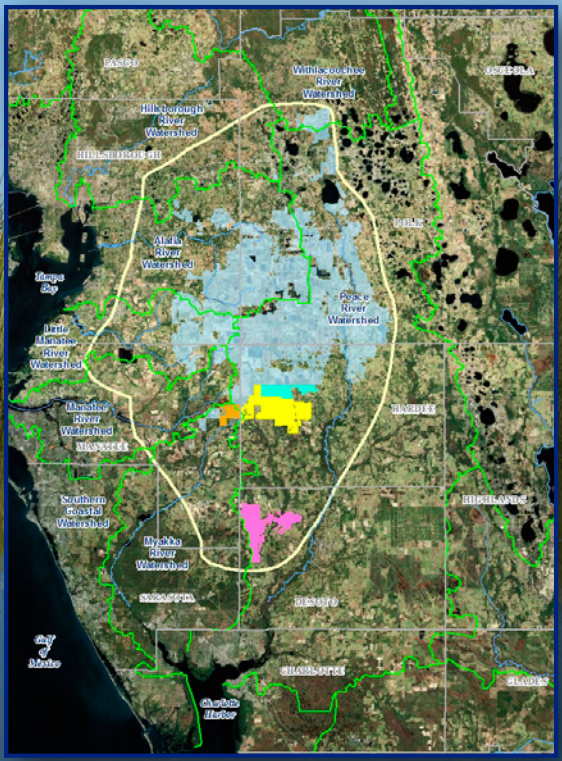
Appendix J
Impact Evaluation Methods for the Final AEIS on Phosphate Mining in the CFPD



Impact Evaluation Methods for the Final AEIS on Phosphate Mining in the CFPD

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1.0 Introduction

Impact evaluations for each of the alternatives were often performed using publically available geographic information system (GIS) databases and supplementary data from the four applications for the Applicants' Preferred Alternatives plus the four offsite alternatives. Mosaic also provided some additional information about the Pine Level/Keys and Pioneer offsite alternatives. Relevant literature and information provided by the public during the scoping and Draft Areawide Environmental Impact Statement (DAEIS) comment periods further added to the database. Additional evaluations that went beyond GIS review, as described in the following sections, were performed for surface water resources, groundwater resources, ecological resources (including fish and wildlife habitats), and economic resources. Offsite alternatives were part of the evaluation, but because of the lack of site-specific, ground-truthed information about these sites and a lack of site-specific mine plans for these alternatives, their impact on resources was largely inferred based on current mining practices and proposed mining operations for the Applicants' Preferred Alternatives. The offsite alternatives A-2 and W-2 were the most speculative of the four offsite alternatives and had even less available data, which further limited the evaluation for some resource categories.

2.0 Surface Water Quantity Evaluation Methods

Evaluation of the potential effects of phosphate mining alternatives on surface water resources within the AEIS study area focused on addressing concerns that the expansion of mining could result in reduced quantities and quality of surface water to downstream reaches of streams and rivers, and to the Charlotte Harbor estuary. Reduced surface water flow and/or quality caused by a single mine or as a cumulative impact from multiple activities, including mining as well as other water users, could result in impacts to downstream aquatic biological communities, wildlife habitat, listed species, wetlands, recreational activities, or public water supplies. This section describes the methods used to assess the surface water quantity, while the next section describes water quality analysis methods.

The surface water quantity evaluation for the Final AEIS included modifications to address public comments, although the overall methodology to predict surface water flow from the landscape was similar in the Draft and Final AEIS. The stormwater capture curves were mostly the same in both analyses with minor adjustment of the Pine Level/Keys Tract boundary provided by Mosaic as a GIS shape file after publishing the Draft AEIS. The capture curves were adjusted to better align with subwatershed boundaries. The runoff coefficient approach was retained to estimate seasonal surface water delivery from the subwatersheds, but projected land uses in previously mined areas (extractive land use) that had been modified provided a better assessment of the impacts from reclamation and release of the existing mines.

Evaluations added to the Final AEIS to address comments on the Draft AEIS included an analysis of 50 percent capture of stormwater on active mined lands. This additional analysis provides an evaluation of average capture rates that are closer to information available from the Applicants' water use permit (WUP) applications. This

50 percent capture scenario is still very conservative but the 100 percent scenario evaluated in the Draft AEIS was also retained to provide an even more conservative bounding analysis approach.

New excess precipitation computations for active mine blocks were developed for the Final AEIS for use with the new 50 percent capture scenario. This 50 percent capture analysis also was used in the groundwater modeling to determine the recharge rates at the Applicants' Preferred Alternatives. Surface water computations and results were updated to incorporate these changes.

A new low-flow analysis near the existing Peace River/Manasota Regional Water Supply Authority (PRMRWSA) intake was added to perform a bounding analysis of potential surface water supply impacts. However, there were insufficient data to conduct a comparable assessment at the City of North Port's intake location. In addition, this Final AEIS includes more definitions, assumptions, and explanations in Chapter 4 and Appendix G to address public comments and to add clarification to the document.

Information on the proposed durations and schedules of mining were available for each of the four Applicants' Preferred Alternatives: Desoto Mine, Ona Mine, Wingate East Mine, and South Pasture Mine Extension. Two of the four offsite alternatives (Pine Level/Keys Tract and Pioneer Tract) were considered reasonably foreseeable and likely to occur in the timeframe of the AEIS, based on their being likely extensions of the Desoto and Ona Mines, respectively. Therefore, conceptual mine plans were prepared for these two offsite alternatives based on information on site boundaries provided by Mosaic and assumptions based on other similarly sized mines for which mine plans were available. In considering these two offsite alternatives as independent mines to either of the Applicants' Preferred Alternatives, the scheduled implementation of these offsite alternatives would be moved up in time but the magnitude of their impact on surface water flow would be similar to that indicated by their evaluation as extensions to other mines.

The other two offsite alternatives (Sites A-2 and W-2) are more speculative since there has been no apparent interest by the Applicants to date in their future use. As a result, mine plans and site-specific information on potential mining activities are not available for these alternatives. Additional details on potential mining activities would be required before site-specific impact analyses could be completed. Therefore, rather than perform detailed modeling analyses, evaluations of these additional offsite alternatives are based on extrapolation, applying results from other analyses to the extent practical, using information on the size of the site, its location, existing land use, and other readily available information.

The temporal scope of the direct and indirect impacts analysis for each alternative is for the life of the mine operations, including reclamation, or through 2060. The Pine Level/Keys and Pioneer Tracts are considered both as individual mines as well as extensions to other mines under a cumulative impact analysis. The timeframe for these mines vary in each case: as an independent mine alternative, it is assumed they would start in 2025 and extend to about 2060; as extensions to other alternative mines, they would start after these host mines closed and extend beyond the year 2060. But no analyses are considered beyond a 50-year timeframe since the mines included under the Applicants' Preferred Alternatives would all be closed by that date.

The locations of the Applicants' Preferred Alternatives in relation to the Peace River and Myakka River watersheds and specific subwatersheds within the overall river watersheds are shown in Figures 1 and 2. Of the four Applicants' Preferred Alternatives, three are primarily in the Horse Creek subwatershed, with smaller areas in the Peace River at Arcadia subwatershed (Desoto Mine, Ona Mine, and South Pasture Mine Extension) and one (Wingate East Mine) is primarily in the Upper Myakka River subwatershed. One of the four offsite alternatives (Pioneer Tract) is similarly aligned within the Horse Creek and Peace River at Arcadia subwatersheds (about equally split between them), and a second (Pine Level/Keys Tract) is primarily in the Big Slough subwatershed in the Lower Myakka River subwatershed with a fraction located in Horse Creek. Because the Big Slough Basin is the only waterbody in the Lower Myakka River subwatershed affected by any of the alternatives considered, these are treated together as the Big Slough/Lower Myakka Subwatershed.

FIGURE 1

Location of the Alternatives in Relation to Peace River Subwatersheds

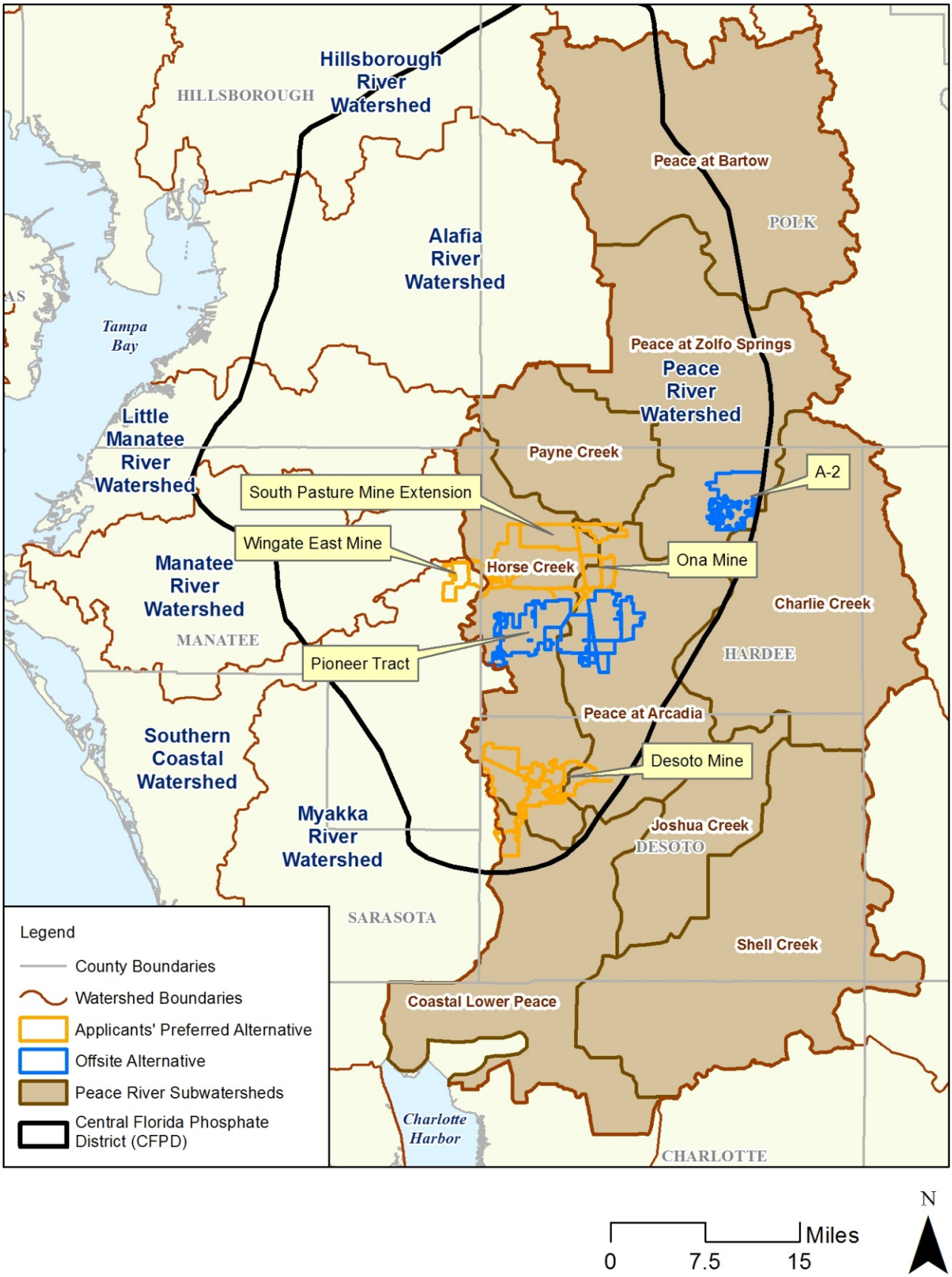
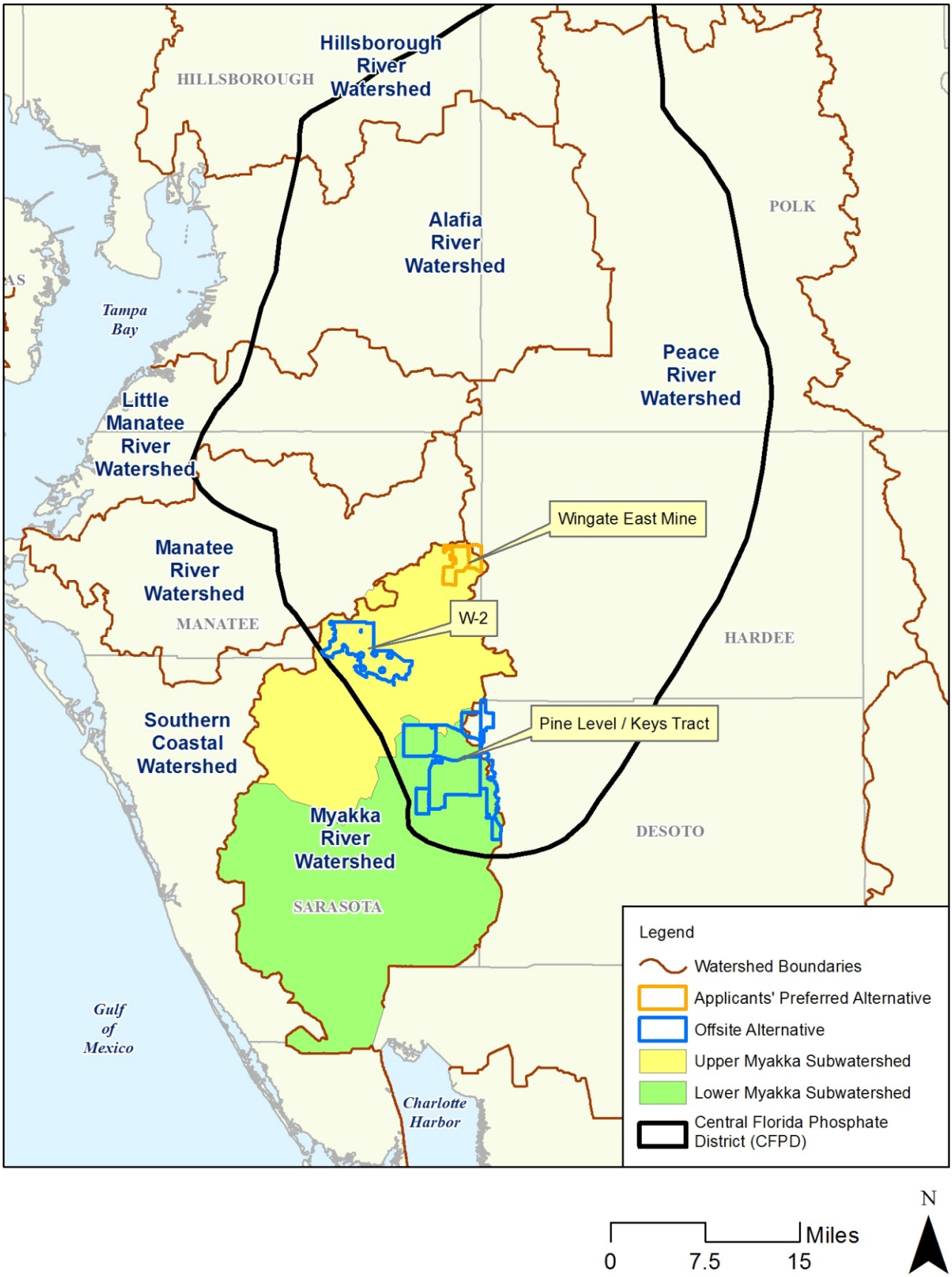


