Florida Watershed Monitoring Status and Trend Program Design Document

Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection
2025

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Executive Summary

The Florida Department of Environmental Protection (DEP or department) is committed to protecting and restoring Florida's waters, and to providing sound, scientific water quality monitoring information. Comprehensive water quality monitoring and assessment is essential for water resource management**.** This document articulates the overall goals, objectives, strategy and design of the department's Status and Trend Monitoring Program to meet federal Clean Water Act (CWA) and state of Florida legislative requirements for the determination of water quality

Under the CWA, states are required to determine whether waters meet water quality standards (i.e., meet their designated uses or functional classifications), establish special monitoring for unique resources and support the evaluation of program effectiveness. Under Florida's laws and rules, DEP also is required to carry out various types of monitoring, including groundwater monitoring, and to coordinate monitoring activities statewide.

The Status and Trend Monitoring Program design is comprised of 10 elements defined by the U.S. Environmental Protection Agency (EPA) document, Elements of a State Water Monitoring and Assessment Program (EPA 2003). The 10 elements are monitoring program strategy, objectives, design, indicators, quality assurance, data management, data analysis and assessment, reporting, programmatic evaluation, and general support and infrastructure planning.

This document has been prepared to meet requirements specified under CWA Section 106. Updates are prepared annually to address any changes to the design of the Status and Trend Monitoring Program.

Introduction

Both the U.S. Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (DEP or department) recognize that monitoring is essential to water resources management. At the federal level, Section 305(b) of the Clean Water Act (CWA) (Federal Water Pollution Control Act, 33 U.S. Code 1251–1375, as amended) directs each state to (1) prepare and submit a biennial report that describes the water quality of all navigable surface waters to the EPA and (2) protect balanced indigenous populations. Furthermore, Section 106 (e) (1) of the CWA directs EPA to determine whether states meet the prerequisites for monitoring their aquatic resources. Florida addresses federal CWA responsibilities through programs implemented by DEP.

Monitoring groundwater quality is also required under Florida law through a series of rules that govern the department's activities. The 1983 Water Quality Assurance Act (section 403.063, Florida Statutes [F.S.]) directs DEP to establish and maintain a groundwater quality monitoring network designed to detect or predict contamination of the state's groundwater resources.

This report presents the goals, objectives, strategy and design of DEP's Status and Trend Monitoring Program as they pertain to (1) meeting CWA requirements, (2) meeting Florida's statutory requirements and (3) fulfilling Florida's commitment to protect and restore water resources by providing sound, scientific water quality monitoring.

Status and Trend Monitoring Program

Element 1: Monitoring Program Strategy

A monitoring program strategy addresses implementation and documents the timeline and plan needed to carry it out. The department has had monitoring programs for ambient ground and surface freshwater resources throughout its history, and formalized statewide monitoring into an Integrated Water Resource Monitoring (IWRM) program in 2000.

The Status and Trend Monitoring Program is a tool used to document the overall condition of state waters (thus the term "ambient"). It does not address regulatory or point source contamination. The department routinely evaluates whether the monitoring program answers questions relevant to state interests and programs, and revises program strategy and design to address needed modifications.

The objective of the Status and Trend Monitoring Program is to provide scientifically defensible and relevant data to support long-term ambient monitoring goals via specialized monitoring networks:

- The Status Monitoring Network provides an overview of the condition of state waters. The department uses results from this network to infer the proportion of waters meeting water quality standards and to track statewide and region-wide changes overtime.
- The Trend Monitoring Network tracks changes in the quality of targeted waters over time.

DEP uses data collected from both networks to determine if there are changes in water quality due to management and restoration efforts throughout the state. Resource management focused on protecting water quality is less costly than restoration of impaired waters.

Both the Status and Trend Monitoring Networks focus on freshwater resources—lakes, rivers, streams, canals, and groundwater— described in **Element 3**. There are other water resources in the state: wetlands, springs, estuaries, and near and offshore marine waters that are not monitored by the Status and Trend Monitoring Networks. DEP monitors these resources only as management needs arise. There are however other federal and state monitoring programs external to DEP which do monitor these resources.

Impediments and shortcomings identified in the implementation of the Status and Trend Monitoring Networks include the need for continued state and federal funding to retain skilled staff and support operating expenses including the addition of analytes (indicator substances) of concern. Well-trained staff are a necessary part of any monitoring program. Currently, the Status and Trend Monitoring Program has the following staff located in Tallahassee: environmental administrator, quality assurance officer, data coordinator, data analysis and reporting coordinator, data manager, data analysts and project managers. Field support is provided by regionally located department staff and through contracted regional government agencies to allow reasonable spatial coverage of the state.

Element 2: Monitoring Objectives

Program Goals and Objectives

Florida law requires water resource monitoring to provide insight into the condition of Florida's surface and groundwater, thus allowing protection and conservation of state water resources. Section 403.063, F.S., directs the department to establish and maintain a groundwater quality monitoring network designed to detect or predict contamination of the state's groundwater resources. DEP performs ambient monitoring of the state's surface waters to meet the federal requirements in the CWA (33 United States Code [U.S.C.] 1315[b]).

DEP has designed two networks to address goals of both the department and the CWA. The Status Monitoring Network provides a snapshot of the overall quality of waters in the state, answering questions about chemical, physical, and biological water quality standards. The Trend Monitoring Network measures changes in water quality over time at specific targeted locations.

Through these monitoring networks, the state fulfills its commitment to protect surface and groundwater resources by providing sound, scientific water quality data. These data are available to outside agencies and other departmental programs for use in their water quality evaluations.

Status Monitoring Network

The Status Network uses an EPA developed probabilistic design to provide information on the statewide condition of surface and groundwater. The network was initiated in 2000 and has a long-term record of data available for analysis. DEP also uses these data for more in-depth investigations, including establishment of watershed and indicator-specific priorities. Data from the network can answer questions such as:

- What percentage of river miles statewide has less than optimal habitat?
- What number or area of lakes statewide exceeds the standard for *E. coli*?
- Has the statewide extent of Florida streams not meeting water quality criteria for total nitrogen decreased between time periods A and B.

Status Monitoring Network activities collectively address the following goals and objectives:

- Identify and document the statewide condition of Florida's freshwater resources with known certainty.
- Infer the proportion of the state's freshwater resources that meet water quality thresholds and other indicators of ecosystem health.
- Collect data on important chemical, physical and biological parameters to characterize waterbodies in accordance with Florida water quality standards in Rules 62-302 and 62-303, F.A.C.
- Provide data, with known data quality objectives and quality assurance, that can be used to determine the status of a watershed's long-term overall health and to establish water quality standards.
- Provide reliable data for management decision making.
- Provide technically sound information to managers, legislators, agencies, and the public.

DEP conducts statewide Status Monitoring Network sampling for both surface and groundwater resources each year. The department submits a summary of the state's probabilistic assessments to EPA for inclusion in the National Water Quality Inventory Report to Congress through the integrated 305(b) and 303(d) reporting process.

Trend Monitoring Network

Designed to examine water quality changes in groundwater and flowing freshwater systems over time, the Trend Monitoring Network consists of fixed monitoring stations across the state. The network was initiated in 1998 and has a long-term record of data available for analysis.

A fixed-station monitoring network can answer many of the same questions as the Status Monitoring Network, as well as the following questions:

- Has water quality significantly improved or worsened based on the indicators measured at this location?
- Is there seasonality to the data?
- How do the Trend Monitoring Network results compare to the Status Monitoring Network results for a region?

DEP discusses surface and groundwater trends in the integrated 305(b) and 303(d) report (DEP 2024a).

Data Quality Objectives

The Data Quality Objectives (DQOs) process is a planning tool that can save financial resources. Good planning streamlines the study process and increases the likelihood of efficiently collecting appropriate and useful data. DQOs invest time and money in the planning stages to ensure that the final product satisfies the needs of data users. The process identifies data collection activities that address the most critical questions. The DQO process consists of two major activities:

- Specifically state the question(s) that needs to be answered for the problem at hand.
- Specifically state the amount of uncertainty that investigators are willing to tolerate when attempting to answer that question with collected data.

Other issues addressed by the DQO process are missing samples and data censoring. Element 7 addresses procedures for dealing with missing data values for both the Status and Trend Monitoring Networks. Data censoring has its own concerns and procedures, which are the same for both networks. Laboratory detection limits may be higher than the actual values of environmental samples. These laboratory detection limits are referred to as method detection limits and can lead to censoring of environmental data—that is, the data distribution is truncated at its lower end.

For statistical analyses, all data reported as below detection level (BDL) are assigned values either based on the maximum likelihood estimation (MLE) calculation, given a value equal to the method detection limit (MDL), or as in the case with compounds with extremely low MDLs assigned a value of zero. New analytical methods or instrumentation upgrades may result in better detection limits at lower concentrations.

Some DQOs can be used by both monitoring networks. An overarching DQO for both networks is:

— Provide data of a known quality and confidence to use in departmental programs and to aid in the development of rules and thresholds in support of effective management of state water resources.

Other DQOs are specific to each monitoring network. The DQO specifically focused on the requirements of the Status Monitoring Network is:

— Produce data to estimate the condition of each type of water resource, with a 95% confidence level and margin of error between 5 and 15%.

The following DQOs are specific to the Trend Monitoring Network:

— Produce an adequate amount of data to determine whether trends exist in fresh flowing surface water or groundwater resources across the state.

— Collect data during a time-period covering temporal cycles in the data (e.g., because temperature changes over time, sampling must be at a frequency that can show seasonal fluctuations).

Element 3: Monitoring Design

It is fiscally and logistically prohibitive to sample every segment of river or stream, every acre of lake, and each well in the state on a regular basis. EPA has stated that a probabilistic monitoring design is a cost-effective approach in producing a statement of known statistical confidence to describe the aggregate condition of water resources. A probabilistic approach allows for an unbiased sampling of the state's water resources.

Following EPA guidelines, the department implemented the Status Monitoring Network, based on a probabilistic design, to provide unbiased, spatially balanced estimates of statewide and regionwide ambient freshwater quality condition with known statistical confidence.

The department designed the Trend Monitoring Network to monitor changes in selected waterbodies over time. To achieve this goal, rivers, streams, canals, and wells are sampled regularly at fixed locations. The Trend Monitoring Network complements the Status Monitoring 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).

Water Resources Monitored

The following resources are monitored by the Status and/or Trend Monitoring Networks:

— **Groundwater (confined and unconfined aquifers):** Groundwater includes those portions of Florida's aquifers that have the potential for supplying potable water or for affecting the quality of currently potable water. This does not include groundwater that lies directly within or beneath a permitted facility's zone of discharge.

— **Rivers and streams:** Rivers and streams include linear waterbodies with perennial flow that are 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 Section 312.020, F.A.C. "Canal" is a trench, the bottom of which is normally covered by water, with the upper edges of its two sides normally above water. "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 ditch" or "irrigation ditch" is a man-made trench dug for draining water from the land or for transporting water for use on the land and is 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 on the United States Geological Survey (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, or lakes less than four hectares in area.

Neither the Status nor Trend Monitoring Network currently monitors estuaries, wetlands or marine waters.

Sampling

The department and contracted organizations regularly collect samples from the water resources listed above to monitor water quality. All samples are collected and shipped following department-approved protocols described in the Sampling Manual (DEP 2022a). Samples are shipped to the department's Laboratory in Tallahassee or contracted laboratories for analysis.

Status Monitoring Network

The department launched the Status Monitoring Network in January 2000. Starting in 2009, DEP instituted an annual assessment of statewide water resource conditions using the Generalized Random Tessellation Stratified sampling design (supported by EPA's Office of Research and Development). Geographic stratification breaks the state into non-overlapping zones (**Figure 1**) from which DEP chooses sample stations using probability-based sample surveys specific to the water resource. The zones correspond to the state's five water management district (WMD) boundaries, with South Florida WMD (SFWMD) divided into eastern and western regions. Each sample survey design ensures that sampling stations are representative of the target resources, are spatially balanced, and that their selection is not biased. DEP generates random station locations each year from the geographic extent of each water resource.

DEP and contracted organizations annually attempt to collect 90 samples each from rivers, streams, small lakes, and large lakes statewide; 60 samples from canals within Zones 3 through 6; and 120 samples statewide from each groundwater resource type. Collection of this number of samples satisfies the Network's DQO. Based on these sample sizes, the range of error associated with the 95% confidence interval for the estimate of statewide condition is approximately ± 12% for surface water and ± 9% for groundwater. Factors such as periods of drought or unsafe access can reduce the number of stations sampled.

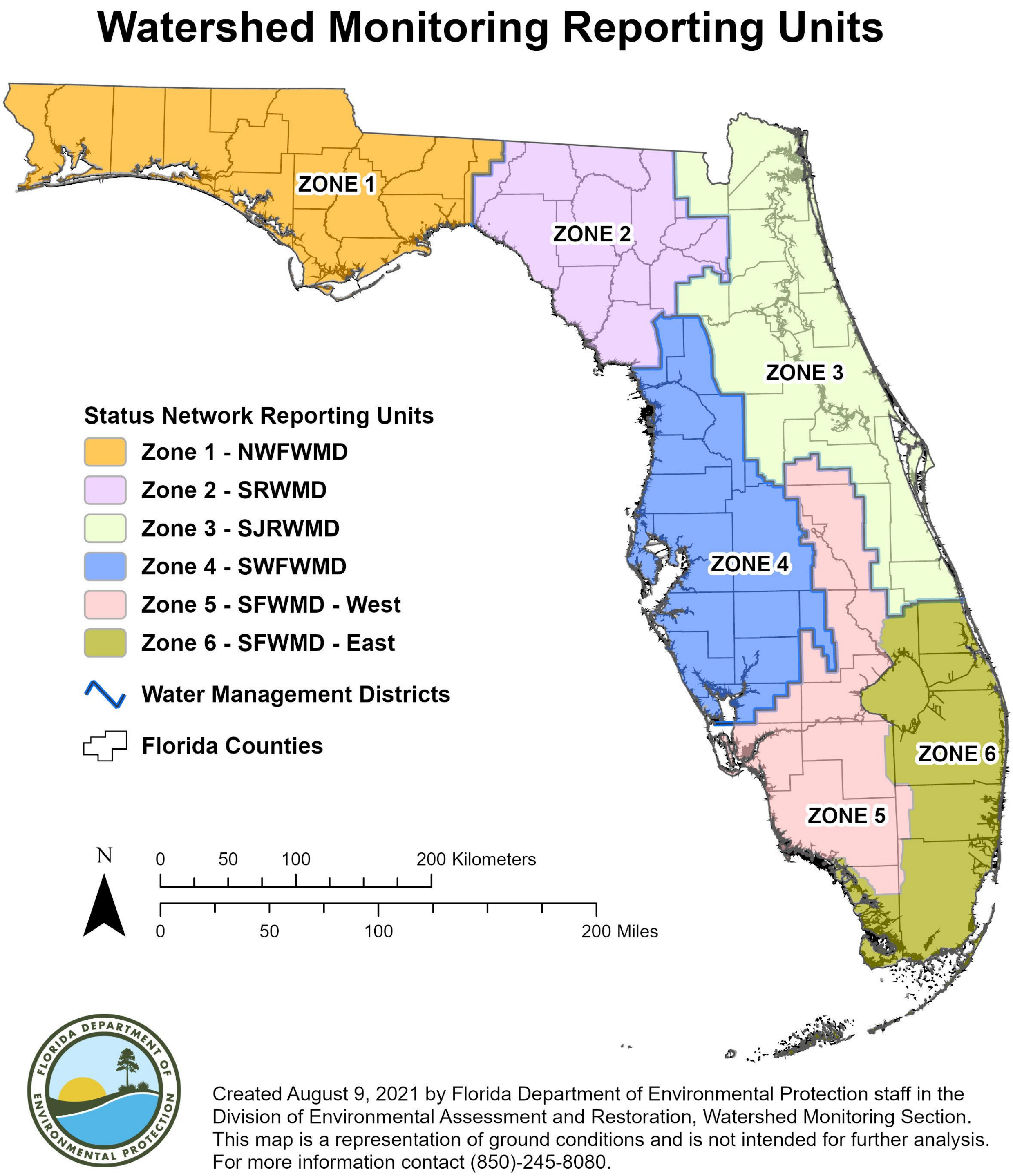

Figure 1. Florida Reporting Unit Map

Groundwater

Florida has three major aquifer systems, all of which are sampled: the surficial aquifer system (SAS), the intermediate aquifer system (IAS), and the Floridan aquifer system (FAS). For the purposes of sampling and resource characterization, DEP subdivides the groundwater resource into two target populations: (1) unconfined aquifers and (2) confined aquifers. All three aquifer systems contain portions that are unconfined and confined. Confinement conditions must be determined prior to sampling.

