Priority Focus Area for Gemini Springs

Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

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More Information

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Introduction

Under the Florida Springs and Aquifer Protection Act, the Florida Department of Environmental Protection (DEP) is required to delineate priority focus areas (PFAs) for all Outstanding Florida Springs (OFS) identified as impaired. According to the Florida Springs and Aquifer Protection Act, adopted by the Florida Legislature in 2016 (Chapter 373, Part VIII, Florida Statutes [F.S.]):

> *" 'Priority focus area' means the area or areas of a basin where the Floridan Aquifer is generally most vulnerable to pollutant inputs where there is a known connectivity between groundwater pathways and an Outstanding Florida Spring, as determined by the department* [DEP] *in consultation with the appropriate water management districts, and delineated in a basin management action plan. Using the best data available from water management districts and other credible sources, the department, in coordination with the water management districts, shall delineate priority focus areas for each Outstanding Florida Spring or group of springs that contains one or more Outstanding Florida Springs and is identified as impaired in accordance with s. 373.807. In delineating priority focus areas, the department shall consider groundwater travel time to the spring, hydrogeology, nutrient load, and any other factors that may lead to degradation of an Outstanding Florida Spring. The delineation of priority focus areas must be completed by July 1, 2018, shall use understood and identifiable boundaries such as roads or political jurisdictions for ease of implementation, and is effective upon incorporation in a basin management action plan.*"

Factors to consider in establishing these geographically bounded areas include the following:

- Groundwater travel time to the spring, which could be based on empirical data from tracer studies and/or predicted travel time from modeling, if such data or studies are available.

- Hydrogeology, which includes the spring's groundwater contributing area (or springshed), the amount of confining material protecting the Floridan aquifer, the aquifer recharge characteristics, the capacity for the aquifer to transmit water, and other characteristics that help determine the aquifer vulnerability and the likelihood of adverse water quality impacts to springs.

- Nutrient load to the spring, which includes the actual measured load in the water discharging from the spring as well as the potential nutrient load based on land uses in specific regions that would most probably influence water quality in the spring.

- Other factors, including soil characteristics that are favorable for pollutant leaching to the aquifer in the springshed and the presence or absence of pollutant sources in the area.

- Identifiable boundaries, including roads, natural boundaries, and political jurisdictions.

Steps in Delineating the Gemini Springs PFA

The PFA for Gemini Springs was developed using geographic information system (GIS) tools, spring-specific data, and published information to help identify the portion of the springs' contributing area that is most important from the perspectives of both water quality restoration and protection. The steps discussed below were taken to develop a PFA for review and input by stakeholders. The overlapping of mapped characteristics that express high vulnerability, a high potential for pollutant mobility, and likely pollutant sources provides the best assurance that the PFA includes the areas of greatest concern for water quality restoration and protection.

Step 1. Establish the springshed for the priority springs. The springshed boundary for Gemini Springs used for this evaluation was developed by the St. Johns River Water Management District (SJRWMD) in 2017 based on a flow path analysis of potentiometric surface contour maps developed by the U.S. Geological Survey (USGS) and the Florida Geological Survey (FGS) in cooperation with the water management districts.[1] Flow pathways were compared for multiple dates to identify contributing areas that account for seasonal variation in flow direction, and the springshed boundary was conservatively drawn to capture all potential areas of groundwater contribution. **Figure 1** shows the boundaries for the Gemini Springshed and the PFA.

Step 2. Identify regions in the contributing area where the greatest recharge occurs. Several GIS coverages developed by the USGS and water management districts delineate areas of high, medium, and low recharge to the Floridan aquifer system as well as areas of aquifer discharge. The areas to be considered in the PFA delineation are the areas of highest recharge to the aquifer that are most likely to influence flow in the springs. These could occur as diffuse infiltration through permeable geological material, as well as focused recharge to sinkholes that breach confining layers. Pollutant sources in high-recharge areas have the greatest potential for causing adverse impacts to groundwater and springs because water is impeded the least as it infiltrates to the aquifer from the surface. In high-recharge areas, recharge is 10 inches per year (in/yr) or greater.

The recharge areas shown in **Figure 2** are taken from 2015 recharge GIS coverage developed by the SJRWMD.[2] The high-recharge areas represent recharge of 10 in/yr or greater. Pollutant sources in the higher recharge area north of the St. Johns River are more likely to influence the springs than sources to the south because of the large discharge area south of the springs.

1 Mouyard, K., and F. Gordu. March 2017. *Springshed delineation: Alexander Springs, Silver Glen Springs, Ponce de Leon Springs and Gemini Springs – Draft.* SJRWMD Technical Memorandum.

2 Boniol, D., and K. Mouyard. 2016. *Recharge to the upper Floridan aquifer in the St. Johns River Water Management District*. Technical Fact Sheet SJ2016-FS1.

