December 24, 2024

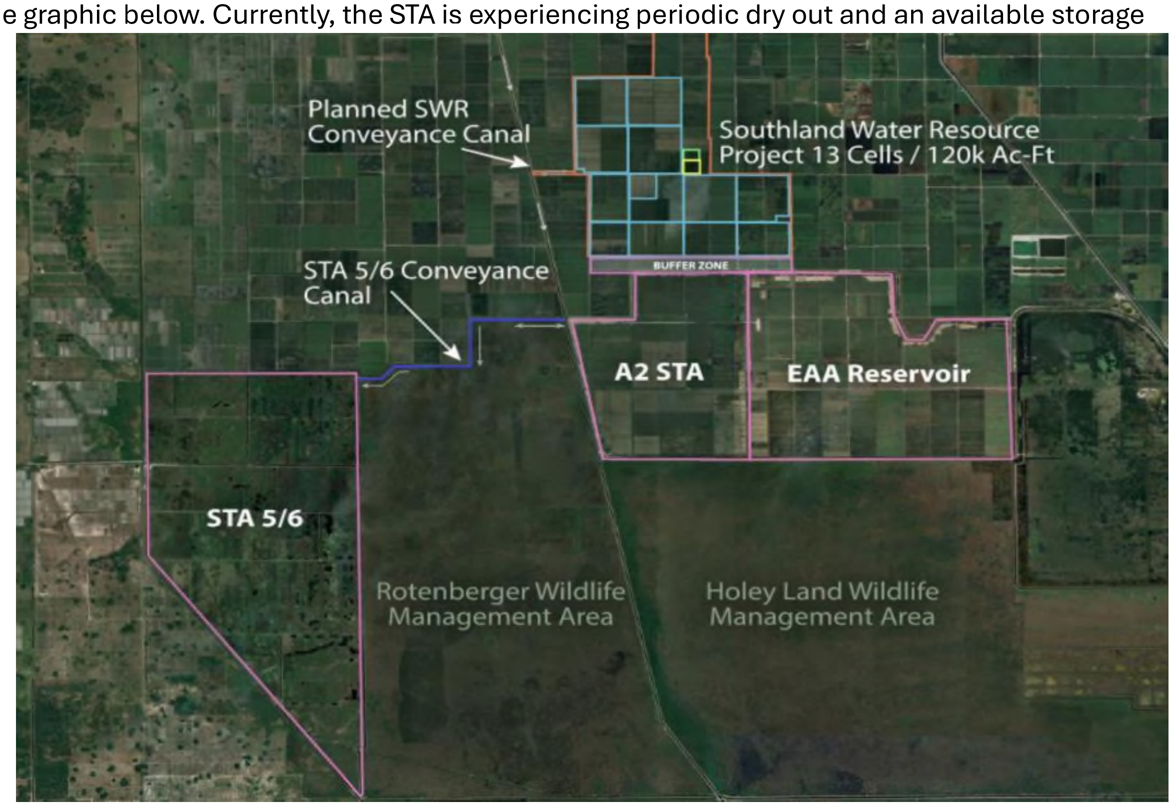
South Florida Water Management District
3301 Gun Club Rd.
West Palm Beach, Florida 33406

On Behalf Of:
Phillips and Jordan Inc.
c/o Matt Eidson
30115 State Road 52
Suite 301
San Antonio, Fl 33576

Mr. Drew Bartlett,

On behalf of Phillips and Jordan Inc., please accept the below information to assist the South Florida Water Management District (SFWMD) in its review of the Southland Water Resource Project, as part of Palm Beach County's comprehensive plan requirements**.**

The Southland Water Resource project would make available +/-120,000 acre/ft of low hazard water storage with conveyance facilities from Lake Okeechobee to the Miami Canal. The newly constructed facility would create opportunities for water managers to utilize additional storage South of Lake Okeechobee, which can be used in the currently constructed stormwater treatment areas to benefit Everglades Restoration. Namely, Stormwater Treatment Area (STA) 5/6 as shown in the graphic below. Currently, the STA is experiencing periodic dry out and an available storage



feature providing the necessary 50,000–60,000 acre/feet of storage would balance the system and provide year-round nutrient removal.

An added benefit is also realized for the EAA A-2 STA. As it is currently operational but does not have an available water storage facility to maintain vegetative growth during the dry season, the Southland Water Resource project location is strategically located to provide a benefit for all facilities in the region critical to Everglades Restoration.

Additionally, the Southland Water Resource project has been designed in a phased delivery approach, which will allow for an accelerated benefit to the SFWMD. For example, we anticipate the first 18,000-20,000 acre/ft of water storage to be available within five years.

Like several projects included within the Comprehensive Everglades Restoration Plan (CERP), construction of the water resource project will have the incidental result of excavated aggregate material that will benefit Florida's need for aggregate to support new infrastructure projects across the state. Overall, the project design incorporates 13 individual storage cells. The excavated material will be removed from each cell and exported from the site via rail, which ensures there is no impact to surrounding property owners and the traveling public.

To date, Phillips and Jordan Inc., has further developed and completed the detailed seepage analysis, hydraulic modeling report, and final water availability report that utilizes the latest District and USACE information, including previous and future projects in the region. As we have progressed all aspects of the above modeling, we have further developed the civil plans to 60% per the SFWMD standards specifications. Our current design provides for buffer zones against adjacent properties so as not to interfere in any way with other State or Federal projects. The design and construction techniques of this project are very similar to the construction of the EAA Reservoir project, as well as the benefits. Seepage calculations and water availability reports are attached, and we would welcome the opportunity to engage with SFWMD staff for input as we move forward.

As we have worked to bring the project forward, we have continued on-site water quality monitoring, water level monitoring as well as continued threatened and endangered species inspections for well over 16 months. The associated data can and will also be provided.

Currently the project is in the final RFI response phase associated with the Florida Department of Environmental Protection environmental resource permit process and we expect to have the final submittal returned this month.

We have continued our interaction with the USACE, submitted all requested documentation for the 404 NPR, and are in the process of scheduling the required USACE site visit in early January.

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As a final step in the process, we have provided all necessary documents to Palm Beach County (PBC), with the exception of the SFWMD project identification letter. Upon receipt of the identification letter, our team will complete the file for submission and work towards the next steps in the PBC zoning process.

The Southland Water Resource Project is a valuable tool in the Everglades region for SFWMD. The project provides much needed storage capacity for STA 5/6 to aid in dry season function, as well as all other current and future water quality projects before sending water southward. The project complements, supports, and provides storage for water treatment in the region for the advancement and acceleration of improving water quality and supply for south Florida.

Not only can our team move forward and provide much needed storage capacity to the SFWMD at an accelerated pace, but we also accomplish this at a much better value for the taxpayer.

We look forward to engaging you and your team to continue to advance the project and are committed to continued coordination.

Thank You,
Matt Eidson
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DN: C=US, E=meidson@pandj.com, O="Phillips and Jordan Inc. ", CN="Matt Eidson "
Date: 2024.12.24 18:23:49-05'00'

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Revised Draft Technical Memorandum

Southlands Water Storage

Preliminary 3D Groundwater Modeling

Collective Water Resources

Subject:	**Southlands Water Storage: Preliminary 3D Groundwater Modeling for Estimating Seepage Impact**
To:	Craig Irwin, P.E., Brown and Caldwell
Date:	Draft Revision November 13, 2024 (from Draft May 30, 2024)
Prepared by:	Desiree Heinl, P.E., Collective Water Resources, LLC
Reviewed by:	Maria Loinaz, P.E., PhD, Emily McBryan, P.E., Collective Water Resources, LLC

1. Background/Introduction

This document describes the methods for quantifying and managing the anticipated seepage losses from a conceptual representation of the Southlands Water Storage (SWS) project. The SWS project site has a total footprint area of approximately 8,680 acres of which the water storage area occupies an area of approximately 6,360 acres. SWS is located just north of the proposed Everglades Agricultural Area (EAA) A-2 Stormwater Treatment Area (STA) and Reservoir east of the Miami Canal, and west of the North New River Canal. Surrounding lands consist mostly of sugarcane agricultural use.

Three-dimensional (3D) MODFLOW groundwater modeling was performed to estimate seepage from the SWS. The groundwater model was used to evaluate the following:

- Flow to/from SWS and its impact on the surrounding water management systems including the EAA A-2 STA and Reservoir project, the Miami Canal, the North New River Canal, and surrounding farm fields,
- The effectiveness of various seepage control elevations in the seepage management canal surrounding the project,
- The amount of unrecoverable seepage or drawdown, if any, that migrates to surrounding areas, and,
- The effect of any unrecoverable seepage or drawdown on groundwater levels in the surrounding areas.

A description of the model development, simulated seepage impacts, model limitations and conclusions are included in this technical memorandum.

2. 3D Groundwater Model Development

The 3D groundwater model development is described as follows and includes a description of the:

- Model Area
- Model Grid
- Hydrogeological Parameters and Layers
- With and Without Project Models

The modeling described in this memorandum is a conceptual representation of the Southlands Water Storage (SWS) project. It is based on the current project boundary provided to Collective Water Resources in April 2024 and assumes that the SWS facility is segmented by an existing west-east farm canal. The modeling described herein has not been verified as that effort will be completed in the Reconnaissance Phase of the project. The model results presented herein are based on the conceptual representation and assumptions identified in the memorandum.

The model utilized for the evaluation of the SWS project is based on a revision of the steady-state 3D groundwater model developed for the A-2 STA design (A-2 Stormwater Treatment Area Final Groundwater Modeling Report, 2021).

2.1 Model Area

The model outer boundary coincides with existing waterbodies on each side of the project. For the 3D seepage analysis for the SWS project, the model boundary was extended 4 (four) miles north of the Southlands project (to the Bolles Canal) to evaluate impact to the farm land north of the Southlands project. The east and west boundaries are the North New River and Miami Canals, and the Southern Boundary follows the STA 3/4 Inflow Canal on the north edge of Holey Land and the and A-2 Inflow/Outflow Canal on the north edge of the A-1 FEB. The model area is shown in Figure 1.

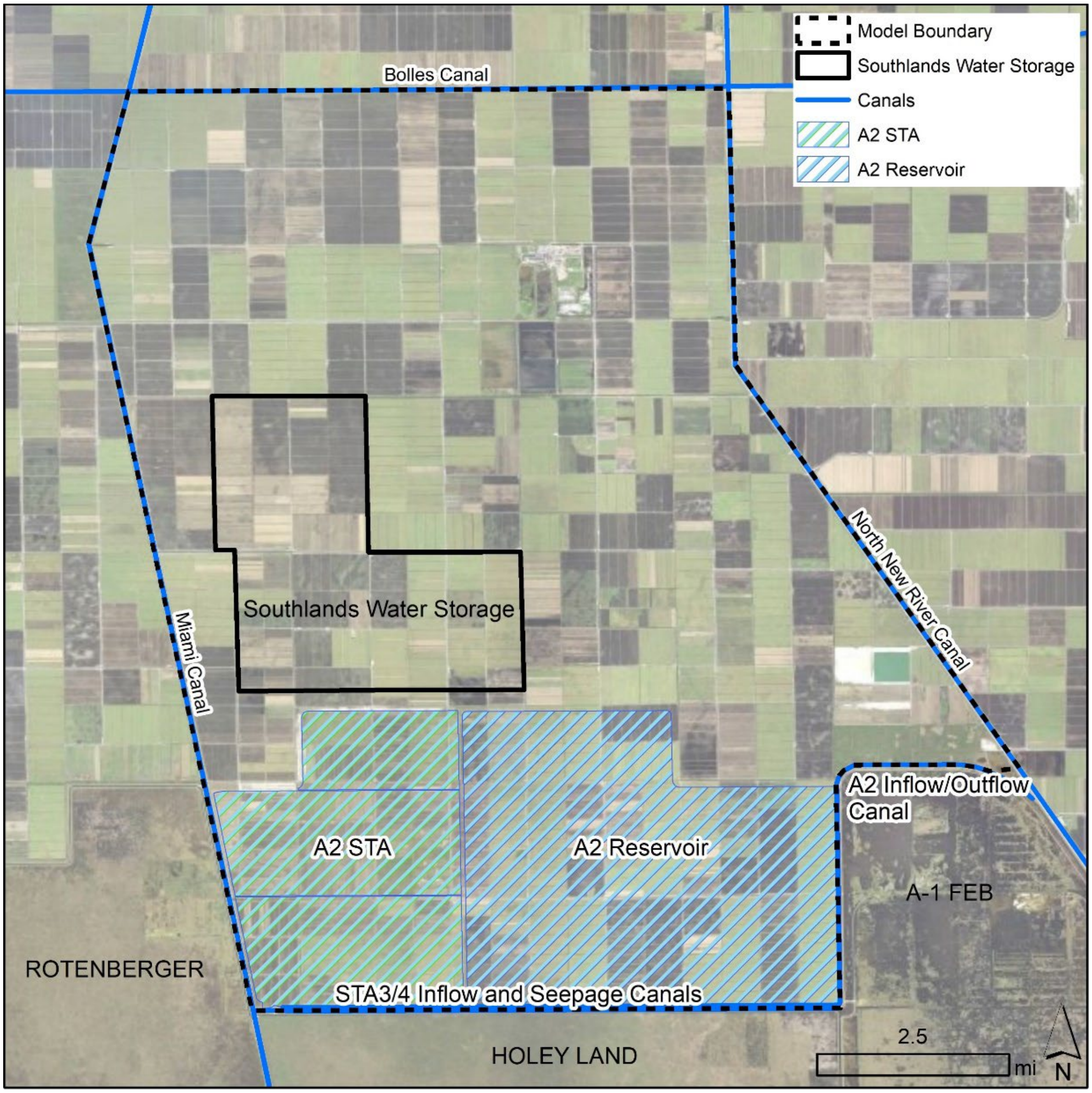

Figure 1. Model Area

2.2 Model Grid

The numerical model used is the MODFLOW 2005 structured finite difference grid with variable cell sizes. The larger grid cells furthest from the project features are approximately 1,500 feet x 1,500 feet. The finer project features, such as embankments, canals, and cutoff walls are represented with smaller cells sizes, according to the shape, direction, and relative distances between the features. The smallest grid cell sides are 16 feet in the x- (east-west) direction and 17 feet in the y- (north-south) direction. Figure 2 shows the model grid zoomed in to the entire SWS area and the southwest corner of the facility.

