PMTurkeyCOLPEm Resource

From: Orthen, Richard [Richard.Orthen@fpl.com]
Sent: Wednesday, May 18, 2011 9:50 AM
To: Brown, Alison; Bortone, Pilar; Matthews, David; Franzone, Steve; Hamrick, Steven; Madden, George; Maher, William; Comar, Manny; Orthen, Richard; Ross, Mitch; Stewart, Scott; McCree, Victor; Kugler, Andrew
Subject: L-2011-174 Signed 05-18-11 ER Audit Items H13_AQ4 Response
Attachments: L-2011-174 Signed 05-18-11 ER Audit Items H13_AQ4 Response.pdf

Re: Florida Power & Light Company
Proposed Turkey Point Units 6 and 7
Docket Nos. 52-040 and 52-041
Response to NRC Environmental Audit Data and Information Need Items
AQ-4, H-13, H-23, H-31, H-34, H-35, H-38, H-40, NR-6

Reference:

1. NRC Site Audit Trip Report dated September 21, 2010, Summary of the Environmental Site Audit Related to the Review of the Combined License Application for Turkey Point Units 6 and 7 (ML1018807860, ML1018807852)

Florida Power & Light Company (FPL) provides, as an attachment to this letter, its response to the Nuclear Regulatory Commission's (NRC) Environmental Audit Data and Information Need Items AQ-4, H-13, H-23, H-31, H-34, H-35, H-38, H-40, and NR-6 provided in Enclosure 2 of the referenced letter. The attachment completes the remaining outstanding ER audit responses and identifies changes that will be made in a future revision of the Turkey Point Units 6 and 7 Combined License Application (if applicable).

The enclosed optical storage media (OSM) is not intended to comply with the recommendations for electronic submission in NRC Guidance Document, Guidance for Electronic Submissions to the NRC.

Richard F. Orthen
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May 18, 2011

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Re: Florida Power & Light Company
Proposed Turkey Point Units 6 and 7
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The enclosed optical storage media (OSM) is not intended to comply with the recommendations for electronic submission in NRC Guidance Document, Guidance for Electronic Submissions to the NRC.

If you have any questions, or need additional information, please contact me at 561-691-7490.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on May 18, 2011.

Sincerely,

William Maher
Senior Licensing Director – New Nuclear Projects

WDM/RFO

Attachment 1: FPL Response to NRC Item H-13 (ER 4.2)
Attachment 2: FPL Response to NRC Item H-23, H-31, H-34, H-38, H-40, NR-6 (ER 5.2)
Attachment 3: FPL Response to NRC Item H-35, AQ-4 (ER 5.3)

Enclosure: Environmental Audit and Information Needs NRC Request H-34 GIS Files for ER 5.2 Groundwater Figures - May 2011 (1 OSM)

cc (w/o enclosure):
PTN 6 & 7 Project Manager, AP1000 Projects Branch 1, USNRC DNRL/NRO
Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant 3 & 4

NRC Site Audit Trip Report dated September 21, 2010

SRP Section: Environmental Report Section 4.2 – Water Impacts

NRC Environmental Audit Data and Information Need Item: H-13

Have available a subject matter expert responsible for the ER analysis of dewatering the excavations for the proposed units.

FPL RESPONSE:

In order to allow construction of the Unit 6 & 7 deep foundations, a permanent reinforced concrete diaphragm “cutoff” wall will be constructed to hydraulically isolate the required excavations from horizontal groundwater flow. It is anticipated that the diaphragm wall will be installed into the top of the Fort Thompson Formation.

After completion of this diaphragm wall, a horizontal seepage barrier, or grout plug, which prevents vertical seepage, approximately 25 feet thick, will be constructed from elevation -35 feet NAVD88 to elevation -60 feet NAVD88. Installation of this grout plug will be accomplished by drilling and grouting using borings. The plug will be integral with the diaphragm wall so that construction dewatering can be accomplished by use of sump pumps, or similar methodologies, located within the excavation.

To install the grout plug, vertical boreholes will be drilled in a grid pattern and grouted in an iterative process, which is estimated to consist of four rounds of drilling and grouting, prior to excavation. Successive rounds of grouting will be performed by dividing the spacing of the previous round of boreholes used for grouting. The later rounds of grouting will experience lower grout “take” – that is, as formation voids and flow pathways are filled during the initial grouting rounds, the formation will “take” less grout. The use of this approach of successive rounds of grouting, in addition to both overlapping criteria and a designed program to indicate completeness of the program - based on such factors as grout injection pressure, volume pumped into the formation, and observable seepage, if any - will determine the adequacy and completeness of the horizontal grouting program.

During foundation excavation and construction, three distinct dewatering phases are anticipated: testing and remedial grouting phase, excavation phase, and foundation construction. Each dewatering phase has an estimated maximum dewatering rate, as discussed below.

The testing and remedial grouting phase would consist of up to four separate grouting injection events, based on observations made during each grouting injection phase. The estimated duration for this phase is thirteen weeks per excavation, with an estimated maximum dewatering pumping rate of 1000 gallons per minute (gpm).

The excavation phase is expected to be three months in duration. As the excavation proceeds, remaining seepages that are revealed by the excavation will be evaluated and remediated as necessary. The estimated maximum dewatering pumping rate for this phase is 1000 gpm.

A groundwater model was used to calculate the dewatering rates anticipated during the foundation construction phase. As discussed previously, a grout plug was placed from elevation -35 feet NAVD88 to elevation -60 feet NAVD88 in the model. The groundwater modeling results indicated that the dewatering rates for the Units 6 and 7 excavations were approximately 140 gpm and 136 gpm, respectively, based on a grout plug hydraulic conductivity of 1E-04 centimeters/second (cm/sec). For the purposes of this analysis, the total dewatering rate per excavation is assumed to be 200 gpm and twenty four months in duration.

For the dewatering impact analysis, it is conservatively assumed that the Unit 7 testing and remedial grouting phase would occur simultaneously with the Unit 6 foundation construction phase. It is further conservatively assumed, for maximum potential impacts, that the timeframe for these simultaneous dewatering phases is one year. Therefore, the estimated annualized maximum dewatering rate would be 1200 gpm (1.73 MGD) for one year in duration.

The circulating water flow rate in the industrial wastewater facility for Units 1 through 4 is 4250 cubic feet per second (2747 MGD). The extracted groundwater from dewatering, which would be released into the cooling canals of the industrial wastewater facility, is approximately 0.06 percent of the circulating water flow rate. As described in Subsection 2.3.1.2.2.5, makeup water for the industrial wastewater facility comes from treated process water, rainfall, stormwater runoff, and groundwater infiltration. This inflow, along with the low amount of predicted water withdrawal from the discharge canal, would result in minimal net effect on the cooling canals of the industrial wastewater facility.

The mean annual rainfall and standard deviation for this rainfall for the period 1948-2010 is 59.95 inches and 11.74 inches (Miami International Airport), respectively. Considering a cooling canal area of 4370 acres, the total and standard deviation of this annual rainfall, in total gallons of water added to the cooling canals on an annual basis, is 21,832 acre-feet/year (7114 MG/year) and 4275 acre-feet/year (1393 MG/year), respectively. Conservatively assuming the maximum dewatering rate of 1200 gpm (1.73 MGD) is maintained for one year, the resulting annual dewatering discharge of 631 MG/year into the cooling canals is less than the standard deviation, or natural variability, of the observed annual rainfall added to the cooling canals (1393 MG/year).

Based on the groundwater modeling results for the dewatering simulations, the radius of influence is confined to the Turkey Point Plant site.

With the clarifications outlined above, the impacts of dewatering for Units 6 & 7 would continue to be SMALL and not require further mitigation, based on several factors, including the use of a horizontal seepage barrier, which prevents vertical seepage, at the bottom of each excavation, the discharge flow rate of dewatering compared to the flow rate within the cooling canals and the historical observed standard deviation of precipitation, and the predicted drawdown in the dewatered units based on groundwater modeling simulations.

This response is PLANT SPECIFIC.