FIGURE 2

Location of the Alternatives in the Myakka River Subwatersheds



Accordingly, this surface water hydrologic analysis primarily focused on these three specific subwatersheds (Horse Creek and Peace River at Arcadia in the Peace River watershed and the Big Slough/Lower Myakka in the Myakka River watershed) within the AEIS study area, and subsequently to Charlotte Harbor estuary. The other two offsite alternatives are in the Peace River at Zolfo Springs (Site A-2) and the Upper Myakka River (Site W-2) subwatersheds. As discussed previously, analyses of these two offsite alternatives were qualitatively conducted for surface water direct and indirect impacts. Some of the alternatives also had smaller areas overlapping the subwatershed boundaries as defined by federal water resource agencies (U.S. Geological Survey [USGS] and U.S. Department of Agriculture [USDA]), and these are addressed as appropriate. The subwatershed boundaries and alternative boundaries do not always coincide in the GIS database. Furthermore, the landscapes at the upland boundaries are typically flat and some historic flow paths have been altered by ditching. This leaves some portions around the subwatershed boundary uncertain as to where runoff may flow. Very small areas and some larger areas, which are identified in the analysis, were considered insignificant because it was determined that the expected impact of an area of 500 acres or less would be less than 1 cubic foot per second (cfs) on an average annual basis. All flows were rounded to the nearest cfs, so small changes in flow would not be significant at the subwatershed scale.

During the ore extraction phase of phosphate mining (i.e., active mining), much of the direct rainfall on a given mine area is captured and held within a mine's recirculation system, consisting of a network of open-channel ditches and canals, clay settling area (CSA) impoundments, and a network of pipelines used for conveyance of water, matrix, sand, and clay slurries. Following capture, the stormwater is used and reused to support these conveyances and other onsite treatment and mitigation functions, with excess rainfall being released through National Pollutant Discharge Elimination System (NPDES) permitted outfalls or seeped into the surrounding surficial aquifer system (SAS) to hydrate adjacent wetlands and streams. For the AEIS, the direct impact of capturing the stormwater onsite at proposed mines was represented by capture area curves (area of mine included in the recirculation system at any given time). The reuse of onsite stormwater was a recommendation by the U.S. Environmental Protection Agency (USEPA) in their 1978 EIS for the phosphate industry as a way of reducing groundwater withdrawals (USEPA, 1978b).

The offsite, indirect impacts required a reasonable quantification of the potential reductions in offsite flow rates during active mining to evaluate the reduction of runoff to downstream resources that may occur on a long-term average basis. Following reclamation and the release of blocks of land from the control systems, the reclaimed land use responds hydrologically closer to pre-mining conditions (see Appendix G). The following section includes a description of the evaluation method and assumptions used in the AEIS for surface water flow estimates.

The AEIS had to support detailed assessment of the potential impacts on net downstream water deliveries for the subwatersheds affected by the Applicants' Preferred Alternatives and the offsite alternatives in various stages of mining and reclamation and for the overall river watersheds far into the future. The surface water effect of the No Action Alternative also had to be assessed. The methodology applied to assess surface water runoff changes had to meet the following goals:

- Account for runoff differences between different soils and land uses
- Support analysis of affected subwatersheds as well as the overall river watersheds where the subject mines are located
- Account for a seasonal component since central Florida has distinct dry and wet seasons
- Account for changes in land use, including mining, far into the future (to 2060) with reasonable accuracy and sensitivity

A review of available methods and computer models is provided in Appendix G. In summary, no detailed hydrologic computer simulation models have been developed for the entire study area that could be readily applied without significant expense and lengthy work. Detailed hydrologic computer modeling of short-term relationships was not viewed as an appropriate technical approach to support the AEIS evaluations. Rather, a

simpler method was used that would provide long-range predictions that account for changes in land use over time both within the mine footprint as well as for the subwatersheds where the mines are located.

2.1 Runoff Calculation Method Overview

The approach adopted to estimate the offsite surface water delivery is based on the one used for a recent analysis of pollutant loading to the Charlotte Harbor estuary performed on behalf of the Charlotte Harbor National Estuary Program (CHNEP) by Janicki (2010). The evaluations conducted for the CHNEP coupled the hydraulic evaluations of watershed runoff with water quality information to generate pollutant load estimates. For the AEIS evaluations, the method adopted was based on the hydraulic component of the overall pollutant loading analysis.

Runoff amounts resulting from the rainfall on the land not in the Applicants' Preferred Alternatives were calculated taking into account a combination of factors, including watershed and subwatershed boundaries (acreages), land uses, and soil hydrologic groups. The combination of land use and soil types was used to develop land use-specific runoff coefficients.

For any given watershed, the flow for a given seasonal or annual period can be calculated by applying the equation:

$$Q = C_D * A * P * j * k$$

This equation is part of a pollutant loading method sometimes called the USEPA Simple Method, and it is often used to predict annual runoff for pollutant loading estimates. For this equation:

Q is the flow in cfs

C_D is the runoff coefficient for the contributing subwatershed

A is the drainage area that contributes flow to the gaged location

P is the total precipitation during the analysis frequency (annual or seasonal)

j is the long-term hydrologic adjustment factor

k is a factor applied for units conversion

The USGS maintains flow recording gages near the downstream ends of each of the major subwatersheds identified in Figures 1 and 2. To calculate seasonal and annual flows in the subwatersheds at the USGS gage stations, the subwatershed-level runoff calculation method was calibrated to the AEIS subwatersheds of interest in the Peace and Myakka Rivers. This was done by using historical rainfall records and GIS-based data for subwatershed boundaries (and subwatershed acreage), soil hydrologic types, land use information, and land use-specific runoff coefficients developed by Janicki (2010) for land areas tributary to the Charlotte Harbor estuary. The referenced long-term hydrologic adjustment factor was used for calibration of this runoff assessment approach to the specific subwatersheds in the study area. In general, j is used to account for a variety of influences on the retention and storage volume within a watershed (for example, either in lakes and reservoirs or in the subsurface soil layers) and it varies between subwatersheds and with annual rainfall amount (i.e., wet year or season versus dry year or season).

This analytical method was tested against USGS gaged flows within the Peace River and Myakka River subwatersheds to validate this empirical approach for the AEIS evaluations. Detailed information on the data used to support method development and the results of method validation analysis are presented in Appendix G. Figures 3 and 4 reflect the method validation demonstration. The discharge calculations generated through this land-use based runoff assessment method closely matched the measured flows based on the applicable USGS gage records. In general, the accuracy of predicting average annual flow rates at the subwatershed level (i.e., at the USGS gages) was about the same as reported for studies with more detailed computer modeling. Using the long-term adjustment factor as a calibration factor for the runoff coefficient water balance approach provided reasonable results when compared to measured flow records. By calibrating these coefficients to observed flow data, the past and present indirect impacts of mining on subwatershed surface water yield are implicitly included in the baseline 2010 conditions.

