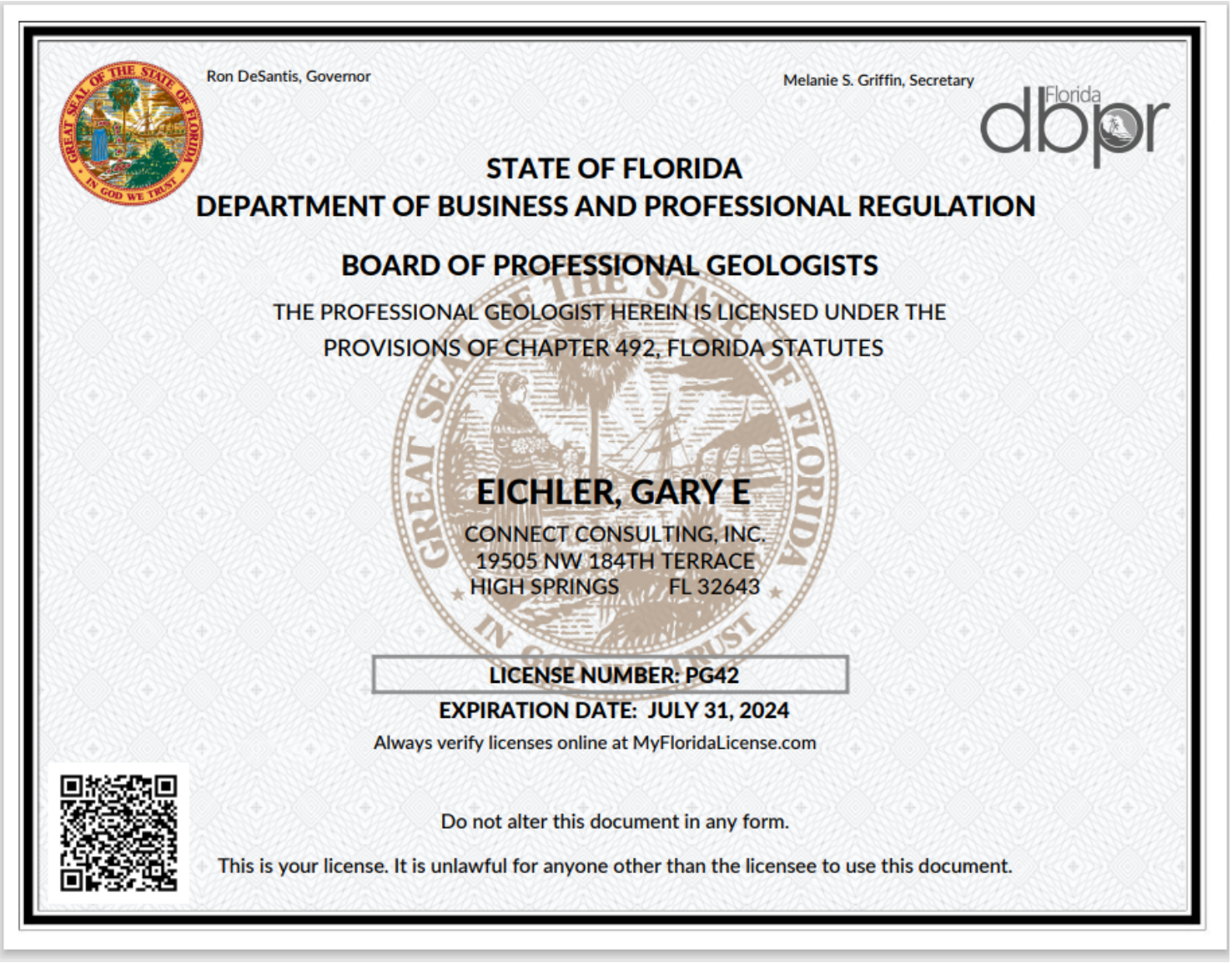
The Critical Importance of The Sand and Gravel Aquifer

Gary E. Eichler, P.G.

Connect Consulting, Inc.

Adapted/Modified from a presentation originally presented by Scott Sigler, PG



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Presenter:
Gary E. Eichler, PG
CCI for FRUS

Twice Combat Wounded Veteran Vietnam Honorable Discharge US Marine Corps 1969

BS- Construction & Geology Syracuse University 1972

MS-Geology w/ minor in Civil Engineering, University of Florida 1974

Professional Geologist #42
48 years of experience in water supply development and well field contamination in Florida

Developed over 1 billion gallons per day of well field capacity in Florida

- Investigated over 50 sites of ground water and well field contamination throughout the United States

Co-founder of water supply development company

- Comprehensive Plan Policy 1.1.D.5 • The extraction of natural resources shall be permitted only where compatible with adjacent land uses and when minimal resource degradation will occur. Further, resource extraction shall be strictly prohibited within a 500-foot zone around public supply potable water wells and the East Milton Area Wellfield Protection District. Note: The determination of minimal degradation, if necessary, will be made in cooperation with the appropriate State or Federal Agency regulating resource extraction activities. Further, resource extraction in environmentally sensitive areas which cannot be restored shall be prohibited. For the purposes of this policy, routine silvicultural and agricultural activities are not considered resource extraction activities.

- **EXISTING COMPREHENSIVE PLAN POLICY 1.1.D.5**

The establishment of the original Wellfield Protections were deliberative, and data driven. We have not seen any data presented to the SRCC since the original establishment that could justify a change.

- Between 2010 and 2013, Santa Rosa County studied and implemented the East Milton Area Wellfield Protection District located in East Milton.
- The purpose of this overlay district is to provide an added degree of **protection** for the aquifer recharge area in the vicinity of the **Fairpoint Regional Utility System and East Milton Water System wellfield** .
- Together these water systems provide water to approximately **50 percent of the county population**.
- It is the intent of this overlay district to protect twelve (12) **present and future public potable water supply** wells and wellfields from water quality degradation by contamination from regulated substances.

BACKGROUND

The Santa Rosa County Comprehensive Plan and Land Development Code currently prohibit resource extraction such as borrow pits within the East Milton Wellfield Protection Area. Borrow pits were prohibited from the East Milton Wellfield Protection District because of the particularly vulnerable nature of the aquifer in this area and the hazards that borrow pit activities pose to the County's drinking water supply.

