	**7,748** (area greater than or equal to 10 acres)
Area of lakes, reservoirs, and ponds	1,615,466 acres
Area of largest lake	**Lake Okeechobee** (320,314 acres)
Area of freshwater and tidal wetlands	**11,326,720 acres**
Prominent wetland systems	Everglades and Big Cypress Swamp, Green Swamp, Okefenokee Swamp, Big Bend coastal marshes, St. Johns River marshes
Total coastline (measurement of general outline)	**2,118.73 linear miles**
Total estuarine area	**1,702,023 acres**
Number of known springs	**1,089**
Combined spring outflow	17, 017 cfs
Number of first-magnitude springs (discharge greater than 100 cfs)	33
Number of state parks and state trails (as of 2013)	**171**
Total attendance at state parks and state trails (2013–14)[d]	**27,100,000**

Population

According to the U.S. Census Bureau, Florida's population in 2014 was estimated at 19,893,297 (Census Bureau 2015). From 2010 to 2014, the state's population grew by 3.8% (Bureau of Economic and Business Research 2014a). Florida became the third most populous state in 2014, behind California and Texas (Census Bureau 2014).

Within the next two decades, the state's total population is expected to increase to more than 25 million people (Bureau of Economic and Business Research 2014b). Florida is expected to gain 1.8 million people through international migration between 1995 and 2025, the third largest net gain in the country (Campbell 1997).

As the baby-boom generation (those born between 1946 and 1964) reaches retirement age, the number of residents aged 65 and over will accelerate rapidly in all states. In Florida, the proportion of people over 65 was 17.42% as of 2009, and this number is projected to grow to 19.5% in 2015 (U.S. Environmental Protection Agency [EPA] 2010a).

The state has a number of large, expanding population centers, including southeastern Florida (Dade, Broward, and Palm Beach Counties), Jacksonville, Tampa–St. Petersburg, southwest Florida (from Sarasota to Naples), and Orlando (**Figure 2.1**). In contrast, other relatively large areas of Florida are sparsely populated.

Climate

The state's climate ranges from a transitional zone between temperate and subtropical in the north and northwest, to tropical in the Florida Keys. Summers are long, with periods of very warm, humid air. Maximum temperatures average about 90°F, although temperatures of 100°F or greater can occur in some areas. Winters are generally mild, except when cold fronts move across the state. Frosts and freezes are possible, but typically, temperatures do not remain low during the day, and cold weather usually lasts no more than two or three days at a time.

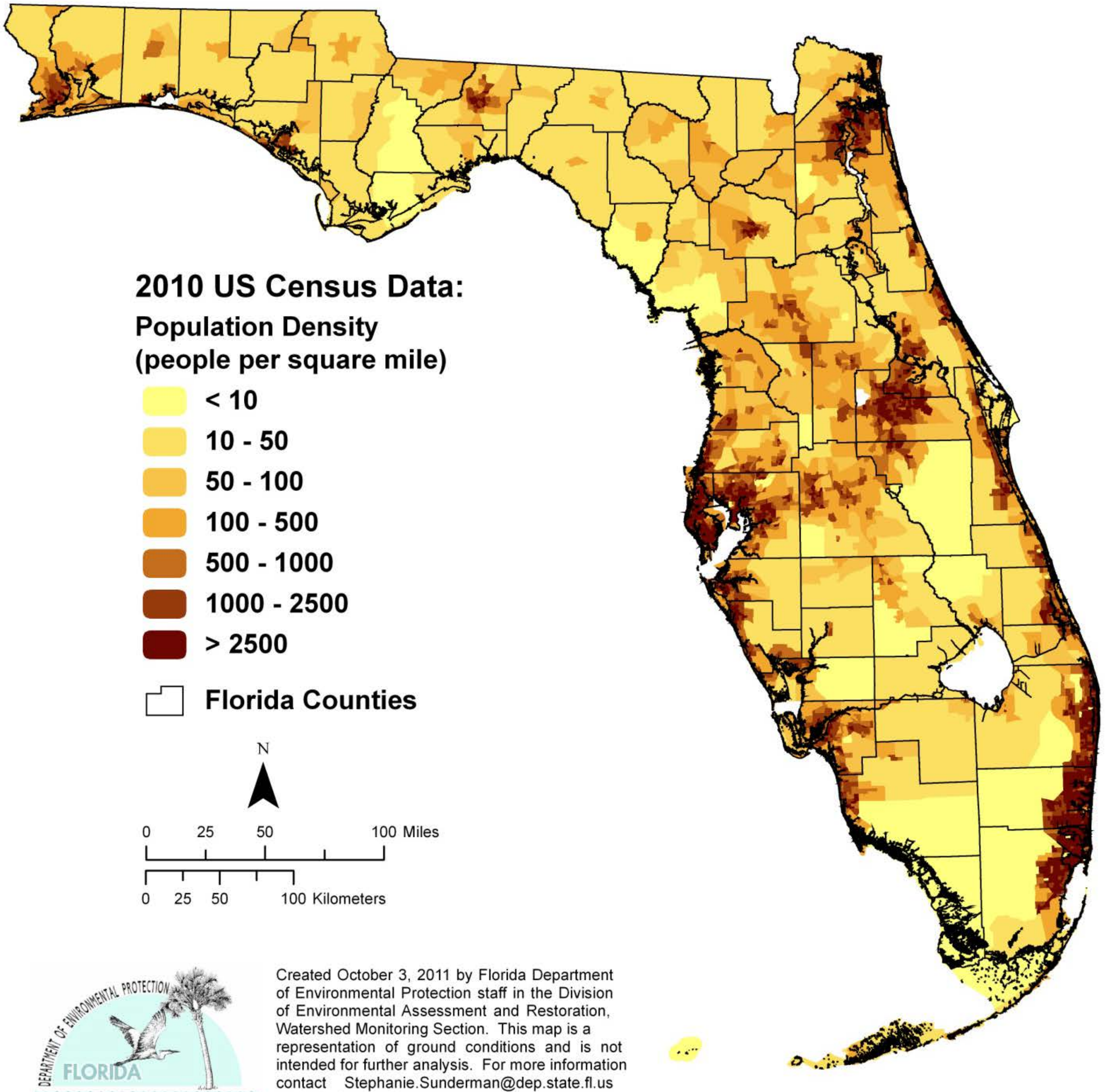
Rainfall across the state varies with location and season. On average, more than 60 inches per year falls in the far northwest and southeast, while the Florida Keys receive about 40 inches annually (**Figure 2.2**). The heaviest rainfall occurs in northwestern Florida and in a strip 10 to 15 miles inland along the southeast coast. Variability in rainfall, both spatially and temporally, can contribute to local water shortages. Historically, Florida has had periods of high rainfall along with periods of low rainfall (*i.e.*, drought). Precipitation data are available from rain gauges across the state for the period of record from 1895 to the present. Based on these data, 2006 and 2007 were the driest back-to-back calendar years Florida has experienced in 60 years (Southeast Regional Climate Center [SERCC] 2014).

Except for the northwestern part of the state, most of Florida has a rainy season and a relatively long dry season. In the peninsula, half of the average annual rainfall usually falls between June and September. In northwestern Florida, a rainy season occurs in late winter to early spring. The lowest rainfall for most of the state occurs in fall (October and November) and spring (April and May). The varying patterns of rainfall create differences in the timing of high and low discharges from surface waters.

An approximate diagonal line drawn from the mouth of the St. Johns River at the Atlantic Ocean to the boundary of Levy and Dixie Counties on the Gulf of Mexico depicts a climatic river basin divide. North and northwest of the divide, streams have high discharges in spring and late winter (March and April) and low discharges in the fall and early winter (October and November). A second low-water period occurs from May to June. South of the climatic divide, high stream discharges occur in September and October, and low discharges occur from May to June (Kelly 2004).

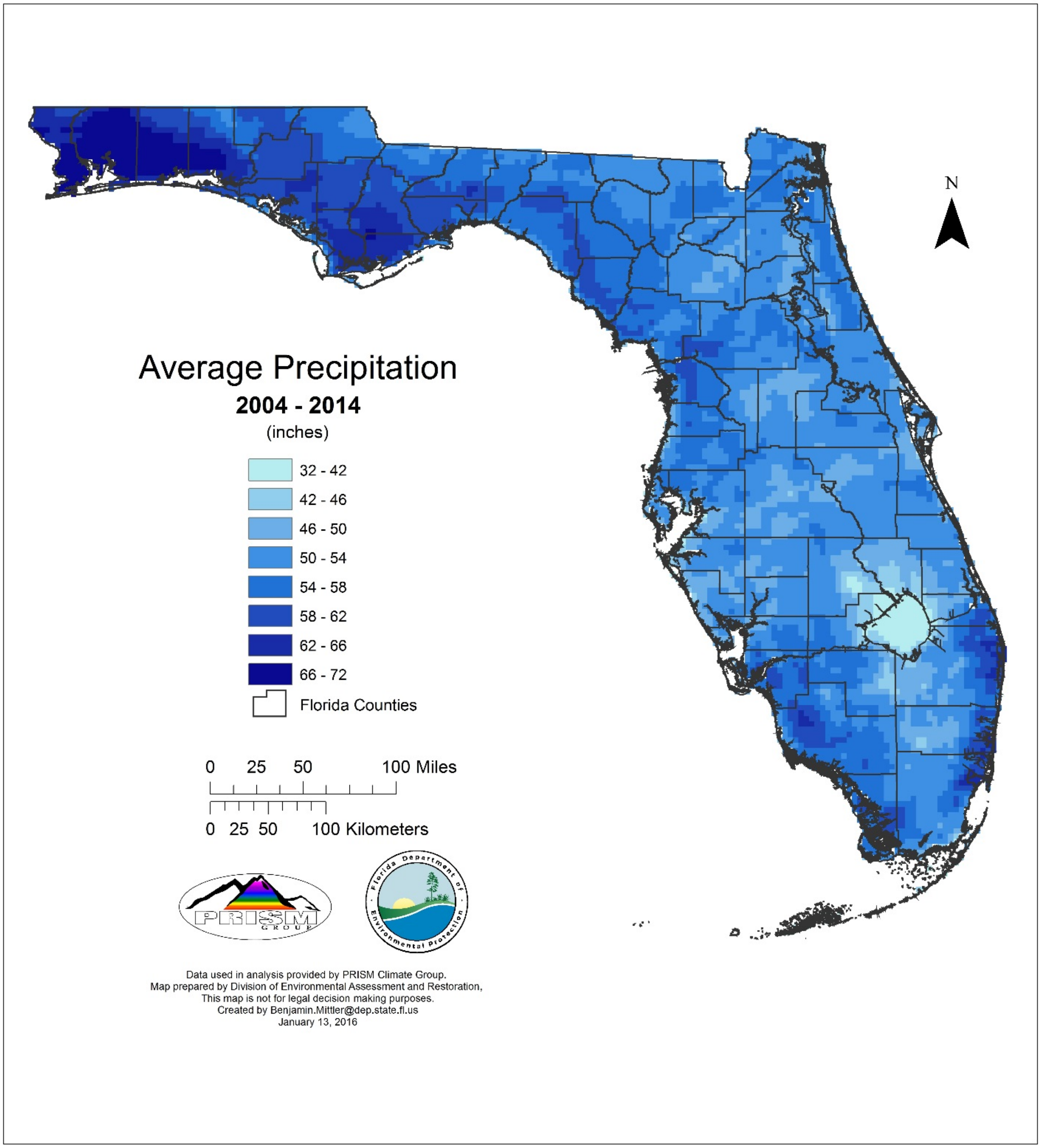
Physical Setting

Most of Florida is relatively flat. At 345 feet, Britton Hill (near Lakewood, in Walton County) has the highest elevation in the state (americasroof.com website 2013). The longest river, the St. Johns on Florida's east coast, only falls about a tenth of a foot per mile from the headwaters to the mouth. Surface drainage and topographic relief are greatest in the streams and rivers entering north and northwest Florida from Alabama and Georgia. As the land flattens farther south, surface drainage becomes less distinct, and the rivers and streams are typically slower moving, and meandering.



Created October 3, 2011 by Florida Department of Environmental Protection staff in the Division of Environmental Assessment and Restoration, Watershed Monitoring Section. This map is a representation of ground conditions and is not intended for further analysis. For more information contact Stephanie.Sunderman@dep.state.fl.us or (850)-245-8433.

Figure 2.1. Florida's population distribution, 2010



Data used in analysis provided by PRISM Climate Group.
Map prepared by Division of Environmental Assessment and Restoration,
This map is not for legal decision making purposes.
Created by Benjamin.Mittler@dep.state.fl.us
January 13, 2016

Figure 2.2. Florida's average annual rainfall, 2004–14

Surface Water and Ground Water Resources

Florida has many types of water sources that have a variety of uses; therefore, the protection of both water quality and quantity is critical to the state's well-being. The state has 27,561 miles of streams and rivers and 47,708 miles of ditches and canals. It has more than 7,700 lakes larger than 10 acres in size, with a total surface area greater than 1,615,466 acres. Florida also has 11,326,720 acres of freshwater and tidal wetlands, as well a coastline ranking second in length only to Alaska with 2,118.73 linear miles. Several sources of high-quality ground water underlie virtually all of Florida. Ninety percent of the state's population relies on these ground water resources for their drinking water. Springs, another ground water resource, are very prominent throughout the state, with a total of 1,089 as the current count.

Streams and Rivers

The state has more than 1,700 streams and rivers. Differences in climate, hydrogeology, and location all affect their water quality. The longest river entirely in the state is the St. Johns, which flows north as a recognizable stream about 273 miles from the St. Johns Marsh in northern St. Lucie County, to its mouth at Jacksonville. The river drains a land area equal to about one-sixth of Florida's surface. The Apalachicola River, in the Florida Panhandle, has the largest discharge flow, averaging more than 25,374 cubic feet per second (cfs) from 1977 to 1992. Its basin, draining about 19,600 square miles in Alabama, Georgia, and Florida, extends to north Georgia's southern Appalachian Mountains (Northwest Florida Water Management District [NWFWMD] 2012). In some parts of Florida, springs give rise to rivers, and ground water baseflow makes up most of these rivers' flow.

The state has several types of natural river systems, including blackwater streams, spring runs, and estuarine or tidal streams, and these systems can be perennial or intermittent. Most of Florida's rivers exhibit characteristics of more than one type of river system, either at different locations along their length or at different times of the year. Furthermore, the links between surface water and ground water can also affect natural systems. For example, the Suwannee River, which originates in the Okefenokee Swamp as a blackwater stream, becomes spring fed south of Ellaville. Springwater and groundwater has become an increasingly important source of flow, but surface drainage remains a critical component of river flow. During periods of high flow, it carries sand and sediments, behaving like a true alluvial stream (sediment carrying). During low flow, however, the river's base flow comes from multiple springs, including several first-magnitude springs (defined as springs that discharge on average at least 100 cfs). These variations in flow affect the downstream stretches of the river and the receiving estuary.

In north and northwest Florida, many rivers are alluvial. The Choctawhatchee, Apalachicola, and Escambia best represent this type of river. Common features include a well-developed floodplain, levees, terraces, oxbows, and remnant channels (sloughs) that parallel the active riverbed. Typically, because flows fluctuate more than with other types of rivers, habitats are more diverse.

Florida contains many blackwater streams and rivers. Blackwater rivers usually have acidic, highly colored, slow-moving waters containing few suspended sediments. These systems typically drain acidic flatwoods or swamps. The upper Suwannee River and north New River are examples of this type of river system.

Many major river systems that originate as springs are found in central and north Florida, the Big Bend area of the Gulf Coast, and the southern portion of the Tallahassee Hills. Chemically, these rivers are clear, alkaline, and well buffered. They have little temperature variation, relatively constant flows, and little sediment. Their clear water encourages the growth of submerged plants that provide habitat for diverse animal species. Many spring-fed rivers flow directly into estuaries, and the constant temperatures offer protection from temperature extremes to a number of species, including estuarine fish such as spotted seatrout and red drum, as well as marine mammals such as manatees.

Major dams have been built on the Apalachicola, Ocklawaha, Ochlockonee, Hillsborough, and Withlacoochee (South) Rivers. The most extreme alterations were damming the Ocklawaha to create the Cross-Florida Barge Canal and channelizing the Kissimmee River. The hydrology of the southern third of Florida's peninsula has been significantly altered, and few naturally flowing streams and rivers remain. Most fresh waterbodies in south Florida are canals.

Several efforts are under way to reverse some of the alterations, thus restoring natural flows and function to waterbodies. Significant work on the Kissimmee River since the 1990s has successfully restored flow in portions of the historical river channel, leading to improved habitat, fisheries, and water quality. Additional information on the ongoing Kissimmee restoration is available on the South Florida Water Management District (SFWMD) Kissimmee River website.

Lakes

Florida's more than 7,700 lakes provide important habitats for plant and animal species and are a valuable recreational resource. The largest, Lake Okeechobee (covering 467,200 acres), is the ninth largest lake in surface area in the U.S. and the second largest freshwater lake wholly within the conterminous U.S. (Fernald and Purdum 1998). Most of the state's lakes are shallow, averaging 7 to 20 feet deep, although many sinkhole lakes and parts of other lakes can be much deeper.

Florida's lakes are physically, chemically, and biologically diverse. Some lakes are spring fed; others are seepage lakes fed by ground water; and still others are drainage lakes fed by surface water sources. Most Florida lakes are seepage lakes—nearly 70% of the lakes in Florida have no surface water streams flowing into or out of them (Palmer 1984). Florida lakes are classified according to pH, color, and the ecoregion of the lake basin. Additional information on Florida lake regions and the ecology of Florida's lakes is available from the Florida LakeWatch website and the EPA Ecoregions of Florida website.

Estuaries and Coastal Waters

With more than 2,000 coastal miles, Florida is second only to Alaska in amount of coastline. Florida's estuaries are some of the nation's most diverse and productive. They include embayments, low- and high-energy tidal salt marshes, lagoons, mangrove swamps, coral reefs, oyster reefs, and tidal segments of river mouths. Florida has more Estuaries of National Significance (Tampa Bay, Sarasota Bay, Charlotte Harbor, and Indian River Lagoon), designated by the EPA, than any other state in the nation.

The Atlantic coast of Florida from the mouth of the St. Marys River to Biscayne Bay is a high-energy shoreline bordered by long stretches of barrier islands, behind which lie highly saline lagoons. This stretch of coast contains only 18 river mouths and inlets. Biscayne Bay spans the transition from high- to low-energy shorelines.

At the southern end of the state lie Florida Bay and the Ten Thousand Islands, both of which are dominated by mangrove islands fronting expansive freshwater marshes on the mainland. Many tidal creeks and natural passes connect the islands and marshes. Historically, the area's fresh water came mainly from sheet flow across the Everglades.

Florida's west coast has low relief, and the continental shelf extends seaward for many miles. Unlike the east coast, numerous rivers, creeks, and springs contribute to estuarine habitats. Generally, the west coast's estuaries are well-mixed systems with broad variations in salinity. They often lie behind barrier islands or at the mouths of rivers that discharge into salt marshes or mangrove-fringed bays. The Big Bend coast from the Anclote Keys north to Apalachee Bay is a predominantly marsh shoreline. While it does not conform to the classical definition of an estuary, its flora and fauna are typically estuarine. Many freshwater rivers and streams that discharge along this coastline are either spring runs or receive significant quantities of spring water. The Florida Panhandle from Apalachee Bay west to Pensacola Bay includes high-energy shoreline, with sandy beaches fronting the Gulf of Mexico.

Major coastal and estuarine habitats vary from northern to southern Florida. Salt marshes dominate from Apalachicola Bay to Tampa Bay and from the Indian River Lagoon north to the Georgia state line, while there are few salt marshes west of Apalachicola Bay. Mangrove swamps dominate the southwestern Florida coast and are found along the southeastern coast. There are about 6,000 coral reefs between the city of Stuart on the Atlantic Coast south and west to the Dry Tortugas. Seagrasses are most abundant in the Big Bend region, from Tarpon Springs to Charlotte Harbor, and from Florida Bay to Biscayne Bay (Hale *et al.* 2004).

Wetlands

Because of its low elevation and peninsular geography, Florida has many varied types of wetlands, including estuarine *Spartina* and mangrove salt marshes, as well as freshwater sawgrass marshes, cypress swamps, and floodplain marshes. Wetlands comprise almost one-third of the state. The largest and most important are as follows:

- The Everglades and the adjacent Big Cypress Swamp. Including the Water Conservation Areas (diked portions of the original Everglades system) and excluding the developed coastal ridge, this system extends from about 20 miles south of Lake Okeechobee to Florida Bay.

- The Green Swamp in the state’s central plateau.

- The Big Bend coast from the St. Marks River to the (south) Withlacoochee River.

- Vast expanses of Spartina salt marsh between the Nassau and St. Marys Rivers.

- The system of the St. Johns River marshes. Before alteration by humans, all but the northernmost one-fifth of the river basin was an extensive freshwater system of swamps, marshes, and lakes (Kushlan 1990). Even today, half of the length of the St. Johns River is actually marsh, and in many respects it functions like a northern-flowing Everglades.

— The headwaters and floodplains of many river systems throughout the state, especially the Apalachicola, Suwannee, St. Johns, Ocklawaha, Kissimmee, and Peace Rivers.

Many of Florida's rivers have their headwaters in wetlands. In its natural setting, the Green Swamp in central Florida is the headwater for five major river systems: Withlacoochee (South), Ocklawaha, Peace, Kissimmee, and Hillsborough. In north Florida, the Suwannee and St. Marys Rivers originate in the Okefenokee Swamp of southern Georgia. Throughout the state, smaller streams often disappear into wetlands and later re-emerge as channeled flows.

In the past, many wetlands were drained for agriculture and urban development, and numerous rivers were channelized for navigation. The modifications were most intense in south Florida, where, beginning in the 1920s, canals and levees were built to control flooding and to drain wetlands. These modifications resulted in the loss of much of the original Everglades wetlands from Lake Okeechobee south. The Everglades restoration currently under way is intended to improve water quality. There are preliminary successes; however, restoration is a long-term effort involving many agencies working to revitalize the heavily altered system.

Aquifers and Springs

Florida lies atop aquifer systems that provide potable water to most of the state's population. Ground water naturally discharges into streams, lakes, wetlands, coastal waters, and springs. Florida has more than 1,000 known springs (DEP 2014), which discharge an estimated total of about 17,000 cfs; the state also contains 33 of the 78 first-magnitude springs in the U.S. and may contain the largest concentration of freshwater springs on Earth. Several river systems in the state originate as or are largely supported by spring discharges.

Archaeological evidence indicates that humans have been attracted to Florida's life-giving springs for thousands of years. Florida's springs continue to attract millions of visitors each year at the fourteen Florida state parks that surround springs attract millions of visitors each year, in addition to private spring attractions and parks are a multimillion-dollar tourist industry.

Hydrogeology

Ground Water

Florida is in the Coastal Plain physiographic province, which is blanketed by surficial sands and underlain by a thick sequence of bedded limestone and dolomite. Together the surficial sands, limestone, and dolomites form enormous reservoirs that provide proportionally larger quantities of ground water than are found in any other state.

These sources of high-quality, potable ground water underlying virtually all of Florida supply more than 90% of the drinking water for almost 20 million residents (Census Bureau 2011) and more than 98 million tourists a year (as of 2014) (Visit Florida website 2015). In addition, ground water resources supply over 50% of all water needs, including agricultural, industrial, mining, and electric power generation.

Florida primarily relies on the following four aquifer (ground water) systems as public supply drinking water sources:

- The Floridan aquifer system, one of the most productive sources of ground water in the U.S., extends beneath all of Florida, southern Georgia, and adjoining parts of Alabama and South Carolina. Many public water systems (PWS)—including those of Jacksonville, Orlando, Clearwater, St. Petersburg, and Tallahassee—tap into the Floridan. It is also a major supplier of water for industrial, irrigation, and rural use.

- Surficial and intermediate aquifers, which are present over much of the state, are used when the deeper aquifers contain nonpotable water or are permeable enough to support intended uses. They are used mainly in rural locations.

- In southeast Florida, the Biscayne aquifer supplies virtually all the water needs for densely populated Dade, Broward, Palm Beach, and Monroe Counties. The EPA has designated the Biscayne aquifer as a sole source drinking water aquifer.

- The sand and gravel aquifer is the major source of water supply in the western part of the Florida Panhandle.

Surface Water–Ground Water Interactions

Florida’s low relief, coupled with its geologic history, has created unique hydrogeologic features. Large areas are characterized by karst topography, which forms when rainfall replenishing the ground water dissolves limestone. Landforms in these areas include streams that disappear underground, springs and seeps where ground water rises to the surface, sinkholes, karst windows and caves. Surface water commonly drains underground and later reappears, sometimes in a completely different surface water basin from where it entered the ground. For example, drainage from a large karst area in Marion County provides water for Silver Springs and Silver River, which discharges to the Ocklawaha River and then to the St. Johns River and the Atlantic Ocean. Karst areas in western Marion County provide water for Rainbow Springs and the Rainbow River, which discharges to the Withlacoochee River (South) and then to the Gulf of Mexico. The entire Suwannee River drainage basin depends on ground water discharge via springs to support base flow to rivers.

Florida's porous and sandy soils, high average rainfall, and shallow water table promote close and extensive interactions between ground water and surface water. By the same mechanisms, surface waters recharge underlying aquifers. The fact that Florida contains more than 1,000 springs is an indication of significant ground water and surface water interchange in the extensive areas of the state dominated by karst terrain. Most lakes and streams receive water from and discharge water to ground water. In general, ground water baseflow can be 40% to 60% of the total stream flow, and in karst areas where springs discharge, it can provide 70% to 80% of the flow to streams.

Although there are many surface water–ground water interactions, a hydrologic divide exists that interrupts the movement of Florida’s water resources. The divide is represented by an approximate line extending from near Cedar Key on the Gulf Coast to New Smyrna Beach on the Atlantic Coast. Except for the St. Johns and Ocklawaha Rivers, little, if any, surface water or ground water flows south across this barrier. Most major rivers north of the line receive part of their discharges from outside Florida, in addition to local (Florida) rain. South of the divide, rainfall is the sole freshwater source. Hydrologically, the half of Florida lying south of the divide is isolated. About 75% of the state’s population lives in this area in peninsular Florida.

Chapter 3: Issues of Environmental Interest and Water Quality Initiatives

This chapter describes some major issues of environmental interest and water quality initiatives being undertaken primarily by DEP.

Algal Growth in Springs

Water quality has declined in most springs since the 1970s; in particular, increased levels of nitrate and blue-green algal growth in springs are widespread. Recognizing the need to assess the status of cyanobacteria not just in springs but all waters, in 1998 the Florida Legislature approved funding for the FWC Harmful Algal Bloom Task Force to address potential concerns regarding algal blooms through monitoring and investigation (see the section on *Implementation of Numeric Nutrient Criteria to Address Nutrient Enrichment* later in this chapter. The state continues to monitor cyanobacteria closely and is taking measures to reduce nutrient loading and improve water quality. The FDOH Aquatic Toxins Program, in coordination with DEP, has developed and implemented several tools to help identify and assess algal blooms. Additionally, DEP's approved nitrate criterion for spring vents (0.35 mg/L) will serve as an appropriate target for restoration efforts to reduce algal growth.

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 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 emerging contaminates. 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 primadone), pain relievers (acetaminophen), and fragrances (tonalide).

The compound sucralose (trade name Splenda) has proven to be 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, is a man-made chemical, has low toxicity, is highly soluble in water, is not effectively metabolized or removed by wastewater treatment processes, persists in the environment with a one- to two-year environmental half-life, and is easily detected at a concentration of 10 nanograms per liter (ng/L). DEP's monitoring of sucralose has helped solve environmental problems such as identifying sites for more intensive study, tracking contaminant migration routes in surface and ground waters, and discerning abatable versus nonabatable sites based on impacts caused by anthropogenic activities.

Many potential tracers commonly found in human wastewater streams—such as chloride/sulfate, conductivity, boron, bromide, caffeine and its metabolites, sulfur hexafluoride (SF_6), fluorescent dyes, optical brighteners (laundry detergents), fragrances (galoxide, tonalide), gadolinium and other medical contrast agents, artificial sweeteners (Splenda, NutraSweet), pain relievers, and other medications or personal care products do not display some of the desirable characteristics. Environmental persistence, a requirement for chemical tracers, can be detrimental to the environment or become less useful over time because of their increasing prevalence. For example, the man-made compound SF6, which is used in the construction of industrial transformers, is a superb gas tracer compound and is useful as a tracer of ground water flow. However, it has an extremely long half-life in the environment (1,000+ years) and is a potent greenhouse gas; thus it must be released into the environment cautiously.

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 a useful tracer 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 amongst sources.

In most cases chemical tracers are used as broad aggregate wastewater indicators rather than as an individual source identification tools. 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.

Florida Water Resources Monitoring Council Projects

To ensure maximum coordination and the efficient use of resources, DEP sponsors and chairs the Florida Water Resources Monitoring Council. The council, a coordinating body of 21 stakeholders, comprises federal, state, local, and volunteer monitoring organizations. It holds quarterly public meetings, both in person and via teleconference, as announced in the *Florida Administrative Weekly*. The current council (restarted in 2011) collaborates to inform, plan, and coordinate Florida water resource monitoring efforts at state, local and federal levels, and is focused on implementing action items in a plan developed in 2009. Subsection 373.026(3), F.S., describes the council's authority for statewide coordination and cooperation.

The council focuses on pertinent, meaningful projects and products to advance high-quality, integrated water resource monitoring in Florida. Currently, the council has three workgroups, as follows:

- The **Catalog Workgroup** is working collaboratively with the University of South Florida's Water Institute on refining and populating the **Catalog of Florida Monitoring Programs** (Water-CAT), which was first released in May 2014. This centralized, searchable website provides the "who, what, when, where, and why" of water resource monitoring conducted in Florida. Created to set the stage for other monitoring council projects, the Water-CAT is critical to many efforts, including improved resource management, data sharing, gap identification, minimizing the duplication of effort, and facilitating adverse event monitoring response. It currently contains metadata on freshwater, marine, ground water, sediment, and biological resource monitoring. Both spatial and tabular interfaces allow searches by organization, station locations, monitoring frequency, time range, sampled parameters, segments with WBID numbers, active versus inactive stations, and other pertinent metadata. The Water-CAT serves as a "first cut" in locating ongoing monitoring efforts for water resource managers, policy makers, and citizens. This web application has proven useful in identifying baseline monitoring points for a stream impacted by a sewage spill, all monitoring locations in feeder streams and canals flowing to the Indian River Lagoon, and organizations collecting water quality data in selected areas of Florida Bay.

- The **Salinity Monitoring Network (SNW)** is a network of existing monitoring networks covering the entire state. Although it emphasizes ground water it also works closely with surface water monitoring programs. Member organizations of the SNW include DEP, the WMDs, the USGS, and several counties. The SNW goal is to provide scientifically defensible data and information on the chemical, physical, and biological characteristics of water. The public, state policymakers, and the scientific community can use this information to better understand the status and trends regarding the encroachment of saline water into Florida’s freshwater resources. Such encroachment can adversely affect drinking water supplies, agricultural production, and industry as well as surface water environments.

    - The SNW completed its first project, a pilot study for the development of a composite statewide map for the upper Floridan aquifer that displays ground water levels, represented in terms of percentile rankings for spring 2010. The SNW is slated to produce annual May and September maps of the percentile rankings of ground water levels; the maps are easily understood by scientists, water managers, and the public.

    - The second SNW project is the development of a Coastal Salinity Monitoring Network (CSMN) to evaluate changing conditions along Florida’s coast with respect to salinity indicators; it connects existing monitoring programs in a "rind around the state." Delineations are based on DEP-generated data and show areas in the state with the highest concentrations of chloride, sulfate, total dissolved solids, and specific conductance. This delineation serves as a template so that other SNW members can submit data on wells from the same areas.

- The council's original Coastal Monitoring Workgroup spearheaded the Adverse Events Response Plan to facilitate monitoring coordination in response to events that cross different environmental agency jurisdictions. The council identified the need as "lessons learned" from long-term monitoring crises, such as the 2010 Deepwater Horizon oil spill and the 2013 seagrass, marine mammal, and bird die-off in the Indian River Lagoon. This effort produced a draft response plan, a draft adverse events monitoring call tree, and a searchable map viewer, currently in beta format. Once populated, the map viewer will allow users to conduct a preliminary asset search and obtain information on agency responsibilities, topic experts, equipment, supplies, and contact information for adverse event monitoring needs.

Low-Impact Development (LID) Projects and Practices

DEP is working with the development community and local governments to promote LID and practices such as green roofs, pervious pavements, and stormwater harvesting. During the past year, an excellent demonstration site for LID was completed at the Escambia County One Stop Center, where all development permits are issued. The site includes a traditional and LID parking lot to demonstrate the differences, as well as the largest green roof in Florida.

LID practices such as green roof/cistern systems, pervious pavements, and stormwater harvesting have been extensively monitored. The data obtained from these projects have helped to promote the acceptance of LID practices by the WMDs and local governments. DEP encourages the use of LID practices by local governments as one important step they can take towards the restoration of springs.

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, or to the ingestion of contaminated drinking water, or the consumption of contaminated fish or shellfish. It is also clear that cyanoacteria post a potential rish to aquatic ecosystems when present in large quantities as their decomposition contributes to oxygen depletion, which can lead to an increased mortality rate in local populations due to hypoxia. In addition, some toxins may also 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 tricky. There are currently no federal or state water quality criteria or guidelines for cyanobacteria toxins. Public outreach regarding cyanobacteria blooms is based on minimizing risks—*i.e.*, if the water is green, stay out, keep pets and livestock out, and do not use bloom water to spray irrigate lawns.

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.

Elevated nutrients are thought to be principally responsible for the majority of HABs. Other contributing factors may include warm temperatures, reduced flow, the wind-driven mixing of the water column and sediments, the absence of animals that eat algae, aquatic resource management practices, and previous occurrences of blooms in an area. Freshwater HABs occur more frequently during the warmer months, but they can happen year-round. Warmer weather can bring increased storm activity with the potential to deliver additional nutrients into surface waters through increased stormwater runoff, as well as the resuspension of nutrients from sediments caused by wind-driven mixing and increased flow.

Because most freshwater HABs are ephemeral and unpredictable, the state does not have a long-term freshwater HAB monitoring program that routinely samples set stations. Instead, DEP, the WMDs, FDOH, FWC, and FDACS respond to HABs as soon as they are reported or observed.

Florida state agencies coordinate HAB response in a manner that is complimentary rather than duplicative. Each agency has identified staff to act as HAB contacts and as agency resources on issues related to bloom events. When a bloom event is reported or observed, the cyanobacteria bloom contacts coordinate their response through email, phone calls, 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 kill events but can identify when an algal bloom is suspected to be the cause of the bloom. FDOH's Caspio web tool acts as more of 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 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 receiving notification of a bloom event and when investigating the bloom.

FWC predominantly documents, and when possible, determines the cause(s) of fish and wildlife mortality events. The agency focuses on managing the living resources. In addition to responding to fish and wildlife mortality events, FWC 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 has laboratory staff who can quickly identify the bloom species and determine whether they are potential algal toxin–producing species. Information on species composition, density, and in some cases, the level of toxins being produced, are relayed to other state and federal agencies, local governments, and the public. Waters with reoccurring or persistent HAB issues are assessed for nutrient impairment, and those that are deemed impaired are restored through the implementation of TMDLs and BMAPs. DEP focuses on managing the state's aquatic resources.

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* (FWRI Technical Report TR-14), which provides recommendations on the materials needed to develop plans for local public health response to HABs.

Microbial Source Tracking (MST) Implementation

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, *E. coli*, and *Enterococci* are commonly found in the feces of humans and warm-blooded animals, but can also grow freely throughout the environment. Standard microbiological culture-based methods cannot discriminate between enteric (from the gut of a host animal) and environmental bacteria (free-living bacteria 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 helps DEP focus its time and money on solving the right problem more quickly. To do that, DEP has devised a multipronged approach that fully utilizes the latest technologies available. These include the Biology Program’s development of a Molecular Biology Laboratory to run culture-independent genomic DNA-based analyses on water samples as well as 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) based assays for two markers, one for human waste (HF183) and another for shorebirds (GULL2). In addition, the laboratory has recently implemented a method to distinguish between live and dead bacteria in a water sample using the dye propidium monoazide (PMA) with qPCR analysis. DEP will continue to refine new tracer methods and molecular markers such as those for birds, dogs, and cattle in the coming year.

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 ground water. This tool is being used as part of BMAPs designed to restore water quality in impaired springs and spring runs. NSILT is an ArcGIS- 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, estimated using 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 ground water 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

(UFA). NSILT results are used to focus efforts on projects designed to reduce nitrogen loads to ground water in BMAP areas.

Numeric Nutrient Criteria (NNC) Implementation to Address Nutrient Enrichment

Significant progress has been made in reducing nutrient loads to state waters (see **Chapter 7**, which summarizes TMDL and BMAP activities that address nutrient loading to impaired waters and describes the permitting programs that have reduced nutrient loading from point sources and from new development). Efforts are under way to reduce nutrient loading from nonpoint sources to ground water. 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 ground water 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 (TAC) 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 the EPA signed a settlement agreement that included a detailed schedule for the EPA to promulgate nutrient criteria. DEP provided its data to the EPA, which promulgated criteria in November 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. In October 2013, the EPA approved additional NNC provisions, which included NNC for the remaining estuaries and coastal waters and incorporation by reference of a document entitled *Implementation of Florida's Numeric Nutrient Standards* (or Implementation Document), into Chapter 62-302, 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 scenarios for how the criteria will be implemented in the 303(d) assessment process; and a description of how the water quality–based effluent limitation (WQBEL) process is used to implement the nutrient standards in wastewater permitting. Finally, because of the complexity associated with assessing nutrient enrichment effects in streams, a summary of the evaluation involving flora, fauna, and nutrient thresholds is provided.

Because the floral community is an important component of nutrient assessment in streams, the Implementation Document uses several floral metrics and tools to assess stream health, including the following:

- Linear Vegetation Survey (LVS), including the calculation of a coefficient of conservatism and consideration of invasive exotics.
- Rapid Periphyton Survey (RPS), which considers the thickness and extent of periphyton as well as autecology (interpreting species information).
- Water column chlorophyll *a*.
- Habitat Assessment (HA) as ancillary data, such as substrate type, availability, and mapping.

The floral metrics, which were derived from the same minimally disturbed stream data used for the TP and TN thresholds, are useful in representing the range of potential floral responses to nutrients and were instrumental in developing the nutrient enrichment conceptual model. DEP and stakeholders routinely use floral metrics and tools. These comprise the best rapid assessment tools currently available for the state.

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 that are 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.

Until a demonstration is made that a waterbody segment meets the definition in Paragraph 62-302.200(36)(a) or (b), F.A.C., the generally applicable numeric nutrient standards for streams will be used as DEP implements its programs. A waterbody will be considered nonperennial if biological indicators, such as vascular plants and benthic macroinverterbates, show that dessication results in the dominance of taxa more typically found in wetland or terrestrial conditions. Similarly, a waterbody will be considered tidally influenced if chloride or specific conductance data collected during typical hydrologic conditions, along with tide and flow data temporally coupled with water quality sampling events, demonstrate changing salinity conditions.

For potential ditches, canals, and other conveyances, information must be provided that the conveyance is primarily used for water management purposes such as flood protection, stormwater management, irrigation, or water supply. An HA (DEP SOP FT 3000) will be conducted. If the overall score is poor to marginal, the Substrate Diversity and Availability and Artificial Channelization scores are in the poor category, and information is provided demonstrating the conveyance is used for water management purposes, DEP will conclude that the conveyance is predominantly altered and is being maintained in a manner to serve the primary purpose of water management.

While the 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 the EPA to formally withdraw its promulgated NNC for lakes and springs before the criteria could go into effect. The 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.[2]

In November 2014, DEP subsequently adopted by rule estuarine NNC for estuaries that were previously included in an 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, Mosquito Lagoon, several portions of the Intracoastal Waterway [ICWW]). While EPA previously approved the NNC in the August 1, 2013 report, the NNC for some of the estuaries that were

---

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

adopted by rule were revised by DEP during rule development based on additional information, and the EPA is currently reviewing those NNC.

Additional information is available on the DEP NNC Development website.

Pesticide Testing in Surface Waters and Spring Waters

The third year of surface water monitoring for pesticides continued in 2015 as part of a project jointly implemented by DEP and FDACS. Twenty-three surface waterbodies were selected from a rotating list of those that were impaired for either nutrients or copper. Of the 64 analytes included in the lab testing methods, 42 were not detected in surface water samples. In this program, 13 herbicides, 3 insecticides, 2 insecticide degradates, and 1 herbicide degradate were detected. Where detected, concentrations were all below published ecological levels of concern.

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 can often be found in the environment, albeit at low levels. Insecticides detected included fipronil (in 12% of the samples), imidacloprid (in 70%), malathion (in 49%) and chlorpyrifos (in 56%). Sixteen waterbodies were tested for analytes during the 2015 calendar year.

During the 2014 calendar year, 22 springs were tested for pesticide residues. The laboratory results indicate that 77% of the sampled springs receive water from contributing areas where pesticides are used and are moving into spring waters. Atrazine (or its degradate, atrazine desethyl) was detected in 77% of the springs. None of the pesticides detected exceeded an EPA aquatic benchmark. All pesticides detected were at least 10 times below any aquatic benchmark of concern. Quarterly sampling of these springs for pesticides continued through 2015.

Reduction of Potential Fertilizer Impacts

Another major focus was reducing potential nutrient impacts from the fertilization of urban landscapes. This is being implemented through a DEP partnership with the University of Florida Institute of Food and Agricultural Sciences (UF–IFAS); the Florida-Friendly Landscaping (FFL) Program, which includes Florida Yards and Neighborhoods (FYN), Florida Yards and Neighborhoods Builder/Developer, and the Green Industries BMP Training and Certification Program. Related efforts also include a Florida-Friendly Model Landscape Ordinance and recent changes by FDACS to Florida's fertilizer labeling rules to allow for higher application rates of extended slow-release nitrogen fertilizers, so that the leaching of soluble nitrogen is reduced during the summer rainy season. Changes to the Florida Statutes several years ago also now require the following:

1. All local governments in a watershed with a waterbody that is impaired for nutrients must implement a Florida-friendly fertilizer ordinance.

2. All commercial applicators of fertilizer must be trained through the Green Industries BMP Training Program and receive a limited certification for urban landscape commercial fertilizer application from FDACS. This program requires a photo identification, continuing education units (CEUs), and renewal every four years.

Since 1994, Florida has educated homeowners on FYN (which later became a part of FFL), including BMPs for fertilizer application. In 2009, the Florida Legislature found "that the use of Florida-friendly landscaping and other water use and pollution prevention measures to conserve or protect the state's water resources serves a compelling public interest and that the participation of homeowners' associations and local governments is essential to the state's efforts in water conservation and water quality protection and restoration" (Paragraph 373.185[3][a], F.S.). This finding allowed for the invalidation of both new and existing covenants, restrictions, and ordinances that prohibit homeowners' use of FFL on their property.

The Green Industries BMP Program, a science-based educational program for green industry workers (lawn care and landscape maintenance professionals), teaches environmentally safe landscaping practices that help conserve and protect Florida's ground and surface waters. It was initiated in 2000 by an industry request for DEP BMPs, and was merged with the two FYN Programs in 2008 to form FFL. These programs have produced numerous publications, including the manual *Florida-Friendly Best Management Practices for Protection of Water Resources by the Green Industries*.

In part because of the successes of these programs, in 2009 the Florida Legislature took aim at the overuse and misuse of fertilizer in urban landscapes. The new statute encouraged all county and municipal governments "to adopt and enforce the Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes or an equivalent requirement" and went as far as requiring every "county and municipal government located within the watershed of a water body or water segment that is listed as impaired by nutrients [to] adopt DEP's Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes" (Paragraphs 403.9337[1] and [2], F.S.).

Additionally, the Nonpoint Source Management Program addresses fertilizer application on golf courses in a widely accepted and industry-supported program. The 2007 manual, *BMPs for Enhancement of Environmental Quality on Florida Golf Courses*, reprinted in 2009 and 2012, provides a comprehensive approach to environmental stewardship and pollution prevention at golf courses. The document has received national attention and accolades, and the University of Florida faculty who assisted in its development recently (2015) received a golf industry grant from the Golf Course Superintendents Association of America (GCSAA) to develop a national BMP manual template for the golf industry. In addition to more than 20 years of cooperation in the development of Florida golf course BMP manuals (first published by DEP in 1995), in 2011 the Florida Golf Course Superintendents Association developed a comprehensive training and BMP certification program for Florida superintendents at no cost to the state.

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, which was initiated in the 1940s to provided 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 that were constructed from uplands, wetlands, or existing transverse glades. The current C&SF Project, operated by the SFWMD, includes 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, the water quality and aquatic life in canals 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 are (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 that can be used to guide management decisions. The study includes monthly water quality sampling, quarterly vertical profile sampling and sonde deployments for metered parameters, and quarterly biological sampling. Information about canal maintenance activities, including water-level manipulations and aquatic vegetation removal or herbicide applications, will also be collected so that the influence of routine canal maintenance can be quantitatively assessed.

The study is scheduled to continue through the end of 2016, but preliminary results for the state's east coast canals indicate significant differences among canals with respect to water quality and the aquatic life present. As expected, very few of the canal sites pass 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 the man-made south Florida canals, DEP is working to better define reasonable aquatic life expectations for the canals and develop more appropriate assessment tools. A 2014 update on the study is available online.

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 plans to submit the Triennial Review to the EPA Region 4 in early 2016.

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.
- 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 the EPA 2012 national recreational water quality criteria (Office of Water 820-F-12-058). The national recommendations were reviewed by the Bacteria Technical Advisory Committee (BACTAC), a group of experts in bacteriology that was formed in 2013. BACTAC recommended that DEP adopt the 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.

Increased 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. In Florida, many TMDLs were 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 can help establish more effective restoration plans.

Different models can be used in TMDL development, depending on the complexity of the impaired systems, parameters, and time scale within which the pollutant targets are needed. In most cases, modeling is a resource-intensive task 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, therefore, desirable that, when conducting TMDL modeling, technical expertise, existing models and model required input information and data, and site-specific knowledge of the impaired waters from different entities can be integrated, 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 that conduct modeling on Florida waterways. Historically, modeling efforts by Florida's five WMDs were 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 water quantity management 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 WMD jurisdiction as integrated ecosystems. Protecting the water quality of these priority 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 Indian River Lagoon and Banana River Lagoon; 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 is now coordinating with the 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 15 impaired segments located 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, USGS, counties, and other stakeholders—strive to enhance the joint efforts of modeling to protect and restore precious Florida water resources. Routine communications between DEP and the WMDs have been established via a workgroup, the Florida Water Model Coordination Group, so that information can be streamlined and facilitated. Face-to-face meetings occurred on December 17, 2014, and February 11 and September 15, 2015. In addition, DEP has had email exchanges, teleconferences, and webinars to better identify areas where modeling efforts are overlapping or complementary, prioritize modeling needs, coordinate interagency modeling efforts through establishing formal technical support requests, 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 group. The common goal of DEP and the WMDs is to integrate multiagency financial and intellectual resources to streamline water quality modeling efforts in order to protect precious Florida water resources.

Chapter 4: Overview of Water Protection and Restoration Programs

Maintaining overall water quality and supplies, protecting potable water supplies, satisfying competing and rapidly increasing demands for finite quantities of fresh water, minimizing damage to future water reserves, addressing habitat loss and associated aquatic life use, and ensuring healthy populations of fish and wildlife are major objectives of water resource management and protection. To meet these objectives, many different programs and agencies throughout the state, including DEP, work to address activities and problems that affect surface water and ground water quality and quantity. In cooperation with other agencies and stakeholders, DEP has also initiated a number of programs and activities, which are discussed in this chapter, to expand the scientific understanding of Florida's water resources and improve the protection, management, and restoration of surface water and ground water.

Florida Water Resource Management Programs

In 1967, the Florida Legislature passed the Florida Air and Water Pollution Control Act, Section 403.011 *et seq.*, F.S., and in 1972, recognizing the importance of the state's water resources, passed the Florida Water Resources Act, Section 373.013 *et seq.*, F.S. Many goals and policies in the State Comprehensive Plan, Chapter 187, F.S., also address water resources and natural systems protection.

In addition to having DEP district offices around the state, Florida is unique in that there are also five regional WMDs, broadly established along natural watershed boundaries:

- Northwest Florida.
- St. Johns River.
- Southwest Florida.
- South Florida.
- Suwannee River.

Section 373.026(7), F.S., gives DEP "general supervisory authority" over the districts and the authority to exercise any power authorized to be exercised by the districts. DEP exercises its general supervisory authority through several means, including coordinating water supply planning efforts that extend across district boundaries, assisting the Governor's Office in reviewing district budgets, and providing program, policy, and rule guidance through the Water Resource Implementation Rule (Chapter 62-40, F.A.C.). DEP reviews district rules for consistency with Chapter 373, F.S., and Chapter 62-40, F.A.C. This approach combines state-level oversight with regional decision making. It facilitates appropriate statewide consistency in the application of Florida water law, while maintaining regional flexibility where necessary to accommodate the wide-ranging climatic, geological, and environmental conditions that affect the state's water resources.

The water management activities of DEP and the WMDs are divided into the following four areas of responsibility:

- **Water Supply:** Promoting the availability of sufficient water for all existing and future reasonable and beneficial uses and natural systems.
- **Flood Protection and Floodplain Management:** Preventing or minimizing damage from floods, and protecting and enhancing the natural system values of floodplains.
- **Water Quality Management:** Improving, protecting, and maintaining the quality of surface and ground water.
- **Natural System Management:** Preserving, protecting, and restoring natural systems.

These responsibilities are carried out through a variety of activities, including planning, regulation, watershed management, assessment through the application of water quality standards, the management of nonpoint source pollution, ambient water quality monitoring, ground water protection, educational programs, and land management.

Overview of Surface Water Monitoring Programs

Watershed-Based Monitoring and Reporting

Different types of monitoring, ranging from the general to the specific, are needed to answer questions about water quality at varying scales. Questions may pertain to larger national, statewide, or regional/local conditions; whether trends exist in water quality over time; or whether there are problems in individual surface or ground waters. Other monitoring may include gathering project-specific information to develop standards or to fill data gaps if there is a need to address specific regulatory problems. To that end, DEP has developed diverse monitoring programs to resolve questions in response to these needs.

DEP has embraced a tiered monitoring approach and is reporting the results of statewide ambient monitoring networks (Tier I; **Chapter 5**), strategic monitoring for the verification of impairment and identification of causative pollutants (Tier II; **Chapters 6** and **7**), and specialized, site-specific monitoring (Tier III). Tier I consists of statewide Status Monitoring (probabilistic) and Trend Monitoring Networks, TMDL basin- and waterbody-specific monitoring, and site-specific monitoring for special projects and regulatory needs, such as statewide DO and nutrient criteria monitoring.

The Tier I Status Network used a statewide probabilistic monitoring design to estimate water quality across the entire state during 2010–12, based on a representative subsample of water resource types. These estimates are based on a variety of threshold values, including water quality standards, water quality indices, and other appropriate ecological indicators. The Trend Network uses a fixed station design to examine changes in water quality over time in select river and stream sites throughout the state.

Strategic monitoring (Tier II) includes monitoring designed to address data gaps in order to verify impairment in potentially impaired waterbodies and monitoring in response to citizen concerns and environmental emergencies. Another example, the Springs Monitoring Network, encompasses all of the extensive monitoring activities begun in 1999 to address the needs of Florida freshwater spring systems, a fragile and unique resource type that is at risk.

Tier III monitoring addresses questions that are regulatory in nature or that support specific program needs and quality objectives. Examples include monitoring to determine whether moderating provisions or other alternatives, such as SSAC, should apply to certain waters, monitoring tied to regulatory permits issued by DEP (including fifth-year inspections of wastewater facilities under the National Pollutant Discharge Elimination System [NPDES] Program), intensive surveys for the development of TMDLs, monitoring to evaluate the effectiveness of BMPs, and monitoring to establish or revise state water quality standards.

Each DEP core monitoring programs has a monitoring design, a list of core and supplemental water quality indicators, and specific procedures for quality assurance, data management, data analysis and assessment, reporting, and programmatic evaluation. DEP relies on both chemical and biological sampling in all of its monitoring programs and conducts the bulk of the biological sampling statewide.

The remainder of this chapter contains information about these programs, their objectives, and the results of each of their efforts.

Overview of Surface Water Protection Programs

Water Quality Standards (WQS) Program

Florida's surface water quality standards are described in Chapter 62-302, F.A.C. The components of this system, which are described below, include water quality classifications; water quality criteria; an antidegradation policy; and moderating provisions.

Water Quality Classifications

Florida's WQS Program, the foundation of the state's program of water quality management, designates the "present and future most beneficial uses" of the waters of the state (Subsection 403.061(10), F.S.). Florida's surface water is protected for the following designated use classifications:

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 (e.g., large agricultural lands, located mainly around Lake Okeechobee).**
Class V	**Navigation, utility, and industrial use (Note: There are no state waters currently in this class).**

Class I waters generally have the most stringent water quality criteria and Class V 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. All waters of the state are required to meet the "Minimum Criteria for Surface Waters," as 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. **Chapter 6** discusses the relationship between the state and EPA designated use classifications.

Water Quality Criteria

Water quality criteria, expressed as numeric or narrative limits for specific parameters, describe the water quality necessary to maintain designated uses (such as fishing, swimming, and drinking water) for surface water and ground water. These criteria are presented in Chapter 62-302, F.A.C., and specifically in Rule 62-302.530, F.A.C. Because of the complexity of numeric nutrient standards, separate rules were established for fresh waters (Rule 62-302.531, F.A.C.) and marine waters (Rule 62-302.532, F.A.C.). Additionally, criteria for DO were recently revised and are contained in Rule 62-302.533, F.A.C. Previously, criteria for DO were concentration-based but are now percent saturation-based.

Antidegradation Policy

The Florida Antidegradation Policy (Rules 62-302.300 and 62-4.242, F.A.C.) recognizes that pollution that causes or contributes to new violations of water quality standards or to the continuation of existing violations is harmful to the waters of the state. Under this policy, the permitting of new or previously unpermitted existing discharges is prohibited where the discharge is expected to reduce the quality of a receiving water below the classification established for it. Any lowering of water quality caused by a new or expanded discharge to surface waters must be in the public interest (*i.e.*, the benefits of the discharge to public health, safety, and welfare must outweigh any adverse impacts on fish and wildlife or recreation). Furthermore, the permittee must demonstrate that other disposal alternatives (*e.g.*, reuse) or pollution prevention are not economically and technologically reasonable alternatives to the surface water discharge.

Moderating Provisions

Florida's water quality standards include a variety of moderating provisions (provided in Subsection 62-302.300(10) and Chapter 62-4, F.A.C., and described in Rules 62-302.300, 62-4.244, and 62-4.243, F.A.C., and Sections 403.201 and 373.414, F.S.), which include mixing zones, zones of discharge, exemptions, and variances. These provisions are intended to moderate the applicability of water quality standards where it has been determined that, under certain special circumstances, the social, economic, and environmental costs of such applicability outweigh the benefits.

Watershed Assessment Program

The primary tasks of the Watershed Assessment Program include coordinating strategic monitoring; implementing Florida's IWR (Chapter 62-303, F.A.C.); ensuring the completion of the biannual Integrated Report; and submitting annual updates of Florida's 303(d) list to the EPA. Section 303(d) of the federal CWA requires states to submit to the EPA lists of surface waters that do not meet applicable water quality standards (*i.e.*, their designated uses or water quality criteria) and establish TMDLs for each of these waters on a schedule. Pollution limits are then allocated to each pollutant source in an individual river basin. A waterbody that does not meet its designated use is defined as impaired.

Florida Watershed Restoration Act

The 1999 FWRA (Section 403.067 *et seq*., F.S.) clarified the statutory authority of DEP to establish TMDLs, required the department 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 the department to establish an Allocation Technical Advisory Committee (ATAC) to assure the equitable allocation of load reductions when implementing TMDLs. In 2005, the FWRA was amended to include provisions to allow for the development and implementation of BMAPs to guide TMDL activities; however, BMAPs are not mandatory for the implementation of TMDLs.

Another significant component of the FWRA was the requirement for FDACS and DEP to adopt, by rule, BMPs to reduce urban and agricultural nonpoint sources of pollution. As Florida already has an urban stormwater regulatory program, this new authority was particularly important in strengthening Florida's agricultural nonpoint source management program. This section of the law requires DEP to verify the effectiveness of the BMPs in reducing pollutant loads.

Once FDACS adopts the BMPs, commercial agricultural producers whose land lies within the Northern Everglades or an adopted BMAP can monitor or show their runoff is not causing or contributing to the impairment or they must sign a notice of intent (NOI) to FDACS, specifying the BMPs that will be applied on specific land parcels and the schedule for BMP implementation. With an NOI, the landowners also must maintain records, such as fertilizer use, and allow FDACS staff to inspect the

BMPs. By submitting an NOI, the landowners become eligible for state and federal cost-share funding to implement BMPs and receive a presumption of compliance that they are meeting water quality standards. The BMP rules and the associated BMP manuals that have been adopted are available from the FDACS Office of Agricultural Water Policy (OAWP) website.

The FWRA identifies BMAPs as the primary mechanism for implementing TMDLs to restore water quality. The BMAPs are developed cooperatively with local stakeholders over a 12- to 18-month period following TMDL development. Management strategies developed in each BMAP are implemented in NPDES permits for wastewater facilities, municipal separate storm sewer system (MS4) permits, and local capital improvements and agricultural BMPs.

The 2005 Florida Legislature's amendments to the FWRA focused on the development and adoption of BMAPs as an appropriate method for implementing TMDLs. The Legislature also 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, that level of funding has not been consistently provided. Additionally, the 2005 amendments provide DEP with the ability to take enforcement action against nonpoint sources that do not implement the BMPs they agreed to implement in the BMAP.

Impaired Surface Waters Rule

Waterbodies are assessed and TMDLs are developed and implemented using the methodology in Florida's IWR (Chapter 62-303, F.A.C.). This science-based methodology for evaluating water quality data in order to identify impaired waters establishes specific criteria for impairment based on chemical parameters, the interpretation of the narrative nutrient criterion, biological impairment, fish consumption advisories, and ecological impairment. The IWR also establishes thresholds for data sufficiency and data quality, including the minimum sample size required and the number of exceedances of the applicable water quality standard for a given sample size that identify a waterbody as impaired. The number of exceedances is based on a statistical approach designed to provide greater confidence that the outcome of the water quality assessment is correct. The IWR directs DEP to prioritize TMDL development and implementation where the impairment poses a threat to public water supplies, poses a threat to human health, or contributes to the decline of threatened or endangered species.

The 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.

Watershed management is a comprehensive approach to managing water resources on the basis of hydrologic units—which are natural boundaries such as river basins—rather than arbitrary political or regulatory boundaries. Each basin is assessed as an entire functioning system, and aquatic resources are evaluated from a basinwide perspective that considers the cumulative effects of human activities. From that framework, individual causes of pollution are addressed.

Florida's watershed management approach provides a mechanism to focus resources on specific units (river or estuary basins), rather than trying to work on all state waters at one time. An important feature is the involvement of all the stakeholders with an interest in an individual basin (including federal, state, regional, tribal, and local governments and individual citizens) in a cooperative effort to define, prioritize, and resolve water quality problems. Many existing programs are coordinated to manage basin resources and to reduce the duplication of effort.

The watershed management approach is not new, nor does it compete with or replace existing programs. Rather than relying on single solutions to water resource issues, it is intended to improve the health of surface and ground water resources by strengthening coordination among such activities as monitoring, stormwater management, wastewater treatment, wetland restoration, agricultural BMPs, land acquisition, and public involvement.

Florida's watershed management approach involves a multiple-phase, five-year, rotating basin cycle. During Phase 1, a monitoring plan is prepared in a collaborative process with stakeholders. During this phase, DEP seeks to determine when and where additional monitoring is needed to assess waters that are potentially impaired. This effort culminates in the preparation of a Strategic Monitoring Plan that is implemented the following year, during Phase 2 of the cycle.

The key product of Phase 2 is the Verified List of impaired waters. These lists are developed through applying the Florida Surface Water Quality Standards in Chapter 62-302, F.A.C., as well as the methodologies provided in Chapter 62-303, F.A.C. Generally draft lists are provided to stakeholders for comment. Lists are finalized based on public comment and any additional information received throughout the process.

During Phase 3 of the cycle, TMDL development occurs for impaired waters and the preliminary allocations to point and nonpoint sources are assigned. In developing and implementing TMDLs for a specific waterbody, DEP may develop a BMAP that addresses some or all of the watersheds and basins that flow into the impaired waterbody. The BMAPs are a discretionary, proactive tool that appropriately integrates the management strategies available to the state through the existing water quality protection programs in order to achieve the reduction goals of the TMDLs. Depending on the circumstance, a Basin Working Group may be formed during this phase of the cycle 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 TMDL. Other options include stakeholder led restoration activities or plans that would not be a BMAP that is adopted by the department Secretary.

DEP's mechanism for prioritizing its TMDL development schedule was to use a recovery potential screening approach to choose impaired waters where site-specific TMDLs are most appropriate and most likely to succeed. This type of approach can be applied at different scales, ranging from waterbody segments to entire watersheds; recognizes that it is not possible to work on every impaired waterbody at once; and is used to help agencies identify waterbodies on which to focus their recovery strategies by measuring several important indicators. DEP considers factors (indicators) at the scale of the eight-digit HUC basins. The selected factors include stressor indicators (number of impairments, aquifer recharge area), social indicators (Outstanding Florida Waters [OFWs], BMAP and RA plan areas, environmental justice), and ecological indicators (wildlife index, percent anthropogenic land use). These indicators reflect EPA national and regional priorities by focusing on nutrient impairments and environmental justice areas (see **Chapter 8** for more details on the TMDL Program).

Work under the prioritized plan began in October 2015. Public engagement continues to be an important component of the process. The material was presented at a series of workshops held in August and September 2015 and discussions with affected stakeholders occur as needed. Input from the public has helped refine the one-year and two-year TMDL development plans that have been submitted to EPA.

Flexibility is inherent in the priority schedule that currently goes out to 2022 with some "check-in" periods during which future public comments, new sampling data, new assessment information, and new verified impairments can be incorporated. The first check-in will involve catching up on straggling TMDLs and re-prioritizing the overall plan. In the second check-in period, DEP will finalize all remaining TMDLs and re-prioritize to develop the next long term plan under the 303(d) vision.

To date, DEP has adopted a total of 392 TMDLs. Of these, 207 were developed for DO, nutrients, and/or un-ionized ammonia, 179 were developed for bacteria, and five are for other parameters such as iron, lead, and turbidity. In addition, the state 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). Many more TMDLs have been drafted or are in various stages of development.

During Phase 4 of the cycle, the Basin Working Group and other stakeholders—especially other state agencies, WMDs, and representatives of county and municipal governments, including local elected officials—develop the BMAP. This process may take 12 to 18 months and culminates in the formal adoption of the BMAP by the Secretary of DEP.

The most important component of a BMAP is the list of management strategies to reduce the pollution sources, as these are the steps needed to implement the TMDL. These efforts are usually implemented by local entities, such as wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, and individual property owners. The management strategies may improve treatment of pollution (*e.g.*, wastewater treatment facilities upgrades or retrofitting an urban area to enhance stormwater treatment) or the activities may improve source control (see **Chapter 9** for more details on the BMAP Program).

Both the BMAP and the Verified List of impaired waters are adopted by Secretarial Order, while all TMDLs are adopted by rule. Like all official agency actions, there are opportunities for public participation throughout the entire process. Public meetings and workshops are held where draft and final materials are presented for input. Additionally, the adoptions are subject to state administrative procedures set forth in Chapter 120, F.S. Once a BMAP, Verified List, or TMDL is adopted, a notice is published in the *Florida Administrative Register (FAR)*, and any affected party has the opportunity to request an administrative hearing to challenge the adoption.

DEP maintains an integrated database of assessment information that reflects whether water quality standards are being attained. The Verified Lists of impaired waters, lists of waters to be delisted, BMAPs, TMDL reports, and other information are available on the DEP Watershed Assessment Program website.

Watershed plans that implement TMDLs are, by definition, BMAPs and must be adopted by the DEP Secretary. There are opportunities, however, to develop plans to address impairments and improve water quality prior to the 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.

Public Participation

The success of Florida's water resource management program, especially its watershed management approach/TMDL Program, depends heavily on input from local stakeholders in each watershed. This process is highly collaborative, and DEP staff closely coordinate and communicate with stakeholders in all phases of the five-year, rotating basin cycle.

DEP works with a variety of stakeholders in developing a draft Verified List of impaired waters for each basin. The draft lists are placed on the DEP Watershed Assessment Program website and are also sent by request to interested parties via mail or email. As part of the review process, public workshops are advertised and held in each basin to help explain the process for developing the Verified Lists, exchange information, and encourage public involvement. The workshops are noticed in the *FAR* and on the website. Stakeholders are given the opportunity to comment on the draft lists in person at public workshops and/or through email and letters. If additional information or data are provided during the public comment period, DEP typically creates a revised draft Verified List for further review and comment before submitting the final proposed list to the Secretary for adoption and then to the EPA.

All public meetings are recorded, and specific comments are noted in written meeting summaries. Significant comments typically receive a written response. All written comments received and DEP's responses are kept in a permanent file maintained by DEP. These are included in an appendix to each water quality assessment report. The reports are available on DEP's Watershed Management website.

Surface Water Improvement and Management Program

In 1987, the Florida Legislature passed the Surface Water Improvement and Management (SWIM) Act (Sections 373.451 through 373.4595, F.S). The act directed the state to develop management and restoration plans for preserving or restoring priority waterbodies. The legislation designated six SWIM waterbodies: Lake Apopka, Tampa Bay, Indian River Lagoon, Biscayne Bay, Lower St. Johns River, and Lake Okeechobee. Currently, 29 waterbodies are on the priority list. Additional information and the list of priority waterbodies are available on the DEP SWIM Program website.