FIGURE 3

Calculated and Measured Flows at the Horse Creek USGS Gage

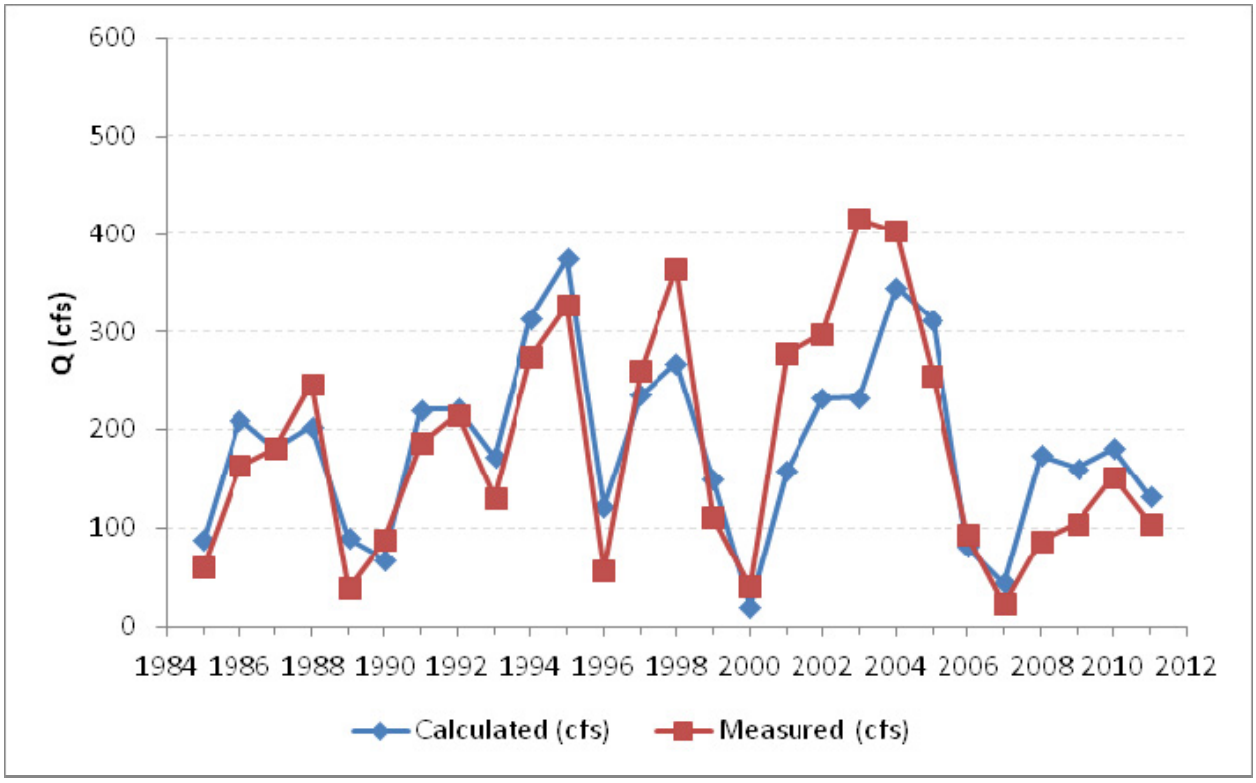
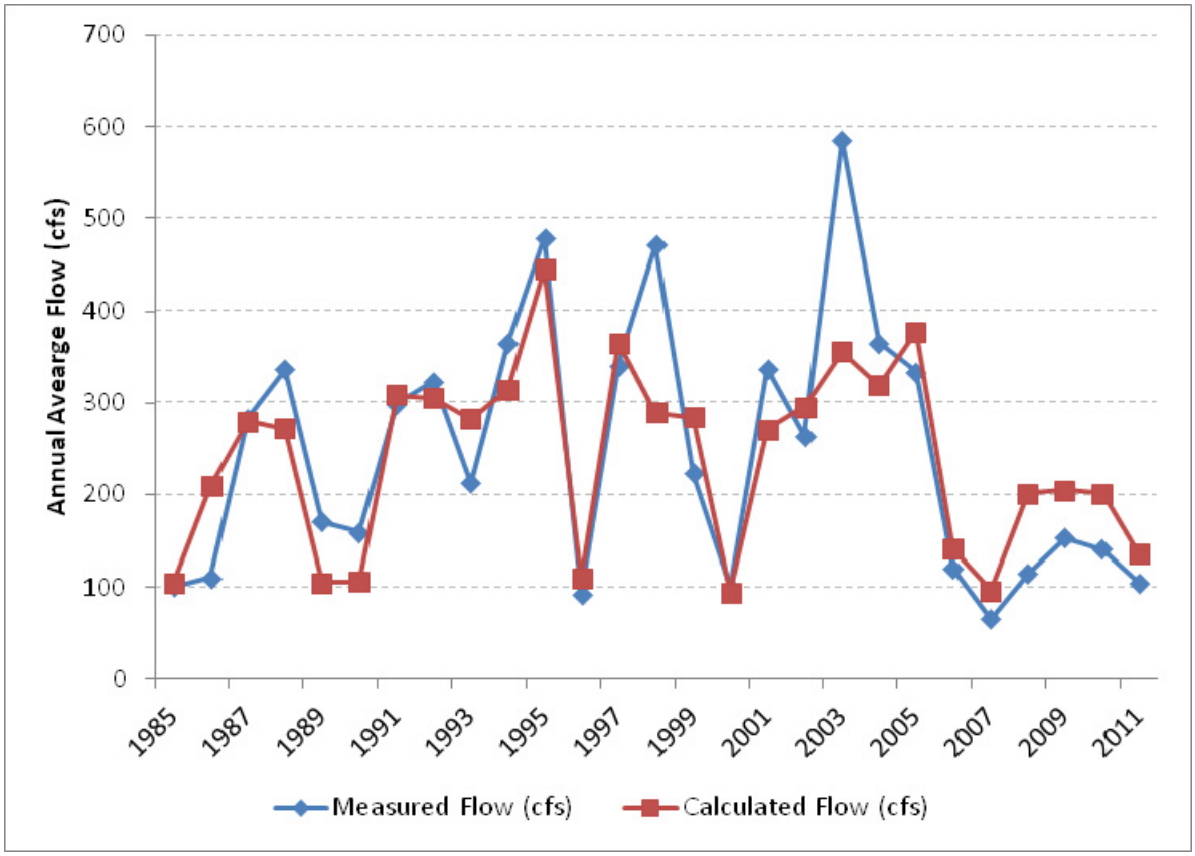


FIGURE 4

Calculated and Measured Flows at the Upper Myakka River Subwatershed USGS Gage



2.2 Key Assumptions Supporting Surface Water Runoff Analyses

Several key assumptions were applied during the surface water evaluations. Because stormwater runoff from natural land is associated with land use, future land use was estimated based on long-term trends and the available information about the existing mines. The No Action Alternative was estimated assuming that no new future mining would be initiated, even though some upland mining could occur if permits were denied and the Applicants modified their applications to avoid jurisdictional wetlands and surface waters. This assumption is conservative for the No Action Alternative because higher surface water flows would be predicted in the future if no additional mining area is captured. If there were mining in uplands only, then the downstream No Action Alternative flows would be somewhat higher because essentially the areas in the capture curves would likewise be smaller. Consequently, the greatest computed impact from the No Action Alternative would be to assume no future mining in these subwatersheds.

Existing mines were assumed to complete mining on schedule and their reclaimed land was assumed to return to predominantly agricultural land use. Additional information about the basis for these computations is provided in Appendix G.

One key assumption was that the current practice of using ditch and berm systems would continue at all mine alternatives to prevent uncontrolled offsite runoff from the active mining area to offsite lands, and also to support capture and retention of surface water within the mine's recirculation system to conserve groundwater and to help hydrate surrounding surficial groundwater. The capture of stormwater at mine sites and the controlled release through outfalls permitted as industrial point source discharges (NPDES) is a regulatory requirement.

Mosaic and CF Industries have included specific features designed to maintain the levels in the surrounding surficial aquifers during mining. The baseflow component and the post-reclamation conditions are addressed by USEPA regulations published at Title 40, Code of Federal Regulations, Part 436.180 (40 CFR 436.180) requiring Mosaic and CF Industries to construct a berm around the perimeter of active mining and reclamation areas to capture stormwater to preclude nonpoint discharges of turbid water and resulting water quality violations. Mosaic and CF Industries design their perimeter ditch and berm systems to contain the runoff generated by a 25-year, 24-hour storm event (Florida Department of Environmental Protection [FDEP], 2006c). Water captured in the ditches adjacent to the berms is routed to CSAs for quiescent settling of solids and subsequent water reuse in the mining process, or is discharged through an outfall permitted under Section 402 of the Clean Water Act (an NPDES permit). Use of this water quality treatment system creates the potential for changes in overland flow to streams as well as the timing of flows, or the stream hydrographs. Mosaic and CF Industries are proposing to site a series of permitted outfalls adjacent to surface waters on or near project boundaries. Use of multiple outfalls would offset the loss of overland flow to the extent practicable as required by 40 CFR 436.180.

Large areas that are to be mined (mine blocks) are surrounded by ditch and berm systems before active mining operations and the ditches support surface water management for the active mine areas until those lands are reclaimed and subsequently re-connected to the watershed by removing the ditch and berm systems (also referred to as being "released" from the regulated areas). Each mine plan shows how the active mining would proceed by mine block during discrete periods of time.

The sequencing of ditch and berm installation around mine blocks, and subsequent reclamation and release schedules, define the timing and duration of removal of the particular mine block areas from contribution to downstream runoff except through NPDES outfalls and seepage from the surrounding ditch and berm systems. The acreage included in a mine's "capture area" varies over time, with the theoretical capture area curve following a somewhat parabolic shape over the course of a given mine's life cycle (these curves are presented in Chapter 4 and in Appendix G). The amount of an active mine's total footprint that is removed from contribution to downstream water deliveries is less than the total footprint, and the relative influence on downstream water deliveries is variable rather than static. Understanding the effects of a given mine on downstream water deliveries thus requires assessment of this dynamic relationship over the full life cycle of the mine. Details on the analysis of capture area relationships for each of the alternatives with schedules are provided in Appendix G.

The capture curves for each of the Applicants' Preferred Alternatives and reasonably foreseeable alternatives were developed as an independent analysis of possible mine acres directly impacted over the life of the mine. The capture area for a given mine represents the portion of the mine which retains its stormwater within the recirculation system for the period of time required to prepare the land for mining, mine the land, fill the mine pits with overburden and sand tailings, reclaim the land, and then monitor water quality until there is adequate documentation allowing mine block release from within the industrial operations' boundaries. The following assumptions based on typical current mining practices were applied in determining the capture areas for each of the four Applicants' Preferred Alternatives as a function of time during the individual mine's life cycle:

- Land clearing is initiated 1 year prior to mining.
- The ditch and berm system is constructed prior to land clearing.
- Areas to be isolated by the ditch and berm system and how the blocks would be mined were defined in the mine plan, based on current practices and typical dragline production rates (except for Wingate East Mine, which uses a hydraulic dredge).
- The active mining operation includes the filling of the mine cuts with sand tailings.
- The reclamation parcel is re-connected to the watershed 1 year after completion of reclamation (total of 3 years).
- CSAs require a minimum of 5 years for consolidation and 3 years for reclamation with the overall average being 10 years from last filling.
- The mine plan and the reclamation plan submitted with the applications were used to determine the years of capture.

The capture curves developed in this manner included the mined and disturbed lands within the mine through reclamation. For each of the four Applicants' Preferred Alternatives, the capture areas developed in this manner are conservative – that is, the area exceeded the maximum acres captured at any one time over the life of the mine as presented in the Applicants' mine plan data submitted in the applications. This independent estimate was applied in the AEIS process to bound potential changes to the schedule that may cause larger area impacts in the future. The capture areas are used to calculate the effect to the stormwater on the mines and associated stream flow in each subwatershed by defining approximate acres and years that the mines would impact watersheds during mining and reclamation activities. A similar analysis was used for the two reasonably foreseeable mines (Pine Level/Keys and Pioneer Tracts) to develop conceptual mining schedules and corresponding capture curves. The analysis of each alternative in Chapter 4 provides the capture curves and any additional assumptions applied for each alternative analyzed with this method.

The ability of a given mine to capture stormwater may be constrained by the available storage capacity in the recirculation system at the onset of rainfall events. This creates a very dynamic system and is largely dependent on the rainfall as well as the mine schedule. For the runoff calculations for each of the Applicants' Preferred Alternatives and the Offsite Alternatives, the AEIS impacts analysis approached the assessment conservatively. The water balance data included in the Water Use Permit (WUP) applications for active mines indicated a maximum 40 percent capture of runoff at existing Mosaic mines, but the data also indicated that during dry years nearly all of the runoff could be retained. To be conservatively high in the reduction of offsite runoff from an active mine area, a runoff capture of 50 percent was assumed to be a reasonably high average surface water reduction. To be even more conservative in times of drought and to form a maximum bounding scenario, it was further assumed that all of the runoff would be captured at times. For this case, the capture area analyses applied in the AEIS ignore the fact that at times some of the water captured in the active mine areas is still delivered downstream, at least through seepage from the ditch and berm system.

The ditch and berm system collects rainfall and reuses it inside the active mines, as described above. One purpose of this system is to provide the stormwater as an alternative water supply for settling ponds in the CSAs. The water stored onsite is subject to evaporation from open water or evapotranspiration (ET) from the soil and cover.

