Proposed Mosaic DeSoto County Mine and Potential Impacts on Surface Waters Flowing to the City of North Port

City of North Port Literature and Data Review

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Executive Summary

The purpose of this document is to summarize the potential water quantity and water quality risks for the City of North Port's drinking water supply and/or potential environmental impact as a result of the proposed Mosaic 'DeSoto Mine' phosphate mine, which include both the DeSoto East Mine (Peace River watershed) and the DeSoto West Mine (Big Slough watershed). The DeSoto East Mine, located outside but adjacent to the Big Slough watershed, is in the permit application process, with only the U.S. Army Corps of Engineers Section 404 permit left to obtain. The DeSoto West Mine is in the planning process as an extension of the DeSoto East Mine phase (See **Figure ES-1**).

Impacts to water quantity are expected to result in a possible reduction in surficial flows to Big Slough associated with the DeSoto West Mine - or possibly a change in the timing of flows during active mining operations. Following reclamation of the land during and post mining operations, studies suggest that contribution of surficial flows to receiving waterbodies decreases compared to pre-mining flows (Ardaman and Associates (2002) and AEIS, (2012)).

With respect to water quality, impacts are expected to be minor, if any, during the mining phase from water leaving the active mining area, as a result of mining discharge treatment requirements and the characteristics of water, which consists of surficial aquifer water and groundwater for creating slurries, in active mining areas. Of greater concern at both DeSoto Mines would be process water associated with the beneficiation plant and clay settling areas, as most major water quality issues associated with phosphate mining have been a result of spills from clay settling areas and/or phosphogypsum stacks (stacks are associated with fertilizer processing facilities and are NOT proposed for either DeSoto Mine and no new stacks are currently planned anywhere in the Central Florida Phosphate District (CFPD, **Figure ES-2**)).

While the proposed beneficiation plant is to be located outside the Big Slough watershed, it is proposed approximately 100 ft or so from the watershed divide, which is is located in an area with just a one to three feet high barrier. The proposed clay settling areas associated with the DeSoto East Mine are also located outside but adjacent to the watershed divide (see **Figure ES-3**). In addition, it is expected that if the west mine site is developed, clay settling areas on the east side of the watershed divide will be used initially, but eventually they will reach capacity and clay settling areas will need to be developed in the Big Slough watershed.

Overall, the risk to the City of North Port's water supply is expected to be low; impacts to water quantity likely would result in a minor reduction in flows in Big Slough by 2050 (6% annual average and wet season, and 7% dry season, AEIS, 2012). Impacts to water quality reside in the potential for contamination of the water supply if spills from proposed clay settling areas were to occur.

The risk for spills is highly improbable for phosphogypsum stacks, as currently, none are known to be planned for the DeSoto Mine site. While numerous spills associated with phosphogypsum stacks associated with fertilizer plants have been reported in recent years, there are no known spills from clay settling areas in the CFPD since 1994, and therefore the potential for spills from the proposed clay settling areas can be expected to be low as well; however, if a spill from the clay settling areas were to occur, the impact to the City's water supply could be catastrophic, and therefore the City should request additional assurances during the permitting process, including siting of clay settling areas as far as possible from Big Slough, and as further detailed in the Recommendations for Further Action section. The risk associated with clay settling areas cannot be reduced to zero and spill incidents are most likely to occur in association with extreme weather events, such as hurricanes. At least one study indicates that water may move from clay settling areas into adjacent surficial aquifer water and surface waters, but associated impacts on water quality from such migration have not been determined.

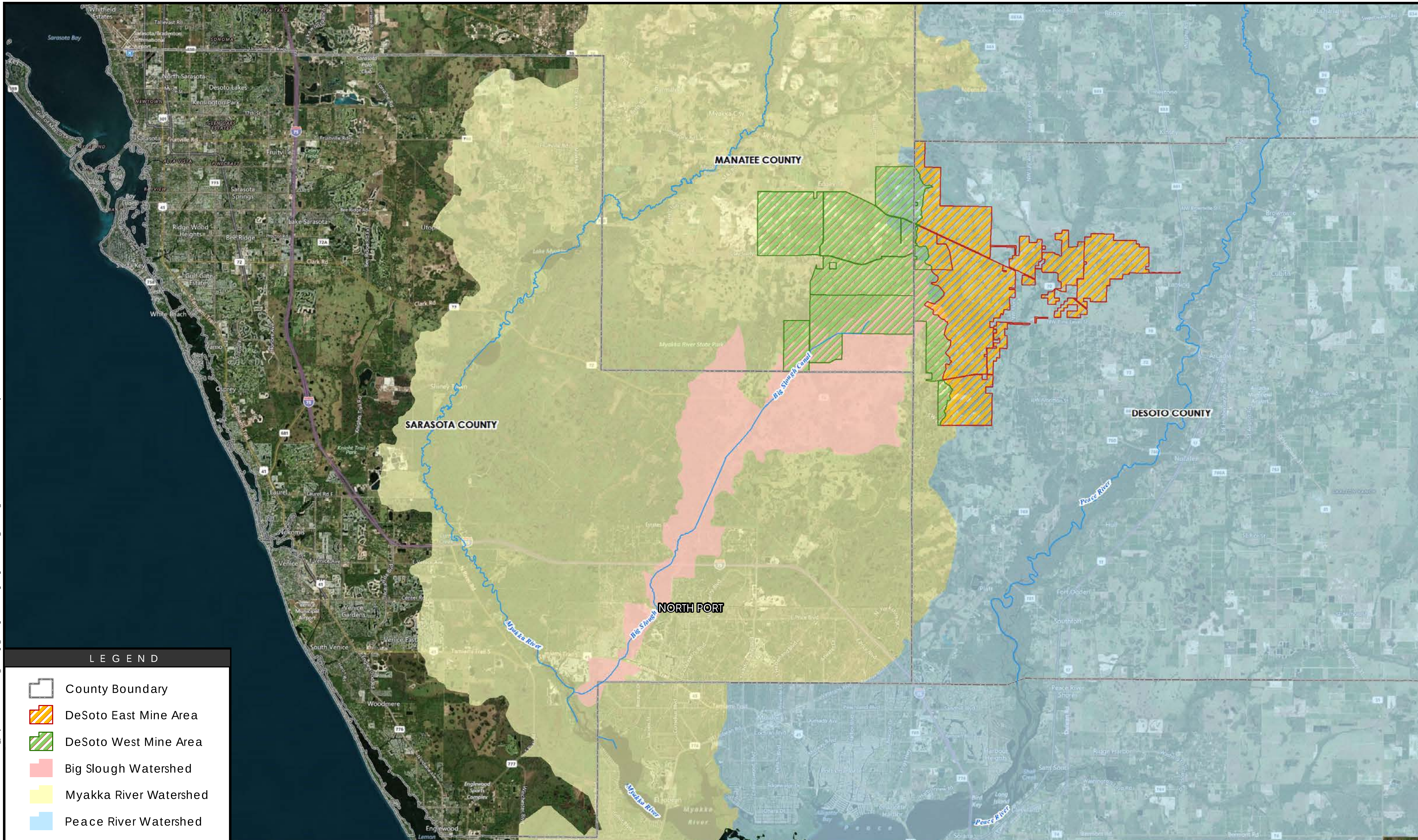

Figure ES-1: Big Slough Watershed **and DeSoto East and West Mine Boundaries**

DeSoto Mines Map

January 2018

Notes:
1. Coordinate System: NAD 1983 StatePlane Florida West FIPS 0902 Feet
2. Source data: SWFWMD
3. Imagery: BING MAPS HYBRID

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Figure ES-2: River basins and the Central Florida Phosphate District (CFPD) (Source: AEIS, 2012)

