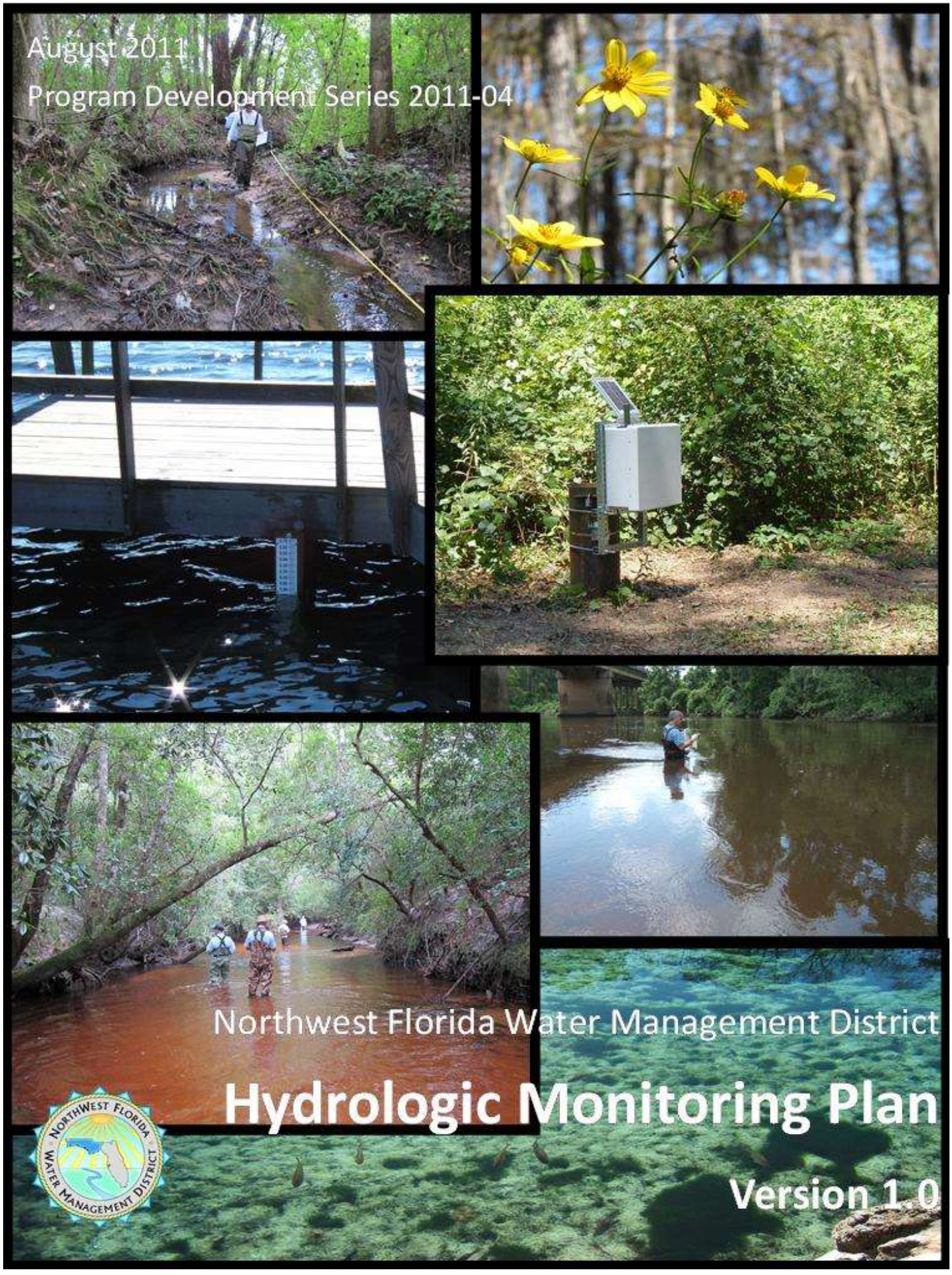
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Program Development Series 2011-04
Northwest Florida Water Management District
Hydrologic Monitoring Plan
Version 1.0

Hydrologic Monitoring Plan: Version 1.0

By Kristopher Barrios, Ronald L. Bartel, Nick Wooten, and Michelle Lopez

NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Program Development Series 2011-04

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I: INTRODUCTION

The Northwest Florida Water Management District (NWFWMD or District) is responsible for managing, protecting and regulating water resources within a sixteen county area that stretches from the St. Marks River Basin in Jefferson County to the Perdido River in Escambia County. The mission of the District is to protect and manage the water resources of northwest Florida in a sustainable manner for the continued welfare of its residents and natural systems. The NWFWMD areas of responsibility (AOR) include water supply, flood protection and floodplain management, water quality, and natural systems. The AORs and statutory requirements are defined in the Strategic Water Management Plan (SWMP) which can be found at http://www.nwfwmd.state.fl.us/pubs/swmp/SWMP2010-2011.pdf.

Hydrologic monitoring activities are essential functions of water management districts. The NWFWMD utilizes information and data collected through its monitoring programs to assess the status of district-wide water resources and identifying threats or vulnerabilities related to the resource. The District also performs detailed analyses of hydrologic conditions related to water resources planning or other detailed hydrologic analyses required as part of its mission. Monitoring programs are currently implemented in an integrated manner so that one monitoring activity may serve multiple programs or AOR, with the broad goal of using limited resources as effectively and efficiently as possible. The HMP is intended to provide guidance and direction to supervisory staff involved with monitoring so that the District will continue to perform monitoring activities in an organized, coordinated, and systematic way. The importance of the development of this Hydrologic Monitoring Plan (HMP or Plan) and its relationship with ongoing monitoring and data collection activities with District programs and water resources are summarized in **Table 1**.

Table 1. Overview of Hydrologic Monitoring Activities Performed by NWFWMD

Programs Supported by Hydrologic Monitoring	*Water Resources Monitored or Related Activities*
Water Resource Development/ Regional Water Supply	Shoal River Water Resource Development
	Sand and Gravel Aquifer Resource Development
	Bay County Inland Well Field Development
	Water Quality Temporal Variability Monitoring
	Deer Point Lake Watershed Monitoring Program
	Water Supply Assessment
Reservations/Cumulative Impacts Analysis/ Fresh Water Needs Assessment	Apalachicola River and Bay
	Wakulla Spring/ St. Marks River Monitoring
	Inland Sand and Gravel Aquifer Santa Rosa County
	Yellow River
	Coastal Floridan Aquifer
	Morrison Springs
	Deer Point Lake and Watershed
	Jackson Blue Spring Basin Monitoring
Surface Water Improvement and Management Act	Integrated Water Resource Monitoring Network
	Water Quality Temporal Variability Monitoring Network
	Quarterly Springs Sampling

Table 1. Overview of Hydrologic Monitoring Activities Performed by NWFWMD (cont'd)	
Programs Supported by Hydrologic Monitoring	*Water Resources Monitored or Related Activities*
Surface Water Improvement and Management Act (cont'd)	Tate's Hell Restoration Monitoring
	Telogia Creek Streamflow
	Bayou Chico Restoration Monitoring
Technical Assistance to Local Governments	Leon County/City of Tallahassee Stormwater Monitoring Network
	Bay County Stormwater Monitoring Network
	Water Quality Status Monitoring Network
Flood Warning and Hazard Mapping	FEMA Risk MAP and Map Modernization
Hydrologic Conditions and Drought Warning / Water Storage Sources	Floridan Aquifer Ground Water Level Mapping Monitoring Network
	Saltwater Intrusion Monitoring
	Spring Flow and Level Evaluations
	Lake Levels Network
	NWFWMD Rainfall Network
Lands Management	Econfina Tracts Coliform Sampling
Consumptive Use Permitting	Fairport Regional Utility System
	Region II Floridan Aquifer
	Telogia Creek Streamflow
	Inland Bay County Wellfield
	Ten Mile Creek
	Gulf American Shrimp Surficial Aquifer Project
Umbrella, Watershed-Based Regional Mitigation Plan	Tate's Hell Restoration Monitoring
	Sand Hill Lakes Mitigation Bank
	Pine Log Creek Restoration Site
Special Projects	Leon County/City of Tallahassee Stormwater Monitoring Network
	Bay County Stormwater Monitoring Network
	Water Quality Status Monitoring Network
	Integrated Water Resource Monitoring Network
	Water Quality Temporal Variability Monitoring
	Quarterly Springs Sampling
	Deer Point Lake Watershed Monitoring Program

1. Purpose and Plan Objectives

The overall purpose of the Hydrologic Monitoring Plan (HMP) is to provide a comprehensive strategy for current and future hydrologic data collection activities for the assessment and characterization of the District's water resources. The Plan document provides the history of monitoring activities within the District and provides the tactics to be employed at an operational and functional level to meet the many program requirements of the District. It is also designed as a dynamic annual decision making document to meet the monitoring requirements of the

SWMP and other District plan strategies and objectives. Furthermore, it is designed to establish monitoring priorities, show where a single monitoring activity may serve more than one purpose, focus on efficiencies that may be gained with new technology and equipment, identify funding sources, and determine staffing resources and equipment requirements.

Another aspect of this plan's development is to identify other agencies that may be performing similar monitoring activities. This allows the District to stretch its resources further and also employ outside resources where it does not have either the staff or financial resources to fulfill its duties. The District currently contracts with other agencies in a cooperative and collaborative manner to obtain data that helps to meet overall program objectives and staffing resource needs. This plan further details those agency relationships. Thus, another general tactic of the HMP is, where possible, to integrate the cooperative programs with the District's partner organizations into a comprehensive program to cost-effectively monitor the District's water resources.