The SWIM Program addresses a waterbody's needs as a system of connected resources, rather than isolated wetlands or waterbodies. Its goals are protecting water quality and natural systems, creating governmental and other partnerships, and managing watersheds. While DEP oversees the program, the WMDs are responsible for its implementation—including developing lists of additional high-priority waterbodies and waterbody plans (outlined under Chapter 62-43, F.A.C.). In a collaborative effort, other federal and state agencies, local governments, and the private sector provide funds or in-kind services. SWIM plans must contain the following:

- A description of the waterbody.
- A list of governmental agencies with jurisdiction.
- A description of land uses.
- A list of point and nonpoint source discharges.
- Restoration strategies.
- Research or feasibility studies needed to support restoration strategies.
- A restoration schedule.
- An estimate of costs.
- Plans for interagency coordination and environmental education.

Pollutant Load Reduction Goals

A pollutant load reduction goal (PLRG) is an estimated reduction in stormwater pollutant loadings needed to preserve or restore designated uses in SWIM waterbodies that receive stormwater. Ultimately, the water quality in a receiving water should meet state water quality standards, and PLRGs provide benchmarks toward which specific strategies can be directed. Interim PLRGs are best-judgment estimates of the pollution reductions from specific corrective actions. Final PLRGs are goals needed to maintain water quality standards.

The Water Resource Implementation Rule (Chapter 62-40, F.A.C.) requires the WMDs to establish PLRGs for SWIM priority waters and other waterbodies, and include them as part of a SWIM plan, other watershed management plan, or districtwide or basin-specific rules.

Point Source Control Program

Florida's well-established wastewater facility regulatory program was revised in 1995 when the EPA authorized DEP to administer a partial NPDES Program, and then expanded again in 2000 when the EPA authorized DEP to administer the NPDES Stormwater Program. While the federal program only regulates discharges to surface waters, the state program issues permits for facilities that discharge to either surface water or ground water. Of about 3,556 wastewater facilities in Florida, approximately 471 are permitted to discharge to state surface waters under individual permits. While an additional 982 facilities discharge to surface waters under general (called generic) permit authorization (and many others discharge stormwater to surface waters under the NPDES Stormwater Program), most wastewater facilities in Florida discharge indirectly to ground water via land application, reuse, or deep well injection.

An important component of the state’s wastewater management is the encouragement and promotion of reuse. Florida leads the nation in reuse. In fact, the current reuse capacity (2014 data) represents about 65% of the total permitted domestic wastewater treatment capacity in Florida.

The six DEP district offices handle most of the permitting process, with the Tallahassee office overseeing the program, conducting rulemaking, providing technical assistance, managing the state and federal wastewater databases that are the repositories of all program data, and coordinating with the EPA. The Tallahassee office also oversees the administrative relief mechanisms for applicants that are allowed under Florida law, as well as permits for steam electric–generating power plants that discharge to waters of the state and the implementation of the pretreatment component of the NPDES Program. Wastewater permits, issued for up to five years, set effluent limits and monitoring requirements to provide reasonable assurance that water quality criteria will be met. A permit may allow a mixing zone when there is enough dilution to ensure that a waterbody's designated use will not be affected. In other special cases, a variance allows certain water quality standards to be exceeded temporarily.

Facilities that cannot comply with new requirements may be issued or reissued a permit containing the effluent limitations to be met and an administrative order setting out the steps required to achieve compliance. This procedure applies only to facilities complying with an existing permit, and is not used in lieu of enforcement when a permittee is out of compliance with an existing permit or operating without a required permit.

All facilities must meet, at a minimum, the appropriate technology-based effluent limitations. In many cases, WQBELs may also be necessary. Two types of WQBELs are used (as defined in Chapter 62-650, F.A.C.). Level I WQBELs are generally based on more simplified evaluations for streams and for permit renewals. To determine Level II WQBELs, which are typically calculated for more complicated situations, a waterbody is generally sampled intensively, and computer models are used to predict its response to a facility's discharge.

Permit Compliance

The primary objective of the DEP Wastewater Program is to protect the quality of Florida's surface water and ground water by ensuring that permitted wastewater facilities meet the conditions of their permits, and to quickly identify unpermitted pollution sources and those facilities that do not meet water quality standards or specific permit conditions. To provide proper oversight of the wastewater facilities in the state, the DEP Water Compliance Assurance Program developed a compliance inspection strategy based on its five-year permitting cycle (permits are issued for five years).

For NPDES-permitted facilities, the goal is to conduct at least an annual compliance evaluation inspection (CEI) and to conduct a performance audit inspection (PAI) immediately following permit renewal. When an NPDES-permitted facility is approximately one year away from submitting a permit renewal application, a much more comprehensive inspection, or fifth-year inspection (FYI), is scheduled. The FYI consists of an overview of the facilities operation but also includes an in-depth sampling plan consisting of a compliance sampling inspection (CSI), toxic sampling inspection (XSI), compliance biomonitoring inspection (CBI), impact bioassessment inspection (IBI), and water quality inspection (WQI). The results of these inspections help to determine if current permit limits are adequate to protect the quality of the receiving waters. Land application facilities are also inspected annually as resources allow; however, they are not sampled as intensely as the surface water dischargers.

District compliance and enforcement staff make every effort to work with permittees to resolve minor problems before beginning a formal enforcement action. During an inspection, it is the inspector's responsibility to determine if a facility is in compliance with its permit limits and compliance schedules. This is accomplished by verifying the accuracy of facility records and reports, plant operation and maintenance requirements, effluent quality data (discharge monitoring reports [DMRs]), and the general reliability of the facility's self-monitoring program.

Enforcement

The DEP Wastewater Program uses the *Office of General Counsel Enforcement Manual* as a guide for developing specific types of enforcement actions such as consent orders and notices of violation (NOVs). However, in order to provide guidance on specific wastewater issues related directly to the Wastewater Program, the Wastewater Program *Enforcement Response Guide* was developed to aid inspectors in determining the proper course for corrective actions. The guide also provides consistency in addressing enforcement actions specifically related to wastewater issues.

When formal enforcement is necessary, staff attempts to negotiate a consent order, which is a type of administrative order in which civil penalties (such as fines) and corrective actions for noncompliance can be assessed. Consent orders also establish step-by-step schedules for complying with permit conditions and Florida law, and set a final compliance date for the facility to return to compliance.

In 2001, the Florida Legislature enacted the Environmental Litigation Reform Act (ELRA) (Section 403.121, F.S.) to provide a fair, consistent, and expedient method for determining appropriate penalty amounts for violations. If a settlement cannot be reached through the consent order process, DEP has the authority to issue an NOV to collect penalties (up to $10,000), as specified in ELRA. The NOV can also be used when only corrective actions are needed and no penalties are being sought. When a serious violation endangers human health or welfare, or the environment, DEP issues a complaint for injunctive relief or takes other legal action, including an immediate final order for corrective action.

Nonpoint Source Management Program

The importance of minimizing nonpoint source pollution, especially from new development, was recognized in Florida in the late 1970s when the state's growth rate increased greatly. Over the past 25 years, Florida has implemented one of the most comprehensive and effective urban and agricultural nonpoint source management programs in the country and has made significant progress towards addressing elevated nutrients.

However, nutrient impairment is still an ongoing challenge, as evidenced by eutrophic conditions in some state surface waters and increased nitrates in ground water. Nutrient impairment because of fertilizer use by the state's agricultural industry, as well as continued population growth, remain a concern. Both of these will continue to increase wastewater and nonpoint source nutrient loads. Discharges from urban stormwater systems, especially those built before the Stormwater Rule was implemented in 1982 (currently Chapter 62-25, F.A.C.; formerly Chapter 17-25, F.A.C.), and septic tanks continue to be a leading source of loading to Florida's surface and ground waters. The cumulative impacts of nonpoint source pollution, also called "pointless personal pollution," continue to be an issue.

It is important to remember that many activities resulting in nonpoint source pollution often are not regulated and that public education, cultural change, and personal stewardship are essential to protecting Florida's water resources. A simple example is controlling pet wastes, which can add nutrients and fecal bacteria to the landscape that are washed off with each rainstorm. Picking up and properly disposing of pet waste is essential to preventing this source of "pointless personal pollution." This was demonstrated in north Florida by the Ochlockonee River Soil and Water Conservation District's very successful Think About Personal Pollution (TAPP) public service ads on pet waste, followed by surveys that documented the successes. These multimedia ads increased awareness of the problem (to over 90% of the population in the Tallahassee area) and increased the percentage of pet owners in the region who pick up their pet waste and dispose of it properly by 30%. In addition, the city of Tallahassee estimated that the load reduction associated with the increased proper disposal of pet waste saved $2.5 million per year in potential capital improvement costs associated with a traditional stormwater retrofitting project.

The comprehensive DEP Nonpoint Source Management Program, in collaboration with the TMDL Program (which is being implemented through the watershed management approach), provides the institutional, technical, and financial framework to address these issues. The program includes a mixture of regulatory, nonregulatory, restoration and financial assistance, and public education components, which are discussed below.

Urban Stormwater Rule

The cornerstone of Florida's urban nonpoint source program is the state's Environmental Resource Permit (ERP) Program. Florida was the first state in the country to establish a statewide stormwater permitting program that requires the treatment of stormwater from all new development. The state's first Stormwater Rule was adopted in 1979, with a more comprehensive rule going into effect in 1982. In

1995, stormwater rules were combined with the Wetland Resource Permitting rules into a comprehensive "one-stop shop" ERP rule in four of the five WMDs.

On July 1, 2007, DEP and the NWFWMD joined the rest of the state with the adoption of their joint ERP Rule (Chapter 62-346, F.A.C.). New developments, except for single-family dwellings, and modifications to existing discharges must obtain stormwater permits. Projects must include a stormwater management system that provides flood control and BMPs such as retention, detention, or wetland filtration to reduce stormwater pollutants. This technology-based Stormwater Rule establishes design criteria for various stormwater treatment BMPs to obtain the minimum level of treatment established in the state's Water Resource Implementation Rule (Chapter 62-40, F.A.C.). Specifically, these BMPs are designed to remove at least 80% of the average annual load of pollutants that would cause or contribute to violations of state water quality standards (Subparagraph 62-40.432[2][a]1., F.A.C.).

For OFWs, sensitive waters (such as shellfish-harvesting areas), and waters that are below standards, BMPs must be designed to remove 95% of the average annual load of pollutants that would cause or contribute to violations of state water quality standards (Subparagraph 62-40.432[2][a]2., F.A.C.). The ERP also provides the mechanism for wetland protection. Today, DEP continues to monitor and evaluate BMPs to be used with its development of the statewide ERP Rule.

Wetlands Protection and Permitting

A second important nonpoint source regulatory program is the state's wetlands protection law and permitting program. This program has been instrumental in minimizing the loss of wetlands, especially isolated wetlands. The section on the *Wetlands Program* at the end of this chapter provides additional details.

Agricultural Nonpoint Source Management

Under the ERP Program, only certain agricultural discharges may be subject to permitting, depending on the rules of the specific WMD. For example, the SFWMD permits new agricultural activities in a manner similar to urban development, while the SJRWMD only requires permits for certain pumped agricultural discharges.

However, as discussed earlier in this chapter (in the section on the Watershed Assessment Program), the FWRA requires FDACS' OAWP to develop and adopt, by rule, BMPs to reduce agricultural nonpoint source pollution. Under the FWRA, Paragraph 403.067(7)(c), F.S., DEP is charged with providing initial verification that the BMPs are reasonably expected to be effective, including monitoring their effectiveness. The BMP rules and the associated BMP manuals that have been adopted are available on the FDACS OAWP website.

This nonregulatory program provides agricultural producers with incentives to implement BMPs. Participation in the program opens the door for state and federal cost-share dollars to implement BMPs, and it provides the landowner with a presumption of compliance that water quality standards are being met. To participate, landowners must submit a NOI to FDACS, specifying the lands to be covered, the BMPs to be implemented, the BMP implementation schedule, and the annual tracking requirements such as fertilizer use. Under the FWRA (Section 403.067, F.S.), agricultural nonpoint sources of pollution are required to submit a NOI to FDACS to implement BMPs when located in specified impaired watersheds, unless they monitor to prove compliance with reductions specified in the BMAP. **Table 4.1** lists the most recent statistics on the number of enrolled acres and NOIs as of early 2016.

Table 4.1. Number of enrolled acres and NOIs as of early 2016

Notes: The statewide Citrus manual was adopted per Chapter 5M-16, F.A.C., in 2012. All Ridge citrus and all new or nonenrolled citrus were required to submit NOIs under the new program; however, some flatwoods operations were allowed to avoid refiling provided they adopted certain requirements of the new manual. The Dairy manual was adopted under Chapter 5M-17, F.A.C., in January 2016, but no NOIs have been submitted yet. A Poultry rule and manual are also expected in 2016.

Program/Manual	Enrolled Acres	Number of NOIs
Citrus – Gulf	77,680.83	77
Citrus – Indian River	139,197.73	326
Citrus – Peace River	120,694.16	443
Citrus -Statewide	293,502.92	2,587
Conservation Plan Rule	33,288.88	13
Container Nurseries	27,758.04	1,151
Lake Okeechobee Protection Program	377,243.84	157
Specialty Fruit & Nut	12,949.58	363
Statewide Cow/Calf	2,348,000.06	1,608
Statewide Equine	5,686.49	97
Statewide Sod	31,555.30	71
Statewide Nurseries	9,264.49	175
Vegetable and Agronomic Crops	1,343,743.50	1,756
Wildlife	1,990.91	2
Total	**4,822,556.73**	**8,826**

Recent Nonpoint Source Management Program Enhancements

Restoring Florida's impaired waters and protecting its pristine waters is a critical part of the state's Nonpoint Source Management Program. The program is responsible for overseeing restoration efforts occurring throughout the state through the distribution of federal and state grants aimed at addressing nonpoint sources. A significant focus of grant funding is retrofitting urban areas to treat urban stormwater runoff. However, funding also goes to agricultural BMP development and implementation, sediment and erosion control, bioassessment of the state's waters, and public outreach and education. Recent and current initiatives include the following:

Carrying Out Stormwater BMP Effectiveness Monitoring

As discussed in the section on *Ongoing and Emerging Issues of Concern*, DEP has undertaken a broad array of projects and policy revisions to better address the impacts of nutrients on Florida's surface and ground water. In cooperation with the WMDs and local governments, DEP has been carrying out stormwater BMP monitoring over the past ten years to increase the effectiveness of Florida's urban stormwater program in reducing pollutant loadings, especially nutrient loadings. A variety of projects have been completed to quantify the benefits and refine the design criteria for both traditional and innovative BMPs. These projects have included the monitoring of traditional BMPs such as wet detention systems, underdrain filtration systems, and dry detention systems. They also include innovative BMPs such as managed aquatic plant systems (MAPS) or floating wetland mats, soil amendments to increase nutrient removal in retention basins, and polyacrylamides (PAM) Floc Logs®.

Promoting LID

DEP is working with the development community and local governments to promote LID and practices such as green roofs, pervious pavements, and stormwater harvesting. During the past year, an excellent demonstration site for LID was completed at the Escambia County One Stop Center, where all development permits are issued. The site includes a traditional and LID parking lot to demonstrate the differences, as well as the largest green roof in Florida.

LID practices such as green roof/cistern systems, pervious pavements, and stormwater harvesting have been extensively monitored. The data obtained from these projects have helped to promote the acceptance of LID practices by the WMDs and local governments. As part of the DEP Springs Initiative, a model LID land development code was developed to make it easier for local governments to revise their land development regulations to allow and even encourage low-impact design.

Reducing Potential Fertilizer Impacts

Another major focus has been reducing potential nutrient impacts from the fertilization of urban landscapes. This is being implemented through the University of Florida Institute of Food and Agricultural Sciences (UF–IFAS) Florida-Friendly Landscaping (FFL) Program (which includes Florida Yards and Neighborhoods), the Green Industries BMP Training and Certification Program, the development of a Florida-Friendly Model Landscape Ordinance, and a change in Florida's fertilizer labeling rules so that only "Florida-friendly fertilizers" with low or no phosphorus and slow-release nitrogen are sold in Florida. Changes to the Florida Statutes in recent years also now require the following:

1. All local governments within a watershed with a waterbody that is impaired for nutrients must implement a Florida-friendly fertilizer ordinance.
2. All commercial applicators of fertilizer must be trained through the Green Industries BMP Training Program and receive, by January 1, 2014, a limited certification for urban landscape commercial fertilizer application.

Since 1994, Florida has educated homeowners on FFL, including BMPs for fertilizer application. In 2009, the Florida Legislature found "that the use of Florida-friendly landscaping and other water use and pollution prevention measures to conserve or protect the state's water resources serves a compelling public interest and that the participation of homeowners' associations and local governments is essential to the state's efforts in water conservation and water quality protection and restoration" (Paragraph 373.185[3][a], F.S.). From the FFL Program grew the Green Industries BMP Program, a science-based educational program for green industry workers (lawn-care and landscape maintenance professionals) to teach environmentally safe landscaping practices that help conserve and protect Florida's ground and surface waters. These programs have produced numerous publications, including the manual *Florida Friendly Best Management Practices for Protection of Water Resources by the Green Industries*.

In part because of the successes of these programs, in 2009 the Florida Legislature took aim at the overuse and misuse of fertilizer in urban landscapes. The new statute encourages all county and municipal governments "to adopt and enforce the Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes or an equivalent requirement" and went as far as requiring every "county and municipal government located within the watershed of a water body or water segment that is listed as impaired by nutrients [to] adopt the department's [DEP] Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes" (Paragraphs 403.9337[1] and [2], F.S.).

Additionally, the Nonpoint Source Management Program addresses fertilizer application at golf courses in a widely accepted and industry-supported program. The 2007 manual, *BMPs for Enhancement of Environmental Quality on Florida Golf Courses*, discusses the approach for environmental stewardship and pollution prevention at golf courses.

Onsite Sewage Treatment and Disposal Systems (OSTDS)

On March 27, 2008, in accordance with the Coastal Zone Management Act, the EPA and NOAA found that "the state of Florida has satisfied all conditions placed on approval of the Florida coastal nonpoint pollution control program…." To date, of the 29 coastal states (excluding territories), Florida is one of 17 states to have a fully approved program.

While FDOH regulates OSTDS in Florida, the DEP Nonpoint Source Management Program provides financial and technical support for OSTDS inventorying, maintenance, educational efforts, and inspection and enforcement. Between federal FY 2004 and FY 2012, DEP dedicated nearly $2.3 million of Section 319(h) grant funds to OSTDS projects.

During the past few years, DEP, in cooperation with Florida State University, has monitored traditional OSTDS and performance-based systems (PBS) to better quantify the nutrient loads discharged to ground water and the performance of these systems in removing nutrients. In addition, DEP contracted with the University of Central Florida on a research project to develop, demonstrate, and quantify the ability of passive nutrient-removing OSTDS. The final report, *Onsite Sewage Treatment and Disposal Systems Evaluation for Nutrient Removal*, was published in April 2011. Two types of passive systems show great potential with an ability to reduce TN to under 10 mg/L: a subsurface flow wetland and a traditional OSTDS with a modified drainfield that includes an aerobic and an anaerobic zone, together with a green sorption media filter.

Public Education and Outreach

Public education is an important component of the Florida Nonpoint Source Management Program. Over the past 20 years, a wide variety of educational materials have been developed and distributed. Nearly all of these materials are now available electronically and can be downloaded from either DEP's website or from the University of Central Florida Stormwater Management Academy website. Recently, a new educational website, WatershedED, was implemented to provide nonpoint source managers even greater accessibility to educational materials to assist them implement and evaluate their programs. Given the state's rapid growth rate, and the number of people arriving from out of state, these materials are important in teaching residents how they contribute to nonpoint source pollution and how they can be part of the solution to "pointless personal pollution."

Nonpoint Source Funding

Water pollution sources are divided into point sources (typically domestic and industrial wastewater discharges) and nonpoint sources (generally related to leaching or runoff associated with rainfall events from various land uses). Funding for nonpoint source initiatives and activities comes from multiple funding sources across the state, including, but not limited to, Section 319(h) grant funding, TMDL Water Quality Restoration Grant funding, State Revolving Fund (SRF) loan funding, springs restoration funding, and legislatively appropriated grant funding for a wide variety of water quality projects and restoration activities.

Section 319(h) Grants

The Nonpoint Source Management Section in the DEP Division of Watershed Restoration Assistance administers grant money it receives from the EPA through Section 319(h) of the federal CWA. These grant funds are used to implement projects or programs that will help to reduce nonpoint sources of pollution. Florida requires all retrofit projects to include at least a 40% nonfederal match. In recent years, DEP has awarded between $4 million and $5 million each year in Section 319(h) funds to local governments and others in Florida to implement projects designed to reduce the impacts of nonpoint source pollution.

Between federal FYs 2005 and 2015, more than $52.1 million in grant funds were spent on restoration projects under the Section 319(h) Program. Funding was also used for demonstration projects (for agricultural and urban BMPs), training opportunities, and educational programs. Between federal FYs 2005 and 2015, nearly $7.3 million went directly to agricultural projects, while nearly $10.5 million went to education and outreach, including the Florida-Friendly Landscaping Program, Green Industries BMP Program, and Septic Tank Program efforts (inventorying, monitoring, sediment/erosion control, and public education and outreach), described above.

TMDL Water Quality Restoration Grants

DEP receives legislative funding for the implementation of projects to reduce urban nonpoint source pollution discharged to impaired waters. These funds are restricted to projects to reduce stormwater pollutant loadings from lands developed without stormwater treatment that discharge to waterbodies on the state's Verified List of impaired waters, waterbodies with a TMDL proposed or adopted by DEP, or waterbodies with a BMAP proposed or adopted by DEP. The funds are used for urban stormwater retrofitting projects undertaken by local governments, the WMDs, or other government entities. Grant funds may not be used to provide stormwater treatment for new development or redevelopment activities.

In 2008, DEP adopted Chapter 62-305, F.A.C. (TMDL Water Quality Restoration Grants), to set forth the procedures for administering these grant funds. All TMDL grant projects require a minimum of 50% matching funds, with at least 25% of the match coming from local government. Projects are evaluated, ranked, and selected for funding three times each year based on the criteria found in the TMDL Water Quality Restoration Grant Rule. The criteria for project evaluation and ranking include the impairment status of the receiving waterbody, the anticipated load reduction of the pollutants of concern, the percentage of local matching funds, the cost-effectiveness of the project in terms of cost per pound of pollutant removed per acre treated, the inclusion of an educational component, and whether the local government sponsor has implemented a dedicated funding source for stormwater management, such as a stormwater utility.

With state funding, DEP has issued $16.1 million in TMDL grants from 2005–15 and over $11 million in contracts for urban BMP research, with the results of these projects being used to improve stormwater design in Florida.

Clean Water State Revolving Fund (CWSRF) Program

The CWSRF Program provides low-interest loans for planning, designing, and building water pollution control activities and facilities. Since the program began in 1989, DEP has made over $4.3 billion in loans to date. The program revolves in perpetuity, using state and federal appropriations, loan repayments, investment earnings, and periodic bond proceeds.

This program evolved from the federal Construction Grants Program as a result of the 1988 amendments to the federal CWA. Between 1958 and 1988, almost $2 billion was disbursed from the Construction Grants Program to help municipalities meet the enforceable requirements of the CWA, particularly applicable NPDES permit requirements. Only a few federal construction grants were awarded after 1988, with the last grant awarded in 1994 to Marathon.

Projects eligible for CWSRF loans include wastewater management facilities, reclaimed wastewater reuse facilities, stormwater management facilities, widely accepted pollution control practices (sometimes called BMPs) associated with agricultural stormwater runoff pollution control activities, brownfields associated with the contamination of ground water or surface water, and estuarine protection activities and facilities.

In 2013, Florida received more than $45 million in CWSRF funds. This was increased to more than $47 million in both 2014 and 2015.

The 2014 federal Water Resources Reform and Development Act (WRRDA) includes amendments to Titles I, II, V and VI of the Federal Water Pollution Control Act (FWPCA) and requires DEP to include Davis-Bacon wage rates and American Iron and Steel provisions in all loan agreements. To offset the additional costs that result from these new requirements, the base financing rate will be reduced by 1% in all construction agreements. Additionally, these amendments require the development and implementation of a fiscal sustainability plan that must be accepted and implemented prior to the final construction loan is disbursed.

Springs Restoration Funding

Since 2013-14, the Florida Legislature has provided money specifically for the restoration of Florida’s world-renowned spring systems. The total amount appropriated between 2013–14 and 2015–16 was just under $80 million. With those funds, DEP has been able to award 65 grants to help underwrite the WMDs and local governments to implement a wide variety of point and especially nonpoint source projects, including urban and agricultural BMPs, wastewater projects to replace septic tank systems, water storage and reuse facilities, and other restoration activities. DEP has been able to leverage the $80 million in legislative appropriations, primarily through WMD and local government matching contributions, into more than $184 million in total project funding.

In the 2016–17 budget, which takes effect July 1, 2016, the Legislature not only appropriated $50 million for springs restoration but, through enabling legislation (House Bill 989), created a dedicated revenue source using documentary stamp funds made available through Florida’s Water and Land Conservation Initiative constitutional amendment ("Amendment 1"), approved by popular vote in November 2014.

Wetlands Program

Wetlands Inventory and Wetlands Protection

This section provides an inventory of the major wetlands and historical coverage of wetlands in the state, discusses the development of wetlands water quality standards, and describes management and protection efforts for wetlands and other surface waters. Florida does not have a program to comprehensively monitor the areal extent (gains or losses of wetland acreage) or health (water quality and functions) of wetlands on a statewide basis. Some monitoring is required in the process of reviewing and granting permits for dredging and filling in wetlands and other surface waters, particularly when the permit authorizes mitigation for work in wetlands or other surface waters, and for activities that discharge wastewater to wetlands.

Historical Wetlands Coverage in Florida

Although information on the historical extent of Florida's wetlands is limited, one researcher estimates that the state lost as much as 46% of its original wetlands between the 1780s and the 1980s. **Table 4.2** lists estimates of Florida's historical wetland acreage at a number of different points in time, beginning in the late 1700s.

Table 4.2. Historical estimates of wetlands in Florida, 1780–1980

Period	Wetlands Acreage	Source
circa 1780	approx. 20,325,013	Dahl 1990
mid-1950s	12,779,000	Hefner 1986
mid-1970s	11,334,000	Hefner 1986
mid-1970s	11,298,600	Frayer and Hefner 1991
1979–80	11,854,822	Tiner 1984
circa 1980	11,038,300	Dahl 1990

What is notable about the estimates above is that the rate of wetland loss has significantly slowed since the mid-1970s, corresponding to when federal and state dredge-and-fill regulatory programs were enacted. There is no single, current, comprehensive way to estimate wetland acreage in Florida. The state developed its own wetland delineation methodology, which has been adopted as Chapter 62-340, F.A.C. This methodology, used by all state and local agencies throughout the state, requires field-based, site-specific determinations on a case-by-case basis—including an assessment of onsite soils, hydrology, and vegetation. As such, wetland estimates using the Florida methodology cannot be determined based on aerial surveys or mapping. The U.S. Fish and Wildlife Service has estimated wetlands coverage nationwide, including Florida, using the National Wetlands Inventory, and many of the estimates in the table are based on that inventory. However, wetlands mapped in the inventory have not been ground-truthed, and maps produced using the inventory do not directly correspond to either the state methodology or the wetland mapping methodology used by the USACOE.

Development of Wetlands Water Quality Standards

Wetlands are considered surface waters of the state. Florida does not have separate water quality standards for wetlands. Water quality standards do not apply to wetlands or other surface waters that are wholly owned by one person other than the state, except for discharges off-site and into ground water.[3] Wetlands in which water quality standards apply are subject to the same water quality standards as other surface waters, including the same five functional classifications described earlier and the state's anti-degradation rules (as set out in Rules 62-302.300 and 62-4.242, F.A.C.). Most wetlands, like most surface waters in Florida, are designated as Class III.

Florida's rules already contain qualitative and quantitative biological criteria—*e.g.*, substances shall not be present in concentrations that will result in a dominance of nuisance species, and there is a maximum allowable degradation of biological integrity. The state has developed procedures for assessing biological communities in streams and lakes; defining relevant ecoregions; identifying relatively pristine reference sites; and developing numeric nutrient criteria (NNC) for Florida lakes, streams, and estuaries. Florida has also developed and implemented one of the toughest standards for phosphate loading in the country (10 parts per billion [ppb] for the Everglades, as adopted in Rule 62-302.540, F.A.C.). Lake Apopka (in central Florida), which has long been degraded by agricultural runoff and wastewater discharges, and its associated wetlands also have a special standard of 55 ppb for TP, as adopted in Paragraph 373.461(3)(a), F.S.[4]

Wetlands Management and Protection

Florida implements an independent state regulatory permitting program that operates *in addition to* the federal dredge-and-fill permitting program. Under the authority of Part IV of Chapter 373, F.S., the state's regulatory permit program, known as the Environmental Resource Permitting (ERP) Program, governs the construction, alteration, operation, maintenance, abandonment, or removal of any surface water management system (including stormwater management systems), dam, impoundment, reservoir, appurtenant work or works, including dredging or filling in wetlands and other surface waters, and for

---

[3] Wetlands owned entirely by one person other than the state are not considered waters of the state; this would include isolated wetlands owned entirely by one permit (Subsection 403.031[13], F.S.).

[4] Also in Section 13.7 of the *Environmental Resource Permit Applicant's Handbook II: For Use within the Geographic Limits of the SJRWMD.*

the maintenance and operation of existing agricultural surface water management systems or the construction of new agricultural surface water management systems dredging and filling. A separate regulatory program under Sections 403.9321 through 403.9333, F.S., governs the trimming and alteration of mangroves, which consist of tropical to subtropical wetland swamp vegetation growing within tidal environments, primarily in south Florida. Where trimming, alteration or other impacts to mangroves occur as a direct result of an activity regulated or exempted under the ERP Program, the ERP rules and statutes govern, in accordance with Section 403.9328(5), F.S.

As discussed below, the Florida ERP Program is a collaboration of DEP, the WMDs, and two delegated local governments. The program was implemented statewide through numerous rules adopted by DEP and each of the WMDs until October 1, 2013. On that date, the program implemented a cohesive, new set of statewide ERP rules for all the agencies. Those include Chapter 62-330, F.A.C., and an *Applicant's Handbook.* Volume I, for use statewide, contains general and environmental criteria; and a separate Volume II for each of the WMDs (NWFWMD, SRWMD, SJRWMD, SWFWMD, and SFWMD) contains specific stormwater and special basin criteria for use in each district. Other Florida rules affecting wetlands regulations include Chapters 62-340, 62-342, and 62-345, F.A.C. The major provisions of the ERP Program are as follows:

— The statewide ERP Program regulates most alterations to the landscape, including all tidal and freshwater wetlands and other surface waters (including isolated wetlands) and uplands. This includes projects such as the construction of single-family residences in wetlands, convenience stores in uplands, dredging and filling for any purpose in wetlands and other surface waters (including maintenance dredging), the construction of roads located in uplands and wetlands, and agricultural alterations that impede or divert the flow of surface waters.

— The statewide ERP review process addresses dredging and filling in wetlands and other surface waters, as well as stormwater runoff quality (i.e., stormwater treatment) and quantity (*i.e.,* stormwater attenuation and flooding of other properties), including that resulting from alterations of uplands. The conditions of issuance of an ERP include reasonable assurance that the project will do the following:

  - Not cause adverse flooding or adverse impacts to water quantities of receiving waters or adjacent lands, surface water storage, or conveyance.
  - Not adversely affect the values of functions provided to fish and wildlife by wetlands and other surface waters.
  - Not adversely affect the quality of receiving waters.
  - Not cause adverse secondary impacts to water resources.
  - Not adversely impact surface or ground water levels or surface water flows, or a Work of the District.
  - Be capable of performing and functioning as proposed and be conducted by an entity with the capability of ensuring that it will be performed in compliance with the permit.
  - Will comply with any applicable special basin criteria.
- Additional requirements for issuing an ERP permit for projects that include dredging, filling, or other work in wetlands or other surface waters include the following:
  - That the activity not be contrary to the public interest, or, if located in an OFW, the activity must be clearly in the public interest.[5] This is determined based on a balancing test of seven factors, as defined in Section 373.414(1), F.S.
  - That the activity not cause unacceptable cumulative impacts.
  - That the activity comply with special criteria if located in certain designated, Class II shellfish waters.
  - That the construction of new vertical seawalls be limited to only certain categories of projects.
- Projects must generally be designed to eliminate and reduce adverse impacts, to the greatest practicable extent. If adverse impacts remain, after such elimination and reduction, applicants may propose mitigation to offset the project impacts. Mitigation is reviewed in accordance with the ERP criteria and the Uniform Mitigation

---

[5] Although this last designation, created in 1989, applies to Everglades and Biscayne National Parks, it has not been confirmed by the Florida Legislature.

Assessment Method under Chapter 62-345, F.A.C. Mitigation for certain projects may also be obtained by purchasing credits from a Mitigation Bank permitted under Chapter 62-342, F.A.C.

— The issuance of an ERP also constitutes a water quality certification or waiver under Section 401 of the CWA, 33 U.S.C. 1341. In addition, the issuance of an ERP in coastal counties constitutes a finding of consistency under the Florida Coastal Management Program under Section 307 (Coastal Zone Management Act). The ERP Program is implemented jointly by DEP, the WMDs, and two delegated local governments (Broward County and the Environmental Protection Commission of Hillsborough County), in accordance with operating agreements that identify the respective divisions of responsibilities. In addition, the WMDs administer permits for surface water and ground water withdrawals (consumptive use permitting) under Part II of Chapter 373, F.S.

Under Sections 373.406 and 403.927, F.S., certain agricultural activities— including agriculture, forestry, floriculture, horticulture, and silviculture—are exempted from the need for an ERP. The review of all agricultural activities, including permitting, compliance, and enforcement, is the responsibility of the Florida WMDs. FDACS, in cooperation with DEP and the WMDs, has developed numerous BMP manuals to help the agricultural community work in a manner that minimizes adverse impacts to wetlands and other surface waters.

Statewide ERP rules contain additional exemptions and general permits that may be applicable to certain agricultural activities such as aquaculture. Certified aquaculture activities that apply appropriate BMPs adopted under Section 597.004, F.S., are exempt from the need for permits under Part IV of Chapter 373, F.S. Compliance, enforcement, and permitting of such aquaculture activities are the responsibility of FDACS. Compliance, enforcement, and permitting of activities that are not certified continue to be the responsibility of DEP.

In addition to the *regulatory* permit programs described above, activities that are located on submerged lands owned by the state (otherwise called sovereign submerged lands) also require a *proprietary* authorization for such use under Chapter 253, F.S., and Chapter 18-21, F.A.C. Such lands are held, in the public trust, by the Governor and Cabinet, as the Board of Trustees of the Internal Improvement Trust Fund. State-owned submerged lands generally extend waterward from the mean high water line (of tidal waters) or the ordinary high water line (of fresh waters) both inland and out to the state's territorial limit (approximately three miles into the Atlantic Ocean, and ten miles into the Gulf of Mexico). Such authorization considers issues such as riparian rights, impacts to submerged land resources, and the preemption of other uses of the water by the public. Authorizations typically are in the form of consents of use, easements, and leases.

This program is implemented jointly by DEP and four of the state's five WMDs, in accordance with the same operating agreement that governs the ERP Program. The program is structured so that applicants who do not qualify at the time of the permit application for both the regulatory permit and the proprietary authorization cannot receive either a permit or an authorization.[6] DEP and the WMDs act as staff to the Board of Trustees and can grant proprietary authorization for delegated activities. Activities that exceed delegation thresholds must be approved directly by the board.

If such lands are located in certain designated Aquatic Preserves, the authorization also must meet the requirements of Chapter 258, F.S., as well as Chapter 18-18, F.A.C. (in the Biscayne Bay Aquatic Preserve) and Chapter 18-20, F.A.C. (in all the other Aquatic Preserves).

Although each DEP and WMD office has its own enforcement officers, the public reports many violations. Public education occurs through several state pamphlets and documents, technical and regulatory workshops, and newspaper coverage.

As discussed above, Florida uses its own methodology (Chapter 62-340, F.A.C.), rather than the federal methodology, to delineate the boundaries of wetlands and other surface waters. This approach, designed specifically for Florida wetland communities, determines the landward extent of wetlands and other surface waters. It applies to both isolated and contiguous wetlands, and must be used by all local, state, and regional governments.

Numerous programs are working to restore both freshwater and estuarine wetlands—most notably the Everglades system. About 57,000 acres of filtration marshes, known as stormwater treatment areas (STAs), have been built to reduce the phosphorus in agricultural runoff entering the Everglades.

Land acquisition is crucial to wetlands preservation. The state has bought thousands of acres of wetlands and other environmentally sensitive lands since the early 1960s that are managed by DEP and the

---

[6] This only applies to individual ERP permits. It does not apply to the use of ERP general permits or verifications of exemptions, for which the regulatory determination is not subject to concurrent proprietary approval.

WMDs. In addition to outright land purchases, the state and WMDs can enter into agreements where the owner retains use of the property with certain restrictions, such as conservation easements, the purchase of development rights, leasebacks, and sale with reserved life estates.

Mitigation, which is often used to offset otherwise unpermittable wetlands impacts, may include the restoration, enhancement, creation, or preservation of wetlands, other surface waters, or uplands. Before 2004, the recommended ranges of ratios for offsetting wetland impacts through mitigation generally ranged from 1.5:1 to 4:1 for created or restored marshes, 2:1 to 5:1 for created or restored swamps, 4:1 to 20:1 for wetlands enhancement, 10:1 to 60:1 for wetlands preservation, and 3:1 to 20:1 for uplands preservation.

In 2007, DEP, in consultation with the WMDs, implemented the statewide Uniform Mitigation Assessment Method (UMAM), under Chapter 62-345, F.A.C. All state, regional, and local agencies in the state use UMAM to determine the amount of mitigation required to offset impacts to wetlands and other surface waters. UMAM is used to determine the amount of functional loss caused by a proposed project and the amount of "lift" needed to offset that loss of function. The current UMAM rules are currently under further development, with the goal of making assessments more consistent and repeatable.

DEP and the WMDs adopted rules governing mitigation banks in 1994 (Chapter 62-342, F.A.C.). A mitigation bank is a large area set aside for enhancement, restoration, and preservation. Mitigation credits are the increase in ecological value from restoring, creating, enhancing, or preserving wetlands. Permit applicants can use mitigation credits to offset damage to wetlands functions. **Table 4.3** lists all open mitigation banks in the state and the agency administering each of them.

Integrity of Wetlands Resources

Table 4.4 shows the acreage of wetlands that have been authorized to be dredged, filled, created, improved, and preserved as a result of ERPs and Wetland Resource Permits (WRPs) issued by DEP and the WMDs as of November 2015.

Table 4.3. Open mitigation banks in Florida as of November 2015

[1] SFWMD = South Florida Water Management District
SJRWMD – St. Johns River Water Management District
SWFWMD = Southwest Florida Water Management District

Bank Name	Administrative Agency[1]	Acres	Potential Credits	Credits Released	Credits Used
Bear Point	DEP	317.00	49.80	49.80	5
Breakfast Point	DEP	4,637.00	1,011.28	194.19	30.58
Corkscrew	DEP	635.00	351.80	155.69	113.06
Devils Swamp	DEP	3,049.20	516.74	208.20	10.36
FMB	DEP	1,582.00	847.50	847.50	815.50
FPL/EMB I	DEP	4,125.00	390.71	390.71	281.57
FPL/EMB II	DEP	9,026.00	1,769.53	547.27	208.77
Garcon	DEP	337.00	172.39	77.40	25.41
Graham	DEP	66.00	32.50	29.25	5.50
Lox	DEP	1,264.00	641.60	470.60	336.50
LPI	DEP	1,264.00	807.00	330.60	236.85
NOKUSE	DEP	2220.00	273.83	27.38	0.00
San Pedro	DEP	6,748.00	1,083.00	388.60	31.30
Sand Hill Lakes	DEP	2,155.00	298.40	178.90	87.36
Wekiva River	DEP	1,643.00	258.24	97.53	28.95
Big Cypress	SFWMD	1,280.00	1,001.78	641.19	246.23
Bluefield	SFWMD	2,695.00	1,244.00	868.00	408.00
Panther	SFWMD	2,788.00	934.64	880.85	851.63
Reedy Creek	SFWMD	2,993.00	627	590.13	416.00
RG Reserve	SFWMD	638.00	32.48	10.00	2.55
Treasure Coast	SFWMD	2,545.14	1,033.43		
Barberville	SJRWMD	366	84.30	58.30	57.42
Blackwater	SJRWMD	347.00	152.13	15.31	2.01
Brick Road	SJRWMD	2945.00	451.41		
CGW	SJRWMD	150.00	66.20	54.60	42.70
Colbert	SJRWMD	2,604.00	718.80	560.30	515.90
East Central	SJRWMD	1,061.00	286.30	286.30	286.04
Farmton	SJRWMD	23,992.00	4,585.00	783.20	720.87
Lake Louisa	SJRWMD	1,007.00	297.90	246.00	245.90
Lake Monroe	SJRWMD	603.00	199.90	130.00	114.58
Loblolly	SJRWMD	6,247.00	2,031.80	1,074.51	1,008.50
Longleaf	SJRWMD	3,021.00	808.30	444.58	169.13
Mary A	SJRWMD	2,069.00	1,252.80	707.29	394.92
NE Florida	SJRWMD	779.00	407.30	393.90	376.98
Port Orange	SJRWMD	5,719.00	1,176.30	237.90	112.10
Sundew	SJRWMD	2,107.00	698.30	192.01	129.85
Thomas Creek	SJRWMD	594.00	72.48	20.91	
TM-Econ	SJRWMD	5,199.00	1,568.60	879.46	538.94
Toso	SJRWMD	1,312.00	185.00	185.00	152.90
Tupelo	SJRWMD	1,524.80	459.70	258.76	209.37
Boran	SWFWMD	237.00	108.59	108.59	100.70
Hammock Lakes	SWFWMD	819.00	58.04		

Bank Name	Administrative Agency[1]	Acres	Potential Credits	Credits Released	Credits Used
Myakka	SWFWMD	380.00	224.60	38.20	12.09
Tampa Bay	SWFWMD	161.200	111.55		
Upper Coastal	SWFWMD	149.00	47.62		
Wetlandsbank	SFWMD	420.00	370.00	367.37	367.37
Split Oak	SFWMD	1,049.00	206.50	88.80	88.80

Table 4.4. Acreage of affected wetlands regulated by DEP and the WMDs as of November 2015

[1] Data do not represent impacts from nonregulated or unpermitted activities.
[2] Wetlands destroyed.
[3] Wetlands created where none existed.
[4] Wetlands with additional protective devices placed on them (*i.e.*, conservation easements).
[5] Poor or lesser quality jurisdictional wetlands enhanced through various activities (*i.e.*, improved hydrology, removal of exotics, re-establishment of native flora).

Agency	Wetlands Acreage Permanently Lost[2]	Wetlands Acreage Created[3]	Wetlands Acreage Preserved[4]	Wetlands Acreage Improved[5]
DEP	23.21	3.14	29.17	21.35
NWFWMD	65.38	1.68	59.30	22.66
SWFWMD	467.25	156.33	2,079.12	188.73
SJRWMD	589.48	139.32	1,584.22	4,979.25
SFWMD	1,199.56	973.05	2,359.38	800.98
SRWMD	89.51	3.11	131.89	10.46
Total[1]	**2,434.39**	**1,276.63**	**6,243.08**	**6,023.43**

Chapter 5: Statewide Probabilistic and Trend Assessments, 2012–14

Background

Initiated in 2000, the DEP 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 and ground water 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 resources and potential changes from anthropogenic or natural influences, including extreme events (*e.g.*, droughts and hurricanes).

Taking guidance from the EPA document, *Recommended Elements of a State Monitoring Program*, a *Design Document for the Status and Trend Monitoring Networks* was developed and is updated annually; this document provides details of both monitoring networks.

Water Resources Monitored

The following resources are monitored by the Status and/or Trend Monitoring Networks. Additional details on each of the resources are provided in the *Design Document*:

- **Ground water (confined and unconfined aquifers):** Ground water includes those portions of Florida's aquifers that have the potential for supplying potable water or affecting the quality of currently potable water. However, this does not include ground water that lies directly within or beneath a permitted facility's zone of discharge (ZOD) and water influenced by deep well injection (Class I and II wells).

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

- **Canals (excluding drainage and irrigation ditches as defined below):** Canals include man-made linear waterbodies that are waters of the state (Chapters 373 and

403, F.S.). The following definitions are provided in Chapter 312.020, F.A.C. 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 dug for the purpose of draining water from the land, or for transporting water for use on the land, and 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.

Neither the Status nor Trend Monitoring Network is currently intended to monitor estuaries, wetlands, or marine waters.

Summary of Status Network Surface Water Results

Introduction

The Status Network uses a probabilistic approach to sample and report on the condition of surface water resources for the entire state. This chapter summarizes the results of the combined assessments for 2012 through 2014. The combination of three years of data allows for regional assessments per monitoring zone (**Appendix A**), in addition to the statewide assessment.

Five surface water resources were assessed: rivers, streams, canals, large lakes, and small lakes. **Table 5.1** 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 the report. From 2012 through 2014, approximately 15 samples were collected annually from each resource in each zone.

Table 5.1. Summary of surface water resources assessed by the Status Network's probabilistic monitoring, 2012–14

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	2,677 miles/4,308.3 kilometers
Streams	16,385 miles/26,369 kilometers
Canals	2,630 miles/4,233 kilometers
Large Lakes	1,702 lakes (1,009,052 acres/408,349 hectares)
Small Lakes	1,891 lakes (28,810 acres/11,659 hectares)

The indicators selected for surface water reporting include fecal coliform, DO, un-ionized ammonia, total nitrogen, and total phosphorous. Chlorophyll a is also included in reporting for rivers, streams, and canals. **Tables 5.2a** through **5.2e** summarize the indicators and their threshold values. Refer to the *Design Document* for 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. The water quality thresholds are derived 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 Ground Water.

It is important to note that the diversity of Florida's aquatic ecosystems also means there is a large natural variation in some water quality parameters. For example, surface waters that are dominated by ground water inflows or flows from wetland areas may naturally have lower DO levels.

Table 5.2a. Nutrient indicators used to assess river, stream, and canal resources

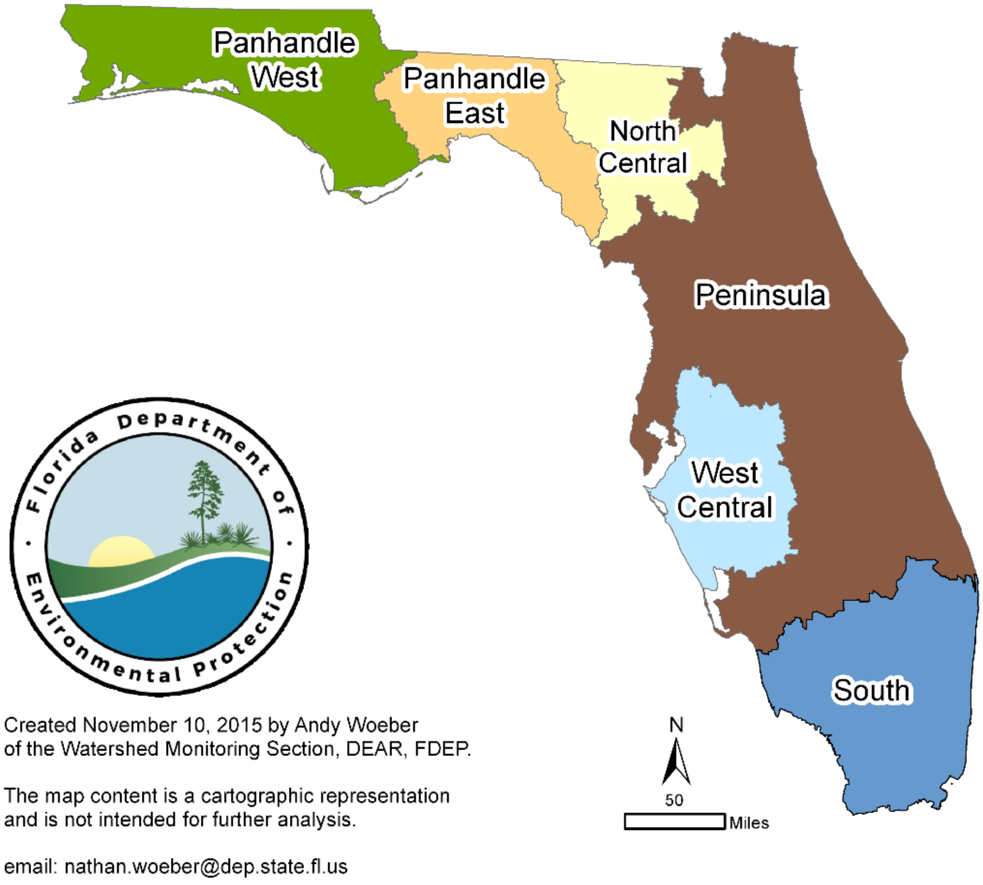
mg/L = Milligrams per liter

[1] Not applied as criteria, but rather as a threshold used to estimate the impairment of 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 Nutrient Region (**Figure 5.1**).

[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



Created November 10, 2015 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

email: nathan.woeber@dep.state.fl.us

Figure 5.1. Nutrient regions for river, stream, and canal resources

Table 5.2b. Nutrient indicators used to assess lake resources

PCU = Platinum cobalt units; $CaCO_3$ = 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 impairment of 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 the verification of impairment, as defined in Rule 62-303, F.A.C.

[2] For lakes with color > 40 PCU in the West Central Nutrient Region (***Figure 5.1***), the TP threshold is 0.49 mg/L, regardless of the chlorophyll concentration.

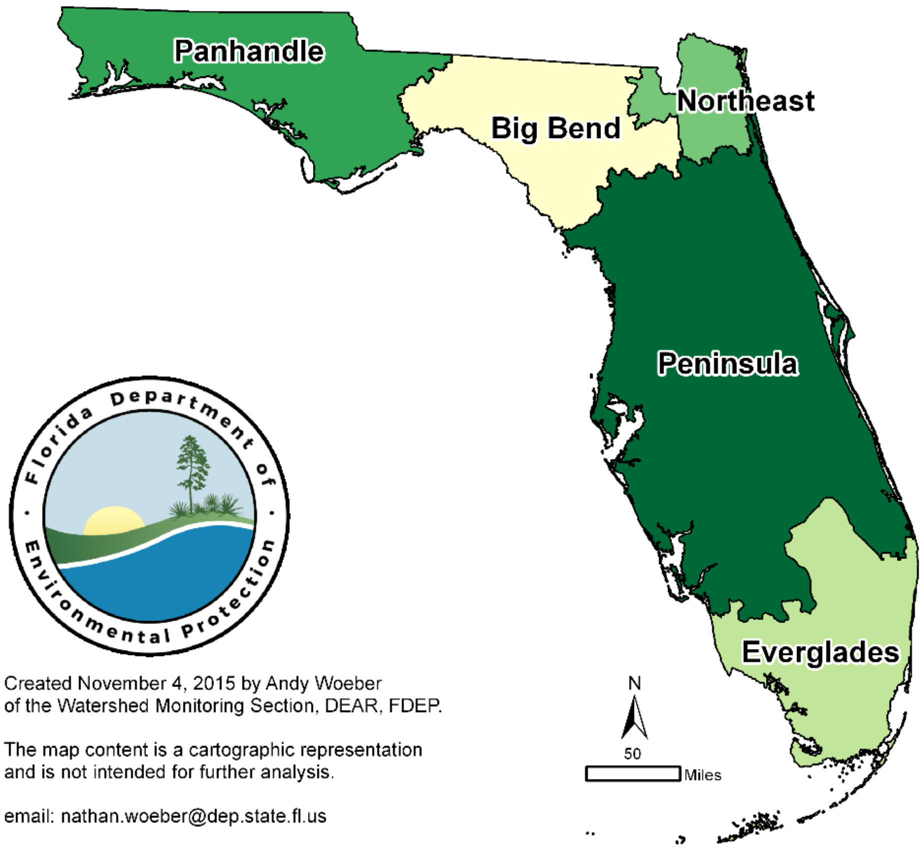
Lake Color and Alkalinity	Chlorophyll *a* Threshold[1] (µg/L)	TP Threshold[1] (mg/L)	TN Threshold[1] (mg/L)	Designated Use
Color > 40 PCU	≤ 20	≤ 0.16[2] if meets Chlorophyll *threshold*; ≤ 0.05[2] if not	≤ 2.23 if meets Chlorophyll *threshold*; ≤ 1.27 if not	Aquatic Life
Color ≤ 40 PCU and Alkalinity > 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 5.2c. DO thresholds used to assess surface water resources

[1] Not applied as criteria, but rather as a threshold used to estimate the impairment of 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 bioregion (**Figure 5.2**). 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



Created November 4, 2015 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

email: nathan.woeber@dep.state.fl.us

Figure 5.2. Bioregions for lake, river, and stream resources

Table 5.2d. Status Network physical/other indicators for aquatic life use with water quality thresholds

[1] Not criteria, but rather a threshold used to estimate the impairment of 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.

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 5.2e. Status Network microbiological indicators for recreational use with water quality thresholds

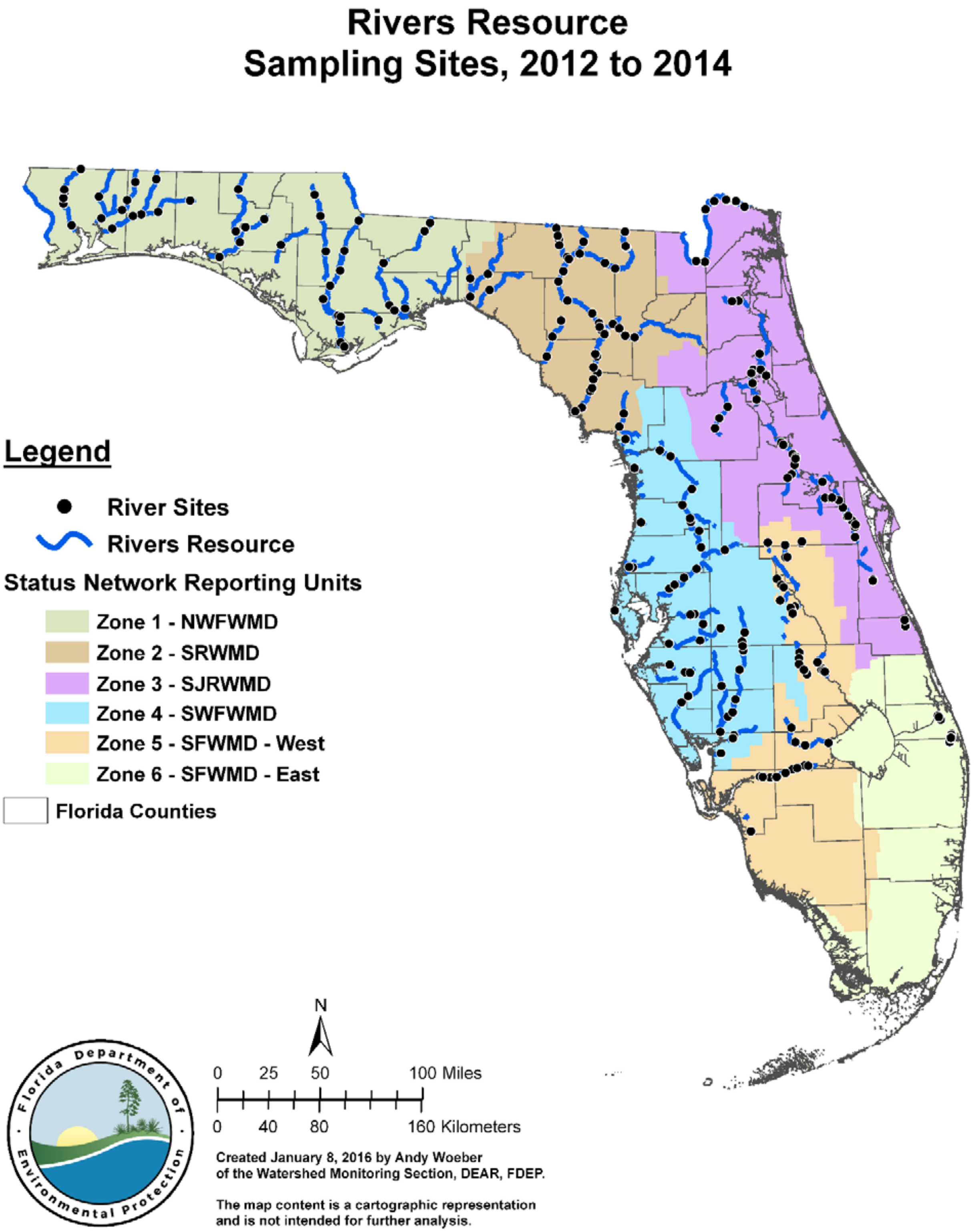
Microbiological Indicator/ Index for Recreational Use (Surface Water)	Threshold
Fecal Coliform Bacteria	< 400 colonies/100mL

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

The following pages present 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 5.3, 5.5, 5.7, 5.9** and **5.11**), a figure with a summary of the statewide results (**Figures 5.4, 5.6, 5.8, 5.10**, and **5.12**), and a table of the statewide results for each indicator for a particular resource (**Tables 5.3b** through **5.3e**). **Table 5.3a** explains the terms used in the statewide summary tables.

Table 5.3a. Explanation of terms used in Tables 5.3b through 5.3e

Term	Explanation
Analyte	Indicators chosen to assess condition of waters of 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 indicator's threshold value.
95% Confidence Bounds (% Meeting Threshold)	Upper and lower bounds for 95% confidence of % meeting specific indicator's threshold value.
% Not Meeting Threshold	% estimate of target population that does not meet specific indicator's threshold value.
Assessment Period	Duration of probabilistic survey sampling event.