Fairpoint Regional Utility System

- The Fairpoint Regional Utility System was established in response to the Floridan Aquifer Resource Recovery Plan and was designed to provide potable water to the portion of Santa Rosa County located within the Water Resource Caution Area utilizing the Sand- and Gravel Aquifer as an alternate water source.

- Production wells have been developed along with a pipeline in order to develop water production from the inland Sand and Gravel Aquifer for use in the coastal portions of the County.

- This development alleviates pumping pressures in the WRCA or from the coastal Floridan Aquifer.

- The Fairpoint Regional Utility System sells water to the City of Gulf Breeze, to the Holley Navarre Water System, the Midway Water System, and the Navarre Beach Water System.

The NWFWMD Recently Issued a NEW Consumptive Use Permit for FRUS

- The new CUP expires in 2032
- The annual allocation is annual average day withdrawal of 6,734,000 GPD
- The 2022 annual average daily water use is ~6,000,000 GPD
- This allocation was based on projections of all entities served by FRUS over the next 10 years
- There are currently no plans for additional expansion to the FRUS service area within this 10-year planning period
- All entities served by FRUS are required to pursue reuse and conservation measures
- Future use of the Floridan aquifer is currently restricted by the NWFWMD
- The CUP has 30 conditions which are part of the permit, including Condition no. 25 which states:
  The Permittee, by October 31, 2025, shall conduct a feasibility study in coordination with Midway Water System to evaluate options to reduce the amount of water being withdrawn from the Floridan aquifer. The Permittee, by April 30, 2026, shall submit the results of the feasibility study to reduce the demand of Midway Water System's Floridan aquifer wells and receive more sand-and-gravel aquifer water from FRUS. The study shall include an implementation schedule and projected reductions of Midway Water System's Floridan aquifer water use.
- The Sand and Gravel aquifer is the only viable source of potable water

Figure 1-Designated Water Resource Caution Area
Modified from: https://nwfwmd-open-data-nwfwmd.hub.arcgis.com/datasets/water-resource-caution-area-1

Water Resource Caution Area

Santa Rosa County - Navarre to Gulf Breeze

Santa Rosa Island-Pensacola Beach

The aquifers in this region do not contain sufficient volumes of fresh potable water to sustain the population there.