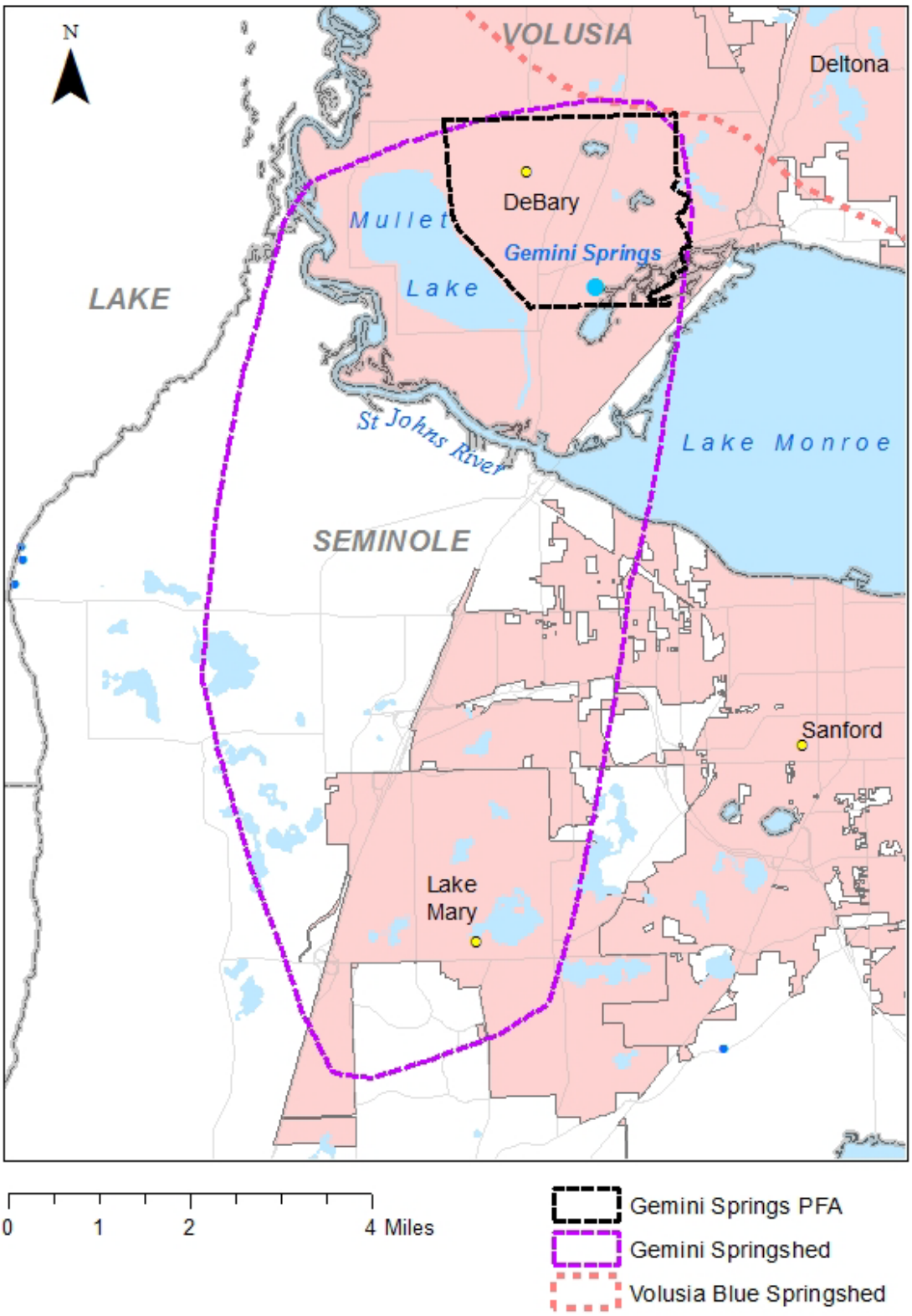

Figure 1. Gemini Springs Springshed and PFA boundary

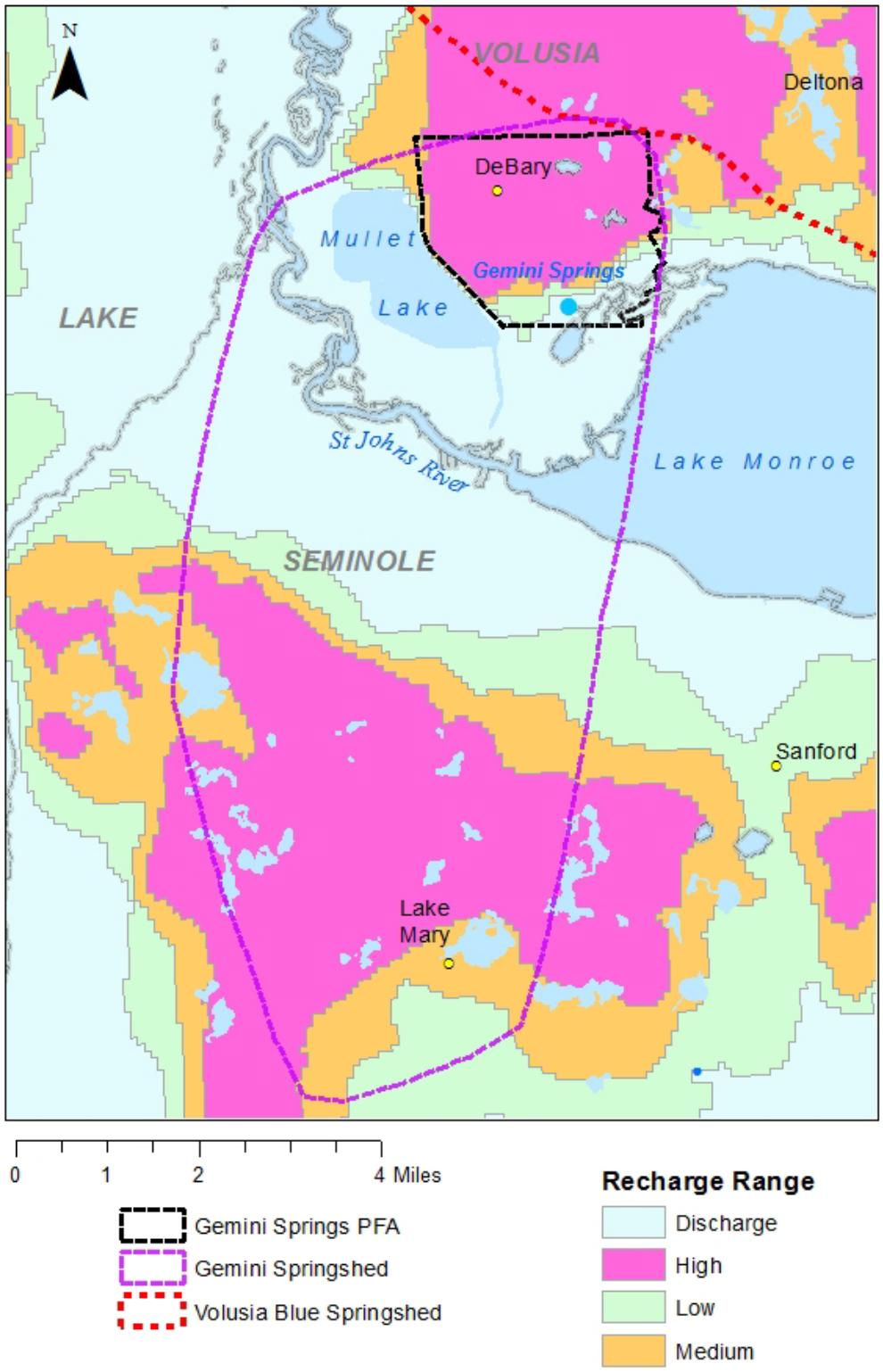

Figure 2. Recharge to the Floridan aquifer based on SJRWMD 2016 methodology and PFA boundary

Step 3. Identify regions in the springshed where the Floridan aquifer is most vulnerable. The FGS developed the Florida Aquifer Vulnerability Assessment (FAVA) model to provide spatial coverage of aquifer vulnerability ranges across an area of interest.[3] The map in **Figure 3** summarizes the modeling results from the statewide FAVA model, which is quite generalized. Often, the areas of greatest aquifer vulnerability occur where aquifer recharge is also greatest. Regions in the springshed for Gemini Springs that are mapped as "more vulnerable" correspond somewhat with areas that have high recharge. Areas of low recharge to discharge are mapped as "vulnerable."

Step 4. Consider nitrogen load. Gemini Springs was verified as impaired by nitrate-nitrogen, which exceeds Florida's numeric standard for spring vents of 0.35 milligrams per liter (mg/L). The impairment was supported by evidence of an imbalance of aquatic flora. The source of flow and nutrients in the springs is groundwater discharged from the Floridan aquifer system. In the draft total maximum daily load (TMDL) document, which establishes the restoration threshold for nitrate in the spring, the median nitrate concentration for the 2007–16 period of record used for calculating the TMDL was 0.55 mg/L.[4] Nitrate-nitrogen has become the major nutrient of concern in Florida's spring systems because of its pervasive nature in groundwater, its mobility, and its availability for uptake by aquatic flora when it is discharged from springs.

The nitrogen load from Gemini Springs depends on concentration and flow. Using the median nitrate concentration for the TMDL period of record (1.18 mg/L) and an average flow of 9.7 cubic feet per second (cfs) for the same period, the estimated total nitrogen (TN) load (as nitrate) from the springs is 22,500 pounds per year (lbs/yr).

[3] Arthur, J.D., H.A.R. Wood, A.E. Baker, J.R. Cichon, and G.L. Raines. 2007. Development and implementation of a Bayesian-based aquifer vulnerability assessment in Florida. *Natural Resources Research* 16(2): 93–107. For additional information, see the DEP FAVA website.

4 DEP. April 2017. *Nutrient TMDL for DeLeon Spring (WBID 2912A) and Gemini Springs (WBID 2893) and documentation in support of development of site-specific numeric interpretation of the narrative nutrient criterion.* Draft TMDL report. Tallahassee, FL: Division of Environmental Assessment and Restoration, Water Quality Evaluation and TMDL Program.