Hydrologic monitoring requires that short-term and long-range tasks be performed to implement effective hydrologic monitoring; therefore, both short and long term monitoring needs are addressed in this plan. Some of these needs are considered in assessing collection approaches and types of monitoring equipment, including new computer technology and better availability of telemetric devices to collect data automatically, remotely and on a more frequent basis. An objective of the HMP is to balance the use of cost-effective modern technology with ongoing monitoring activities.

II: HISTORY AND BACKGROUND

Since the establishment of the District in 1976, resource monitoring has played an important role in assessing and managing water resources. Monitoring activities provide essential information about the quality, quantity, and status of water resources that support the decision making process and help achieve the mission and goals of the District.

Monitoring of ground water and surface water resources began soon after the District was founded. The District collected rainfall, river, stream and ground water data in cooperation with the U.S. Geological Survey (USGS) during the initial years of the District's operation. The river and stream data were collected to assess the dynamics of the surface water hydrology in the Panhandle, identify watershed characteristics, and provide flood information for local government agencies and the public. Ground water resources provide the majority of the public water supply in the Florida Panhandle and reliable information on changes in aquifer levels is essential to managing and protecting this resource. Rapid growth and development in the Panhandle in the late 1940s and 1950s caused declines in ground water levels in coastal communities. Supply wells in the Panama City area began experiencing salt water intrusion in the late 1950s. This experience and the reliance on ground water as the primary source for water supply in the Panhandle reinforced the need for reliable long term monitoring of ground water resources.

The District has worked on cooperative monitoring programs for many years with state, federal and local government agencies for mutually beneficial data collection efforts. These programs include data collected by District personnel, volunteers, contractors and permittees, as well as data collected as part of the District's cooperative program with the USGS, Florida Department of Environmental Protection, and other state and local agencies. A condensed list of cooperating agencies has been included in Appendix B of this planning document.

Monitoring activities at the NWFWMD have in the past been constrained by funding limitations. The Water Management Districts have the authority to levy ad valorem (property) taxes to support water management activities. Four of the five water management districts are constitutionally allowed to levy up to one mil while the NWFWMD is limited to less than one-twentieth of a mil (.05 mils). Thus, funding for equipment and staff for monitoring activities has historically been very limited. Much of the funding for monitoring programs and activities in the past has come from cooperative projects, U.S Environmental Protection Agency (EPA) grants, and legislatively funded programs such as Surface Water Improvement and Management (SWIM) Program, and the FDEP Integrated Water Resource Monitoring Network (IWRM). More recently, the NWFWMD has been able to use a small portion of its statutorily appropriated share of revenues received through the Water Management Land Trust Fund to perform SWIM and water resources development related monitoring activities. However, in the past funding for monitoring activities has generally been associated with programs or projects which are decided upon externally and budgeted on a year to year basis. Several monitoring efforts have continued receiving outside financial support for nearly two decades.

It has become apparent that with increased demands on water resources in the NWFWMD, the need for pertinent hydrologic data has increased as well. Increasingly, data collected for the District's client and cooperative programs are used to measure changes in the health of water resources, monitor trends, identify and analyze existing or potential resource problems, and develop programs to correct existing

water resource problems and prevent future problems from occurring. While focused data collection programs are capable of providing quality hydrologic data for monitoring needs in specific areas, the distribution of these networks across the Panhandle leaves significant gaps in data availability for many areas. At the same time, however, new monitoring technologies continue to enhance the capability and efficiency of hydrologic data collection and improve our ability to fill in some of these gaps.

III: CURRENT AND ONGOING WATER RESOURCES MONITORING ACTIVITIES

This section of the monitoring plan describes the current activities the District is undertaking, including those activities which continue to expand due to increasing demands on water resources and the corresponding additional monitoring requirements. This includes the geographic extent and types of monitoring activities. These monitoring activities include ground water and surface water quality and quantity, rainfall quantity and distribution, and other biological and environmental information used to characterize water resources throughout the District. Monitoring activities are intended to provide information for supporting all program areas of the District, including planning, management, protection, regulation, and resource restoration activities. Monitoring is also necessary to evaluate the success of management decisions involving the intended uses of the resource as well as cumulative impacts. Monitoring data may also be utilized to understand achievement of strategic water management objectives and goals which are further described in District plans and the SWMP. Furthermore, monitoring data collected and stored in permanent databases are maintained to provide historic records of hydrologic or water quality conditions. Upkeep of long term records may also be used to evaluate historic droughts and floods which in turn are useful for drought and floodplain management applications.

Water resources monitoring consists of two broad categories: the collection of instantaneous and continuous hydrologic data. Instantaneous data are generated by the collection of individual on-site field measurements of physical and chemical characteristics using portable equipment to measure water level, velocity, flow, temperature, dissolved oxygen, pH, and other data. These data are typically classified as instantaneous as they provide a characterization of water quality at a single point in time.

Continuous data are generated by automated data logging equipment deployed on-site to record water resource information and provide a comprehensive picture of the characteristics of the resource. Devices and sensors utilized by the District for the collection of continuous hydrologic data may serve many purposes when tailored to work with other technological modeling tools or knowledge-based advances in the District. Improving technology has increased the accuracy and reliability of these instruments. The typical types of continuous data collected include: stage (water level data), rainfall, discharge (flow quantity), velocity, temperature, pH, dissolved oxygen concentration, conductivity, salinity, water direction, depth, and wind speed and wind direction. As new technologies are developed, additional types of data will likely be added to the continuous data collection efforts to improve resource evaluation, knowledge, and management activities.

Water resource monitoring data are generally collected to provide information for a specific resource question. Depending on the nature of the data collection need, a monitoring location may be operated for a short term (days or months) or a long term period (months or years). Short-term monitoring focuses on the immediate environmental effects of an activity, such as a pump test or a dredging operation. Once the activity stops, there is no longer a need to monitor the resource. Long-term monitoring is intended to provide a data record for a period of months or years to investigate the variability and overall change in a resource due to anthropogenic or natural causes. Stations that are intended for determining normal distributions or flood frequency and prediction must often be in operation for decades before the appropriate range of conditions are measured and used for forecasts.

Hydrologic monitoring, equipment operation, record keeping and data management, and monitoring station maintenance are currently performed by staff that has been trained to operate various District

equipment and data entry programs. A more detailed discussion of District operations, where data collection and quality assurance are concerned, is provided in **Appendix A.**

To better illustrate this planning initiative, several of the District's major ongoing monitoring efforts and programs and the relationship between these individual data collection efforts are described below. Maps showing the distribution of District Automated Hydrologic Monitoring Stations and the Quarterly Ground Water Level Network are provided in **Figures 1 and 2**. Integration of these individual projects and programs into a District-wide regional network is and will continue to be an essential goal of this plan.

A. Hydrologic Monitoring

1. Deer Point Lake Watershed Monitoring Program

Deer Point Lake reservoir is the primary drinking water supply for Bay County and Panama City. Preservation and management of this vital resource is a priority for the District and Bay County. The District has actively participated in the protection and management of this resource through land acquisition and protection activities along Econfina Creek, the principal tributary supplying Deer Point Lake. The Deer Point Lake Watershed Monitoring Program enhances the management and protection of the resources in the watershed by providing a long term record used to evaluate resource trends and the effectiveness of management practices and other activities that occur in the watershed.

Now in its 13th year, this cooperative program is funded in part by Bay County and provides stream flow, stage and rainfall data within the watershed and along the major tributaries to Deer Point Lake. The District operates and maintains six stream flow/stage stations and three rainfall stations, including two stage stations and two rainfall stations that are real-time enabled. The continuous monitoring data collected for this network is used by Bay County to manage its water supply and has several uses for managing water resources, including quantification of freshwater supplies, lake level supervision, drought monitoring, as well as natural systems and hydrologic conditions reporting.

2. Yellow River Water Resource Development Monitoring

The Sand-and-Gravel Aquifer between the Yellow and Blackwater Rivers is being evaluated for the District's Region II Water Supply Plan as an alternative water supply to reduce demand on the Floridan Aquifer in coastal Santa Rosa and Okaloosa counties. In this area, the District is currently operating six continuous surface water stage stations, two automated rainfall gauges - operated in conjunction with stage stations, and one continuous ground water level station. Two of these gages record flows on the Yellow and Blackwater Rivers. In addition, instantaneous ground water level measurements have been taken several times per year since 2002 at approximately 40 wells within the monitoring area. These data are used by the District to determine ground water interaction with streams and to develop and validate a steady-state ground water model. The ground water model has been developed to serve as a management tool to assist the District in evaluating the water resource development of the Sand-and-Gravel Aquifer for water supply in this area. Continued data collection from surface water, ground water, and rainfall sites are required to verify model forecasts and observe actual aquifer conditions. The continuous and instantaneous data will also provide a long term historical record to assess the impact of future withdrawals from the Sand-and-Gravel Aquifer if it is utilized as a water supply source.

3. Bay County Inland Water Supply Monitoring

Bay County is utilizing grant funds to develop an inland wellfield that will be interconnected with its current water supply system. Bay County Utilities provides water for municipalities and unincorporated areas throughout the County, including Tyndall Air Force Base and Mexico Beach. The facilities to be constructed include Floridan Aquifer wells with associated pumping, treatment, and transmission components necessary for development of this inland ground water source. The Region III Water Supply Plan for Bay County identifies development of an inland wellfield as a priority alternative water supply project for the County. As part of that water resource development effort and for regulatory compliance purposes, the District is currently operating continuous monitoring equipment at nine ground water locations (three Floridan, three Intermediate System, and three Surficial Wells), three stream locations, and one rainfall station within the proposed wellfield area.

4. Ground Water Level Monitoring and Mapping Network

The ground water monitoring network is a District wide water level monitoring network of approximately 200 wells visited on a quarterly basis. Wells representing all of the major aquifers are included in this network. Many of these wells have a long historical record dating back 40 or more years. These data have been used to monitor the condition of the ground water resources across the District and provide a record of the aquifer's response to periods of above normal rainfall and drought. The data provide a record of the effect of ground water withdrawals on aquifer levels and are also used for ground water model development, water supply planning, water use permitting, development of potentiometric surface maps, and coastal monitoring for salt water intrusion into the aquifer.