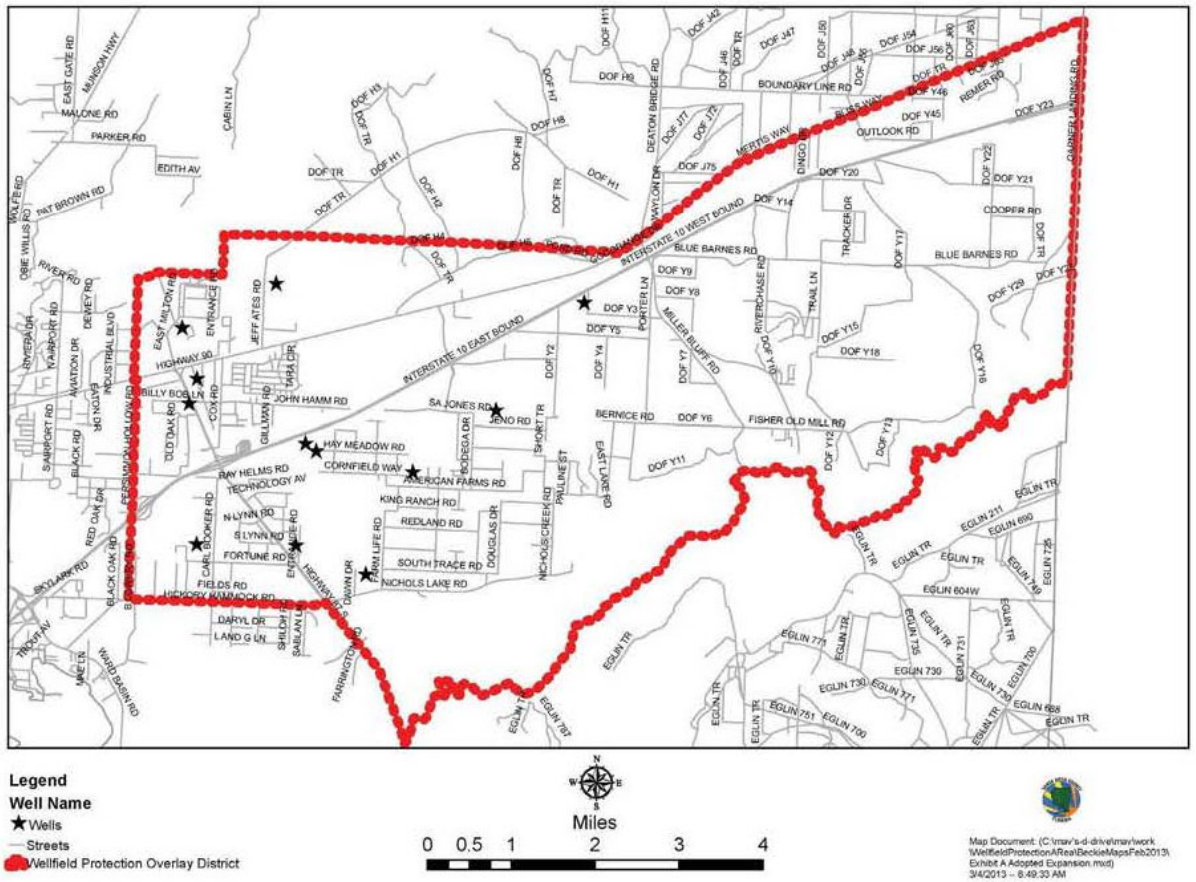


Figure 2 Wellfield protection Area

CURRENT WPA

Boundaries of Current Wellfield Protection District

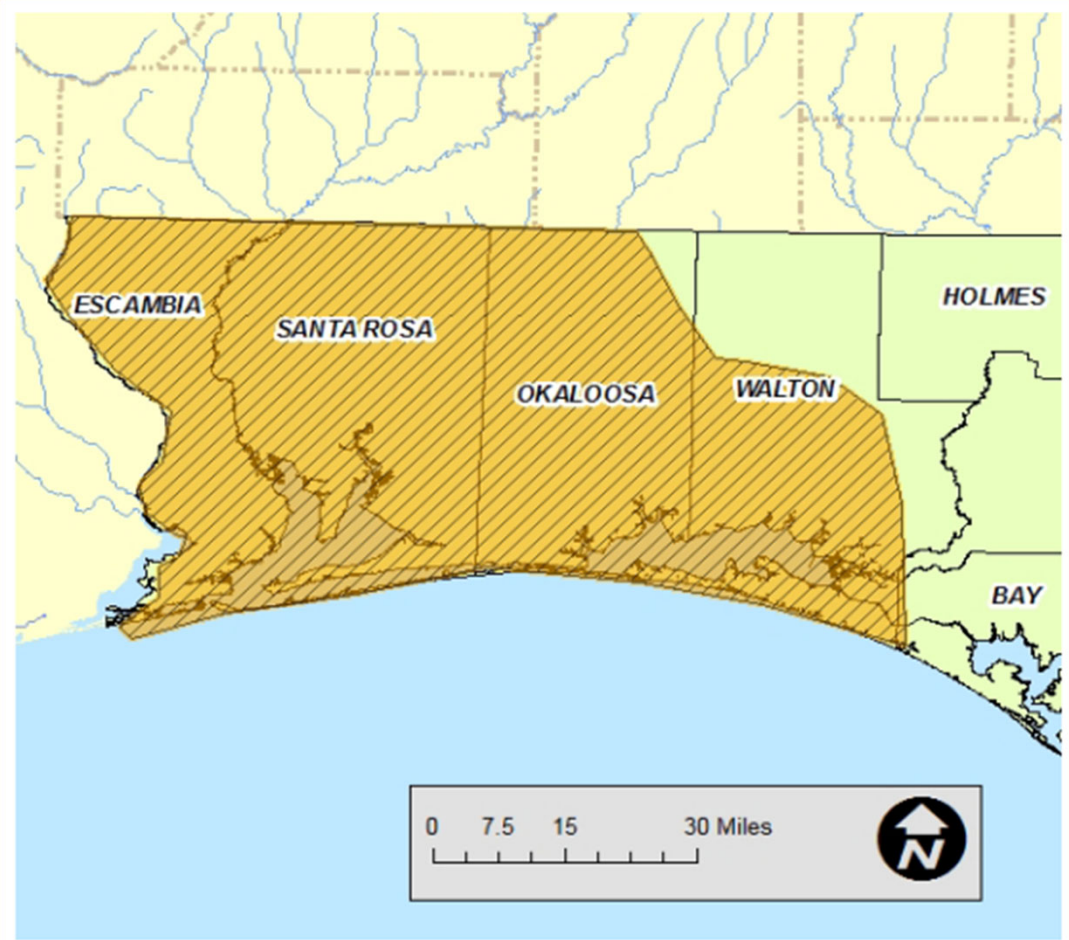


Figure 3- Aerial Extent of the Sand and Gravel Aquifer

- The SGA is limited in aerial extent but locally an important source of fresh, potable water.
- The SGA consists of Fluvial(river) deposits of silt, clay, sand and gravel.
- The SGA is mostly unconfined and is recharged directly from rainfall.
- In some areas, where clay lens occurs, the SGA is semi-confined and there are some areas where these clay layers result in a “perched” water table.

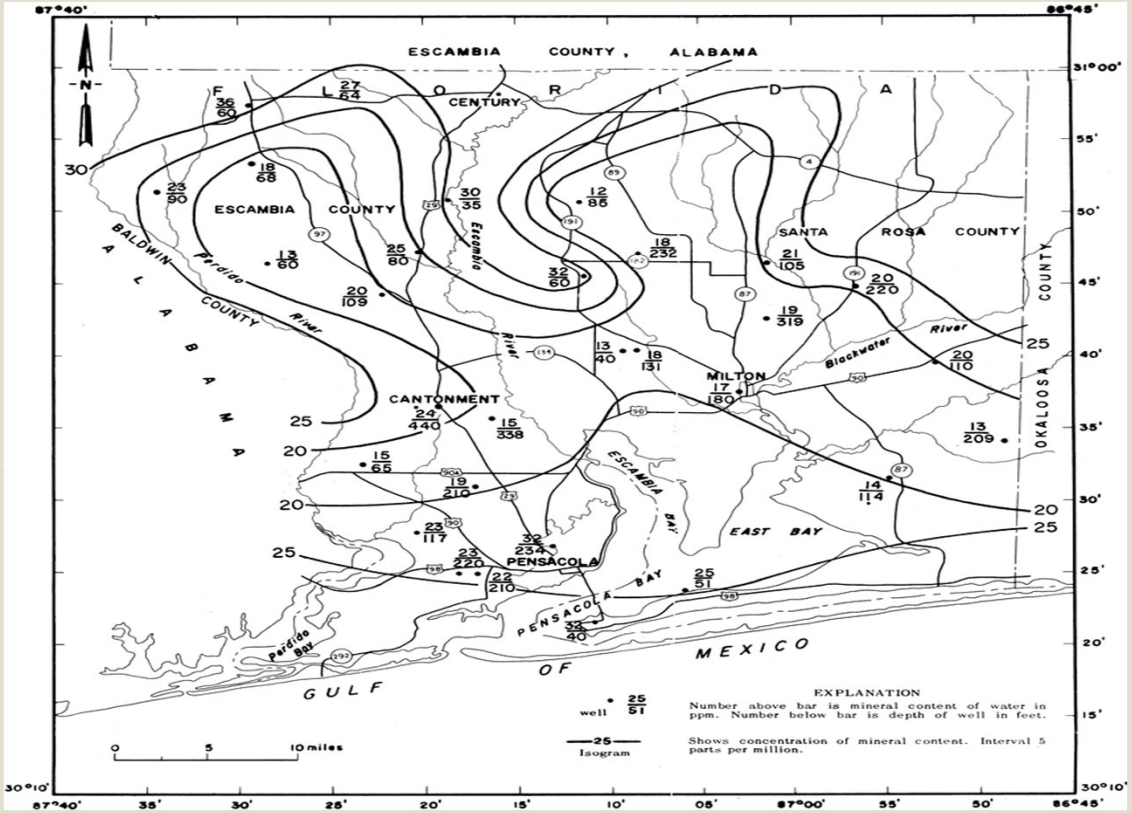
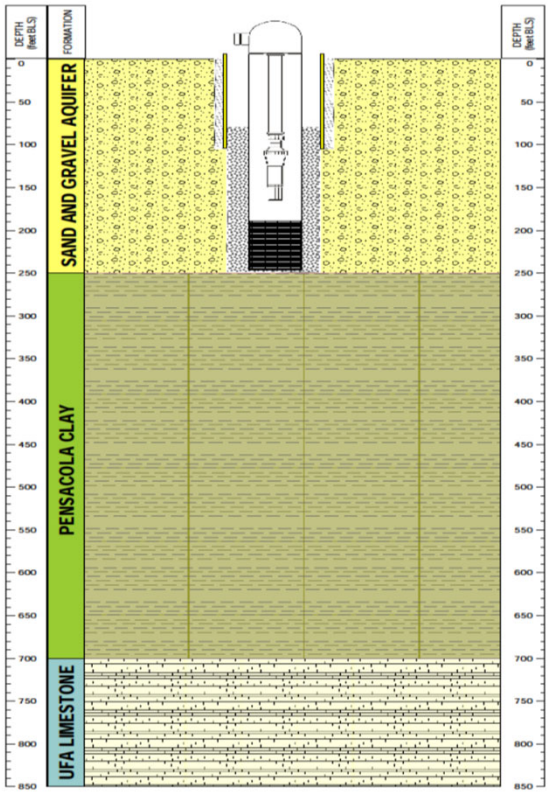