DEP selects individual wells from an annually updated list consisting of wells from:

- Recommendations submitted by each WMD.
- DEP's historic Groundwater Quality Monitoring Background Network.
- DEP's historic Very Intense Study Area (VISA) Network.
- A Florida Department of Health (DOH) private well survey cosponsored by the department.
- WMD and county saltwater intrusion networks.
- Upgradient monitoring wells associated with department-permitted facilities.
- USGS monitoring wells.
- Public and private water supply wells.

The well list is a dynamic and diverse representation of the state's groundwater resource. Selections include public supply wells because pumping typically removes high volumes of water, which may induce the lateral or upward movement of saline water. The resulting degradation of water quality results in significant and costly changes in water supply systems. Selections avoid wells in areas of industrialization and known contamination.

Surface Water

Surface waters are divided into two groups: flowing (lotic) or still waters (lentic).

Rivers, Streams, and Canals

The lotic group consists of rivers, streams, and canals. DEP initially identifies rivers and then classifies the remaining flowing surface waters as streams or canals. DEP classifies canals as a separate resource because their biota and associated water quality may differ from that found in streams and rivers. DEP excludes segments of impounded rivers, streams, and canals from the list frames. DEP also excludes estuaries and marine waters, as well as fresh waters focused on by other sections of the department (e.g., wetlands, and springs).

Large and Small Lakes

The lentic group consists of many types of natural lakes, including sandhill lakes, sinkhole lakes, oxbow lakes, and established reservoirs (i.e., not private impoundments used for agriculture). Water quality standards do not apply within artificial waterbodies that are not waters of the state, including stormwater retention ponds, golf course ponds and other man-made water features. DEP excludes these artificial waters from the resource list frame.

DEP subdivides lakes into two populations: (1) small lakes, 4 to less than 10 hectares (~10 to ~25 acres); and (2) large lakes, 10 hectares and larger (~25 acres). All lakes must include at least 1,000 square meters (m^2) (1/10 hectare or ~1/4 acre) of open water, be at least 1-meter deep at the deepest point, and not be in direct contact with or influenced by oceanic waters. Size differentiation allows better representation of the resource types.

Geographic Design

The department organizes and stores surface water resource location information in a Geographic Information System (GIS) database (**Appendix A**) using the Environmental Systems Research Institute's ArcGIS Pro. Groundwater well location data is stored in the GWIS (Generalized Water Information System) Oracle database (**Appendix B**). R software (R Core Team 2025) is used to retrieve the well data and convert it to a GIS coverage for use in the site selection process. For both Surface water and groundwater, DEP uses the GIS data with associated information (metadata) and the probabilistic sample survey methodology to randomly select sample stations (**Figure 2**).

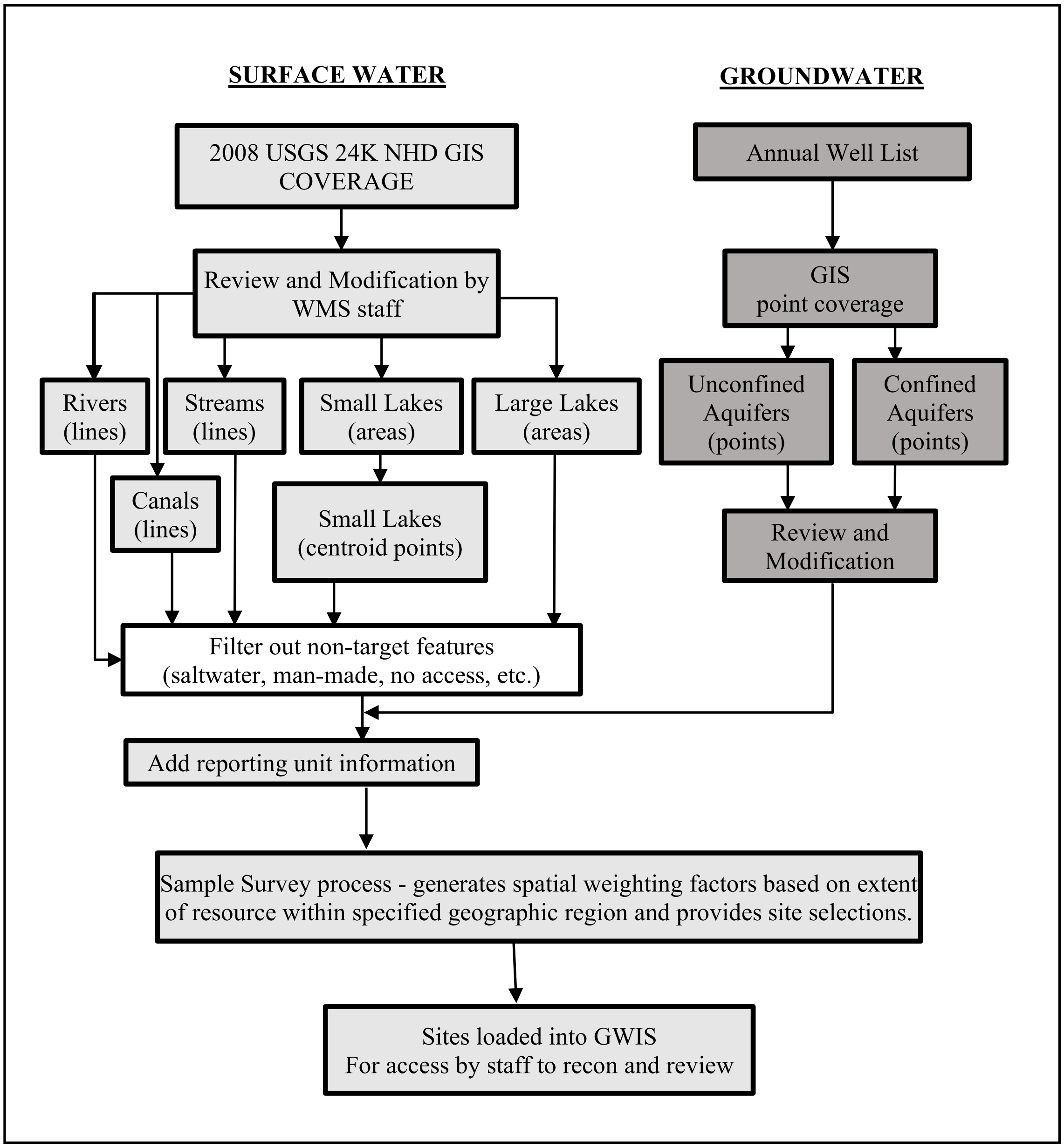

Figure 2. Random Selection Process Flow Chart

Station Selection and Sample Frequency

Using Florida's six zones (**Figure 1**) facilitates the statewide spatial distribution of stations. Each year, DEP randomly selects 15 primary stations and 135 alternate stations from streams, rivers, large lakes and small lakes in each zone, resulting in 3,600 potential surface water sample stations (150 potential stations × 4 resources × 6 zones). In Florida, targeted canals exist only in Zones 3 through 6. Of these, DEP randomly selects 600 potential stations (150 potential stations × 4 zones). For each groundwater resource type, DEP selects 20 primary stations and 180 alternate stations from each zone, resulting in 2,400 potential groundwater stations (= 200 potential stations × 2 resources × 6 zones). **Figure 3** shows the sampling periods and lists the number of samples collected from each resource type.

Sample sites for all resources are selected using R software (R Core Team 2025) and the grts function in the spsurvey package (Dumelle et. al. 2023). All resources use a sample survey design that is stratified by zone. Equal inclusion probability methodology is used for selecting sample sites for flowing waters and small lakes. Large lakes in each zone are sorted by area and split into five groups of approximately equal total lake area. Unequal inclusion probability methodology based on lake area category is used for selecting sample sites for large lakes. For each aquifer resource, the density of wells within each zone is estimated using a two-dimensional kernal density estimator, and each well is assigned a multi-density category based on the inverse of the calculated density. Proportional inclusion probability methodology based on multi-density category is used for selecting sample sites for aquifers. R markdown files are used to generate supporting documentation for each set of sample sites.

Alternate stations are necessary because of the high probability of sampling problems, such as access denials, dry resources, and other challenges associated with random sampling designs. Staff use an online application called the Generalized Water Information System (GWIS) Database Utilities (see **Element 6**) to access potential sample station data and geographic information stored in an Oracle database. This application also allows staff to review selected stations using its online, interactive mapping system. In addition, DEP continually uses comments that field staff enter into GWIS to update resource coverages.

STATUS NETWORK SAMPLING PERIODS

Effective October 1, 2017

120 ground water samples per resource (confined aquifers and unconfined aquifers) are split equally among 6 reporting units (20 samples each, in Zones 1 - 6).

90 surface water samples per resource (rivers, streams, large lakes, and small lakes) are split equally among 6 reporting units (15 samples each, in Zones 1 - 6).

60 surface water samples in canals are spilt among 4 reporting units (15 samples each, in Zones 3 - 6).

Totals do not include quality assurance samples.

Month	Confined Aquifers	Unconfined Aquifers	Canals	Rivers	Streams	Large Lakes	Small Lakes
Jan			60				
Feb	120						
Mar							
Apr				90			
May						90	
Jun							
Jul					90		
Aug							
Sep							90
Oct		120					
Nov							
Dec							

Primary Sampling Period

Overflow Sampling Period

Figure 3. **Status Monitoring Network Sampling Schedule**
The numbers represent the statewide target sample size, which is chosen to satisfy the Network's DQO.

Sample Station Reconnaissance

Reconnaissance is a process by which staff assess stations before they are sampled. This step saves time and resources by ruling out unsuitable stations before sample collection. DEP maintains a Reconnaissance Manual (DEP 2024b), which describes the procedures for determining station suitability. Station reconnaissance begins in the office, where staff use GWIS Database Utilities to review all available documentation. After evaluating the suitability of primary stations, staff review alternate stations (if needed) in the order in which they were generated. When a station is deemed sampleable, staff must obtain permission from the property owner. Staff make three attempts to contact the owner before excluding the station and moving on to evaluating the next station.

The final stage of reconnaissance takes place during a station visit. Staff visit the selected stations and determine whether the station is sampleable. If so, the station is sampled; otherwise, staff record exclusion details and proceed to the next station.

Trend Monitoring Network

DEP uses the Trend Monitoring Network to determine if selected water quality indicators change over time (**Table 14** through **Table 18**, **Element 4**). A certain number of samples must be collected continually to complete a statistically valid trend analysis. Before trends can be determined, seasonal variability in the data must be considered.

DEP has separated the Trend Monitoring Network into surface water (rivers, streams, and canals) and groundwater (confined and unconfined aquifers including springs). Lakes are not part of the Trend Monitoring Network due to fiscal and logistical limitations. Trend Monitoring Network data provide a temporal reference on a regional scale for the Status Monitoring Network.

Surface Water Trend Monitoring Network

The Surface Water Trend Monitoring Network consists of 78 fixed stations (**Figure 4**) sampled monthly for field and laboratory analytes. WMS chose station locations based on Florida's 52 USGS 8-digit drainage basins. Many stations are located at or near existing USGS, SFWMD or SJRWMD gauging stations, and often are situated at the lower end of a watershed, enabling the department to obtain biology, chemistry, and loading data at a point that reflects multiple land use activities within the watershed. Some stations are located at or near the Florida boundary with Alabama and Georgia to obtain chemistry and loading data for major streams entering Florida.

DEP uses data from Surface Water Trend Monitoring Network stations to evaluate trends in Florida's surface water resources. This network is not designed to monitor point sources of pollution, since the stations are located away from known outfalls or other regulated sources.

