Final Report

National Ground Water Monitoring Network Portal Grant
Award #G18AC00076

Florida Department of Environmental Protection

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Overview of work provided

The Florida Department of Environmental Protection (FDEP) was awarded $98,112.03 in July 2018, for a two-year grant to 1) Support becoming a new data provider, 2) Support persistent data service, and 3) Fill gaps in information at National Ground Water Monitoring Network (NGWMN) sites. Due to COVID 19 pandemic response the grant was amended for a new end date, 12/30/2020, in May 2020. This funding has allowed FDEP to enter all 51 of their Ground Water Trend Network (GWT) stations into the National Registry, and to develop the web services necessary for the transfer of well construction, water levels, and lithology for these wells. Water quality data for the wells is being pulled directly from the US EPA's WQX database.

Description of the Agency's existing groundwater trend monitoring network

The GWT is comprised of 23 confined wells, 26 unconfined wells and 2 springs (Fig. 1, Table 1). The well and spring locations were selected to represent confined and unconfined aquifer conditions in each of Florida's USGS 8-digit Hydrologic Unit Code areas. A description of the FDEP Trend Monitoring Network including additional links to field measurement SOPs, and data management procedures is found here: https://floridadep.gov/dear/watershed-monitoring-section/content/trend-network. More information on the Groundwater Trend Monitoring network is available in the design document for the status and trend monitoring networks found here: http://publicfiles.dep.state.fl.us/dear/DEARweb/WMS/Reports_Docs_SOPs/Design_Docs/WMS-MonitoringDesignDocument.pdf. The confined wells are sampled quarterly for field and analytical measurements, and the unconfined wells and springs are sampled monthly for field measurements and quarterly for analytical measurements. The standard set of field measurements include; depth to water from measuring point, total depth, temperature, pH, specific conductance, turbidity, and dissolved oxygen. Quarterly water quality samples are collected for total and fecal coliforms, nutrients, major ions, color, hardness, and total dissolved solids. Annually in October, all wells are sampled for trace metals. A complete list of the measurements collected at these stations is provided in Table 2.

