APPENDIX E
HYDRAULICS & HYDROLOGY

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E H&H APPENDIX: LIST OF ANNEXES

APPENDIX E
HYDRAULICS & HYDROLOGY

ANNEX 1
CERP IMC MODEL DOCUMENTATION REPORTS

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Interagency Modeling Center

Central Everglades Planning Project South (CEPP-South) Pre-Project Planning Support Model Documentation Report

IMC MSR Central Everglades Planning Project: South Features **April 24, 2020**

1.0 Overview

Identification

The Central Everglades Planning Project South (CEPP-South) is one phase of the overarching Central Everglades Project, an effort undertaken as part of the overall Comprehensive Everglades Restoration Plan (CERP) (**USACE, 1999**), a program led by the United States Army Corps of Engineers (USACE) with the South Florida Water Management District (SFWMD) as local sponsor. The Central Everglades Project (**USACE, 2014**) was authorized by Congress in the 2016 Water Resource Development Act (WRDA) and as individual phases of the project are implemented, modeling support is provided through the CERP Interagency Modeling Center (IMC) to assist with ongoing planning and preliminary design efforts including project validation steps and refinement of project and system operating protocols. Modeling workflow and coordination were performed in a manner consistent with the procedures outlined in IMC Modeling Services Request (MSR) “Central Everglades Planning Project: South Features” dated June 10, 2019.

Scope and Objectives

Modeling support for CEPP-South focused on working with the larger project planning team and other interested parties to incorporate the latest project feature information and to formulate and test operational strategies associated with this phase of the plan. This effort focused on defining an appropriate planning baseline condition (circa 2027), improving the representation of project features in IMC model application relative to previously supported efforts and evaluating a variety of operational strategies to explore potential effects of the project. Modeling products were developed at the appropriate level of detail to provide information to all necessary evaluations required for plan development and documentation in the project National Environmental Policy Act (NEPA) documents (**USACE, 2020a**).

From a modeling deliverable perspective, the entirety of the CEPP-South modeling support can be summarized by reviewing the following two Model Documentation Reports (MDRs):

1. CEPP-South Pre-Project Planning Support – Reviews the modeling work associated with the application of the Regional Simulation Model Glades-LECSA (RSMGL) covering baseline development and alternative simulation. (this document, **IMC, 2020a**)

2. CEPP-South Pre-Project Flood Assessment Support – Reviews the modeling work associated with the application of the Miami-Dade Regional Simulation Model (MDRSM) covering baseline development and alternative simulation. (**IMC, 2020b**)

This CEPP-South Pre-Project Planning Support MDR describes the assumptions, model implementation steps and observed outcomes associated with the baseline and alternatives simulations performed with the RSMGL. These model runs were predominantly used by the CEPP-South project team to explore the effects of a range of operational strategies that could be pursued concurrent with the infrastructure improvements authorized in the plan. This document will focus on the modeling details of these scenarios; information on the use and rationale for the definition of these conditions is contained in the CEPP-South Environmental Assessment (**USACE, 2020a**).

2.0 Basis

Project Assumptions

This CEPP-South Pre-Project Planning Support MDR describes the assumptions, model implementation steps and observed outcomes associated with RSMGL modeling the following scenarios:

- CEPP South Baseline Condition 2027 (CSB2027)
- CEPP South Alternative B1 (ALTB1)
- CEPP South Alternative B2 (ALTB2)
- CEPP South Alternative B3 (ALTB3)

In general, the CSB2027 baseline scenario attempts to model future projected hydrologic conditions associated with a timeframe circa 2027 and include, relative to existing conditions, additional representations of planned future project activities, including state, federal and CERP projects. Assumptions for this scenario were informed by the CERP Integrated Delivery Schedule and recent planning efforts including the USACE's Combined Operational Plan (COP) (**USACE, 2020b,c**), the Western Everglades Restoration Project (**SFWMD and IMC, 2019b)**) and RECOVER's Interim Goals & Targets (**SFWMD and IMC, 2019a**). This baseline also considers the "No Action" alternative and/or Alternative A (ALTA). Some key assumptions included in the baseline scenario include:

- Includes the C11 Impoundment, C43 Reservoir, Indian River Lagoon project features and other authorized projects projected to be completed by 2027
- Does not include any other CEPP project features such as the EAA reservoir / A2STA / CEPP New Water or CEPP North components
- Water Conservation Area 3A and Everglades National Park are operationally consistent with the COP Alternative Q+ which includes the Tamiami Trail Flow Formula (TTFF) and the latest operations for South Dade canals and the 8.5 Square Mile Area.

A detailed project assumption table for the CEPP-South Baseline 2027 is provided in **Appendix A** and key elements of model implementation are described in Section 3.

Alternatives B1, B2 and B3 are all defined with a common set of CEPP South Infrastructure enhancements relative to the baseline and shown in Figure 2.1. The differences among these alternatives are the assumed operations to define discharges for the structures along the L67A and Tamiami Trail (all ALTs retain COP L29 constraints):

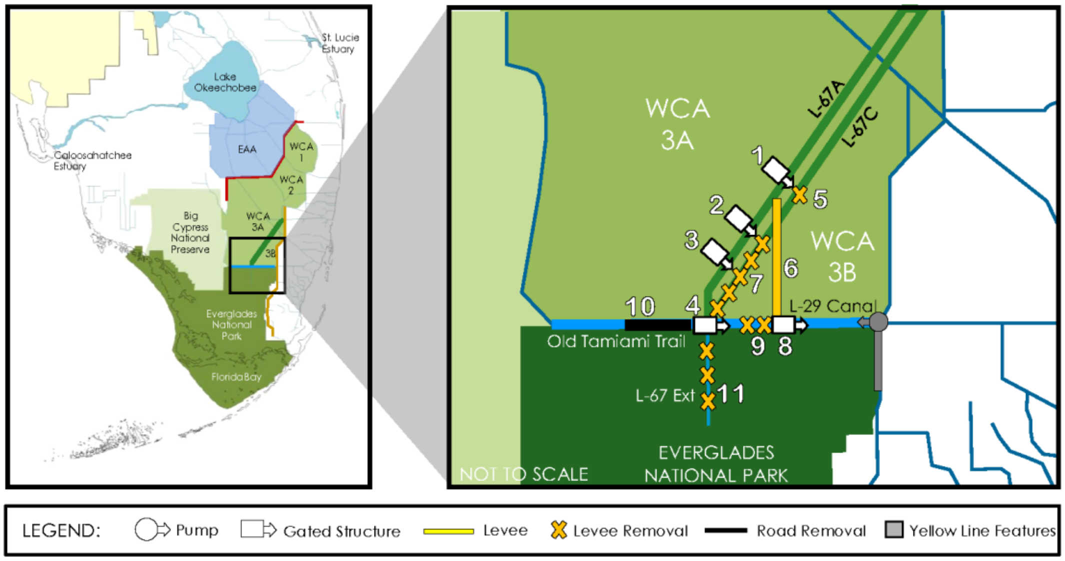
- ALTB1 utilizes the Rainfall Driven Operation (RDO) used in the CEPP ALT4R2 (**SFWMD and IMC, 2014c**) and EAA PACR C240 (**SFWMD, 2018**) modeling and informed by iModel (**Ali, 2009**) optimization from the original CEPP effort in 2012. In this paradigm, many elements of the ERTP WCA3A regulation schedule are still assumed and RDO targets define the “environmental” portions of the rainfall plan deliveries at Tamiami Trail (S333, S333N and S12’s) and also unique environmental targets along L67A (S631, S632 and S633).
- ALTB2 utilizes the COP-like operations including the TTFF, but spatially distributes the target flow to both the Blue Shanty (S632 and S633) and Tamiami Trail (S333, S333N and S12’s) to take advantage of the infrastructure improvements from CEPP-South; S631 is operated using the existing protocols from the S152 (DECOMP Physical Model or DPM) structure.
- ALTB3 also assumes CEPP-like RDO similar to ALTB1 but utilizes an updated iModel optimization to define the “environmental” portions of the rainfall plan deliveries at Tamiami Trail (S333, S333N and S12’s) and also unique environmental targets along L67A (S631, S632 and S633). This new optimization effort was done in consultation with the CEPP-South ecological sub-team and was informed by the updated restoration targets provided by that sub-team.

