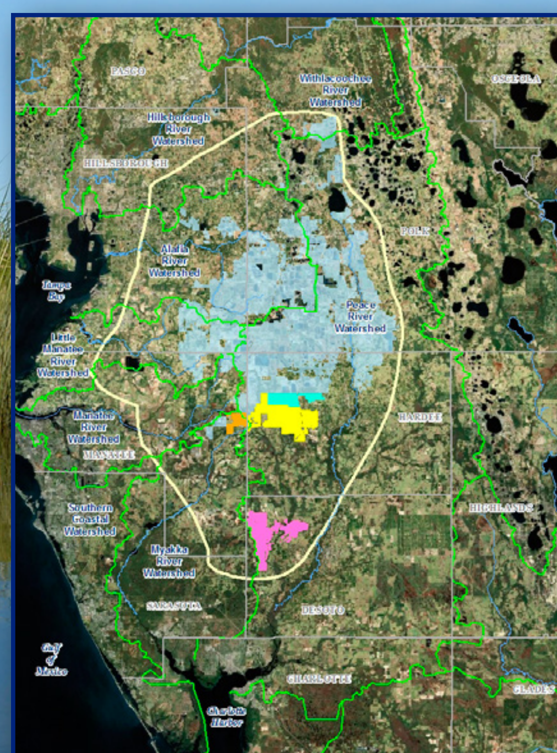
Appendix D
Surface Water Quality Evaluations for the Final AEIS on Phosphate Mining in the CFPD



Surface Water Quality Evaluations for the Final AEIS on Phosphate Mining in the CFPD

PREPARED FOR: U.S. Army Corps of Engineers, Jacksonville District

COPY TO: U.S. Environmental Protection Agency
Florida Department of Environmental Protection

PREPARED BY: CH2M HILL

DATE: May 7, 2012; revision date March 1, 2013

PROJECT NUMBER: 418237.07.01

Contents

1.0 Introduction

Mosaic Fertilizer, LLC (Mosaic) and CF Industries, Inc. (CF Industries), collectively referred to as the Applicants, have applied for Clean Water Act Section 404 permits from the U.S. Army Corps of Engineers (USACE). The permits would authorize construction and operation of the Applicants’ four proposed phosphate mines, Desoto (Alternative 2), Ona (Alternative 3), Wingate East (Alternative 4), and South Pasture Mine Extension (Alternative 5) in an area known as the Central Florida Phosphate District (CFPD). This review also includes information that applies to the four offsite alternatives, Pine Level/Keys (Alternative 6), Pioneer (Alternative 7), A-2 (Alternative 8) and W-2 (Alternative 9). Figure 1 and Figure 2 show the locations of these Applicants’ Preferred Alternatives and the Offsite Alternatives in relation to their positions within watersheds in the CFPD.

The USACE is preparing an Areawide Environmental Impact Statement (AEIS) to evaluate the potential environmental consequences of federal authorization of these proposed mines. An important evaluation topic focuses on the direct and indirect impacts these phosphate mines could have on surface water quality of streams and rivers downstream of permitted discharges from active phosphate mines. This evaluation also considers the potential longer-term impacts on such water bodies if reclaimed mine lands should contribute elevated loads of pollutants, in addition to the discharges from past, current, or reasonably foreseeable future activities, which could degrade the quality of downstream reaches or other water bodies because of cumulative effects. This technical memorandum (TM) summarizes information compiled in support of water quality subsections of the AEIS, primarily in Section 4.4.

FIGURE 1
Location of the Three Applicants' Preferred Alternatives (Desoto, Ona, and South Pasture Mine Extension) and the Offsite Alternatives Pioneer Tract and Alternative A-2 in the Peace River Watershed
Central Florida Phosphate District, Florida

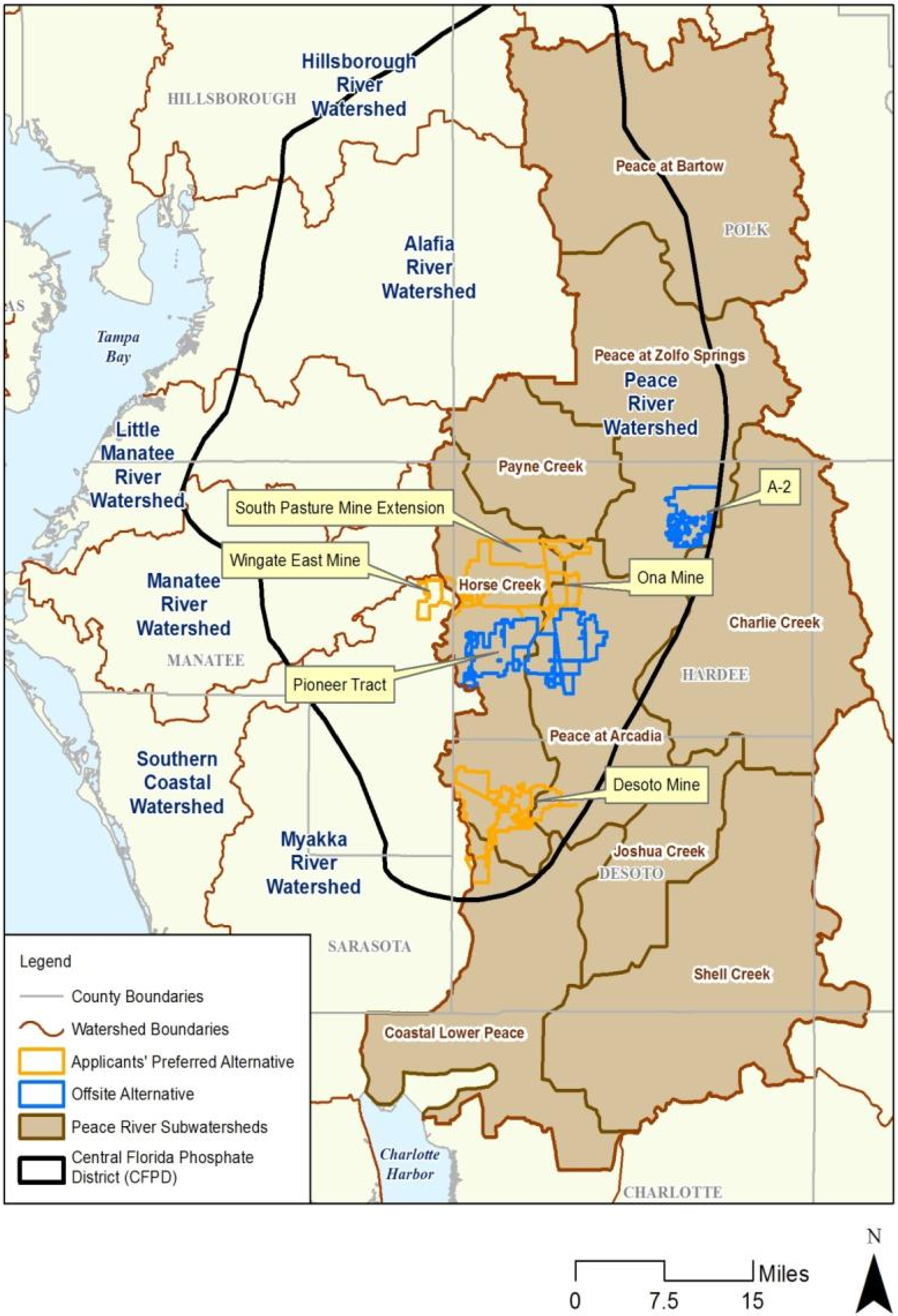
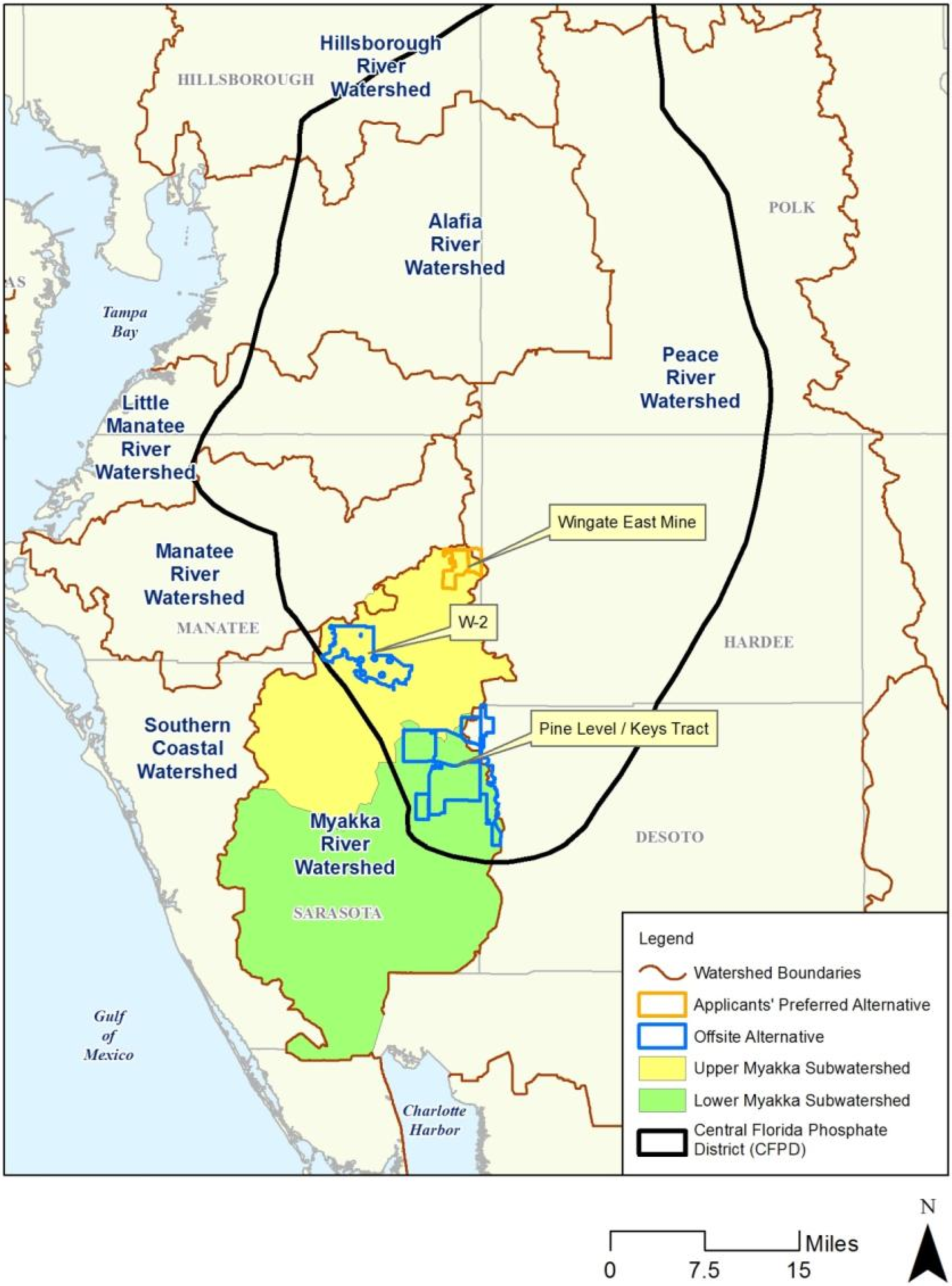


FIGURE 2

Location of the One Applicant Preferred Alternative (Wingate East) and Offsite Alternatives Pine Level/Keys Tract and W-2 in the Myakka River Watershed

Central Florida Phosphate District, Florida



2.0 Florida Surface Water Classifications and Water Quality Standards

Surface waters in Florida are classified in one of several "designated use" categories defined in Chapter 62-302, Florida Administrative Code (F.A.C.), and listed in Table 1. Each category has numerical and narrative criteria for physical, chemical, or biological parameters that are designed to protect the designated uses. These criteria, in conjunction with applicable implementation protocols allowed under the F.A.C., comprise the surface water standards used by the Florida Department of Environmental Protection (FDEP) to ensure that discharges from regulated facilities like phosphate mines do not cause or contribute to violations of applicable standards.

Certain water bodies receive a higher level of regulatory protection against water quality degradation. Chapter 62-302.700, F.A.C., identifies specific water bodies in the state designated as either Outstanding Florida Waters (OFWs) or Outstanding National Resource Waters. There are only two formally defined Outstanding National Resource Waters in Florida:

- Everglades National Park
- Biscayne National Park

TABLE 1
Surface Water Classifications in Florida per Chapter 62-302, F.A.C.

Category	Designated Uses
Class I	Potable Water Supply
Class II	Shellfish Propagation or Harvesting
Class III (Fresh Waters)	Fish Consumption; Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife
Class III (Marine Waters)	
Class III Limited	Fish Consumption; Recreation or Limited Recreation; and/or Propagation and Maintenance of a Limited Population of Fish and Wildlife
Class IV	Agricultural Water Supplies
Class V	Navigation, Utility, and Industrial Use

It is notable, however, that the National Estuary Program (NEP) was established in 1987 by an amendment to the Clean Water Act to protect and restore the water quality and ecological integrity of estuaries of national significance. There are now 28 "estuaries of national significance" in the NEP, and the CFPD river watersheds are tributary primarily to 2 of the 4 estuaries of national significance in Florida:

- In 1991, the Tampa Bay National Estuary Program (TBNEP) was established as a partnership of Hillsborough, Manatee and Pinellas counties; the Cities of Tampa, St. Petersburg, and Clearwater; the Southwest Florida Water Management District; the FDEP; and the U.S. Environmental Protection Agency (USEPA). The Hillsborough, Alafia, Little Manatee, and Manatee River watersheds are tributary to the TBNEP planning area.
- In 1995, Governor Lawton Chiles submitted an application to USEPA to designate the Charlotte Harbor estuary as an estuary of national significance under the NEP. The application was accepted by USEPA and the Charlotte Harbor NEP (CHNEP) was established. The Peace and Myakka River watersheds are two of the major tributaries contributing inflow to the CHNEP planning area.

Protection strategies for these estuaries include prevention of water quality degradation and, where applicable, measures to improve water quality conditions through pollutant load reductions from tributary basins. Sarasota Bay is also an NEP estuary, but the generally recognized CFPD boundary includes only a small area that would drain to this natural system.

Water bodies designated by the state as OFWs include national parks, wildlife refuges, and wilderness areas, waters in the state park system, many waters in areas acquired through the state's environmental land acquisition programs, rivers designated as wild and scenic, Florida's aquatic preserves, and other specially designated waters listed in Chapter 62-302, F.A.C. While all surface waters are regulated using standards defined in this chapter of the F.A.C., these specially designated waters are afforded extra protection under the antidegradation provisions of the rule. OFW antidegradation requirements state that the water quality shall not be degraded further after the date when the water body is designated an OFW, among other provisions. The following water bodies in the CFPD watersheds have been given additional protection through designation as OFWs:

- Hillsborough River State Park
- The Little Manatee River
- Lake Manatee State Recreation Area
- Paynes Creek State Historic Site
- The estuarine portion of the Peace River (downstream of U.S. Highway 41), designated as an OFW because of its location in the Charlotte Harbor Aquatic Preserve
- The entire portion of the Myakka River that flows through Sarasota County and the estuarine portions of the river, designated as an OFW because they lie, respectively, in a segment designated as a Wild and Scenic River and within the Gasparilla Sound–Charlotte Harbor Aquatic Preserve
- Becker Tract (Manatee County)
- Certain segments of Hillsborough River (Chapter 62-302.700(9)(i)4, F.A.C.)
- Certain segments of Myakka River (Chapter 62-302.700(9)(i)22, F.A.C.)
- Certain segments of Little Manatee River (Chapter 62-302.700(9)(i)20, F.A.C.)

Other than these designations, most of the streams, rivers, and associated water bodies within and downstream of the CFPD are designated Class III waters by default. Exceptions identified by FDEP in the *Tampa Bay Tributaries Water Quality Assessment Report* (FDEP, 2005) and the Sarasota Bay and Peace and Myakka Rivers Water Quality Assessment Report (FDEP, 2006a) include the following:

- The portion of the Hillsborough River between Flint Creek and the City of Tampa Dam, as well as Cow House Creek, is a Class I water.[1]
- Segments of the Manatee River above the Rye Road Bridge, including Lake Manatee, tributaries entering Lake Manatee, and tributaries entering the upstream reaches of the river are Class I because they supply drinking water for Manatee County.
- The Braden River, from the Bill Evers Reservoir upstream to State Road (S.R.) 675, and most of the length of all its tributaries entering the Manatee River above the reservoir dam, are also Class I waters.
- Portions of the Peace River watershed, including: the lower portion of Horse Creek from the northern border of Section 14, T38S, R23E, southward to the Peace River; the headwaters of Prairie Creek to the Charlotte County line; and the headwaters of Shell Creek to the Hendrickson Dam. These tributaries (or portions of them) serve as potable water supply sources for the cities of Punta Gorda and North Port, and several surrounding counties (Charlotte, Sarasota, and DeSoto).
- Portions of the Myakka River watershed, including the river reach that extends south from the Manatee County line through Upper and Lower Myakka Lakes to Manhattan Farms (north boundary of Section 6, T39S,

[1] Class I waters are designated as potable water supply sources. However, surface waters that may be used for water supply are not automatically designated a new classification, FDEP must make a rule change for a new classification.

R20E) and Big Slough Canal (headwaters to U.S. Highway 41) are Class I waters. Big Slough Canal/Myakkahatchee Creek is a potable water source for the city of North Port.

Additionally, estuarine portions of the river systems draining the CFPD designated as Class II waters include the following:

- The lowermost reach of the Peace River, extending from the Barron Collier Bridge (U.S. Highway 41) to the river mouth, falls within the Charlotte Harbor Aquatic Preserve and is designated as a shellfish propagation and harvesting area (Class II).
- The southernmost reaches of the Myakka River, extending south from the western boundary of Section 35, T39S, R20E in Sarasota County and all of the river in Charlotte County are designated as a shellfish propagation and harvesting area (Class II).

In assessing the potential for phosphate mining to affect the designated uses of these CFPD and downstream water bodies, compliance with applicable numeric standards is an important aspect to be included in the evaluations. The specific numeric criteria applicable to surface waters in Florida are detailed in Chapter 62-302, F.A.C. However, there are additional non-numeric (narrative) criteria and standards that may affect how water quality is assessed. These criteria are discussed in this TM, as appropriate.

3.0 State of Florida Assessments of Ambient Water Quality

Evaluation of a water body's compliance with the water quality standards is outlined in Florida's assessment methodology in Chapter 62-303, F.A.C. As required by the Clean Water Act, FDEP updates USEPA every 2 years concerning surface water body use attainment in its 305(b) report and 303(d) list of impaired waters. The primary purposes of 305(b) analyses are to determine the extent that waters are attaining water quality standards, to identify waters that are impaired and need to be added to the 303(d) list, and to identify waters that can be removed from the list because they are attaining standards. The biannual updates by the FDEP are report cards to the general public and USEPA, and as part of the assessment they identify water bodies with water quality impairment such that the applicable designated use is not met (those waters are included on the 303(d) list). Florida must develop a Total Maximum Daily Load (TMDL) for each of the impaired waters where the impairment results from abatable, human-induced causes. A TMDL is the maximum loading of a particular pollutant that can be discharged in a surface water and still allow it to meet its designated uses and applicable water quality standards. TMDL evaluations include parameter-specific analyses identifying the daily loads that should be used as pollutant limits for the water body, and set the stage for identifying Basin Management Action Plans (BMAPs) which will decrease excessive pollutant loads and return the water body to compliance with its designated use. Each assessment and TMDL is for a specific segment of a water body defined by FDEP with an identification code called its WBID (water body ID).

The 1998 impaired waters evaluations by FDEP led to identification of water body segments in the AEIS study area that the agency considered impaired, and also led to initial prioritization of whether such areas were considered high, medium, or low priority for completion of TMDL studies. Table 2 lists those water bodies in the AEIS study area for reference. For WBIDs in Table 2 that are noted to have "all parameters addressed," every listed parameter either had a TMDL developed or the parameter was determined not to be impaired after the 1998 list was developed.

The most recently approved Florida 303(d) list of impaired waters is for Reporting Year 2010, which was formally approved by USEPA on May 13, 2010. This is the current list of waters that are considered impaired and either needs a TMDL or for which a TMDL already has been completed. The list can be accessed on USEPA's website ().

TABLE 2
Central Florida Phosphate District Water Bodies Included on the 1998 Impaired Waters List

River Basin	WBID No.	Name	Parameters Listed	Priority Set by FDEP - Targeted Year	Special TMDL Status, or Other Notes
Hillsborough	1542A	Mill Creek	Dissolved Oxygen, Coliforms, Nutrients, Un-ionized Ammonia, Lead	Low - 2008	Completed for Coliforms
Hillsborough	1482	Blackwater Creek	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Biochemical Oxygen Demand	High - 2003	Completed for Coliforms
Hillsborough	1561	Sparkman Branch	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Total Suspended Solids	High - 2003	Completed for Coliforms
Hillsborough	1543	Lake Hunter Outlet	Nutrients	High - 2003	Completed for Coliforms
Alafia - North	1621E	North Prong of the Alafia River	Dissolved Oxygen, Nutrients, Coliforms	Low - 2009	Monitoring - Facility BMPs
Alafia - North	1578B	Turkey Creek Above Little Alafia River	Coliforms, Nutrients, Turbidity	Low - 2008	Completed for Coliforms
Alafia - North	1592C	English Creek	Coliforms, Nutrients	Low - 2008	Completed for Coliforms
Alafia - North	1583	Poley Creek	Coliforms, Nutrients, Turbidity	Low - 2008	Completed for Coliforms
Alafia - North	1639	Thirty Mile Creek	Dissolved Oxygen, Coliforms, Nutrients	High - 2003	Completed for Total Nitrogen
Alafia - South	1653	South Prong of the Alafia River	Coliforms, Nutrients	Low - 2008	
Alafia - South	1675	Owens Branch	Coliforms, Nutrients	Low - 2008	
Little Manatee	1790	So. Fork Little Manatee River	Dissolved Oxygen, Coliforms, Nutrients	Low - 2008	Completed for Coliforms
Little Manatee	1742A	Little Manatee River	Dissolved Oxygen, Coliforms, Nutrients	Low - 2008	Completed for Coliforms
Manatee	1840	Gilly Creek	Dissolved Oxygen, Coliforms, Nutrients	Low - 2008	Completed for Coliforms
Peace - Upper	1751	Whidden Creek	Nutrients, Turbidity, Total Suspended Solids, Dissolved Oxygen	High - 2004	FDEP WQ Study
Peace - Upper	1539	Peace Creek Canal	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Total Suspended Solids Biochemical Oxygen Demand, Mercury (Fish Consumption)	High - 2004	2011 for Mercury

TABLE 2
Central Florida Phosphate District Water Bodies Included on the 1998 Impaired Waters List

River Basin	WBID No.	Name	Parameters Listed	Priority Set by FDEP - Targeted Year	Special TMDL Status, or Other Notes
Peace - Upper	1580	Wahneta Farms Drainage Canal	Dissolved Oxygen, Coliforms, Nutrients, Turbidity	High - 2004	
Peace - Upper	1613	Peace Creek Tributary Canal	Dissolved Oxygen, Coliforms, Nutrients, Turbidity	High - 2004	Artificial canal through swamp.
Peace - Upper	1757A	Payne Creek - East	Dissolved Oxygen, Nutrients	Low - 2008	
Peace - Upper	1757B	Payne Creek - West	Coliforms, Nutrients	Low - 2008	
Peace - Upper	1774	Little Charlie Creek	Coliforms, Nutrients	Low - 2008	
Peace - Middle	1844	Thompson Branch	Coliforms, Nutrients	Low - 2008	
Peace - Middle	1871	Alligator Branch	Dissolved Oxygen, Coliforms, Nutrients	High - 2004	
Peace - Middle	1921	Limestone Creek	Dissolved Oxygen, Coliforms, Nutrients, Total Suspended Solids	High - 2004	
Peace - Middle	1939	Brandy Branch	Nutrients	High - 2004	
Peace - Middle	1948	Bear Branch	Dissolved Oxygen, Nutrients	Low - 2008	
Peace - Upper	1623J	Peace River - J (Above Bowlegs Creek)	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Total Suspended Solids Biochemical Oxygen Demand, Mercury (Fish Consumption)	High - 2004	2011 for Mercury; Completed for Coliforms
Peace - Upper	1623H	Peace River - H (Above Payne Creek)	Dissolved Oxygen, Coliforms, Nutrients, Mercury (Fish Consumption)	High - 2004	2011 for Mercury
Peace - Middle	1623E	Peace River - E (Above Oak Creek)	Nutrients, Turbidity, Total Suspended Solids, Mercury (Fish Consumption)	High - 2004	2011 for Mercury
Peace - Middle	1623D	Peace River - D (Above Charlie Creek)	Coliforms, Nutrients, Turbidity, Total Suspended Solids, Mercury (Fish Consumption)	High - 2004	2011 for Mercury
Peace - Middle	1623C	Peace River - C (Above Joshua Creek)	Dissolved Oxygen, Nutrients, Total Suspended Solids, Mercury (Fish Consumption)	High - 2004	2011 for Mercury

TABLE 2
Central Florida Phosphate District Water Bodies Included on the 1998 Impaired Waters List

River Basin	WBID No.	Name	Parameters Listed	Priority Set by FDEP - Targeted Year	Special TMDL Status, or Other Notes
Peace - Middle	1787A	Horse Creek	Dissolved Oxygen, Coliforms, Nutrients, Biochemical Oxygen Demand	Low - 2008	
Peace - Lower	1995	Myrtle Slough	Dissolved Oxygen, Nutrients, Biochemical Oxygen Demand, Coliforms	Low - 2008	
Peace - Lower	1997	Hawthorne Creek	Coliforms, Nutrients	Low - 2008	
Peace - Lower	1962	Prairie Creek	Dissolved Oxygen, Nutrients, Turbidity	Low - 2008	
Peace - Estuarine	2056A	Peace River - Lower Estuary	Dissolved Oxygen, Nutrients, Mercury (Fish Consumption)	Low - 2008	2011 for Mercury
Peace - Estuarine	2056B	Peace River - Mid Estuary	Dissolved Oxygen, Nutrients, Mercury (Fish Consumption)	Low - 2008	2011 for Mercury
Myakka - Upper	1933	Owen Creek	Dissolved Oxygen, Coliforms, Turbidity, Nutrients, Total Suspended Solids	High - 2001	all parameters addressed
Myakka - Upper	1981C	Upper Lake Myakka	Based on biological sampling		done (2001)
Myakka - Upper	1981B	Myakka River	Dissolved Oxygen, Coliforms, Nutrients, Total Suspended Solids	Low - 2001	all parameters addressed
Myakka - Lower	1958	Mud Lake Slough	Dissolved Oxygen, Coliforms, Nutrients, Turbidity, Total Suspended Solids	High - 2001	all parameters addressed
Myakka - Lower	1976	Big Slough Canal	Dissolved Oxygen, Coliforms, Nutrients	Low - 2001	all parameters addressed
Myakka - Lower	2014	Un-Named Ditch System (Northport)	Dissolved Oxygen, Nutrients, Biochemical Oxygen Demand	Low - 2001	all parameters addressed
2009 Amendments (Additions)					
Charlotte Harbor Proper	2065A	Upper Segment Charlotte Harbor Estuary	Nutrients	Medium	
Charlotte Harbor Proper	2071	North Prong - Alligator Creek	Coliforms	Low	
Charlotte Harbor Proper	2073	Mangrove Point Canal	Mercury (Fish Consumption)	High	
Charlotte Harbor Proper	2074	Alligator Creek	Dissolved Solids	Medium	

TABLE 2
Central Florida Phosphate District Water Bodies Included on the 1998 Impaired Waters List

River Basin	WBID No.	Name	Parameters Listed	Priority Set by FDEP - Targeted Year	Special TMDL Status, or Other Notes
Charlotte Harbor Proper	2087	Direct Runoff to Bay	Mercury (Fish Consumption)	High	
Charlotte Harbor Proper	2090	Direct Runoff to Bay	Mercury (Fish Consumption)	High	

Notes:
FDEP's determination of high-, low-, and medium-priority waters was based on the following criteria.

