Central/Southwest Districts • Withlacoochee Basin

Final Report

Nutrient TMDLs for Wilson Head Spring (WBID 1329R), Blue Spring (Citrus County) (WBID 1329S), and Gum Springs (Alligator Springs) (WBID 1338A) and Documentation in Support of the Development of Site-Specific Numeric Interpretations of the Narrative Nutrient Criterion

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October 2019

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Executive Summary

This report presents the total maximum daily loads (TMDLs) developed to address the nitrate-nitrite impairment of Wilson Head Spring, Blue Spring (Citrus County), and Gum Springs (Alligator Springs). Wilson Head Spring is a third magnitude spring located in Marion County, east of the Withlacoochee River. Blue Spring is a second magnitude spring located in Citrus County, west of the Withlacoochee River. Gum Springs is a group of spring vents with a combined second magnitude flow located on the boundary of Sumter County and Marion County, east of the Withlacoochee River.

Wilson Head Spring (waterbody identification [WBID] number 1329R), Blue Spring (WBID 1329S), and Gum Springs (WBID 1338A) were identified as impaired for nitrate-nitrite (NO_3-NO_2, measured as the sum of nitrate and nitrite) based on elevated annual geometric mean (AGM) concentrations and were added to the 303(d)/Verified List by Secretarial Order on June 27, 2017. TMDLs for nitrate-nitrite have been developed, and **Table EX-1** lists supporting information for the TMDLs. The TMDLs were developed in accordance with Section 303(d) of the federal Clean Water Act and guidance developed by the U.S. Environmental Protection Agency.

Table EX-1. Summary of TMDL supporting information for Wilson Head Spring, Blue Spring (Citrus County), and Gum Springs (Alligator Springs)

Type of Information	Description
Waterbody name/ WBID number	Wilson Head Spring/1329R Blue Spring (Citrus County)/1329S Gum Springs (Alligator Springs)/1338A
Hydrologic Unit Code (HUC) 8	03100208
Use classification/ Waterbody designation	Class III/Fresh
Targeted beneficial uses	Fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife
303(d) listing status/ Verified List status	Verified List of Impaired Waters for the Withlacoochee Basin, Cycle 3, Group 4, adopted via Secretarial Order dated June 27, 2017
TMDL pollutants	Nitrate-nitrite (NO_3-NO_2, measured as the sum of nitrate and nitrite)
TMDLs and site-specific interpretations of the narrative nutrient criterion	**WBIDs 1329R, 1329S, 1338A:** **Nitrate-Nitrite:** 0.35 milligrams per liter (mg/L), expressed as an AGM concentration not to be exceeded in any year.
Concentration reductions required to meet the TMDLs	**WBID 1329R**: 43 % nitrate-nitrite reduction to achieve a target of 0.35 mg/L. **WBID 1329S**: 61 % nitrate-nitrite reduction to achieve a target of 0.35 mg/L. **WBID 1338A**: 78 % nitrate-nitrite reduction to achieve a target of 0.35 mg/L.

Acknowledgments

This analysis was accomplished thanks to significant contributions from staff in the Florida Department of Environmental Protection's Division of Environmental Assessment and Restoration, specifically, the Watershed Services Program, Watershed Assessment Section, Standards Development Section, Water Quality Restoration Program, Central and Southwest Regional Operations Centers, and Watershed Evaluation and TMDL Section. The Southwest Florida Water Management District provided significant collaborative assistance and data.

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Contents

List of Figures

List of Tables

Acronyms and Additional Abbreviations Used in Report

AGM	Annual Geometric Mean
BMP	Best Management Practice
CASTNET	Clean Air Status and Trend Network
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
CWA	Clean Water Act
°F	Degrees Fahrenheit
DEP	Florida Department of Environmental Protection
EPA	Environmental Protection Agency
F.A.C.	Florida Administrative Code
FAVA	Florida Aquifer Vulnerability Assessment
FDOH	Florida Department of Health
FL	Florida
FGS	Florida Geological Survey
FNAI	Florida Natural Areas Inventory
F.S.	Florida Statutes
FWRA	Florida Watershed Restoration Act
FWS	U.S. Fish and Wildlife Service
GIS	Geographic Information System
GWIS	Generalized Well Information System
HUC	Hydrologic Unit Code
in/yr	Inches Per Year
IPaC	Information for Planning and Conservation
IWR	Impaired Surface Waters Rule
LA	Load Allocation
lb/ac/yr	Pounds Per Acre Per Year
MCUD	Manatee County Utility District
MFL	Minimum Flows and Levels
mgd	Million Gallons Per Day
mg/L	Milligrams/Liter
MOS	Margin of Safety
NA	Not Applicable
MS4	Municipal Separate Storm Sewer System
NADP	National Atmospheric Deposition Program
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_{3}-NO_2	Nitrate-Nitrite
N	Nitrogen
n	Number
NNC	Numeric Nutrient Criteria
NPDES	National Pollutant Discharge Elimination System
OFW	Outstanding Florida Water
OSTDS	Onsite Sewage Treatment and Disposal System
P	Phosphorus
PLRG	Pollutant Load Reduction Goal

RIB	Rapid Infiltration Basin
SAS	Surficial Aquifer System
SAV	Submerged Aquatic Vegetation
SJRWMD	St. Johns River Water Management District
SSO	Sanitary Sewer Overflow
STORET	Storage and Retrieval
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement and Management
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
UFA	Upper Floridan Aquifer
U.S.	United States
WBG	Wilson Head Spring, Blue Spring, and Gum Springs
WBID	Waterbody Identification
WLA	Wasteload Allocation
WQS	Water Quality Standards
WWTF	Wastewater Treatment Facility

Chapter 1: Introduction

1.1 Purpose of Report

This report presents the total maximum daily loads (TMDLs) developed to address the nutrient impairment of Wilson Head Spring, Blue Spring (Citrus County), and Gum Springs (Alligator Springs), located in the Withlacoochee Basin. The TMDLs will also constitute the site-specific numeric interpretation of the narrative nutrient criterion set forth in Paragraph 62-302.530(48)(b), Florida Administrative Code (F.A.C.), that will replace the otherwise applicable numeric nutrient criteria (NNC) in Subsection 62-302.531(2), F.A.C., for these particular waterbodies, pursuant to Paragraph 62-302.531(2)(b)2, F.A.C. These waterbodies were verified as impaired for nutrients using the methodology in the Identification of Impaired Surface Waters Rule (IWR) (Chapter 62-303, F.A.C.), and were included on the Verified List of Impaired Waters for the Withlacoochee Basin that was adopted by Secretarial Order—first on November 2, 2010, and February 7, 2012, for algal mats, and second on June 27, 2017, for nitrate-nitrite (NO_3-NO_2, measured as the sum of nitrate and nitrite).

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and provides water quality targets needed to achieve compliance with applicable water quality criteria based on the relationship between pollutant sources and water quality in the receiving waterbody. The TMDLs presented in this report establish the allowable loadings to Wilson Head Spring, Blue Spring (Citrus County), and Gum Springs (Alligator Springs) that would restore the waterbodies so that they meet their applicable water quality criteria for nutrients.

1.2 Identification of Waterbody

For assessment purposes, the Florida Department of Environmental Protection (DEP) divided the Withlacoochee Basin (Hydrologic Unit Code [HUC] 8 – 03100208) into watershed assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or surface water segment. Wilson Head Spring is WBID 1329R, Blue Spring (Citrus County) is WBID 1329S, and Gum Springs (Alligator Springs) is WBID 1338A. **Figure 1.1** shows the location of the springs in the basin and major geopolitical and hydrologic features in the region, and **Figures 1.2**, **1.3**, and **1.4** contain more detailed maps of the WBIDs.

1.2.1 Spring Vents

Gum Springs (Alligator Springs), sometimes referred to as the Gum Slough Springs Group, is a group of spring vents with a combined second magnitude flow. Discharge data for all the springs in this report are limited, but based on previous studies, a typical cumulative discharge for Gum Springs is 88 cubic feet per second (cfs) (Holzwart et al. 2016; Trommer et al. 2009). These springs are located near the boundary between Sumter and Marion Counties, east of the

Withlacoochee River and 10 miles southwest of Ocala. Gum Springs Main is the largest of the springs and the headwaters for Gum Slough. Less than 0.8 miles downstream from the main spring, at least 7 additional springs discharge into the slough as it flows southwest 4 miles to the confluence with the downstream "northern" segment of the Withlacoochee River (WBID 1329D) (Rosenau et al. 1977; Scott et al. 2004).

In a 2001 study by Champion and Starks, Wilson Head Spring was classified as a part of the Gum Slough Springs Group. However, it is a separate WBID and is assessed separately. Wilson Head Spring is a third magnitude spring located in Marion County, 5 miles west-northwest of Gum Springs Main. A previous study indicates a typical discharge of 5 cfs (Trommer et al. 2009). A short spring run connects the headspring to the Withlacoochee River 6 miles downstream from the Gum Slough confluence (Rosenau et al. 1977; Scott et al. 2004).

Blue Spring is a second magnitude spring in Citrus County. A previous study indicates a typical discharge of 18 cfs (Trommer et al. 2009). It is located on the west side of the Withlacoochee River, 1 1/2 miles upstream from the Wilson Head Spring run, 10 miles from Dunnellon. The headspring has a 120-foot diameter pool partially impounded by a man-made dike. The pool deepens to 22 feet toward the center at the vent. The vent connects to a cavern system reported to be more than 180 feet deep.

The spring run is a 0.4-mile man-made canal connecting the headspring to the Withlacoochee River. Historically, the spring connected almost directly to the river to the northeast. However, the dike surrounding the pool has prevented this, and water has since been rerouted through the present-day canal (Rosenau et al. 1977; Scott et al. 2004).

1.2.2 Contributing Area

The area where precipitation falls and percolates to groundwater, from which a spring receives its water, is known as a groundwater contributing area, or springshed. This area can be estimated using groundwater elevation contour maps, also known as potentiometric surface maps. Geographic information system (GIS) tools are used to create flow lines from areas of higher to lower groundwater elevation and to draw spring capture zones for multiple dates that account for a range of hydrologic conditions, since groundwater elevations change seasonally and over time because of fluctuations in rainfall and withdrawals.

DEP and the Southwest Florida Water Management District (SWFWMD) developed and revised the combined contributing area for Wilson Head Spring, Blue Spring, and Gum Springs (referred to as the "WBG contributing area" in this document) in 2017 to provide estimates of the maximum areal extent where groundwater may contribute to the springs, based on a consistent methodology using potentiometric surface spatial data for the Floridan aquifer developed by the Florida Geological Survey (FGS) (Cichon 2016a and 2016b). The information assists DEP in evaluating areas where potential nutrient sources could influence water quality in the springs.

Figure 1.2 shows the contributing area for these springs, and **Figures 1.3** and **1.4** show the major geopolitical and hydrologic features in Wilson Head and Blue Spring, and in Gum Springs, respectively. The contributing area encompasses 154 square miles in Marion, Sumter, and Citrus Counties, and is located within the SWFWMD and St. Johns River Water Management District (SJRWMD) boundaries. The portion of the contributing area in Citrus County is minimal, consisting only of a small 12-acre area around the Blue Spring vent; Citrus County is therefore not a focus of this report.

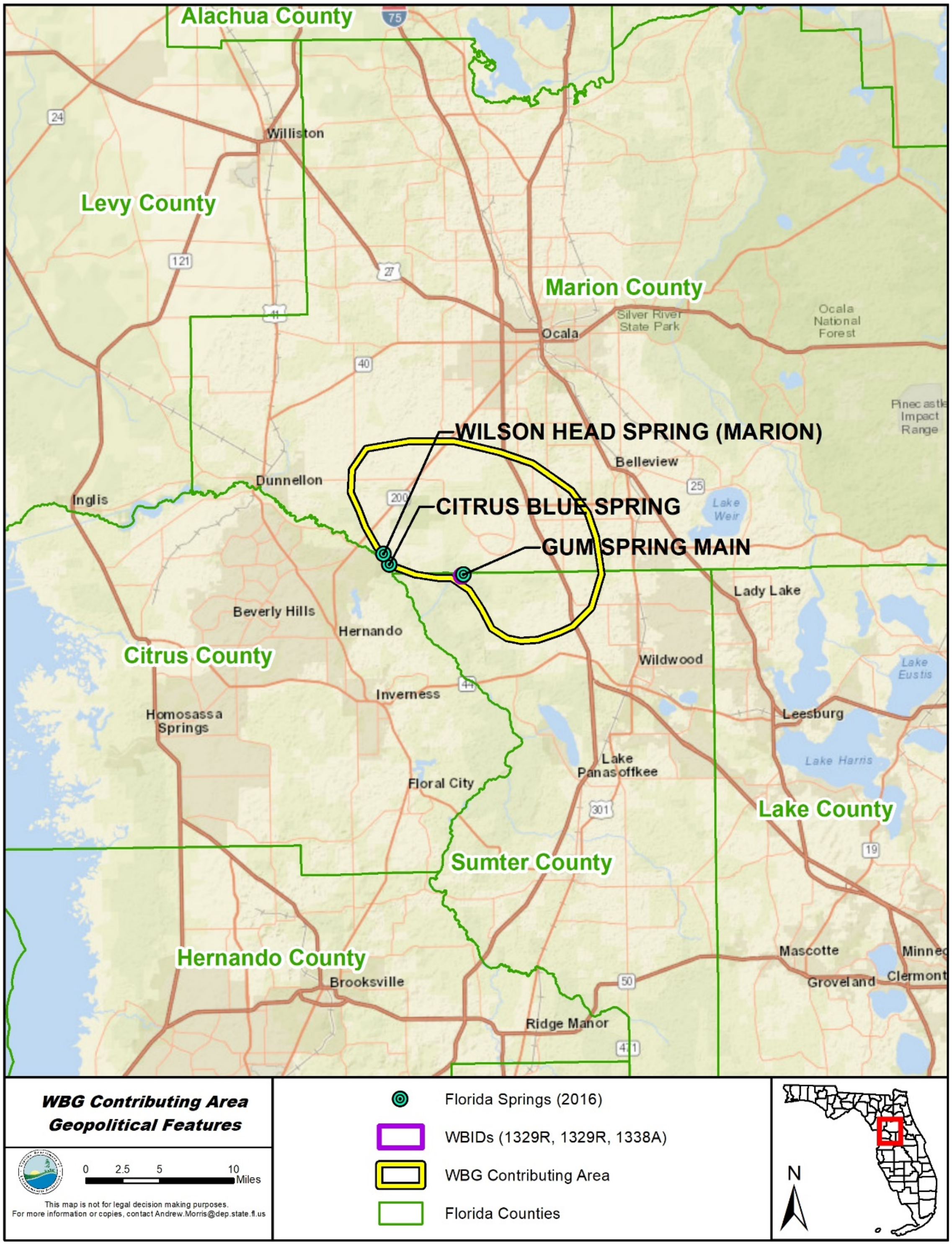

Figure 1.1. **Location of Wilson Head, Blue, and Gum Springs in the Withlacoochee Basin and major hydrologic and geopolitical features in the area**