Rivers Resource
Sampling Sites, 2012 to 2014

Created January 8, 2016 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.3. Statewide Status Network river sample locations

Table 5.3b. 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	2,677	269	70.6%	75.1-66.2%	29.4%	2012–14
TP	2,677	269	85.5%	88.8-82.2%	14.5%	2012–14
Chlorophyll *a*	2,677	269	91.7%	93.8-89.6%	8.3%	2012–14
Un-Ionized Ammonia	2,677	268	100.0%	100.0%	0.0%	2012–14
Fecal Coliform	2,677	269	95.2%	97.8-92.6%	4.8%	2012–14
DO	2,677	270	95.5%	98.1-92.9%	4.5%	2012–14

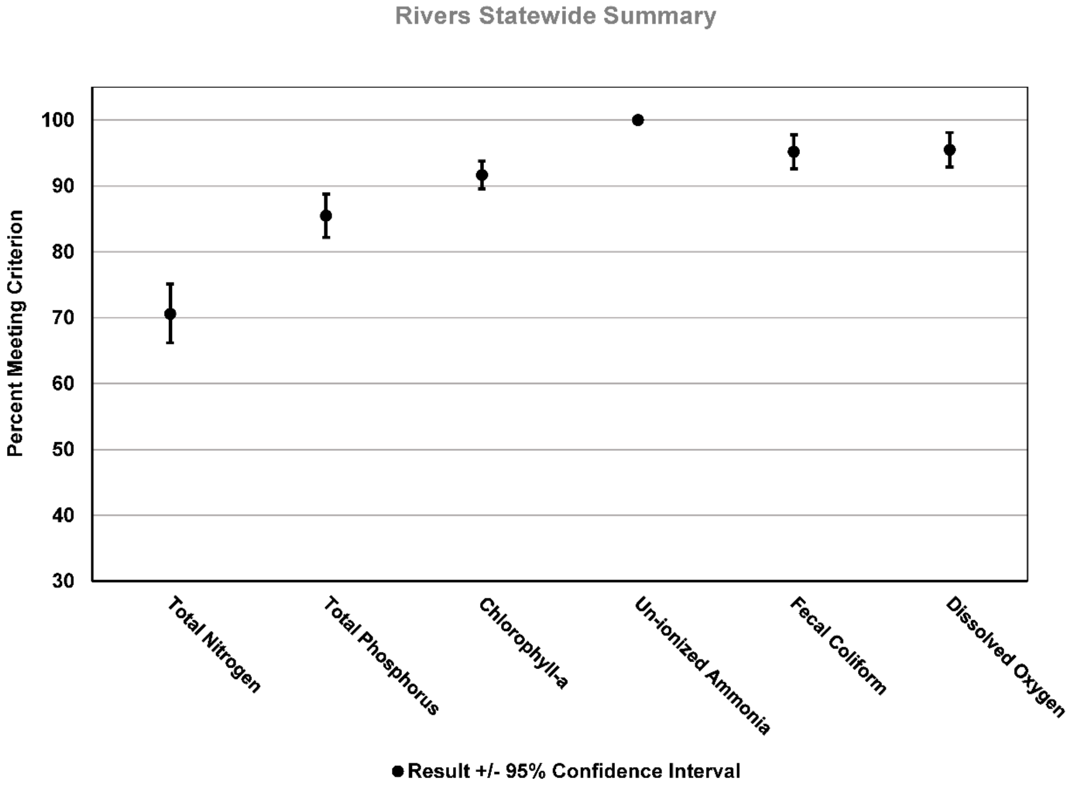
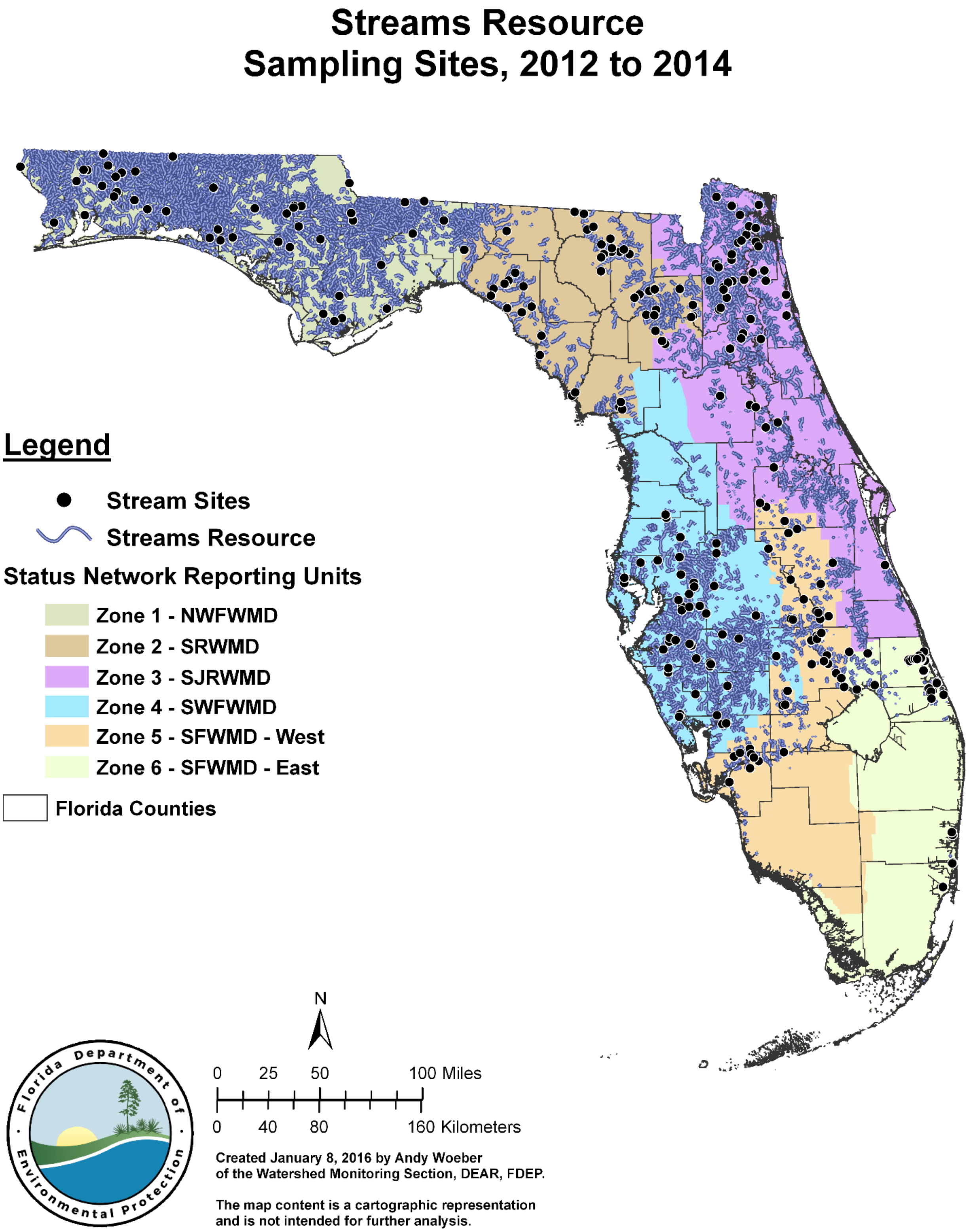


Figure 5.4. Statewide summary of Status Network river results



Streams Resource
Sampling Sites, 2012 to 2014

Created January 8, 2016 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.5. Statewide Status Network stream sample locations

Table 5.3c. 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	16,385	266	67.3%	72.8-61.8%	32.7%	2012–14
TP	16,385	266	74.9%	79.3-70.5%	25.1%	2012–14
Chlorophyll *a*	16,385	271	95.4%	97.8-93.0%	4.6%	2012–14
Un-Ionized Ammonia	16,385	271	100%	100.0%	0.0%	2012–14
Fecal Coliform	16,385	270	78.4%	83.4-73.4%	21.6%	2012–14
DO	16,385	271	77.1%	82.2-72.0%	22.9%	2012–14

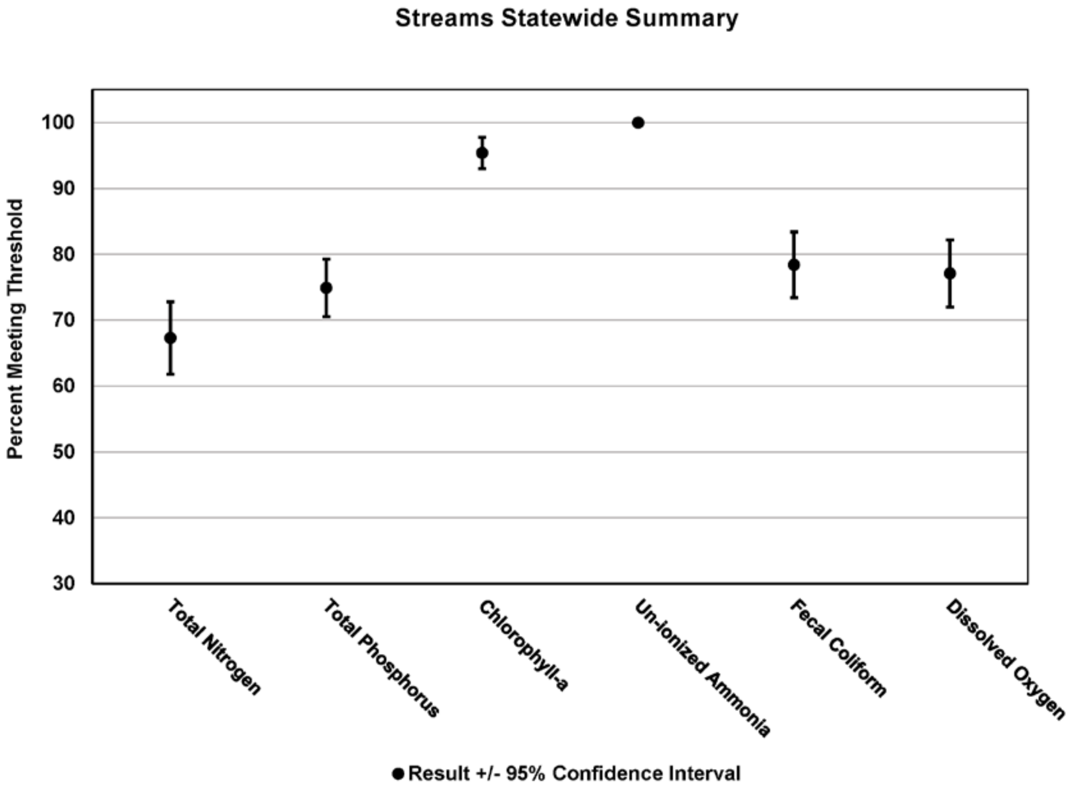
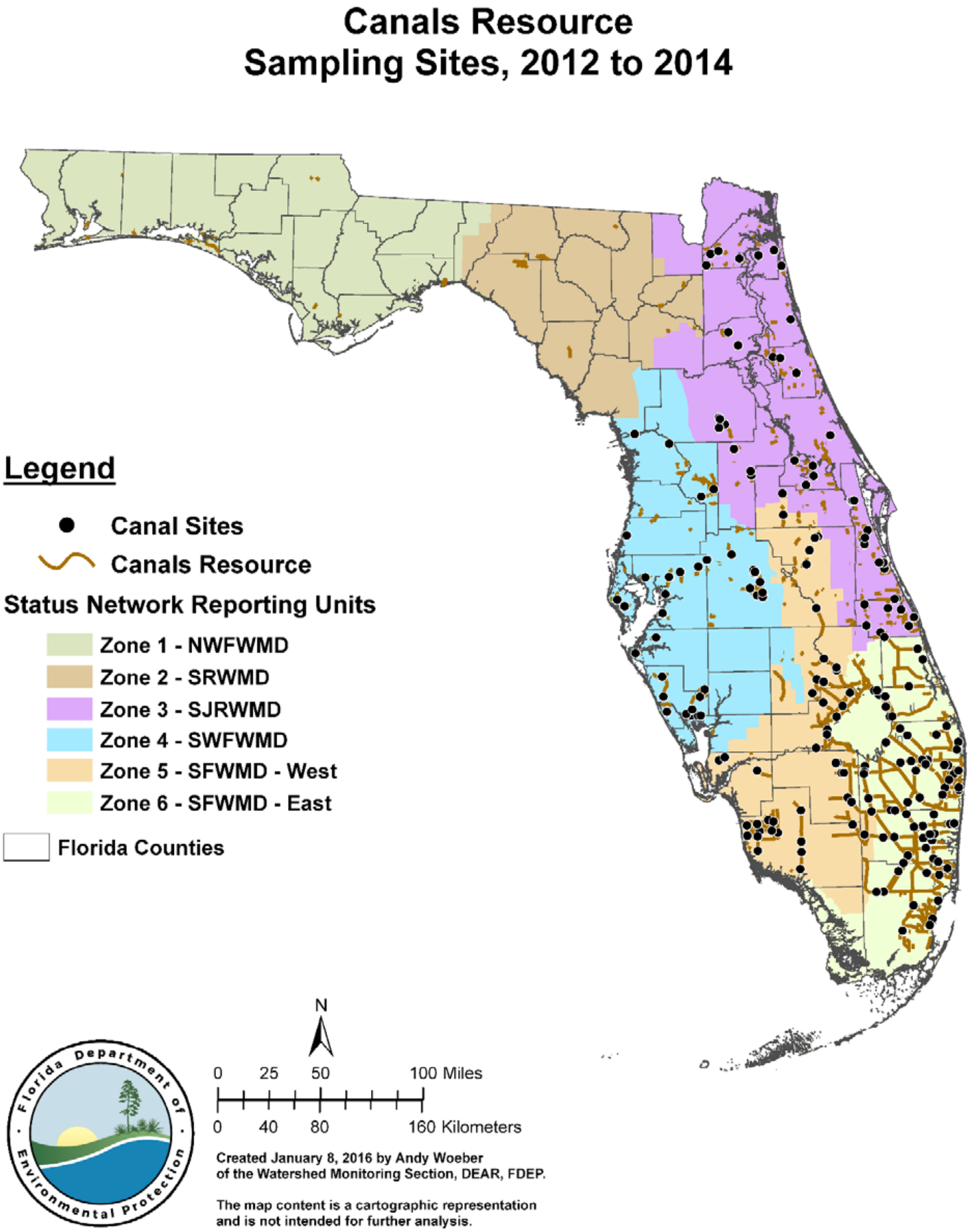


Figure 5.6. Statewide summary of Status Network stream results



Created January 8, 2016 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.7. Statewide Status Network canal sample locations

Table 5.3d. 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	2,630	126	81.2%	88.9-73.5%	18.8%	2012–14
TP	2,630	126	92.2%	96.6-87.8%	7.8%	2012–14
Chlorophyll *a*	2,630	207	80.5%	85.5-75.6%	19.5%	2012–14
Un-Ionized Ammonia	2,630	207	100%	100.0%	0.0%	2012–14
Fecal Coliform	2,630	207	90.3%	93.3-87.3%	9.70%	2012–14
DO	2,630	207	93.0%	95.5-90.4%	7.0%	2012–14

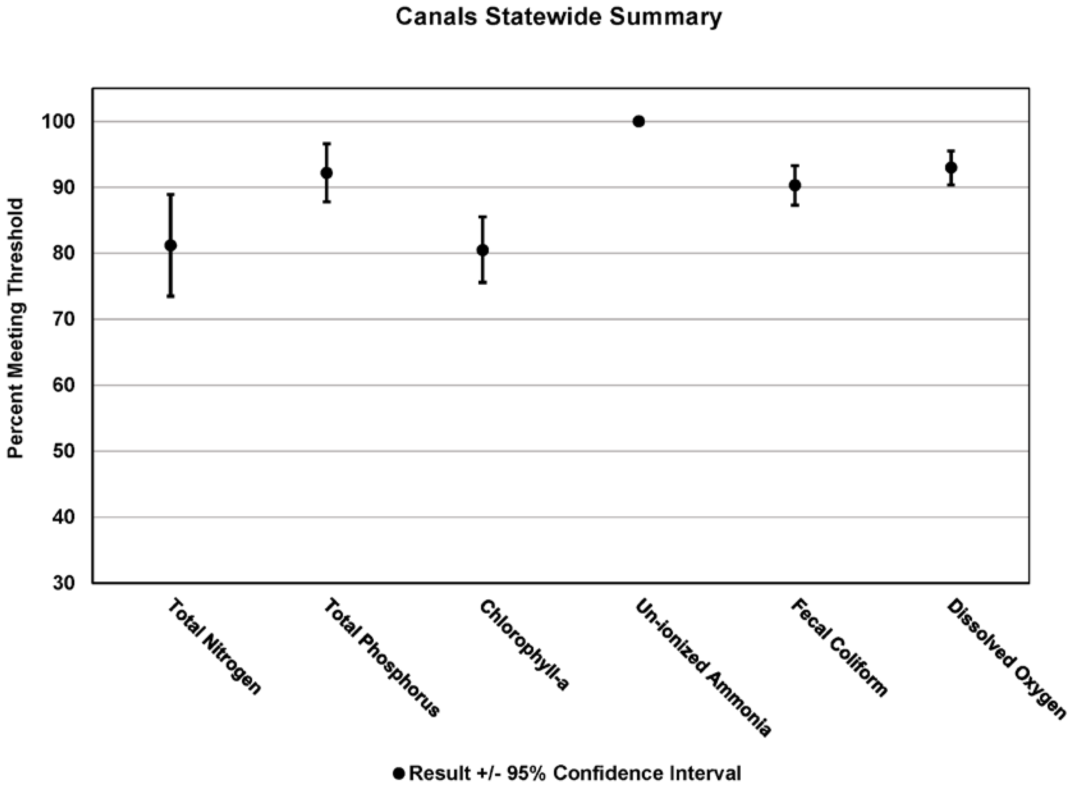
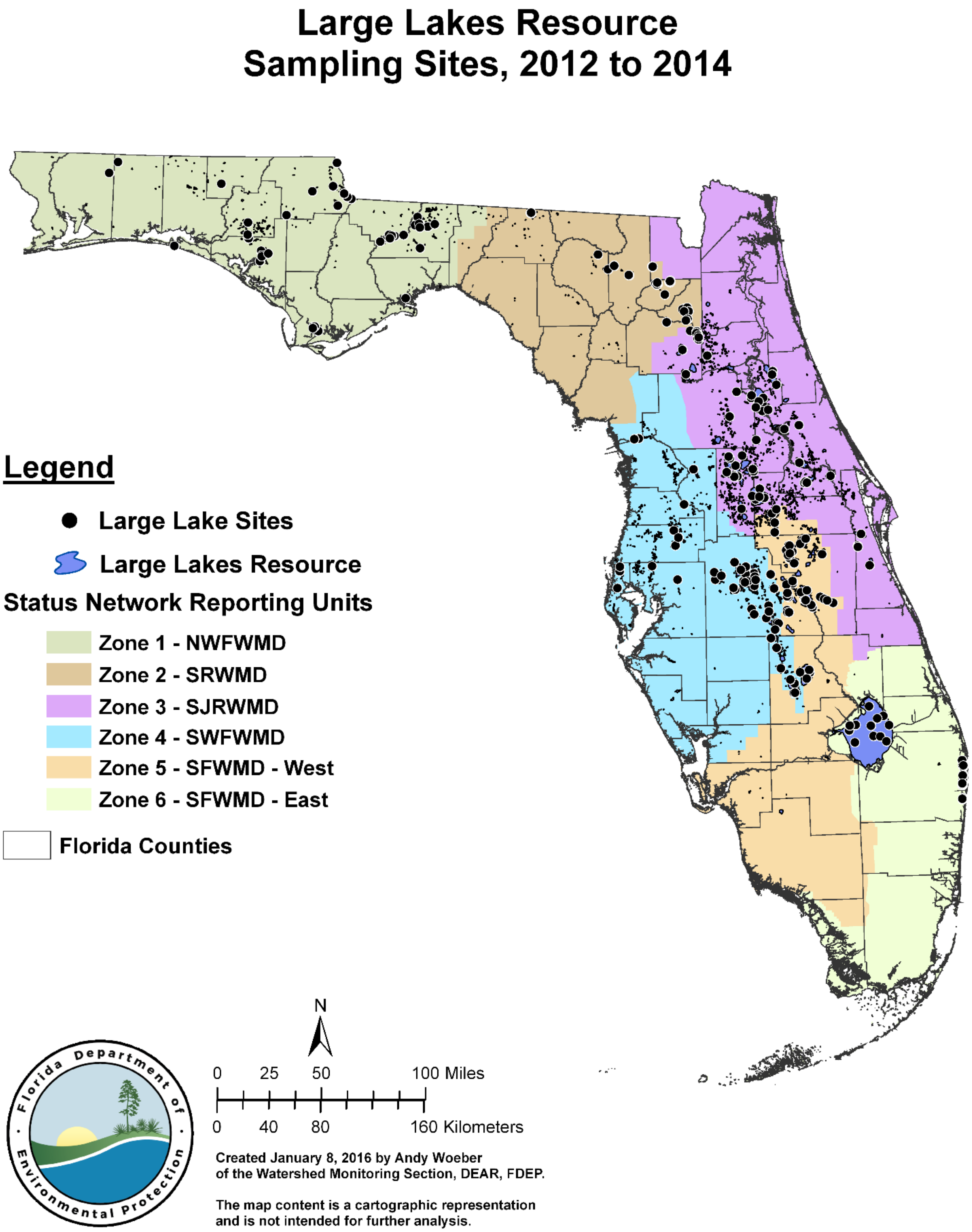


Figure 5.8. Statewide summary of Status Network canal results



Created January 8, 2016 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.9. Statewide Status Network large lake sample locations

Table 5.3e. 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 failure 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	1,009,070	269	90.3%	94.8-85.8%	9.7%	2012–14
TP	1,009,070	270	77.6%	89.1-66.1%	22.4%	2012-14
Chlorophyll *a*	1,009,070	270	47.8%	60.8-34.9%	52.2%	2012-14
Un-Ionized Ammonia	1,009,070	270	98.3%	100.0-95.7%	1.7%	2012–14
Fecal Coliform	1,009,070	270	100%	100.0-99.9%	<1.0%*	2012–14
DO	1,009,070	270	98.5%	99.5-97.5%	1.5%	2012–14

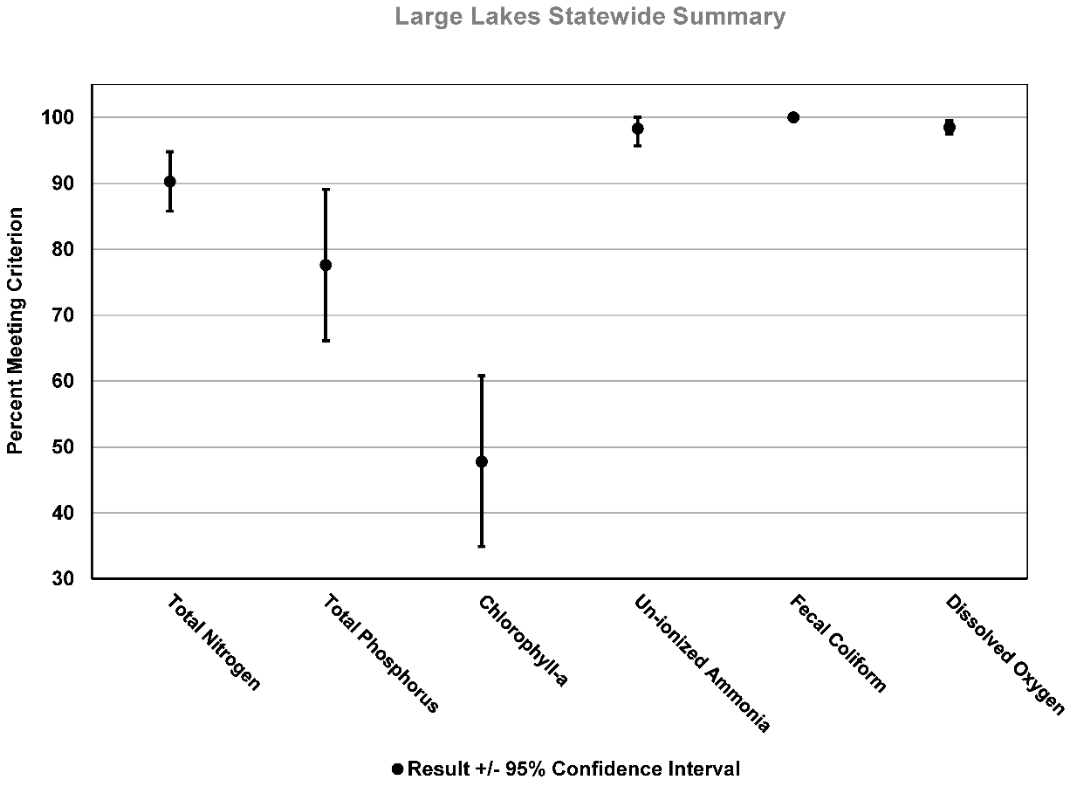
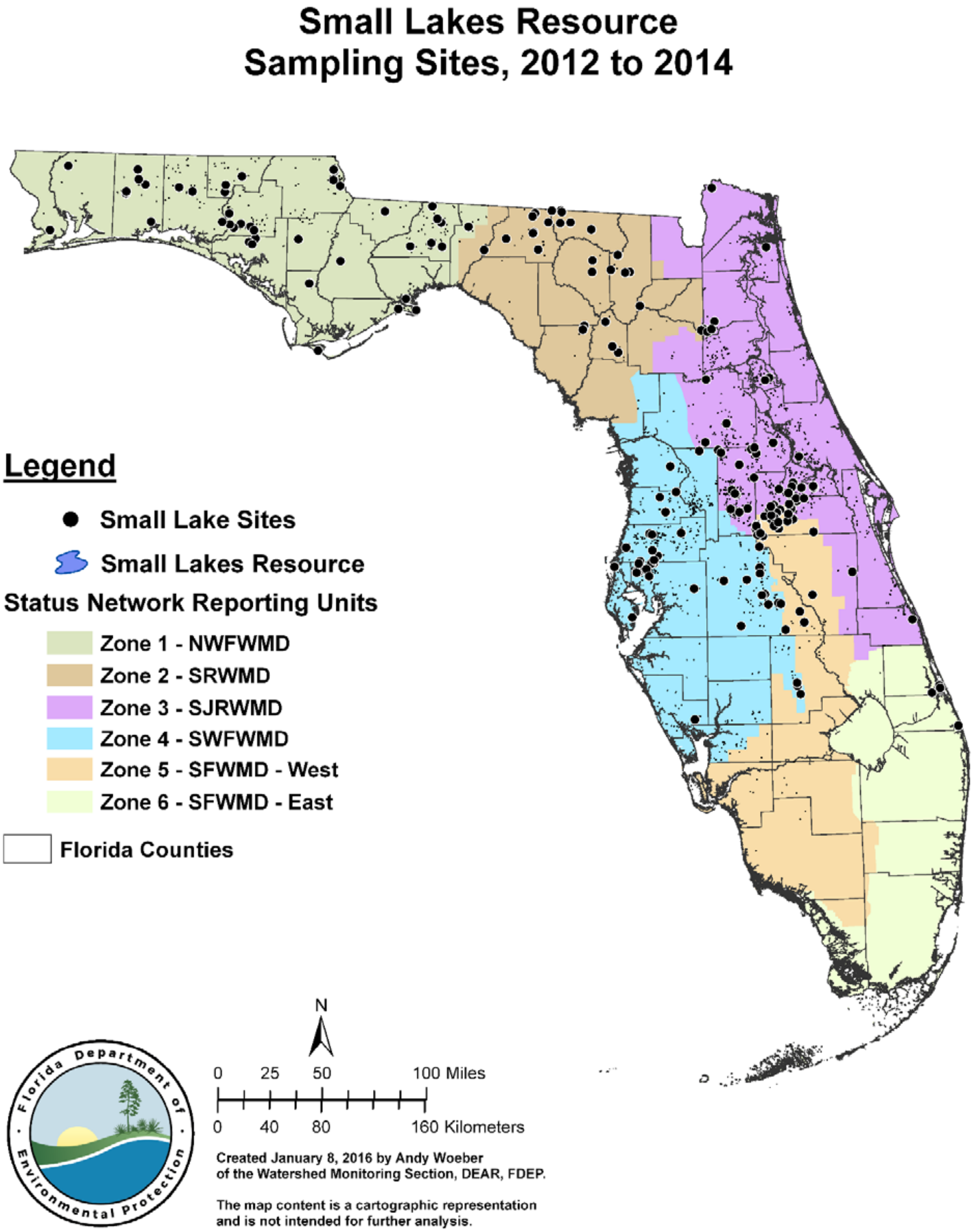


Figure 5.10. Statewide summary of Status Network large lake results



Small Lakes Resource
Sampling Sites, 2012 to 2014

Created January 8, 2016 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.11. Statewide Status Network small lake sample locations

Table 5.3f. 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	1,891	232	91.4%	95.2-87.7%	8.6%	2012–14
TP	1,891	232	89.6%	93.5-85.6%	10.4%	2012-14
Chlorophyll *a*	1,891	232	54.8%	61.4-48.1%	45.2%	2012-14
Un-Ionized Ammonia	1,891	232	100.0%	100.0%	0.0%	2012–14
Fecal Coliform	1,891	228	98.7%	100.0-97.3%	1.3%	2012–14
DO	1,891	233	86.2%	90.4-81.9%	13.8%	2012–14

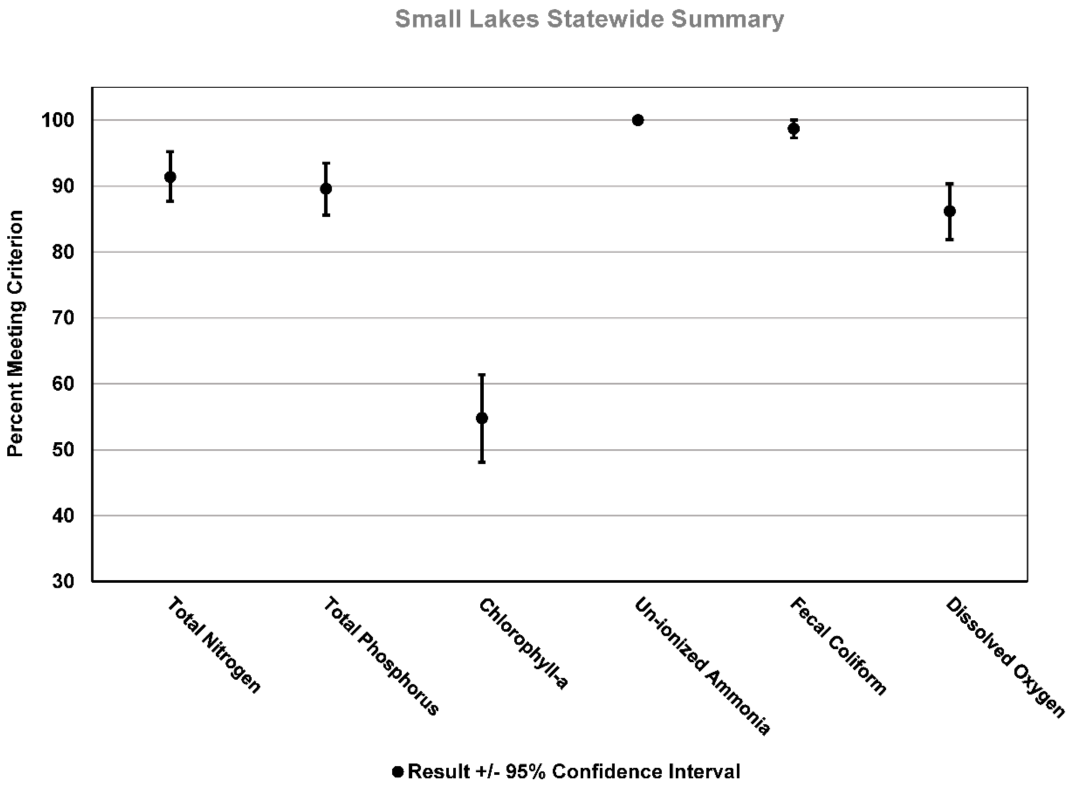


Figure 5.12. Statewide summary of Status Network small lake results

Sediment Quality Evaluation

Background

In aquatic environments, sediments provide essential habitat, 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 cannot fully evaluate aquatic ecosystems, as it usually is not designed to assess the cumulative impact of sediment contaminants. Knowledge of a site's sediment quality is important for environmental managers in evaluating future restoration and dredging projects. Unlike many water column constituents, the DEP has no standards (criteria) for sediment, 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, is not straightforward because metallic elements are natural sediment constituents. For sediment metals data analysis, two interpretive tools were developed, which are available in these 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, 2003). These documents 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. These agencies employed several approaches, including a weight-of-evidence statistical strategy, which derived guidelines from studies containing paired sediment chemistry and associated biological responses. The DEP selected this weight-of-evidence approach to develop its sediment guidelines. To this end, to provide guidance in the interpretation of sediment contaminant data, the following documents were referenced: *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 *et al.* 2003). Rather than traditional pass/fail criteria, DEP's weight-of-evidence approach uses two guidelines for each sediment contaminant: a lower guideline, the threshold effects concentration (TEC), and a higher guideline, the probable effects concentration (PEC). A value below the TEC indicates a low probability of harm occurring to sediment-dwelling organisms. Conversely, sediment values above the PEC have a high probability of causing biological harm.

Small and Large Lakes

Of the four Status Network surface water resources, large and small lakes were selected as appropriate resources to evaluate for sediment contaminants, since lakes integrate runoff within watersheds. A total of 497 samples were collected from the state's two lake resources in 2012 through 2014: 231 from small lakes and 266 from large lakes. Samples were analyzed for major elements (aluminum and iron), a suite of trace metals (including methyl mercury), and three sediment nutrients. To ensure accurate metals data, samples were prepared for chemical analysis using EPA Method 3051 (total digestion) rather than with the EPA 200.2 method (referred to as the total recoverable method). Both the geochemical metals tool and the freshwater biological effects guidance values (MacDonald *et al.* 2003) were used in tandem to evaluate lake sediment chemistry data.

DEP staff compared the sediment metal concentrations with DEP's freshwater sediment guidelines (**Table 5.4a**). When the concentration of a particular metal exceeded the TEC, the metal concentration was evaluated with the sediment statistical normalization tool. If the metal concentration was still within the predicted naturally occurring range, the sediment sample was classified as "not exceeding the TEC" because of natural metal concentrations. Results can be found in **Figures 5.13** and **5.14**, along with **Tables 5.4b** and **5.4c**, which display two rows for each metal. The first row contains the uncorrected metals results, while the second row, with the heading corrected metals, contains the results after applying the metals normalization analysis. Some sites that appear impacted, in fact, exhibit expected sediment metal concentrations. Copper (still widely employed as an aquatic herbicide), lead, and zinc are the most elevated in many small lakes. Elevated lead and zinc concentrations often are caused by stormwater input. Arsenic, cadmium, chromium, and silver rarely exceed the sediment guidelines. Not surprisingly, sediment metals are highest in lakes in urbanized areas, and the largest number of lake sites with elevated metals occurs in peninsular Florida.

Table 5.4a. DEP freshwater lake sediment contaminant thresholds for metals

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 5.4b. Statewide percentage of large lakes meeting sediment contaminant threshold values

Metal	% Meeting TEC Threshold	% Not Meeting TEC Threshold	% Not Meeting PEC Threshold	% of Stations >TEC Because of Natural Metal Concentrations
Arsenic Uncorrected	89.5%	10.5%	0.0%	NA
Arsenic Corrected	89.5%	0.8%	0.0%	9.7%
Cadmium Uncorrected	95.1%	4.9%	0.0%	NA
Cadmium Corrected	95.1%	0.0%	0.0%	4.9%
Chromium Uncorrected	80.9%	19.1%	0.0%	NA
Chromium Corrected	80.9%	1.1%	0.0%	18.0%
Copper Uncorrected	80.8%	16.2%	3.0%	NA
Copper Corrected	80.8%	12.4%	3.0%	3.8%
Silver Uncorrected	99.6%	0.0%	0.4%	NA
Silver Corrected	99.6%	0.0%	0.4%	0.0%
Nickel Uncorrected	95.9%	4.1%	0.0%	NA
Nickel Corrected	95.9%	0.0%	0.0%	4.1%
Lead Uncorrected	77.1%	21.8%	1.1%	NA
Lead Corrected	77.1%	13.9%	1.1%	7.9%
Mercury Uncorrected	77.5%	22.5%	0.0%	NA
Mercury Corrected	77.5%	1.1%	0.0%	21.4%
Zinc Uncorrected	93.6%	6.4%	0.0%	NA
Zinc Corrected	93.6%	4.1%	0.0%	2.3%

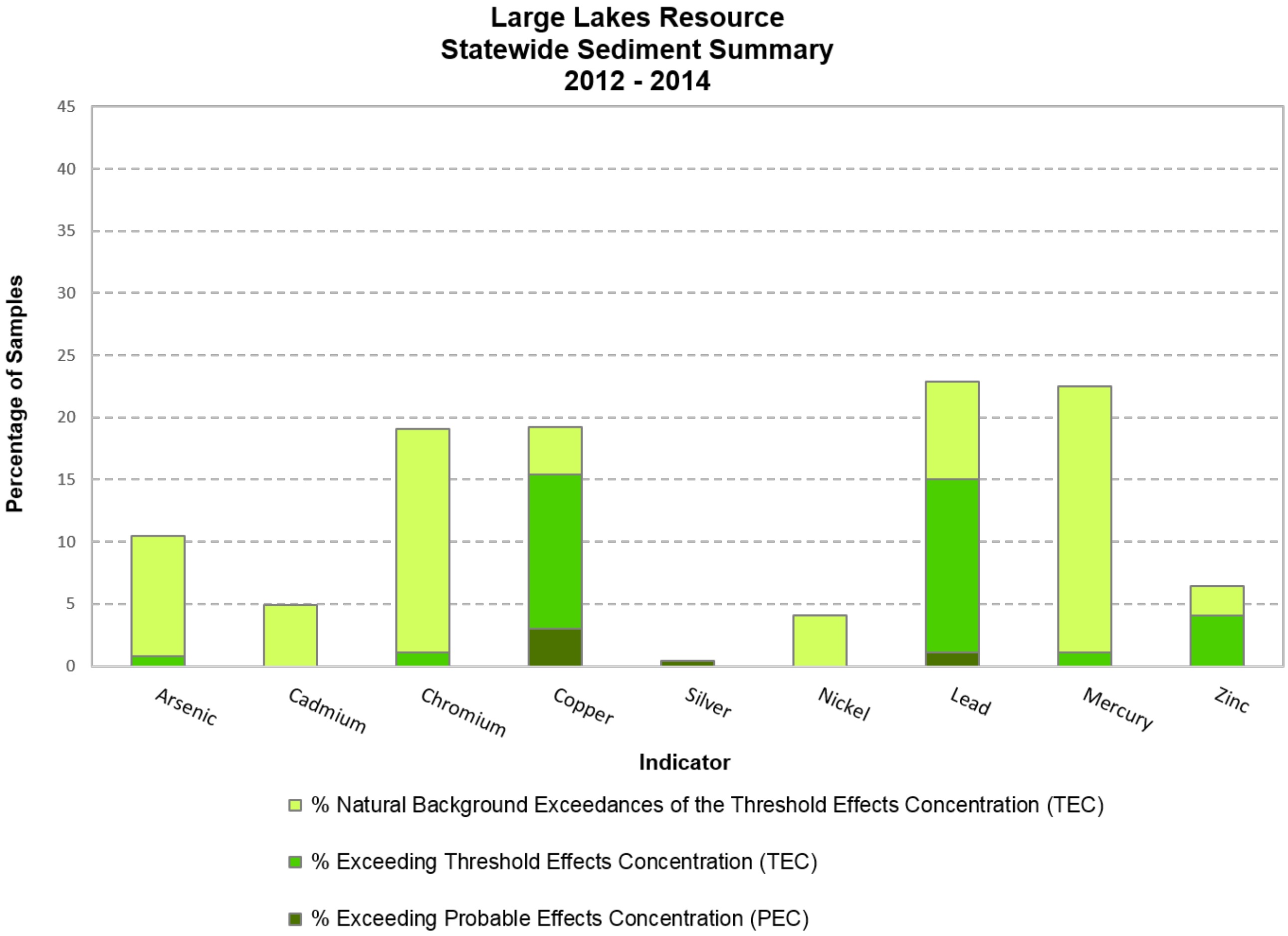


Figure 5.13. Statewide summary of large lake sediment results

Table 5.4c. Statewide percentage of small lakes meeting sediment contaminant threshold values

Metal	% Meeting TEC Threshold	% Not Meeting TEC Threshold	% Not Meeting PEC Threshold	% of Stations >TEC Because of Natural Metal Concentrations
Arsenic Uncorrected	79.6%	19.5%	0.9%	NA
Arsenic Corrected	79.6%	1.7%	0.9%	17.8%
Cadmium Uncorrected	81.8%	18.2%	0.0%	NA
Cadmium Corrected	81.8%	0.9%	0.0%	17.3%
Chromium Uncorrected	71.4%	28.6%	0.0%	NA
Chromium Corrected	71.4%	0.0%	0.0%	28.6%
Copper Uncorrected	66.6%	22.1%	11.3%	NA
Copper Corrected	66.6%	17.8%	11.3%	4.3%
Silver Uncorrected	97.0%	2.6%	0.4%	NA
Silver Corrected	97.0%	1.3%	0.4%	1.3%
Nickel Uncorrected	92.2%	7.8%	0.0%	NA
Nickel Corrected	92.2%	0.0%	0.0%	7.8%
Lead Uncorrected	58.0%	34.2%	7.8%	NA
Lead Corrected	58.0%	22.9%	7.8%	11.3%
Mercury Uncorrected	65.4%	34.6%	0.0%	NA
Mercury Corrected	65.4%	1.3%	0.0%	33.3%
Zinc Uncorrected	69.7%	25.1%	5.2%	NA
Zinc Corrected	69.7%	16.5%	5.2%	8.6%

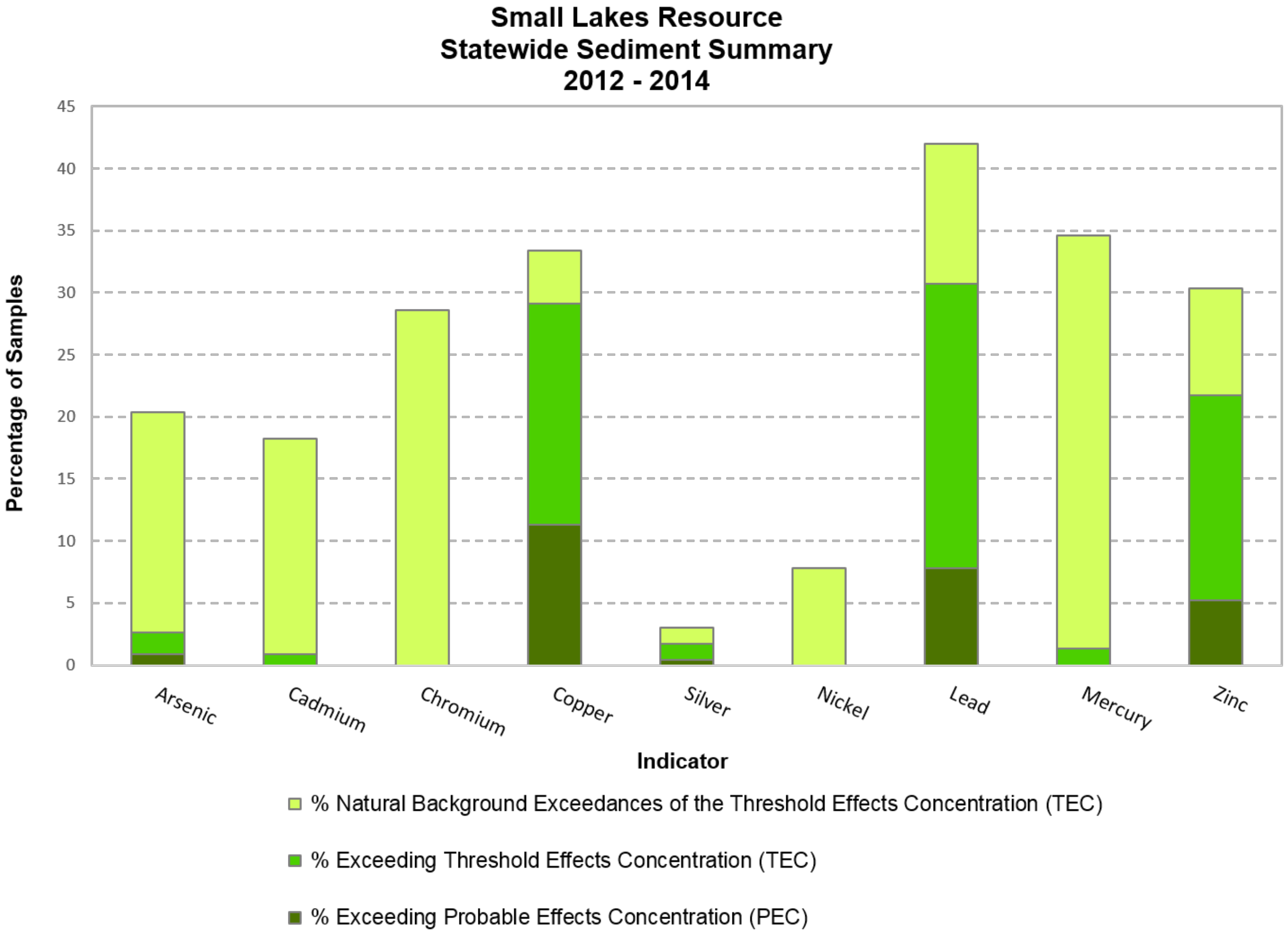


Figure 5.14. Statewide summary of small lake sediment results

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

The water quality results indicate that, for recreation usage and aquatic life support, Florida's flowing waters and lakes are in relatively good health. However, an inspection of the indicators shown in **Figures 5.4, 5.6, 5.8, 5.10,** and **5.12** reveals several trends. Of the three flowing water resources monitored, streams show the lowest percentage of passing values for TP and TN (< 75%), while in lakes, the nutrient response indicator, chlorophyll *a*, shows the lowest percentage of passing values (< 55%), for aquatic life support. DEP has developed numerous TMDLs, BMAPs, and restoration areas to address both TN and TP inputs (see **Chapter 4** for details).

The sediment results for lakes indicate that, for aquatic life support, the sediment quality of Florida's lakes is also in generally good health. However, an inspection of the indicators given in **Figures 5.13** and **5.14** shows generally better sediment quality in large lakes than in small lakes. The sediment metals copper and lead are a concern in both large and small lakes with exceedances of the TEC of approximately 20%. It is not surprising that small lakes would 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. To address the mercury inputs, the state has a statewide mercury TMDL, as described in **Chapter 4**.

Summary of Status Network Ground Water Results

The DEP Watershed Monitoring Section has monitored ground water quality since 1986 in both confined and unconfined aquifers. The current Status Network ground water monitoring program uses a probabilistic monitoring design to estimate confined and unconfined aquifer water quality across the state. This estimate is, by necessity, based on a subsampling of wells representing both the confined and unconfined aquifers. The wells used in this evaluation include private, public, monitoring, and agricultural irrigation wells. **Figures 5.15** and **5.17** depict the randomly selected wells that were sampled for confined and unconfined aquifers, respectively.

The assessment period for this report is January 2012 through December 2014. **Table 5.5** describes the ground water indicators used in the analysis and lists drinking water standards (thresholds). Some of the more important analytes include total coliform, nitrate-nitrite, trace metals such as arsenic and lead, and sodium (salinity), all of which are threats to drinking water quality.

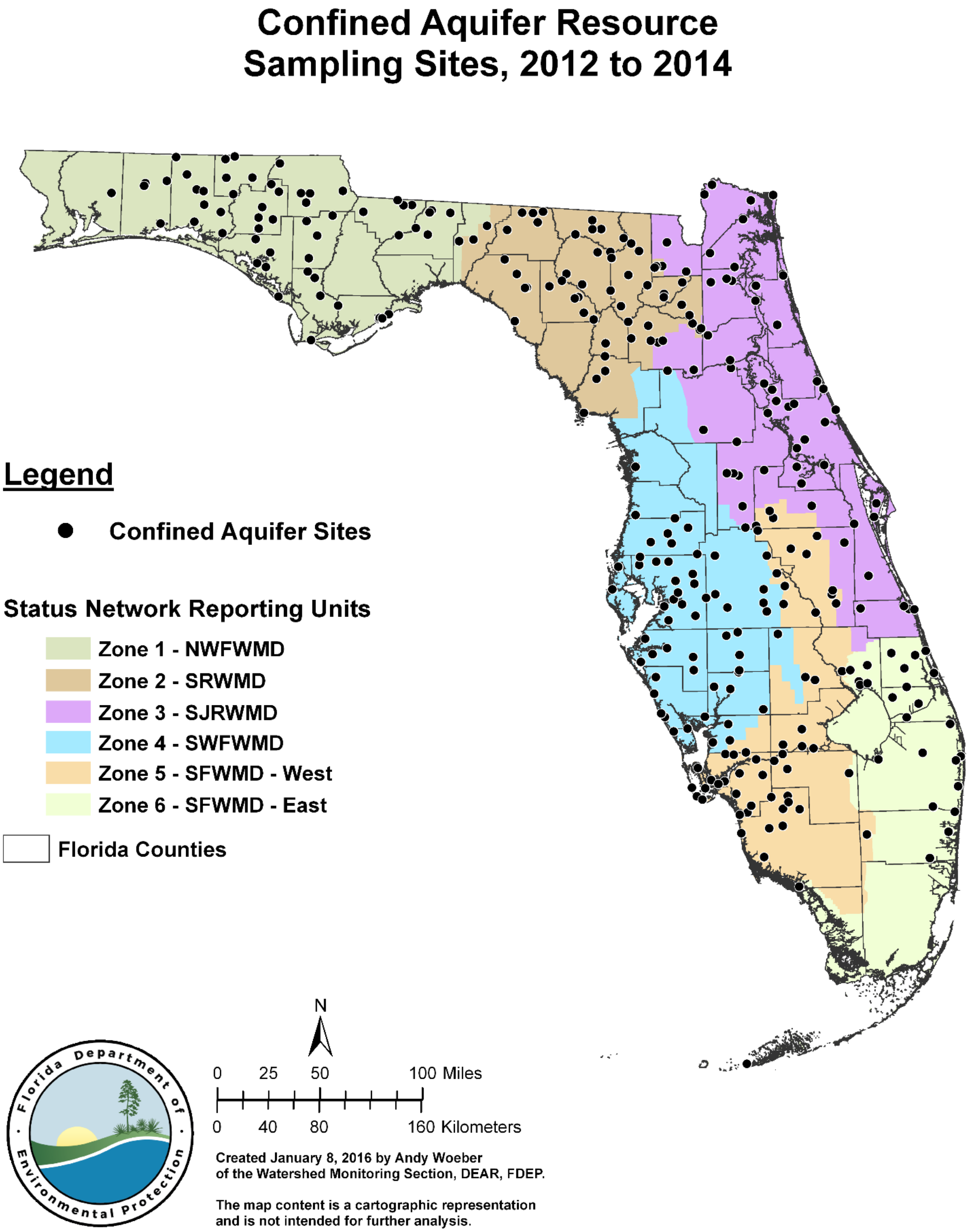
Table 5.5. Status Network physical/other indicators for potable water supply for ground water with water quality thresholds

Indicator	Threshold for Potable Water Supply (Ground Water)
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	< 2 counts /100mL
Total Coliform Bacteria	≤4 counts /100mL

For each Status Network ground water resource (confined aquifers and unconfined aquifers), there is a map showing the sample site locations (**Figures 5.15** and **5.17)**, a figure summarizing the statewide results (**Figures 5.16** and **5.18**), and a table containing the statewide results for each indicator for a particular resource (**Tables 5.6b** and **5.6c**). **Table 5.6a** contains a legend for the terms used in **Tables 5.6b** and **5.6c**. **Tables 5.6b** and **5.6c** provide an estimate of the quality of Florida's confined and unconfined aquifers by listing the percentage of the resource that meets a potable water threshold.

Table 5.6a. Legend for terms used in Tables 5.6b and 5.6c

Term	Explanation
Analyte	Indicators chosen to base assessment of condition of waters of 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 indicator's threshold value.
95% Confidence Bounds (% Meeting Threshold)	Upper and lower bounds for 95% confidence of % meeting specific indicator's threshold value.
% Not Meeting Threshold	% estimate of target population that does not meet specific indicator's threshold value.
Assessment Period	Duration of probabilistic survey's sampling event.



Confined Aquifer Resource Sampling Sites, 2012 to 2014

Created January 8, 2016 by Andy Woeber of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation and is not intended for further analysis.

Figure 5.15. Statewide Status Network confined aquifer well locations

Table 5.6b. 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	13,449	344	99.3%	100.0-98.2%	0.7%	2012–14
Cadmium	13,449	344	100.0%	100.0%	0.0%	2012–14
Chromium	13,449	344	100.0%	100.0%	0.0%	2012–14
Lead	13,449	344	99.8%	100.0-99.6%	0.2%	2012–14
Nitrate-Nitrite	13,449	344	99.5%	100.0-98.7%	0.5%	2012–14
Sodium	13,449	344	96.4%	97.3-95.5%	3.6%	2012–14
Fluoride	13,449	344	99.3%	100.0-98.2%	0.7%	2012–14
Fecal Coliform	13,449	344	99.3%	99.9-98.7%	0.7%	2012–14
Total Coliform	13,449	341	90.2%	95.0-85.5%	9.8%	2012–14

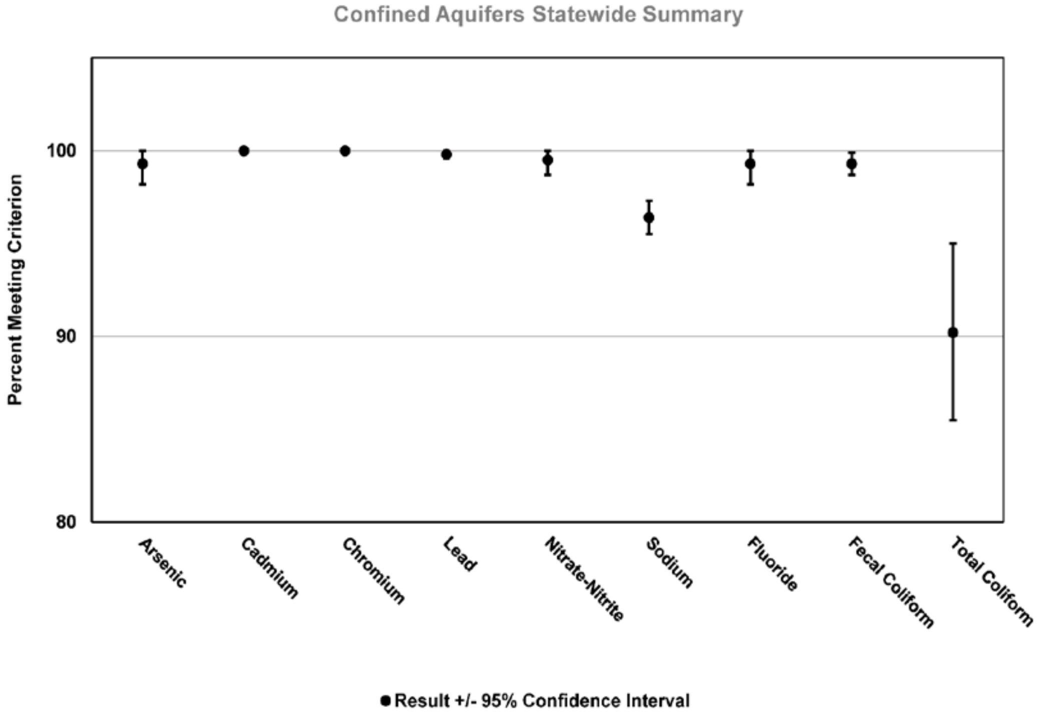
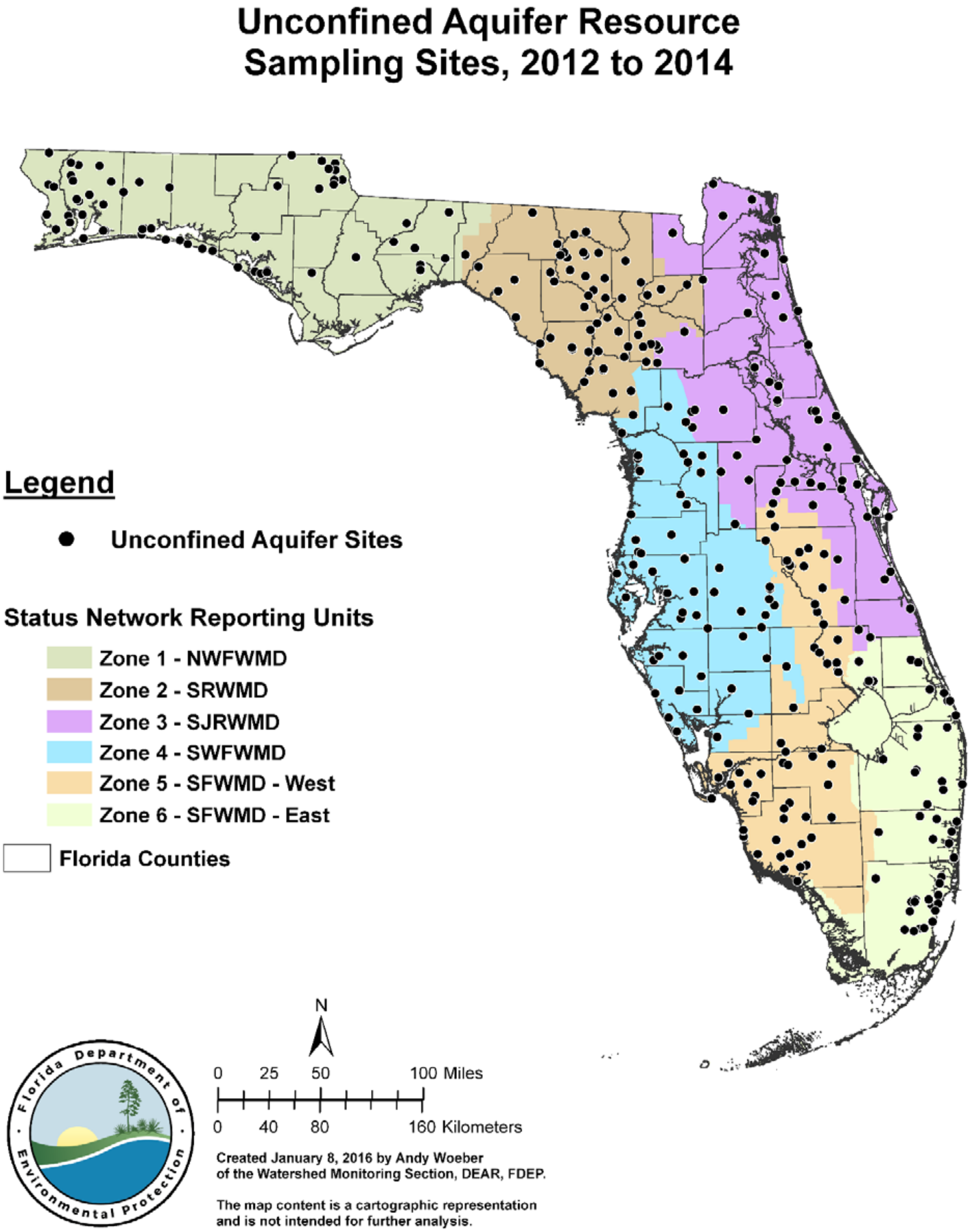


Figure 5.16. Statewide summary of Status Network confined aquifer results



Unconfined Aquifer Resource Sampling Sites, 2012 to 2014

Created January 8, 2016 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.17. Statewide Status Network unconfined aquifer well locations

Table 5.6c. 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	16,027	343	97.4%	100.0-94.0%	2.6%	2012–14
Cadmium	16,027	343	99.9%	100.0-99.8%	0.1%	2012–14
Chromium	16,027	343	100.0%	100.0%	0.0%	2012–14
Lead	16,027	343	96.9%	100.0-93.4%	3.1%	2012–14
Nitrate-Nitrite	16,027	343	98.3%	100.0-96.0%	1.7%	2012–14
Sodium	16,027	343	97.8%	98.7-96.9%	2.2%	2012–14
Fluoride	16,027	343	100.0%	100.0%	0.0%	2012–14
Fecal Coliform	16,027	342	96.3%	99.3-93.3%	3.7%	2012–14
Total Coliform	16,027	342	90.8%	94.1-87.5%	9.2%	2012–14

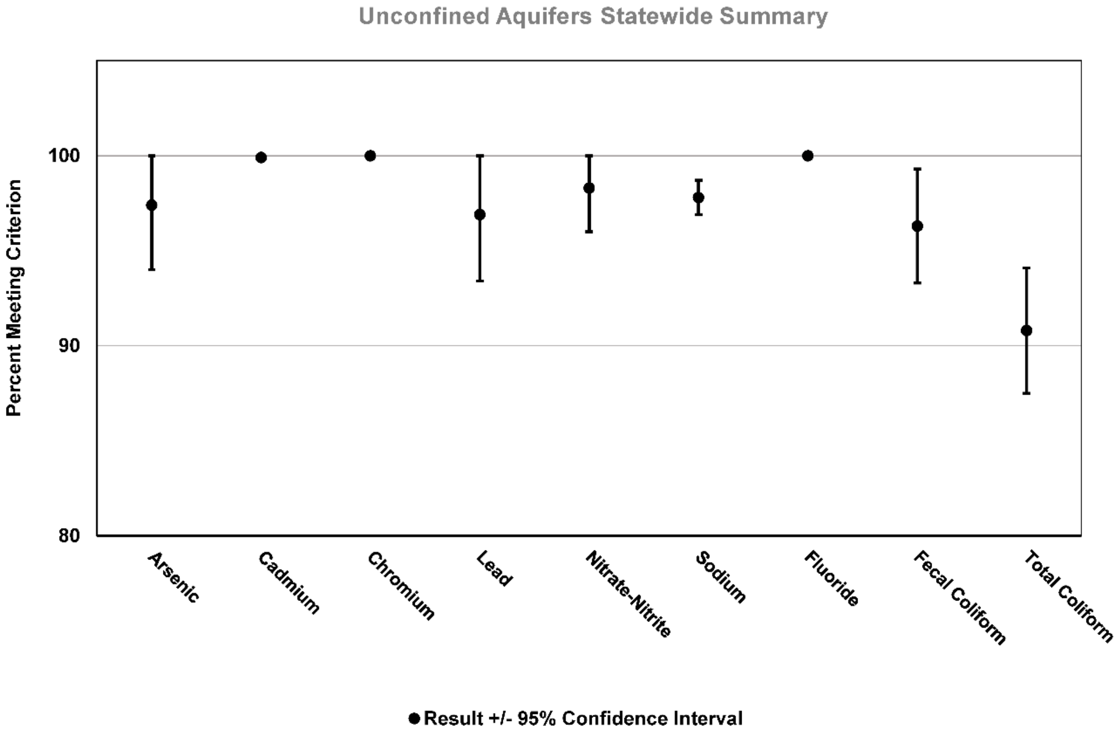


Figure 5.18. Statewide summary of Status Network unconfined aquifer results

Discussion of Confined and Unconfined Aquifers

Water quality results indicate that Florida's potable ground water is in generally good condition, with all drinking water indicators showing greater than 90% passing values. Concerns for ground water are related to the fact that in Florida ground and surface waters connectivity is great. Therefore, ground water entering surface water systems may trigger failures of aquatic life support indicators, especially for the nutrients TN and TP. DEP has developed BMAPs and restoration areas to address these facts; which are discussed in more detail in **Chapter 4**. The section summarizing the Trend Network Analysis contains an additional discussion of ground water concerns for Florida.

Summary of Surface and Ground Water Trend Network Results

Overview

In flowing surface waters, flow rate is highly variable and can complicate data analysis unless it is taken into consideration. Where available, flow rates from associated USGS gauging stations were collected at the same time as surface water samples. The surface water quality data were adjusted for flow before Seasonal Kendall (SK) trend analysis. In contrast ground water flow rates are generally much slower and no flow adjustment is needed prior to performing the SK analyses.

If a trend was found to exist for either flow-adjusted or nonflow-adjusted data, the corresponding slope was determined using the Sen Slope (SS) estimator (Gilbert 1987). The estimator measures the median difference between successive observations over the time series. The SS 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 the impairment or improvement of the analyte being measured in the waters.

Surface Water Trends

The Surface Water Trend Network consists of 76 fixed sites that are sampled monthly (**Figure 5.19**); however, as of December 2015, only 74 stations had sufficient data for analysis.

Created January 7, 2016 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.19. Surface Water Trend Network sites with sufficient period of record

Thirty-six surface water stations were adjusted for flow, while the remaining 38 stations were not flow-adjusted. **Table 5.7** provides a general statewide overview of the analyses conducted on the surface water trend data (1999–2014). For the results of the analyses by station, see **Tables 5.8a** through **5.8c**. **Table 5.8a** contains the legend for the acronyms and abbreviations used in **Tables 5.8b** and **5.8c. Tables 5.8b** and **5.8c** present the results of the trend analyses, and **Figures 5.20** through **5.27** show the results graphically for each indicator.

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 potential changes that may be occurring is helpful. For a more detailed explanation of the information goals of the Trend Monitoring Network, including data sufficiency and analysis methods, see Appendix C of the *Design Document*.

An inspection of the indicators in **Table 5.7** reveals that several appear to have gone through changes for the period from 1999 to 2014. The following methodology was used to select indicators that appear to have gone through those changes. Flow-adjusted and nonflow-adjusted sites were combined into one category (surface water), and all sites *not* displaying significant trends were excluded. For each analyte, the percentage of sites with increasing trends was compared to the percentage of sites with decreasing trends, and the greater percentage was noted. The number of sites with the greater percentage was divided by the total number of sites which displayed trends, and a subjective cutoff was set at 67%. If the percent of sites with trends in the strong direction was less than 67%, the analyte was not selected for further discussion. Based on this process, changes in the following analytes are apparent. Concentrations of nitrate plus nitrite and DO are increasing, and the concentration of TP is decreasing.

The concentration of nitrate plus nitrite 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 algae growth. Sources for these nutrients include animal waste, decaying plant debris, fertilizers, and urban drainage. Although there are many management and restoration efforts underway to reduce the concentrations of nitrate and nitrite entering surface waters, many of these efforts are relatively new and improvements that may be occurring are not yet apparent at the scale of this analysis.

The concentration of DO appears to have increased at a large percentage of sites. Natural conditions, such as increased photosynthesis from algae and plants can increase DO levels in waterbodies. Increased photosynthesis may be fueled by the increased availability of nutrients discussed above. Decreased inputs from springs and swamps/wetlands during drought conditions may also contribute to higher DO in surface waters. This higher concentration of DO indicates that the quality of the water is improving for the animals (vertebrates and invertebrates) living in these waters.

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

Table 5.7. Surface water trend summary (1999–2014)

Note: Flow-adjusted site percentages were calculated based on a sample size of 36 stations that are associated with a USGS gauging station and adjusted for water flow. Nonflow-adjusted site percentages were calculated based on a sample size of 38 stations.

Indicator	Flow-Adjusted Sites, % Increasing Trend	Flow-Adjusted Sites, % Decreasing Trend	Flow-Adjusted Sites, % No Trend	Nonflow-Adjusted Sites, % Increasing Trend	Nonflow-Adjusted Sites, % Decreasing Trend	Nonflow-Adjusted Sites, % No Trend
Nitrate + Nitrite	38.9%	16.7%	44.4%	36.8%	15.8%	47.4%
Total Kjeldahl Nitrogen	33.3%	19.5%	47.2%	28.9%	23.7%	47.4%
TP	8.3%	44.5%	47.2%	7.9%	44.7%	47.4%
Total Organic Carbon	27.8%	13.9%	58.3%	21.05%	21.05%	57.9%
Chlorophyll *a*	52.8%	19.4%	27.8%	39.5%	31.6%	28.9%
Fecal Coliform	13.9%	8.3%	77.8%	21.0%	13.2%	65.8%
pH	13.9%	33.3%	52.8%	13.2%	21.0%	65.8%
DO	50.0%	5.6%	44.4%	44.7%	5.3%	50.0%

Table 5.8a. Legend for the acronyms and abbreviations used in Tables 5.8b and 5.8c

Acronym/Abbreviation	Indicator
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TOC	Total Organic Carbon
DO	Dissolved Oxygen
pH	pH, Field

Table 5.8b. Trends for specified analytes for Surface Water Trend Network stations that are associated with a USGS gauging station and adjusted for river flow

Positive trends are indicated with a plus sign (+), negative trends are indicated with a minus sign (-), and no trends are indicated by zero (0).

Station	River	Nitrate + Nitrite	TKN	TP	TOC	Chlorophyll *a*	Fecal Coliform	pH	DO
3494	Barron	+	+	o	+	+	o	o	o
3497	Fisheating Creek	o	o	-	o	+	o	o	+
3500	St. Lucie	o	-	-	o	+	-	+	+
3509	Anclote	-	-	-	o	-	+	-	o
3513	Withlacoochee	o	+	o	+	o	-	-	-
3515	St. Johns	o	-	o	o	o	o	o	o
3517	Ocklawaha	+	+	o	+	o	+	o	o
3522	Suwannee	+	o	o	o	+	o	o	+
3524	Apalachicola	+	o	-	o	+	o	o	+
3527	Ochlockonee	o	o	o	o	+	o	o	+
3528	St. Marks	+	o	o	-	-	o	o	+
3530	Suwannee	+	o	o	o	+	o	o	+
3531	Econfina Creek	+	+	o	o	-	o	o	+
3532	Telogia Creek	o	o	-	o	-	o	-	+
3534	Choctawhatchee	+	o	-	o	+	o	-	+
3535	Suwannee	o	+	+	+	+	+	+	o
3539	Withlacoochee	+	o	o	o	+	o	+	o
3541	Escambia	+	+	+	o	+	o	-	+
3542	Perdido	-	o	-	+	-	o	-	+
3543	Apalachicola	+	o	-	o	+	o	o	o
3545	Blackwater	o	o	-	o	-	+	o	+
3548	Choctawhatchee	o	o	o	o	o	o	-	o
3549	Escambia	+	+	+	o	+	o	-	+
3554	Alafia	-	+	-	+	+	o	o	o
3555	Little Manatee	o	+	-	+	o	+	-	o
3556	Peace	-	o	o	+	+	o	-	o
3557	St. Johns	o	-	o	o	o	-	o	o
3560	Withlacoochee	o	-	-	-	o	o	o	+
3561	Charlie Creek	o	+	o	+	o	o	o	o
3563	New	o	o	o	o	+	o	o	o
3564	Waccasassa	+	+	o	+	o	o	o	+
3565	Eleven mile Creek	-	-	-	-	o	o	-	+
3566	Weeki Wachee	+	+	-	-	-	o	-	-
3568	Caloosahatchee	-	o	-	o	+	o	+	+
3569	Little Econ	o	-	-	-	+	o	+	o
21460	Wright’s Creek	o	o	o	o	+	o	o	o

Table 5.8c. Trends for specified analytes for surface water stations from the Trend Network and not adjusted for river flow

Note: Positive trends are indicated with a plus sign (+), negative trends are indicated with a minus sign (-), and no trends are indicated by zero (0).