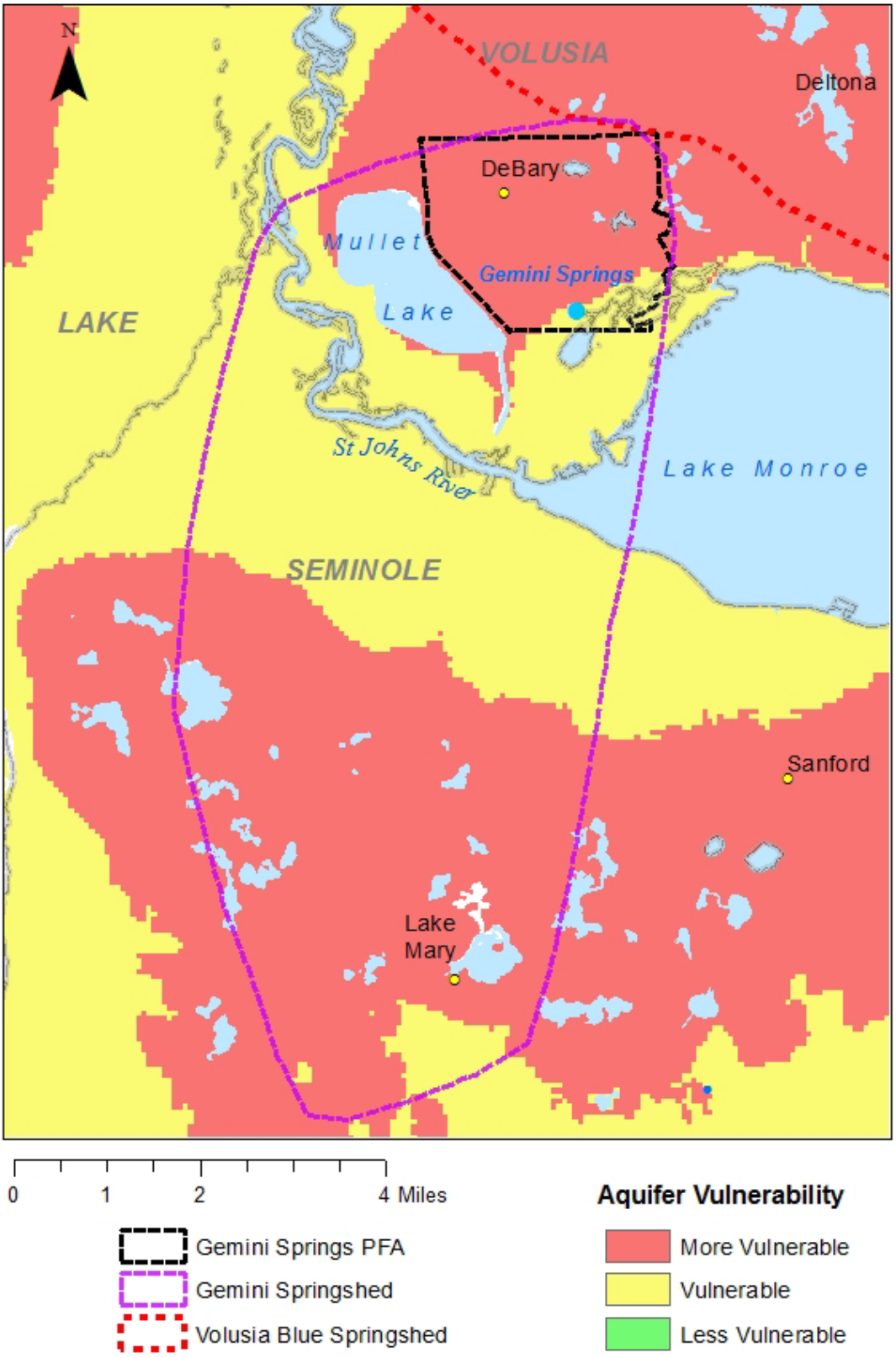

Figure 3. Gemini Springs–area aquifer vulnerability assessment and PFA boundary

Step 5. Consider groundwater travel time in creating the PFA boundaries. To the extent possible, PFAs should include parts of contributing areas that have demonstrated or anticipated short travel times to the springs. Springs occur in areas of karst terrain where surface and subsurface erosion of the limestone can result in the development of complex networks of solution channels and conduits in the aquifer material. In these areas, groundwater can move rapidly from points where the water enters the aquifer to the spring vents. In some OFS areas, researchers have conducted dye trace studies to measure the travel times, and information from these studies can be incorporated into PFA development. In other areas, models have been used to estimate travel times and define protection zones and can also be used to help define PFAs. In the absence of modeled or demonstrated travel times, the best professional judgment of groundwater professionals experienced in the spring area may be considered.

In the Gemini Springs area, there are no past dye trace studies or models that could be used in refining the PFA. Most of the springshed is situated in an area of mantled karst with numerous karst erosional features expressed as ponds and sinkholes that provide ready access to the aquifer. Therefore, it is assumed that groundwater travel times could be quite rapid in parts of the springshed, but specific areas of potentially rapid groundwater transport are not known and none have been mapped for this purpose. It is, however, understood that proximity to the springs should be a consideration in creating the PFA boundary. **Figure 4** shows the area within a 3-mile radius of Gemini Springs. It includes the higher recharge areas close to the springs, where rates of groundwater migration are most likely to be greatest and should be included in the PFA.

Step 6. Identify regions in the contributing area where soil conditions are most favorable for the leaching of nitrogen from surface sources. Nitrogen is the target nutrient for spring restoration. Research has shown that the removal of nitrogen in the soil zone through denitrification and its tendency to leach is related to soil drainage class.[5] Denitrification is lowest and nitrogen leaching is highest in areas with soils that are excessively drained, somewhat excessively drained, or well drained. Leaching may occur in areas with moderately well-drained soils and is least likely to occur in soils that are poorly drained, somewhat poorly drained, or very poorly drained because of their greater potential for denitrification.

[5] Otis, R.J. 2007. *Estimates of nitrogen loadings to groundwater from onsite wastewater treatment systems in the Wekiva Study Area, Task 2 report, Wekiva onsite nitrogen contribution study.* Prepared by Otis Environmental Consultants for the Florida Department of Health (FDOH).

Hofstra, N., and A.F. Bouwman. 2005. Denitrification in agricultural soils: Summarizing published data and estimating global annual rates. *Nutrient Cycling in Agroecosystems* 72: 267–278.

Figure 4. Gemini Springshed, 3-mile radius from springs, and PFA boundary

The portions of the contributing area where soil conditions are more favorable for nitrogen leaching can be mapped using the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database for Florida.[6] These excessively to well-drained soils tend to occur in areas where aquifer recharge is highest and vulnerability is greatest. **Figure 5** shows the areas where soil conditions are most favorable for nitrogen leaching and also areas where moderate leaching could occur. The areas of highest leaching include soils in the excessively drained, somewhat excessively drained, and well-drained SSURGO drainage classes. The areas of higher soil drainage to some extent intersect the higher groundwater recharge areas. Areas of moderate leaching are those with moderately well-drained soils.

Step 7. Identify regions in the contributing area to exclude or include based on land use and potential pollutant sources. Conservation lands, wetlands, and undeveloped open lands protected from development may be excluded from the PFA if there is no expectation that they would include pollutant sources affecting springs in the foreseeable future and are under protection. The most significant conservation areas in the Gemini Springs contributing area include the Volusia County–owned Gemini Springs Park and the Seminole County–owned Black Bear Wilderness Area. A small portion of Wekiwa Springs State Park is also located in the springshed. **Figure 6** shows conservation lands from the Florida Natural Areas Inventory (FNAI) Conservation Lands (FNAI Managed Areas) GIS layer. The PFA boundary encompasses the part of Gemini Springs Park that includes the springs.