Information Technology (IT) Infrastructure

Data from GWT are housed in the newly developed Watershed Information Network (WIN) enterprise Oracle database. All ground water trend stations are set up in WIN along with their physical well, field, and analytical data. Data from WIN is periodically uploaded to EPA's WQX database. Additionally, lithologic data for the GWT stations are housed in the Florida Geologic Survey's GEODES enterprise database.
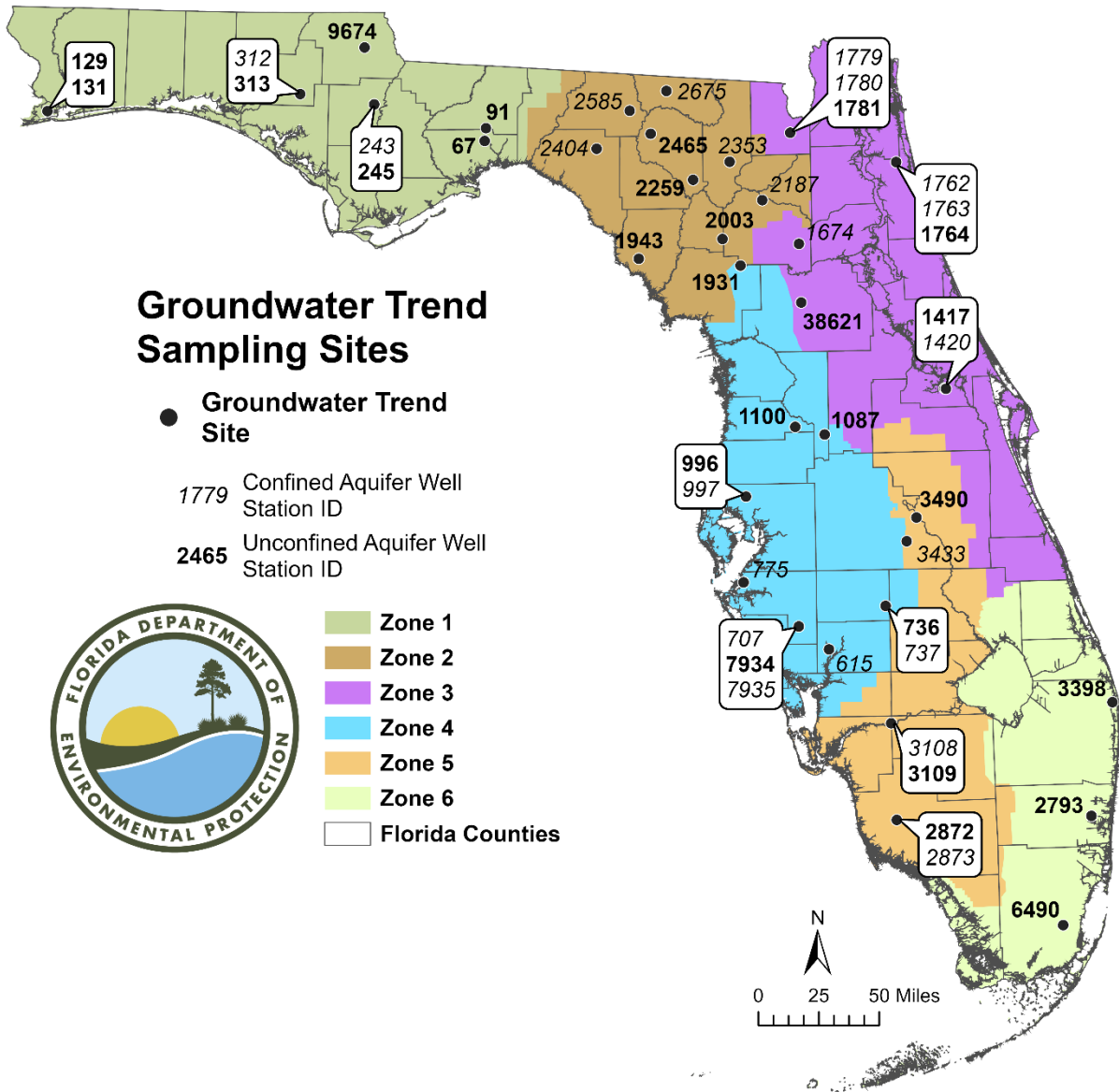
Groundwater Trend Sampling Sites

- Groundwater Trend Site
- *1779* Confined Aquifer Well Station ID
- **2465** Unconfined Aquifer Well Station ID

Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Florida Counties

Figure 1. Locations of Ground Water Trend Network Stations.