Station	River	Nitrate + Nitrite	TKN	TP	TOC	Chlorophyll *a*	Fecal Coliform	pH	DO
3495	Golden Gate Canal	o	o	-	-	+	o	+	+
3499	Myakka	o	+	o	+	+	o	o	+
3501	Kissimmee	o	o	-	-	+	-	o	+
3502	Phillippe Creek	o	+	o	o	+	+	-	o
3504	C-25 Canal	o	o	o	o	+	o	o	o
3505	Manatee	+	+	-	+	+	+	o	o
3506	C-38 Canal	o	-	-	-	+	o	-	-
3507	Hillsborough	o	o	-	o	+	o	-	o
3508	Indian River Lagoon	+	-	-	-	+	-	+	+
3516	Tomoka	+	o	+	-	o	o	+	o
3519	Suwannee	+	+	o	+	o	+	o	o
3521	Santa Fe	o	+	+	+	-	+	o	o
3526	Aucilla	+	+	o	o	-	o	o	o
3533	East Bay	-	o	-	o	-	o	-	+
3536	Alaqua Creek	-	+	-	+	-	o	-	+
3537	Nassau	o	o	o	o	+	o	o	o
3538	Alapaha	o	o	o	o	o	o	o	+
3540	Ochlockonee	o	o	-	o	+	o	o	+
3544	St. Marys	-	o	o	o	-	-	o	o
3546	Yellow	+	o	o	o	o	+	o	+
3547	Cowarts Creek	+	+	o	o	o	o	o	o
3550	Brushy Creek	-	-	-	o	-	-	o	+
3551	Yellow	o	o	o	o	-	o	o	+
3552	Chipola	o	o	-	o	o	o	o	+
3553	St. Johns	-	-	-	o	+	o	+	o
3558	Miami Canal	-	-	-	o	o	o	o	+
3559	Hillsboro Canal	o	-	o	-	+	-	o	+
3570	Aerojet Canal	+	+	-	o	o	+	+	+
3571	Black Creek Canal	+	o	o	-	+	o	o	+
3572	Miami	+	-	-	-	+	o	o	+
6976	Econfina	o	+	o	+	-	+	-	o
6978	Steinhatchee	o	+	+	+	-	o	o	o
21179	Spruce Creek	+	o	-	o	o	+	o	o
21200	Rice Creek	o	o	o	o	-	o	o	o
21201	Moultrie Creek	o	o	o	o	o	o	o	o
21202	Orange Creek	+	o	o	+	-	o	-	-
21380	Homosassa Springs	+	-	o	o	o	o	o	o
21461	Big Coldwater Creek	+	-	-	o	-	o	-	o

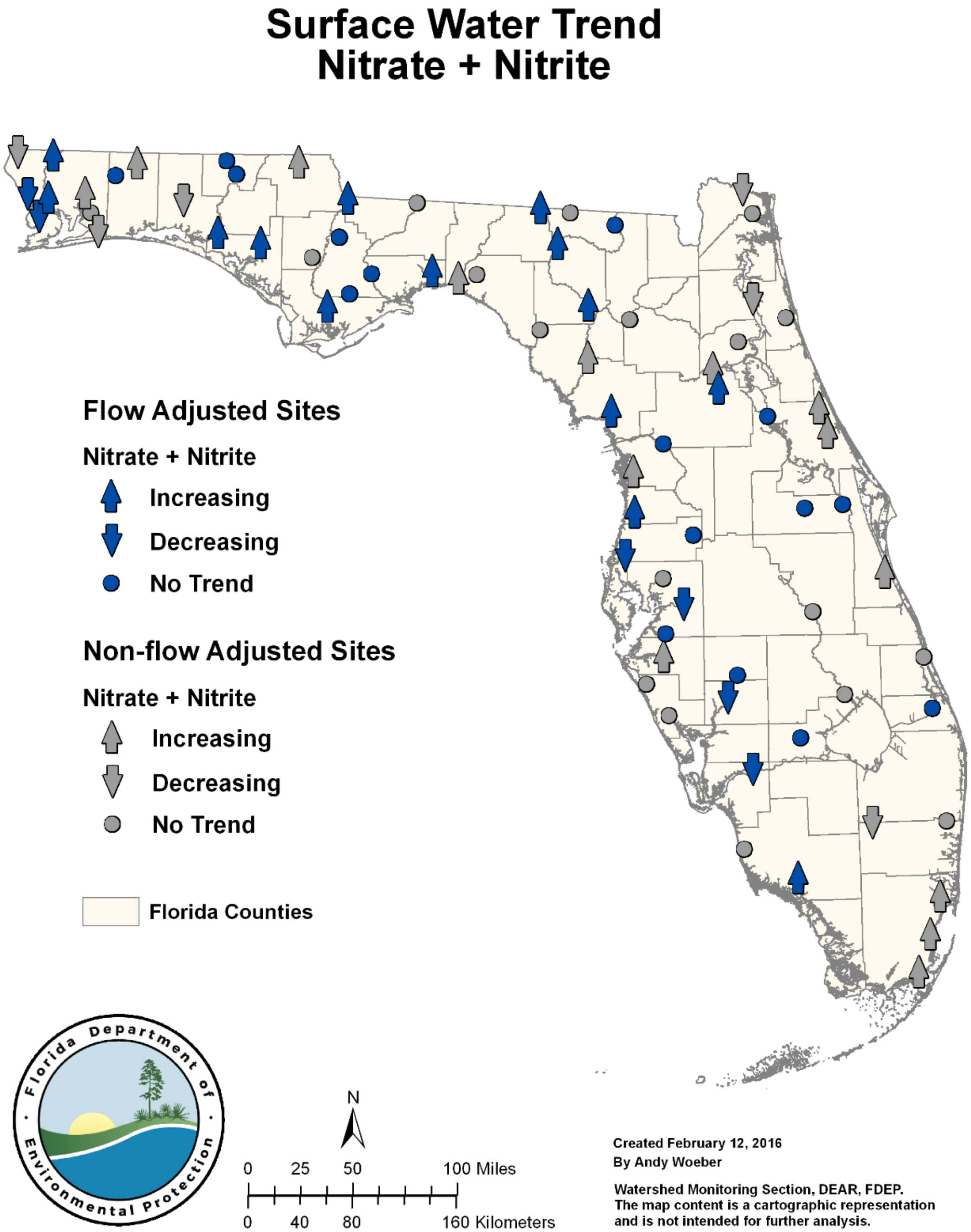


Figure 5.20. Surface water trends for nitrate + nitrite, 1999–2014

Highlights

— There were 28 stations with increasing trends and 12 stations with decreasing trends. Trends in nitrate + nitrite may indicate changes in anthropogenic input.

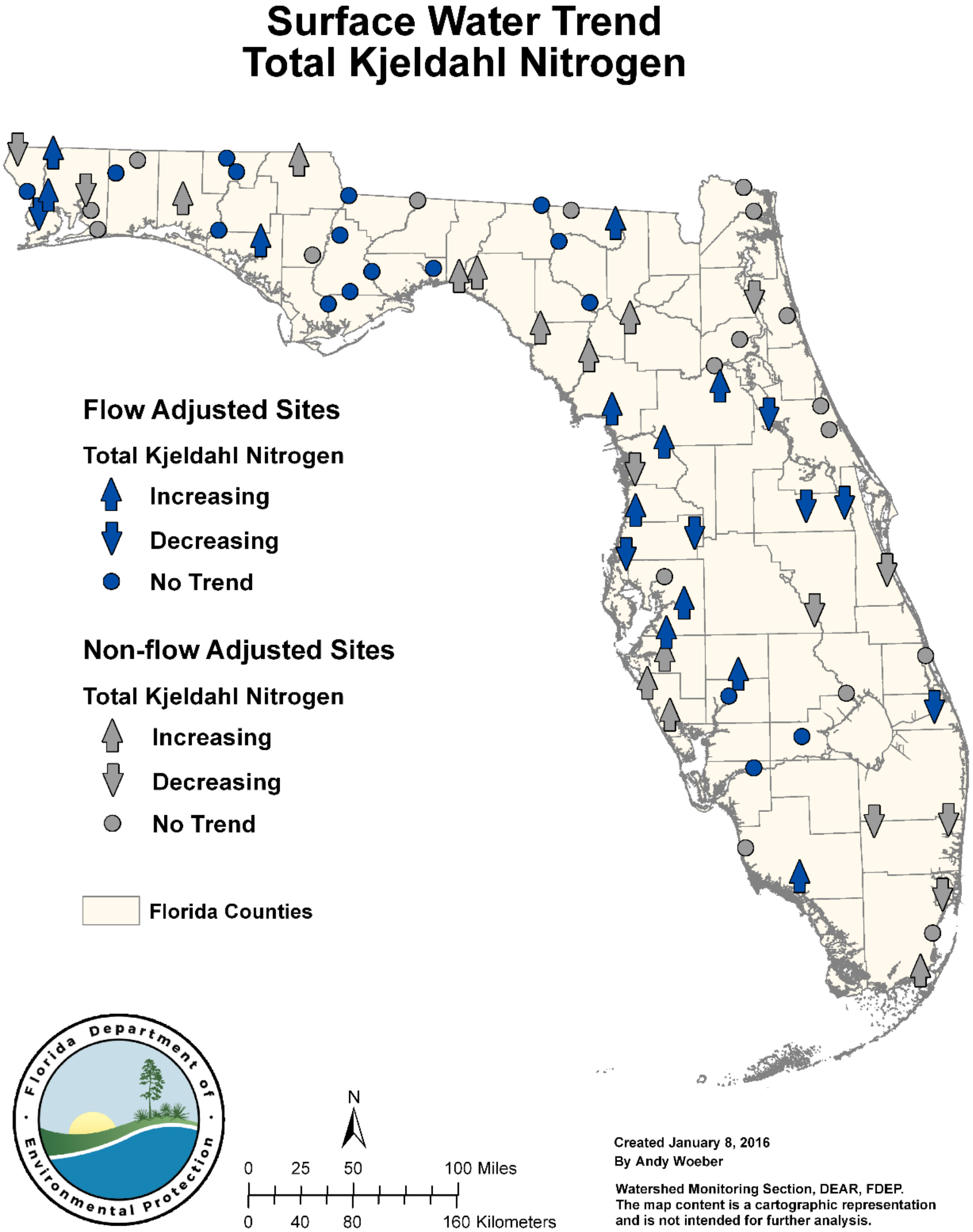


Figure 5.21. Surface water trends for TKN, 1999–2014

Highlights

— TKN had 22 stations with increasing trends and 16 stations had decreasing trends. TKN is ammonia plus organic nitrogen.

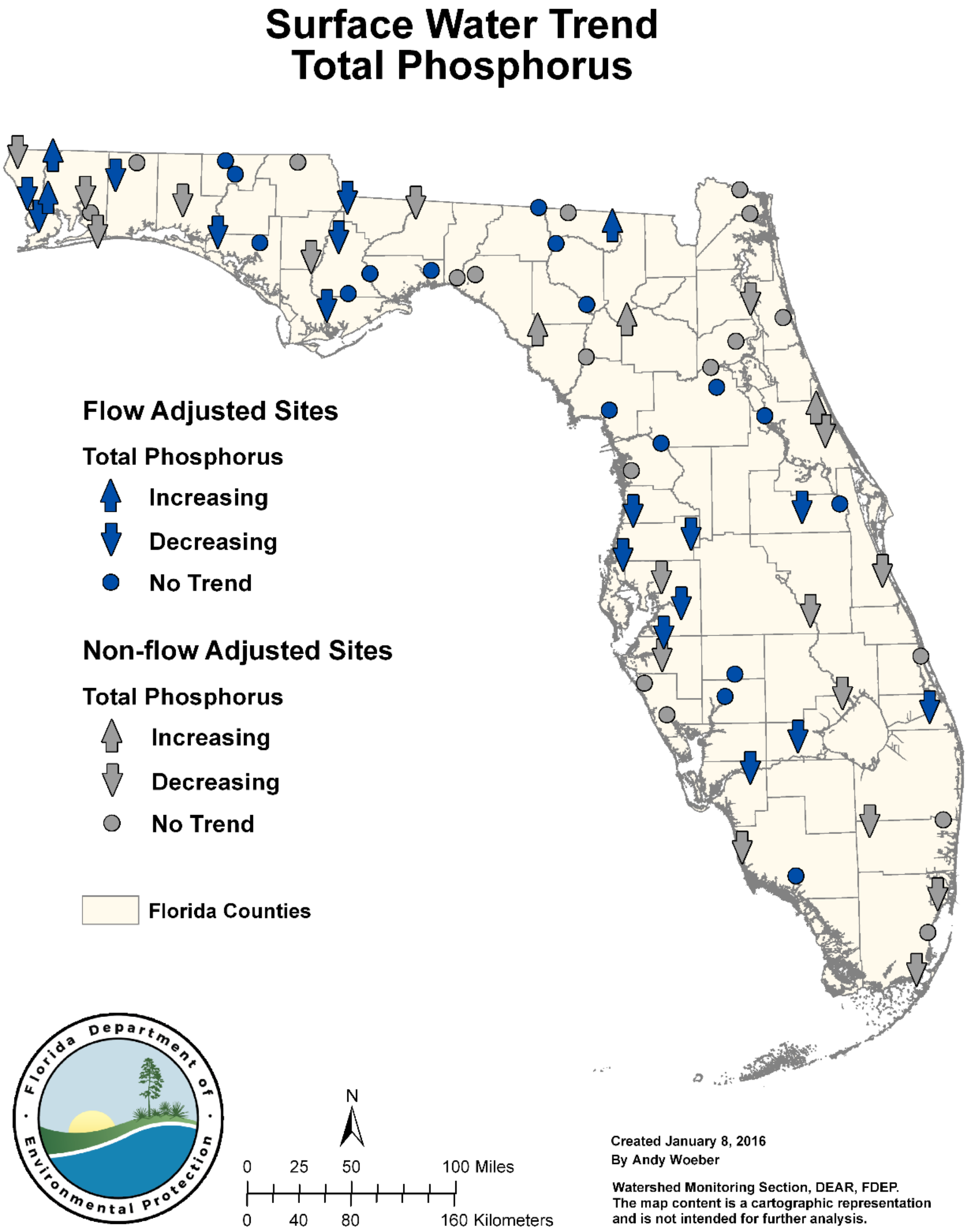


Figure 5.22. Surface water trends for TP, 1999–2014

Highlights

— TP had 6 stations with increasing trends and 33 stations with decreasing trends across the state. Phosphorus is found naturally in ground water in many areas of the state.

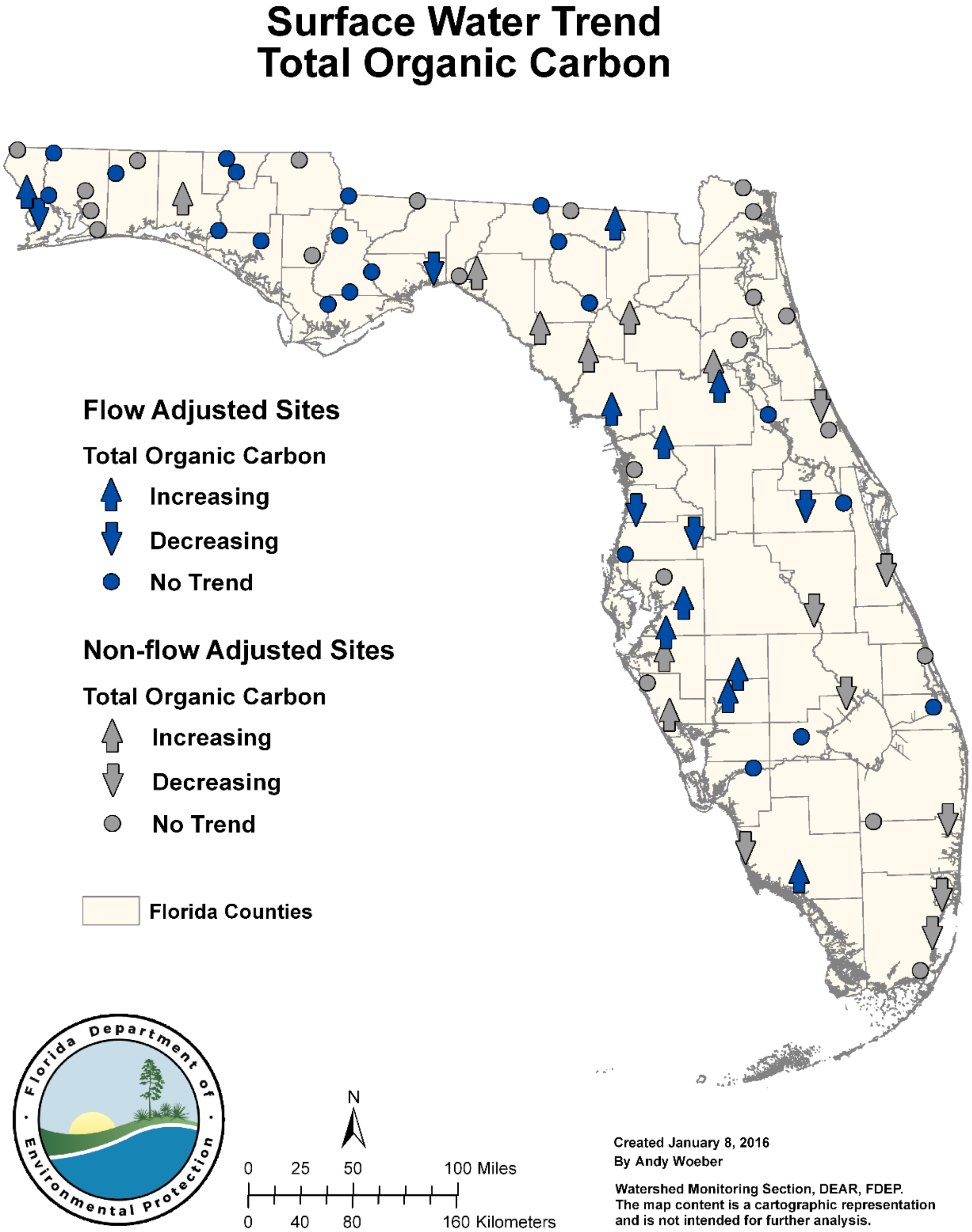


Figure 5.23. Surface water trends for TOC, 1999–2014

Highlights

- There were 17 stations with increasing trends and 13 stations with decreasing trends for TOC across the state.

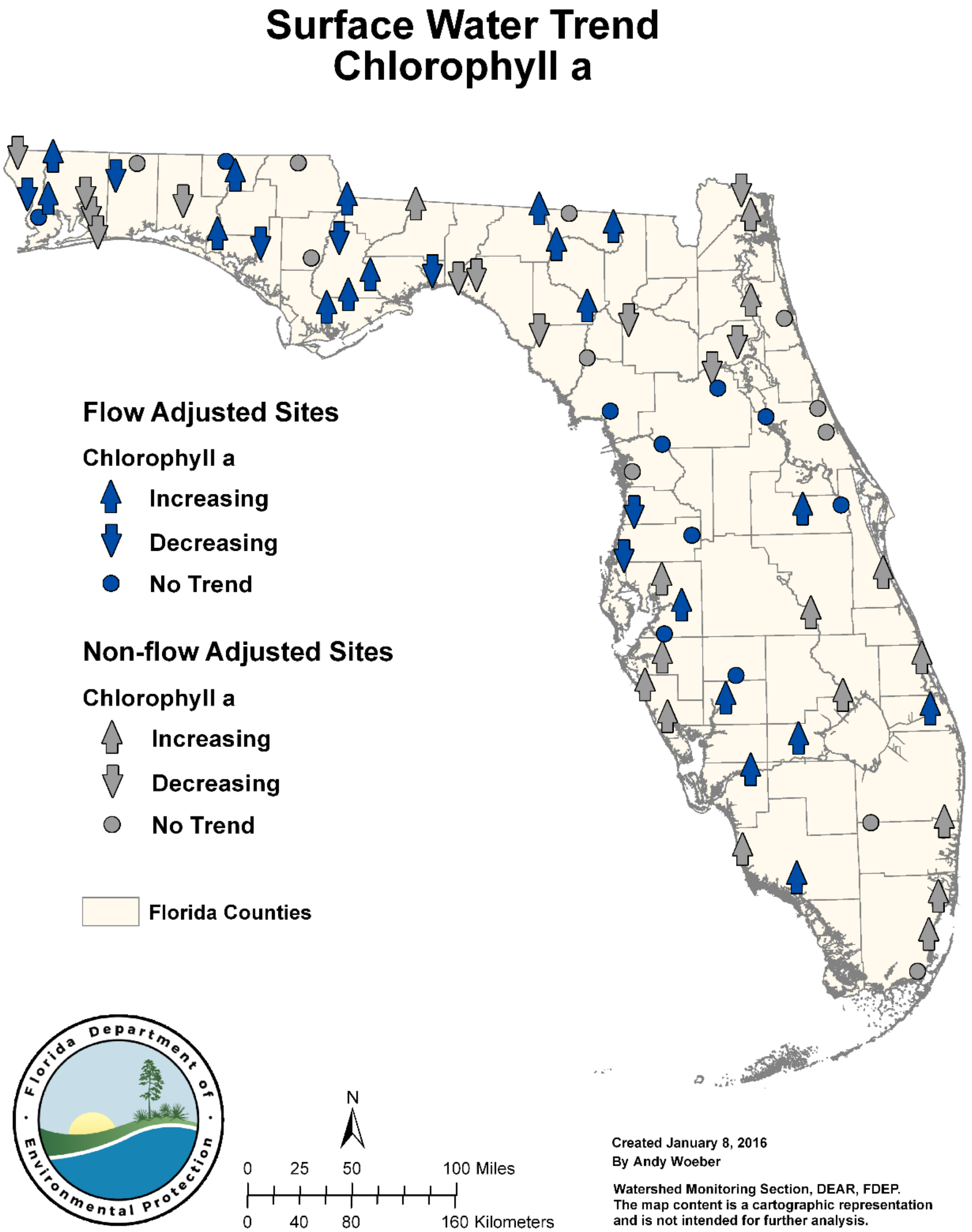


Figure 5.24. Surface water trends for chlorophyll *a*, 1999–2014

Highlights

- The trends for chlorophyll a were mixed, with 33 stations having an increasing trend and 19 stations a decreasing trend. Chlorophyll a is a photosynthetic pigment and may be used as a surrogate indicator of changes in plant biomass related to nutrients.

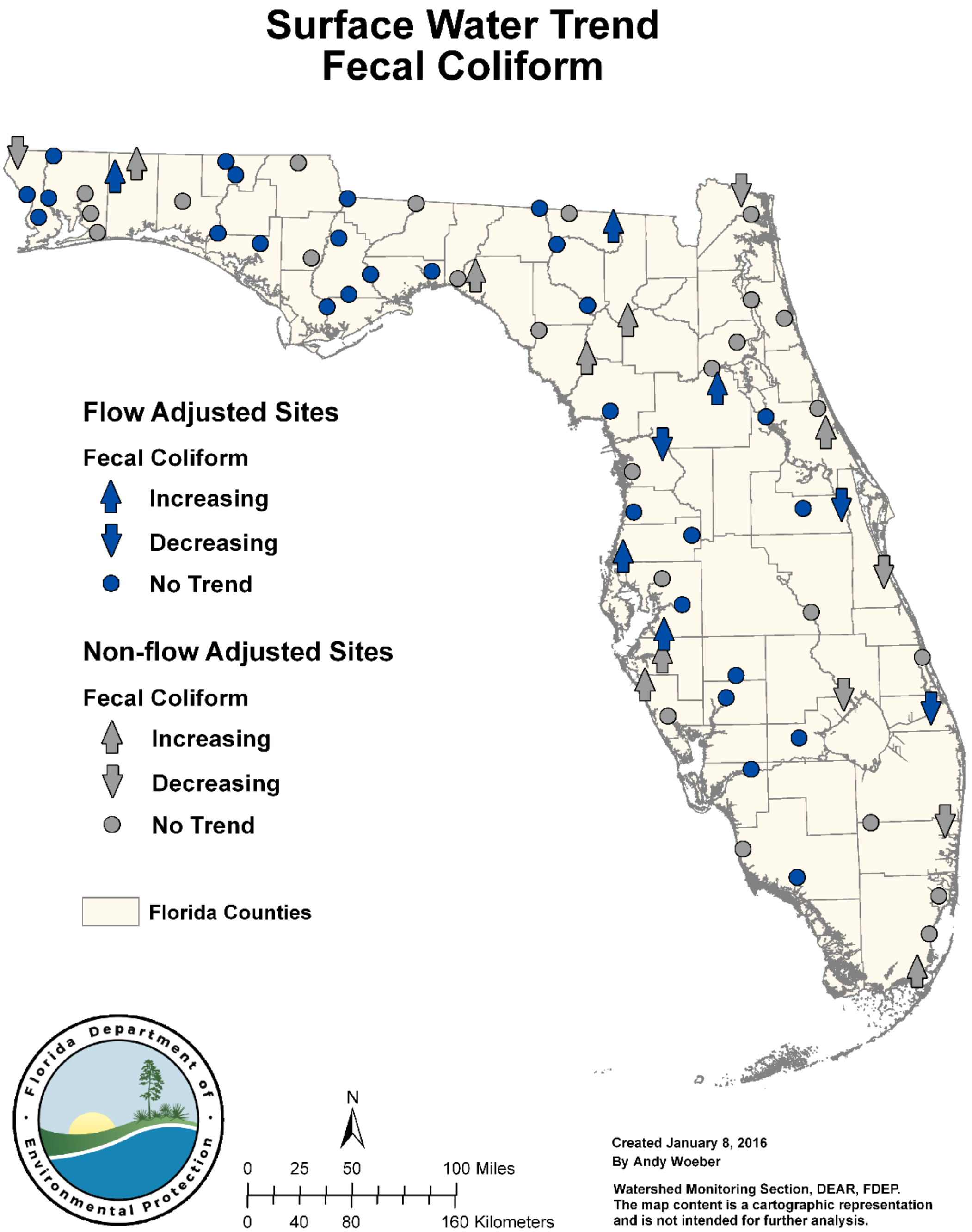
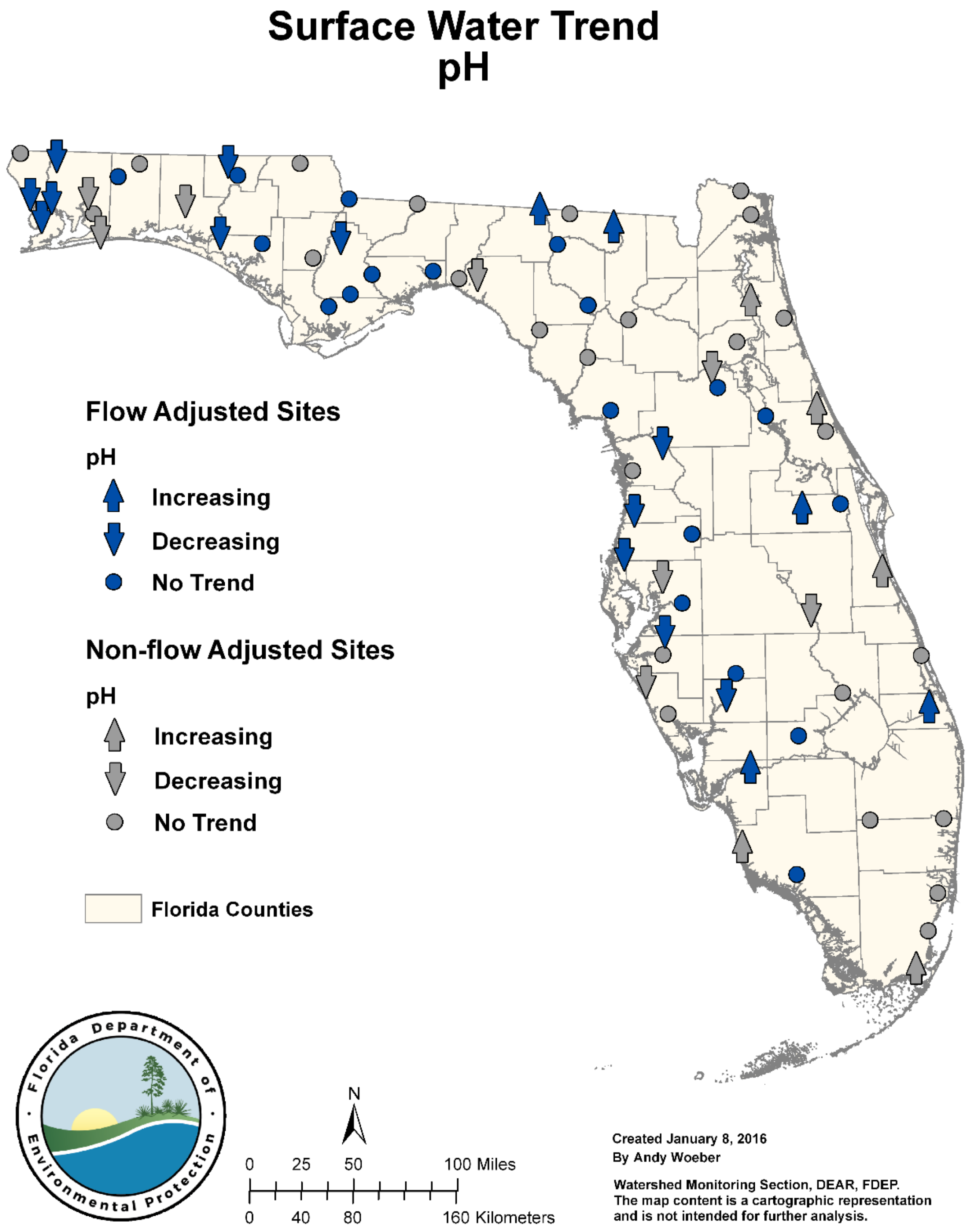


Figure 5.25. Surface water trends for fecal coliform bacteria, 1999–2014

Highlights

— There were 13 stations with an increasing trend for fecal coliform bacteria and 8 stations with a decreasing trend. Increased levels of fecal coliform in surface waters can indicate inadequate treatment of domestic wastewater, sewer line spills, or failing septic tanks; however, there are also many natural sources of coliform, and the EPA no longer supports the use of fecal coliform as an indicator organism.



Created January 8, 2016
By Andy Woeber

Watershed Monitoring Section, DEAR, FDEP.
The map content is a cartographic representation and is not intended for further analysis.

Figure 5.26. Surface water trends for pH, 1999–2014

Highlights

— There were 10 stations with increasing trends and 20 stations with decreasing trends for pH around the state.

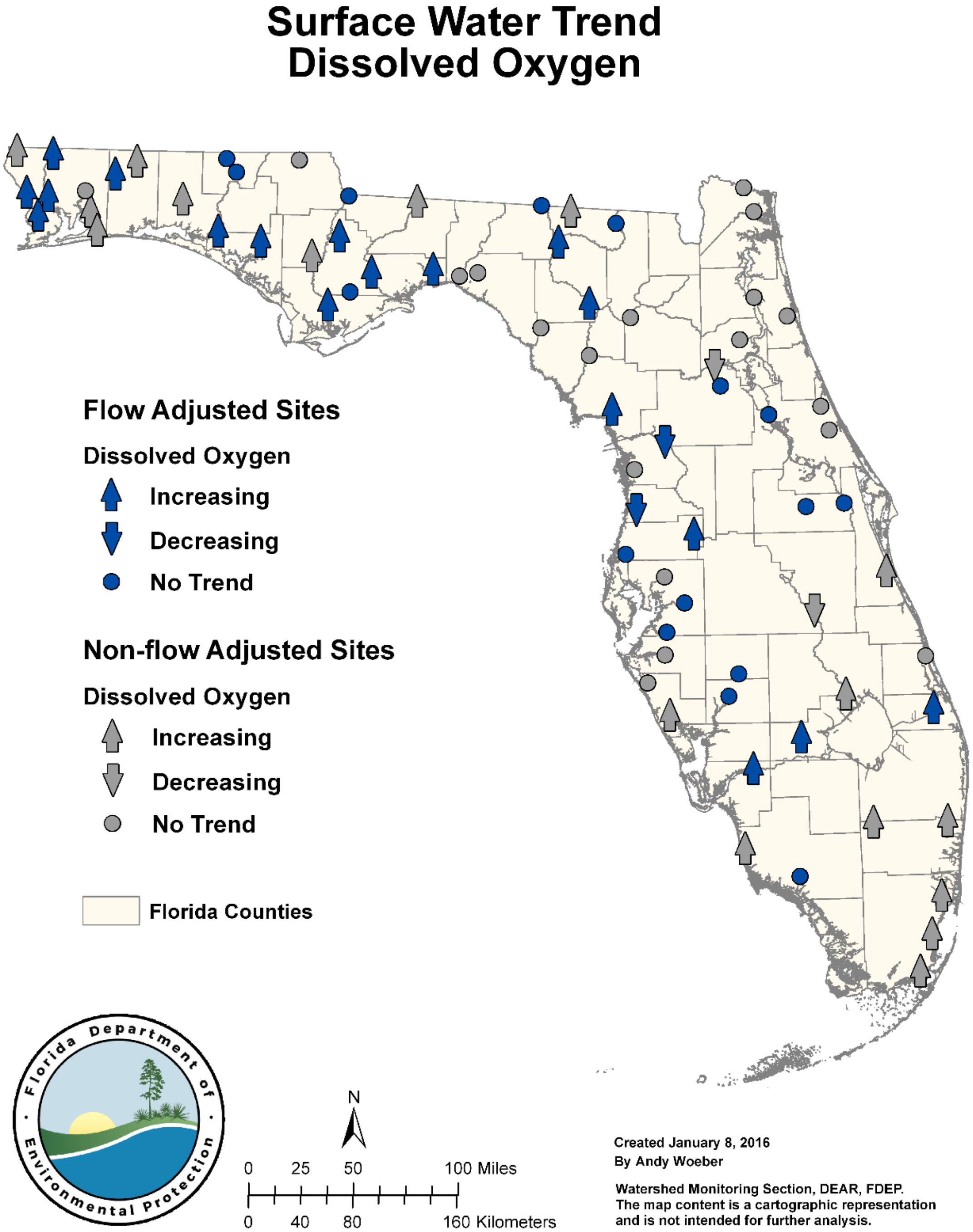


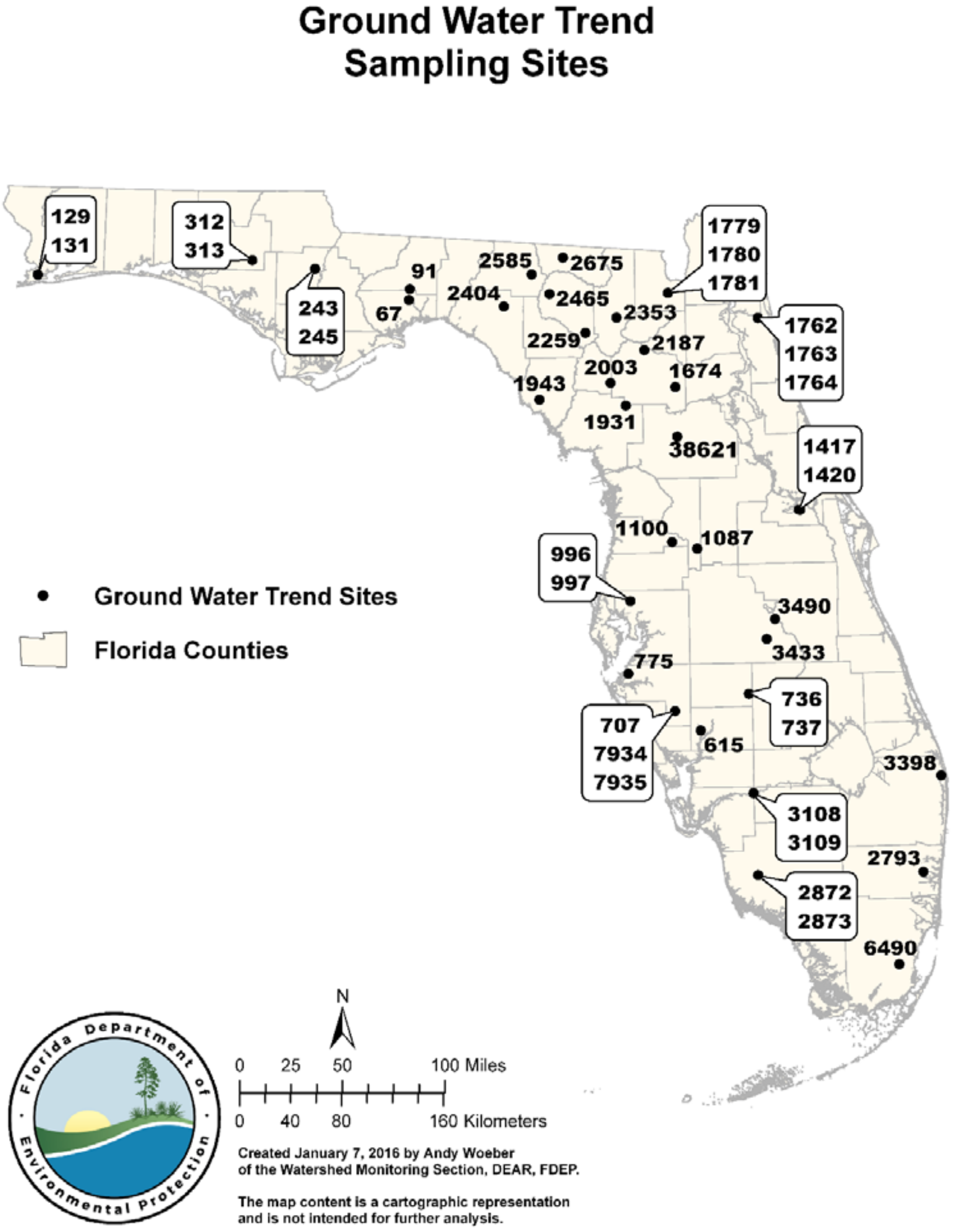
Figure 5.27. Surface water trends for DO, 1999–2014

Highlights

- There were 35 stations with an increasing trend for DO concentrations and 4 stations with a decreasing trend.

Ground Water Trends

The Ground Water Trend Network consists of 49 fixed sites that are used to obtain chemistry and field data in confined and unconfined aquifers; however, only 48 stations had sufficient data for analysis (**Figure 5.28**).



Created January 7, 2016 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.28. Ground Water Trend Network sites with sufficient period of record

Ground water 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 the impairment or improvement of the analyte being measured in the waters.

Of the wells, 23 tap confined aquifers, while 25 tap unconfined aquifers. **Table 5.9** provides a general statewide overview of the analyses conducted on the ground water trend data (1999–2014) by indicator. For the results of the analyses by station, see **Tables 5.10a** through **5.10c**. **Tables 5.10b** and **5.10c** present the results of the trend analyses, and **Figures 5.29** through **5.48** show the results graphically for each analyte. At some locations there are multiple wells tapping different areas of the aquifers. These are shown in the figures as a bubble grouping. **Table 5.10a** contains the legend for the acronyms and abbreviations used in **Tables 5.10b** and **5.10c**.

Caution should be used when describing changes in water quality, especially on a statewide scale. It is important to note that in order to verify the changes, more detailed evaluations are needed. Nevertheless, a generalized overview of potential changes that may be occurring is also needed.

An inspection of the indicators in **Table 5.9** reveals that several appear to have gone through changes for the period from 1999 to 2014. The following methodology was used to select indicators that appear to have gone through those changes. Confined and unconfined aquifers were combined into one category (ground water), and all sites not displaying significant trends were discarded from further discussion. For each analyte, the percentage of sites with increasing trends was compared with the percentage of sites with decreasing trends, and the direction of change with the greatest percentage was noted (this direction is referred to as the strong direction). The number of sites with trends in the strong direction was divided by the total number of sites that displayed trends, and a subjective cutoff was set at 67%. If the percent of sites with trends in the strong direction was less than 67%, the analyte was not selected for further discussion. Based on this process, changes in the following analytes are apparent. Concentrations of calcium (Ca), magnesium (Mg), alkalinity (Alk), specific conductance (SC), sodium (Na), chloride (Cl), potassium (K), total Kjeldahl nitrogen (TKN), and DO are increasing, and temperature (Temp) and pH are decreasing.

Table 5.9. Ground water trend summary (1999–2014)

Note: Unconfined aquifer percentages were calculated based on a sample size of 25 stations. Confined aquifer percentages were calculated based on a sample size of 23 stations.

Indicator	Confined Aquifers, % Increasing	Confined Aquifers, % Decreasing	Confined Aquifers, % No Trend	Confined Aquifers, % Insufficient Data	Unconfined Aquifers, % Increasing	Unconfined Aquifers, % Decreasing	Unconfined Aquifers, % No Trend	Unconfined Aquifers, % Insufficient Data
Temperature	13%	22%	65%	0%	12%	56%	32%	0%
Specific Conductance	44%	17%	39%	0%	60%	24%	16%	0%
DO	39%	4%	57%	0%	64%	8%	28%	0%
pH	17%	35%	48%	0%	20%	48%	32%	0%
Depth to Water	9%	0%	87%	4%	0%	36%	60%	4%
Total Dissolved Solids	17%	22%	61%	0%	32%	8%	56%	4%
Total Organic Carbon	9%	13%	78%	0%	8%	20%	68%	4%
Nitrate + Nitrite	0%	4%	91%	5%	8%	8%	80%	4%
Total Kjeldahl Nitrogen	17%	4%	74%	4%	32%	0%	64%	4%
Ortho Phosphate	17%	22%	57%	4%	12%	20%	64%	4%
Total Phosphorus	17%	17%	61%	5%	8%	20%	68%	4%
Potassium	35%	0%	61%	4%	48%	0%	48%	4%
Sulfate	17%	9%	70%	4%	20%	20%	56%	4%
Sodium	48%	0%	48%	4%	24%	12%	60%	4%
Chloride	39%	0%	57%	4%	32%	16%	48%	4%
Calcium	17%	4%	74%	5%	28%	8%	60%	4%
Magnesium	39%	0%	57%	4%	40%	8%	48%	4%
Alkalinity	9%	0%	91%	0%	24%	12%	60%	4%
Total Coliform	0%	0%	100%	0%	8%	0%	88%	4%
Fecal Coliform	0%	0%	100%	0%	0%	0%	96%	4%

Table 5.10a. Legend for the acronyms and abbreviations used in Tables 5.10b and 5.10c

Acronym/Abbreviation	Indicator
Temp	Temperature (°C)
SC	Specific Conductance, Field
DO	Dissolved Oxygen, Field
pH	pH, Field
DTW	Depth to Water (from measuring point)
TDS	Total Dissolved Solids (TDS measured)
TOC	Total Organic Carbon
NO_X	Nitrate + Nitrite, Dissolved (as N)
TKN	Total Kjeldahl Nitrogen, Dissolved (as N)
Ortho P	Orthophosphate, Dissolved (as P)
P	Phosphorus, Dissolved (as P)
K	Potassium, Dissolved
SO_4	Sulfate, Dissolved
Na	Sodium, Dissolved
Cl	Chloride, Dissolved
Ca	Calcium, Dissolved
Mg	Magnesium, Dissolved
ALK	Alkalinity, Dissolved (as calcium carbonate [$CaCO_3$])
TC	Coliform, Total (MF method)
FC	Coliform, Fecal (MF method)

Table 5.10b. Trends for specified analytes for stations in the Ground Water Trend Monitoring Network, confined aquifers

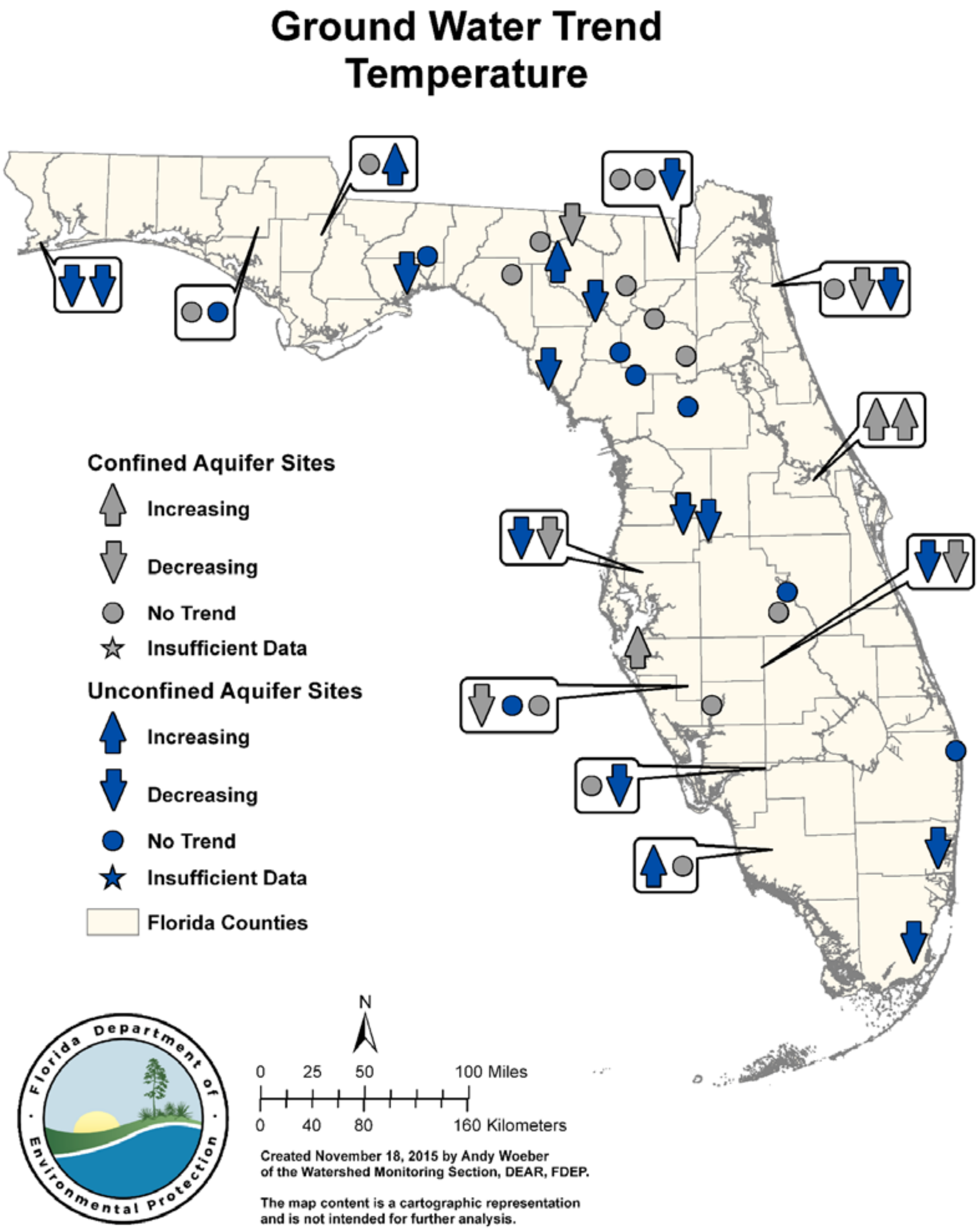
Note: A positive trend is indicated with a plus sign (+), a negative trend is indicated with a minus sign (-), no trend is indicated by a zero (o), and insufficient data to determine a trend is indicated by (ISD). Unless otherwise noted, based on data collected between January 1999 and January 2015.

Station	Temp	SC	DO	pH	DTW	TDS	TOC	NO_X	TKN	Ortho P	P	K	SO_4	Na	Cl	Ca	Mg	ALK	TC	FC
243	0	+	0	-	0	+	0	-	0	0	0	0	-	+	0	0	+	0	0	0
312	0	+	0	-	0	+	-	0	0	+	+	+	0	0	+	+	+	0	0	0
615	0	0	+	0	+	0	0	0	0	-	-	+	0	+	+	0	+	0	0	0
707	-	+	+	-	0	+	0	0	0	-	0	+	0	0	0	0	0	0	0	0
737	-	+	+	-	0	0	0	0	0	-	-	+	0	+	+	0	+	0	0	0
775	+	-	0	-	0	0	0	0	0	+	0	0	0	+	0	0	+	0	0	0
997	-	0	+	-	0	-	0	0	+	0	0	0	0	+	0	0	+	0	0	0
1417	+	+	0	0	0	+	+	0	+	+	+	+	-	+	0	+	+	+	0	0
1420	+	0	0	+	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0	0
1674	0	0	-	-	0	0	0	0	+	0	0	0	+	+	+	-	0	+	0	0
1762	0	0	0	+	0	0	0	0	0	0	0	+	0	+	+	0	+	0	0	0
1763	-	+	0	+	0	-	0	0	0	0	+	+	+	+	+	+	0	0	0	0
1779	0	0	0	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0
1780	0	-	0	0	0	0	0	0	0	-	0	0	0	0	0	0	0	0	0	0
2187	0	-	0	0	+	0	-	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	0	0	0
2353	0	+	0	0	0	0	0	0	0	+	0	0	+	+	0	+	+	0	0	0
2404	0	0	0	0	0	-	0	0	0	0	+	0	0	0	+	0	0	0	0	0
2585	0	+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2675	-	+	+	0	0	0	0	0	+	0	0	+	0	0	0	0	0	0	0	0
2873	0	0	+	0	0	-	-	0	0	0	-	0	0	0	0	0	0	0	0	0
3108	0	-	+	+	0	-	0	0	0	-	0	0	0	0	0	0	0	0	0	0
3433	0	0	+	0	ISD	0	0	0	0	0	0	0	0	0	+	0	0	0	0	0
7935	0	+	+	-	0	0	+	0	0	0	0	0	+	+	+	0	0	0	0	0

Table 5.10c. Trends for specified analytes for stations in the Ground Water Trend Monitoring Network, unconfined aquifers

Note: A positive trend is indicated with a plus sign (+), a negative trend is indicated with a minus sign (-), no trend is indicated by zero (0), and insufficient data to determine a trend is indicated by (ISD). Unless otherwise noted, based on data collected between Jan. 1999 and Jan. 2015. * = collected between July 2010 and January 2015.

Station	Temp	SC	DO	pH	DTW	TDS	TOC	NO_X	TKN	Ortho P	P	K	SO_4	Na	Cl	Ca	Mg	ALK	TC	FC
67	-	+	-	-	ISD	0	0	-	+	0	0	0	0	0	0	0	0	0	+	0
91	0	0	+	-	0	0	0	0	+	0	0	0	0	0	0	0	0	0	0	0
129	-	+	0	0	-	0	0	0	0	0	0	0	0	+	0	0	0	0	0	0
131	-	+	0	-	-	+	0	0	+	0	0	+	0	+	+	+	0	0	0	0
245	+	+	+	-	0	0	0	0	0	0	0	+	+	+	+	0	+	0	0	0
313	0	0	+	0	0	0	0	0	0	0	0	+	0	0	0	+	+	+	0	0
736	-	-	+	-	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0
996	-	-	+	0	0	0	0	+	0	-	-	0	-	-	0	0	0	0	0	0
1087	-	0	+	-	-	0	0	0	+	0	0	0	+	0	0	0	+	0	0	0
1100	-	+	+	-	0	+	-	0	+	0	0	0	+	0	+	+	+	0	0	0
1764	-	+	0	+	0	0	+	0	0	+	+	+	-	0	+	+	-	0	0	0
1781	-	-	+	-	-	-	0	+	0	-	-	0	0	+	-	-	0	-	0	0
1931	0	+	-	-	0	+	0	0	0	+	0	+	+	+	+	+	+	+	0	0
1943	-	+	0	0	0	0	0	0	+	0	0	+	-	0	0	0	+	0	0	0
2003	0	+	0	-	0	0	0	0	+	+	+	0	0	0	0	0	+	+	+	0
2259	-	+	0	-	-	+	-	0	+	0	0	+	0	0	0	+	+	0	0	0
2465	+	+	+	0	-	+	0	-	0	0	0	+	0	0	-	0	+	0	0	0
2793	-	+	+	-	-	+	0	0	0	0	0	0	-	0	+	0	0	0	0	0
2872	+	-	+	+	0	0	-	0	0	-	0	+	-	0	+	0	0	0	0	0
3109	-	+	+	+	0	+	-	0	0	-	0	+	+	+	+	0	+	+	0	0
3398	0	+	+	0	-	0	-	0	0	-	-	0	0	0	0	-	0	-	0	0
3490	0	-	+	0	0	0	0	0	0	0	-	+	0	-	-	0	-	+	0	0
6490	-	-	+	+	0	0	0	0	0	0	-	0	0	0	0	0	0	-	0	0
7934	0	0	+	+	0	+	+	0	0	0	0	+	0	-	-	+	0	+	0	0
38621*	0	+	0	0	-	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD	ISD



Created November 18, 2015 by Andy Woeber of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation and is not intended for further analysis.

Figure 5.29. Ground water trends for temperature, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 3 stations with an increasing trend and 5 stations with a decreasing trend for temperature.
- There were 3 stations with increasing trends in the unconfined aquifer wells and 14 stations with decreasing trends.

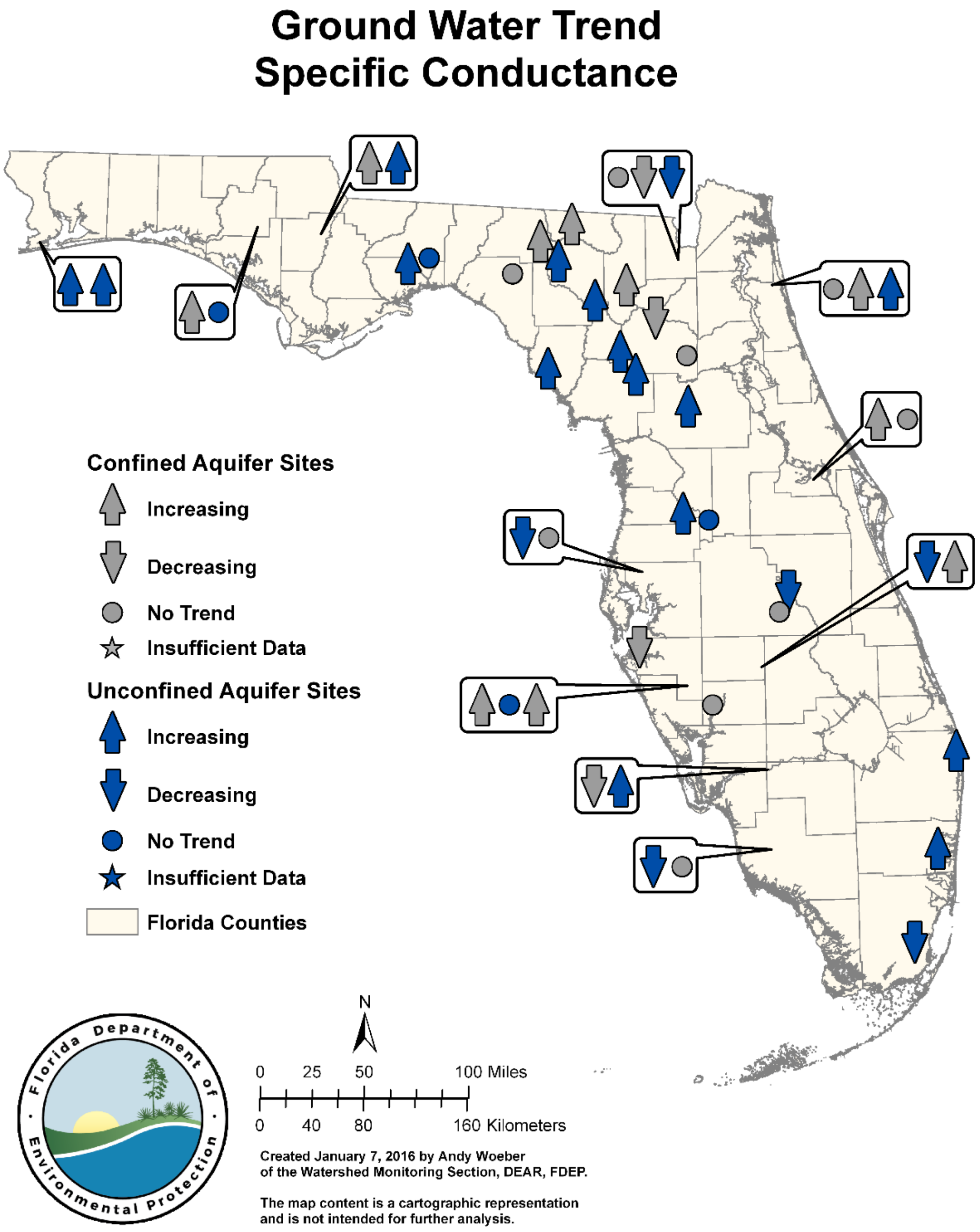


Figure 5.30. Ground water trends for specific conductance, 1999–2014

Highlights:

- — The trend analysis for the confined aquifer wells reported 10 stations with an increasing trend and 4 stations with a decreasing trend for specific conductance.
- — There were 15 stations with increasing trends in the unconfined aquifer wells and 6 stations with decreasing trends.

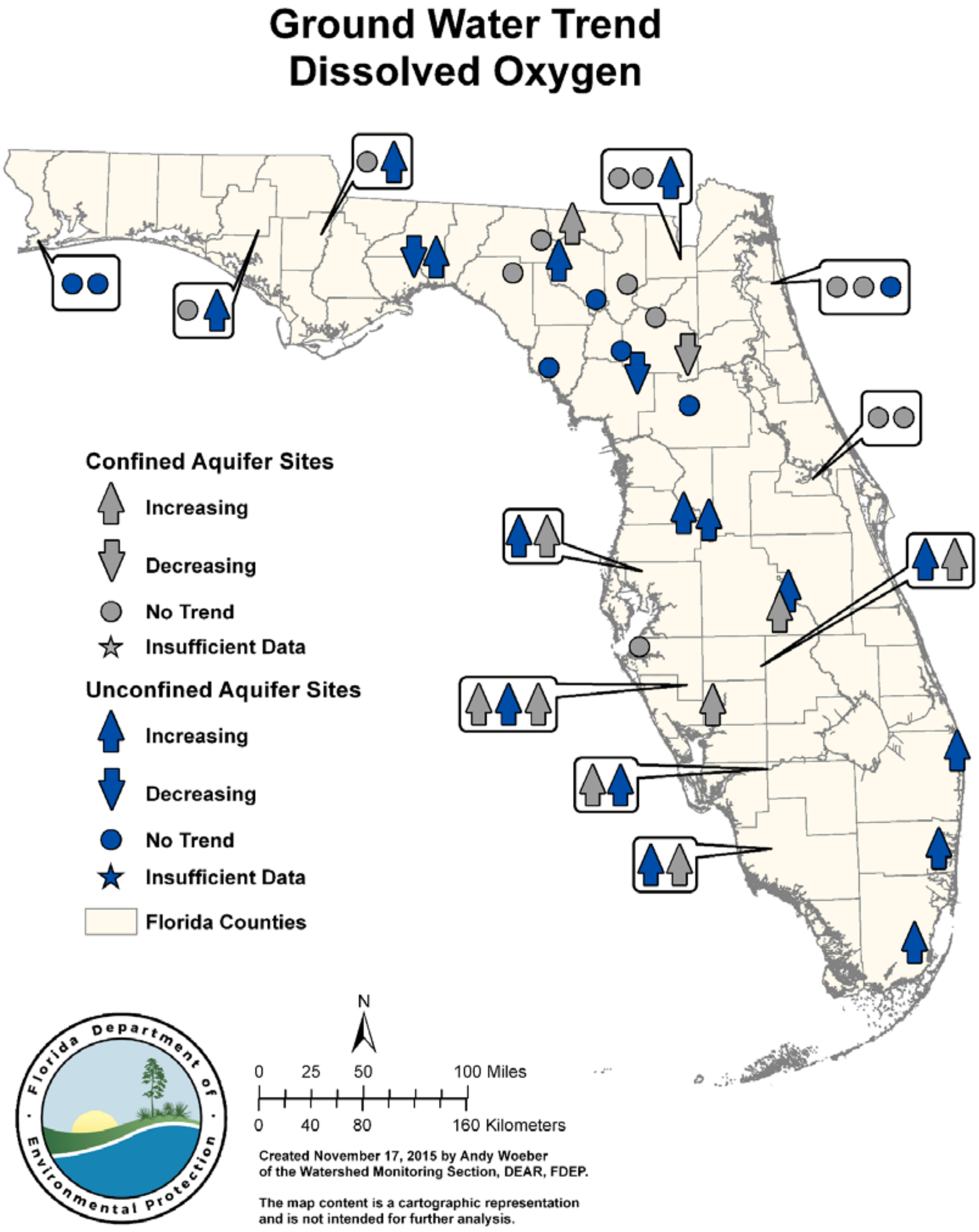
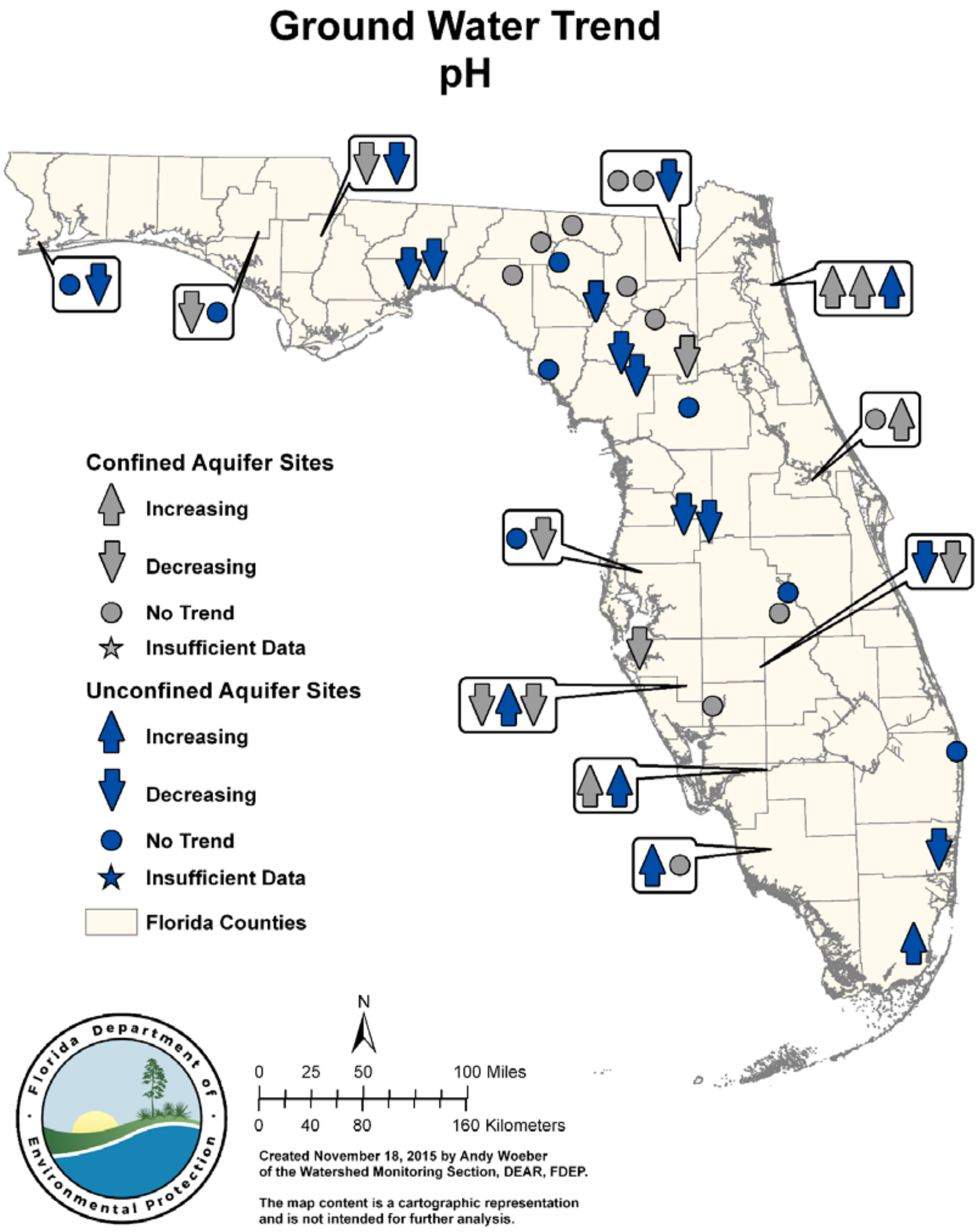


Figure 5.31. Ground water trends for DO, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 9 stations with an increasing trend and 1 stations with a decreasing trend for DO.
- There were 16 stations with increasing trends in the unconfined aquifer wells and 2 stations with decreasing trends.



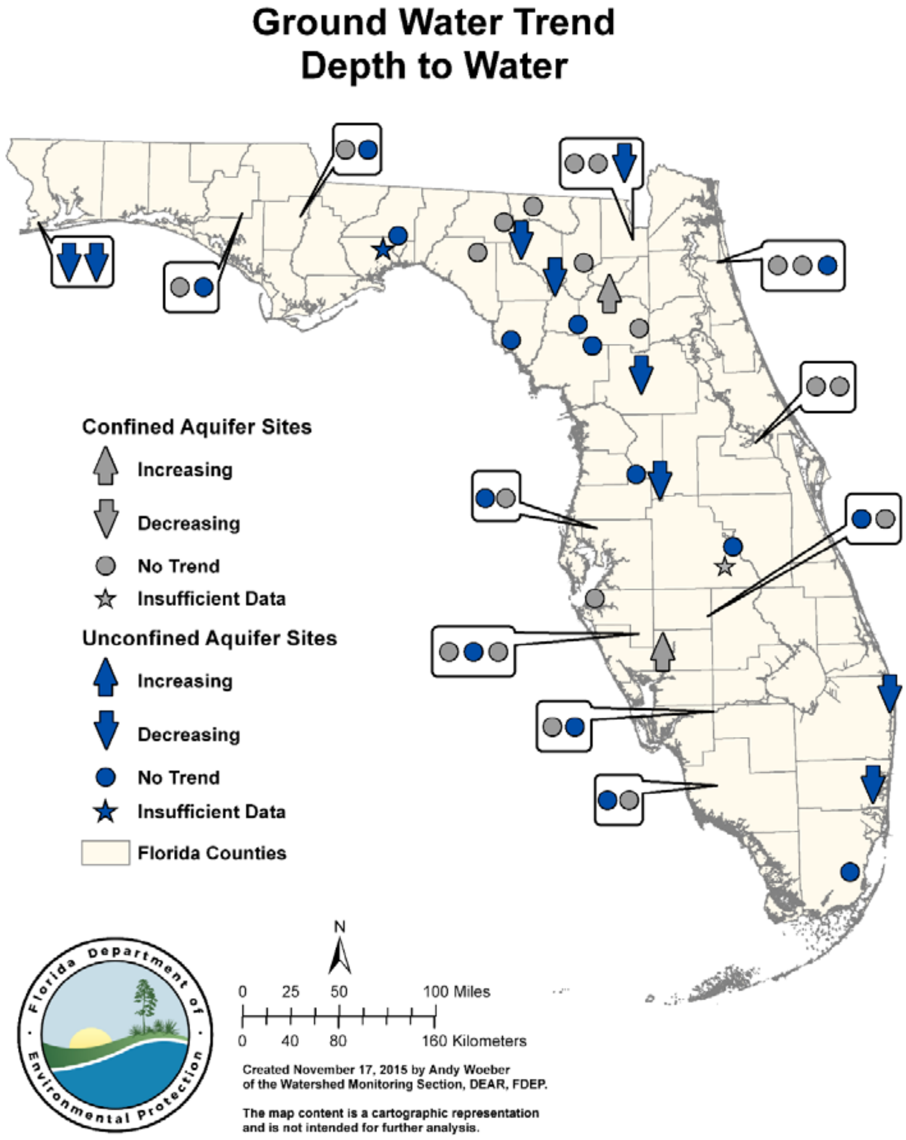
Created November 18, 2015 by Andy Woeber of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation and is not intended for further analysis.

Figure 5.32. Ground water trends for pH, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 4 stations with an increasing trend and 8 stations with a decreasing trend for pH.
- There were 5 stations with increasing trends in the unconfined aquifer wells and 12 stations with decreasing trends.