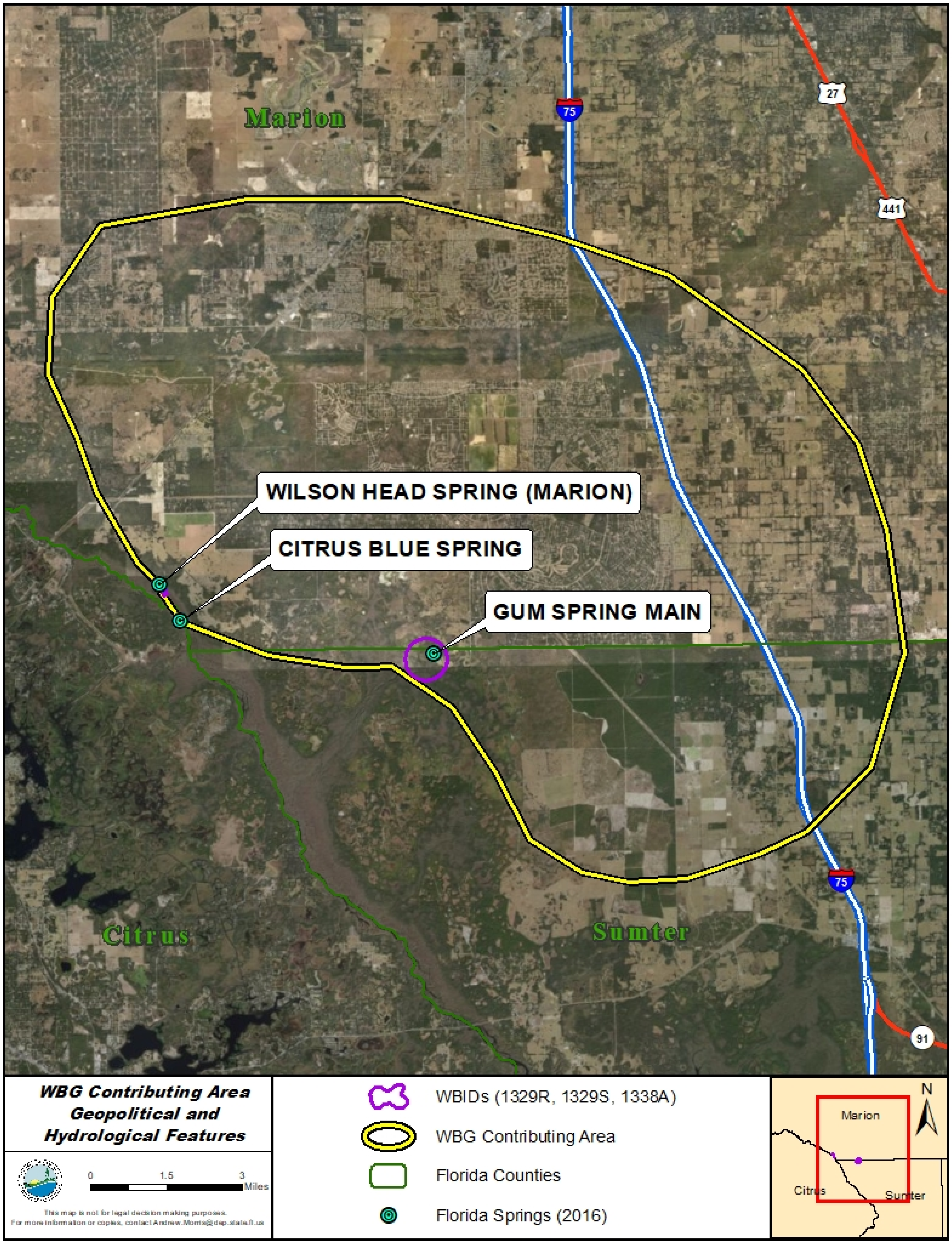

Figure 1.2. Location of WBIDs 1329R, 1329S, and 1338A in the WBG contributing area

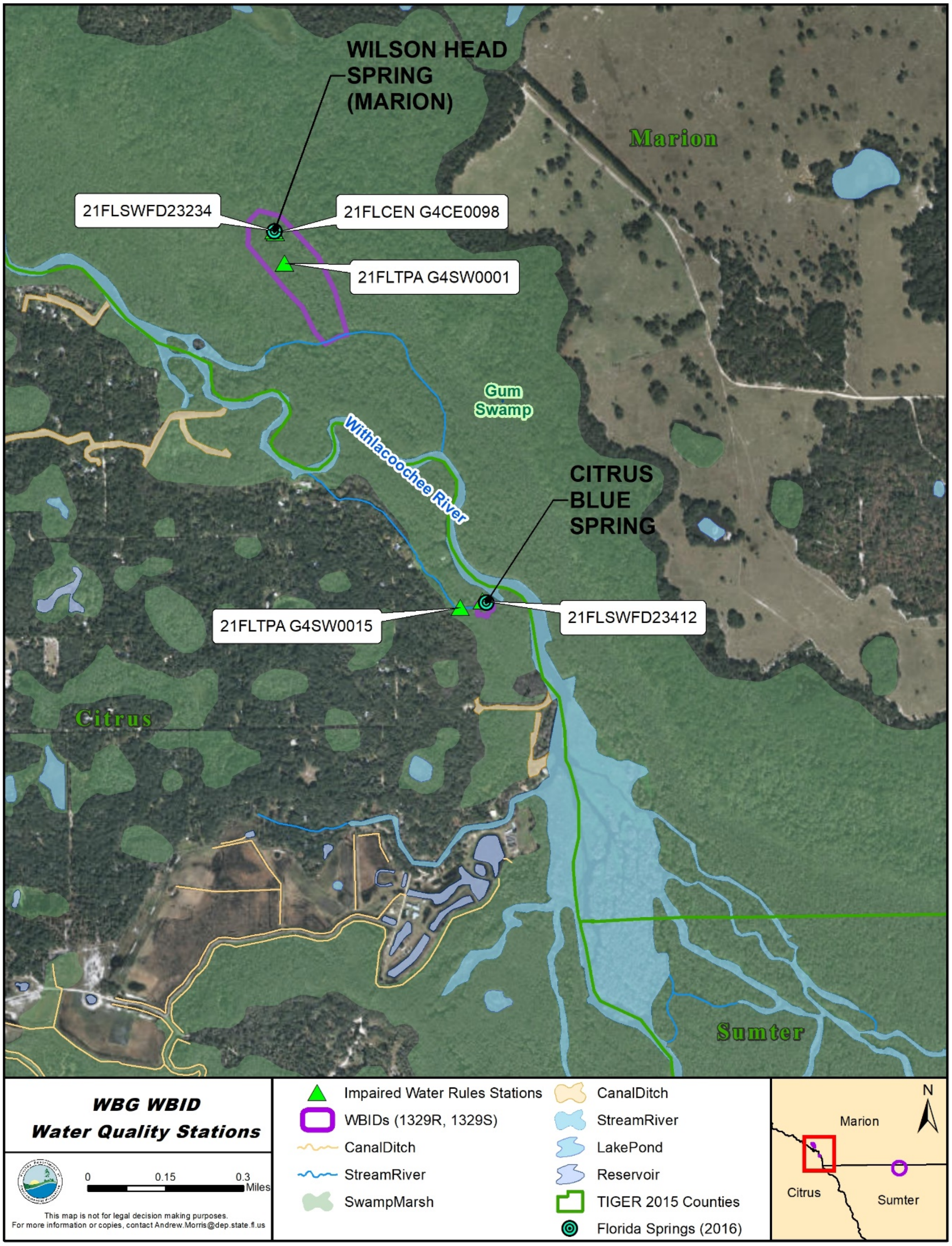

Figure 1.3. Wilson Head Spring (WBID 1329R) and Blue Spring (WBID 1329S)

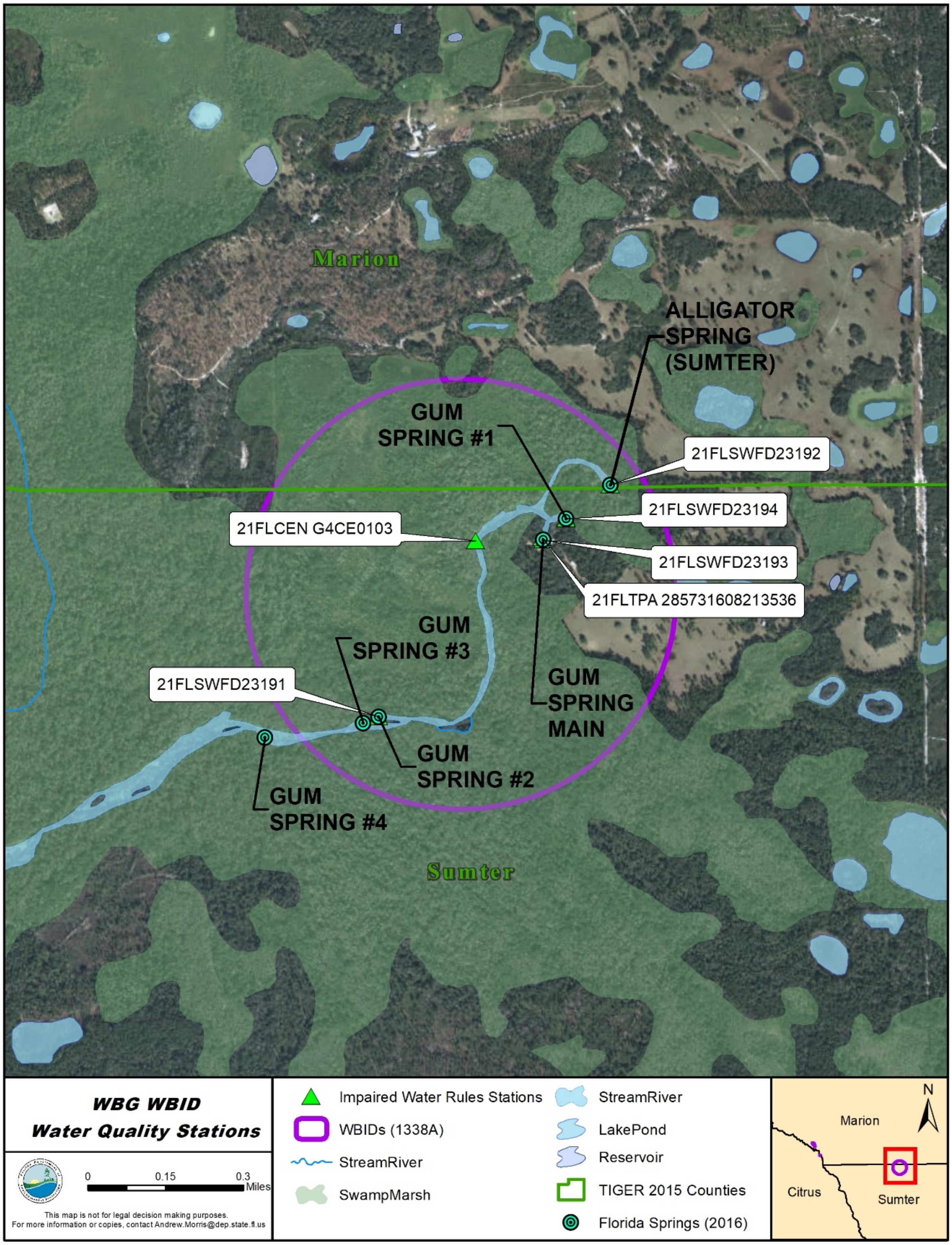

Figure 1.4. Gum Springs (WBID 1338A)

1.3 Contributing Area Information

1.3.1 Population and Geopolitical Setting

According to the U.S. Census Bureau, the population density in Marion and Sumter Counties in the most recent Census year (2010) was 209.1 and 170.8 persons per square mile, respectively. The Census Bureau reports that the total population in 2010 for Marion and Sumter Counties (which includes but is not exclusive to the contributing area of these springs) was 331,298 persons with 164,050 housing units, and 93,420 with 53,026 housing units, respectively. The land area of Marion County is 1,584.55 square miles, and Sumter County covers an area of 546.93 square miles (U.S. Census Bureau 2018). There are no incorporated cities in the WBG contributing area, and surrounding municipalities outside the contributing area include Inverness, Ocala, Dunnellon, Wildwood, and Belleview.

1.3.2 Topography

The WBG headsprings are situated in the Tsala Apopka Plain in the northern part of the Western Valley physiographic region. The Tsala Apopka Plain is the lowest-lying region of the Western Valley and contains a system of lakes, marshes, and canals hydrologically connected to the Withlacoochee River. The northern part of the Western Valley where the springs are located is bound by the Brooksville Ridge to the west and the Sumter Upland and Cotton Plant Ridge to the east. The Brooksville Ridge is largely made up of sand and clastic sediments of the Alachua and Bone Valley formations, which are more resistant to erosion than the surrounding soluble carbonates. Both the Cotton Plant Ridge and the Sumter Upland are largely sand dominated and represent relict dune structures (Yamataki et al. 1984; Kimrey and Anderson 1987; Bush and Johnston 1988).

1.3.3 Climate

The climate in the WBG contributing area is humid subtropical, with hot, rainy summers and cool, drier winters. Recharge to groundwater and flow in springs depends on climatic patterns and available precipitation. Rainfall amounts and temperatures from the nearby Inverness weather station were used to represent climatic conditions in the contributing area. Rainfall and temperature data were reviewed for the period from 1950 to 2017. DEP used data from the Inverness, FL National Oceanic and Atmospheric Administration (NOAA) Station: Inverness 3 SE, FL US, GHCND: USC00084289.

Table 1.1 summarizes monthly temperature data for this 68-year period of record. Annual rainfall averaged 51.4 inches per year (in/yr), with an average air temperature of 67.1° F. (NOAA 2017). **Figure 1.5** shows the historical rainfall trends measured for Inverness. Over this period, the lowest annual rainfall of 22.08 inches occurred in 1951. The highest annual rainfall of 85.77 inches occurred in 1960, when Hurricane Donna, estimated to be a Category 4 storm, made landfall on peninsular Florida. Six to 12 inches of rainfall were measured across the state (NOAA 2018).