Table 1. Sites for which data are being provided via the portal

AgencyCd	SiteNo	SiteName	NatAqfrDesc	SiteType	AquiferType
FLDEP	67	WAKULLA COMPOSITE	Floridan aquifer system	SPRING	UNCONFINED
FLDEP	91	CHARLES DONAHUE	Floridan aquifer system	WELL	UNCONFINED
FLDEP	2404	-30833001	Floridan aquifer system	WELL	CONFINED
FLDEP	2585	-11011002	Floridan aquifer system	WELL	CONFINED
FLDEP	2465	-21231001	Floridan aquifer system	WELL	UNCONFINED
FLDEP	2675	21332004	Floridan aquifer system	WELL	UNCONFINED
FLDEP	2259	-61401003	Floridan aquifer system	WELL	UNCONFINED
FLDEP	2187	R19T07SEC230101	Floridan aquifer system	WELL	CONFINED
FLDEP	1763	SJ0030	Intermediate aquifer system	WELL	CONFINED
FLDEP	1762	SJ0029	Floridan aquifer system	WELL	CONFINED
FLDEP	1764	SJ0032	Surficial aquifer system	WELL	UNCONFINED
FLDEP	2353	-41734002	Floridan aquifer system	WELL	CONFINED
FLDEP	1780	BA0055	Intermediate aquifer system	WELL	CONFINED
FLDEP	1779	BA0054	Floridan aquifer system	WELL	CONFINED
FLDEP	1781	BA0056	Surficial aquifer system	WELL	UNCONFINED
FLDEP	1943	-111117007	Floridan aquifer system	WELL	UNCONFINED
FLDEP	2003	-101601002	Floridan aquifer system	WELL	UNCONFINED
FLDEP	1931	R18T11SEC3101	Floridan aquifer system	WELL	UNCONFINED
FLDEP	1674	R22T10SEC2001	Intermediate aquifer system	WELL	CONFINED
FLDEP	38621	R22T14SEC2001	Floridan aquifer system	WELL	UNCONFINED
FLDEP	1100	RDGE MNR RMP99X SH-A	Surficial aquifer system	WELL	UNCONFINED
FLDEP	1087	WITHLA. ST. FOREST G	Floridan aquifer system	WELL	UNCONFINED
FLDEP	50919	M-0501	Floridan aquifer system	WELL	CONFINED
FLDEP	50920	P-0164	Floridan aquifer system	WELL	CONFINED
FLDEP	1420	S-0038	Floridan aquifer system	WELL	CONFINED
FLDEP	1417	S-0045	Surficial aquifer system	WELL	UNCONFINED
FLDEP	3109	L-02202	Surficial aquifer system	WELL	UNCONFINED
FLDEP	3108	L-02200	Intermediate aquifer system	WELL	CONFINED
FLDEP	615	ROMP 17 SWNN	Floridan aquifer system	WELL	CONFINED
FLDEP	707	ROMP 23-1 DEEP	Floridan aquifer system	WELL	CONFINED
FLDEP	7935	ROMP 23 PZ2	Intermediate aquifer system	WELL	CONFINED
FLDEP	7934	ROMP 23 SURFICIAL	Surficial aquifer system	WELL	UNCONFINED
FLDEP	737	CREWSVILLE UP INT-AG	Intermediate aquifer system	WELL	CONFINED
FLDEP	736	CREWSVILLE SH-AGW	Surficial aquifer system	WELL	UNCONFINED
FLDEP	775	ROMP TR 8-1 INT	Intermediate aquifer system	WELL	CONFINED
FLDEP	996	CLAYWELL ELEM. SF	Surficial aquifer system	WELL	UNCONFINED
FLDEP	997	CLAYWELL ELEM. FL	Floridan aquifer system	WELL	CONFINED
FLDEP	3433	POF-0008	Floridan aquifer system	WELL	CONFINED
FLDEP	3490	KISSPARK	Surficial aquifer system	WELL	UNCONFINED

AgencyCd	SiteNo	SiteName	NatAqfrDesc	SiteType	AquiferType
FLDEP	6490	27-3	Biscayne aquifer	WELL	UNCONFINED
FLDEP	2872	C-00972	Surficial aquifer system	WELL	UNCONFINED
FLDEP	2873	C-00973	Intermediate aquifer system	WELL	CONFINED
FLDEP	2793	G-2364	Biscayne aquifer	WELL	UNCONFINED
FLDEP	3398	PBS-S44	Surficial aquifer system	WELL	UNCONFINED
FLDEP	245	BLOUNTSTOWN SURFICIAL	Surficial aquifer system	WELL	UNCONFINED
FLDEP	243	BLOUNTSTOWN FLORIDAN	Floridan aquifer system	WELL	CONFINED
FLDEP	9674	JACKSON BLUE SPRING SIPQ	Floridan aquifer system	SPRING	
FLDEP	131	WELLER AVE SHALLOW	Coastal lowlands aquifer system	WELL	UNCONFINED
FLDEP	129	WELLER AVE MPZ	Coastal lowlands aquifer system	WELL	UNCONFINED
FLDEP	312	USGS 422A NR GREENHD	Floridan aquifer system	WELL	CONFINED
FLDEP	313	USGS 422B NR GREENHD	Surficial aquifer system	WELL	UNCONFINED

Table 2. Water quality and measurement analyte list

This table reflects the indicator list effective August 1, 2018.
T = Total sample (unfiltered sample); D = Dissolved sample (filtered sample); X = Other sample or measurement;
* Collected once a year per site.
**Collected quarterly per site.
SM= *Standard Methods for the Examination of Water and Wastewater*