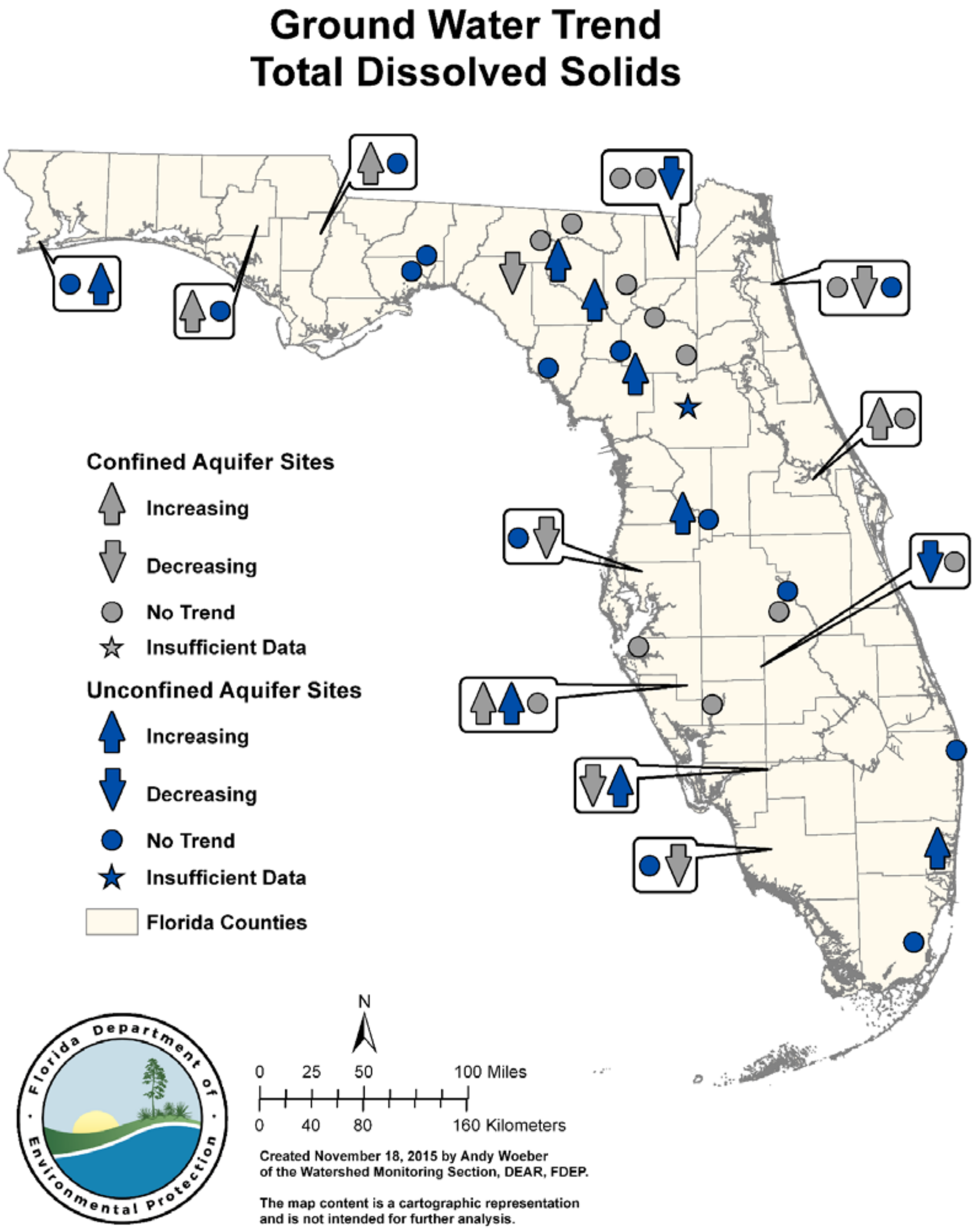
Created November 17, 2015 by Andy Woeber of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation and is not intended for further analysis.

Figure 5.33. Ground water trends for depth to water, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 2 stations with an increasing trend and no stations with decreasing trends for depth to water. One station did not have enough data to determine if a trend exists (ISD). An increasing trend indicates the water level in the well is decreasing relative to mean sea level; a decreasing trend indicates the water level in the well is increasing.
- There were no stations with an increasing trend in the unconfined aquifer wells and 9 stations with decreasing trends. One station did not have enough data to determine if a trend exists (ISD).



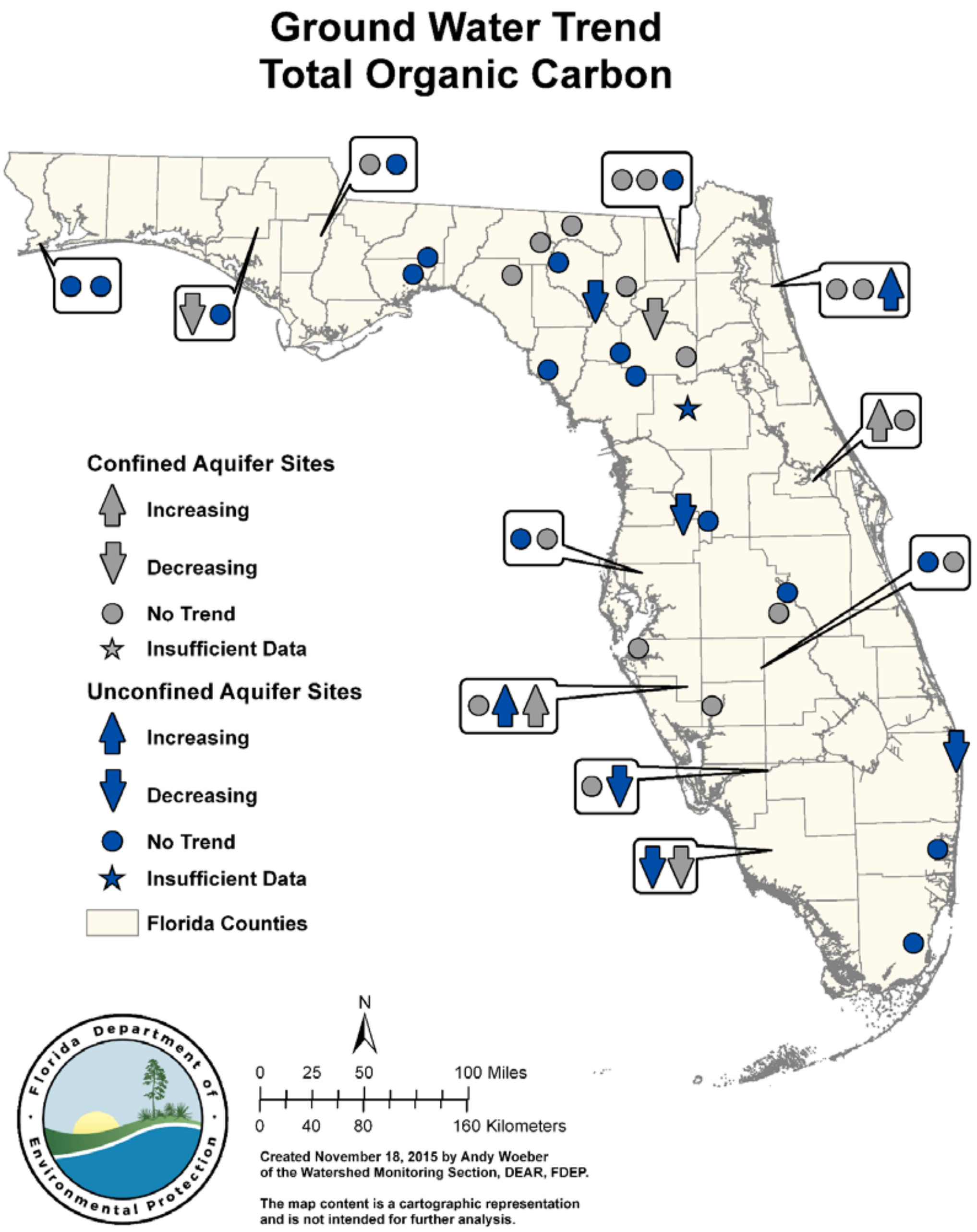
Created November 18, 2015 by Andy Woeber of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation and is not intended for further analysis.

Figure 5.34. Ground water trends for TDS, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 4 of the stations with an increasing trend and 5 stations with a decreasing trend for total dissolved solids.
- There were 8 stations with increasing trends in the unconfined aquifer wells and 2 stations with decreasing trends. One station did not have enough data to determine if a trend exists (ISD).



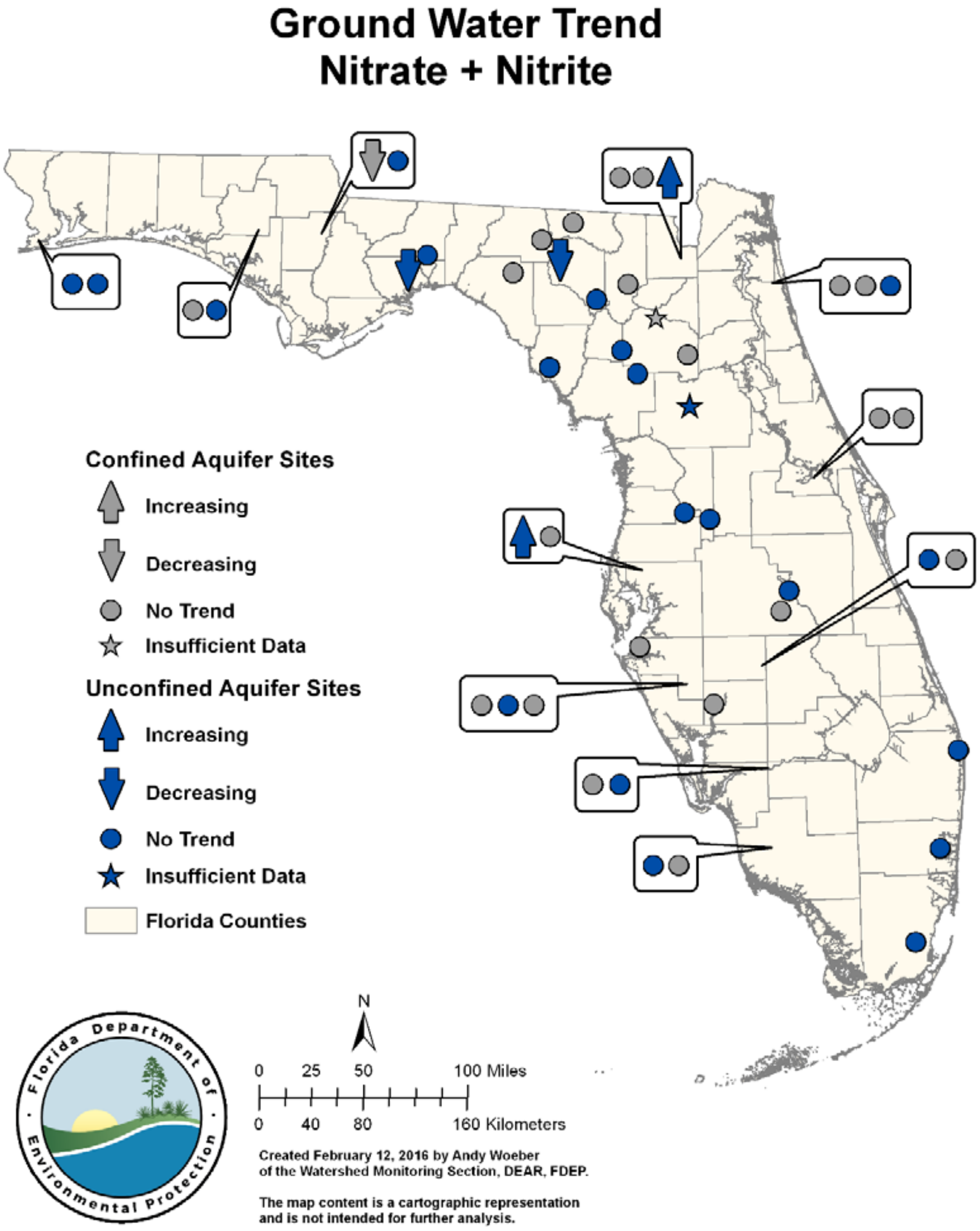
Created November 18, 2015 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.35. Ground water trends for TOC, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 2 stations with an increasing trend and 3 stations with a decreasing trend for total organic carbon.
- There were 2 stations with an increasing trend in the unconfined aquifer wells and 5 stations with a decreasing trend. One station did not have enough data to determine if a trend exists (ISD).



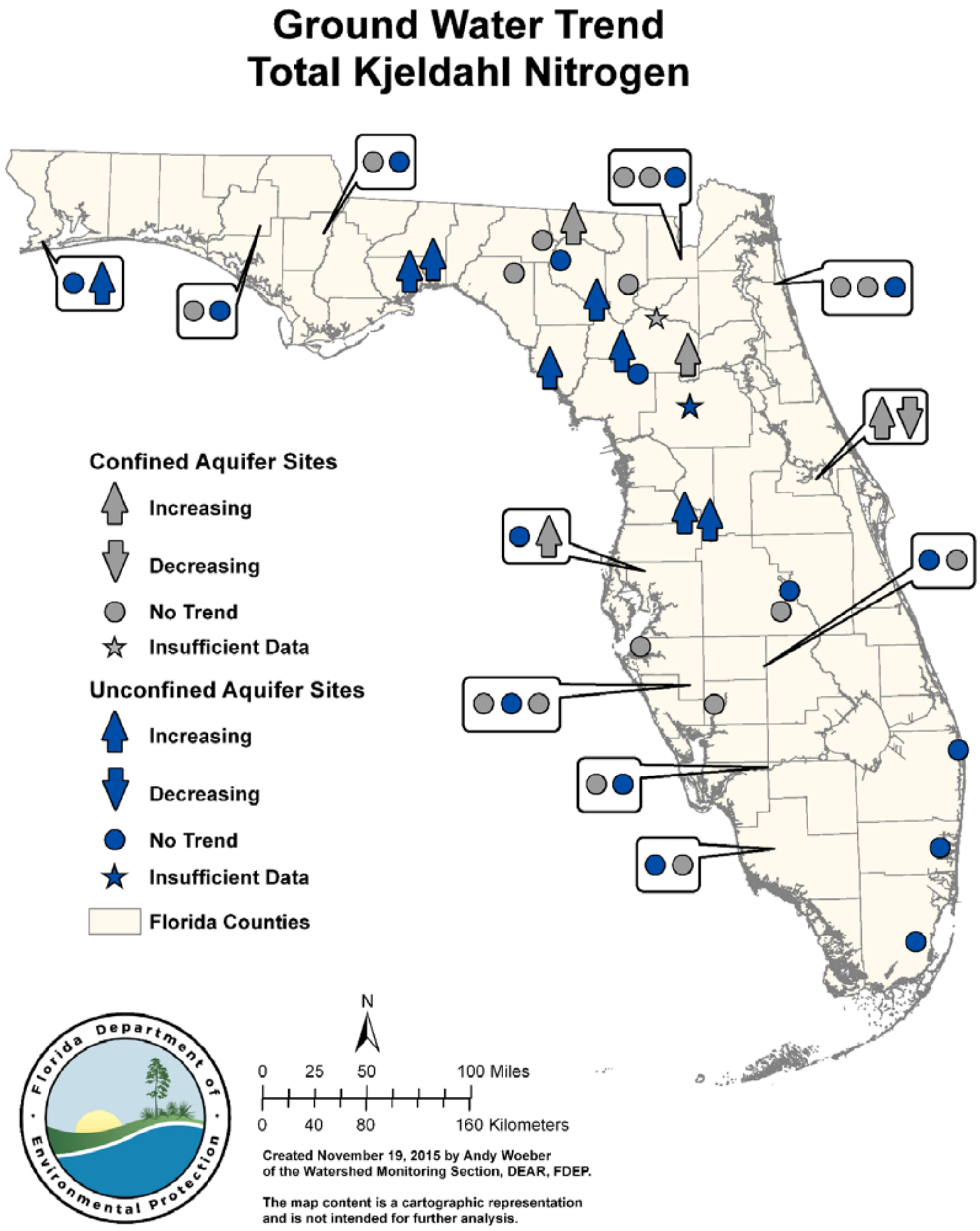
Created February 12, 2016 by Andy Woeber of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation and is not intended for further analysis.

Figure 5.36. Ground water trends for nitrate + nitrite, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported no stations with an increasing trend and 1 station with a decreasing trend for nitrate + nitrite. One station did not have enough data to determine if a trend exists (ISD).
- There were 2 stations with increasing trends in the unconfined aquifer wells and 2 stations with decreasing trends. One station did not have enough data to determine if a trend exists (ISD).



Created November 19, 2015 by Andy Woeber of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation and is not intended for further analysis.

Figure 5.37. Ground water trends for TKN, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 4 stations with increasing trends and 1 station with decreasing trends for TKN. One station did not have enough data to determine if a trend exists (ISD).
- There were 8 stations with increasing trends in the unconfined aquifer wells and no stations with decreasing trends. One station did not have enough data to determine if a trend exists (ISD).

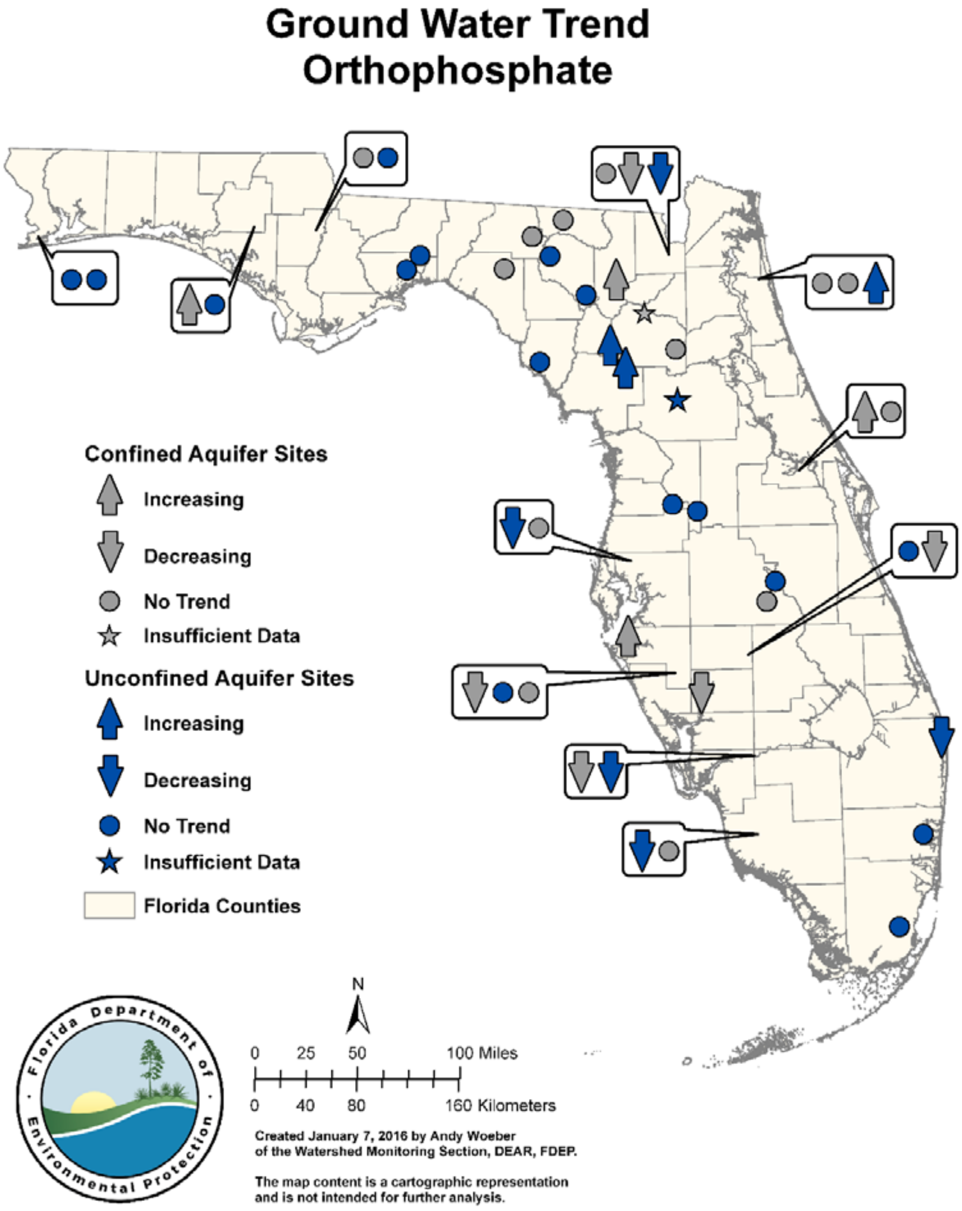


Figure 5.38. Ground water trends for orthophosphate, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 4 stations with increasing trends and 5 stations with decreasing trends for ortho phosphate. One station did not have enough data to determine if a trend exists (ISD).
- There were 3 stations with increasing trends in the unconfined aquifer wells and 5 stations with decreasing trends. One station did not have enough data to determine if a trend exists (ISD).

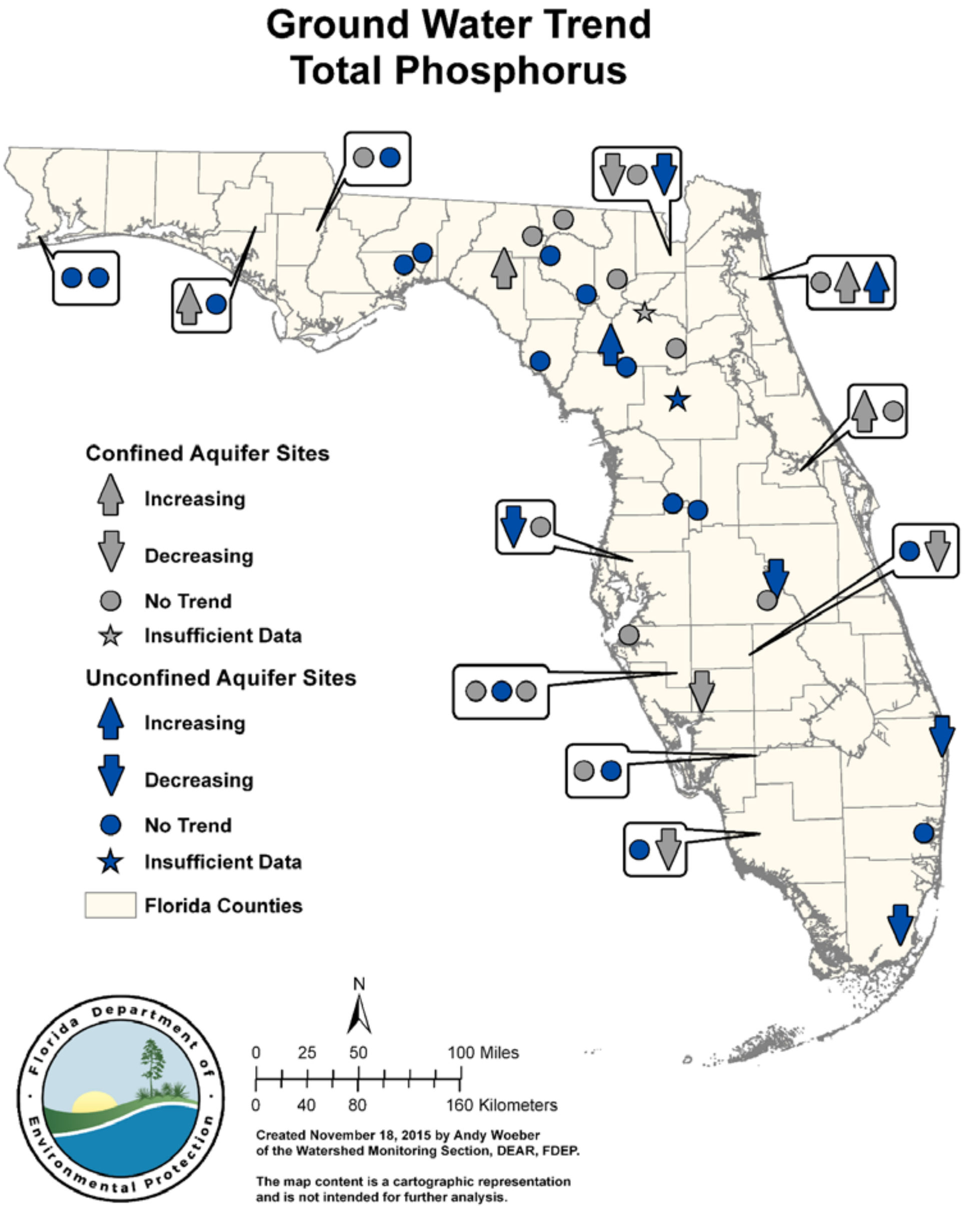
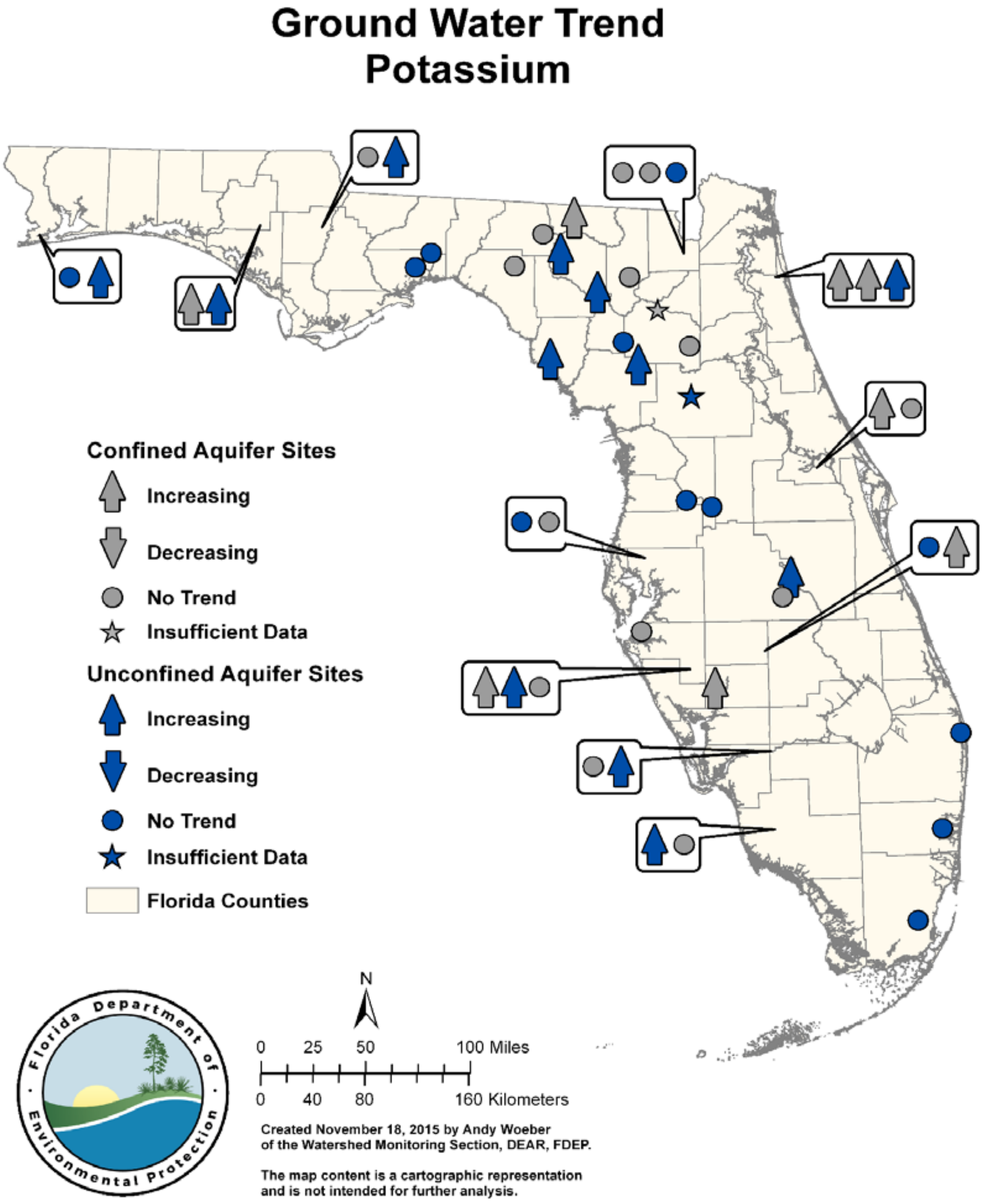


Figure 5.39. Ground water trends for phosphorus, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 4 stations with increasing trends and 4 stations with decreasing trends for phosphorus. One station had insufficient data.
- There were 2 stations with increasing trends in the unconfined aquifer wells and 5 stations with decreasing trends. One station did not have enough data to determine if a trend exists (ISD).



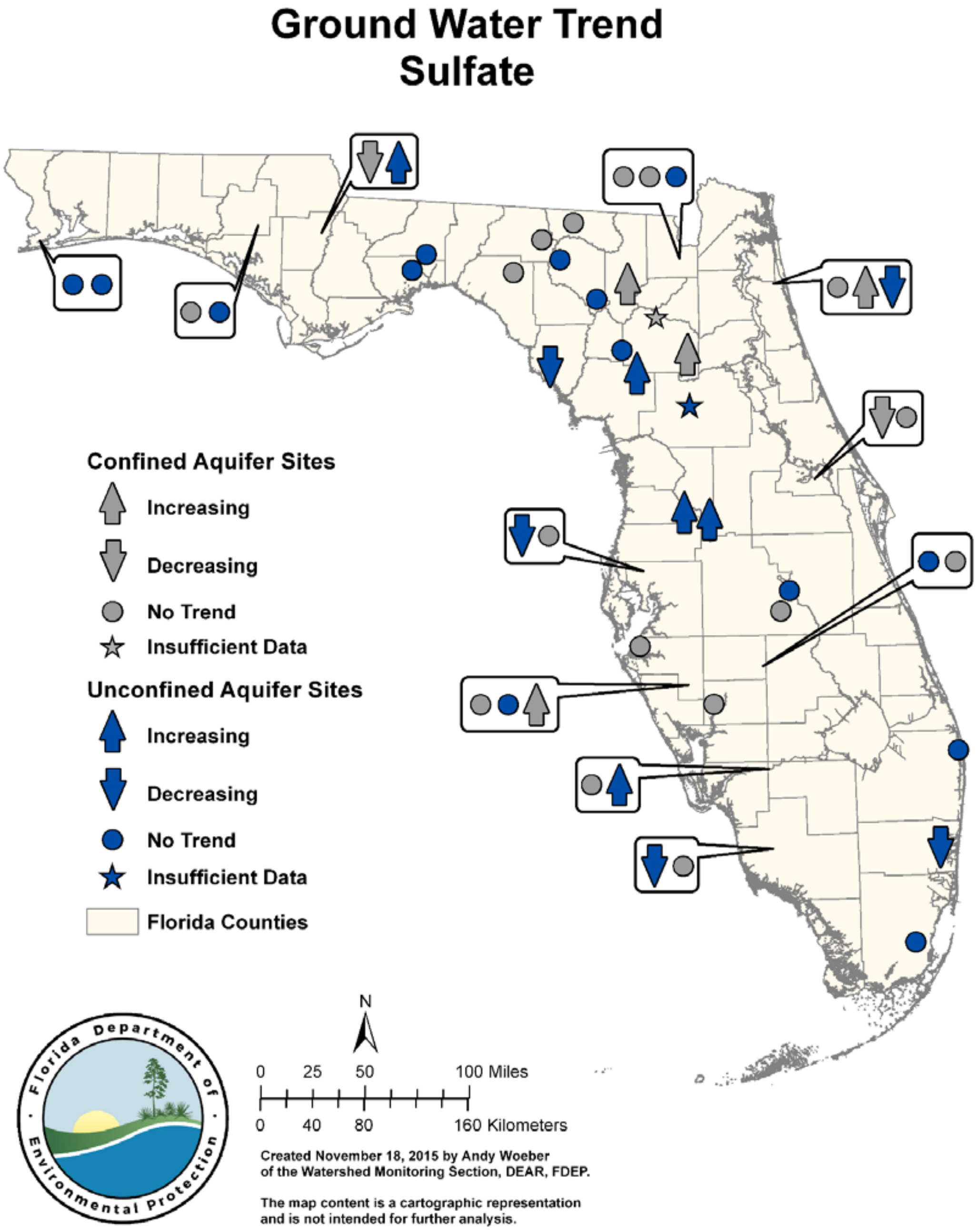
Created November 18, 2015 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.40. Ground water trends for potassium, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 12 stations with increasing trends and no stations with decreasing trends for potassium. One station had insufficient data.
- There were 8 stations with increasing trends in the unconfined aquifer wells, and no stations with decreasing trends. One station had insufficient data.



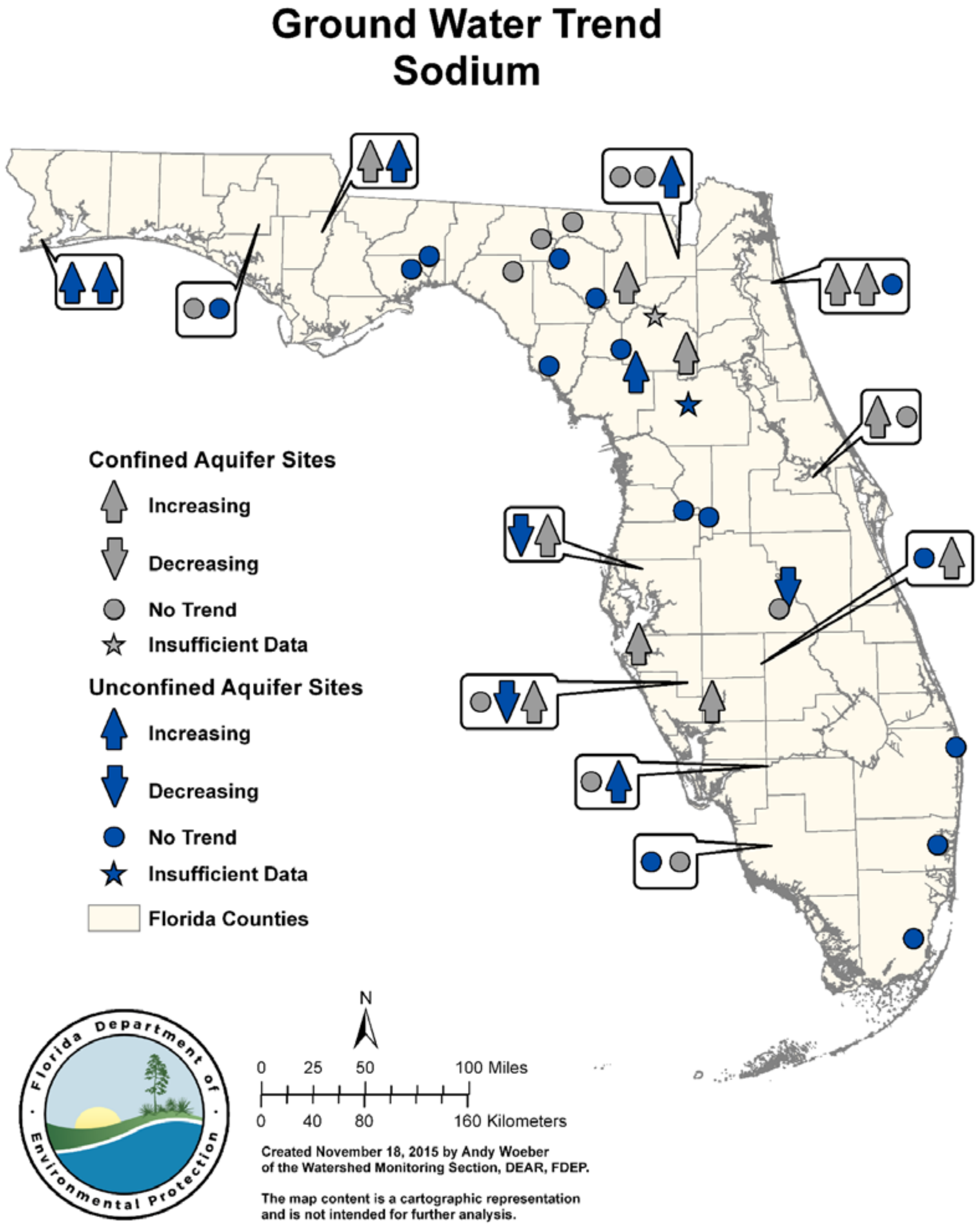
Created November 18, 2015 by Andy Woeber of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation and is not intended for further analysis.

Figure 5.41. Ground water trends for sulfate, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 4 stations with increasing trends and 2 stations with decreasing trends for sulfate. One station had insufficient data.
- There were 5 stations with increasing trends in the unconfined aquifer wells and 5 stations with decreasing trends. One station had insufficient data.



Created November 18, 2015 by Andy Woeber
of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation
and is not intended for further analysis.

Figure 5.42. Ground water trends for sodium, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 11 stations with increasing trends and no stations with decreasing trends for sodium. One station had insufficient data.
- There were 6 stations with increasing trends in the unconfined aquifer wells and 3 stations with decreasing trends. One station had insufficient data.

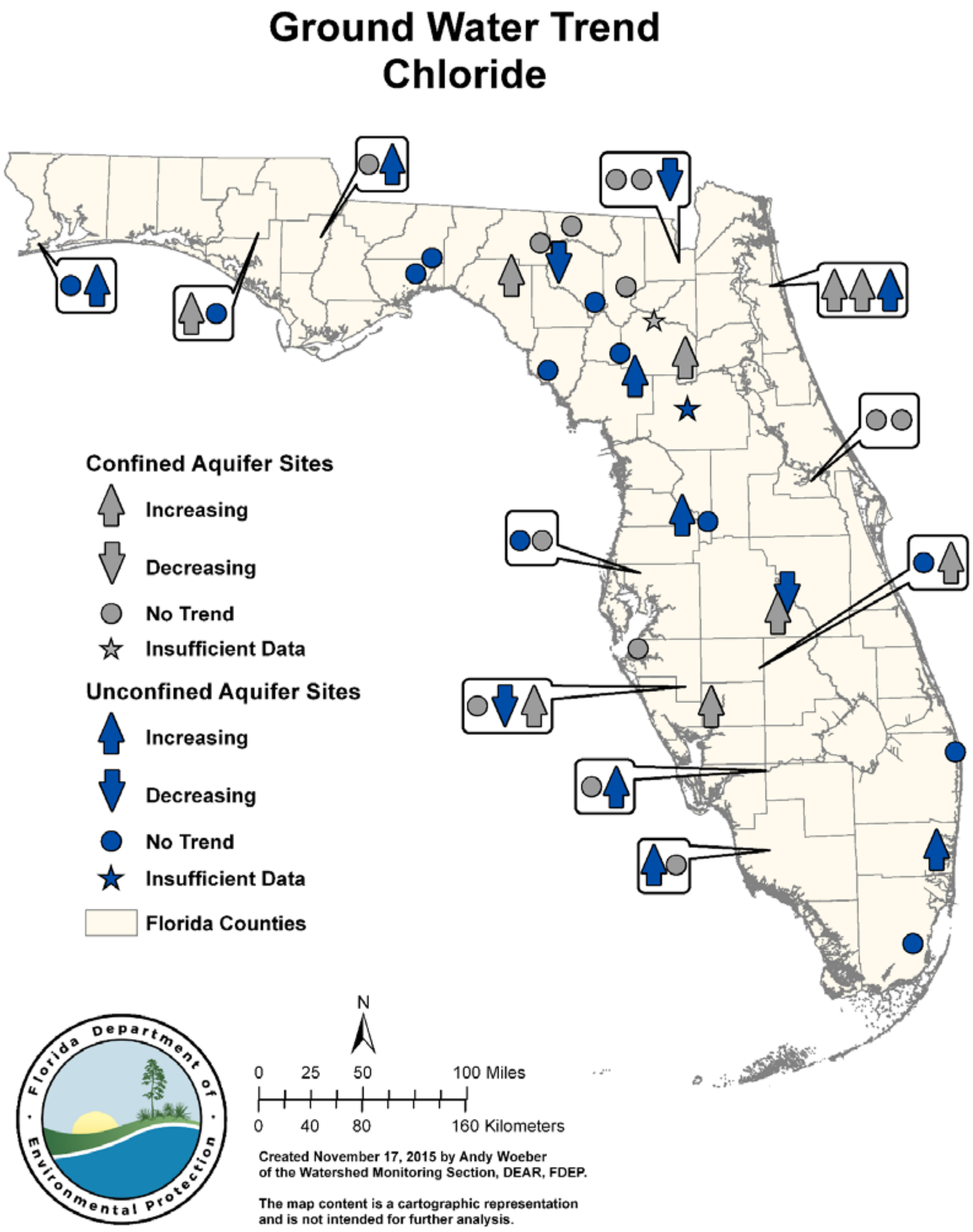
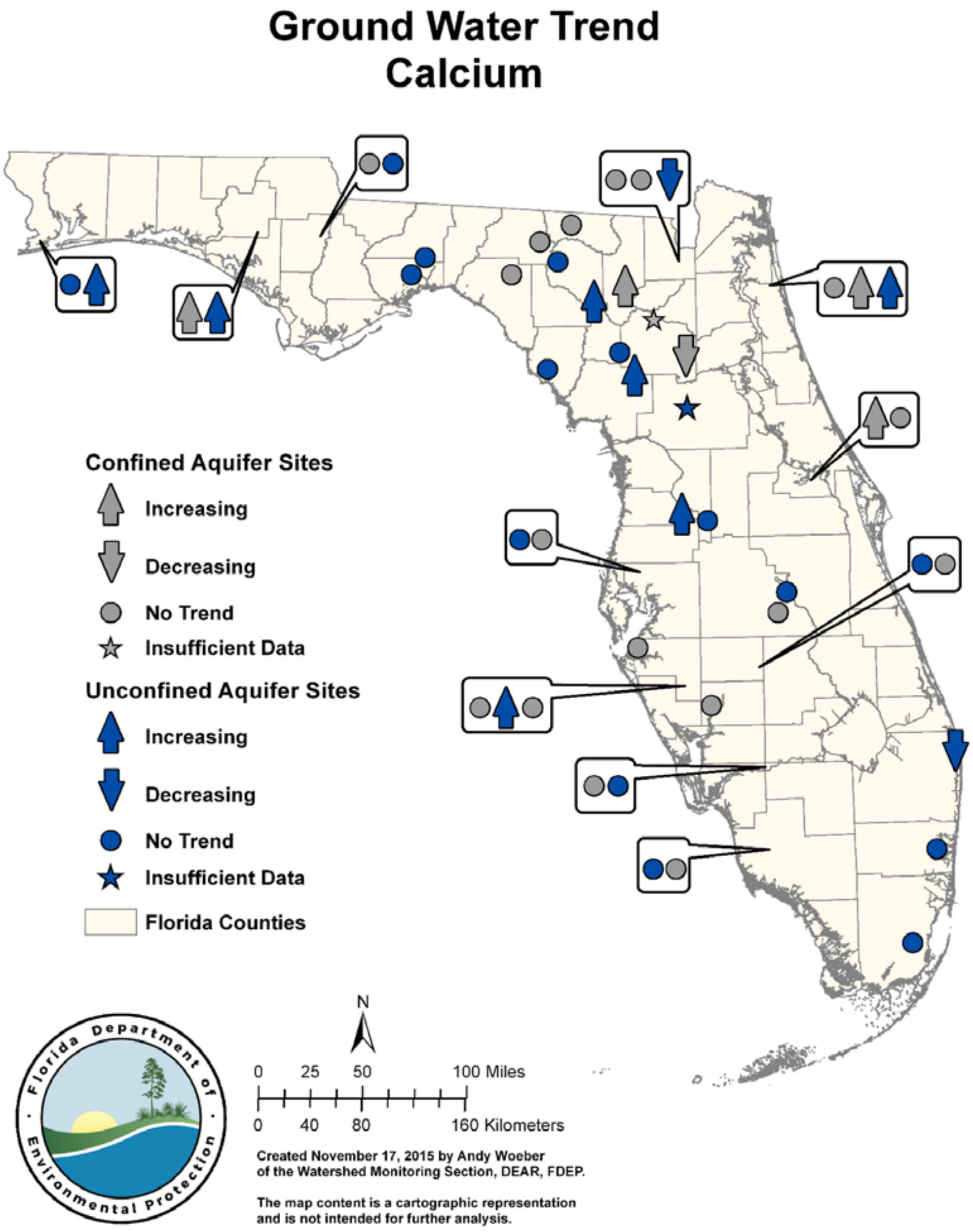


Figure 5.43. Ground water trends for chloride, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 9 stations with increasing trends and no stations with decreasing trends for chloride. One station had insufficient data.
- There were 8 stations with increasing trends in the unconfined aquifer wells and 4 stations with decreasing trends. One station had insufficient data.



Created November 17, 2015 by Andy Woeber of the Watershed Monitoring Section, DEAR, FDEP.

The map content is a cartographic representation and is not intended for further analysis.

Figure 5.44. Ground water trends for calcium, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 4 stations with increasing trends and 1 station with a decreasing trend for calcium. One station had insufficient data.
- There were 7 stations with increasing trends in the unconfined aquifer wells and 2 stations decreasing trends. One station had insufficient data.

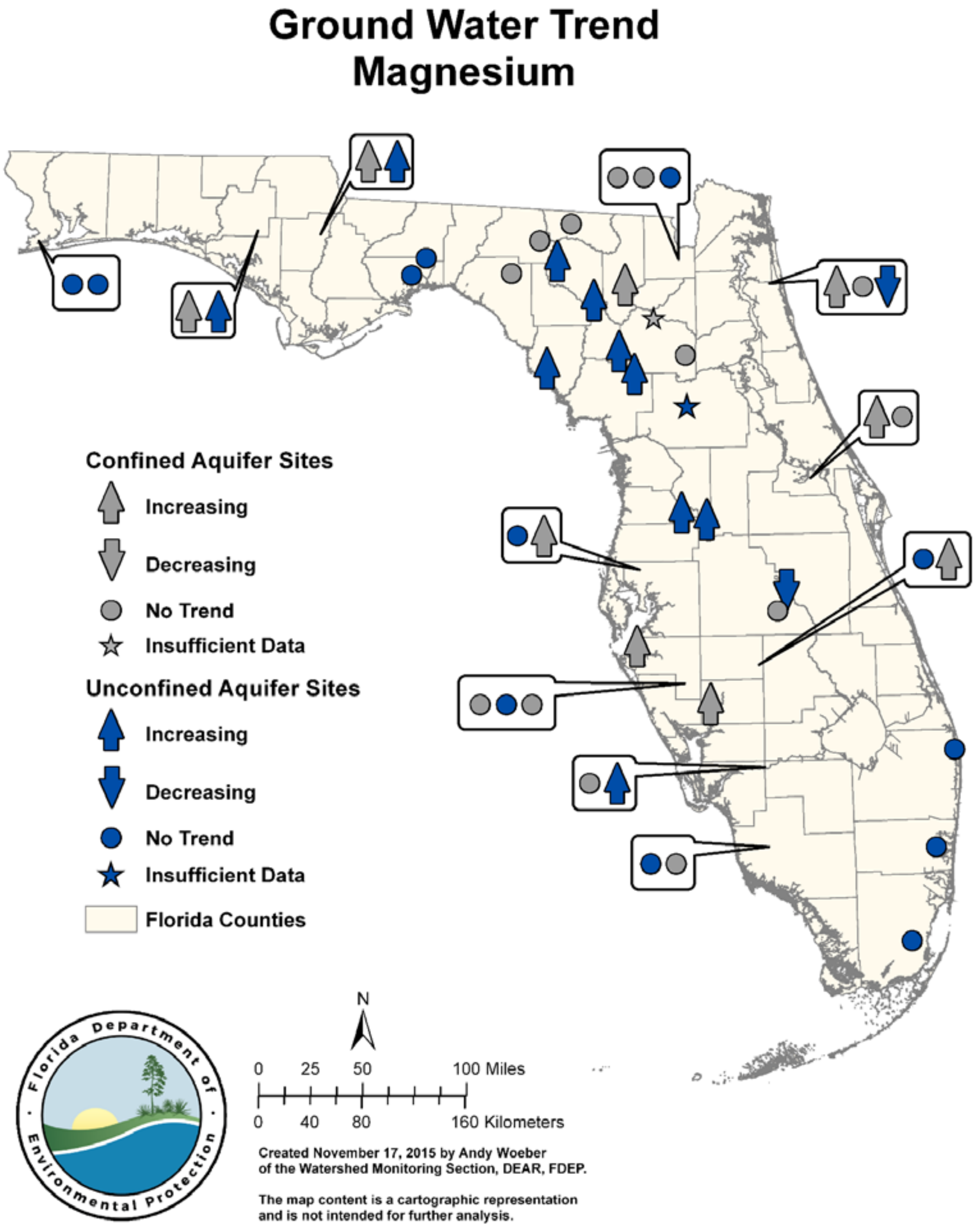


Figure 5.45. Ground water trends for magnesium, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 9 stations with increasing trends and no stations with decreasing trends for magnesium. One station had insufficient data.
- There were 10 stations with increasing trends in the unconfined aquifer wells and 2 stations with decreasing trends. One station had insufficient data.

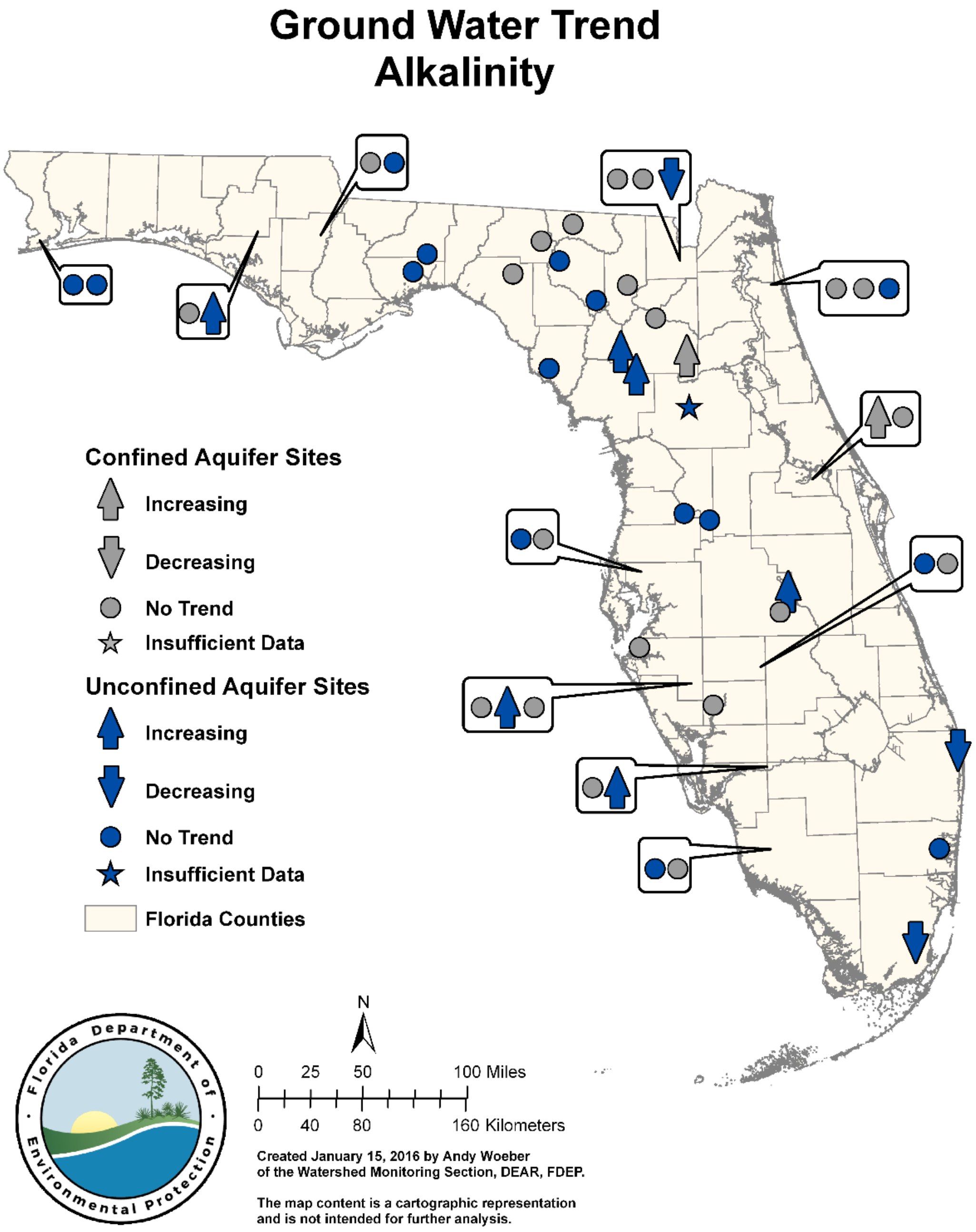


Figure 5.46. Ground water trends for alkalinity, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported 2 stations with increasing trends and no stations with a decreasing trend for alkalinity.
- There were 6 stations with increasing trends in the unconfined aquifer wells and 3 stations with decreasing trends. One station had insufficient data.

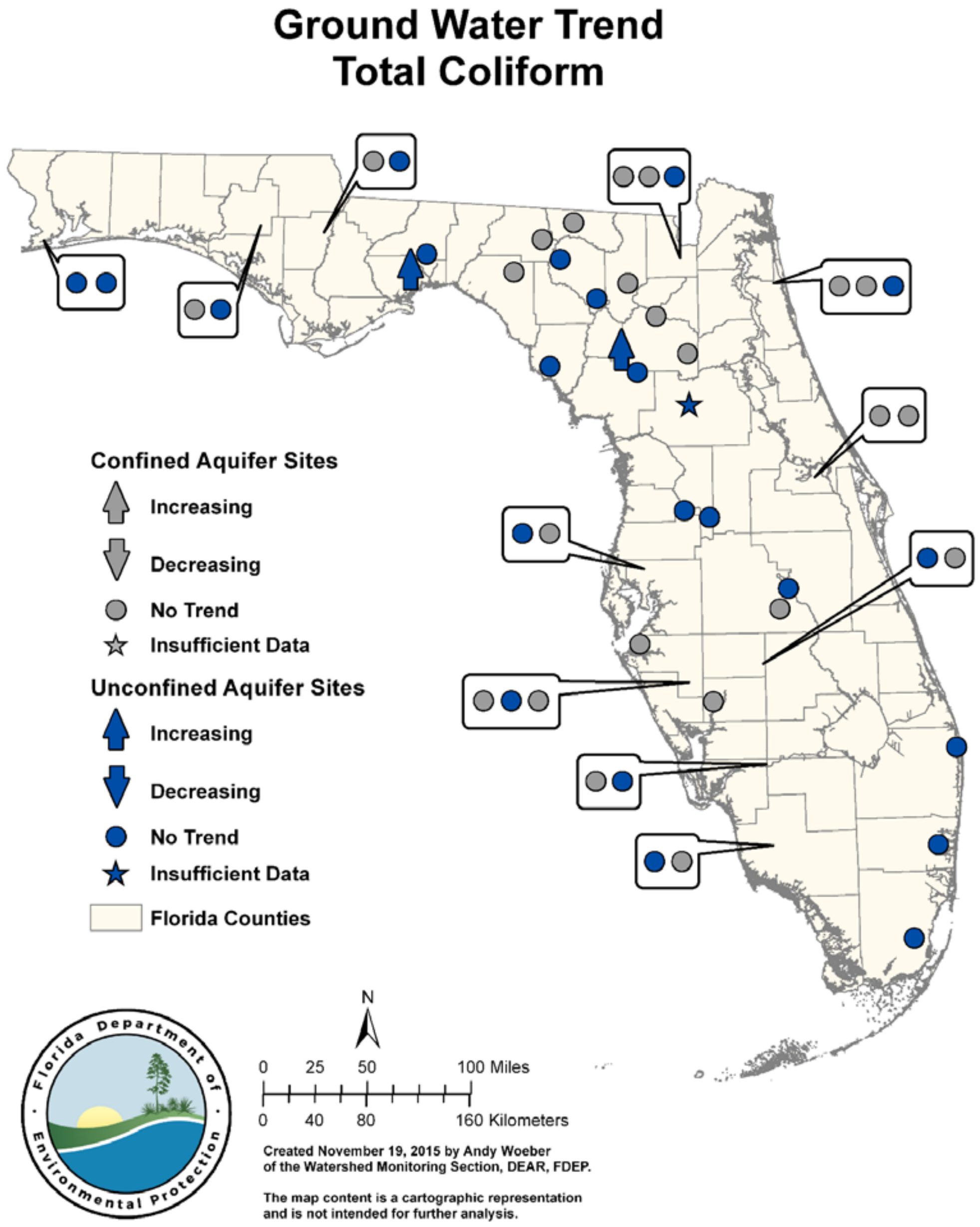


Figure 5.47. Ground water trends for total coliform, 1999–2014

Highlights:

— The trend analysis for the confined aquifer wells reported no stations with either an increasing or decreasing trend for total coliform.

— The trend analysis for the unconfined aquifer wells reported 2 stations with increasing trends and no stations with a decreasing trend for total coliform. One station had insufficient data.

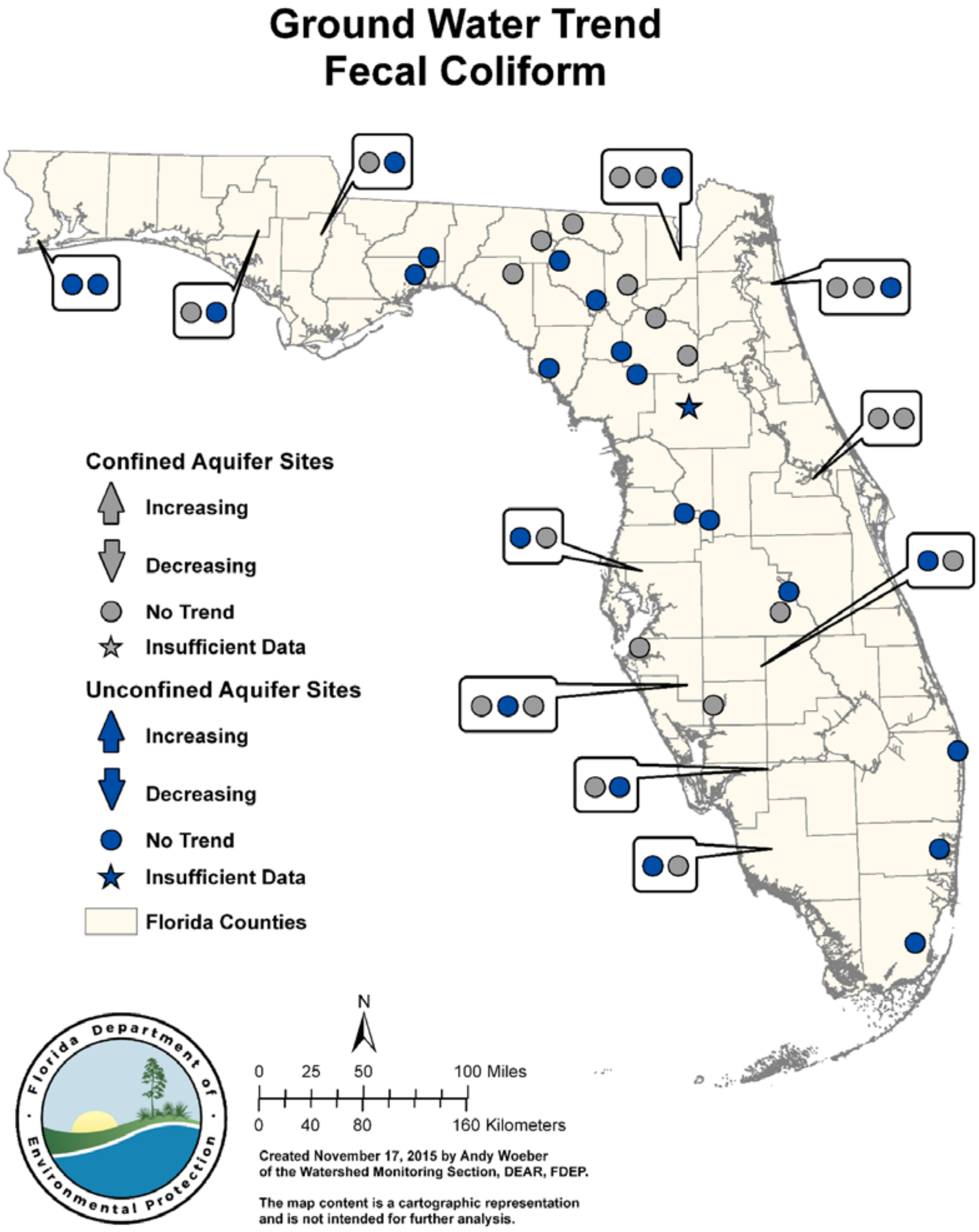


Figure 5.48. Ground water trends for fecal coliform, 1999–2014

Highlights:

- The trend analysis for the confined aquifer wells reported no stations with either an increasing or decreasing trend for fecal coliform.
- The trend analysis for the unconfined aquifer wells reported no stations with either an increasing or decreasing trend. One station had insufficient data.

Chapter 6: Overview of Strategic Monitoring and Assessment Methodology for Surface Waters

In 1999, the Florida Legislature enacted the FWRA (Section 403.067, F.S.), which authorized DEP to develop a rule under which waters of the state would be assessed to determine impairment status for the purpose of developing TMDLs, as required by Section 303(d) of the CWA. Beginning in July 1999, DEP held extensive meetings of a Technical Advisory Committee to establish and develop the scientific basis for the new rule. At the conclusion of this process, the Environmental Regulation Commission (ERC) adopted Florida's Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.), on April 26, 2001.

Although the IWR has been amended since it was initially adopted, the basic methodology has not changed. The IWR was most recently amended on August 1, 2013, to include a revised DO criterion and numeric interpretations of the narrative nutrient criterion. The current IWR (Chapter 62-303, F.A.C.) and the Florida Surface Water Quality Standards (Chapter 62-302, F.A.C.), are available online.

Assessment Methodology: The IWR

According to the EPA, "The assessment methodology constitutes the decision process (including principles of science, statistics, and logic used in interpreting data and information relevant to water quality conditions) that a state employs to determine which of the five integrated reporting categories a waterbody segment belongs. It is important that assessment methodologies must be consistent with applicable water quality standards. They should also be consistent with sound science and statistics" (Regas 2005).

In Florida, the water quality status of waters of the state is evaluated using the science-based assessment methodology described in Chapter 62-303, F.A.C. The methodology provides a detailed process by which the attainment of applicable water quality standards is determined, and consists of two distinct steps aimed at the identification of impaired waters: (1) using a statistical methodology to identify water 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 found to be caused by a pollutant, and if the impairment is verified, then the segment is placed on the Verified List. The methodology described in the IWR was designed to provide a pre-specified 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 have previously been identified as impaired and 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. **Appendix B** describes the IWR methodology in greater detail.

The Watershed Management Approach

The IWR is implemented following the DEP watershed management approach, which is implemented using a five-year basin rotation. Under this approach, Florida's 52 HUC basins (51 HUCs plus the Florida Keys) are grouped into 29 distinct basins that are distributed among each of the 6 DEP districts. Five basin groups in each of the Northwest, Central, Southwest, South, and Southeast Districts, and 4 basin groups in the Northeast District, comprise the basin rotation groups. Within each district, one basin group in the basin rotation is assessed each year (except for the Northeast). **Table 6.1** lists the basin groups included in each of the basin rotations by DEP district.

Table 6.1. 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

Implementation of the TMDL Program under the Rotating Basin Approach

As discussed in Chapter 4, under the rotating basin approach there are five distinct phases (**Table 6.2** provides further details for each of the cycle's phases).

Table 6.2. Phases of the basin management cycle

Phase	Schedule	Activities
Phase 1: Preliminary Basin Evaluation	Year 1	- Identify stakeholders/participants. - Coordinate with stakeholders to upload their data to Florida STORET. - Conduct basin kick-off technical working group meeting to introduce cycle. - **Primary Product:** **> Develop Strategic Monitoring Plan (SMP) for assessments performed in support of TMDL Program.**
Phase 2: Strategic Monitoring	Years 2–3	- Carry out strategic monitoring to collect additional data identified in Phase 1. - Acquire additional data and enter into Florida STORET. - Evaluate new data and incorporate findings into draft version of Verified List of impaired waters and Delist List (additional ancillary lists are distributed, but are not adopted by DEP's Secretary as update to 303[d] list). - Distribute draft Verified List of Impaired Waters, Delist List, and additional supporting assessment lists for review. - Conduct public meetings and request/respond to public comments on draft Verified List. - **Primary Products:** **> Finalize Verified List of Impaired Waters and Delist List for Secretarial adoption.** **> Adopt both lists by Secretarial Order.** **> Submit finalized lists to EPA as annual update to 303(d) list.**
Phase 3: TMDL Development	Years 2–4	- Complete TMDLs for verified impaired waters according to prioritization.
Phase 4: Development of Restoration Plan	Year 4	- Finalize management goals/objectives. - Develop draft restoration plans or BMAPs, including TMDL allocation. - Identify monitoring and management partnerships, needed rule changes and legislative action, and funding opportunities. - Develop Monitoring and Evaluation Plans. - Seek funding. - Obtain participant commitment to implement plans.
Phase 5: Implementation	Year 5+	- Implement the restoration plans or BMAPs. - Carry out rule development/legislative action.

Assessment Periods for the Planning and Verified List Assessments

Table 6.3 lists the specific assessment periods for the Planning and Verified Lists for each of the five basin groups for the first three cycles of the basin rotation. Assessments for the waters in the first basin group for the third cycle were performed in 2012 and adopted by Secretarial Order in February 2013. Assessments for the second basin group for the third cycle were recently completed and are in the process of being adopted.

Table 6.3. 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

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.

In Florida, the designated uses for waters of the state are established and protected within the surface water quality classification system (included in the Florida Surface Water Quality Standards) (Chapter 62-302, F.A.C.). Class-specific water quality criteria for individual analytes describe the water quality necessary to meet the present and future most beneficial designated uses for surface waters of the state. **Chapter 4** provides additional details on this classification system.

Table 6.4 lists the use support categories evaluated by assessments performed under the IWR. These categories correspond hierarchically to the surface water classifications that are included in the Florida Standards.