5. Tallahassee/Leon County Stormwater Monitoring Program

This cooperative program between the City of Tallahassee, Leon County and the District provides stream flow, water level and rainfall data in the City and County. The District has operated and maintained the monitoring network for 22 years. It consists of 39 stage and rainfall stations which are used by the City and County for watershed modeling, stormwater modeling and improvements, flood evaluation and attenuation and water quality enhancement projects. The monitoring data is also used by the City and County to assess the EPA National Pollutant and Discharge Elimination System (NPDES) requirements designed to reduce non-point discharges downstream to regionally important water bodies including Lake Munson, Wakulla Springs and Lake Jackson.

This program also includes the operation of a real-time radio telemetry flood warning network in the Leon County Area. This monitoring network is a cooperative program between the District, Leon County and the National Weather Service. The network includes thirteen rainfall and stream stage stations that provide real-time rainfall and water level data to help identify developing flood conditions so city and county emergency management staff can respond as quickly as possible and notify the public to reduce injury and property loss.

6. Bay County Stormwater Monitoring Program

The Bay County Stormwater network is a joint program between the District and Bay County. The monitoring network has been operated and maintained by the District during the last 12 years for the purposes of stormwater modeling and improvements, flood evaluation and attenuation, water quality enhancement projects, and NPDES requirements. The network

consists of two stage/discharge stations and two rainfall stations. However, station locations are not fixed and are periodically moved as county stormwater improvements are completed and new projects develop.

7. Tate's Hell Restoration

This monitoring program is intended to assess the effects of restoration activities within Tate's Hell Swamp in Franklin County as well as provide basic quantitative data to characterize the hydrology of the Tate's Hell State Forest. Five monitoring stations are operated by the District to measure stage, rainfall and discharge at selected locations. The monitoring stations provide data for assessing the effects of the existing ditch and road network on the hydrology and providing data to plan restoration activities. The monitoring data is also used to assess the success of restoration activities for restoring historic flow patterns, enhancing ground water recharge and improving water quality discharging from the Tate's Hell State Forest into the bay.

8. Bayou Chico Restoration

As part of ongoing efforts to restore water quality in Bayou Chico (a tributary bayou of Pensacola Bay), the District, the U.S. Army Corps of Engineers (Corps) and Escambia County worked cooperatively to hydraulically dredge the bayou to improve circulation and water quality. A dredge permit was issued for this restoration project that requires monitoring of the dredge spoil disposal site known as North Pond, located on Escambia County property. The permit requires monitoring by the District for a three year period after completion of dredging activities. The dredging was completed at the end of April 2008. The monitoring activities are designed to detect any potential effects from the dredge material on the Sand-and-Gravel Aquifer or the Jackson Branch Tributary adjacent to the disposal site. Two wells that sit at North Pond are monitored continuously for water and rainfall levels; water quality samples have also been collected in the monitoring wells at the site and in Jackson Branch to detect any potential effects from the pumped dredge spoil material. These two wells include an on-site deep well and adjacent shallow well and will continue to be maintained to gather data on potential saltwater intrusion as well as regional drought conditions or excessive drawdown in the southern part of the Sand and Gravel Aquifer. The continuously recorded water levels also provide excellent water resource data to report on Sand and Gravel Aquifer levels in southern Escambia County.

9. River Flow Monitoring

The NWFWMD and USGS jointly fund the collection of stage and discharge data at four stations located within the District. For the past 31 years, the District has participated in cooperative water resource investigations with the USGS. The joint program provides funding for the operation of continuous monitoring stations on Telogia Creek near Bristol, Apalachicola River at Chattahoochee, Apalachicola River at Sumatra and the Yellow River near Milton. These stations are operated by the USGS and the near real-time gauging data is available on their web site through the National Water Information System (NWIS) at http://waterdata.usgs.gov/fl/nwis/rt. These stations are all high priority long-term stations for the District for regulating water consumption, drought warning and management, flood management and water supply management. Participation in this joint funding program also enables the District to access maps, records, reports, and computer databases maintained by the USGS.

Other hydrologic data is collected by the USGS, FDEP, and the Corps on the remaining basins in the District.

River flow monitoring by the District also occurs at two locations on major rivers. The NWFWMD operates stage/discharge monitoring stations on the Shoal River at US90 and Yellow River at SR2. These sites are long-term stations that provide data for alternative water supply evaluation, flood management and resource management.

10. Major Springs Flow and Level Evaluations

The District operates and maintains continuous monitoring stations in the Wakulla Springshed to characterize the hydrology of Wakulla Springs and the Wakulla River. Within the Edward Ball Wakulla Spring State Park, the District operates a rainfall station, a spring discharge station, a river stage station, and a temperature/conductivity station. The District also operates several additional rainfall stations in the springshed including one near River Sinks, an area of high recharge to Wakulla Springs, and several in southern Leon County. These data are used to establish relationships between rainfall, spring discharge, and water quality in the spring and river. The data supports modeling efforts to characterize the hydrology of the Wakulla Springshed. Long-term collection of the data is important for assessing downstream freshwater needs and evaluating the cumulative effects of water supply withdrawals, wastewater disposal practices in the springshed on flows, and water quality in the spring and downstream water resources.

The District operates a rainfall station, ground water stage station, and spring discharge station at Blue Spring in Jackson County. These data are used to establish relationships between rainfall and spring discharge and to assess drought conditions as well as the cumulative effects of withdrawal on the spring. The data gathered from collection activities are being used in development management strategies for droughts. Water quality data is collected with other agencies interesting in reducing nutrient inputs, which is a major concern in this springshed.

In cooperation with other environmental agencies like the Florida Geological Survey and FDEP, the District maintains an inventory of all documented Floridan Aquifer and major surficial seepage springs located within its boundaries. The inventory information that has been collected includes physical, chemical, and geographic data, such as site location coordinates, site photographs, pH, temperature, conductivity and dissolved oxygen measurements, and discharge. As hydrologic conditions vary during the year, the springs are revisited on a periodic basis to monitor and record changes.

Figure 1. NWFWMD Hydrologic Recorder Stations

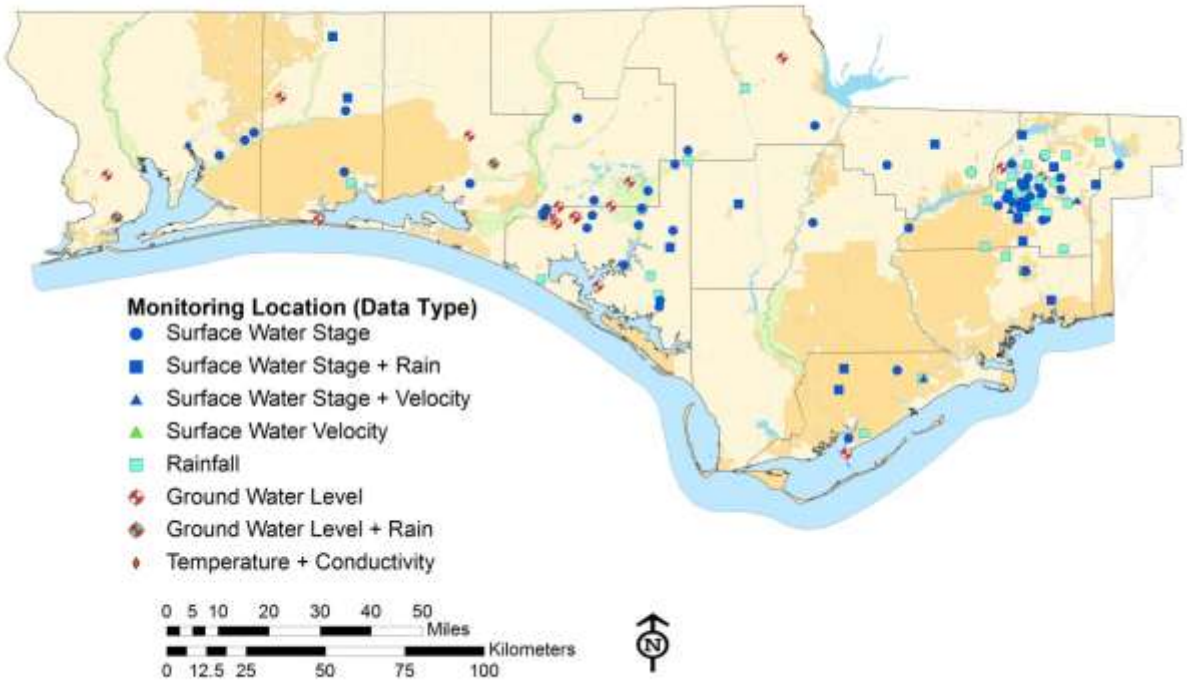
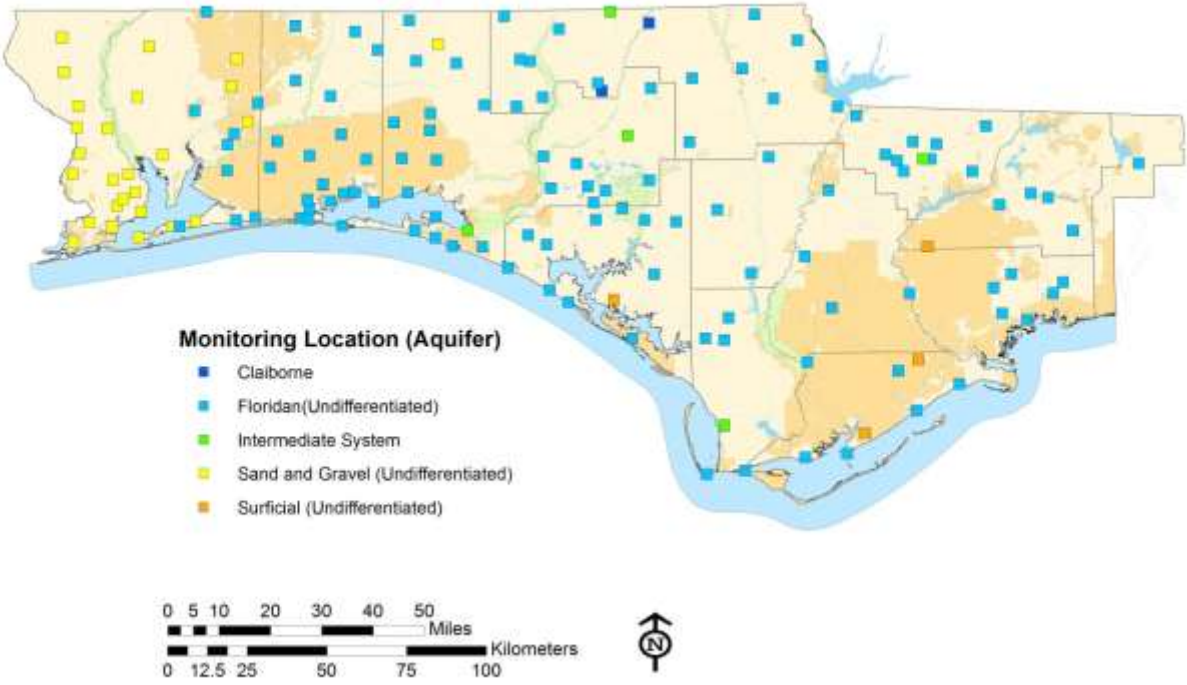