High-priority waters:
- Water body segments where the impairment poses a threat to potable water supplies or human health.
- Water body segments where the impairment is due to a pollutant regulated by the Clean Water Act and the pollutant has contributed to the decline or extirpation of a federally listed threatened or endangered species.
- Water body segments verified as impaired that are included on the USEPA's 1998 303(d) list as high priority.

Low-priority waters:
- Water body segments that were listed before 2010 because of fish consumption advisories for mercury.
- Canals, urban drainage ditches, artificial water body segments listed only due to exceedances of dissolved oxygen.
- Water body segments identified as impaired during Phase 2 and added to the Verified List.
- Additional water body segments identified by USEPA through its own methods.

Medium-priority waters:
All segments not designated high- or low-priority were designated in this list as medium-priority.

4.0 Total Maximum Daily Load Program Considerations

During the past 25 years, USEPA has defended numerous cases in which plaintiffs have alleged that USEPA has a mandatory duty to "backstop" state establishment of TMDLs under Clean Water Act section 303(d) (i.e., that USEPA has a duty to establish TMDLs in states that fail to do so). In 27 state cases, including Florida, USEPA was placed under a court order, or agreed in a consent decree, to establish TMDLs if the state failed to do so within a prescribed schedule.

In Florida, the backstop for TMDLs is for waters identified on the 1998 list, and the consent decree is due to be fulfilled in 2013 (ref: *Consent Decree entered in the case of Florida Wildlife Federation, et al. v. Carol Browner, et al.*). To assist in TMDL development, Florida is also implementing a “5-Year Rotating Basin Cycle” by analyzing each of the state’s major river basins over a 5-year period. The current list of Florida TMDLs proposed or finalized by USEPA (including Public Notices of Availability) can be accessed on USEPA’s website (http://www.epa.gov/region4/water/tmdl/florida/index.html).

This cycle of water quality assessment and regulation for the state’s major river basins is implemented continually by the following steps:

- Updating criteria with new scientific information
- Monitoring, reporting, and creating TMDLs for impaired waters
- Adjusting permit limits, as needed
- Using best management practices (BMPs) to restore waters

Fundamental to this process is Florida’s antidegradation policy, which protects existing water quality above the minimum criteria levels and requires that once uses are achieved, they must be maintained.

Table 3 lists the locations within the CFPD of study areas for TMDLs completed by FDEP, along with the specific applicable water quality parameters of concern. Figure 3 reflects the locations of these TMDL study areas in the CFPD (see Attachment A for FDEP’s larger-scale maps of the water bodies), and specifically in relation to the four Applicants’ Preferred Alternatives and two of the offsite alternatives, Pine Level/Keys and Pioneer Tracts, also considered as reasonably foreseeable future mines for purposes of cumulative impact assessment. Sites A-2 and

W-2 are at the headwaters of rural streams without impairments and are not shown in Figure 3. Of the 18 TMDLs in the table and the figure, only one (for Thirty Mile Creek) has a parameter associated specifically with phosphate mining and is within a subwatershed dominated by phosphate mining (about 61 percent is extractive land use; FDEP, 2004).

The TMDL Report for Thirty Mile Creek (FDEP, 2004) concluded that total nitrogen was the limiting nutrient for algal growth in the creek, and that decreasing total nitrogen concentrations and loads would result in increased dissolved oxygen levels and compliance with the dissolved oxygen criterion. The study also characterized seasonal variations in total nitrogen, total phosphorus, and chlorophyll *a* based on monitoring results from 1998 through 2003. Average total phosphorus concentrations were highest in summer and average total nitrogen concentrations were highest during spring. Average chlorophyll *a* values were lowest during winter and spring, and highest in summer. The seasonal average chlorophyll *a* values based on data collected between 1998 and 2003 were all less than the screening value of 20 micrograms per liter (µg/L) used to identify impaired waters. One annual average value for 2002 was 28.3 µg/L because of several high values during that year, but those values did not cause the overall seasonal averages to exceed 20 µg/L. The annual average values of the nutrients in the report did not appear to be geometric means, which is the basis for evaluating compliance with the forthcoming numeric nutrient criteria (NNC), but all of the annual average total phosphorus and nitrogen values exceeded the baseline NNC limits that will apply to streams in the CFPD (see Section 7 for additional discussion of NNC).

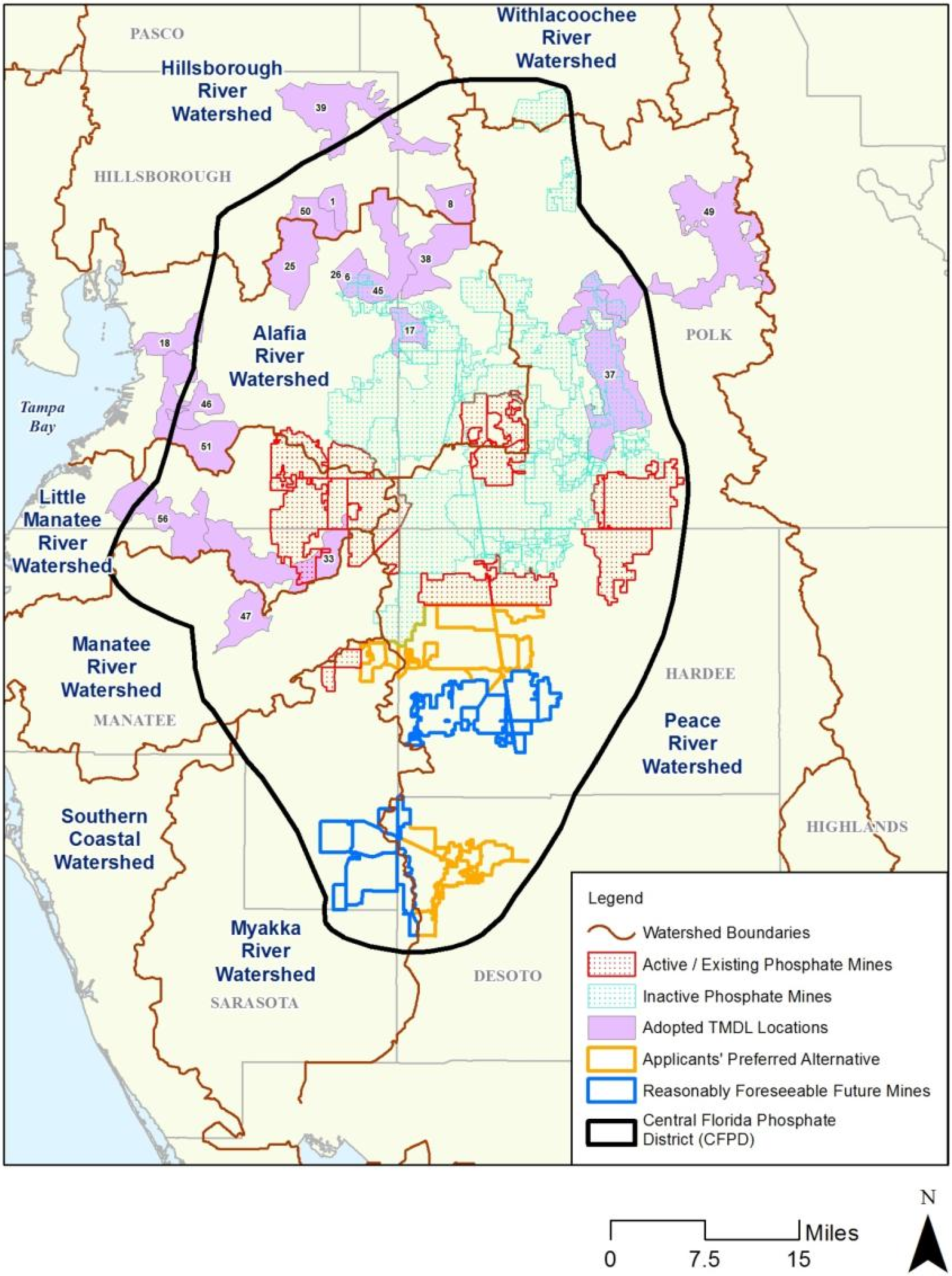
IMC operated the Kingsford Mine Complex in the Thirty Mile Creek watershed at the time of the TMDL study. Three permitted mine outfalls discharged to an unnamed tributary to Thirty Mile Creek, Guy Branch, and George Allen Creek. The wasteload allocation associated with the TMDL required outfalls that discharge from the IMC mine to the affected portion of Thirty Mile Creek to limit total nitrogen concentrations to a maximum of 3.0 milligrams per liter (mg/L) as a monthly average. Kingsford Mine is being completed (still in reclamation phase) and this TMDL-derived provision is being enforced through the National Pollutant Discharge Elimination System (NPDES) permit.

TABLE 3
Summary of Completed TMDLs for Water Body Segments within the CFPD as of 2010

Map ID No.	Water Body Name	Water Body Type	Pollutant of Concern	TMDL Status
1	Mill Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL
25	Turkey Creek Above Little Alafia River	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
26	Mustang Ranch Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
33	Little Manatee River (South Fork)	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
37	Peace River Above Bowlegs Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
38	Poley Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
39	Blackwater Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
45	English Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
46	Little Bullfrog Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
47	Gilly Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
49	Peace Creek Drainage Canal	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
50	Spartman Branch	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
51	Bullfrog Creek	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
56	Little Manatee River	Stream	Fecal Coliform Bacteria	Adopted TMDL and USEPA Approved
17	Thirty Mile Creek	Stream	Total Nitrogen	Adopted TMDL and USEPA Approved
6	Mustang Ranch Creek	Stream	Total Nitrogen and Total Phosphorus	Adopted TMDL and USEPA Approved
8	Lake Hunter Outlet	Stream	Total Nitrogen and Total Phosphorus	Adopted TMDL and USEPA Approved
18	Alafia River Above Hillsborough Bay	Estuary	Total Nitrogen	Adopted TMDL and USEPA Approved

Source: FDEP, 2013d

FIGURE 3
Locations of Completed TMDL Studies within the CFPD
Central Florida Phosphate District, Florida



Source: FDEP TMDL list and Florida Geographic Data Library for WBID shapefiles, 2012

5.0 Phosphate Mine Monitoring Programs

Projection of the environmental consequences of authorization of the Applicants' Preferred Alternatives and offsite alternatives on surface water quality is best supported by review of such effects documented for recent or ongoing phosphate mines. In terms of the Applicants' Preferred Alternatives under USACE review, two are extensions of existing mines. Accordingly, review of mine water quality monitoring records for the Wingate Creek Mine and South Pasture Mine was particularly relevant because the Wingate East Mine (Alternative 4) and South Pasture Mine Extension (Alternative 5) would have recirculation systems integrated with the existing mines. Therefore, future offsite discharges through the applicable NPDES-permitted outfalls would be reasonably expected to reflect the same or similar water quality characteristics. The direct and indirect effects of these two alternatives on the applicable receiving water bodies are reviewed in this section. Effects from these extensions of existing mines would be expected to be similar to those effects demonstrated through ongoing monitoring records.

For the Ona Mine (Alternative 3), predictions on water quality impacts must rely on characterization of typical conditions documented at nearby "reference mines," which reasonably could include both the Wingate Creek and South Pasture Mines because they are adjacent to the Ona Mine site. In contrast, the Desoto Mine site (Alternative 2) is south of any existing phosphate mines in the CFPD. Despite this geographic separation, there still is justification for using a "reference mines" approach to this projection of potential environmental consequences since the proposed mine operation is similar to those of the existing mines. The Desoto Mine's discharges offsite would primarily have the potential to affect Horse Creek, with only a small portion of its drainage area discharging east to the Peace River at Arcadia subwatershed. Pine Level/Keys Tract (Alternative 6) is mostly in the lower Myakka River subwatershed, specifically in the Big Slough Basin. The Pioneer Tract (Alternative 7) is between the Desoto and Ona Alternative mine sites, with about half of it in Horse Creek and the other half in the Peace River at Arcadia subwatershed. Site A-2 (Alternative 8) is in the Peace River at Zolfo Springs subwatershed. Site W-2 (Alternative 9) is in the upper Myakka River subwatershed. Again, these four offsite alternatives should have similar discharge characteristics because of the types of soils, streams, and likely mining operations to be conducted in these areas.

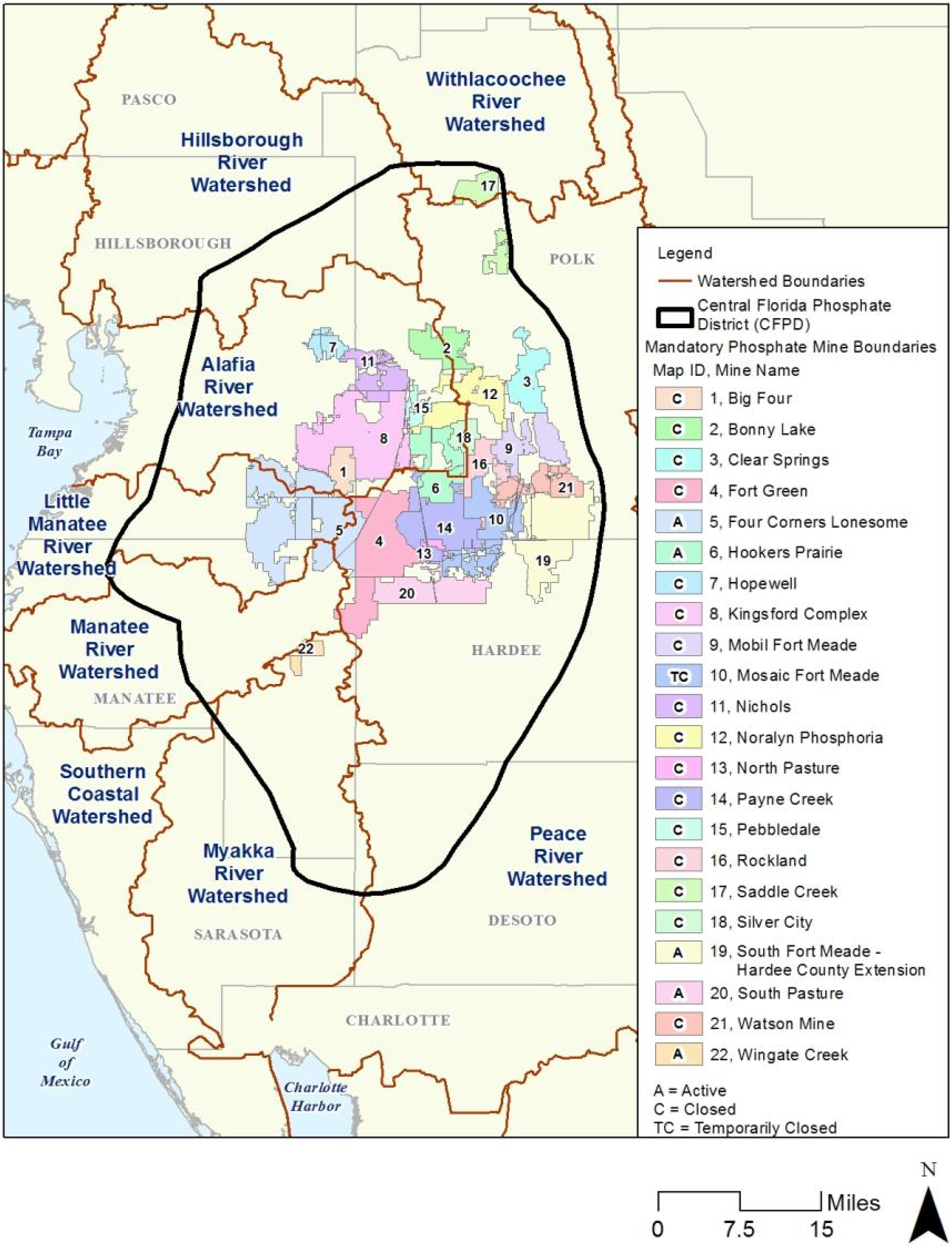
Mosaic's proposed mining technologies and BMPs for water quality-based impact avoidance and minimization for these new mines are essentially the same as those proposed for existing mines. To broaden the geographic extent of the mines included in the "reference mines" comparison, data were summarized for a total of six mines; four of these are actively involved in phosphate rock production, beneficiation, and reclamation; the other two are inactive in terms of phosphate rock production and beneficiation, but are still engaged in reclamation. A total of 11 mines were reviewed with 31 permitted outfalls; however, 13 of those outfalls were at two mines (Kingsford and Fort Green Complex) and some outfalls did not have a lot of data for analysis because there was limited discharges and sampling normally is only required when discharge occurs. The reference mines used in this TM are identified as follows:

- Active mines: Four Corners/Lonesome, South Fort Meade, Wingate Creek, and South Pasture
- Inactive mines: Fort Green Complex and Kingsford

Discharges from these mines were considered most relevant to the AEIS surface water quality evaluation because these NPDES discharge locations were related solely to mine operations, whereas some outfalls from other mines in the study area discharge stormwater and wastewater from facilities that include chemical manufacturing sites. Locations of these reference mines are shown in Figure 4.

Reference is made to the applicable outfalls from mines in the following descriptions of potential environmental effects of mining on surface water quality of offsite discharges. The primary focus is on assessment of the potential direct impacts as reflected by water quality characteristics in offsite discharges. However, the potential for indirect effects also is addressed in terms of any indications of aquatic biological community response to offsite discharges.

FIGURE 4
Locations of Historical and Existing Phosphate Mines in the CFPD, Including Reference Mines Used in the AEIS Surface Water Quality Review
Central Florida Phosphate District, Florida



5.1 NPDES Discharge Data

Operating permits issued by FDEP for phosphate mines contain specific conditions that include requirements for hydrologic isolation of a mine's water management system from Waters of the State, with all discharges from the water management system limited to those passing through specific permitted outfalls defined in the permits. Typically, water quality monitoring is required for any month during which a discharge occurs. While the analytical parameters called for in the various permits reviewed were not always consistent, they often included most of the following:

- pH
- Specific conductance
- Temperature
- Turbidity
- Dissolved oxygen
- Total suspended solids
- Fixed suspended solids
- Total phosphorus
- Total nitrogen
- Fluoride
- Sulfate
- Chlorophyll *a*
- Total radium
- Gross alpha

Discharge compliance with the applicable surface water quality standards is required by these FDEP-specified permit conditions.

The NPDES outfall monitoring data for 2005 through 2010 were summarized for example discharges from five outfalls at active Mosaic phosphate mines: the Four Corners Mine (two outfalls), Wingate Creek Mine (two outfalls), and South Fort Meade Mine (one outfall). Monitoring data for discharges from the two permitted outfalls at the CF Industries South Pasture Mine were also summarized for the same period of record. Parameter averages for 2005 through 2010 summarized in Table 4 indicate that the various mine discharges generally have similar water quality and that on average the discharges comply with the applicable Class III surface water quality criteria.

Comparable records were compiled for two inactive Mosaic mines that remain engaged in reclamation only (no active phosphate rock extraction or beneficiation); these mean values are summarized in Table 5. For nearly all parameters, the values shown for the inactive mines were comparable to those for the active mines. Sulfate mean values were substantively lower for the inactive mine outfalls.

To support further evaluation of the relative influence of phosphate mining on ambient water quality conditions, scatter plots of the monitoring records supporting the long-term averages summarized in Tables 4 and 5 were prepared. Figures 5 through 11 compare discharge and background records for the following parameters, respectively:

- Specific conductance (Conductivity)
- Total suspended solids
- Total phosphorus
- Total nitrogen
- Sulfate
- Fluoride
- Chlorophyll *a*

These figures reflect the high level of variability in the datasets for the background as well as the NPDES discharge data groups, and are instructive in that the values reflect substantive overlap in values from mine to mine as well as across the various reference ambient locations from multiple CFPD subwatersheds.

TABLE 4

Phosphate Mine Discharge Mean Water Quality Values for Selected Active Mosaic and CF Industries Mine NPDES Outfalls (Averages for Period of Record 2005 – 2010)

			Outfall							
Parameter	**Units**	**Class III Criteria**	**FCO D001**	**FCO D002**	**WIN D001**	**WIN D002**	**SFM D001**	**SP D004**	**SP D005**
pH	SU	6.0 - 8.5	7.2	7.4	6.6	7.0	7.6	7.5	7.4
Specific Conductance	µmho/cm	1275	569	653	408	600	782	781	651
Temperature	°C	--	26.9	23.4	27.9	35.2	24.9	23.1	27.5
Turbidity	NTU	Bkgd + 29	15.7	7.0	5.1	6.2	5.6	6.7	8.1
Dissolved Oxygen	mg/L	5.0	6.0	7.8	6.9	8.0	7.7	7.5	6.9
Total Suspended Solids	mg/L	--	11.8	5.0	3.6	4.7	5.1	6.5	6.6
Fixed Suspended Solids	mg/L	--	7.2	2.3	2.2	2.4	1.8	3.2	3.5
Total Phosphorus	mg/L	--	1.10	1.23	1.00	1.51	1.44	1.13	0.87
Total Nitrogen	mg/L	--	0.88	0.93	0.95	0.99	0.97	0.98	1.23
Fluoride	mg/L	10.0	1.4	1.7	ND	0.88	2.1	2.1	2.4
Sulfate	mg/L	--	98	204	204	273	278	222	204
Chlorophyll *a*	µg/L	--	6.7	14.8	5.8	13.2	13.5	15.3	10.0
Total Radium	pCi/L	5	2.93	2.20	1.52	1.57	ND	ND	ND
Gross Alpha	pCi/L	15	10.30	9.50	2.22	3.22	ND	11.60	12.27

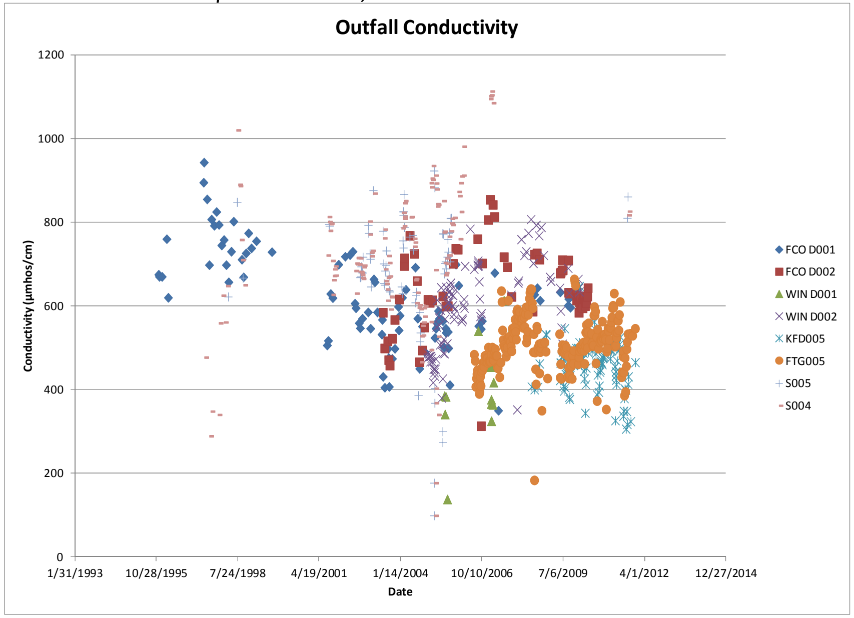
Notes:
FCO = Mosaic Four Corners Outfall
WIN = Mosaic Wingate Creek Outfall
SFM = Mosaic South Fort Meade Outfall
SP = CF Industries South Pasture Outfall

TABLE 5

Phosphate Mine Discharge Mean Water Quality Values for Selected Inactive Mosaic NPDES Outfalls

			Outfall	
Parameter	**Units**	**Class III Criteria**	**Fort Green 005**	**Kingsford 005**
pH	**SU**	**6.0 - 8.5**	**7.2**	**7.8**
Specific Conductance	**µmho/cm**	**1275**	**508**	**465**
Temperature	**°C**	**--**	**23.2**	**25.1**
Turbidity	**NTU**	**Bkgd + 29**	**5.5**	**7.6**
Dissolved Oxygen	**mg/L**	**5**	**--**	**7.8**
Total Suspended Solids	**mg/L**	**--**	**7.7**	**9.7**
Fixed Suspended Solids	**mg/L**	**--**	**0.9**	**2.9**
Total Phosphorus	**mg/L**	**--**	**1.03**	**0.72**
Total Nitrogen	**mg/L**	**--**	**1.60**	**1.43**
Fluoride	**mg/L**	**10**	**1.32**	**1.44**
Sulfate	**mg/L**	**--**	**62**	**42**
Chlorophyll-a	**µg/L**	**--**	**12.6**	**38.4**
Total Radium	**pCi/L**	**5**	**--**	**--**
Gross Alpha	**pCi/L**	**15**	**--**	**3.01**
Fort Green (2006-2011)				
Kingsford (2008-2011)				

FIGURE 5
Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Conductivity
Central Florida Phosphate District, Florida



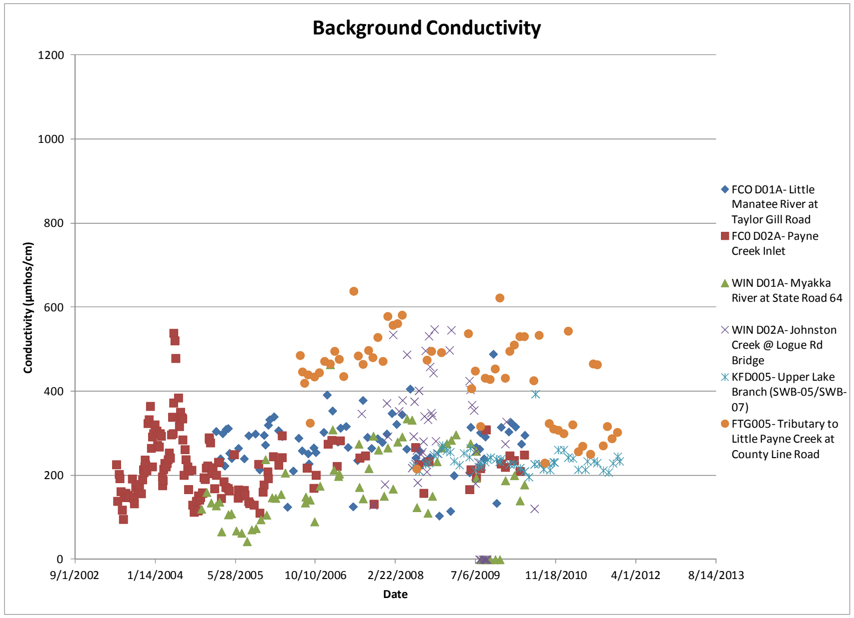
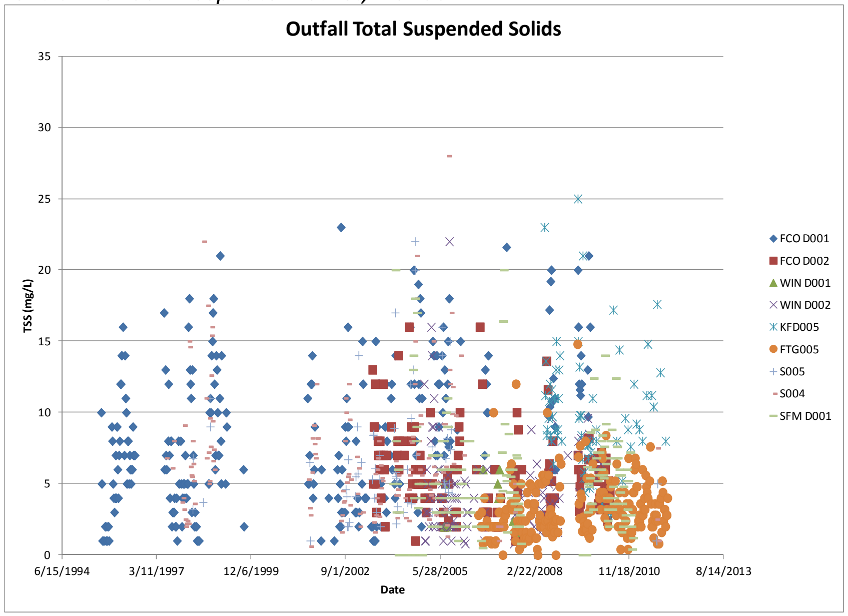