References:

None

ASSOCIATED COLA REVISIONS:

ER Section 3.9.1.7 will be revised as follows, to reflect the grouting approach:

- ~~A temporary dewatering system would be installed for the two power block area deep excavations. Drainage sumps would be installed at the bottom of the excavations from which surface drainage and/or accumulated groundwater would be pumped to the cooling canals of the industrial wastewater facility.~~
- The two excavations for the containment and auxiliary buildings would extend to an approximate elevation of –35.0 feet NAVD 88 or to the top of competent rock in the Fort Thompson Formation. To permit construction of the deep foundations and to hydraulically isolate this excavation from horizontal groundwater flow, a permanent reinforced concrete diaphragm “cutoff” wall would be constructed. It is anticipated that the diaphragm wall would be installed into the Key Largo Formation to a depth of approximately ~~-65.0~~ **60.0** feet NAVD 88 or just below a semi-confining layer in the Biscayne Aquifer. The top of the diaphragm wall would be at elevation 2.0 feet NAVD88 or two feet above the construction working surface elevation of 0.0 NAVD88.
- The cutoff wall will be constructed sequentially by excavating vertical panels, roughly 3 feet wide, by 12 to 14 feet long, by ~~65~~ **60** feet deep to form the outer footprint of each deep nuclear island excavation.
- **After completion of this diaphragm wall, a horizontal seepage barrier, or grout plug, which prevents vertical seepage, approximately 25 feet**

thick, will be constructed from elevation -35 feet NAVD88 to elevation -60 feet NAVD88 by first drilling from the ground surface, and then grouting. The barrier will be integral with the diaphragm wall so that construction dewatering can be accomplished by use of sump pumps or similar methodologies, located within the excavation.

- **To install the grout plug, vertical boreholes will be drilled in a grid pattern and grouted in an iterative process, which is estimated to consist of four rounds of drilling and grouting, prior to excavation. Successive rounds of grouting will be performed by dividing the spacing of the previous round of boreholes used for grouting. The later rounds of grouting will experience lower grout "take" – that is, as formation voids and flow pathways are filled during the initial grouting rounds, the formation will "take" less grout. The use of this approach of successive rounds of grouting, in addition to both overlapping criteria and a designed program to indicate completeness of the program - based on such factors as grout injection pressure, volume pumped into the formation, and observable seepage, if any - will determine the adequacy and completeness of the horizontal grouting program.**
- **A temporary dewatering system would be installed for the two power block area deep excavations. Drainage sumps would be installed at the bottom of the excavations from which surface drainage and/or accumulated groundwater would be pumped to the cooling canals of the industrial wastewater facility. The subsequent dewatering phases, known as the excavation phase and foundation construction, are further discussed in Section 4.2.**

ER Section 4.2.1.1.1 will be revised as follows, to reflect the grouting approach and its impact on construction dewatering:

Curtain wall technology **and foundation grouting** would be used to isolate the cooling canals of the industrial wastewater facility from the plant area **and minimize the amount of dewatering required during power block excavation and construction**. Dewatering would not be expected to be required for the first 5 feet depth of excavated material, but would be required for subsequent excavation depths in the power block areas. As described in Subsection 2.3.1.2, the subsurface soils underlying the 5 feet of muck in the vicinity of the power blocks consist of formational material capable of substantial groundwater yield. The placement of engineered fill would alter the permeability of the subsurface material currently at the plant area. As described in Section 3.9, a ~~slurry~~ diaphragm wall would be installed to a depth of approximately –~~65~~**60** ft NAVD around the power blocks during dewatering and excavating subsurface materials. **Following completion of the diaphragm wall, a grout plug, approximately 25 feet thick, would be constructed beneath the power block from elevation -35 feet NAVD88 to elevation -60 feet NAVD88 by drilling from the ground surface and injecting grout. This barrier, which is integral with the diaphragm wall, would allow any seepage encountered during excavation to be controlled by use of sump pumps or similar methodologies, located within the excavation.** The ~~slurry~~ **diaphragm** wall **and grout plug,** which would **both** be permanent, would alter local horizontal groundwater flow around the power block excavations and would, therefore, alter the hydrologic flow through the power block area. Impacts to the hydrologic flow of groundwater would occur from the presence of the **diaphragm** ~~slurry~~ wall and the emplacement of the engineered fill material. The impacts would be limited to the vicinity of the **diaphragm** ~~slurry~~ wall. The use of the **diaphragm** ~~slurry~~ wall would allow dewatering of the power block areas with minimal impacts to groundwater directly outside of the **diaphragm** ~~slurry~~ wall containment area. Groundwater flow may also be locally altered as a result of backfilling the dead-end canal.

~~A geo-hydrologic model (Visual MODFLOW) was used to simulate impacts to the surficial aquifer from these dewatering activities. The maximum rate of groundwater production required to maintain a “dry” level of –35 feet NAVD 88 in each excavation simultaneously is estimated to be approximately 18,000 gpm or 26 MGD. This was considered the worst case, or bounding, scenario. The groundwater elevation during dewatering would exist in the upper part of the Fort Thompson formation. Based on the simulation, approximately 50 percent (9000 gpm or 13 MGD) of the dewatering flow would come from Biscayne Bay, while the remaining flow would come from the discharge side of the cooling canals of the industrial wastewater facility and inland areas west of the plant area.~~

During foundation excavation and construction, three distinct dewatering phases are anticipated: testing and remedial grouting phase, excavation phase, and foundation construction. Each dewatering phase has an estimated maximum dewatering rate, as discussed below.

The testing and remedial grouting phase would consist of up to four separate grouting injection events, based on observations made during each grouting injection phase. The estimated duration for this phase is thirteen weeks per excavation, with an estimated maximum dewatering pumping rate of 1000 gallons per minute (gpm).

The excavation phase is expected to be three months in duration. As the excavation proceeds, remaining seepages that are revealed by the excavation will be evaluated and remediated as necessary. The estimated maximum dewatering pumping rate for this phase is 1000 gpm.

A groundwater model was used to calculate the dewatering rates anticipated during the foundation construction phase. As discussed previously, a grout plug was placed from elevation -35 feet NAVD88 to elevation -60 feet NAVD88 in the model. The groundwater modeling results indicated that the dewatering rates for the Units 6 and 7 excavations were approximately 140 gpm and 136 gpm, respectively, based on a grout plug hydraulic conductivity of 1E-04 centimeters/second (cm/sec). For the purposes of this analysis, the total dewatering rate per excavation is assumed to be 200 gpm and twenty four months in duration.

For the dewatering impact analysis, it is conservatively assumed that the Unit 7 testing and remedial grouting phase would occur simultaneously with the Unit 6 foundation construction phase. It is further conservatively assumed, for maximum potential impacts, that the timeframe for these simultaneous dewatering phases is one year. Therefore, the estimated annualized maximum dewatering rate would be 1200 gpm (1.73 MGD) for one year in duration.

The circulating water flow rate in the industrial wastewater facility for Units 1 through 4 is 4250 cubic feet per second (2747 MGD). The extracted groundwater from dewatering**, which would be released into the cooling canals of the industrial wastewater facility, is** ~~would be~~ ~~less than 1~~ **approximately 0.06** percent of the circulating water flow rate~~, assuming all~~ ~~9000~~ ~~gpm came directly from the discharge canal~~. ~~The water withdrawn from the excavations would be released into the industrial wastewater facility~~. As described in Subsection 2.3.1.2.2.5, makeup water for the industrial wastewater facility comes from treated process water, rainfall, stormwater runoff, and groundwater infiltration. This inflow, along with the low amount of predicted water withdrawal from the discharge canal, would result in minimal net effect on the cooling canals of the industrial wastewater facility.

The mean annual rainfall and standard deviation for this rainfall for the period 1948-2010 is 59.95 inches and 11.74 inches (Miami International Airport), respectively. Considering a cooling canal area of 4370 acres, the total and standard deviation of this annual rainfall, in total gallons of water added to the cooling canals on an annual basis, is 21,832 acre-feet/year (7114 MG/year) and 4275 acre-feet/year (1393 MG/year), respectively. Conservatively assuming the maximum dewatering rate of 1200 gpm (1.73 MGD) is maintained for one year, the resulting annual dewatering discharge of 631 MG/year into the cooling canals is less than the standard deviation, or natural variability, of the observed annual rainfall added to the cooling canals (1393 MG/year).

Based on the groundwater modeling results for the dewatering simulations, the radius of influence is confined to the Turkey Point Plant.

The net effect on water withdrawal from construction dewatering on Biscayne Bay, would also be minimal due to the substantial amount of water in the bay and the relatively temporary nature of the dewatering activities.