Figure 2. NWFWMD Quarterly Ground Water Level Network



B. Water Quality Monitoring

1. NWFWMD Water Quality Database

In 2009 the District completed development of the NWFWMD Water Quality Database, an Oracle-based platform that serves as a central repository for the large amount of water quality data generated by and provided to the District. The District was previously utilizing the STORET (STOrage and RETrieval) Water Quality database that was developed by the U.S. EPA. The STORET database resided on the District's computer network and was periodically uploaded to the EPA's nation-wide STORET database; however, operational support for STORET is being phased out, requiring the District to develop an alternative water quality database. The current District water quality database can be queried by general or specific site information and can quickly provide a detailed inventory and summary of water quality data available for the District's water resources.

2. NWFWMD Contract with the FDEP Laboratory

Many of the District's water quality analytical services are performed under contract with the Florida Department of Environmental Protection Central Chemistry Laboratory in Tallahassee, Florida. The FDEP lab provides consistently accurate data and maintains a vigorous quality assurance program in addition to providing analysis services to the District at a cost-effective rate. Quality assurance and quality control data are typically stored or reported with the FDEP lab submittals.

3. Integrated Water Resource Monitoring (IWRM) Program

The NWFWMD has worked cooperatively with FDEP for 24 years on monitoring programs throughout the District. For the last 10 years, the NWFWMD has operated the Integrated Water Resource Monitoring (IWRM) Program under a grant agreement with the FDEP. The purpose of the IWRM Program is to characterize environmental conditions of Florida's fresh water resources and to determine how these conditions change over time due to natural variation and changes in land use practices. The program is designed to address questions at three different spatial scales: 1) the state of Florida as a whole, 2) the Panhandle area encompassed within the Northwest Florida Water Management District, and 3) watersheds associated with Florida's major rivers and lakes. The IWRM Program is divided into two main components: the Status Network and the Temporal Variability Network, both of which are designed to provide data on separate scales.

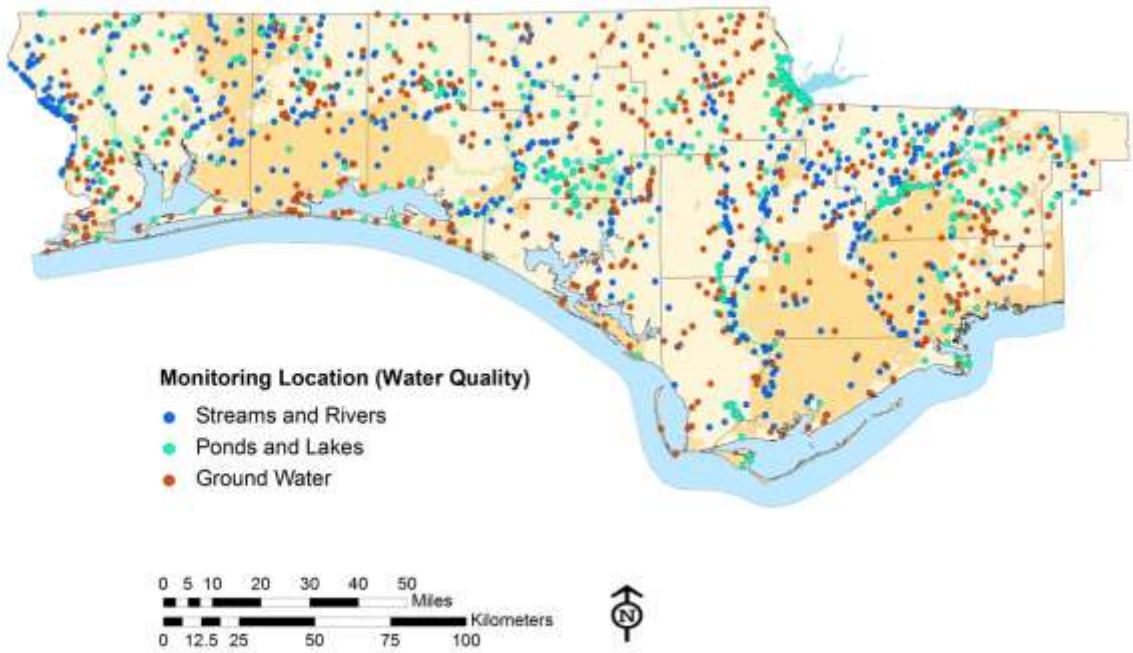
Status Network data are used to statistically describe statewide, regional, and basin-specific water quality characteristics present during each sampling period. The overall statewide sample design provides for the sampling of the entire state within a five–year period (e.g. 2004–2008). Within each water management district, twenty random water quality samples are collected from each of six water resources: 1) unconfined aquifers, 2) confined aquifers, 3) small lakes, 4) large lakes, 5) small streams, and 6) large rivers. Each resource is sampled during a specific index period, depending upon the resource type, location and seasonal characteristics of the resource. In any given year, approximately 200 samples (including sediment, biological, and quality samples) are collected and analyzed. Resource-specific indicator analyses are used to characterize the environmental condition of each resource. These indicators consist of a standard set of chemical, biological, and physical analyses that are used on a state-wide basis. The locations of sites sampled in the District between 2000 and 2009 are shown below in **Figure 3**.

In addition to providing the District with information to characterize its water resources, data from the Status Network are also used to compile Florida's biannual Water Quality Assessment 305(b) Report to the U.S. EPA, a requirement of the Federal Clean Water Act. The 305(b) reports from all states are used

by the EPA to inform Congress and state citizens about national water quality conditions and the health of the natural environment.

The Temporal Variability Network includes monthly or quarterly water quality sample collection on fixed surface water and ground water sampling sites throughout the District. The data are used to determine changes over time in major drainage basins and aquifers, determine natural and seasonal variation of chemical, biological and physical characteristics of the resources, provide a long term historical record to protect and manage the resources, and to use as a comparative and reference data set for the Status Network and other water quality sampling programs.

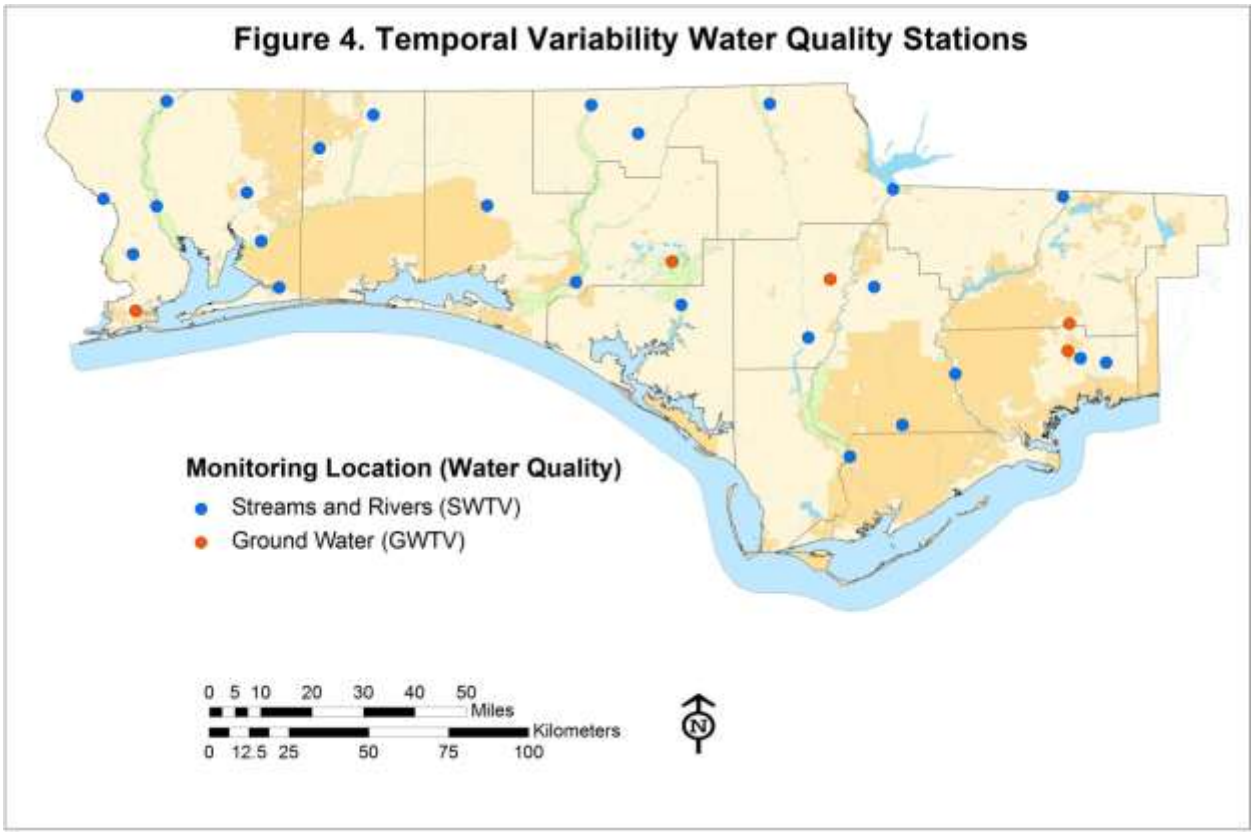
Figure 3. NWFWMD Status Water Quality Stations