The PFA delineation also includes the consideration of areas with significant potential for nitrogen leaching to groundwater, based on the sources of nitrogen that occur there. These could include septic systems (also known as onsite treatment and disposal systems, or OSTDS), urban fertilizer, wastewater facilities, and agricultural sources such as fertilizer or animal waste. These sources occur in urban and agricultural land use areas. Approximately 52 % of the Gemini Springs contributing area is in urban land uses, and about 7 % is in agricultural land use. **Figure 7** shows mapped urban and agricultural lands (based on the 2009 SJRWMD land use–land cover GIS coverage). Significant urban and agricultural lands close to the spring and/or in high-recharge/vulnerable soils areas were included in the PFA.

Figure 8 shows the locations of OSTDS in the area, based on GIS coverage developed as part of the FDOH Florida Water Management Inventory Project. The area with the highest concentration of OSTDS, located north of Gemini Springs, is included in the PFA.

Existing domestic wastewater facilities, including those with design flows greater than or equal to 0.1 million gallons per day (mgd), are also shown in **Figure 8** because they too have the potential to contribute nitrogen to groundwater and should be considered when creating a PFA. Domestic wastewater facility information for the springshed was obtained from the DEP Wastewater Facility Regulation (WAFR) Database.

6 The SSURGO Database is a digital soil survey developed by the National Cooperative Soil Survey. The dataset includes georeferenced digital map data and computerized attribute data. Metadata are available online.

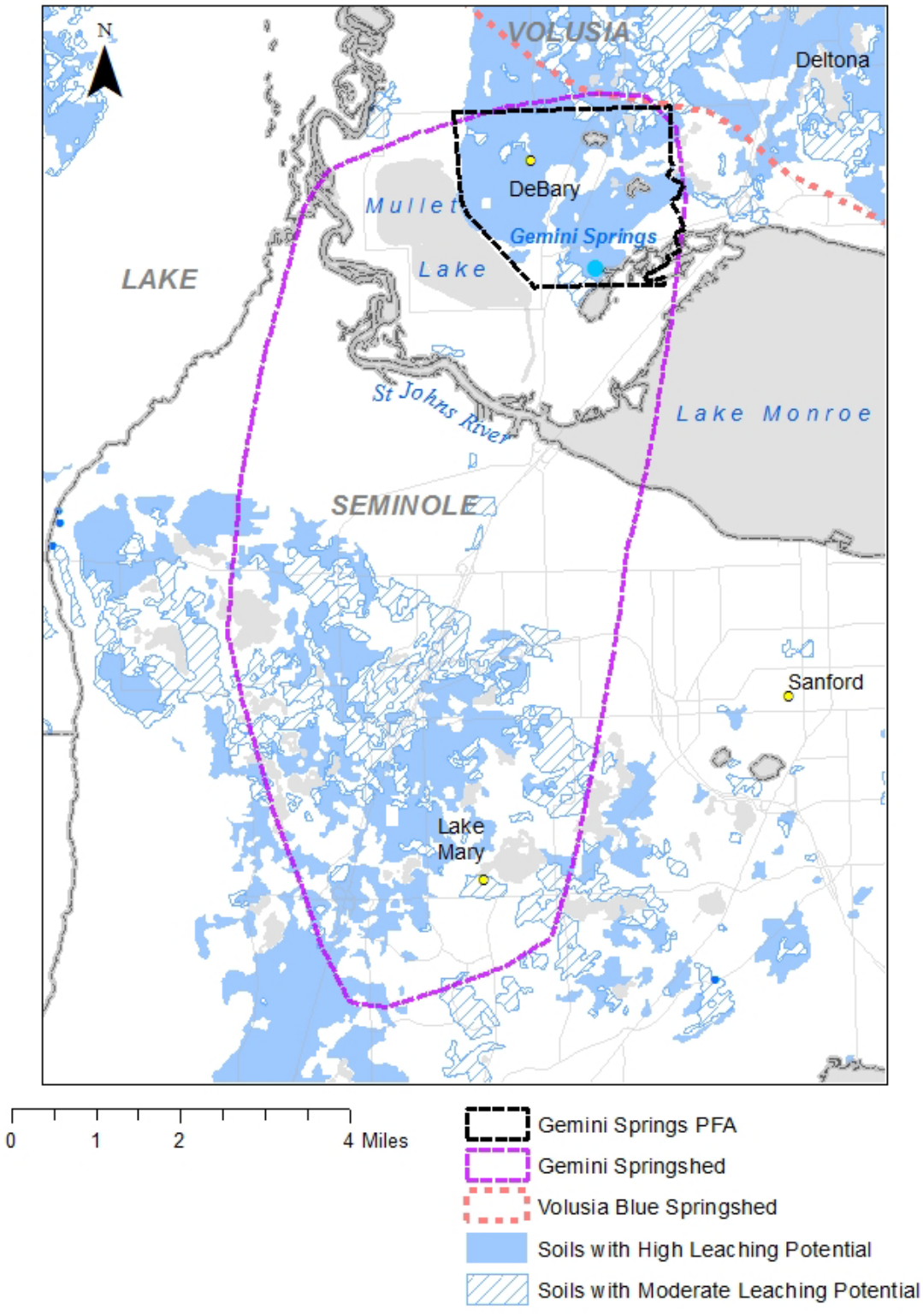

Figure 5. Areas with potential high and moderate nitrogen leaching in soils and PFA boundary