The open water evaporation rate is higher than natural ET rates from uplands, and is a direct impact that may reduce some runoff volume. Similarly, the ET is lower for bare soil, which is another direct impact that may increase some runoff volume. To estimate the relative amount of water available to storage in a year, an annual water balance was conducted to predict the excess precipitation (Excess P) on the active mine site as follows:

Excess P = Annual P – ET – Net Recharge into Surficial Aquifer – Groundwater Discharge

The Net Recharge into Surficial Aquifer and Groundwater Discharge values were obtained from the regional groundwater model developed by the Southwest Florida Water Management District (SWFWMD) (Chapter 3). The rainfall varied by watershed and ET was assigned to the acreage at each mine site that was a CSA, open mine, or reclaimed conditions. Capture rates were applied to the Excess P to determine the direct impact of stormwater reuse for each alternative. This rate was computed for each year and applied over the Applicants' Preferred Alternatives and reasonably foreseeable alternatives schedules. The values applied for ET and the range of Excess P estimated are discussed in Appendix G.

The runoff coefficient values are defined as a function of soils and land use. The surface water delivery can be described as the direct stormwater runoff during and immediately after a rainfall event plus the rainfall that is infiltrated and seeps out to the streams later. Different authors use varying terms to describe the components of the water balance in the near-surface environment. For natural systems on sloped land, there is typically a significant volume of rainfall that infiltrates but re-surfaces at lower elevations, delayed but relatively soon after a storm (from hours to days depending on the slope and geology). While not necessarily computed as direct runoff, this delayed flow is part of the record of surface water delivery as monitored at downstream USGS gages. By using observed gage runoff data to calibrate and adjust the coefficients, the coefficients inherently include all components of the surface water delivery from a watershed. Similarly, these coefficients also implicitly include past and present flow impacts from mining because these factors are reflected in the observed data used during calibration.

The surficial aquifer is the region of most interest concerning direct soil impacts because it is dramatically altered during the mining process. The surface water runoff would be affected by the nature of the top layer of soil (A horizon) and the position of the groundwater table during the year. The amount of rainfall infiltrated is reduced during high water table conditions and stored groundwater could discharge more readily when the water table is closer to the surface. Florida rules require that the restoration of the mines meet their reclamation plan objectives, but primarily with respect to the vegetation goals. The landscape is topographically restored to contours similar to pre-mining conditions, and the soils must be returned in a manner to support their use (uplands, forested wetlands, emergent wetlands, etc.). Once the reclaimed mine is released, the outfalls are removed and there is no practical way to monitor flows. Therefore, it is presumed that the long-term runoff is similar to pre-mining conditions on an area-weighted basis. Appendix G provides an overview of an assessment of the change between pre- and post-mining runoff potential. Based on available data, the net water balances between the pre- and post-mining conditions for each alternative are considered to be similar and the differences small. The runoff coefficient method was considered adequate to apply to the reclaimed mine lands.

Often the local zoning requirements or county-level plans for future land uses influence the post-mining land use (agricultural, water features, etc.); however, on a large-scale average, most of these lands would be used for agricultural purposes after mining. Following typical practices in the region, for the AEIS assessment it was assumed that 46 percent of the mined land is reclaimed to pasture, 42 percent to row crop, 5 percent to forested wetlands, and 7 percent to non-forested wetlands. This change was applied to both the existing mined land after scheduled reclamation and the alternatives analyzed quantitatively.

2.3 Surface Water Assessment Results Format

Surface water delivery for the No Action Alternative was computed for each subwatershed where the Applicants' Preferred Alternatives and the two reasonably foreseeable offsite alternative mine sites are located, with projected land use changes that included the reclaimed existing mines. This involved calculating area-weighted average runoff coefficients for each subwatershed included in the analysis for 2020, 2030, 2040, 2050, and 2060. For each future year (the 5 cases at 10-year intervals), a spreadsheet-based computation was conducted by

applying precipitation to the area-weighted runoff coefficients derived from the soil/land use polygons within the subwatershed.

For each Applicants' Preferred Alternative and the reasonably foreseeable alternatives (six alternatives total), the mine capture area curves were applied for each time period on each subwatershed to remove that amount of the mine's area from contributing flow to downstream stream or river reaches. The Excess P estimate was used to predict the amount of rainfall captured in the 50 percent capture scenario, while all of the active area was captured in the 100 percent scenario. A revised area-weighted runoff coefficient for the remaining subwatershed (i.e., without the alternative's land area) was computed to evaluate the change to the coefficient applied for that time period's runoff calculation. Each Applicants' Preferred Alternative (Ona Mine, Desoto Mine, Wingate East Mine, and South Pasture Mine Extension) and each of the two reasonably foreseeable alternatives (Pine Level/Keys and Pioneer Tracts) was analyzed individually in Chapter 4, including the two alternatives that were qualitatively discussed (Sites A-2 and W-2). The combined effects of multiple mines operating with overlapping periods of activity were evaluated in Chapter 4.

3.0 Surface Water Quality Evaluation Methods

During and following mining, water quality parameters in mine discharges are regularly monitored and reported to the FDEP and in-stream biological conditions are also monitored through various programs (Chapter 3). Near-surface water table levels are also monitored during mining and regularly reported to SWFWMD and FDEP. The water quality assessment presented in Chapter 4 was based on recent data for current mining practices, since the Applicants' Preferred Alternatives would use similar practices.

The primary change to the water quality analysis methodology from the Draft to the Final AEIS was to add plots of the data (in Appendix D) to better illustrate the range of the data. A statistical analysis of upstream, downstream, and outfall water quality as described below was added for the Final AEIS. Additional definitions, assumptions, and explanation were added in Chapter 4 and Appendix D to address public comments and to add clarification.

Evaluation of the potential effects of the Applicants' Preferred Alternatives on surface water quality focused on discharges from NPDES-authorized mine outfalls to surface waters. Discharge monitoring results from eight NPDES outfalls at five mines were used to project the environmental consequences of all of the Applicants' Preferred Alternatives and the Offsite Alternatives on surface water quality. The monitoring data were from the following three mines that were actively involved in rock production, beneficiation, and reclamation, and two that had active reclamation projects ongoing but no rock production or beneficiation activities:

- Active Mines: Four Corners (two outfalls), Wingate Creek (two outfalls), and South Pasture (two outfalls)
- Inactive Mines: Fort Green (one outfall) and Kingsford (one outfall)

All outfall monitoring programs except the South Pasture outfalls also included background (upstream or reference locations) and downstream stations specified in the NPDES permits. Surface water quality characteristics and potential impacts were evaluated using tabular and graphic presentations of descriptive statistics for the outfall, upstream and downstream stations, statistical comparisons of paired data for outfalls and corresponding upstream and downstream stations, and summaries of the frequency of exceedances of applicable criteria where available. Detailed discussions of the methods and results of the analyses are included in Appendix D and selected portions are included in Chapters 3 and 4. Appendix D and Chapters 3 and 4 also provide additional information in response to public comments requesting more detail on numeric nutrient criteria (NNC). The results of sampling for total phosphorus, total nitrogen, and chlorophyll *a* are summarized 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 the data, and the sampling procedures that may be required to determine NNC compliance, may differ.

4.0 Groundwater Resource Evaluation Methods

A groundwater flow model was developed to support AEIS evaluations of the potential water level changes resulting from the No Action alternative and the Applicants' Preferred Alternatives. The model simulates the effects of pumping the Floridan aquifer on groundwater levels in the surficial aquifer system (SAS), intermediate

aquifer system (IAS), and upper Floridan aquifer (UFA). Modeling was not done for Pine Level/Keys or Pioneer Tracts because there are no specific water supply plans from the Applicants. Assumptions were made that those mines would use existing wellfields, thereby extending the withdrawals over a longer timeframe but not changing the quantity. Alternatives A-2 and W-2 were not modeled because no information is available on the quantity, timeframe, or water supply plans. The model was based on the SWFWMD District-Wide Regulatory Model Version 2.1 (DWRM2.1), which is a MODFLOW model (Harbaugh et al., 2000) used by SWFWMD to conduct groundwater resource evaluations and specifically support its water supply permitting and planning decisions. Additional information on the DWRM2.1 model, including its development and calibration, can be found in its documentation (ESI, 2007). A more detailed description of model development and the simulations conducted supporting this AEIS is presented in Appendix F.

For a groundwater resource evaluation, the potential environmental consequences from phosphate mining must examine potential impacts to the surficial, intermediate, and Floridan aquifers. Chapter 3 provides a discussion of aquifer systems. Use of the Floridan aquifer system (FAS) as a water supply by phosphate mines was identified as a particular issue of concern during the scoping process. The mining industry's groundwater withdrawals cause drawdown of the FAS, which could result in impacts in the form of increased saltwater intrusion, reduced groundwater contributions to regional river flows, and associated net impacts on regional water supply interests of potable water suppliers or others reliant on the Floridan aquifer for water supply purposes. These effects could be direct or indirect effects associated with a single mine, or cumulative effects associated with multiple mines, or multiple mines plus other water users. The surficial and intermediate aquifers were also evaluated using the groundwater model to determine mining operation impacts to the surficial aquifer and Floridan aquifer pumping impacts to the Intermediate aquifer.

Of the alternatives developed in Chapter 2, information on the proposed durations and schedules of mining and associated use of Floridan aquifer wells for water supply augmentation was available from the Applicants to support analysis of the existing operating mines (No Action Alternative) and the four Applicants' Preferred Alternatives (Desoto Mine, Ona Mine, Wingate East Mine, and South Pasture Mine Extension), which were designated Alternatives 2, 3, 4, and 5, respectively. As described in Chapter 3, the Wingate East Mine and the South Pasture Mine Extension are mine extensions, where new mine water supply wells and/or new FAS allocations would not be needed. The extensions would, however, extend the planned period of operations of the parent mine. The Ona Mine would require new water supply wells to be installed in accordance with the already permitted allocation from the FAS. The Desoto Mine is proposed to rely on water supply drawn from an existing phosphate mine well system, with pipeline conveyance to deliver the water to the new mine location.

These water supply strategies would be among those that could be considered by any reasonably foreseeable mine projects. Analysis of the potential effects of the Preferred Alternatives mine projects on the regional UFA, as well as the SAS and IAS, illustrates the order of magnitude effects that can be anticipated for reasonably foreseeable mine projects of similar spatial and temporal scale.

4.1 DWRM2.1 Analytical Overview

The No Action Alternative is described in Chapter 2 and Chapter 4. Under this alternative, existing mines would continue to operate as approved until the end of their rock production, but new permits for the Applicants' Preferred Alternatives would be denied, or modified to eliminate all discharges of dredged or fill material into Waters of the U.S.

Table 1 summarizes the projected periods of mine operations for the existing phosphate mines within the CFPD; this summary represents the No Action Alternative. As indicated, under the 2010 baseline set of operational conditions, the mines in rock production operation consisted of Mosaic's Four Corners/Lonesome, Hookers Prairie, South Fort Meade, and Wingate Creek Mines, and CF Industries' South Pasture Mine. Mosaic's Hopewell facility also maintained an FAS water supply allocation to support ongoing reclamation activities.

TABLE 1
Projected Floridan Aquifer Groundwater Withdrawal Rates (mad) - Alternative 1, No New Mines
Central Florida Phosphate District, FL

Year	Four Corners	Hookers Prairie	Hopewell	Ona	Desoto	South Fort Meade	Wingate	South Pasture	Total
2010	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2011	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2012	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2013	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2014	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2015	15.6	0	0.5	0	0	11.3	5.8	6.39	39.59
2016	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2017	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2018	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2019	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2020	0	0	0	0	0	11.3		6.39	17.69
2021	0	0	0	0	0	0	0	6.39	6.39
2022	0	0	0	0	0	0	0	6.39	6.39
2023	0	0	0	0	0	0	0	6.39	6.39
2024	0	0	0	0	0	0	0	6.39	6.39
2025	0	0	0	0	0	0	0	6.39	6.39

Note:
Yellow-shaded rows indicate years for which steady-state model simulations were conducted and output was generated.