Indicator	Analysis Method	Ground Water
pH	DEP-SOP-001/01 FT 1100	X
Temperature	DEP-SOP-001/01 FT 1400	X
Specific Conductance	DEP-SOP-001/01 FT 1200	X
Dissolved Oxygen	DEP-SOP-001/01 FT 1500	X
Turbidity	DEP-SOP-001/01 FT 1600	X
Total Depth	Manual/electronic measuring device	X
Micro Land Use	WMS Sampling Manual (01/2016), Sec. 4	X*
Depth to Water from mpe	DEP-SOP-001/01 FS 2211	X
Total Coliform	SM 9222 B	T**
Fecal Coliform	SM 9222 D	T**
Total Organic Carbon	SM 5310 B-00	T**
Nitrate + Nitrite	EPA 353.2 Rev. 2.0	T**
Ammonia	EPA 350.1 Rev. 2.0	T**
Total Kjeldahl Nitrogen	EPA 351.2 Rev 2.0	T**
Total Phosphorus	EPA 365.1 Rev 2.0	T**
Orthophosphate	EPA 365.1 Rev 2.0	D**
Chloride, Sulfate	EPA 300.0 Rev 2.1	T**
Fluoride	SM 4500 F-C-97	T**
Calcium, Magnesium, Potassium, Sodium	EPA 200.7 Rev. 4.4	T**
Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Silver, Thallium, Zinc	EPA 200.7 Rev. 4.4 / 200.8 Rev. 5.4	T*
Alkalinity	SM 2320 B-97	T**
Hardness	SM 2340 B	T**
Turbidity (Lab)	EPA 180.1 Rev. 2.0	T**
Specific Conductance (Lab)	EPA 120.1	T**
Color (True)	SM 2120 B	T**
Total Dissolved Solids	SM 2540 C-97	T**

Types of data

Water quality data for assessment of region-wide groundwater resources are being collected from the GWT monitoring network's 2 springs and 49 wells. Quarterly water quality data is collected at all GWT sites. Water-level data is typically collected monthly at the 26 unconfined aquifer wells and collected quarterly at the 23 confined aquifer wells. However, beginning in March 2020 due to the COVID-19 pandemic, field data collection for all stations, including water levels, has been reduced to quarterly

sampling along with the water quality data collection. Lithology for the GWT well stations was determined by the Florida Geological Survey during 2020 and 2021 and has been loaded into GEODES.

Data and Metadata Standards

FDEP's GWT network data are stored natively in an enterprise relational database management system, Generalized Water Information System (GWIS). The GWIS data elements conform to the Environmental Data Standards Council's (EDSCs) and the Federal Geographic Data Committee (FGDC) standards. A data dictionary of all GWIS elements is maintained and allowed data element mapping to those elements necessary for the well registry. Data are reviewed and approved according to FDEP standard operating procedures and program quality assurance guidance. Water-level data are collected manually using either an electronic measuring device or wheeled tape measure. The data collection procedure requires that two water-level measurements are made that are within 0.01 feet. As the native data are collected from the well measuring point, it was necessary to write a procedure that uses this depth and each station's measuring point elevation and land surface elevation to calculate depth to water from land surface elevation for transfer to the NGWMN.

Plans for Archiving and Preservation of Access

Water-level data are entered into an electronic form using the ArcGIS online Survey123 platform while staff are on site or when staff return to the office if issues occur with the electronic forms. They are then exported from Survey123 with the remainder of the field generated data and saved as a .csv file. Once saved the data are transferred to the GWIS database. Water quality samples are collected then shipped to the FDEP laboratory for analyses. Once the analyses are completed and authorized by FDEP lab staff they are transferred directly to the GWIS database via a chronological job. The field forms and sample custody sheets are stored electronically. These electronic field sheets and the GWIS database itself are backed up as part of FDEP's routine system maintenance.