Figure 4- Potentiometric Map Showing the Direction of Groundwater Flow in the Region



- The SGA is recharged directly from rainfall. This fact is also one of the SGA's biggest vulnerabilities, meaning not only does rainfall recharge the aquifer but any and all contamination that occurs at or near the surface also makes its way to the SGA. Once introduced into the aquifer, contamination flows naturally to the south and/or is diverted and captured by a pumping well.

- The FRUS wells are high capacity with pumping rates between 800 to 1000 gallons per minute (GPM).

- There is no natural protection from this vertical migration by the occurrence of a continuous stratum of very low permeability or impermeable clay.

Figure 5- Illustration of a Typical FRUS Well Construction Detail

ID	Well Name	Water System	Cased Depth	Total Well Depth (ft.)	Well Use
1	EMWS#1	East Milton	200	246	Public Supply
2	EMWS#2	East Milton	143	183	Public Supply
3	EMWS#4	East Milton	200	260	Public Supply
4	EMWS#5	East Milton	170	270	Public Supply
5	FRUS #1	FRUS	185	275	Public Supply
6	FRUS #3A	FRUS	**135**	215	Public Supply
7	FRUS #3B	FRUS	**135**	215	Public Supply
8	FRUS #4	FRUS	170	260	Public Supply
9	FRUS #5	FRUS	140	220	Public Supply
10	FRUS #6	FRUS	170	260	Public Supply
11	FRUS #7B Test	FRUS	170	260	Test
12	EMWS#6 Test	East Milton	160	210	Test