The year 2010 was used as the "baseline year" representing present conditions because at the time of the start of AEIS preparation (February 2011), 2010 was the latest year for which FAS withdrawal information was compiled by the SWFWMD. Conditions of the groundwater resources evaluated using the 2010 withdrawals represented the cumulative effects of all prior phosphate mining, agricultural activities, and urban, industrial, commercial, and recreational development through 2010.

The use of 2010 as the baseline year for AEIS impact evaluations pertaining to SAS, IAS, and UFA water levels was the approach adopted to provide that "…the current aggregate effects of past actions…" was used in the AEIS' cumulative effects review. Modeling of the current FAS water supply allocations to all users of the Floridan aquifer set the baseline water levels reflecting the influences of all such users, including past uses, and future changes from this baseline to reflect the cumulative impacts of the future scenarios of water supply uses by the various water supply categories. For the groundwater modeling analyses, the nominal 2010 condition actually represents the baseline FAS water supply allocations permitted by the SWFWMD through 2006 and included in the DWRM2.1 model. Since regional water use did not change significantly for 2006 to 2010, this approach was reasonable. Use of this baseline year for comparative purposes is the typical procedure applied by all of the water management districts in assessing the potential effects of any proposed change in existing FAS water supply allocations, and the approach was adopted to support the AEIS to remain as consistent as possible with how the cumulative effects of all user categories on aquifer water levels would be evaluated by the SWFWMD.

The 2010 baseline condition represents SWFWMD's current level of FAS water supply allocations to all Floridan aquifer users, inclusive of the above listed phosphate mining operations, potable water supply systems, agriculture, recreational irrigation, industrial/commercial operations, and any other permitted wellfield systems. Where those allocations have been reduced by the mining industry, or otherwise modified over time, the FAS

water level recoveries are reflected by the baseline 2010 simulations against which all other scenarios modeled are compared.

As summarized in Table 1, by 2016, the Hookers Prairie allocation is reduced to a lower level solely supporting reclamation activities; the other water supply allocations remain essentially unchanged except for a slight reduction in the allocation for the South Pasture Mine. By 2025, the Four Corners/Lonesome Mine's water supply allocation is reduced to a reclamation support level; the others remain the same. By 2030, only the South Fort Meade and South Pasture Mines are predicted to remain in rock production operation mode. By 2035, only the South Fort Meade Mine is predicted to still be in operation, supporting reclamation. The No Action set of model runs conducted to evaluate the likely changes in FAS water levels associated with this alternative consisted of model runs for these years, highlighted in yellow in Table 1. This set of model runs is based on the no new mines scenario where the four proposed new phosphate mines would not be authorized.

In contrast, Table 2 summarizes the projected operating periods of the existing phosphate mines as well as the Applicants' Preferred Alternatives (Desoto Mine, Ona Mine, Wingate East Mine, and South Pasture Extension Mine). The Desoto and Ona Mines would be new mines with discrete predicted start and stop points in time; their indicated water supply allocations represent new FAS withdrawal allocations compared to the 2010 baseline condition. In contrast, the Wingate East Mine and South Pasture Extension Mine would merely result in increased durations of the operational periods of the Wingate Creek Mine and South Pasture Mine. The rock production operational periods for some of the Applicants' Preferred Alternatives would extend as far as 2048 based on information provided by the Applicants. This timeframe would include reclamation activities. As stated above, on the basis of these projections, the temporal scope for this issue was determined to be 40 years. Within that timeframe, selected years for which model runs were conducted to support AEIS evaluations of the No Action Alternative (Alternative 1) plus the Desoto Mine, Ona Mine, Wingate East Mine, and South Pasture Extension Mine (Alternatives 2, 3, 4, and 5, respectively), as well as the cumulative impacts of Applicants' Preferred Alternatives in combination, are highlighted in yellow in Table 2.

As the withdrawals by the industry change in quantity and location in the future, the water levels in the UFA would change in response to those pumping stresses. In much of the study area, the UFA water levels remain the same or increase, leading to no detrimental impact to other well owners. Where increased drawdown in the UFA occurs, other well owners may experience lower water levels during parts of the year. The model was used to estimate the number of other wells that may experience lower water levels by using the well location file in the model and extracting out the water level change under steady-state conditions. A summary table of the number of wells with more than 1 foot of drawdown resulting from mining withdrawals is presented in Chapter 4 and in Appendix F.

The impact of mining on changes in groundwater discharge to rivers was evaluated using the DWRM2.1 model, the surface water evaluations in Appendix G, and data from the 2010 SWFWMD Water Supply Plan (SWFWMD, 2010a. The Water Supply Plan summarized the surface water available to help meet public supply demand for each watershed. The evaluation of the changes in available surface water was performed using permitted withdrawals from surface water users and the estimated available quantities in each river provided in the 2010 Water Supply Plan (SWFWMD, 2010a). Table 3 presents a summary of surface water availability to meet public supply demand. Using the results of the surface water analysis described in Appendix G and the changes in flow from River cells in the DWRM2.1 model for Alternatives 2, 3, 4, and 5, an estimate of the combined changes in river flow resulting from mining was prepared. The results indicated a net increase in river flow as a result of land use changes in the region and an increased groundwater discharge to the rivers resulting from mining.

TABLE 2

Projected Floridan Aquifer Groundwater Withdrawal Rates, mgd - Alternatives 1, 2, 3, 4, and 5 using Drought Year and Flexible Withdrawals

Central Florida Phosphate District, Florida

Year	Four Corners	Hookers Prairie	Hopewell	Ona	Desoto	South Fort Meade	Wingate/ Wingate East	South Pasture	Total
2010 [a]	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2011	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2012	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2013	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2014	15.6	4.2	0.5	0	0	11.3	5.8	6.39	43.79
2015A	15.6	0	0.5	0	0	11.3	5.8	6.39	39.59
2015B	20	0	0.5	0	0	11.2	5.7	6.39	43.79
2015C	15.7	0	0.5	0	0	15.4	5.8	6.39	43.79
2016	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2017	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2018	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2019A	15.6	0	0	0	0	11.3	5.8	6.39	39.09
2019B	20	0	0	0	0	11.6	5.8	6.39	43.79
2019C	16.2	0	0	0	0	15.4	5.8	6.39	43.79
2020A	0	0	0	11.9	0	11.3	5.8	6.39	35.39
2020B	0	0	0	15.0	0	15.4	5.8	6.39	42.59
2021	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2022	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2023	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2024	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2025A	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2025B [a]	0	0	0	15	10.7	0	5.8	6.39	37.89
2026	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2027	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2028	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2029	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2030	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2031	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2032	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2033	0	0	0	11.9	10.7	0	5.8	6.39	34.79

TABLE 2

Projected Floridan Aquifer Groundwater Withdrawal Rates, mgd - Alternatives 1, 2, 3, 4, and 5 using Drought Year and Flexible Withdrawals

Central Florida Phosphate District, Florida

Year	Four Corners	Hookers Prairie	Hopewell	Ona	Desoto	South Fort Meade	Wingate/ Wingate East	South Pasture	Total
2034	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2035	0	0	0	11.9	10.7	0	5.8	6.39	34.79
2036A	0	0	0	11.9	0	0	5.8	6.39	24.09
2036B	0	0	0	15	0	0	5.8	6.39	27.19
2037	0	0	0	11.9		0	5.8	6.39	24.09
2038	0	0	0	11.9		0	5.8		17.70
2039	0	0	0	11.9		0	5.8		17.70
2040	0	0	0	11.9		0	5.8		17.70
2041	0	0	0	11.9		0	5.8		17.70
2042	0	0	0	11.9		0	5.8		17.70
2043	0	0	0	11.9		0	5.8		17.70
2044	0	0	0	11.9		0	5.8		17.70
2045	0	0	0	11.9		0	5.8		17.70
2046	0	0	0	11.9		0	5.8		17.70
2047A	0	0	0	11.9		0	0		11.90
2047B	0	0	0	15		0	0		15.00
2048	0	0	0	11.9		0	0		11.90
2049	0	0	0	0		0	0		0.00
2050	0	0	0	0		0	0		0.00
Transient Model Peaking Factor	1.74	1.64	1.25	1.88	1.88	1.62	1.25	1.17	

Note:

[a]Transient models also developed for these scenarios.

Minor quantities may be used for reclamation activities as facilities close down. The South Pasture Mine withdrawals in years 2036 and 2037 are for reclamation and infill parcels.

Yellow-shaded rows indicate years for which steady-state model simulations were conducted and output was generated.

TABLE 3
Surface Water Available to Meet Public Supply Demand
Central Florida Phosphate District, Florida

	SWFWMD Water Supply Plan					Watershed Wide Mining Operation Impacts from 2009 to 2050		
Watershed	**Adjusted Annual Average Flow[a]** **mgd**	**Permitted Average Withdrawal[a]** **mgd**	**2003 to 2007 Withdrawal[a]** **mgd**	**2003 to 2007 Unused Permitted Withdrawal[a]** **mgd**	**Unpermitted Potentially Available Withdrawal [a]** **mgd**	**Change in Surface Water Runoff[b]** **mgd**	**Change in Streamflow Contribution from Groundwater[c]** **mad**	**Total Change in Streamflow Contribution[d]** **mgd**
Peace River	813.0	32.8	14.9	17.9	80.4	62.69	14.52	77.21
Hillsborough River	255.0	113	91.6	21.4	TBD	NC	2.78	NC
Alafia River	261.0	23.6	15.7	7.9	18.5	NC	3.02	NC
Manatee River	117.0	35	30	5	2.2	NC	0.25	NC
Little Manatee River	98.6	8.7	3.7	5	0.2	NC	0.36	NC
Myakka River	163.5	0	0	0	41.7	18.10	1.15	19.25
Withlacoochee River	1002.0	0.5	0.01	0.49	93.2	NC	0.96	NC
Total	**2710.1**	**213.6**	**155.91**	**57.69**	**236.2**	**80.8**	**23.0**	**96.5**

Notes:
[a] Values are from SWFWMD 2010 Water Supply Plan
[b] Values are from Surface Water Analysis, Appendix G (Only the Peace and Myakka River Watersheds were assessed for future changes to flow resulting from land use change in the AEIS)
[c] Values are from Groundwater Modeling River Cells for Alternatives 1, 2, 3, 4, and 5
[d] Sum of Change in Surface Water Runoff and Change in Streamflow Contribution from Groundwater
NC = Not Calculated

Seasonal variability in withdrawal rates typically results in regional lowering of aquifer levels during the spring dry season and recovery of water levels in the winter. This evaluation was performed by first compiling regional withdrawals for all water use types for 7 years (from 1996 to 2002) using information from SWFWMD. This compilation was used to determine the monthly multipliers applicable to each water use type (i.e., public supply, agriculture, industrial, etc.). Those multipliers were used in the future model simulations to ultimately develop the seasonal water level changes tables and graphs. Seasonal recharge values were obtained from the DWRM2.1 transient model calibration files and were applied to the future model simulations in the appropriate month of the simulations. Three transient models were set up to evaluate seasonal variations within the IAS Zone 1, Zone 2, and the UFA aquifer layers using 13 stress periods, or time periods. Variations in the SAS were not evaluated because the SAS was not calibrated to transient conditions. Also, the River and Drain cell elevations were not modified from steady state. As a result, the DWRM2.1 cannot be used to reliably simulate the SAS under transient conditions. Therefore, seasonal variations in SAS water levels were not simulated. Seasonal variations can only be simulated reliably using a local-scale model that incorporates the site-specific aquifer, surface water, topographic, and drainage detail that was unavailable for this study.