Table 1.1. Temperature and precipitation at Inverness, FL (NOAA Station: Inverness 3 SE, FL US, GHCND: USC00084289), 1950–2017

Analysis	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean Maximum Temperature (°F.)	70.1	72.4	77.7	83.1	88.6	91.1	91.8	91.5	89.6	83.9	77.6	72.1	**82.5**
Mean Minimum Temperature (°F.)	44.7	46.3	51.5	56.8	63.5	69.8	71.7	71.9	70.0	61.9	52.9	46.8	**59.0**
Mean Observed Temperature (°F.)	54.2	56.3	61.4	66.6	72.6	76.5	77.7	77.2	75.8	68.4	61.9	56.3	**67.1**
Mean Monthly Precipitation (inches)	2.6	2.6	3.0	2.6	3.9	8.2	8.0	9.0	5.7	2.2	2.0	1.7	**51.4**

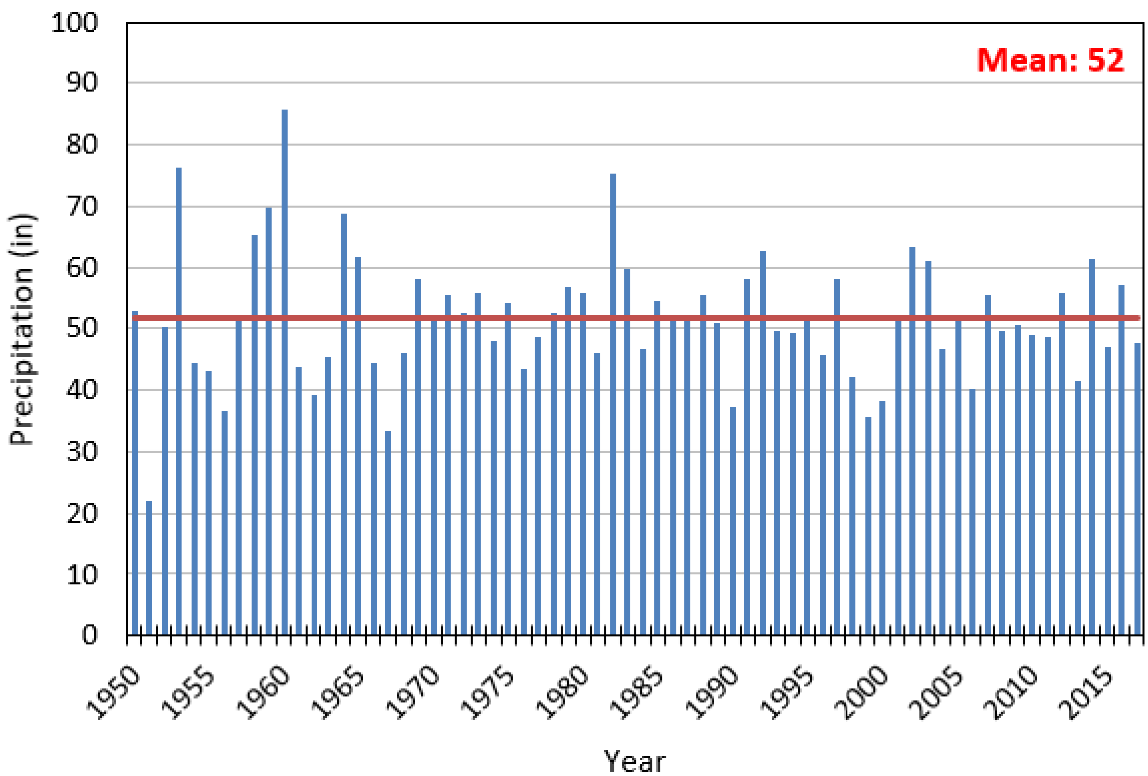

Figure 1.5. Total annual precipitation record for Inverness, FL, 1950–2017 (NOAA Station: Inverness 3 SE, FL US, GHCND: USC00084289)

1.3.4 Hydrogeological Setting

1.3.4.1 Aquifers

Groundwater flows to the WBG spring systems from the Upper Floridan aquifer (UFA). In this locale, the UFA is largely composed of an Eocene-era limestone and dolostone called the Ocala Limestone, which is highly permeable and transmissive (Scott 2001). Across the contributing area, the average depth to the top of the UFA is 32 meters based on field observations and nearby FGS well data. The shallower surficial aquifer system (SAS), prevalent throughout much of Florida, is largely absent in this region because of local variability in geology. In the contributing area, the UFA is largely unconfined because of the lack of a confining unit (Basso et al. 2011).

Over geologic time, the elevation of the water table has shifted in response to changes in sea level, and many vertical and lateral paths or conduits have developed in the underlying carbonate strata in the basin. Many of these lie below the present water table and greatly facilitate groundwater flow. Openings along these paths or conduits provide easy avenues for water to travel toward springs (Rutledge 1982). Groundwater rich in nutrients has the potential to flow rapidly through these passages in the limestone, or slowly through much smaller pore spaces in the rock matrix.

The groundwater discharging at and near the Gum Springs Group and Wilson Head Spring tends to have low total dissolved solids (TDS) (less than 250 milligrams per liter [mg/L]) (Champion and Starks 2001) and high sulfate concentrations because of localized sulfate upwelling through rock fractures (40 mg/L) (IWR Run 53). Chloride concentrations tend to be low, indicating the springs are likely predominately recharged by nearby precipitation (Champion and Starks 2001).

1.3.4.2 Recharge

The rate of groundwater recharge in an area is a function of the thickness of the overburden material, the presence or absence of sinkholes, and the differences in aquifer water level elevations. **Figure 1.6** shows the potential recharge rates to the Floridan aquifer in the WBG contributing area based on a 2009 assessment of recharge by the Florida Natural Areas Inventory (FNAI) (2016) subcontracted by Advanced Geospatial, Inc. The data used to construct the statewide Recharge Potential model consisted of soil hydraulic conductivity, proximity to karst features, depth to water, and overburden. Priority classes were established where the highest priority class (Priority 1) is associated with a higher recharge rate and the potential for greater vulnerability of the aquifer to contamination.

In the Sumter Upland, recharge rates are high because of the excessively drained, fine sandy soils. The lowlands of the Withlacoochee River floodplain in the Western Valley are made up of frequently flooded and poorly drained soils where the UFA either discharges groundwater through springs or seepage, or has low recharge rates (Yamataki et al. 1984; Kimrey and Anderson 1987; Bush and Johnston 1988).

The statewide Florida Aquifer Vulnerability Assessment (FAVA) model for the Floridan aquifer system developed by the FGS generally represents the vulnerability to aquifer contamination based on conditions such as soil characteristics, depth to groundwater, recharge rate, and the prevalence of sinkhole features (Arthur et al. 2007). According to the model outputs, in the areas classified as "more vulnerable," contaminants from the surface can more readily move vertically to the aquifer through the geological material or through sinkholes. In the area classified as "vulnerable," confining material is present and sinkholes are less prevalent. The FAVA model for the entire WBG contributing area is classified as "more vulnerable."

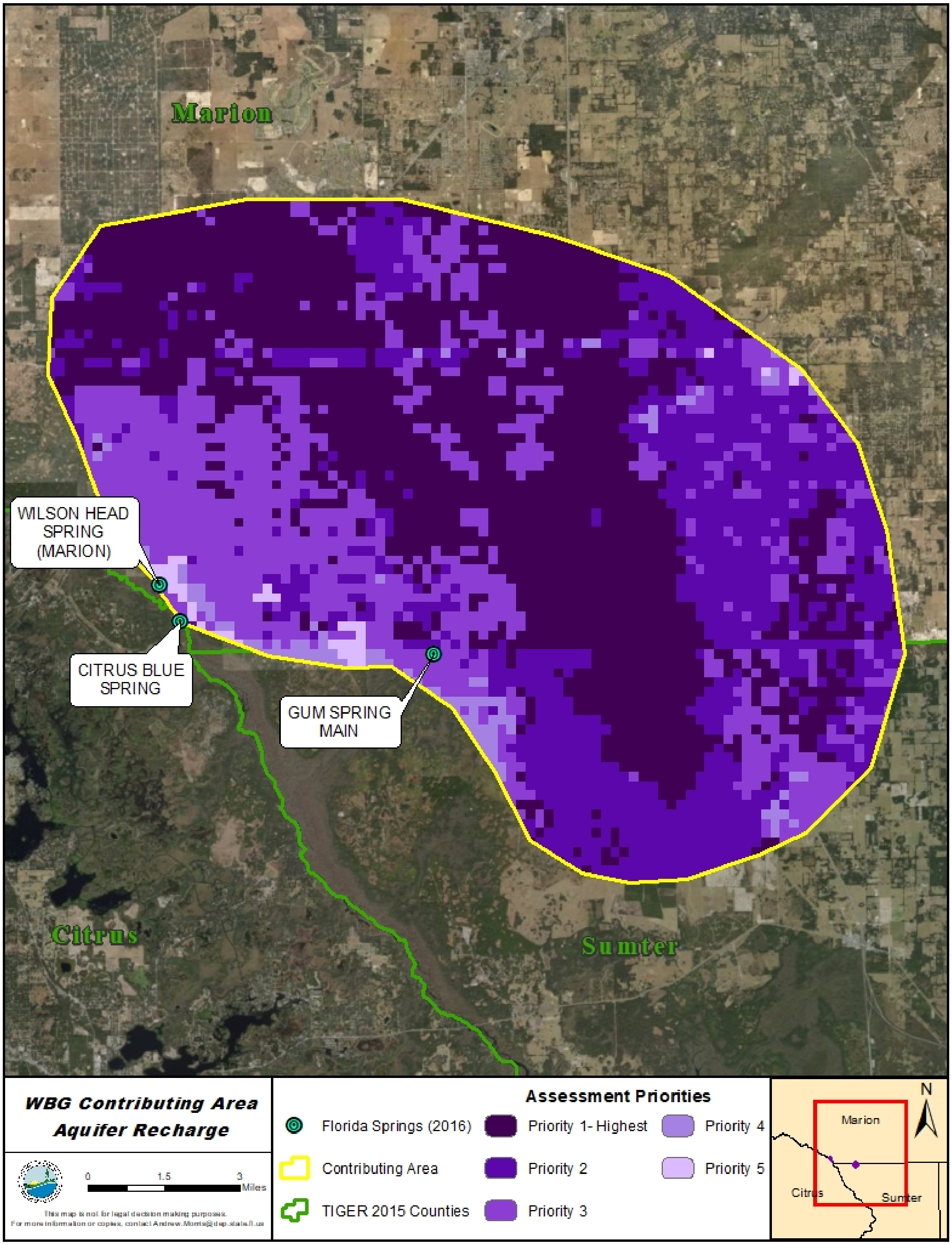

Figure 1.6. Floridan aquifer recharge potential in the WBG contributing area

Chapter 2: Water Quality Assessment and Identification of Pollutants of Concern

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act (CWA) requires states to submit to the U.S. Environmental Protection Agency (EPA) lists of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment of listed waters on a schedule. DEP has developed such lists, commonly referred to as 303(d) lists, since 1992.

The Florida Watershed Restoration Act (FWRA) (Section 403.067, Florida Statutes [F.S.]) directed DEP to develop, and adopt by rule, a science-based methodology to identify impaired waters. The Environmental Regulation Commission adopted the methodology as Chapter 62-303, F.A.C. (the IWR), in 2001. The rule was amended in 2006, 2007, 2012, 2013, and 2016.

The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4], F.S.). The state's 303(d)/Verified List is amended annually to include basin updates.

2.2 Classification of the Waterbody and Applicable Water Quality Standards

Wilson Head Spring, Blue Spring, and Gum Springs are Class III (fresh) waterbodies, with a designated use of fish consumption, recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the verified impairment (nutrients) for these waterbodies is Florida's nutrient criterion in Paragraph 62-302.530(48)(b), F.A.C. Florida adopted NNC for lakes, spring vents, and streams in 2011. These were approved by the EPA in 2012 and became effective in 2014.

Florida's nitrate-nitrite NNC for spring vents, set forth in Paragraph 62-302.531(2)(b)2, F.A.C., is expressed as an annual geometric mean (AGM) value of 0.35 mg/L, not to be exceeded more than once in any consecutive 3-year period. DEP's hierarchical approach gives preference to the numeric nutrient value of 0.35 mg/L of nitrate-nitrite for spring vents based on the quantifiable stressor-response relationships between nutrients and biological response (DEP 2013).

2.3 Determination of the Pollutant of Concern

2.3.1 Data Providers

Figures 1.3 and **1.4** show the locations of the water quality sampling stations used for assessing impairment at Wilson Head Spring and Blue Spring, and at Gum Springs, respectively. SWFWMD and DEP collected all the samples used to verify the impairment at the spring pools. To ensure that the nutrient TMDLs were developed based on current conditions and that recent trends in spring water quality were included, monitoring data from samples collected during the Cycle 3 verified period, plus more recently (2009–17), were used.

The individual water quality measurements discussed in this report are available in IWR Database Run 53 and are available on request.

2.3.2 Information on Verified Impairment

Chapter 62-303, F.A.C., includes the methodology for listing impaired surface waters based on documentation that supports the determination of a waterbody's imbalance in flora or fauna attributable to nutrients. DEP used the IWR Run 53 data to assess water quality impairments in Wilson Head, Blue, and Gum Springs, which were verified as impaired for nutrients based on elevated AGM nitrate-nitrite values during the Cycle 3 verified period. These springs exceeded the spring vent nitrate-nitrite criterion of 0.35 mg/L every year during the verified period and more recently.

2.4 Nutrient Enrichment in Springs

Nutrient enrichment contributes to the impairment of many surface waters, including springs. The two major nutrient parameters monitored are nitrogen (N) and phosphorus (P). These are essential nutrients to plant life, including algae. For aquatic vegetation and algae to grow, both nutrients must be present. In fact, one can be present in excess, but if the other is absent, the overgrowth of vegetation or algae is unlikely to occur. Historically, many spring systems have had sufficient naturally occurring phosphorus to trigger an imbalance. It is widely accepted that primary production in spring-fed waterbodies is controlled by nutrients, sunlight, flow, spring discharge, temperature, and mineral content in groundwater.

Ongoing research on many Florida springs has resulted in significant progress in understanding the threshold concentrations of nitrogen and phosphorus that cause the overgrowth of nuisance macroalgae (Stevenson et al. 2007). Macroalgae may also sequester nutrients from groundwater seepage, although this may not be apparent from surface water or spring monitoring data. The elevated nitrogen concentrations are connected to the significant overgrowth of macroalgae in Wilson, Blue, and Gum Springs. The nutrient inputs contributing to the algal growth in these springs may not be exclusively related to spring discharge, as legacy nutrients found in the sediments in the contributing area can diffuse back into the water column.