ASSOCIATED ENCLOSURES:

None

NRC Site Audit Trip Report dated September 21, 2010

SRP Section: Environmental Report Section 5.2 – Water Impacts

NRC Environmental Audit Data and Information Need Items: H-23, H-31, H-34, H-38, H-40, NR-6

Have available a subject matter expert responsible for the ER analysis of water quality impacts in Card Sound and Biscayne Bay. (H-23)

Have available the subject matter expert responsible for the ER analysis of the impacts to groundwater of the construction and operation of the proposed units, including the cumulative impacts from the groundwater use of the existing units. Have available for review and demonstration the input/run files and numerical results for the updated (2009- submitted to SFWMD) MODFLOW (and other model) calculations of the impact of radial wells on the Biscayne aquifer and surrounding coastline (including water quality issues related to salinity). (H-31)

Have available the subject matter expert responsible for the ER analysis of the groundwater model and have available for review the GIS information, including the original GIS layer and Digital Elevation Map (DEM data used to generate Figure 5.2-1. (H-34)

Have available the subject matter expert responsible for the ER analysis of the muck layer in the vicinity of the radial wells. (H-38)

Have available the subject matter expert responsible for the ER analysis of the MODFLOW setup and calculations. (H-40)

Have available the subject matter expert responsible for the ER analysis of impacts on potable water supplies from building and operation of the proposed units. (NR-6)

FPL RESPONSE:

Revision 4 of the *Groundwater Flow Model for Biscayne Aquifer Calculation* is available for inspection in the Reading Room. The input and output files for the groundwater model calculation (Visual MODFLOW/MODFLOW 2000) have been forwarded under separate cover to the NRC (FPL Letter L-2011-098 dated March 17, 2011).

A general discussion of the conceptual model, including model layers and boundary conditions and calibration, is included with this response. In addition, the predicted impacts of radial collector well operation to surface water and groundwater quality, surface and groundwater use, and potential impacts to potable water supplies, based on the groundwater model predictive runs, have also been included in this response.

The conceptual hydrogeology of the groundwater model consists of fourteen layers. These layers are described as follows: Model Layer 1 (onshore muck and rock and sandy material in Biscayne Bay); Model Layers 2/3 (Miami Limestone); Model Layer 4 (Upper Higher Flow Zone); Model Layer 5/6 (Key Largo Limestone); Model Layer 7 (Freshwater Limestone), Model Layer 8/9 and 11/12/13 (Fort Thompson Formation); Model Layer 10 (Lower Higher Flow Zone); Model Layer 14 (Tamiami Formation). The model layers of interest in assessing the impacts of radial collector well operation, specifically Model Layer 1 and Model Layer 4, are further discussed below.

Model Layer 1 consists of muck onshore and rock and sandy material in Biscayne Bay. The location of these layers was based on the results of investigations performed in 1971 (Dames & Moore, 1971) and 2008. Specifically, muck is known to be present on land (MACTEC Engineering and Consulting, 2008.), however this unit does not extend into Biscayne Bay, where exposed rock and sandy material are present in its place. The Model Layer 1 hydrostratigraphic units in Biscayne Bay were assigned using the Marine Resources Geographic Information System (MRGIS) "Benthic Habitats – South Florida" file (FWRI, 2010). Benthic zones designated as "Continuous Seagrass" were designated as sandy material in Layer 1 as loose material is necessary to support seagrass. "Patchy (Discontinuous) Seagrass" and "Hardbottom with Seagrass" benthic zones were designated as rock in Model Layer 1.

Model Layer 4 consists of marine limestone and is referred to as the Upper Higher Flow Zone. This layer is at the boundary between the Miami Limestone and Key Largo Limestone and can be described as laterally continuous relatively thin layer of secondary porosity. The presence of this layer was confirmed by both review of boring logs, which indicated mud loss at the contact between the Miami Limestone and Key Largo Limestone, and caliper logs, which also indicated an enlarged boring diameter at this depth. Uprate monitoring borings, drilled under the supervision of the USGS in 2010, confirmed these interpretations. The radial collector well laterals, which are 25 to 40 feet below grade, are in this high flow zone layer.

The groundwater model incorporated the local and regional surface water features as different types of boundary layers, based on the feature and its conceptual contribution to groundwater flow. These boundary layers include the following:

<u>Biscayne Bay</u> - This feature is located east of Units 6 & 7 and is a shallow, subtropical lagoon along the southeastern coast of Florida. The bay is conceptualized as a general-head boundary at the top of Model Layer 1 to represent the exchange of water between the bay and the underlying aquifer. The specified head is stipulated at -1.05 ft NAVD88 for the calibration phase of model development, based on the average of the monthly surface elevation between February 2009 and May 2009. The use of this type of boundary layer allows for limiting the exchange of water between Biscayne Bay and the underlying aquifer based on the sea floor sediments.

Cooling Canal System, Card Sound Canal, and Other Offsite Canals - The cooling canals of the industrial wastewater facility are a closed system and do not discharge directly to adjacent surface water; however, the canals are unlined and therefore, interact with groundwater. The other canals (e.g. Card Sound Canal, L-31E Canal, C-107 Canal, and Florida City Canal) are open systems that also interact with groundwater. The canals are specified as river boundaries to account for surface water-groundwater interaction based on surface water level elevation and conductance of the sides and bottom of the canals.

Finally, other model boundaries were conceptualized and included in the groundwater model as follows:

Recharge/Evapotranspiration Boundary – These boundaries are applied to the ground surface, or top of Model Layer 1. These conditions are applied to land surfaces only, including wetlands. No recharge/evapotranspiration is applied to surface water bodies, buildings, or paved areas.

Horizontal Flow Barrier Boundary – Mechanically Stabilized Earth (MSE) Retaining Wall and Cut-Off Walls for Units 6 & 7. The horizontal flow barrier boundary was used to simulate the effects of the excavation cut-off walls surrounding the power blocks for Units 6 & 7 for construction dewatering and the MSE retaining wall surround the plant area.

Model Domain Perimeter – General-head boundary conditions are assigned to the perimeter in all model layers. The general-head boundary represents the influence of conditions beyond the model area.

No-Flow Boundary – Bottom of the Model – The bottom of the model is designated a no-flow boundary because water levels in the Biscayne Aquifer are expected to be negligibly affected by upward leakage through the Lower Tamiami Formation and Hawthorne Group, which is several hundred feet thick and acts as a confining layer.

No-Flow Boundary – Units 6 & 7 Excavations – The excavations are designated as inactive to flow. Minor seepage will occur through the cut-off walls into the excavations but the quantities will be insignificant.

The groundwater model was both calibrated and verified as follows:

- Three pumping tests were used in the model calibration phase; two of these tests were conducted in the Key Largo Limestone and one in the Fort Thompson Formation.
- The model included a validation step, whereby an additional pumping test was simulated following the calibration phase.

- A range for the hydraulic conductivity anisotropy value (K_h:K_v) of between 8:1 and 15:1 was used for the various hydrogeologic units. These values were determined during calibration and constrained by literature and field observations.

The calibrated and verified groundwater model was used to predict the impacts of radial collector well operation on the surrounding environment, including groundwater drawdown, areas of recharge, and groundwater and surface water quality. The radial conceptual model design used in the groundwater model predictive simulation is summarized as follows:

- The water level in Biscayne Bay was set to the long-term average of -0.81 feet NAVD88.
- The Unit 6 & 7 plant area was assumed complete and the relevant recharge/ evapotranspiration zones were altered to reflect as-built conditions. The muck layer was removed from the plant area, as discussed in Section 3.9, and replaced with backfill.
- Three of the four radial collector wells were operational. To provide a conservative estimate of the source of water from inland areas to the radial collector wells, the three wells closest to the shore were modeled as operational.
- Four pumping wells were placed on the last 300 feet of each lateral to represent the screened intervals. Flows were distributed along the laterals to reflect friction losses and the distributed flow along the length.
- The radial collector wells laterals were located within the Upper Higher Flow Zone.
- The simulation was executed at steady-state conditions.

The cone of depression in Model Layer 1 (onshore – muck; offshore – rock/sand) ranged from 3 to 0.1 feet and was generally confined to the area local to the radial collector wells (areal extent of 211 acres based on the 0.1 foot drawdown contour in Biscayne Bay) and the Units 1 through 5 plant area, as depicted in Figure 5.2-1 (refer to 'Associated COLA Revisions' for figure). The drawdown in Model Layer 4 (Upper Higher Flow Zone) ranged from 3 to 0.1 feet and was also generally confined to the area local to the radial collector wells (areal extent of 729 acres based on the 0.1 foot drawdown contour in Biscayne Bay), as depicted in Figure 5.2-2 (refer to 'Associated COLA Revisions' for figure).