The base year 2010 was modeled along with two models for the year 2025: one representing the change in withdrawal from all users and one for the change in withdrawal by mining only. The mining withdrawal is the same as in Alternatives 2, 3, 4, and 5: 2025B with the Ona Mine at its flexible permit withdrawal rate. The transient model peaking factor was applied to the Stress Period 5, which represents the month of April (Ona: 1.88, Desoto: 1.88, Wingate East: 1.25, and South Pasture Extension: 1.17). An intermediate peaking factor was applied to the month preceding and following April in order to represent the dry season. The rest of the months were adjusted downward, so that the average withdrawal for the year is the same as the drought year average annual. The other users' well withdrawals were adjusted according to well type using the multipliers, which were averaged using data from the DWRM2.1 transient calibration as discussed above.

4.2 Key Working Assumptions for the Groundwater Modeling

Tables 1 and 2 reflect the drought year permitted annual FAS allocations and the currently anticipated FAS use periods for the indicated mines based on the existing WUP-defined allocations currently authorized by the SWFWMD (Mosaic WUP No. 20011400.025, expiration 2032; CF Industries WUP No. 20003669.010, expiration 2017). For these AEIS evaluations, a key assumption applied was that the Applicants' currently authorized annual average FAS allocations would remain the same out through 2040. Additionally, it is notable that these groundwater model simulations are conservative estimates of the potential effects of these new mine projects on aquifer water levels since the simulations were run using drought year withdrawals, which are significantly higher than permitted annual average and more so when actual withdrawals are considered.

The water supply allocations used in the modeling are drought year withdrawals that could be conducted to support matrix extraction and transport to the beneficiation plants, and for subsequent clay and sand tailings conveyance. In reality, actual pumping rates vary depending on precipitation. Phosphate mines in the past decade have used substantially less than their drought year or annual average water supply allocations authorized under WUPs because of modified water management practices, including a greater reliance on surface waters contained within their recirculation systems.

As addressed in Chapter 3, some mines have not had to pump their FAS wells for years, because adequate water supply was available as a result of rainfall accumulations and industry efforts focused on water conservation and reuse. Conversely, under drought conditions, increased pumping rates and longer duration FAS withdrawals can be needed. For this AEIS evaluation, however, the analysis focused on long-term average conditions and the conservative approach adopted was to conduct the model simulations using the annual average allocation rates.

As noted above, DWRM2.1 is the primary analytical tool used by the SWFWMD in evaluating proposed water supply allocations from the FAS under its water use regulatory program. Mosaic recently completed consolidation of its various mine-specific individual WUPs into an Integrated Water Use Permit (IWUP). Detailed groundwater modeling was conducted in support of the IWUP application (Progressive Water Resources [PWR], 2011) using a model based on DWRM2.1. The groundwater modeling conducted in support of this AEIS is different than the modeling recently conducted by Mosaic to support the IWUP application in several ways. For example, in the

application, standard SWFWMD water use permitting simulations are run without making changes to any of the groundwater withdrawals of other water users included in the model. In contrast, for analysis of potential effects of projects addressed under this AEIS, the analyses included consideration of future changes in such allocations for other users.

A second difference between the AEIS modeling and standard groundwater modeling supporting Mosaic's IWUP application reviews by SWFWMD is that the water use permitting simulations only addressed Mosaic's projected FAS water uses to 2030, which corresponded to the duration covered by the IWUP. For the AEIS, simulations had to address various mine operations through approximately 2050, and also had to account for the proposed changes to the CF Industries duration of use of the South Pasture Mine/South Pasture Mine Extension wells.

In the Southern Water Use Caution Area (SWUCA) recovery strategy, SWFWMD recognizes that "annual withdrawals from the Floridan aquifer need to be reduced by 50 mgd (from 650 to 600 mgd) to ensure that the saltwater intrusion minimum aquifer level is met." However, "if withdrawals were optimally distributed (i.e., declines in the most impacted areas and increases in the least impacted areas) a reduction of significantly less than 50 mgd would be required."

Nonetheless, for the DWRM2 model, a 50-mgd reduction of agricultural groundwater use was used, with all other users capped at their current levels. It should be noted that in the same report, SWFWMD recognizes that reductions in phosphate industry groundwater quantities have played an important role in SWUCA recovery, stating, "Average daily use of groundwater associated with mining and processing of phosphate ore in the SWUCA has declined from over 300 mgd in the mid-1970s to less than 75 mgd in recent years…" (SWFWMD, 2006b). Allocations for groundwater withdrawals for other users would be maintained at their current levels. Thus, for the AEIS modeling evaluations, projected agricultural use reductions of 50 mgd were accounted for, but all other users' allocations were maintained at the 2006 rates included in the DWRM2.1 model. It was assumed that withdrawal rates in the base year conditions of 2010 were the same as in 2006, since there was very little growth in demand between 2006 and 2010.

For the modeled scenarios, a linear rate of decrease (-2.5 mgd/yr) in agricultural withdrawal allocations was assumed to occur between 2005 and 2025. This reduction was simulated as follows:

- 2010 12.5 mgd reduction
- 2020 37.5 mgd reduction
- 2030–2060 50 mgd reduction

The reductions above were applied proportionally to each agricultural well in the SWUCA, based on the well's simulated withdrawals. These types of adjustments to account for changed allocations of other users in the future are not applied during water use permitting-based modeling analyses. While it is recognized that agricultural use reductions would not be uniform throughout the region, there is no reasonable methodology available to predict the future pattern of change so the uniform assumption is the best available method for incorporating the changes in agricultural use in the model.

These differences are noted to clarify that the AEIS modeling results are not comparable to those generated by PWR (2011) because of the different analytical objectives, the modeling assumptions applied, and the different modeling conditions included in the respective analyses.

4.3 Groundwater Model Results Presentation Formats

Each model run consisted of a steady-state simulation for which drawdown was calculated and compared relative to 2010 conditions. While water demand projections were developed for every mine for the years 2010 through 2050, model runs were only conducted for years in which there were significant changes in withdrawals relative to adjacent years (for example, a new mine might begin operating, or a mine might have shut down). Many years have the same pumpage as the preceding and following years; thus no additional information would be gained by running annual simulations because the results would be identical.

The SWFWMD has established a Saltwater Intrusion Minimum Aquifer Level (SWIMAL) for the SWUCA (SWFWMD, 2002b). This level is the "*minimum aquifer level necessary to prevent significant harm caused by saltwater*

intrusion in the UFA in the SWUCA." The SWIMAL is calculated each year based on the 10-year average water level in 10 specific SWFWMD monitoring wells in the SWUCA. Each well is assigned a weight based on a GIS analysis performed by the SWFWMD. The individual well averages and weights are used to develop a single SWIMAL value for the aquifer.

Because this study evaluated simulated drawdown rather than aquifer levels, the simulated drawdown at each observation well was multiplied by the adjusted SWIMAL weight to obtain a weighted drawdown for the well. Individual weighted drawdowns were summed to quantify the simulated change in the SWIMAL for each model run.

The simulated water level change is presented in 85 Regional Observation Monitoring Well Program (ROMP) monitor wells that are within the model domain: 16 wells in Layer 1, 17 wells in Layer 2, 18 wells in Layer 3, and 34 wells in Layer 4. Unlike the SWIMAL, the water level change at each of these wells is assessed separately. The monitor wells were selected from a database of 1,304 wells in the SWFWMD. The 85 wells were selected because they comprised the network of wells used to calculate the SWIMAL, were within the SWUCA, were not located close to one another, represented a good distribution across the study area, and are completed in each of the aquifer zones of interest (i.e. SAS, IAS, and UFA).

For the No Action Alternative (Alternative 1) and the Applicants' Preferred Alternatives (Alternatives 2, 3, 4, and 5) and for each simulation year analyzed, two predictions were run. For all simulations, water level changes were determined in the SAS, IAS Zone 1, IAS Zone 2, and UFA ROMP wells. The No Action Alternative was simulated with the applicable mine water supply allocations for drought year withdrawals with all other groundwater users unchanged at 2010 rates. Agricultural uses remained unchanged for these simulations. A second set of simulations was run for the same conditions except with the 50 mgd agricultural reduction included. The offsite alternatives were not included in the modeling because no water supply plans are available.

For the Applicants' Preferred Alternatives, the water supply allocations from Alternative 1 were added to the projected allocations in Alternatives 2, 3, 4, and 5. These simulations are the cumulative impacts simulations. These simulations were run the same as above, with one set of simulations including the applicable mine water supply allocations for drought year withdrawals and all other groundwater users unchanged at 2010 rates. Agricultural uses remained unchanged for these simulations. A second set of simulations was run for the same conditions except with the 50 mgd agricultural reduction included. The indicated combinations of mine operations over the study period provided information on the effects of all mining with and without the agricultural reduction.

The comparative analysis yielded estimates of the relative magnitude of the phosphate mining effects on the SAS, IAS, and UFA water levels and the relative spatial extent of drawdown or recovery effects out to a 0.5-foot contour (either drawdown [- values] or recovery [+ values]). These measures also were used to calculate an overall relative influence of phosphate mining withdrawals for the indicated simulation years calculated for the CFPD, and comparative metrics were also calculated for the influence of all users combined. Lastly, the results allowed calculation of the effects of the various mine combinations in relation to conditions at specific regional monitoring wells (ROMP wells) for which SWFWMD has set Minimum Flows and Levels (MFL) targets. The ROMP well groupings are addressed further in the discussion of modeling results presented in Chapter 4 and in Appendix F.

4.4 Qualitative Assessment of Groundwater Effects

As explained in the introduction to this section, modeling was not done for Pine Level/Keys or Pioneer Tracts because there are no specific water supply plans from the Applicants. Assumptions were made that those mines would use existing wellfields, thereby extending the withdrawals over a longer timeframe but not changing the quantity. Alternatives A-2 and W-2 were not modeled because no information is available on the quantity, timeframe, or water supply plans. These alternatives' effects on groundwater were considered qualitatively, by extrapolating the modeled results of other alternatives or existing mines' effects. Pine Level/Keys Tract was compared to Desoto Mine, Pioneer Mine was compared to Ona, Site A-2 was compared to the existing South Fort Meade Mine, and Site W-2 was compared to the existing Wingate Creek Mine.

5.0 Ecological Resource Impact Analysis Methods

Ecological resources could be impacted by various aspects of phosphate mining operations, such as land clearing in advance of mining, mining activities, and construction of the infrastructure supporting mining such as access roads, pipeline corridors, and CSAs. Ecological effects may be direct such as the clearing of wetlands within areas to be mined, or indirect, such as the dewatering of wetlands adjacent to mining areas. For the Draft AEIS, the ecological impact analyses for all alternatives evaluated, including the Applicants' Preferred Alternatives, were based largely on GIS-based data/tools. Public comments received on the Draft AEIS recommended that the ecological impact analyses for the Applicants' Preferred Alternatives be based primarily on field-collected data included in the Applicants' federal Section 404 permit applications to allow for more accurate representation of the ecological resources that exist on the Applicants' Preferred Alternatives. In response to these recommendations, the ecological impact analyses conducted for the Applicants' Preferred Alternatives for the Final AEIS were based primarily on information included in the Applicants' Section 404 permit applications. The information obtained from the Section 404 permit applications for the ecological impact analyses included field data collected by the Applicants on aquatic biological communities, wetlands/waters, wildlife habitats, and listed species, as well as the Applicants' proposed impact avoidance/minimization measures and compensatory mitigation.

Site-specific field data on ecological resources for the offsite alternatives were unavailable at the time of preparation of this AEIS. In lieu of collecting field data for each offsite alternative, the following GIS-based data/tools were used to support the analysis of potential impacts of each offsite alternative on ecological resources:

- 2009 SWFWMD Florida Land Use, Cover, and Forms Classification System (FLUCCS) data (SWFWMD, 2009a)
- USGS National Hydrography Dataset (NHD) data (USGS, 2013b)
- Critical Lands and Waters Identification Project (CLIP) tool (Florida Natural Areas Inventory [FNAI] et al., 2011)

FLUCCS is the primary system used to classify land use and cover in Florida (see Chapter 3). For this AEIS, FLUCCS data were used to estimate the spatial coverage (in acres) and composition (types) of wetlands, non-stream surface waters, native uplands (rangelands and upland forests), and agricultural land on each offsite alternative. The comprehensive FLUCCS data for the offsite alternatives are provided in Appendix E-1.