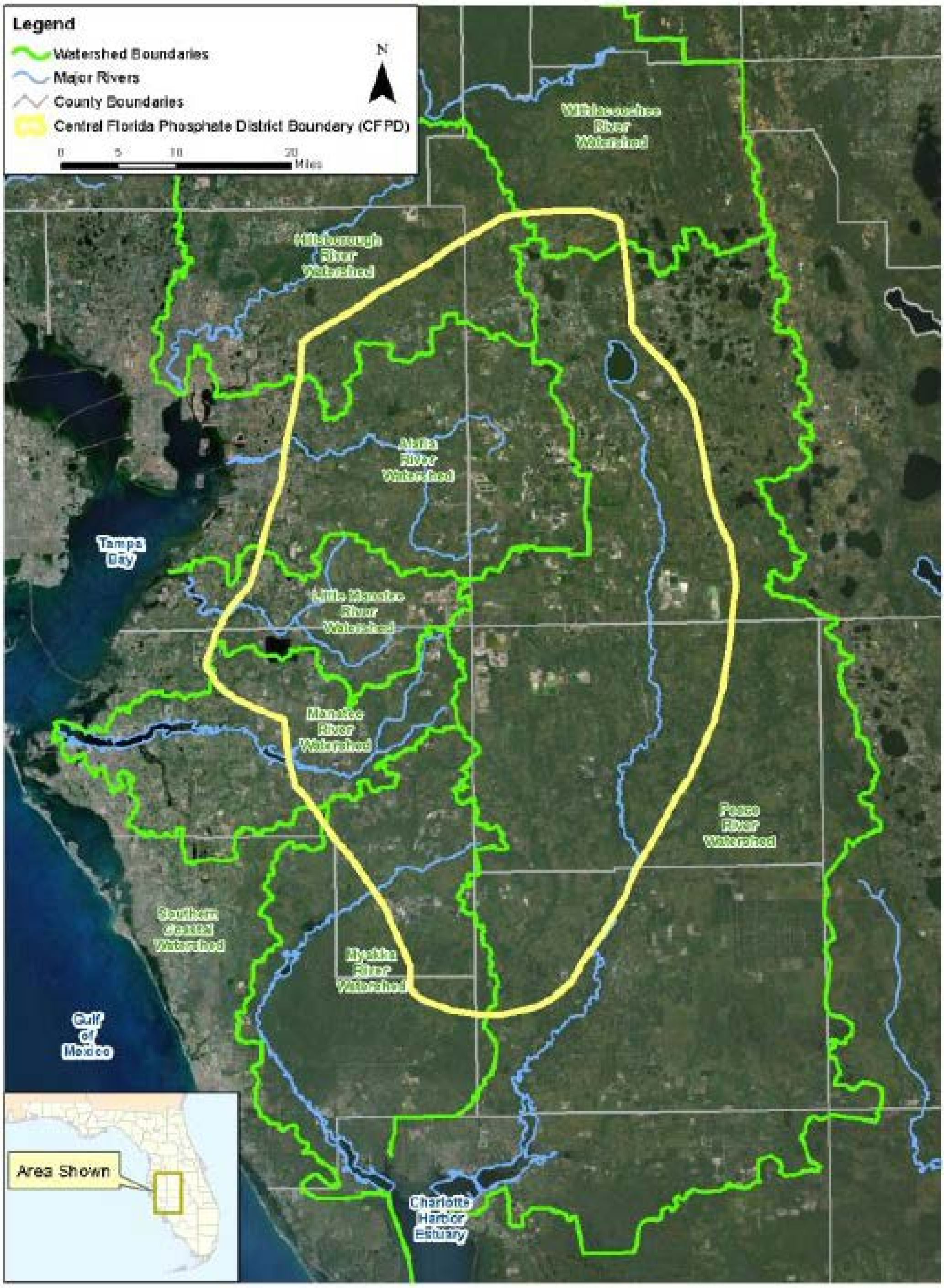
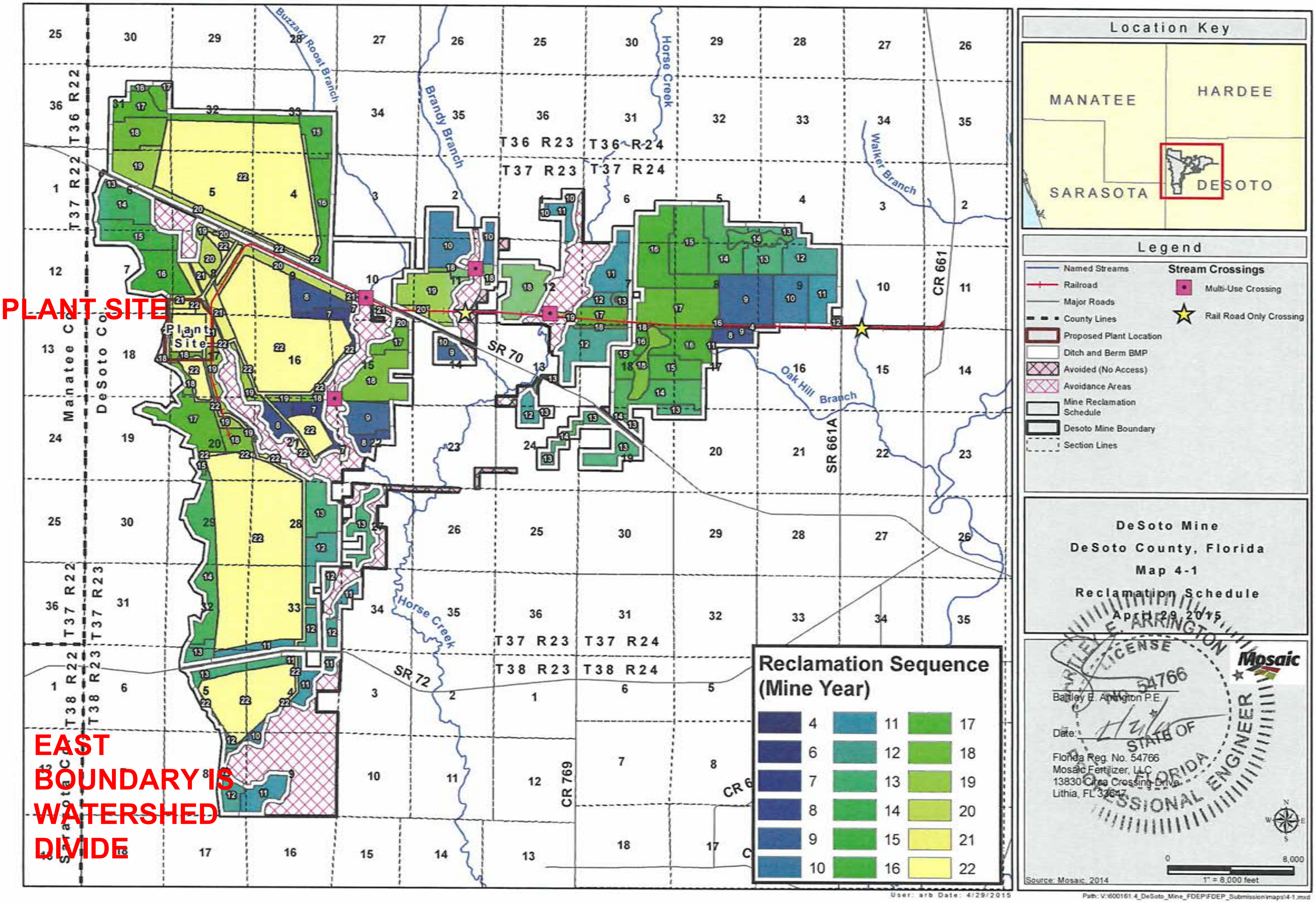


Figure ES-3: DeSoto East Mine Site Facilities (FDEP) (shaded areas). Note the beneficiation "Plant Site" shown in the west-central portion of the site.



File No. MMR_331292-001

Abbreviations

AEIS	Areawide Environmental Impact Statement
BLS	Below land surface
CFPD	Central Florida Phosphate District
cfs	cubic feet per second
CRP	Conceptual Reclamation Plan
CSA	Clay Settling Area
ERP	Environmental Resource Permit
ET	Evapotranspiration
FDEP	Florida Department of Environmental Protection
FIPR	Florida Industrial and Phosphate Research Institute or Florida Institute of Phosphate Research
HCSP	Horse Creek Stewardship Program
mgd	million gallons per day
SAS	Surficial Aquifer System
SWFWMD	Southwest Florida Water Management District
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WUP	Water Use Permit

1.0 INTRODUCTION

The purpose of this report is to summarize existing data and research to evaluate the risk of phosphate mining in the Big Slough watershed to the City of North Port's (City) potable water supply and surface water quality and quantity for storm drainage purposes. The proposed phosphate mining area within the Big Slough watershed is shown in **Figure ES-1*.** The proposed 'DeSoto Mine' is divided into eastern and western portions and only the western portion (a.k.a. the Pine Level/Keys Tract) is located in the Big Slough watershed. The location of proposed facilities for the east mine site are shown in **Figure ES-3.** The eastern portion is currently undergoing permitting and it is expected that the western portion will eventually be permitted as an extension to the eastern portion.

The following is a discussion of permits required, the mining process, a review of literature and data related to potential water quality and quantity impacts, and a summary of the potential risks to the City's drinking water supply and storm water management system.

***Note:** There is a difference of approximately 659 acres between the Southwest Florida Water Management District (SWFWMD) watershed boundary and the watershed boundary included in the mining permit applications. The mining permit application boundary should be considered the more accurate boundary as site specific data is collected for permit applications. Differences in watershed boundaries occur in regions where the topography is flat, and the microtopography of small areas may still result in water flow across the boundary. Differences in elevations in this area are only one to three feet.

2.0 PHOSPHATE MINING PROCESS

The phosphate mining process occurs in two distinct phases as further described below.

2.1 EXTRACTION

The first step in the phosphate mining process is removal of overburden material, including trees, vegetation, topsoil, etc., to access the underlying phosphate deposit (ore body) for extraction. This 'matrix' includes phosphate, rock, clay and sand, and is typically extracted using a dragline for excavation after the overburden is removed. Some extraction may occur through hydraulic dredging. Since the ore is typically found at depths of 30 feet below land surface (bls) or greater, dewatering of the excavation area is often required to lower the surficial aquifer system (SAS) water level to the mining depth, this dewatering water is usually pumped into recirculation trenches surrounding the pit (AEIS, 2012).

Water in the recirculation trenches flows downward, creating a hydraulic barrier that prevents the SAS outside of the mined area from being drawn down, protecting adjacent wetlands, surface waters, and shallow wells. It should be noted that these recirculation trenches must be inspected and maintained to remove fine particulates that may 'clog' the bottoms of the trenches, which prevents the downward filtration of water required to create the hydraulic barrier. Because the trench and berm system used in the mining of a given area is designed to capture storm and dewatering water, and only discharge water after significant or prolonged storm events, through National Pollutant Discharge Elimination System (NPDES) outfalls, the areas in active mining are effectively removed from the watershed that would otherwise drain to a surface water feature. These outfalls often have no discharge, changing the quantity and timing of water reaching adjacent streams and wetlands (AEIS, 2012).

Once excavated via dragline, the matrix material is transferred to a slurry pit, where the matrix is blasted with high pressure water sprays to create a slurry that is then piped back to a beneficiation plant for further processing, which may be up to ten miles away. Groundwater pumped from the Intermediate or Upper Floridan aquifer (as authorized by a water use permit issued by the Southwest Florida Water Management District (SWFWMD)), is used in this transport process. Approximately 10.7 million gallons per day (mgd) have been allocated by the SWFWMD Water Use Permit (WUP) No. 200114400.026 for use at the DeSoto Mine facility, issued in 2013. The groundwater is needed to maintain seals on booster pumps placed approximately every mile between the extraction site and the beneficiation plant. Surface water or other recycled mine water has too many impurities and solids to be used for this purpose (AEIS, 2012).

2.2 BENEFICIATION

2.2.1 Process

Once the slurry reaches the beneficiation plant, the material is processed to separate the phosphate from the other materials in the matrix. Typically, sheer forces in the transport pipeline will separate much of the clay from the phosphate and sand during the transport process, though further processing is still required (AEIS, 2012). In general, the following steps occur to remove the phosphate from the matrix (AEIS, 2012):

1. The material is washed through screens to separate phosphate rock from sand and clay.
2. Floatation methods are used to further separate sand-sized phosphate and silica.
3. Chemicals are used in the floatation process to separate phosphate from the sand.
4. The separated phosphate is removed from the site by train or truck to be further processed for sale as fertilizer.
5. Recycled water from the beneficiation process is used to pipe clay from the plant to clay settling areas, which are further discussed below.

2.2.2 Separated Sand

Sand separated from the matrix during the beneficiation process may be returned to a slurry state and piped to mining blocks scheduled for reclamation to use for filling the void created during the extraction process (AEIS, 2012).