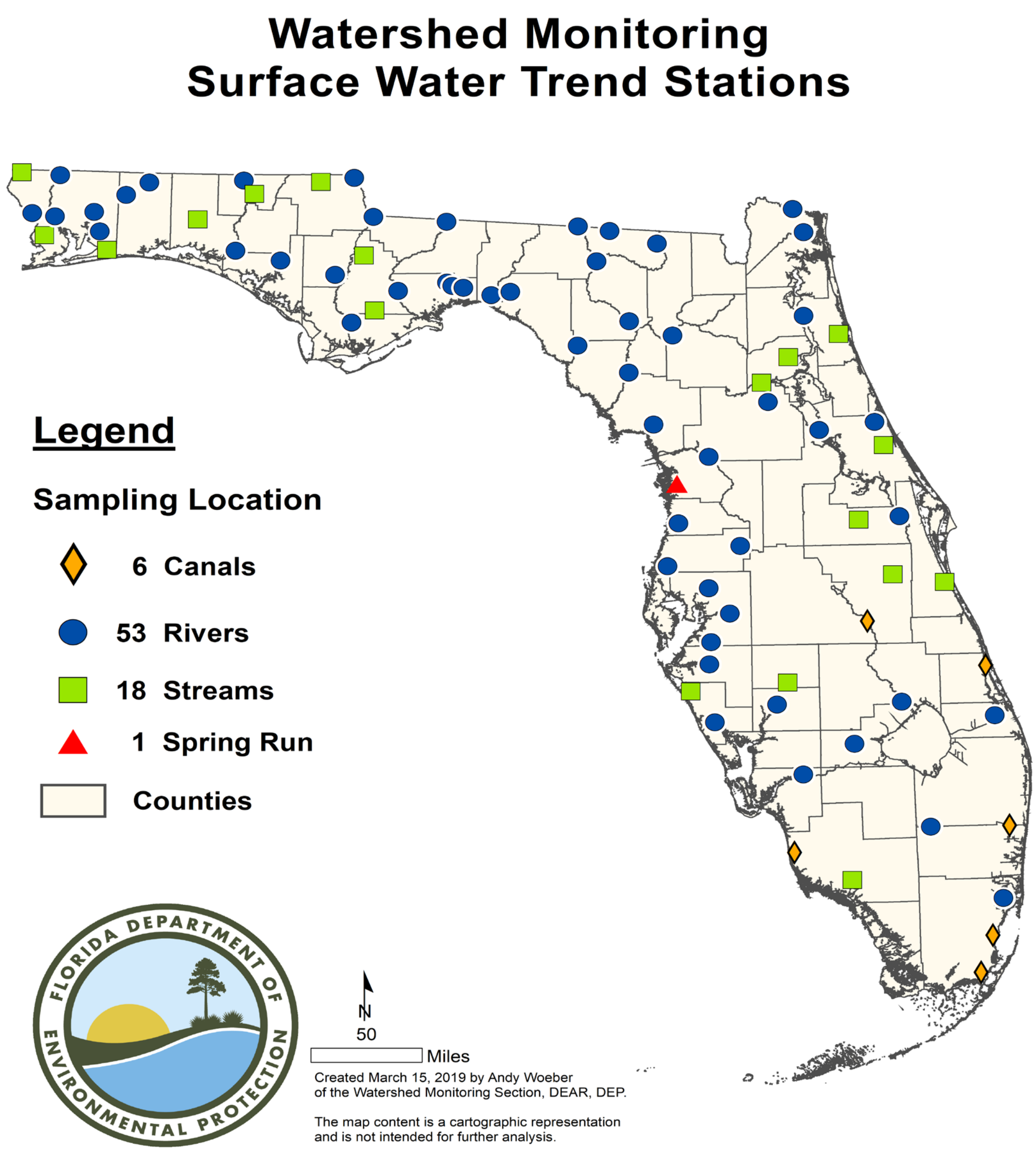

Figure 4. Locations of Surface Water Trend Monitoring Network Stations

Groundwater Trend Monitoring Network

The Groundwater Trend Monitoring Network consists of 51 fixed stations (**Figure 5**) used to quantify trends in groundwater resources by obtaining chemistry and field data from confined and unconfined aquifers. DEP chose station locations, based on the USGS 8-digit drainage basins, to obtain a representative statewide distribution. Each quarter, staff collect water samples and field measurements at all stations in the Trend Network. In addition, staff measure field analytes in the unconfined aquifer stations monthly. A micro-land use form, completed at all stations annually, aids in determining potential sources of groundwater contamination.

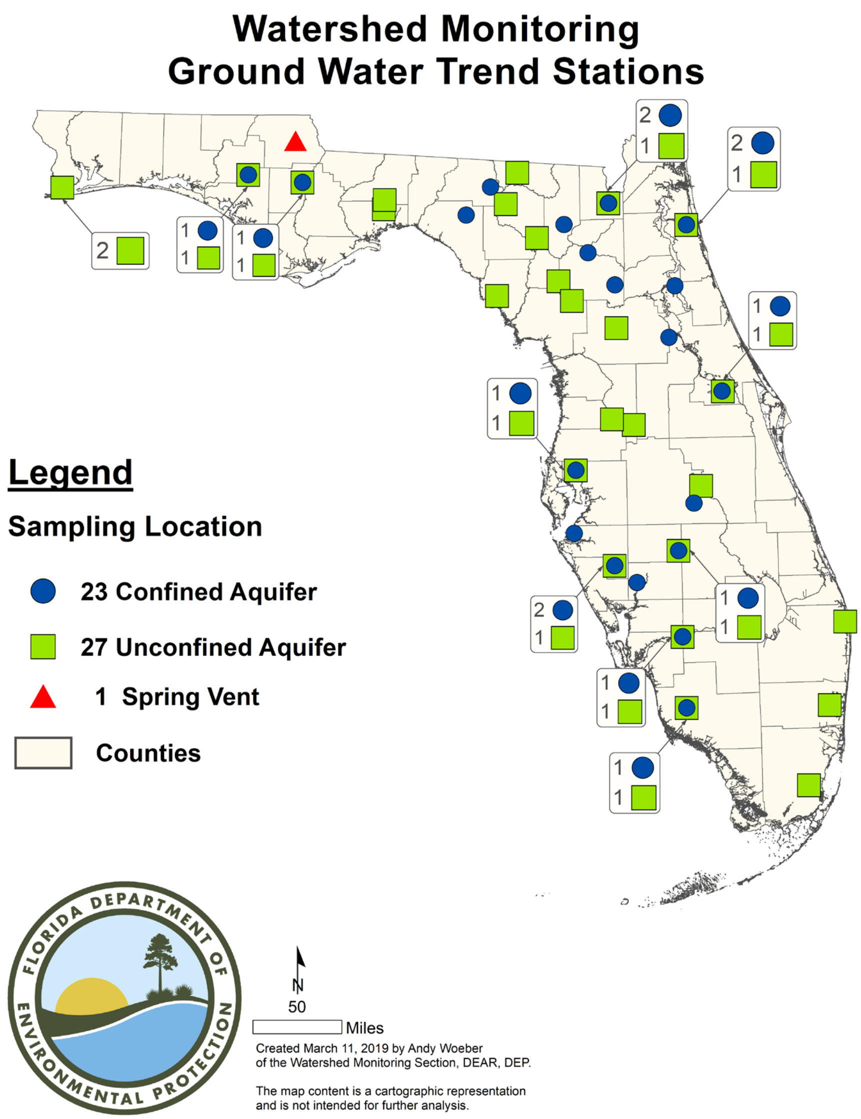

Figure 5. Locations of Groundwater Trend Monitoring Network Stations

Element 4: Core and Supplemental Water Quality Indicators

While most water quality monitoring historically has focused on chemistry, the department's Status and Trend Monitoring Programs expand this scope to include biological and physical indicators. Together, these indicators provide scientific information about the condition of the state's water resources and whether they meet their designated uses based on state and EPA guidance. DEP uses these indicators, specified as either core or supplemental, to evaluate the condition of each water resource.

Core indicators provide information about the chemical, biological and physical status of surface and groundwater, including suitability for human and aquatic uses. These data can be used to gauge condition based on water quality standards or guidance. Supplemental indicators provide extra information about the status of surface and groundwater and aid in screening for potential pollutants. The department often chooses supplemental indicators to support special projects or to develop water quality criteria.

DEP combines some indicators to form indices that help evaluate waterbody condition. Indices using multiple indicators provide a broader understanding of a waterbody's health. One example of an index is the numeric nutrient criteria (NNC) for lakes, springs, and streams. The NNC pass/fail status is based on indicators such as lake color, floral and faunal health, and nutrient concentrations. The department's NNC website (DEP 2022b) has guidance on NNC implementation.

Core and supplemental indicators consist of different chemical, physical and biological parameters, only some of which are applicable for all water resource types. For example, the department collects chemical and bacteriological indicators for all resource types. In contrast, certain biological indicators, such as chlorophyll *a*, are only collected in surface waters. Additionally, the department collects and analyzes sediment samples only in lakes.

Waterbody Classifications and Designated Uses

Florida classifies its surface waters into five categories according to their use, as follows:

- Class I— Potable water supplies.
- Class I-Treated— Treated potable water supplies.
- Class II— Shellfish propagation and harvesting.

- Class III— Fish consumption; recreation; and 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.

Water quality classification order reflects the degree of required protection, with Class I water generally having the most stringent water quality criteria and Class V having the least. Surface waters designated as Class I, Class III or Class III-Limited under Florida Surface Water Quality Standards (Chapter 62-302, Florida Administrative Code [F.A.C]) are sampled in the Status and Trend Monitoring Networks. Class I criteria protect surface waters used as a source of potable water (subsection 62-302.400(1), F.A.C.). Class III and Class III-Limited waters include recreational activities such as fishing, swimming, boating, and the protection of aquatic life (subsections 62-302.400(4) and (6), F.A.C.). Many indicators sampled for in the Status and Trend Monitoring Networks have numeric surface water quality criteria to protect one or more of these uses (**Table 1** through **Table 7**).

Florida classifies groundwater as a potable water supply based on Rule 62-520.460, F.A.C. Primary and secondary drinking water standards are used to determine if aquifers meet designated uses (Chaper 62-550, F.A.C., Drinking Water Standards). Core and supplemental indicators support the evaluation of aquifer condition (e.g., contamination and saltwater intrusion).

The department has been instrumental in developing biological indices to evaluate waterbody conditions in Florida. The five bioassessment tools used are: one for Status Network lakes (Lake Vegetation Index [LVI]), one for Status Network rivers and streams (Habitat Assessment [HA]) and four applicable to Trend Network rivers and streams (Stream Condition Index [SCI], Habitat Assessment [HA], Rapid Periphyton Survey [RPS] and Linear Vegetation Survey [LVS]).

Table 1. Primary indicators with water quality criteria/thresholds used by the Status and Trend Networks for potable water supplies

This is a two-column table. Column 1 lists the indicator and Column 2 lists the water quality criterion/threshold.

mg/L – milligrams per liter; µg/L – micrograms per liter

Note: The water quality criteria and thresholds in **Table 1 - Table 7** are derived from Rule 62-302.530, F.A.C., Criteria for Surface Water Classifications; Rule 62-302.531, F.A.C., Numeric Interpretation of Narrative Nutrient Criteria; Rule 62-302.533, F.A.C, Dissolved Oxygen Criteria for Class I, Class II, Class III, and Class III-Limited Waters; Rule 62-550, F.A.C., Drinking Water Standards; Rule 62-303, F.A.C., Identification of Impaired Surface Waters; and Rule 62-520.420, F.A.C., Standards for Class G-I and Class G-II Groundwater, and DOH Health Advisory Levels for drinking water.

Primary Indicator/Index for Potable Water Supply	***Criterion/Threshold***
Antimony	≤ 6 µg/L
Arsenic	≤ 10 µg/L
Barium	≤ 2 mg/L
Beryllium	≤ 4 µg/L
Cadmium	≤ 5 µg/L
Chromium	≤ 100 µg/L
Fluoride	≤ 4 mg/L
Lead	≤ 15 µg/L
Nickel	≤ 100 µg/L
Nitrate + Nitrite	≤ 10 mg/L
Selenium	≤ 50 µg/L
Sodium	≤ 160 mg/L
Thallium	≤ 2 µg/L
Total Coliform Bacteria (#/100mL)	≤ 4 colonies/100mL

Table 2. Secondary indicators with water quality criteria/thresholds used by the Status and Trend Networks for potable water supplies

This is a two-column table. Column 1 lists the indicator and Column 2 lists the water quality criterion/threshold.

mg/L – milligrams per liter; su – standard units

Secondary Indicator/Index for Potable Water Supply	Criterion/Threshold
Aluminum	≤ 0.2 mg/L
Chloride	≤ 250 mg/L
Copper	≤ 1 mg/L
Fluoride	≤ 2 mg/L
Iron	≤ 0.3 mg/L
Manganese	≤ 0.05 mg/L
pH	≥ 6.5, ≤ 8.5 su
Silver	≤ 0.1 mg/L
Sulfate	≤ 250 mg/L
Total Dissolved Solids (TDS)	≤ 500 mg/L
Zinc	≤ 5 mg/L

Table 3. Microbiological indicators with water quality criteria/thresholds used by the Status and Trend Networks for recreational use

This is a two-column table. Column 1 lists the indicator and Column 2 lists the water quality criterion/threshold.

mL – milliliters

Microbiological Indicator/Index for Recreation Use (Surface Water)	Criterion/Threshold
Escherichia coli	≤ 410 colonies/100mL

Table 4. Other indicators with water quality criteria/thresholds used by the Status and Trend Networks for aquatic life use

This is a two-column table. Column 1 lists the indicator/index and Column 2 lists the water quality criterion/threshold.

mg/L – milligrams per liter; µg/L – micrograms per liter; su – standard units; NTU – nephelometric turbidity units

Note: 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 Chapter 62-303, F.A.C. These chlorophyll thresholds apply to rivers, streams, and canals only. Chlorophyll criteria for lakes are listed in **Table 5.**

Physical/Other Indicator/Index for Aquatic Life Use (Surface Water)	***Criterion/Threshold***
pH	≥ 6, ≤ 8.5 su
Total Ammonia Nitrogen	See Ammonia Criteria
Fluoride	≤ 10 mg/L
Chlorophyll a	≤ 20 µg/L
Stream Condition Index	SCI Score ≥ 35
Lake Vegetation Index (LVI)	LVI Score ≥ 43
Habitat Assessment (HA)	HA score ≥ 80
Antimony	≤ 4300 µg/L
Arsenic	≤ 50 µg/L
Beryllium	≤ 0.13 µg/L
Cadmium	See Metals Criteria Calculator
Chromium	See Metals Criteria Calculator
Copper	See Metals Criteria Calculator
Lead	See Metals Criteria Calculator
Iron	≤ 1000 µg/L
Nickel	See Metals Criteria Calculator
Selenium	≤ 5 µg/L
Silver	≤ 0.07 µg/L
Thallium	< 6.3 µg/L
Zinc	See Metals Criteria Calculator

Table 5. Nutrient indicators used to assess lake resources

This is a five-column table. Column 1 lists the lake color and alkalinity, Column 2 lists the chlorophyll a *criterion, Column 3 lists the total phosphorus criterion, Column 4 lists the total nitrogen criterion, and Column 5 lists the designated use of the water.*

PCU – platinum cobalt units; $CaCO_3$ – calcium carbonate; µg/L – micrograms per liter; mg/L – milligrams per liter

[1] For lakes with color > 40 PCU in the West Central Nutrient Region (**Figure 6**), the Total Phosphorus criterion is ≤ 0.49 mg/L, regardless of the chlorophyll concentration.