2.4.1 Ecological Issues Related to Nutrients

The amount and type of aquatic vegetation are linked to water quality and clarity. Submerged aquatic vegetation (SAV) communities support wildlife species, stabilize sediments, prevent erosion, and remove contaminants from the water column and sediments. Evidence of excessive algal coverage has been documented in Wilson Head, Blue, and Gum Springs. **Figure 2.1** shows algal impacts underwater at Blue Spring.

The response of algae to nutrient enrichment in these springs is not unique to these systems. Unfortunately, algal growth is prolific in many spring systems where nutrient concentrations are elevated. The conditions here are similar to those documented in the nutrient TMDLs for the Suwannee and Santa Fe Rivers (Hallas and Magley 2008), Wekiva River and Rock Springs Run (Gao 2007), Wakulla River (Gilbert 2012), Silver Springs and River (Holland and Hicks 2012), Rainbow Springs and River (Holland and Hicks 2013), Jackson Blue Spring (Dodson 2013), Weeki Wachee Spring (Dodson and Bridger 2014), Volusia Blue Spring (Holland and Bridger 2014), Wacissa River and Springs (Bridger et al. 2016), and DeLeon and Gemini Springs (Huggins et al. 2017).

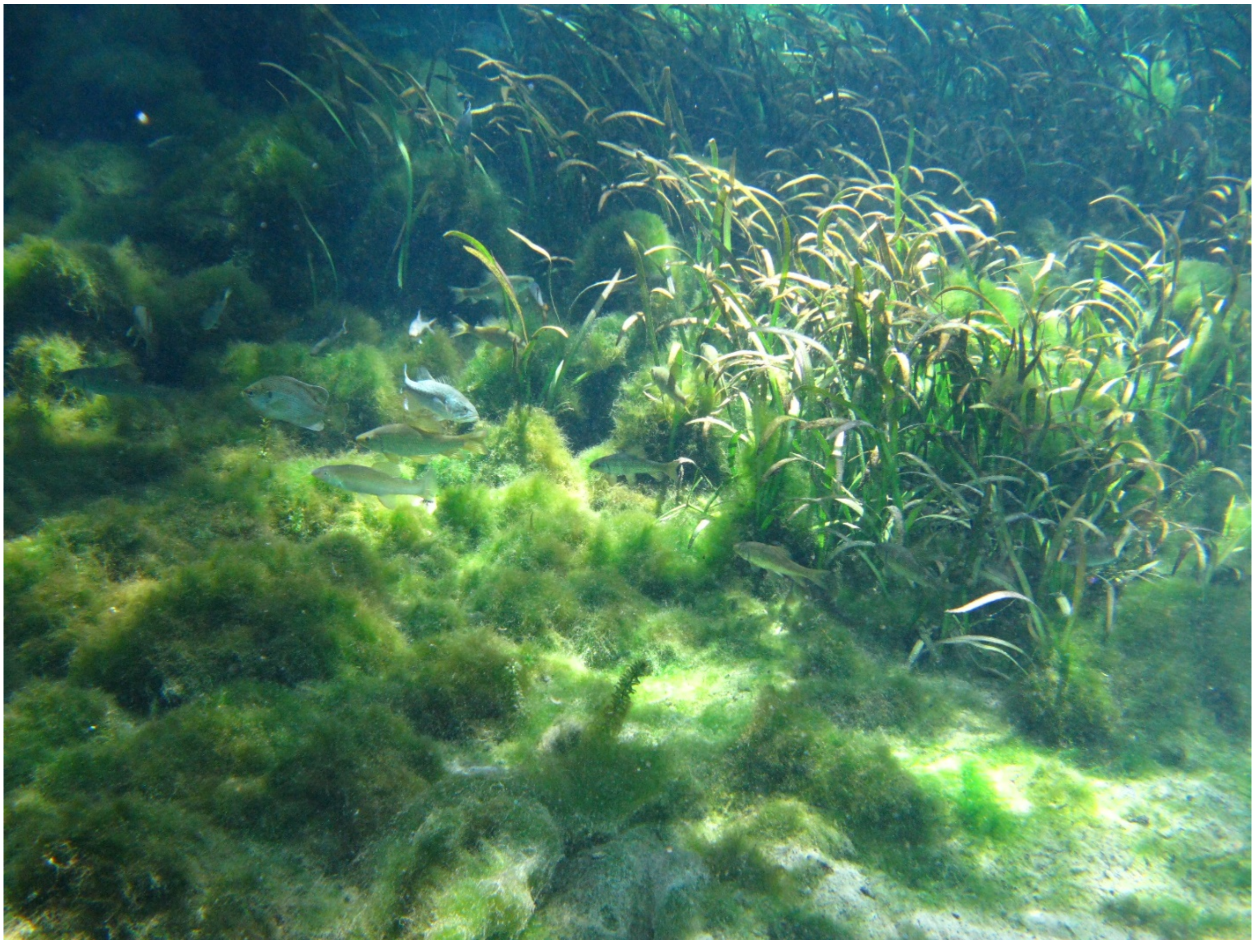

Figure 2.1. Underwater algal impacts near the shoreline of the Blue Spring pool, Citrus County (photo courtesy of SWFWMD 2010)

2.5 Monitoring Results

2.5.1 Nitrogen

Nitrogen is found in several forms and is ubiquitous in the environment. Nitrate-nitrogen is the nutrient most commonly associated with ecological imbalances in spring systems because it is the most mobile and available form of nitrogen for use by plants and algae. Increased nitrate concentrations in springs correlate with the degradation of biological systems because of the overgrowth of filamentous algal mats, phytoplankton blooms, and sometimes aquatic plants (Harrington et al. 2010).

Nitrate-nitrite is the form of nitrogen occurring in the highest concentrations in groundwater and springs. Historically, nitrogen was only a minor constituent of spring water, and typical nitrate concentrations in Florida were less than 0.2 mg/L until the early 1970s. Since then, elevated concentrations of nitrate have been found in many springs.

Nitrate is the dominant form of nitrogen in Wilson Head, Blue, and Gum Springs. For the period of record used in TMDL development, nitrate-nitrite concentrations make up an average of 92 % of the total nitrogen in samples from Wilson Head and Blue Springs, and 96 % in Gum Springs. This indicates that other forms of nitrogen (organic nitrogen and ammonia) make up less than 10 % of total nitrogen in these springs.

Historical water quality data for the three springs provide a glimpse of current versus background water quality. Water quality data have been collected from various locations around the springs and their receiving waters and stored in the Florida Storage and Retrieval (STORET) and SJRWMD Databases.

At Wilson Head Spring, the earliest dated nitrate sample in STORET (IWR Run 53), collected by SWFWMD in 1999, showed a concentration of 1.01 mg/L. SWFWMD continued quarterly sampling from 1999 through TMDL development in 2018. In 2014, DEP also began quarterly sampling.

At Blue Spring, the earliest dated nitrate-nitrite sample in STORET (IWR Run 53) was a single sample collected by DEP in 2002, with a concentration of 0.51 mg/L. SWFWMD then resumed quarterly sampling in 2005 through TMDL development in 2018. In 2014, DEP also began quarterly sampling.

At Gum Springs, samples were collected at Gum Springs Main, Alligator Springs, and Gum Springs 1 and 2. The earliest dated nitrate-nitrite sample in STORET (IWR Run 53), collected by SWFWMD in 1998 from Gum Springs Main, had a concentration of 1.03 mg/L. The water management district continuously sampled the springs through TMDL development in 2018. The IWR Database contains information on 3 sampling events conducted by DEP: 1 in 2009 and 2 in 2016.

AGMs were calculated for nitrate-nitrite concentrations from 2009 to 2017 for all three springs. Data sufficiency requirements for AGM calculations for TMDL development require four temporally independent samples per year, with at least one sample taken between May 1 and September 30 and at least one sample taken during the other months of the calendar year. Years without sufficient data are included in the summary statistics in **Table 2.1** and **Figures 2.2**, **2.3**, and **2.4** as reference, but were not used in the determination of the TMDLs or percent reductions in **Chapter 5**.

Of the years with sufficient historical data, AGM values from samples at Wilson Head Spring ranged from 0.42 to 0.61 mg/L. Of the years with sufficient historical data for Blue Spring, AGM nitrate-nitrite concentrations ranged from 0.60 to 0.90 mg/L. However, in 2015 when the lowest AGM occurred (0.60 mg/L; n = 9), an anomalous sample with a value of 0.077 was included. This single value drops the AGM from 0.77 to 0.60, but it was included because the sample had no qualifier code. Of the years with sufficient historical data for Gum Springs, AGM nitrate-nitrite concentrations ranged from 1.09 to 1.58 mg/L. Samples were collected at 4 springs within the WBID, and thus the AGMs reflect the average nitrate-nitrite concentration of the Gum Springs Group.

The nitrate-nitrite concentrations for all three springs exceeded the 0.35 mg/L AGM threshold set under the NNC (Paragraph 62-302.531[2][b]2, F.A.C.) every year during the verified period, and for the subsequent years through 2016. AGM concentrations for 2017 are listed but were calculated using only three samples at each spring, since the fourth quarter sampling data were not available at the time of TMDL development and therefore did not meet data sufficiency requirements.

Table 2.1 summarizes the nitrate-nitrite monitoring results for Wilson Head, Blue, and Gum Springs. Because it is the main form of nitrogen in the springs, nitrate-nitrite is the target nutrient for the TMDLs. **Chapter 5** discusses the nutrient impairment and the setting of the target concentration for nitrate.

Table 2.1. Summary statistics for Wilson Head, Blue, and Gum Springs nitrate-nitrite data, 2009–17

Location	Analyte	Sample Dates	Units	Number of Samples	Arithmetic Mean	Median	Minimum	Maximum
Wilson Head Spring	Nitrate+ Nitrite	1/2009–7/2017	mg/L	36	0.499	0.492	0.209	0.645
Blue Spring	Nitrate+ Nitrite	1/2009–7/2017	mg/L	44	0.759	0.662	0.077	1.200
Gum Springs	Nitrate+ Nitrite	1/2009–4/2017	mg/L	117	1.410	1.430	0.140	1.700