2.2.3 Clay Settling Areas

Clays separated from the matrix during the beneficiation process is piped as a slurry to a CSA, where it may take 10-20 years for the slurry to become somewhat solid. In the meantime, the high-water content material has a pudding-like consistency, preventing the land from being utilized for many years, and use will typically be limited to agriculture that does not require heavy equipment or structures. These CSAs may comprise up to 40% of the land area of the mining operation and each CSA will typically cover 400-600 acres. The matrix in the more southern mine areas, such as the DeSoto Mine, has less clay content and therefore CSAs are expected to occupy a somewhat smaller percentage of the total reclaimed land area. Earthen levees are constructed around the CSAs to contain the material, which has different water quality and chemical composition than natural soils and surficial groundwater (AEIS, 2012).

2.3 PHOSPHATE PROCESSING

Once the extracted ore has been separated from sands and clays at the beneficiation plant, the remaining material needs to be processed further into a form that plants can easily use. This occurs at a fertilizer processing plant, which will not be located at the DeSoto Mine sites, the material will be trucked to existing plants located between Plant City and Bartow.

2.3.1 Phosphogypsum Stacks

Phosphogypsum is a weakly radioactive by-product of the production of fertilizer that occurs at a fertilizer production plant (not at the beneficiation plant). The radioactivity of the waste is high enough that the US Environmental Protection Agency (USEPA) prohibits its use for most applications, and therefore it is stored in large stacks near fertilizer processing plants. Phosphogypsum (gyp) stacks are not proposed for the DeSoto Mine site or any other new mining site in the CFPD at this time. Incidents relating to gyp stack spills are included below to distinguish gyp stack incidents from clay settling area (CSA) spill incidents, as many gyp stack spills have been in the news in recent years.

3.0 PERMITS REQUIRED AND PERMITTING STATUS

3.1 COUNTY PERMITS - DESOTO AND MANATEE COUNTY

DeSoto County's Future Land Use map includes a Phosphate Overlay (**Figure 3-1**) that covers the area proposed for the Desoto East Mine.

The DeSoto West Mine located in Manatee County is still zoned for agricultural use and has not been approved for mining. Mosaic will first need to rezone this area for excavation (EX) and the rezone application must be accompanied by a Master Mining Plan (MMP) application. After obtaining the rezone and MMP approval, Mosaic will still need to obtain an operating permit from Manatee County to begin operations. This process has not been started with Manatee County.

3.2 STATE PERMITS

3.2.1 FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP)

3.2.1.1 ENVIRONMENTAL RESOURCE PERMIT

Environmental Resource Permit No. MMR_331292-001 was issued for the DeSoto East Mine on April 7, 2017. The DeSoto East Mine will cover 18,287 acres, of which 2,881.8 acres are wetlands and other surface waters that will be impacted.

3.2.1.2 CONCEPTUAL RECLAMATION PLAN

The FDEP approved the Conceptual Reclamation plan for the DeSoto East Mine on April 7, 2017.

3.2.1.3 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT

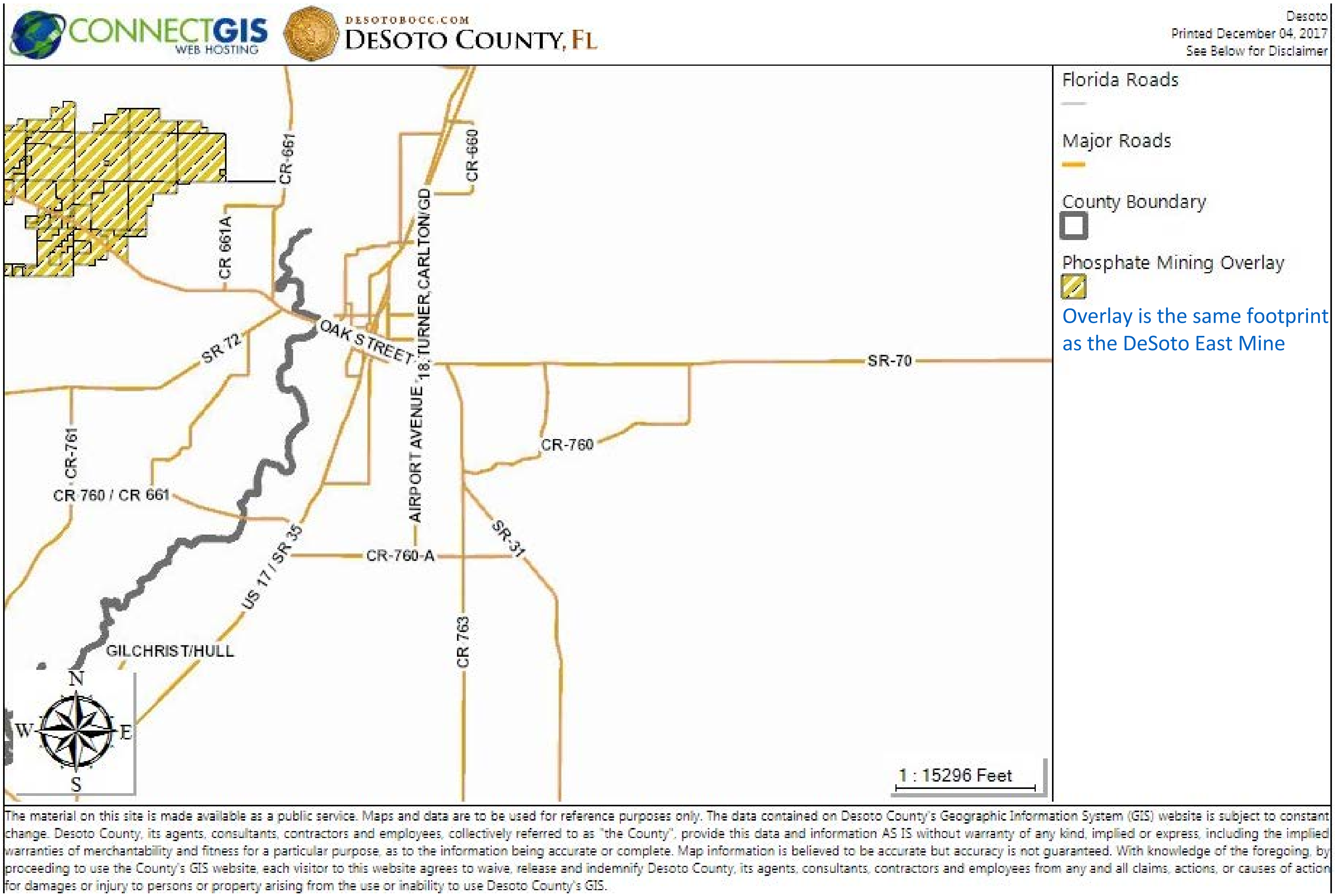
There are currently no active NPDES permits for the DeSoto East Mine/Mosaic in DeSoto County (FDEP, 2017b).

3.2.2 SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT (SWFWMD)

3.2.2.1 WATER USE PERMIT (WUP)

Integrated WUP No. 20011400, which covers all of Mosaic's properties in Polk, Hardee, DeSoto, Hillsborough, and Manatee Counties, was issued on March 27, 2012. A modification was issued on December 13, 2013. This permit includes water quantities for the DeSoto Mine, although the majority of the water for the DeSoto Mine will be piped to the site from the Fort Green mine in Hardee County. The WUP also authorizes dewatering for mining activities and includes an Environmental Management Plan.

Figure 3-1: DeSoto County Phosphate Mining Overlay boundary. (Source: https://desoto.connectgis.com/Map.aspx)



3.3 FEDERAL PERMITS

3.3.1 UNITED STATES ARMY CORPS OF ENGINEERS (USACE)

3.3.1.1 SECTION 404 PERMIT

The initial Section 404 permit application was submitted to the USACE in July 2011. As a result of several concurrent requests for new phosphate mines, the USACE required that an Areawide Environmental Impact Statement (AEIS) be conducted for all proposed mines prior to permitting. The AEIS was completed in 2012 and a revised Section 404 permit application for the DeSoto East Mine was submitted to the USACE in June 2014. The revised application is still pending permit issuance. (A status request has been made to the USACE but a response has not been received as of the date of this report.)

3.3.1.2 U. S. FISH AND WILDLIFE SERVICE (USFWS)

A threatened and endangered species authorization is required from the USFWS prior to issuance of the Section 404 permit. This process is occurring concurrently with Section 404 permitting for the DeSoto East Mine.

4.0 POTENTIAL IMPACTS OF MINING ON SURFACE WATER QUANTITY

There are several aspects of the phosphate mining operation to consider when evaluating the potential impact of mining on surface water resources.

4.1.1 Active Mining

An area under active mining conditions will be effectively removed from the watershed until the area is reclaimed, which will reduce the amount of water reaching receiving waters, such as Big Slough. Due to the implementation of stormwater management practices and NPDES permit requirements, water will only leave the actively mined areas after significant or prolonged rainfall events.

4.1.1.1 Dewatering

Dewatering the SAS to a depth of 30 feet bls or greater could result in a drawdown of water levels in adjacent wetlands, lakes, streams and other surface water features. However, as previously stated, the use of recirculation trenches can be used to mitigate this effect. The recirculation trenches must be properly designed, maintained and monitored to ensure that they remain effective for the duration of the dewatering. Fine particulates in dewatering water may clog soil pores in the trenches, preventing the downward filtration of water and therefore eliminating the hydraulic barrier. The need to clean the trenches will vary by location. As reported in the AEIS (2012), recirculation trenches are not always effective and localized vertical drawdowns of up to 20 feet have been observed in some monitoring wells adjacent to active mining areas. The current WUP includes an Environmental Management Plan (EMP) that in part addresses minimizing environmental impacts of dewatering. In the absence of mining plans for the western DeSoto Tract it is not possible to ascertain the distance between excavation areas and Big Slough.