The Surface Water Temporal Variability (SWTV) Network consists of 25 fixed location sites in major streams and rivers across the district that are sampled on a monthly basis. The sites are located at key locations in the drainage basins near flow gauging stations so river flows and levels can be compared with the water quality data. These sites allow the District and FDEP to obtain chemistry, discharge, and loading data (quantitative water quality data in pounds or kilograms) at locations that integrate the land use activities of the watershed. In addition, some SWTV sites are located near the state boundary with Alabama and Georgia and are used to collect chemistry and loading data for major river systems entering Florida. The data from the SWTV stations provides a historic record to analyze long term trends and changes to the major rivers and streams in the District. It also provides information to evaluate changes or potential negative impacts from interstate boundary drainage basins.

The Ground Water Temporal Variability (GWTV) Network consists of eight fixed sampling sites (four unconfined aquifer wells, three confined aquifer wells, and one spring vent site). These sites were chosen as locations so that each major drainage basin has a representative site for both the confined and

unconfined aquifer systems when both of these types of systems are present within a drainage basin. Since the temporal variability of water chemistry in confined aquifers is much less than that of unconfined aquifers, field analyses at confined sites are sampled quarterly and unconfined ground water resources are sampled monthly. Laboratory analyses at both confined and unconfined aquifers are sampled quarterly. This provides valuable information to the District for managing the ground water resources that provide about 90% of the water supply in northwest Florida. Location of the SWTV and GWTV sampling sites is provided below in **Figure 4**.



4. Econfina Tracts Coliform Sampling

The District operates and maintains public swimming areas on six lakes and springs on District Lands in the Econfina Creek Water Management Area, located in Washington and Bay counties. The District makes all of its lands available to the public with the exception of conservation easement properties or environmentally sensitive areas. The Florida Department of Health (DOH) requires public swimming areas to be tested monthly for fecal coliform to protect public health and safety. Fecal coliform is a bacterial indicator that signifies public health threats when levels are high in water bodies. To fulfill the DOH requirement and provide safe swimming areas, the District collects monthly water quality samples from seventeen sites in the Econfina Creek Water Management Area and submits the samples for analysis to the FDEP Central Chemistry Laboratory. The test results are reported to DOH and reviewed by District staff to ensure a safe recreational environment for the public.

5. *Quarterly Springs Water Quality Sampling*

The District is currently monitoring the water quality at two of its first-magnitude springs, Jackson Blue Spring and Wakulla Spring. Springs and spring systems are particularly vulnerable to non-point sources of nutrient pollution. Water quality monitoring provides the District with valuable information regarding the anthropogenic effects on water resources from land use changes, land management practices, and water use.

6. *Salt Water Intrusion Monitoring*

Approximately 15 coastal wells are sampled annually and analyzed for sodium chloride and other constituents as saline indicators of salt water intrusion into the Floridan Aquifer. These data supplement data provided to the District from Consumptive Use permittees and other government agencies for use in ground water resource evaluation, ground water model development, water supply planning and water use permitting. Saltwater intrusion into the aquifer is typically caused by over pumping of water supply wells near the coast but can be amplified by reduced aquifer recharge due to drought or land use changes. Monitoring saltwater intrusion in coastal areas is a barometer for historical ground water trends and provides vital information for managing current resources and protecting future water resources for water supply and natural systems.

Table 2: NWFWMD Program/Activity Major Deliverables

Projects/Fund	Stations	Operational Tasks Performed	Major Deliverables	Record(s) Type	Customer	Total FTE
SPECIAL PROJECTS						6.51
Ground Water Temporal Variability	212	Collect samples from 212 sites, update sample site information	Monitor condition of ground water resources, provide record of aquifer's response to period of rainfall and drought	Long-term water quality records, Resource water quality data	FDEP (Contract)	2.31
Surface Water Temporal Variability	25	Collect monthly samples from 25 sites	Obtain chemistry, discharge, and loading data for the watershed.	Long-term water quality records	FDEP (Contract)	1.22
Leon Cty. SW Monitoring Network	39	Download stations, Perform maintenance, Perform discharge measurements / stage rating	Watershed/SW modeling and improvements, flood evaluation and water quality enhancement	Long-term hydrologic records, Peak Discharge	Leon County-Tallahassee (Contract)	1.28
Deer Point Lake Watershed	9	Download stations, Perform maintenance, Perform discharge measurements/stage rating	Manage water resources, drought monitoring, natural systems, hydrologic conditions reporting	Long-term hydrologic records, Peak Discharge	Bay County (Contract)	0.37

Table 2: NWFWMD Program/Activity Major Deliverables (cont'd)						
Projects/Fund	**Station**	**Operational Tasks Performed**	**Major Deliverables**	**Record(s) Type**	**Customer**	**Total FTE**
Bay Co. Stormwater	4	Download stations, Perform maintenance, Perform discharge measurements/stage rating	Measurements of stormwater, discharge of various sub-watersheds	Long-term hydrologic records, Peak Discharge	Bay County (Contract)	0.16
Walton Co. Wells		Download stations, Perform maintenance		Long-term hydrologic records	Region II WSP	0.11
Fairpoint Peninsula		Download stations, Perform maintenance, Perform discharge measurements / stage rating		Monitoring of wellfield project, long-term hydrologic records		0.16
Blackwater River/Shoal Tributary	2	Download stations, Perform maintenance, Perform discharge measurements/stage rating		Resource development monitoring	Region II WSP	0.21
Chloride Ground Water Monitoring	15	Collect samples from 15 ground water sites	Ground water tested for salt water intrusion	Water quality samples	Region II WSP	0.16
Bay Co. Wellfield		Download stations, Perform maintenance, Perform discharge measurements/stage rating		Monitoring wellfield project, long-term hydrologic records	Region III WSP	0.49
Eastpoint Monitoring		Download stations, Perform maintenance		Long-term hydrologic records	Region V WSP	0.08
Early Flood Warning	33	Installation of 33 flood warning/monitoring stations	Flood warning/peak data to FDEM and local government	Flood warning/ resource monitoring	FDEM (Contract)	0.79
SWIM PROJECTS						1.77
Tate's Hell – Apalachicola	5	Download stations, Perform maintenance, Perform discharge measurements/stage rating	Measurement of restoration successes	Long-term hydrologic records, Peak Discharge	Tate's Hell Restoration Plan	0.41
Choctaw (Valparaiso Rainfall)		Download stations, Perform maintenance		Long-term hydrologic records	SWIM	0.01
Pensacola (Bayou Chico – Clark Sand)	2	Download stations, Perform maintenance	Fulfilled dredge material permit requirements	Monitoring of dredging project, long-term hydro records	USACOE/ Escambia County (Permit)	0.13

Table 2: NWFWMD Program/Activity Major Deliverables (cont'd)						
Projects/Fund	**Stations**	**Operational Tasks Performed**	**Major Deliverables**	**Record(s) Type**	**Customer**	**Total FTE**
Wakulla, Jackson Blue Springs	7+	Download stations, Perform maintenance, Perform discharge measurements/stage rating	Information regarding anthropogenic effects, establishing relationships between rainfall and spring discharge	Long-term hydrologic records, Peak Discharge	1st order magnitude	0.37
District Rainfall		Download stations, Perform maintenance	Measure of hydrologic conditions	Long-term hydrologic records	SWIM Hydrologic conditions	0.17
Yellow – Shoal Rivers	2	Download stations, Perform maintenance, Perform discharge measurements / stage rating	Regulating water consumption, flood management, and resource management	Long-term, continuous hydrologic records, Peak Discharge	MFL Priority List SWIM	0.21
St. Marks River		Download stations		Long-term hydrologic records	SWIM	0.14
Turkey and Lafayette Creeks	2	Perform maintenance		Peak Discharge	SWIM	0.08
Ochlockonee-Little River	2	Perform discharge measurements / stage rating			SWIM	0.08
Quincy-Telogia Creeks		Download stations, Perform maintenance, Perform discharge measurements / stage rating	Regulating water consumption, flood management, and resource management	Long-term hydrologic records	District	0.08
Lake Level Network*	5			Long-term Hydrologic Records	District	0.17
LANDS PROJECTS						0.17
Econfina Creek Water Quality	17	Monthly water quality sampling at 17 sites	Monthly water quality report	Long-term water quality record	Lands Management Division	0.17
GENERAL FUND PROJECTS						0.68
Technical Assist		Provide hydrologic data to the general public	Complete data requests by consultants and the general public	Requests fulfilled in a timely manner	District	0.05
Quarterly GW Level Measurements		Measure aquifer levels at network of well stations		Long-term hydrologic records	District	0.23

Table 2: NWFWMD Program/Activity Major Deliverables (cont'd)						
Projects/Fund	**Stations**	**Operational Tasks Performed**	**Major Deliverables**	**Record(s) Type**	**Customer**	**Total FTE**
Lake Jackson Facility		Download stations, Perform maintenance, Operate and maintaining facility		Long-term hydrologic records, Storm water treatment for Lake Jackson	District	0.07
Misc. SW Sampling and Gauging		Download stations, Perform maintenance		Maintenance Only Not Applicable	District	0.23
REGULATORY						1.10
Gulf American Shrimp	10	Quarterly water quality sampling at 10 sites	Quarterly water quality report	Permitee monitoring	Regulatory Division	0.09
Ten Mile Creek/Sand & Gravel Well 5D		Download stations, Perform maintenance, Perform discharge measurements / stage rating		Permitee monitoring, Long-term hydrologic records	Regulatory Division	0.09
TOTAL						10.24
*** Includes Jackson, Compass, Miccosukee, Ocheese, Pate**						

IV. INTEGRATING MONITORING PROJECTS INTO A DISTRICT-WIDE MONITORING NETWORK

Currently, the NWFWMD operates approximately 110 hydrologic gauging stations with the total number varying due to changes in project requirements and funding. In addition water quality samples are obtained from approximately 50 locations monthly and 250 locations annually.