The NHD is a USGS digital-vector dataset used for mapping and geospatial analysis of surface waters (USGS, 2013b). For this AEIS, NHD data were used to estimate the total stream length (in linear feet) on each offsite alternative. The linear feet of streams were calculated as the combined length of all NHD flowline features except for the "canal/ditch" feature. The comprehensive NHD data for the offsite alternatives are provided in Appendix E-2.

CLIP is a GIS-based tool that allows rapid assessment of the ecological quality and importance of a given parcel of land in Florida. The CLIP User Tutorial includes guidelines for use of CLIP data, including a disclaimer that CLIP data are not intended to be used for regulatory permitting decisions. For this AEIS, CLIP provides estimates of the quality of wetlands on each offsite alternative without the need to obtain permission to access the sites, do field surveys, etc. Any U.S. Army Corps of Engineers (USACE) permitting decisions related to this AEIS would be supported by additional data beyond the data available using CLIP, including site-specific, field-verified information.

The CLIP tool was developed through a collaborative effort between the FNAI, University of Florida, and Florida Fish and Wildlife Conservation Commission (FFWCC). The CLIP tool has been revised and updated with new data since its initial creation in 2006. CLIP 2.0, the 2011 update of the tool used for this AEIS, is organized into a set of core GIS data layers that are combined into five resource models: Biodiversity, Landscapes, Surface Water, Groundwater, and Marine. Depending on the model or data layers used, CLIP can provide a broad assessment of the overall ecological quality of an area, or it can provide a more focused assessment of the quality of a specific resource within an area, such as wetlands. According to the CLIP tool, areas or specific resources that are ranked as CLIP Priority 1 or 2 have the highest priority for conservation significance (FNAI et al., 2011). In lieu of Wetland Rapid Assessment Procedure (WRAP) or Uniform Mitigation Assessment Methodology (UMAM) data, which are

not available for the offsite alternatives, the CLIP "Wetlands" GIS data layer, which is a component of the CLIP Surface Water model, was used to assess the quality of wetlands on each offsite alternative. The CLIP Wetlands layer has six priority levels, reported from 1 to 6. Priority 1 represents the highest conservation priority level and Priority 6 represents the lowest conservation priority level. For this AEIS, wetlands ranked as CLIP Priority 1 and 2 are considered to represent wetlands of high quality, wetlands ranked as CLIP Priority 3 and 4 are considered to represent wetlands of moderate quality, and wetlands ranked as CLIP Priority 5 and 6 are considered to represent wetlands of low quality on each offsite alternative. Accordingly, the percentages of wetlands ranked as CLIP Priority 1 and 2 (high-quality wetlands), wetlands ranked as CLIP Priority 3 and 4 (moderate-quality wetlands), and wetlands ranked as CLIP Priority 5 and 6 (low-quality wetlands) were calculated for each offsite alternative. The comprehensive CLIP Wetland data for the offsite alternatives are provided in Appendix E-3.

6.0 Economic Evaluation Methods

An independent assessment of the effects of the Applicants' Preferred Alternatives on economic activity was performed to support the evaluation of the consequences of projects proposed by the Applicants and currently under USACE review.

Information on the proposed durations and schedules of mining were available for the four Applicants' Preferred Alternatives (Desoto Mine, Ona Mine, Wingate East Mine, and South Pasture Mine Extension). In addition, conceptual mine plans were prepared for two offsite alternatives (the Pine Level/Keys Tract and Pioneer Tract). These two offsite alternatives were evaluated as alternatives to the Applicants' Preferred Alternatives, and as reasonably foreseeable alternatives as part of the cumulative impacts assessment. Insufficient information was available to prepare similar analyses for the two other offsite alternatives (A-2 and W-2). In addition, these alternatives were not considered reasonably foreseeable. The economic analyses considered the potential effects of each of the four Applicants' Preferred Alternatives for the expected life of each mine, plus the cumulative mining impacts of the four proposed mines, plus the two reasonably foreseeable offsite alternatives from the 2010 baseline condition through 2060.

The AEIS economic evaluations included evaluation of direct, indirect, and induced impacts of the Applicants' Preferred Alternatives and the two reasonably foreseeable offsite alternatives on an eight-county region consisting of five counties in the CFPD and three adjoining counties. The analyses of the individual mines consider the impacts of the four Applicants' Preferred Alternatives, and two reasonably foreseeable offsite alternatives. The cumulative areawide analyses evaluated the impact of all of the Applicants' Preferred Alternatives and reasonably foreseeable offsite alternatives being permitted, as well as the impact of multiple alternatives being approved in a single county (Hardee), and the impacts of the Wingate East Mine, Desoto Mine, and Pine Level/Keys Tract being approved on the combination of DeSoto and Manatee Counties. Direct, indirect, and induced impacts are defined as follows:

- Direct Impacts – Refers to the change in the impact of a change in "final demand" on a given business or industry. In this case it refers to the change in value of phosphate production and agricultural production resulting from the permitting of the Applicants' Preferred Alternatives and the two reasonably foreseeable offsite alternatives.
- Indirect Impacts – Indirect impacts are the employment and income generated by the purchase of goods and services from local suppliers by the directly impacted industries.
- Induced Impacts – Induced impacts result from changes in household expenditures, as employees of the directly or indirectly impacted businesses purchase goods and services in the local economy.

Direct economic effects would be anticipated predominantly on the specific counties where the proposed mines would be located. Some direct impacts may also accrue to surrounding counties. For example, this analysis associated direct employment and labor income impacts to the place of work (location of mine), not the place of residence. To the extent that employees reside in another county, it could be argued that some direct employment and labor income impacts would occur to the surrounding counties. Indirect and induced economic effects would occur on the counties where the mines would be located and to varying degrees on the surrounding counties. For this economic analysis, the area included in the evaluation encompassed each county in its entirety,

not just the areas that would be mined or downstream from the proposed mines. The direct impacts on the prospective host counties (Manatee, Hardee, and DeSoto Counties) were evaluated along with the indirect and induced effects on these counties, as well as for Polk, Hillsborough, Charlotte, Sarasota, and Lee Counties. Economic impacts outside the eight-county region were not included in this analysis.

Direct impacts would result from the mining and reclamation activities and changes in agricultural activities in the Applicants' Preferred Alternatives as land currently devoted to pasture, citrus, and row crops would be converted to mining and then returned to agricultural or other uses over the study period. Other direct impacts would relate to revenues to local governments, including severance taxes and ad valorem taxes. Indirect and induced impacts would consist of secondary impacts generated by the purchase of goods and services from local suppliers by the mining and agricultural activities and by their employees. Indirect and induced impacts resulting from direct impacts were estimated using an economic modeling application called Impact Analysis for Planning (IMPLAN) (MIG Inc., 2012). Information on IMPLAN is accessible at www.implan.com/.

The purpose of these evaluations was to compare a number of different scenarios associated with their respective economic values:

- No Action Alternative
- Alternatives 2 through 7—The impact on host counties of individual alternatives, referred to as the "Mining Alternatives" (as noted previously, Alternatives 8 and 9 are not considered further in this analysis)
- Mining Contribution to Cumulative Impacts—The areawide impacts of permit approval of the individual mines plus reasonably foreseeable offsite alternatives This includes:
  - The impact of the three Hardee County mines (Ona Mine, South Pasture Mine Extension, and Pioneer Tract
  - The impact of Manatee and DeSoto County mines (Desoto Mine, Wingate East Mine, and Pine Level/Keys Tract)
  - The impact of mines in an eight-county region, resulting from the Applicants' Preferred Alternatives and the Pioneer and Pine Level/Keys Tracts

The impacts in each analysis were measured for 10-year increments over a 50-year period (2010 to 2060). The 10-year increments were used for this analysis because the timing of the mining was not considered precise enough to warrant shorter time increments. This analysis projected the average annual level of economic productivity over each 10-year period. The total impacts were the summation of the direct, indirect, and induced impacts. The net present value of the difference in output or income between the mining alternatives and the No Action Alternative was calculated to estimate the change in employment and income associated with the mining scenario being evaluated. Present value analysis is a tool for comparing alternatives with varying schedules of costs and/or revenues over time. Future costs and revenues are discounted to estimate their present worth.

6.1 Overview of Calculation Methods

Key calculation methods supporting the economic evaluations are summarized in the following paragraphs.

6.1.1 Value of Output (Total Income)

The monetary value of the direct output of the mining and agricultural activities was calculated by associating the change in land use within the mine footprint over time with an estimated land use revenue production rate. The change in land use associated with each mine over the 50-year period was forecast based on the mine plans. The number of acres of land mined in each 10-year period multiplied by the average tonnage of phosphate rock produced per acre and by the value of the phosphate rock per ton provided the value of the phosphate rock produced in each 10-year period. Similarly, the average annual inventory of land in each 10-year period devoted to agricultural activities (pasture, citrus, vegetables, and melons) multiplied by the estimated crop value per acre provided the average annual revenue from crop production in each 10-year forecast period.

6.1.2 Severance Tax Revenues to Local Governments

The state collects a tax on the amount of phosphate rock mined. A portion of the revenue collected by the state is returned to the counties from which the phosphate was mined. The severance tax rate is applied to the phosphate produced to derive the state tax revenue estimate. The portion of this revenue returned to each county was calculated per the formula specified in the state law authorizing the collection of the severance tax. These revenues are considered a redistribution of the revenue generated from the production of the phosphate rock.

6.1.3 Indirect and Induced Effects

The indirect and induced economic impacts were estimated using the economic modeling software IMPLAN. IMPLAN calculates economic impacts in a transparent manner using known data sources for its calculations. For this analysis, data specific to the Applicants' Preferred Alternatives and beneficiation plants in the eight counties were used. The IMPLAN data, derived from the U.S. Census Bureau and other government sources, approximates how, from where, and on what products and services various industries spend money. IMPLAN also estimates the employment effects by industry. The IMPLAN analysis was based on national transactions in 2008. This was the most recent version of IMPLAN available at the time this analysis was prepared. Regional models based on the national model are adjusted to reflect the industries in the specific region and their purchases and output or production.

6.1.4 Net Impact

The present value of the total income, value added, and labor compensation impacts were calculated for the individual or cumulative impacts of the Applicants' Preferred Alternatives and the No Action Alternative. The present value of the No Action Alternative over the 50-year period was subtracted from the various mining alternatives to estimate the impacts of the applicable mining projects. This difference between the various Applicants' Preferred Alternatives and the No Action Alternative is the net impact of the Applicants' Preferred Alternatives.

6.2 Key Assumptions Supporting the Economic Analyses

Key assumptions were applied to aid in developing the economic impact evaluations presented in this Final AEIS. The assumptions are in several broad categories, as discussed in the following paragraphs.

6.2.1 Economic Impact Model Selection

The AEIS economic analysis provides an estimate of the impacts of the alternatives on the local and regional economy. The new phosphate rock production and the associated reduction in agricultural production are the direct impacts of the alternatives. A model of the economy is used to estimate the indirect and induced impacts of these direct impacts, which include the purchase of goods and services from the local economy by the mining and agricultural companies, and purchases by their employees.

There are three recognized commercially available models that can be used for this purpose:

- IMPLAN – Impact Analysis for Planning (MIG, Inc., 2012)
- RIMS II - Regional Industrial Multiplier System (U.S. Department of Commerce, 1997)
- REMI – (Regional Economic Models Inc., undated)

6.2.1.1 IMPLAN

IMPLAN is a regional input/output (I/O) model. I/O models are based on a cross-sectional analysis of the economy that describes the transactions between the various sectors of the economy (industry, trade, services, etc.). For each sector, the purchases of supplies, services, and other inputs and sales of products and services between sectors are mapped. Assuming that these transactional relationships do not change, the mapping allows the model to predict how a change in demand in one sector will affect the demands in other sectors. IMPLAN is based on national transactions that are then regionalized based on regional purchase coefficients that estimate the

portion of the total demand for a good or service in a region that is satisfied by local suppliers of that good or service. A region is defined in IMPLAN as a county or collection of counties.