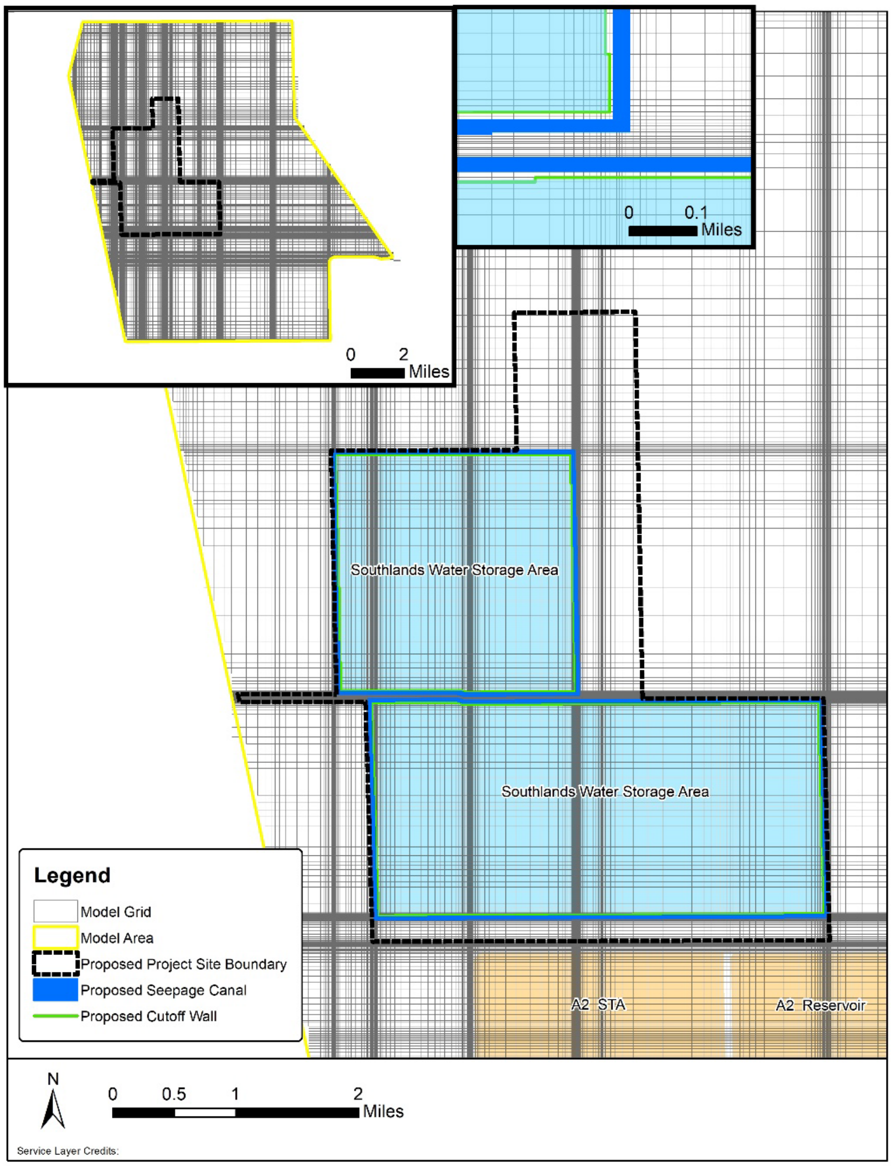

Figure 2. Model Grid with Zoomed in Views Near Project Features

2.3 Hydrogeological Parameters and Layers

Subsurface profiles from field boring logs were collected and interpreted at various locations near and within the A-2 STA and Reservoir project sites and SWS project site to develop hydrogeological parameters and layers. The hydraulic conductivity values used were defined as constant in each layer, but each layer has elevations that vary throughout the model area according to the interpolation of surfaces from the collected boring data.

For the effort documented in this technical memorandum, additional boring data from 27 borings (WIRX, 2023) were added to the previous data set (A-2 Stormwater Treatment Area Final Groundwater Modeling Report, 2021) and layer surfaces were re-interpolated. Information was collected from 80 boring logs located in the A-2 STA, A-2 Reservoir, and SWS project sites (locations shown in Figure 3). The version of the model documented in this technical memorandum uses the new elevations and the additional boring conductivities that were recommended based on the field permeability testing.

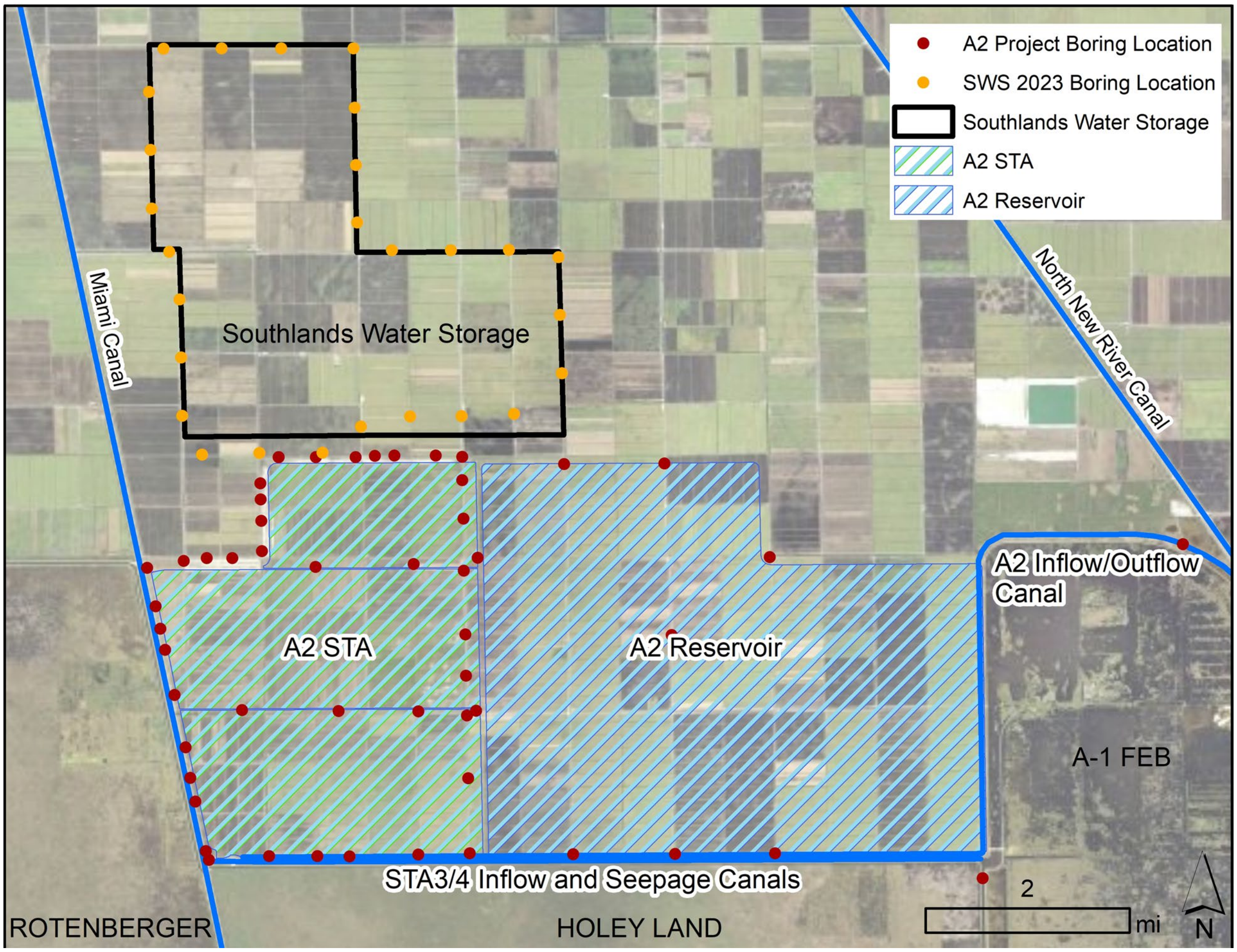

Figure 3. Hydrogeologic Boring Locations

2.3.1 Hydrogeologic Model Background

The evolution of the hydrogeologic model used for this analysis is as described in the following paragraphs with text directly from the *A-2 Stormwater Treatment Area Final Groundwater Modeling Report* (2021):

A conceptual hydrogeologic model of the surficial aquifer for the EAA was developed, studied, and calibrated based on constructed test cells during the EAA A-1 Basis of Design Report dated 2006 and prepared by Black and Veatch. This model consisted of 5 hydrogeologic layers:

1. The top muck/peak layer, consisting of generally organic deposits,
2. The Caprock layer, consisting of calcareous limestone,
3. The highly variable Fort Thompson Formation, consisting of unconsolidated, calcareous and fossiliferous quartz sands to well indurated, sandy fossiliferous marine and freshwater limestone and clayey sand and sandy clays,
4. The Caloosahatchee Marl, consisting of sandy marl, clay, silty sand and shell beds, and
5. The Tamiami Formation, consisting of sand, clayey sand and poorly consolidated cream to white limestone and greenish-gray clay and marl.

The Hawthorn formation underlying the surficial aquifer was not included in the model. It was assumed that the top of the Hawthorn formation acts as a confining layer and restricts vertical movement of groundwater. In the MODFLOW model developed for this effort, the elevations and conductivities of the layers were treated with uniform values.

During the *A-2 Post Authorization Change Report* (PACR, 2018), the hydrogeologic model was revised and further split into seven layers, dividing the Caprock layer into a top lower permeability layer and a bottom higher permeability layer and the Fort Thompson Formation into a top higher permeability layer and a bottom lower permeability layer. The previously calibrated conductivity values associated with these layers were modified and varied along the 4 sides of the A-2 Reservoir.

During the A-2 STA design, this hydrogeologic model was further divided into eight layers, per further analysis and collection of borings. For the A-2 STA design effort, the horizontal and vertical spatial distribution of the materials was considered and interpolated into variable layer elevations and conductivity surfaces. This eight-layer hydrogeologic model is also used for the analysis presented herein, with minor modifications on the permeabilities used for one of the layers and additional spatial distribution based on the new boring information collected for the SWS project.

2.3.2 Hydrogeologic Model Parameterization

Details on the parameterization of the hydrogeology for the SWS 3D groundwater model are provided in the following paragraphs.

The baseline hydraulic conductivity values assigned for each of the model layers are shown in Table 1. The baseline values were recommended by the SWS geotechnical consultant, WIRX and are consistent with the *WIRX Geotechnical Data Report (September 2023*). A brief description of the sources is provided below. Further details are provided in the geotechnical appendices included as part of the *A-2 STA Intermediate Design Report* (2020), the *WIRX Geotechnical Data Report* (September 2023), and supplied by communications with WIRX (July 2023).

For the muck layer (Model Layer 1), a conductivity value of 1 foot per day (horizontal and vertical) was assigned based on the typical value indicated for peat in the publication entitled *Surface-Water and Ground-Water Interactions in the Central Everglades, Florida* (2004).

Conductivity values for hard and weak limestone (Model Layers 2, 3, 5 and 6) were based on the field permeability tests (Hydraulic Load Tests) performed during the period of May 26 to June 16, 2020 (Geotechnical Hydraulic Load Test Technical Memorandum – A-2 STA, 2020).

Conductivity values used for silty/clayey sands (SM/SC) of the Forth Thompson-Caloosahatchee Formation (Model Layer 4) are based on the field permeability tests performed at the EAA Reservoir-STA.

Conductivity values for Model Layers 7, 8 and 9 are based on the PACR.

Table 1. Baseline Hydrogeologic Model and Model Layers.

Hydrogeologic Layer	Model Layer	Description	Hydraulic Conductivities (K)	
			K_h (ft/d)	K_v (ft/d)
HGL1	ML1	Muck	1	1
HGL2	ML2	Hard Limestone	370	1
HGL3	ML3	Weak Limestone	1300	1000
HGL4	ML4	Silty sand with gravel	10	5
HGL5	ML5	Hard limestone	370	1
HGL6	ML6	Weak limestone	1300	1000
HGL7[i]	ML7/ML8	Sand with silt, gravel, limestone lenses (Caloosahatchee)	50	25
HGL8	ML9	Silty sand, gravel, limestone lenses (Tamiami)	30	15

[i] HGL7 is split in the with-project condition model at the bottom elevation of the SWS seepage cutoff wall. Model Layer 7 is the portion of HGL7 that has the cutoff wall and Model Layer 8 is the portion of HGL7 that is below the cutoff wall.
[ii] K values are spatially interpolated to account for either the absence of materials or materials found in different vertical order than the order of the hydrogeological model in some of the borings.

The bottom elevations of each layer are illustrated in Figure 4 through Figure 11. The bottom elevations are not included in the figures for Model Layer 7 since this layer was created to make the model capable of representing the seepage cutoff wall and has a continuous bottom elevation of -34.1 ft-NAVD (the elevation of the bottom of the seepage cutoff wall).