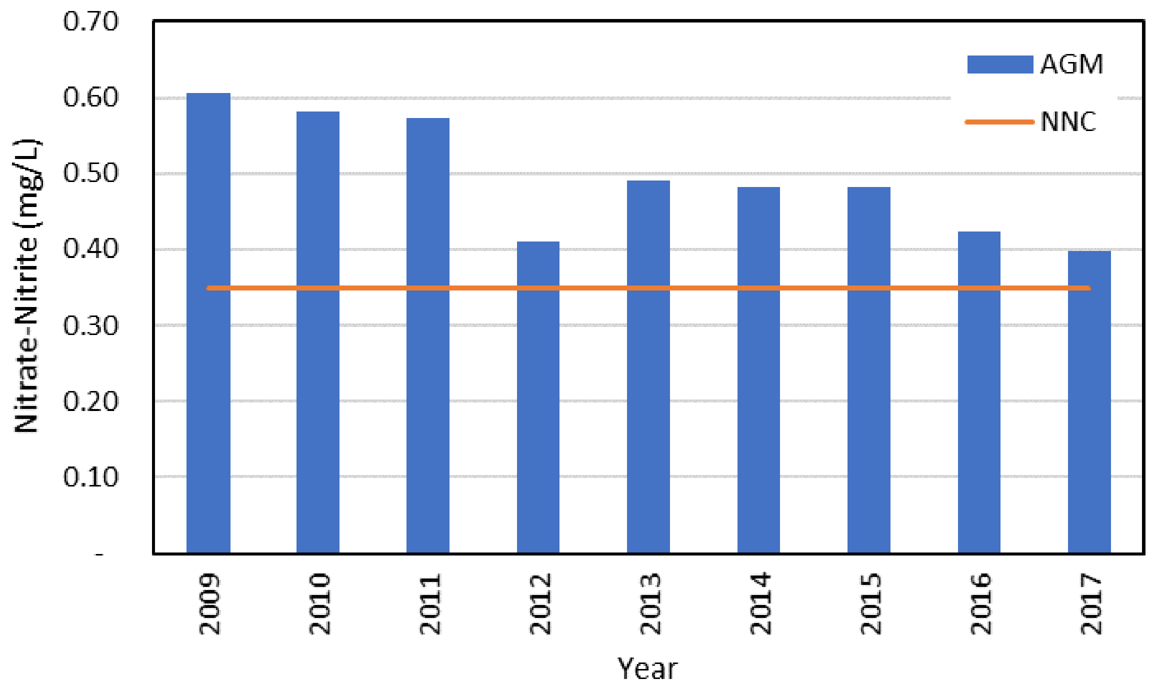

Figure 2.2. AGM nitrate-nitrite at Wilson Head Spring, 2009–17

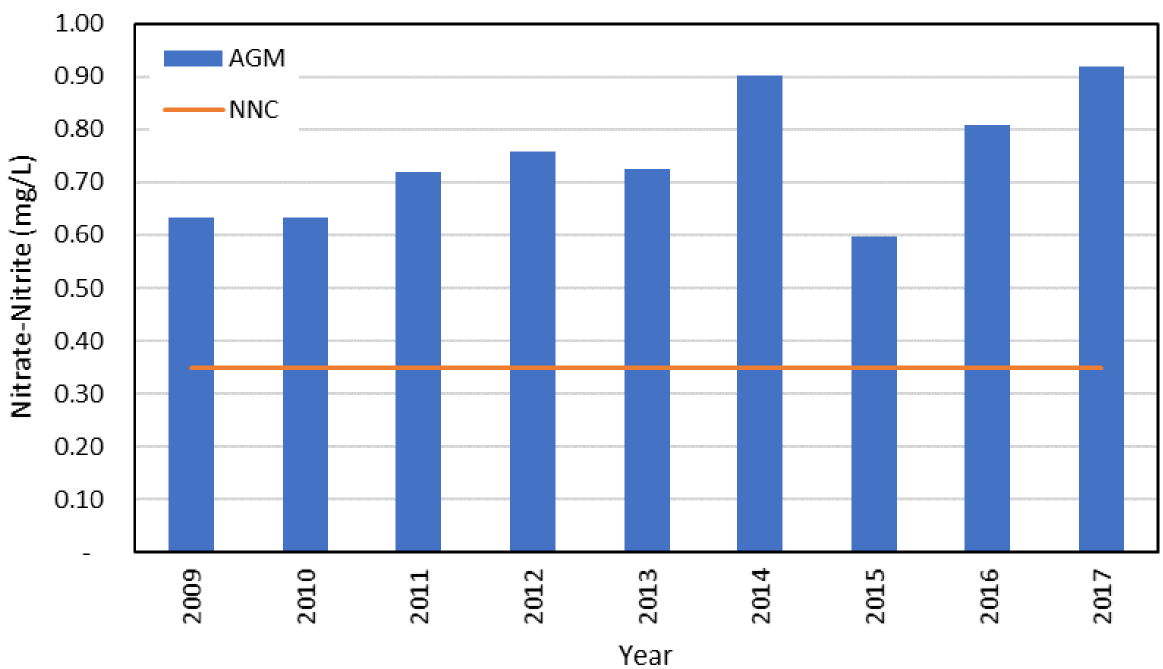

Figure 2.3. AGM nitrate-nitrite at Blue Spring, 2009–17

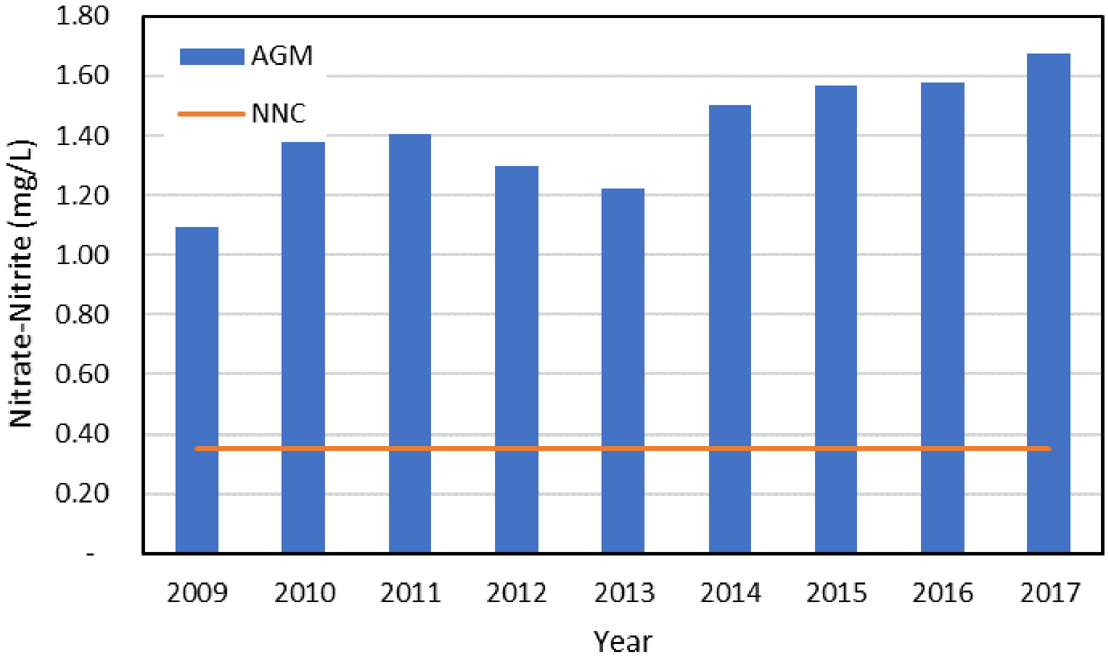

Figure 2.4. AGM nitrate-nitrite at Gum Springs, 2009–17

2.5.2 Phosphorus

Total phosphorus (TP) includes both phosphorus from organic sources and orthophosphate. Organic phosphorus comes from peat and muck in riverbeds and lake bottoms and decaying aquatic vegetation. The organic phosphorus content in spring water is normally low. Orthophosphate is naturally abundant in the geologic material in much of Florida, coming from clays overlying the Floridan aquifer and in the limestone as dissolved phosphorus bound to calcium in the rock matrix (Fitts 2013). Only the inorganic form of phosphorus, orthophosphate, is generally found at significant concentrations in groundwater and springs.

In Wilson Head, Blue, and Gum Springs, orthophosphate has been the largest contributor to TP based on historical water quality data. Comparing the median orthophosphate concentrations with TP concentrations for Wilson Head, Blue, and Gum Springs from 2009 to 2017, orthophosphate makes up 95 %, 74 %, and 93 % of TP, respectively. These concentrations are similar to the basin wide concentrations measured in groundwater monitoring wells. Historical monitoring data for orthophosphate for these springs, as well as groundwater samples collected across the Withlacoochee Basin, show no significant trends, indicating that the orthophosphate is a persistent natural condition.

Table 2.2 summarizes TP and orthophosphate statistics for the springs for the verified period from SWFWMD and DEP samples, as well as basin wide TP and orthophosphate statistics for groundwater in the Withlacoochee Basin from the Florida Generalized Well Information System (GWIS) Database.

Table 2.2. Summary phosphorus statistics for Wilson Head, Blue, and Gum Springs (2009–17) and the Withlacoochee Basin (1980–2017)

Wilson Head Spring

Sample Dates	Units	Analyte	Number of Samples	Arithmetic Mean	Median	Minimum	Maximum
Jan. 2009–July 2017	mg/L	Total Phosphate	36	0.053	0.044	0.039	0.270
Jan. 2009–July 2017	mg/L	Ortho-phosphate	42	0.045	0.042	0.022	0.190

Blue Spring

Sample Dates	Units	Analyte	Number of Samples	Arithmetic Mean	Median	Minimum	Maximum
April 2009–July 2017	mg/L	Total Phosphate	41	0.046	0.039	0.028	0.14
Jan. 2009–July 2017	mg/L	Ortho-phosphate	44	0.031	0.029	0.026	0.099

Gum Springs

Sample Dates	Units	Analyte	Number of Samples	Arithmetic Mean	Median	Minimum	Maximum
Jan. 2009–April 2017	mg/L	Total Phosphate	112	0.034	0.030	0.020	0.163
Jan. 2009–April 2017	mg/L	Ortho-phosphate	117	0.031	0.028	0.005	0.121

Withlacoochee Basin Groundwater

Sample Dates	Units	Analyte	Number of Samples	Arithmetic Mean	Median	Minimum	Maximum
Jan. 1980–Mar. 2017	mg/L	Total Phosphate	Maximum value of 56 wells	0.111	0.051	0.002	1.300
Jan. 1980–Mar. 2017	mg/L	Ortho-phosphate	Maximum value of 53 wells	0.088	0.057	0.002	0.953

Chapter 3: Site-Specific Numeric Interpretation of the Narrative Nutrient Criterion

3.1 Establishing the Site-Specific Interpretation

The nutrient TMDLs presented in this report, upon adoption into Chapter 62-304.640, F.A.C., will constitute the site-specific numeric interpretation of the narrative nutrient criterion set forth in Paragraph 62-302.530(48)(b), F.A.C., that will replace the otherwise applicable NNC in Subsection 62-302.531(2), F.A.C., for this particular waterbody, pursuant to Paragraph 62-302.531(2)(a), F.A.C. **Appendix B** summarizes the relevant details to support the determination that the TMDLs provide for the protection of Wilson Head, Blue, and Gum Springs and for the attainment and maintenance of water quality standards in downstream waters (pursuant to Subsection 62-302.531[4], F.A.C.), and to support using the nutrient TMDLs as the site-specific numeric interpretations of the narrative nutrient criterion.

3.2 Site-Specific Response Variable Target Selection

Paragraph 62-302.530(48)(b), F.A.C., states that "in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna." The spring vent nitrate-nitrite criterion is based on a strong stressor-response relationship between nitrate-nitrite and the presence of nuisance algal mats, with the criterion established at a concentration that would prevent nuisance mats from occurring (compared with natural background levels).

Florida's nitrate-nitrite NNC for spring vents, set forth in Subparagraph 62-302.531(2)(b)2, F.A.C., is expressed as an AGM value of 0.35 mg/L, not to be exceeded more than once in any consecutive 3-year period. DEP's hierarchical approach gives preference to the numeric nutrient value of 0.35 mg/L of nitrate-nitrite for spring vents based on the quantifiable stressor-response relationships between nutrients and biological response (DEP 2013).

3.3 Numeric Expression of the Site-Specific Numeric Interpretation

While TMDLs can establish a site-specific interpretation of the narrative nutrient criterion, Wilson Head, Blue, and Gum Springs have the characteristics of typical freshwater, nontidal spring systems to which the NNC for spring vents applies. Consequently, an AGM of 0.35 mg/L nitrate-nitrite (NO_3- NO_2) not to be exceeded in any year is the most appropriate target for the TMDLs.

3.4 Downstream Protection

The imbalance of flora in Wilson Head, Blue, and Gum Springs is attributable to elevated nitrate-nitrite concentrations at the spring vents. When the nitrate-nitrite concentration thresholds established for these springs are met, algal growth contributing to the floral imbalance will be reduced so that algal coverage will be at background levels (< 20 %) (DEP 2013). Since the source of elevated nitrate-nitrite is the headsprings, decreasing the concentration from the headsprings will also reduce nitrate-nitrite in downstream waters.

Gum Springs, located farthest upstream, flows along Gum Springs Slough (WBID 1338B) and connects with the downstream “northern” segment of the Withlacoochee River (WBID 1329D; impaired for nutrients [macrophytes]). Based on the USGS station 02312722, located within WBID 1329D, this segment of the Withlacoochee River has a flow of 894 ft^3/s in the 75th percentile (based on 13 water years of record) and therefore, Gum Springs does not provide a significant portion of the flow to the Withlacoochee River. As the Withlacoochee River continues flowing northward, the adjacent downstream WBID 1329C is unimpaired. Flows from Blue Spring and Wilson Head Spring connect with the Withlacoochee River in this segment. The river then connects to Lake Rousseau (WBID 1329B; unimpaired) and back into the Lower Withlacoochee through a bypass channel (WBID 1337A; impaired for nutrients [algal mats]). Two lower Withlacoochee River segments (WBIDs 1337C and 1337B; unimpaired) then connect the bypass with the Gulf of Mexico (WBID 8038C).

Alternately, water from the bypass can be routed through a segment of the Cross-Florida Barge Canal (WBID 1329A; impaired for nutrients [chlorophyll *a*]), which connects to the Gulf. The Withlacoochee River (WBID 1329D) is partially located in the Kings Bay/Crystal River and Chassahowitzka River Basin Management Action Plan (BMAP) areas and consequently will likely benefit from ongoing BMAP activities. The reductions in nitrate-nitrite loads prescribed in this TMDL analysis are not expected to contribute nutrient impairments downstream and therefore will be protective of water quality in downstream waters.

3.5 Endangered Species Consideration

Section 7(a)(2) of the Endangered Species Act (ESA) requires each federal agency, in consultation with the services (i.e., the U.S. Fish and Wildlife Service [FWS] and NOAA National Marine Fisheries Service [NMFS]), to ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. The EPA must review and approve changes in water quality standards (WQS) such as setting site-specific criteria.

Prior to approving WQS changes for aquatic life criteria, the EPA will prepare an Effect Determination summarizing the direct or indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. The EPA categorizes potential effect outcomes as either (1) "no effect," (2) "may affect, not likely to adversely affect," or (3) "may affect: likely to adversely affect."

The service(s) must concur on the Effect Determination before the EPA approves a WQS change. A finding and concurrence by the service(s) of "no effect" will allow the EPA to approve an otherwise approvable WQS change. However, findings of either "may affect, not likely to adversely affect" or "may affect: likely to adversely affect" will result in a longer consultation process between the federal agencies and may result in a disapproval or a required modification to the WQS change.

The FWS online tool, Information for Planning and Conservation (IPaC),[1] identifies the West Indian manatee (*Trichechus manatus latirostris*) as a species potentially affected by activities in waters related to these springs. According to the Manatee Sanctuary Act of 1978 (Rule 68C-22.012, F.A.C.), while the manatee inhabits the waters of the Withlacoochee River downstream of these spring vents, the FWS does not designate the Withlacoochee as a critical habitat for any endangered or threatened species. The Citrus County Land Development Code Manatee Protection Plan Element[2] (Citrus County; adopted 1997) notes that manatee sightings are largely limited to waters around the mouth of the Withlacoochee. It is unlikely that the impairment in these springs is cause for any potential manatee habitat degradation in the context of the overall Withlacoochee water budget. However, any additional improvements to water quality that may result from the TMDLs would likely only serve to improve current habitat conditions downstream.

In a July 21,2015 Concurrence Letter to DEP, the FWS stated "…*that the adoption of site-specific nutrient criteria that are more stringent than the current default criteria* [0.35 mg/L of nitrate-nitrite (N03 + N02) as an annual geometric mean not to be exceeded more than once in a consecutive three year period] …*may affect, but are not likely to adversely affect any aquatic or aquatic dependent federally listed species or critical habitats in Florida. The EPA may use this letter as concurrence for future actions that require the approval of site-specific nutrient criteria."* Therefore, since the site-specific criteria used for Wilson Head, Blue, and Gum Springs in this TMDL analysis are more stringent than the generally applicable criteria, DEP is confident that these TMDLs will be protective of all endangered species related to these springs.

[1] https://ecos.fws.gov/ipac/

[2] http://myfwc.com/media/4324518/citruscountympp_1997.pdf

Chapter 4: Assessment of Sources

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of the pollutant of concern in the target watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point sources or nonpoint sources. Historically, the term "point sources" has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from septic systems; and atmospheric deposition.

However, the 1987 amendments to the CWA redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination System (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, such as those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with CWA definitions, the term "point source" is used to describe traditional point sources (such as domestic and industrial wastewater discharges) and stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1** on **Expression and Allocation of the TMDL**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Point Sources

4.2.1 Wastewater Facilities

Domestic wastewater land application sites can produce a significant load of nitrogen in spring areas. Six permitted domestic wastewater facilities discharge in the WBG contributing area, and two permitted facilities have land application sites that may be partially within the contributing area boundary. Land application practices at these facilities include rapid infiltration basins (RIBs) and reuse (treated water sent to agriculture, public access, and golf courses). When the effluent is applied to the land surface, it infiltrates into groundwater and can deliver nutrient loads to the aquifer. **Table 4.1** and **Figure 4.1** provide details on these facilities.

Table 4.1. Permitted wastewater facilities in the WBG contributing area

mgd = million gallons per day
* Facility is not located within the contributing area boundary; however, land application sites may be within the boundary.