The model indicates that the uplands could be dewatered on the Turkey Point peninsula during steady-state conditions; however this would be confined to areas immediately around the radial collector wells. Drawdown in the uplands on the Turkey Point peninsula would range from 1 to 3 feet. Drawdown west of Turkey Point would be generally confined to the shoreline adjacent to Units 1 through 5 and would be approximately 0.1 feet (see Figure 5.2-1).

Based on the results of the groundwater modeling, approximately 97.8 percent (121 MGD) of groundwater recharge to the radial collector wells would originate from Biscayne Bay and 2.2 percent (2.8 MGD) would come from areas inland, including 1.9 percent (2.4 MGD) from the cooling canals of the industrial wastewater facility. The remaining 0.3 percent of recharge (0.4 MGD) would come from boundaries representing precipitation onshore. The 0.3 percent from precipitation recharge represents a relatively small amount of water. Because precipitation is fresh water, it will tend to remain in the upper layers of the aquifer. Since the radial collector wells draw water at depth, the 0.3 percent is a conservative prediction of the water entering the radial collector wells. Therefore, the amount of fresh water drawn by the radial collector wells will be inconsequential and will not adversely impact the environment. Thus, impacts to the Biscayne Aquifer west of the Turkey Point plant property would be insignificant.

Although 1.9 percent of recharge (2.4 MGD) is predicted to originate from the cooling canals of the industrial wastewater facility, which are hypersaline, this recharge water drawn towards the radial collector wells will remain at depth within the aquifer due to the placement of the radial collector well laterals below the seabed and due to the higher density of this hypersaline water relative to seawater.

Any hypersaline water drawn into the aquifer from the cooling canals would not impact potable water supplies, which are further inland due to the presence of brackish, non-potable water near the coast.

This response is PLANT SPECIFIC.

References:

Dames & Moore, 1971, *Geohydrologic Conditions Related to the Construction of Cooling Ponds*, Florida Power & Light Company, Steam Generating Station, Turkey Point, Florida, Prepared for Brown and Root, Inc.

MACTEC Engineering and Consulting, 2008. *Final Data Report – Geotechnical Exploration and Testing: Turkey Point COL Project Florida City, Florida, Rev. 2,* October 6, 2008.

Fish and Wildlife Research Institute (FWRI), 2010. Marine Resources Geographic Information System (MRGIS) GIS Data, Benthic Habitats – South Florida. Available at: http://ocean.floridamarine.org/mrgis_ims/Description_Layers_Marine.htm, accessed June 25, 2010

ASSOCIATED COLA REVISIONS:

ER Section 2.3.1.2.3 will be revised as follows, to reflect this item response:

In order to better characterize the groundwater flow system, a three-dimensional numerical groundwater flow model was used. The model code used was MODFLOW-2000 (Harbaugh et al. 2000) as implemented in the Visual MODFLOW software. The MODFLOW model is a constant-density, three-dimensional finite-difference model, with modular capability to add various equation solvers and boundary conditions to the basic model. The model developed for Units 6 & 7 used a geometric multigrid (GMG) solver.

~~The Biscayne aquifer is represented in the model by six layers: 1) muck, 2) Miami Limestone, 3) Key Largo Limestone, 4) freshwater limestone, 5) Fort Thompson Formation, and 6) Tamiami Formation. The horizontal discretization for most simulations in the model is represented by a telescopic grid that ranges from a coarse grid (200 by 450 feet) at the model perimeter to a fine grid (20 by 20 feet) in the immediate area of Units 6 & 7. Hydrological features are represented in the model as boundary conditions. The river boundary condition is used to represent the industrial wastewater facility and the regional water management canals. Recharge and evapotranspiration boundaries are assigned to the top layer of the model, with properties varying depending on the surface conditions. These conditions include open water (canals), wetlands, and impervious surfaces (Units 1 through 5). The perimeter of the model is represented by a general head boundary, except in portions of the top layer at Biscayne Bay. The general head boundary represents the influence of conditions beyond the model area, primarily recharge from the Everglades. The top layer in Biscayne Bay is represented in the model as a constant head boundary condition using an average head based on tidal monitoring at Virginia Key. The remaining layers beneath Biscayne Bay are represented as general head boundaries at the perimeter of the model. The bottom layer of the model (Tamiami Formation) is represented as a no flow boundary condition. The vertical seepage upwards or downwards through the Tamiami Formation and the Hawthorn Group is assumed to be negligible relative to the horizontal flow in the Biscayne aquifer. Calibration of the model was performed by adjusting the river boundary condition conductance and riverbed thickness values in the industrial wastewater facility and regional water management canals and by adjusting hydraulic conductivities. The calibration targets for the model were the average measured groundwater levels in the upper and lower monitoring zones at Units 6 & 7 and two SFWMD wells adjacent to the plant area. The average inflow/outflow between the industrial wastewater facility and Biscayne Bay was also used as a calibration target. The calibrated model was used to simulate the impacts of construction dewatering, construction of Units 6 & 7 (site grade increase and use of diaphragm walls for groundwater control), and operation of the radial collector wells. The results of these model simulations are presented in FSAR Subsection 2.4.12, Appendix 2CC.~~

The groundwater model layers were created based on the local and regional geology conditions at the site, as well as observations made during several field investigations. A general description of the groundwater model setup, including model layers, surface water features incorporated into the model, boundary conditions, and calibration/verification approach is provided in the following paragraphs.

Model Layer 1 – This layer consists of muck onshore and rock and sandy material on the floor of Biscayne Bay. The location of these layers is based on the results of investigations performed in 1971 (Dames & Moore 1971) and 2008 (MACTEC 2008). Specifically, muck is known to be present on land; however this unit does not extend into Biscayne Bay, where exposed rock and sandy material are present in its place. The Model Layer 1 hydrostratigraphic units in Biscayne Bay were assigned using the Marine Resources Geographic Information System (MRGIS) “Benthic Habitats – South Florida” file (FWRI, 2010). Benthic zones designated as “Continuous Seagrass” were designated as sandy material in Layer 1 as loose material is necessary to support seagrass. “Patchy (Discontinuous) Seagrass” and “Hardbottom with Seagrass” benthic zones were designated as rock in Model Layer 1.

Model Layers 2/3 – This layer consists of marine limestone, referred to as the Miami Limestone. The Miami Limestone is a white, porous sometimes sandy, fossiliferous, oolitic limestone.

Model Layer 4 – This layer consists of marine limestone and is referred to as the Upper Higher Flow Zone. This layer is at the boundary between the Miami Limestone and Key Largo Limestone and can be described as laterally continuous relatively thin layer of high secondary porosity.

Model Layer 5/6 – This layer consists of marine limestone and is referred to as the Key Largo Limestone. This is a coralline limestone (fossil coral reef) believed to have formed in a complex of shallow-water, shelf-margin reefs and associated deposits along a topographic break during the last interglacial period.

Model Layer 7 – This layer consists of freshwater limestone and is referred to as the Freshwater Limestone, and where this is absent the Key Largo Limestone. The limestone is generally two feet or more thick and often possesses a sharp color change from light to dark gray at its base marking the transition from the Key Largo Limestone to the Fort Thompson Formation.

Model Layer 8/9 and 11/12/13 – This layer consists of marine limestone and is referred to as the Fort Thompson Formation. The Pleistocene Fort Thompson

Formation directly underlies the Key Largo Limestone. The Fort Thompson Formation is generally a sandy limestone with zones of uncemented sand interbeds, some vugs, and zones of moldic porosity after gastropod and/or bivalve shell molds and casts.

<u>Model Layer 10</u> – This layer consists of marine limestone and is referred to as the Lower Higher Flow Zone. At the location of Units 6 & 7, another zone of high secondary porosity was identified within the Fort Thompson Formation from drillers and caliper logs. This layer is approximately 15 feet beneath the top of the Fort Thompson Formation at the location of the proposed power blocks.

<u>Model Layer 14</u> – This layer consists of well sorted silty sand, but is locally interlayered with clayey sand, silt, and clean clay and is referred to as the Tamiami Formation. The Pliocene Tamiami Formation directly underlies the Fort Thompson Formation. The contact between the Tamiami Formation and the Fort Thompson Formation is an inferred contact picked as the bottom of the last lens of competent limestone encountered. The Tamiami Formation represents a semi-confining unit.