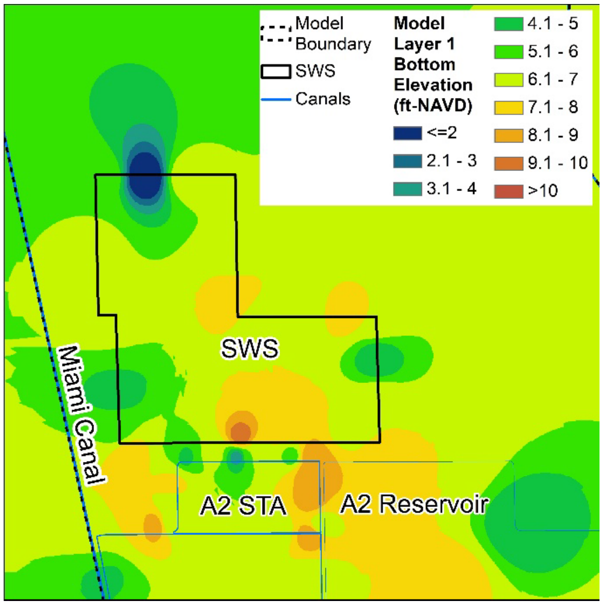

Figure 4. Model Layer 1 Bottom Elevation

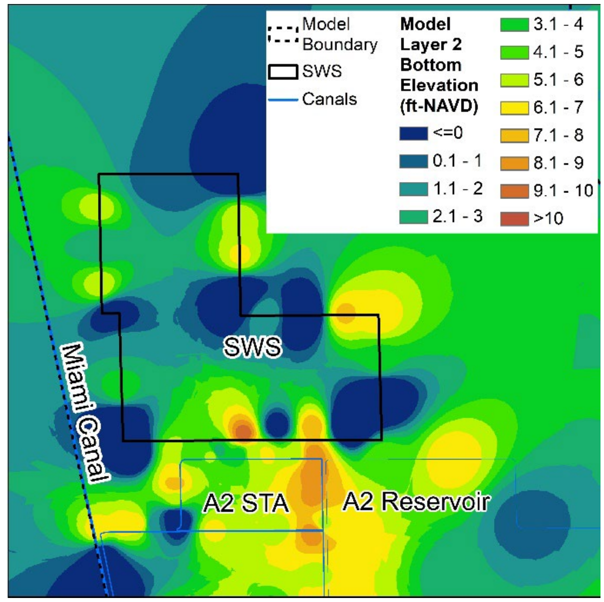

Figure 5. Model Layer 2 Bottom Elevation

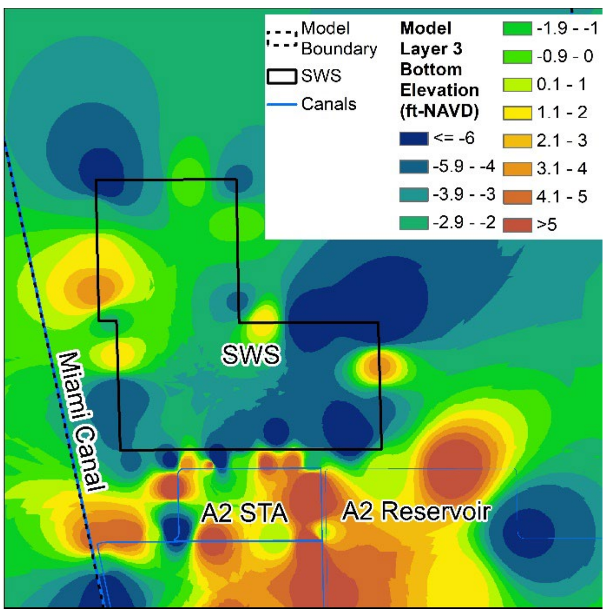

Figure 6. Model Layer 3 Bottom Elevation

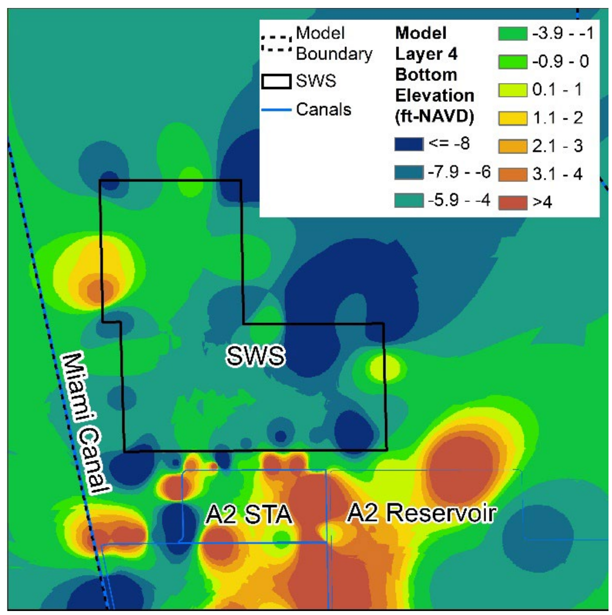

Figure 7. Model Layer 4 Bottom Elevation

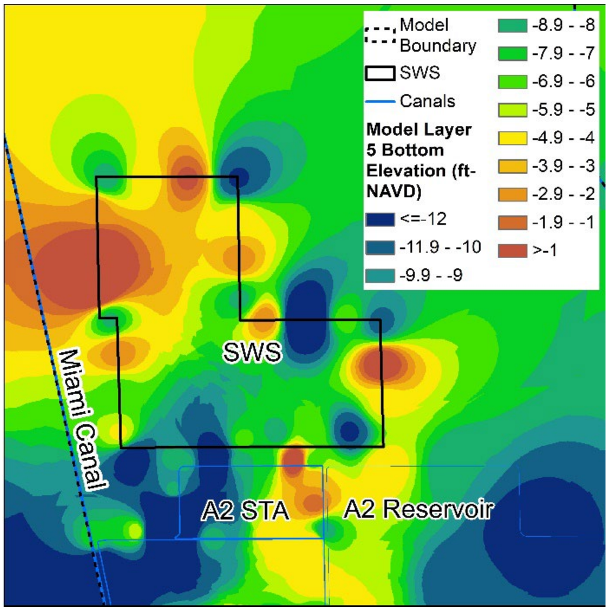

Figure 8. Model Layer 5 Bottom Elevation

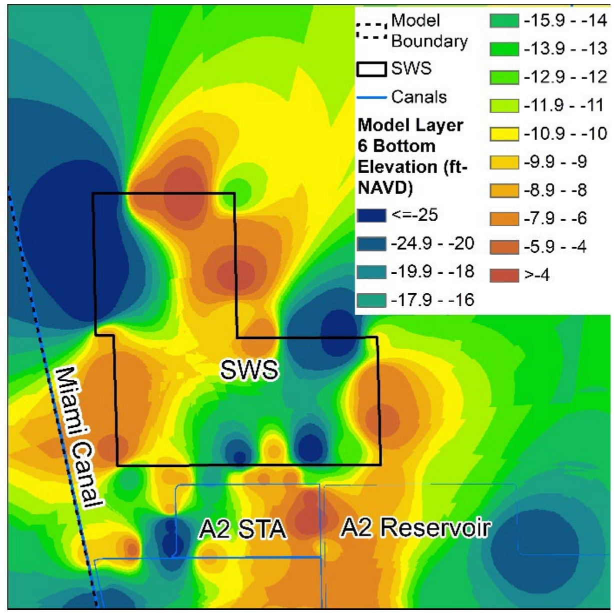

Figure 9. Model Layer 6 Bottom Elevation

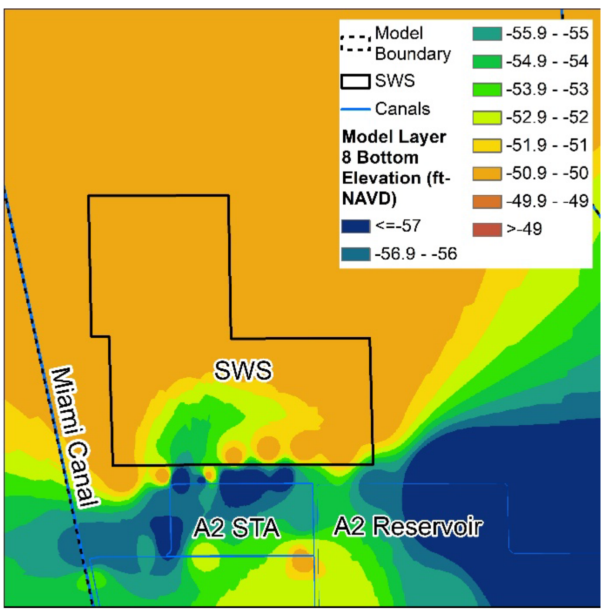

Figure 10. Model Layer 8 Bottom Elevation

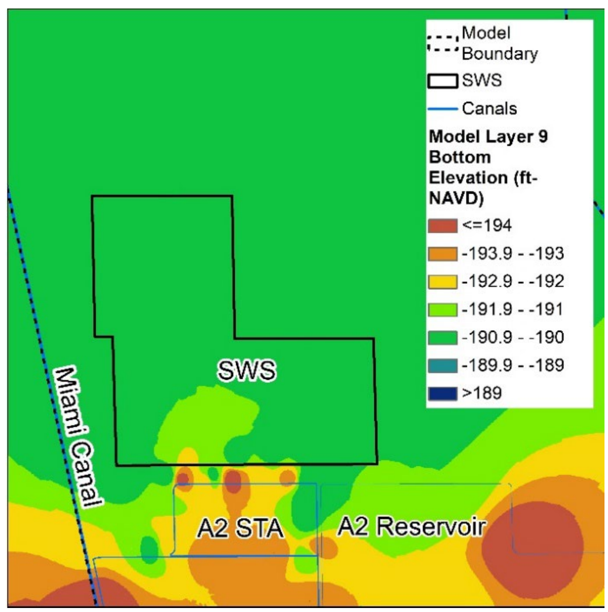

Figure 11. Model Layer 9 Bottom Elevation

2.4 With and Without Project Models

The with-project models were developed based on the Phillips and Jordan Southland Storage Feasibility Study permit submittal design plans for the SWS dated February 2024 (Southland Storage Feasibility Study – Permit Plans, 2024). Without-project models were also developed for seepage impact comparison. The same model grid was used for both the with- and without-project models. Layer elevations are the same everywhere in the with- and without-project models except for the project site where the storage facility's bottom elevation was burned into the model layers in the with-project models. The following sections describe the with-project models and without-project models.

2.4.1 With Project Model

The following section describes the parameterization of the seepage management features as well as the definition of the boundary conditions in the with-project model. Details are provided on the conductance calculations for the seepage canal and the farm drains.

2.4.1.1 Model Parameterization of Seepage Management Features

The top elevation of the model is the ground surface and is based on the 2016/2017 Palm Beach County LiDAR collected by the USGS and Dewberry. The design elevations of the embankments as they continue to slope down below the existing ground elevation and the bottom of the proposed storage facility were incorporated into the digital elevation model (DEM) and the average elevations of the resulting DEM were calculated for the model cells within the project footprint.

The SWS seepage management features are illustrated in Figure 12 and are simulated as follows:

- Cutoff wall – Assumed the same depth and permeability as the cutoff wall for the A-2 Reservoir with a depth of 42.6 ft (bottom elevation -34.1 ft-NAVD), width of 3-ft, and permeability of 0.0028 ft/d). The cutoff wall was modeled along the perimeter extents of the "northern" and "southern" segments of Southlands (north and south of the existing east-west farm canal).
- Seepage canal – Assumed the bottom of the seepage canal is 10 feet wide and at elevation -8.0 ft-NAVD, the side slopes are 3:1 H:V, and the top of bank elevation is 8.6 ft-NAVD. Also assumed the seepage canal follows the perimeter boundary of the "northern" and "southern" segments of Southlands (north and south of the existing east-west farm canal).