Mosaic is required to monitor groundwater water levels and water levels in the maintenance ditches (recirculation trenches) at numerous locations per Special Conditions 10, 11, 12, 16 and 17 in WUP 20011400, as further detailed in the Environmental Management Plan (EMP) attached to the WUP as Exhibit E. Specific Condition 15 of the ERP requires that Mosaic follow these WUP conditions and that Mosaic copy FDEP on all correspondence with SWFWMD regarding these WUP conditions. Section 6 of the EMP describes internal and external triggers for Mosaic to take action based on water level data. From the EMP:

- <u>Internal Trigger</u> – The water level and duration which requires Mosaic to initiate investigative measures and take corrective actions if necessary. This trigger occurs immediately upon specified piezometer's water level range dropping below the P95 elevation for the appropriate season.
- <u>External Trigger</u> – The water level and duration which requires Mosaic to notify the [SWFWMD] and initiate investigative measures and take corrective actions, if necessary. This trigger is reached during the dry season (October through May) when the measurement at specified piezometers is less than the dry season P95 value for a period of three consecutive weekly monitoring events. The external trigger is reached during the wet season (June through September) when the measurement at specified piezometers is less than the wet season P95 value for a period of two consecutive weekly monitoring events.
- <u>P95 Exceedance Value</u> – The percentile ranking represented by the elevation of the water level in the SAS that is equaled or exceeded 95% of the time during the appropriate season calculated from the baseline data set. P95 exceedance values will be determined for both the wet season (June – September) and dry season (October – May) at each monitoring point based on the water levels observed at the location during the baseline monitoring period.

A description of dewatering practices were provided by Mosaic for the AEIS (2012):

- "A grid of dewatering wells is installed in an area representing two or three mine cut widths and pumps are operated to draw down the water level in the SAS. The number of wells for a dewatering grid can range from 30 to 70 or more, depending on the level of dewatering being maintained. Dewatering at a given well occurs for periods up to 4 months.

- The dragline operations proceed. Dewatering operations stay ahead of the dragline by several mine cut widths (approximately 1,000 feet). Pumps in the dewatering wells are pulled and moved ahead of the active mine cut operations.
- As the dragline moves away from the applicable dewatered min[e] cut area, water is allowed to re-accumulate in the completed mine cuts."

4.1.1.2 Water Use

Water pumping for use in creating and transporting slurries and for beneficiation is not expected to impact the Big Slough region, as the current Water Use Permit (WUP) requires that the DeSoto mine be supplied by wells located at the Fort Green Facility, located 39 miles to the north. The estimated 10.7 million gallons per day (mgd) of water needed (SWFWMD, 2013) will be pumped to the DeSoto site via a pipeline.

Historically, considering actual mine operations, mining impacts on the Peace River have been related to water quantity/flow decreases as a result of groundwater being pumped from the aquifer, which is much more closely connected to streamflow in the Polk/Hardee County area than in the DeSoto/Manatee/Sarasota County region.

4.1.2 Reclamation

One study, based on data collected from the Peace River downstream of a mine, indicated that peak discharges were found to be higher on reclaimed lands following intense, short-duration storms, but discharges were similar for unmined and reclaimed lands following low-intensity, long-duration storms. Also, streamflows generally responded more slowly to rainfall in reclaimed versus unmined basins as a result of increased surface storage and decreased drainage network development (Lewelling and Wylie, 1993).

In another study, a net reduction in flows associated with phosphate mine reclamation was estimated at 8.5 to 17 cfs for the Peace River from an average flow of 881 cfs (30 year average flow ending in 1998), a 0.96-1.9% flow reduction. This number cannot be directly extrapolated for use in the Big Slough watershed due to numerous, soil, geologic, topographic and vegetation differences (Ardaman & Associates, 2002). This study indicated that the decrease in flow may have been a result of an increase in lakes, created/mitigation wetlands and clay soils in reclamation areas, which in turn would increase evapotranspiration and attenuation (storage) of water that otherwise might contribute to streamflow.

The Ardaman study also concluded that water available to the Peace River Manasota Regional Water Supply Authority facility downstream actually increased as a result of stormwater management practices, which captured water during peak storm events, to be released later during drier periods, when more of it could be withdrawn by the facility. While the overall flow was estimated to decrease, flows "evened out" over the year, with more reduction in wet season flows and a slight increase in dry season flows as a result of stormwater management, resulting in a net increase in the water available to the Peace River facility over the course of the year.

Alternatively, Schreuder, Inc. (2006) used modeling and stream flow analysis on mined and unmined creeks to estimate the impact of phosphate mining on streamflow. Model results were compared to actual flow measurements and were found to correlate reasonably well with an R^2 value (probability of correlation) of 70-80%. Overall, their findings indicated that streamflows were equal to or higher in mined basins compared to unmined basins, though no numeric value was determined. Flood flows were found to be reduced and base flows were shown to significantly increase. Flood flows in this report are defined as the daily mean streamflow achieved only 10% of the time (90% of the time flows are lower) and base flows are defined as daily mean stream flows achieved 90% of the time (flows fall below the base flow level only 10% of the time). However, this study included both actively mined and reclaimed areas within each basin, while other studies separated active areas from reclaimed areas, which is more likely to produce accurate site-specific results.

The AEIS (2012) states that the altered soils on reclaimed lands may result in altered rainfall infiltration rates and/or altered runoff characteristics. Overburden removed prior to mining may be mixed with sand to provide a better media for plant growth, resulting in a modified surface substrate compared to unmined lands. The AEIS predicts an overall reduction in the flow of up to 6 or 7% of the flow of Big Slough. (AEIS, 2012). The modeled results of the AEIS, showing predicted changes in surface water flows under different conditions, are presented in **Tables 4-1 and 4-2.**

For the purpose of surface water flow modeling done for the AEIS, the west DeSoto Mine tract was initially considered to be a stand-alone mine that would begin excavation in 2025 and continue until 2057, with reclamation continuing until 2065. The more likely scenario, assuming the eastern tract of the DeSoto Mine becomes fully permitted, is that the western tract will become an extension of the eastern tract, and that mining will actually begin in 10-20 years (2034 was used in the AEIS). This is subject to change and no actual mine plans for the western tract are currently available.

Table 4-1: Projected flows in 2050 (worst case scenario modeled) and percent change from 2009 flows in Big Slough as a result of mining the western tract of the Mosaic DeSoto Mine (aka Pine Level/Keys Tract) (AEIS, 2012), assuming a stand-alone mine commencing in 2025. Percent capture is the percentage of stormwater retained in the capture area of the mining operation.*

Condition in model year 2050	Annual Average Flow (cfs)	Annual Average % change from 2009 flows	Dry season Average flow (cfs)	Dry season % change from 2009 flows	Wet season Average Flow (cfs)	Wet season % change from 2009 flows
Average Rainfall year with 100% capture	203	-6%	109	-7%	589	-6%
Average Rainfall year with 50% capture	210	-3%	113	-3%	609	-3%
Low rainfall year with 100% capture	165	-6%	89	-7%	478	-6%
Low rainfall year with 50% capture	171	-3%	92	-3%	494	-3%

*These numbers are conservative. Actual mine capture rates are estimated to be around 35% (AEIS, 2012).

Table 4-2: Projected flows in 2055 (worst case scenario modeled) and percent change from 2009 flows in Big Slough as a result of mining the western tract of the Mosaic DeSoto Mine (aka Pine Level/Keys Tract) (AEIS, 2012), assuming that the area will be an extension of the eastern DeSoto mine, with operation commencing in 2034. Percent capture is the percentage of stormwater retained in the capture area of the mining operation.*

Condition in model year 2055	Annual Average Flow (cfs)	Annual Average % change from 2009 flows	Dry season Average flow (cfs)	Dry season % change from 2009 flows	Wet season Average Flow (cfs)	Wet season % change from 2009 flows
Average Rainfall year with 100% capture	202	-7%	108	-7%	584	-7%
Average Rainfall year with 50% capture	210	-4%	113	-4%	607	-4%
Low rainfall year with 100% capture	164	-7%	88	-7%	474	-7%
Low rainfall year with 50% capture	170	-4%	91	-4%	492	-4%

*These numbers are conservative. Actual mine capture rates are estimated to be around 35% (AEIS, 2012).

5.0 POTENTIAL IMPACTS OF MINING ON SURFACE WATER QUALITY

5.1 LITERATURE REVIEW SUMMARY

5.1.1 Creeks and Streams

Lewelling and Wylie (1993) found that SAS water in reclaimed basins generally had higher levels of most constituents compared to SAS water in unmined basins. These increased levels still mostly met state water quality standards at the time. Exceedances of state water quality standards occurred in some samples in some basins for color, dissolved solids, sulfate, iron, manganese, and lead for mined sites and for iron and gross-alpha radiation at unmined sites. High levels of gross-alpha radiation at unmined sites were attributed to near-surface deposits of phosphate ore in the sampling area. Ammonia concentrations also significantly exceeded state water quality standards in two creeks at unmined locations. In addition, surface water samples collected in reclaimed and unmined basins generally had similar water quality; however, magnesium, orthophosphorus, alkalinity and calcium were higher in some reclaimed basins. Uranium-234 activity was also increased at a recently reclaimed clay settling basin. Arsenic in the SAS in the study area ranged from <1 to 1 ug/L in the unmined basins and from <1 to 7 ug/L in the reclaimed mined basins (State Class I water quality criteria require arsenic levels to be $\leq$10 ug/L, the standard for Class III waters is $\leq$50 ug/L).

Additional studies conducted by BRA (2006), Entrix (2009) and Entrix (2010) for the Horse Creek Stewardship Program (HCSP) found mixed results in water quality data downstream of mining operations and found that exceedances in parameters occurred in low rainfall/low flow years when little or no water was discharged from mining sites, and therefore mining operations could not be attributed to the water quality variations. Other studies have also found variations in water quality that may have been linked to mining and/or numerous other land use changes in the Alafia, Hillsborough and Peace River Basins (PBS&J, 2010 and Khare et al., 2012). Khare (2012) found a correlation between phosphate mining and total phosphorus concentrations in surface waters.

5.1.2 Clay Settling Areas

CSAs can comprise up to 40% of the post-mining landscape, in large blocks separated from the rest of the landscape by a berm, and they present many reclamation challenges as they may require decades of draining and drying before they can be converted to a beneficial use, such as farmland or wildlife habitat. Dam walls for these settling areas may be 20 feet to 60 feet in height to contain the material (Beavers, et al., 2015), which includes water and soils that can cause (and have caused) significant damage to water and wildlife if released into the environment.