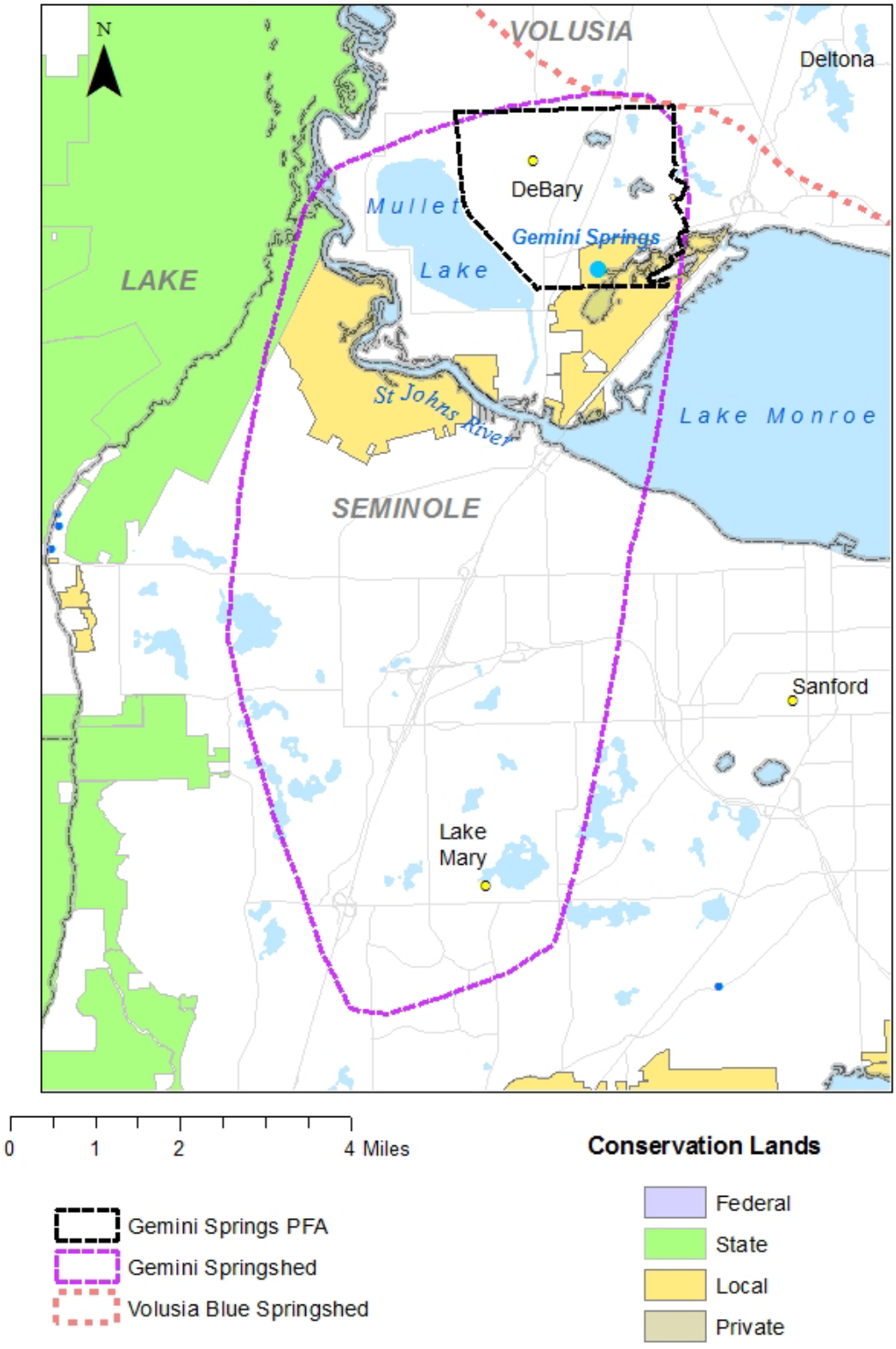

Figure 6. Conservation lands and PFA boundary

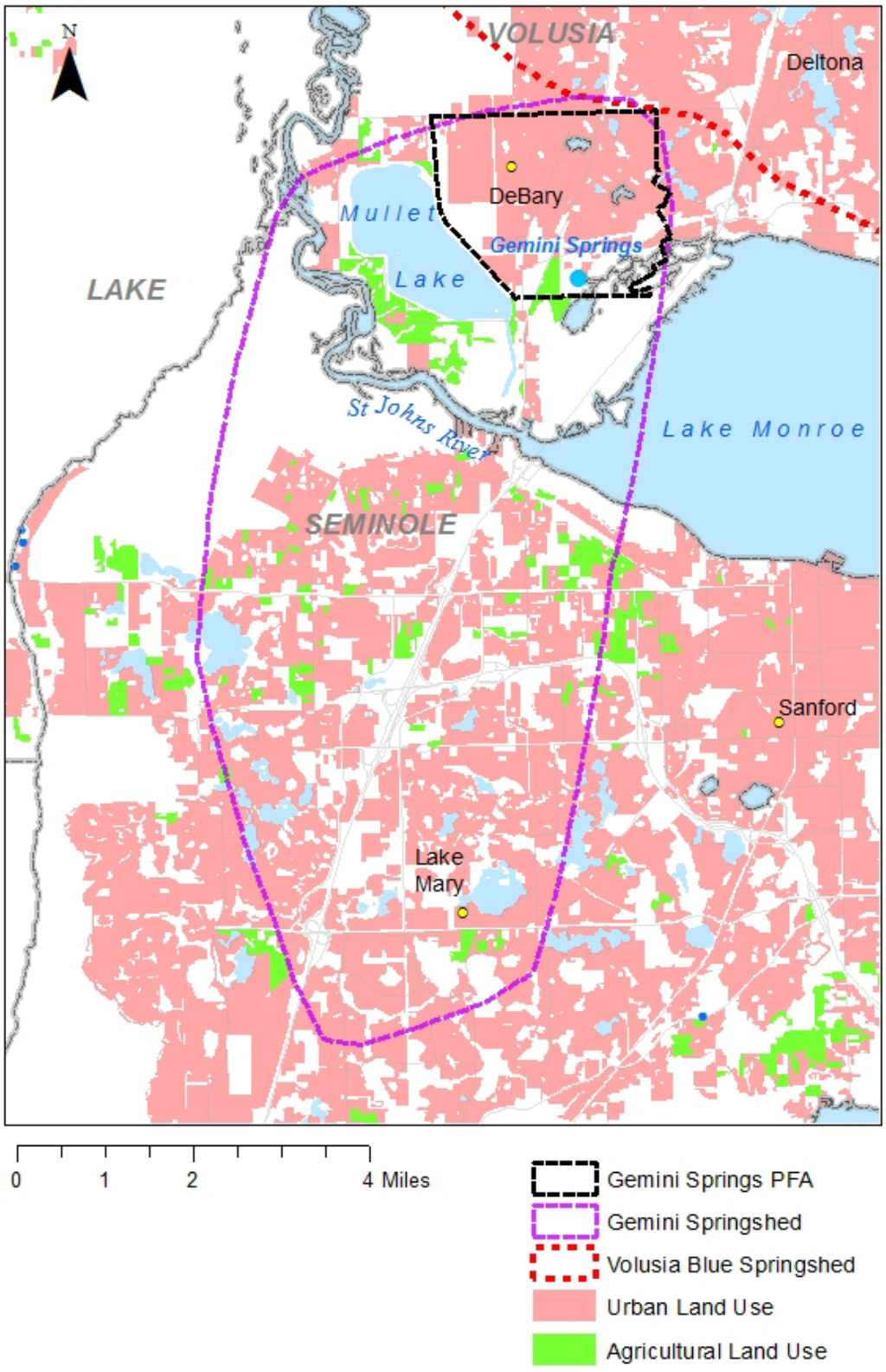

Figure 7. Urban and agricultural land use areas and PFA boundary

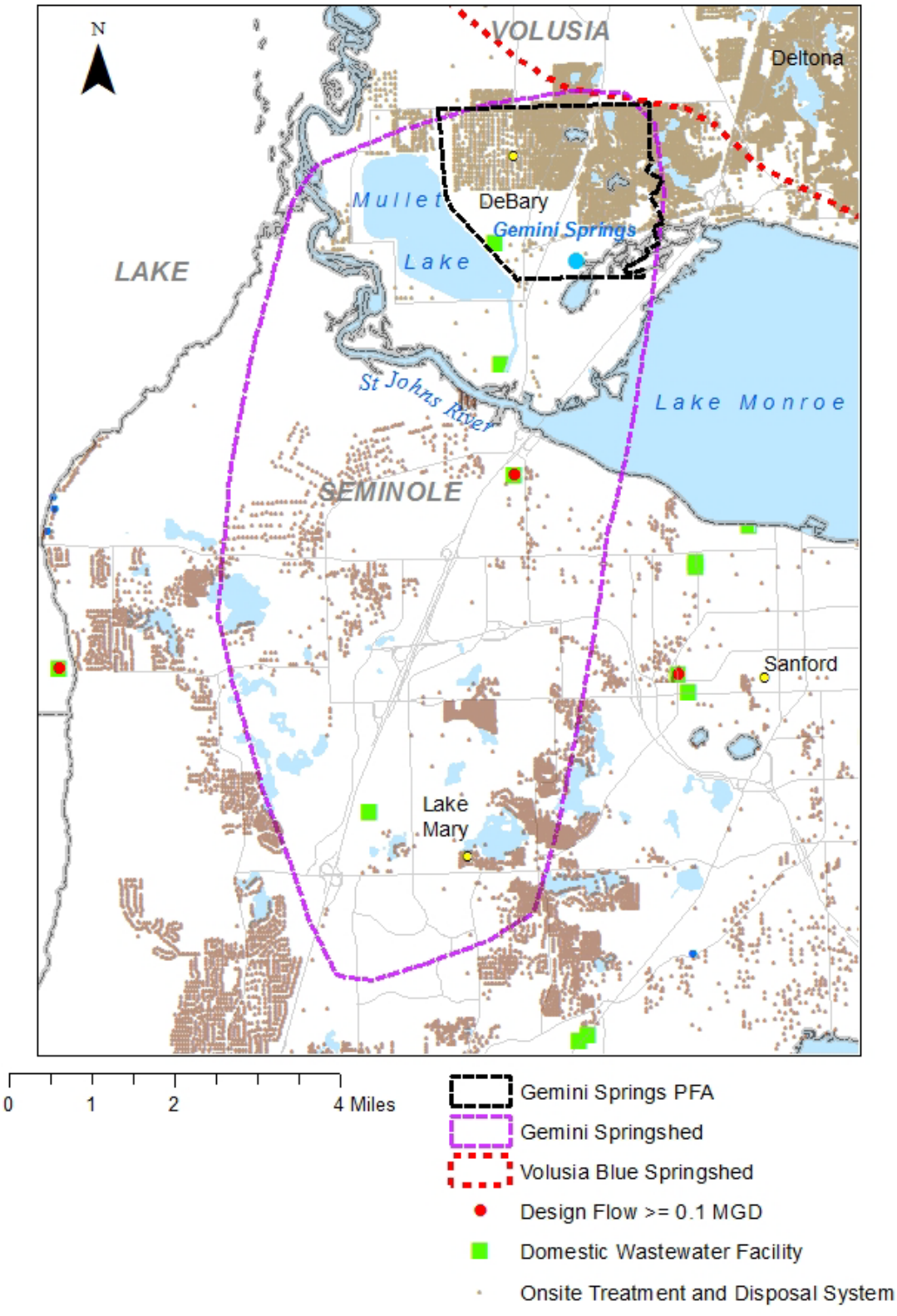

Figure 8. OSTDS, domestic WWTFs, and PFA boundary

Step 8. Create PFA boundaries that correspond with understood and identifiable geographic, hydrologic, and political features. For stakeholders to implement restoration and protection actions, the PFA boundaries must be clearly defined and associated with features and boundaries easily recognizable on a map, including geographic, hydrologic, and political features. The PFA for Gemini Springs was developed based on several readily identifiable conservation area boundaries, political boundaries, and major roads.