Lake Color and Alkalinity	*Chlorophyll a Criterion (µg/L)*	*Total Phosphorus Criterion (mg/L)*	*Total Nitrogen Criterion (mg/L)*	*Designated Use*
Color > 40 PCU	≤ 20	≤ 0.16[1] if meets Chlorophyll criterion; ≤ 0.05[1] if not	≤ 2.23 if meets Chlorophyll criterion; ≤ 1.27 if not	Aquatic Life
Color ≤ 40 PCU and Alkalinity > 20 mg/L $CaCO_3$	≤ 20	≤ 0.09 if meets Chlorophyll criterion; ≤ 0.03 if not	≤ 1.91 if meets Chlorophyll criterion; ≤ 1.05 if not	Aquatic Life
Color ≤ 40 PCU and Alkalinity ≤ 20 mg/L $CaCO_3$	≤ 6	≤ 0.03 if meets Chlorophyll criterion; ≤ 0.01 if not	≤ 0.93 if meets Chlorophyll criterion; ≤ 0.51 if not	Aquatic Life

Table 6. Nutrient indicators used to assess river and stream resources

This is a four-column table. Column 1 lists the Nutrient Region, Column 2 lists the total phosphorus criterion, Column 3 lists the total nitrogen criterion, and Column 4 lists the designated use of the water.

mg/L – milligrams per liter
[1]The nutrient criteria for rivers and streams depend on the Nutrient Region (**Figure 6**).
[2]No numeric criterion. The narrative criterion in paragraph 62-302.530(47)(b), F.A.C., applies.

Nutrient Region[1]	*Total Phosphorus Criterion (mg/L)*	*Total Nitrogen Criterion (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[2]	N/A[2]	Aquatic Life

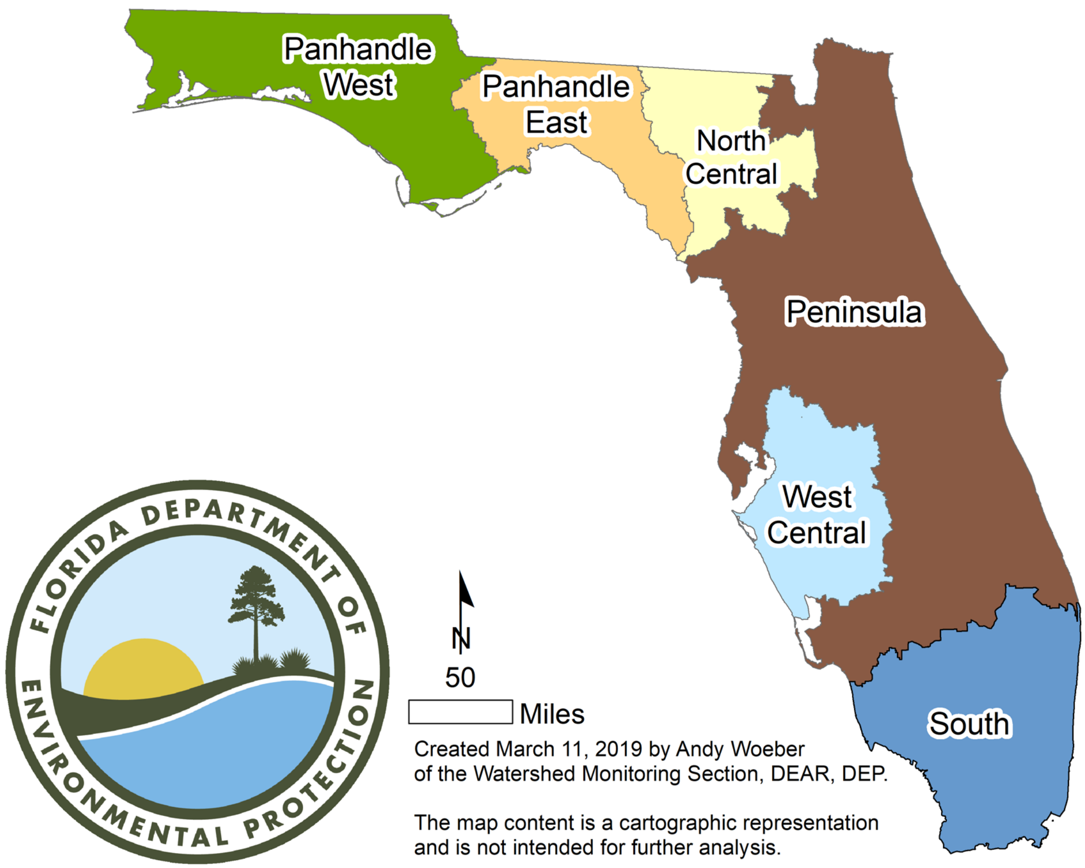

Figure 6. Nutrient Regions for River and Stream Resources

Table 7. Dissolved oxygen (DO) criteria used to assess surface water resources

This is a three-column table. Column 1 lists the Bioregion, Column 2 lists the dissolved oxygen criterion, and Column 3 lists the designated water use.

[1]The DO criteria for lakes, rivers, and streams depend on the Bioregion (**Figure 7**).

Bioregion[1]	*Dissolved Oxygen Criterion (% saturation)*	*Designated Use*
Panhandle	≥ 67	Aquatic Life
Big Bend	≥ 34	Aquatic Life
Northeast	≥ 34	Aquatic Life
Peninsula	≥ 38	Aquatic Life
Everglades	≥ 38	Aquatic Life

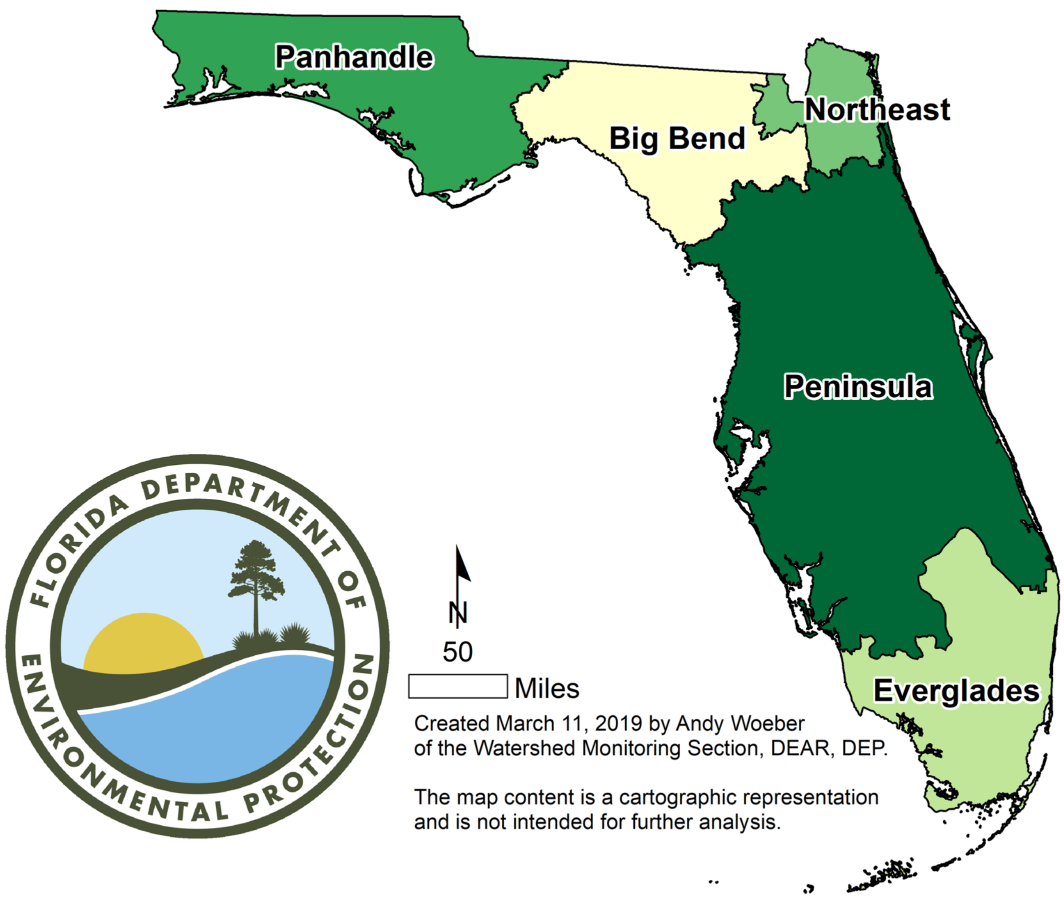

Figure 7. Bioregions for Lake, River, and Stream Resources

In addition to the suite of water chemistry indicators, Florida has developed geochemical and biological tools to assess sediment quality. These tools help quantify the natural levels of metals in sediments (geochemistry) as well as the effects of metal and organic contaminants on sediment-dwelling organisms. DEP compares sediment data results with a set of biologically based sediment quality guidelines contained in the technical report, Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters (DEP 2003). These guidelines define Threshold Effect Concentrations (TECs) and Probable Effect Concentrations (PECs). **Table 8** contains the geochemical and biological threshold levels.

Table 8. Metal thresholds used by the Status Network for sediment analysis in lakes

This is a three-column table. Column 1 lists the indicator, Column 2 lists the TEC value, and Column 3 lists the PEC value.

mg/kg DW -- milligrams per kilogram dry weight

Sediment Metal Indicator	*TEC (mg/kg DW)*	*PEC (mg/kg DW)*
Arsenic	9.8	33.0
Cadmium	1.0	5.0
Chromium	43	110
Copper	32	150
Lead	36	130
Total Mercury	0.18	1.1
Nickel	23	49
Silver	1	2.2
Zinc	120	460

Status Monitoring Network

DEP chose the Status Monitoring Network indicators (**Table 9** through **Table 13**) after discussions within the department and among participating agencies. The department can use selected surface water resource indicators to detect major threats to water quality, such as nutrient enrichment, which can lead to eutrophication and habitat loss. For groundwater, selected indicators can reflect conditions consistent with drinking water standards. Indicators such as chloride, nitrate, and bacteria serve to assess the suitability of groundwater for drinking water purposes.

Table 9. Metal indicators used by the Status Network for sediment analysis in lakes

This is a two-column table. Column 1 lists the indicator(s), and Column 2 lists the analytical method.

Note: For **Table 9**, all methods, unless otherwise stated, are based on EPA 600, Methods for Chemical Analysis of Water and Wastes.

Sediment Metal Indicator(s)	*Analysis Method*
Aluminum, Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Zinc	EPA 6010C/6010D, 6020A/6020B
Total Mercury	EPA 7473

Table 10. Field measurement indicators used by the Status Network

This is a three-column table. Column 1 lists the indicator, Column 2 lists the analytical method(s), and Column 3 lists the sampled resource(s).

Note: For **Table 10** through **Table 13** all samples are unfiltered. All methods, unless otherwise stated, are based on *EPA 600, Methods for Chemical Analysis of Water and Wastes*. The entry “All” indicates all resource types (lakes, streams, rivers, canals, and aquifers).

Field Measurement Indicator	*Analysis Method(s)*	*Sampled Resource(s)*
pH	DEP-SOP-001/01 FT 1100	All
Temperature	DEP-SOP-001/01 FT 1400	All
Specific Conductance	DEP-SOP-001/01 FT 1200	All
DO	DEP-SOP-001/01 FT 1500	All
Turbidity	DEP-SOP-001/01 FT 1600	Aquifers
Secchi Depth	DEP-SOP-001/01 FT 1700	Lakes, Streams, Rivers, Canals
Total Depth	Manual/electronic measuring device	All
Sample Depth	Manual/electronic measuring device	Lakes, Streams, Rivers, Canals
Micro-Land Use	Status and Trend Monitoring Networks Sampling Manual (04/2022), Section 4	Aquifers
Depth to Water	DEP-SOP-001/01 FS 2211	Aquifers

Table 11. Biological and microbiological indicators used by the Status Network

This is a three-column table. Column 1 lists the indicator, Column 2 lists the analytical method, and Column 3 lists the sampled resource(s).

Biological Indicator	*Analysis Method*	*Sampled Resource(s)*
Chlorophyll *a*	SM 10150 B	Lakes, Streams, Rivers, Canals
Habitat Assessment (HA)	DEP-SOP-001/01 FT 3000	Streams, Rivers
LVI	DEP-SOP-003/11 LVI 1000	Lakes
Total Coliform	SM 9223 B Quanti-Tray	Aquifers
Escherichia coli	SM 9223 B Quanti-Tray	All

Table 12. Organic, nutrient, and major ion indicators used by the Status Network

This is a three-column table. Column 1 lists the indicator, Column 2 lists the analytical method, and Column 3 lists the sampled resource(s).

Organic/Nutrient Indicator	*Analysis Method*	*Sampled Resources*
TOC	SM 5310 B-2014	All
Nitrate + Nitrite	Method 353.2 Rev. 2.0	All
Ammonia	Method 350.1 Rev. 2.0	All
TKN	Method 351.2 Rev. 2.0	Lakes, Streams, Rivers, Canals
Total Nitrogen	ASTM D8083-16	Aquifers
Phosphorus	Method 365.1 Rev. 2.0	All
Chloride, Sulfate	Method 300.0 Rev. 2.1	All
Fluoride	SM 4500 F-C-2011	All

Table 13. Additional indicators used by the Status Network

This is a three-column table. Column 1 lists the indicator(s), Column 2 lists the analytical method, and Column 3 lists the sampled resource(s).

Indicator(s)	*Analysis Method*	*Sampled Resource(s)*
Alkalinity	SM 2320 B-2011	All
Turbidity (Lab)	Method 180.1 Rev. 2.0	All
Specific Conductance (Lab)	Method 120.1	All
True Color	DEP SOP: NU-094-1	All
Total Suspended Solids (TSS)	SM 2540 D-2015	Lakes, Streams, Rivers, Canals
TDS	SM 2540 C-2015	Aquifers
Hardness	SM 2340 B-2011	All
Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Zinc	EPA 200.7 Rev. 4.4 / 200.8 Rev. 5.4	All
Desmethyl microcystin, Microcystin, Cylindrospermopsin, Nodularin, Anatoxin, Neosaxitoxin, Saxitoxin	EPA 8321 B	Lakes, Streams, Rivers, Canals

Trend Monitoring Network

DEP also chose the Trend Monitoring Network indicators (**Table 14** through **Table 18**) after discussions with participating agencies. For data comparability, the Status and Trend Monitoring Network indicator lists include many of the same indicators. To maintain the historical aspect of the data, DEP minimizes, but does not restrict, changes to the indicator lists.

Table 14. Field measurement indicators used by the Trend Network

This is a four-column table. Column 1 lists the indicator, Column 2 lists the analytical method(s), Column 3 lists the sampling regime for surface waters, and Column 4 lists the sampling regime for groundwaters.

X = Measurement collected; N/A = Not applicable
[1] Collected once a year per station.

Note: For **Table 14** through **Table 18**, all methods, unless otherwise stated, are based on EPA 600, Methods for Chemical Analysis of Water and Wastes.