The Upper and Lower Higher Flow Zones are relatively thin zones of high secondary porosity. These zones were defined based on a review of geophysical logs and drilling records and are assumed to be continuous across the model domain. The Upper Higher Flow Zone was primarily identified from the loss of drilling fluid at the boundary of the Miami Limestone and Key Largo Limestone. This observation was also coincident with an increase in the boring diameter as identified by the caliper logging. The Lower Higher Flow Zone was identified at a depth of approximately 15 feet below the top of the Fort Thompson Formation from the 2008 subsurface investigation borings within the Units 6 & 7 plant area. In 2010, 14 borings were drilled in and around the Turkey Point plant area as part of the FPL Unit 3 & 4 Uprate Conditions of Certification (JLA Geosciences 2010). These borings did not identify a laterally persistent layer corresponding to the Lower Flow Zone identified within the Units 6 & 7 plant area, but rather more isolated zones at varying depths. As represented in the model, the Lower Higher Flow Zone represents an aggregation of these observations and is conservative due to the fact it is modeled as laterally extensive. The location and lateral persistence of the Upper Higher Flow Zone is generally confirmed by the 2010 borings (JLA Geosciences 2010). Cunningham et al 2009 discuss the presence and origin of high flow zones in the Biscayne aquifer.

The groundwater model incorporated the local and regional surface water features as different types of boundary conditions, based on the feature and its

conceptual contribution to groundwater flow. These boundary conditions include the following:

Biscayne Bay - This feature is located east of Units 6 & 7 and is a shallow, subtropical lagoon along the southeastern coast of Florida. The bay is conceptualized as a general-head boundary at the top of Model Layer 1 to represent the exchange of water between the bay and the underlying aquifer.

The head is specified at -1.05 ft NAVD88 for the calibration phase of model development, based on the average of the monthly surface elevation between February 2009 and May 2009. The use of this type of boundary condition allows for limiting the exchange of water between Biscayne Bay and the underlying aquifer based on the sea floor sediments.

Cooling Canal System, Card Sound Canal, and Other Offsite Canals - The cooling canals of the industrial wastewater facility are a closed system and do not discharge directly to adjacent surface water; however, the canals are unlined and therefore, interact with groundwater. The other canals (e.g. Card Sound Canal, L-31E Canal, C-107 Canal, and Florida City Canal) are open systems that also interact with groundwater. The canals are specified as river boundaries to account for surface water-groundwater interaction based on surface water level elevation and conductance of the sides and bottom of the canals.

Finally, other model boundaries were conceptualized and included in the groundwater model as follows:

Recharge/Evaportranspiration Boundary - These boundaries are applied to the top of Model Layer 1. These conditions are applied to land surfaces only, including wetlands. No recharge/evapotranspiration is applied to surface water bodies, buildings, or paved areas.

Horizontal Flow Barrier Boundary – Mechanically Stabilized Earth (MSE) Retaining Wall and Cut-Off Walls for Units 6 & 7. The horizontal flow barrier boundary was used to simulate the effects of the excavation cut-off walls surrounding the power blocks for Units 6 & 7 for construction dewatering and the MSE retaining wall surrounding the plant area.

Model Domain Perimeter – General-head boundary conditions are assigned to the perimeter of all model layers. The general-head boundary represents the influence of conditions beyond the model area.

No-Flow Boundary – Bottom of the Model - The bottom of the model is designated a no-flow boundary because water levels in the Biscayne Aquifer are expected to be negligibly affected by upward leakage through the Lower Tamiami Formation and Hawthorne Group, which is several hundred feet thick and acts as a confining layer.

No-Flow Boundary – Units 6 & 7 Excavations - The excavations are designated as inactive to flow. Minor seepage will occur through the cut-off walls into the excavations but the quantities will be insignificant.

The numerical groundwater model was then calibrated and validated as follows:

- **Three pumping tests were used in the model calibration phase; two of these tests were conducted in the Key Largo Limestone and one in the Fort Thompson Formation.**
- **The model included a validation step, whereby an additional pumping test was simulated following the calibration phase.**
- **A range for the hydraulic conductivity anisotropy value of between 8:1 and 15:1 was used for the various hydrogeologic units. These values were determined during calibration and constrained by literature and field observations.**

Qualitative comparisons of model results were made to regional potentiometric surface maps (Langevin, 2001) and the interaction of groundwater with the cooling canal system. The interaction of groundwater with the cooling canal system was assessed by comparing model results against estimates obtained from an independent steady-state water balance model (Golder, 2008).

The calibrated and validated groundwater model was then utilized to simulate construction dewatering and steady-state radial collector well operation. The modeling approach and impacts of these predictive runs are further discussed in Sections 4.2 (dewatering) and 5.2 (radial collector well operation). Additionally, Section 5.3 provides a discussion of the ecological impacts of radial collector well operations. A detailed discussion of the groundwater model development, conceptual design, and calibration is presented in FSAR Subsection 2.4.12, Appendix 2CC.

ER Section 2.3 (References) will be revised as follows, to reflect this item response:

Fish and Wildlife Research Institute (FWRI), 2010. Marine Resources Geographic Information System (MRGIS) GIS Data, Benthic Habitats – South Florida. Available at: http://ocean.floridamarine.org/mrgis_ims/Description_Layers_Marine.htm, accessed June 25, 2010.

Golder Associates, Inc., 2008. ***Final Report on Florida Power & Light Company. Turkey Point New Nuclear Project Cooling Canal Data and Analysis Report.*** **Available at: http://publicfiles.dep.state.fl.us/SEC/LewisLongmanWalkerTurkeyPoint/Siting%20Turkey%20Point%20Hard%20Copies/Final%20Report-FP&L%20Turkey%20Point%20New%20Nuclear%20Project.pdf, accessed May 17, 2011.**

JLA Geosciences Inc., 2010. ***Geology and Hydrogeology Report for Turkey Point Plant Groundwater, Surface Water & Ecological Monitoring Plan.*** **Available at: http://my.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/fpl_tp_geo_and_h2ogeo_rept.pdf?bcsi_scan_72822C1E3A290063=0&bcsi_scan_filename=fpl_tp_geo_and_h2ogeo_rept.pdf, accessed May 17, 2011**

ER Section 5.2.1.1.8 will be revised as follows, to reflect this item response:

5.2.1.1.8 Operation of the Radial Collector Wells

A groundwater flow model (MODFLOW 2000/Visual MODFLOW) was used to assess the impacts of radial collector well operation to surface water and groundwater. The calibrated and verified groundwater model, as previously discussed in Subsection 2.3.1.2.3, was used as the basis for the predictive runs for radial collector well operation. The radial collector well conceptual model design is summarized as follows:

- **The water level in Biscayne Bay was set to the long-term average of -0.81 feet NAVD88.**
- **The Unit 6 & 7 plant area was assumed complete and the relevant recharge/ evapotranspiration zones were altered to reflect as-built conditions. The muck layer was removed from the plant area, as discussed in Section 3.9, and replaced with backfill.**
- **Three of the four radial collector wells were operational. To provide a conservative estimate of the source of water from inland areas to the radial collector wells, the three wells closest to the shore were modeled as operational.**
- **Four pumping wells were placed on the last 300 feet of each lateral to represent the screened intervals. Flows were distributed along the laterals to reflect friction losses and distributed flow along the length.**
- **The radial collector well laterals were located within the Upper Higher Flow Zone.**

- **The simulation was executed at steady-state conditions.**

The groundwater drawdown in Model Layer 1 (muck and rock/sandy material) and Model Layer 4 (Upper Higher Flow Zone) is depicted in Figures 5.2-1 and 5.2-2, respectively. The operational impacts of the radial collector wells to groundwater and surface water are discussed in the following sections.

Surface Water

Four radial collector wells would be installed adjacent to Biscayne Bay to provide cooling water for Units 6 & 7 (see Figure 3.1-3). The well caissons would be located on the Turkey Point peninsula east of the existing units. Each radial collector well would consist of a central reinforced concrete caisson extending below the ground level with laterals projecting from the caisson. The well laterals would be advanced horizontally a distance of up to 900 feet beneath Biscayne Bay and installed at a depth between ~~of approximately~~ **25 and** 40 feet. The four radial collector wells would provide up to 86,400 gpm (124 million gallons per day [mgd]) to supplement the reclaimed water source for cooling water makeup for Units 6 & 7 (Table 3.3-2).