The organization and planning of monitoring needs on a project-by-project basis may potentially improve efficiency in the operation of the monitoring network by integration into the District's overall hydrologic data requirements. For example, two separate projects may spatially overlap and inadvertently increase mobilization and operational costs. Projects may also be designed with different equipment with different specifications resulting in increased training and maintenance costs for the District. These are just a couple of examples of inefficiencies which may generally be avoided with good planning. Monitoring projects with other agencies or entities also cannot always be counted on to address the District's hydrologic data requirements due to divergent goals and/or design; however, due to the nature of District funding and monitoring needs, separate projects which fulfill the same objectives should when possible be avoided. As a matter of practice it is essential that District staff continue to review the design of both externally and internally funded projects as they are initiated or planned to determine overlapping objectives and relevance to other ongoing monitoring activities. Resource monitoring efforts and the tactics outlined in this plan should also continue to be coordinated to determine how the specific monitoring activity fits within the broader mission statement and strategic goals in the SWMP of the District.

Staff resources in addition to other project resources are often budgeted on the basis of availability of project contract funding rather than overall priority or need to monitor important water resources. However, where ever possible potential improvements in efficiency or usefulness of staff are always considered in an effort to balance important monitoring objectives with other more specific project needs.

Also there are many examples where the measurement of precipitation, surface water flows and levels and aquifer levels on a project basis are all very closely related to overall water resource monitoring objectives of the District. This includes routinely taking advantage of the often strong interrelationships which exist between ground and surface waters. Ultimately, the more that is understood about District water resources the more hydrologic data of one type can be used to enhance observations or even substitute observations of another type. For example spring discharge may be substituted with ground water level data to produce more accurate predictions of the hydrologic variable of interest. Furthermore, this integration may be put to practice by development of basin scale hydrologic simulation models which may be successfully calibrated with piecemeal data for predicting regional water resource trends.

In cases where the District has invested substantial resources in the development and long-term operation of a hydrologic monitoring station, it is usually important that the station continue to provide data into the future to establish trends or to better quantify hydrologic variability. The need for long-term monitoring data for resource planning and management is important for understanding natural statistical variability as well as understanding trends such as declining water levels due to water withdrawals. This is at least until reliable prediction models may be developed based upon the data collected. The determination of hydrologic characteristics such as base flow, flow variability, precipitation averages and historical trends may require data extending over a period of twenty to thirty years. In other cases, long-term data may

prove useful for calibrating and validating hydrologic models that are utilized to assess hydrologic conditions in response to proposed water management decisions or changes in natural conditions. Thus, the decision to keep a monitoring station in operation, development of a new one, and the specific design of a monitoring station is always important.

Table 3. NWFWMD Program Integration Matrix

Projects/ Activity	District Rainfall	GW Temporal Variability	SW Temporal Variability	Leon Cty. SW Monitoring	Deer Point	Bay Co. SW	Blackwater River/Shoal Tributary	Chloride GW Monitoring	Walton Co. Wells	Fairpoint Peninsula	Eastpoint Monitoring	Bay Co. Wellfield	Early Flood Warning	**SWIM PROJECTS**	Tate's Hell/ Apalachicola	Choctaw (Valparaiso Rainfall)	Pensacola (Bayou Chico – Clark Sand)	Wakulla/ Jackson Blue	Yellow/Shoal Rivers	St. Marks River	Turkey Lafayette Creeks	Ochlockonee/ Little River	Lake Level Network	Quincy/Telogia Creeks	**LANDS PROJECTS**	Econfina Creek Water Quality	**GEN. FUND PROJECTS**	Quarterly GW Level Measurements	Lake Jackson Facility	Misc. SW Sampling and Gauging	Technical Asst.	**REGULATORY**	Ten Mile Creek/Sand & Gravel Well 5D	Gulf American Shrimp
District Rainfall	■		▨	▨	▨	▨	▨		▨	▨	▨	▨	▨		▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		▨			▨	▨	▨		▨	
Ground Water Temporal Variability		■						▨	▨		▨	▨						▨										▨							
Surface Water Temporal Variability			■		▨													▨	▨	▨															
Leon Cty. SW Monitoring	▨		▨	■									▨					▨				▨	▨						▨					
Deer Pt.	▨		▨		■								▨										▨											
Bay Co. SW						■							▨																					
Blackwater River/Shoal Tributary	▨						■												▨															
Chloride GW Monitoring		▨						■																				▨						
Early Flood Warning	▨			▨	▨	▨							■		▨			▨		▨		▨	▨											
Tate's Hell/ Apalachicola	▨										▨		▨		■																			

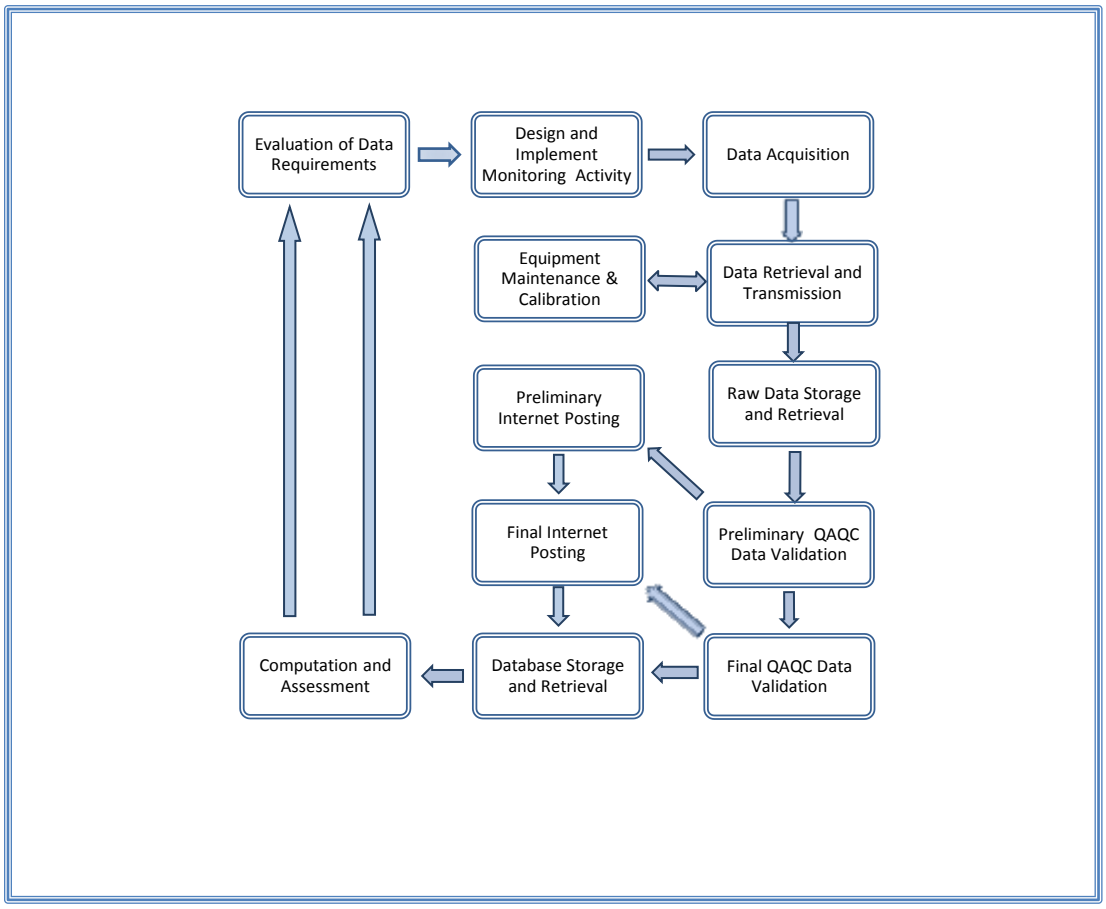
Table 3. NWFWMD Program Integration Matrix (cont'd)

Projects/ Activity	District Rainfall	GW Temporal Variability	SW Temporal Variability	Leon Cty. SW Monitoring	Deer Point	Bay Co. SW	Blackwater River/Shoal Tributary	Chloride GW Monitoring	Walton Co. Wells	Fairpoint Peninsula	Eastpoint Monitoring	Bay Co. Wellfield	Early Flood Warning	**SWIM PROJECTS**	Tate's Hell/ Apalachicola	Choctaw (Valparaiso Rainfall)	Pensacola (Bayou Chico – Clark Sand)	Wakulla/ Jackson Blue	Yellow/Shoal Rivers	St. Marks River	Turkey Lafayette Creeks	Ochlockonee/ Little River	Lake Level Network	Quincy/Telogia Creeks	**LANDS PROJECTS**	Econfina Creek Water Quality	**GEN. FUND PROJECTS**	Quarterly GW Level Measurements	Lake Jackson Facility	Misc. SW Sampling and Gauging	Technical Asst.	**REGULATORY**	Ten Mile Creek/Sand & Gravel Well 5D	Gulf American Shrimp
Choctaw (Valparaiso Rainfall)	▒								▒							■																		
Pensacola (Bayou Chico – Clark Sand)	▒																■						▒						▒						
(Wakulla, Jackson Blue Springs)	▒		▒	▒														■		▒								▒						
Yellow – Shoal Rivers	▒						▒												■												▒				
St. Marks River	▒												▒							■															
Ochlockonee-Little River	▒												▒									■													
Lake Level Network	▒		▒	▒	▒								▒				▒	▒					■												
Quarterly GW Level Measurements		▒						▒	▒		▒	▒					▒	▒										■		▒	▒		▒		
Lake Jackson Facility	▒			▒																			▒						■					

V. DATA COLLECTION, STORAGE, OPERATIONAL AND MAINTENANCE PROCEDURES

Despite the diverse range of funding sources and monitoring designs, the key to a successful hydrologic monitoring program centers on consistent operational and maintenance policies. The District has adopted a standard operating procedure **(Figure 5)** applicable to all field activities, categorized by the following flow chart.