FIGURE 6

Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Total Suspended Solids

Central Florida Phosphate District, Florida



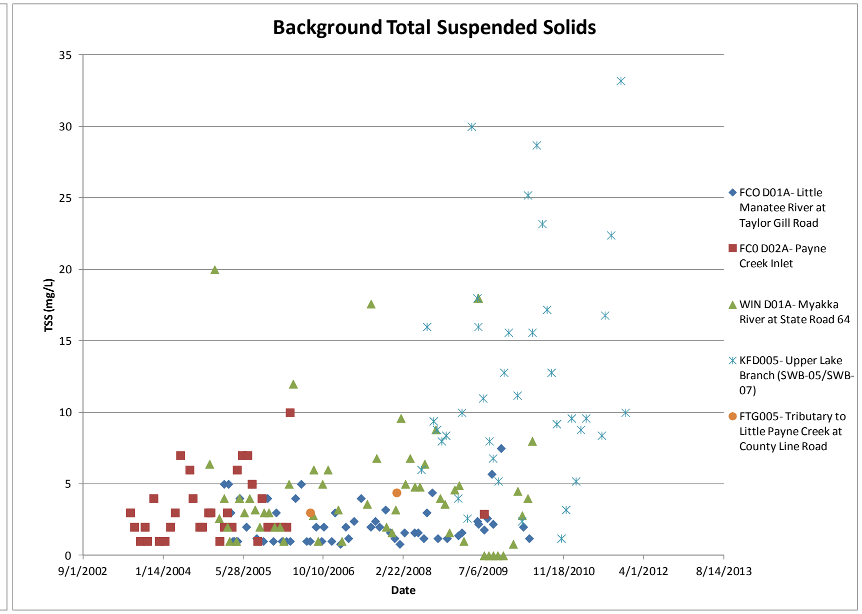
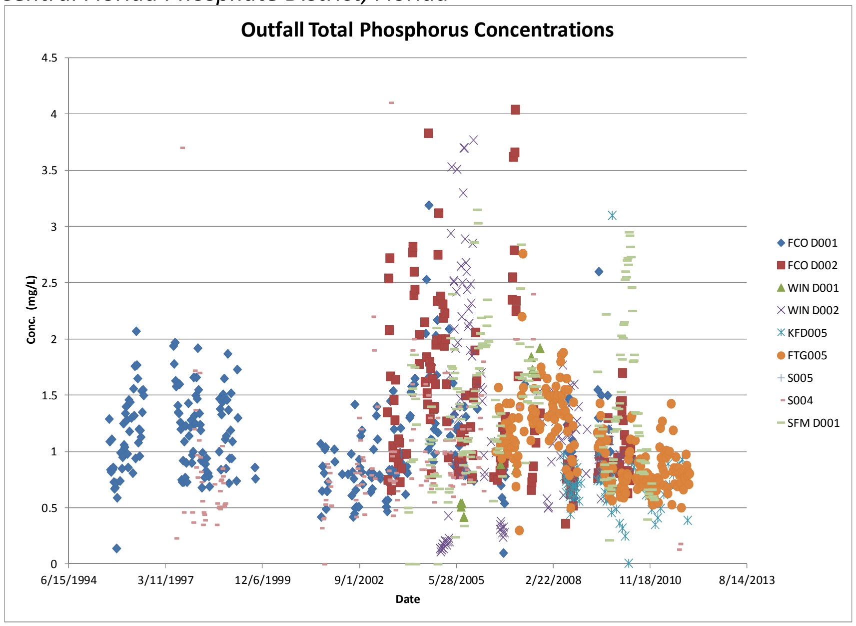


FIGURE 7
Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Total Phosphorus
Central Florida Phosphate District, Florida



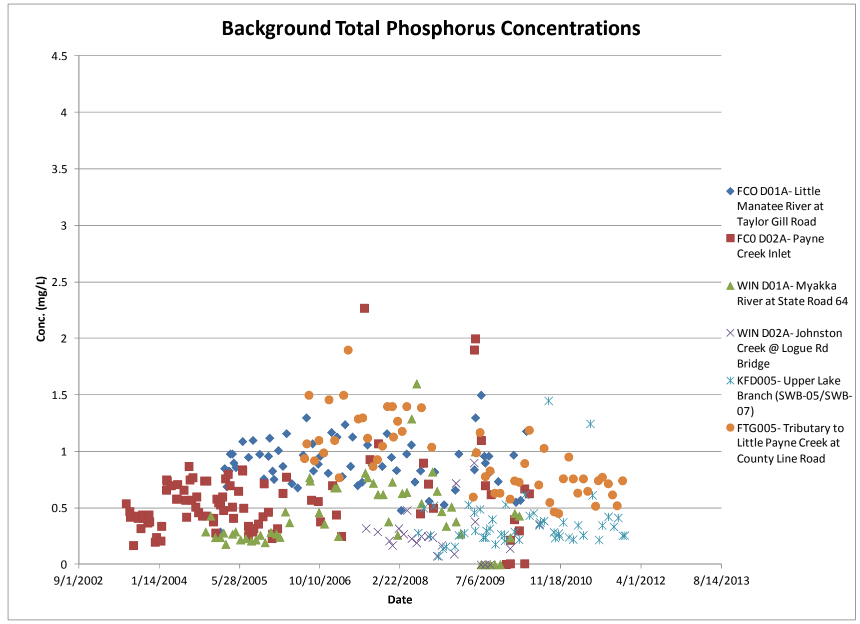
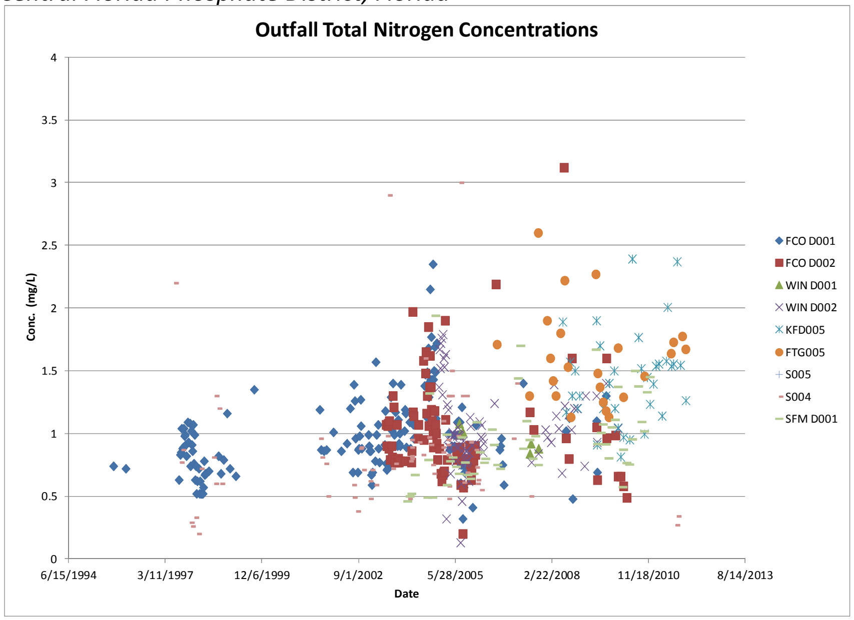


FIGURE 8
Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Total Nitrogen
Central Florida Phosphate District, Florida



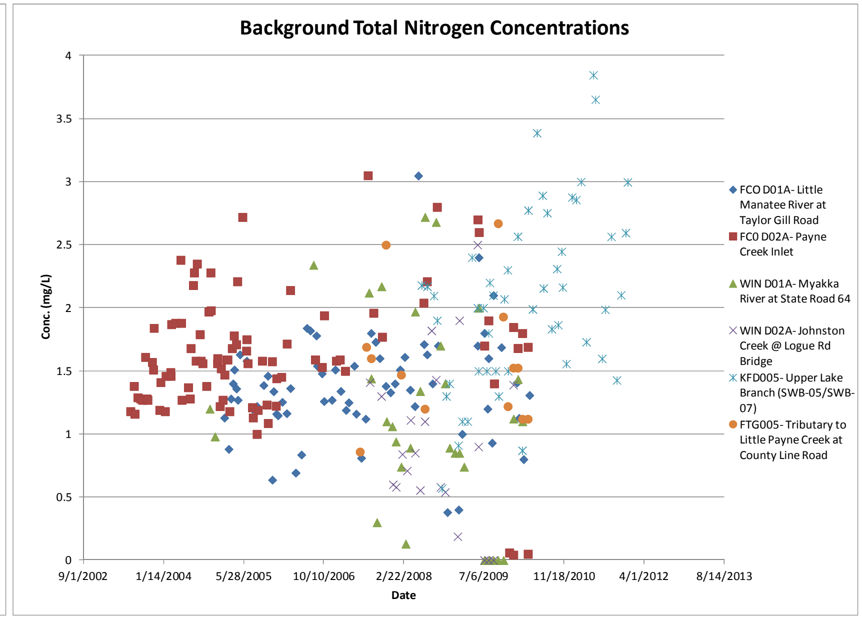
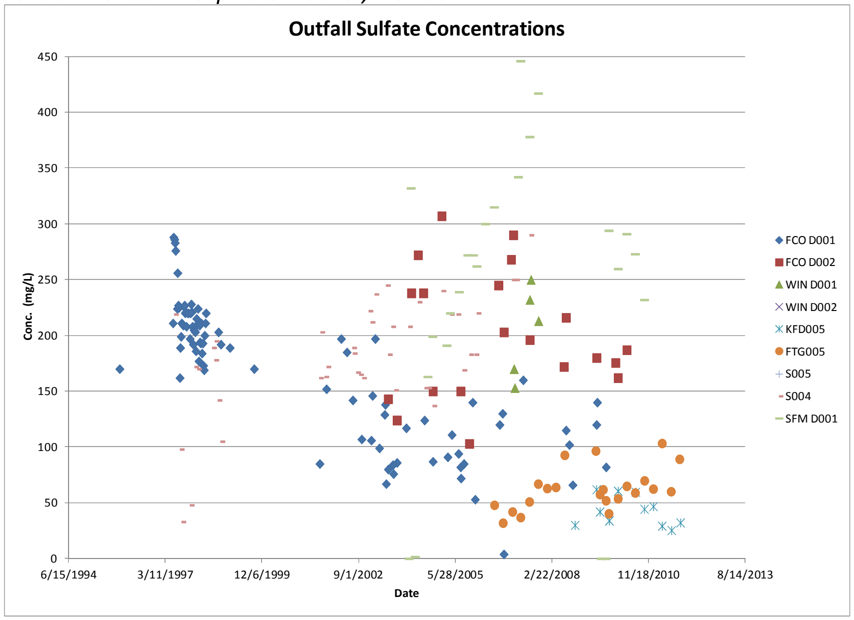


FIGURE 9

Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Sulfate

Central Florida Phosphate District, Florida



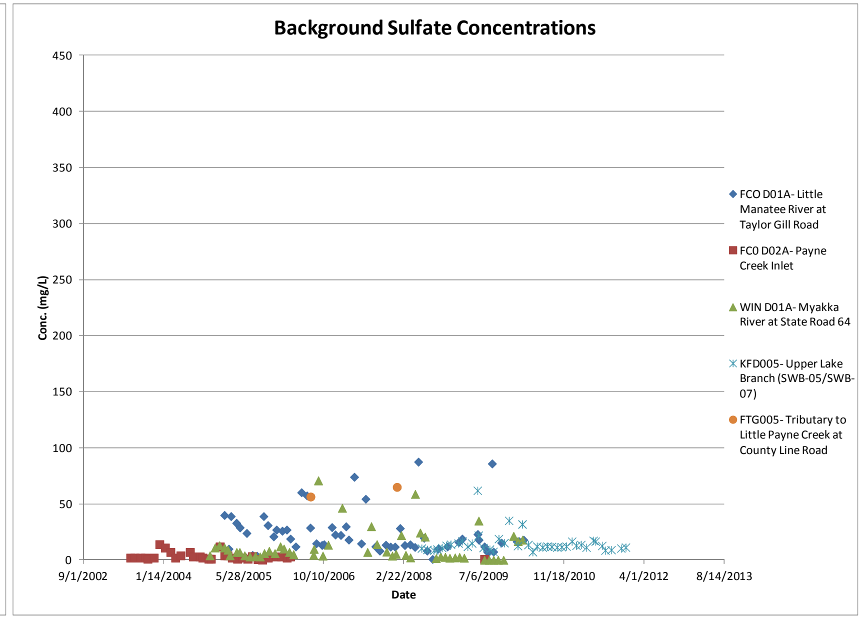
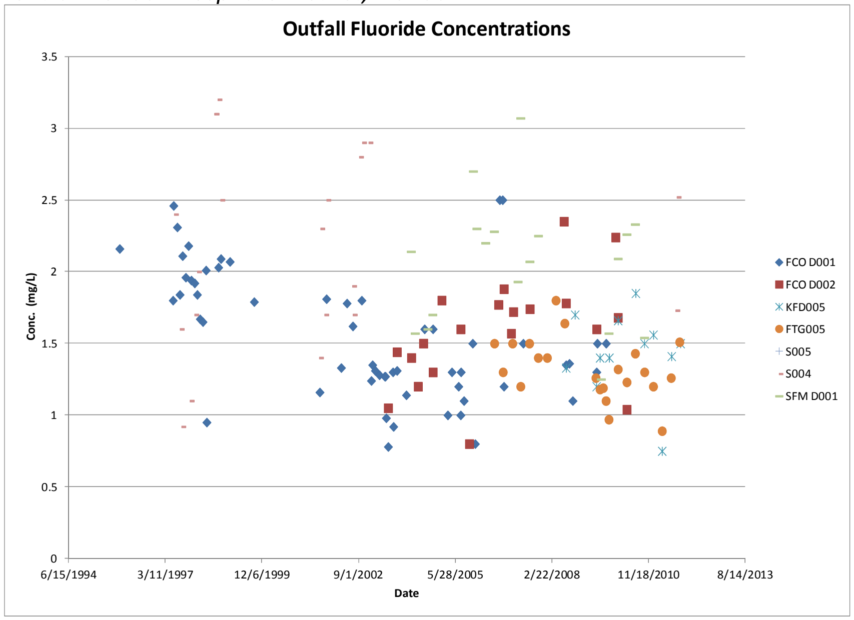


FIGURE 10

Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Fluoride

Central Florida Phosphate District, Florida



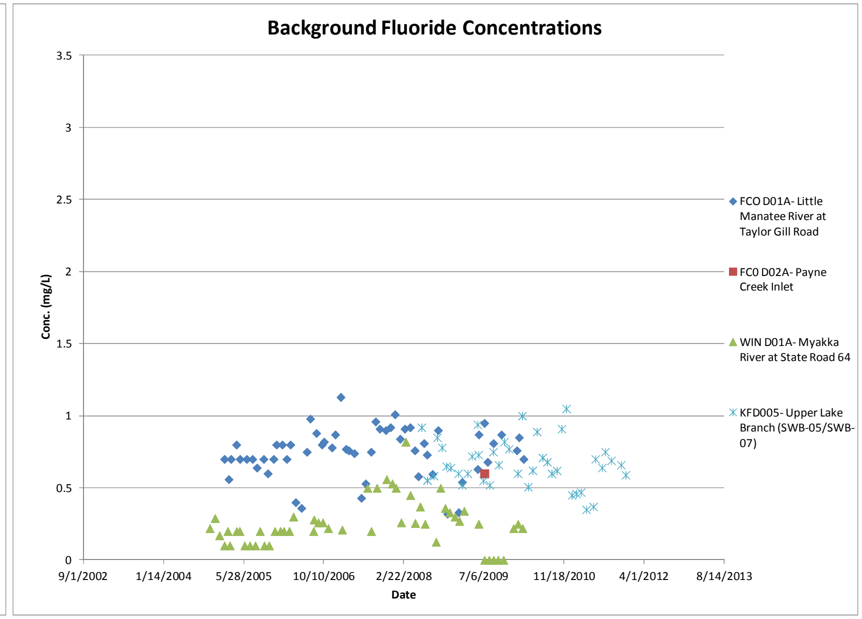
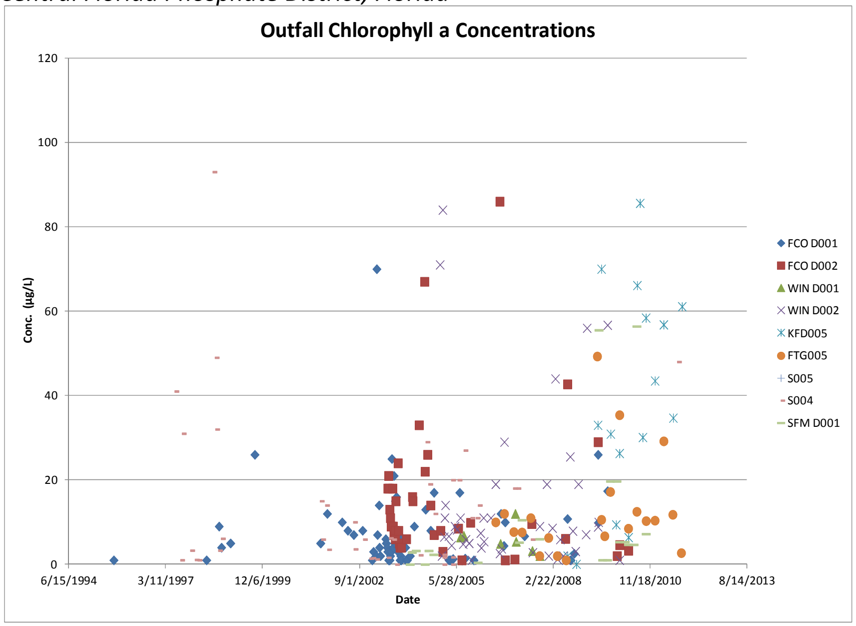
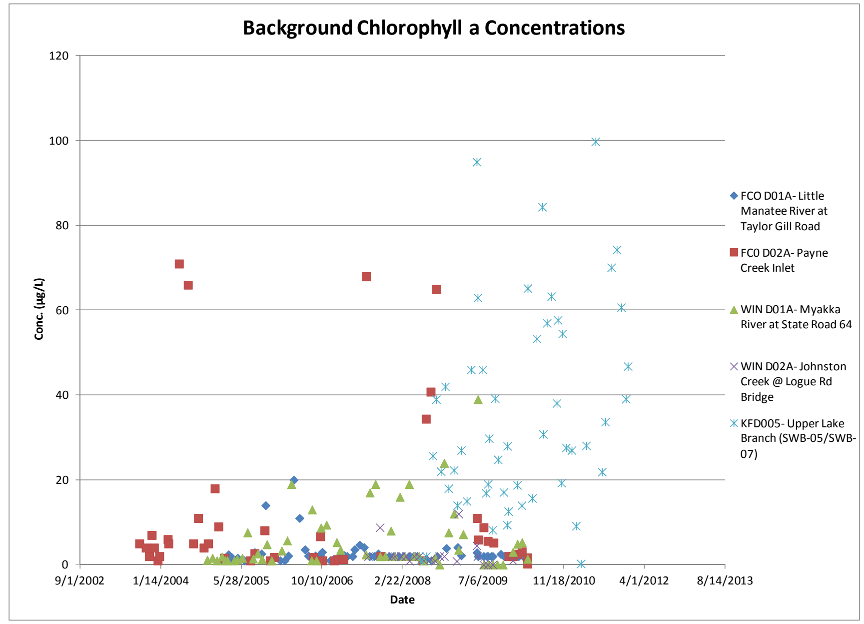


FIGURE 11

Comparison of Phosphate Mine NPDES Discharge and Ambient Water Quality: Chlorophyll *a*

Central Florida Phosphate District, Florida





5.2 Upstream and Downstream Monitoring Records

The Mosaic outfall monitoring program requirements for the Four Corners and Wingate Creek mines included monitoring of receiving water locations upstream (background) and downstream of each NPDES point of discharge for a subset of the water quality parameters monitored in the discharge samples. Comparable monitoring requirements exist for the Fort Green Complex and Kingsford Mine. Table 6 summarizes the averages and number of observations for the background, outfall, and downstream stations for Four Corners Outfall D-001. Table 7 provides the corresponding summary for Four Corners Outfall D-002. Figure 12 shows the locations of the two Four Corners Mines outfalls and the corresponding background and downstream sampling stations. Tables 8 and 9 summarize the averages and number of observations for background, outfall, and downstream stations for Wingate Creek Mine Outfalls D-001 and D-002, and Figure 13 shows the locations of the stations. Tables 10 and 11 summarize parameter averages for background, outfall, and downstream stations for the Fort Green Complex Outfall 005 and Kingsford Outfall 005, respectively. Figures 14 (Fort Green Complex) and 15 (Kingsford Mine) illustrate the outfalls and sampling station locations at these mines.

TABLE 6

Mean Water Quality Monitoring Data for Four Corners Mine; Background, Outfall 001 and Downstream Locations, 2005 - 2010

		Background		Outfall		Downstream	
Parameter	**Units**	**Value**	**N**	**Value**	**N**	**Value**	**N**
pH	SU	6.78	21	7.26	21	7.18	21
Specific Conductance	µmho/cm	268	21	584	21	556	21
Turbidity	NTU	2.97	17	16.15	17	5.86	17
DO	mg/L	5.03	21	6.29	21	6.62	21
Total P	mg/L	0.91	20	1.22	20	0.68	20
Total Nitrogen	mg/L	1.46	20	0.87	20	1.12	20
Chlorophyll-a	µg/L	1.89	16	6.70	16	4.89	16

Background Station: Little Manatee River at Taylor Gill Rd.
Effluent Station: FCO D001
Downstream Station: Alderman Creek at Taylor Gill Rd.

TABLE 7

Mean Water Quality Monitoring Data for Four Corners Mine; Background, Outfall 002 and Downstream Locations, 2005 – 2010

		Background		Outfall		Downstream	
Parameter	**Units**	**Value**	**N**	**Value**	**N**	**Value**	**N**
pH	SU	6.68	31	7.48	31	6.85	31
Specific Conductance	µmho/cm	217	30	870	30	643	30
Turbidity	NTU	1.88	9	5.29	9	3.38	9
DO	mg/L	3.31	30	7.50	30	5.78	30
Total P	mg/L	0.87	28	1.23	28	0.98	28
Total Nitrogen	mg/L	1.70	19	1.03	19	1.03	19
Chlorophyll-a	µg/L	11.83	12	16.46	12	8.90	12

Background Station: Payne Creek inlet
Effluent Station: FCO D002
Downstream Station: Payne Creek at pipe crossing in Section 49

TABLE 8

Mean Water Quality Monitoring Data for Wingate Creek Mine; Background, Outfall 001 and Downstream Locations, 2005 - 2010

		Background		Outfall		Downstream	
Parameter	**Units**	**Value**	**N**	**Value**	**N**	**Value**	**N**
pH	SU	6.7	9	6.9	9	6.7	9
Specific Conductance	µmho/cm	258	5	481	5	375	5
Turbidity	NTU	4.2	6	4.7	6	1.9	6
DO	mg/L	6.9	3	7.3	3	7.2	3
Total P	mg/L	0.47	2	0.88	2	0.29	2
Total Nitrogen	mg/L	2.15	2	0.90	2	1.02	2
Chlorophyll-a	µg/L	2.75	2	3.70	2	3.70	2

Background Station: Myakka River at State Road 64
Effluent Station: WIN D-001
Downstream Station: Wingate Creek @ State Route 64

TABLE 9

Mean Water Quality Monitoring Data for Wingate Creek Mine; Background, Outfall 002 and Downstream Locations, 2005 - 2010

		Background		Outfall		Downstream	
Parameter	**Units**	**Value**	**N**	**Value**	**N**	**Value**	**N**
pH	SU	6.9	61	7.3	61	7.2	61
Specific Conductance	µmho/cm	323	24	671	24	612	24
Turbidity	NTU	5.7	33	6.2	33	6.0	33
DO	mg/L	5.7	15	8.2	15	7.5	15
Total P	mg/L	0.31	18	1.41	18	1.23	18
Total Nitrogen	mg/L	1.09	20	1.07	20	1.33	20
Chlorophyll-a	µg/L	2.69	20	14.53	20	11.37	20

Background Station: Upstream/Johnston Creek @ Logue Rd Bridge
Effluent Station: WIN D-002
Downstream Station: Downstream/Johnston Creek @ 64

TABLE 10

Mean Water Quality Monitoring Data for the Fort Green Mine Complex; Background, Outfall 005 and Downstream Locations, 2006 - 2011

			Station		
Parameter	**Units**	**Class III Criteria**	**Upstream**	**Ft. Green**	**Downstream**
pH	**SU**	**6.0 - 8.5**	**7.4**	**7.2**	**7.6**
Specific Conductance	**µmho/cm**	**1275**	**442**	**508**	**445**
Turbidity	**NTU**	**Bkgd + 29**	**5.9**	**5.5**	**4.6**
Dissolved Oxygen	**mg/L**	**5**	**6.47**	**--**	**7.10**
Total Phosphorus	**mg/L**	**--**	**0.95**	**1.03**	**0.82**
Total Nitrogen	**mg/L**	**--**	**1.57**	**1.60**	**1.45**
Chlorophyll-a	**µg/L**	**--**	**--**	**12.58**	**--**
Fort Green (2006-2011)					

TABLE 11

Mean Water Quality Monitoring Data for Kingsford Mine; Background, Outfall 005 and Downstream Locations, 2008 - 2010

			Station		
Parameter	**Units**	**Class III Criteria**	**Upstream**	**Kingsford**	**Downstream**
pH	**SU**	**6.0 - 8.5**	**7.2**	**7.8**	**7.5**
Specific Conductance	**µmho/cm**	**1275**	**236**	**465**	**361**
Turbidity	**NTU**	**Bkgd + 29**	**13.7**	**7.6**	**7.6**
Dissolved Oxygen	**mg/L**	**5**	**6.05**	**7.77**	**5.27**
Total Phosphorus	**mg/L**	**--**	**0.36**	**0.72**	**0.53**
Total Nitrogen	**mg/L**	**--**	**2.13**	**1.43**	**1.88**
Chlorophyll-a	**µg/L**	**--**	**37.2**	**38.4**	**28.6**
Kingsford (2008-2011)					

FIGURE 12
Location of NPDES Discharge and Ambient Water Quality Stations Evaluated at Four Corners Mine
Central Florida Phosphate District, Florida