Detailed description of the model implementation for these alternative infrastructure and operational strategies are provided in Section 3.

Model Limitations and Intended Use of Results

The primary modeling products of CEPP-South were evaluated based on outputs from the Regional Simulation Model (RSM (**SFWMD, 2005a** and **2005b**). The RSM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g., use available input-driven options to represent more complex project operations). The RSMBN (**SFWMD et al., 2009a,b,c,d**) and RSMGL (**SFWMD, 2010** and **2011**) models were reviewed through the USACE validation process for engineering software, as part of the CEPP project. The RSM models were classified as “allowed for use” for South Florida applications in August 2012. The MDRSM model development and model calibration were completed by SFWMD in April 2018 (**Arteaga et al., 2018**), and the model calibration was subsequently independently reviewed by both the IMC and through the USACE Agency Technical Review.

BLUE AND GREEN LINES
DISTRIBUTION AND CONVEYANCE



#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-631	Gated Culvert	500	Delivers water from WCA 3A to 3B, east of L-67D Levee
2	S-632	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
3	S-633	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
4	S-333 (N)	Gated Spillway w/new canal	1150	Delivers water from L-67A Canal to L-29 Canal; supplements existing S-333 gated spillway
5		L-67C Levee Removal Gap		Gap, ~ 6000 feet (corresponding to S-631)
6	L-67D	Blue Shanty Levee		Levee, ~ 8.5 miles, connecting from L-67A to L-29 (6 feet high, 14-foot crest width, 3:1 side slopes)
7		L-67C Levee Removal		Complete removal of ~ 8 miles from New Blue Shanty Levee (L-67D)south to intersection of L-67A/L-67C; L-67C canal is not backfilled
8	S-355W	Gated Spillway	1230	Maintains water deliveries to eastern L-29 Canal
9		Levee Removal (L-29)		Removal of ~ 4.3 miles between L-67A and Blue Shanty Levee intersection with L-29 Levee
10		Removal of remnants of Old Tamiami Trail roadway		Removal of ~ 6 miles of roadway west of L-67 Extension
11		L-67 Extension Levee Removal and Canal Backfill)		Complete removal of ~ 5.5 miles of remaining L-67 Extension, including S-346 culvert
12		L-356 Pump Station Modifications	1,000	Increases pump capacity

Figure 2.1. CEPP-South Project Features

3.0 Simulation

Modeling Tools Used

RSM Version “vendor_3.1_5541” was used to run the RSMGL model.
Release date 8/26/2019, SVN Version #5541.

Model Set Up

The CEPP-South scenarios were developed using the RSMGL model as shown in **Figure 3.1**. The RSMGL modeling was updated from previously performed regional modeling in support of the USACE’s Combined Operational Plan (COP) (**USACE, 2020b,c**), specifically Alternative Q as modeled by RSMGL (consistent with the May 3, 2019 release of model data). RSMBN was not rerun specifically for CEPP-South application, but rather the IGIT RUN1_2025_2026 run was used for boundary conditions since it reflected the desired planning features. The period of simulation utilizes a climate record from 1965 to 2005.

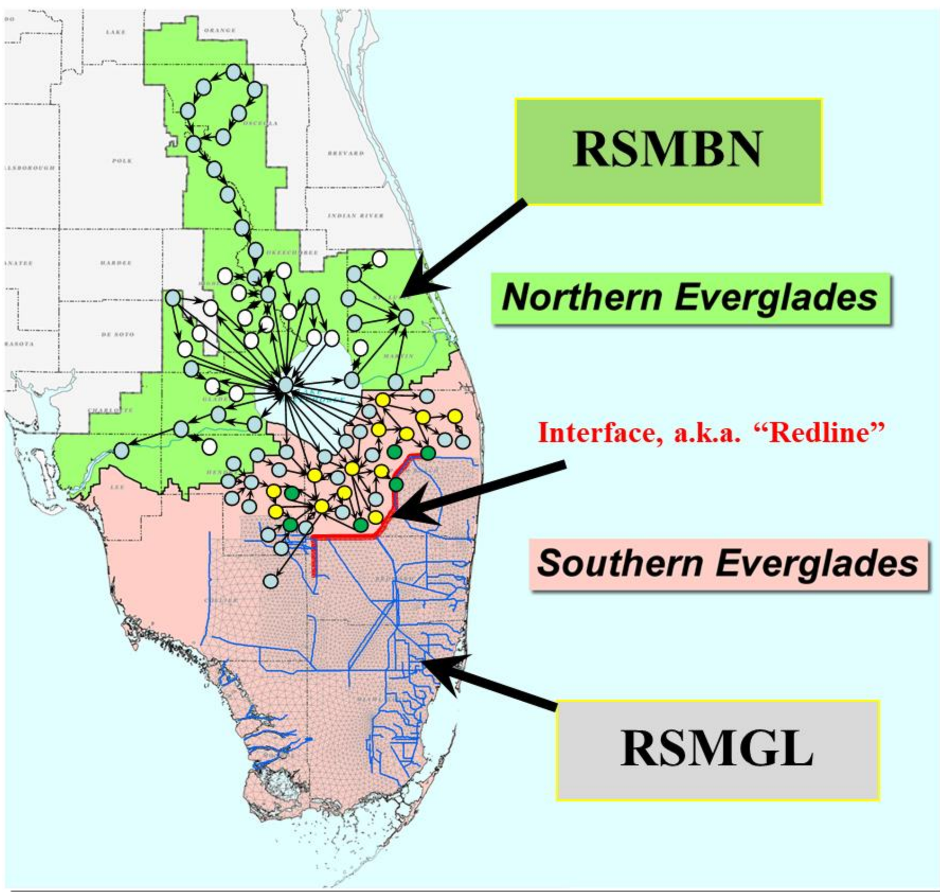


Figure 3.1. CEPP-South Modeling Utilizing RSMGL

RSMGL CEPP-South Baseline 2027 (CSB2027) Scenario

In order to represent the assumed 2027 conditions, three general groups of updates were made to the RSMGL as follows:

- Northern boundary conditions to the RSMGL were updated to utilize the RSMBN "Run 1" from the Interim Goals & Targets modeling (**SFWMD and IMC, 2019a**). This scenario was consistent with the planning assumptions identified in CEPP-South above the "red-line" (C43 Reservoir, Indian River Lagoon, etc...) and as such was utilized to update the RSMGL inflow boundary conditions.
- The Broward County Water Preserve Areas (BWPAs) C-11 Impoundment modeled as an above ground reservoir with area 1221 acres and maximum depth of 4.3 ft. RSM representation of operations were consistent with the Interim Goals & Targets modeling (**SFWMD and IMC, 2019a)** and attempt to represent project intent and outcomes consistent with the 2012 BWPA Project Implementation Report (**USACE and SFWMD, 2012**).
- Several small operational enhancements beyond the COP Alternative Q starting point for RSMGL were identified in the COP process (**USACE, 2020c**) as part of "Alternative Q+" or ALTQ+. This scenario was not modeled in COP, but several of the elements of ALTQ+ and other enhancements to better represent COP operational intent in the RSMGL were made as follows:
    - Update S335 to hold stages slightly higher in L30. In the model this is represented as changing the operational ranges of S335_3 (up to 400 cfs from Aug 1 to Feb 14) from 6.0/5.5 to 6.3/6.0. Also added a S335_4 structure in the model to incorporate a representation of the ALTQ+ Taylor Slough environmental deliveries from WCA3A.
    - Removed S344 seasonal closures.
    - Refined S331 open and close criteria. Imposed an updated tailwater limit and consideration when S357 is pumping at full capacity and S357 headwater is still above 4.5 ft.
    - S332D allowable discharges of 250 cfs were extended through Dec 31st.

Infrastructure Updates Common to all RSMGL CEPP-South Alternatives

In order to represent the CEPP-South project features, changes as listed below were made to the RSMGL CSB2027 to develop the alternative scenarios. The CEPP-South modeling effort sought to utilize the latest preliminary design information and improve the regional modeling representation of the project features. In particular, the modeling of the Blue Shanty feature was significantly updated relative to previous representations in the CEPP (**SFWMD and IMC, 2014c**) and EAA (**SFWMD, 2018**) efforts and now simulates explicit modeling of the L67 "pocket" area. This improved modeling representation is illustrated in **Figure 3.2** and further described below. All alternatives utilized the same assumptions for infrastructure, but operations were varied as described in subsequent sections. Locations and other detail for representing project features in the model were identified based on reference to preliminary project design drawings provided by the project team and included in **Appendix B**.

- S152 capacity set to zero cfs.

- Added the Blue Shanty levee (from L67A to L29).
- Added S631, S632 and S633 structures. Each has 500 cfs design capacity with improved representation of these structures conveying water from WCA3A to WCA3B. Instead of jumping the flow across the L67 gap, structures discharge into cells downstream of the L67A levee. S631 is subject to the Site71 tailwater constraint and S632 and S633 are subject to the L29 west tailwater constraints.
- L67C levee removed south and west of the Blue Shanty levee. 6000' of L67C levee gap north and east of the Blue Shanty levee to convey flows from S631.
- Removed L29 levee between S333 and Blue Shanty levee.
- Added L29 divide structure in L29 canal near terminus of Blue Shanty levee. The structure opens only if there is a positive head gradient from west to east and the eastern portion of the canal is below 7.0'.
- The same L29 constraint at S333/S333N/S356 was applied as follows: 8.5' for Jan and Oct-Dec and 8.25' for Feb-Sep.
- Increased S356 capacity to 1000 cfs.
- Removed the L67ext canal and levee. The shunt previously connecting Old Tamiami Trail (OTT) canal and L67ext canal removed (OTT canal still extends to previous L67ext canal location).
- Removed OTT road overland flow constriction east of Tram Road (OTT canal now has direct overbank connection to the marsh). Removed OTT canal plug between S12C and S12D.
- Incorporated S333N into CEPP-South alternative operational calculations (S333N is no longer constrained by DEP permit).

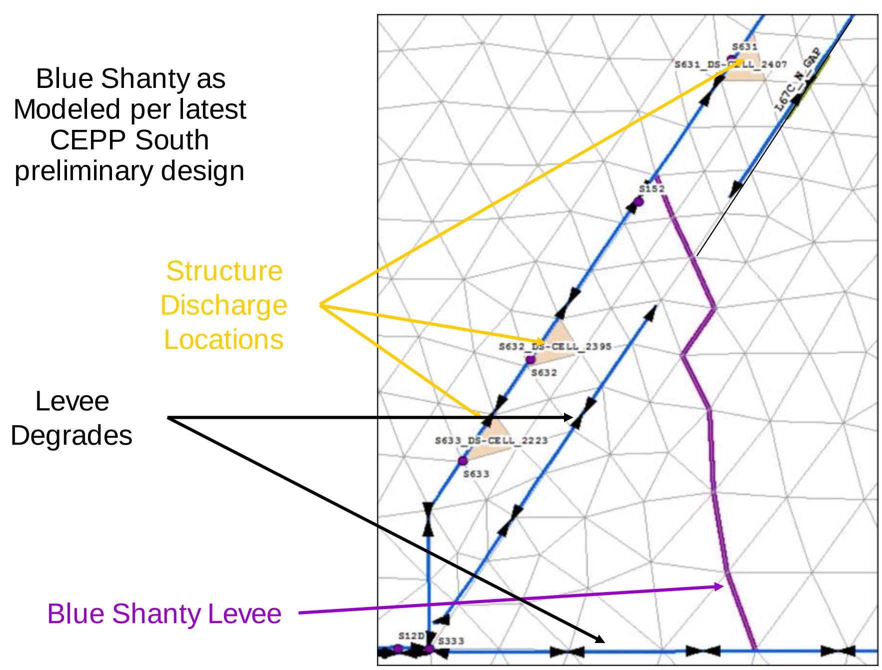


Figure 3.2: Modeling Details for RSMGL Representation of the Blues Shanty Levee and L67 Control Structures.

RSMGL CEPP-South Alternative B1 (ALTB1) Scenario

ALTB1 attempts to mimic the operational intent of the original, as authorized, complete CEPP plan and as such, it utilizes the RDO logic used in the previous CEPP modeling and informed by iModel optimization from the original CEPP effort in 2012 (**SFWMD and IMC, 2014d**). The operations at Tamiami Trail are mechanistically the same as CEPP ALT4R2, with transformed iModel flows (CEPP ALT4R2 inputs) being used to replace the rainfall plan target of the 2012 ERTP (**USACE, 2011)** schedule (**Figure 3.3**) as well as to set targets for S631, S632 and S633. The "bounce back" operation in CEPP that redirects S12A-B flow to the Blue Shanty if capacity is available is also included. While S333 and S333N are independently modeled, their combined operational intent is the same as the expanded S333 in ALT4R2 with S333 having initial priority.