6.2.1.2 RIMS

RIMS II (RIMS) is similar to IMPLAN in that it is also based on an I/O analysis. RIMS, however, is less complicated. It involves the purchase of multipliers for each sector in the region, which an analyst can use to estimate the change in output for other goods and services, employment, and income in the region, based on a change in final demand for a good or service.

6.2.1.3 REMI

REMI has been variously described in the literature as a conjoined I/O model and behavior model, or as an I/O model integrated with an econometric and computable general equilibrium model. REMI incorporates forecast changes in the regional economy over time in a "control forecast," and then runs a separate forecast that incorporates an anticipated change due to the policy decision, new industry, or other direct economic impact to the region. It uses the change from the control forecast to determine the change in output, employment, and income.

6.2.1.4 Model Comparison

Each of the I/O models includes approximately 500 economic sectors (industries), about 11 of which are mining-related, and allows users to estimate a variety of economic statistics (revenues, value added, employment, and income). Each I/O model is based on national statistics from the U.S. Bureau of Economic Analysis (BEA) and other sources, and adjusts the national information to reflect the regional economy in differing ways.

IMPLAN and RIMS are widely used by government agencies, universities, and others for similar types of economic impact analyses such as those conducted for this AEIS (Lynch, 2000). These models are relatively easy to use and transparent, with results that are replicable. In addition, their results can be explained relatively easily. One main difference between the IMPLAN and RIMS models for their use in this analysis is that the IMPLAN model allows the analyst to more readily and accurately make changes to the economy (i.e., add sectors that may not currently be in the region), whereas the multipliers for RIMS are based on existing sectors in the region. Thus, in DeSoto County, which does not currently have any phosphate mining, there would not be any RIMS multipliers for this sector. IMPLAN allows the user to modify the economy in the county to include this new sector.

REMI is a significantly more complex model that includes an I/O default option, but offers the advantage of being dynamic, with an analysis that can consider changes in the economy over time. This can also be a disadvantage because the accuracy of the projections will depend on the underlying econometric model, which is not straightforward for the user to verify or for others to replicate. For situations where the model will be used for multiple years and can be refined over time, such as for analyzing tax policies by states, these disadvantages can be overcome. The complexity of the model and associated analysis also makes explaining any resulting analysis to decision-makers and the public more challenging.

The focus of the economic analysis for this AEIS is on the direct, indirect, and induced impacts of a change in primarily just two sectors—phosphate mining and agriculture. IMPLAN was selected to perform the analysis for these reasons, as well as the study area's location in a primarily rural economy, which is not changing rapidly. In addition, the Applicants' Preferred Alternatives would contribute to sustaining employment in the industry and preventing the region from experiencing a significant contraction relative to the No Action Alternative. Thus, it is not anticipated that the Applicants' Preferred Alternatives will lead to changes in the economic structure of this region over time, a scenario that may benefit from a dynamic modeling approach.

6.2.2 IMPLAN Model and Analysis

The IMPLAN model and analysis was based on costs and revenues in 2008 dollars. Present value analysis assumes a 2.0 percent real discount rate per the White House Office of Management and Budget (OMB) 2012 Circular A-94 (OMB, 2012).

The value of production of agricultural crops from the IMPLAN model for each crop was divided by the acres of land devoted to production of those crops in the county based on a GIS analysis of the land use in each county, to derive the average revenue per acre that was applied to the forecast land use at each Applicants' Preferred Alternative, to project agricultural revenue for those mine sites.

The parcels comprising each of the Applicants' Preferred Alternatives were provided by the Applicants.

6.2.3 Mining and Reclamation Timeline and Costs

Mining operations were assumed to be complete within 4 years of the end of rock production. Reclamation was assumed to be complete within 8 years of the end of mining operations in accordance with Florida law. A reclamation cost of $8,015 per acre was assumed based on information from the FDEP Bureau of Mining and Minerals Regulation: Mandatory Reclamation Financial Assurance Requirement MOA Contouring Not Complete, for 2008 (FDEP, Updated December 13, 2012). Reclaimed land would be available for other uses within 8 years of completion of mining operations

6.2.4 Phosphate Revenues

Revenue per ton of phosphate was assumed to be $90.78, which is the average from 2009 through 2011 for United States imported natural calcium phosphates (U.S. Department of Commerce Bureau of Census, Commodity 2510). Table 4 shows the estimated phosphate produced in tons per acre; the rate varies by mine. The value of 7,858 tons per acre was used for existing mines based on the weighted average of permit applications for the four Applicants' Preferred Alternatives.

TABLE 4
Phosphate Production in Tons per Acre
Central Florida Phosphate District, Florida

Mine	Tons per Acre Mined
Desoto	6,453
Ona	9,139
Wingate East	11,726
South Pasture Extension	8,035
Existing Mines	7,858

6.2.5 Beneficiation Plants

It was assumed that two new beneficiation plants would be constructed during the first decade of mining, one for the Desoto Mine and the other for the Ona Mine. In addition, the individual mine analyses for the Pioneer and Pine Level/Keys Tracts assumed that beneficiation plants would be constructed for these alternatives. However, for the cumulative impact analyses, it was assumed that the beneficiation plants constructed for the Ona and Desoto Mines would also be used for the Pioneer and Pine Level/Keys Tracts, respectively. Thus new beneficiation plants would not be constructed for the Pioneer and Pine Level/Keys Tracts for the cumulative analysis. The cost of constructing a new beneficiation plant and associated infrastructure was estimated at $1 billion, based on information provided by the Applicants.

6.2.6 Employment

The employment and employee compensation for each agricultural crop in each county from the IMPLAN model were divided by the acres of land devoted to production of those crops in the county, based on a GIS analysis of the land use in each county, to derive the average employment per acre and average employee compensation per acre, that was applied to the forecast land use at each Applicants' Preferred Alternative, to project agricultural employment and agricultural employee compensation for those mine sites.

6.2.7 Tax Revenues

Data on average annual tax revenue per acre by land use were collected from the tax assessor's offices in each county for each of the Applicants' Preferred Alternatives. Property tax revenues were projected based on mining plan land use projections and average tax rates per acre by land use for each county. The state severance tax rate was assumed to be $1.61 per metric ton in the first decade, which is the rate collected by the state for the period from January 1 – June 30, 2012. The severance tax rate was assumed to increase to $1.81 per metric ton in the second through fifth decades. The percentage of the state severance tax distributed to all of the counties with mining activities was assumed to be 12.8 percent, per legislation adopted in 2012. These revenues are shared among all of the counties in the CFPD and Hamilton County in proportion to their shares of the state's total phosphate production.

An additional 10 percent of the severance tax revenues collected by the state is distributed to counties identified as Rural Areas of Critical Economic Concern (RACECs). Counties in this group include Hardee, DeSoto, and Hamilton. These revenues are shared among these counties in proportion to their respective shares of projected phosphate production.

Each county in which the Applicants' Preferred Alternatives or offsite alternatives are located collects a local option sales tax or surcharge. The mining and agricultural activities are expected to generate additional sales tax revenues for the local governments. However, these revenues have not been included in this analysis. This is a conservative assumption and has the effect of underestimating the revenues to local governments, under both the No Action Alternative and the Applicants' Preferred Alternatives.

6.2.8 Land Use

For the Applicants' Preferred Alternatives, the post-reclamation land use was based on a GIS analysis of the Applicants' post-reclamation land use plans. For existing mines and the offsite alternatives, it was assumed that 40 percent of the reclaimed land would be used as pasture after reclamation. This estimate likely underestimates the amount of post-mining lands that would be devoted to agricultural pursuits, having the effect of underestimating the value of post-mining agricultural production and reducing the net economic impact of the Applicants' Preferred Alternatives.

The amount of acreage on each of the Applicants' Preferred Alternatives devoted to various agricultural and other uses was based on GIS analysis of the land use on each mine site. The initial distribution of agricultural lands on each of the Applicants' Preferred Alternatives and offsite alternatives between pasture, crop land, citrus, and other land uses was assumed to reflect the distribution of lands devoted to these crops in the county in which the mine resides. This initial distribution was based on information provided by the county tax assessor's offices.

6.2.9 Water Supply and Ecosystem Services

A significant portion of each alternative is undeveloped and lies in a natural state, as uplands, wetlands, streams, etc. These natural lands provide a number of ecosystem services that have value from an economic perspective. These services include those provided by wetlands, for example, which contribute to surface water supplies, help filter or naturally treat the water, help recharge groundwater supplies, and provide habitat for fish and wildlife.

The intent of the economic analysis of these ecosystem services was not to estimate the value of these services, but rather to describe these services, and as practicable estimate the physical change in these services (such as change in air quality, noise levels, groundwater recharge, etc.) under each alternative.

Chapter 4 described the current conditions, described anticipated physical changes that would result under each of the Applicants' Preferred Alternatives, and to the extent practicable quantified the physical impacts (acres of wetlands impacted, changes in water quality, etc.). It is often difficult to place a market value on these services because there is no active market for aesthetics, wildlife habitats, and so on. While a number of methods have been developed to try to estimate the value of these services, they often require extensive data collection, surveys, or sophisticated economic modeling, and the accuracy of results is often questioned. The analysis of the ecosystem impacts focused, therefore, on qualitatively describing these economic impacts.

Chapter 4 of this AEIS summarized the findings of the projected impacts of the Applicants' Preferred Alternatives and offsite alternatives on surface water, groundwater, water quality, ecological resources, and land use and recreation. The findings showed that while the impacts were major prior to mitigation, with mitigation the ecosystem impacts were minor to moderate with the exception of Listed Species, which with mitigation had an insignificant effect. Based on this information, it was determined that a qualitative description of these impacts was sufficient. Similarly, the cumulative impacts on these ecosystem services while major with no mitigation were minor to moderate with mitigation; as a result, a qualitative description of these impacts was deemed appropriate.

6.2.10 Water Resources

It was assumed, based on hydrologic modeling, that there would be no substantive reductions in flows that would affect recreational uses of surface waters. Also, based on the mitigation framework that would be applied by the USACE to avoid, minimize, and/or restore or otherwise compensate for stream and wetlands losses, this mitigation credit would be adequate to compensate for the debit incurred by mining and other phosphate operations. Therefore, there was no basis for evaluation of economic impacts to these resources.

6.2.11 Other Assumptions

- Four Corners Mine is equally distributed between Polk, Hardee, Manatee, and Hillsborough Counties.
- Land that is currently used in agricultural production or is in a natural state that is not mined would continue in its current use until mined.
- Hamilton County phosphate production was assumed to be 3.1 million short tons annually, which is the average annual production of the Swift Creek mine (the only mine currently operating in Hamilton County). While Hamilton County is not in the study area, its phosphate production does affect the total severance tax revenues collected by the state, and the portion of these revenues returned to the counties in the CFPD.

6.3 Economic Evaluation Results Format

For each scenario analyzed, the direct economic effects calculated included the value of phosphate rock and agricultural product revenues generated for each of the evaluated decades. The associated severance tax and subsequently the portion of this tax returned to the applicable county were calculated, and the estimated property tax accrual to the county was accounted for. The IMPLAN tool was applied to each decade-based analysis to estimate the overall indirect and induced economic effects of the calculated direct revenue productivity. IMPLAN provided estimates of employment generated by the direct impact totals by decade, and the estimated indirect and induced employment, labor income, value added, and revenue increases associated with the changes in phosphate and agricultural productivity over time. The results are presented as summary tables in Appendix H, presenting the direct impacts calculated and the net present value assessment of the overall effects of the scenario with and without the subject mine. More detailed breakdowns of the direct, indirect, and induced impact estimates for each analysis for the applicable decade are provided in Appendix H.