Facility ID #	Facility Name	Design Capacity (mgd)	Permitted Capacity (mgd)	Land Application	County
FLA010693	Oak Bend Manufactured Home Community	0.06	0.06	RIBs	Marion
FLA012669	Manatee County Utility District (MCUD)/Marion Oaks WWTF	0.225	0.225	RIBs	Marion
FLA012683	On Top of the World WWTF*	0.75	0.75	Reuse, RIBs, Biosolids	Marion
FLA012687	103rd Street Square Center WWTF	0.01	0.01	RIBs	Marion
FLA012697	Oak Run	0.8	0.8	Reuse, RIBs	Marion
FLA012707	Circle Square Shopping Center WWTF*	0.015	0.015	RIBs	Marion
FLA012709	Meadowbrook RV Resort	0.025	0.025	RIBs	Marion
FLA016867	Spruce Creek Preserve	0.095	0.095	Reuse	Marion

4.2.2 Municipal Separate Storm Sewer System (MS4) Permittees

MS4s may also discharge pollutants to waterbodies in response to storm events. To address stormwater discharges, the EPA developed the NPDES stormwater permitting program in two phases. Phase I, promulgated in 1990, addresses large and medium-size MS4s located in incorporated areas and counties with populations of 100,000 or more. Phase II permitting began in 2003. Regulated Phase II MS4s are defined in Rule 62-624.800, F.A.C., and typically cover urbanized areas serving jurisdictions with a population of at least 10,000 or discharging into Class I or Class II waters, or into Outstanding Florida Waters (OFWs).

A portion of the WBG contributing area is covered by a NPDES MS4 Phase II permit held by Marion County (FLR04E021) and a NPDES MS4 Phase II permit held by the Florida Department of Transportation (FDOT) District 5 (FLR04E024). However, currently no discharges are regulated under the MS4 permits because there are no direct discharges to the springs or associated runs. For more information on MS4s in the watershed, send an email to NPDES-stormwater@dep.state.fl.us.

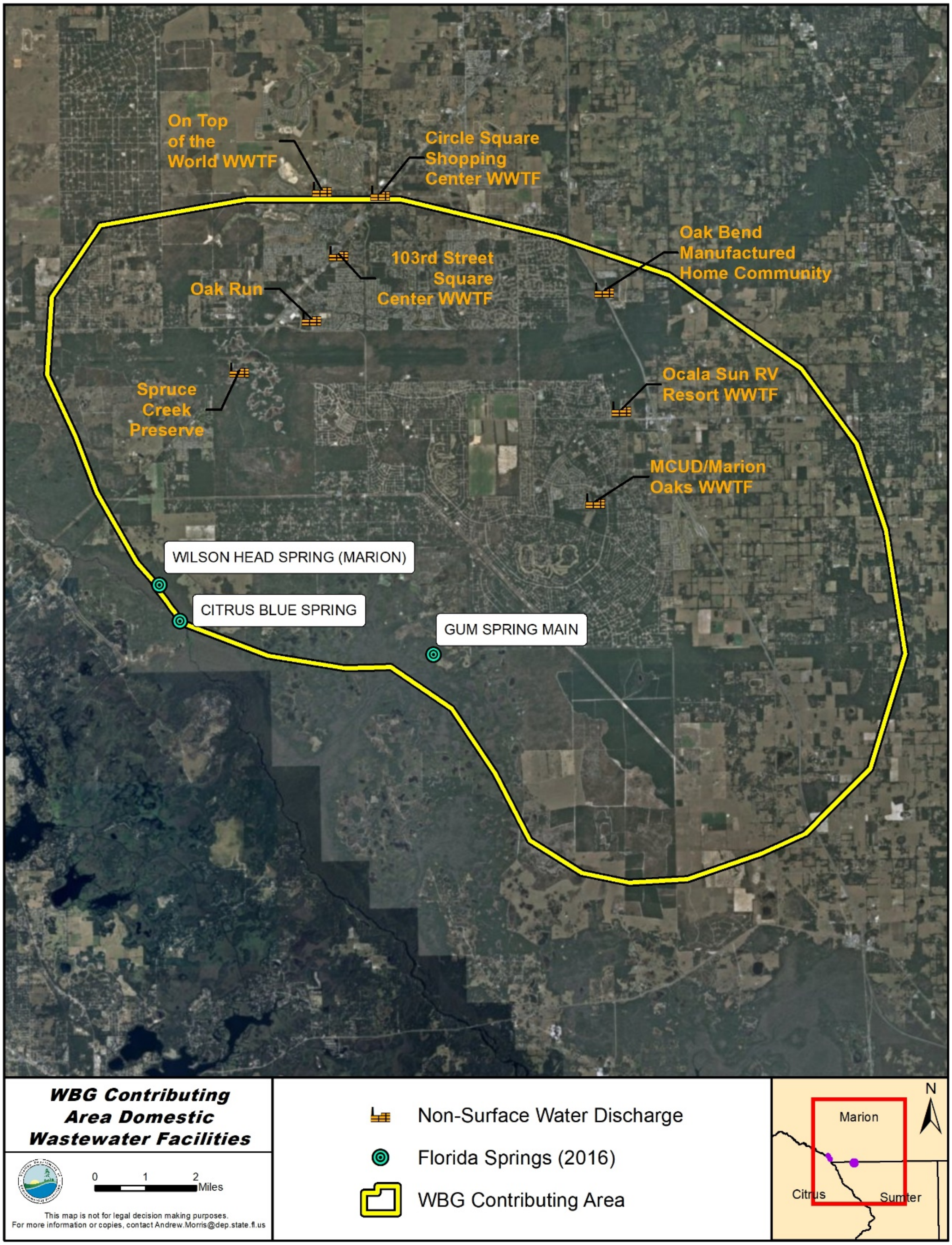

Figure 4.1. Permitted domestic wastewater facilities in the WBG contributing area

4.3 Nonpoint Sources

Pollutant sources that are not NPDES wastewater or stormwater dischargers are generally considered nonpoint sources. Nutrient loadings to the WBG contributing area are primarily generated from nonpoint sources. Nonpoint sources addressed in this analysis mainly comprise loadings from agriculture, urban areas, onsite sewage treatment and disposal systems (OSTDS), and precipitation within the contributing area recharging the UFA (atmospheric deposition).

4.3.1 Land Uses

Land use is an important factor in determining nutrient loadings to the contributing area. Nutrients at the surface can infiltrate into groundwater and concentrate at spring vents. Both human land use areas and natural land areas generate nutrients. However, human land uses typically generate more nutrient loads per unit of land surface area than natural lands can produce.

Land use information for the WBG contributing area was obtained from the 2011 SWFWMD and 2014 SJRWMD land use GIS coverage, which were the most recent land use data available. **Table 4.2** and **Figure 4.2** show the breakdown of the various land use categories in the contributing area. From 2011 to 2014, forest, agriculture and low-density residential were the predominant land uses, covering 32 %, 22 %, and 18 %, respectively. Open land was fourth, comprising almost 8 %. These 4 categories make up 80 % of the contributing area.

4.3.1.1 Urban Land Use

Urban areas include land uses such as residential, industrial, utility easements, recreational, institutional, commercial, and extractive (mining). Nutrient loading from urban areas (whether in an MS4 jurisdiction or not) can come from multiple sources, including groundwater seepage, stormwater runoff, illicit discharges of sanitary waste as a result of sanitary sewer overflows (SSOs), domestic animals, and fertilizers applied to home gardens, lawns, and golf courses. Of the total land area in the WBG contributing area, 28 % is mapped (**Figure 4.2**) as one of these urban land uses.

4.3.1.2 Agricultural Land Use

Agricultural land uses in the contributing area are likely to contribute nitrogen to the springs. Nitrogen sources related to these land uses include fertilizer applied to fields and nurseries, and livestock waste in pastures, housing, and feeding areas. In the WBG contributing area, land uses associated with agricultural activity include pastures, feeding operations, poultry operations, and horse farms, field and row crops, nurseries and vineyards, tree nurseries, ornamental farms, and various other specialty farms (2011 SWFWMD; 2014 SJRWMD land use layers).

Table 4.2. Percentages of major land uses in the WBG contributing area, SWFWMD (2011) and SJRWMD (2014)

Code	Land Use	Square Miles	Acres	% of Contributing Area
1100	Low-Density Residential	28.46	18,220.31	18.44
1200	Medium-Density Residential	4.69	3,002.39	3.04
1300	High-Density Residential	3.49	2,239.99	2.27
1400	Commercial	0.87	562.44	0.57
1500	Light Industrial	0.20	131.39	0.13
1600	Extractive/Quarries/Mines	0.12	80.59	0.08
1700	Institutional	0.34	222.60	0.23
1800	Recreational (Golf Courses, Parks, Marinas, etc.)	2.06	1,322.68	1.34
1900	Open Land	12.27	7,853.14	7.95
2000	Agriculture	34.36	21,994.51	22.26
3000 and 7000	Rangeland	4.89	3,138.96	3.18
4000	Forest/Rural Open	49.90	31,936.86	32.33
5000	Water	0.20	131.04	0.13
6000	Wetlands	9.78	6,263.40	6.34
8000	Communication and Transportation	2.63	1,688.61	1.71
	Total	**154.26**	**98,788.91**	**100**

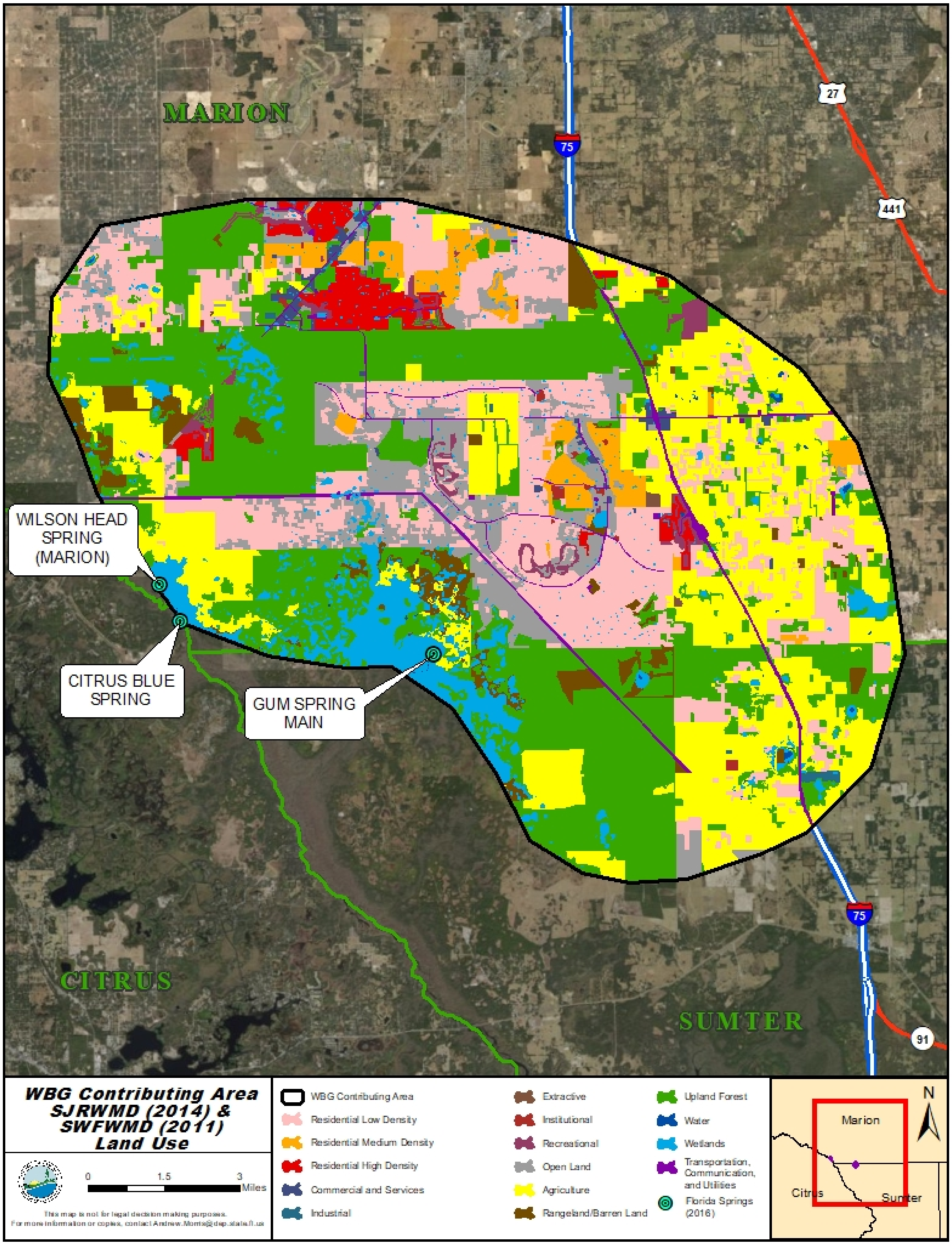

Figure 4.2. **Land use in the WBG contributing area, SWFWMD (2011) and SJRWMD (2014)**

4.3.2 OSTDS

OSTDS are used to dispose of domestic waste at homes that are not on central sewer, often because providing central sewer is not cost-effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDS are a sanitary means of disposing of domestic waste. The nitrogen concentrations in effluent from OSTDS are considerably higher than those in effluent from typical domestic WWTFs, although the wastewater profile can vary from home to home. The physical setting of an OSTDS (soil and aquifer characteristics and proximity) is also a factor in the amount of nitrogen it can contribute to groundwater and springs.

On average, the total nitrogen (TN) concentration in the effluent from a typical OSTDS is 57.7 mg/L (Hazen and Sawyer 2009), although this concentration is reduced further as the effluent is discharged to the drainfield and percolates to groundwater. In a low-density residential setting, nitrogen loadings from OSTDS may not be significant, but in a higher density setting, one could expect the nitrogen input to be 129 pounds per acre per year (lb/ac/yr) (Harrington et al. 2010). However, some nitrogen reduction occurs in the drainfield and soil above the water table, and, as discussed previously, the actual load to groundwater would vary based on actual use and setting.

Figure 4.3 shows the known and likely locations of OSTDS in the WBG contributing area. These were obtained from the 2016 Florida Department of Health (FDOH) Florida Water Management Inventory. Currently, there are 15,512 OSTDS in the contributing area.

4.3.3 Atmospheric Deposition

Atmospheric deposition can also be a contributing source of nitrogen to springs. Wet and dry deposition will be estimated using a nationwide model developed by Schwede and Lear (2014) based on several monitoring networks—including the Clean Air Status and Trend Network (CASTNET), the National Atmospheric Deposition Program (NADP) Ammonia Monitoring Network, the Southeastern Aerosol Research and Characterization Network, and modeled data from the Community Multi-Scale Air Quality Model and the National Trends Network. Specific atmospheric loading calculations can be done during the restoration process.

4.4 Estimating Watershed Loadings

During the development of a restoration plan for the springs an inventory of nitrogen sources will be needed to calculate the potential loads of nitrogen to groundwater in the WBG contributing area as applicable. As discussed above, the main nitrogen sources include WWTFs, fertilizers (urban and agricultural), livestock waste, septic tanks, atmospheric deposition, and any additional source category relevant to the specific area. Nitrogen inventory assessments consider factors such as recharge potential, attenuation, hydrology, and soil type. Any nitrogen assessment would require significant stakeholder involvement, since no two areas are the same.