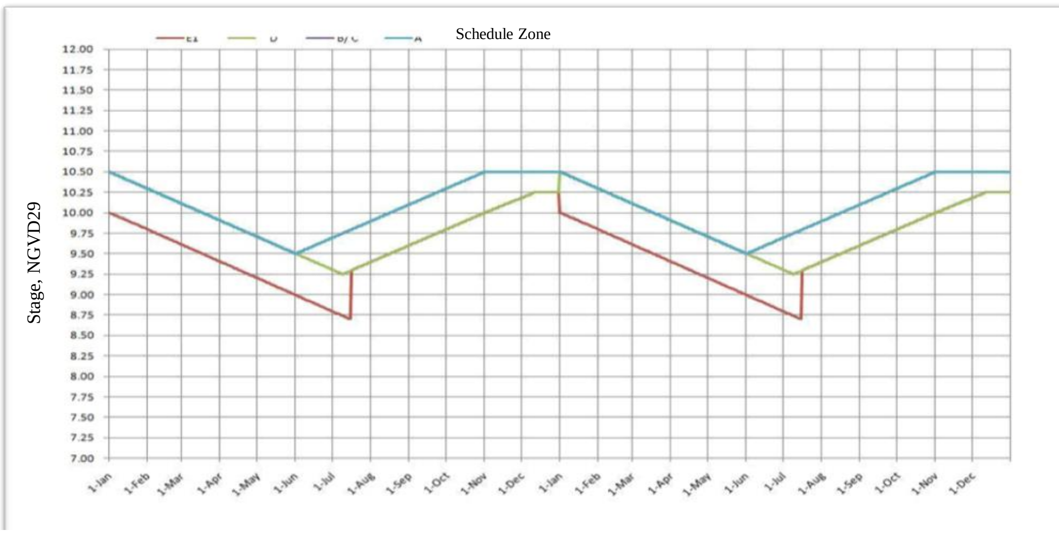


Figure 3.3: WCA3A ALT4R2 Schedule (with RDO adjustments) in RSMGL.

RSMGL CEPP-South Alternative B2 (ALTB2) Scenario

ALTB2 explores whether the operational intent of the COP effort could be leveraged to operate the CEPP-South infrastructure and as such, it utilizes the COP operations consistent with Alternative Q (**USACE, 2020c**), including the TTFF, but redistributes the target flow to both the Blue Shanty (S632 & S633) and Tamiami Trail (S333, S333N & S12s).

- ALTB2 operations per COP ALTQ (schedule with only Zone A and TTFF); the TTFF target flows are calculated the same but spatially distributed as follows:
  - 1st priority = 25% TTFF target to S632 subject to structure capacity
  - 2nd priority = 25% TTFF target to S633 subject to structure capacity
  - Remaining TTFF target volume sent in priority / available capacity order from east to west to S333, S333N, S12D, S12C, then technically to S12B and S12A, but S12 B&A never operate unless in Zone A.
- S631 is operated per the S152 criteria from the CSB2027 & COP ALTQ

RSMGL CEPP-South Alternative B3 (ALTB3) Scenario

ALTB3 provided an opportunity to explore a new RDO scheme specific to CEPP-South and leveraging the latest ecological targets available. Mechanistically, ALTB3 is modeled exactly the same as ALTB1 but uses updated iModel optimization outcomes (flow target time-series) derived in consultation with the CEPP-South ecological sub-team. This modeling strategy is consistent with previous CEPP and COP efforts to examine new RDO operations and stops short of developing a real-time operating protocol like the TTFF.

The iModel optimization effort paralleled the previous CEPP "Greenline iModel Screening" (**SFWMD and IMC, 2014d**) strategy. In this case, the infrastructure was identified as the CEPP South project features and new set of holistic targets were identified by the CEPP-South ecological sub-team. As described by the project team, the CEPP South target definition is characterized as follows:

- The ecological health of the Everglades is dependent upon the hydropattern spatial and temporal variability throughout.
- For CEPP-South, target locations were identified for WCA3A, WCA3B and ENP consistent with previous COP optimization efforts. Additional locations were added in WCA3B, the Blue Shanty and ENP to further inform desired outcomes (**see Figure 3.4** for a comprehensive map of all target locations)
- Target time series are products of natural system models NSM (**Van Zee, 2000**) and NSRSM (**Said and Brown, 2013**) reviewed and modified by scientists through interagency discussions.
- Two "holistic" sets of targets were analyzed: 1A and 1B where the only difference was that the "1A" target set used a full-depth Ridge and Slough landscape target in the Blue Shanty flowway and the "1B" target set used a modified Ridge and Slough landscape target in the Blue Shanty flowway.
- The objective of the iModel optimization is to make the system perform spatially and temporally in correspondence to the target time series.
- Target weights are imposed to allow for relative importance during optimization, but for CEPP-South, all locations were assumed to have equal weight.
- Constraints such as flood protection are also applied (via a different mechanism) in the iModel.

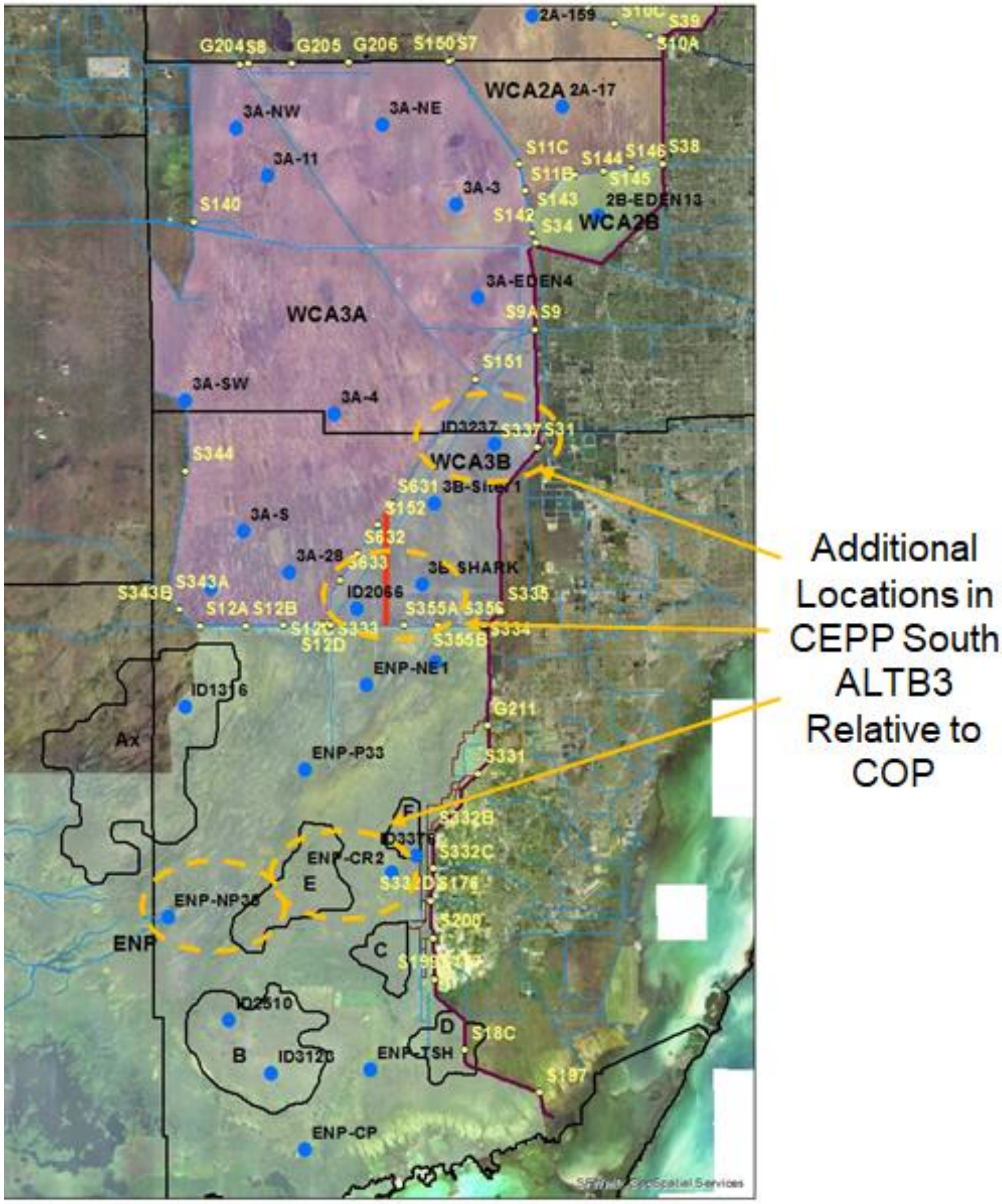


Figure 3.4: iModel Target Locations Defined in CEPP-South.