~~A geo-hydrologic model (Visual MODFLOW) was used to assess the impacts to surface water, including Biscayne Bay and the cooling canals of the industrial wastewater facility, from the operation of the radial collector wells. Since areas below the high tide shoreline are inundated from the bay about twice a day, there is an unlimited water supply in these areas. Therefore, the high tide shoreline was selected as the model shoreline, and areas below the high tide shoreline were modeled as a "constant head boundaries". The results of the simulation are depicted on Figure 5.2-1, (Key Largo Limestone potentiometric surface). At steady-state conditions, the radial collector wells would be recharged at a rate ranging from 92 to 100 percent (114 mgd to 124 mgd) from Biscayne Bay. The recharge would be predominately localized in the area of the radial collector wells. The remaining recharge, if any, would be from groundwater beneath the plant property. The groundwater modeling and results are described in FSAR Appendix 2.4.12-CC.~~

As previously discussed in Subsection 2.3.1, surface water features within the local area of the radial collector wells included Biscayne Bay, Card Sound, the cooling canals of the industrial wastewater facility, and several surface water control canals (e.g. L-31 Canal). The surface water elevation in each of these features was set to known values based on seasonal or long-term data. Notably, the water levels in the predominant surface water features in the site were stipulated as follows: Biscayne Bay/Card Sound (-1.05 feet NAVD88); cooling canals of industrial wastewater system (discharge side: 1.28 feet NAVD88; intake structure: -3.38 feet NAVD88).

As part of the steady-state radial collector well groundwater simulation, the volumetric flow rates were calculated for each of the boundary conditions (e.g. general head at Biscayne Bay/Card Sound, river boundary at the cooling canals of the industrial wastewater facility). Based on this calculation, it was observed that 97.8 percent (121 MGD) of the groundwater recharge originated from Biscayne Bay and 2.2 percent (2.8 MGD) originated from inland areas. The recharge from Biscayne Bay would be predominately localized in the area of the radial collector wells. Notably, 1.9 percent (2.4 MGD) originated from the cooling canals of the industrial wastewater facility.

Groundwater

~~As previously described, groundwater modeling was performed to simulate the steady-state conditions resulting from operation of the radial collector wells. The cone of depression ranges from -2 to -15 feet in the Key Largo Limestone and would generally be confined to the local area of the radial collector wells, indicating a small influence on regional groundwater flow (Figure 5.2- 1). The model indicates that the muck layer could be de-watered on Turkey Point during steady state conditions; however this would be confined to the upland (non-wetland) areas immediately around the radial collector wells. Drawdown in the muck layer on the eastern shoreline of the plant property near Turkey Point could range up to a maximum of 1.5 feet.~~

~~Based on the results of the groundwater modeling, approximately 92 to 100 percent of recharge to the radial collector wells would come from Biscayne Bay and up to 8 percent would come from beneath the plant property or from other areas within the saltwater aquifer. The impacts to the Biscayne Aquifer west of the Turkey Point plant property would be insignificant.~~

As previously discussed, groundwater modeling was performed to simulate the steady-state conditions resulting from operation of the radial collector wells. The cone of depression in Model Layer 1 (onshore – muck; offshore – rock/sand) ranged from 3 to 0.1 feet and was generally confined to the area local to the radial collector wells (areal extent of 211 acres based on the 0.1 foot drawdown contour in Biscayne Bay) and the Units 1 though 5 plant area, as depicted on Figure 5.2-1. The drawdown in Model Layer 4 (Upper Higher Flow Zone) ranged from 3 to 0.1 feet and was also generally confined to the area local to the radial collector wells (areal extent of 729 acres based on the 0.1 foot drawdown contour in Biscayne Bay), as depicted in Figure 5.2-2.

The model indicates that the uplands could be dewatered on the Turkey Point peninsula during steady state conditions; however this would be confined to areas immediately around the radial collector wells. Drawdown in the muck layer on the eastern shoreline, based on the results of the groundwater model, is not anticipated (see Figure 5.2-1).

Based on the results of the groundwater modeling, approximately 97.8 percent of groundwater recharge to the radial collector wells would originate from Biscayne Bay and 2.2 percent would come from areas inland, including 1.9 percent from the cooling canals of the industrial wastewater facility. The remaining 0.3 percent of recharge (0.4 MGD) would come from boundaries representing precipitation onshore. The 0.3 percent from precipitation recharge represents a relatively small amount of water. Because precipitation is fresh water, it will tend to remain in the upper layers of the aquifer. Since the radial collector wells draw water at depth, the 0.3 percent is a conservative prediction of the water entering the radial collector wells. Therefore, the amount of fresh water drawn by the radial collector wells will be inconsequential and will not adversely impact the environment. Thus, impacts to the Biscayne Aquifer west of the Turkey Point plant property would be insignificant.

ER Section 5.2.2.1.2 will be revised as follows, to reflect this item response:

As described in Subsection 2.3.1, Biscayne Bay is hydrologically connected to the upper zone of the Biscayne Aquifer. Based on groundwater modeling described above, the radial collector wells would be recharged at a rate ~~ranging from 92 to 100~~ **of 97.8** percent (~~114 mgd to 124~~ **121** ~~mgd~~ **MGD**) from Biscayne Bay. This would be predominately localized in the area of the radial collector wells. The remaining recharge would be from **surface water (e.g. cooling canals) and** groundwater beneath the plant property. The amount of saltwater used (up to approximately **121** ~~124~~ ~~mgd~~ **MGD** if **97.8**~~100~~ percent saltwater) compared to the size of the saltwater resource available would be insignificant. Impacts to Biscayne Bay surface waters would be SMALL and would not require mitigation.

ER Section 5.2.2.2.2 will be revised as follows, to reflect this item response:

As described in Subsection 5.2.1.1.8, it is estimated that the radial collector wells would be recharged at a rate ~~ranging from 92 to 100~~ **of 97.8 percent** (~~114 mgd to 124~~ **121 MGD** ~~mgd~~) from Biscayne Bay. This would be predominately localized in the area of the radial collector wells. The remaining recharge would be from **the inland area west of the radial collector wells, including the cooling canals of the industrial wastewater facility, estimated at 2.4 MGD, and other areas, estimated at 0.4 MGD, including** groundwater beneath the plant property. ~~(see Figure 5.2-1), thereby having minimal effect on the Biscayne aquifer where used as a water source~~. **Recharge from groundwater would occur** ~~The majority of recharge flow would come from east of the radial collector well~~s in an area where the groundwater is too brackish for potable use. **Based on the amount of expected recharge from groundwater sources and the**

non-potable classification of the groundwater at the site (due to its salinity), the predicted impacts to groundwater use due to the operation of the radial collector wells would be SMALL.

ER Section 5.2.3.1.2 will be revised as follows, to reflect this item response:

Operation of radial collector wells installed beneath Biscayne Bay would not impact the water quality of the bay. Although recharge would occur from the bay, it is estimated to be a small percentage of natural freshwater recharge. **Additionally, although 1.9 percent of recharge (2.4 MGD) is predicted to originate from the cooling canals of the industrial wastewater facility, which are hypersaline, this recharge water drawn towards the radial collector wells will remain at depth within the aquifer due to the placement of the radial collector well laterals below the seabed and due to the higher density of this hypersaline water relative to seawater.** Effects on salinity of the bay, based on the predicted amount of withdrawal versus the natural recharge, would be minimal.

ER Section 5.2.3.2.3 will be revised as follows, to reflect this item response:

As described in Subsection 5.2.2.2, it is estimated that the radial collector wells would be recharged at a rate ~~ranging from 92 to 100~~ **of 97.8** percent (~~114 mgd to 124~~ **121 MGD** ~~mgd~~) from Biscayne Bay. This would be predominately localized in the area of the radial collector wells. The remaining recharge would be from **surface water (e.g. cooling canals) and** groundwater beneath the plant property ~~(see Figure 5.2-1)~~, thereby having minimal effect on the Biscayne aquifer where used as a water source. The majority of recharge flow would come from ~~east of~~ the **local area of the** radial collector wells ~~in an area~~ where the groundwater is too brackish for potable water use. **As discussed above, any hypersaline water drawn into the aquifer from the cooling canals would not impact potable water supplies, which are further inland due to the presence of brackish, non-potable water near the coast.** Therefore, impacts to groundwater quality as a result of radial collector well operations would be SMALL and not require mitigation.

The ER will be revised to indicate that the radial collector wells will be at a depth of between 25 and 40 feet.

ER Figure 5.2-1 will be revised and a new Figure 5.2-2 will be added as shown on the next two pages to reflect the item response.