El-Shall (2009) found that, without additional physical work on the CSAs, decades may be required for the solids content to reach just 25-35% (starting from 3% solids when pumped into the CSA). The reclamation process can be reduced to years instead of decades by cutting extensive drainage canals throughout the CSA to allow water to escape more quickly (Beavers, et al., 2015). The Florida Institute for Phosphate Research (2017) indicates that 50-60% solids in the top crust can be attained in 3-5 years with new technologies, although the underlying clay retains the consistency of pudding for many years longer. The process may also be shortened by mixing the clay with sand tailings from the mining process (not planned for this area), which results in an initial solids content of 28% (versus 3%) and an initial pH of around 7.3 to 7. However, using a sand clay mix process results in 60% of the land being removed from beneficial use (versus 40%) (Beavers, et al., 2015).

Murphy, et al. (2008), used bromide tracers to study the movement of water within a CSA (approximately 20 years old and located at the Ft. Meade Mine) and to determine whether there is hydrological connectivity between CSAs and surrounding landscapes. The study determined that water falling on CSAs is prevented from moving vertically downward due to a clay-rich sublayer, which in turn results in lateral movement of water to the surrounding landscapes. Study results indicate that water from CSAs discharges laterally to surrounding surface waters and the surficial aquifer through CSA berms and/or vertically through the clay-rich sublayer.

Model results from this study indicated that CSA water shallow and/or deep was expected to be found in all downgradient waters and may comprise 50% or more of the downgradient waters. However, the study did not quantify the effects on the hydrology of surrounding features, nor did the study address water quality impacts that might be associated with CSA water movement (Murphy, et al., 2008).

Lazareva and Pichler (2009) found that constructed wetlands significantly improved water quality in waters discharged from an area used for clay settling in Polk County, including a reduction in arsenic, sulfate, fluoride, chloride, nitrate, nitrite, bromide, sodium, potassium, calcium and magnesium.

Osmond, et al. (1985) indicated that surficial and shallow aquifer groundwaters in phosphate deposit areas have higher than average concentrations of radium. The study found that the natural pattern was not greatly altered by mining activity, except in the immediate vicinity of the pit and spoil areas. The study found that most of the radioelements accumulated in the waste clays, and therefore the CSAs. Hanlon et al. (1996) found that some crops grown on CSA land had elevated levels of radionuclides, although the increase in cancer risk from consumption of these crops was determined to be negligible.

5.1.3 Phosphogypsum Stacks

Gyp stack process water is highly acidic (pH less than 2) and chemically complex due to other constituents from the mining process (see Table 5-1on following pages), presented here for reference, although gyp stacks are not planned for the DeSoto Mine site at this time. Nifong (1998) conducted a study to determine water movement from gyp stacks to groundwater under the stacks. The study found that only about 1% of the gyp stack water at Piney Point in Manatee County reached the groundwater. Gyp stack water has historically reached surface water resources through spill events, further described below.

5.1.4 Reclaimed Lakes

Lakes are often created as part of the reclaimed landscape following phosphate mining, and as part of the post-reclamation watershed, their water quality may impact the quality of waters downstream. Wilson and Hanlon (2012) found that the water quality in these new surface water features, which may discharge to the downstream watershed, was overall within the range of variability of natural lakes in central Florida. Overall, the study concluded that created lakes will take decades to reach equilibrium, water quality may change over time compared to the results found in the study, and that the additional research is needed to determine long term characteristics of these lakes.

A summary of the study's findings is described here (numeric values were not presented in the report). The pH of created lakes is generally lower than found in natural lakes and alkalinity is generally higher than in natural lakes. Hardness was generally higher in the created lakes, reducing the solubility of some metals (e.g. cadmium, chromium, copper, lead, nickel, mercury and zinc). Sulfate, barium, total phosphorus and electrical conductivity were also higher in created lakes, while potassium, nickel, silver, zinc, selenium, manganese and chloride were lower compared to natural lakes. However, created lake sediments have significantly elevated levels of cadmium and iron, which may enter the water column if storm events result in sediment suspension, and the created lakes at times exceeded the Class III water quality standards for cadmium and iron as a result. Ammonia is also higher in the created lakes and at times may exceed Class III water quality criteria. Finally, radium-226 levels were elevated in created lake sediments, resulting in higher radium-226 levels in cattail roots, though no increase in radium levels were found in clams or fish (Wilson and Hanlon, 2012).

A much older study on the water quality of reclaimed lakes found that reclaimed lakes less than 6 months old were significantly different from older reclaimed lakes, with higher levels of turbidity, aluminum and selenium and lower pH values in the younger lakes. This study also found that the reclaimed lakes older than 1 year spanned the variability of parameters found in natural lakes (similar to the study described above), although this study focused more on microbial parameters than water quality measurements (Borris et al., 1986).

5.2 WATER QUALITY DATA SUMMARY

Table 5-1(a-c) compares concentrations of constituents in waters upstream and downstream of mine discharges, in NPDES outfall discharges in Big Slough Canal/Myakkahatchee Creek as measured by the City of North Port for its drinking water supply, and at a few other select locations (**Figure 5-1**). Water quality data upstream, downstream and at NPDES discharges was obtained from the AEIS (2012). For discussion purposes, NPDES outfalls generally only flow after significant or prolonged storm events. Mines are designed to hold a 25-year 24-hour (8-inch) rain event; however, these site discharge more than once every 25 years. In addition to discharging after an 8-inch rainfall, sites will also discharge after numerous smaller back-to-back events. The amount of rainfall that will cause discharge will vary depending on the amount of water that the stormwater management system is already holding at the time of the rainfall, which varies considerably and cannot be predicted long-term.

Site specific data such as used in the AEIS is difficult to obtain as much of the information was reported to FDEP in large (often 100+ pages) documents, with one document submitted per sampling event. There is no known publicly available database with all the many years of data for multiple sites collected in one location.

Comparing water quality data provided by the City for sample locations associated with Big Slough/Myakkahatchee Creek to water quality data related to mining obtained from other sources indicates that Big Slough/Myakkahatchee Creek water quality data taken at NPDES (hydrobiological) sampling sites at Myakkahatchee Creek and Appomattox (Site 1) and Cocoplum (Site 2) are generally in the same range as water quality data collected from NPDES mining outfalls and Horse Creek watershed background data (with the exception of gyp stack data) (AEIS, 2012). Phosphorus levels are somewhat elevated at some mine outfall locations; however, Myakkahatchee Creek is nitrogen-limited and NPDES outfall total nitrogen data appear to be within data ranges for the City's existing watershed. Fluoride levels in mine outfall water does appear to be slightly elevated compared to Big Slough/Myakkahatchee Creek watershed data provided by the City, including Big Slough monitoring data provided to the City by Mosaic (highlighted in yellow in **Table 5-1**), exceeding Class I water quality standards at a few existing mine outfall locations (AEIS, 2012) (note: fluoroapatite is a phosphate mineral commonly found in phosphorus deposits).

Overall, the poor water quality of the gyp stacks process will not be an issue for Big Slough unless plans change and a fertilizer plant is proposed. The water quality from the mine outfalls described in the AEIS generally meets Class I and Class III requirements (average values meet the requirements but a few individual measurements, including some from upstream locations, exceeded state criteria). Total phosphorus and total nitrogen were elevated at mine outfalls (which only flow after significant or repeated storm events) compared to Myakkahatchee Creek samples taken at Appomattox and Cocoplum/Sumter. Whether outfall water may affect downstream waters is discussed further with **Table 5-2** data. Fluoride concentrations in outfalls were overall in exceedance of Class I water quality criteria and downstream impacts of fluoride discharges are unknown as this is not a commonly measured water quality parameter. The Fluoride Action Network (fluroidealert.org) has posted a number of articles indicating that phosphate mining has resulted in increased fluoride levels in rivers, however no scientific publications were found on this topic.

Table 5-2 summarizes water quality data comparing background/upstream values to water quality at NPDES outfalls (when flowing) and downstream water quality. The data indicate that there is no significant change in stream water quality as a result of active mining areas. None of the measurements exceed Class I water quality criteria, although the constituents analyzed here are limited.

Outfall water had significantly higher (with a statistical probability of 95%) values for the following parameters when compared to upstream values for most locations in **Table 5-2:** specific conductance, dissolved oxygen, pH, and total phosphorus. However, water typically only flows from the NPDES outfalls after significant or repeated storm events and outfall water will be diluted when mixed with stream water. Downstream water had significantly higher (with a statistical probability of 95%) values for the following parameters compared to upstream values for most locations in **Table 5-2**: specific conductance, dissolved oxygen, pH, and total phosphorus (although total nitrogen was significantly higher at most upstream locations) (AEIS, 2012).

Based on the AEIS (2012) data analysis, phosphate mining results in a reduction in total nitrogen downstream of mining operations, which will result in a benefit to nitrogen-limited Myakkahatchee Creek. Phosphate mining is not expected to contribute to the Big Slough Canal Total Maximum Daily Load (TMDL) impairment for fecal coliforms as mining is not associated with this parameter. Removal of natural areas from the watershed may temporarily decrease fecal coliforms (due to reduced wildlife use), though any decrease would be reversed after land reclamation.

Table 5-1a: Water quality data summary associated with phosphate mining, Horse Creek watershed background monitoring data, and City of North Port monitoring locations