PFA Boundary for Gemini Springs

The PFA boundary shown in **Figure 9** was developed by considering GIS coverages of recharge, vulnerability, soils, conservation lands, and potential contaminant nitrogen source areas. It includes a region in the springshed with high groundwater recharge/vulnerability conditions, likely short travel times, and potential nitrogen sources (urban land uses and high OSTDS density).

In addition, conservation land boundaries, natural features, political boundaries, and roads in the area were considered in the development of a readily identifiable boundary. The PFA includes part of the City of Debary, which in this area is primarily in urban residential development and served by OSTDS. The area also includes the portion of Gemini Springs Park containing the spring vents.

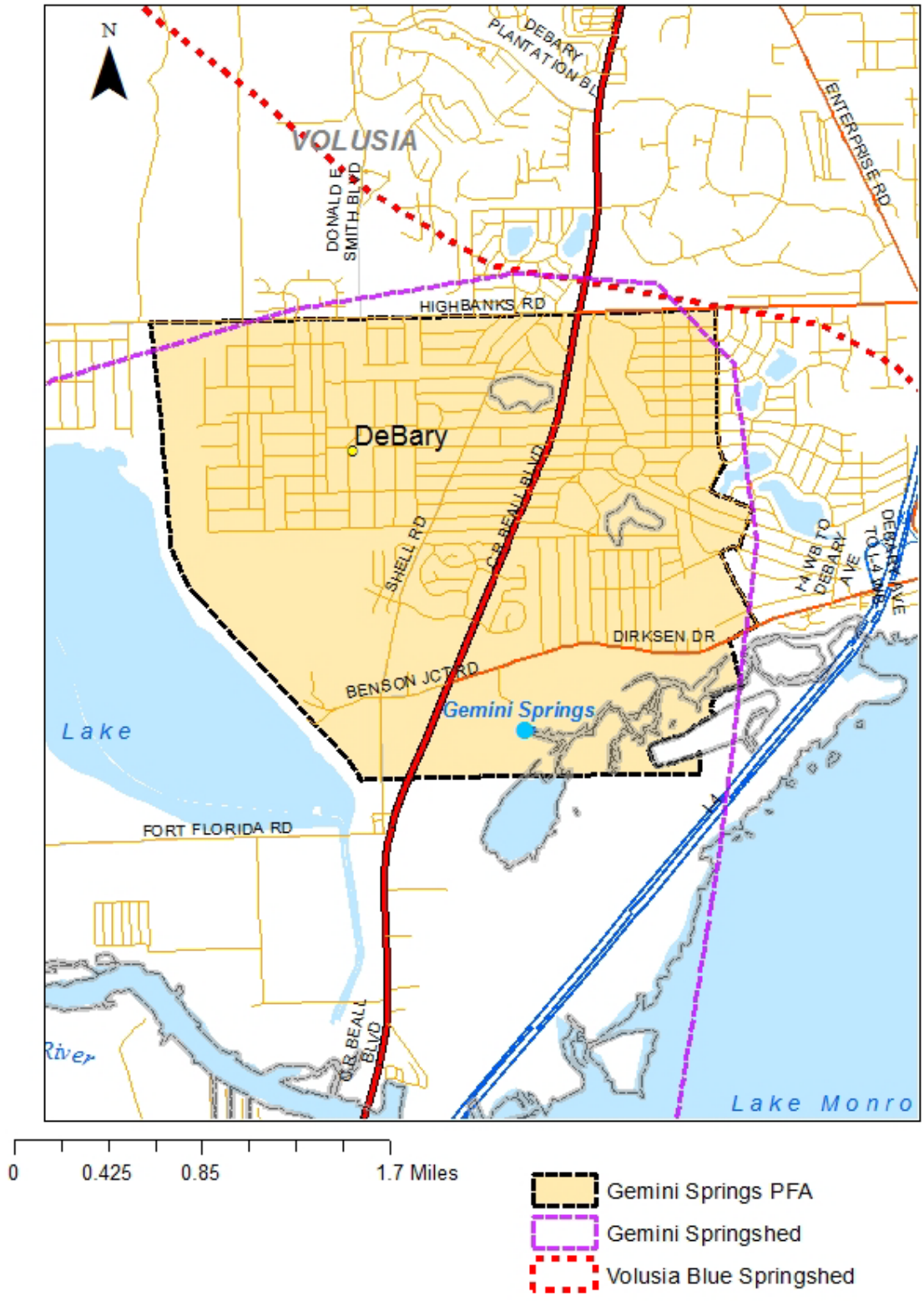

Figure 9. PFA boundary for Gemini Springs

Appendix A. Important Links

Cover page:
DEP home page: www.dep.state.fl.us

p. 2, Additional Information
Moira Homann email address: moira.homann@dep.state.fl.us
Richard Hicks email address: richard.w.hicks@dep.state.fl.us

p. 8, Step 4:
SJRWMD springs data portal: http://www.sjrwmd.com/springs/discharge.html

p. 8, Footnote 4:
DEP FAVA website: http://www.dep.state.fl.us/geology/programs/hydrogeology/fava.htm

p. 14, Step 7:
FDOH Florida Water Management Inventory Project:
http://www.floridahealth.gov/environmental-health/onsite-sewage/research/flwmi/index.html

p. 14, Footnote 11:
SSURGO metadata website: https://catalog.data.gov/dataset/soil-survey-geographic-ssurgo-database-for-various-soil-survey-areas-in-the-united-states-