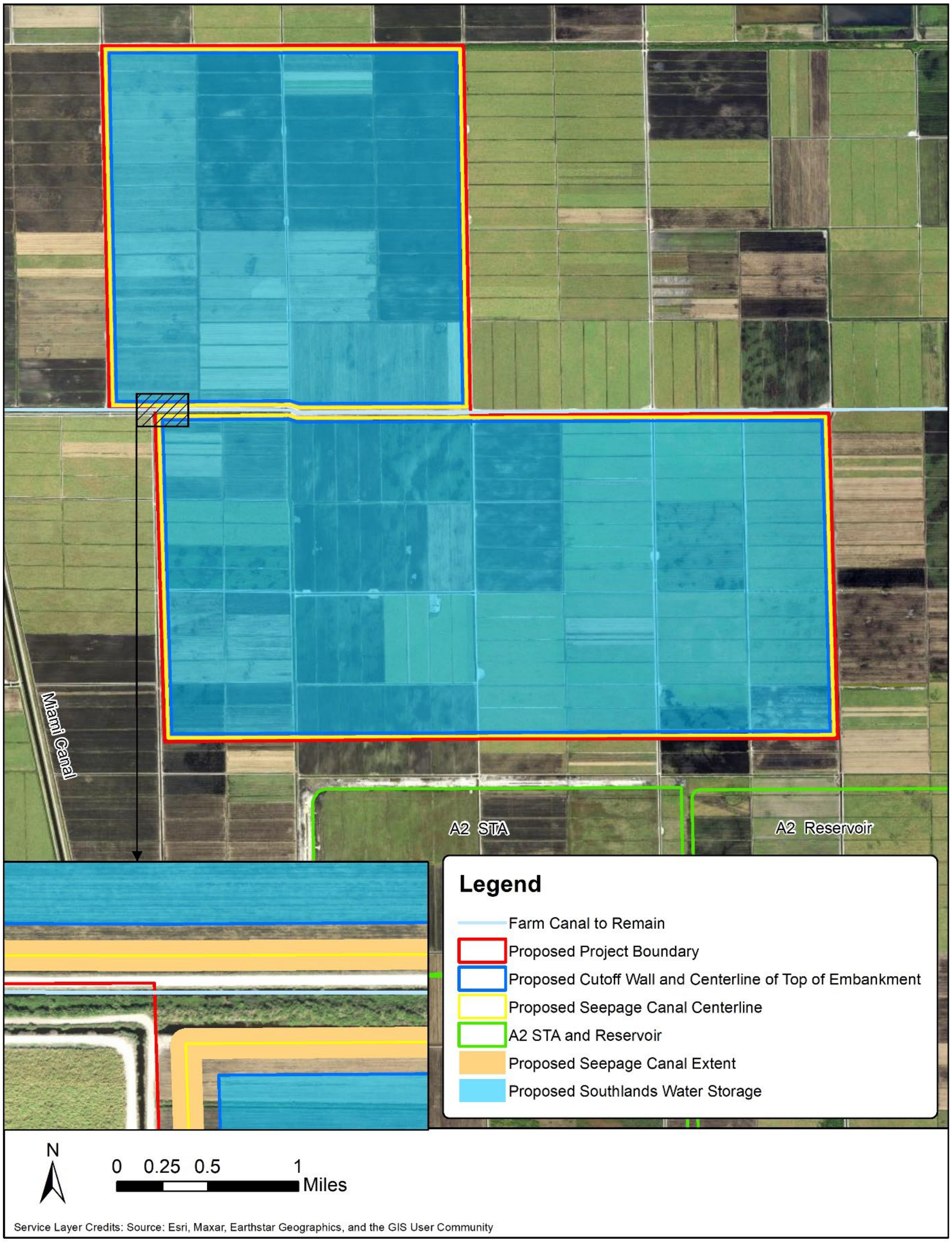

Figure 12. Modeled Project Features

2.4.1.2 Boundary Conditions

The seepage canal is represented with a river boundary in MODFLOW, in which canal stages are fixed or specified and the flow exchange between the boundary and the surrounding aquifer cells is calculated based on the head differential and the river boundary conductance. The conductance term was calculated based on the canal geometry and boundary cell properties, assuming that the exchange between the aquifer and canal is controlled by the aquifer hydraulic conductivity, i.e., there is no additional bed resistance due to accumulation of sediments in the channel. The conductance was calculated based on the MODFLOW conceptualization for the river boundary conductance (McDonald and Harbaugh, 1988).

$$C = \frac{K \times W \times L}{M}$$

Where, C = conductance (ft^2/d), K = conductivity of streambed material (ft/d), W = width of the river reach in the cell (ft), L = length of the river reach in the cell (ft), M = thickness of the streambed (ft). K was assumed to be the horizontal conductivity of the layer since this will be a newly constructed canal with no sedimentation. W was estimated as the width of the cell perpendicular to the direction of flow or the width of the canal, whichever is smaller. L was estimated as the length of the cell in the direction of flow. M was assumed to be 1 foot, such that conductance is neither increased or decreased by this unknown factor.

Farm canals are represented with drain boundaries, which remove water from the model when the water table exceeds the specified levels. Drain levels were assumed to be 21 inches below the average ground surface of the agricultural area that surrounds the project because these farm field areas typically operate with water levels 18-24 inches below existing ground elevation. Setting these drain levels at 21 inches below the average ground elevation keeps the drain elevation within that 18-24 inch below ground surface range in most of the area surrounding the SWS. Conductance for the farm canal drains was calculated using a similar approach as the seepage canal river boundary, described above, apart from the conductivity and streambed thickness values used. The conductivity for the east-west canal that transects the project was assumed to be 1 ft/day, and the M value was assumed to be two since about 2 feet of muck sedimentation was surveyed in the canal (Pickett Survey, 2024). The other farm canals used the vertical conductivity of the layer as K in the conductance calculation since it is assumed that these canals have sedimentation that impacts conductance. A value of 1 was used as M in the conductance calculation for the other farm canals.

Constant head boundary (CHB) conditions were specified for the SWS project, existing canals, which were based on measured values and on planned operational stages for the A-2 complex features.

The boundary stages and locations for all water bodies in the model are shown in Table 2.

Table 2. Boundary Conditions for Water Bodies in the Model

Description	Boundary Type	Stage (ft-NAVD)	Comments/Source
SWS	CHB	See Table 3	Stage dependent upon modeled Scenario
SWS Seepage Canal	River	See Figure 13	Stage optimized depending on modeled scenario
A-2 Reservoir	CHB	See Table 3	Stage dependent upon modeled Scenario
A-2 STA	CHB	11	Assumed the normal operating depth of an STA (2 feet). Normal design depth of an STA is 1.25 - 1.5 feet at downstream end of cells, depending on topography typically results in an average depth across an STA of approximately 2 feet. Assuming build-out conditions for the A-2 STA for the with and without (Southlands) Project.
Miami Canal	CHB	Varying profile 8.27 to 11.11	A2 Modeling[i], Profile of wet season stage (lower end of canal operating range)
STA 3/4 Inflow Canal	CHB	14.2	A2 Modeling[i]
North New River Canal	CHB	Varying profile 9.8 to 10.12	A2 Modeling[i], Profile of wet season stage (lower end of canal operating range)
A-2 Inflow and Outflow Canal	River	9.3	A2 Modeling[i]
A-2 STA and Reservoir Seepage Canal	River	7.05	Assumed to be the same elevation of the farm canals.
A-2 STA Inflow Canal	River	11	A-2 STA Canals assumed at the same elevation as the A-2 STA cells.
A-2 STA Distribution Canal	River	11	A-2 STA Canals assumed at the same elevation as the A-2 STA cells.
A-2 STA Collection Canal	River	11	A-2 STA Canals assumed at the same elevation as the A-2 STA cells.
A-2 STA Outflow Canal	River	11	A-2 STA Canals assumed at the same elevation as the A-2 STA cells.
Farm canals	Drain	7.05	2016/2017 Palm Beach County LiDAR collected by USGS and Dewberry was used to calculate the average ground elevation for agricultural areas surrounding the SWS project area. 21 inches was subtracted from this average ground elevation for the assumed water surface elevation.

Description	Boundary Type	Stage (ft-NAVD)	Comments/Source
East-West Farm Canal to remain	River	7.05	Assumed to be the same elevation of the farm canals.
Bolles Canal (East of DBHydro monitoring station BLSW to North New River Canal)	CHB	10.12	Wet season stage based on the stage of the North New River Canal at the intersection of the Bolles Canal up to DBHydro monitoring station BLSW.
Bolles Canal (West of DBHydro monitoring station BLSW to Miami Canal)	CHB	11.11	Wet season stage based on the stage of the Miami Canal at the intersection of the Bolles Canal up to DBHydro monitoring station BLSW

[i]*A-2 Stormwater Treatment Area Final Groundwater Modeling Report, 2021*

2.4.2 Without Project Model

The without-project models assume the A-2 STA and A-2 Reservoir and associated seepage and inflow-outflow canals are constructed as evaluated in the A-2 STA 3D groundwater modeling (A-2 Stormwater Treatment Area Final Groundwater Modeling Report, 2021). Without project models (or existing conditions) models were developed to compare the simulated head elevations of the with-project model. Two conditions were evaluated for these existing conditions – a scenario where the A-2 Reservoir is at a high level (31.4 ft-NAVD), and a scenario where the A-2 Reservoir is at a low level (8.8 ft-NAVD). The high and low scenario elevations are described further in Section 3. The grid and project features for the without-project models are identical to those used in the with-project model with the exception of the boundary conditions for the SWS project features (seepage canal, water storage area, and cutoff wall). The without-project models have existing ground elevation on the SWS project site for the top elevation of layer 1 and do not have the depth of the water storage area burned into the layer elevations. Lastly, the without-project models contain the existing farm ditches within the project boundary whereas the with-project model has certain farm ditches removed where they are likely to be removed upon construction of the project.

3. Simulated Seepage Impact

Three scenarios were chosen to examine a range of steady-state conditions. Table 3 describes the three scenarios that were developed in order to demonstrate potential seepage impact to surrounding land and stormwater features for this preliminary modeling effort. The SWS water surface elevations are those in the Phillips and Jordan Southland Storage Feasibility Study permit submittal design plans for the SWS dated February 2024 (Southland Storage Feasibility Study – Permit Plans, 2024). The A-2 Reservoir high elevation is based on the full storage depth of 22.6 feet and the calculated average ground elevation which results in an average water surface of 31.4 ft-NAVD. The A-2 Reservoir low elevation was calculated based on the average ground elevation within the A-2 Reservoir footprint from the 2016/2017 Palm Beach County LiDAR collected by USGS and Dewberry.

Table 3. Steady-State Scenarios Evaluated

Scenario	Southlands Water Storage (SWS)	A-2 Reservoir (A2)
	Water Surface Elevation (ft-NAVD)	
1 (SWS High-A2 High)	13	31.4
2 (SWS Low- A2 High)	-3	31.4
3 (SWS Low- A2 Low)	-3	8.8

For each of the three scenarios, several model simulations were conducted to determine the SWS seepage canal stages that would limit offsite seepage impacts. As a result of these model simulations it was determined that the SWS seepage canals will likely need to be segmented and controlled at varying stages to limit offsite seepage impacts. For the modeling documented herein, the SWS seepage canals were segmented and stages in each of the segments were identified for each of the three scenarios to minimize impacts to surrounding land and stormwater features. Segmentation was based on iteration results caused by variability in the impact of surrounding surface water features such as the Miami Canal and farm ditches as well as the impact of variability within the hydrogeological layers. Figure 13 shows the segmentation and stages in the seepage canals identified for each of the three scenarios.

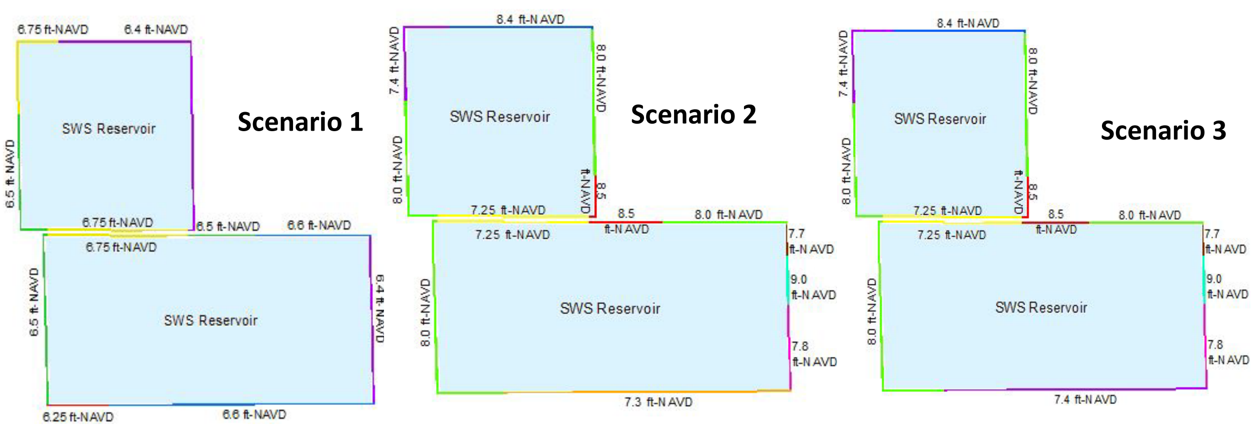

Figure 13. Simulated Seepage Canal Segmentation and Levels

The results of the SWS conceptual model simulations for the with-project and without-project are described below in terms of head differences and seepage flows along the seepage canal for the three scenarios.

3.1 Simulated Water Table Elevations

To illustrate the impact of the predicted water table under various boundary condition approaches, maps showing the deviation from the target groundwater condition (1.5 feet – 2 feet underground) were created and analyzed for both with- and without-project conditions. Figure 14 through Figure 16 illustrate the deviation from the target groundwater condition of 1.5 to 2 feet underground. The results of the model simulations for deviation from target groundwater level show that the seepage mounding/drawdown beyond the target groundwater levels caused by SWS is minimal and does not extend significantly past the project boundary.