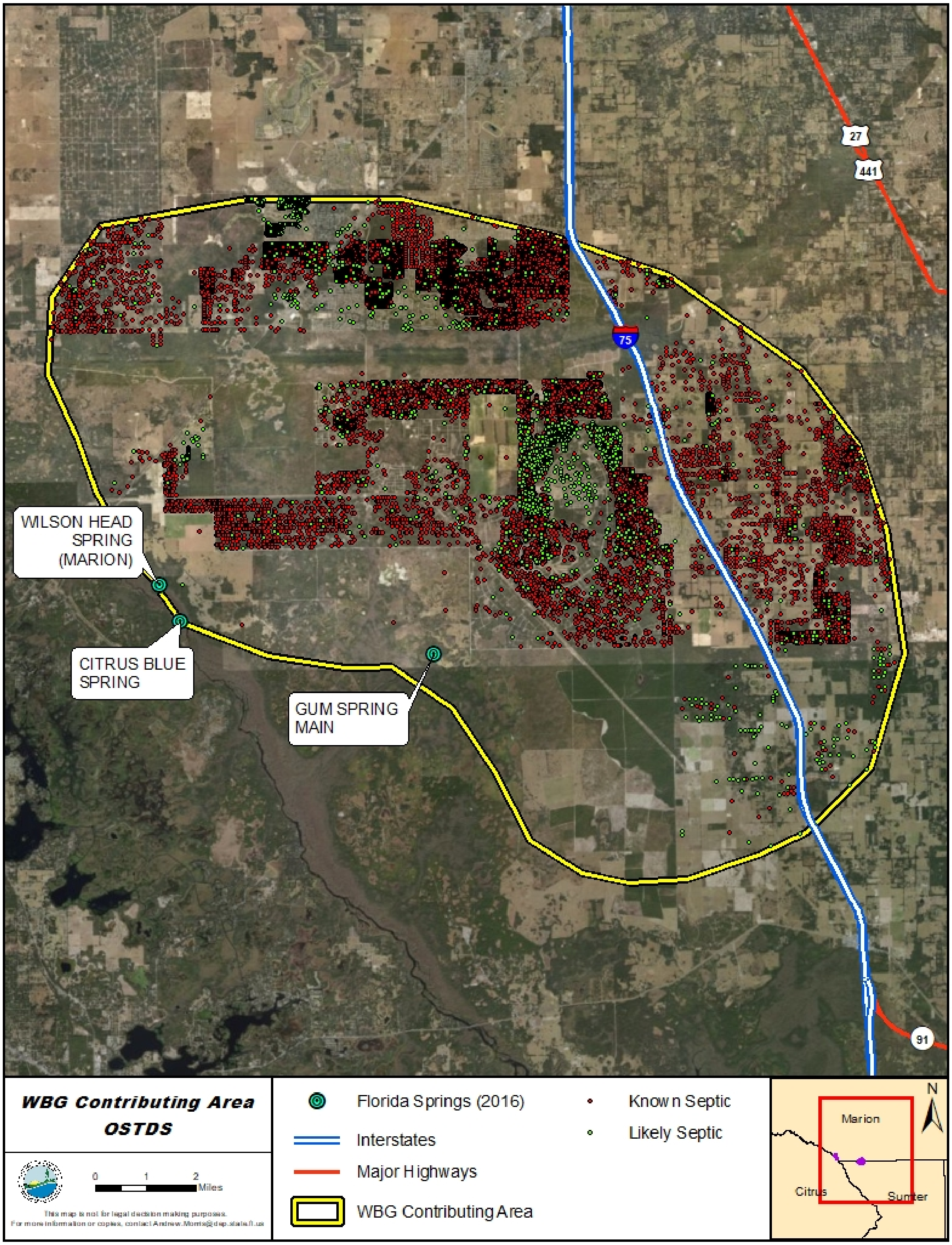

Figure 4.3. OSTDS in the WBG contributing area

Chapter 5: Determination of Assimilative Capacity

5.1 Determination of Loading Capacity

Typically, the target loading and existing loading for a stream or watershed are based on hydrologic and water quality modeling. Many of these models depend on the relationship between flow and surface water drainage area, as well as the relationship between land use, soils, and pollutant delivery.

The predominant source of nutrient loading to Wilson Head, Blue, and Gum Springs is by nutrient rich groundwater discharged at the springs. In most of the contributing area, recharge to the aquifer can readily occur. Rainwater percolates directly through the soil profile, and surface drainage flows toward sinkholes and closed depressions, where it infiltrates and reaches the surface via groundwater discharged from the spring vents. Thus, the relationship between surface water loadings in the watershed and groundwater is indirect. This diffuse loading situation requires the use of an alternative approach for establishing the NNC and TMDLs.

Existing spring loading can be estimated by multiplying the measured spring flow by the measured pollutant concentrations in the spring. To calculate the pollutant loading in this way, synoptic flow and concentration data measured at the outlet of each spring vent under assessment are required. These data were not available when the NNC and TMDLs were developed. Therefore, the nitrate loads were not explicitly calculated; nor were they needed, since the NNC and TMDL targets for these waters are established as concentrations.

The percent reductions required to achieve the nitrate concentration targets for Wilson Head, Blue, and Gum Springs were calculated using the following formula:

[(maximum mean concentration – target concentration)/maximum mean concentration] x 100

5.2 Critical Conditions and Seasonal Variation

The estimated assimilative capacity is based on annual conditions, rather than critical/seasonal conditions, because (1) the methodology used to determine assimilative capacity does not lend itself very well to short-term assessments, especially in a groundwater system, (2) DEP is generally more concerned with the net change in overall primary productivity in a segment, which is better addressed on an annual basis, and (3) the methodology used to determine impairment is based on annual conditions.

Additionally, as part of a minimum flows and levels (MFL) study, SWFWMD (Holzwart et al. 2016) reviewed a statistical analysis of the relationship between discharge and nitrate-nitrite concentrations at Gum Springs conducted by Heyl (2012). The study found that nitrate-nitrite concentrations are not significantly related to discharge. Since the contributing area for Gum Springs is combined with that of Wilson Head and Blue Springs, a relationship between nitrate-nitrite concentrations and discharge is likely absent in all three springs. Therefore, it is also unlikely that seasonal variation in precipitation and discharge would have a significant corresponding effect on nitrate concentrations in these springs, indicating that an annual assessment is more appropriate.

5.3 Water Quality Analysis to Determine Assimilative Capacity

Florida's nitrate-nitrite NNC for spring vents, set forth in Paragraph 62- 302.530(48)(b), F.A.C., is expressed as an AGM value of 0.35 mg/L, not to be exceeded more than once in any consecutive 3-year period. Since Wilson Head, Blue, and Gum Springs have the characteristics of typical freshwater, nontidal spring systems to which the NNC for spring vents applies, 0.35 mg/L nitrate-nitrite is the most appropriate target for the TMDLs. An AGM is more appropriate than a monthly mean because DEP is generally more concerned with the net change in overall primary productivity in the segments, which is better addressed on an annual basis. AGM concentrations were calculated for each spring for each year based on measured concentrations beginning at the start of the verified period in 2009 and more recently (through 2017).

Tables 5.1, 5.2, and **5.3** list the calculated AGM concentrations for Wilson Head, Blue, and Gum Springs, respectively. The highest AGM nitrate-nitrite concentrations were used as existing annual mean concentrations to calculate the percent reduction required to achieve the nitrate-nitrite target. This approach adds to the margin of safety (MOS) of the TMDLs because it ensures that the AGM concentrations will meet the concentration target even under the worst-case scenario.

Table 5.1. Wilson Head Spring AGM nitrate-nitrite concentrations, 2006–17

* Indicates highest annual mean nitrate-nitrite concentration for assessment period
** Insufficient data

Year	Nitrate-Nitrite (mg/L) AGM	n
2009	**0.61**	**4***
2010	0.58	4
2011	0.57	4
2012	0.41	4
2013	0.49	4
2014	0.48	4
2015	0.48	4
2016	0.42	5
2017	0.40	3**

Table 5.2. Blue Spring (Citrus County) AGM nitrate-nitrite concentrations, 2006–17

* Indicates highest annual mean nitrate-nitrite concentration for assessment period
** Insufficient data

Year	Nitrate-Nitrite (mg/L) AGM	n
2009	0.63	4
2010	0.63	4
2011	0.72	4
2012	0.76	4
2013	0.72	4
2014	**0.90**	**7***
2015	0.60	9
2016	0.81	5
2017	0.92	3**

Table 5.3. Gum Spring (Alligator Spring) AGM nitrate-nitrite concentrations, 2006–17

* Indicates highest annual mean nitrate-nitrite concentration for assessment period
** Insufficient data.

Year	Nitrate-Nitrite (mg/L) AGM	n
2009	1.09	16
2010	1.38	16
2011	1.40	14
2012	1.30	11
2013	1.22	15
2014	1.50	15
2015	1.57	12
2016	**1.58**	**14***
2017	1.67	4**

5.4 Calculation of the TMDLs

The percent reductions for Wilson Head, Blue, and Gum Springs were based on the highest annual mean nitrate-nitrite concentration for each year, which occurred in 2009, 2014, and 2016, respectively (**Table 5.1**). This approach is the most protective and adds to the implicit MOS. The maximum annual mean nitrate-nitrite concentration was 0.61 mg/L for Wilson Head Spring, 0.90 mg/L for Blue Spring, and 1.58 mg/L for Gum Springs. The percent reductions required to achieve the water quality target for each spring were calculated using the following formula:

[(maximum mean concentration – target concentration)/maximum mean concentration] x 100

For **Wilson Head Spring**:

[(0.61 mg/L – 0.35 mg/L) / 0.61 mg/L] * 100

Equals a 43 % reduction in nitrate-nitrite.

For **Blue Spring**:

[(0.90 mg/L – 0.35 mg/L) / 0.90 mg/L] * 100

Equals a 61 % reduction in nitrate-nitrite.

For **Gum Springs**:

[(1.58 mg/L – 0.35 mg/L) / 1.58 mg/L] * 100

Equals a 78 % reduction in nitrate-nitrite.

Reductions of 43 %, 61 %, and 78 % in nitrate-nitrite concentrations for Wilson Head, Blue, and Gum Springs, respectively, are proposed because they are protective values that, when achieved, will satisfy the nutrient reduction requirement for the springs.

Chapter 6: Determination of Loading Allocations

6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating loads to all the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (wasteload allocations, or WLAs), nonpoint source loads (load allocations, or LAs), and an appropriate margin of safety (MOS), which accounts for uncertainty in the relationship between effluent limitations and water quality:

$$\textbf{TMDL} = \sum \textbf{WLAs} + \sum \textbf{LAs} + \textbf{MOS}$$

As discussed earlier, the WLA is broken out into separate subcategories for wastewater discharges and stormwater discharges regulated under the NPDES Program:

$$\textbf{TMDL} \cong \sum \textbf{WLAs}_{\textbf{wastewater}} + \sum \textbf{WLAs}_{\textbf{NPDES Stormwater}} + \sum \textbf{LAs} + \textbf{MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (1) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (2) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

WLAs for stormwater discharges are typically expressed as "percent reduction" because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the "maximum extent practical" through the implementation of best management practices (BMPs).

This approach is consistent with federal regulations (40 Code of Federal Regulations [CFR] § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or other appropriate measure. The TMDLs for these springs are expressed in terms of the nitrate-nitrite concentration that the springs can assimilate and maintain healthy levels of algal growth that do not contribute to an ecological imbalance.

Table 6.1 lists the TMDLs for Wilson Head Spring, Blue Spring (Citrus), and Gum Springs. The TMDLs will constitute the site-specific numeric interpretation of the narrative nutrient criterion set forth in Paragraph 62-302.530(48)(b), F.A.C., that will replace the otherwise applicable NNC in Subsection 62-302.531(2), F.A.C., for these particular waters. The TMDLs are also represented as the percent reductions in existing nitrate-nitrite concentrations required to achieve the nutrient targets. The existing nitrate-nitrite concentrations used for the springs are conservative and based on worst-case water quality conditions from the TMDL period of record. The percent reductions assigned to all the nonpoint source areas (LAs) are the same as those defined for the TMDL percent reductions.

Table 6.1. TMDL components for nutrients in Wilson Head Spring (WBID 1329R), Blue Spring (Citrus) (WBID 1329S), and Gum Springs (WBID 1338A)

NA = Not applicable
[1]Nutrient concentrations represent AGM, not to be exceeded.
* The required percent reductions listed in this table represent the reduction from all sources.

Waterbody (WBID)	Parameter	TMDL[1] (mg/L)	WLA Wastewater (% reduction)	WLA NPDES Stormwater (% reduction)*	LA (% reduction)*	MOS
1329R	Nitrate-Nitrite	0.35	NA	43	43	Implicit
1329S	Nitrate-Nitrite	0.35	NA	61	61	Implicit
1338A	Nitrate-Nitrite	0.35	NA	78	78	Implicit

6.2 Load Allocation

To achieve the LA in Wilson Head, Blue, and Gum Springs, a 43 %, 61 %, and 78 % reduction in current nitrate-nitrite concentrations, respectively, will be required.

The TMDLs are based on the percent reduction in nitrate-nitrite concentration. However, it is not DEP's intent to abate natural conditions. It should be noted that the LA includes loading from stormwater discharges regulated by DEP and the water management districts that are not part of the NPDES stormwater program (see **Appendix A**).

6.3 Wasteload Allocation

6.3.1 NPDES Wastewater Discharges

As noted in **Chapter 4**, no active NPDES-permitted facilities currently discharge directly into Wilson Head, Blue, or Gum Springs. Therefore, a WLA for wastewater discharges is not applicable. Any new potential discharger is expected to comply with the Class III criterion for nutrients and with nitrate limits consistent with these TMDLs. If it is determined that any of the wastewater facilities discharge into these springs, they will be subject to meeting the TMDL.

6.3.2 NPDES Stormwater Discharges

Table 6.1 lists the NPDES stormwater percent load reductions that would result in ecosystem improvement. There are currently no regulated MS4 discharges to the springs or spring runs. It should be noted that any future MS4 permittee is only responsible for reducing the anthropogenic loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

The MOS can either be implicitly accounted for by choosing conservative assumptions about loading or water quality response, or explicitly accounted for during the allocation of loadings. Consistent with the recommendations of the Allocation Technical Advisory Committee (DEP 2001), an implicit MOS was used in the development of these TMDLs. The MOS is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody (CWA, Section 303[d][1][c]). Considerable uncertainty is usually inherent in estimating nutrient loading from nonpoint sources, as well as in predicting water quality response. The effectiveness of management activities in reducing loading is also subject to uncertainty.