Figure 5. NWFWMD Data Acquisition, QA/QC and Storage Process



A. Data Collection and Quality Assurance Procedures

While each step in the process of a hydrologic or water quality monitoring program is essential, arguably the most important process begins and ends with high quality measurement and data collection. No matter how effective the data management process is following acquisition, inaccurate measurements cannot be corrected. In order to collect reliable hydrologic data, field instrumentation must meet accuracy standards for the desired metric. Instrumentation must be maintained in good working order, staff must be properly trained, field activities must be documented completely, and data processing and storage procedures must be thorough and efficient. Specific sets of standards are

developed for each type of instrument the NWFWMD owns and operates (see Appendix A for a detailed list of the steps included in defining data collection and quality assurance procedures for each instrument owned and operated. This information is also available internally and is available upon request).

B. Data Transmission and Storage

Also key to the data management process is the organized and complete transfer of field data to storage at District headquarters. There are two broad categories of data transmission currently in use: manual and automated transmission.

1. Manual Data Transmission

Includes written and electronic records collected in the field by District staff.

a. Electronic data records collected in the field must be uploaded to project-specific Field Data folders on the Resources Management Division (RMD) Projects network drive within one week of data collection.
b. Written records of field data must be copied and submitted to the Field Services Section data management staff for conversion into electronic format and uploaded to project-specific Field Data folders.
c. A minimum of three months of field data should be archived on the field storage device to provide a redundant back-up for electronic data and deleted only when data has been loaded to the District database and archived.
d. Data should be transferred from field storage devices to the District's computer network through direct connection or portable flash drive. The District's computer network is backed up daily to preserve and protect all electronic files and data.

2. Automated Data Transmission

Includes electronic data transmitted directly to the District's computer network from remote stations by telemetry (radio, telephone, satellite or internet).

a. All telemetry is configured to transmit data on a daily or more frequent basis.
b. Data transmitted by telemetry must include data identity tag, date/time, and data result values.
c. Raw telemetered data shall be temporarily stored on the District's network.
d. Telemetered data is considered provisional until verified by manual instrumentation download and data post processing.

C. Preliminary Processing/Initial QA-QC

1. Data File Verification

Field staff should verify that data has been uploaded to the District database.

2. Field Data Archive

The District network is backed-up daily after all raw field data has been copied to the appropriate project folder.

3. Consolidation of Field Notes

Separate field records should be combined into the same monthly project folders by field staff.

4. Formatting and Conversion

Electronic data should be properly formatted and converted to standard format so that field staff can compare and verify date and time data with previously recorded site data. This ensures standardization of all field data.

5. Field Notes Referencing

Field staff should check station notes for data corrections and instrument issues. If data is corrupt or substantial discrepancies are found, the database manager will determine if data can be edited and validated or if the data is invalid and should not be uploaded to database.

6. Visual and Computational Inspection

Data should be plotted and inspected for outlying data values outside of expected or valid range.

D. Computation

1. Data Unit Conversion

Raw data may require conversion to the standard measurement units allowed in the Surface Water database. For example, data may be converted from pressure sensor units to feet of water for stage measurements.

2. Data File Adjustment

a. Missing Data – In order to maintain a continuous record where possible, missing data may be filled for short periods if data integrity is not compromised. For example: if rainfall data is missing for a period that can be confirmed to have had no rain (verified with radar, adjacent rainfall stations and/or other observational data), zero values (0.00 inches) may be entered to fill missing record period(s). Stage, discharge, and other linear forms of data may be interpolated from existing data depending on variability and length of the missing record period.

b. Data Drifting – Data recorded from a sensor that has small incremental value changes due to measurement error (drift) may be corrected by a sensor shift, in constant or linear time scale adjustment if data correction provides valid data.

c. Outlying Data – Individual data values or a limited time series of data known to be erroneous in an otherwise correct data record may be corrected to an estimated or interpolated value.

d. Corrupt Data – Data that is invalid with no identifiable compensation to correct it is considered corrupt and is not uploaded to the database.

3. Discharge Calculation

a. Manual Calculation – Calculations done either by hand or from field notes or measurements are entered into a spreadsheet for tabulation. Manual discharge calculations will be reviewed and verified by the database manager or designated staff before archiving the data in the project folder and database.

b. Software Calculation – Some flow instruments have processing capabilities that generate a total discharge result from measured cross-section velocity values. The output data file will

be reviewed and verified by the database manager or designated staff before being archived in the project folder and database.

E. Post Processing/Final QA-QC

1. Format Verification

Time step and format errors are recognized by the Surface Water database application during the upload process at this stage. Flagged errors will be reviewed and corrected.

2. Data Review

A second visual and computational inspection of data is required before being loaded into the database. Any errors encountered return the data file to the Computation step (see above, Section C). Final data review is completed by the database manager before data is uploaded to the Surface Water database.

F. Data Storage and Retrieval

1. Continuous Hydrologic Data

Continuous hydrologic data or continuous time step data, (generated by an automated recording device at a specific time interval) are loaded into the Surface Water Database after processing and final QAQC verification. The database uses a compressed text file storage system to store the large volume of data. The data may be extracted from the database through the District's Oracle Database Portal. The Standard Operating Procedures Manual for the Surface Water Database is updated on an ad hoc basis as needed and is available internally at http://iweb/isb/oracle/docs/swdb/sw_users_guide.pdf upon request.

2. Instantaneous Hydrologic Data

Instantaneous data (discrete individual measurements) collected by field staff are currently stored in project spreadsheets on the District's computer network. Final development of the Levels and Discharge Database is currently in production by the District's Information Systems Bureau. All instantaneous data will be stored in the Levels and Discharge Database when it is operational.

VI. DATA ANALYSIS AND REPORTING

The Field Service Section's goal is to provide timely and accurate water quantity and quality data to clients within the District and externally. These data are used for a variety of purposes within the Resource Management Division and throughout the District which may be summarized in broad terms as the measurement and subsequent evaluation of the status and trends of surface water and ground water resources.

A. Quantitative Hydrologic Data Reporting

Hydrologic data reporting serves many purposes. Some of the specific objectives of this monitoring program are to determine how flows and levels at sampling sites respond to changes in climactic conditions and consumptive use, provide analytical water quantity information that describes present conditions and changes over time, provide analytical water quantity information that assists water managers in developing and calibrating models for specific locations or watersheds, support the permitting process, and provide timely and high-quality data for other resource evaluations and other users.

Hydrologic reports that are routinely generated for District staff, clients and the public include:

1. Hydrologic Conditions Report

The Hydrologic Conditions Report is a quarterly summary of hydrologic conditions to meet the requirements of 373.145, FS. The report provides trends in surface water flows and levels, ground water levels, and rainfall that are intended to provide information to the public about the current state of water resources. The report is available at the NWFWMD website: http://www.nwfwmd.state.fl.us/pubsdata/hydrologicdata.html

2. Weekly Hydrologic Report

The Weekly Hydrologic Report is an update of data from real time rainfall, surface water, and ground water monitoring stations meant for internal informational use. The report is circulated weekly through an email distribution list.

3. Real-Time Hydrologic Data

Data from the District's real-time hydrologic monitoring stations are available at the following link: http://www.nwfwmd.state.fl.us/hydrology/realtime/realtime.htm. The information provided on the website is limited to the most recent 30-day period. Additional data is available upon request. Efforts have also been underway to coordinate with other agencies the District cooperates with to develop a one-stop approach.

4. Monthly Hydrologic Data

The most recent data from all the District's hydrologic monitoring stations are available at the link: http://www.nwfwmd.state.fl.us/hydrology/monthly/monthly_stations.htm. The information available from the website is limited to the most recent 30-day period. Additional data is available upon request.

5. Monthly Precipitation Summary

The District provides a monthly total rainfall table of long-term National Weather Service stations. The chart is available at http://www.nwfwmd.state.fl.us/rmd/rain/miscrain.htm. The District also produces monthly maps of estimated gauge-adjusted radar rainfall: http://www.nwfwmd.state.fl.us/hydrology/rainfall/monthly_rainfall_map.htm.

6. Ground Water Potentiometric Surface

The Resource Management Division's Ground Water Bureau has produced a biannual update of the Floridan Aquifer potentiometric surface map using data collected during the May-June quarterly ground water level monitoring program. The map is intended to provide the status of the resource and is useful for ground water model calibration purposes to assess the condition of ground water supplies and extractions. The map also provides general information to District staff and the public regarding the general status of ground water levels across the District. The latest maps, as well as historic maps, are located on the district's website: http://www.nwfwmd.state.fl.us/pubsdata/GISdata.html. These historic maps may also be coupled somewhat to long term, continuous, telemetered ground water monitoring stations strategically located throughout the District.