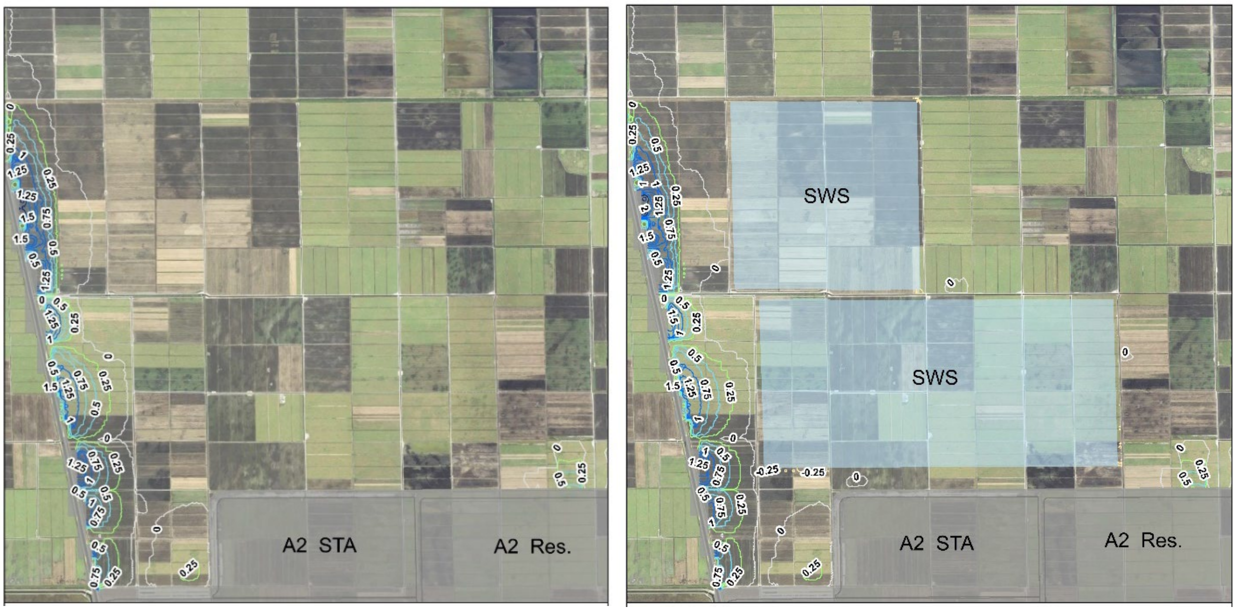

Figure 14. Without-Project A2 High (left) vs. Scenario 1 SWS-High and A2-High (right), Deviation from Target Groundwater (feet)

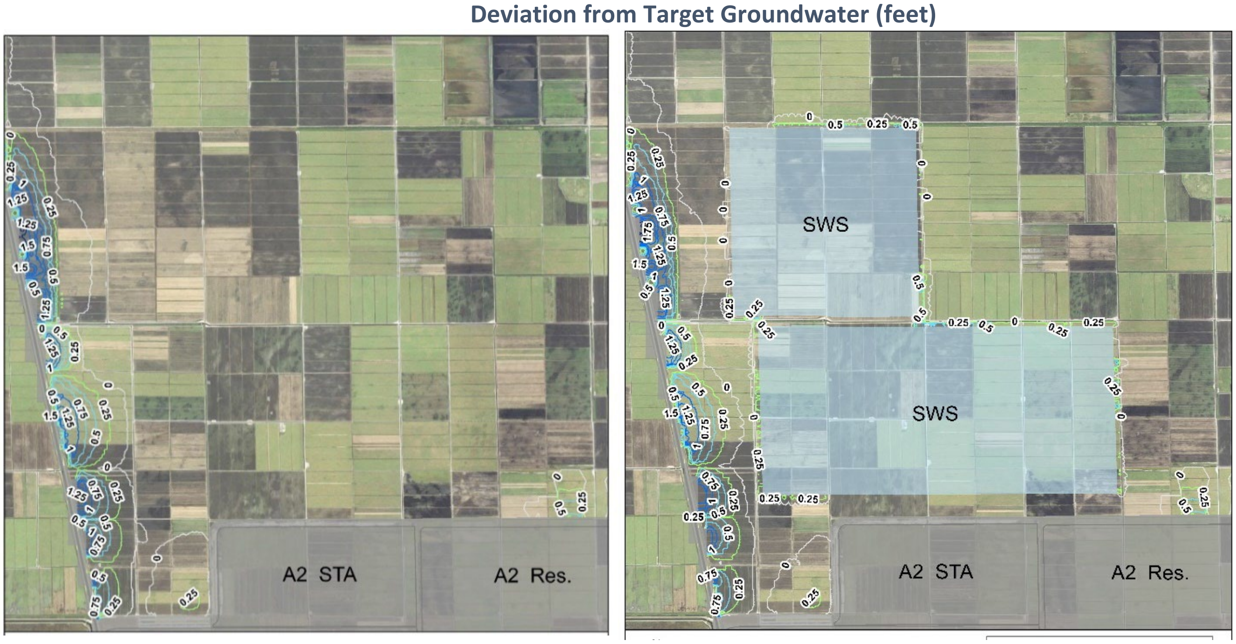

Figure 15. Without-Project A2 High (left) vs. Scenario 2 SWS-Low and A2-High (right), Deviation from Target Groundwater (feet)

Figure 16. Without-Project A2 Low (left) vs. Scenario 3 SWS-Low and A2-Low (right), Deviation from Target Groundwater (feet)

3.2 Simulated Groundwater Flows

As a preliminary estimate of pumping rates for controlling the SWS seepage canals, the groundwater flow quantities for the north and south segments of the SWS seepage canals were summed. Table 4 shows the estimate of the seepage pumping rates to the nearest 25 cfs.

Table 4. Preliminary Estimates of Pumping Rates for Controlling the Seepage Canals based on the Conceptual Representation of SWS

	Scenario 1 (SWS High-A2 High)	Scenario 2 (SWS Low-A2 High)	Scenario 3 (SWS Low-A2 Low)
	(cfs)		
North Segments	75	100	100
South Segments	75	125	125
Pump Flow Direction	**Out of the Seepage Canal**	**Into the Seepage Canal**	**Into the Seepage Canal**

To examine the amount of seepage flow that SWS draws or contributes to surrounding features, the groundwater flux results were extracted from the with-project model by individual feature and compared to the groundwater flux results of those same features in the corresponding without-project model. Table 5 shows these flux results for Scenarios 1 through 3. The total magnitude of the flux differences between the with- and without-project models is minimal. Although the flow difference is small into the transecting east-west farm canal from the project, this flux difference for Scenarios 2 and 3 can likely be mitigated by allowing flow that is entering the east-west farm canal from the SWS system to be pumped back into the SWS system if deemed necessary, further minimizing project impact to surrounding features.

Table 5. Simulated Boundary Flow Comparison of With- and Without-Project

	Without Project Boundary Flow (cfs)[i]			With Project Boundary Flow (cfs)[i]			Flux Difference (cfs)[ii]		
	Scenario								
	1	2	3	1	2	3	**1**	**2**	**3**
Transecting East-West Farm Canal	-0.9	-0.9	-0.9	-0.9	-3.0	-3.0	**0.0**	**-2.1**	**-2.1**
A2 STA	3.0	3.0	7.4	3.0	0.0	7.4	**0.0**	**-3.0**	**0.0**
A2 Reservoir	194.9	194.9	-18.4	195.0	195.0	-18.3	**0.1**	**0.1**	**0.0**
A2 Inflow-Outflow Canal	84.3	84.3	162.5	85.7	85.8	163.6	**1.3**	**1.5**	**1.1**
A2 Seepage Canal	-209.2	-209.2	-189.2	-208.6	-207.3	-187.7	**0.5**	**1.8**	**1.5**
Miami Canal	-2.2	-2.2	-2.2	-2.2	-2.2	-2.2	**0.0**	**0.1**	**0.1**
North New River Canal	15.9	15.9	15.9	15.7	15.7	15.7	**-0.2**	**-0.2**	**-0.2**

[i]Sign Convention: if water the boundary acts as a source to the aquifer, flow is positive. If the boundary removes water from the aquifer, flow is negative.
[ii]Difference = with-project seepage flux minus without-project flux.

An evaluation of the modeled seepage to nearby drains in farm fields was performed to analyze the SWS project impact to these surrounding lands. Figure 17 shows the reach breakdown in the farm canal reaches nearest to the project with more likelihood of being impacted where farm field seepage impacts were examined. Table 6 shows the total magnitude of flux differences between the with- and without-project models in these farm fields. The differences displayed in these results between with- and without-project are small in magnitude and can likely be managed by pumping back into SWS if deemed necessary.

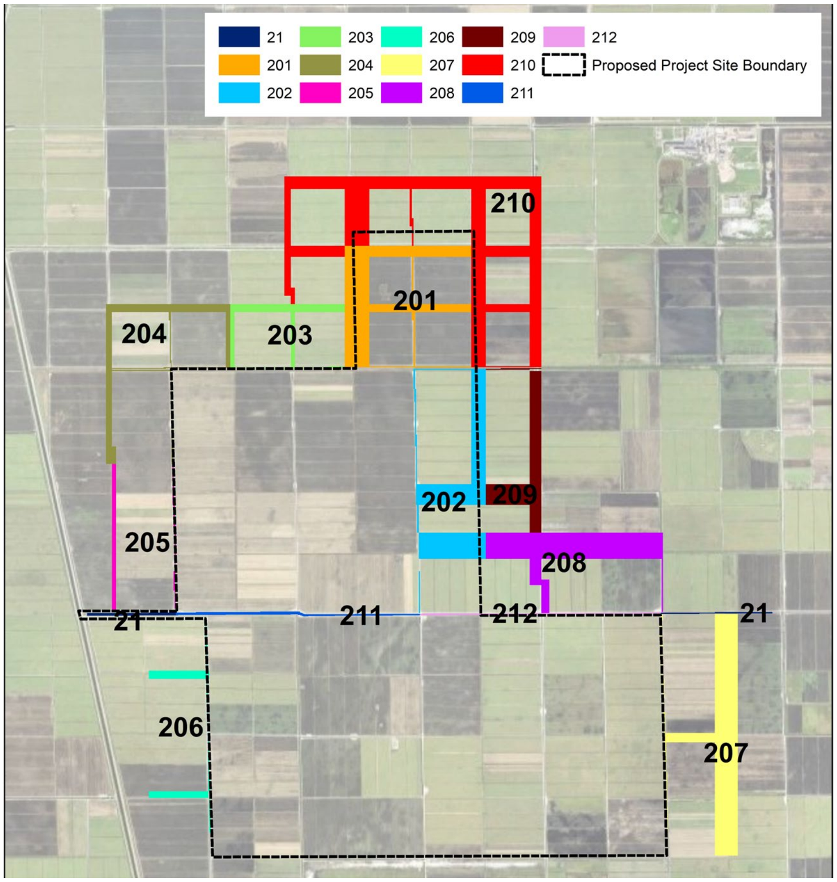

Figure 17. Farm Field Reach Identifiers for Seepage Breakdown

Table 6. Simulated Farm Field Flow Comparison of With- and Without-Project

Nearby Farm Drains Outside Project Boundary	Without Project Boundary Flow (cfs)[i]			With Project Boundary Flow (cfs)[i]			Flux Difference (cfs)[ii]		
	Scenario								
	1	2	3	1	2	3	1	2	3
201	0.0	0.0	0.0	-0.1	-0.2	-0.2	**-0.1**	**-0.2**	**-0.2**
202	0.0	0.0	0.0	0.0	-1.5	-1.5	**0.0**	**-1.4**	**-1.5**
203	0.0	0.0	-0.1	0.0	-0.3	-0.3	**0.0**	**-0.3**	**-0.2**
204	-0.7	-0.7	-0.7	-0.6	-0.8	-0.8	**0.1**	**-0.1**	**-0.1**
205	-1.3	-1.3	-1.3	-1.3	-1.7	-1.7	**0.1**	**-0.3**	**-0.3**
206	-0.6	-0.6	-0.6	-0.5	-0.7	-0.7	**0.1**	**-0.1**	**-0.1**
207	-0.2	-0.2	-0.1	-0.2	-1.0	-0.9	**0.0**	**-1.0**	**-0.8**
208	0.0	0.0	0.0	-0.1	-0.1	-0.1	**-0.1**	**-0.1**	**-0.1**
209	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	**0.0**
210	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**	**0.0**

[i]*Sign Convention: if water the boundary acts as a source to the aquifer, flow is positive. If the boundary removes water from the aquifer, flow is negative.*
[ii]*Difference = with project seepage flux minus without-project flux.*

4. Model Limitations

The model used for this analysis is based on the assumed uniform permeabilities assigned to each hydrogeological layer. While these permeabilities are based on lab testing from boring materials collected in the project site, the model has not been calibrated or verified against measured observations. Since hydrogeologic data is based on a finite number of borings, it is subject to error from interpretation and interpolation of those borings.

Only steady-state and spatially uniform conditions in the farm fields were evaluated. This means that the model equilibrates to a uniform set of conditions and neglects the spatial changes in stages over time caused by the farm field management and water availability. Hydrologic water budget components, such as rainfall, evapotranspiration, overland flow, and infiltration, are not simulated, nor are the quantities of water pumped into farm fields from SFWMD primary canals.

As previously stated, the model results presented are based on the conceptual representation of the SWS project and the assumptions described in the previous sections. Lastly, the SWS seepage canal representation in the model is conceptual and will be further refined in future phases of the project.

5. Conclusions

Based on the evaluation of the three with-project scenarios and comparison to the baseline without-project scenarios, initial simulations indicated that seepage management is required to mitigate head differentials outside of the SWS project area. Controlling the seepage canal in segments with variable stages indicates the capability of minimizing offsite seepage impacts to works of the District, existing stormwater management systems, and water quantity in surrounding lands. This effort serves as a guide to provide preliminary estimates of the infrastructure required to manage seepage from the SWS project. The number of pumps and dividing control structures within the SWS seepage canals required should be confirmed after the verified dynamic processes are incorporated in the model.

6. References

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Water Availability Analysis Evaluating the Performance of the Southland Project Reservoir

Results of Water Budget Model of the Southland Project Reservoir

June 18, 2024

Prepared by

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Background

The Southland Project is a proposed water resource project located in the Everglades Agricultural Area. The project is located adjacent to the Miami Canal where it can collect excess agricultural runoff in wet periods and deliver water for beneficial uses in dry periods. Since completion, the Stormwater Treatment Area (STA) 5/6 Complex in the South Florida Water Management District (SFWMD) has been hampered by frequent dry-outs due to the lack of water that can be delivered to the headwater of the STA-5N. A water availability analysis (WAA) was performed to better understand the availability of source water that the proposed Southland Project Reservoir (Reservoir) could store and send to benefit STA-5N (Figure 1). The WAA evaluated different outflow capacities of the STA-5N to determine the balance between what amount of water that could be sent to STA-5N, while best utilizing the storage volume available in the facility. Sending too much water through STA-5N would keep the Reservoir and STA-5N at lower water level elevations for extended periods of time, while sending too little water through STA-5N would not fully utilize the reservoir's storage capacity and as well as limit the benefits to STA-5N.