Sand Mine Activities

- Excavation and Removal of Native Cover

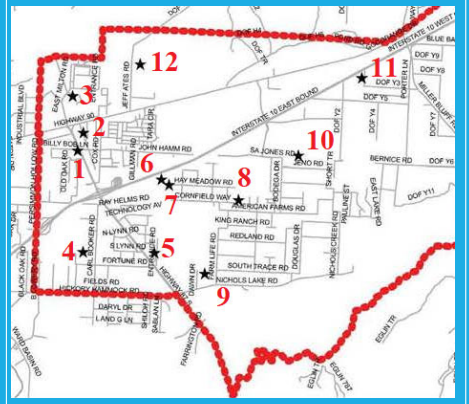
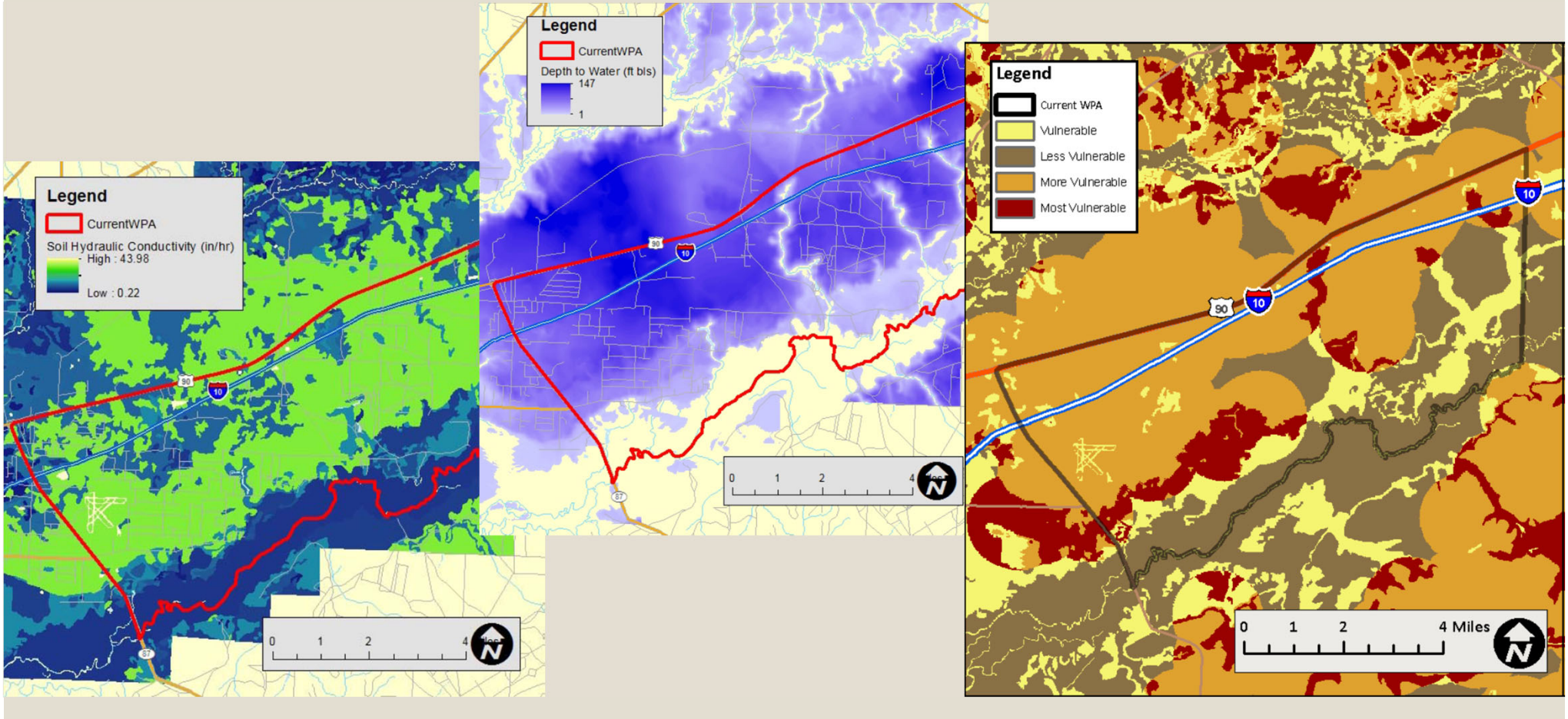
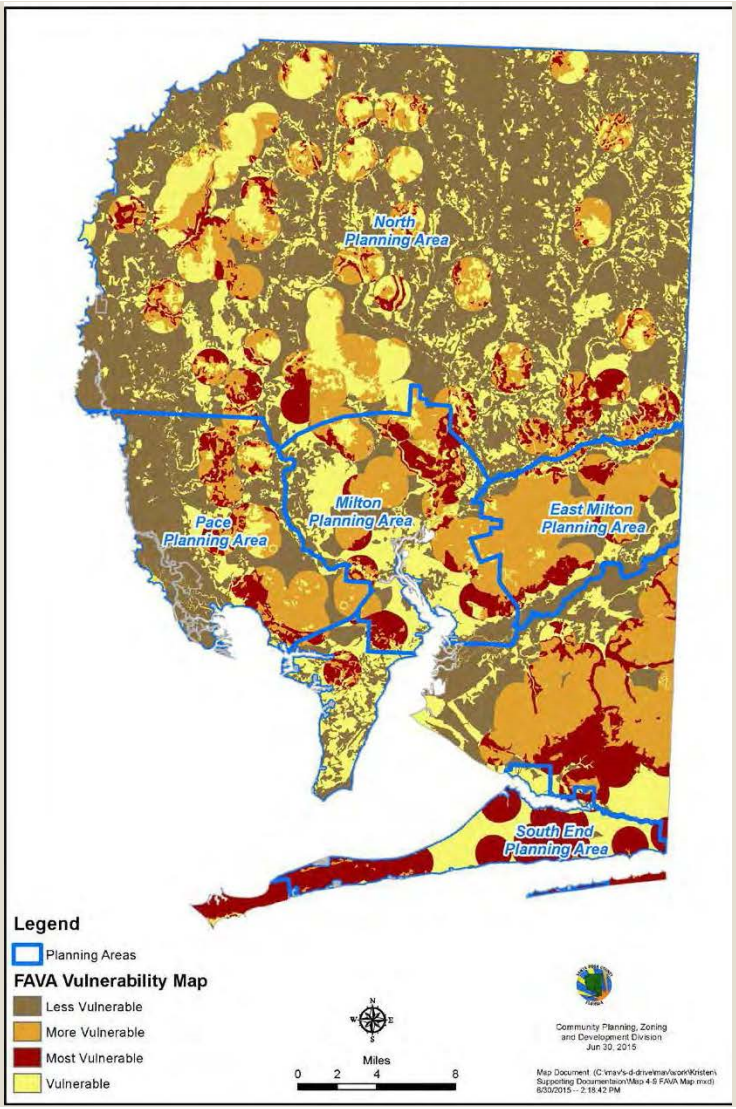


Figure 6- Assessment of the Extent & Effectiveness of the WPA & Wellfield Protection Ordinance (Ashby and Baker, June 2011 for Santa Rosa County BOCC)





Florida Aquifer Vulnerability Assessment – Santa Rosa County

The East Milton Wellfield Protection Area is Unique

Compared to other inland portions of the county, nearly the entire East Milton Planning Area is rated as More Vulnerable to Most Vulnerable.

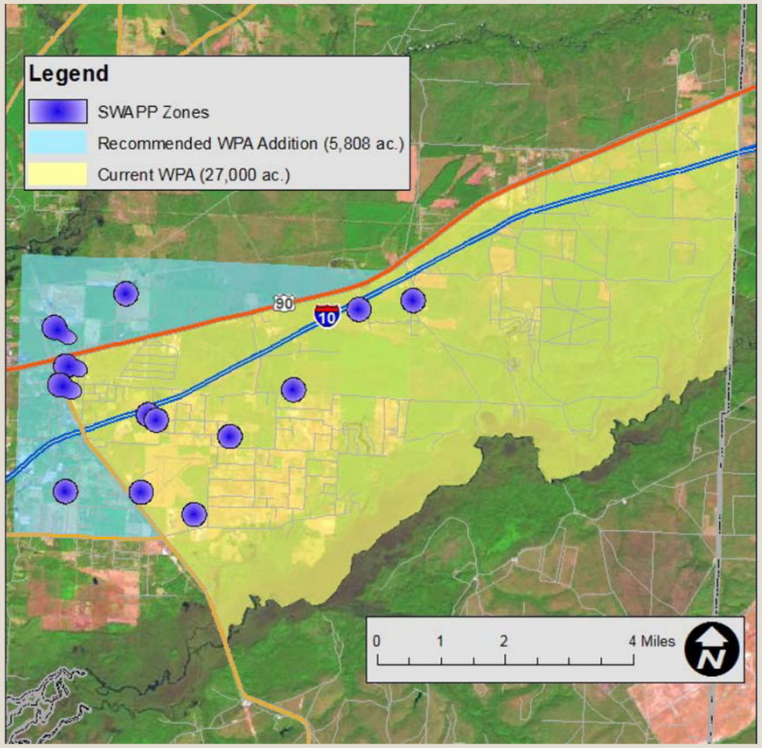


Figure 8- From *Assessment of the Extent and Effectiveness of the WPA & Wellfield Protection Ordinance* (Ashby and Baker, 2011).