7. Project Specific Progress Reports

As part of its cooperative monitoring agreements with the Florida Department of Environmental Protection, Leon County, City of Tallahassee, and Bay County, the District is responsible for providing monthly or quarterly monitoring network progress reports to the respective contract manager for the City and County. The progress reports include data summaries, activities completed under the agreements, and copies of digital data collected for each program. It is the responsibility of the Field Services Section Director to ensure these deliverables are completed in a timely manner.

B. Water Quality Data Reporting

These data are used for a variety of resource evaluation and management purposes, such as the determination of status and trends in surface water and ground water quality. Some specific objectives of the water monitoring program are as follows: determine whether water quality at sampling sites exceeds state or federal water quality standards, provide analytical water quality information that describes present conditions and changes (trends), support the Total Maximum Daily Load (TMDL) process, support modeling to evaluate the transport and fate of pollutants, support the permitting process, and provide timely and high-quality data for other users.

1. Quarterly Water Quality Program Progress Reports

Under the IWRM sampling program contract with the Department of Environmental Protection, quarterly progress reports are required for the Status/GWTV, SWTV, and Springs Initiative monitoring projects. The reports summarize the tasks completed during the quarter, details of site information, and quality assurance documentation. Digital copies of the field and laboratory data and hard copies of field sheets are provided as well. It is the responsibility of the Field Services Section Director to ensure these deliverables are completed in a timely manner.

2. Econfina Creek Recreation Area Monthly Sampling Report

The laboratory results of fecal coliform samples taken at the Econfina Creek Recreation Area are submitted to the Lands Division on a monthly basis. The summary report includes the laboratory results for the monthly monitoring of District public swimming areas. The report identifies any sites that exceed the Department of Health's standards for public recreation areas.

3. DEP STORET/Impaired Waters Submittal

The District is contracted to load water quality data when it receives state funds into the Florida STORET water quality database. A report is completed quarterly and submitted to DEP's Northwest Florida STORET manager. The report includes submittal of a data disk containing an electronic copy of the water quality data.

VII. MONITORING SYSTEM CONTINUOUS IMPROVEMENT PROCESS

This section of the Monitoring Plan will be developed as part of future plan updates to discuss potential improvements of the hydrologic monitoring system. Thus the plan calls for employment of a continuous improvement program. This is an important part of the plan recognizing staff and funding are very limited and monitoring efficiency can always be improved.

A. Automated Distribution of Hydrologic and Water Quality Data

Currently, all client data requests for District hydrologic and water quality data must be completed by District staff due to the Oracle database structure that at the present time only allows internal access. In the near term, operations will continue this way. However, changing the distribution of data to a publicly available web-based structure would both allow additional time for staff to complete additional tasks as well as improve service to clients and the public. A number of options exist to achieve this goal, including, but not limited to: development of an external web-based server in-house, development by a consultant, and purchase of a turn-key system. As such efforts will continue under this monitoring plan to develop, test, and eventually implement a system that is more efficient, cost effective, and more accessible to the public. Currently there is no schedule or funding dedicated to this task but this will addressed in the future as the HMP is updated.

B. Conversion of Additional Monitoring Stations to Real-Time Telemetry

A significant improvement to hydrologic monitoring capabilities for District staff and clients would be the conversion of selected high priority monitoring stations to real-time using remote telemetry. The benefits from upgrading a monitoring station to real-time include:: 1) hydrologic data are transmitted within the hour of collection and are instantly available for use in forecasting or warning in particular during storms and flood events but also during droughts; 2) problems with equipment are detected immediately, resulting in increased data reliability and fewer missing data; 3) cost savings by reductions of staff time required for site visits and manual downloading of data on site, and 4) enhanced public use of data products. Careful selection of the location of real-time telemetered sites may also reduce the need of other manually operated sites as well as better characterize the regional response of water resources to climate and demands.

C. Increased Frequency of Instantaneous Discharge Measurements

For stream monitoring stations with discharge calculated from a stage rating, the desired number of comparison discharge measurements to begin a rating is approximately eight to twelve with an additional four to six annually for verification. Field Services staff is currently able to perform close to the minimum of this estimate for established stations. Organization of field staff to complete additional discharge measurements may improve the accuracy of the stage/discharge rating.

D. Review Unused or Underutilized Monitoring Stations

An annual review of monitoring stations and activities should be performed by management staff to determine what, if any, stations can be discontinued and removed from service due to completion of monitoring requirements. This includes fulfillment of District or “customer” needs for specific assessments or resource evaluations. This review enables staff and equipment resources to be

effectively and efficiently utilized. Accordingly, stations retained and recommended in this plan have been reviewed during development of this plan.

E. Enhancement or future needs of the Hydrologic Monitoring Network

As water demand continues to increase in northwest Florida, there are likely to be additional impacts on water resources. This includes the need for increase or enhanced monitoring to assist with the District's regulatory program as well as the District's technical programs to evaluate cumulative water resource impacts. Monitoring enhancements of ground water and surface water resources will be an essential tool for evaluating and managing resources in the future and ensuring that sufficient water resources are available to meet water supply and natural resource needs. Ground water is the primary water supply source in the District and continued monitoring of this resource is necessary to determine if aquifer levels are declining, and to what extent trends are due to climactic and anthropogenic impacts. Resource management decisions are based on the best information available, which requires efficient, comprehensive and reliable water resource monitoring systems.

F. Unmet Monitoring Needs

At this time this plan is primarily focused on existing monitoring priorities and projects. It does not attempt to address or research unmet monitoring needs including staffing and equipment for unmet monitoring needs. This will be addressed in future HMP updates and include consideration of items such as outsourcing options, purchase of new equipment, deployment of existing equipment, and existing staffing capabilities to expand the monitoring network. This discussion should include the where, when, and how the unmet needs would need to be met and may provide better assessment data for District programs. This discussion should also explain or investigate why there is an unmet need and assist with the association of funding sources to overcome monitoring deficiencies where identified.

G. Annual Work Program Plan for Monitoring

Annual review of the information collected through the District's monitoring programs and activities and reformulation of the plan is necessary to avoid redundant gauges and generally duplication of effort. Should any duplication of effort be identified, a recommendation can be made in the interest of reserving and responsibly reallocating district resources without sacrificing tasks and major deliverables. Although this process routinely takes place it is recommended that it be documented and be incorporated in the form of an annual work program and plan. This plan would also be able to identify emerging monitoring issues, evaluate the information collected to identify any data gaps affecting monitoring efforts and data processing improvements. A table listing each station, including newly planned, newly constructed, existing, areas of coverage, objectives, contract customer or "District" would facilitate meeting this purpose. This table would include a column that discusses efficiency or improvements. This table may evaluate each gage and attempt to define the importance and priority of retaining each station. The work plan may also include a second table in the same format listing possible improvements related to known needs, gaps or improved efficiencies as gathered from gauges and stations. This information would also assist in meeting the goals of recommendations D, E, and F as presented above.

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APPENDIX A: DATA COLLECTION AND QUALITY ASSURANCE

1. Instrumentation Maintenance and Operation
   a. Evaluation of data collection requirements and selection of proper equipment for data collection activity
   b. All field equipment used for data collection must be maintained according to manufacturer specifications.
   c. All field deployed data-recording instruments must be inspected and downloaded monthly.
   d. Instrumentation must be kept clean and clear of debris that may impact performance.
   e. All electronic firmware and software must be maintained at the most recent version.
   f. Instrumentation not meeting the required accuracy standards must be calibrated in the field; or if calibration fails, returned to the Field Services laboratory for testing.
   g. Instrumentation malfunction that cannot be diagnosed in the field must be brought to the Field Services laboratory for testing.
   h. Accidents or damage to instrumentation must be documented in writing.

2. Staff Training
   a. All staff must review the operation manual for all instruments prior to use and receive hands-on training by qualified personnel for all instruments prior to use.
   b. All staff must complete the USGS Surface Water Field Methods Training Class available at: http://wwwrcamnl.wr.usgs.gov/sws/SWTraining/FlashFandR/Index.html
   c. All staff must complete the FDEP Field Methods Training Class offered each fall and renew the class every five years thereafter.
   d. Staff must display proficiency operating instrumentation before working independently in the field.

3. Field Activity Documentation
   a. A Hydrologic Monitoring Field Notebook will be maintained and updated by all Field Services personnel. The Field Notebooks will contain all operational and maintenance information for equipment and site specific calibration information.
   b. Field activities and data collection must be documented on the project specific field sheet or field notebook.
   c. Electronic data collected in the field must be stored on a notebook computer hard drive, flash drive, or PDA non-volatile memory.
   d. All field activities and data collection must be documented in Local Standard Time (LST).
   e. Data collected in the field must be verified before leaving the site.

4. Instrumentation Accuracy Standards
   a. Level: +/- 0.03 feet
   b. Distance: +/- 0.03 feet
   c. Water Velocity: +/- 0.05 ft/s
   d. Temperature: +/- 0.1 C
   e. Specific Conductance: +\- 5% of reading
   f. pH: +\- 0.1 s.u.
   g. Rainfall: +\- 0.01 inch every 0.25 inch
   h. Dissolved O_2: +/- 0.3 mg/L
   i. GPS Position: <3 meters

APPENDIX B: LISTED COOPERATING AGENCIES

U.S. Geological Survey

U.S. Environmental Protection Agency

Florida Department of Environmental Protection

Bay County

Bay County Utilities

Escambia County

City of Tallahassee

Leon County

U.S. Army Corps of Engineers

Florida Geological Survey

Florida Department of Health

NWFWMD Lands Management Division

NWFWMD Regulatory Division