The iModel optimization was performed for both the 1A and 1B target sets. Graphical and tabular summary of results were provided to the project team for review. An example of a CEPP-South iModel outcomes for a target location is provided in **Figure 3.5**. After reviewing the outcomes of both target sets, the project team determined the “1B” target set should be utilized. These iModel time-series were then transformed into the RSMGL inputs for ALTB3.

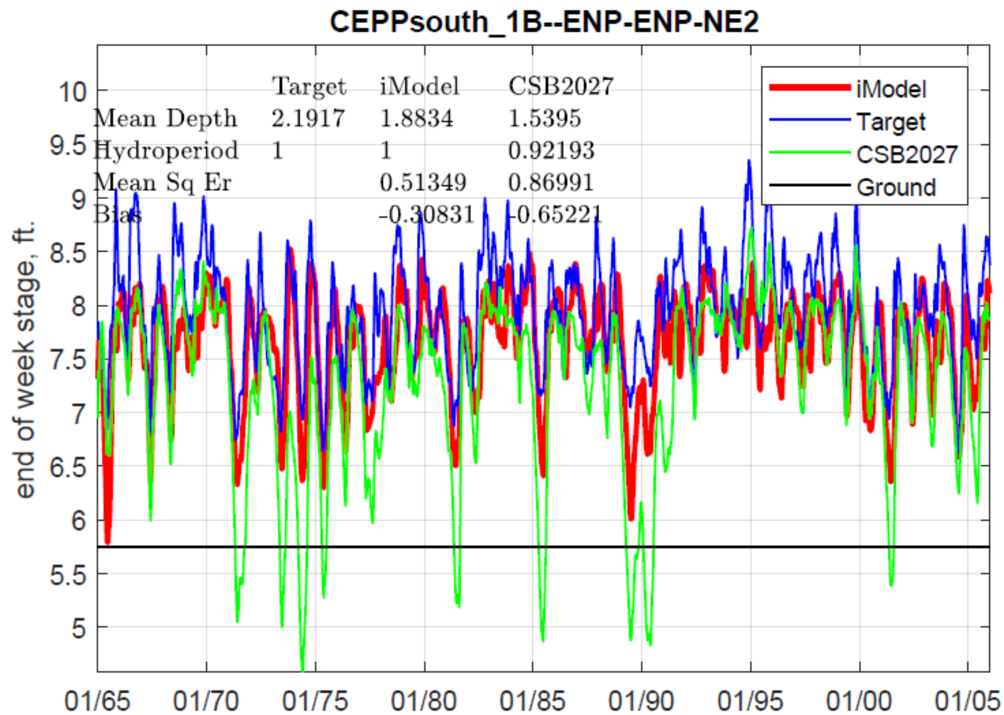


Figure 3.5. Example iModel graphic output comparing optimized outcomes to project baseline conditions and desired ecological targets at a specific location.

4.0 Results

The final CEPP-South modeling products were distributed to the project team using the SFWMD's secure FTP location. Since files are not permanently retained in the FTP location, all posted model outcomes will be archived into the Statewide Model Management System (SMMS) which can be accessed through the system's main interface at:

https://www.sfwmd.gov/science-data/mms

or directly via:

https://apps.sfwmd.gov/smmsviewer/

Project files can be identified in the system using the "Project" tab and selecting CEPP-South from the available dropdown.

While the CEPP-South modeling products have been archived in the above systems, **Table 4.1** below lists more specific information including model version, inputs used and detailed archival location. Version numbers and "svnroot" paths refer to a model version control system found on the SFWMD network that is not generally accessible.

Table 4.1 Version information and model file locations for RSMGL

RSMGL CSB2027 12312019	**RSM_vendor_3.1_5541 and xml_v15418**
Input:…svnroot/trunk/rsm_imp/CEPP_South/models/rsmgl/CSB2027/input Output: /nw/hesm_nas/projects/CEPP_South/models/rsmgl/CSB2027/output_123119_xml15418	
RSMGL ALTB1 01112020	**RSM_vendor_3.1_5541 and xml_v15456**
Input: …svnroot/trunk/rsm_imp/CEPP_South/models/rsmgl/ALTB1/input Output: /nw/hesm_nas/projects/CEPP_South/models/rsmgl/ALTB1/output_011120_xml15456	
RSMGL ALTB2 01112020	**RSM_vendor_3.1_5541 and xml_v15456**
Input: …svnroot/trunk/rsm_imp/CEPP_South/models/rsmgl/ALTB2/input Output: /nw/hesm_nas/projects/CEPP_South/models/rsmgl/ALTB2/output_011120_xml15456	
RSMGL ALTB3 01192020	**RSM_vendor_3.1_5541 and xml_v15497**
Input: …svnroot/trunk/rsm_imp/CEPP_South/models/rsmgl/ALTB3/input Output: /nw/hesm_nas/projects/CEPP_South/models/rsmgl/ALTB3/output_011920_xml15497	

Review of Local and Regional Level Results

The RSMGL modeling scenarios were reviewed from the perspective of ensuring that localized effects of project implementations were observed as expected and that regional performance was considered reasonable. Specific checks on RSM outputs included the following:

- Review of localized flow vectors in the vicinity of the CEPP-South project features indicates that the RSMGL is physically performing as intended. The implementation of S631 and the Blue Shanty flowway increased sheetflow in the area where the L67 extension is removed relative to the CSB2027 is shown in **Figure 4.1**. It can be observed that the alternative results show different degrees of utilization of the Blue Shanty flowway consistent with their relative specified operations.
- All alternatives generally increase stages in Water Conservation Area 3B (WCA3B) both within the Blue Shanty footprint and outside (e.g. at Site 71) by sending flow through the CEPP-South S631, S632 and S633 structures. Stage differences can in WCA3B be observed in **Figure 4.2** and **4.3**.
- All alternatives indicate an increase in flow across Transect 18 in Northeast Shark River Slough (NESRS) in Everglades National Park (ENP) with increases in both wet and dry season flows consistent with the increased operational flow targets and enhanced CEPP-South infrastructure as seen in **Figure 4.4**.
- Stage differences can be observed in upstream Water Conservation Area 3A (WCA3A) and downstream ENP as shown in **Figures 4.5** to **4.7**. The alternatives show differences relative to the CSB2027, with ALTB1 tending to promote the most differences in NESRS, ALTB2 generally being closest to the baseline and ALTB3 creating the largest effects in Central Shark River Slough. Increase in higher peak stages in NESRS in all alternatives can be attributed to the direct connection between NESRS and the Blue Shanty Flow-way, allowing for direct rainfall on the Blue Shanty footprint to reach ENP despite no changes in L29 constraints for inflow structures compared to the baseline.
- Dry year performance differences are evident across the operational alternatives as seen by observing the hydroperiod differences relative to the baseline in 2001 as shown in **Figure 4.8**. Due to a limited upstream water budget (no CEPP “new water”) combined with a maximum water level constraint for L29 common to all scenarios, changes in performance are largely realized as timing shifts and a lowering of stages later in the dry season can be seen in the alternatives. Another example of this performance is seen in increased duration of time below maintenance level in the South Dade canals as seen in **Figure 4.9**.
- Despite lower stages at times due to differences in timing of ENP inflows, average annual surface water flows in southern ENP and discharges toward Biscayne Bay are only minimally changed across the scenarios as shown in **Figure 4.10** and **Table 4.1**.