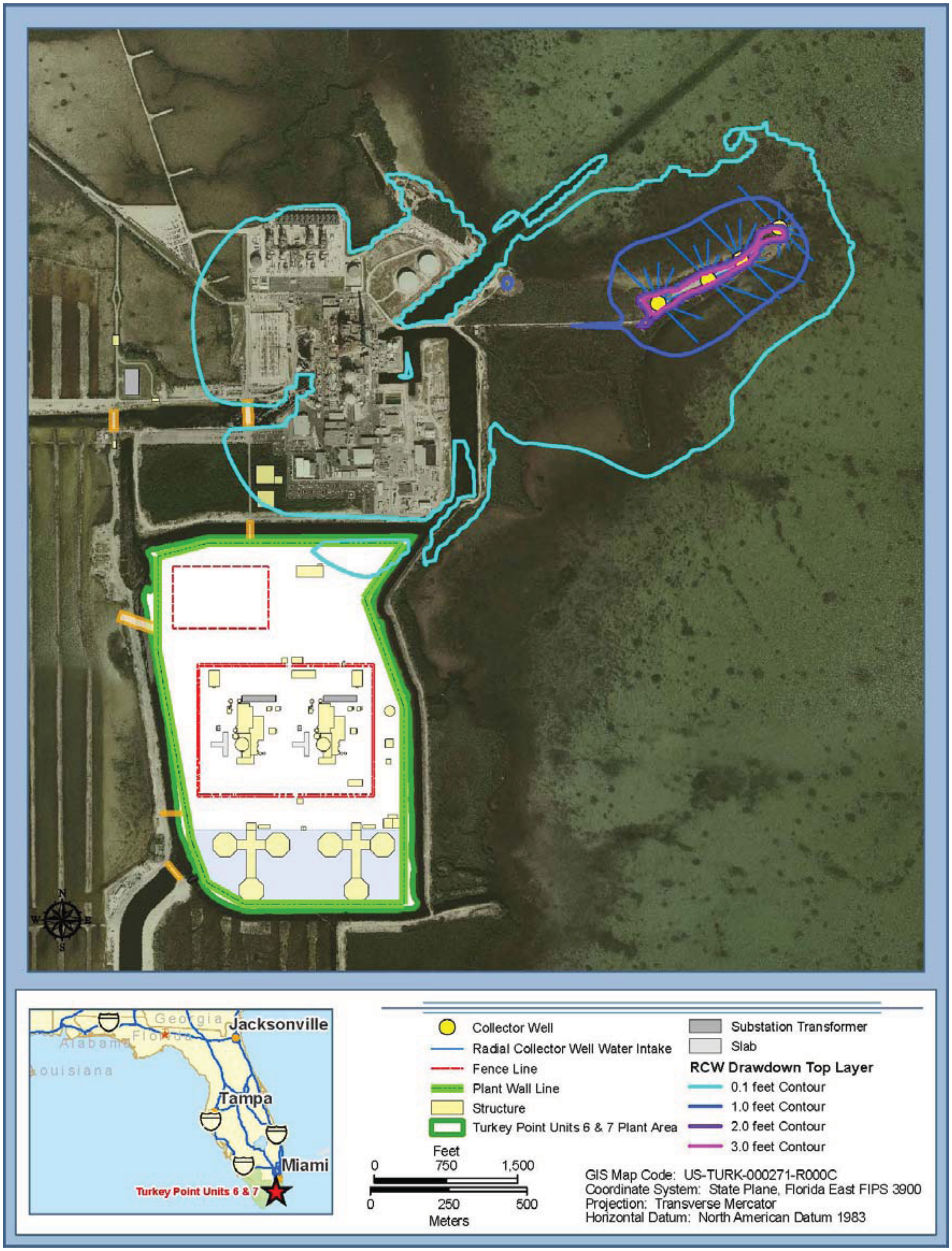

Figure 5.2-1 Radial Collector Well Drawdown in Model Layer 1 (Muck Layer)

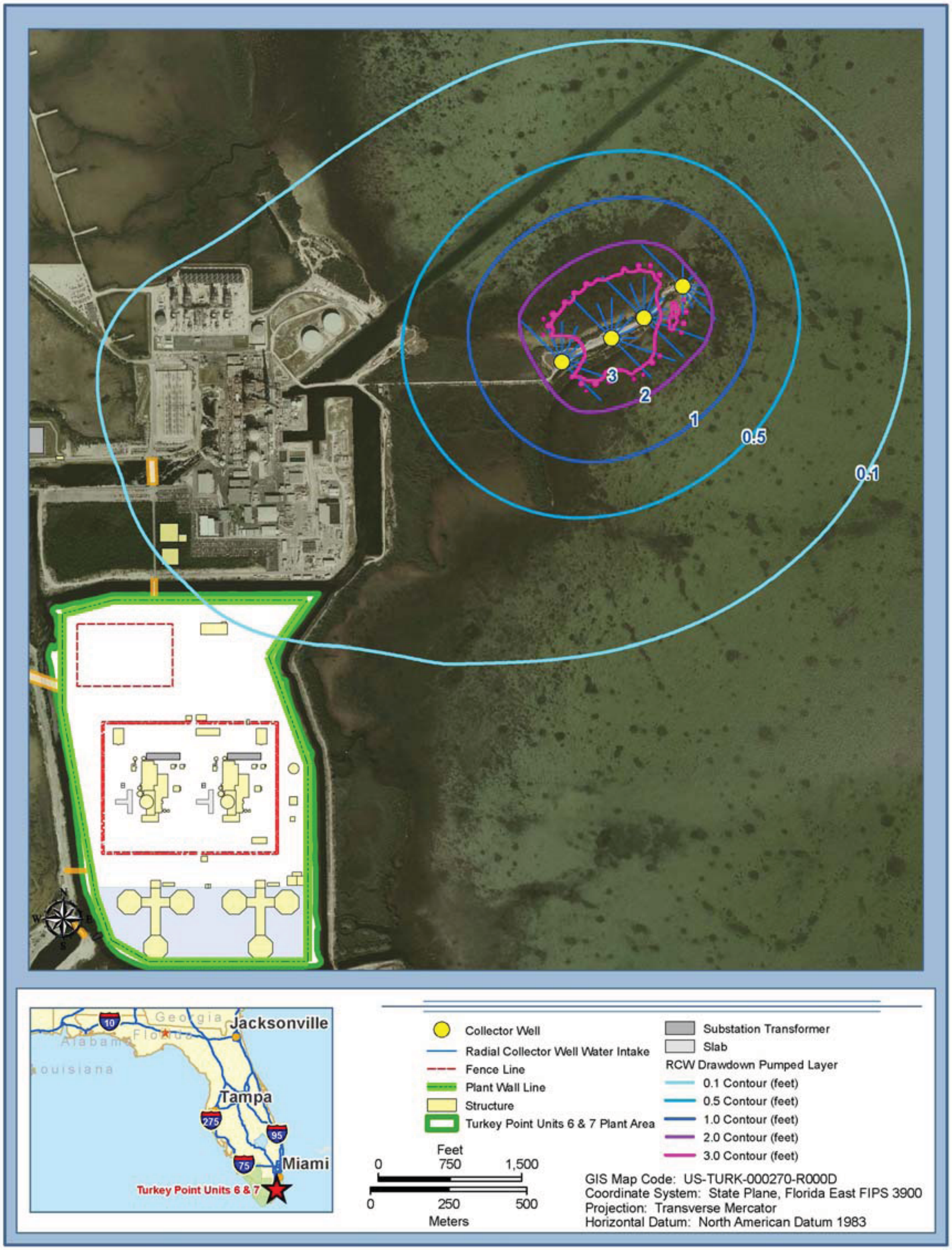

Figure 5.2-2 Radial Collector Well Drawdown in Model Layer 4 (Upper Higher Flow Zone)

ASSOCIATED ENCLOSURES:

1 OSM – GIS Files for ER 5.2 Groundwater Figures (ER Figure 5.2-1 and Figure 5.2-2), disk contents below:

LAYER_ID	LAYER_TITLE	LAYER_NAME
TURK-BD-000006-2008	Turkey Point Associated Facilities	VGIS_BD_ASSOC_FACIL_AREA
TURK-BD-000002-2008	Turkey Point Units 6 & 7 Plant Area	VGIS_BD_PLANT_AREA
TURK-BD-000005-2008	Turkey Point Units 6 & 7 Project	VGIS_BD_PROJECT_AREA
TURK-BD-000003-2008	Turkey Point Units 6 & 7 Site	VGIS_BD_SITE_AREA
TURK-BG-000003-2008	Turkey Point Proposed Concrete Slabs	VGIS_BG_SLAB_FUTURE_AREA
TURK-BG-000002-2008	Turkey Point Proposed Structures Units 6 & 7	VGIS_BG_STRUCT_FUTURE_AREA
TURK-EH-000015-2009	Turkey Point RCW Drawdown within Pumped Layer	VGIS_EH_GRNDWATER_LN_PUMP_ZN
TURK-EH-000018-2011	Turkey Point RCW Drawdown within Top Layer	VGIS_EH_GRNDWATER_LN_TOP_LAYER
TURK-FP-000001-2008	Turkey Point Utilization Plan Areas	VGIS_FP_LAND_USE_AREA
USFL-HY-000009-2008	Turkey Point Cooling Water Canal Line	VGIS_HY_CANAL_LN_DTL
TURK-HY-000003-2008	Turkey Point Makeup Water Reservoir	VGIS_HY_SURFACE_WATER_AREA
TURK-IM-000002-2008	Turkey Point Fence Line	VGIS_IM_FENCE_LN
TURK-IM-000004-2008	Turkey Point Homestead Raceway	VGIS_IM_RACEWAY_LN
TURK-IM-000003-2008	Turkey Point Proposed MSE Retaining Wall	VGIS_IM_WALL_LN
TURK-IM-000029-2009	Turkey Point Radial Collector Well Locations	VGIS_IM_WATER_WELL_PT_RCW
TURK-SO-000001-2009	Turkey Point Disturbed Soil Area (Heavy Haul Road)	VGIS_SO_DISTURB_AREA_HAUL_ROAD
TURK-SO-000002-2009	Turkey Point Disturbed Soil Area (Radial Collector Water Pipeline)	VGIS_SO_DISTURB_AREA_RCW
TURK-SO-000004-2009	Turkey Point Disturbed Soil Area (Water Treatment Pipeline)	VGIS_SO_DISTURB_AREA_WTP
TURK-TR-000006-2008	Turkey Point Bridges	VGIS_TR_ROAD_BRIDGE_AREA
TURK-TR-000001-2008	Turkey Point Road Edge of Pavement	VGIS_TR_ROAD_EDGE_PAVEMNT_LN
TURK-UT-000037-2008	Turkey Point Power Block Area	VGIS_UT_POWER_BLOCK_AREA
TURK-UT-000003-2008	Turkey Point Substation Area	VGIS_UT_SUBSTATION_AREA
TURK-UT-000008-2008	Turkey Point Radial Collector Well Laterals (Intake Lines)	VGIS_UT_WATER_INTAKE_LN
TURK-UT-000004-2008	Turkey Point Water Lines	VGIS_UT_WATER_LN
TURK-UT-000051-2009	Turkey Point Potable Water Lines	VGIS_UT_WATER_LN_POTABLE
TURK-UT-000038-2008	Turkey Point Cooling Water Lines (radial)	VGIS_UT_WATER_LN_RADIAL

NRC Site Audit Trip Report dated September 21, 2010

SRP Section: Environmental Report Section 5.3 – Cooling System Impacts

NRC Environmental Audit Data and Information Need Item: H-35, AQ-4

Have available the subject matter expert responsible for the ER analysis of the area affected and the velocities in the vicinity of the radial wells' intake structure. (H-35)

Have available the subject matter expert responsible for the ER analysis of the impacts of the operation of the radial collector well system on nearshore benthic resources (benthic organisms, seagrasses, demersal fish). (AQ-4)

FPL RESPONSE:

Induced seabed velocities, caused from radial collector wells operation on an averaged basis, were calculated to be 0.00002 foot per second. Operation of the radial collector wells is not anticipated to result in significant adverse effects on seagrasses. Seagrasses have low nutrient requirements and are able to recycle nutrients efficiently, so that they are strong competitors under low nutrient levels (Koch, 2001; Armitage et al., 2005). *Thalassia testudinum* is the dominant species of seagrass in the area and is more tolerant of low phosphorus/nutrient environments that could potentially result from induced flow through the seabed.

There are several macroinvertebrates and vertebrate species that utilize the seagrass beds of Biscayne Bay, including the areas over which the proposed radial collector well laterals will be located. Based on studies performed in 2009, the fish and invertebrates observed in the area are well adapted to living in areas of relatively swift currents associated with tidal exchange and wind and wave-driven shallow water turbulence. There is little likelihood that they would be affected by the very minor velocity changes at the seabed expected form operation of the radial collector wells.

Based on the model results, the steady-state operation of the radial collector wells could dewater the upland layer (areas above the high water shoreline) on the Turkey Point peninsula. Drawdown in the uplands on the Turkey Point peninsula would range from 1 to 3 feet. Drawdown west of Turkey Point would be generally confined to the shoreline adjacent to Units 1 through 5 and would be approximately 0.1 feet.

This response is PLANT SPECIFIC.

References:

Koch, E.W. 2001. Beyond light: Physical, geological, and geochemical parameters as possible submersed aquatic vegetation habitat requirements. *Estuaries* 24:1-17.

Armitage, A.R., Frankovich, K.L. Jr. Heck and J.W. Fourqurean, 2005. Experimental nutrient enrichment causes complex changes in seagrass, microalgae, and macroalgae community structure in Florida Bay. *Estuaries* 28: 422-434.

ASSOCIATED COLA REVISIONS:

ER Section 5.3.1.2 will be revised as follows, as shown in the following text change, to reflect the RAI response:

The use of reclaimed water would not impact any aquatic resources because aquatic organisms would have no contact with this water, which would be subjected to secondary treatment and high level disinfection, then transported via pipelines to the FPL reclaimed water treatment facility. Withdrawal of saltwater from Biscayne Bay through the radial collector wells would not affect aquatic resources in Biscayne Bay. Biscayne Bay, which is connected directly to the Atlantic Ocean, would not experience a noticeable loss of water to the radial collector wells. Also, because the water is not collected directly by the wells, but instead flows through the porous limestone approximately 40 feet below the bottom of Biscayne Bay, no aquatic organisms in Biscayne Bay would be affected. The **average for all radial collector laterals** flow rate at the sediment-water interface resulting from the radial collector well operation would be approximately 0.00004~~1~~**2** foot per second.

Operation of the radial collector wells is not anticipated to result in significant adverse effects on seagrasses. Seagrasses have low nutrient requirements and are able to recycle nutrients efficiently, so that they are strong competitors under low nutrient levels (Koch, 2001; Armitage et al., 2005). ***Thalassia testudinum*** **is the dominant species of seagrass in the area and is more tolerant of low phosphorus/nutrient environments that could potentially result from induced flow through the seabed.**

There are several macroinvertebrates and vertebrate species that utilize the seagrass beds of Biscayne Bay, including the areas over which the proposed radial collector well laterals will be located. Based on studies performed in 2009, the fish and invertebrates observed in the area are well adapted to living in areas of relatively swift currents associated with tidal exchange and wind and wave-driven shallow water turbulence. There is little likelihood that they would be affected by the very minor velocity changes at the seabed expected from operation of the radial collector wells.

The operation of the radial collector wells and the potential impacts on water bodies including Biscayne Bay and the cooling canals in the industrial wastewater facility have been evaluated through groundwater modeling (Section 5.2 and FSAR Appendix 2.4.12-CC). Based on the model results, the steady-state operation of the radial collector wells could dewater the upland ~~muck~~ layer (areas above the high water shoreline) on the Turkey Point peninsula. Drawdown in the **uplands** ~~muck layer adjacent and~~ **on the** ~~west of~~ Turkey Point **peninsula** would range from **1** ~~0.1~~ to **3** ~~1.5~~ feet. **Drawdown west of Turkey Point would be generally confined to the shoreline adjacent to Units 1 through 5 and would be approximately 0.1 feet (see Figure 5.2-1).** Based on the evaluation, impacts with respect to aquatic vegetation (e.g. shoreline mangroves) would be SMALL and not warrant mitigation. Additionally, impacts to important aquatic species from operation of the radial collector wells would be SMALL and would not require mitigation.

ER Section 5.3 (References) will be revised as follows, as shown in the following text change, to reflect the RAI response:

Koch, E.W. 2001. Beyond light: Physical, geological, and geochemical parameters as possible submersed aquatic vegetation habitat requirements. *Estuaries* 24:1-17.

Armitage, A.R., Frankovich, K.L. Jr. Heck and J.W. Fourqurean, 2005. Experimental nutrient enrichment causes complex changes in seagrass, microalgae, and macroalgae community structure in Florida Bay. *Estuaries* 28: 422-434.

ASSOCIATED ENCLOSURES:

None