Evaluating the Performance of the Southland Project Reservoir and Deliveries to STA-5N

A daily water budget spreadsheet model was developed to estimate the availability of source water. The time series basis of the model is the RSM-BN output for the LOSOM PA25 model run. PA25 is the preferred Lake Okeechobee Regulation Schedule that is expected to be in place by August 2024. The RSM-BN analysis period is 52 years (1965 through 2016) which includes several drought years and several extreme wet years ensuring that there are representative conditions to evaluate water availability and performance of the Reservoir.

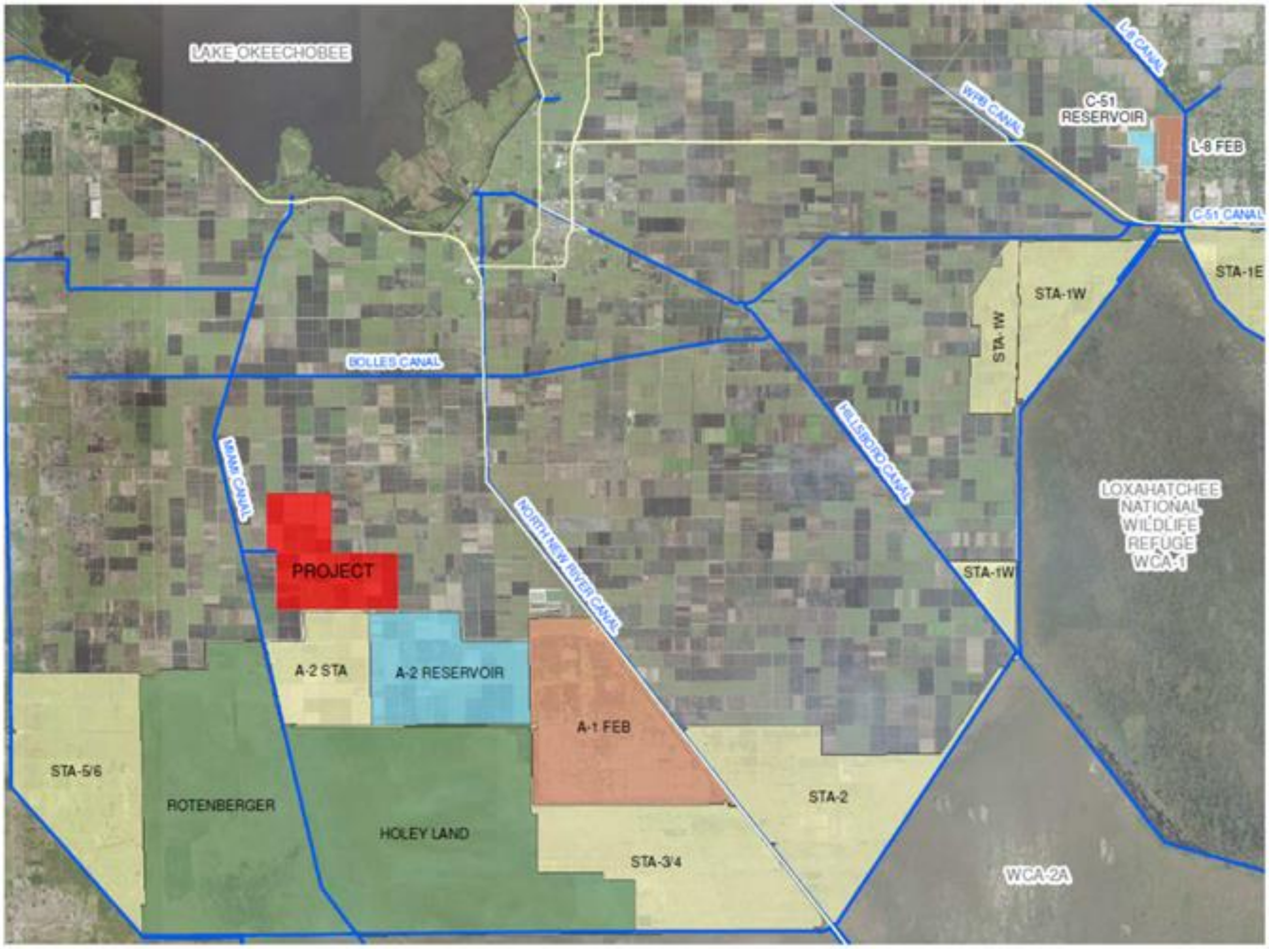


Figure 1. The proposed Southland Project is located south of the Bolles Canal and east of the Miami Canal. It borders the northern boundary of the SFWMD's A-2 STA and A-2 Reservoir.

Design Criteria

Reservoir Design

Figure 2 illustrates the cell sizes and storage capacities of the proposed Reservoir. The total area of the Reservoir is 6,077 acres, with a total storage capacity of 97,232 acre-feet (ac-ft). The cells will be excavated to an elevation of -9 feet NAVD88 and have a top of bank elevation of +21.5 feet NAVD88. The design minimum water elevation is -3 feet NAVD88 and a design high water elevation is +13 feet NAVD88. A soil bentonite cutoff-wall will be constructed where appropriate to a design bottom elevation of -31.4 feet NAVD88 to control seepage.

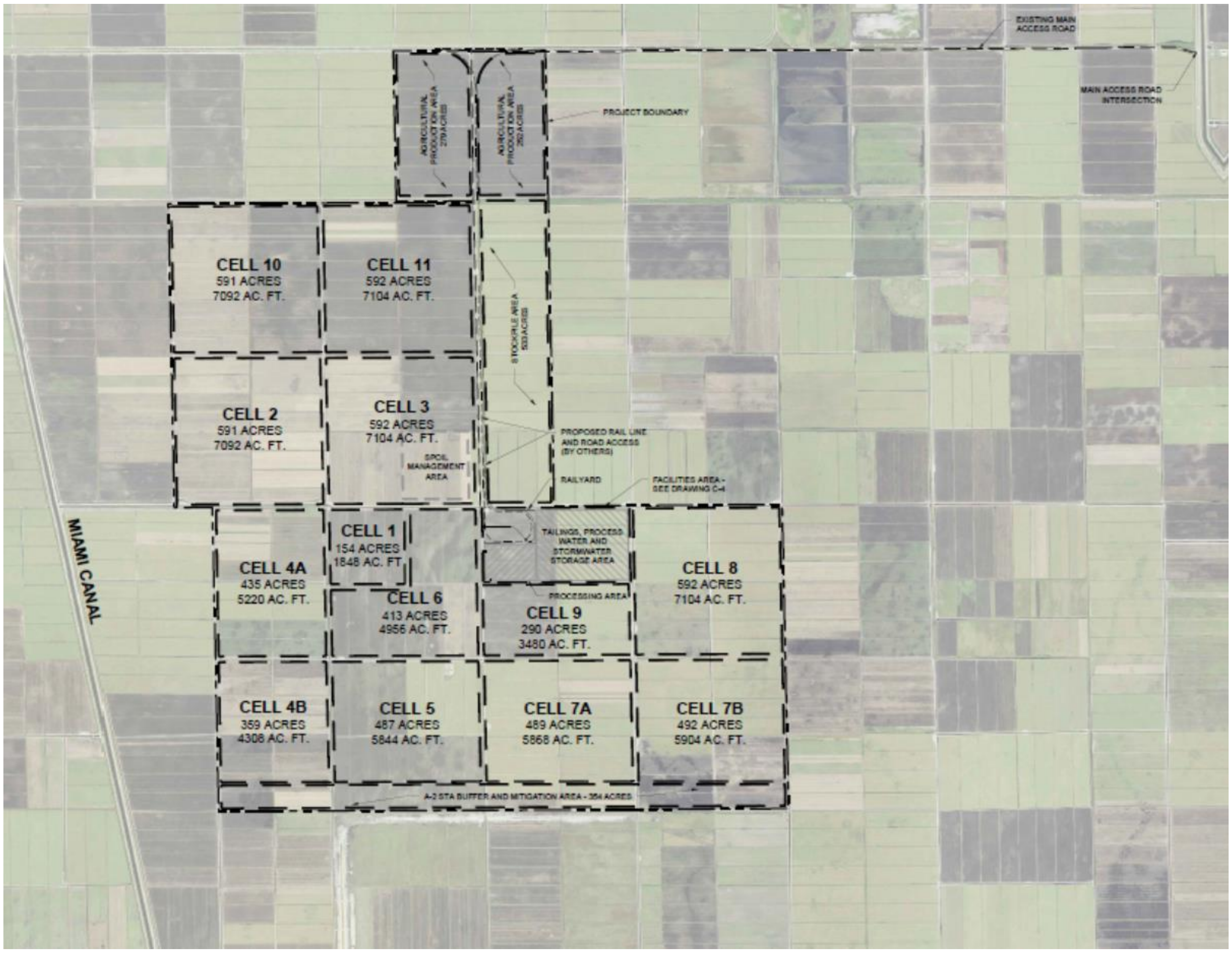


Figure 2. The Reservoir’s cell sizes and storage capacities

Model Input for Southland Reservoir

Area = 6,077 acres

Operating range = -3 to +13 NAVD88 = 16 feet

Total storage capacity = 97,232 ac-ft

Model Input for STA-5N

Area = 4,851 acres

Target depth = 18 inches

Model Parameters

The Lake Okeechobee System Operating Manual (LOSOM) Regional System Model Basins (RSMBN) model is the source for the following parameters:

- Daily flow data for runoff into the Miami Canal
- Daily irrigation data from the Miami Canal
- Daily flow data for STA-5N
- Daily rainfall data
- Daily evapotranspiration (ET) data
- Daily seepage loss from STA-5N
- Daily water level for STA-5N – The Base Run is defined as the daily stage from the LOSOM RSMBN model.
- Reservoir groundwater seepage rate was based on a 3-D groundwater model by Collective Water Resources, LLC (this is only for tracking purposes and not for the water budget)

Model Operating Assumptions and Simulations

While many scenarios were simulated, the following operating assumptions are the most representative of the benefits of the Southland Reservoir to STA-5N. The operating assumptions for the alternatives are:

- Southland Reservoir
  - Inflow capacity =
    - 1,000 cfs inflow up to an elevation of +7.0' NAVD88, which is the average water control elevation in the area.
    - 300 cfs above elevation +7.0' NAVD88
  - Outflow capacity = 300 cfs
  - Maximum elevation = +13' NAVD88
  - Minimum elevation = -3' NAVD88

- Runoff cutoff = 500 cfs
  - Runoff cutoff is the amount of runoff allowed to bypass the Southland Reservoir Project and go to the A-1 FEB/STA 3/4 initially (and ultimately the A-2 complex).
- STA-5N
  - Inflow capacity = 300 cfs
  - Extra outflow flow capacity = variable
  - Extra outflow allowed when depth > 6”
  - Target depth = 18”

Four alternatives were simulated using the above-described operating assumptions. The alternatives show how much water can be moved through the STA-5N and what the impact is on the Reservoir and STA-5N. Table 1 illustrate the inputs used for the 4 alternatives and please note that there is a Base Run for the STA-5N which is defined as the daily stage from the LOSOM RSMBN model:

Table 1. The summary of inputs for the Alternatives
(Note: The Extra Outflow Capacity is what is changing between the Alternatives)

Alternative	Southland Reservoir		STA5N		
	Reservoir Inflow (cfs) and elevation	Reservoir Outflow (cfs)	Target Depth (inch)	Extra Outflow Capacity (cfs)	Extra Outflow Capacity start Elevation (inch)
1	1,000/300, 7.0'	300	18.0	300	6.0
2	1,000/300, 7.0'	300	18.0	200	6.0
3	1,000/300, 7.0'	300	18.0	100	6.0
4	1,000/300, 7.0'	300	18.0	62	6.0

Summary of Model Simulation Results

Table 2. The summary of results for the 4 different Alternatives

Alt.	Southland Reservoir			STA-5N			
	Percent of time Stage is at or below -3' NAVD	Percent of time Stage is at or below 0' NAVD	Percent of time Stage is at or below 5' NAVD	Extra Outflow Capacity (cfs)	Extra Outflow Capacity start Elevation (inch)	Inflow from Reservoir (cfs)	Percent of time below ground elevation
1	60	95	100	300	6.0	109.1	11.8%
2	54	90	100	200	6.0	109.0	11.2%
3	18	48	86	100	6.0	103.1	3.7%
4	1	6	42	62	6.0	81.0	0.0%

Results Summary

In Table 2, the "Percent of time stage is at or below -3 NAVD" column represents the amount of time the Reservoir was at or below the low-level operating level for the Reservoir (which is -3 NAVD88). The "Percent of time stage is at or below 5' NAVD" column was selected to show the percent of time the reservoir is less than half full (operation of reservoir is from -3 NAVD to 13 NAVD). The "Percent of time stage is at or below 0' NAVD" was selected to show an intermediate water level between -3' NAVD and 5' NAVD.

These results show that moving an additional 300 cfs through STA-5N keeps the STA-5N water levels significantly higher than the Base Run (which is the daily stage from the LOSOM RSMBN model), but moves so much water through the STA that the Reservoir is very low and not utilizing its constructed capacity. As the amount of additional water you can move through STA-5N decreases to 200 cfs, 100 cfs and 62 cfs, it is apparent that the Reservoir is being used more, while the STA still is being maintained at water levels that are more beneficial and closer to the target depth of 18 inches. The following output graphs for the Reservoir and STA-5N illustrate this relationship.