Table 6.4. 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

Designated Use Category Evaluated by Assessments Performed under the IWR	Applies to Waters Having This Surface Water Classification
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 the identification of impaired waters, for the purpose of reporting use support status to the EPA, DEP uses a classification system based on the EPA integrated reporting guidance. Originally, this guidance recommended that states adopt the EPA five-category reporting system and assign each waterbody to only one of each of the five reporting categories; however, beginning with the 2006 reporting cycle, at the request of many states the EPA has advocated for the option of a multi-category approach built on the original five-category reporting system. The multi-category approach provides additional flexibility for states to establish subcategories within each of the original five categories as needed to more accurately and precisely characterize the water quality status of jurisdictional waters in the reporting framework. **Table 6.5** lists the categories for waterbodies or waterbody segments in the 2016 Integrated Report.

Under the IWR methodology, assessments are used to compare measures of individual surface water quality parameters with the class-specific criteria from the Florida Surface Water Quality Standards and additional threshold values included in the IWR. Use support is reported using the EPA multi-category approach, which includes the original EPA reporting categories together with subcategories. Although assessments performed under the IWR are waterbody and analyte specific, a summary category (*i.e.*, a summary subcategory) for each segment is determined by summarizing the results of the individual assessments over all assessments performed for each of the segments. Use support is derived based on the corresponding summary assessment category.

Table 6.5. 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.

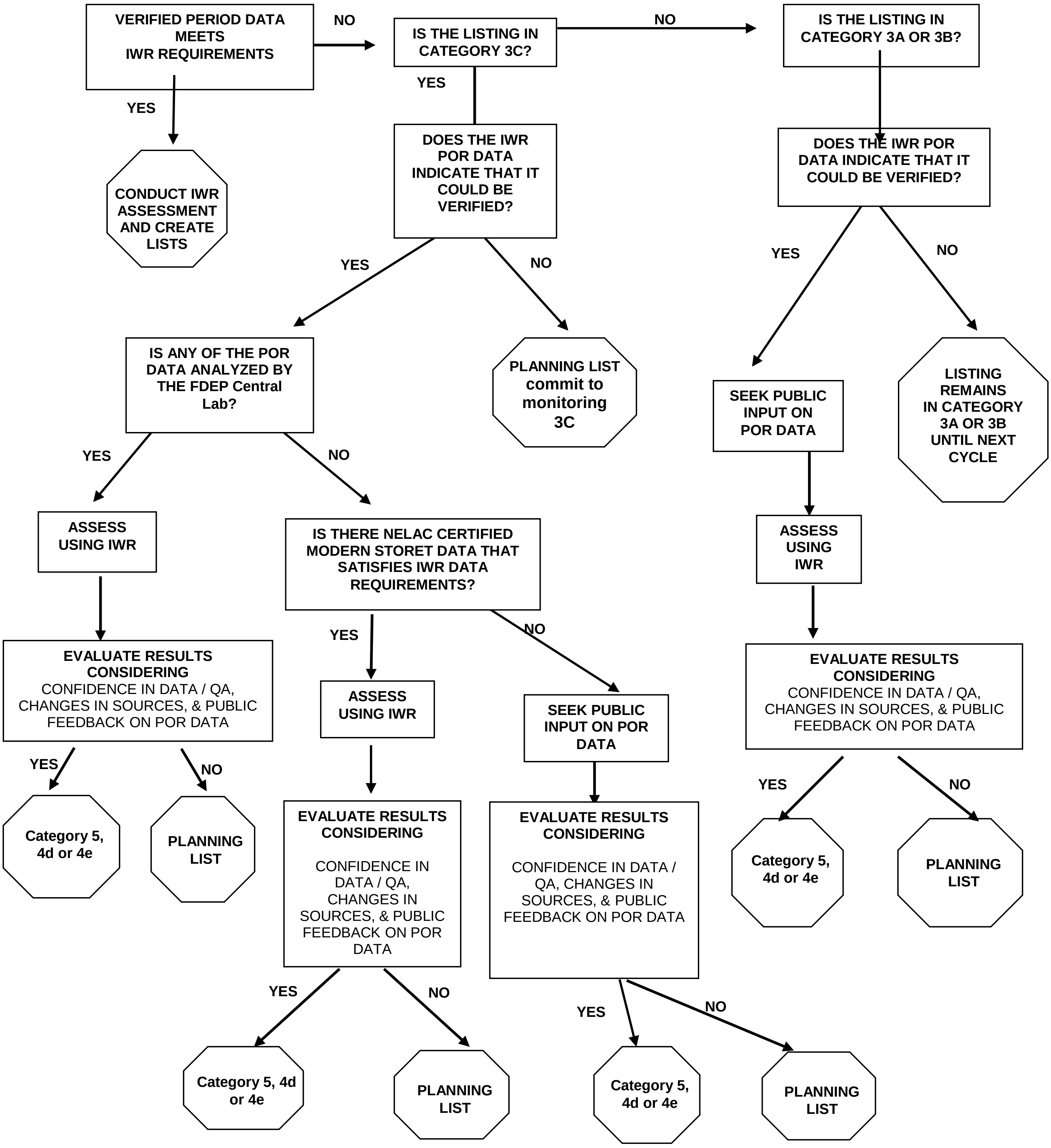
Category	Description	Comments
1	Indicates that all designated uses are attained.	Not currently used by DEP.
2	Indicates that sufficient data are available to determine that at least one designated use is attained and insufficient data or no information are available to determine if remaining uses are 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 the 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.
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 the EPA as Florida's 303(d) list of impaired waters at the end of Phase 2.

While assessments and subsequent listing decisions performed using the methodology described in the IWR relate specifically to only the current assessment periods, to supplement those listing decisions for segments that cannot be fully assessed using only data from the current assessment periods the EPA has encouraged the state to incorporate a complete review of all water quality data for the entire period of record (POR). To accommodate this request, DEP has extended the assessment methodology to include the POR data when such additional data are available and can be determined to meet DEP QA requirements (often the quality and/or the reliability of older data cannot be established). **Figure 6.1** illustrates how data from the POR are evaluated and considered for incorporation into the assessment process.

Public Participation in the Process

To provide opportunities for public participation in the development of basin-specific lists, numerous meetings and workshops are held in each of the group-specific assessed basins throughout the state during each listing cycle. The public may be notified of upcoming list development activities through e-mails to basin-specific interested parties via distribution lists that are maintained by DEP, as well as in announcements in the *FAR*. Notices may also be published in selected newspapers located throughout the state. In addition, these announcements are posted on the DEP Watershed Assessment website.

Figure 6.1. POR assessment flow chart



Citizens, stakeholders, and other interested parties are encouraged to provide comments and feedback on the draft lists presented at basin-specific public meetings either in person and/or in writing. Specific types of information typically solicited through the public participation process may include the following:

- Comments on the appropriateness of the listing results for individual waterbody segments.
- Updated and/or more recent information about the listed waters, including water quality and bioassessment data.
- Additional supporting information (such as evidence of algal blooms or site-specific studies about nutrient impairment in area waters).
- Information about planned pollution control mechanisms.

Additional types of information of particular interest to DEP during the most recently completed assessment cycle also included the following:

- Information on the existing uses of waterbodies and other designated uses that may no longer be attained (*e.g.,* shellfish harvesting).

When additional information or data is provided prior to and/or during the public comment period, it is evaluated and, if necessary, assessment results may be revised before lists are finalized by Secretarial adoption and subsequently submitted to the EPA.

Data Management

Sources

The IWR provides that the primary source for data used for assessment purposes in the state is Florida STORET (or its successor database). 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; data acquired from Legacy STORET currently accounts for approximately only

20% of all data available for assessment purposes. **Table 6.6** lists the agencies and organizations that have provided data used in assessments performed under the IWR.

Additional sources of information used in connection with the IWR assessments include the Florida Department of Health (FDOH) (including fish consumption advisories and information on beach closures, advisories, and/or warnings), as well as FDACS (which provides information on the classification of shellfish harvesting areas) and the FMRI.

Table 6.6. Agencies and organizations providing data used in the IWR assessments

- Alachua County Environmental Protection Department
- 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
- Environmental Protection Commission of Hillsborough County
- Environmental Research and Design, Inc.
- Florida Dept. of Agriculture and Consumer Services
- Florida Dept. of Environmental Protection (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
- Florida Dept. of Health, Division of Environmental Health, Bureau of Water Programs
- Florida Fish and Wildlife Conservation Commission
- Florida Fish and Wildlife Research Institute
- 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 Water Management District

- 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 Water Management District
- Southwest Florida Water Management District
- Southwest Florida Water Management District – Project Coast
- St. Johns River Water Management District
- Suwannee River Water Management District
- Tampa Bay Water
- The Nature Conservancy of the Florida Keys
- Volusia County Environmental Health Lab

Quality Assurance/Quality Control (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 assessments performed under the IWR. All data are required to meet DEP's QA rule requirements (Chapter 62-160, F.A.C.). To further ensure that the QA/QC objectives of the TMDL Program are being met, DEP's Aquatic Ecology and Quality Assurance (AEQA) Section, upon request, conducts audits of data providers (or laboratories used by data providers) on behalf of the TMDL 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. 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) do not represent ambient conditions and are excluded from assessments performed under the IWR. 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 they are included in the IWR assessment process.

If specific deficiencies are noted as a result of QA/QC audits of data providers (or laboratories used by data providers) performed on behalf of the TMDL Program, corresponding subsets of the data received from the audited agency or organization may be excluded from the assessment process. For audits where deficiencies have been identified, the AEQA will provide recommendations that generally apply only to the water quality data from specific data providers, or processed by specific laboratories, and refer to specific analytes and/or specific periods.

Data may also be precluded from use for assessment purposes if during the review of water quality data used to support assessment results, specific discrepancies or anomalies are observed. Typically, such discrepancies include systematic issues in the data received by DEP from a particular data provider (*e.g.,* 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).

When such discrepancies or anomalies are identified, the data are excluded from further processing and 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 assessments performed under the IWR.

Table 6.7 provides additional details about the specific types of data that have been excluded from assessments performed under the IWR.

Table 6.7. 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 upon 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 water management district (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.
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	

Data Excluded	Comment
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.
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 TMDL Program	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)	

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 designed to evaluate progress in improving water quality in conjunction with the implementation of pollutant load reduction projects. Monitoring projects are developed collaboratively with stakeholders to ensure cooperation and the effective allocation of resources in sampling efforts and are designed to be adequately robust to demonstrate changes in water quality that may occur. After being uploaded to Florida STORET, or into DEP's Statewide Biological Database (SBIO), data collected in conjunction with these monitoring efforts can be used in water quality assessments conducted during the subsequent cycles of the basin rotation and those assessment results can be compared with the results from previous assessments. Such comparisons of assessment results over time can document changes in water quality and inform future monitoring, assessment, and restoration activities.

Chapter 7: Results for Designated Use Support in Surface Waters

For assessment purposes, DEP has delineated the waters of the state into assessment units, with each assessment unit representing a relatively homogenous and hydrologically distinct segment of a major surface water feature. Each assessment unit is represented by a unique waterbody identifier and is characterized by waterbody type (including rivers/streams, lakes, estuaries, coastal waters, and beaches) and a waterbody class. For assessments performed under the IWR during the most recent basin rotation, there were 6,573 distinct segments with waterbody identification (WBID) numbers represented in the state's waterbody system.

River and stream WBIDs average about five miles in length; are frequently bounded by headwaters, river mouths, or other major intersecting streams; and include only perennial waters of significant size. Estuarine WBIDs typically average approximately five square miles (frequently bounded by bridges). For small lakes, individual WBIDs might encompass an entire lake. However, for larger lakes, or for those lakes characterized by hydrologically distinct areas, a lake may be represented by multiple WBIDs.

The use support determinations and summary results presented in this chapter are based on surface water quality assessments performed under the IWR for the most recently completed set of group-specific assessments in the basin rotation. These assessments encompass those adopted by the state for waters in Groups 2 through 5 in Cycle 2 of the basin rotation and have been submitted to and approved by the EPA as updates to the 303(d) list. They also include waters in Group 1, Cycle 3, of the basin rotation that have been adopted by the state and also submitted to, and currently under review by, the EPA.

Although the summary information in this report is presented in terms of recently developed spatial metrics for specific water features as well as the more traditional counts of water segments, these values refer to distinctly different ways of quantifying assessment results: the spatial metrics for features are based on a more complete NHD and are reported on a spatial scale (except for springs, which are presented only as counts of individual springs). However, when appropriate, the more traditional counts of assessment results for individual waterbody segments are also reported. To the extent possible, mileages for stream segments and acres for lake and estuary segments reported in this chapter have been calculated using, and are consistent with, the 1:24,000 NHD GIS coverage and based on the WBID waterbody type. This means that measures in this chapter may be different than those reported in other parts of this report where the measure is based on all water features, not just those assigned to a particular WBID or assessment unit. There are instances where small lakes may be included within the boundary of a WBID, but not assessed because there are no monitoring stations associated with that lake. However, the acres for that lake were included in statewide water feature measures described in other chapters of this report.

In previous reports, canal miles were included as part of the reported stream miles. However, because of the extensive number of canals included in the NHD, this report presents stream miles both with and without the inclusion of canals. **Table 7.1a** lists the total size of waters assessed by waterbody type, both with and without canals; **Table 7.1b** lists the counts and total size for waterbodies assessed; waterbodies identified as impaired; and those that are covered by an area with a TMDL.

Table 7.1a. Total water size by WBID water feature type

Waterbody Type	Units	Water Size without Canals	Water Size with Canals	Number of Waterbody Segments
Beach	Miles			353
Coastal	Miles	2,386	2,386	154
Estuary	Acres	1,645,282	1,645,282	658
Lake	Acres	942,287	942,287	1,419
Spring	Count	293	293	136
Stream	Miles	26,558	72,063	3,853
Total				**6,573**

Table 7.1b. Total water size for each type of measure associated with assessment and TMDL activities by water feature type

Note: Waters in EPA Category 3a (no data and/or information are available to determine if any designated use is supported) are not included in the calculations for waters that were assessed.

Feature	Total Acres (assessed)	Total Miles (assessed)	Count (assessed)	Number of Waterbody Segments (assessed)	Total Acres (impaired)	Total Miles (impaired)	Count (impaired)	Total Acres (TMDL)	Total Miles (TMDL)	Count (TMDL)
Streams/ Rivers		17,554		1,430		9,642			2,057	
Coastline		1875		138		589			11	
Canals		38,536				33,655			6,678	
Lakes	1,324,690			891	1,065,265			555,302		
Estuaries	1,671,159			588	993,581			231,161		
Springs			865	107			620			326
Total	**2,995,849**	**57,965**	**865**	**3,154**	**2,058,846**	**43,886**	**620**	**786,463**	**8,746**	**326**

303(d) Listed Waters

Only those WBID/analyte combinations that are placed in EPA Category 5 as a result of assessments performed under the IWR are included on the state's Verified List of impaired waters which is adopted by Secretarial Order. The listing results in EPA Category 5 correspond to the WBID/analyte combinations where water quality standards are not being met that *will require the development of a TMDL*. These listings are included as part of the list subsequently submitted to the EPA as the annual update to the 303(d) list.

Although water quality standards are not met for WBID/analyte combinations in any of the EPA Category 4 subcategories (including 4a, 4b, 4c, 4d, or 4e), these WBID/analyte combinations are not included on the state's Verified List of impaired waters because a TMDL is not currently required. While a TMDL may not be a current requirement for WBID/analyte combinations in either subcategory 4b, 4d or 4e, but because a TMDL may later be required for these WBID/analyte combinations, these listings are also included among those submitted to EPA as the annual update to the 303(d) list.

Causes of Impairment

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.

Although DO is the most frequently identified impairment for waters of the state, when the assessments summarized in this report were performed the water quality standard in effect for DO was based on outdated national guidance. That guidance relied on results from research conducted in the 1960s and 1970s and did not adequately consider the unique needs of Florida's aquatic species and its subtropical climate. Many waters in the state (particularly springs and streams fed by wetlands) are naturally low in DO and under those standards might have triggered listing thresholds because of exceedances of criteria values, even when designated uses were being supported.

To address these concerns, during 2005 and 2006 DEP initiated extensive statewide freshwater DO studies in lakes and streams with the intent of acquiring data to support the development of revisions to the DO standard. Based on the results of these studies, the DO standard for both fresh and marine waters was revised to better reflect the needs of Florida's aquatic species and its subtropical environment. The revised standard addresses DO in terms of percent saturation rather than as water column concentrations. Also, for fresh waters, it includes a calculation that adjusts DO measurements for the time of day.

Approved by the Florida ERC in 2013, the recently adopted revisions to the DO standard (Rule 62-302.533, F.A.C.) will help to provide better protection for healthy, well-balanced aquatic communities and contribute toward improved assessment decisions by reducing the number of instances where waters are misidentified as impaired for DO when designated uses are actually being supported. As a result of the implementation of these revisions, resources ultimately can and will be better focused and utilized to address priority water quality issues where designated uses are threatened or not supported.

Assessment Results

To summarize all assessment results for the previous cycle in the basin rotation, in each waterbody segment a ranking order was applied to individual assessment results to develop a single summary assessment to represent the water quality status for the waterbody segment. **Table 7.2a** lists the distribution of these summary assessments by waterbody type and EPA reporting category. **Table 7.2b** lists the ten most frequently identified impairments by waterbody type. Within each waterbody segment, assessments for individual analytes were grouped to create impairment-specific subgroups and, within each impairment-specific subgroup, a ranking order was applied to develop an impairment-specific subgroup summary assessment for the waterbody segment. Impairment-specific subgroup summary assessments for all waterbody segments were then summarized by waterbody type and EPA reporting category.

Tables 7.3a and **7.3b** and **Figures 7.1a and 7.1b** present the distribution of the impairment-specific subgroup summary assessments for pathogens and nutrients by waterbody type and EPA reporting category. Results reported in EPA Category 3a were excluded from these analyses. For the information summarized in these tables and figures, impairment-specific subgroups consisted of the following groupings of assessment results:

- **Pathogens:** Assessment results classified as pathogens included results for all waterbody segments that were assessed for fecal coliform, results for all assessed waterbody segments that had a waterbody type of "BEACH," and results for all Class 2 waterbody segments that were assessed for changes in shellfish classification by FDACS.
- **Nutrients:** Assessment results classified as nutrients included results for all waterbody segments that were assessed for either chlorophyll-a or historic chlorophyll-a when the waterbody type was not a lake; and TSI, historic TSI, and TSI trend for waterbody segments that were lakes.

Table 7.2a. 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**

Table 7.2b. Ten most frequently identified causes of impairment by waterbody type

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
TSI	223						223
Bacteria (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

Table 7.3a. 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.

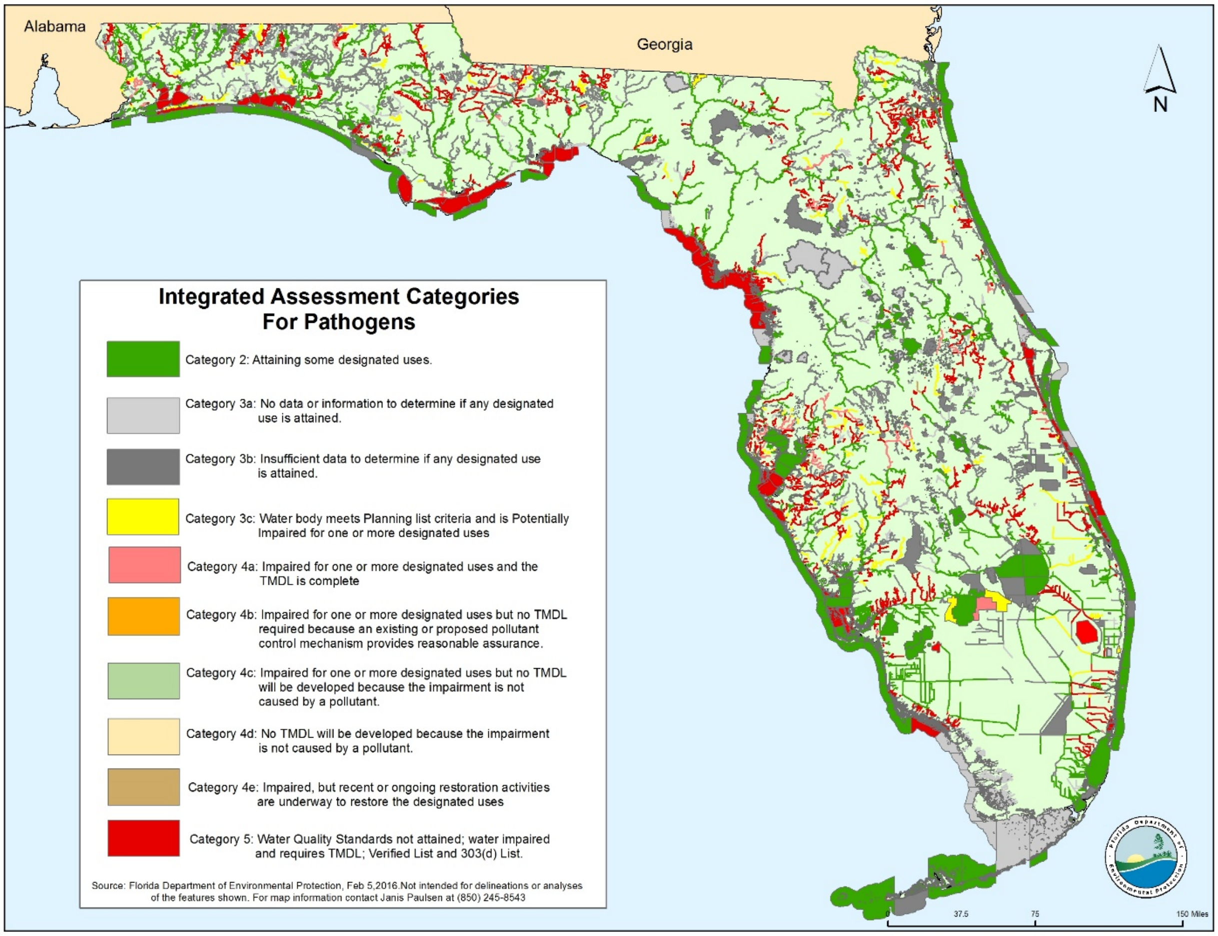
Waterbody Type	EPA Cat. 2	EPA Cat. 3b	EPA Cat. 3c	EPA Cat. 4a	EPA Cat. 4b	EPA Cat. 4c	EPA Cat. 4d	EPA Cat. 4e	EPA Cat. 5	Total Number of Assessments
Coastal	92	7							13	112
Estuary	246	45	18	17					182	508
Lake	370	519	16						11	916
Spring	50	42	1							93
Stream	363	683	98	43				1	347	1,535
Total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

Table 7.3b. 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.

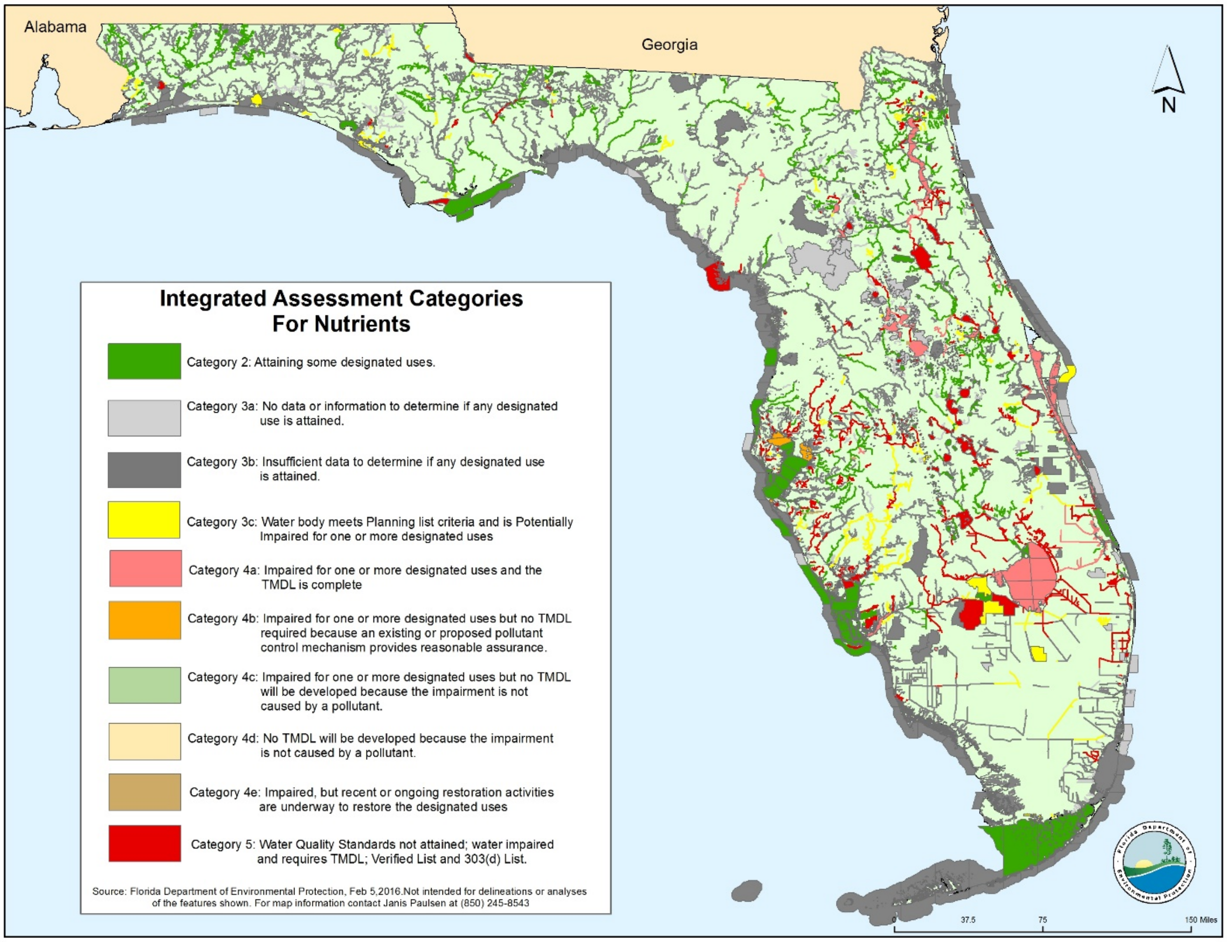
The EPA Integrated Report categories are as follows:
1—Attains all designated uses.
2—Attains some designated uses.
3a—No data and information are available to determine if any designated use is attained (not displayed)
3b—Some data and information are available, but they are insufficient for determining 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**



Source: Florida Department of Environmental Protection, Feb 5,2016.Not intended for delineations or analyses of the features shown. For map information contact Janis Paulsen at (850) 245-8543

Figure 7.1a. Results of Florida's surface water quality assessment: EPA assessment categories for pathogens



Source: Florida Department of Environmental Protection, Feb 5,2016.Not intended for delineations or analyses of the features shown. For map information contact Janis Paulsen at (850) 245-8543

Figure 7.1b. Results of Florida's surface water quality assessment: EPA assessment categories for nutrients

Impairment Summary

Tables 7.4a through **7.4d** summarize the number and size of waterbody segments/analyte combinations that have been identified as impaired and for which a TMDL may be required (*i.e.*, in Subcategories 4d, 4e, or 5) by the specific impairment identified. Since a single WBID may be identified as being impaired for multiple analytes, the totals presented do not necessarily reflect the total size of waterbodies that have been identified as impaired (presented in Table 7.1b), 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 about 467,200 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 7.4a. Miles of rivers/streams impaired by cause

Note: There are some stream WBIDs that 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
Unionized 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 7.4b. 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 7.4c. 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 7.4d. 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**

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 because of natural causes, or not caused by a pollutant.

Although the IWR specifies the specific requirements for delisting decisions, determining the ultimate assessment category (or subcategory) for delisted segments is not always necessarily straightforward. For example, the 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.

Even when a waterbody meets the delisting thresholds described in the IWR for nutrients based on chlorophyll *a* or TSI assessments, if the waterbody has also been identified as impaired for DO, and if either TN or TP has been identified as the causative pollutant, then the waterbody cannot be delisted unless site-specific information is available to demonstrate use attainment. **Figure 7.2** shows the decision process for delisting waters that have been identified as impaired based on the assessment of chlorophyll *a*.

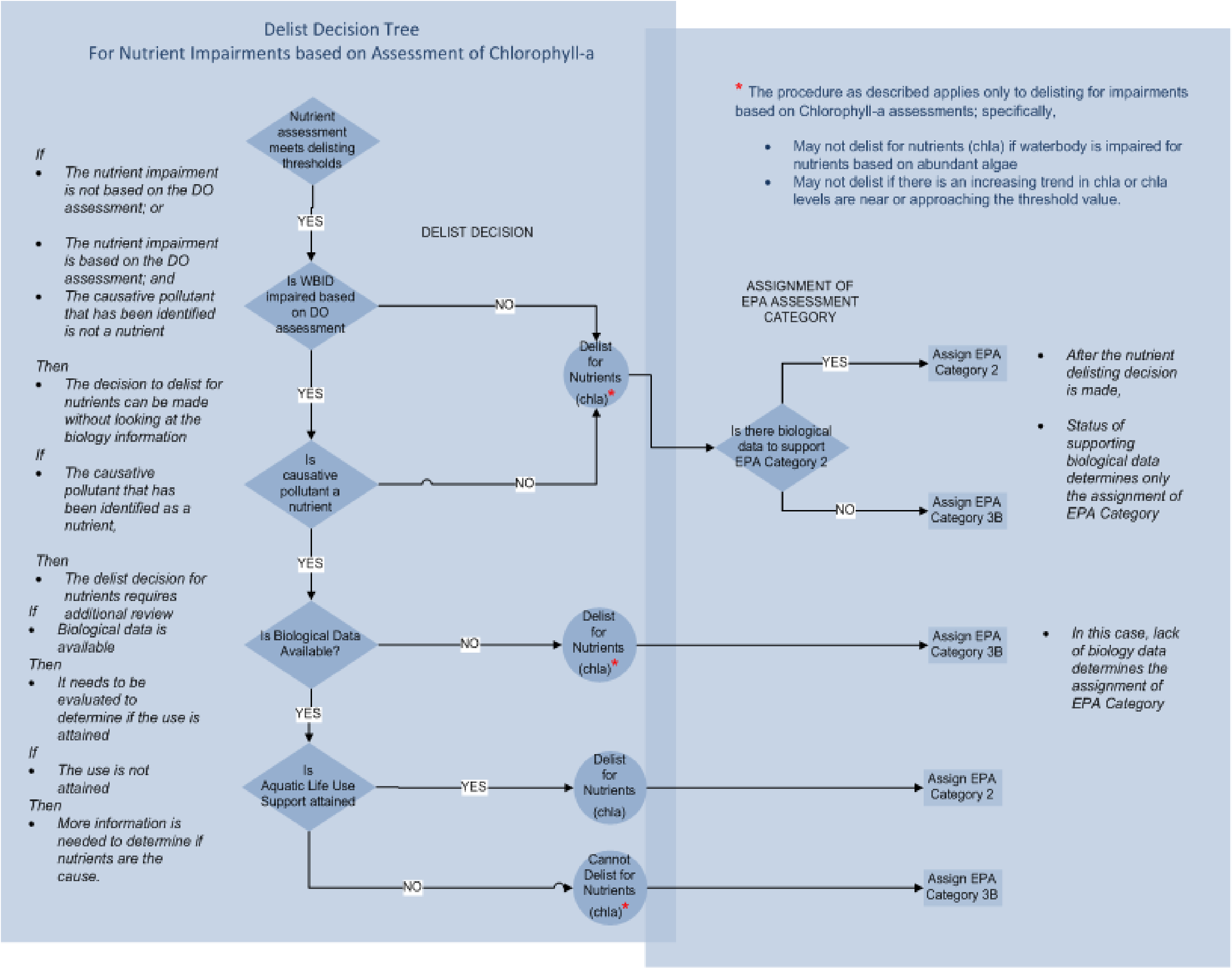


Figure 7.2. Decision tree for delisting for nutrient impairment based on chlorophyll *a* (chl*a*)

Biological Assessment

Biological assessment results are particularly significant because biota inhabiting a waterbody function as continual natural monitors of environmental quality, capable of detecting the effects of both episodic, as well as cumulative, water quality, hydrologic, and habitat alterations. By monitoring the composition, abundance, and health of these biological communities, DEP is able to determine the health of the state’s streams, rivers, lakes, and wetlands. Note that wetland bioassessment methods have not been fully validated, and estuarine methods are not yet fully developed. These tools are used in conjunction with physical and chemical water quality measurements to determine not only the impairment status of a waterbody, but proper strategies for restoration.

Under the IWR, biological assessments can provide the basis for impairment determinations, or can be used as an adjunct to support assessment determinations made for other parameters (as is the case for some waterbodies having naturally low DO concentrations where it may be possible to demonstrate that aquatic life use is fully supported by using biological information). For such waterbody segments, when there is sufficient biological information to demonstrate that aquatic life use is fully supported, a TMDL would not be required, and the waterbody segment would be placed in Subcategory 4c.

Use and Interpretation of Biological Results

Biological assessment tools used in conjunction with assessments performed under the IWR consist primarily of the SCI and the Biological Reconnaissance (BioRecon). However, because the BioRecon is used primarily as a screening tool, low BioRecon scores are not used as the sole basis for making an impairment decision. To determine impairment based on BioRecon results, DEP requires follow-up sampling with the SCI, which provides 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.

Biological assessment methods, as well as the delineation of the statewide bioregions and the corresponding interpretation of bioassessment results (calibration), used by DEP have changed over time. The BioRecon was revised in 1992, 2004, and again in 2008; the SCI was revised in 1992, 2007, and again, most recently in 2012 to incorporate a Human Disturbance Gradient (HDG) that was not explicitly included in earlier versions of the SCI. Since it is difficult to know the extent to which apparent changes in bioassessment results are representative of actual changes in the biological health of waterbody segments—or whether such changes may be artifactual, or confounded by revisions and refinements of the methodology—the use and interpretation of results generated by these tools and methods can be somewhat complex, especially when comparing differences in biological results over time, and may depend on the specific version of the tool, or methodology used.

Table 7.5 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 performed 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, two temporally independent SCI results with an average less than 40 would be required for an impairment determination).

Table 7.5. 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

Special Focus: Lakes

Lakes are a particular focus of the EPA’s Integrated Report guidance. This section addresses CWA Section 314 reporting requirements, providing information on lake trends, approaches to controlling lake pollution and lake water quality, and publicly owned lakes with impaired uses. Assessment information for lakes is included in **Tables 7.1** through **7.3**. **Table 7.4b** lists the acres of lakes identified as impaired by the cause of impairment.

Lake Trends for Nutrients

Although assessments performed to identify impaired lake segments evaluate current nutrient status, the IWR incorporates additional methodologies to evaluate trends in the nutrient enrichment status of lakes over time. The nutrient criteria that were 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.*, total nitrogen and Ttotal phosphorus), 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 were developed under the earlier narrative criteria that relied on 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 ten-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, which was incorporated by reference in Section 62-303.352(3), F.A.C.

Since the IWR methodology focuses on the identification of impaired waters of the state, in the evaluation of trends a one-sided statistical test is used; correspondingly, the methodology has not explicitly sought to identify trends where water quality has improved over time. However, if for a particular lake segment the average TSI from the current assessment period is less than the historical baseline TSI, this suggests that water quality for that lake segment has improved over time.

Methodology 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 period of record 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 period of record (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 period of record (up to, but not including, the current assessment period).

Approaches to Controlling Lake Pollution and Lake Water Quality

The assessment process described in **Chapter 6** provides an approach to controlling the point and nonpoint source pollution entering Florida's lakes and restoring lake water quality. In particular, BMAPs developed for water segments identified as impaired under the IWR methodology describe 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 the implementation of management actions, procedures for monitoring and reporting on progress, data management and QA/QC procedures, a description of methods used to evaluate progress towards goals, 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.

Publicly Owned Lakes with Impaired Uses

Appendix D lists all publicly owned lakes in the state that have been identified as impaired and for which a TMDL will be required, the basin group, waterbody identifier within which each lake is located, and the listing parameter (basis for listing).

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). **Table 7.6** lists the total miles of rivers/streams, acres of lakes/reservoirs, and number of springs designated for drinking water use.

Table 7.6. Total miles of rivers/streams, acres of lakes/reservoirs, and number of springs designated for drinking water use

Waterbody Type	Water Size	Units	Number of Waterbody Segments
Lake	337,520	Acres	24
Spring	4	Count	4
Stream	3,619	Miles	86

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. However, Class I, II, and III surface waters all share water quality criteria established for other designated uses.; and since criteria applicable to evaluate designated use support is hierarchical, Class I waters are subject to the criteria used to evaluate use support for all other use classifications: Class I rivers/streams and lakes are consequently assessed for all applicable criteria, including those that are protective of these other uses.

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 7.7** lists the miles of rivers/streams and acres of lakes/reservoirs designated for drinking water use in each of the EPA's five reporting categories. Note that Lake Okeechobee is a Class I waterbody and comprises 320,314 acres of the 337,520 total acres of Class I lakes.

Table 7.7. 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

About 13% of Florida's public drinking water systems receive some or all of their water from a surface water source. In 2015, there were 5,275 public drinking water systems statewide, 17 of which obtain their water from surface water. An additional 58 systems wholly or partially purchase water from these 17 systems. Because it is expensive to operate a surface water system (given that filtration and advanced disinfection are costly), such systems are quite large.

In conjunction with assessments performed under the IWR, the adopted Verified List of impaired surface waters were compared with the coverage of the source water assessment areas generated for the Source Water Assessment and Protection Program (SWAPP). The source water assessment area coverage for community drinking water systems was modeled based on a three-day travel time to the intake within surface waters and their 100-year floodplains. **Table 7.8** lists the river/stream miles (including springs) and square miles of lakes/reservoirs that overlap source water areas for community water systems that are impaired for fecal coliform.

Table 7.8. 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	4400 acres

Chapter 8: Florida's TMDL Priorities

Implementing the EPA's New Long-Term Vision for the TMDL Program

The EPA grant policy requires work plans for state categorical program grants. DEP developed and agreed to a work plan associated with the CWA Section 106 grant to the state for federal FY 2015. As part of that work plan, DEP agreed to provide the EPA with a priority framework document that addresses how its 303(d) and TMDL Programs will implement the new long-term vision for Section 303(d) of the CWA. DEP submitted its priority framework document to the EPA on August 8, 2014. The August 2014 submittal incorporated review comments that had been received from EPA Region 4 and included all of the minimum required elements for a priority framework document.

While that document was labeled "draft," the August 2014 version should still be considered the final DEP priority framework document for purposes of the Section 106 work plan. The August 2014 priority framework document focused on Florida's transition away from a pace-driven TMDL development schedule based on meeting consent decree requirements and describes the new approach based on recovery potential screening as described in the 2014 version.

DEP's prioritization efforts in 2014, as documented in the August 2014 report, generated a two-year TMDL development schedule for FY15 and FY16. 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. DEP submitted its updated priority framework document to the EPA via email to Gracy Danois on September 1, 2015.

Background

DEP adopts water quality standards based on the waterbody classification (*i.e.,* designated use, such as drinking water supply or recreation) and type (such as lake, stream, spring, or estuary). After setting the criteria, DEP collects water quality data through its own monitoring programs and in collaboration with municipalities and other agencies and monitoring groups. These data are assessed against the applicable water quality criteria to determine which waterbodies are considered impaired. One pathway to restore these impaired waters involves establishing scientifically based restoration goals (*i.e.,* TMDLs) to limit the amount of pollutants that may be present in a waterbody if the waterbody is to be considered healthy.

To meet these restoration goals, DEP facilitates coordination among local stakeholders to develop broad-based plans to achieve reductions in pollutant loading.

The previous priority-setting approach was grounded in the rotating basin concept, which continues to be an important component of DEP’s water quality restoration approach, especially as it relates to ensuring statewide coverage of the monitoring and assessment program. DEP recognizes, however, that developing TMDLs and BMAPs often takes longer than one year. More importantly, the TMDL/BMAP path to restoration is not always the most efficient or cost-effective approach. In some parts of the state, and for some types of waterbody impairments, a straight-to-implementation approach makes more sense and will achieve cleaner water faster. As noted in DEP's recent RA guidance, "early implementation of restoration activities is more cost-effective, and may allow the department [DEP] to forgo certain regulatory steps" such as TMDLs and BMAPs, which "focuses limited local and state resources directly on measures that will improve water quality."[7]

Likewise, for the verified impairments where TMDLs are necessary or desirable, DEP must focus its efforts and prioritize its workload because it cannot work on all the waterbodies at once. One important change from previous TMDL priority-setting efforts is a new focus on waters where the TMDL/BMAP approach is the best of the available options for restoration. The resultant list of priorities is therefore best interpreted as "those impaired waters where the department [DEP] expects to develop a site-specific TMDL."

Calling these waters "priorities" is a nod to the language contained in the EPA 303(d) long-term vision and associated guidance. It does not mean that the waters on the list are the only DEP, priorities for restoration. Other impaired waters may be the subject of alternative restoration activities such as a statewide TMDL project (*e.g.*, the statewide TMDL for mercury, or the ongoing project to establish a statewide fecal indicator bacteria TMDL). In addition, some waters may be good candidates for a TMDL alternative, such as an RA Plan or water quality restoration plan (so-called "4b plans" and "4e plans"). Still other waters may have improving water quality trends or additional source identification information suggesting naturally high levels of a given pollutant. Waters labeled a priority by this exercise, therefore, are simply those that are ripe for site-specific TMDL development.

---

[7] Florida Department of Environmental Protection. June 2015. *Guidance on Developing Restoration Plans as Alternatives to TMDLs—Assessment Category 4b and 4e Plans*. Tallahassee, FL: Division of Environmental Assessment and Restoration, Water Quality Assessment Program.

Florida's Overall Approach

Figure 8.1 shows the major steps DEP followed in updating and expanding the priority-setting process.

- **Step 1: Florida's Concerns.** DEP used these concerns to prioritize waterbodies for TMDL development. Some concerns—such as the presence of OFWs and waters with impacts to public health or endangered species—have their origins in the IWR (Rule 62-303.500, F.A.C.). Other concerns derive from state water quality goals, such as springs and nutrient impairments. Still others represent administrative efficiency, alignment with federal priorities, or the desire for a public, transparent process.

- **Step 2: Waterbodies Impaired under New Criteria and Current Data.** Under Florida statutes, DEP can only develop TMDLs for waterbodies that have been verified as impaired following the procedures in the IWR. As such, the starting point for the process is all of the verified impairments from DEP's comprehensive Verified List. Florida, however, has implemented new standards for DO and nutrients, and so DEP reevaluated the comprehensive Verified List using recent data and the new criteria. In this step of the analysis, the following three types of impairments where site-specific TMDLs are likely to be a lower priority were filtered out:

    - Impairments where available data indicate that a waterbody may no longer be impaired under the new criteria, once it is formally reassessed.

    - Impairments for mercury, which are addressed by a statewide TMDL.

    - Impairments based on advisories from other state agencies, such as bathing beach or shellfish consumption advisories.

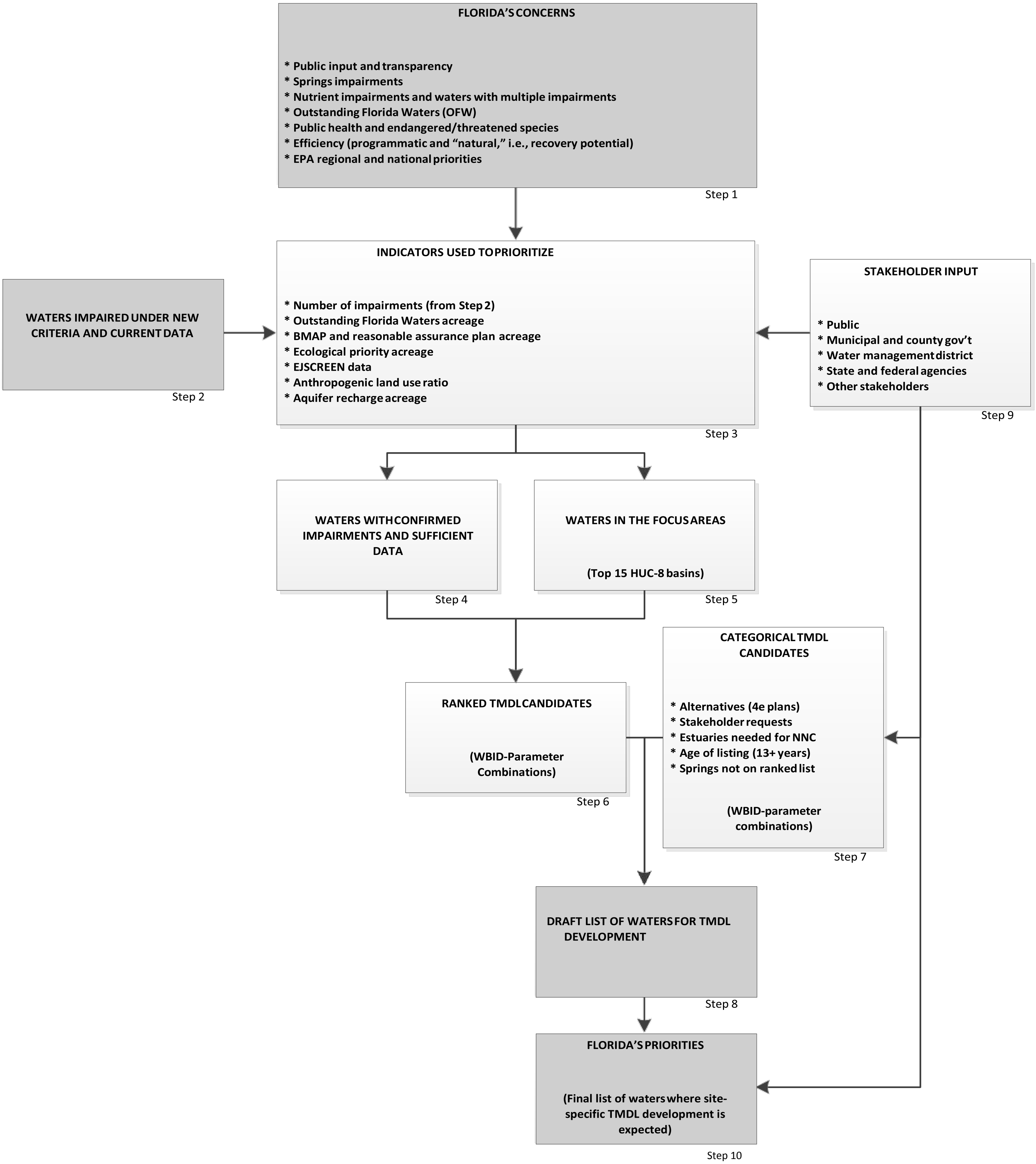


Figure 8.1. Process outcomes for Florida's site-specific TMDL priorities

- **Step 3: Indicators Used to Prioritize.** Another change in the process involved the scale of the analysis. In 2014 DEP gathered indicator data to describe the characteristics of each individually impaired WBID (*i.e.*, each waterbody segment). To better focus resources on priority areas, the state was divided into 52 larger basin-based planning areas using the eight-digit HUC boundaries per the NHD. DEP pulled data and calculated the indicator scores at the basin scale. Expanding to the HUC-8 basin scale allowed DEP to better group impaired WBIDs and focus resources. The specific indicators used are described in the following section.

- **Step 4: Waters with Confirmed Impairments and Sufficient Data.** The list from Step 2 includes a subset of waterbody segments (identified by their WBID numbers) with sufficient nutrient, biological, or DO data to confirm the impairment and proceed with site-specific TMDL development. In this step, the fecal coliform–related impairments were filtered out, because there is an ongoing effort to update fecal indicator bacteria criteria and to implement a statewide TMDL. The Step 4 subset of waters therefore became the candidate list for potential site-specific TMDLs.

- **Step 5: Waters in the Focus Areas.** Summing the indicator scores for each HUC-8 basin and ranking the results in order revealed a break-point in the results (see **Figure 8.2**) that aligned with workload goals and waters where a TMDL is the best approach. The top 15 HUC-8 basins represent the focus area for this priority-setting exercise.

- **Step 6: Ranked TMDL Candidates.** The ranked TMDL candidate waters were those located in the focus areas (*i.e.*, the top 15 HUC-8 basins from Step 5) and on the list of waters with confirmed impairments and sufficient data (*i.e.*, the results from Step 4). The focus area basins contain more than 70% of the site-specific TMDL candidates. These pollutant-WBID combinations were included in the draft list of waters for site-specific TMDL development as "ranked WBIDs" because they were selected as a result of the priority ranking of their HUC-8 basin.

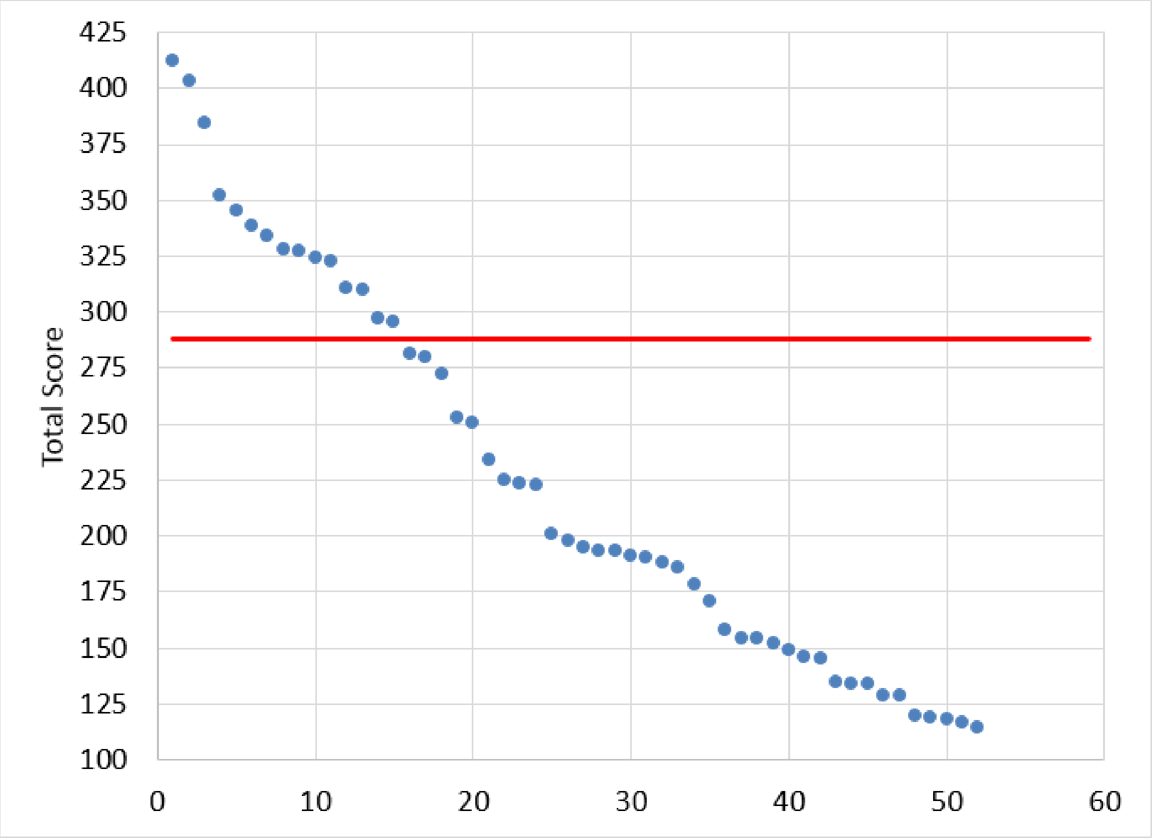


Figure 8.2. HUC-8 basins sorted by the sum of normalized indicator scores

- **Step 7: Categorical TMDL Candidates.** In addition to the ranked WBIDs, DEP intends to develop site-specific TMDLs for some waterbodies regardless of their basin's rank. These "categorical WBIDs" include those where stakeholders have petitioned for TMDL development, estuaries where TMDLs are needed to complete obligations related to implementing the state's new NNC, and some impairments that will reach 13 years old prior to the conclusion of the plan in FY22.

- **Step 8: Draft List of Waters for TMDL Development.** The draft list of waters for site-specific TMDL development is the combination of the ranked and categorical WBIDs. An important internal step involved having the TMDL developers review the draft list. They were able to add and remove some waters from the list based on their expertise and knowledge of local waterbodies. The resulting draft list for public comment reflected review and input from DEP staff and management.

- **Step 9: Stakeholder Input.** Outreach to the public, local governments, other agencies, and other stakeholders has continued since the conclusion of priority-setting efforts. For example, stakeholder comments and interactions influenced the inclusion of some WBIDs on the categorical list, and DEP provided updates at Florida Stormwater Association meetings and WMD workshops. In August and September 2015, DEP presented the draft list of waters for site-specific TMDL development in a series of public workshops held across the state. Comments were taken not only on the draft list, but also on the process used and the indicators that were selected.

- **Step 10: Florida's Priorities.** The list of priorities was submitted to the EPA and meets the requested federal timeline for setting priorities. Any changes to the list resulting from stakeholder comments will be incorporated during the detailed negotiations of annual and two-year TMDL development.

This process is intended to select impaired waters where site-specific TMDLs are appropriate and are the most likely solution for successful restoration. The priority-setting process is time consuming, and 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, to reprioritize the workload, and to complete any TMDLs behind schedule (see **Table 8.1**).

Table 8.1. Overall timeline for long-term vision priorities (FY16 through FY22)

State Fiscal Year	Federal Fiscal Year	Calendar Quarter	Comments
SFY 15-16	FY15	July to Sept 2015	Establish plan
	FY16	Oct to Dec 2015	Beginning of plan
		Jan to Mar 2016	
		Apr to Jun 2016	
SFY 16-17		July to Sept 2016	Annual planning
	FY17	Oct to Dec 2016	
		Jan to Mar 2017	
		Apr to Jun 2017	
SFY 17-18		July to Sept 2017	Annual planning
	FY18	Oct to Dec 2017	
		Jan to Mar 2018	
		Apr to Jun 2018	
SFY 18-19		July to Sept 2018	Annual planning
	FY19	Oct to Dec 2018	Check-in period 1 (re-prioritize)
		Jan to Mar 2019	
		Apr to Jun 2019	
SFY 19-20		July to Sept 2019	Annual planning
	FY20	Oct to Dec 2019	
		Jan to Mar 2020	
		Apr to Jun 2020	
SFY 20-21		July to Sept 2020	Annual planning
	FY21	Oct to Dec 2020	
		Jan to Mar 2021	
		Apr to Jun 2021	
SFY 21-22		July to Sept 2021	Annual planning
	FY22	Oct to Dec 2021	
		Jan to Mar 2022	
		Apr to Jun 2022	Check-in period 2 (re-prioritize)
SFY 22-23		July to Sept 2022	
	FY23	Oct to Dec 2022	New plan begins

Indicators Used to Prioritize Waters

Applying indicators at the scale of the eight-digit HUC basin allowed for a different perspective to determining priority waters in Florida. Previously the approach ranked each WBID individually without accounting for other impairments in the same basin. In contrast, the revised approach starts with 52 larger basin-sized planning units. Indicators were then calculated for the following basin-scale characteristics:

- **Indicator A – Number of impairments (from Step 2).** This indicator is the number of WBIDs from Step 2 that are within the borders of each HUC-8 basin.

- **Indicator B – OFW acres.** This indicator is based on the number of acres of OFWs in the basin divided by the total acreage of the basin.

- **Indicator C – BMAP and RA Plan acres.** Similarly, this indicator is the ratio of acres in the basin that are also within the boundary of one or more BMAPs, RA Plans, or both, compared with the total acreage of the basin.

- **Indicator D – Wildlife/ecological importance.** To derive this score, DEP used the same ecological watershed index as in previous years, following the "Southeastern Ecological Framework" analysis of ecological significance. The ratio used for this indicator is the acreage in the basin identified as either a priority or significant ecological area divided by the total acreage of the basin.

- **Indicator E – Environmental justice.** For this indicator, DEP used data from the EPA's EJSCREEN, an environmental justice screening and mapping tool that uses demographic and environmental data to highlight places that may have higher environmental burdens and vulnerable populations. The ratio used for this indicator is the acreage in the basin identified as having communities combining environmental burdens and vulnerable populations, divided by the total acreage of the basin.

— **Indicator F – Anthropogenic land use.** This indicator derives from dividing the acreage assigned to an anthropogenic land use category by the total acreage of the basin (*i.e.*, anthropogenic plus natural land use types).

— **Indicator G – Aquifer recharge area.** This indicator accounts for impacts to springs areas and surface waters with significant ground water inputs. Its score is based on the areal percentage of the basin where anthropogenic land uses intersect high aquifer recharge zones.

These indicators reflect EPA national and regional priorities by focusing on nutrient impairments and environmental justice areas.

Before combining the indicator scores, each was normalized on a scale from 0 to 100. For example, the Upper St. Johns River HUC-8 basin had 74 impaired WBIDs under the new criteria and using current data (*i.e.*, the Step 2 results), which was the most of any HUC-8 basin. The normalized score for this indicator for this basin was 100, and normalized scores were assigned to the other basins as follows:

$$\frac{\#\, WBIDs\ from\ Step\ 2\ in\ the\ basin}{74} * 100 = Normalized\ indicator\ score$$

DEP followed a similar approach to normalize the scores for the other indicators. This approach applied equal weight to each of the selected indicators so as not to bias any indicator over another. The sum of the normalized scores was then used for each basin to select the focus areas (*i.e.*, the top 15 basins).

The numbers on DEP’s webpage or other reporting and tracking mechanisms will look different when compared with those that the EPA will compute by following its own methodology. The most obvious difference will be in acreage of waters with TMDL coverage—the state’s numbers will represent only lake TMDLs, while the federal numbers will represent all the TMDLs.

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

Chapter 9: Florida's Basin Management Action Plan Program

Basin Management Action Plan Development

BMAPs are Florida's primary mechanism for implementing TMDLs adopted through Section 403.067, F.S. As the management actions are implemented largely through local efforts, BMAPs are produced through collaboration with local stakeholders, encouraging the greatest amount of cooperation and consensus possible. The BMAPs are developed under DEP's leadership in response to restoration prioritization, public comment, and local initiative. The process usually involves a series of meetings and technical discussions on sources, allocations, management strategies, monitoring, and tracking progress. The results of these discussions are summarized in the BMAP document. A BMAP describes the management strategies that will be implemented under existing water quality programs, schedules, funding strategies, tracking mechanisms, and the fair and equitable allocations of pollution reduction responsibilities to the sources in the watershed.

Where pollutant reductions are assigned, the management strategies and their schedule for implementation become the compliance schedule for each responsible entity. The process is designed to solicit cooperation and agreement on the assignments for reductions, and public meetings and proper notice are required. However, DEP can proceed with BMAP adoption, even if all the affected parties do not agree on the provisions. The decision to adopt a BMAP is provided, by statute, to the Secretary of DEP and by this means become legally enforceable.

When the BMAP is adopted, the management strategies and schedule become the compliance plan for the responsible entities. The BMAP requirements are connected to NPDES permits, when applicable, agricultural BMP implementation, or BMAP authorities for other nonpoint sources. Nonparticipating entities are not exempt from responsibility and are expected to meet their requirements without a compliance period. While voluntary measures may be included with a BMAP, the assigned reductions are required on schedule.

Depending on the basin and the type of impairment, the following management strategies may be used to address pollution sources:

- Domestic and industrial wastewater treatment upgrades.
- Installation and maintenance of stormwater treatment BMPs, such as baffle boxes.
- Source controls and policies.
- Public education to promote source control.
- Street sweeping.
- Septic tank system improvements or phase outs.
- Aquatic vegetation harvesting.
- Restoration dredging of muck.

For fecal coliform impairments, DEP has established a preferred approach to addressing the sources of bacterial contamination. Rather than establishing BMAPs or 4b or 4e plans, DEP has developed a guidance manual based on experiences in collaborating with local stakeholders around the state. This guidance document, *Implementation Guidance for the Fecal Coliform Total Maximum Daily Loads Adopted by the Florida Department of Environmental Protection*, provides local stakeholders with useful information for identifying sources of fecal coliform bacteria in their watersheds and examples of management actions to address these sources.

To date, DEP has adopted 26 BMAPs, summarized in **Table 9.1**. Combined, these adopted BMAPs address 136 WBIDs throughout the state that are impaired for nutrients (TN and/or TP), biochemical oxygen demand (BOD), and fecal coliforms. **Table 9.2** summarizes the accomplishments to date for those BMAPs that have completed at least one year of implementation, or the expected outcomes for those BMAPs still within the first year of implementation.

DEP currently has five BMAPs under development, summarized in **Table 9.3**. Once completed, these combined BMAPs will address an additional 20 WBIDs throughout the state that are impaired for nutrients, BOD, and fecal coliforms. **Figure 9.1** shows the locations of the adopted BMAPs, areas with BMAPs under development, areas with BMAPs planned, and locations with other restoration plans in place. In addition to these BMAPs, local governments and WMDs are concurrently carrying out restoration activities in many other waterbodies statewide. Information on BMAP activities is available on DEP's Water Quality Restoration Program website.

Table 9.1. Summary of adopted BMAPs

[1] The Lower St. Johns River (LSJR) Tributaries BMAP areas overlap with the LSJR Main Stem BMAP area.
[2] Costs were not provided for every management strategy included in the BMAP. The cost per strategy varies greatly; therefore, the costs included in the table cannot be extrapolated to estimate the full cost of all the BMAP management strategies.