Field Measurement Indicator	*Analysis Method*	*Surface Water*	*Groundwater*
pH	DEP-SOP-001/01 FT 1100	X	X
Temperature	DEP-SOP-001/01 FT 1400	X	X
Specific Conductance	DEP-SOP-001/01 FT 1200	X	X
DO	DEP-SOP-001/01 FT 1500	X	X
Turbidity	DEP-SOP-001/01 FT 1600	N/A	X
Secchi Depth	DEP-SOP-001/01 FT 1700	X	N/A
Total Depth	Manual/electronic measuring device	X	X
Sample Depth	Manual/electronic measuring device	X	N/A
Depth to Water	DEP-SOP-001/01 FS 2211	N/A	X
Micro Land Use	Status and Trend Monitoring Networks Sampling Manual (04/2022), Section 4	N/A	X[1]

Table 15. Biological and microbiological indicators used by the Trend Network

This is a four-column table. Column 1 lists the indicator, Column 2 lists the analytical method, Column 3 lists the sampling regime for surface waters, and Column 4 lists the sampling regime for groundwaters.

[1] Collected twice a year at applicable stations
[2] Collected quarterly per station
T = Total sample (unfiltered sample); X = Measurement collected; N/A = Not applicable

Biological/Microbiological Indicator	*Analysis Method*	*Surface Water*	*Groundwater*
Chlorophyll *a*	SM 10150 B	T	N/A
Biological Community (SCI)	DEP-SOP- SOP-IZ06	X[1]	N/A
HA	DEP-SOP-001/01 FT 3000	X[1]	N/A
LVS	DEP-SOP-001/01 FS 7320	X[1]	N/A
RPS	DEP-SOP-001/01 FS 7230	X[1]	N/A
Total Coliform	SM 9223 B Quanti-Tray	N/A	T[2]
Escherichia coli	SM 9223 B Quanti-Tray	T	T[2]

Table 16. Organic and nutrient indicators used by the Trend Network

This is a four-column table. Column 1 lists the indicator, Column 2 lists the analytical method, Column 3 lists the sampling regime for surface waters, and Column 4 lists the sampling regime for groundwaters.

[1] Collected quarterly per station
T = Total sample (unfiltered sample); D = Dissolved sample (filtered sample); N/A = Not applicable

Organic/Nutrient Indicator	*Analysis Method*	*Surface Water*	*Groundwater*
TOC	SM 5310 B-2014	T	T[1]
Nitrate + Nitrite	Method 353.2 Rev. 2,0	T	T[1]
Ammonia	Method 350.1 Rev. 2.0	T	T[1]
TKN	Method 351.2 Rev. 2.0	T	N/A
Total Nitrogen	ASTM D8083-16	N/A	T[1]
Phosphorus	Method 365.1 Rev. 2,0	T	T[1]
Orthophosphate	Method 365.1 Rev. 2.0	N/A	D[1]

Table 17. Major ion indicators used by the Trend Network

This is a four-column table. Column 1 lists the indicator, Column 2 lists the analytical method(s), Column 3 lists the sampling regime for surface waters, and Column 4 lists the sampling regime for groundwaters.

[1] Collected quarterly per station
T = Total sample (unfiltered sample); D = Dissolved sample (filtered sample)

Major Ion Indicator	Analysis Method(s)	Surface Water	Groundwater
Chloride, Sulfate	Method 300.0 Rev 2.1	T	T[1]
Fluoride	SM 4500 F-C-2011	T	T[1]
Calcium, Magnesium, Potassium, Sodium	Method 200.7 Rev. 4.4	T	T[1]

Table 18. Additional indicators used by the Trend Network

This is a four-column table. Column 1 lists the indicator, Column 2 lists the analytical method, Column 3 lists the sampling regime for surface waters, and Column 4 lists the sampling regime for groundwaters.

[1] Collected quarterly per station
[2] Collected once a year per station
T = total sample (unfiltered sample); N/A = not applicable

Indicator(s)	Analysis Method	Surface Water	Groundwater
Alkalinity	SM 2320 B-2011	T	T[1]
Turbidity (Lab)	Method 180.1 Rev. 2.0	T	T[1]
Specific Conductance (Lab)	Method 120.1	T	T[1]
True Color	DEP SOP NU-094-1	T	T[1]
TSS	SM 2540 D-2015	T	N/A
TDS	SM 2540 C-2015	N/A	T[1]
Hardness	SM 2340 B-2011	T	T[1]
Aluminum, Arsenic, Antimony, Barium, Beryllium, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Thallium, Zinc	Method 200.7 Rev. 4.4 / 200.8 Rev 5.4	T[2]	T[2]

Element 5: Quality Assurance

Quality Assurance Responsibilities

In a multiagency, statewide program, it is essential to have a centralized quality assurance (QA) system to ensure that water quality data and associated physical and biological data are properly and consistently collected and analyzed. The QA system, as part of the DQO process, warrants that data are useful and defensible. The DEP Watershed Monitoring Section (WMS) quality assurance officer (QAO) coordinates the QA program for the Status and Trend Monitoring Networks in cooperation with departmental staff, QA officers at sampling agencies, and the department's Laboratory. Nevertheless, QA is the responsibility of everyone associated with the Status and Trend Monitoring Networks.

The QAO coordinates and oversees data quality activities, monitors adherence to state and federal policies and procedures, and has direct authority to implement corrective actions. The QAO's responsibilities are:

- Review quality control (QC) data to determine if data are acceptable (based on the blank contamination guidance in the department's Quality Assurance Rule (Chapter 62-160, F.A.C.), as well as the document Process for Assessing Data Usability (Rule 62-160.800, F.A.C.).
- Coordinate and enter sampling schedules into the Laboratory Information Management System.
- Perform audits to ensure compliance with all QA plans and standard operating procedures (SOPs); distribute the results of internal and external audits to management and all affected individuals; and oversee, recommend, review, and verify corrective actions based on audit results.
- Prepare QA reports for management as requested.
- Coordinate and oversee preparation and review of QA manuals, including Quality Assurance Project Plans.
- Review new or proposed procedures to determine appropriate use.
- Provide Status and Trend Monitoring Network training classes.
- Provide information for the annual Quality Assurance Report to the DEP Secretary.

Procedures and Protocols

SOPs are set forth in the department's Quality Assurance Rule and specified in the department's document Standard Operating Procedures for Field Activities (DEP 2018). Following these SOPs is required to meet program-specific DQOs. Similarly, the department's Laboratory has a Quality Assurance Manual and SOPs (DEP 2024c) that address handling and analyzing samples, reporting precision, accuracy, method detection limits, and other data reporting guidelines.

The department's SOPs require each agency to establish and maintain a QA system that must adhere to the following:

- Identify, implement, and promote QA policies and procedures that will produce data of a known and verifiable quality.
- Create and/or identify and follow SOPs for all activities, both technical and administrative.
- Monitor adherence to established policies, procedures, and written SOPs.
- Establish and use procedures for continual improvement through both corrective and preventive action policies.

The Status and Trend Monitoring Networks use a program-specific Quality Manual (DEP 2025a) that adheres to all the requirements and serves as the foundation of the Status and Trend QA system. This document incorporates many elements of the program, including a sampling manual, a data management SOP manual, a project manager manual, and the GWIS Database Utilities User's Manual. The Quality Manual is revised as needed.

The department also prepares and updates, as needed, a program-specific Status and Trend Monitoring Networks Sampling Manual (DEP 2022a) addressing all Status and Trend sampling activities. During all sampling events, field staff must carry a current copy of the sampling manual for reference. Sampling manual updates are communicated to staff through emails, staff meetings, training classes, statewide meetings, and the department website (DEP 2025b). Departmental staff conduct Status and Trend sampling training classes that focus on program-specific sampling requirements. All department staff and contracted samplers must attend a training class. In addition, all samplers must attend a refresher training class once every five years thereafter.

Quality Control

The Status and Trend Monitoring Networks use QC measures to assure that data collected meet the department's SOPs. Some QC measures are required under departmental SOPs (e.g., equipment and/or field blanks), while others are program specific. DEP samplers collect equipment and/or field blanks (samples of clean, deionized water) at a minimum of 10% frequency rate. This allows staff to monitor the on-site environment, equipment decontamination, container cleaning, suitability of preservatives and analyte-free water, and sample transport and storage conditions. If analytes of interest are detected in both the blank and associated samples, the associated sample data are qualified per Chapter 62-160, F.A.C.

Extensive QA/QC procedures continue after the sample collection. To ensure consistency, the department's laboratory analyzes all Status and Trend samples. The National Environmental Laboratory Accreditation Program (NELAP) by DOH has certified the DEP Laboratory for most Status and Trend indicators.

Element 6: Data Management

The management of data and metadata generated by the Status and Trend Monitoring Networks encompasses the use of GIS, an Oracle database, and several in-house software applications. The Data Management Protocols (DEP 2024d) document details how these platforms interact and how staff can use them to review, load, and distribute data.

Data Flow and Storage

The smooth and timely flow of field- and lab-generated data into state and federal data repositories is a high priority. WMS data are stored in an Oracle database called GWIS (Generalized Water Information System), which houses current and historical data. An Internet application, GWIS Database Utilities, allows online access to the random site selections and station information in the database. All data are uploaded monthly to the DEP Watershed Information Network (WIN) (DEP 2025c) Oracle Database where it can be retrieved by the public. Annually all surface and groundwater data are exported from WIN to the EPA Water Quality Exchange (WQX) (EPA 2025). Historic groundwater data (collected prior to 2017 for Status and prior to 2013 for Trend) are stored in GWIS because those data were not accommodated by Florida STORET. Trend groundwater data collected from 2013-present has been loaded to WIN, and efforts will be made to load more historic data as time permits. Historical data that has not been loaded to Florida STORET or WIN can be requested. **Figure 8** is a schematic of the electronic data flow path.

Metadata

Metadata describe the content, context, and structure of data. The GWIS Data Dictionary (DEP 2024e) stores metadata for the GWIS database. The data dictionary identifies all tables and relationships in the database, as well as the individual elements contained in each table. Additionally, the department's GIS library contains metadata describing each GIS layer generated from GWIS information.

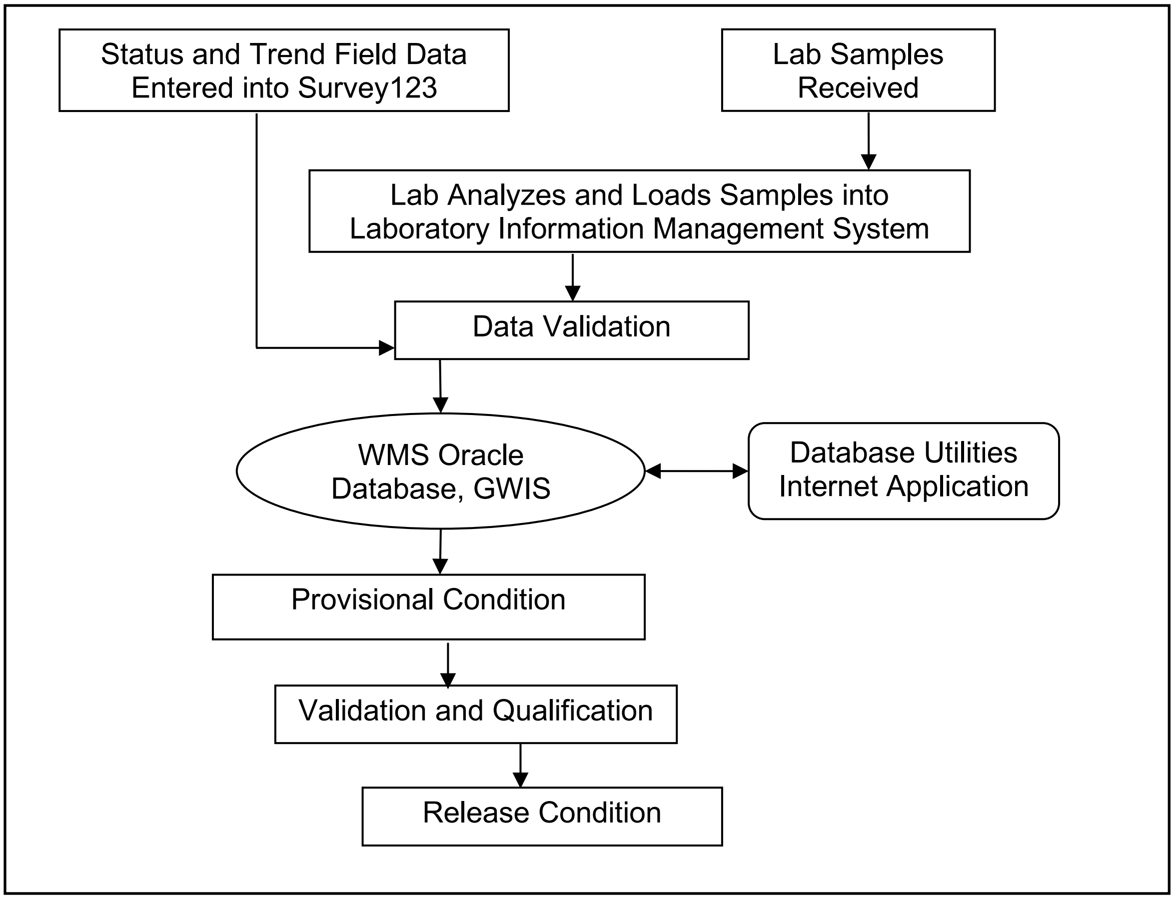

Figure 8. Generalized Flow Path of Status and Trend Monitoring Networks Data

Status Monitoring Network Data

Data management for the Status Monitoring Network begins with the generation of a GIS representation for each water resource / target population (see **Element 3, Geographic Design**). Each year, DEP generates GIS coverages of each water resource and then selects potential stations from these coverages and loads them into GWIS. Staff perform initial station reconnaissance in the office, followed by field reconnaissance. They evaluate stations in sequential order to determine if the assigned water resource is correct and if the station is sampleable. Staff store reconnaissance results in GWIS using its Database Utilities Interface.

Field data collection generates several data types. Once at a sampleable station, staff use a Global Navigation Satellite System (GNSS) unit to record latitude and longitude. Field generated data, including the location data received from the GNSS unit, are captured via an electronic form using the ArcGIS Survey123 platform while staff are on site or when staff return to the office. After data have been entered for all stations within a specific project, they are exported from Survey123 and saved as a .csv file. WMS staff batch load data for individual stations into GWIS.

Once the station and field data are in GWIS and DEP's lab has reported all associated analytical results, WMS combines each station's field and lab data and loads them into GWIS production database tables. Then samplers and project managers can review and disseminate the data via an in-house application known as Automated Data Management (ADM). To perform the data review, staff use ADM to export data from GWIS into spreadsheets and check them for accuracy and completeness. This check includes denoting missing data and outliers, identifying and documenting any random or systematic errors, and making any necessary data changes.