FAVA SUGGESTED LAND USE LIMITATIONS:

1) Landfills, resource extraction areas, and the like;

2) Underground fuel storage facilities;

3) Projects with impervious cover of 50% or more;

4) The bulk storage, handling, or processing of materials listed as Hazardous or Extremely Hazardous on Table 302.4 of 40 CFR and Appendix A to 40 CFR, part 355, respectively;

5) Projects that require the storage, use, handling, production, or transportation of restricted substances such as toxic chemicals, petroleum products, hazardous/toxic wastes, industrial chemicals, medical wastes, and the like;

6) Wastewater/reclaimed water spray fields, land application sites, percolation ponds, and similar facilities, unless treated to drinking water standards;

7) Mines or mining activities;

8) **Excavation of waterways or drainage facilities which intersect the water table**

9) Onsite septic systems for residential developments with greater than 100 planned housing units

Maximum Contaminate Levels(MCLs) & Travel Times

- The US Environmental Protection Agency (USEPA) and the Florida Department of Environmental Projection (FDEP) regulates ground water quality and have established Maximum Contaminant Levels (MCLs) for numerous chemical compounds known to have contaminated ground water all across Florida and the US.
- Many of the MCLs established for these compounds are in the very low Parts per Billion (PPB) or even some of the latest regulated compounds in the Parts per Trillion (PPT) range.
- The establishment of MCLs is an ongoing and continuous process with new compounds added to the list every year.
- The point being that if one or more of these compounds is released on the ground, it WILL make it to the SGA. Once a compound makes it to the SGA, it will Likely be pulled towards a pumping well.
- Travel times as determined from groundwater flow models do not ensure protection of well. Groundwater quality given the unconfined nature of the aquifer, the nature hydraulic gradient of the aquifer, the influence of pumping wells and the extremely low MCLs for various common contaminants

Compounds Commonly Found as Groundwater Pollutants

Petroleum contaminants	
* Benzene	0.005 mg/l
* Toluene	1 mg/l
* Ethylbenzene	0.7 mg/l
* Xylenes (total)	10 mg/l
* Polycyclic Aromatic Hydrocarbons	0.2 ppb

Metals	
* Arsenic	0.010 mg/l
* Antimony	0.006 mg/l
* Cadmium	0.005 mg/l
* Chromium	0.1 mg/l
* Copper	1.3 mg/l - AL
* Lead	0.015 mg/l - AL
* Selenium	0.05 mg/l

Chlorinated solvents	
* Tetrachloroethylene	0.005 mg/l
* Trichloroethylene	0.005 mg/l
* Carbon tetrachloride (CT)	0.005 mg/l
* 1,1,1-trichloroethane	0.2 mg/l
* 1,2-dichloroethane	0.005 mg/l
* Vinyl chloride	0.002 mg/l

PFAS (Perfluorinated alkylated substances)	
* PFOA (Perfluoroactoanoic acid)	0.004 ppt
* PFOS (Perflouroctane sulfonic acid)	0.02 ppt
* GenX chemicals (HFPO dimer acid and its ammonium salt)	10 ppt
* PFBS (Perfluorobutane sulfonate)	2,000 ppt

Sand Mine Activities

- Excavation and Removal of Native Cover
- **Heavy Machinery Use**
  - **Fuel Storage**
  - **Refueling Activities**
- Alternative Site Uses
- Reclamation
  - Off Site Materials
  - Organic Decomposition
  - Leachate

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Unsuitable Soils and Demolition Materials

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Oxygen depleted, chemically reduced, groundwater leaches metals from soil; commonly iron and arsenic.