BMAP	Estimated Acres	Adoption Date	Impairment(s)	Number of WBIDs Addressed	Estimated Costs[2]
Alafia River Basin	47,199	3/4/2014	TN, TP, and Fecal Coliforms	6	More than $170 million.
Banana River Lagoon	97,139	2/7/2013	TN and TP	4	More than $27,147,860 for projects and annual operations and maintenance (O&M) cost of $68,970.
Bayou Chico (Pensacola Basin)	6,906	10/18/2011	Fecal Coliforms	6	More than $22.5 million for 63.9% of BMAP strategies.
Caloosahatchee Estuary Basin	277,408	11/27/2012	TN	3	$10.7 million for 10% of BMAP strategies.
Central Indian River Lagoon	476,469	2/7/2013	TN and TP	4	More than $46 million for BMAP strategies, plus $555,935 for O&M; more than $16 million for 39.1% of southern IRL strategies.
Everglades West Coast	55,469	11/27/2012	TN	3	$4.425 million for 8% of BMAP strategies.
Hillsborough River	50,743	9/18/2009	Fecal Coliforms	6	$80 million for portion of BMAP projects.
Lake Harney, Lake Monroe, Middle St. Johns River, and Smith Canal	241,928	8/30/2012	TN and TP	7	More than $22.4 million for 17% of BMAP strategies, plus $225,000 for O&M.
Lake Jesup	95,718	5/17/2010	TP	2	More than $52 million for project costs, plus $765,000 for O&M.
Lake Okeechobee Basin	3,898,203	12/9/2014	TP	9	Cost estimates provided for 38% of projects exceeds $937.7 million.
Long Branch	3,628	5/15/2008	TN, TP, Fecal Coliforms, and BOD	1	$50,000 for basin-specific actions.
Lower St. Johns River Main Stem	1,807,397	10/10/2008	TN and TP	4	More than $620 million for 33% of BMAP strategies.
Lower St. Johns River Tributaries I[1]	16,543	12/7/2009	Fecal Coliforms	10	More than $31 for 79% of BMAP strategies, plus additional $5.5 million for countywide efforts.
Lower St. Johns River Tributaries II[1]	50,925	8/12/2010	Fecal Coliforms	15	More than $120 million for BMAP strategies.
Manatee River Basin	16,028	3/4/2014	TN, TP, BOD, and Fecal Coliforms	4	Approximately $50 million.
North Indian River Lagoon	211,398	2/7/2013	TN and TP	5	More than $37.6 million for BMAP strategies, plus $519,946 for O&M.
Orange Creek	385,271	5/15/2008	TN, TP, and Fecal Coliforms	7	

BMAP	Estimated Acres	Adoption Date	Impairment(s)	Number of WBIDs Addressed	Estimated Costs[2]
Orange Creek Phase II	385,271	7/1/2014	TN, TP, and Fecal Coliforms	-	More than $183.8 million.
Rainbow Springs and Rainbow Run	434,806	-	Nitrate	2	Estimated cost in excess of $97 million.
Santa Fe River	1,076,656	2/26/2012	Nitrate	3	More than $32.1 million.
Silver Springs Group and Silver River	632,810		Nitrate	3	Cost estimates provided for 43.6% of projects exceeds $216 million.
St. Lucie River and Estuary	521,170	6/11/2013	TN, TP, and BOD	9	More than $255.1 million.
Upper Ocklawaha River Basin	561,999	8/27/2007	TP	18	
Upper Ocklawaha River Basin Phase II	561,999	7/1/2014	TP		$195 million, not including agricultural BMPs or Florida Department of Transportation (FDOT) strategies for Phase I. Cost for Phase II includes more than $20.9 million for 65.1% of additional projects. Year 1 annual reports add projects estimated at $2.3 million.
Upper Wakulla River and Wakulla Springs	848,484		Nitrate	1	Total cost is more than $299,151,300 for 29% of strategies in PFAs. Total cost is almost $9,520,000 for 33% of strategies outside PFAs.
Wekiva River, Rock Springs Run, and Little Wekiva Canal	328,613		Nitrate, TN, and TP	4	Cost estimate provided for more than 50% of projects exceeds $262 million.
Total	**12,142,910**			**136**	

Table 9.2. Summary of accomplishments in the adopted BMAPs

BMAP	Accomplishments
Alafia River Basin	All projects identified in the 2014 Alafia River BMAP have been completed.
Banana River Lagoon	The BMAP is in its third year of implementation. The total reductions to date are 18,528 lbs/yr of TN and 4,655 lbs/yr of TP, or 19% and 21%, respectively, of the reductions needed to meet the TMDLs allocated to the BRL B project zone. These reductions are greater than the required reductions in the first BMAP iteration for the BRL B project zone. Projects completed in the BRL A project zone during the reporting period achieve reductions of 193 lbs/yr of TN and 111 lbs/yr of TP. The total reductions achieved to date in the BRL A project zone are 18,872 lbs/yr of TN and 2,966 lbs/yr of TP.
Bayou Chico (Pensacola Basin)	The fourth year of BMAP implementation of was recently completed. During this time, public education and outreach continued, pump-out facilities were added at marinas in the basin, additional stormwater treatment was provided, and the local utility made efforts to expand its sewer system into neighborhoods along Bayou Chico that previously used septic tanks.
Caloosahatchee Estuary Basin	The third year of implementation was recently completed on the BMAP. Total reductions to date are 172,201 lbs/yr of TN, or 44.3% of the reductions needed to meet the portion of the TMDL allocated to the Caloosahatchee Estuary Basin.
Central Indian River Lagoon	The BMAP is in its third year of implementation. Stakeholders in this area were not required to make additional reductions during the first phase of the BMAPs because the seagrass were meeting restoration targets. Even without reduction requirements, these stakeholders provided

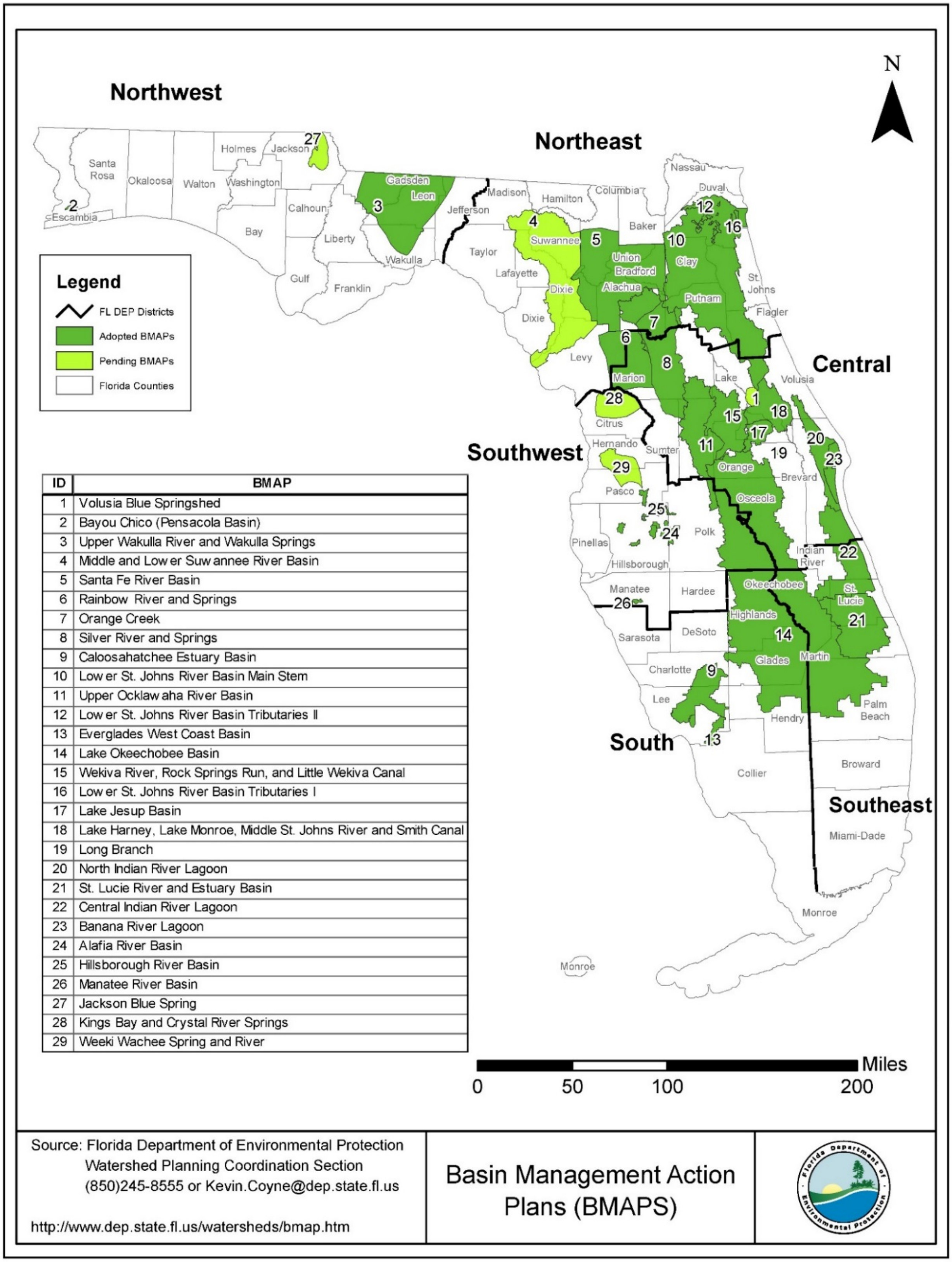
BMAP	Accomplishments
	completed and planned strategies that totaled approximately 113,000 lbs/yr of TN and 49,000 lbs/yr of TP reductions.
Everglades West Coast	The BMAP recently completed its third year of implementation. In the Hendry Creek Basin, the total reductions to date are 6,664 lbs/yr of TN. In the Imperial River Basin, the total reductions to date are 3,533 lbs/yr of TN.
Hillsborough River	The BMAP is now in the second iteration with additional strategies for continuing water quality improvements, and new monitoring to identify additional sources is proposed to help achieve the adopted fecal coliform TMDLs.
Lake Harney, Lake Monroe, Middle St. Johns River, and Smith Canal	The BMAP is in its fourth year of implementation. The total project reductions to date are 81,286.6 lbs/yr of TN and 18,376.8 lbs/yr of TP, which are greater than the required reductions in the first BMAP iteration of 43,828.2 lbs/yr of TN and 8,854.9 lbs/yr of TP. These reductions are 92.7% of the TN required TMDL reductions, and exceed the required TP reductions (111.6%) to meet the TMDL.
Lake Jesup	The BMAP has completed five years of implementation. The reductions to date are greater than the required reductions in the first BMAP iteration. The Lake Jesup BMAP identified "technical uncertainties," and stakeholders committed to address these uncertainties within the first BMAP iteration to allow for the possible recalculation of the TMDLs and requisite adjustments to the allocations required by the BMAP. DEP has hired a contractor to conduct a comprehensive evaluation of the models, examine key issues raised by stakeholders, identify the model refinement needs to address these issues and the needed data for revising the models, and recalibrate the watershed and receiving water models based on revised model structure.
Lake Okeechobee Basin	The BMAP was adopted in December 2014. It is nearing completion of the first year of implementation.
Long Branch	Based on monitoring plan results, DEP plans to delist Long Branch as impaired during the 2014 Group 2 assessment, which is currently under way. DEP’s Central District will continue monitoring the sampling sites identified in the monitoring plan to track water quality in Long Branch. In lieu of future BMAP progress reports, brief annual water quality reports will be prepared to evaluate trends in Long Branch. If the data indicate that water quality is deteriorating, BMAP efforts will resume to help reduce the nutrients and/or fecal coliform contributions to Long Branch.
Lower St. Johns River Main Stem	The BMAP has completed seven years of implementation. The wastewater treatment facilities and MS4s in the freshwater reach have both achieved 100% of their BMAP required reductions. Overall, 84% of the TN reductions have been achieved for the freshwater reach. In the marine reach of the river, 91% of the TN reductions have been achieved.
Lower St. Johns River Tributaries I	The BMAP has completed six years of implementation. Based on data through 2014, five of the tributaries are exceeding the BMAP milestone of a 50% reduction in fecal coliforms from the TMDL period. An additional four tributaries have had improvements in fecal coliform concentrations since the TMDL period.
Lower St. Johns River Tributaries II	The BMAP has completed five years of implementation. Based on data through 2014, McCoy Creek, Fishing Creek, Deep Bottom Creek, Moncrief Creek, Blockhouse Creek, Cormorant Branch, Wills Branch, Sherman Creek, Greenfield Creek, Pottsburg Creek, Middle Trout River, and Lower Trout River are currently exceeding this 50% improvement milestone. Improvements in fecal coliform concentrations have also occurred in Craig Creek, Williamson Creek, and Hopkins Creek.
Manatee River Basin	With the implementation of the projects outlined in the BMAP, continued reductions in the nutrient loads and the identification and remediation of fecal coliform sources in the impaired WBIDs are expected to decrease the contribution of nutrients and fecal coliforms to these WBIDs. Most of the projects identified are a result of the previous work accomplished by the Tampa Bay Estuary Program and the Nitrogen Management Consortium for the ongoing Tampa Bay RAP.

BMAP	Accomplishments
North Indian River Lagoon	The BMAP is in its third year of implementation. In the North A zone, the total reductions to date are 27,902 lbs/yr of TN and 8,626 lbs/yr of TP, or 28% of the TN and 45% of the TP reductions needed to meet the TMDL allocated to the North A project zone. In the North B project zone, the total reductions to date are 43,960 lbs/yr of TN and 14,192 lbs/yr of TP, or 36% of the TN and 43% of the TP reductions needed to meet the TMDL allocated to the North B project zone.
Orange Creek	The BMAP is in its second iteration as of June 2014. An additional 57 projects are adopted with this second phase. They cover a range of management strategies, including purchases of conservation land around the large lakes, urban stormwater BMPs, public education and outreach, and continued monitoring and evaluation of water quality response to management actions.
Rainbow Springs and Rainbow Run	The BMAP was adopted in November 2015.
Santa Fe River	The BMAP has completed the third year of implementation; activities include the enrollment of agricultural producers in BMPs and an RFA.
Silver Springs Group and Silver River	The BMAP was adopted in October 2015.
St. Lucie River and Estuary	The BMAP is in its third year of implementation. The total reductions to date are 491,281 lbs/yr of TN and 133,050 lbs/yr of TP, which are greater than the required reductions in the first BMAP iteration of 316,024.2 5lbs/yr of TN and 121,250 lbs/yr of TP.
Upper Ocklawaha River Basin	The BMAP was in its second iteration as of July 2014. The management strategy commitments in this Phase 2 BMAP continue the efforts for public restoration projects and stormwater improvements. In addition, this BMAP adds focus to specific waterbodies in the basin. The five focus waterbodies are Trout Lake, Lake Carlton, Lake Harris, Palatlakaha River, and Lake Yale. An additional 63 projects are adopted with this second phase. They largely address the management strategy of improved local government stormwater control. Reducing TP discharges into the basin will help achieve Class III designated uses established by DEP for the Upper Ocklawaha River Basin.
Upper Wakulla River and Wakulla Springs	The BMAP was adopted in November 2015.
Wekiva River, Rock Springs Run, and Little Wekiva Canal	The BMAP was adopted in November 2015.

Table 9.3. Summary of BMAPs under development

BMAP	Estimated Acres	Impairment(s)	Number of WBIDs Addressed	Additional Information
Jackson Blue Spring	90,132	NO_3	2	Jackson Blue Spring and Merritts Mill Pond are located in Jackson County. Jackson Blue Spring forms the headwaters of Merritts Mill Pond, which in turn forms the headwaters of Spring Creek, a tributary to the Chipola River, which is designated as an OFW.
Kings Bay/ Crystal River	178,753	TN/TP/NO_3/ OPO_4	6	The Crystal River and Kings Bay Basin is located in Citrus County. Crystal River/Kings Bay is a tidally influenced, spring-fed system located adjacent to the city of Crystal River. The Crystal River/Kings Bay spring complex includes more than 70 springs, which account for 99% of the fresh water entering the 600-acre Kings Bay. Collectively, Kings Bay's numerous springs and countless seeps form the sixth largest spring system

BMAP	Estimated Acres	Impairment(s)	Number of WBIDs Addressed	Additional Information
				in Florida, by discharge. Kings Bay/Crystal River was designated an OFW by the state.
Middle and Lower Suwannee River Basin	1,078,651	TN	8	The Suwannee River Basin drains approximately 10,000 square miles of south Georgia and north Florida, discharging an annual average flow of approximately 10,000 cfs. The Suwannee River is the second largest river in the state in terms of flow. The Suwannee River is designated as "Special Waters" because of its exceptional ecological and recreational significance, and was also designated as an OFW in 1979.
Volusia Blue Springs	66,793	NO_3	2	Volusia Blue Spring and Volusia Blue Spring Run are located in Volusia County in Blue Spring State Park. Volusia Blue Spring is the largest first-magnitude spring on the St. Johns River and discharges from a vent about 20 feet beneath the surface. Blue Spring Run, which was recognized by the Manatee Sanctuary Act of as important manatee habitat, provides the primary warmwater winter refuge for manatees on the St. Johns River.
Weeki Wachee Spring and Spring Run	162,714	NO_3	2	The Weeki Wachee Spring and Weeki Wachee River Basin is located in Hernando and Pasco Counties. Weeki Wachee Spring is the headwaters of the Weeki Wachee River, which flows westward seven miles to the Gulf of Mexico. Weeki Wachee Spring and the Weeki Wachee River support a complex freshwater aquatic ecosystem and together are an important cultural and economic resource for the state. The Weeki Wachee Spring Group is composed of a single, large main spring and numerous smaller springs spread over an area of nearly five square miles. Weeki Wachee Spring is the primary source of the Weeki Wachee River and the largest spring (by discharge) in the group. Weeki Wachee Spring is consistently a first-magnitude spring with discharge greater than 100 cfs.
Total	**1,577,042**		**20**	



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

Source: Florida Department of Environmental Protection
Watershed Planning Coordination Section
(850)245-8555 or Kevin.Coyne@dep.state.fl.us

http://www.dep.state.fl.us/watersheds/bmap.htm

Basin Management Action Plans (BMAPS)

Figure 9.1. Status of BMAPs and other water quality restoration activities

Chapter 10: Introduction to Ground Water Monitoring

Summary of Ground Water Monitoring Programs

The quality of ground water is of foremost concern in Florida, because ground water is so heavily used as a potable water source and because ground water inputs into surface water systems are so important. Over the years, ground water quality monitoring has been incorporated into several programs. The programs pertinent to this report are discussed below and summarized in **Tables 10.1a** and **10.1b.**

Table 10.1a. Summary of ground water monitoring programs and data sources: Monitoring networks maintained by DEP

Monitoring Network or Program	Period	Description
Status Network	1999–2003; 2004–08	The statewide rotating basin, probabilistic sampling network was based on sampling 60 wells from several basins per year. The 1999–2003 cycle (Cycle 1) completed a statewide survey in four years. During 2004–08, the state adopted the TMDL 29-basin design (Cycle 2), completing the statewide survey in five years. These sample locations were randomly selected from a list frame of wells, with samples collected from 30 unconfined and 30 confined aquifers in each five to six reporting units. This report presents the results from Cycle 2.
Status Network	2009–ongoing	This statewide probabilistic sampling network samples 240 wells annually. Sample locations are randomly selected from a list frame of wells, with samples collected from 20 unconfined and 20 confined aquifers in each of six reporting units. The data used to characterize water quality on a statewide scale, and the parameters monitored, correspond with those targeted in surface water evaluations.
Background Network and Temporal Variability (TV) Sub-network	1985–1999	A statewide network of 1,600 water wells and monitoring wells used to spatially monitor general background water quality of local aquifers (surficial, intermediate, and Floridan). On average, each well was sampled once every three years for an extensive list of analytes. TV network wells are sampled monthly to quarterly.
Ground Water Temporal Variability (GWTV) Sub-network	1999–ongoing	The current network consists of 46 wells statewide. It is designed to help correlate Status Network results with seasonal hydrologic variations, and estimate the temporal variance of analytes.
Very Intense Study Area (VISA) Network	1989–1999	The network monitored the effects of land uses on ground water quality in 23 selected areas of the state. Individual VISAs consisted of approximately 20 wells sampled three times over an 11-year period. Sampling was carried out for a targeted list of analytes.
Springs Monitoring Network	2001–ongoing	Until 2010, 58 samples were collected quarterly from 23 first-magnitude and nine second-magnitude spring clusters. Since then, the quarterly network has been reduced to eliminate redundancy with stations also monitored by Florida's WMDs. Since 2012, the network has consisted of 24 springs. The basic analyte list is similar to that used for the Status Network but also includes isotopes for nitrogen sourcing.

Table 10.1b. Summary of ground water monitoring programs and data sources: Programs that include potable ground water sampling: Monitoring networks maintained by DEP

Monitoring Network or Program	Period	Description
Public Water System (PWS) Monitoring	Ongoing	Under Chapter 62-550, F.A.C., all PWS are required to monitor and report water quality at regular intervals within their compliance cycle. Ground water is the primary source of potable water in the state.
FDOH/DEP Water Supply Restoration Program (WSRP)–Private Well Sampling Program	Ongoing	This consists of private well data collected in investigations of potential ground water contamination, maintained in a DEP WSRP Database. The parameter list is variable, depending on the contaminants of concern.
Monitoring of discharges to ground water	Ongoing	Under Chapter 62-520, F.A.C., facilities discharging to ground water are required to implement a ground water monitoring plan and report those results to DEP.

Ground Water and Springs Monitoring Programs Maintained by DEP

DEP established a ground water quality monitoring network in 1984, under the authority and direction of the 1983 Water Quality Assurance Act (Chapter 83-310, Laws of Florida, currently contained in Sections 376.30 through 376.317 and 403.063, F.S.). From 1984 to 1999, the Background Network was maintained to establish the background and baseline ground water quality of major aquifer systems in Florida. In 1999, DEP initiated a probabilistic sampling Status Network to assess ground water and surface water quality on a basinwide scale. This sampling has been integrated into the agency’s watershed management approach. Since the Status Network’s inception, three statewide samplings have been completed.

Monitoring results for the Ground Water Temporal Variability Network (GWTV), which also began in 1999, are used to assess seasonal and long-term variability in ground water quality. Other, historical monitoring efforts include the Background Network, the Very Intense Study Area (VISA) Network, and FDOH’s Private Water Well Quality Survey. Additional information on all these monitoring networks is available on DEP’s Watershed Monitoring website.

This report includes the Status Network monitoring data in the dataset used to evaluate overall ground water quality and ground water parameters of particular concern that may influence receiving surface waters.

DEP established a springs monitoring network in 2001 and has continued quarterly monitoring and data acquisition. Beginning in 2001, this effort initially included quarterly monitoring at each of the state’s first-magnitude springs but has since expanded to include important second-magnitude springs, as well. Currently, DEP samples 18 spring stations quarterly and also integrates spring monitoring data from other providers into its database. In this report, quarterly spring monitoring data collected by DEP as well as the WMDs are evaluated to identify spring water quality with respect to nutrients.

Potable Water Monitoring by FDOH/DEP Water Supply Restoration Program

Contaminated drinking water wells are identified through the sampling efforts of the local county public health units, supported by DEP funding. To optimize resources, wells are sampled in areas of known or suspected contamination, such as agricultural areas, areas of known off-site contamination near regulated facilities, landfills, or near underground storage tanks.

The FDOH Petroleum Surveillance Program concentrates its efforts in areas suspected to have petroleum-related contamination and targets drinking water wells near known storage tanks for sampling.

The FDOH Drinking Water Toxics Program looks for contamination related to the use of pesticides and fertilizers, and contamination from solvents and metals. The program is a cooperative effort between FDOH, county public health units, and DEP. It is funded by DEP through a contract with FDOH, and FDOH directs the sampling effort by local public health units.

In this report, the Water Supply Restoration Program (WSRP) Database maintained by DEP was used in the evaluation of the ground water contaminants of concern identified in private drinking water wells. The database currently has water quality records for approximately 40,000 private wells. A caveat to their use in this evaluation is that these wells are not evenly distributed because they were sampled in areas of known or suspected contamination. Thus, the number of exceedances in a particular basin can be misleading because the results may depend on well density and distribution in relationship to a given problem area.

Public Water System (PWS) Monitoring

Approximately 5,600 public water systems (PWS) in Florida rely on ground water. These are served by over 10,000 wells. Chapter 62-550, F.A.C., sets the drinking water standards and the monitoring requirements and treatment techniques to be met by PWS, and also mandates that testing must be conducted by FDOH-certified laboratories. The ultimate concern of the PWS supervision program is the quality of water when the water reaches consumers, but PWS monitoring involves the direct sampling of wells in some instances. Water quality results include samples from various entry points into the water system and points in the distribution system, include treated water, and for some parameters may include composite samples. Not all samples included in the data are used to determine compliance with Chapter 62-550, F.A.C.

The monitoring framework for PWS is a nine-year compliance cycle containing specific monitoring requirements for individual parameter groups and specific actions based on the detection of parameters above action limits or maximum contaminant levels (MCLs). Water quality data in the PWS Database are reported by the public water system identification number (PWS ID#). 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 because of the compositing or blending of water mentioned above, or because averaging with subsequent samples was below the action level or MCL. Additional information is available on DEP's Drinking Water Program website.

Water quality data in the PWS Database were used in the evaluation of regional and statewide contaminants of concern. These data can either represent one individual well or a composite sample from multiple wells that comprise a system. Generally, the most densely populated areas of the state have public supply systems with multiple wells, while less populated areas may rely on only one well. Each public supply well was assigned to a basin or, in the case of a system, the basin that represented the majority of those wells. In the analyses of contaminants of concern, the number of MCL exceedances is not weighted, and thus each exceedance may represent one individual well or a composite of many wells in a system. Drinking water standards, monitoring requirements, and the frequency of sampling for public water supply wells are based on Chapter 62-550, F.A.C.

Monitoring of Discharges to Ground Water

DEP implements a comprehensive ground water quality protection program that regulates discharges to ground water. The program establishes ground water quality standards and classifications and permitting criteria. Several DEP rules contain construction and operation requirements, minimum setbacks, and ground water monitoring criteria.

Most permitted discharges to ground water are required to submit and implement a ground water monitoring plan showing the location of the proposed upgradient and downgradient monitoring wells, construction details, and ground water sampling and analyses protocols. At a minimum, these plans require three monitoring wells: a background well, an intermediate well, and a compliance well. These wells are generally sampled quarterly by the permittee, and the results of the analyses are submitted to DEP to ensure compliance with Florida's ground water standards.

Chapter 11: Results of the Ground Water Assessments

Overall Ground Water Quality

Data from the DEP in-house ground water monitoring program were used to evaluate the overall quality of ground water based on several categories of primary ground water MCLs and health advisory levels (HALs). Florida's drinking water standards apply to ground water (Chapter 62-520, F. A.C.). The data were sorted into analyte groups, and an "indicator" analyte was selected to determine ground water quality for wells in each of the basins. The groups used in this evaluation include metals, bacteria, nitrate, and saline water, which represent some of the most common threats to drinking water noted by the EPA in national surveys. Organics and radionuclides were not included in the Status Network parameter list but are addressed in this chapter. The ground water evaluation used the same source of data as the Status and Trends reporting in **Chapter 5**. This evaluation also provided information by basin rather than statewide, as was done with the assessments reported in **Chapter 5.**

The wells used in this statewide evaluation of overall ground water quality consist of a mixture of drinking water, irrigation, production, and monitoring wells used by DEP for monitoring ground water quality. It should also be noted that the main network from which these data were obtained uses randomly selected wells for each sampling cycle, and new wells are sampled each time a basin is sampled. These data are meant to represent general basin-scale conditions, and there is no attempt to target specific localized ground water problem areas. Thus, for the purposes of these analyses, the water quality in these wells represents overall ground water conditions.

Table 11.1 presents the results of this evaluation, with the results provided by individual basin and combined for statewide statistics. The results in the table are further broken down to show the results from the past two years and the prior two years, which were reported in the 2012 and 2014 Integrated Reports. Overall, bacteria (as total coliform) and salinity (as sodium) were the analyte groups with the largest percentage of MCL exceedances in ground water 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 ground water contamination problem. For that reason, coliform data should always be scrutinized carefully. The next section on *Ground Water Issues and Contaminants of Concern* discusses the occurrence of coliform bacteria in ground water in greater detail.

Table 11.1. Summary of percent ground water samples achieving primary ground water 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 (As) and lead (Pb), the two primary metals most commonly exceeding their MCL.
N/A = Not available

Basin	Metals, Arsenic[1] 2009–10 / 2011–12 / 2013–14	Metals, Lead[1] 2009–10 / 2011–12 / 2013–14	Coliform, Total 2009–10 / 2011–12 / 2013–14	Nitrate-Nitrite (as N) 2009–10 / 2011–12 / 2013–14	Sodium, Total 2009–10 / 2011–12 / 2013–14
Apalachicola–Chipola	97% - 100% - 95%	100% - 100% - 100%	85% - 83% - 95%	96% - 95% - 100%	100% - 100% - 100%
Caloosahatchee	95% - 94% - 100%	100% - 100% - 100%	58% - 76% - 69%	100% - 100% - 100%	88% - 65% - 81%
Charlotte Harbor	100% - 100% -90%	100% - 100% - 100%	100% - 78% - 100%	100% - 100% - 100%	50% - 60% - 40%
Choctawhatchee–St. Andrew	100% - 100% - 100%	96% - 100% - 100%	93% - 90% - 97%	100% - 100% - 100%	100% - 100% - 100%
Everglades	**100%* - 100%*** - 100%	**100%* - 100%*** - 100%	**80%* - 100%*** - 89%	**100%* - 100%*** - 100%	**100%* - 100%*** - 67%
Everglades West Coast	97% - 100% - 100%	87% - 100% - 92%	67% - 74% - 80%	100% - 100% - 100%	74% - 74% - 68%
Fisheating Creek	**100%* -100%*-** 100%*	**100%* -100%*-** 100%*	**75%* -100%*-** 100%*	**100%* - 100%*-** 100%*	**75%* - 100%*-** 100%*
Florida Keys	**100%-100%*- 100%***	**100%*-100%*-100%***	**100%* -100%*- 100%***	**100%* -100%*- 100%***	**100%* -100%*- 100%***
Indian River Lagoon	**75%* - 100%*-** 100%	**75%*-100%*-** 100%	**100%* - 100%*** - 90%	**100%* - 100%*** - 100%	**100%* - 33%*** - 70%
Kissimmee River	100% - 100% - 98%	96% - 94% - 93%	81% - 82% - 86%	96% - 88% - 95%	100% - 94% - 98%
Lake Okeechobee	100% - 100% -100%	100% - 100% - 100%	100% - 100% - 100%	100% - 100% - 100%	67% - 57% - 67%
Lake Worth Lagoon–Palm Beach Coast	**100%*-100%*-** 100%	**100**%*- **100%*-**100%	**80%* - 80%*** - 92%	**100%* - 100%*** - 100%	**100%* - 30%*** - 23%
Lower St. Johns	95% - 100% - 100%	100% - 90% - 100%	74% - 75% - 55%	100% - 100% - 100%	85% - 100% - 100%
Middle St. Johns	100% - 100% - 100%	100% - 100% - 94%	46% - 76% - 88%	100% - 100% - 94%	92% - 86% - 81%
Nassau–St. Marys	100% - 100% - 100%	100% - 100% - 100%	70% - 67% - 62%	100% - 100% - 100%	100% - 93% - 85%
Ochlockonee–St. Marks	94% - 100% - 100%	100% - 100% - 100%	87% - 70% - 86%	100% - 100% - 100%	100% - 100% - 100%
Oklawaha	100% - 100% - 100%	95% - 100% - 100%	84% - 71% - 87%	96% - 100% - 100%	100% - 100% - 100%
Pensacola	100% - 100% - 100%	100% - 100% - 95%	70% - 93% - 95%	100% - 100% - 100%	100% - 100% - 100%
Perdido	100%- **100%*- 100%***	100%-1**00%*- 100%***	100% - **100%*- 50%***	100% - **100**%*- **100%***	100% - **100%* - 100%***
Sarasota Bay–Peace–Myakka	100% - 100% - 100%	89% - 95% - 100%	65% - 74% - 68%	100% - 100% - 100%	93% - 91% - 85%
Southeast Coast–Biscayne Bay	100% - 100% - 100%	92% - 93% - 100%	50% - 43% - 67%	100% - 100% - 100%	100% - 87% - 61%
Springs Coast	100% - 100% - 100%	87% - 100% - 100%	87% - 100% - 75%	100% - 100% - 100%	75% - 67% - 50%
St. Lucie–Loxahatchee	100% - 100% - 100%	100% - 90% - 88%	91% - 90% - 81%	91% - 100% - 100%	54% - 30% - 37%
Suwannee	97% - 97% - 96%	100% - 100% - 99%	82% - 89% - 85%	97% - 99% - 97%	98% - 100% - 98%
Tampa Bay	100% - **100%*** - 92%	100% - 100% - 100%	67% - 80% - 50%	100% - 100% - 100%	87% - 100% - 100%
Tampa Bay Tributaries	100% - 100% - 100%	100% - 93% - 100%	**57%*** - 93% - 74%	100% - 100% - 100%	100% - 100% - 100%
Upper East Coast	**100%*- 100%*-** 100%	98% - **100%*** - 100%	**75%* - 75%*** - 75%	**100%*- 100%*** - 100%	**100%* - 50%*** - 83%
Upper St. Johns	89% - 89% - 86%	100% - 100% - 100%	89% - 88% - 86%	100% - 100% - 100%	56% - 67% - 43%
Withlacoochee	100% - 100% - 100%	100% - 100% - 100%	67% - 75% - 62%	**100%* - 100%*** - 100%	100% - 100% - 100%
STATEWIDE MEDIAN	**98% - 99% -100%**	**97% - 98% - 100%**	**79% - 83% - 86%**	**99% - 99% - 100%**	**89% - 81% - 85%**

The statewide assessment shows that data from the past two years were similar to the previous years in the number of samples achieving the MCL (86% compared with 83% and 79% of the samples). **Table 11.1** shows the basins with the highest and lowest percentages of wells achieving the ground water standards. The Southeast Coast–Biscayne Bay, Nassau–St. Marys, and Ochlockonee–St. Marks had the lowest percentage of wells achieving the MCL for total coliform in the recent two-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 ground water influence on freshwater aquifers. Higher salinity can be related to increased ground water usage that creates the upward seepage of mineralized ground water from deeper aquifers or the lateral intrusion of seawater if wells are located in coastal areas. Saline water was found to be a potential issue in several of the basins based on their percentage of samples meeting the sodium MCL. The Lake Worth Lagoon, Charlotte Harbor and St. Lucie-Loxahatchee Basins had the lowest percentages of wells achieving the MCL. The statewide assessment shows that data from the past two years were similar to the previous assessment periods in the number of samples achieving the MCL (85% compared with 81 and 89% of the samples). **Table 11.1** shows the basins with the highest and lowest percentages of ground water samples achieving the MCL for sodium.

Statewide, one or more metals exceeding a primary ground water MCL occurred in only about 2% of the samples. Statewide, an equal number of basins had exceedances for lead and arsenic. During the recent two-year period, the Upper St. Johns Basin had the lowest percentage of wells meeting the aresenc MCL and St. Lucie-Loxahatchee had the lowest number of wells meeting the MCL for lead. Elevated lead concentrations in samples are sometimes related to well casing or plumbing material, but when arsenic is found, it is most likely associated with an actual condition in the aquifer.

In ground water, nitrate-nitrogen is a conservative contaminant, and concentrations are not typically biased by well materials or sampling technique. The compound nitrite-nitrogen is seldom detected in ground water and, if present, occurs in only minute concentrations. Therefore, when concentrations of nitrate-nitrite nitrogen are reported together, as they are in **Table 11.1**, 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 11.1** lists the basins with the highest and lowest percentage of samples achieving the

MCL for nitrate. The vast majority of wells in the DEP network that were sampled for nitrate were below the MCL. However, ground water samples from several basins exceeded the MCL. The basins with the lowest percentage of wells meeting the MCL for nitrate during the recent two-year period were the Middle St. Johns, Kissimmee and Suwannee Basins.

These analyses of the regional data show that ground water quality in the state is good overall, when considering these parameters. However, it also indicates that there are some ground water 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 ground water.

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

As discussed in the analyses of ambient data, the overall quality of ground water in Florida is good. However, there are ground water quality issues in specific areas. Public water system sampling data (which include both treated and raw water samples) were used to develop a summary of the categories of parameters that were most frequently found at levels exceeding primary MCLs in Florida's aquifers used for potable supply. Data were obtained for an approximate two-year period of record that extends back to November 2013. The number and distribution of the samples that exceed specific MCLs for ground water during this period help identify current issues and contaminants of concern. The reporting of these exceedances in wells and water systems is not meant to imply that well owners or public water customers are consuming contaminated ground water. Water from PWS is most often treated but sometimes blended to reduce contaminants to safe levels.

Figure 11.1 summarizes statewide findings by contaminant category. **Table 11.2** summarizes contaminant categories in each of the state's 29 major basins, showing the numbers of exceedances reported for PWS since the 2014 Integrated Report data were reported. The data for this evaluation were obtained fromNovember 2013 through July 2015. The contaminant of concern categories include volatile organic compounds (VOCs), other synthetic organic chemicals (SOCs) (such as pesticides), nitrate, primary metals, salinity, and radionuclides. This evaluation is limited to contaminants that have potable ground water primary MCLs. Although not included in the summary tables, THMs and bacteria are also significant contaminants affecting water supplies and are discussed in this section.

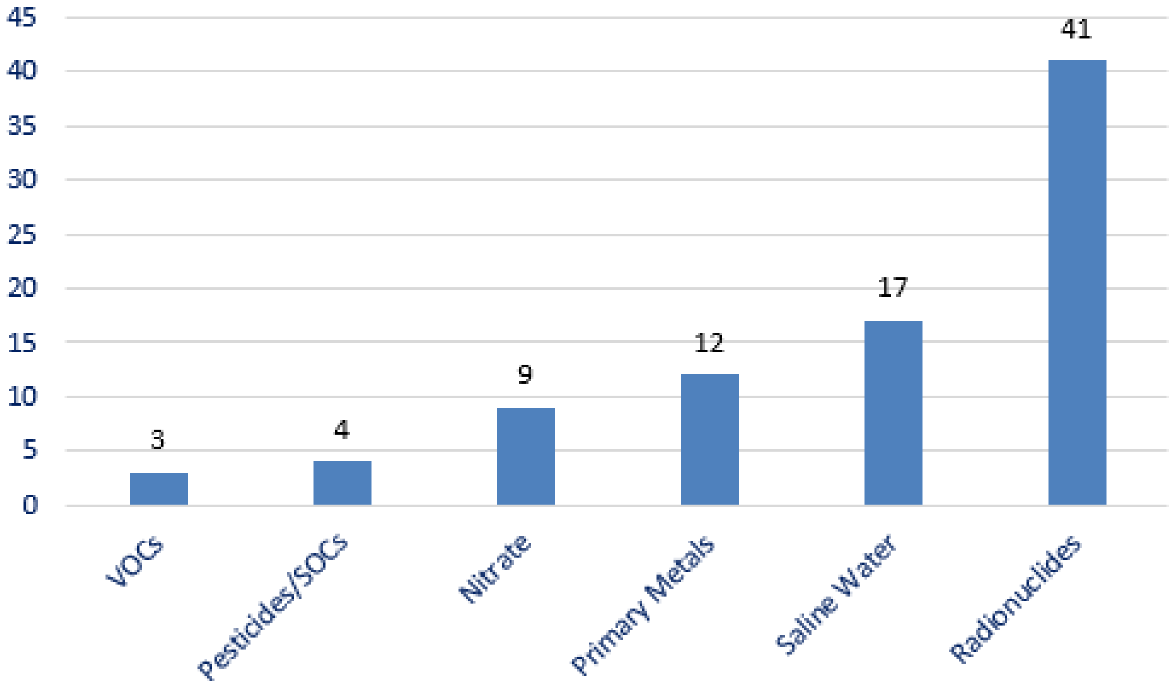


Figure 11.1. Statewide summary number of primary MCL exceedances reported for untreated PWS in the recent two-year period

Table 11.2. Summary of recent exceedances of primary ground water standards in untreated samples from ground water–based PWS

[1] PWS with samples that exceeded primary MCLs for VOCs, excluding trihalomethanes (THMs) and ethylene dibromide (EDB).

[2] PWS with samples that exceeded primary MCLs for pesticides (also known as SOCs).

[3] PWS with samples that exceeded MCLs for nitrate or nitrate-nitrite.

[4] PWS data not restricted to wells only. Some parameter results are for other entry points into a system or composite samples. Data are from systems that operate their own wells. 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.

ND = No data

Contaminant Categories and Number of Water Systems with Samples Exceeding Primary Standards (period of record November 2013–July 2015)

Basin–Aquifer	VOCs[1] in PWS[7]	Pesticides/ SOCs[2] in PWS[7]	Nitrate[3] in PWS[7]	Primary Metals[4] in PWS[7]	Saline Water[5] in PWS[7]	Radionuclides[6] in PWS [7]
Apalachicola–Chipola–Floridan Aquifer System	0	0	0	0	0	0
Caloosahatchee–Surficial Aquifer	1	0	0	0	1	0
Charlotte Harbor–Floridan Aquifer System (SW)[8]	0	0	0	0	0	0
Choctawhatchee–St. Andrew–Floridan Aquifer System	0	0	0	0	1	0
Everglades–Surficial Aquifer (SW)[8]	0	0	0	0	2	0
Everglades West Coast–Surficial Aquifer	0	0	1	0	0	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	2	0
Kissimmee River–Floridan, Intermediate, and Surficial Aquifers	0	0	1	0	0	1
Lake Okeechobee–Surficial Aquifer (SW)[8]	0	0	0	0	1	0
Lake Worth Lagoon–Palm Beach Coast–Surficial Aquifer	0	0	0	0	0	0
Lower St. Johns–Floridan Aquifer System	0	1	0	1	1	0
Middle St. Johns–Floridan Aquifer System	0	0	0	0	0	3
Nassau–St. Marys–Floridan Aquifer System	0	0	0	0	0	0
Ochlockonee–St. Marks–Floridan Aquifer System	0	0	0	0	0	1
Oklawaha–Floridan Aquifer System	0	0	1	1	0	1
Pensacola–Sand-and-Gravel Aquifer	1	1	0	1	2	5
Perdido–Sand-and-Gravel Aquifer	0	0	0	0	0	1
Sarasota Bay–Peace–Myakka–Floridan and Surficial Aquifers	0	0	1	0	1	13
Southeast Coast–Biscayne Bay–Biscayne Aquifer	0	0	0	1	0	0
Springs Coast–Floridan Aquifer System	0	0	1	1	0	1
St. Lucie–Loxahatchee–Surficial Aquifer	1	0	0	0	2	0
Suwannee–Floridan Aquifer System	0	0	0	2	0	1
Tampa Bay–Floridan Aquifer System	0	0	0	1	3	2
Tampa Bay Tributaries–Floridan Aquifer System	0	2	2	4	1	11
Upper East Coast–Floridan Aquifer System and Surficial Aquifer	0	0	0	0	0	0
Upper St. Johns–Floridan Aquifer System and Surficial Aquifer	0	0	1	0	0	1
Withlacoochee–Floridan Aquifer System	0	0	1	0	0	0
STATEWIDE SUMMARY—Nov. 2013 – Jul. 2015	**3**	**4**	**9**	**12**	**17**	**41**
STATEWIDE SUMMARY—2016 Integrated Report	**9**	**7**	**9**	**30**	**29**	**55**

Volatile Organic Compounds (VOCs)

Volatile organics can be highly mobile and persistent in ground water, and incidences of ground water contamination by VOCs have historically been fairly widespread in mainly urban areas. **Table 11.2a** summarizes the numbers of water systems and private wells for which samples contained above-MCL levels of VOCs that have primary drinking water MCLs. Only nine PWS had VOC exceedances during this two-year period. Only three PWS had VOC exceedances during this two-year period.

Benzene has historically been the compound that most frequently exceeded MCLs in each of the two sets of water quality data, followed by trichloroethylene (TCE) and tetrachloroethylene (perchloroethylene [PCE]).

Synthetic Organic Chemicals (SOCs)

Over the past two years, there were only four PWS with SOC exceedances. During that period, eight private wells were found with exceedances, mainly for EDB. FDOH focuses on contaminants of highest priority to health in the state, and new pesticide detections have not led to very much sampling of private wells in the past two years. Historically, ethylene dibromide (EDB) was the compound most frequently detected in PWS and private drinking water wells in Florida. This nematocide, which was used heavily in the 1980s on citrus and other croplands, was found to be highly mobile and a threat to potable ground water supplies. Since the 1980s, EDB has been banned from use, but it is still detected in well water samples in areas where it was formerly used.

Nitrate

Elevated nitrate concentrations in ground water have been associated with inorganic fertilizers, animal waste, and domestic wastewater and residuals (Harrington *et al.* 2010). Nitrate has occasionally been found at concentrations greater than the MCL of 10 mg/L in PWS. Over the past two years, samples from nine systems using ground water have reported nitrate detections above the MCL across eight basins. FDACS works with growers to implement agricultural best management practices in many areas of the state to reduce nitrogen losses to ground water. It is hoped that this program will eventually help to reduce the number of nitrate exceedances in wells where this is a problem.

Primary Metals

Metals have been detected at concentrations above their MCL in PWS. In the past two years, there have been 12 metals exceedances in samples from PWS across eight basins. The Tampa Bay Tributaries had four PWS with metals exceedances. At times, these detections have been because of the materials containing and conveying the water, rather than actual concentrations in ground water. Metal well casings, piping, storage tanks, and plumbing fixtures, in addition to sampling techniques, often cause bias in the analyses of ground water samples for metals. Lead and cadmium have historically been found at concentrations above the MCL in samples from PWS, and both metals are very frequently 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.

Arsenic has recently arisen as the metal of concern in PWS and private wells. Lead, again, may be an artifact of well materials, piping, or plumbing fixtures, but arsenic, which is responsible for the vast majority of exceedances, is not typically associated with any of these.

Arsenic in ground water may be naturally occurring, of anthropogenic origin from human-induced geochemical changes, or a true contaminant released as a result of human activities. Throughout Florida, arsenic is a stable element associated with the minor mineral pyrite. In addition, a recent unpublished study suggests that arsenic may occur in association with the mineral powellite, although much less is known about its distribution in Florida rocks. The prevalence of elevated arsenic detections in some basins may be because of the chemical makeup of the aquifer in these areas.

In addition to this natural source, potential anthropogenic sources include arsenic-based pesticides applied to cotton fields; citrus groves; road, railroad, and power line rights-of way; golf courses; and cattle-dipping vats (which were in use in Florida until 1961; *e.g.,* Walker 2011). In recent years, the use of arsenical pesticides has significantly decreased, and as of 2013 its use is restricted only to monosodium methanearsonate (MSMA) on cotton fields, golf courses, sod farms, and highway rights-of-way (EPA 2013). However, residues from past use, when bound to soil particles, do not readily dissipate. Higher numbers of reported exceedances may be considered an artifact of the change in the EPA arsenic standard for ground water, which was reduced from 50 to 10 µg/L in 2001, and was fully implemented in 2006.

Recent studies indicate that human disturbances which introduce water or oxygen into arsenic-bearing limestone leads to the release of soluble arsenic from the rock matrix. Activities such as mining, well drilling, stormwater discharge into drainage wells, ASR projects (Arthur *et al.* 2002; Price and Pichler 2006), and overpumping can potentially release previously stable arsenic into ground water. In addition, drought can lower the water table, allowing oxygen to permeate the aquifer matrix and cause the release of arsenic compounds from limestone.

Saline Water

Saltwater intrusion has been a well-documented concern in some coastal areas of the state where the wedge of salt water is drawn inland by well pumpage and dewatering of wetland areas (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. Historically, elevated sodium concentrations were found in samples from PWS in the Tampa Bay Tributaries, Middle St. Johns, and Ocklawaha Basins. Over the recent two-year period, however, 17 PWS scattered among 11 basins reported sodium exceedances.

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 and the increased consumption of ground water in Florida are probable 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 may still result in MCL exceedances and a potential health concern. Most radionuclides occur naturally as trace elements in bedrock and soil as a consequence of radioactive decay series, including uranium-238 (U-238) and thorium-232 (Th-232; *e.g.*, NDWC 2000). Elevated radionuclide levels in Florida occur most commonly in phosphate mineral deposits that are common in some areas of the state (DEP 2013). Measurements for radionuclides in ground water include gross Alpha, gross Beta, and analyses for the isotopes radium-226 and radium-228. Of these, gross Alpha is the most commonly measured parameter. **Table 11.2** summarizes radionuclide MCL exceedances in water from PWS.

Historically, PWS in the west–central area of the state have most frequently had MCL exceedances for radionuclides. Over the two-year period, samples of ground water from 41 PWS exceeded MCLs for radionuclides. Most were from systems in the Sarasota Bay–Peace–Myakka and Tampa Bay Tributaries Basins where natural phosphate is abundant. These basins include one of the three largest phosphate-mining areas in the world that encompasses large areas of Manatee, Sarasota, Hardee, DeSoto, Polk, and Hillsborough Counties.

Trihalomethanes (THMs)

Some THMs are unfortunate disinfection byproducts (DBPs) resulting from the addition of halogens (including chlorine, bromine, and iodine) to source water that contains organic matter and are not normally an issue with the actual ground water resource. Halogenation is a disinfection treatment practiced by PWS to kill potentially harmful bacteria. Unlike a number of states, Florida requires PWS to provide disinfection. 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, the number of bacterial exceedances in private wells is poorly documented and not maintained in a central database. Of all water quality issues evaluated, bacterial contamination, as indicated by elevated total coliform counts, is one of the most prevalent issues in ground water samples collected from monitoring wells (**Table 11.1**).

However, the significance of bacteria in water samples as it relates to the ground water resource must still 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 and/or flooding, and the surface water infiltration of a water system. These considerations highlight the fact that individual well assessments are necessary, and that in many cases, bacterial contamination is localized and may not be an issue outside of the individual wells themselves.

Summary of Ground Water Contaminant Sources

The EPA's 2004 Florida Source Water Assessment identified the top five potential sources of contamination in Florida as follows: (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 have commonly been the focus of waste cleanup and monitoring activities in Florida.

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

Petroleum Facilities

The DEP Storage Tank Contamination Monitoring (STCM) Database contains information on all storage tank facilities registered with DEP and tracked for active storage tanks, storage tank history, or petroleum cleanup activity. Currently, the STCM Database lists approximately 65,000 registered petroleum storage tanks, and it shows that approximately 26,000 storage tank facilities have documented contaminant discharges. Petroleum sites and petroleum problems are concentrated in the most populated areas of the state, as well as along major transportation corridors. The main petroleum constituents found in ground water are benzene, toluene, ethylbenzene, xylenes, and methyl tert-butyl ether. Contaminants at older petroleum sites may also contain lead and EDB.

Florida's Petroleum Cleanup Program encompasses the technical oversight, management, and administrative activities necessary to prioritize, assess, and cleanup sites contaminated by the discharges of petroleum and petroleum products from stationary petroleum storage systems. These include sites determined to be eligible for state-funded cleanup using preapproved contractors designated by the property owner or responsible party and state lead contractors under direct contract with DEP, 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 (DSCP) because of evidence of contamination. Of those, approximately 190 are actively being assessed and may be under remedial action. Drycleaning solvent constituents (PCE, TCE, 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 that are contaminated as a result of the operations of a drycleaning facility or wholesale supply facility (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

The DEP 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 that include landfills, dump sites, wood preserving waste sites, industrial solvent disposal sites, electroplaters, petroleum, pesticides, waste oil disposal sites and drycleaners. There are approximately 1,000 sites on the DEP list of currently open PRP sites. Many of the sites on these lists have documented ground water contamination.

Nonpoint Sources

Degraded ground water quality is sometimes not associated with a single contaminant source but instead may be related to multiple sources or land use practices in an area. In many cases, the cumulative effect of human activities through leaching from nonpoint sources of pollution creates ground water quality problems. In urban areas, ground water can receive contaminants from a variety of sources, including residential septic systems, leaking sewer lines, urban stormwater, residential fertilizers and 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 to ground water is highly dependent on the vulnerability of the ground water resource. Ground water is particularly vulnerable in karst (limestone) areas, where it is not protected and discharges can have a direct, unfiltered pathway to the drinking water resource via sinkholes.

Unfortunately, the potable ground water resource in some areas dominated by agricultural activities is often susceptible to direct impacts by fertilizer and agrichemical use. The Ridge citrus area in central Florida, mentioned previously, is an example of an area with known nitrate impacts to ground water. Ridge citrus growers are encouraged to address nonpoint impacts through the Agricultural Nonpoint Source Program, using voluntary fertilizer management practices as a primary BMP to reduce their inputs of nitrate to ground water. This work has served as a model for the development of other BMPs to protect ground water from contamination caused by the use of fertilizers on agricultural lands. Similar

BMPs have been developed to help address urban sources of nutrients. These BMP programs can help reduce the contamination of ground water from some of these nonpoint sources.

Ground Water–Surface Water Interaction

Setting and Pathways

The dependence of Florida's surface waters on ground water contributions cannot be overemphasized. For example, in many areas surface water flows into ground water through sinkholes or reversing springs. As mentioned previously, spring-fed stream systems can depend almost entirely on ground water discharge. Canals can also contain mostly ground water. Other streams and lakes may receive over half of their total inflows via ground water seepage, and natural estuaries rely on ground water seepage as a significant source of fresh water. In areas where the Floridan aquifer system is near the surface, and in southern parts of the state where porous limestone is present near the surface, conduit systems in the limestone material efficiently deliver ground water to streams and canals at high rates. In other areas of the state, ground water discharge occurs as seepage from the surficial aquifer system.

Ground Water Influence on Impaired Surface Waters

Nutrients, DO, and iron are the ground water parameters most likely to influence water quality in impaired or potentially impaired surface waters. **Table 11.3** 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.

The addition of relatively low concentrations of nitrate and phosphorus can create nutrient imbalances in surface water and contribute to impairments. In Florida, both nitrate and phosphorus can be naturally occurring or from anthropogenic sources.

Table 11.3. Median concentrations of ground water–surface water constituents in unconfined aquifers (2000–13)

Notes: Ground water data provided from DEP's Status and Trends Network, all representing unconfined aquifers that have 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 (per Hand *et al.* 2009).

Basin	Nitrate-Nitrite (as N) (mg/L)	Total Phosphorus (mg/L)	DO (mg/L)	Iron (ug/L)	Specific Conductance (µS/cm)
Apalachicola–Chipola	2.40*	0.014	6.77	15	231
Caloosahatchee	0.002	0.045	0.85*	850*	828*
Charlotte Harbor	0.01	0.041	0.59*	840*	870*
Choctawhatchee–St. Andrew	0.16*	0.008	4.01*	76	93
Everglades	0.006	0.022	0.87*	15	1,227*
Everglades West Coast	0.006	0.019	0.30*	720*	835*
Fisheating Creek	0.008	0.025	0.60*	355	109
Florida Keys	0.005	0.018	1.94*	57.5	5,263*
Indian River Lagoon	0.010	0.19*	0.70*	350*	1,016*
Kissimmee River	0.007	0.045	0.98*	520*	311*
Lake Okeechobee	0.004	0.21*	0.35*	620*	620*
Lake Worth Lagoon–Palm Beach Coast	0.002	0.066	0.26*	360	715*
Lower St. Johns	0.007	0.068	0.78*	469*	208
Middle St. Johns	0.02	0.040	1.24*	657*	225
Nassau–St. Marys	0.007	0.078*	1.01*	410*	275*
Ochlockonee–St. Marks	0.13*	0.020	2.81*	180	293*
Ocklawaha	0.68*	0.077*	3.50*	175	260*
Pensacola	0.45*	0.002	7.85	15	38
Perdido	0.35*	0.002	6.16	51	44
Sarasota Bay–Peace–Myakka	0.01	0.23*	1.24*	1,360*	414*
Southeast Coast–Biscayne Bay	0.01	0.013	1.63*	500*	600*
Springs Coast	0.02	0.033	1.39*	540*	443*
St. Lucie–Loxahatchee	0.01	0.11*	0.23*	905*	689*
Suwannee	0.12*	0.051	2.09*	190	387*
Tampa Bay	0.01	0.040	0.72*	583*	640*
Tampa Bay Tributaries	0.02	0.095*	1.49*	1,435*	311*
Upper East Coast	0.01	0.26*	0.67*	835*	745*
Upper St. Johns	0.002	0.098*	0.92*	744*	616*
Withlacoochee	0.03	0.056	1.33*	600*	421*
Statewide (median of all stations)	**0.010**	**0.045**	**1.01***	**500***	**421***
Typical Value for Streams in Florida	**0.051**	**0.076**	**5.8**	**367**	**251**

Nitrate in ground water is associated with anthropogenic sources such as fertilizers, animal waste, and human wastewater. Elevated nitrogen concentrations are of particular concern to clear surface water systems, such as some rivers and estuaries, where phytoplankton in the water column and attached algae can cause biological imbalances. Elevated nitrate is a significant issue with springs, as discussed in a following section.

The more common anthropogenic sources of phosphorus include fertilizers and domestic wastewater/residuals. However, in many parts of the state, naturally occurring phosphate is a significant source of phosphorus in surface waters. In several of Florida’s basins, phosphorus occurs naturally at high concentrations in ground water because of its contact with mineral phosphate in the aquifer material. Phosphorus in ground water in several basins along the east coast is also elevated and is most likely derived from phosphatic sands and shell beds that make up the aquifer material.

Low DO is a normal characteristic of ground water. Depressed DO in springs, spring runs, spring-fed rivers, and many drainage canals is often primarily or entirely attributable to ground water inflows. This is because the primary source of oxygen in waters is from dissolution from the atmosphere. In instances where ground water contributions to surface waterbodies are high, low DO is a typical consequence, and many DO exceedances in Florida waters are partially attributable to ground water.

Iron is another ground water constituent that occurs at high concentrations naturally 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 that are high in iron concentration typically tend to have a high to moderate ground water component, low DO, and high dissolved organic carbon content. Many of the iron exceedances in surface waters in Florida are caused by this set of natural conditions.

Specific conductance is also sometimes an indicator of ground water discharge to surface waters. In some basins, the specific conductance of ground water discharging to surface water (quite often via springs) is higher than 1,000 microSiemens per centimeter (µS/cm), which may reflect an exceedance of the specific conductance criterion for fresh surface waters (the criterion is stated as 50% above background or 1,275 µS/cm, whichever is higher).

Water Quality in Springs and Related Issues

Florida is uniquely endowed with a vast number of natural springs. At latest count there are more than 1,000 named springs in the state. Many of these are routinely monitored by the WMDs, local governments, and DEP. **Table 11.4** includes a list of routinely monitored springs and recent results for some key water quality parameters that provide information about anthropogenic impacts as well as natural chemical characteristics that help define their sources of water. The following discussion provides information on nutrients in springs, age and origin of water and salinity effects. Nutrients and salinity effects are currently the most significant water quality concerns facing Florida's springs.

Nutrients

Nutrient overenrichment causes the impairment of many surface waters, including springs. The two major nutrient groups that are monitored include nitrogen (N) and phosphorus (P). Both N and P are essential nutrients to plant life, including algae. For aquatic vegetation and algae to grow, both nutrients have to be present. In fact, one can be present in excess but if the other is not present, overgrowth of vegetation or algae is not likely to occur. Historically, many spring systems have had sufficient phosphorus to cause an overabundance of plant growth but this was limited by very low concentrations of nitrogen.

Nitrate

Nitrogen is found in several forms and is ubiquitous in the environment. Nitrate is the form of nitrogen that occurs in the highest concentrations in ground water and springs. Nitrite is an intermediate form of nitrogen that is almost entirely converted to nitrate in the nitrogen cycle. While nitrate and nitrite are frequently analyzed and reported together as one concentration (nitrate-nitrite nitrogen), the nitrite contribution is always insignificant. 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. On a statewide basis, as late as the 1980s, the median nitrate concentration in ground water in Florida was less than 0.05 mg/L (Maddox *et al.* 1992). Since then, nitrate concentrations of greater than 1 mg/L can be found in many springs. With sufficient phosphorus in the water column, seemingly low nitrogen concentrations can actually cause a significant shift in the balance of spring ecological communities, leading to the degradation of biological systems caused by overgrowth of algae and sometimes aquatic plants.

Virtually all of the nitrate in ground water and springs comes from anthropogenic sources such as inorganic fertilizer, domestic wastewater, and animal waste. 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 algal 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).

Another reference threshold was provided in documentation supporting spring run-related TMDLs for the Wekiva River and Rock Springs Run by DEP (Gao 2008). The Wekiva River/Rock Springs Run TMDL was based on a nitrogen threshold of 0.286 mg/L, established at a level that would reduce overall periphyton biomass concentration to an acceptable level. Another example of a nitrate threshold was used for the TMDL developed for the Suwannee River and several springs. This method employed a change point analysis that was performed to help understand the functional relationship between periphyton growth and nitrate concentration (Hallas and Magley 2008). It provided a statistical analysis of the range of nitrate concentrations over which periphyton growth would occur.

Based on the combined body of this research, DEP has proposed a surface water standard for nitrogen in spring vents of 0.35 mg/L, which applies to both nitrate and nitrate-nitrite. Most of Florida's springs that are routinely monitored have nitrate concentrations greater than this threshold. More than 75% of the 33 springs included in **Table 11.4** have nitrate concentrations greater than the 0.35 mg/L threshold. The springs in **Table 11.4** 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 forest lands 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, 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. Phosphorus in water can originate from natural sources, primarily phosphate-rich clay and dolomite. Anthropogenic sources of phosphorus include fertilizer, animal waste, human wastewater and biosolids, and industrial wastewater effluent. The tendency for phosphorus to leach to ground water at a particular application or disposal site is based on soil characteristics and the amount and frequency of phosphorus loading to the soil. Phosphorus tends to readily adsorb to clay and organic material in soil and tends to leach to ground water where the soil and geological material are sandy, or where the soil adsorptive capacity for phosphorus has been exceeded.

Table 11.4. 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 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)	Total Phosphorus (mg/L)	DO (mg/L)	Specific Conductance (µS/cm)	Sodium (mg/L)
Apalachicola–Chipola	Jackson Blue Spring		3.6*	0.021	7.55	272	2.0
Choctawhatchee–St. Andrew	Cypress Spring		0.37*	0.024	4.75	216	3.2
Choctawhatchee–St. Andrew	Gainer Spring #1C	Gainer	0.19	0.014	1.69	142	2.0
Choctawhatchee–St. Andrew	Morrison Spring		0.19	0.023	3.48	231	1.9
Middle St. Johns	Alexander Spring		0.03	0.049*	2.06	1189	148
Middle St. Johns	Apopka Spring		3.8*	0.034*	3.15	277	7.3
Middle St. Johns	DeLeon Spring		0.52*	0.060*	0.99	768	80
Middle St. Johns	Fern Hammock Springs		0.09	0.020	6.99	116	2.7
Middle St. Johns	Juniper Spring		0.08	0.025	6.87	117	2.6
Middle St. Johns	Rock Spring		1.3*	0.080*	0.86	273	6.1
Middle St. Johns	Salt Spring (Marion)		0.11	0.014	3.49	5046	762
Middle St. Johns	Silver Glen Springs		0.04	0.020	3.41	1910	248
Middle St. Johns	Volusia Blue Spring		0.28	0.082*	0.65	2283	375
Middle St. Johns	Wekiwa Spring		1.1*	0.120*	0.42	364	11
Ochlockonee–St. Marks	Wakulla Spring		0.42*	0.032*	1.90	293	5.7
Ocklawaha	Silver Spring Main	Silver	1.2*	0.048*	2.13	485	7.0
Springs Coast	Chassahowitzka Spring Main	Chassa-howitzka	0.59*	0.018	4.57	2499	369
Springs Coast	Homosassa Spring #1	Homosassa	0.65*	0.019	3.97	3699	562
Springs Coast	Hunter Spring	Kings Bay	0.60*	0.024	5.17	507	47
Springs Coast	Tarpon Hole Spring	Kings Bay	0.22	0.035*	2.35	2000	297
Springs Coast	Weeki Wachee Main Spring		0.88*	0.008	2.01	342	5.2
Suwannee	Devil's Ear Spring (Gilchrist)	Ginnie-Devil's	1.4*	0.047*	2.64	376	4.7
Suwannee	Falmouth Spring		1.2*	0.054*	1.24	378	3.1
Suwannee	Fanning Springs		5.6*	0.073*	2.50	515	5.6
Suwannee	Ichetucknee Head Spring	Ichetucknee	0.76*	0.025	3.67	321	2.6
Suwannee	Lafayette Blue Spring		3.1*	0.057*	1.48	435	5.0

Basin	Spring Name	Associated Spring Group	Nitrate (mg/L)	Total Phosphorus (mg/L)	DO (mg/L)	Specific Conductance (µS/cm)	Sodium (mg/L)
Suwannee	Madison Blue Spring		1.8*	0.039	2.34	273	3.2
Suwannee	Manatee Spring		2.0*	0.03	2.1	502	4.4
Suwannee	Troy Spring		2.5*	0.033	0.74	388	3.2
Suwannee	Wacissa Spring #2	Wacissa	0.43*	0.042*	2.86	268	3.5
Tampa Bay Tributaries	Lithia Springs Major		2.5*	0.100*	2.97	561	16
Withlacoochee	Rainbow Spring #1	Rainbow	2.4*	0.026	7.02	165	2.9

However, inputs of phosphorus from anthropogenic sources affecting ground water and springs are not easily traced because a significant amount of phosphorus in ground water and springs comes from the natural geological material. Ambient phosphorus concentrations in ground water in the recharge areas or springsheds of springs are frequently higher than the algae-based thresholds offered by Stevenson *et al.* (2007). Approximately 68% of the springs included in **Table 11.4** have phosphorus concentrations greater than the lower algal-based threshold identified in Stevenson's work (0.026 mg/L). The springs in **Table 11.4** with the highest phosphorus concentrations are in the Middle St. Johns and Suwannee Basins.

Dissolved Oxygen

Springs receive their water from the UFA, which in turn 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 deeper springs, which discharge water that has had a longer residence time in the aquifer material. The DO concentration is a key chemical indicator that provides useful information about the relative age of water coming from springs. Rainwater and "newer" ground water typically have higher DO levels, and springs with high DO levels are most vulnerable to surface water quality impacts, if there are nearby sources.

The springs in **Table 11.4** are routinely monitored and those 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 both occur in agricultural areas and have among the highest nitrate concentrations of all springs being monitored. Fern Hammock and Juniper Spring are located 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 ground water with potentially longer flow pathways from the ground water recharge areas. Springs with the lowest DO in **Table 11.4** include Volusia Blue, Wekiwa, and Rock Springs of the Middle St. Johns Basin and Troy Spring of the Suwannee Basin.

Salinity

Although most springs in Florida are considered to be fresh waters, fresh and saline characteristics are important to document to evaluate changes in spring chemistry. Springs can be characterized based on their salinity analyte levels and mineral content. Salinity analytes evaluated in this assessment include specific conductance and sodium. Concentrations of these indicators can in some cases be used to identify ground water chemistry changes caused by drought, sea-level rise, and/or anthropogenic influences. Increasing trends in these salinity indicators could be caused by a lack of recharge during low-rainfall periods, overpumping the aquifer, or a combination of the two. Coastal springs that are tidally influenced cannot be easily evaluated for short-term trends in salinity since the concentrations vary with the tidal cycle. However, long-term increasing trends for salinity indicators in coastal springs could indicate saltwater intrusion.

There has been an increasing trend in salinity in many of the springs in Florida. The more saline springs in **Table 11.4**, 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. Silver Glen, Salt, Volusia Blue, and Alexander Springs are all located in a region of the Middle St. Johns Basin where geologic faults or fractures may provide a pathway for saline water in the Lower Floridan aquifer to migrate vertically upward (upwell) to zones that intersect springs. This upwelling is enhanced in increasingly populated areas of this region by ground water withdrawal. Along the Springs Coast, where Homosassa, Chassahowitzka, and Tarpon Hole Springs are located, salinity is related to the close proximity of the Gulf of Mexico. Along the coast, salinity increases can occur during drought conditions where the aquifer gradients are lower and the influence of ground water withdrawals are more pronounced. Landward movement of the saline water wedge along the coastline may also be influenced by slight increases in sea level observed over the past decades.

References

Abbott, J.P., L.J. Flewelling, and J.H. Landsberg. 2009a. Saxitoxin monitoring of three species of Florida puffer fish. *Harmful Algae* 8: 343–348.

Abbott, G.M., J.H. Landsberg, A.R. Reich, K.A. Steidinger, S. Ketchen, and C. Blackmore. 2009b. *Resource guide for public health response to harmful algal blooms in Florida.* Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Technical Report TR-14.

American Public Health Association. 1995. *Standard methods for the examination of water and wastewater resources.* 19th Edition. Baltimore, MD: United Book Press.

American Safety Council. 2010. *Florida quickfacts*.

Americasroof.com. 2013. *Florida highest named summits.*

Arthur, J.A., A.A. Dabous, and J.B. Cowart. 2002. Mobilization of arsenic and other trace elements during aquifer storage and recovery, southwest Florida. U.S. Geological Survey Open File Report 02–89. *USGS Artificial Recharge Workshop Proceedings.*

———. 2005. Chapter 24: Water-rock geochemical considerations for aquifer storage and recovery: Florida case studies. In: C.F. Tsan and J.A. Apps (Eds.), *Underground Injection Science and Technology, Developments in Water Science (*Amsterdam, Netherlands: Elsevier, v.52, p. 327–339).

Azanza, R.V., and F.J.R.M. Taylor. 2001. Are Pyrodinium blooms in the Southeast Asianregion recurring and spreading? A view at the end of the millennium. *Ambio 30: 356–364.*

Backer, L.C. 2009. Impacts of Florida red tides on coastal communities. *Harmful Algae 8: 618–622.*

Backer, L.C., L.E. Fleming, A.D. Rowan, and D.G. Baden. 2003. Epidemiology, public health and human illnesses associated with harmful marine algae. In: G.M. Hallegraeff, D.M. Anderson, and A.D. Cembella (Eds.), *Manual on harmful marine microalgae* (Paris, France: Intergovernmental Oceanographic Commission of UNESCO, pp. 723–750).