The TMDLs for the springs provide an implicit MOS based on the conservative decisions associated with a number of assumptions and the development of assimilative capacity. Also, when calculating the required percent reduction to achieve the water quality target, the highest AGM of measured nitrate-nitrite concentration in the 8-year data period (2007–16) was used. Requiring the 0.35 mg/L target to be met every year should result in a nitrate-nitrite concentration even lower than the target concentration in the long term and therefore adds to the MOS.

Chapter 7: Implementation Plan Development and Beyond

7.1 Implementation Mechanisms

Following the adoption of a TMDL, implementation takes place through various measures, which could include specific requirements such as NPDES wastewater and MS4 permits, and, as appropriate, local or regional water quality initiatives or BMAPs.

Facilities with NPDES permits that discharge to a TMDL waterbody must respond to the permit conditions that reflect target concentrations, reductions, or WLAs identified in the TMDL. NPDES permits are required for Phase I and Phase II MS4s as well as domestic and industrial wastewater facilities. MS4 Phase I permits require a permit holder to prioritize and act to address a TMDL unless management actions to achieve that particular TMDL are already defined in a BMAP. MS4 Phase II permit holders must also implement the responsibilities defined in a BMAP or other form of restoration plan (e.g., a reasonable assurance plan).

7.2 BMAPs

Section 403.067, F.S. (the FWRA) contains information on the development and implementation of BMAPs. DEP or a local entity may initiate and develop a BMAP that addresses some or all of the contributing areas to the TMDL waterbody. BMAPs are adopted by the DEP Secretary and are legally enforceable.

BMAPs describe the fair and equitable allocations of pollution reduction responsibilities to the sources in the watershed, as well as the management strategies that will be implemented to meet those responsibilities, funding strategies, mechanisms to track progress, and water quality monitoring. Local entities usually implement these strategies, such as wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, state agencies, and individual property owners. BMAPs can also identify mechanisms to address potential pollutant loading from future growth and development.

Additional information about BMAPs is available online.[3]

[3] https://floridadep.gov/dear/water-quality-restoration/content/basin-management-action-plans-bmaps

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[5] http://www.floridahealth.gov/environmental-health/onsite-sewage/research/FLWMI/

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Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. In 1994, DEP stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations, as authorized under Part IV of Chapter 373, F.S.

Chapter 62-40, F.A.C., also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a Surface Water Improvement and Management (SWIM) Program plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, they have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

In 1987, the U.S. Congress established Section 402(p) as part of the federal CWA Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as "point sources" of pollution. The EPA promulgated regulations and began implementing the Phase I NPDES stormwater program in 1990 to address stormwater discharges associated with industrial activity, including 11 categories of industrial activity, construction activities disturbing 5 or more acres of land, and large and medium MS4s located in incorporated places and counties with populations of 100,000 or more.

However, because the master drainage systems of most local governments in Florida are physically interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 special districts; community development districts, water control districts, and FDOT throughout the 15 counties meeting the population criteria. DEP received authorization to implement the NPDES stormwater program in 2000. The authority to administer the program is set forth in Section 403.0885, F.S.

The Phase II NPDES stormwater program, promulgated in 1999, addresses additional sources, including small MS4s and small construction activities disturbing between 1 and 5 acres, and urbanized areas serving a minimum resident population of at least 1,000 individuals. While these urban stormwater discharges are technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. It should be noted that Phase I MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.

Appendix B: Information in Support of Site-Specific Interpretations of the Narrative Nutrient Criterion

Table B-1. Spatial extent of the numeric interpretation of the narrative nutrient criterion

Location	Description
Waterbody name	Wilson Head Spring Blue Spring (Citrus County) Gum Springs (Alligator Springs)
Waterbody type(s)	Springs
WBID	WBIDs: 1329R, 1329S, 1338A (see **Figures 1.3** and **1.4** of this report)
Description	Wilson Head Spring is a third magnitude spring located in Marion County, 10 miles south-southeast of Dunnellon, along the Withlacoochee River. Blue Spring is a second magnitude spring located in Citrus County, 9 miles south-southeast of Dunnellon, along the Withlacoochee River. The Gum Springs Group is a collection of springs with a combined second magnitude flow located in Marion County, 10 miles southwest of Ocala. The Gum Springs Group discharges into Gum Slough and connects with the Withlacoochee River 0.8 miles downstream. The groundwater contributing area covers an area of 154 square miles, spans Marion, Sumter, and Citrus Counties, and is located in the SWFWMD and SJRWMD. **Chapter 1** of this report describes Wilson Head, Blue, and Gum Springs in more detail.
Specific location (latitude/longitude or river miles)	Wilson Head Spring is located at N: 28° 58' 47.232"/ W: 82°19' 16.138". Blue Spring is located at N: 28° 58' 9.602"/ W: 82° 18' 52.344". Gum Springs Main is located at N: 28° 57' 31.400"/ W: 82° 13' 53.493". The site-specific criteria apply to each entire WBID, and locational information is provided as a general reference. For more information on location, see **Figures 1.3** and **1.4**.
Map	**Figure 1.1** shows the general location of the WBG contributing area, and **Figure 4.2** shows land uses in the contributing area.
Classification(s)	Class III Freshwater
Basin name (HUC 8)	Withlacoochee Basin (03100208)

Table B-2. Description of the numeric interpretation of the narrative nutrient criterion

Numeric Interpretation of Narrative Nutrient Criterion	Information on Parameters Related to Numeric Interpretation of the Narrative Nutrient Criterion
NNC summary: Generally applicable lake classification (if applicable) and corresponding NNC	Per Rule 62-302.531, F.A.C., the applicable nutrient criterion for spring vents is 0.35 mg/L of nitrate-nitrite as an AGM, not to be exceeded more than once in any 3-calendar-year period.
Proposed TN, TP, chlorophyll *a*, and/or nitrate + nitrite concentrations (magnitude, duration, and frequency)	DEP selected a nitrate-nitrite threshold of 0.35 mg/L for Wilson Head, Blue, and Gum Springs, expressed as an AGM not to be exceeded in any year. This target is based directly on Rule 62-302.531, F.A.C., because no additional site-specific data were available. Annual targets were selected because the methodology used to determine assimilative capacity does not lend itself very well to short-term assessments, DEP is generally more concerned with the net change in overall primary productivity in the waterbodies, which is better addressed on an annual basis, and the methodology used to determine impairment is based on annual conditions. An annual target of 0.35 mg/L will be protective of Class III designated use. **Chapter 5** of this document describes the approach. The nitrate-nitrite water quality targets will be established as NNC.
Period of record used to develop numeric interpretations of the narrative nutrient criterion for nitrate-nitrite	To ensure that the proposed nitrate TMDL was developed based on current conditions and that recent trends in spring water quality were adequately captured, monitoring data from the Cycle 3 verified period and more recently (2009–17) were used to develop the TMDLs and nutrient criteria.
How the criteria developed are spatially and temporally representative of the waterbody or critical condition	The data used were spatially representative of the waterbodies because the samples were collected at the Wilson Head, Blue, and Gum spring vents. **Figures 1.3** and **1.4** show the locations of the current and historical routine water quality sampling stations. To ensure that the nutrient TMDLs were developed based on current conditions and that recent trends in spring water quality were adequately captured, monitoring data were compiled for the Cycle 3 verified period and more recently (2009–17). The data used for developing the TMDLs are from samples collected by SWFWMD and DEP. **Figures 2.2**, **2.3**, and **2.4** show the AGM nitrate-nitrite monitoring results for these impaired springs for the period of record. **Table 2.1** summarizes the nitrate-nitrite monitoring results for the springs. Establishing the critical condition for nitrate-nitrite inputs that affect algal growth in each contributing area depends on many factors, including the presence of point sources and the land use pattern in the contributing area. The critical condition for point source loading to a waterbody typically occurs during periods of low flow, when dilution is minimized. Typically, the critical condition for nonpoint source loading is a period of rainfall-related flushing preceded by an extended dry period. During the wet weather period, rainfall mobilizes nitrogen that has accumulated on the land surface and in the soil under dry conditions, resulting in higher pollutant concentrations. However, significant nonpoint source contributions can also occur under dry conditions. Also, as detailed in **Chapter 5**, a significant relationship between nitrate-nitrite and spring discharge does not exist, indicating that seasonality does not affect nutrient concentrations. Since DEP is concerned with the net change in overall primary productivity in the segment, an annual basis is most appropriate. Water quality data for variables relevant to TMDL development are available on request.

Table B-3. Summary of how designated use(s) are protected by the criterion

Designated Use Requirements	Information Related to Designated Use Requirements
History of assessment of designated use support	The springs were listed as impaired by nitrate-nitrite because of their elevated nitrate-nitrite concentrations and the corresponding evidence in the upper river and the vicinity of the headsprings of imbalances in flora and fauna caused by algal smothering. This information was used in the determination of impairment and placement on the 2017 Verified List of Impaired Waters.
Basis for use support	DEP selected the nitrate-nitrite criteria based on the nutrient criterion in Rule 62-302.531, F.A.C. The targets for the springs were set at 0.35 mg/L AGM not to be exceeded in any year. These targets are demonstrated to be protective of Class III designated use because Wilson Head, Blue, and Gum Springs have the characteristics of typical freshwater, nontidal spring systems to which the NNC for spring vents applies. Additionally, DEP is primarily concerned with the net change in overall primary productivity in the segments and the lag present in groundwater systems. Therefore, an annual basis is most appropriate. Setting the target not to be exceeded in any year adds a margin of safety to protect the springs under the worst-case scenario.
Approach used to develop criteria and how it protects uses	The numeric interpretations for nitrate-nitrite were based on the nutrient criterion in Rule 62-302.531, F.A.C. These targets were selected because they will protect Class III designated use and reduce the growth rate of algae populations through nitrate reduction. The criterion is based on the quantifiable stressor-response relationships between nutrients and biological response (DEP 2013).
How the TMDL analysis will ensure that nutrient-related parameters are attained to demonstrate that the TMDLs will not negatively impact other water quality criteria	Reductions in nitrate-nitrite concentrations of 43 %, 61 %, and 78 % in Wilson Head, Blue, and Gum Springs, respectively, are proposed because they will result in nitrate-nitrite levels that are demonstrated to be protective. The proposed reductions in concentrations will further improve water quality. Once the target concentrations are consistently achieved, each WBID will be reevaluated to determine if nitrate continues to contribute to an imbalance of flora in the springs because of excessive algal coverage. If such a condition still exists, the waterbodies will be reassessed as part of DEP's watershed assessment cycle. The TMDL target concentrations may be changed if DEP determines that further reductions in nitrate concentrations are needed to address the imbalance. The purpose of a TMDL is to set a pollutant reduction goal that, if achieved, will result in the attainment of designated uses for that waterbody.

Table B-4. Documentation of the means to attain and maintain water quality standards for downstream waters

Protection of Downstream Waters and Monitoring Requirements	Information Related to Protection of Downstream Waters and Monitoring Requirements
Identification of downstream waters	The imbalance of flora in Wilson Head, Blue, and Gum Springs is attributable to elevated nitrate-nitrite concentrations at the spring vents. When the nitrate-nitrite concentration thresholds established for these springs are met, algal growth that contributes to the floral imbalance will be reduced so that algal coverage will be at background levels (< 20 %) (DEP 2013). Since the headsprings are the source of the elevated nitrate-nitrite, decreasing the concentration from the headsprings will also reduce nitrate-nitrite in downstream waters. Wilson Head, Blue, and Gum Springs all flow into the Withlacoochee River. Gum Springs is the farthest upstream, and discharges from the vents flow down Gum Springs Slough (1338B) and connect with the Withlacoochee River (WBID 1329D; impaired for nutrients [macrophytes]). Downstream, the Lower Withlacoochee River (WBID 1329C) is unimpaired. Flows from Blue Spring and Wilson Head connect with the Withlacoochee River in this segment. The river then connects to Lake Rousseau (WBID 1309; unimpaired) and back into the Withlacoochee through a bypass channel (WBID 1337A; impaired for nutrients [algal mats]). The Lower Withlacoochee River segments (WBIDs 1337C and 1337B) then connect the bypass with the Gulf of Mexico at WBID 8038C. There are no listed impairments downstream of the bypass. Alternatively, water from the bypass can be routed through a segment of the Cross-Bridge Barge Canal (WBID 1329D; impaired for nutrients [chlorophyll *a*]), which connects to the Gulf. The impaired Withlacoochee River segment (WBID 1329D) is partially located in the Kings Bay/Crystal River and Chassahowitzka River BMAP areas and consequently will likely benefit from ongoing BMAP activities. The reductions in nitrate-nitrite loads prescribed in this TMDL analysis are not expected to cause nutrient impairments downstream but will improve water quality in downstream waters.
Summary of existing monitoring and assessment related to the implementation of Subsection 62-302.531(4), F.A.C., and trends tests in Chapter 62-303, F.A.C.	SWFWMD and DEP conduct routine monitoring of Wilson Head, Blue, and Gum Springs. The data collected through these monitoring activities will be used to evaluate the effects of BMP implementation and restoration efforts in the contributing areas on nitrate-nitrite concentrations in the spring vents in subsequent water quality assessment cycles.

Table B-5. Documentation of endangered species consideration

Administrative Requirements	Information for Administrative Requirements
Endangered species consideration	The FWS identifies the threatened West Indian manatee (*Trichechus manatus latirostris*) as a species potentially affected by activities in the area of Wilson Head, Blue, and Gum Springs and the downstream waterbodies. As described in **Section 3.5**, It is unlikely that the impairment in the springs is cause for any potential manatee habitat degradation in the context of the overall Withlacoochee water budget. Any additional improvements to water quality that may result from these TMDLs would likely only serve to improve current habitat conditions downstream.

Table B-6. Documentation that administrative requirements are met

Administrative Requirements	Information for Administrative Requirements
Notice and comment notifications	DEP published a Notice of Development of Rulemaking on March 29, 2019, to initiate TMDL development for impaired waters in the Withlacoochee River Basin. A rule development public workshop was held on May 15, 2019. Public comments were accepted on the TMDLs and DEP has prepared a responsiveness summary for these comments.
Hearing requirements and adoption format used; responsiveness summary	Following the publication of the Notice of Proposed Rule, DEP will provide a 21-day challenge period and a public hearing that will be noticed no less than 45 days prior.
Official submittal to EPA for review and General Counsel certification	If DEP does not receive a rule challenge, the certification package for the rule will be prepared by the DEP program attorney. DEP will prepare the TMDLs and submittal package for the TMDLs to be considered a site-specific interpretation of the narrative nutrient criterion, and will submit these documents to the EPA.