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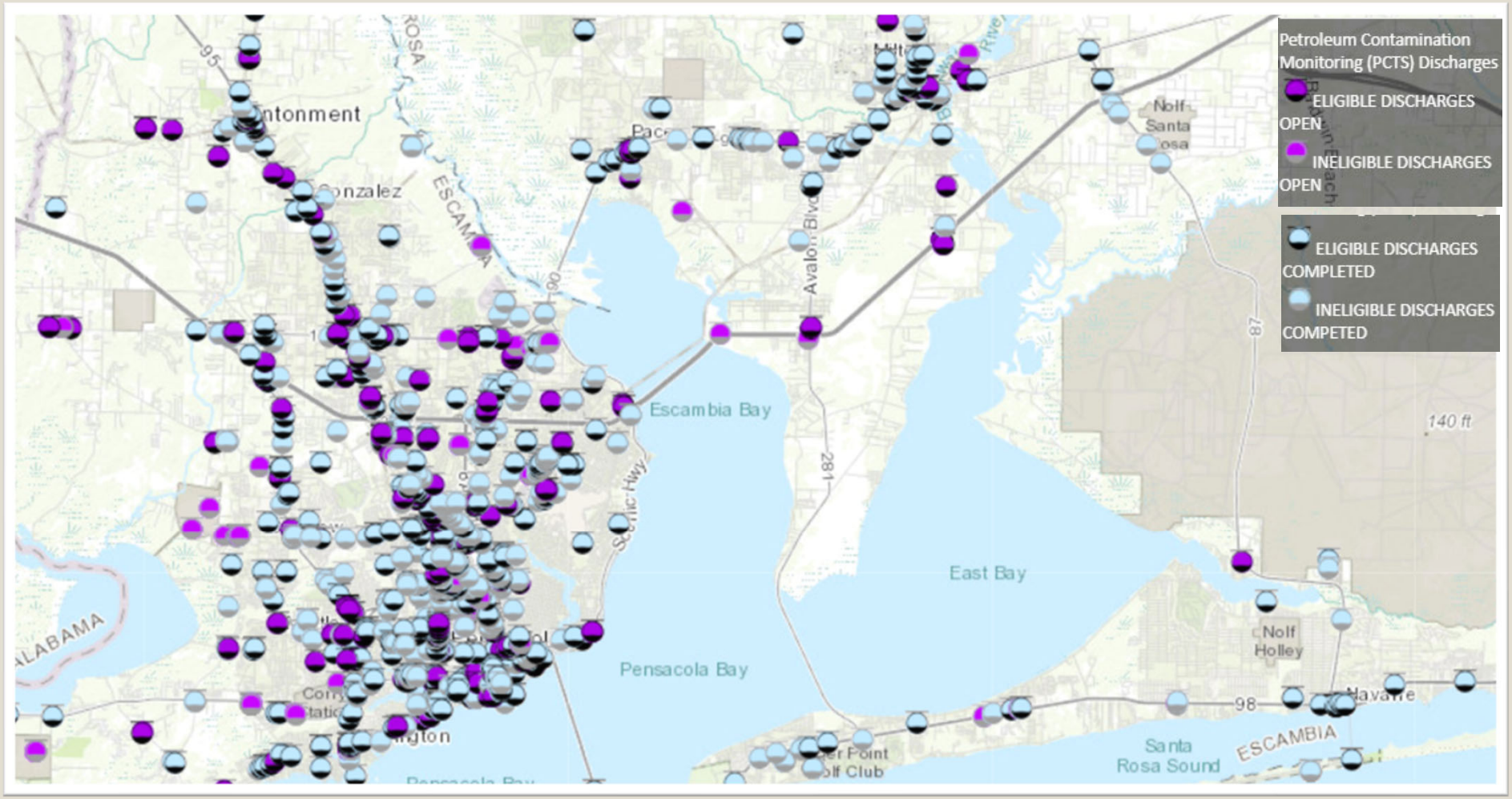
The point of all this is the Sand and Gravel Aquifer (SGA) is already considered an Alternative Water Source (AWS) having replaced wells completed into the deeper Floridian Aquifer which were experiencing water quality degradation. The SGA is extremely vulnerable to near surface contamination and given the cost of treatment and/or developing an alternative AWS, extraordinary measures should be employed to protect the SGA.



FDEP Map Direct 11/10/20

Concrete Crushing and Aggregate Storage

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Asphalt Milling Stockpile

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Uninspected Demolition Materials

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Decomposing Organic Material (Wood or Rubbish) Consumes Oxygen. The source of the Organic material has no bearing on the result.

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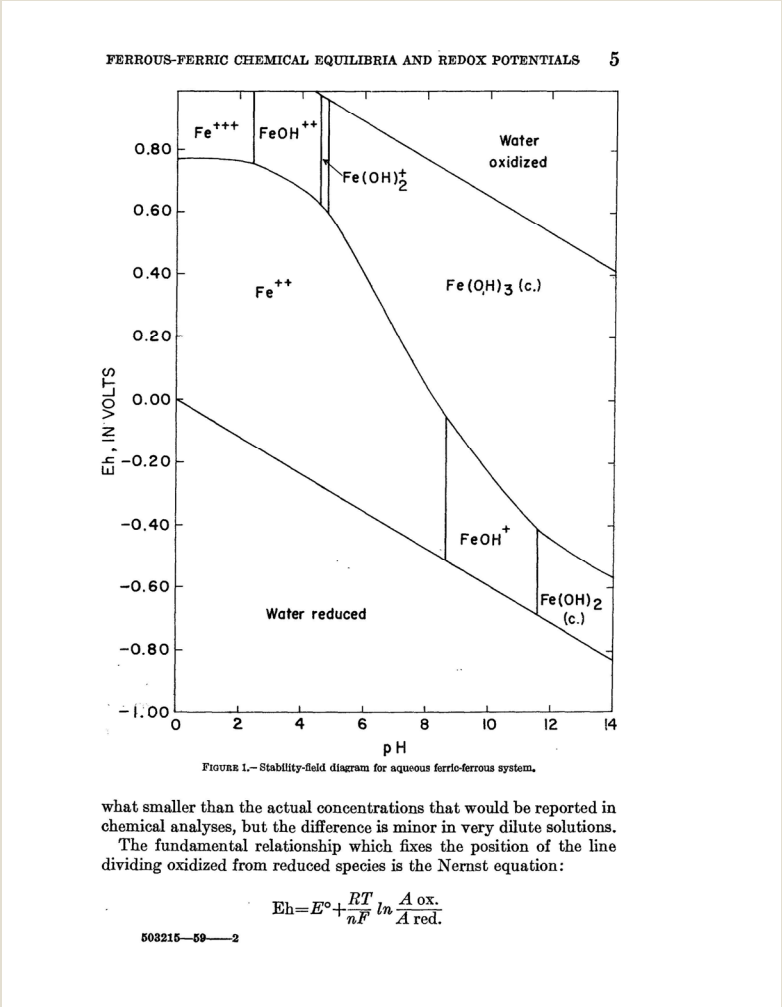


FERROUS-FERRIC CHEMICAL EQUILIBRIA AND REDOX POTENTIALS 5

FIGURE 1.—Stability-field diagram for aqueous ferric-ferrous system.

what smaller than the actual concentrations that would be reported in chemical analyses, but the difference is minor in very dilute solutions.