Water Source/Site	pH	Specific Conductivity (umhos/cm)	Turbidity (NTU)	Color (Pt-Co Units)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (Mg/L)	Iron (mg/L)	Manganese (mg/L)
Class I Water Standards (FDEP 62-302.530)	6.0-8.5	1275	background+29	NA	NA	NA	NA	NA	<1	NA
Class III Water Standards (FDEP 62-302.530)	6.0-8.5	1275	background+29	NA	NA	NA	NA	NA	<1	NA
Median Value for Florida Streams (PBS&J, 2007)	7.1	335	5	71	NA	NA	NA	NA	NA	NA
Process Water in Phosphogypsum Stacks (PBS&J, 2007)	2.1	22,100	0.9	300	538	223	2,260	210	59	15
Inactive Ft Green NPDES Outfall (2006-11) (AEIS, 2012)	7.2	508	5.5	NA	NA	NA	NA	NA	NA	NA
Inactive Kingsford NPDES Outfall (2008-11) (AEIS, 2012)	7.8	465	7.6	NA	NA	NA	NA	NA	NA	NA
Active Mosaic Four Corners Outfall (2005-10) D001 (AEIS, 2012)	7.2	569	15.7	NA	NA	NA	NA	NA	NA	NA
Active Mosaic Four Corners Outfall (2005-10) D002 (AEIS, 2012)	7.4	653	7	NA	NA	NA	NA	NA	NA	NA
Active Mosaic Wingate Outfall (2005-10) D001 (AEIS, 2012)	6.6	408	5.1	NA	NA	NA	NA	NA	NA	NA
Active Mosaic Wingate Outfall (2005-10) D002	7	600	6.2	NA	NA	NA	NA	NA	NA	NA
Active Mosaic South Ft Meade Outfall (2005-10) D001 (AEIS, 2012)	7.6	782	5.6	NA	NA	NA	NA	NA	NA	NA
Active South Pasture Outfall (2005-10) D004 (AEIS, 2012)	7.5	781	6.7	NA	NA	NA	NA	NA	NA	NA
Active South Pasture Outfall (2005-10) D005 (AEIS, 2012)	7.4	651	8.1	NA	NA	NA	NA	NA	NA	NA
PNL SW1 Horse Creek Tributary (1998-2009)*	6.49	349	4.8	NA	NA	NA	NA	NA	0.57	NA
PNL SW2 Horse Creek (1996-2009)*	6.84	465	2.3	NA	NA	NA	NA	NA	0.2	NA
PNL SW3 Horse CR @ SR 72 (1996-2009)*	7.13	537	2.31	NA	NA	NA	NA	NA	0.21	NA
PNL SW4 Brandy Branch @ SR 70 (1998-2009)*	6.87	915	3.23	NA	NA	NA	NA	NA	0.17	NA
PNL SW5 Buzzard BR @ SR 70 (1998-2009)*	6.69	787	4.53	NA	NA	NA	NA	NA	0.38	NA
PNL SW6 Buzzard Branch Trib (1998-2009)*	6.5	531	3.79	NA	NA	NA	NA	NA	0.28	NA
PNL SW7 Buzzard Br @ Pine Level Rd (1998-2009)*	6.74	640	2.86	NA	NA	NA	NA	NA	0.24	NA
PNL SW8 Bud Slough Entrance (1998-2009)*	6.82	543	2.88	NA	NA	NA	NA	NA	0.31	NA
PNL SW9 Wildcat Slough Entrance (1998-2009)*	6.22	862	3.31	NA	NA	NA	NA	NA	0.11	NA
PNL SW10 Big Slough @ SR 72 (1997-2009)*	7.07	745	4.7	NA	NA	NA	NA	NA	0.21	NA
Site 1 - Myakkahatchee Creek at Appomattox 2006-2016 range**	5.49-8.70	89-580	0.60-13.0	60-480	7.6-45.3	3.5-35.9	4.93-22.8	0.47-3.27	NA	NA
Site 2 - Cocoplum at Sumter 2006-2016 range**	6.0-8.3	154-868	1.50-3.90	49-334	10.0-41.7	4.1-28.7	8.13-19.1	0.59-2.38	NA	NA
Station S-1 on Big Slough 1978-79 range*	6.5-7.0	75-498	1.70-1.80	177-272	7.1-47.3	2.7-25.0	4.80-12.7	0.12-2.22	NA	NA
Station S-1 on Big Slough 19779-80 range*	NA	10--1310	1.5-22.0	43-400	NA	NA	NA	NA	NA	NA
Station S-1 on Big Slough 1984-85 range*	NA	256-1400	0.75-17.0	27-320	NA	NA	NA	NA	NA	NA

*Indicates data provided by Mosaic to the City of North Port

**Hydrobiological Monitoring Data provide by the City of North Port

***Hydrobiological sites - this is both Nitrate-N and Nitrite-N and Ammonia-N; for PNL sites this is listed as (Ammonia (or NH3) and NO2/NO3) in the information provided - it is unknown if this actually represents NO2-N and NO3-N or NH3/NH4-N

****Hydrobiological data is Pheo corrected (unknown if PNL data is corrected)

Yellow highlight indicates Big Slough/Myakkahatchee Creek sites

Table 5-1b: Water quality data summary associated with phosphate mining, Horse Creek watershed background monitoring data, and City of North Port monitoring locations - Continued

Water Source/Site	Biochemical Oxygen Demand (mg/L)	Total Organic Carbon (mg/L)	Fecal Coliform (#/ml)*	Radium 226 (pC/L)	Radium 228 (pC/L)	Gross alpha (pC/L)	Chlorophyll A (ug/L)****	Fluoride (mg/L)	Sulfate (mg/L)	Total Suspended Solids (mg/L)
Class I Water Standards (FDEP 62-302.530)	NA	NA	NA	<5		<15	NA	<1.5	NA	NA
Class III Water Standards (FDEP 62-302.530)	NA	NA	NA	<5		<15	NA	<10	NA	NA
Median Value for Florida Streams (PBS&J, 2007)	NA	NA	NA	NA	NA	NA	NA	0.2	NA	7
Process Water in Phosphogypsum Stacks (PBS&J, 2007)	NA	NA	NA	NA	NA	NA	NA	4,120	6,200	22
Inactive Ft Green NPDES Outfall (2006-11) (AEIS, 2012)	NA	NA	NA	NA	NA	NA	NA	1.32	62	7.7
Inactive Kingsford NPDES Outfall (2008-11) (AEIS, 2012)	NA	NA	NA	NA	NA	3.01	NA	1.44	42	9.7
Active Mosaic Four Corners Outfall (2005-10) D001 (AEIS, 2012)	NA	NA	NA	2.93		10.3	NA	1.4	98	11.8
Active Mosaic Four Corners Outfall (2005-10) D002 (AEIS, 2012)	NA	NA	NA	2.2		9.5	NA	1.7	204	5
Active Mosaic Wingate Outfall (2005-10) D001 (AEIS, 2012)	NA	NA	NA	1.52		2.22	NA	NA	204	3.6
Active Mosaic Wingate Outfall (2005-10) D002	NA	NA	NA	1.57		3.22	NA	0.88	273	4.7
Active Mosaic South Ft Meade Outfall (2005-10) D001 (AEIS, 2012)	NA	NA	NA	NA		NA	NA	2.1	278	5.1
Active South Pasture Outfall (2005-10) D004 (AEIS, 2012)	NA	NA	NA	NA		11.6	NA	2.1	222	6.5
Active South Pasture Outfall (2005-10) D005 (AEIS, 2012)	NA	NA	NA	NA		12.27	NA	2.4	204	6.6
PNL SW1 Horse Creek Tributary (1998-2009)*	1.91	NA	NA	0.57	0.1	1.56	4.94	0.51	102.4	2.64
PNL SW2 Horse Creek (1996-2009)*	2.18	NA	NA	0.95	0.23	2.16	3.49	0.62	158.52	2.22
PNL SW3 Horse CR @ SR 72 (1996-2009)*	1.92	NA	NA	0.7	0.15	1.97	1.81	0.55	187.47	2.13
PNL SW4 Brandy Branch @ SR 70 (1998-2009)*	2.04	NA	NA	1.39	0.72	3.82	1.85	0.85	430.72	3.22
PNL SW5 Buzzard BR @ SR 70 (1998-2009)*	2.06	NA	NA	0.98	0.31	2.42	7.36	0.96	378.78	3.54
PNL SW6 Buzzard Branch Trib (1998-2009)*	2	NA	NA	1.4	0.3	1.96	2.75	0.46	189.68	2.9
PNL SW7 Buzzard Br @ Pine Level Rd (1998-2009)*	2.05	NA	NA	1.01	0.51	2.37	1.83	0.64	270.47	2.23
PNL SW8 Bud Slough Entrance (1998-2009)*	2.32	NA	NA	0.97	0.62	2.02	3.22	0.49	227.57	2.26
PNL SW9 Wildcat Slough Entrance (1998-2009)*	2.26	NA	NA	1.78	0.4	4.85	2.59	1.07	430.72	2.29
PNL SW10 Big Slough @ SR 72 (1997-2009)*	1.96	NA	NA	1.2	0.39	2.67	4.71	0.74	280.98	4.16
Site 1 - Myakkahatchee Creek at Appomattox 2006-2016 range**	NA	NA	NA	NA	NA	NA	NA	0.18-1.30	0.5-106	2.0-28.0
Site 2 - Cocoplum at Sumter 2006-2016 range**	NA	NA	NA	NA	NA	NA	NA	0.27-0.97	7-249	1.65-20.5
Station S-1 on Big Slough 1978-79 range*	1.0-2.7	1.0-40.0	5-1800	NA	NA	NA	NA	0.22-0.55	<1-172	NA
Station S-1 on Big Slough 19779-80 range*	<1-3.4	20.8-40.9	<2-660	NA	NA	NA	NA	NA	NA	NA
Station S-1 on Big Slough 1984-85 range*	<1-3.1	19.4-22.2	280-4600	NA	NA	NA	NA	NA	NA	NA

*Indicates data provided by Mosaic to the City of North Port

**Hydrobiological Monitoring Data provide by the City of North Port

***Hydrobiological sites - this is both Nitrate and Nitrite N and Ammonia-N; for PNL sites this is listed as (NO2/NO3) in the information provided but it is unknown if this represents NO2-N and NO3-N or NH3/NH4-N

****Hydrobiological data is Pheo corrected (unknown if PNL data is corrected)

Yellow highlight indicates Big Slough/Myakkahatchee Creek sites

Table 5-1c: Water quality data summary associated with phosphate mining, Horse Creek watershed background monitoring data, and City of North Port monitoring locations - Continued