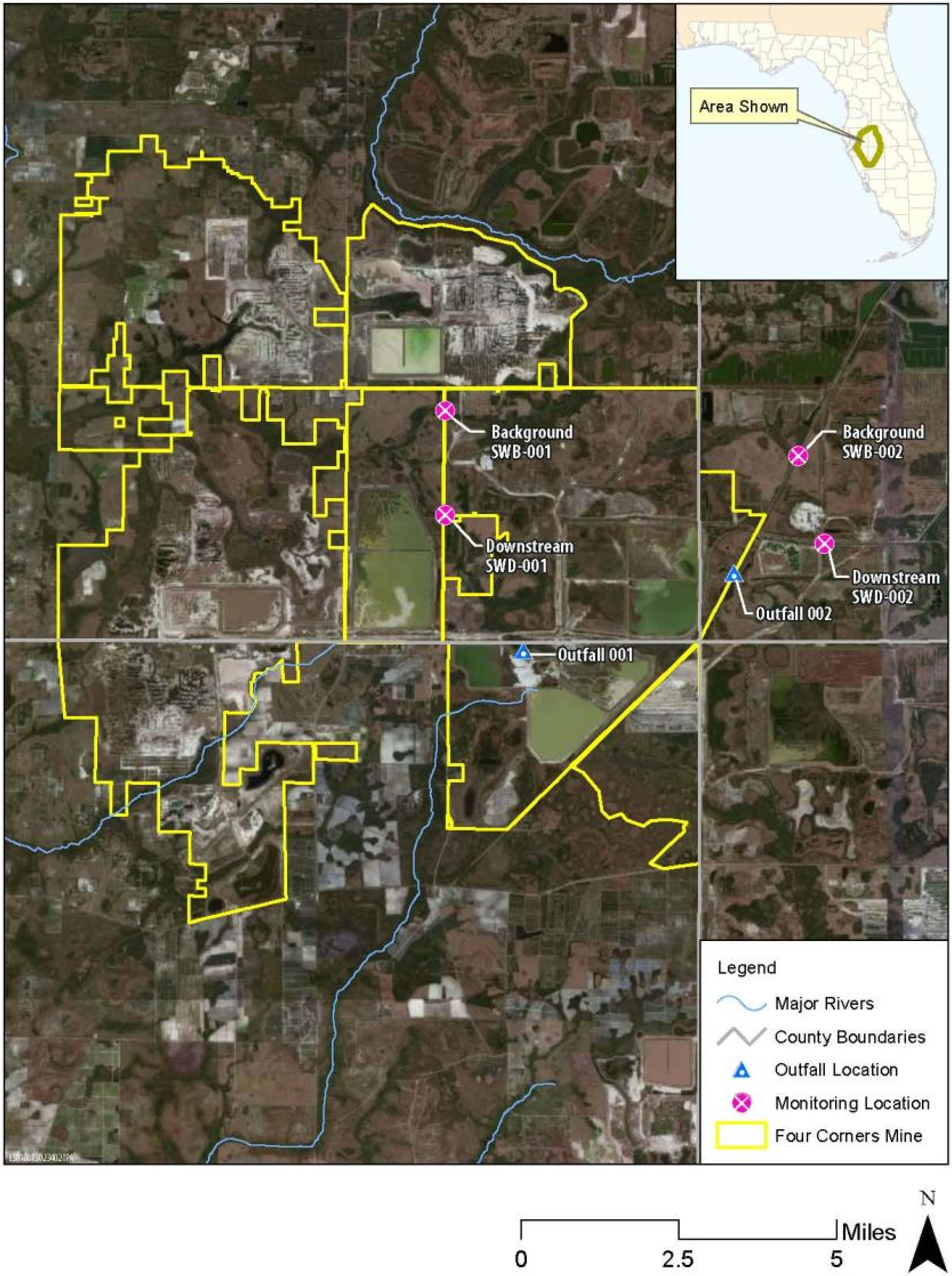


FIGURE 13
Location of NPDES Discharge and Ambient Water Quality Stations Evaluated at Wingate East Mine
Central Florida Phosphate District, Florida

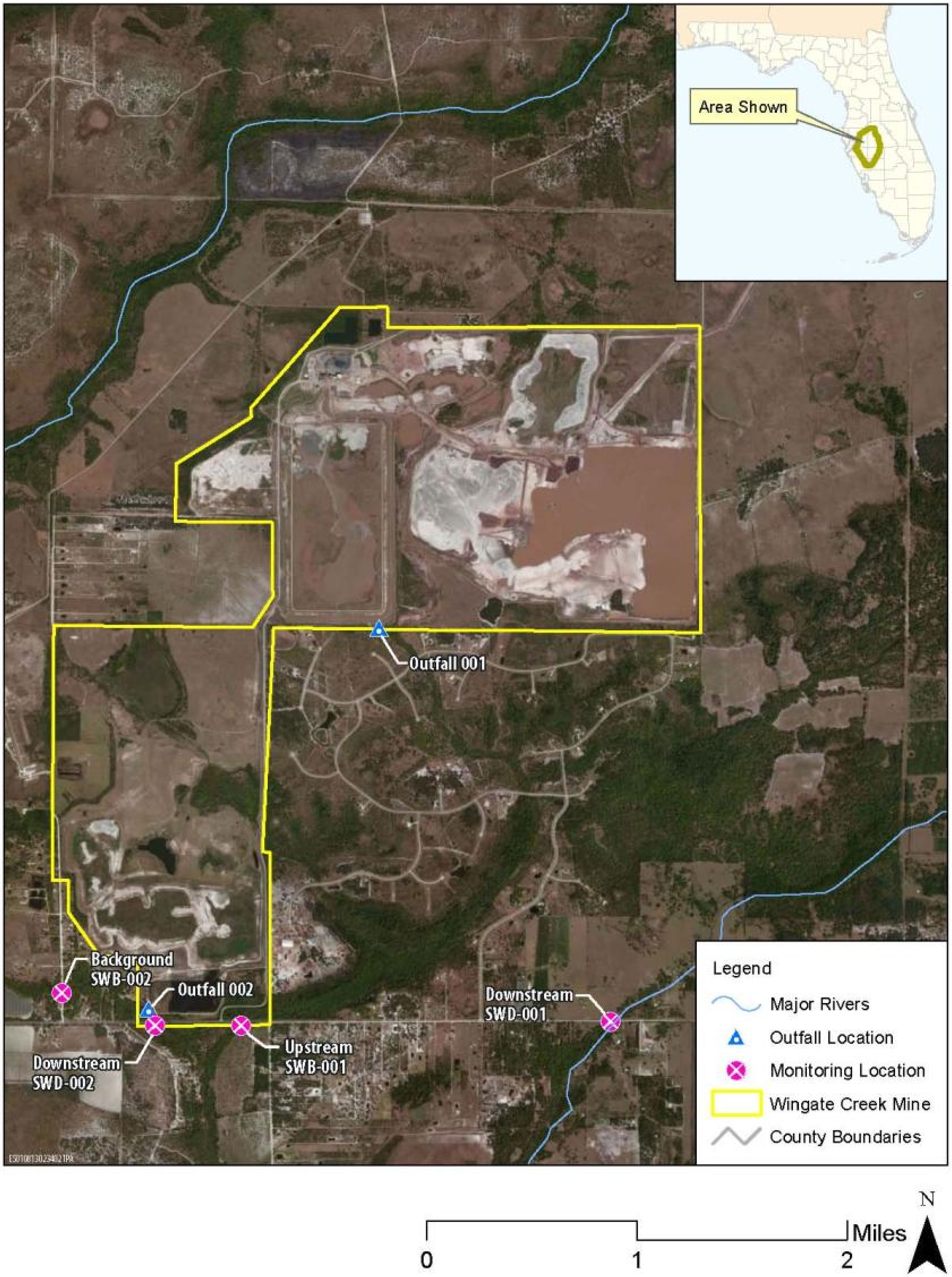


FIGURE 14
Location of NPDES Discharge and Ambient Water Quality Stations Evaluated at Fort Green Mine Complex
Central Florida Phosphate District, Florida

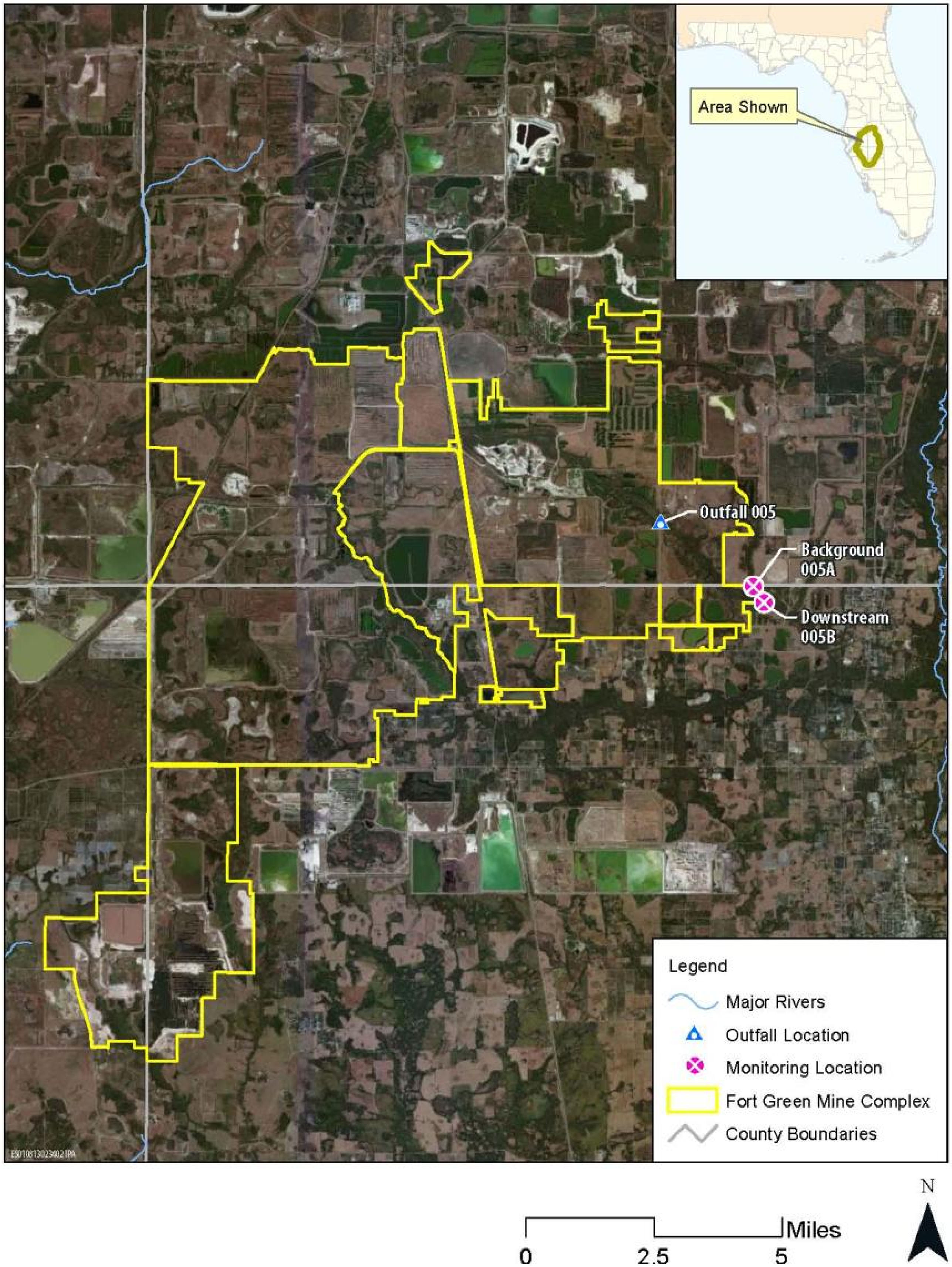
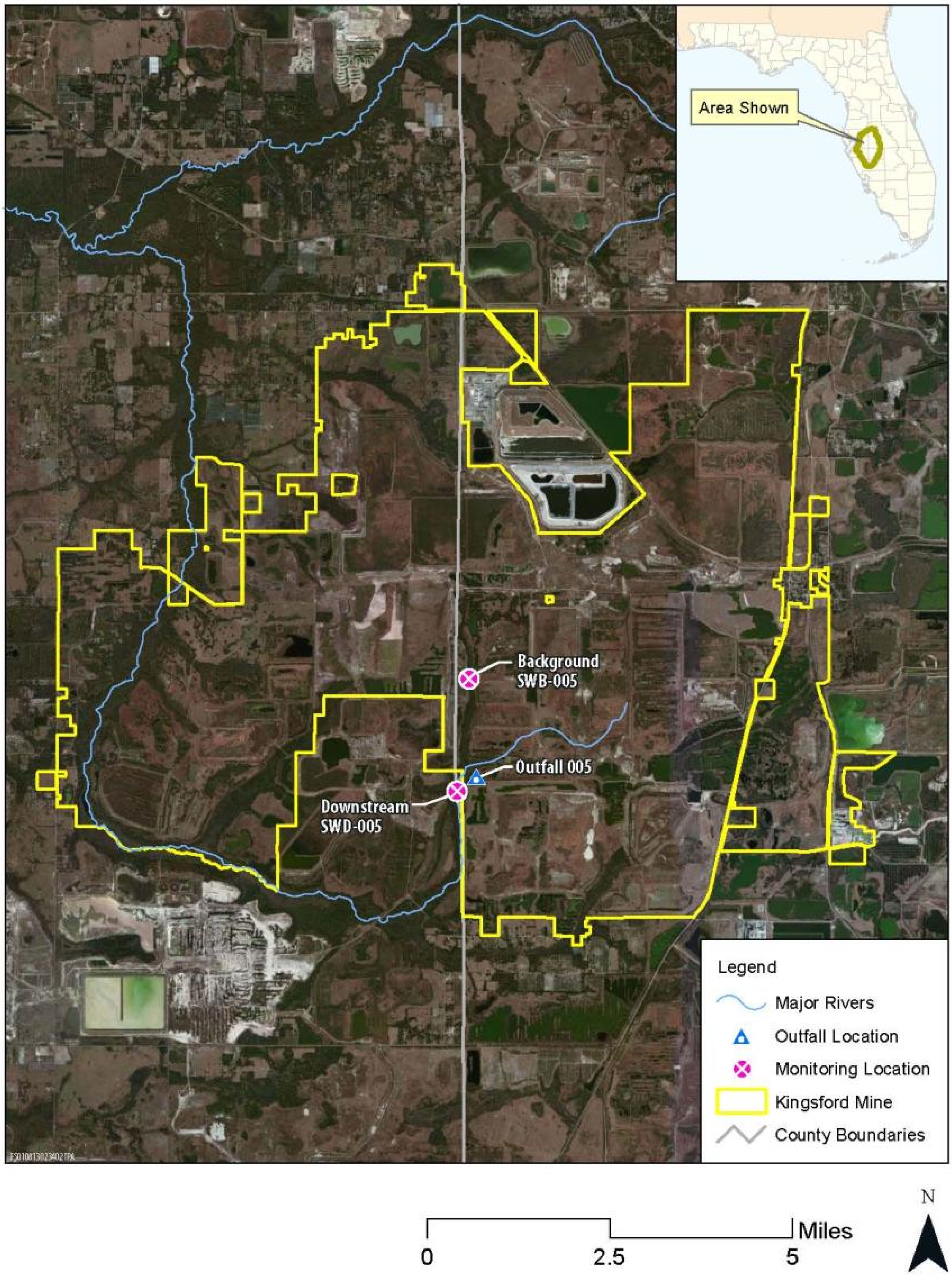


FIGURE 15
Location of NPDES Discharge and Ambient Water Quality Stations Evaluated at Kingsford Mine
Central Florida Phosphate District, Florida



Additional analyses of the NPDES monitoring results were performed to compare water quality at mine outfall stations with corresponding upstream and downstream stations and compliance with applicable surface water quality criteria. These included box and whisker plots and paired comparison tests, as described in the following paragraphs.

Box and whisker plots display information on the central tendency, variability, and skewness of sample data sets by sketching the middle 50 percentile values of the data with a box, and using whiskers to show the tail regions of the distribution; Figure 16 presents an example. A description of box and whisker plot construction follows:

- The height of the box represents the interquartile range (the distance between the 25th and 75th percentiles).
- The horizontal line in the box represents the median.
- The vertical whiskers extend to the minimum and maximum measured values, provided the minimum and maximum values do not extend more than 1.5 times the inter-quartile range beyond the box.
- Individual data symbols represent data points that exceed the whiskers (outliers).

Figures 17 through 23 are box and whisker plots for the parameters listed below for upstream, outfall, and downstream stations at several active and closed mines, and South Pasture outfalls 4 and 5:

- Conductivity
- pH
- Dissolved oxygen
- Turbidity
- Total phosphorus
- Total nitrogen
- Chlorophyll *a*

The plots also provide the number of data points for each station and the number of values that exceeded criteria for conductivity, pH, dissolved oxygen, and turbidity. The conductivity data (Figure 17) are consistent with observations from many of the studies referenced above; conductivity tends to be higher at mine outfalls and downstream locations than at the respective upstream locations. However, all of the conductivity values are less than the criterion of 1,275 micromhos per centimeter (µmhos/cm). The criteria range for pH includes a minimum value of 6.0 and a maximum of 8.5. Most of the values are within that range (Figure 18), except for two upstream values and one outfall value that were less than 6.0, and one outfall and one downstream value that were greater than 8.5. No consistent pattern is apparent between the outfall and upstream locations.

Many dissolved oxygen values were less than the minimum criterion of 5.0 mg/L (Figure 19). The low values generally were observed more frequently at upstream locations than at the corresponding outfalls and downstream stations. No dissolved oxygen exceedances were reported for the four outfalls at the Wingate Creek and Four Corners mines or at South Pasture Outfall 4. Dissolved oxygen showed different trends at the two outfalls associated with closed mines. Dissolved oxygen values at the Kingsford outfall were higher than at the corresponding upstream and downstream stations, while the Fort Green upstream values were lower than at the upstream station. The NPDES permit for the Fort Green outfall does not require dissolved oxygen monitoring at the outfall station.

The turbidity criterion prohibits values greater than 29 nephelometric turbidity units (NTU) above background. The plot of turbidity data used 29 NTU as a very conservative evaluation of compliance with the criterion at upstream, outfall, and downstream locations (Figure 20). Nearly all of the turbidity values were less than 29 NTU, with very infrequent exceedances noted at some upstream, outfall, and downstream stations.

The median total phosphorus values were consistently higher for outfall stations than for upstream or downstream stations (Figure 21). Nevertheless, median total phosphorus values at several downstream locations were lower than total phosphorus values at the corresponding upstream locations. In addition, the total phosphorus inter-quartile ranges for downstream stations generally overlapped the inter-quartile ranges for the upstream stations, including most cases where the downstream median was greater than the upstream median.

This means that there was not a regular increase in concentration downstream that could be statistically discerned given the variability in the monitoring data.

Outfall total nitrogen median values were generally lower than the corresponding upstream and downstream total nitrogen values (Figure 22). The inter-quartile ranges tended to be greater at the upstream stations than at the outfall stations. This suggests much less variability in total nitrogen concentrations for the outfall discharges than at the upstream locations.

The distribution of chlorophyll *a* values was similar for the upstream, outfall, and downstream stations at the Four Corners and Wingate Creek mines (Figure 23). Outfall monitoring at the closed Fort Green and Kingsford mines did not include chlorophyll *a* measurements for the upstream stations. However, the Kingsford outfall and Fort Green downstream stations appeared to have higher chlorophyll *a* values than at the other stations.

FIGURE 16
Example Box and Whisker Plots
Central Florida Phosphate District, Florida

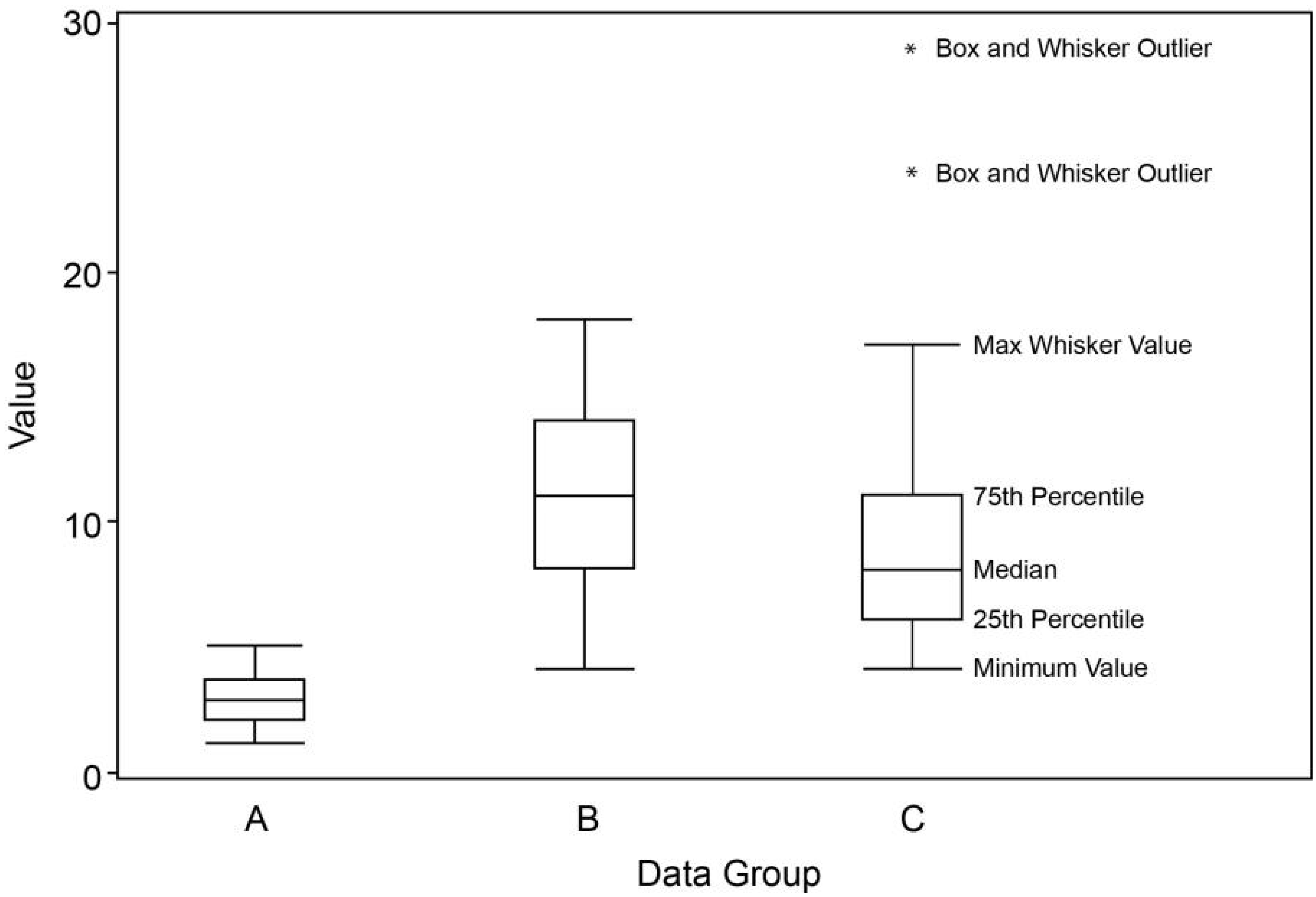
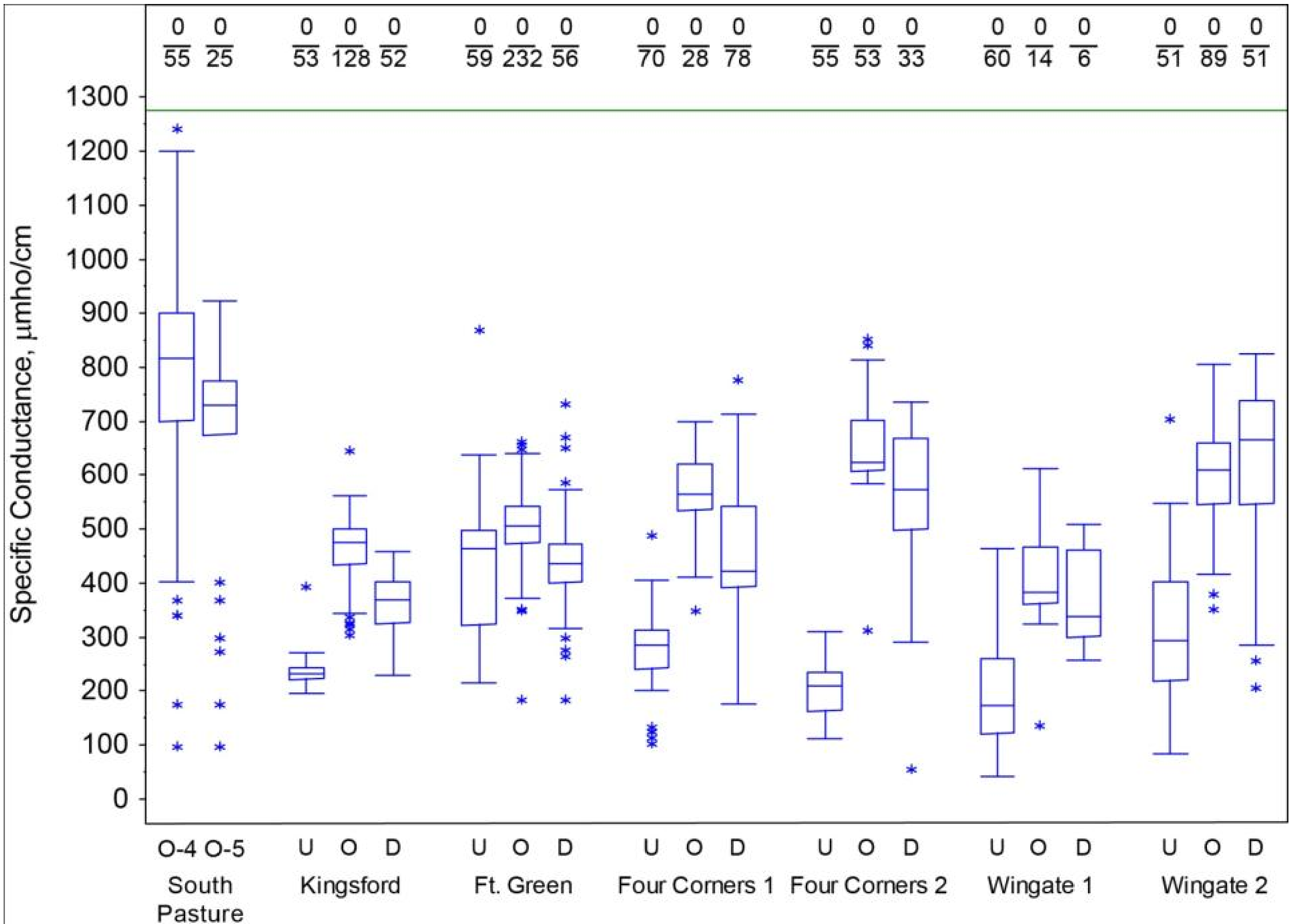
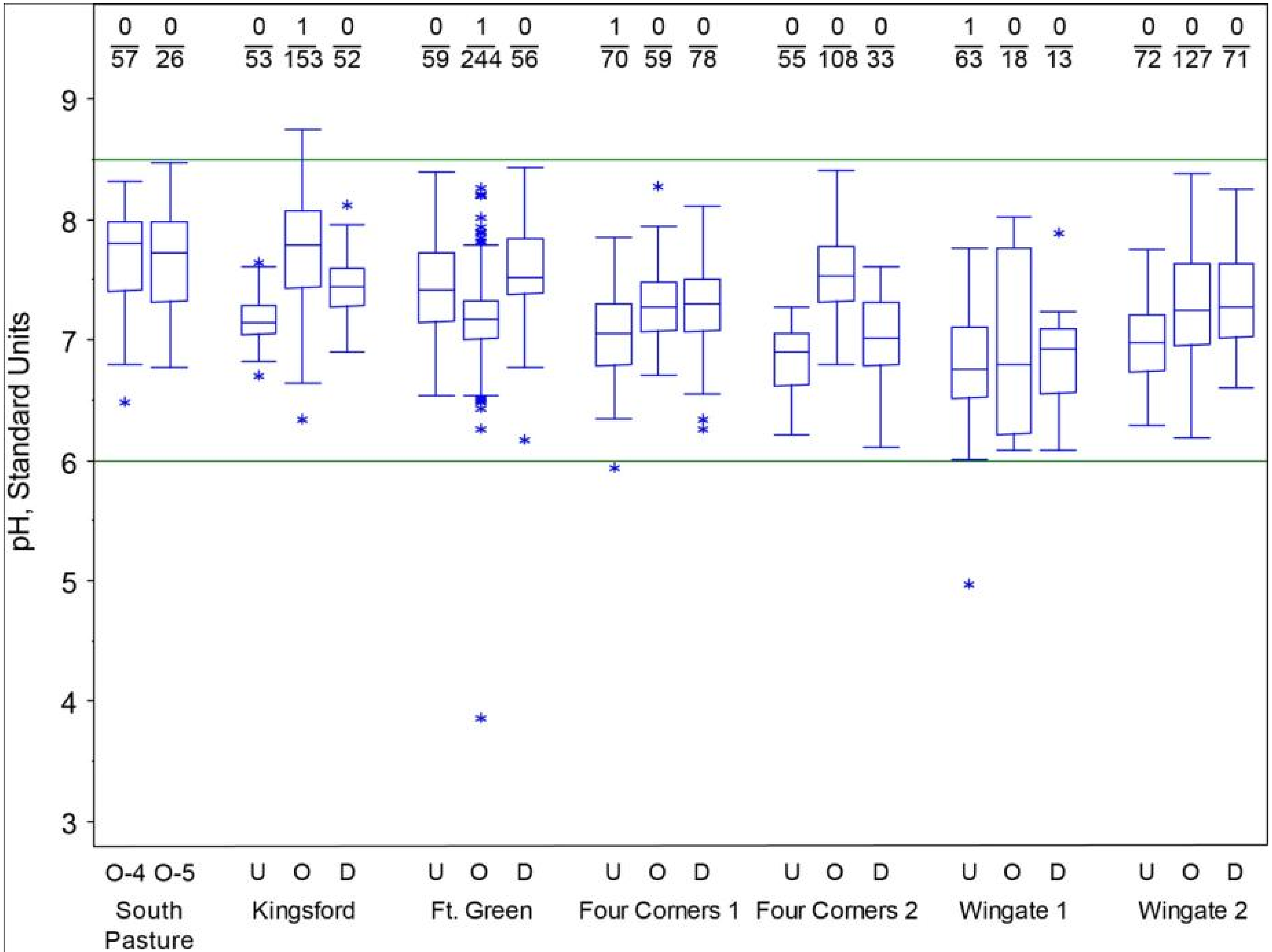