In summary, the CEPP-South RSMGL scenarios provided to the project team are deemed to adequately represent the intended planning conditions and provide a reasonable basis of comparison for the necessary evaluations required by the project team.

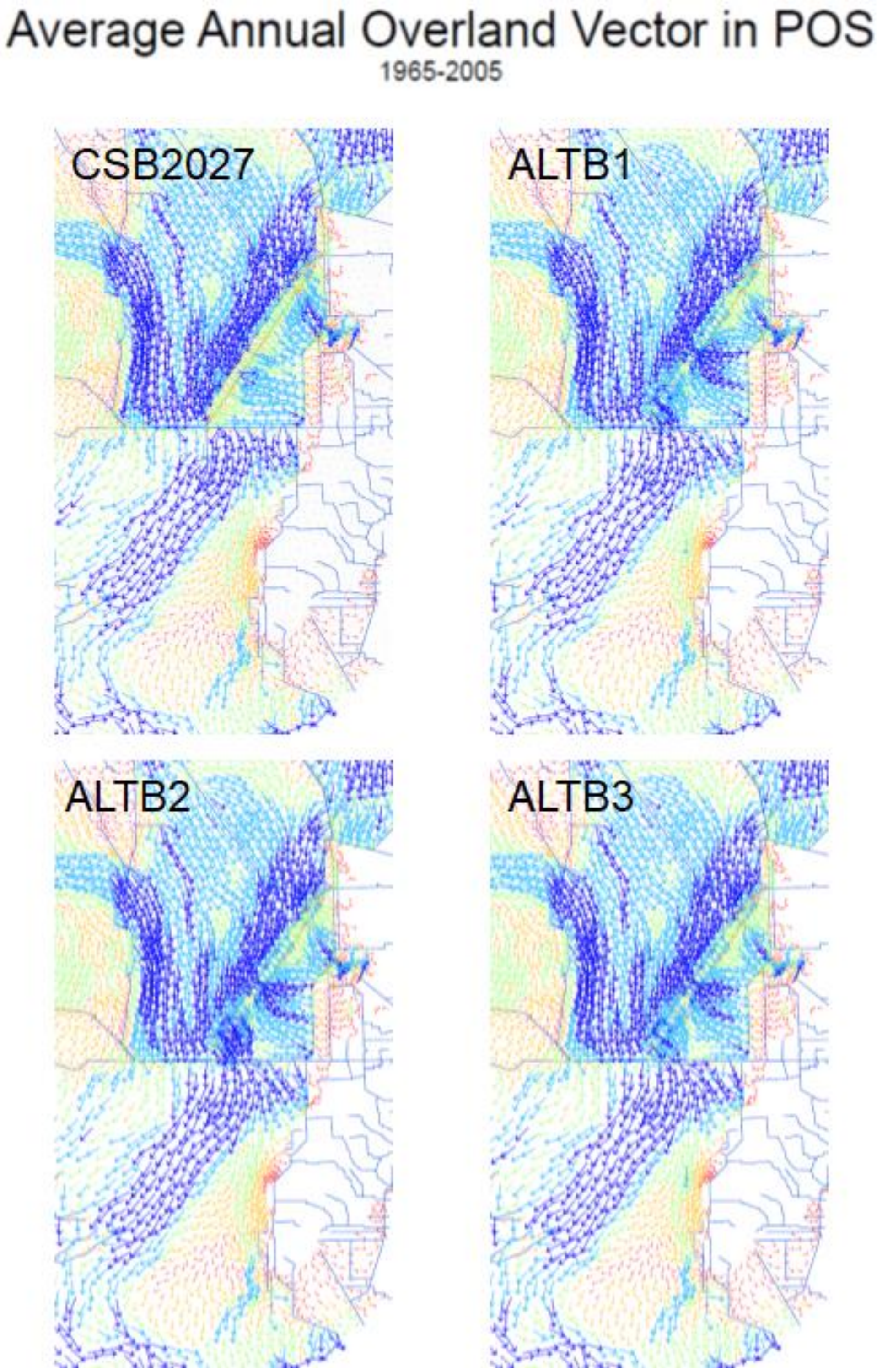


Figure 4.1: RSMGL Average Annual Overland Flow Vectors for CEPP-South Scenarios.

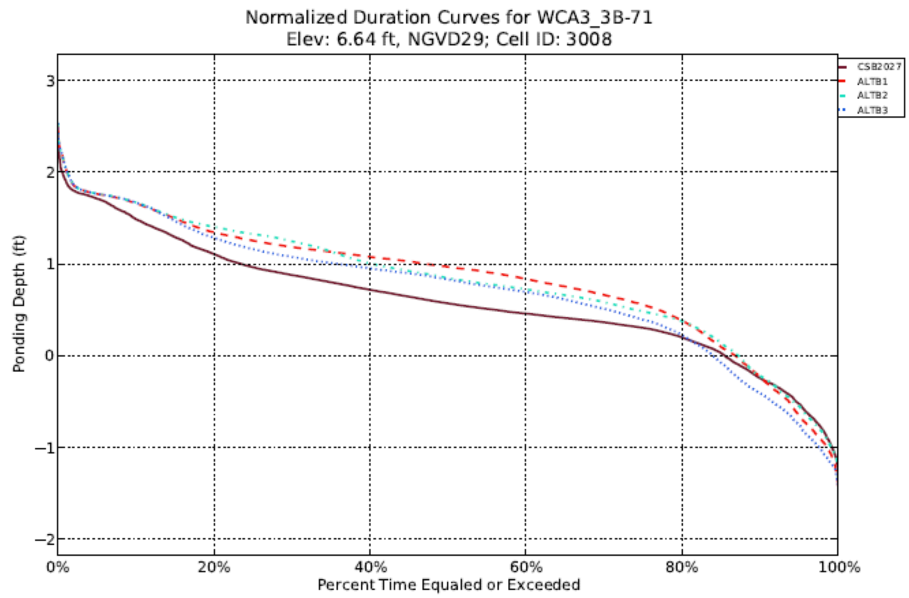


Figure 4.2: RSMGL Stages at Site 71 in Water Conservation Area 3B for CEPP-South Scenarios.