After completing data review, DEP considers the data as "release quality" and makes them available to the public. DEP notifies DOH, department/WMD programs, and property owners of any drinking or aquatic life water quality exceedances. The Data Management Protocols (DEP 2024d) document provides a more detailed description of the data management process.

Trend Monitoring Network Data

The flow path of Trend Monitoring Network data is similar to that of the Status Monitoring Network (**Figure 8**). Staff submit field data via Survey123. Data for each project are exported from Survey123, saved as a .csv file and loaded into GWIS. The Data Management Protocols (DEP 2024d) document outlines procedures for combining Trend Network field data with their corresponding laboratory data, and reviewing and releasing the validated data for public access.

Element 7: Data Analysis/Assessment

Statistical analyses of data provide estimates of known confidence for determining the percentage of resources currently meeting state and federal water quality requirements and for identifying long-term water quality trends. These analyses range from exploratory to higher-level examinations, and rely heavily on nonparametric statistics, which use ranking to describe variance within the data.

The design of the monitoring network determines which statistical analyses are appropriate. The probabilistic method of station selection determines the statistical analyses used for the Status Monitoring

Network, which differ from the time sequence analyses used for the fixed-station design of the Trend Monitoring Network.

Review of both the Status and Trend Monitoring Networks occurs annually to make sure water quality monitoring needs are met. This review guarantees that the monitoring networks' variables are useful for assessing the health of an ecosystem. New variables can be identified and added when necessary, and other changes can be made that would improve network operations.

Status Monitoring Network

The Status Monitoring Network enables the department to estimate the condition of the accessible proportion of the target population with a known statistical confidence. This Network's design allows for annual reporting on statewide water quality. In addition, the Network allows for biennial reporting of groundwater quality and triennial reporting of surface water quality within each of the six zones. The annual 95% confidence interval for the estimate of statewide condition is approximately ±12% for surface waters and ±9% for groundwaters. To obtain a similar confidence interval for each zone, at least two years of groundwater data and three years of surface water data are required. Data also can be post-stratified, or subdivided, according to smaller geographic units, land uses, or resource subdivisions. **Figure 9** shows the distribution of sample size vs. margin of error and proportion meeting a threshold for a binomial population.

The Status Monitoring Network's probabilistic design permits the department to answer many water resource related questions in a three-step process. First, the monitoring must be accomplished following standardized protocols for data acquisition. Second, the target population from which the sample data were collected must be characterized. This step involves statistically describing the magnitude and variability of indicator distributions. In the last step, called statistical inference, the department uses these distributions to draw inferences about the overall status of the resource (the target population) in question.

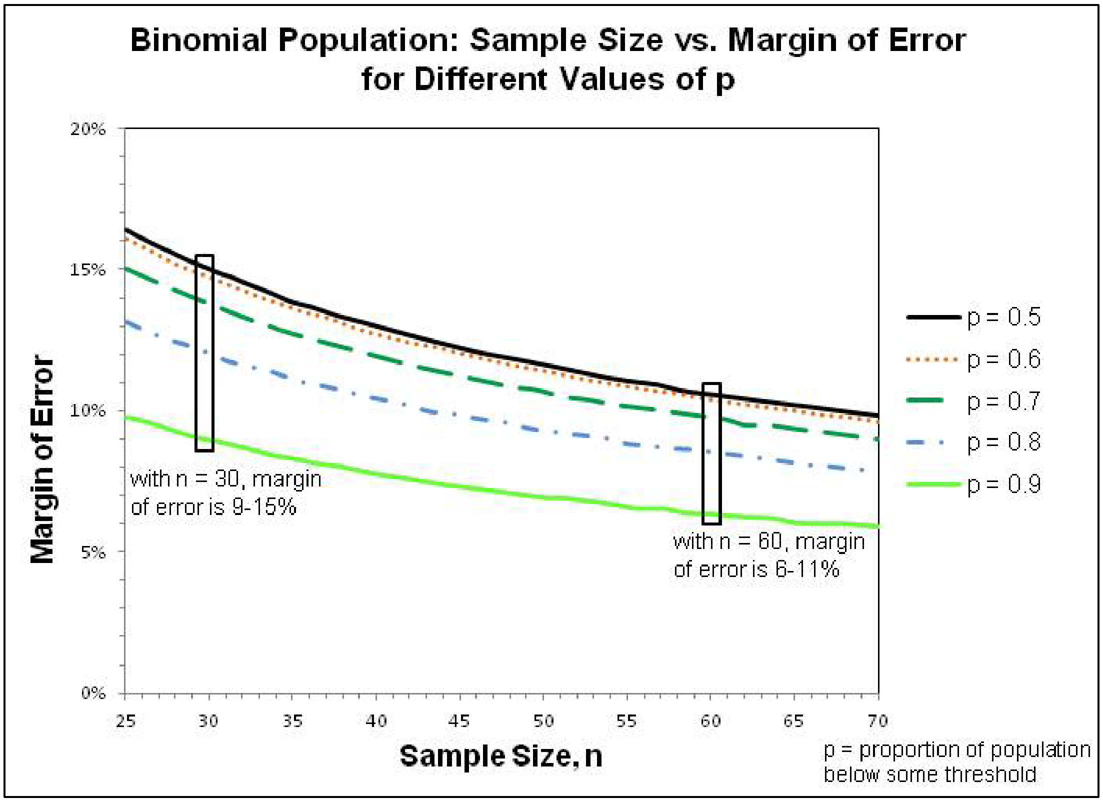

Figure 9. Binomial population used for determining the margin of error associated with sample size. As the sample size increases, the margin of error decreases; however, after approximately 30 samples, the error decreases slowly, and the cost of additional samples outweighs the benefit of a reduced error margin.

Minimum Sample Size

The minimum sample size for the Status Network is generally considered to be 30. This number is based on three considerations discussed in detail by Triola (2018).

First, consider normal and skewed distributions and their relationship to the central limit theorem. Paraphrased from Triola (2018), with regard to the mean, the central limit theorem denotes that if samples are randomly selected from a population, the distribution of the means of each sample will approach a normal distribution as the sample size increases, independent of distribution of the original data set. In addition, the mean of the sample means will be equal to the overall population mean. From a practical consideration, if the sample size is larger than 30, the distribution of the sample means approximates a normal distribution. Thus, if a comparison of means is made for an indicator, over time, or over two areas, as long as n of each sample is greater than 30, the assumption of normality is met. Regarding sample means, this allows the analyst to use both parametric as well as nonparametric statistical procedures.

Second, consider the t-test. The test was designed to compare means for small data sets (small n). One of the assumptions is that the data are normally distributed. Triola (2018) stated that as long as the distribution is close to symmetric, the use of the test is justified. Triola also mentioned that there exists a separate t-distribution for each n, and that when n = 30, the t-distribution approximates the normal distribution.

Third, the binomial distribution is often used when analyzing Status Network data. This is because the department is often concerned with the rate of sample observations exceeding a threshold value (e.g. the standard of 10 mg/L for Nitrate in the two groundwater data sets mentioned above. Recall the relationships between the binomial distribution, sample size, and the margin of error depicted in **Figure 9** and the degree of confidence used for the Status Network is 95%. Triola (2018) stated that if the confidence level is 95%, the corresponding margin of error (MOE) equals 5%. For a binomial distribution,

$$\mathrm{MOE} = \pm\,(1.96)\cdot\sqrt{P\cdot F/n} \tag{1}$$

where:

P = probability observation is less or equal to the corresponding threshold value,

F = probability observation is greater than threshold value,

n = sample size, and

1.96 = Z-score for 95% confidence level.

For a binomial distribution, if the number observations in the P and F categories are both ≥5, the distribution is approximately normal (Triola 2018). The author pointed out for a given n, the greatest MOE occurs with P = 0.50. This relationship is displayed in **Figure 9**. When n is greater than 30, the MOE decreases slowly as n increases. However, when n is less than 30, the MOE increases much more rapidly as n decreases. This can be conceptualized with the following exercise. Let P = 0.50 and let n = 25, 15, and 5. From equation (1), the corresponding MOEs are 19.6%, 25.3%, and 43.8% respectively.

For numerous reasons, obtaining a sample size of 30 is not always possible. For this reason, an absolute minimum of 23 has been set for the Status Network. Using equation (1) and a P = 0.50, this corresponds to a maximum MOE of 20.0%. However, if P were lowered to 0.10. the corresponding MOE is only 12.0%. It should also be noted that even if a minimum of 30 samples are collected, data qualifiers [Rule 62-160.700, F.A.C., Table 1 (Data Qualifier Codes)] may lower the number of observations available for statistical analysis. For the Status Network, if any of the following data qualifiers are present, the observation will not be used for data analysis.

- "O" (Analysis lost or not performed.)
- "?" (Data are rejected and should not be used. Some or all of the quality control data for the analyte were outside criteria, and the presence or absence of the analyte cannot be determined from the data.)
- "N" (Presumptive evidence of presence of material. This qualifier shall be used if: 1. The component has been tentatively identified based on mass spectral library search; or 2. There is an indication that the analyte is present, but quality control requirements for confirmation were not met (i.e., presence of analyte was not confirmed by alternative procedures).
- "T" (Value reported is less than the laboratory method detection limit. The value is reported for informational purposes only and shall not be used in statistical analysis.)

Target Population Characterization

Characterizing the overall distribution of an indicator starts with a question, such as, "What is the distribution of pH in Florida's small lakes?" DEP uses several population descriptors to characterize the data. These include:

— **Median**—The 50th percentile of the cumulative distribution function (CDF). Half of the values of the indicator falls below this value.

— **Percentiles**—10th, 25th, 75th, 90th, and other percentiles describe what proportion of the resource has an indicator value less than the percentile.

— **Range**—The total range of values for an indicator is a measure of its variability.

Environmental data commonly exhibits a gamma distribution which can be highly skewed and may contain extreme values or outliers. Some descriptors (e.g., range) are sensitive to these extreme values or outliers and are therefore inadequate to describe the distribution. As a result, DEP uses descriptors which are not sensitive to extreme values, such as the median and percentiles, for water quality analysis.

In probability theory and statistics, the cumulative distribution function (CDF) is a mathematical expression that describes the probability that a system will take on a specific value or set of values. It is a fundamental tool for characterizing indicator distributions in target populations. The example in **Figure 10** shows the overall variability for the indicator pH, which is shown on the horizontal axis. The percentage of samples (and by inference the overall population) less than or equal to each indicator value is given on the vertical axis. The 95% upper and lower confidence bounds (UCB and LCB, respectively, plotted as dashed lines) provide an estimated range of the percentage of the target population that has a given indicator value. Continuing with this example, the pH of about 60% of the measured small lakes is ≤ 6, and there is 95% confidence that between ~50 and 70% of all small lakes in Florida will have pH ≤ 6.

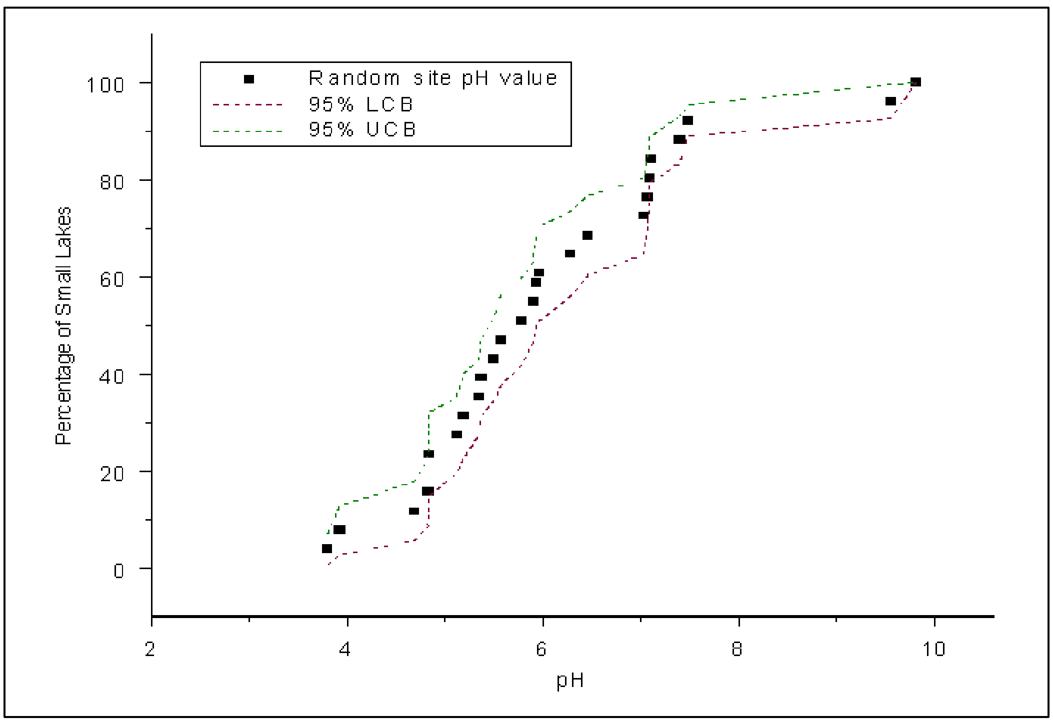

Figure 10. Example of a CDF

The results of the analyses may be categorized as either meeting, or not meeting, a threshold for each indicator. This categorization allows for the creation of an overall summary to communicate the quality of the reporting unit's resources. Statistical analyses selected for the Status Monitoring Network use a 5% significance level (α-level). Additionally, the data may be used to determine if statistically significant change from one time period to another has occurred for each indicator. The Data Analysis Protocols for Status Assessments (DEP 2024f) provides more detail on the information goals and statistical analyses conducted on Status Network data.

Figure 11 is another example of statistical inference, using DO data collected from small lakes in 2000–2003. The DO threshold set by the state during that period was 5 mg/L. Values below this threshold do not meet the criteria. The CDF indicates that 27% of all small lakes sampled were below the threshold. The remaining 73% of small lakes met or exceeded the threshold value. It can be inferred that 73% of the target population (small lakes) meets the state threshold for DO.

Uncertainty Levels and Missing Values

The level of uncertainty (margin of error) for annual status assessments is approximately ±12% for surface waters and ±9% for groundwaters at a 95% confidence level for a binomial distribution. Sample size (60 for canals; 90 for all other surface water resources; and 120 for groundwater resources) and the proportion of the population meeting an indicator's threshold affect uncertainty levels. Larger sample sizes and higher proportions of the population meeting, or not meeting, the threshold diminish uncertainty levels. After several years, samples can be aggregated, reducing the uncertainty level.

A census of the resource occurs when every part or station in the target population is sampled. Ideally, conducting a population census is preferred because it eliminates any margin of error, but a census is not possible for many resources due to fiscal and logistical constraints.