FIGURE 17
Specific Conductance Monitoring Data for Mine Outfalls and Upstream and Downstream Locations
Central Florida Phosphate District, Florida



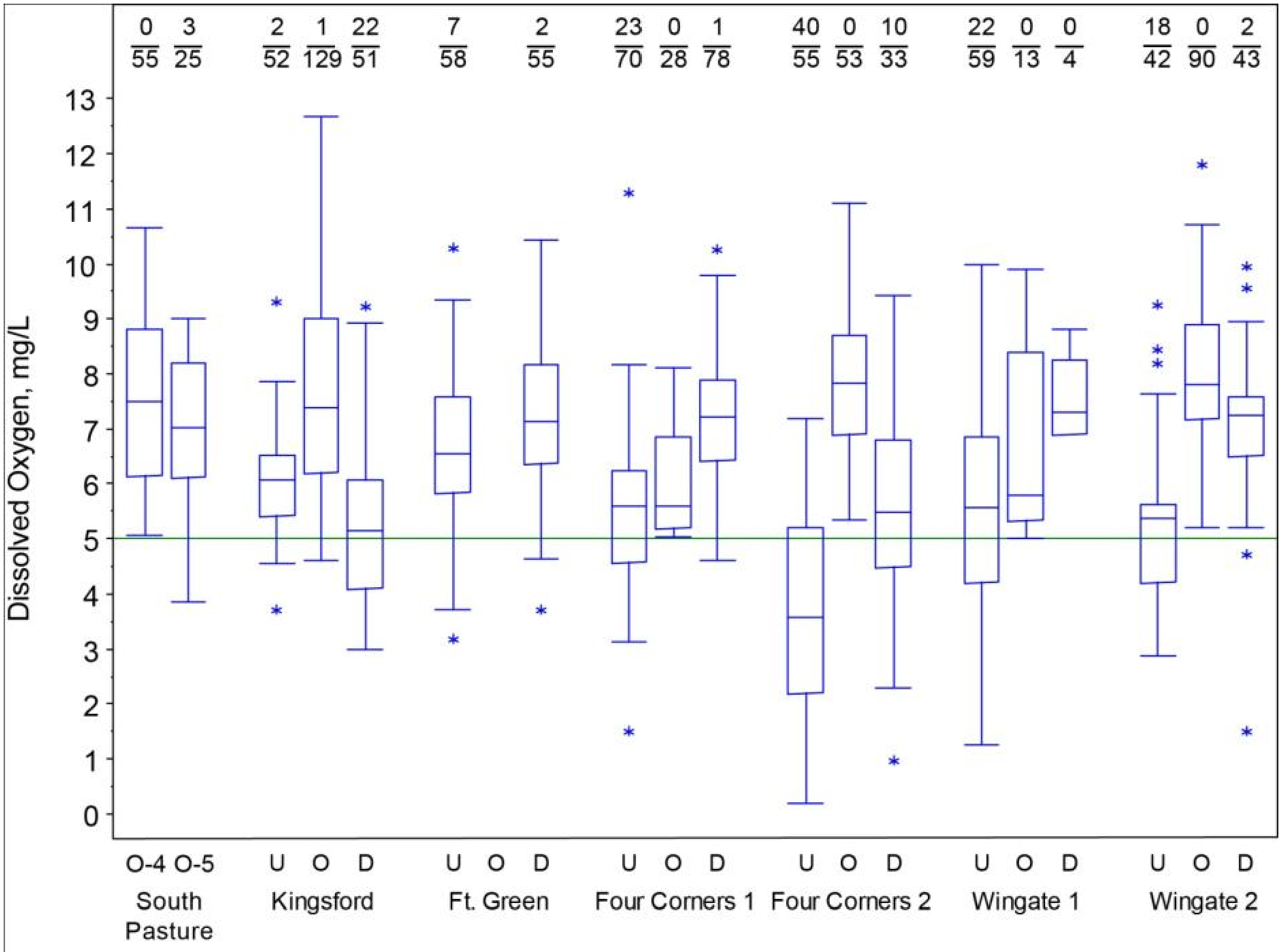
U = Upstream; O = Outfall; D = Downstream
Frequency of SWQ Criteria Exceedances Listed at the Top of Each Plot
Green Horizontal Line at SWQ Criteria

FIGURE 18
pH Monitoring Data for Mine Outfalls and Upstream and Downstream Locations
Central Florida Phosphate District, Florida



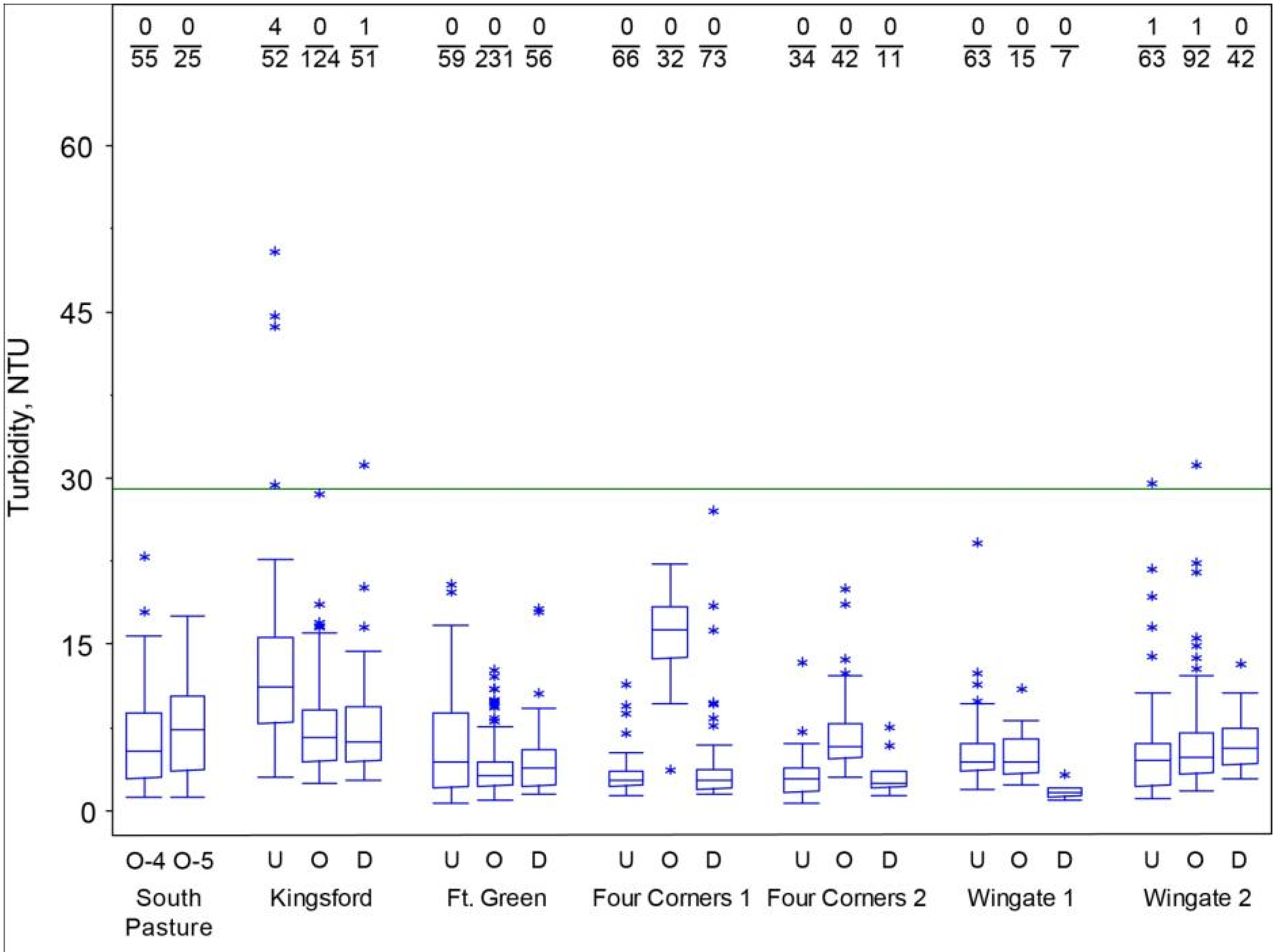
U = Upstream; O = Outfall; D = Downstream
Frequency of SWQ Criteria Exceedances Listed at the Top of Each Plot
Green Horizontal Line at SWQ Criteria

FIGURE 19
Dissolved Oxygen Monitoring Data for Mine Outfalls and Upstream and Downstream Locations
Central Florida Phosphate District, Florida



U = Upstream; O = Outfall; D = Downstream
Frequency of SWQ Criteria Exceedances Listed at the Top of Each Plot
Green Horizontal Line at SWQ Criteria

FIGURE 20
Turbidity Monitoring Data for Mine Outfalls and Upstream and Downstream Locations
Central Florida Phosphate District, Florida



U = Upstream; O = Outfall; D = Downstream
Frequency of SWQ Criteria Exceedances Listed at the Top of Each Plot
Green Horizontal Line at SWQ Criteria

FIGURE 21
Total Phosphorus Monitoring Data for Mine Outfalls and Upstream and Downstream Locations
Central Florida Phosphate District, Florida

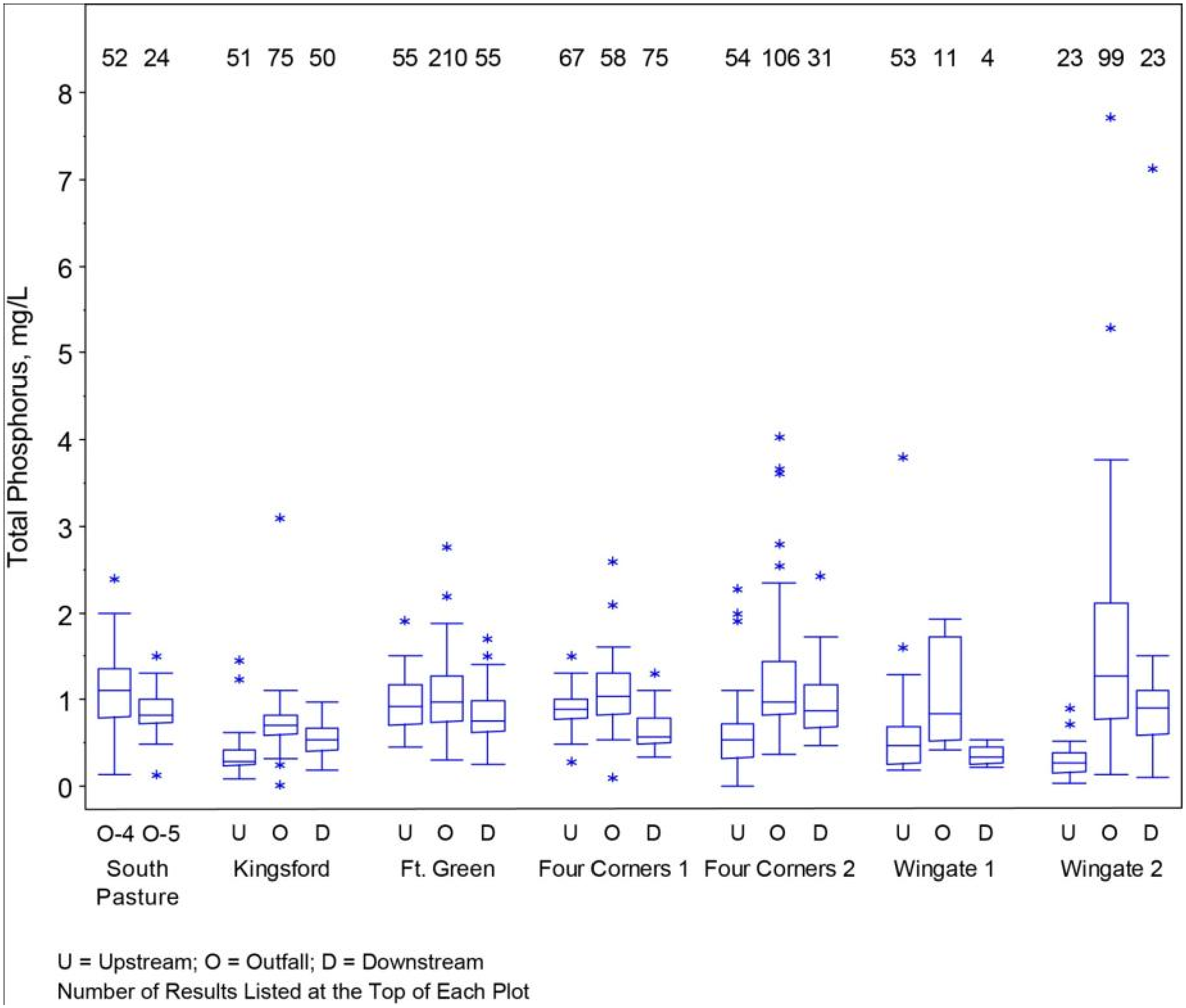


FIGURE 22

Total Nitrogen Monitoring Data for Mine Outfalls and Upstream and Downstream Locations

Central Florida Phosphate District, Florida

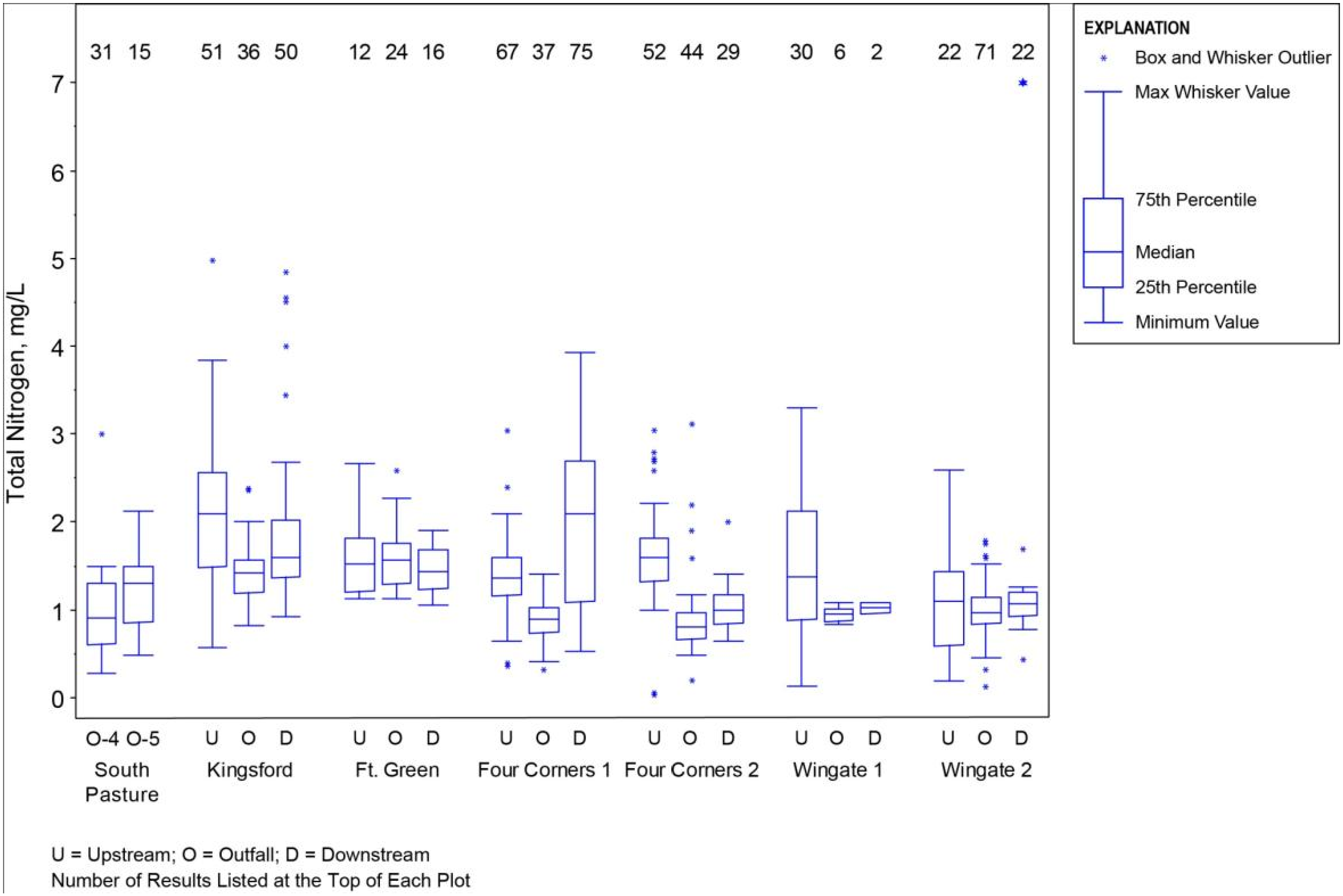
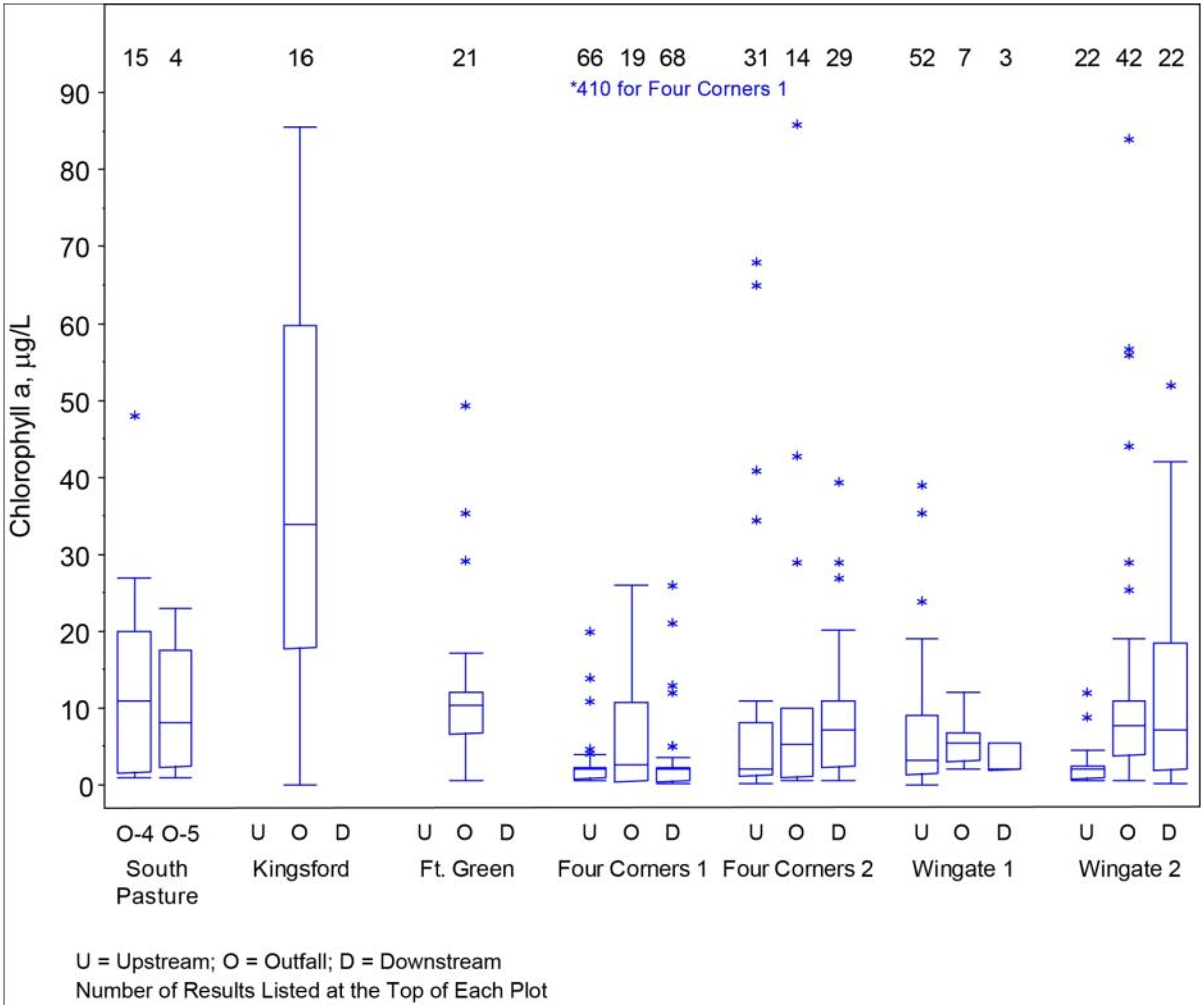


FIGURE 23

Chlorophyll *a* Monitoring Data for Mine Outfalls and Upstream and Downstream Locations

Central Florida Phosphate District, Florida



The time series plots and box and whisker plots display all the data available for each station.[2] However, not all groups of stations (upstream, outfall, and downstream) had the same numbers of observations. A statistical analysis was performed with the Wilcoxon Signed Rank test to evaluate the relationship between surface water quality conditions at upstream locations and the corresponding outfall and downstream stations using only data from dates when all three locations in a group were sampled. This is a non-parametric test that evaluates data for individual pairs of stations to determine whether there is a significant difference between the two for a particular parameter; it is valid whether the data are normally distributed or not.

Table 12 summarizes the Wilcoxon Signed Rank test results for the same parameters plotted in the box and whisker diagrams by listing which station in a pair has significantly higher values, or if there is not a significant difference. The test uses the signs and magnitudes of differences between data pairs collected on the same dates. No comparison was made if there were less than 10 pairs of data points for a pair of stations. This is consistent with the FDEP procedure for evaluating potentially impaired water body segments for the 303(d) planning list, which also requires a minimum of 10 data points (Chapter 62-303, F.A.C.).

The paired specific conductance data showed trends that were similar to the overall datasets; specific conductance values at outfall and downstream stations were greater than values at upstream stations. Dissolved oxygen values were higher at outfall and downstream stations than at the corresponding upstream stations. Paired pH data were higher at the outfall and downstream stations than at the upstream locations except at the Fort Green Mine, where pH was higher at the upstream station than at the outfall. Turbidity was higher at the outfalls than at the upstream locations for the two active mines with at least 10 upstream-outfall data pairs (Four Corners Outfall 1, and Wingate Outfall 2). The opposite was true for the closed mines (Fort Green and Kingsford), where turbidity was higher at the upstream stations than at the outfalls. There was not a significant difference between turbidity values at most of the upstream-downstream station pairs. The paired total phosphorus trends were also generally consistent with the overall datasets. Total phosphorus was higher at outfalls than at corresponding upstream stations, although two upstream stations had higher total phosphorus values than the downstream stations. Total nitrogen was generally higher at the upstream stations than at the outfalls and downstream stations. Only 3 of the 6 mines had at least 10 chlorophyll *a* data pairs. Chlorophyll *a* was higher at the outfalls than at the upstream stations for Four Corners Outfall 1 and Wingate Outfall 2, but there was not a significant difference between the Four Corners Outfall 2 station and the corresponding upstream station. Two of the three upstream-downstream station pairs with 10 or more chlorophyll *a* data points had no significant difference, while chlorophyll *a* was higher at the Wingate Outfall 2 downstream station than at the upstream station.

These data summaries document that for these example discharges from ongoing phosphate mines, some of the mine discharges showed elevated specific conductance, total phosphorus, turbidity, and chlorophyll *a* values compared to the corresponding background locations. In some, but not all, cases downstream values were correspondingly higher than the background levels, reflecting an in-stream influence of the discharge. For three of the outfall monitoring locations, average total nitrogen concentrations were lower for the mine discharges than at the background stations. These observations must be tempered by the high variability in the number of samples included in these average values, and the relatively low number of values. As documented elsewhere in the AEIS, the mines only discharge when their respective recirculation systems exceed their cumulative storage capacities. The low number of monitoring values is reflective of the low number of discharge events for this period of record.

[2] The NPDES permits require monthly monitoring, but only when discharges occur, so there are months without data because there were no discharges and this varied by mine.