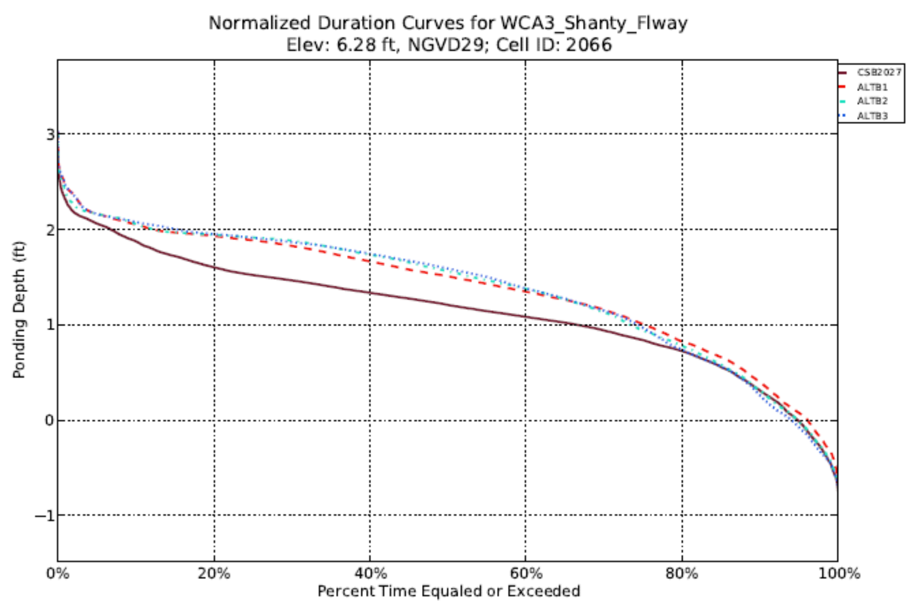


Figure 4.3: RSMGL Stages in the Blue Shanty Flowway for CEPP-South Scenarios.

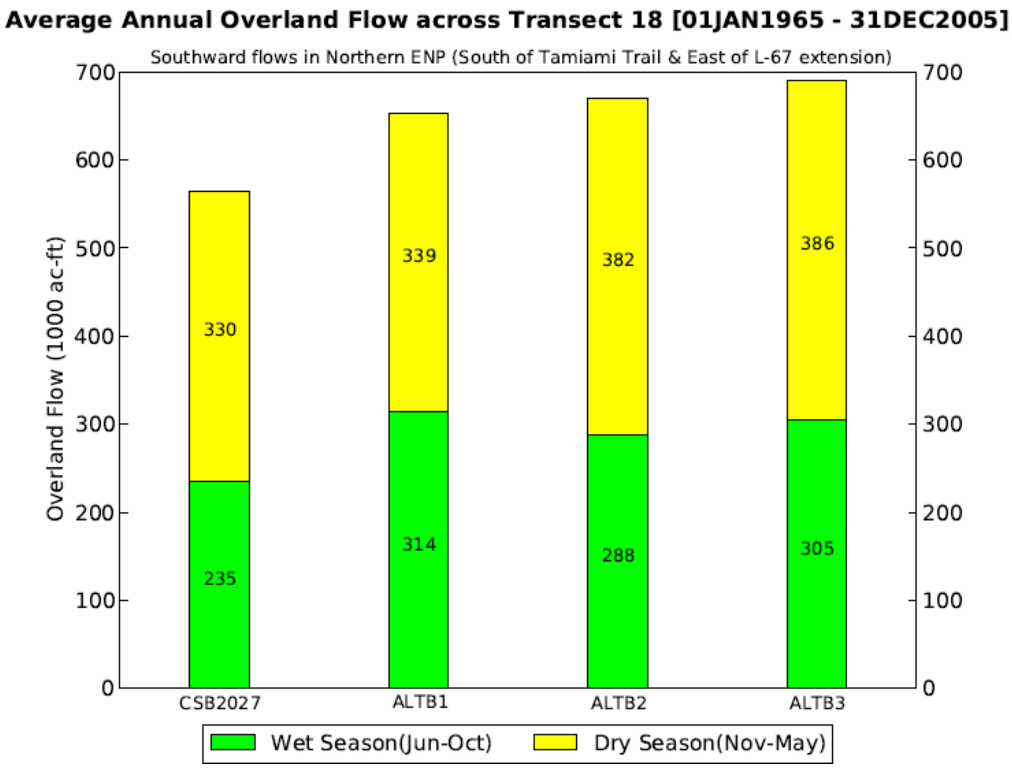


Figure 4.4: Flow differences between CSB2027 and Alternatives in Northeast Shark River Slough.

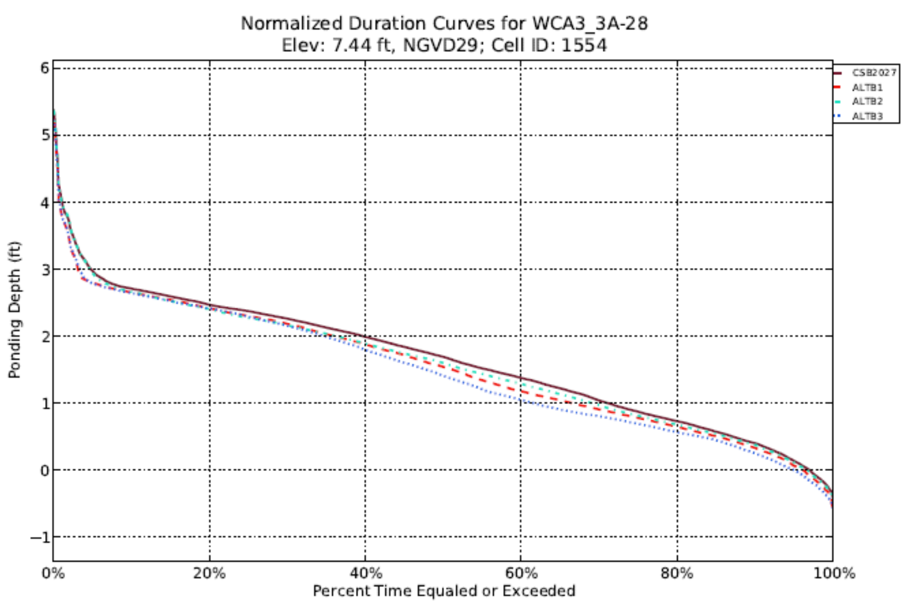


Figure 4.5: RSMGL Stages at 3A-28 (Site 65) in Water Conservation Area 3A for CEPP-South Scenarios.

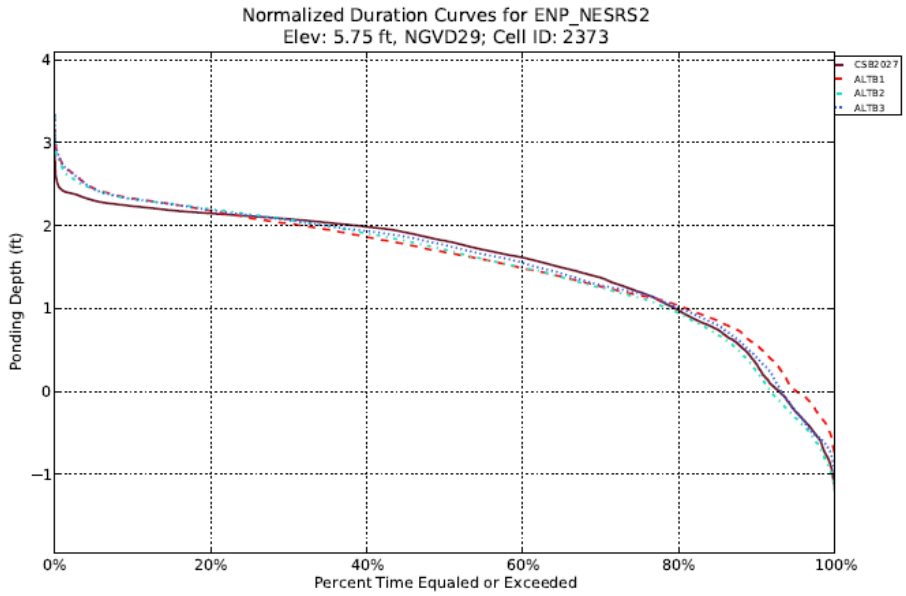


Figure 4.6: RSMGL Stages at NESRS2 in Everglades National Park for CEPP-South Scenarios.