Water Source/Site	Total Phosphorus (mg/L)	Ortho phosphorus-P (mg/L)	Ammonia Nitrogen (mg/L)	Alkalinity (mg/L)	Total Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg N/L)	Nitrate-N (mg/L)***	Total Dissolved Solids (mg/L)	Chloride (mg/L)	Dissolved Oxygen (mg/L)*
Class I Water Standards (FDEP 62-302.530)	NA	NA	equation	>20	NA	NA	<10	NA	<250	See Rule 62-302.533
Class III Water Standards (FDEP 62-302.530)	NA	NA	equation	>20	NA	NA	NA	NA	Not more than 10% above background	See Rule 62-302.533
Median Value for Florida Streams (PBS&J, 2007)	0.09	NA	1.2 (Total N)	NA	NA	NA	NA	NA	NA	NA
Process Water in Phosphogypsum Stacks (PBS&J, 2007)	6,600	NA	1,240	NA	NA	NA	NA	39,800	140	NA
Inactive Ft Green NPDES Outfall (2006-11) (AEIS, 2012)	1.03	NA	NA	NA	1.6	NA	NA	NA	NA	NA
Inactive Kingsford NPDES Outfall (2008-11) (AEIS, 2012)	0.72	NA	NA	NA	1.43	NA	NA	NA	NA	7.8
Active Mosaic Four Corners Outfall (2005-10) D001 (AEIS, 2012)	1.1	NA	NA	NA	0.88	NA	NA	NA	NA	6
Active Mosaic Four Corners Outfall (2005-10) D002 (AEIS, 2012)	1.23	NA	NA	NA	0.93	NA	NA	NA	NA	7.8
Active Mosaic Wingate Outfall (2005-10) D001 (AEIS, 2012)	1	NA	NA	NA	0.95	NA	NA	NA	NA	6.9
Active Mosaic Wingate Outfall (2005-10) D002	1.51	NA	NA	NA	0.99	NA	NA	NA	NA	8
Active Mosaic South Ft Meade Outfall (2005-10) D001 (AEIS, 2012)	1.44	NA	NA	NA	0.97	NA	NA	NA	NA	7.7
Active South Pasture Outfall (2005-10) D004 (AEIS, 2012)	1.13	NA	NA	NA	0.98	NA	NA	NA	NA	7.5
Active South Pasture Outfall (2005-10) D005 (AEIS, 2012)	0.87	NA	NA	NA	1.23	NA	NA	NA	NA	6.9
PNL SW1 Horse Creek Tributary (1998-2009)*	0.8	0.69	0.12	28.7	1.74	NA	0.09	NA	NA	3.76
PNL SW2 Horse Creek (1996-2009)*	0.39	0.32	0.06	39.7	1.16	NA	0.13	NA	NA	6.41
PNL SW3 Horse CR @ SR 72 (1996-2009)*	0.48	0.4	0.08	49	1.24	NA	0.28	NA	NA	7.97
PNL SW4 Brandy Branch @ SR 70 (1998-2009)*	0.48	0.42	0.13	48.4	1.69	NA	0.37	NA	NA	6.77
PNL SW5 Buzzard BR @ SR 70 (1998-2009)*	0.45	0.38	0.11	47.56	1.73	NA	0.28	685.18	NA	5.88
PNL SW6 Buzzard Branch Trib (1998-2009)*	0.58	0.53	0.06	56.57	1.23	NA	0.13	536.75	NA	6.25
PNL SW7 Buzzard Br @ Pine Level Rd (1998-2009)*	0.72	0.45	0.05	46.9	1.41	NA	0.26	569.25	NA	6.83
PNL SW8 Bud Slough Entrance (1998-2009)*	0.43	0.33	0.1	33	1.29	NA	0.12	561.14	NA	7.08
PNL SW9 Wildcat Slough Entrance (1998-2009)*	0.2	0.14	0.1	46.89	1.19	NA	0.22	960.36	NA	5.17
PNL SW10 Big Slough @ SR 72 (1997-2009)*	0.4	0.3	0.08	64.89	1.02	NA	0.11	693.09	NA	6.37
Site 1 - Myakkahatchee Creek at Appomattox 2006-2016 range**	0.080-0.730	0.063-0.524	0.005-0.173	NA	0.420-2.217	0.400-1.880	1.88	NA	10-37	NA
Site 2 - Cocoplum at Sumter 2006-2016 range**	0.050-0.420	0.005-0.277	0.005-0.190	NA	0.485-1.666	0.48-16.615	0.005-0.140	NA	10-36	NA
Station S-1 on Big Slough 1978-79 range*	0.28-0.62	0.047-0.485	0.01-0.15	14-192	NA	0.98-2.05	0-0.058	NA	10.3-19.2	1.9-17.0
Station S-1 on Big Slough 19779-80 range*	0.28-0.69	0.047-0.469	<0.03-0.10	22-139	NA	0.88-1.58	<0.0004-.033	NA	NA	1.8-12.0
Station S-1 on Big Slough 1984-85 range*	0.313-0.382	0.243-0.330	0.03-0.04	51-197	NA	1.1-1.6	<0.010-0.017	NA	NA	5.3-6.8

*Indicates data provided by Mosaic to the City of North Port

**Hydrobiological Monitoring Data provide by the City of North Port

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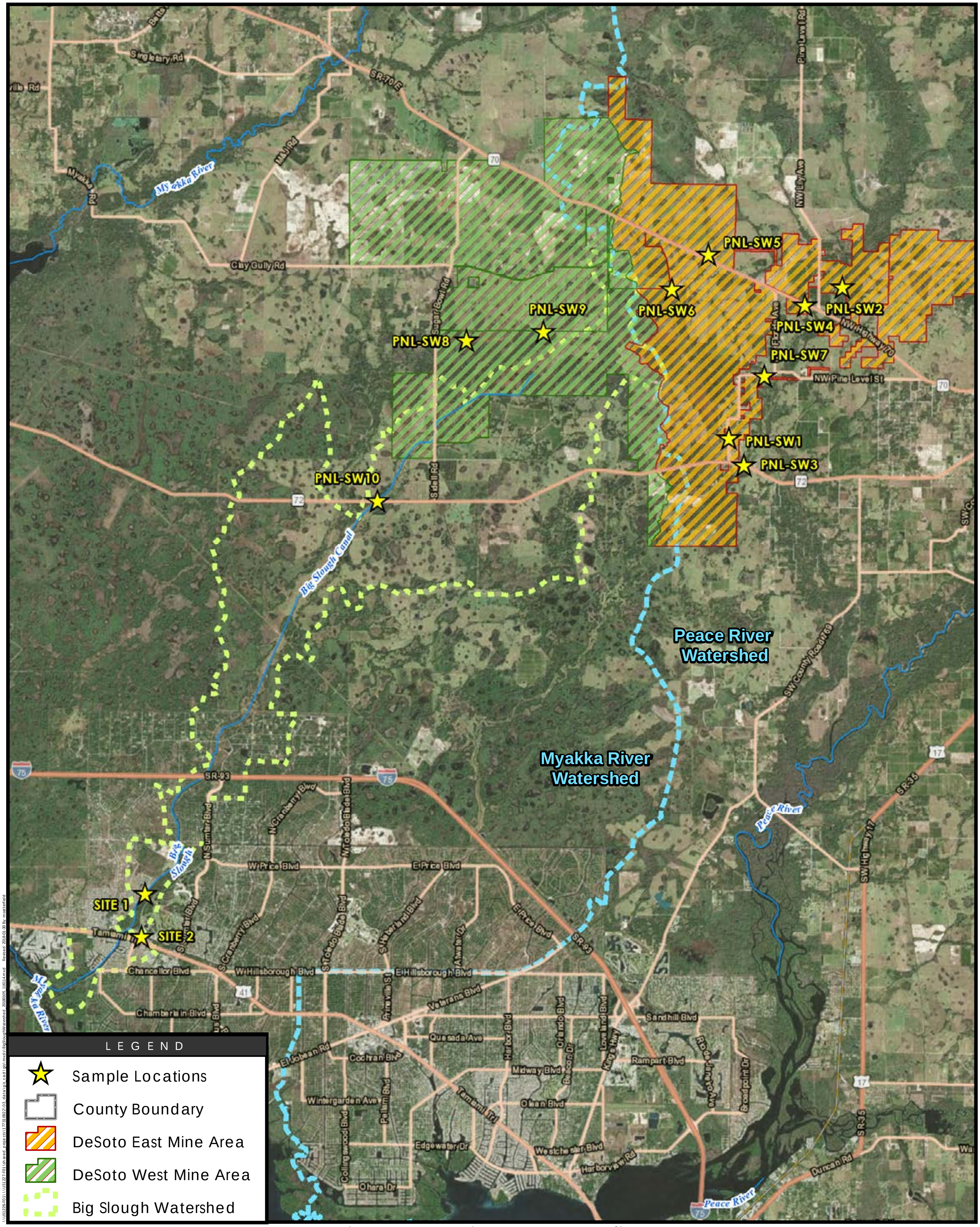
****Hydrobiological data is Pheo corrected (unknown if PNL data is corrected)

Yellow highlight indicates Big Slough/Myakkahatchee Creek sites



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NOTES:
1. Coordinate System: NAD 1983 StatePlane Florida West FIPS 0902 Feet
2. Source data: SWFWMD
3. Imagery: BING MAPS & ESRI WORLD TRANSPORTATION LAYER

Figure 5-1: Surface Water Quality Sample Locations

January 2018

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0 7,750 15,500 Feet

N

Prepared by: M.S. 01/30/18

Table 5-2: Water quality data comparing background, NPDES outfall and downstream water quality for select mine discharges (AEIS, 2012).

Location	Site	pH	Specific Conductance (umho/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Total P (mg/L)	Total N (mg/L)	Chl-a (ug/L)
Four Corners Mine - 1 2005-2010	Background	6.78	268	2.97	5.03	0.91	1.46	1.89
	Outfall	7.26	584	16.15	6.29	1.22	0.87	6.7
	Downstream	7.18	556	5.86	6.62	0.68	1.12	4.89
Four Corners Mine - 2 2005-2010	Background	6.68	217	1.86	3.31	0.87	1.7	11.83
	Outfall	7.48	870	5.29	7.5	1.23	1.03	18.46
	Downstream	6.85	643	3.36	5.79	0.96	1.03	8.8
Wingate Mine - 1 2005-2010	Background	6.7	258	4.2	6.9	0.47	2.15	2.75
	Outfall	6.9	481	4.7	7.3	0.88	0.9	3.7
	Downstream	6.7	375	1.9	7.2	0.29	1.02	3.7
Wingate Creek Mine - 2 2005-2010	Background	6.9	323	5.7	5.7	0.31	1.09	2.69
	Outfall	7.3	671	6.2	8.2	1.41	1.07	14.53
	Downstream	7.2	612	6	7.5	1.23	1.33	11.37
Fort Green Mine - 5 2006-2011	Background	7.4	442	5.9	6.47	0.95	1.57	NA
	Outfall	7.2	508	5.5	NA	1.03	1.6	12.58
	Downstream	7.6	445	4.6	7.1	0.82	1.45	NA
Kingsford Mine - 5 2008-2010	Background	7.2	236	13.7	6.05	0.36	2.13	37.2
	Outfall	7.8	465	7.6	7.77	0.72	1.43	38.4
	Downstream	7.5	361	7.6	5.27	0.53	1.88	28.6

Publicly available data from government monitored sample locations were searched, but the data associated with the monitoring sites was typically insufficient to make a comparable assessment for water quality parameters of interest. As stated above, water quality data reported by the mines to the FDEP is reported in dozens or hundreds of documents, many of which are in excess of 100 pages long. In addition, it should be noted that the data presented above for actual mining situations is not from the Big Slough watershed as there are currently no active mines in the watershed, and therefore, due to differences in land use, soils, geology, hydrological connectivity and other natural features, data collected from other watersheds may or may not be representative of conditions found in the Big Slough watershed. Data from the AEIS appears to be the best publicly available data related to water quality impacts from mining operations.