TABLE 12
Water Quality Comparisons for Outfall, Upstream, and Downstream Stations at Mine NPDES Outfalls
Table indicates which station in pair has significantly higher values based on Wilcoxon Signed Rank Test (α = 0.05)

Station Pairs	Specific Conductance	Dissolved Oxygen	pH	Turbidity	Total Phosphorus	Total Nitrogen	Chlorophyll *a*
Four Corners Mine Outfall 1							
Upstream vs. Outfall	Outfall	Outfall	Outfall	Outfall	Outfall	Upstream	Outfall
Upstream vs. Downstream	Downstream	Downstream	Downstream	NSD	Upstream	Downstream	NSD
Four Corners Mine Outfall 2							
Upstream vs. Outfall	Outfall	Outfall	Outfall	—	Outfall	Upstream	NSD
Upstream vs. Downstream	Downstream	Downstream	Downstream	NSD	Downstream	Upstream	NSD
Wingate Mine Outfall 1							
Upstream vs. Outfall	—	—	NSD	NSD	—	—	—
Upstream vs. Downstream	—	—	NSD	—	—	—	—
Wingate Mine Outfall 2							
Upstream vs. Outfall	Outfall	Outfall	Outfall	Outfall	Outfall	NSD	Outfall
Upstream vs. Downstream	Downstream	Downstream	Downstream	NSD	Downstream	NSD	Downstream
Fort Green Mine							
Upstream vs. Outfall	Outfall	–	Upstream	Upstream	Outfall	—	—
Upstream vs. Downstream	NSD	—	Downstream	NSD	Upstream	Upstream	—
Kingsford Mine							
Upstream vs. Outfall	Outfall	Outfall	Outfall	Upstream	Outfall	Upstream	—
Upstream vs. Downstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	—

Wilcoxon Signed Rank Test used only data from dates when all three stations (outfall, upstream, and downstream) were sampled.
NSD = No significant difference
— = Less than 10 data pairs, no statistical analysis

5.3 Indirect Effects Monitoring

Indirect effects of phosphate mine discharges on downstream reaches of the receiving water body may be difficult to detect solely through water quality monitoring because of low frequency of mine discharges and the variable nature of stream flow. Discharges generally only occur when rainfall accumulations lead to the recirculation systems being full because of seasonal accumulations or because of extended durations and/or multiple large storm events. Thus, mine discharges are most likely to occur when stream base flows are elevated because of the same drivers – large storms, extended durations of rainfall, or gradual seasonal buildup of watershed storage and base flow. Under such scenarios, water quality effects of mine discharges may be quickly diluted by stream base flow, making them difficult to document. However, these same conditions may make it less likely that the discharges would have an effect on the aquatic biological communities associated with the water body.

For these reasons, aquatic biological monitoring is often used to provide an indirect measure of potential water quality effects of a discharge on the receiving stream. The results of two examples of such monitoring activities are described below.

5.3.1 Horse Creek Stewardship Program Aquatic Biological Studies

Of the widely varied studies of fish and macroinvertebrate communities in the AEIS study area pertinent to review of phosphate mining effects, one of the most relevant is the long-term monitoring of these communities conducted under the Horse Creek Stewardship Program (HCSP). This environmental monitoring program was established through the collaborative efforts of Mosaic and the Peace River-Manasota Regional Water Supply Authority (PRMRWSA) to monitor for potential mining-related effects on Horse Creek that could affect PRMRWSA's withdrawal of raw water for potable water supply purposes.

Under this program, monitoring of fish and macroinvertebrate communities at fixed locations in Horse Creek has been conducted since 2003. The monitoring program includes assessments of fish and macroinvertebrate communities three times per year (March-April, July-September, and October-December) at the four sites shown in Figure 24, all of which are along the main stem of Horse Creek (Entrix, 2010a). The upstream station (HCSW1) is slightly less than 8 miles downstream of the nearest phosphate mine outfall. Monitoring of macroinvertebrates is conducted in accordance with FDEP-approved procedures for stream condition index (SCI) analyses. Figure 25 summarizes SCI scores for each of the four stations for monitoring years 2003 through 2008. SCI scores for the upstream station remained in the "healthy" range for this entire study period as did those for the most downstream station. Station HCSW2 consistently was characterized as "impaired" based on its low SCI scores; these were attributed to the influence of a large wetland system adjacent to this monitoring location, which influenced the prevailing flow and water quality conditions. The third monitoring location, HSCW3, variably reflected SCI scores in either the impaired or healthy range. For all four stations, considerable season-to-season and year-to-year variability was evident. None of these patterns appear related to phosphate mining discharges from the two outfalls from the Fort Green Mine in the upper portion of the Horse Creek watershed.

Biological Research Associates (BRA) presented an overview of historical macroinvertebrate monitoring data in the Horse Creek watershed (BRA, 2006b), including data collected prior to HCSP sampling. On the basis of that review, BRA concluded that macroinvertebrate abundance and richness in this creek were greater during the dry season than during the wet season. The lower abundance and richness during the wet season were attributed to macroinvertebrates being flushed out and/or being diluted by greater stream flows during the wet season (BRA, 2006b). These relationships may be relevant as future mining effects are evaluated for individual mines and/or for combinations of mines which may have overlapping operational periods affecting lands in the Horse Creek watershed.

Monitoring of fish species present at these same four stations from 2003 through 2008 produced the species richness (number of species per station) information summarized in Figure 26 (Entrix, 2010a). Through 2008, a total of 41 fish species was collected from these four sampling sites. The number of fish species found at the upstream locations was generally lower than at the locations further downstream, perhaps reflecting the increased opportunity for fish movements up into the watershed from the lower reaches of the system as well as increased habitat diversity in higher order stream reaches. Entrix (2010a) indicated that prior to 2004 when Hurricane Charley caused substantial impacts across this watershed, species richness and diversity were lowest at the upstream site and highest at the location furthest downstream in the study area, and stated that “this pattern of longitudinal zonation of increasing species diversity with increasing stream order is typical of stream systems (Harrel et al., 1967; Whiteside and McNatt, 1972; Sheldon, 1988).” Fish community species richness and diversity were not viewed as related to mining activities in the uppermost reaches of the creek watershed during this period of monitoring. Recovery from Hurricane Charley effects has been suggested by the more recent years of monitoring. In light of the locations of the Applicants’ Preferred Alternatives, this background information regarding long- term fish community composition and structure will be of value in assessing the potential for phosphate mining effects on the Horse Creek watershed in the future.

5.3.2 Wingate Creek Mine Discharge Monitoring for Effects on Macroinvertebrates

The existing Wingate Creek Mine’s industrial operations permit issued by FDEP is unique in that it includes a requirement for an annual wet season evaluation of macroinvertebrate communities upstream and downstream from each of the two NPDES permit-authorized outfalls from this mine. The permit conditions call for monitoring if any outflow through the specific outfall occurs within the 12 months prior to that year’s wet season (August - October); monitoring is conducted following FDEP’s standard operating procedure (SOP; DEP-SOP-001/01 FS 7420, *Stream Condition Index (D-Frame Dipnet) Sampling.*) The permit conditions stipulate that, “At the time of sampling, the appropriate outfall shall be discharging effluent to the receiving stream.”

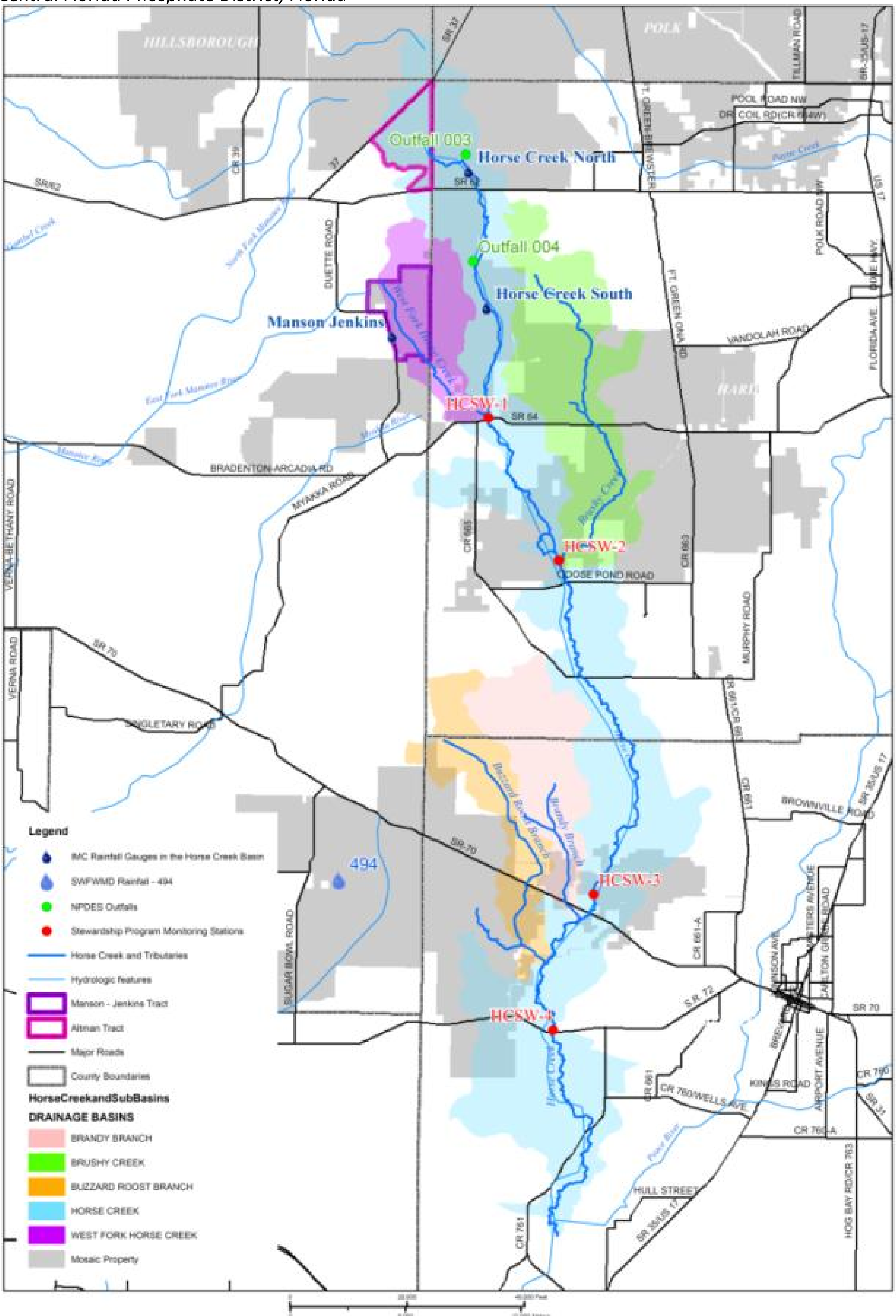
The two permitted Outfalls (D-001 and D-002) discharge to Wingate Creek and Johnson Creek, respectively; these creeks are tributaries of the Myakka River. For Outfall D-002, the upstream and downstream reaches monitored are in Johnson Creek, with each reach defined as a 100-meter length of the creek. Outfall D001 discharges to Wingate Creek and the downstream station is just upstream of the confluence of Wingate Creek with Johnson Creek. No upstream portion of Wingate Creek was suitable as an upstream reference site; therefore, the background monitoring station is in the Myakka River at a location considered as comparable in habitat characteristics as possible to the downstream monitoring station in Wingate Creek. Each monitoring location also is represented by a 100-meter length of the applicable water body. The station locations are shown in Figure 27.

The monitoring records available for 2008, 2009, and 2010 are summarized in Table 13. No discharges from Outfall D-001 occurred during this 3-year period; thus, the limited data reported relevant to this site may be useful for future reference, but cannot be interpreted in terms of assessing potential effects of mine-related discharges. For Outfall D-002, discharges did occur during each of the 3 years, with discharge rates ranging from near zero to a peak rate of up to approximately 19 million gallons per day (mgd). Macroinvertebrate monitoring only occurred during an actual period of discharge for the first year (2008). For both 2009 and 2010, the macroinvertebrate surveys were conducted during periods when no effluent was being released; in both years the most recent discharge had occurred several weeks prior to the stream monitoring effort.

In 2009, both upstream and downstream SCI scores relevant to Outfall D-002 suggested an impaired stream condition. This was in contrast to the 2010 results, which suggested a healthy stream condition. The 2008 monitoring results (healthy upstream but impaired downstream conditions) may indicate a short-term invertebrate community response to high rates of mine discharge. Where such communities are numerically dominated by insect larval forms with short-duration reproductive strategies, recolonization rates may be high enough to result in a rapid recovery to community characteristics similar to those of upstream reference habitats. What may be most relevant is that during both 2009 and 2010, the upstream and downstream values were comparable, suggesting no substantive differences in the macroinvertebrate communities approximately 3 weeks after the last mine discharge from Outfall D-002. If there were short-term effects on the macroinvertebrate communities, recovery occurred within a very short time.

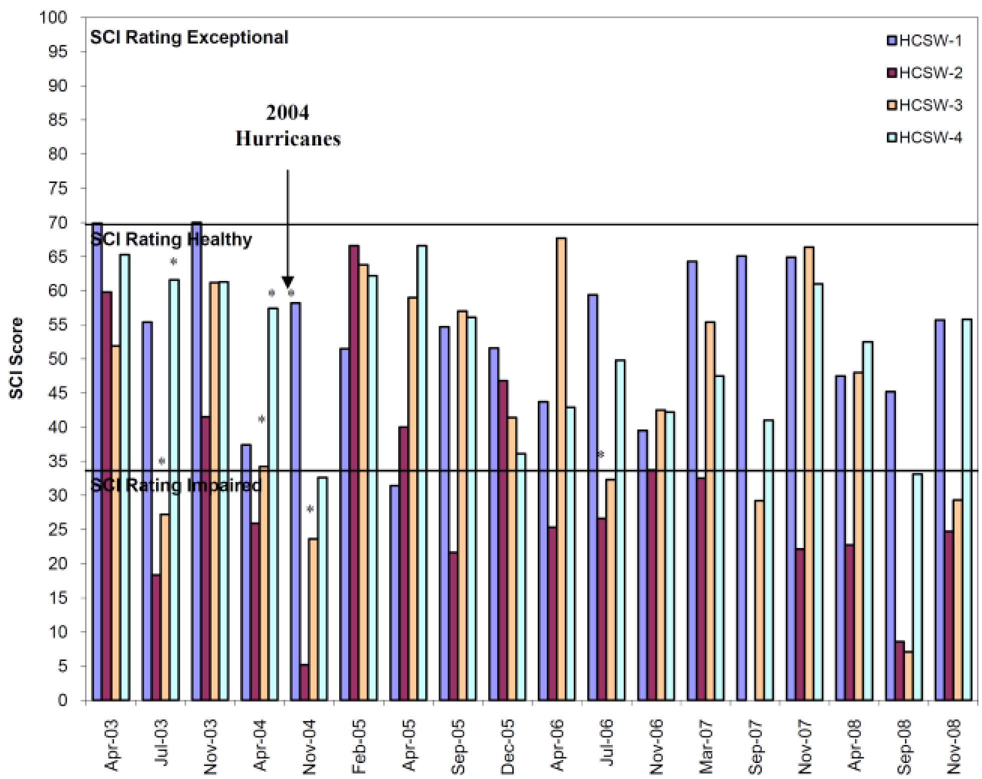
On the basis of these monitoring records, there were no definitive indications of phosphate mine-related indirect water quality impacts on the aquatic communities monitored downstream of the Wingate Creek Mine and Fort Green Mine discharges.

FIGURE 24
Aquatic Biological Monitoring Stations in Horse Creek, Horse Creek Stewardship Program
Central Florida Phosphate District, Florida



Source: Entrix, 2010a

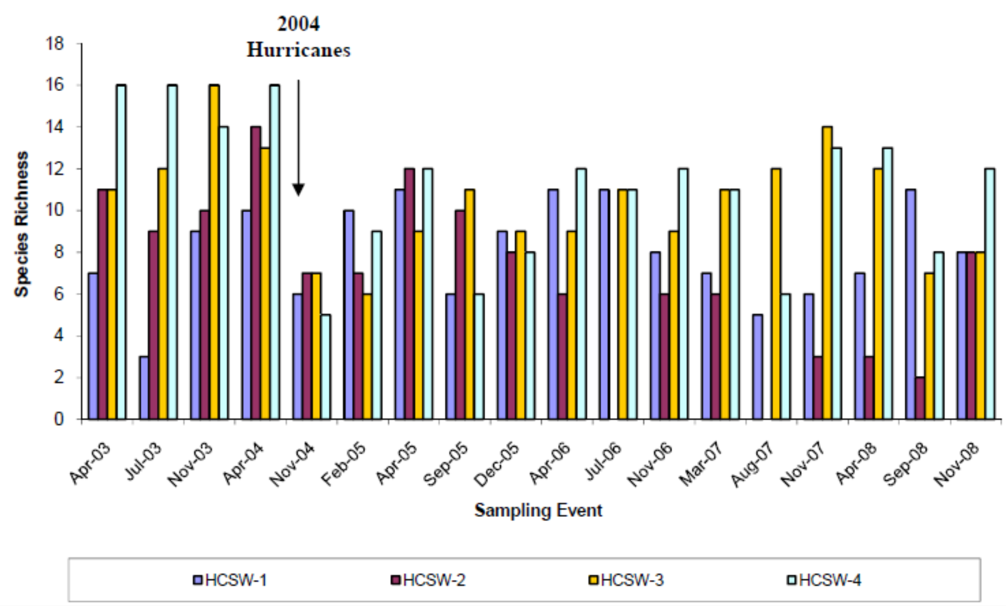
FIGURE 25
Macroinvertebrate Community Assessment Results (SCI Scores), 2003 - 2008, Horse Creek Stewardship Program
Central Florida Phosphate District, Florida



Source: Entrix, 2010a

FIGURE 26

Fish Community Assessment Results (Species Richness), 2003 - 2008, Horse Creek Stewardship Program
Central Florida Phosphate District, Florida

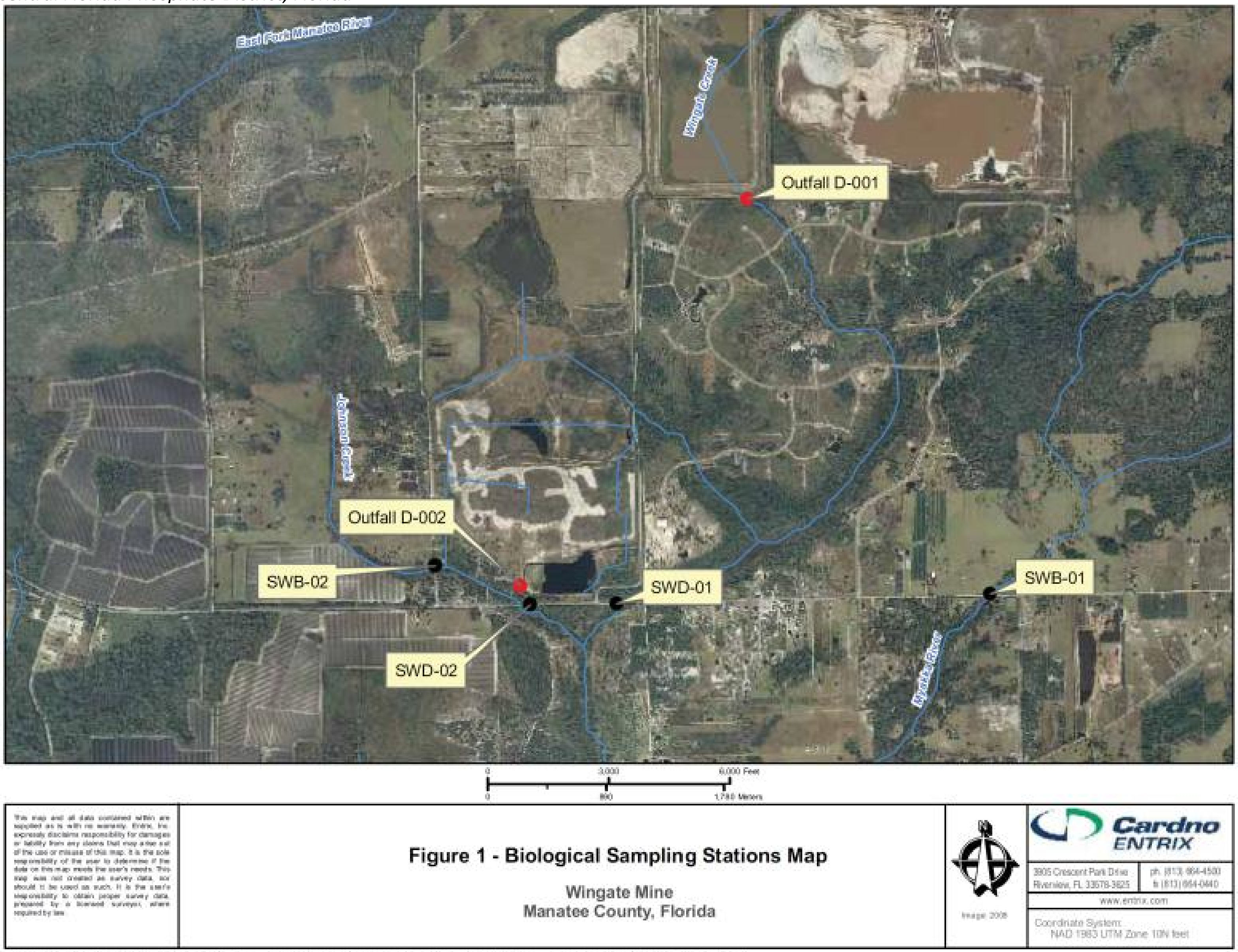


Source: Entrix, 2010a

FIGURE 27

Macroinvertebrate Monitoring Stations for the Wingate Creek Mine (NPDES Permit No. FL0032522)

Central Florida Phosphate District, Florida



(Source: Entrix, 2010a).

TABLE 13
Stream Condition Index Scores for Wingate Creek Mine's Outfalls D-001 and D-002

		Outfall D-001		Outfall D-002	
Year		**Reference**	**Downstream**	**Upstream**	**Downstream**
2008	Flow Condition	No Discharge in Prior Year; No monitoring		High rate of effluent flow (>10 mgd)	
	SCI Score	NA	NA	50	32
2009	Flow Condition	No Discharge in Prior Year; Monitored Per Permit Condition		No Effluent Flow During Sampling, but Monitored	
	SCI Score	Inadequate Flow; No Sampling	46	29	28
2010	Flow Condition	No Discharge in Prior Year; No monitoring		No Effluent Flow During Sampling, but Monitored	
	SCI Score	NA	NA	36	42

Notes.
For these scores, evaluations were as follows per the FDEP SOP specifications: SCI scores of 71-100 = Exceptional; SCI scores of 35-70 = Healthy; SCI scores of 0-34 = Impaired. FDEP has recommended using an SCI score threshold of 40 to differentiate healthy vs. impaired stream habitats.
(Source: BRA, 2008; Entrix, 2010a; Entrix, 2010e; Cardno ENTRIX, 2011b)

5.4 Storage Reservoir Spills

Historically, there have been a number of spills from clay settling areas (CSAs) associated with the mining process and gypsum stacks associated with the chemical plant facilities that have had a direct effect on the adjacent stream at the time of occurrence. At the chemical plants, phosphorus (or phosphoric acid) is extracted from the phosphate rock; the solid waste by-product of the process is calcium sulfate, also called phosphogypsum or just gypsum. Phosphogypsum is stored in large mounds commonly called "stacks." The chemical plants' water containing the phosphogypsum is pumped to ponds on top of the stacks where the phosphogypsum is settled out and the process water returned to the chemical plant (USEPA, 2012c). The mining process includes the beneficiation of the matrix (ore) where the sand tailings and phosphatic clays are separated from the phosphate rock. The phosphatic clays are pumped from the beneficiation plant to the CSAs where the clays settle out by gravity and the water is returned to the mine recirculation system. Table 14 lists, in reverse chronological order, some notable spills from phosphate mines and chemical plants in recent history. These spills include breaches from both chemical plants (i.e., gypsum stacks) and CSAs. Included also are large releases from tanks and pipelines operated by phosphate companies.

TABLE 14
Historical Spills from Stacks and CSAs in the CFPD

Date	Source	Description
May 2011	Mine	About 170 million gallons of dredged material from pipeline leaks were released into Bishop Harbor.
September 2004	Chemical Plant	A dike at the top of a gypsum stack in Riverview, Florida, broke after Hurricane Frances. 60 million gallons of acidic wastewater discharged into Archie Creek, a tributary of the Hillsborough River.
December 1997	Chemical Plant	Large release of phosphogypsum process water related to a dam break from the Mulberry phosphate facility as a result of a hurricane. Estimated 50 million gallons of acidic water released into the Alafia River.
November 1994	Mine	A dam failure at the IMC-Agrico Company Hopewell Mine in Hillsborough County caused about 482 million gallons of water to spill from a CSA. The water spilled into nearby mine cuts and thereafter drained to wetlands and the North Prong of the Alafia River.

TABLE 14
Historical Spills from Stacks and CSAs in the CFPD

Date	Source	Description
October 1994	Mine	An internal CSA dam in IMC-Agrico Company's (IMC) Payne Creek Mine failed. This resulted in a release of 1.8 billion gallons of wastewater onto CF Industries Hardee Mine property, most of which was contained in mine cuts. About 127 million gallons were discharged into Hickey Branch which flows into Payne Creek and then into the Peace River.
June 1994	Chemical Plant	A sinkhole opened up within the gypsum stack releasing gypsum and water into groundwater at the IMC-Agrico New Wales chemical plant
October 1993	Chemical Plant	A spill of undisclosed amount of acidic water into Archie Creek from the Cargill facility East Tampa Plant near Gibsonton.
May 1988	Chemical Plant	Release of about 40,000 gallons of acidic waste from a storage tank into the Alafia River.
December 1971	Mine	A clay settling area owned by Cities Service Company near Fort Meade spilled about 1 billion gallons of clay laden water into Whidden Creek and eventually into the Peace River. The clay laden water caused extensive damage to fish and wildlife down to Charlotte Harbor (USEPA, 1974).
March 1967	Mine	A rupture of a retention dike near Fort Meade, Florida, released 2 million gallons of clay-laden water into the Peace River. The accident killed a million fish and its effects did not subside until 2 years later.

Sources: Alvarez, 2011, personal communication; ManaSota-88, 2008

No new gypsum stacks are proposed for the future mining in the southern portions of the CFPD addressed in the AEIS. One facility with a gypsum stack that drains into the Peace River Basin on Whidden Creek, which is between Fort Meade and Bowling Green, closed and since 2006 most of the water stored within its stack has been treated and discharged under the authority of an NPDES permit (although a small volume of treated discharge will continue for years into the future, currently about 0.6 cubic foot per second on average). Consequently, water quality effects from chemical plants and gypsum stacks are not relevant to the present applications and offsite alternatives.

The effects of a spill from CSAs may entail both flooding- and sediment-related impacts to the downstream environments. The earthen dikes that form the CSAs are regulated primarily under Chapter 62-672, F.A.C. While biological effects occurring after a spill could be devastating to biota, natural systems do tend to recover over time. The historical catastrophic CSA dam failure events are not known to have caused injury or death to humans.

In general, after the advent of new regulations and oversight that began in the mid-1970s, the occurrence of dam failures has decreased substantially. Spills are highly disruptive to mining operations, as well as the environment and all parties (owners and regulators) try to design and maintain facilities that do not fail. However, it is impossible to guarantee that there would not be a combination of events that could occur in the future, causing an accidental dam failure. If a failure were to occur, the responsible owners must remediate and take emergency actions to contain, repair, and mitigate the damage. The risk of such occurrences is viewed as minimal with proper implementation of the current rules regarding earthen dam design and construction.

6.0 Effects of Phosphate Mine Reclamation on Surface Water Quality

Lewelling and Wylie (1993) evaluated hydrology, groundwater quality, and surface water quality for the U.S. Geological Survey (USGS) and the Florida Industrial and Phosphate Research Institute (FIPR Institute) in several small drainage basins in the "four corners area" of west-central Florida, where the applicable boundaries of Hillsborough, Polk, Manatee, and Hardee Counties meet. The surface water evaluation included 3 unmined basins that ranged from 90 to 420 acres in size, and 4 basins ranging in area from 47 to 250 acres that had been mined for phosphate rock and subsequently reclaimed using several different methods. Two of the former phosphate mining areas were reclaimed by backfilling with clay, one was backfilled with sand tailings and capped with overburden, and one was backfilled solely with overburden.