Bay Regional Atmospheric Chemistry Experiment (BRACE). 2011. Tampa, FL: University of South Florida, Health Sciences Center, College of Public Health, Environmental and Occupational Health.

Blair, J.A., and R. Jones. Updated January 15, 2008. *Consumer Fertilizer Task Force: Final report to the 2008 Florida Legislature*. Tallahassee, FL: Florida State University, Florida Conflict Resolution Consortium.

Bodager, D. 2002. Outbreak of saxitoxin illness following consumption of Florida pufferfish. *Florida Journal of Environmental Health* 179: 9–13.

Brown, M.T., K.C. Reiss, M.J. Cohen, J.M. Evans, and P.W. Inglett *et al.* April 28, 2008. *Summary and synthesis of the available literature on the effects of nutrients on spring organisms and systems*. Gainesville, FL: University of Florida Water Institute.

Bureau of Economic and Business Research. April 1, 2014a. *Florida estimates of population 2014*. Gainesville, FL: University of Florida, College of Liberal Arts and Sciences.

———. April 1, 2014b. *Projections of Florida population by county, 2015-2040, with estimates for 2014*. Gainesville, FL: University of Florida, College of Liberal Arts and Sciences.

Burns, J. 2008. Toxic cyanobacteria in Florida waters. *Adv. Exp. Med. Biol.* 619: 127–137.

Burns, J., C. Williams, and A. Chapman. 2002. Cyanobacteria and their toxins in Florida surface waters. In: D. Johnson and R.D. Harbison (Eds.), *Proceedings of health effects of exposure to cyanobacteria toxins: State of the science* (August 13–14, 2002, Sarasota, FL, pp. 16–21).

Campbell, P. May 1997. *Current population reports: Population projections: States, 1995–2025*. Washington, DC: U.S. Census Bureau.

Carvalho, A., W. Schropp, G.M. Sloane, T.P. Biernacki, and T.L. Seal. 2002. *Development of an interpretive tool for assessment of metal enrichment in Florida freshwater sediment*. Jacksonville, FL: Taylor Engineering and Florida Department of Environmental Protection. Prepared for the Florida Department of Environmental Protection.

Chang, N.B., M. Wanielista, A. Daranpob, F. Hossain, and Z. Xuan *et al.* April 17, 2011. *On site sewage treatment and disposal systems evaluation for nutrient removal*. Florida Department of Environmental Protection Project #WM 928. Orlando, FL: University of Central Florida, Civil, Environmental, and Construction Engineering Department, Stormwater Management Academy.

Chapman, A.D., and C.L. Schelske. 1997. Recent appearance of Cylindrospermopsis (Cyanobacteria) in five hypereutrophic Florida lakes. *J. Phycology* 33: 191–195.

Comprehensive Everglades Restoration Plan. 2012.

Conover, W.J. 1999. *Practical nonparametric statistics.* New York: Wiley.

Copeland, R., N.A. Doran, A.J. White, and S.B. Upchurch. 2011. *Regional and statewide trends in Florida's spring and well groundwater quality*. Florida Geological Survey Bulletin No. 69. Tallahassee, FL.

Crabbe, N. February 28, 2008. Drought just tip of water problems. *Gainesville Sun.*

Dahl, T.E. 1990. *Wetlands: Losses in the United States, 1780s to 1980s.* U.S. Fish and Wildlife Service Report to Congress. St. Petersburg, FL: National Wetlands Inventory.

———. 2005. *Florida's wetlands: An update on status and trends, 1985 to 1996.* Washington, DC: U.S. Department of the Interior, Fish and Wildlife Service.

Emslie, S.D., W.D. Allmon, F.J. Rich, J.H. Wrenn, and S.D. Defrance. 1996. Integrated taphonomy of an avian death assemblage in marine sediments from the late Pliocene of Florida. *Palaeogeogr. Palaeocl.* 124, 107–136.

Fernald, E.A., and E.D. Purdum (Eds.). 1998. *Water resources atlas of Florida.* Tallahassee, FL: Florida State University, Institute of Science and Public Affairs.

Fischler, C., P. Hansard, M. Ladle, and C. Burdette. In review. *A review of selected Florida aquifer storage and recovery (ASR) sites and their geochemical characteristics.* Florida Geological Survey Report of Investigation 112.

Fleming, L.E., D.G. Baden, J.A. Bean, R. Weisman, and D.G. Blythe. 1998. Marine seafood toxin diseases: Issues in epidemiology and community outreach. In: *Environmental health resources for community outreach and education: Marine science* (Miami, FL: National Institute of Environmental Health Sciences, Marine and Freshwater Biomedical Sciences Center).

Flewelling, L.J., J.P. Naar, J.P. Abbott, D.G. Baden, and N.B. Barros *et al.* 2005. Brevitoxicosis: Red tides and marine mammal mortalities. *Nature* 435 (7043), 755–756.

Florida Administrative Code. August 8, 2007. *Section 5E-1.003, Fertilizer: Labels or tags*.

Florida Administrative Register. 2013.

Florida Department of Agriculture and Consumer Services (FDACS). Revised November 29, 2007. *Contingency plan for the control of shellfish potentially contaminated by marine biotoxin.* Tallahassee, FL.

———. 2006. *Shellfish harvesting area status*. Division of Aquaculture.

———. 2006. *Red tide.*

———. 2010. *Office of Agricultural Water Policy*.

Florida Department of Environmental Protection. 1994. *Florida coastal sediments contaminants atlas*.

———. 2000. *Integrated water quality assessment for Florida: 2000 305(b) report and 303(d) list update.* Tallahassee, FL: Bureau of Watershed Management.

———. 2000–06. *Basin status reports and water quality assessment reports*.

———. February 2001. *A report to the Governor and the Legislature on the allocation of total maximum daily loads in Florida.* Tallahassee, FL: Bureau of Watershed Management.

———. January 2003. *Interpretative tool for the assessment of metal enrichment in Florida freshwater sediment*.

———. 2004. *Integrated water quality assessment for Florida: 2004 305(b) report and 303(d) list update.* Tallahassee, FL: Bureau of Watershed Management.

———. December 22, 2004 (revised March 30, 2005). *Elements of Florida's water monitoring and assessment program.* Tallahassee, FL: Division of Water Resource Management, Bureau of Watershed Management.

———. 2006a. *Mercury in aquatic ecosystems in Florida*.

———. 2006b. *Criteria for surface water quality classifications*.

———. 2006c. *Florida's springs: Protecting native gems*.

———. 2006d. *Source and Drinking Water Program website*.

———. 2006e. *STORET Program*.

———. May 2, 2006. *Integrated water quality assessment for Florida: 2006 305(b) report and 303(d) list update*. Tallahassee, FL: Bureau of Watershed Management.

———. December 2006. *Canal recharge: A report to the Legislature and Governor*. Preliminary draft report. Division of Water Resource Management in consultation with the South Florida Water Management District.

———. January 2007. *Best management practices for the enhancement of environmental quality on Florida golf courses*.

———. September 2007. *Plan for development of a statewide total maximum daily load for mercury (mercury TMDL)*. Tallahassee, FL: Division of Water Resource Management and Division of Air Resource Management, Bureau of Laboratories.

———. 2008. *Florida friendly best management practices for protection of water resources by the green industries*.

———. March 31, 2008a. *Standard operating procedures for field activities*. DEP-SOP-001/01.

———. March 31, 2008b. *Process for assessing data usability*. DEP-EA-001/07.

———. October 2008. *Integrated water quality assessment for Florida: 2009 305(b) report and 303(d) list update*. Tallahassee, FL: Bureau of Watershed Management.

———. December 3, 2008. *Standard operating procedures for field activities*.

———. 2010. *1:24,000 high-resolution, National Hydrography Dataset*.

———. 2011. *Florida's lands and water – Brief facts*. Tallahassee, FL: Division of State Lands, Bureau of Survey and Mapping.

———. March 2011. *Implementation guidance for the fecal coliform total daily maximum loads adopted by the Florida Department of Environmental Protection*. Tallahassee, FL: Division of Environmental Assessment and Restoration, Bureau of Watershed Restoration.

———. August 29, 2011. *Monitoring design document*. Tallahassee, FL: Watershed Monitoring Program.

———. 2012a. *Agricultural pollution prevention*.

———. 2012b. *Basin management action plans*.

———. 2012c. *Review environmental data to support beach health results*.

———. 2012d. *Blue-green algae.*

———. 2012e. *Bureau of Petroleum Storage Systems.*

———. 2012f. *Chapter 303, Identification of impaired surface waters*. Florida Administrative Code.

———. 2012g. *Delineation Program*.

———. 2012h. *Source and Drinking Water Program*.

———. 2012i. *Drinking Water Toxics Program*.

———. 2012j. *Drycleaning Solvent Cleanup Program*.

———. 2012k. *Emerging substances of concern fact sheet*.

———. 2012l. *Florida Action Team on Energy and Climate Change.*

.———. 2012m. *Florida Forever*.

———. 2012n. *Florida-friendly landscaping. Green industries best management practice training and program overview*.

———. 2012o. *Florida Geological Survey*.

———. 2012p. *Florida's springs*.

———. 2012q. *Florida State Emergency Response Team natural resource damage assessment*.

———. 2012r. *Florida's surface water quality standards: Refining designated uses and classifications*.

———. 2012w. *Hazardous Waste Cleanup Section*.

———. 2012t. *Interpretative tool for the assessment of metal enrichment in Florida freshwater sediment*.

———. 2012u. *Mercury in aquatic systems in Florida*.

———. 2012v. *Nonpoint Source Management Program*.

———. 2012w. *Numeric nutrient standards for Florida waters*.

———. 2012x. *Petroleum Restoration Program*.

———. 2012y. *Sediment guidelines*.

———. 2012z. *Source Water Assessment and Protection Program*.

———. 2012aa. *Statewide stormwater treatment rule development*.

———. 2012bb. *Statistical abstract: Geographical summary*.

———. 2012cc. *Storage tank and petroleum contamination/cleanup monitoring*.

———. 2012dd. *STORET*.

———. 2012ee. *Surface water improvement and management (SWIM)*.

———. 2012ff. *Temporal Variability (Trend) Monitoring Network*.

———. 2012gg. *Total Maximum Daily Loads Program*.

———. 2012hh. *Wastewater permitting*.

———. 2012ii. *Water sampling data*.

———. 2012jj. *Underground Injection Control*.

———. 2012ll. *Watershed Assessment*.

———. 2012mm. *Watershed monitoring*.

———. 2012nn. *Watershed Supply Restoration Program for Contaminated Potable Supply Water Wells*.

———. 2012oo. *Wellhead protection*.

———. 2012pp. *Status Monitoring Network*.

———. July 2013. *Derivation of dissolved oxygen criteria to protect aquatic life in Florida's fresh and marine waters*. Draft technical support document. Tallahassee, FL: Division of Environmental Assessment and Restoration.

Florida Department of Health. 2011. *Human health based screening levels for petroleum products impacting Gulf coastal waters and beach sediments*.

———. 2012a. *Healthy Beaches Program*.

———. 2012b. *Bureau of Water Programs.*

———. 2012c. *Seafood consumption*.

———. 2012d. *Healthy Beaches Program history*.

———. 2012e. Well sampling for petroleum or dry cleaners in Florida.

Florida Fish and Wildlife Conservation Commission. 2010a. *Fish and Wildlife Research Institute*.

———. 2010b. *Fish kill database*.

———. 2010c. *Harmful Algal Bloom Task Force*.

———. 2012a. *The economic impact of saltwater fishing in Florida*.

———. 2012b. *Most recent commercial landings data for freshwater fisheries in Florida.*

———. 2012c. *Value of freshwater fishing in Florida*.

Florida LakeWatch. October 1999. *A beginner's guide to water management: The ABCs*. Gainesville, FL: University of Florida, Department of Fisheries and Aquatic Sciences, Institute of Food and Agricultural Sciences.

———. 2012. LakeWatch website. Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences.

Florida Legislature Bureau of Economic and Demographic Research. 2011. Website.

Florida Springs Task Force. November 2000. *Florida's springs: Strategies for protection and restoration*.

Florida Trend. 2009. *2009 economic yearbook: Bad case of the blues.*

Fore, L.S., R. Frydenborg, D. Miller, T. Frick, and D. Whiting *et al*. March 2007. *Development and testing of biomonitoring tools for macroinvertebrates in Florida streams (Stream Condition Index and BioRecon*. Final report. Prepared for the Florida Department of Environmental Protection, Nonpoint Source Bioassessment Program, by Statistical Design, Inc., Seattle, WA.

Fore, L.S., R. Frydenborg, N. Wellendorf, J. Espy, and T. Frick *et al*. December 2007. *Assessing the biological condition of Florida lakes: Development of the Lake Vegetation Index (LVI)*. Prepared for the Florida Department of Environmental Protection, Nonpoint Source Bioassessment Program, by Statistical Design, Inc., Seattle, WA.

Frayer, W.E., and J.M. Hefner. 1991. *Florida wetlands status and trends, 1970s to 1980s.* Atlanta, GA: U.S. Fish and Wildlife Service, Southeast Region.

Fujiki, H., M. Suganuma, H. Surguri, S. Yoshizawa, and K. Takagi *et al.* 1990. New tumor promoters from marine natural products. In: S. Hall and G. Strichartz (Eds.), *Marine toxins: Origin, structure and molecular pharmacology* (Washington, DC: American Chemical Society, pp. 232–240).

Gabriel, M.C., D.M. Axelrad, T. Lange, and T. Dirk. 2010. Chapter 3B. Mercury and sulfur monitoring: Research and environmental assessment in south Florida. In: *2010 South Florida environmental report, Volume I* (West Palm Beach, FL: South Florida Water Management District).

Gao, X. 2007. *Nutrient TMDLs for the Wekiva River (WBIDs 2956, 2956A, and 2956C) and Rock Springs Run (WBID 2967)*. Draft TMDL report. Tallahassee, FL: Florida Department of Environmental Protection, Watershed Assessment Section.

Gerritsen, J., B. Jessup, E. Leppo, and J. White. July 2000. *Development of Lake Condition Indexes (LCI) for Florida*. Prepared for the Florida Department of Environmental Protection by Tetra Tech, Inc., Owings Mills, MD.

Gilbert, R.O. 1987. *Statistical methods for environmental pollution monitoring*. New York: John Wiley and Sons.

Glibert, P.M., D.M. Anderson, P. Gentien, E. Graneli, and K.G. Sellner. 2005. The global, complex phenomena of harmful algal blooms. *Oceanography* 18, 2 (2005): 136–147.

Governor’s Action Team on Energy and Climate Change. October 15, 2008. *Florida energy and climate change action plan.*

Governor’s Office. October 22, 2014. *Florida’s award-winning state parks and trails continue record-breaking success.* News release. Tallahassee, FL.

Gulf of Mexico Alliance. 2010. Website.

Hale, J.A., T.K. Frazer, D.A. Tomasko, and M.O. Hall. 2004. Changes in the distribution of seagrass species along Florida's Central Gulf Coast—Iverson and Bittaker revisited. *Estuaries* 27(1): 36–43.

Hand, J., N. Lewis, and L. Lord. April 2009. *Typical water quality values for Florida lakes, streams, blackwaters, coastal waters, and estuaries.* Tallahassee, FL: Florida Department of Environmental Protection, Watershed Assessment Section.

Harrington, D., G. Maddox, and R. Hicks. 2010. *Florida Springs Initiative monitoring network report and recognized sources of nitrate*. Tallahassee, FL: Florida Department of Environmental Protection, Division of Environmental Assessment and Restoration.

Hefner, J.M. 1986. Wetlands of Florida 1950s to 1970s. In: E.D. Estevez, J. Miller, J. Morris, and R. Hamman (Eds.), *Proceedings of the conference: Managing cumulative effects in Florida wetlands (*Madison, WI: Omnipress). New College Environmental Studies Program, Publication No. 37.

Heil, C.A., and K.A. Steidinger. 2009. Monitoring, management, and mitigation of *Karenia* blooms in the eastern Gulf of Mexico. *Harmful Algae* 8: 611–617.

Heil, D. 2009. *Karenia brevis* monitoring, management, and mitigation for Florida molluscan shellfish harvesting areas. *Harmful Algae* 8(4): 608–610.

Jones, G.W, and T. Pichler. 2007. The relationship between pyrite stability and arsenic mobility during aquifer storage and recovery in southwest central Florida. *Environmental Science and Technology* 41-3, 723–730.

Kelly, M. 2004. *Florida river flow patterns and the Atlantic Multidecadal Oscillation*. Draft Report. Ecologic Evaluation Section, Southwest Florida Water Management District. Brooksville, FL.

Kirkpatrick, B., L.E. Fleming, L.C. Backer, J.A. Bean, and R. Tamer *et al*. 2006. Environmental exposures to Florida red tides: Effects on emergency room respiratory diagnoses admissions. *Harmful Algae* 5: 526–533.

Kirkpatrick, B., L. Fleming, D. SquicciarinI, L. Backer, and R. Clark *et al.* 2004. Literature review of Florida red tide: Implications for human health. *Harmful Algae* 3: 99–115.

Kushlan, J.A. 1990. Freshwater marshes. In: R.L. Myers and J.J. Ewel (Eds.), *Ecosystems of Florida* (Orlando, FL: University of Central Florida Press).

Landsberg, J.H. 2002. The effects of harmful algal blooms on aquatic organisms. *Reviews in Fisheries Science* 10: 113–390.

Landsberg, J.H., S. Hall, J.N. Johannessen, K.D. White, S.M. Conrad, and J.P. Abbott *et al.* 2006. Saxitoxin puffer fish poisoning in the United States, with the first report of *Pyrodinium bahamense* as the putative toxin source. *Environ. Health Persp.* 114: 1502–1507.

Lane, C.R., M.T. Brown, M. Murray-Hudson, and M.B. Vivas. September 2003. *The Wetland Condition Index (WCI): Biological indicators of wetland condition for isolated depressional herbaceous wetlands in Florida*. Report submitted to the Florida Department of Environmental Protection under Contract #WM-683. Gainesville, FL: University of Florida, H.T. Odum Center for Wetlands.

Lapointe, B.E., and B.J. Bedford. 2007. Drift rhodophyte blooms emerge in Lee County, Florida, USA: Evidence of escalating coastal eutrophication. *Harmful Algae* 6:421–437.

Lapointe, B.E., P.J. Barile, and C.A. Yentsch. 2004. The physiology and ecology of macroalgal blooms (green tides) on coral reefs off northern Palm Beach County, Florida (USA). *Harmful Algae* 3:185–268.

Long, E.R., and L.G. Morgan. 1990. *The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program.* National Oceanic and Atmospheric Administration Technical Memorandum NOS OMA 52. Seattle, WA: National Oceanic and Atmospheric Administration.

MacDonald, D.D. 1994. *Approach to the assessment of sediment quality in Florida coastal waters*. MacDonald Environmental Sciences Ltd. Prepared for the Florida Department of Environmental Protection.

MacDonald Environmental Sciences Ltd. and U.S. Geological Survey. 2003. *Development and evaluation of numerical sediment quality assessment guidelines for Florida inland waters*.

Magaña, H.A., C. Contreras, and T.A. Villareal. 2003. A historical assessment of *Karenia brevis* in the western Gulf of Mexico. *Harmful Algae* 2, 163–171.

Marella, R.L. 2009. *Water withdrawals, use, and trends in Florida, 2005*. U.S. Geological Survey Scientific Investigations Report 2009-5125. Prepared in cooperation with the Florida Department of Environmental Protection. Reston, VA: U.S. Department of the Interior.

———. 2014. *Water withdrawals, use, and trends in Florida, 2010.* U.S. Geological Survey Scientific Investigations Report 2014-5088.

Morris, A., and J.P. Morris. 2009. The Florida handbook: 2009–2010. 32nd biennial edition. Tallahassee, FL: Peninsular Publishing Company.

National Oceanic and Atmospheric Administration. January 6, 2009. *New economic report finds commercial and recreational saltwater fishing generated more than two million jobs*.

———. 2010. *Harmful Algal Bloom Operational Forecast System (HAB-OFS)*.

Natural Resources Defense Council. April 2007. *Florida's coastal and ocean future: A blueprint for economic and environmental leadership*. Florida Ocean and Coastal Coalition. Issue Paper.

Netstate.com. 2010. *The state of Florida*.

Northwest Florida Water Management District. September 19, 2007. *Environmental resource permitting in Florida's Panhandle.* Brochure. District Publication Number PIC 07-01.

———. 2011. *Apalachicola River.*

———. 2012. *NWFWMD wetland programs: Apalachicola River and Bay watershed.*

Obreza, T., M. Clark, B. Boman, T. Borisova, and M. Cohen *et al.* Revised March 2011. *A guide to EPA's numeric nutrient water quality criteria.* Publication SL316. Tallahassee, FL: University of Florida, Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences.

Ollis, S., and G. Redfield. 2010. Introduction. In: *2010 South Florida environmental report, Volume I, Chapter 1* (West Palm Beach, FL: South Florida Water Management District).

Palmer, S.L. 1984. Chapter 6: Surface water. In: E.A. Fernald and D.J. Patton (Eds.), *Water resources atlas of Florida* (Tallahassee, FL: Florida State University, pp. 54–67).

Paul, V.J., R.W. Thacker, and K. Banks. 2005. Benthic cyanobacterial bloom impacts the reefs of South Florida (Broward County, USA). *Coral Reefs* 24:693–697.

Phlips, E.J., S. Badylak, and T.L. Lynch. 1999. Blooms of the picoplanktonic Cyanobacterium Synechococcus in Florida Bay. *Limnol. Oceanogr.* 44:1166–1175.

Phlips, E.J., S. Badylak, E.L. Bledsoe, and M. Cichra. 2006. Factors influencing the distribution and abundance of Pyrodinium bahamense in coastal ecosystems of Florida. *Mar. Ecol. Progr. Ser.* 322:99–115.

Phlips, E.J., S. Badylak, M. Christman, and M. Lasi. 2010a. Climatic trends and temporal patterns of phytoplankton composition, abundance and succession in the Indian River Lagoon, Florida, USA. *Estuaries and Coasts* 33:498–513.

Phlips, E.J., S. Badylak, M. Christman, J. Wolney, J. Garland, and L. Hall *et al.* 2010b. March 2011. Scales of variability of harmful algae blooms in the Indian River, Florida, USA. *Harmful Algae* 10: 277–290.

Phlips, E.J., E. Bledsoe, M. Cichra, S. Badylak, and J.Frost. 2002. The distribution of potentially toxic cyanobacteria in Florida. In: D. Johnson and R.D. Harbison (Eds.), *Proceedings of health effects of exposure to cyanobacteria toxins: State of the science* (August 13–14, 2002, Sarasota, FL, pp. 22–29).

Poli, M.A., S.M. Musser, R.W. Dickey, P. Eilers, and S. Hall. 2000. Neurotoxic shellfish poisoning and brevetoxin metabolites: A case study from Florida. *Toxicon* 38: 981–993.

Price, R.E. and T. Pichler. 2006. Abundance and mineralogical association of arsenic in the Suwannee Limestone (Florida): implications for arsenic release during water-rock interaction. Invited paper for special issue of *Chemical Geology* 228 (1-3), 44–56.

Pichler, T., 2011, Evaluating elevated arsenic and molybdenum concentration at the Pritcher Road site, Lithia, central Florida. In: *Pritcher Road environmental assessment, Lithia, Hillsborough County, Florida*. Florida Department of Environmental Protection Site Investigation Section Preliminary Contamination Assessment Report 2011-2.

Regas, D. July 29, 2005. *2006 integrated report guidance.* Washington, DC: U.S. Environmental Protection Agency.

Reiss, K.C., and M.T. Brown. June 2005a. *The Florida Wetland Condition Index (FWCI): Developing biological indicators for isolated depressional forested wetlands*. Report submitted to the Florida Department of Environmental Protection under Contract #WM-683. Gainesville, FL: University of Florida, Howard T. Odum Center for Wetlands.

———. June 2005b. *Pilot study—The Florida Wetland Condition Index (FWCI): Preliminary development of biological indicators for forested strand and floodplain wetlands*. Report submitted to the Florida Department of Environmental Protection under Contract #WM-683. Gainesville, FL: University of Florida, Howard T. Odum Center for Wetlands.

Richardson, L., R. Sekar, J.L. Meyers, M. Gantar, and J.D. Voss *et al.* 2007. The presence of the cyanobacterial toxin microcystin in black band disease of corals. *FEMS Microbiol Letts* 272: 182–187.

Sato, K., A. Kitahara, K. Satoh, T. Ichikawa, M. Tatematsu, and N. Ito. 1984. The placental form of glutathione S-transferase as a new marker protein for preneoplasia in rat chemical carcinogenesis. *Gann 75: 199–202.*

Schropp, S., and H. Windom. 1988. *A guide to the interpretation of metals concentrations in estuarine sediments*. Tallassee, FL: Florida Department of Environmental Regulation, Coastal Zone Management Section.

Scott, T.M., G.H. Means, R.P. Meegan, R.C. Means, and S.B. Upchurch *et al.* 2004. *Springs of Florida*. Florida Geological Survey. Bulletin 66.

Seal, T., F. Calder, G. Sloane, S. Schropp, and H. Windom. 1994. *Florida coastal sediment contaminants atlas: A summary of coastal sediment quality surveys*. Florida Department of Environmental Protection.

Shafer, M.D., R.E. Dickinson, J.P. Heaney, and W.C. Huber. 1986. *Gazetteer of Florida lakes.* Publication No. 96. Water Research Program Engineering and Industrial Experiment Station. Gainesville, FL: University of Florida and U.S. Geological Survey.

South Florida Water Management District. 2010a. Website.

———. 2010b. *Everglades Project: Florida Bay algal blooms*.

———. 2012c. *Kissimmee Basin*.

Southeast Regional Climate Center. September 8, 2011. *Florida state averaged precipitation data, 1895–2014*.

———. 2012. Website.

———. Accessed August 3, 2014. *Florida state averaged precipitation data, 1895–2013.*

———. 2014. *Historical climate summaries for Florida*. Accessed September 2, 2015.

Southwest Florida Water Management District. 2012. Website.

St. Johns River Water Management District. 2012. *Management and storage of surface waters (MSSW) applicant's handbook.*

Steidinger, K.A., P. Carlson, D. Baden, C. Rodriguez, and J. Seagle. 1998. Neurotoxic shellfish poisoning due to toxin retention in the clam *Chione cancellata.* In: B. Reguera, J. Blanco, M.L. Fernández, and T. Wyatt (Eds.), *Harmful algae* (Paris, France: Xunta de Galicia and Intergovernmental Oceanographic Commission of UNESCO, pp. 457–458).

Steidinger, K.A., J.H. Landsberg, C.R. Tomas, and J.W. Burns. 1999. *Harmful algal blooms in Florida.* Unpublished technical report submitted to the Florida Harmful Algal Bloom Task Force. St.

Petersburg, FL: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute.

Steidinger, K.A., J.H. Landsberg, E.W. Truby, and B.S. Roberts. 1998. First report of *Gymnodinium pulchellum* Larsen 1994 (Dinophyceae) in North America and associated fish kills in the Indian River, Florida. *J. Phycology* 34: 431–437.

Stevenson, R.J, A. Pinowska, A. Albertin, and J.O. Sickman. 2007. *Ecological condition of alga and nutrients in Florida springs: The synthesis report*. Michigan State University, Department of Zoology, Florida Department of Environmental Protection Contract WM858.

Suwannee River Water Management District. 2010. *Nitrate information*.

———. 2012. Website.

Tiner, R.W., Jr. 1984. *Wetlands of the United States: Current status and recent trends*. Washington, DC: U.S. Fish and Wildlife Service, National Wetlands Inventory.

U.S. Census Bureau. 2010a. *Resident population by age and state—Projections: 2010 and 2015.*

———. 2010b. *Statistical abstract of the United States 2011*. 130th Edition. Washington, DC: U.S. Government Printing Office.

———. 2011. *Statistical abstract of the United States 2012*. 131st Edition. Washington, DC: U.S. Government Printing Office.

———. 2012. *State and county quickfacts: Florida*. Accessed July 30, 2015.

———. December 23, 2014. *Florida passes New York to become the nation's third most populous state, Census Bureau reports*. Release Number: CB14-232. Washington, DC.

U.S. Environmental Protection Agency. May 20, 2002. *EPA review of 2002 Section 303(d) lists and guidelines for reviewing TMDLs under existing regulations issued in 1992*.

———. March 2003. *Elements of a state water monitoring and assessment program*. Washington, DC: Office of Wetlands, Oceans and Watersheds. EPA 841-B-03-003.

———. July 29, 2005. *Guidance for 2004 assessment, listing, and reporting requirements under Sections 303(d) and 305 (b) of the Clean Water Act.* Watershed Branch, Office of Wetlands, Oceans and Watersheds.

———. 2006a. *Ecoregions of Florida.*

———. 2006b. *TMDLs in Florida.*

———. 2006c. *National STORET/WQX Program*.

———. 2009. *Contaminant candidate 3 list.*

———. January 14, 2009. *Letter to Michael Sole, Florida Department of Environmental Protection Secretary, from Benjamin Grumbles, Assistant Administrator.* Washington, DC: Office of Water.

———. 2012a. *Aquatic resource monitoring.*

———. 2012b. *Human health benchmarks for chemicals in water.*

———. 2012c. *National Priorities List*.

———. 2012d. *Watershed improvement summaries.*

U.S. Fish and Wildlife Service 2010. *Wetlands status and trends*. National Wetlands Inventory, Branch of Resource and Mapping Support.

U.S. Geological Survey. May 1995. *Springs of Florida*. Fact Sheet FS-151-95. Tallahassee, FL.

———. 2008. *Historical water use by category, 1970–2000*.

———. 2012a. *The Apalachicola-Chattahoochee-Flint (ACF) River National Water Quality Assessment (NAWQA) Program study. Basin description: Apalachicola River Basin*. Atlanta, GA: Georgia Water Science Center.

———. 2012b. *Water resources of the United States*.

U.S. Geological Survey and Florida Water Science Center. 2010. Environmental Data Server.

University of Central Florida Stormwater Management Academy. 2012. Orlando, FL.

University of Florida Institute of Food and Agricultural Sciences. February 2010. *A guide to EPA's proposed numeric nutrient water quality criteria for Florida*. SL316. Gainesville, FL: Soil and Water Science Department, Florida Cooperative Extension Service.

———. 2012. *Florida-Friendly Landscaping Program*.

Upchurch, S.B. 1992. Quality of water in Florida's aquifer systems. In G.L. Maddox, J.M. Lloyd, T.M. Scott, S.B. Upchurch, and R.E. Copeland (Eds.*), Florida's groundwater quality monitoring program—Background hydrogeochemistry* (Florida Geological Survey Special Publication 34:12–63).

Verdi, R.J., S.A. Tomlinson, and R.L. Marella. 2006. *The drought of 1998–2002: Impacts on Florida's hydrology and landscape*. U.S. Geological Survey Circular 1295.

Visit Florida, Florida Commission on Tourism. 2012. *Research.*

Visit Florida website, accessed July 30, 2015.

Vogel, M. April 2006. Economic yearbook 2006: Good migrations. *Florida Trend.*

Water Quality Association. 2006. *Water quality glossary: pH.*

Watkins, S.M., A. Reich, L.E. Fleming, and R. Hammond. 2008. Neurotoxic shellfish poisoning. *Marine Drugs* 6: 431–455.

Wayland, R.H. November 19, 2001. *2002 Integrated water quality monitoring and assessment report guidance.* Memorandum. Washington, DC: U.S. Environmental Protection Agency.

Wekell, J.C., J. Hurst, and K.A. Lefebvre. 2004. The origin of the regulatory limits for PSP and ASP toxins in shellfish. *J. Shellfish Res.* 23: 927–930.

Welch, P.S. 1948. *Limnological methods.* New York: John Wiley and Sons, Inc.

Williams, C.D., M.T. Aubel, A.D. Chapman, and P.E. D'Aiuto. 2007. Identification of cyanobacterial toxins in Florida's freshwater systems. *Lake and Reservoir Management* 23: 144–152.

Williams, C.D., J. Burns, A. Chapman, M. Pawlowicz, and W. Carmichael. 2006. *Assessment of cyanotoxins in Florida's surface waters and associated drinking water resources.* Final report to the St. Johns River Water Management District, Palatka, FL.

Appendices

Appendix A: Tables from the 2012–14 Status Network Regional Assessment Results for Large Lakes, Small Lakes, Rivers, Streams, Canals, Confined Aquifers, and Unconfined Aquifers

Appendix B. IWR Methodology for Evaluating Impairment

Appendix C: Section 314 of the Federal Clean Water Act Update, Listing Impaired Lakes in Florida, Group 1–5 Basins

Appendix A: Tables from the 2012–14 Status Network Regional Assessment Results for Large Lakes, Small Lakes, Rivers, Streams, Canals, Confined Aquifers, and Unconfined Aquifers

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

- Rivers are major rivers of the state.
- Streams are the remaining streams.
- Canals are primary canals.
- Large Lakes are 25 acres or greater.
- Small Lakes are 10 to less than 25 acres in size.

This appendix contains information on the following indicators for Rivers, Streams, Canals, Small Lakes, and Large Lakes for the Status Network:

- Dissolved oxygen (DO).
- Fecal coliform.
- Un-ionized ammonia (calculated).
- Chlorophyll *a*.
- Total nitrogen (TN).
- Total phosphorus (TP).

Note: The Status and Trend Program Design Document 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. 2012–14 Statewide and regional percentages of rivers meeting threshold values for indicators calculated using probabilistic monitoring design

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

Resource Rivers	DO	Fecal Coliform	Chlorophyll a	Un-Ionized Ammonia	TN	TP
Statewide Number of Sites	270	269	269	268	269	269
Statewide % Meeting Threshold	95.5	95.2	91.7	100	70.6	85.5
Statewide % Not Meeting Threshold	4.5	4.8	8.3	0	29.4	14.5
Zone 1 Number of Sites	45	44	44	43	44	44
Zone 1 % Meeting Threshold	91.2	95.5	100	100	52.3	95.5
Zone 1 % Not Meeting Threshold	8.8	4.5	0	0	47.7	4.5
Zone 2 Number of Sites	45	45	45	45	45	45
Zone 2 % Meeting Threshold	100	100	100	100	88.9	86.7
Zone 2 % Not Meeting Threshold	0	0	0	0	11.1	13.3
Zone 3 Number of Sites	45	45	45	45	45	45
Zone 3 % Meeting Threshold	97.8	95.5	71.1	100	73.3	95.6
Zone 3 % Not Meeting Threshold	2.2	4.5	28.9	0	26.7	4.4
Zone 4 Number of Sites	45	45	45	45	45	45
Zone 4 % Meeting Threshold	95.6	88.9	95.6	100	77.8	64.4
Zone 4 % Not Meeting Threshold	4.4	11.1	4.4	0	22.2	35.6
Zone 5 Number of Sites	45	45	45	45	45	45
Zone 5 % Meeting Threshold	97.8	100	68.9	100	75.6	82.2
Zone 5 % Not Meeting Threshold	2.2	0	31.1	0	24.4	17.8
Zone 6 Number of Sites	45	45	45	45	45	45
Zone 6 % Meeting Threshold	95.8	100	89.1	100	95.8	59.7
Zone 6 % Not Meeting Threshold	4.2	0	10.9	0	4.2	40.3

Table A.2. 2012–14 Statewide and regional percentages of streams meeting threshold values for indicators calculated using probabilistic monitoring design

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

Resource Streams	DO	Fecal Coliform	Chlorophyll *a*	Un-Ionized Ammonia	TN	TP
Statewide Number of Sites	271	270	271	271	266	266
Statewide % Meeting Threshold	77.1	78.4	95.4	100	67.3	74.9
Statewide % Not Meeting Threshold	22.9	21.6	4.6	0	32.7	25.1
Zone 1 Number of Sites	45	45	45	45	45	45
Zone 1 % Meeting Threshold	75.6	88.9	97.8	100	68.8	93.4
Zone 1 % Not Meeting Threshold	24.4	11.1	2.2	0	31.2	6.6
Zone 2 Number of Sites	45	45	45	45	45	45
Zone 2 % Meeting Threshold	86.6	89.0	97.8	100	55.2	55.6
Zone 2 % Not Meeting Threshold	13.4	11.0	2.2	0	44.8	44.4
Zone 3 Number of Sites	45	44	45	45	45	45
Zone 3 % Meeting Threshold	73.3	68.2	95.6	100	82.2	57.8
Zone 3 % Not Meeting Threshold	26.7	31.8	4.4	0	17.8	42.2
Zone 4 Number of Sites	45	45	45	45	45	45
Zone 4 % Meeting Threshold	77.8	55.6	91.1	100	55.6	53.3
Zone 4 % Not Meeting Threshold	22.2	44.4	8.9	0	44.4	46.7
Zone 5 Number of Sites	46	46	46	46	46	46
Zone 5 % Meeting Threshold	84.7	74.3	80.4	100	59.1	74.3
Zone 5 % Not Meeting Threshold	15.3	25.7	19.6	0	40.9	25.7
Zone 6 Number of Sites	45	45	45	45	40	40
Zone 6 % Meeting Threshold	90.7	53.5	91.3	100	76.3	15.4
Zone 6 % Not Meeting Threshold	9.3	46.5	8.7	0	23.7	84.6

Table A.3. 2012–14 Statewide and regional percentages of canals meeting threshold values for indicators calculated using probabilistic monitoring design

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	Chlorophyll *a*	Un-Ionized Ammonia	TN	TP
Statewide Number of Sites	207	207	207	207	126	126
Statewide % Meeting Threshold	93.0	90.3	80.5	100	81.2	92.2
Statewide % Not Meeting Threshold	7.0	9.7	19.5	0	18.8	7.8
Zone 3 Number of Sites	45	45	45	45	45	45
Zone 3 % Meeting Threshold	82.2	73.3	88.9	100	62.2	73.3
Zone 3 % Not Meeting Threshold	17.8	26.7	11.1	0	37.8	26.7
Zone 4 Number of Sites	43	43	43	43	43	43
Zone 4 % Meeting Threshold	83.7	81.4	65.1	100	67.4	88.4
Zone 4 % Not Meeting Threshold	16.3	18.6	34.9	0	32.6	11.6
Zone 5 Number of Sites	45	45	45	45	22	22
Zone 5 % Meeting Threshold	97.8	93.3	86.7	100	ISD	ISD
Zone 5 % Not Meeting Threshold	2.2	6.7	13.3	0	ISD	ISD
Zone 6 Number of Sites	74	74	74	74	16	16
Zone 6 % Meeting Threshold	96.1	96.1	78.7	100	ISD	ISD
Zone 6 % Not Meeting Threshold	3.9	3.9	21.3	0	ISD	ISD

Table A.4. 2012–14 Statewide and regional percentages of large lakes meeting threshold values for indicators calculated using probabilistic monitoring design

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

Resource Large Lakes	**DO**	**Fecal Coliform**	**Chlorophyll *a***	**Un-Ionized Ammonia**	**TN**	**TP**
Statewide Number of Sites	270	270	270	270	269	270
Statewide % Meeting Threshold	98.5	100	47.8	98.3	90.3	77.6
Statewide % Not Meeting Threshold	1.5	0	52.2	1.7	9.7	22.4
Zone 1 Number of Sites	45	45	45	45	45	45
Zone 1 % Meeting Threshold	87.4	100	80.3	100	97.9	92.9
Zone 1 % Not Meeting Threshold	12.6	0	19.7	0	2.1	7.1
Zone 2 Number of Sites	45	45	45	45	44	45
Zone 2 % Meeting Threshold	100	100	82.0	100	100	93.2
Zone 2 % Not Meeting Threshold	0	0	18.0	0	0	6.8
Zone 3 Number of Sites	45	45	45	45	45	45
Zone 3 % Meeting Threshold	100	100	45.6	94.2	87.8	94.3
Zone 3 % Not Meeting Threshold	0	0	54.4	5.8	12.2	5.7
Zone 4 Number of Sites	45	45	45	45	45	45
Zone 4 % Meeting Threshold	92.5	100	39.3	100	85.6	80.6
Zone 4 % Not Meeting Threshold	7.5	0	60.7	0	14.4	19.4
Zone 5 Number of Sites	45	45	45	45	45	45
Zone 5 % Meeting Threshold	100	100	16.4	100	72.9	77.3
Zone 5 % Not Meeting Threshold	0	0	83.6	0	27.1	22.7
Zone 6 Number of Sites	45	45	45	45	45	45
Zone 6 % Meeting Threshold	100	100	60.1	100	100	60.1
Zone 6 % Not Meeting Threshold	0	0	39.9	0	0	39.9

Table A.5. 2012–14 Statewide and regional percentages of small lakes meeting threshold values for indicators calculated using probabilistic monitoring design

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

ISD = Insufficient data for analysis

Resource Small Lakes	DO	Fecal Coliform	Chlorophyll *a*	Un-Ionized Ammonia	TN	TP
Statewide Number of Sites	233	227	232	231	232	232
Statewide % Meeting Threshold	86.2	98.7	54.8	100	91.4	89.6
Statewide % Not Meeting Threshold	13.8	1.3	45.2	0	8.6	10.4
Zone 1 Number of Sites	45	45	45	45	45	45
Zone 1 % Meeting Threshold	70.5	100	61.6	100	89.7	87.3
Zone 1 % Not Meeting Threshold	29.5	0	38.4	0	10.3	12.7
Zone 2 Number of Sites	45	43	45	45	45	45
Zone 2 % Meeting Threshold	59.1	95.2	44.9	100	91.7	80.3
Zone 2 % Not Meeting Threshold	40.9	4.8	55.1	0	8.3	79.7
Zone 3 Number of Sites	45	45	45	45	45	45
Zone 3 % Meeting Threshold	93.5	97.9	53.8	100	91.0	97.8
Zone 3 % Not Meeting Threshold	6.5	2.1	46.2	0	9.0	2.2
Zone 4 Number of Sites	44	42	44	44	44	44
Zone 4 % Meeting Threshold	85.5	100	47.2	100	92.6	80.0
Zone 4 % Not Meeting Threshold	14.5	0	52.8	0	7.4	20.0
Zone 5 Number of Sites	47	45	46	45	46	46
Zone 5 % Meeting Threshold	98.2	95.4	77.0	100	93.7	95.5
Zone 5 % Not Meeting Threshold	1.8	4.6	23.0	0	6.3	4.5
Zone 6 Number of Sites	7	7	7	7	7	7
Zone 6 % Meeting Threshold	ISD	ISD	ISD	ISD	ISD	ISD
Zone 6 % Not Meeting Threshold	ISD	ISD	ISD	ISD	ISD	ISD

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

- Confined Aquifers.
- Unconfined Aquifers.

This appendix contains information on the following indicators for Confined and Unconfined Aquifers for the Status Network:

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

Note: The Status and Trend Program *Design Document* 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.6. 2012–14 Statewide and regional percentages of confined aquifers meeting threshold values for indicators calculated using probabilistic monitoring design

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

Resource Confined Aquifer	Arsenic	Cadmium	Chromium	Lead	Nitrate-Nitrite	Sodium	Fluoride	Fecal coliform	Total coliform
Statewide Number of Sites	344	344	344	344	344	344	344	344	341
Statewide % Meeting Threshold	99.3	100	100	99.8	99.5	96.4	99.3	99.3	90.2
Statewide % Not Meeting Threshold	0.7	0	0	0.2	0.5	3.6	0.7	0.7	9.8
Zone 1 Number of Sites	57	57	57	57	57	57	57	57	57
Zone 1 % Meeting Threshold	100	100	100	100	100	100	98.9	100	92.3
Zone 1 % Not Meeting Threshold	0	0	0	0	0	0	1.1	0	7.7
Zone 2 Number of Sites	60	60	60	60	60	60	60	60	58
Zone 2 % Meeting Threshold	96.3	100	100	100	97.5	100	100	98.1	84.3
Zone 2 % Not Meeting Threshold	3.7	0	0	0	2.5	0	0	1.9	15.7
Zone 3 Number of Sites	60	60	60	60	60	60	60	60	60
Zone 3 % Meeting Threshold	100	100	100	100	100	82.2	100	100	90.5
Zone 3 % Not Meeting Threshold	0	0	0	0	0	17.8	0	0	9.5
Zone 4 Number of Sites	60	60	60	60	60	60	60	60	59
Zone 4 % Meeting Threshold	100	100	100	98.2	98.8	86.1	100	96.7	87.2
Zone 4 % Not Meeting Threshold	0	0	0	1.8	1.2	13.9	0	3.3	12.8
Zone 5 Number of Sites	60	60	60	60	60	60	60	60	60
Zone 5 % Meeting Threshold	100	100	100	99.0	100	69.5	100	94.2	87.5
Zone 5 % Not Meeting Threshold	0	0	0	1.0	0	30.5	0	5.8	12.5
Zone 6 Number of Sites	47	47	47	47	47	47	47	47	47
Zone 6 % Meeting Threshold	100	100	100	97.6	100	14.3	100	100	90.6
Zone 6 % Not Meeting Threshold	0	0	0	2.4	0	85.7	0	0	9.4

Table A.7. 2012–14 Statewide and regional percentages of unconfined aquifers meeting threshold values for indicators calculated using probabilistic monitoring design

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

Resource Unconfined Aquifer	Arsenic	Cadmium	Chromium	Lead	Nitrate-Nitrite	Sodium	Fluoride	Fecal coliform	Total coliform
Statewide Number of Sites	343	343	343	343	343	343	343	342	342
Statewide % Meeting Threshold	97.4	99.9	100	96.9	98.3	97.8	100	96.3	90.8
Statewide % Not Meeting Threshold	2.6	0.1	0	3.1	1.7	2.2	0	3.7	9.2
Zone 1 Number of Sites	60	60	60	60	60	60	60	60	60
Zone 1 % Meeting Threshold	96.9	100	100	96.9	98.0	100	100	96.2	95.9
Zone 1 % Not Meeting Threshold	3.1	0	0	3.1	2.0	0	0	3.8	4.1
Zone 2 Number of Sites	60	60	60	60	60	60	60	60	60
Zone 2 % Meeting Threshold	98.2	100	100	98.6	98.6	97.1	100	98.6	92.0
Zone 2 % Not Meeting Threshold	1.8	0	0	1.4	1.4	2.9	0	1.4	8.0
Zone 3 Number of Sites	60	60	60	60	60	60	60	60	60
Zone 3 % Meeting Threshold	96.8	100	100	96.2	98.3	92.4	100	98.5	76.8
Zone 3 % Not Meeting Threshold	3.2	0	0	3.8	1.7	7.6	0	1.5	23.2
Zone 4 Number of Sites	58	58	58	58	58	58	58	58	58
Zone 4 % Meeting Threshold	97.7	100	100	98.9	97.7	92.0	100	95.5	74.8
Zone 4 % Not Meeting Threshold	2.3	0	0	1.1	2.3	8.0	0	4.5	25.2
Zone 5 Number of Sites	59	59	59	59	59	59	59	59	59
Zone 5 % Meeting Threshold	97.5	97.9	100	89.7	100	94.5	100	93.1	77.0
Zone 5 % Not Meeting Threshold	2.5	2.1	0	10.3	0	5.5	0	6.9	23.0
Zone 6 Number of Sites	46	46	46	46	46	46	46	45	45
Zone 6 % Meeting Threshold	100	100	100	96.0	100	89.3	100	93.2	70.8
Zone 6 % Not Meeting Threshold	0	0	0	4.0	0	10.7	0	6.8	29.2

Appendix B: IWR Methodology for Evaluating Impairment

All surface waters of the state have been classified according to designated uses, as follows:

Rule 62-302.400 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. Class I, II, and III surface waters share water quality criteria established to protect the designated uses of fish consumption, recreation, and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife.

The particular type of data and/or information required to determine use support varies by designated use and—in addition to discrete measurements of analytical results that reflect the physical and chemical characteristics of the water column and bacteriological data—includes biological data, fish consumption advisories, beach closure and advisory information, and other information related to changes in the classification of shellfish-harvesting areas. At times information from field surveys and recons is also used 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 methodology described in the IWR 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 Florida Storage and Retrieval (FLASTORET); 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.

Primary Contact and Recreation Use Support

The methodology described in the IWR determines primary contact and recreation use attainment based on the evaluation of the following types of information (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 that make direct use of discrete bacteria counts, FDOH reports the bacteriological results used as the basis for the beach advisories to Florida STORET; these data are combined with bacteriological results reported by other data providers statewide. Beach advisories, warning and beach closure information is received directly from FDOH. 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.

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 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.

Assessments performed under the IWR that are based on the evaluation of discrete sampling results to determine shellfish consumption use support use data reported to Florida STORET by FDACS as well as data reported by other data providers statewide. Fish consumption advisories issued by FDOH for surface waters based on mercury levels (and, at times, other analytes as well) found in fish tissue studies are provided directly to DEP. Data in support of fish advisories are provided by FWC/FWRI. In addition, information related to shellfish area actions is received directly from FDACS.

When a Class I, II, or III waterbody fails to meets 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.

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 B.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 B.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

Analyte	Number of Observations
Copper	7,673
Demeton	609
Detergents	19
Dichlorodiphenyltrichloroethane (DDT)	724
Dieldrin	835
Dissolved Oxygen	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
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, segments are first classified 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, four-day station-median concentrations are calculated, and these values are then compared with the applicable class-specific criterion values in the Florida Standards (in some instances, however, the IWR specifies the use of daily values, 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, the count of the number of samples and exceedances of the applicable criterion from the Florida Standards is calculated, and the exceedance count is compared 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 for samples of known sizes and to place an assessed segment on the Planning List and Verified List (Tables 1 and 3, respectively, of Subsection 62-303.320[1], F.A.C.). 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, a waterbody segment assessed under Subsection 62-303.320(1), F.A.C., is placed 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. Sample size requirements for placing a waterbody segment on the Planning List include a minimum of 10 samples from the 10-year period preceding the Planning List assessment (waters may also be placed on the Planning List if there are at least three exceedances of the applicable water quality criterion when this sample size requirement is not met).

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%. Sample size requirements for placing a waterbody segment on the Verified List include a minimum of at least 20 samples from the last 7.5 years preceding the Verified List assessment (however, waters may be placed on the Verified List if there are at least five exceedances of the applicable water quality criterion when the sample size requirement is not met).

Interpretation of Narrative Nutrient Criterion

The Florida standards also include a narrative nutrient criterion rather than a numeric value for nutrient thresholds. This narrative criterion 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) are the primary means for assessing whether a waterbody should be further assessed for nutrient impairment, as follows:

- For streams assessed under Rule 62-303.351, F.A.C., nutrient enrichment is indicated when the annual mean chlorophyll a concentrations are greater than 20 µg/L, or if annual mean chlorophyll a concentrations have increased by more than 50% over historical values for at least two consecutive years. The IWR interpretation of the narrative criterion for nutrients also incorporates the consideration of direct evidence and additional information, when such information is available, indicative of an imbalance in flora or fauna caused by nutrient enrichment, such as algal blooms, excessive macrophyte growth, a decrease in the distribution (either in density or aerial coverage) of seagrasses or other submerged aquatic vegetation, changes in algal species richness, or excessive diel oxygen swings.
- Rule 62-303.352, F.A.C., provides the following narrative nutrient interpretation for lakes:
    - For lakes having a mean color greater than 40 PCU, an annual mean TSI exceeding 60 suggests potential nutrient enrichment.
    - For lakes having a mean color less than or equal to 40 PCU, an annual mean TSI exceeding 40 indicates potential nutrient enrichment.
- Potential nutrient enrichment is also indicated for any lake by a statistically significant increase in TSI over the assessment period, or if TSI values have increased by 10 units over historical values.
- In estuarine areas and open coastal waters (Rule 62-303.353, F.A.C.), nutrient enrichment is indicated when the annual mean chlorophyll a concentrations are greater than 11 µg/L, or if annual mean chlorophyll *a* concentrations have increased by more than 50% over historical values for at least two consecutive years.

Exceedances of Biological Thresholds

Biological assessment is an applied scientific discipline that uses the response of resident aquatic biological communities to various stressors as a method of evaluating ecosystem health. The rationale in using bioassessment methodology to characterize surface water quality status and attainment of designated uses recognizes the fact that biological components of the environment can manifest long-term water quality conditions. Thus these components can potentially provide a more comprehensive indication of a waterbody's health than can be characterized by discrete chemical or physical measurements alone.

Bioassessment results are particularly significant because biota inhabiting a waterbody function as continual natural monitors of environmental quality, capable of detecting the effects of both episodic, as well as cumulative, water quality, hydrologic, and habitat alterations. Monitoring the composition, abundance, and health of these natural communities enhances the state's ability to evaluate the health of its waters.

In conjunction with assessments performed under the IWR, bioassessment tools can often provide a direct measure of whether the designated aquatic life use, a "well-balanced population of fish and wildlife," is being attained (Rule 62.302-400, F.A.C.). In addition to their use as an adjunct to physical and chemical water quality measurements to determine the impairment status of waterbody segments, bioassessment tools often can provide insights into appropriate restoration strategies.

Metrics Used

Bioassessment tools used in conjunction with assessments performed under the IWR incorporate multimetric methods to quantify biological community structure or function that responds in a predictable manner to changes in the environment. When multimetric methods are used, individual metrics (*e.g.,* number of long-lived taxa, number of sensitive taxa, percent filter feeders, percent clingers) are determined, and the results of the individual metrics 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 in conjunction with IWR assessments 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 prior to August 2007 used a somewhat smaller, but similar, set of input metrics than those that were ultimately included in the final recalibrated index; however, 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 in the development of multimetric indices for periphyton (attached algae) and phytoplankton (drifting algae) that incorporate the HDG have also been attempted, but significant relationships between human disturbance and biological response in these communities have not been established. DEP has since developed and implemented a Rapid Periphyton Survey (RPS) method to evaluate periphyton communities and continues to use chlorophyll *a* concentrations to quantify imbalances in phytoplankton communities.

Bioassessment Data Used

Only macroinvertebrate data from ambient sites located in surface waters of the state were used in the bioassessments included in water quality assessments performed under the IWR. Although sites designated as test and/or background sites for National Pollutant Discharge Elimination System (NPDES) fifth-year inspections may be included, data from locations established to sample effluent outfalls from discharging facilities, or from monitoring sites not clearly established to collect ambient water quality data, are excluded from assessments performed for IWR purposes.

Site-specific habitat and physicochemical assessment (*e.g.*, percent suitable macroinvertebrate habitat, water velocities, extent of sand or silt smothering, and riparian [or streamside] buffer zone widths) provides adjunct information that can be important in identifying the stressors responsible for a failed bioassessment and is collected when a bioassessment is performed. This information is also evaluated in conjunction with IWR assessments and can be extremely useful in a definitive determination of biological impairment, since biological communities sometimes respond to factors other than water quality, such as habitat disruption and hydrologic disturbances.

In using bioassessment data in conjunction with water quality assessments performed under the IWR, waterbody segments that are 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 Standard Operating Procedures (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 quality assurance (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 their bioassessment data can be used in conjunction with assessments performed under the IWR.

Stream Condition Index

A total SCI score was calculated by averaging the scores of the 10 metrics in the method: 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 B.2** for calculations). A poor or very poor (or Category 3) rating based on the total score constituted a failed bioassessment, based on the IWR.

Table B.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

To establish an impairment rating based on BioRecon data, the six metrics as calculated in **Table B.3** and the index thresholds in **Table B.4** were used.

Table B.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 B.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)

Appendix C: Section 314 of the Federal Clean Water Act Update, Listing Impaired Lakes in Florida, Group 1–5 Basins

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 website.

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

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
4	1449A	Withlacoochee	Lake Deeson	Nutrients (TSI)
4	145	Pensacola	Lake Karick	Dissolved Oxygen
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	Dissolved Oxygen (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	Dissolved Oxygen
1	1473W	Tampa Bay	Lake Juanita	Dissolved Oxygen; 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	Dissolved Oxygen; Nutrients (TSI)
1	1478H	Tampa Bay	Lake Reinheimer	Dissolved Oxygen
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	Dissolved Oxygen (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)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
1	1493E	Tampa Bay	Buck Lake	Dissolved Oxygen; 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	Dissolved Oxygen
1	1498Z	Tampa Bay	Dosson Lake	Dissolved Oxygen (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	Dissolved Oxygen
1	1516E	Tampa Bay	Lake Ellen	Nutrients (TSI)
1	1519D	Tampa Bay	Pretty Lake	Dissolved Oxygen; 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	Dissolved Oxygen; 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	Dissolved Oxygen (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)
3	1539R	Sarasota Bay–Peace–Myakka	Lake Daisy	Nutrients (TSI)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
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	Dissolved Oxygen (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	Dissolved Oxygen (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	Dissolved Oxygen; Nutrients (TSI)
3	1617A	Sarasota Bay–Peace–Myakka	Lake Effie	Dissolved Oxygen (Nutrients)
4	1619A	Kissimmee River	Lake Wales	Nutrients (TSI)
3	1623L	Sarasota Bay–Peace–Myakka	Lake Hancock	Dissolved Oxygen (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	Dissolved Oxygen; 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	Dissolved Oxygen
1	1731A	Tampa Bay	Lake Maggiore	Nutrients (TSI)
4	1761H	Kissimmee River	Lake Lucas	Dissolved Oxygen
4	179A	Pensacola	Bear Lake	Dissolved Oxygen
2	1807B	Tampa Bay Tributaries	Lake Manatee Reservoir	Dissolved Oxygen; Fecal Coliform; Nutrients (TSI)
2	180A	Apalachicola–Chipola	Merritts Mill Pond	Nutrients (Algal Mats)
4	1813E	Kissimmee River	Bonnet Lake	Nutrients (TSI)
4	1813F	Kissimmee River	Lake Angelo	Nutrients (TSI)
4	1813G	Kissimmee River	Little Bonnet Lake	Nutrients (TSI)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
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	Dissolved Oxygen; 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)	Dissolved Oxygen
4	2105A	Nassau–St. Marys	Hampton Lake	Dissolved Oxygen
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	Dissolved Oxygen; Mercury (in fish tissue)
2	2308	Lower St. Johns	Eagle Run	Dissolved Oxygen; Fecal Coliform
5	2320F	Upper East Coast	Lake Vedra–Guana River (Freshwater Portion)	Dissolved Oxygen (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	Dissolved Oxygen; 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	Dissolved Oxygen; Nutrients (Historic TSI)
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)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
2	2575	Lower St. Johns	Cue Lake	Mercury (in fish tissue)
2	2593A	Lower St. Johns	Davis Lake	Dissolved Oxygen
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	Dissolved Oxygen (Nutrients)
1	2717	Ocklawaha	Kanapaha Lake	Dissolved Oxygen (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	Dissolved Oxygen; Fecal Coliform
1	2738A	Ocklawaha	Lochloosa Lake	Nutrients (Historic TSI); Nutrients (TSI Trend); Nutrients (TSI)
1	2740B	Ocklawaha	Lake Ocklawaha	Dissolved Oxygen
1	2742A	Ocklawaha	Star Lake	Nutrients (TSI)
1	2749A	Ocklawaha	Orange Lake	Dissolved Oxygen (Nutrients)
1	2771A	Ocklawaha	Lake Eaton	Dissolved Oxygen (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	Dissolved Oxygen
1	2803A	Ocklawaha	Holly Lake	Dissolved Oxygen
1	2806A	Ocklawaha	Lake Umatilla	Nutrients (TSI)
1	2811	Ocklawaha	West Emeralda Marsh Conservation Area	Dissolved Oxygen; Nutrients (TSI)
1	2819A	Ocklawaha	Trout Lake	Dissolved Oxygen (Nutrients and BOD)
1	2821B	Ocklawaha	Lake Joanna	Nutrients (Historic TSI)
1	2825A	Ocklawaha	Silver Lake	Nutrients (TSI)
1	2829A	Ocklawaha	Lake Lorraine	Dissolved Oxygen
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)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
1	2839M	Ocklawaha	Lake Louisa	Dissolved Oxygen (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	Dissolved Oxygen; Nutrients (TSI)
1	2873C	Ocklawaha	Johns Lake	Dissolved Oxygen; Nutrients (Historic TSI); Nutrients (TSI)
1	2875B	Ocklawaha	Lake Tilden	Dissolved Oxygen (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	Dissolved Oxygen (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	Dissolved Oxygen; 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	Dissolved Oxygen (Nutrients); Mercury (in fish tissue); Nutrients (Historic TSI)
3	2893O	Upper St. Johns	Lake Washington	Dissolved Oxygen (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	Dissolved Oxygen (Nutrients); Mercury (in fish tissue); Nutrients (TSI)
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)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
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	Dissolved Oxygen
2	2961	Middle St. Johns	Lake Sylvan	Mercury (in fish tissue)
2	2964A	Middle St. Johns	Lake Harney	Dissolved Oxygen; Mercury (in fish tissue); Nutrients (TSI)
3	2964B	Upper St. Johns	Puzzle Lake	Dissolved Oxygen; 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	Dissolved Oxygen
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	Dissolved Oxygen
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); 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);

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
				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	Dissolved Oxygen; 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	Dissolved Oxygen; 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)
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)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
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	Dissolved Oxygen
4	3168W6	Kissimmee River	Lake Warren	Dissolved Oxygen
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)	Dissolved Oxygen
4	3168Y3	Kissimmee River	Lake Greenwood	Dissolved Oxygen
4	3168Y4	Kissimmee River	Lake Davis	Nutrients (TSI)
4	3168Y7	Kissimmee River	Lake Theresa	Dissolved Oxygen
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	Dissolved Oxygen (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	Dissolved Oxygen
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

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
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)	Dissolved Oxygen; Nutrients (TSI)
4	3184	Kissimmee River	Lake Marian	Nutrients (TSI)
2	3194C	St. Lucie–Loxahatchee	Savannas	Copper; Dissolved Oxygen
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	Dissolved Oxygen (Nutrients)
3	3245B	Lake Worth Lagoon–Palm Beach Coast	Lake Clarke	Dissolved Oxygen; Fecal Coliform
3	3245C2	Lake Worth Lagoon–Palm Beach Coast	Clear Lake	Nutrients (TSI)
3	3245C4	Lake Worth Lagoon–Palm Beach Coast	Pine Lake	Dissolved Oxygen; Fecal Coliform; Nutrients (TSI)
3	3256A	Lake Worth Lagoon–Palm Beach Coast	Lake Osborne	Dissolved Oxygen
3	3262A	Lake Worth Lagoon–Palm Beach Coast	Lake Ida	Nutrients (TSI)
1	3366A	Suwannee	Lake Francis	Nutrients (TSI)
1	3438A	Suwannee	Peacock Lake	Dissolved Oxygen (BOD)
2	344	Apalachicola–Chipola	Ocheesee Pond	Dissolved Oxygen
1	3472	Suwannee	Tenmile Pond	Dissolved Oxygen
1	3496A	Suwannee	Low Lake	Dissolved Oxygen
1	3593A	Suwannee	Lake Crosby	Nutrients (TSI)
1	3648A	Suwannee	Sunshine Lake	Dissolved Oxygen
1	3703A	Suwannee	Watermelon Pond	Dissolved Oxygen
1	3731A	Suwannee	Lake Marion	Dissolved Oxygen
1	3738A	Suwannee	Little Bonable Lake	Dissolved Oxygen
1	442	Ochlockonee–St. Marks	Lake Iamonia	Dissolved Oxygen
2	51A	Apalachicola–Chipola	Dead Lake	Mercury (in fish tissue)

Basin Group	WBID	Basin Group Name	Waterbody Segment Name	Identified Parameters
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	Dissolved Oxygen; Nutrients (TSI)
1	582C	Ochlockonee–St. Marks	Carr Lake	Dissolved Oxygen
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	Dissolved Oxygen
1	647F	Ochlockonee–St. Marks	Lake Kanturk	Dissolved Oxygen; Nutrients (TSI)
1	647G	Ochlockonee–St. Marks	Alford Arm	Dissolved Oxygen
1	689A	Ochlockonee–St. Marks	Lake Overstreet	Dissolved Oxygen
1	689B	Ochlockonee–St. Marks	Lake Hall	Dissolved Oxygen
1	756B	Ochlockonee–St. Marks	Lake Piney Z	Dissolved Oxygen (Nutrients); Nutrients (Historic TSI); Nutrients (TSI)
1	756C	Ochlockonee–St. Marks	Lake Lafayette (Lower Segment)	Dissolved Oxygen (Nutrients); Nutrients (TSI)
1	756F	Ochlockonee–St. Marks	Lake Lafayette (Upper Segment)	Dissolved Oxygen; Nutrients (Historic TSI); Nutrients (TSI)
5	784	Perdido	Tee And Wicker Lakes	Mercury (in fish tissue)
1	791N	Ochlockonee–St. Marks	Lake Miccosukee	Dissolved Oxygen
1	807C	Ochlockonee–St. Marks	Lake Munson	Dissolved Oxygen (BOD); Nutrients (TSI); Turbidity
4	83A	Pensacola	Hurricane Lake	Dissolved Oxygen
1	878C	Ochlockonee–St. Marks	Lake Hiawatha	Dissolved Oxygen
1	878D	Ochlockonee–St. Marks	Cascade Lake	Dissolved Oxygen
1	878E	Ochlockonee–St. Marks	Grassy Lake	Dissolved Oxygen
2	926A1	Apalachicola–Chipola	Lake Mystic	Mercury (in fish tissue)
3	959	Choctawhatchee–St. Andrew	Morris Lake	Dissolved Oxygen
3	959D	Choctawhatchee–St. Andrew	Draper Lake	Dissolved Oxygen
3	959E	Choctawhatchee–St. Andrew	Alligator Lake	Dissolved Oxygen
3	959G	Choctawhatchee–St. Andrew	Fuller Lake	Dissolved Oxygen
3	959I	Choctawhatchee–St. Andrew	Big Redfish Lake	Dissolved Oxygen
3	959J	Choctawhatchee–St. Andrew	Little Redfish Lake	Dissolved Oxygen
1	971B	Ochlockonee–St. Marks	Lake Weeks	Dissolved Oxygen (Nutrients)
1	971C	Ochlockonee–St. Marks	Eagle Lake	Dissolved Oxygen