6.0 PREVIOUS SPILL/POLLUTION INCIDENTS RELATED TO PHOSPHATE MINING

The summary below includes incidents in Florida related to both gyp stacks and CSAs. Incidents related to CSAs are in bold as they are the most relevant incidents for the City of North Port. Information regarding gyp stack incidents is included for reference to distinguish the risks for this site from recent incidents that have appeared in the news.

6.1 CLAY SETTLING AREA INCIDENTS

- 1940-1967 – 26 documented clay settling area dike failures (AEIS, 2012).
- 1971 – Cities Service Company – Catastrophic failure of clay settling area discharged 2.3 billion gallons of wastewater into the Peace River, resulting in a fish kill (AEIS, 2012). Florida Rule 17-9, F.A.C. was adopted as a result of this spill. This Rule specified criteria for the construction, operation, maintenance and inspection of engineered earthen dams (now covered under Rule 62-672).
- 1994 – IMC Payne Creek Mine – an internal clay settling area dam failure resulted in a release of 2-3 billion gallons of wastewater, mostly onto adjacent CF Industries property, although approximately 127 million gallons escaped into Hickey Creek (which drains to Paynes Creek and then the Peace River). (AEIS, 2012).
- 1994 – IMC Hopewell Mine – Clay settling area dam failure resulted in approximately 482 million gallons being released ultimately into the North Prong of the Alafia River. (AEIS, 2012). Rule 62-672 (formerly Rule 17-9) was amended as a result of this spill to require improvements in spillway design (construction methodology on the spillway was determined to be the cause of the 1994 failure). The amended Rule also required inspection of pre-rule dams and BMP requirements for non-clay impoundment berms. (AEIS, 2012).

*****NOTE: There are no known incidents involving CSA spills since 1994 (AEIS, 2012 and document research).**

6.2 PHOSPHOGYPSUM STACK AND OTHER INCIDENTS

- 1962 - American Cyanamid Spill – 3 billion gallons of acidic water was released from a gyp stack due to a break in a dike around a new gyp stack/cooling pond. The water entered Hookers Prairie but was stopped before entering the South Prong of the Alafia River and the contaminated water was treated with lime. The lime treatment and prevention of water from entering the Alafia River resulted in a very low fish kill (a few bushels) (Foley and Pollock, 2000).

- 1988 – Large release of gyp stack water into the Alafia River from the closed Gardinier facility, releasing about 40,000 gallons of acidic waste from a storage tank into the Alafia River (AEIS, 2012).
- 1993 – Cargill facility gyp stack spill into Archie Creek, size of spill was undisclosed.
- 1994 – A sinkhole opened under the gyp stack at the IMC plant and released water into the groundwater at this location.
- 1997 – Mulberry Phosphates – 50 million gallons of acidic gyp stack water was discharged into a marsh and small ponds and some of the spill reached the North Prong of the Alafia River. Mulberry Phosphates was prevented from treating the river with lime and an estimated 50,000 to 3 million fish, blue crab and shrimp were killed as a result of the spill (Foley and Pollock, 2000) along a 30 mile stretch of the river (PBS&J, 2007).
- 2004 – Cargill - Hurricane Frances resulted in a release of 65 million gallons of gyp stack water to Archie Creek resulting in a fish kill (Pittman, 2017).
- 2010 – CF Industries required to pay millions in penalties and provide $163.5 million in financial assurances to close a gyp stack at its Plant City facility (USEPA, 2010).
- 2001 – Piney Point – Tropical Storm Gabrielle resulted in a release of over 1 billion gallons of acidic gyp stack water (FDEP, 2001). The spill resulted in an addition of 16.2 tons of nitrogen into Bishop's Harbor, raising nitrogen levels from 1 to 33 ug/L, increasing chlorophyll levels from 10 to 25 ug/L, and reports of murkiness in the water and reduced fish catches (http://baysoundings.com/legacy-archives/sum02/pineypt.html).
- 2011 – Piney Point gyp stack released 170 million gallons of acidic water from dredged material into Bishop Harbor (Slaman, 2013). Sources do not describe the impact the spill had on the harbor.
- 2015 – Settlement reached between Mosaic and USEPA for RCRA violations to establish a $1.8 billion trust fund for closure of gyp stacks at 8 sites in Florida and Louisiana – including the Bartow, New Wales and Riverview Plants. $8 million in civil penalties were also assessed (USEPA, 2015).
- 2016 – Mosaic Sinkhole, New Wales facility – A sinkhole opened under a gyp stack at Mosaic's New Wales facility, allowing at least 215 million gallons of waste to drain into the sinkhole (Earthjustice, 2016).

- 2016 – Mosaic Plant City – Release from Plant on County Line Road. Approximately 50,000 gallons were released when a connection between a pump and motor failed (The Ledger, 2016).

7.0 FDEP REPORTS FROM EXISTING MINES

Hundreds of documents regarding dozens of different types of reports, some of which are hundreds of pages long, are available through the FDEP web site (http://prodenv.dep.state.fl.us/DepNexus/public/searchPortal) and therefore a thorough review of all reports is not possible within the scope of this work effort. Also, reports were not found in the form of a summary of annual water quality data, water flows in streams, etc. This information was typically spread through numerous reports with one page for each sample location, of which there are dozens or hundreds.

8.0 SUMMARY OF RISKS

8.1 WATER QUANTITY

The risk to the quantity of water available to the City's water supply appears to be low but present. Many studies have attempted to measure actual and/or model predicted streamflow changes over many years. These studies have resulted in a wide range of results. However, overall it appears that there will be at least a small reduction in flows by 2050 (as much as 6% annual average and wet season, and 7% in the dry season according to the AEIS) in Big Slough during active mining.

8.2 WATER QUALITY

8.2.1 Active Mining

With respect to water quality associated with active mining, the risk of water quality degradation to the City's drinking water supply appears to be low. While mine outfall water exceeds water quality criteria for fluoride and is elevated for several parameters, the outfall water only flows after significant or prolonged storm events and downstream waters have remained well within state Class I and Class III water quality standards for the mines discussed here. Also, phosphate mining has been occurring in the Peace River Basin for many years and the Peace River itself does not currently have any TMDLs assigned to it, except for fecal coliforms above Bowlegs Creek.

8.2.2 Spill Events

Water quality impacts associated with gyp stack failures are not an issue in this watershed as no new fertilizer plants are currently planned. All of the spill events associated with phosphate mining in the past 23 years have been associated with fertilizer plants and gyp stacks.

Water quality impacts from CSAs are probably low in this watershed. While CSAs are planned upstream of the City, changes to engineering design requirements after previous spills have resulted in no clay settling area spills in the CFPD since 1994. However, dam failures are still possible, particularly following extreme weather events, and a CSA spill into Big Slough could be catastrophic to the City's drinking water supply.

9.0 RECOMMENDATIONS FOR FURTHER ACTIONS

Based on the overview of phosphate mining considerations described above, as well as a consideration of the City's interest in protecting its drinking water supply, the following items are recommended to the City for future courses of action:

- Collaboratively work with Mosaic staff and permitting agencies to remain fully informed of permitting and design processes related to the DeSoto West mine. Agencies include DeSoto and Manatee County, the USACE, FDEP and SWFWMD and notification requests should be submitted to each agency for the City to receive copies/notification of submitted materials.

- Collaboratively work with Mosaic staff to use mine pits to detain excess water during rainy periods to alleviate flooding in the City, and to release the detained water during drier periods.

- Work through regulatory agencies during permitting processes to review submittals and provide feedback to the agencies for items that might affect the City to ensure that existing regulations are fully met, that extra protections for Big Slough be required as appropriate, and to provide site specific information that the City might provide that might not otherwise be available to the agencies and/or Mosaic.

- Remain in regular contact with Manatee and DeSoto County mining program staff to monitor the progress of County approvals and opportunities to submit feedback at various stages of the approval process, which has not yet begun for Manatee County related to the DeSoto West mine.

- The City should request copies of annual reports submitted by Mosaic to SWFWMD related to baseline water level monitoring that will occur over several years prior to permit issuance, and copies of water quality data submitted to the FDEP prior to and during mining.

- The City should begin baseline monitoring fluoride levels at the Appomattox NPDES/hydrobiological water quality monitoring site (Site 1).

- The City should work with Mosaic to verify that the same water quality parameters being monitored before and during mining for the DeSoto East Mine, per FDEP ERP No, 331292.001, are included in baseline and during-mining monitoring for the DeSoto West Mine FDEP permit, particularly at the Big Slough at SR 72 surface water sampling location. The parameters monitored should include pH, dissolved oxygen, conductivity, turbidity, total alkalinity, hardness, total suspended solids, total phosphorus, ammonia, orthophosphate, total nitrogen, Total Kjeldahl Nitgrogen, nitrate/nitrite, fluoride, sulfate, total organic carbon, chloride, chlorophyll-a, akuminum, selenium, calcium, magnesium, arsenic, calcium, chromium, iron, lead, nickel, zinc, gross alpha and radium 226/228.

- The AEIS used conservative estimates of 50% and 100% for the amount of stormwater retained onsite to determine an estimated 6-7% flow reduction in Big Slough during mining. However, the AEIS (2012) indicated that Mosaic has said a 35% retention rate is more accurate. The City might request that surface water flows be modeled for the 35% retention scenario during the permitting process.
- Request that CSAs be located as far away from Big Slough as possible and/or that extra protections for Big Slough be added, as appropriate.
- Request that mining occur in the smallest possible footprint at any given time and that the mined areas be restored as quickly as possible after mining is complete, minimizing the area covered by open pits at any one time.
- Work with Mosaic staff to remain informed about baseline water quality monitoring data that might already be collected, or to be collected in the future, provide input on monitor site locations where possible and request collected data either from Mosaic or from FDEP or SWFWMD, as appropriate.

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