Surface water samples were collected during an initial reconnaissance evaluation and also during routine sampling that occurred during base flow and high flow conditions in most of the basins from November 1988 through October 1990. Two basins that were reclaimed using clay only had sufficient water for sampling during 2 routine sampling events. The number of samples collected from the 3 unmined basins and the other 2 mined and subsequently reclaimed basins ranged from 11 to 16 at each site. Reconnaissance samples were analyzed for nutrients, major ions, trace metals, and radionuclides. Routine samples were analyzed for alkalinity, chloride, sulfate, specific conductance, pH, orthophosphorus, dissolved solids, and suspended solids. USGS observations included the following:

- The major constituents in water from the streams in the study basins were the cations calcium, magnesium, sodium, and potassium; and the anions sulfate, chloride, fluoride, nitrate, and carbonate and bicarbonate.
- Parameters for which there were no observed differences between the reclaimed and unmined basins included color, nitrate/nitrite, sulfate, sodium, fluoride, potassium, and total dissolved solids.
- Analysis of water samples collected from streams during base flow and high flow conditions indicated that the water chemistry of surface waters in the unmined and reclaimed basins generally was similar. Higher concentrations of magnesium, orthophosphorus, alkalinity, and calcium were detected in water from streams at some of the reclaimed basins.
- Radiological evaluations included gross-alpha and radium-226. Gross alpha activity levels in water samples from streams in unmined basins ranged between 0.34 and 3.54 picocuries per liter (pCi/L), compared to 0.34 to 10.2 pCi/L from streams in mined basins. All values were less than the Florida surface water standard of 15 pCi/L. All measurements of radium-226 activity levels were below the Florida surface water standard of 5 pCi/L.
- The hydrologic characteristics and surface and groundwater quality of two reclaimed basins where overburden was used to either fill the mine cuts or cap sand tailings used to fill mine cuts were similar to those of the unmined basins.
- In contrast, the hydrologic characteristics and surface and groundwater quality of two reclaimed basins where either clay or a clay/sand mix was used to support reclamation differed somewhat from the unmined basins in exhibiting reduced runoff because of additional surface storage; increased uranium-234 activity levels at one recently reclaimed site; and more rapid runoff response to rainfall, reduced flow rates, greater depths to the water table, and a more gradual water table response to recharge at a more mature reclaimed site[3].

Overall, the surface water quality data gathered by USGS over this 2-year study period indicated that all the basins were in compliance with the surface water quality standards applicable at the time of the study (Lewelling and Wylie, 1993).

7.0 Effects of Evolving Numeric Nutrient Criteria on CFPD Phosphate Mining

Nutrient pollution is one of America's most widespread, costly, and challenging environmental problems. Phosphorus is one of the primary nutrients that regulates algal and macrophyte growth in natural waters, particularly in freshwater. Phosphate, the form in which almost all phosphorus is found in the water column, can enter the aquatic environment in several ways. Natural processes transport phosphate to water through atmospheric deposition, groundwater percolation, and terrestrial runoff. Municipal treatment plants, industries, agriculture, and domestic activities can also contribute to phosphate loading through direct discharge and natural transport mechanisms.

Similar to phosphorus, nitrogen is ubiquitous and naturally present in the environment. Like phosphorus, it is a nutrient essential for normal plant and animal growth. At elevated concentrations, however, nitrogen has been

[3] The four Application mines are not proposing to use the clay/sand mix in reclamation. Future reclamation will utilize overburden.

shown to contribute to accelerated and enhanced algal and macrophyte growth patterns that can lead to water body eutrophication. Traditionally, nitrogen has been considered the limiting nutrient in estuarine and marine water systems, while phosphorus has been considered the limiting nutrient in freshwater systems. In transitional environments, both of these nutrients can be limiting factors under different ambient conditions. Even within a single water body, nutrient limitation can shift spatially (different limiting nutrients in different segments) and temporally (different limiting nutrients during different seasons). Equally important, if only phosphorus is limited in upstream freshwaters, high nitrogen loads may be delivered downstream to estuarine and marine environments, potentially eliminating nitrogen limitation in those waters and causing algal blooms, which can result in decreased dissolved oxygen levels and algal turbidity. Thus, both USEPA and FDEP have adopted the position that development of numeric nutrient criteria (NNC) is needed for both parameters in fresh and estuarine/coastal waters.

Both FDEP and the USEPA are working to develop water quality standards to prevent nutrient pollution in Florida rivers, perennial streams, lakes, and estuaries from Tampa Bay to Biscayne Bay, including Charlotte Harbor. These NNC establish levels for nitrogen, phosphorus, and chlorophyll *a*. FDEP's standards also include biological conditions that must be met to protect healthy waterways.

The USEPA's criteria development follows its January 2009 Clean Water Act determination that NNCs are necessary in Florida – whether adopted by the state or USEPA. Following that determination, USEPA entered into a Consent Decree with Florida Wildlife Federation and several other groups in August 2009. Under the Consent Decree, USEPA committed to a schedule to propose and finalize nutrient pollution rules covering Florida's inland and coastal waters if the state did not act first. The Consent Decree has since been revised, and some deadlines have been extended.

Pursuant to the Consent Decree, USEPA finalized its Inland Rule in December 2010, promulgating NNC for lakes, springs and flowing waters in Florida. In February 2012, a federal district court upheld part of the Inland Rule against various challenges and sent part of the Rule back to USEPA for further clarification.

In June 2012, the state submitted its own rule to USEPA for review pursuant to section 303(c) of the CWA. The state rule covered many of the same waters addressed by USEPA's Inland Rule as well as some estuaries. USEPA approved Florida's rule on November 30, 2012, but that rule is not yet effective under state law. Under the Consent Decree, USEPA was still required to move forward with its federal rules for the waters not covered by the state's rule. On November 30, 2012, USEPA proposed NNC for Florida's estuaries and coastal waters and also proposed a new rule covering those parts of the Inland Rule that were remanded by the court. Pursuant to the Consent Decree, USEPA must finalize the new Inland Remand Rule and the Coastal Rule by August and September of 2013, respectively. However, the agency is prepared to not move forward with – or withdraw– its rules for any waters that become covered by state law that meets the requirements of the Clean Water Act.

The only NNC that have taken full effect are those portions of USEPA's Inland Rule applicable to lakes and springs and FDEP's estuary criteria, which cover some state estuaries. The estuary criteria are set out in Section 62-302.532, F.A.C. For flowing waters and the remainder of the state's marine waters, the applicable water quality standards remain the state narrative criteria set out in subsection 62-302.530(47), F.A.C., as well as any established restoration goals in the form of TMDLs.

Tables 16, 17, and 18 summarize the results of sampling for total phosphorus, total nitrogen, and chlorophyll *a* for several mine outfalls, plus upstream and downstream locations, from 2001 through 2011. It is important to note that these data are provided for informational purposes only. The sampling procedures used to produce this data, and the sampling procedures that may be required to determine NNC compliance, may differ. The NNC limits for total phosphorus and total nitrogen shown are taken from Section 62-302.532, F.A.C.; the standard described in that statute allows for no more than one exceedance in any three calendar year period. The chlorophyll *a* limit shown is not in the NNC rule; rather it is the value FDEP uses to assess impairment.

TABLE 16
Total Phosphorus Annual Geometric Mean Values (mg/L) for Mine Outfall, Upstream and Downstream Stations

	Year										
Mine/Station	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
South Pasture											
Outfall 4	0.52	0.79	0.93	1.02	0.98	1.22	1.95	—	—	—	—
Outfall 5	—	0.62	0.77	1.01	0.88	—	—	—	—	—	—
Kingsford (inactive)											
Upstream	—	—	—	—	—	—	—	0.23	0.30	0.37	0.35
Outfall	—	—	—	—	—	—	—	0.69	0.77	0.40	0.62
Downstream	—	—	—	—	—	—	—	0.52	0.52	0.46	0.59
Fort Green (inactive)											
Upstream	—	—	—	—	—	1.12	1.17	1.25	0.78	0.71	0.69
Outfall	—	—	—	—	—	1.18	1.24	1.27	0.89	0.77	0.82
Downstream	—	—	—	—	—	0.91	1.04	0.94	0.66	0.69	0.62
Four Corners 1											
Upstream	—	—	—	—	0.85	0.94	0.94	0.75	0.94	0.78	—
Outfall	0.77	0.74	0.86	1.43	1.11	0.57		0.95	1.38	—	—
Downstream	—	—	—	—	0.56	0.55	0.65	0.65	0.71	0.47	—
Four Corners 2											
Upstream	—	—	0.36	0.54	0.47	0.54	0.76	0.62	0.41	0.13	—
Outfall	—	—	1.20	1.92	1.31	1.10	1.56	0.74	0.89	1.05	—
Downstream	—	—	0.67	1.26	0.98	1.03	1.19	0.57	0.90	0.80	—
Wingate 1											
Upstream	—	—	—	—	0.24	0.43	0.70	0.64	0.59	—	—
Outfall	—	—	—	—	0.50	—	1.25	—	—	—	—
Downstream	—	—	—	—	—	—	0.34	—	—	—	—
Wingate 2											
Upstream	—	—	—	—	—	—	—	0.19	0.39	—	—
Outfall	—	—	—	0.13	1.30	0.62	1.69	1.17	0.90	—	—
Downstream	—	—	—	—	—	—	—	0.91	0.58	—	—

Note: — indicates less than four data points for that year.
NNC limit for TP = 0.49 mg/L

TABLE 17
Total Nitrogen Annual Geometric Mean Values (mg/L) for Mine Outfall, Upstream and Downstream Stations

Mine/Station	Year										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
South Pasture											
Outfall 4	0.74	0.61	0.93	0.85	0.99	—	—	—	—	—	—
Outfall 5		0.64	0.47	0.85	1.08	—	—	—	—	—	—
Kingsford											
Upstream	—	—	—	—	—	—	—	1.53	1.75	2.16	2.45
Outfall	—	—	—	—	—	—	—	1.40	1.36	1.25	1.56
Downstream	—	—	—	—	—	—	—	2.76	1.41	1.63	1.90
Fort Green											
Upstream	—	—	—	—	—	—	—	—	—	1.31	—
Outfall	—	—	—	—	—	—	—	1.58	1.40	—	—
Downstream	—	—	—	—	—	—	—	—	—	1.48	1.26
Four Corners 1											
Upstream	—	—	—	—	1.24	1.32	1.33	1.41	1.34	1.13	—
Outfall	0.95	0.96	0.94	1.32	0.82	0.80	—	—	—	—	—
Downstream	—	—	—	—	1.24	1.83	2.33	1.93	1.65	2.76	—
Four Corners 2											
Upstream	—	—	1.36	1.68	1.46	1.69	1.91	—	1.11	0.52	—
Outfall	—	—	0.91	1.13	0.76	—	—	1.40	1.00	0.59	—
Downstream	—	—	1.20	1.43	0.97	1.06	1.01	—	1.21	0.72	—
Wingate 1											
Upstream	—	—	—	—	—	—	1.15	1.11	1.54	—	—
Outfall	—	—	—	—	—	—	—	—	—	—	—
Downstream	—	—	—	—	—	—	—	—	—	—	—
Wingate 2											
Upstream	—	—	—	—	—	—	—	0.85	1.24	—	—
Outfall	—	—	—	1.56	0.89	0.99	—	1.07	1.10	—	—
Downstream	—	—	—	—	—	—	—	1.04	1.39	—	—

Note: — indicates less than four data points for that year.
NNC limit for TN = 1.65 mg/L

TABLE 18
Chlorophyll *a* Annual Geometric Mean Values (µg/L) for Mine Outfall, Upstream and Downstream Stations

Mine/Station	Year										
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
South Pasture											
Outfall 4	8.1	4.2	2.2	8.4	4.9	—	—	—	—	—	—
Outfall 5	—	—	1.9	14.7	—	—	—	—	—	—	—
Kingsford											
Upstream	—	—	—	—	—	—	—	—	—	—	—
Outfall	—	—	—	—	—	—	—	—	28.6	34.4	47.8
Downstream	—	—	—	—	—	—	—	—	—	—	—
Fort Green											
Upstream	—	—	—	—	—	—	—	—	—	—	—
Outfall	—	—	—	—	—	—	5.0	—	15.7	14.0	9.9
Downstream	—	—	—	—	—	—	—	—	—	—	—
Four Corners 1											
Upstream	—	—	—	—	1.1	1.9	3.4	1.4	1.6	—	—
Outfall	—	8.2	3.8	5.6	0.9	—	—	—	—	—	—
Downstream	—	—	—	—	0.9	2.0	1.8	1.6	1.7	—	—
Four Corners 2											
Upstream	—	—	3.2	9.4	2.0	1.3	3.9	14.6	5.7	1.5	—
Outfall	—	—	9.8	18.4	3.4	—	—	—	—	—	—
Downstream	—	—	7.5	16.2	4.3	3.9	4.4	2.2	14.5	5.7	—
Wingate 1											
Upstream	—	—	—	—	1.5	4.2	5.1	2.0	9.0	3.2	—
Outfall	—	—	—	—	—	—	4.5	—	—	—	—
Downstream	—	—	—	—	—	—	—	—	—	—	—
Wingate 2											
Upstream	—	—	—	—	—	—	—	1.2	2.8	—	—
Outfall	—	—	—	—	7.2	7.7	—	5.5	18.2	—	—
Downstream	—	—	—	—	—	—	—	3.2	10.6	—	—

Note: — indicates less than four data points for that year.
Impairment screening value for chlorophyll *a* = 20 µg/L

8.0 Conclusions

Agency reports and literature reviewed and summarized in this TM and Chapters 3 and 4 of the Final AEIS identified that the potential exists for phosphate mining to affect surface water quality as well as groundwater quality because of localized elevated concentrations of parameters influenced by the intensive interaction of water and soil media associated with mining and conveyance of matrix, sand tailings, and clay in mine site pipelines and other elements of the recirculation system. Most of the studies on groundwater quality indicate no substantive effects of mining operations on water quality in the surficial aquifer with the exception of potential localized effects near CSAs as suggested by some monitoring records. Periodic screenings for beneficiation-related chemicals have indicated compliance with primary and secondary drinking water standards. Annual screenings of water used to transport sand tailings for mining-related parameters also show levels that comply with applicable criteria. FDEP continues to monitor such records to ensure that the mining operations are not causing contaminant entry at levels exceeding the applicable standards or reference values.

More rigorous monitoring of mining effects on surface waters is conducted through FDEP's inclusion of NPDES discharge monitoring conditions in the state-issued mine operating permits. The monitoring records reviewed included recent discharge monitoring records for multiple example mines, some of which are active and some of which are primarily only engaged in reclamation. Post-reclamation water quality records viewed as of particular relevance were embodied in USGS's 2-year study of unmined and mined/reclaimed basins in the general vicinity of the Four Corners area in the CFPD. In the aggregate, these monitoring records confirmed that offsite discharges from phosphate mines occurred primarily when wet season accumulations, large tropical storm events, or similar large rainfall events contribute to recirculation system storage to such an extent that water must be released to protect the physical integrity of the associated infrastructure. Discharges were not continuous or year-round because mines are operated to maximize reuse and conservation of water. Monitoring records identified several parameters typically present at elevated concentrations compared to ambient background levels, and these are detailed in this TM. Instream monitoring upstream and downstream of NPDES discharge locations, where practicable, has suggested some increase in downstream concentrations within approximately 100 meters of the discharge location. Aquatic biological community monitoring results at these upstream and downstream locations have not been conclusive in defining the nature of the biological response to the NPDES-permitted discharges, and long-term monitoring of stream reaches in Horse Creek downstream of the Fort Green Mine's NPDES outfalls has not identified indirect effects of mine-related discharges.

Geographically, the following is a list of the watersheds and subwatersheds that would be primarily impacted by the Action Alternatives:

- Desoto: Peace River – Horse Creek and Peace River at Arcadia
- Ona: Peace River – Horse Creek and Peace River at Arcadia
- Wingate East: Myakka River – Upper Myakka River
- South Pasture Extension: Peace River – Horse Creek and Peace River at Arcadia
- Pine Level/Keys Tract: Myakka River – Big Slough; Peace River – Horse Creek
- Pioneer Tract: Peace River – Horse Creek and Peace River at Arcadia
- Site A-2: Peace River – Peace River at Zolfo Springs
- Site W-2: Myakka River – Upper Myakka River

The No Action Alternative - Upland Only scenario includes future mining in upland areas of the Applicants' Preferred Alternatives (Desoto, Ona, Wingate East, and South Pasture Extension), plus Pine Level/Keys Tract and Pioneer Tract. Mining under the Upland Only scenario would primarily affect the same watersheds and subwatersheds as those alternatives.

On the basis of the information reviewed for the AEIS, it appears that phosphate mining does have some impacts on receiving waters in the form of elevated concentrations of selected constituents, but that the impacts are localized and relatively short-term in duration, with the potential exception of nutrients. Discharge volumes are relatively small in scale compared to the flows of overall subwatersheds that may be influenced by mine discharges. The measurable effects on water quality in receiving waters are difficult to quantify because of the complex relationships between rainfall seasonality, mine water supply strategies focused on storage rather than drainage, and the capture area temporal relationships over the course of a given mine's life cycle. These observations suggest that with proper attention to stormwater quality-based BMPs, mining operations can minimize their water quality impacts on areas beyond their mine recirculation system boundaries (inside the limits of the ditch and berm system). As described in detail in Chapter 4, the Applicants' Preferred Alternatives or any of the offsite alternatives are expected to have only minor to moderate impacts on downstream water quality based on a review of recent reference mine data.

Changes in the applicable surface water quality standards are imminent. Most notable are the NNC, which will be applicable within the reasonably foreseeable future after USEPA completes rulemaking to repeal the federal NNC for Florida and determine whether Florida's rule addresses the January 2009 determination that NNC are needed in Florida. Evaluation of compliance with NNC for specific streams will require performing biological assessments in addition to obtaining total nitrogen and total phosphorus data. Stream segments in the AEIS study area that are determined to be noncompliant with the NNC will require developing and implementing basin management regulatory strategies, which will likely include state-of-the-art nutrient removal technologies designed to contribute to nutrient load reductions. These nutrient load reductions could be translated to reductions in long-term average total nitrogen and total phosphorus concentrations in waters delivered to downstream water bodies like the Charlotte Harbor estuary.

9.0 References

Alvarez, Calvin/Chief, Bureau of Mining and Minerals Regulation, Florida Department of Environmental Protection, 2011, Personal Communication with Steve Gong/CH2M HILL, May 26.

Biological Research Associates (BRA), 2006a, *Horse Creek Stewardship Program Summary of Historical Information On Water Quantity, Quality and Aquatic Biology*, April.

Biological Research Associates (BRA), 2008, Mosaic Wingate Facility Bioassessment Report Wet Season 2008, September.

Cardno Entrix, 2011b, *Mosaic Wingate Facility Bioassessment Report Wet Season 2010*.

Entrix, 2010a, Horse Creek Stewardship Program 2008 Annual Report, September.

Entrix, 2010e, *Mosaic Wingate Facility Bioassessment Report Wet Season 2009*, January.

Florida Department of Environmental Protection (FDEP), 2004, TMDL Report, Nutrient and Dissolved Oxygen TMDL for Thirty Mile Creek, Polk County, Florida, WBID 1639.

Florida Department of Environmental Protection (FDEP), 2005, Water Quality Assessment Report - Tampa Bay Tributaries.

Florida Department of Environmental Protection (FDEP), 2006a, Water Quality Assessment Report - Sarasota Bay and Peace and Myakka Rivers.

Florida Department of Environmental Protection (FDEP). 2013d. "Total Maximum Daily Loads Program." http://www.dep.state.fl.us/water/tmdl/index.htm. Accessed on March 13, 2013.

Lewelling, B. R. and R.W. Wylie, 1993, *Hydrology and Water Quality of Unmined and Reclaimed Basins in Phosphate-Mining Areas, West Central Florida*, U.S. Geological Survey, Water-Resources Investigations Report 93-4002.

ManaSota-88, 2008, "Clay Settling Areas." Accesed online at: . Copyright 2008.

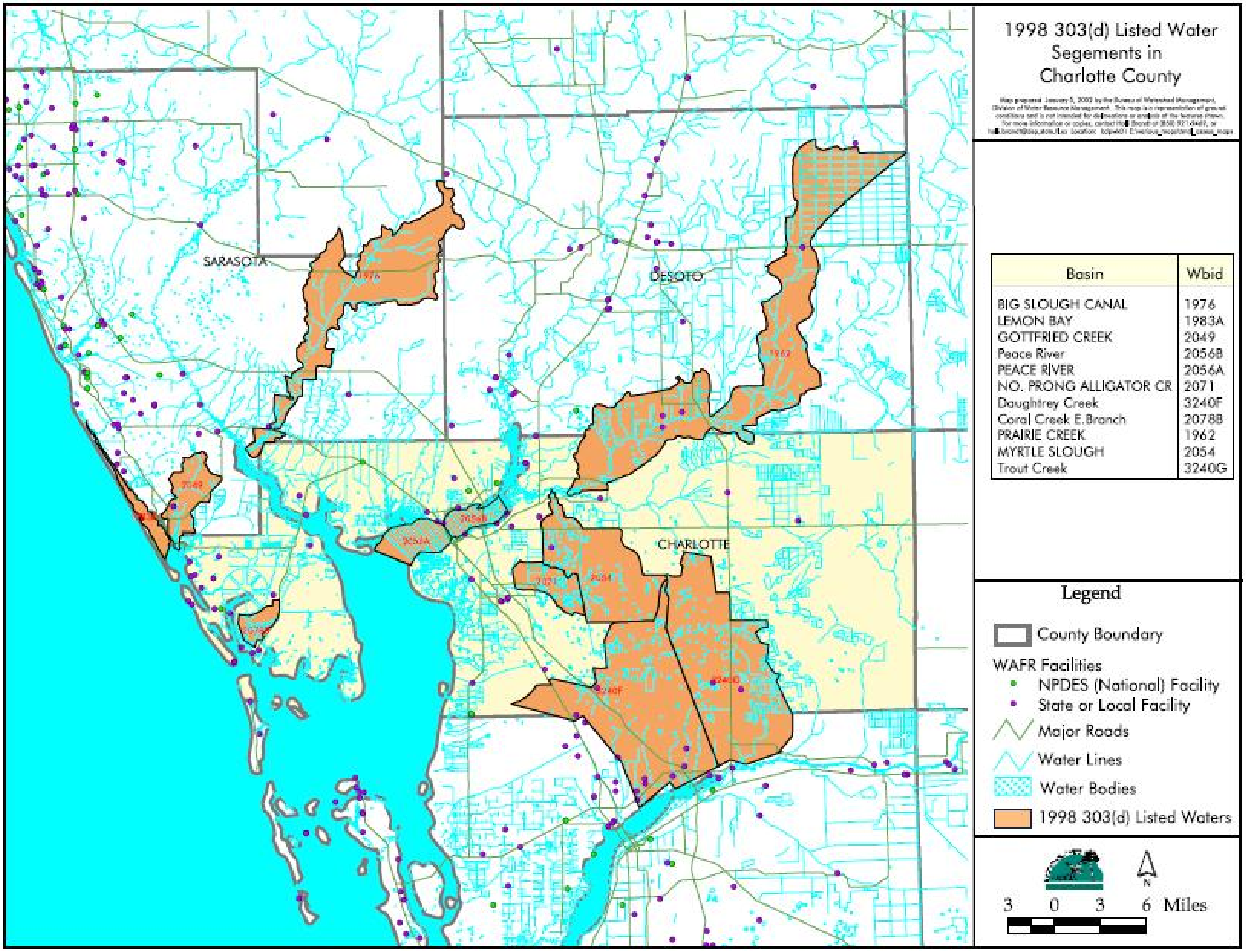
U.S. Environmental Protection Agency (USEPA), 1974, Report to Congress, Disposal of Hazardous Waste. Prepared by the Office of Solid Waste Management Programs. Publication SW-115. Washington, D.C. p. 43. Available at:

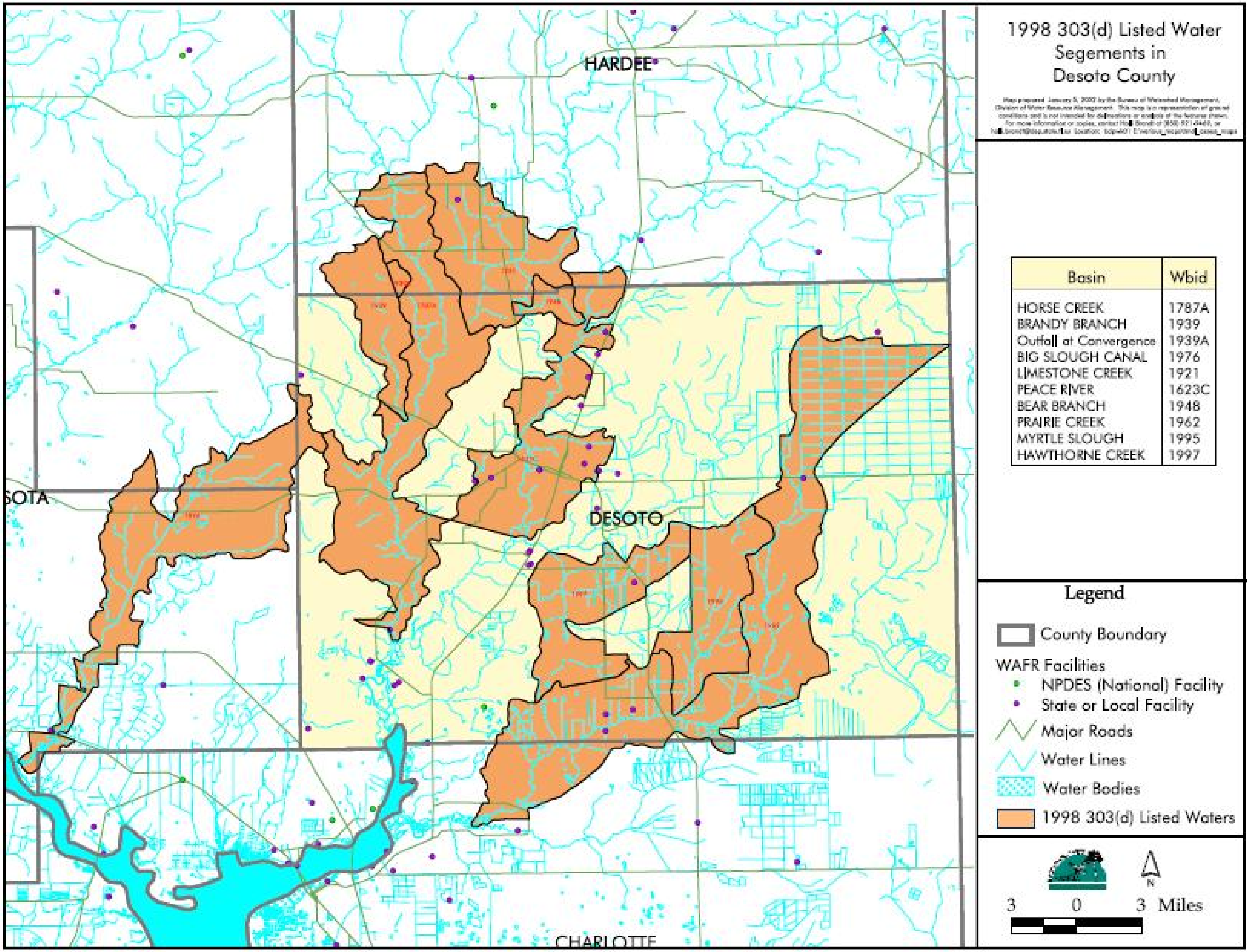
U.S. Environmental Protection Agency (USEPA), 2012c, "About Phosphogypsum, Stacks," Last update on July 31, 2012.