Specific Model Output

Figure 3. Alternative 1 - Southland Reservoir Daily Water Level & Lower Operational Level (-3') 1965-2016 (ft. NAVD88)

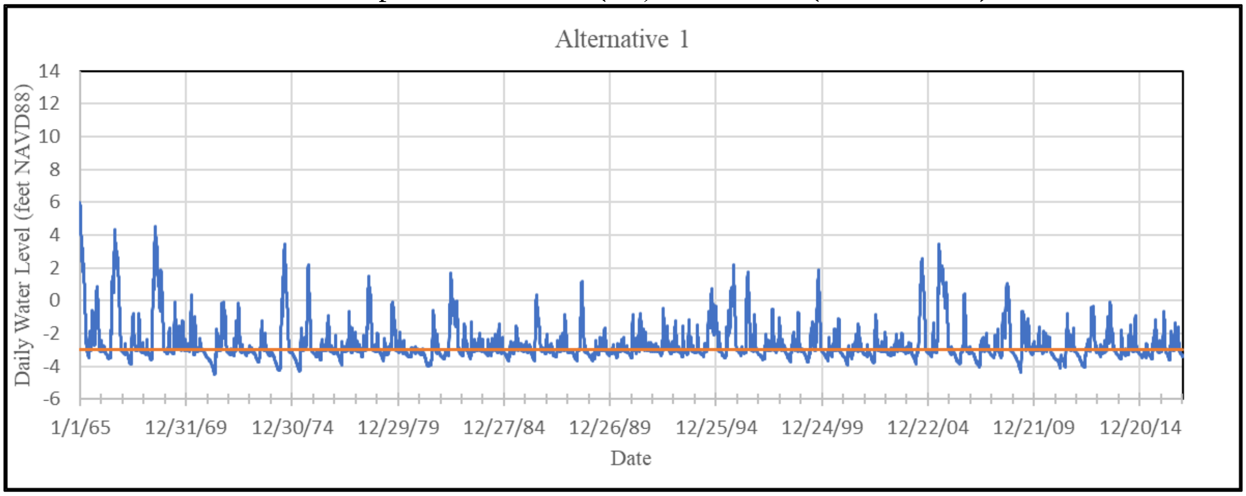
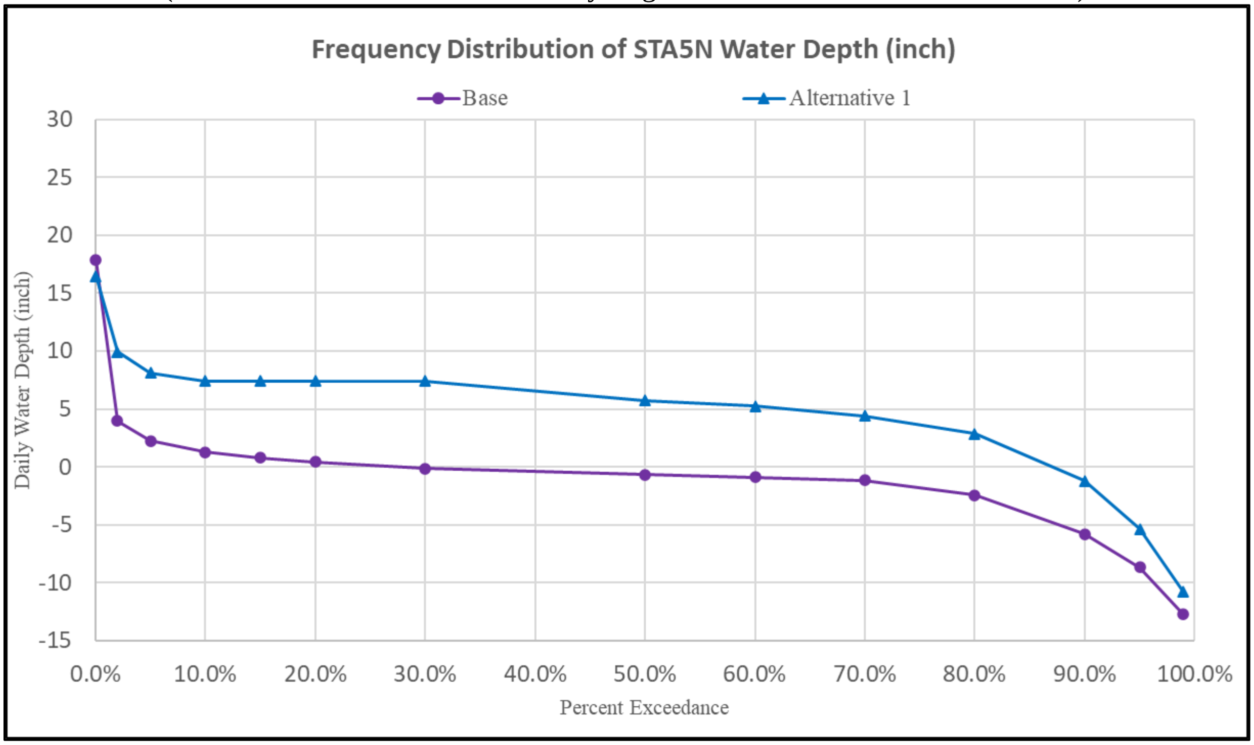


Figure 4. STA-5N Daily Water Depth Frequency Distribution 1965-2016 (inch)
(The Base Run is defined as the daily stage from the LOSOM RSMBN model)



This illustrates that moving an extra 300 cfs through the STA-5N keeps the Reservoir water level very low. The STA-5N water level is better than the Base Run, but it is not meeting the desired conditions of maintaining an elevation of 18 inches.

Figure 5. Alternative 2 - Southland Reservoir Daily Water Level & Lower Operational Level (-3') 1965-2016 (ft. NAVD88)

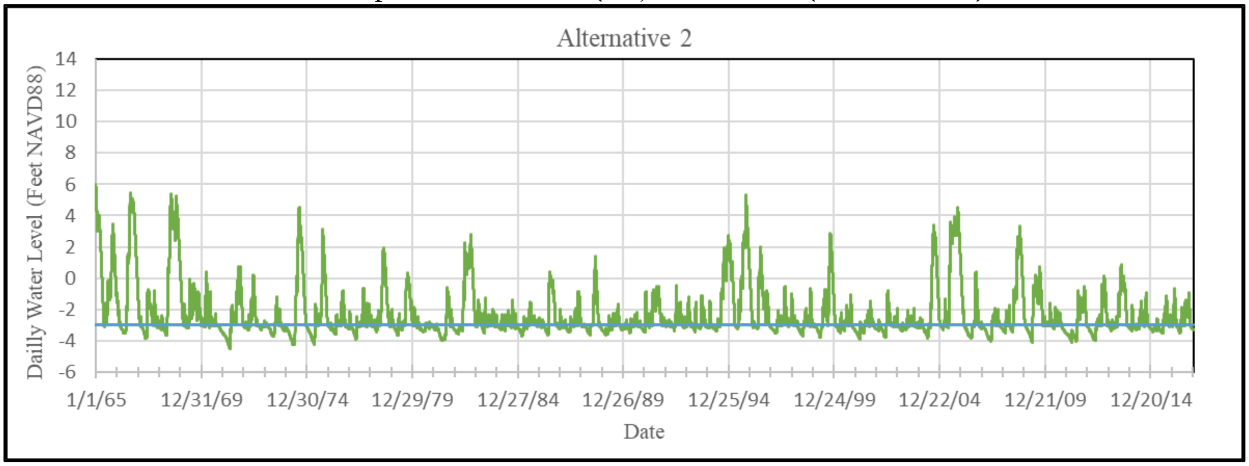
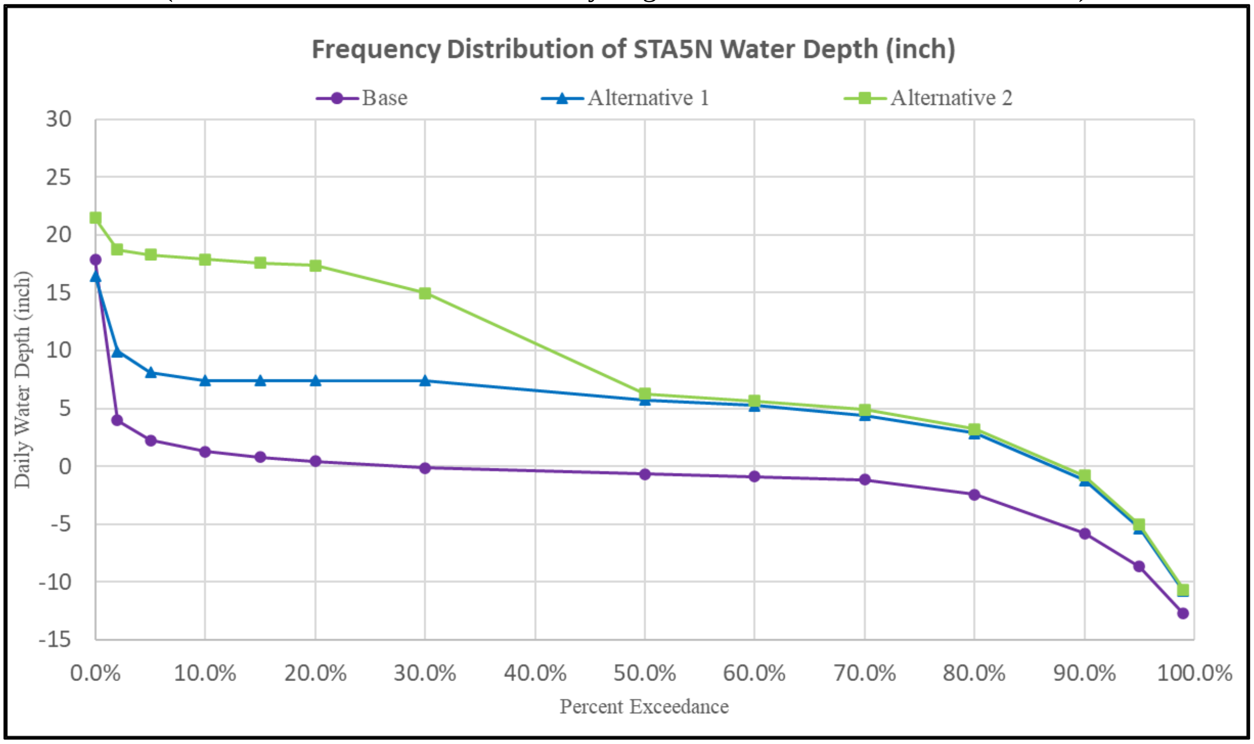


Figure 6. STA-5N Daily Water Depth Frequency Distribution 1965-2016 (inch)
(The Base Run is defined as the daily stage from the LOSOM RSMBN model)



This illustrates that moving an extra 200 cfs through the STA-5N allows a little more use of the Reservoir but the STA-5N water level is still very low and as a result is not meeting the desired conditions of maintaining 18 inches.

Figure 7. Alternative 3 - Southland Reservoir Daily Water Level & Lower Operational Level (-3’) 1965-2016 (ft. NAVD88)

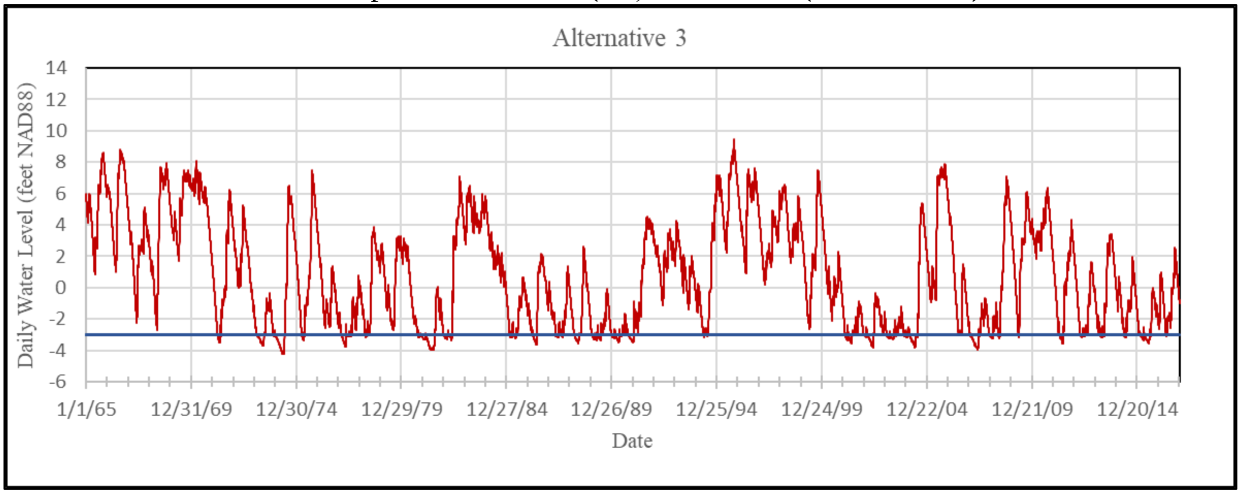
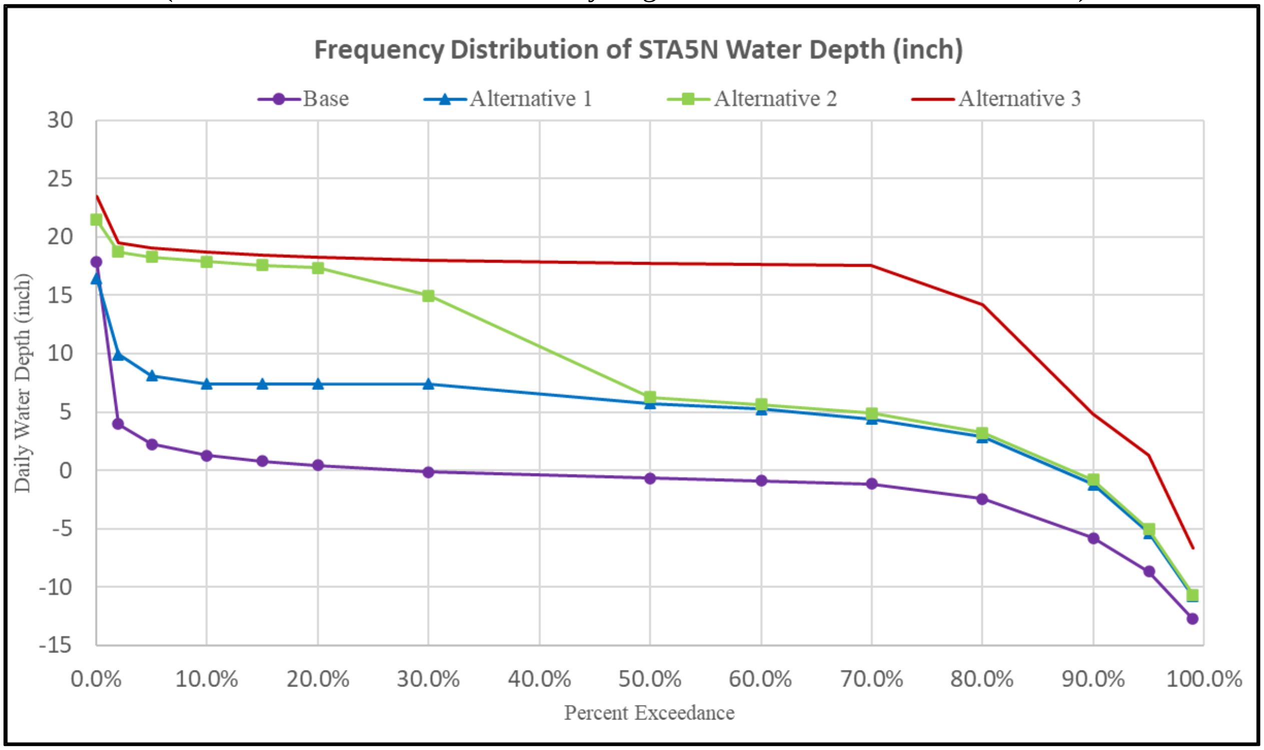