List of Minimum Data Elements for USGS Well Registry

Well Registry Minimum Data Elements (Information hand entered Well Registry by Liz Miller):

- Agency Identifier
- Site Number
- Site Name
- Country
- State
- County
- Latitude
- Longitude
- Horizontal Datum
- Lat/Long Method

- Lat/Long Accuracy
- Altitude (Land surface elevation)
- Altitude Unit
- Altitude Datum
- Well Depth
- Well Depth Units
- National Aquifer Code
- Local Aquifer Code
- Site Type
- Aquifer Confinement Status

Conditionally Required Data Elements for Registry:

- If in Water-level sub-network:
    - Water-level network name
- If Water-level baseline:
    - Water-level well type
    - Water-level well characteristics
    - Water-level well purpose (Water-level well purpose notes optional)
- If in Water quality sub-network:
    - Water quality network name
- If Water quality baseline:
    - Water quality well type
    - Water quality well characteristics
    - Water quality well purpose (Water quality well purpose notes optional)

Water Quality Minimum Data Elements (Information pulled directly from WQX using Monitoring Location ID's provided to Candice Hopkins by Liz Miller. No web service needed)

- Monitoring Location Identifier
- Activity Identifier
- Activity Type Code
- Activity Media Name
- Activity Start Date
- Activity Start Time
- Time Zone Code
- Characteristic Name
- Result Measure Value
- Measure Unit Code
- Result Sample Fraction Text
- Result Detection Condition Text
- Method Identifier
- Method Identifier Context

- Method Name
- Result Value Type Name
- Result Comment Text

Well construction, water-level and lithology provided via xml web service
https://prodenv.dep.state.fl.us/nationalwaterservice/swagger-ui.html

Well Construction Minimum Data Elements (provided via xml web service wells-controller):

- Site Number
- Agency ID
- Agency Name
- Casing Depth From
- Casing Depth From Unit
- Casing Depth To
- Casing Depth To Unit
- Casing Diameter
- Casing Diameter Unit
- Casing Material
- Screen Depth From

Well Construction Minimum Data Elements continued:

- Screen Depth From Unit
- Screen Depth To
- Screen Depth To Unit
- Screen Diameter
- Screen Diameter Unit
- Screen Material

Water-level Minimum Data Elements (provided via xml web service water-levels-controller):

- Monitoring Location ID
- Activity Start Timestamp
- Activity End Timestamp
- Activity Time Zone
- Analysis Method
- Result Value
- Result Unit
- Accuracy
- Accuracy Unit

Well Lithology Minimum Data Elements (provided via xml web service lithology-controller)

- Monitoring Location ID
- Lithology Name
- Lithology Description
- Lithology Observation Method
- Lithology Unit Begin Depth
- Lithology Unit End Depth
- Lithology Depth Unit

Notes on any sites that have missing required data elements

Well SITE NUMBER - 2003, SITE NAME – 101601002, is failing and was not sampled between 1998 and early 2020. It was redeveloped in late 2019 and is now being sampled again. However, FDEP is planning on installing a new well nearby to draw water from the same zone as the existing well. Once the well is installed and we are satisfied with the water quality results we will transition to the new well.

Description of the web services used or installed for this project

As mentioned in the List of Minimum Data Elements the development of three webservices was necessary to transfer the required FDEP GWT data to the NGWMN Portal. Each of these web services required translations of FDEP data elements to NGWMN data elements.

The water quality data did not require a web service. These data are pulled directly from the US EPA's WQX via each station's monitoring location ID. The NGWMN fields were already named to map easily to WQX.

The three web services are for well construction information (from WIN), water level data (from WIN) and lithology (from GEODES). All three xml web services can be found at **https://prodenv.dep.state.fl.us/nationalwaterservice/swagger-ui.html**.

List of laboratories and their accreditation for analyzing properties and constituents included in the monitoring program

All analytical analyses are performed by the FDEP laboratory located at the Bob Martinez Center, 2600 Blair Stone Road, Tallahassee, FL 32399. The lab is certified by the Florida Department of Health Environmental Lab Certification Program per National Laboratory Accreditation Program (NELAP) standards (lab certification ID # E31780).