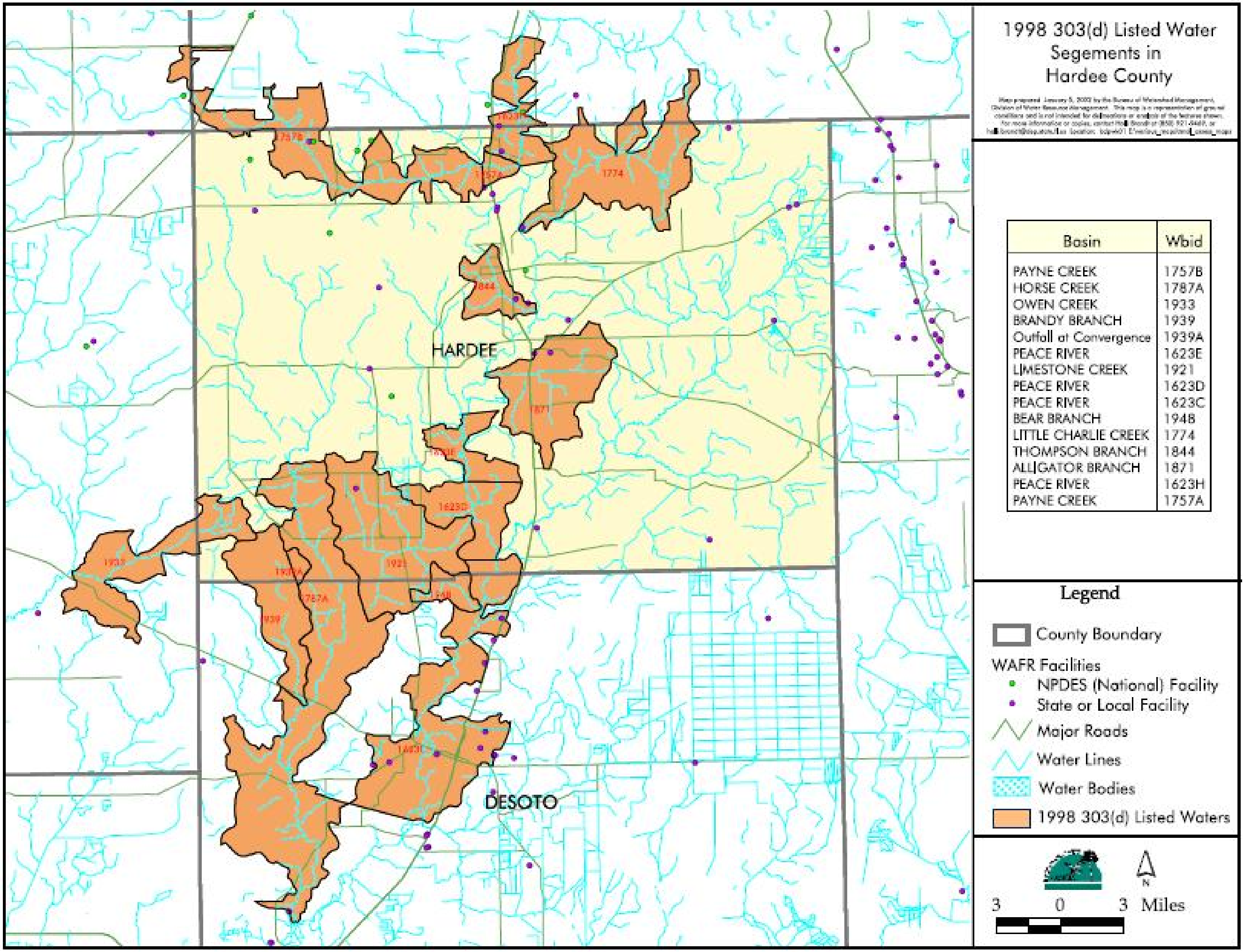
Attachment A
1998 303(d) Listed Water Bodies in AEIS Study Area Counties

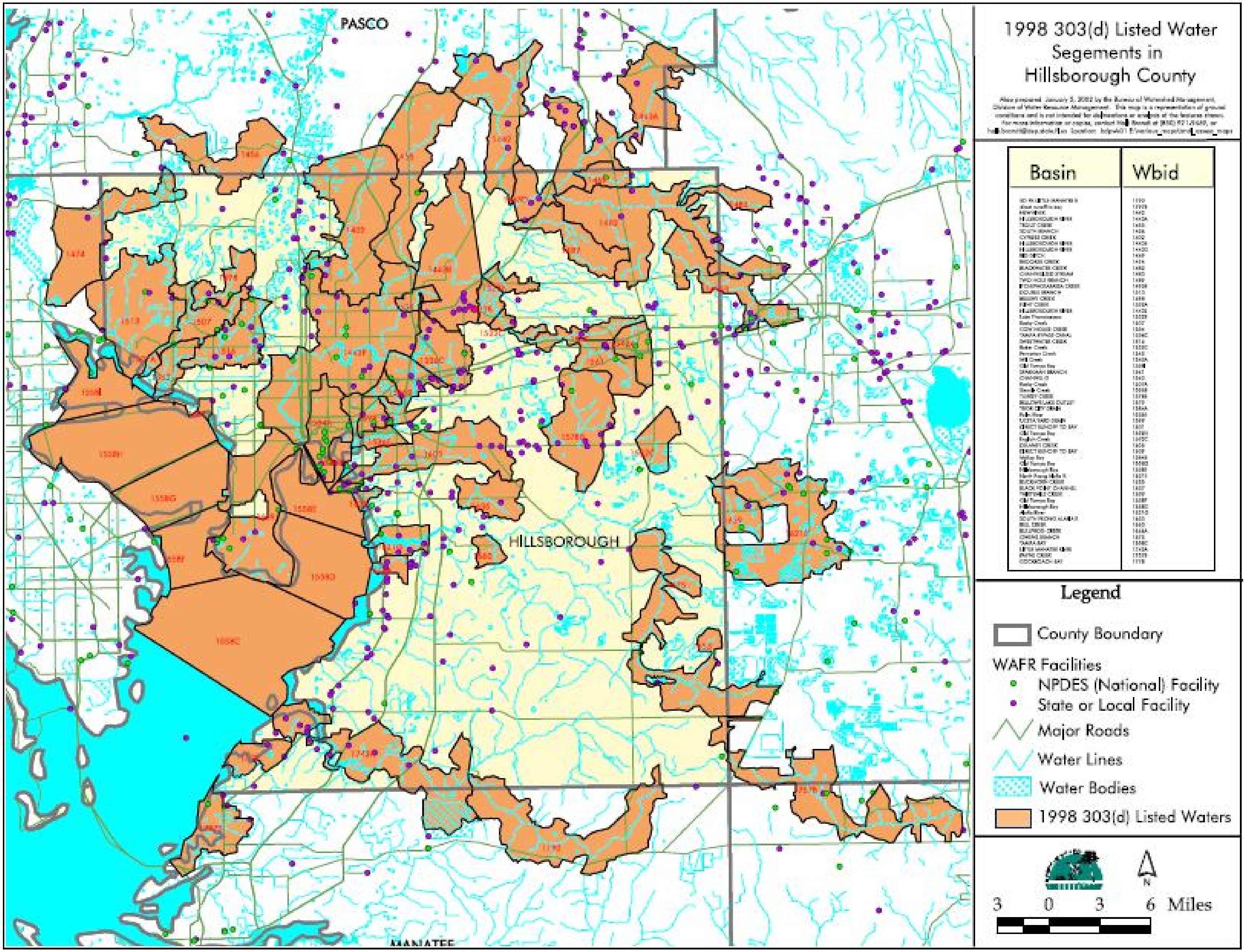
- Charlotte
- DeSoto
- Hardee
- Hillsborough
- Lee
- Manatee
- Polk
- Sarasota

This page intentionally left blank.

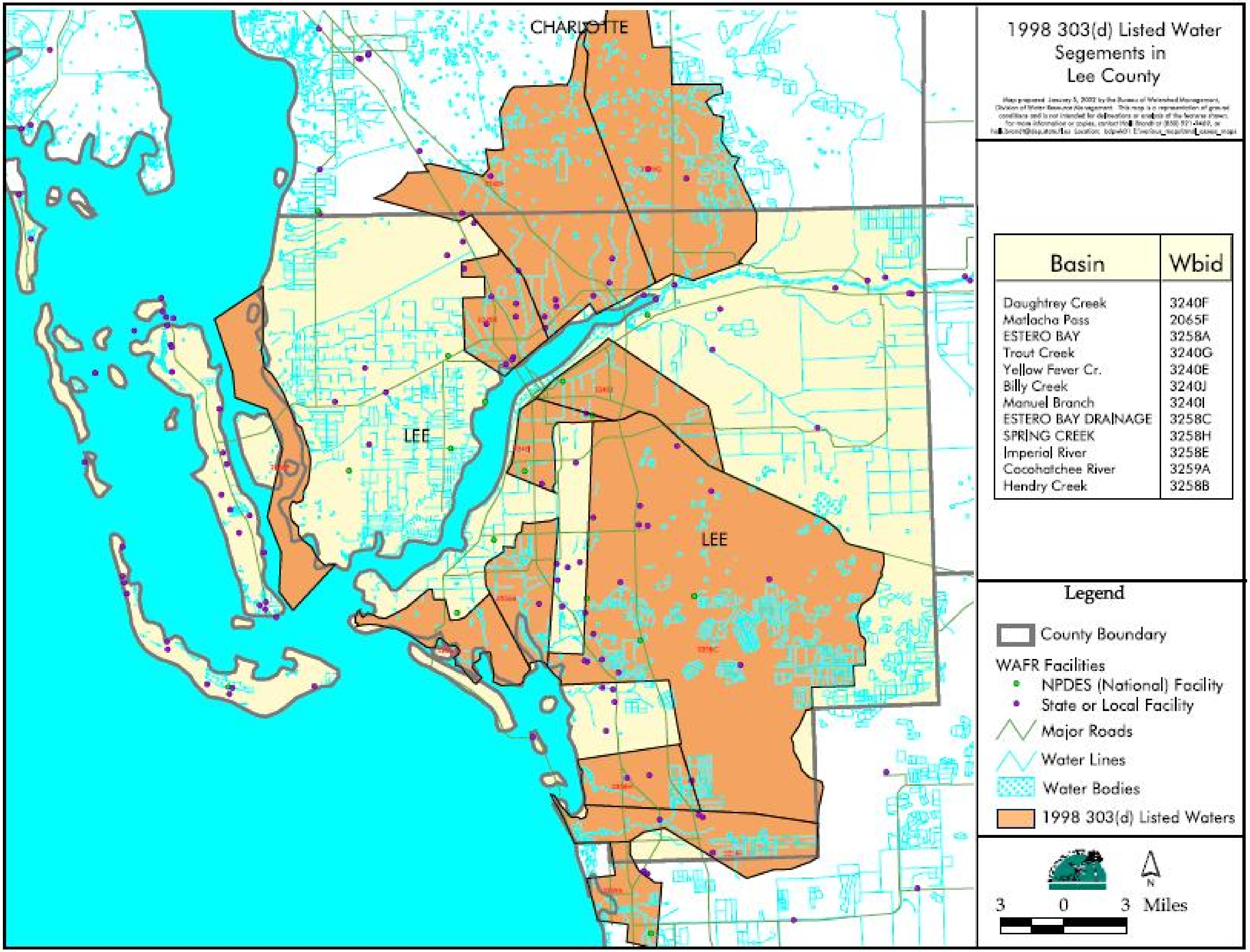

1998 303(d) Listed Water Segements in Charlotte County
SARASOTA
DESOTO
CHARLOTTE
Basin | Wbid
BIG SLOUGH CANAL | 1976
LEMON BAY | 1983A
GOTTFRIED CREEK | 2049
Peace River | 2056B
PEACE RIVER | 2056A
NO. PRONG ALLIGATOR CR | 2071
Daughtrey Creek | 3240F
Coral Creek E.Branch | 2078B
PRAIRIE CREEK | 1962
MYRTLE SLOUGH | 2054
Trout Creek | 3240G
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
N
3 0 3 6 Miles


1998 303(d) Listed Water Segements in Desoto County
HARDEE
SOTA
DESOTO
CHARLOTTE
Basin
Wbid
HORSE CREEK 1787A
BRANDY BRANCH 1939
Outfall at Convergence 1939A
BIG SLOUGH CANAL 1976
LIMESTONE CREEK 1921
PEACE RIVER 1623C
BEAR BRANCH 1948
PRAIRIE CREEK 1962
MYRTLE SLOUGH 1995
HAWTHORNE CREEK 1997
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
N
3 0 3 Miles

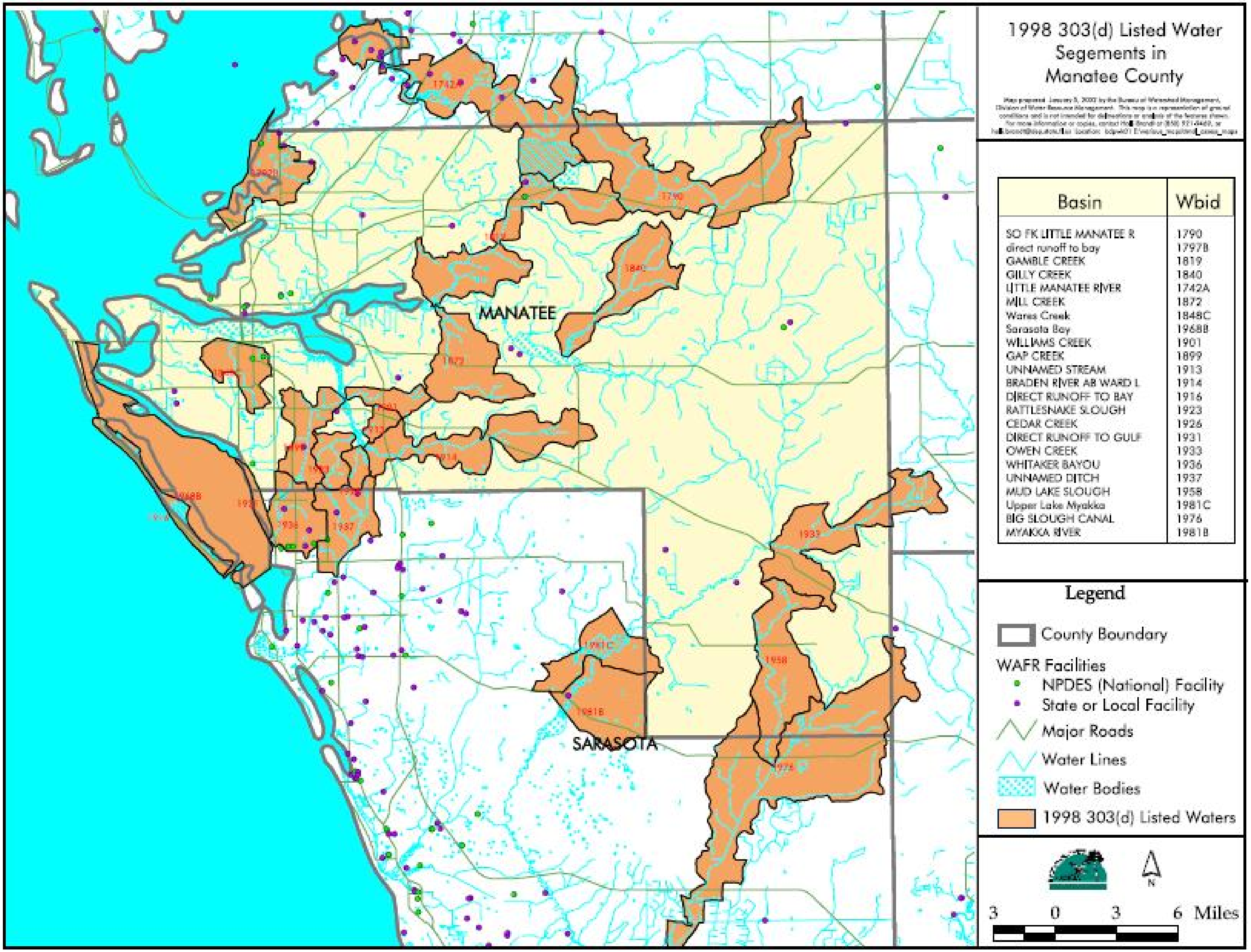

1998 303(d) Listed Water Segements in Hardee County
HARDEE
DESOTO
Basin | Wbid
PAYNE CREEK 1757B
HORSE CREEK 1787A
OWEN CREEK 1933
BRANDY BRANCH 1939
Outfall at Convergence 1939A
PEACE RIVER 1623E
LIMESTONE CREEK 1921
PEACE RIVER 1623D
PEACE RIVER 1623C
BEAR BRANCH 1948
LITTLE CHARLIE CREEK 1774
THOMPSON BRANCH 1844
ALLIGATOR BRANCH 1871
PEACE RIVER 1623H
PAYNE CREEK 1757A
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
3 0 3 Miles

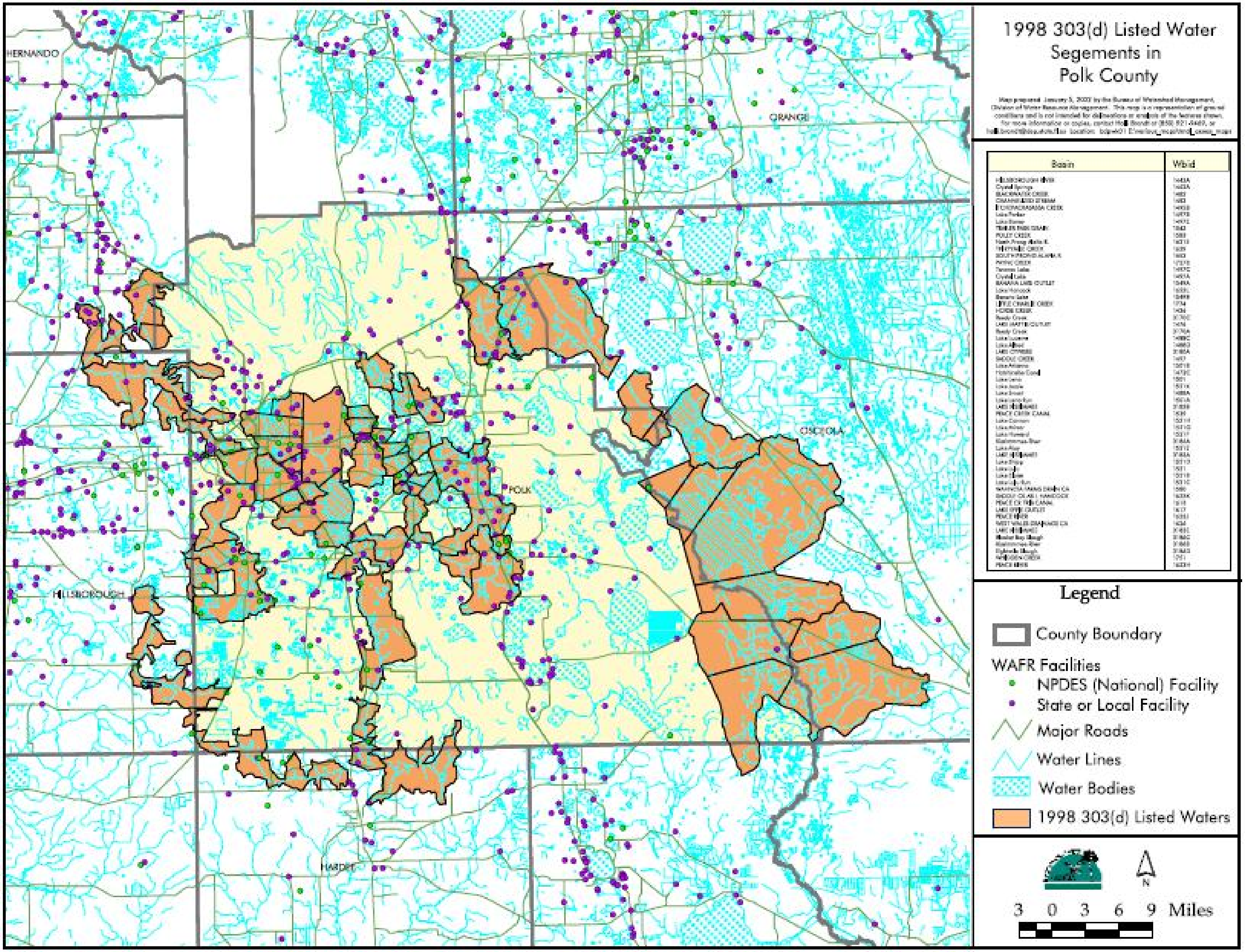


1998 303(d) Listed Water Segements in Hillsborough County
Basin
Wbid
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
PASCO
HILLSBOROUGH
MANATEE
N
3 0 3 6 Miles



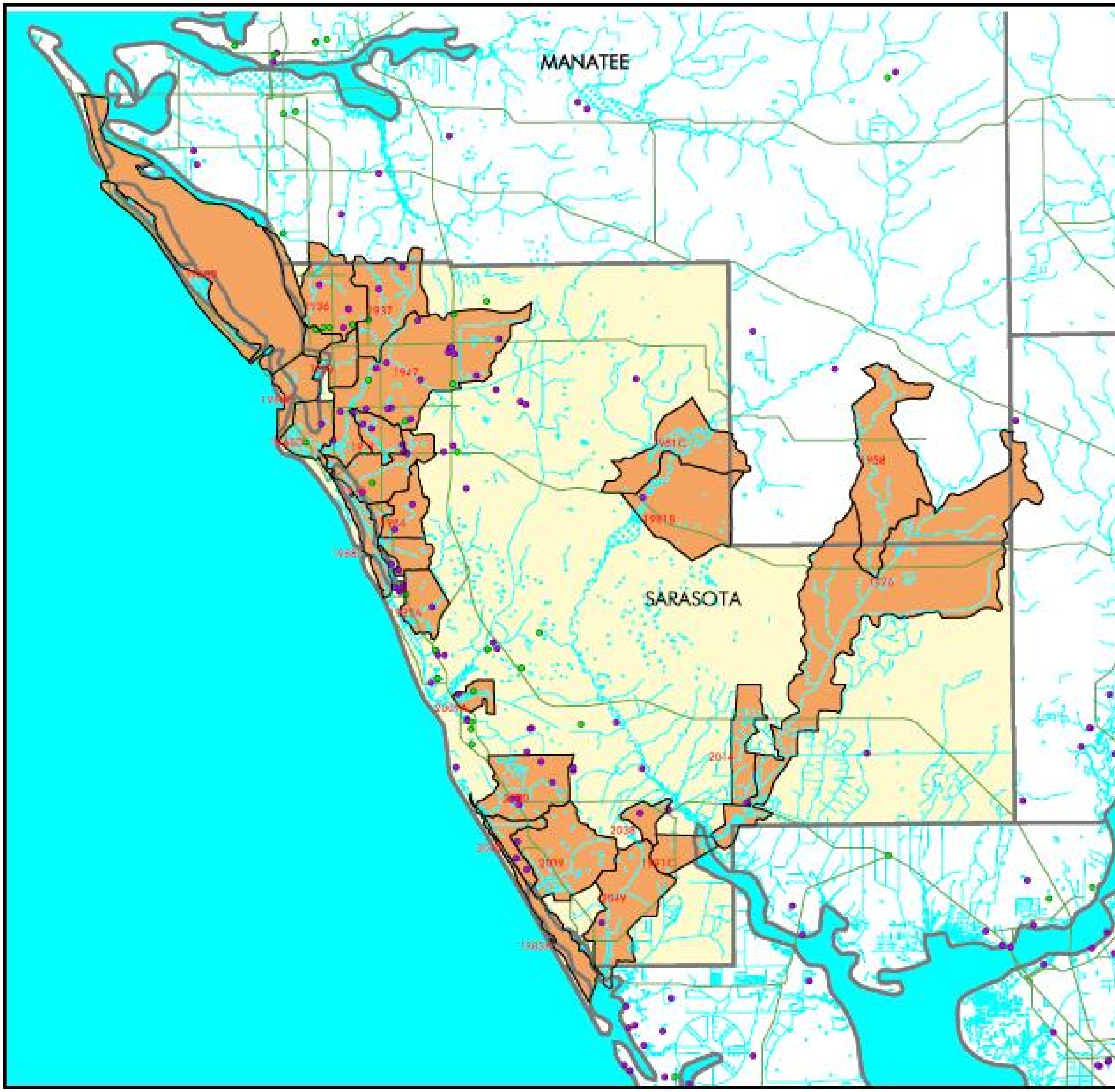
CHARLOTTE
LEE
LEE
1998 303(d) Listed Water
Segements in
Lee County
Basin
Wbid
Daughtrey Creek 3240F
Matlacha Pass 2065F
ESTERO BAY 3258A
Trout Creek 3240G
Yellow Fever Cr. 3240E
Billy Creek 3240J
Manuel Branch 3240I
ESTERO BAY DRAINAGE 3258C
SPRING CREEK 3258H
Imperial River 3258E
Cocohatchee River 3259A
Hendry Creek 3258B
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
3 0 3 Miles


1998 303(d) Listed Water Segements in Manatee County
Basin | Wbid
SO FK LITTLE MANATEE R 1790
direct runoff to bay 1797B
GAMBLE CREEK 1819
GILLY CREEK 1840
LITTLE MANATEE RIVER 1742A
MILL CREEK 1872
Wares Creek 1848C
Sarasota Bay 1968B
WILLIAMS CREEK 1901
GAP CREEK 1899
UNNAMED STREAM 1913
BRADEN RIVER AB WARD L 1914
DIRECT RUNOFF TO BAY 1916
RATTLESNAKE SLOUGH 1923
CEDAR CREEK 1926
DIRECT RUNOFF TO GULF 1931
OWEN CREEK 1933
WHITAKER BAYOU 1936
UNNAMED DITCH 1937
MUD LAKE SLOUGH 1958
Upper Lake Myakka 1981C
BIG SLOUGH CANAL 1976
MYAKKA RIVER 1981B
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
MANATEE
SARASOTA
N
3 0 3 6 Miles



1998 303(d) Listed Water Segements in Polk County
Basin
Wbid
Legend
County Boundary
WAFR Facilities
NPDES (National) Facility
State or Local Facility
Major Roads
Water Lines
Water Bodies
1998 303(d) Listed Waters
N
3 0 3 6 9 Miles
HERNANDO
ORANGE
OSCEOLA
POLK
HILLSBOROUGH
HARDEE

1998 303(d) Listed Water Segements in Sarasota County



Basin	Wbid
Sarasota Bay	1968B
DIRECT RUNOFF TO BAY	1916
DIRECT RUNOFF TO GULF	1931
WHITAKER BAYOU	1936
UNNAMED DITCH	1937
PHILIPPE CREEK	1947
DIRECT RUNOFF TO BAY	1951
HUDSON BAYOU	1953
Sarasota Bay	1968C
MUD LAKE SLOUGH	1958
Upper Lake Myakka	1981C
ROBERTS BAY	1968D
UNNAMED DITCH	1971
Elligraw Bayou	1975
BIG SLOUGH CANAL	1976
MYAKKA RIVER	1981B
CATFISH CREEK	1984
Little Sarasota Bay	1968E
Clowers Creek	1975A
North Creek	1984A
SOUTH CREEK	1982A
CURRY CREEK	2009A
UNNAMED DITCH SYSTEM	2014
ALLIGATOR CREEK	2030
LEMON BAY	1983A
UNNAMED CREEK	2038
FORKED CREEK	2039
DIRECT RUNOFF TO BAY	2042
MYAKKA RIVER	1991C
GOTTFRIED CREEK	2049

Legend

County Boundary

WAFR Facilities

- NPDES (National) Facility
- State or Local Facility

Major Roads

Water Lines

Water Bodies

1998 303(d) Listed Waters

N

3 0 3 6 Miles