On occasion, fewer than the maximum number of samples (60, 90, or 120) may be collected. When this occurs, the reasons for the missing samples must be documented.

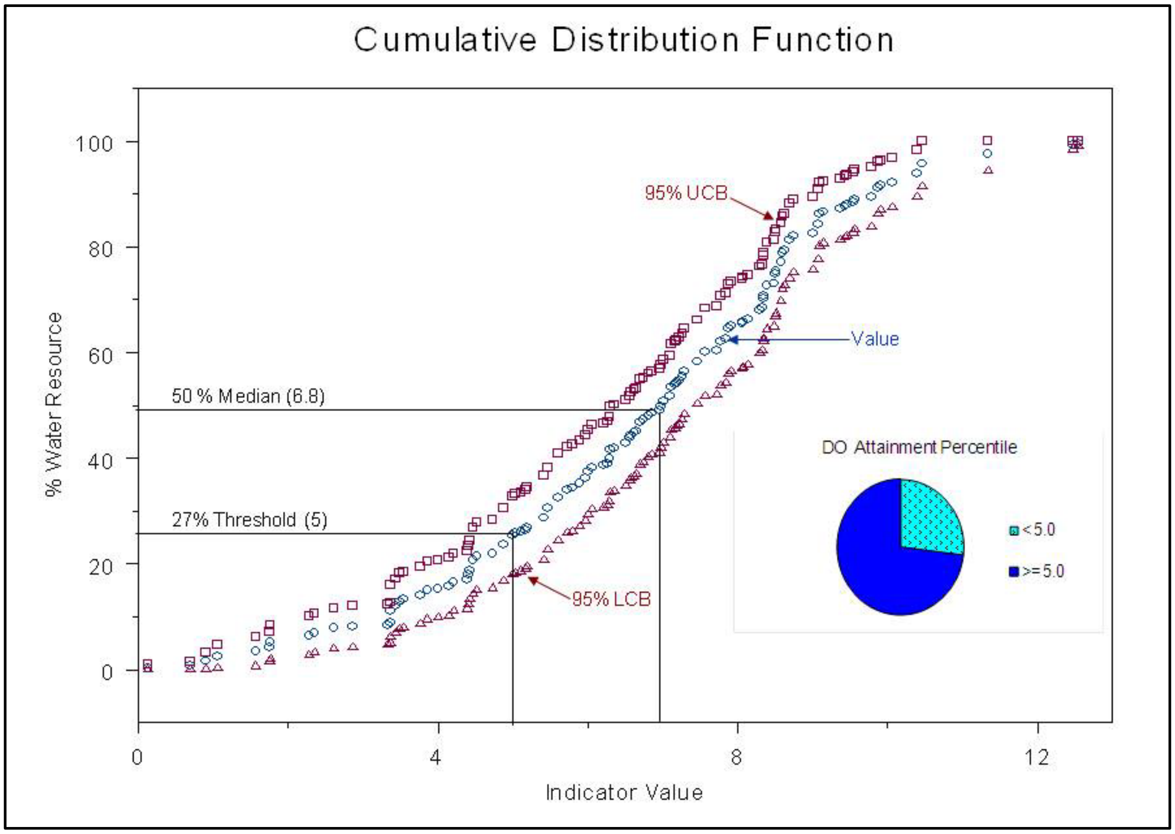

Figure 11. CDF of 2000-03 DO data collected from small lakes.
The pie chart is another representation of water quality, indicating percent meeting threshold in solid blue, and percent not meeting threshold in cross-hatched light blue.

Water Quality Trend Detection

Monotonic and Step Trends

Helsel and Hirsch (2002) categorize trend tests into those using data collected throughout a single period (monotonic trends) and those comparing data collected in two or more nonoverlapping periods (step trends). DEP uses Trend Network (monotonic) data for trend determination at individual stations and for region wide trends of flowing surface waters and groundwaters. Additionally, Status Network data collected in the early and late periods (steps) are evaluated for determination of region wide trends for flowing surface waters, lakes, and groundwaters.

The following methods are used to identify water-quality changes over time (trend detection):

1. Seasonal Kendall (SK) test for individual station water-quality indicator trend detection. This analysis is run every four years for all trend network stations having sufficient data.

2. Change Analysis (CHAN) for region wide water-quality indicator trend detection. This analysis is run on time-period subsets of status network data, *e.g.* 2009-11 vs 2020-22 unconfined aquifer sample survey results. This analysis is also run every four years.

The SK method is used for monotonic trend analyses, while CHAN is used for step trend analyses. For both trend analyses, statistical significance is defined as the probability of accepting the null hypothesis of no change (probability value [p-value] is < 5 %). The Status and Trend Monitoring Networks Trend Analysis Protocols (DEP 2024g) provides more detail on the information goals and statistical analyses conducted.

Seasonal Kendall Analyses

The statistical analyses used to evaluate data from the Trend Monitoring Network require a long period of record to be meaningful. WMS uses these sampling frequencies to determine trends: 1) monthly field data collection and laboratory analyses for rivers, streams, and canals; 2) monthly field data collection for unconfined aquifers; and 3) quarterly (once every three months) laboratory analyses for confined and unconfined aquifers, and field data collection for confined aquifers.

Gilbert (1987) stated that variations added by regularly spaced cycles make it more difficult to detect trends if they exist. Regarding environmental data, Gilbert mentioned that major cycles are often referred to as seasonality. To address this issue, Hirsch and Slack (1984) developed the SK test. It removes the effect of the seasonal cycles. DEP uses the SK test to look for trends for each indicator at each surface water and groundwater Trend Network site. R software (R Core Team 2025) and the kendallSeasonalTrendTest function in the EnvStats R package (Millard 2013) are used to perform these analyses.

As with seasonal cyclicity, in flowing surface waters highly variable flow rates make it more difficult to detect trends. Where available, data on flow rates from associated USGS, SFWMD or St. Johns River WMD (SJRWMD) gaging stations are collected at the same time as surface water samples. DEP adjusts surface water quality data for flow before conducting the SK trend analyses. In contrast, groundwater flow rates generally are much slower, and DEP makes no flow adjustments prior to performing the SK analyses for groundwater.

If a trend exists for either flow-adjusted or nonflow-adjusted data, DEP determines the corresponding slope by using the Sen Slope (SS) estimator which measures the median difference between all observations over the time series (Gilbert 1987). The SS provides an estimate of the magnitude of change for a water quality indicator over the period of record. Reporting a trend as increasing or decreasing indicates the direction of the slope and does not necessarily indicate impairment or improvement of the analyte being measured.

Change Analysis

In addition to providing analyses for a specific contiguous period, Status Network monitoring data may be used to compare summarized data from one period with those from another period. This methodology utilizes CHAN, as described in Kincaid and Olsen (2019). The Change Analysis function in R software's (R Core Team 2022) package spsurvey (Dumelle M, T. Kincaid, A.R. Olsen, M. Weber 2023) is used for these analyses. Individual R scripts are written for each water resource analyzed.

CHAN utilizes status network data to accommodate the effects of spatial correlation. The CHAN test calculates the difference in spatially weighted medians, and means, for each indicator between the early (E) and late (L) periods and a 95% confidence interval (CI) for the difference. These values are referred to as difference estimates. If the CI for the estimate of the difference between the 2 periods (L minus E) does not include 0, there is statistical evidence that the values differ. Note that CHAN does not calculate p-values. However, if 0 does not lie within the 95 % CI for the difference estimate, the p-value is known to be < 0.05.

Element 8: Reporting

DEP uses Status and Trend Monitoring Network data to report on the condition of Florida's freshwater resources to EPA, the Florida Legislature and the public. Examples of documents and reporting tools include Statewide Reports (DEP 2025d) and relevant chapters of the biennial integrated 305(b) and 303(d) report (DEP 2024a). DEP prepares interpretative reports as requested.

Status Monitoring Network

The Status Monitoring Network's stratified random design allows for statewide reporting on Florida's surface and groundwater resource quality. Samples must be analyzed, and the resultant data checked, verified, and released before a report may be written. Annually, DEP prepares a report on the condition of the state's waters utilizing data from a three-year period. These reports use the categories of "meeting" or "not meeting" indicator thresholds set by the state. Charts graphically depict the percentages of indicators meeting and not meeting thresholds (**Figure 11**). When human health-based thresholds are not met, DEP informs both DOH and affected property owners.

Trend Monitoring Network

Trend Monitoring Network reports describe the overall temporal variability of specific waterbody segments. DEP uses at least four years of data for adequate trend analysis, and reports trends as increasing, decreasing, or not present. These results are detailed in various reports, including the biennial report submitted to EPA and Florida Geological Survey Bulletin No. 69 (Revised) (DEP 2011).

Element 9: Programmatic Evaluation

Programmatic evaluations measure the effectiveness and success of programs and identify areas in need of potential improvement. DEP conducts a systematic review annually. To ensure year-to-year data compatibility and relevance to agency programs, DEP consults with the department's divisions, programs, and sections to determine whether the monitoring networks meet their needs. The evaluation of the Status and Trend Monitoring Networks incorporates direction provided by EPA, the Florida Legislature, and other state and local agencies. The expected outcome is improved program effectiveness. For example, in 2008, the Legislature's need for an annual statewide water quality assessment resulted in the evaluation of departmental monitoring programs and subsequent redesign of the Status Monitoring Network.

The department also reviews the Status and Trend Program's monitoring design annually. This review provides guidance for modifying the design to support management's monitoring needs. Periodically, DEP changes the indicator list to reflect water quality criteria development needs. These modifications also allow metrics such as isotope ratios, the LVI, SCI, LVS, and RPS to be field-tested prior to validation and subsequent rule adoption.

Program implementation, reviewed most often at the section level, is orchestrated tightly among project managers, laboratory staff, the data coordinator, the data manager, the analysis and reporting coordinator, and data analysts. WMS project managers work closely with the QAO, who conducts field sampling audits and responds to procedural issues. The audits ensure compliance with EPA, department, and internal requirements. Incorporating sampler feedback leads to changes in protocols and is a valuable tool in the design of the program.

WMS staff continually search for ways to enhance efficiency and reduce costs. Sample locations are evaluated routinely and coordinated with the WMDs to ensure there is no duplication of monitoring for similar purposes. For example, in 2013, managers discovered that two Trend stations in south Florida could be monitored by SFWMD as a part of the WMD's routine activities. SFWMD staff now collect data for both the WMS Trend Network and for SFWMD projects during the same sampling event.

By incorporating guidance, program review, data needs, and staff feedback, WMS can evaluate and respond to changing resource conditions. This flexibility supports the effectiveness and success of federal, state, and departmental water quality monitoring objectives.

Element 10: General Support and Infrastructure

The success of a long-term monitoring program relies on continuous support and an established infrastructure. The department has managed water quality monitoring networks for over 20 years and has considerable in-house expertise. Long-term professional relationships exist within the department and among other agencies.

The foundation of the monitoring program is the field sampling staff. Safety, QA, and training require the presence of two or more sampling staff at all sampling events. Newly hired samplers are paired with experienced staff to ensure compliance with SOPs. New samplers must participate in a WMS Sampling Training course, and all samplers are required to attend this course every five years as a refresher.

In addition, Bioassessment Program staff train sampling staff in conducting biological assessments, such as the HA, SCI, LVS, RPS, and LVI. An apprenticeship program for less experienced samplers is in place to provide long-term training in HA and SCI. Before samplers are allowed to collect HA and SCI data on their own, they must pass testing administered by the WQSP (DEP 2024h).

Project managers have responsibility for assigned reporting units within the state and are trained and given guidance by experienced staff. The *Project Managers' Manual* is available as part of the Quality Manual (DEP 2025a) which provides written guidance on policies, procedures, and practices. The QAO and data coordinator are involved in apprising project managers and samplers of new procedures and data management protocols.

All staff receive ongoing, standardized training through classes, manuals, meetings, conferences, and day-to-day interactions. For example, DEP participates in annual meetings, which serve as forums for training, problem solving, networking, and discussing sampling results and their interpretation. In addition, staff participate in annual program evaluations, plan for new monitoring cycles, and maintain collaborative relationships with other entities.

Currently, the department receives state and EPA grant funding to retain talented staff, fund sampling contracts, and provide and maintain sampling field equipment. Field equipment includes field computers (tablets and phones), water quality sondes, GNSS units, vehicles, and groundwater pumps, all of which are required to run a high-quality monitoring program. The QAO, project managers, laboratory staff, and samplers are responsible for guaranteeing that supplies needed for sampling, calibration, and QA are provided or kept in stock.

The department provides data management resources at different levels. The data coordinator works in concert with the data manager and project managers to prepare, combine, correct, and store data. Data is uploaded to an Oracle database supported and managed by the department. Data is also uploaded into DEP's Watershed Information Network (WIN) oracle database, managed by the Office of Watershed Services, and EPA's WQX. Written references for data management procedures can be found in the WMS Data Management Protocols (DEP 2024d) document and the GWIS Database Utilities User's Manual (DEP 2024i).

WMS has two data analysts who select stations for the Status Network and analyze data from the Status and Trend Networks. The analysts, in conjunction with a GIS analyst external to WMS, the data analysis and reporting coordinator, data coordinator, and administrator, develop reports, write peer-reviewed scientific papers, present at conferences and meetings, and make recommendations for future program design. Staff participate in preparing reports, documents, brochures, webpage content, and presentations.

The department audits samplers one to two times a year, develops and maintains the Status and Trend Monitoring Networks Sampling Manual (DEP 2022a) and WMS Quality Manual (DEP 2025a), maintains records of QA/QC blank results for WMS, troubleshoots issues, and often assists with program evaluation and planning. Audits require that samplers respond to the QAO and project managers' concerns to ensure that state SOPs are followed.

WMS works closely with the DEP Laboratory, which is accredited by NELAP, for most indicators sampled. Laboratory staff include highly trained chemists and biologists.

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Appendices

Appendix A: Surface Water List Frame Development Methodology

Lakes

The lakes features are based on the 1:24000 (1:24K) NHD waterbody feature class (**Figure 12**). As lake geometries are updated in the 1:24K NHD, WMS transfers the updated geometries to the list frame to improve representation and capture of lake boundaries in the coverage. WMS categorizes lakes in the database as:

- Small Lake – feature area ≥ 4.0 hectares, and < 10.0 hectares.
- Large Lake – feature area ≥ 10.0 hectares.

To reduce the dataset to features that are most likely permanent, WMS does not include lakes less than 4.0 hectares (40,000 m^2) in area in the lakes' coverage.