Figure 8. STA-5N Daily Water Depth Frequency Distribution 1965-2016 (inch)
(The Base Run is defined as the daily stage from the LOSOM RSMBN model)



This illustrates that moving an extra 100 cfs through STA-5N allows much more use of the Reservoir and as a result is meeting the target elevation of 18 inches most of the time.

Figure 9. Alternative 4 - Southland Reservoir Daily Water Level & Lower Operational Level (-3') 1965-2016 (ft. NAVD88)

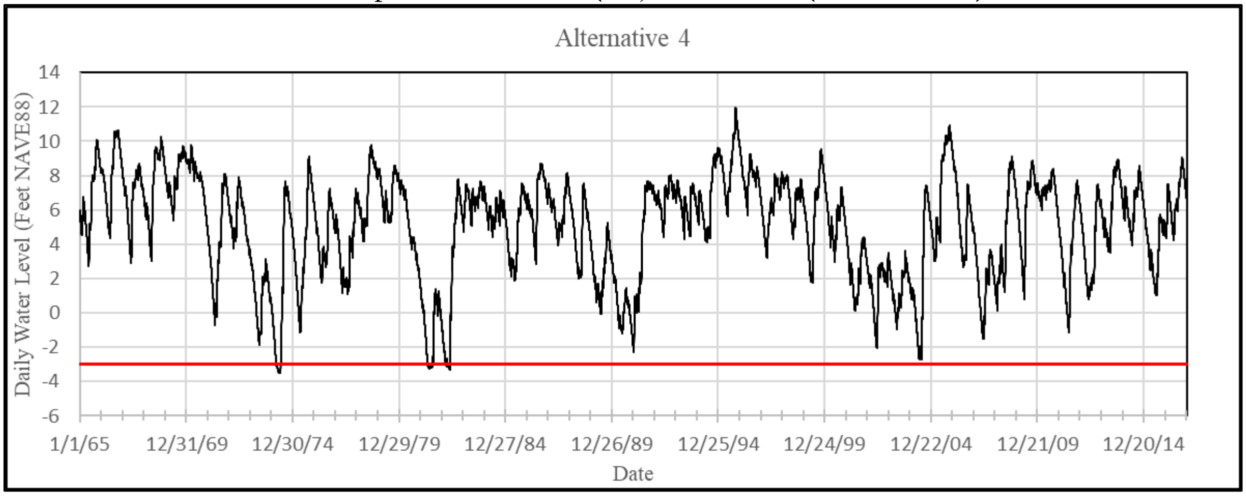
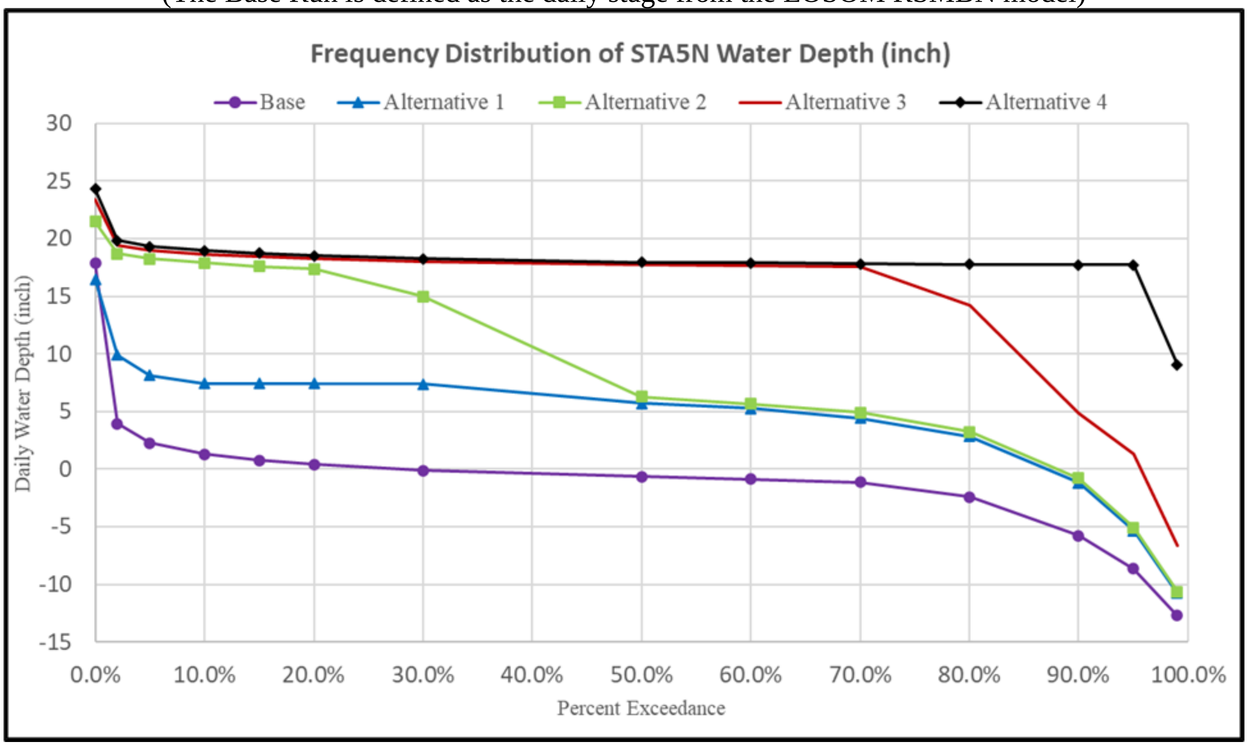


Figure 10. STA-5N Daily Water Depth Frequency Distribution 1965-2016 (inch)
(The Base Run is defined as the daily stage from the LOSOM RSMBN model)



This illustrates that moving an extra 62 cfs through STA-5N allows a significant use of the Reservoir and as a result is meeting the target elevation of 18 inches in the STA nearly all the time.

Figure 11. Southland Reservoir Daily Water Level Frequency Distribution
1965-2016 (ft. NAVD88)

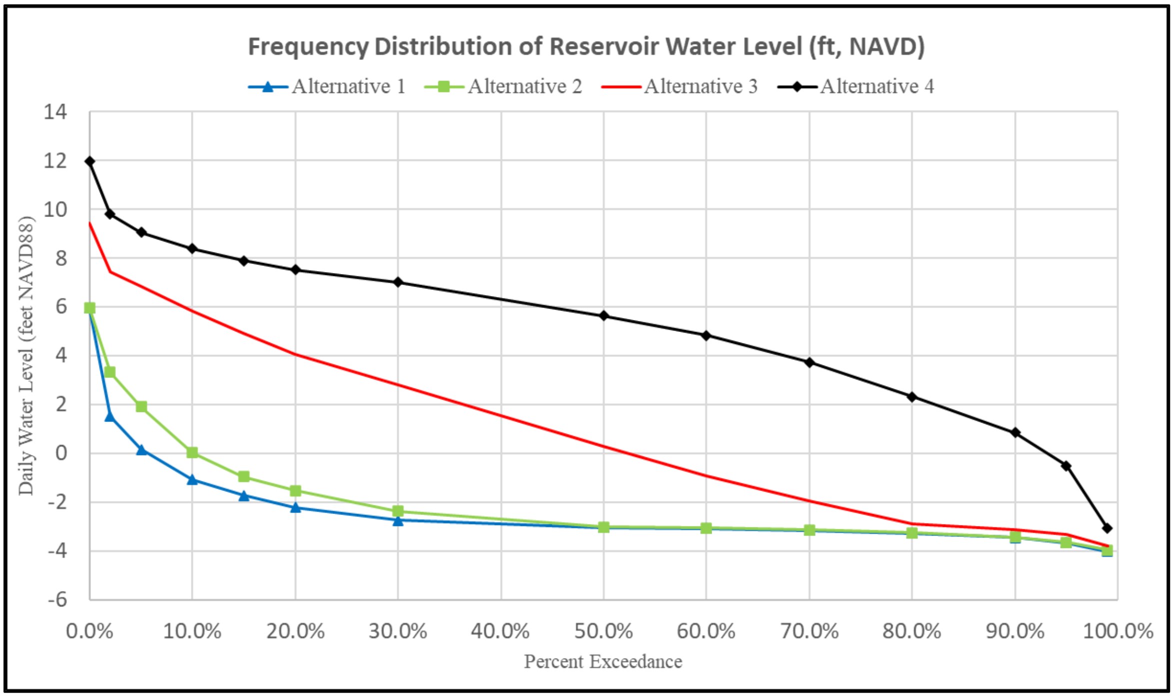
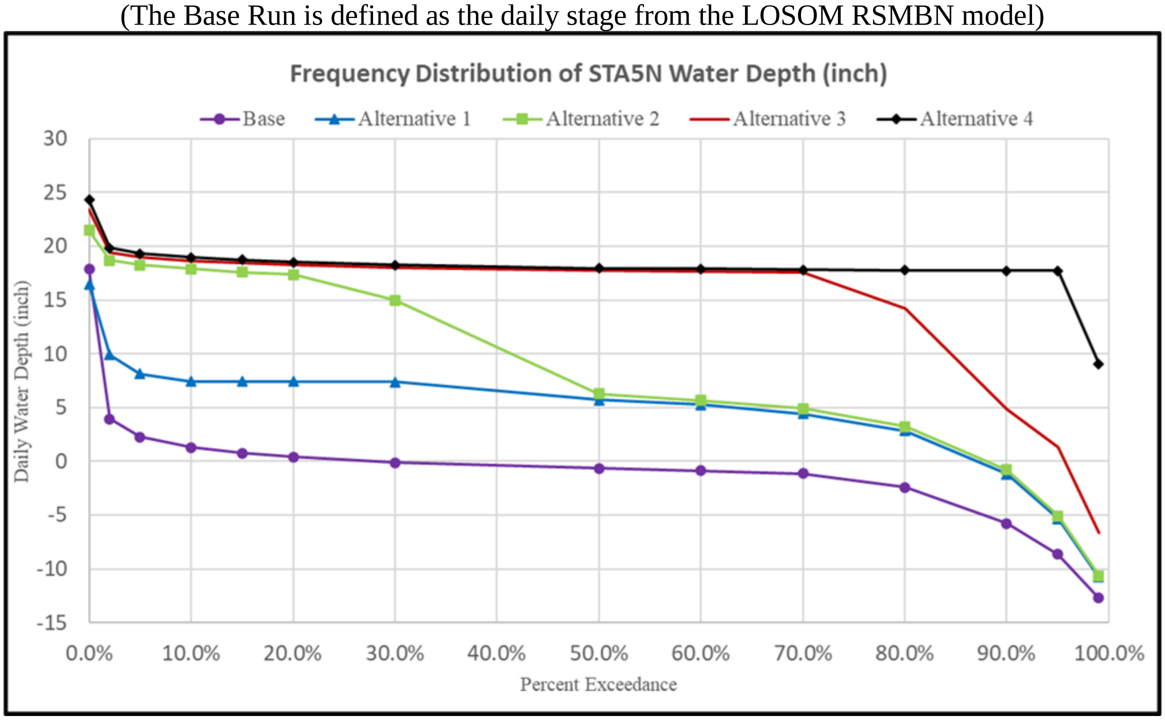


Figure 12. STA-5N Daily Water Depth Frequency Distribution
1965-2016 (inch)
(The Base Run is defined as the daily stage from the LOSOM RSMBN model)



This illustrates the water depth frequency for both the Reservoir and the STA-5N and illustrates that moving an extra 62 cfs through STA-5N allows a significant use of the Reservoir and as a result is the most beneficial to the STA.