The fundamental relationship which fixes the position of the line dividing oxidized from reduced species is the Nernst equation:

$$Eh = E^\circ + \frac{RT}{nF} \ln \frac{A\ \text{ox.}}{A\ \text{red.}}$$

503215—59——2

Nolan, T., Chemistry of Iron in Natural Water, U.S. Geological Survey Water Supply Paper 1459, United States Department of the Interior, 1962

Regional Groundwater

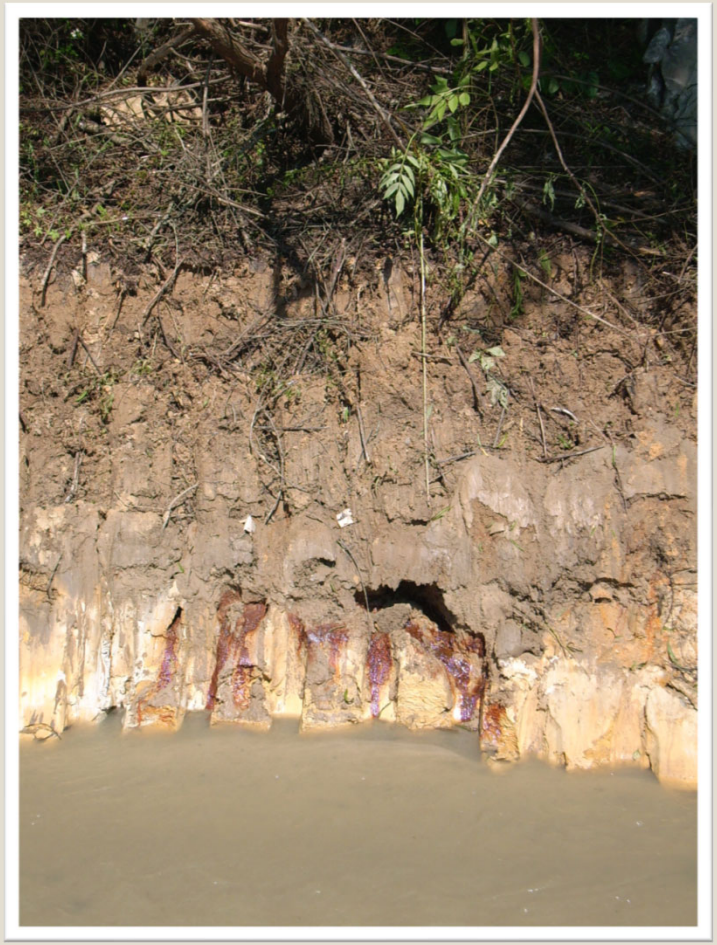
- Mildly Acidic –

  pH = 5.5

- Local Municipalities Add Lime to the water to buffer the pH to drinking water standards

  pH 6.5-8.5

- Under low oxygen and acidic pH conditions, metals in the soil become soluble.



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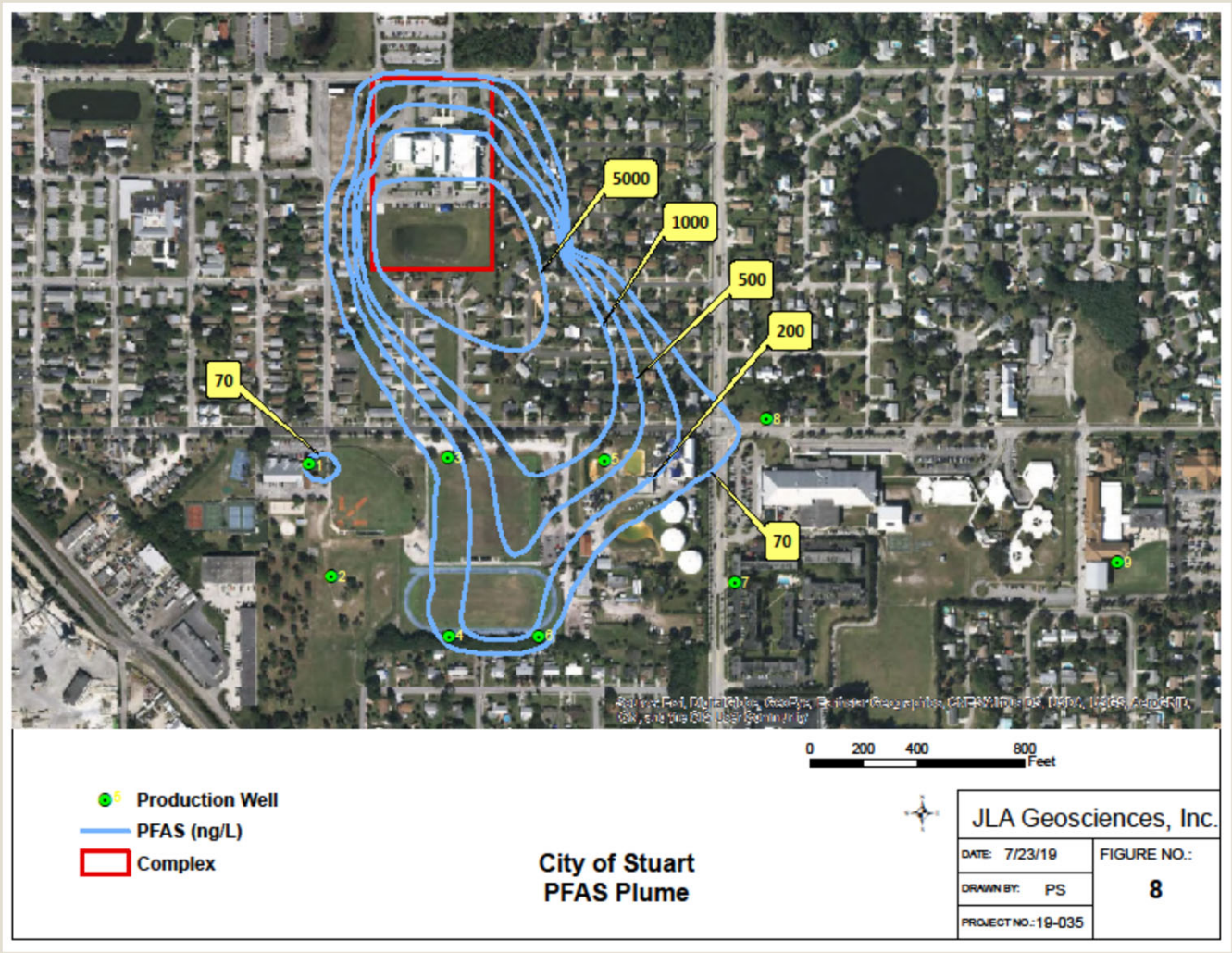
5000
1000
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Feet
Production Well
PFAS (ng/L)
Complex
City of Stuart
PFAS Plume
JLA Geosciences, Inc.
DATE: 7/23/19
FIGURE NO.:
8
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PROJECT NO.: 19-035

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Threats to the East Milton Wellfield Protections