Flowing Waters

The flowing waters features consist of rivers, streams, and canals obtained from the 1:24K NHD flowline feature class (high resolution) which WMS uses as a basis for the flowing waters layer (**Figure 13**). To reduce the dataset and enhance the targeted resources for the coverage, WMS matches the 1:24K features to the 1:100,000 (1:100K) NHD flowline feature class to include permanent, non-ephemeral, and non-intermittent segments within the WMS surface water list frame geodatabase. WMS also may use other hydrography datasets obtained from DEP and/or WMDs to enhance this coverage. Geographically, zones 1 and 2 have very few canal segments and the original NHD attributes are preserved and updated via reconnaissance. The remaining zones are matched to available primary canal coverages provided by the individual WMD and departmental staff. WMS adds features that match these coverages to the geodatabase.

Surface Water List Frame Development Process

For both flowing waters and lakes resources, WMS staff conduct a manual review of the statewide coverage annually and may incorporate new features. Most features will remain in the list frame for the next year's site selections, but some are excluded permanently as described below.

Examples of features remaining in list frame for next year's selection:

- Sampled during current sampling cycle.
- Dry or water level too low for sampling, but not appearing permanently dry.
- Flood conditions.

- Inaccessibility (requiring more than three hours to get equipment to location or to access the random sample location).
- Dangerous sampling conditions.
- Private property refusal.

Examples of features permanently removed from list frame:

- Ditch.
- Artificial waterbodies including roadside borrow pits, mining operations, and stormwater retention areas.
- Wetland areas.
- Restoration areas.
- Saline or estuarine condition (via field observation or ancillary GIS data).
- Large landowner refusal.
- DEP-permitted facility.
- Other WMS staff recommended exclusion.

These latter features are not part of the target population, as described in **Element 3.**

Field staff perform office and field reconnaissance of selected sampling stations and enter exclusion criteria and comments into the GWIS database via the Database Utilities application. The WMS Status Network Reconnaissance Manual has specific guidelines for performing office and field reconnaissance.

Exclusions are reviewed during the designated reconnaissance and sampling periods, and after sampling concludes at all stations for a resource. The excluded random station selections are extracted from the GWIS database, transferred into a GIS geodatabase, and visually inspected to identify the features they reside in and the reasons for exclusion. The review process is iterative due to the dynamics of the sampling and reporting of exclusions. During this process, sites that have incomplete exclusion criteria or lack sufficient evidence for exclusion are reviewed by project managers. Permanently excluded sites are removed from the list frame prior to extracting the datasets to generate shapefiles for the next year's selection cycle.

Surface Water Feature Extraction Process

The finalized list frame datasets for flowing waters and lakes are extracted and compared to datasets from the previous cycles to note changes or possible inconsistencies. Once completed, shapefiles are generated and submitted to the data analyst to run the sample survey process to produce individual station selections for each of the resource types.

The submitted flowing waters are linear segments. The large lakes remain polygons, as sampling points within these lakes are determined by a weighted area station selection process. Small lake polygons are converted into centroids (point features) using the "Feature to Point" tool in ArcGIS with an option selected to make sure the point resides within the polygon. When a lake exists in both Florida and a bordering state, the lake is split at the state boundary and only includes the Florida portion that meets the four-hectare minimum area.

Once site selections are completed, decimal degrees latitude and longitude data are attributed to the generated stations. The data coordinator then loads station data into an Oracle database which auto-populates the following information:

- Water Management District.
- Departmental District.
- HUC Number.
- HUC Name.
- TMDL Basin Name.
- TMDL Planning Unit.
- Waterbody Identification (WBID).
- FIPS County Name.
- FIPS County Number.

Samplers and project managers perform office and field reconnaissance on the selected stations and enter station verification information into the GWIS database and the cycle repeats for the following year's selections.

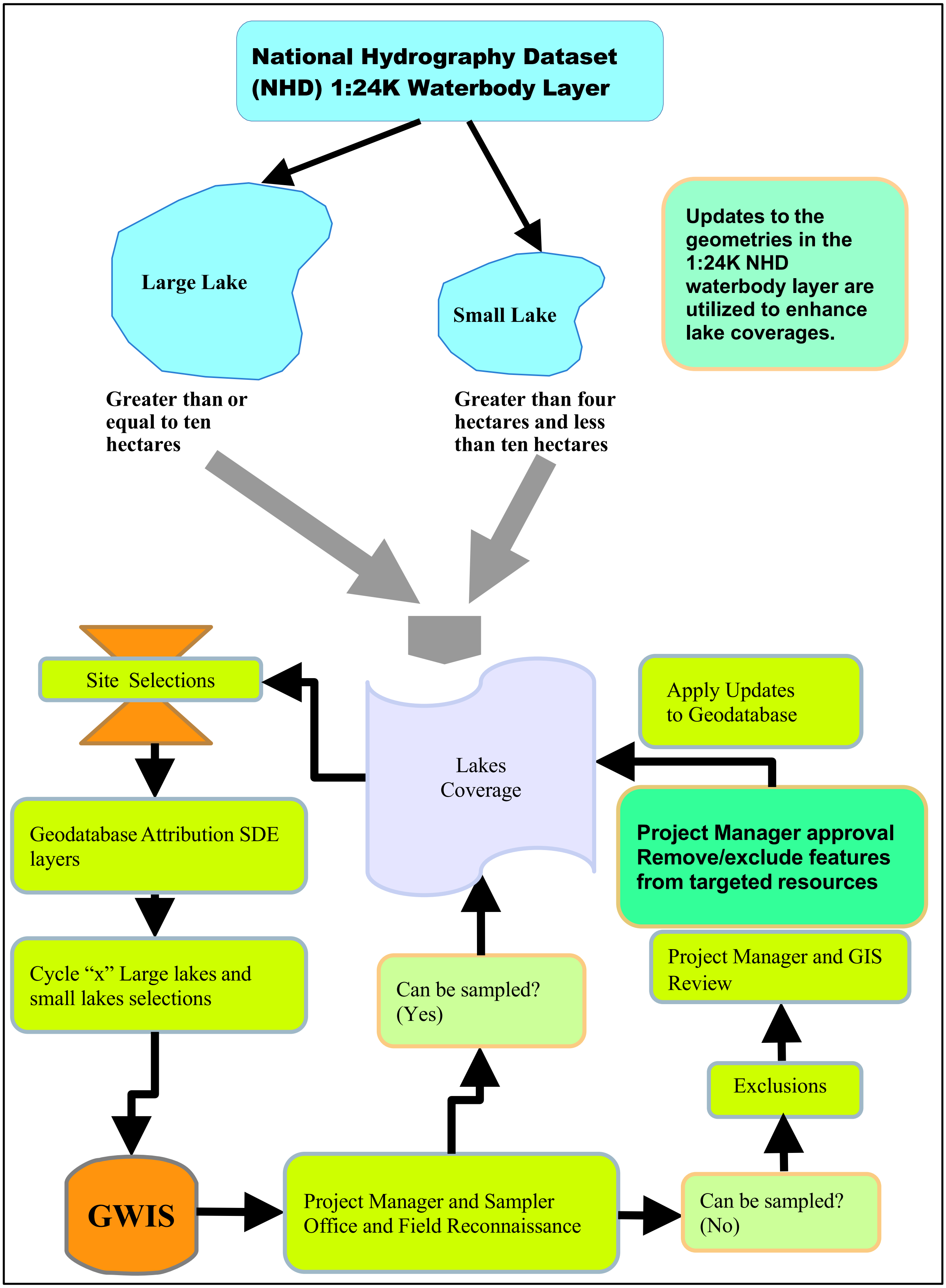

Figure 12. Status Monitoring Network flow chart for lakes coverage development

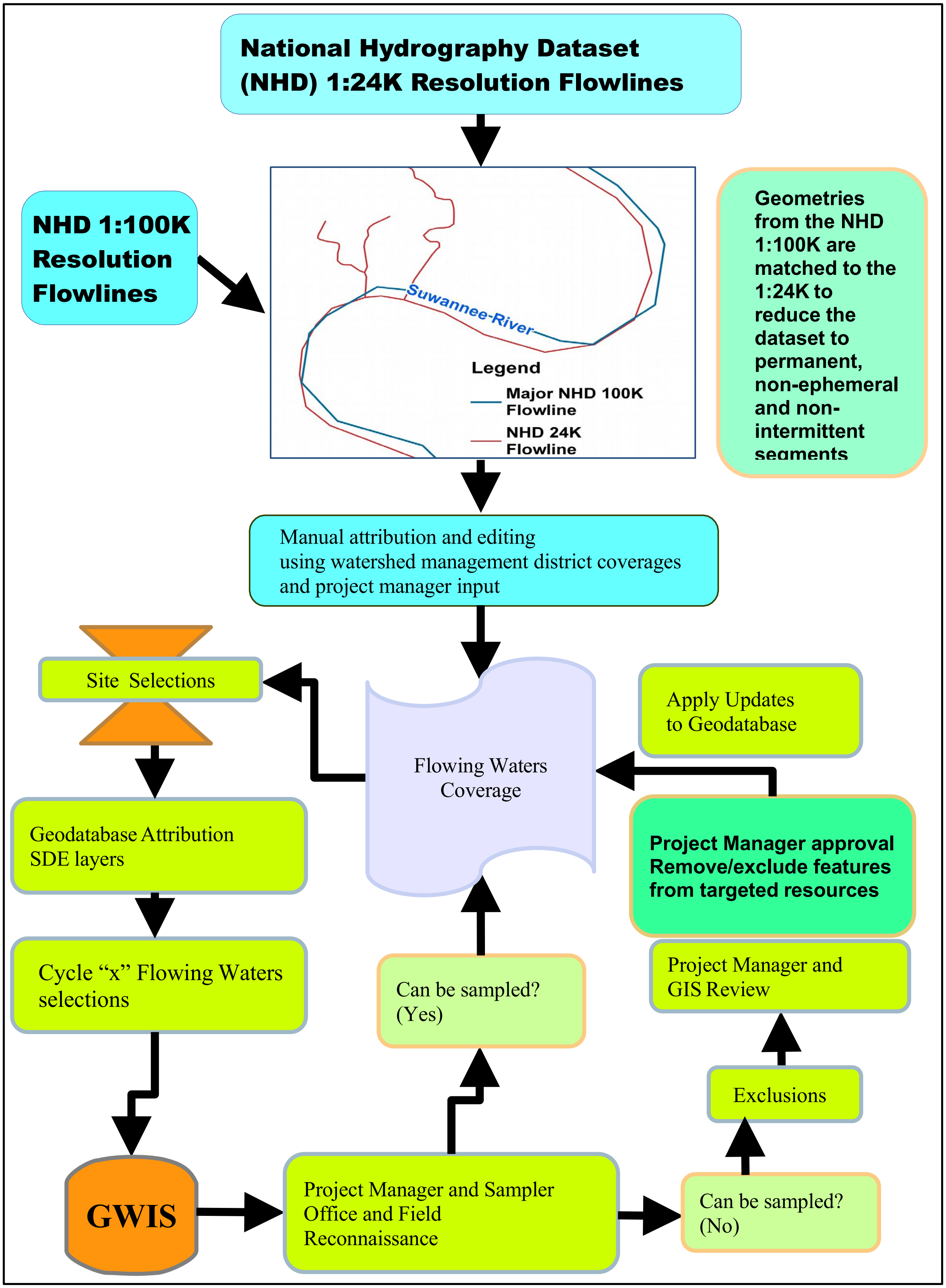

Figure 13. Status Monitoring Network flow chart for flowing waters coverage development

Appendix B: Groundwater List Frame Development Methodology

Aquifers

The list frame for the unconfined aquifers and confined aquifers resources consists of individual wells from an annually updated list. Sources of well information include:

- Recommendations submitted by each WMD.
- DEP's historic Groundwater Quality Monitoring Background Network.
- DEP's historic Very Intense Study Area (VISA) Network.
- A Florida Department of Health (DOH) private well survey cosponsored by the department.
- WMD and county saltwater intrusion networks.
- Upgradient monitoring wells associated with department-permitted facilities.
- USGS monitoring wells.
- Public and private water supply wells.

The WELL_LISTFRAME table of the GWIS Oracle database is used to manage information about wells in the Status Network list frame. Each year, a record for each well in the list frame is added to the WELL_LISTFRAME table. The LISTFRAME_YEAR field in the WELL_LISTFRAME table indicates the year of the list frame that an individual record belongs to. If a well remains in the list frame for many years, it will have multiple records in the WELL_LISTFRAME table, one for each year that the well appears in the list frame.

Groundwater List Frame Development Process

WMS staff conduct a manual review of the statewide well list frame annually and may incorporate new wells. Most wells will remain in the list frame for the next year's site selections, but some are excluded permanently as described below.

Examples of features remaining in list frame for next year's selection:

- Sampled during current sampling cycle.
- Inaccessibility (unable to get equipment to well location or unable to get equipment into well).
- Dangerous sampling conditions.
- Private property refusal.

Examples of features permanently removed from list frame:

- Required physical and/or geological information not available for well.
- Well nonfunctional as sampling device (well destroyed).
- Sample withdrawal location after filter or softener.
- Cannot locate well.
- Well not upgradient well at DEP-permitted facility.
- Well taps wrong resource
- Other WMS staff recommended exclusion.

Field staff perform office and field reconnaissance of selected sampling stations and enter exclusion criteria and comments into the GWIS database via the Database Utilities application. The [WMS Status Network Reconnaissance Manual] has specific guidelines for performing office and field reconnaissance.

Exclusions are reviewed during the designated reconnaissance and sampling periods, and after sampling concludes at all stations for a resource. The review process is iterative due to the dynamics of the sampling and reporting of exclusions. During this process, sites that have incomplete exclusion criteria or lack sufficient evidence for exclusion are reviewed by project managers. Permanently excluded sites are removed from the list frame prior to loading the well information for the next year's list frame into the GWIS WELL_LISTFRAME table.

Groundwater Feature Extraction Process

R software (R Core Team 2025) is used to retrieve the following data fields for all wells in a single list frame year, from the GWIS WELL_LISTFRAME table.

- FL_ID
- PK_STATION
- STATION_NAME
- WATER_RESOURCE
- LATITUDE
- LONGITUDE
- CMCD_COORDINATE_METHOD_ID
- DCD_DATUM_ID
- LAT_DD
- LAT_MM
- LAT_SS

- LONG_DD
- LONG_MM
- LONG_SS
- DATA_SOURCE

An R script is used to assign the corresponding Status Network Zone to each well, add Albers X and Y coordinates, and export the data as a GIS coverage (point shapefile) for use in the site selection process. The data analyst uses the shapefile to run the sample survey process to produce individual station selections for each of the two aquifer resources.

Once site selections are completed, the data coordinator pairs the site selection information with the corresponding record for each well in the WELL_LISTFRAME table. The combined sites selection and well information data is then loaded into the T_WELL_LISTFRAME table of the GWIS Oracle database. Samplers and project managers perform office and field reconnaissance on the selected stations and enter station verification information into the GWIS database and the cycle repeats for the following year's selections.