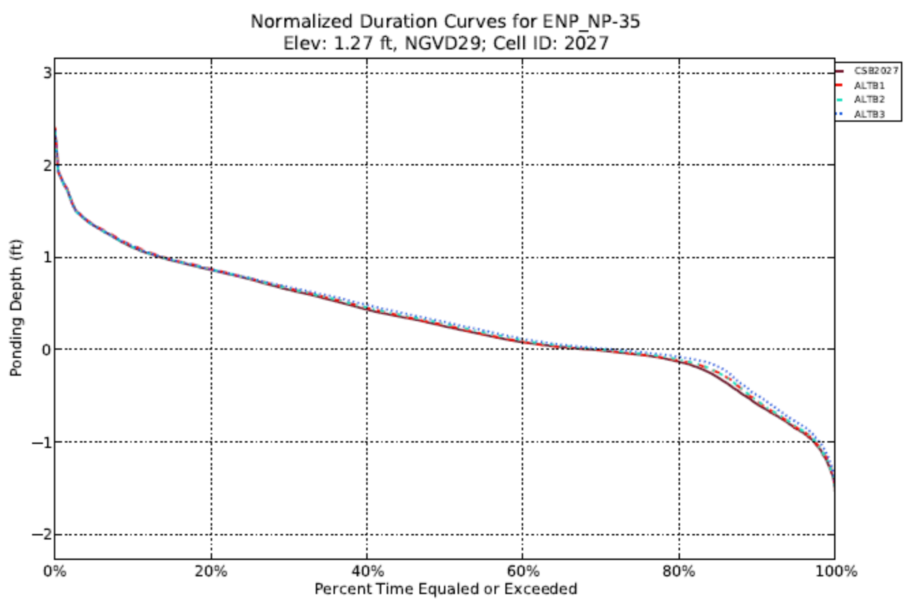


Figure 4.7: RSMGL Stages at NP-35 (Central Shark River Slough) in Everglades National Park for CEPP-South Scenarios.

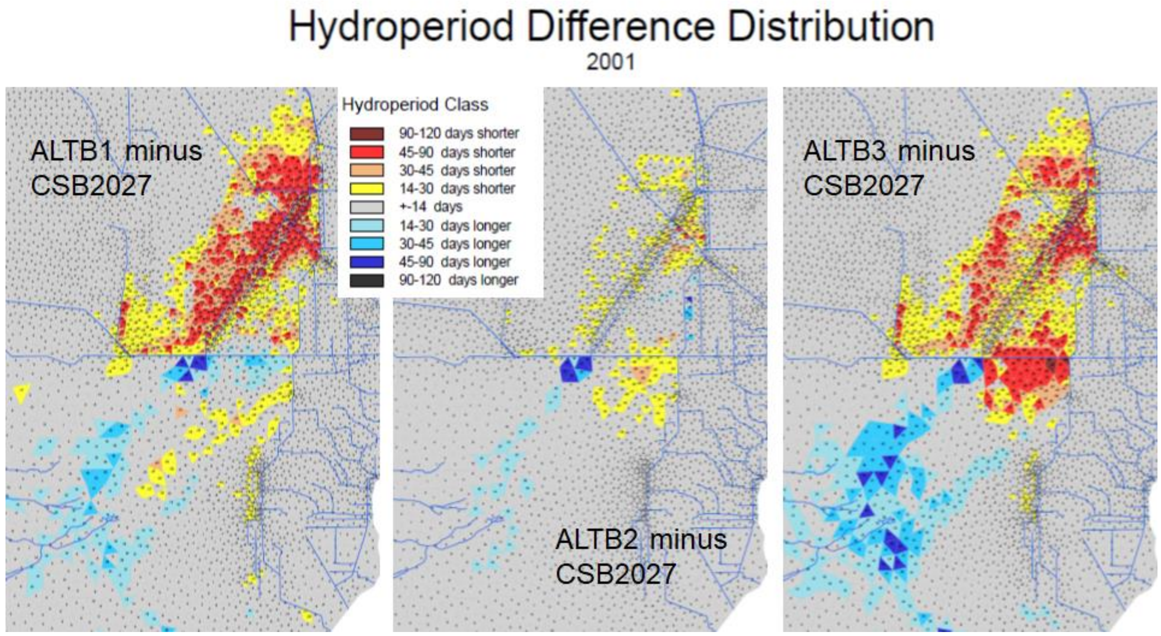


Figure 4.8: Hydroperiod Differences for CEPP-South Alternatives Relative to the CSB2027 in a Dry Year (2001).

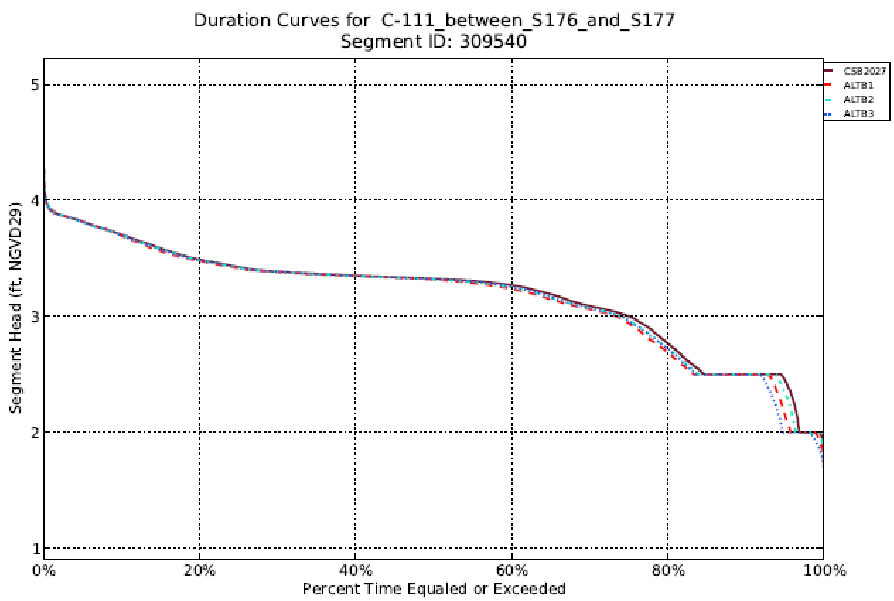


Figure 4.9: RSMGL Stages in the C111 canal for CEPP-South Scenarios.

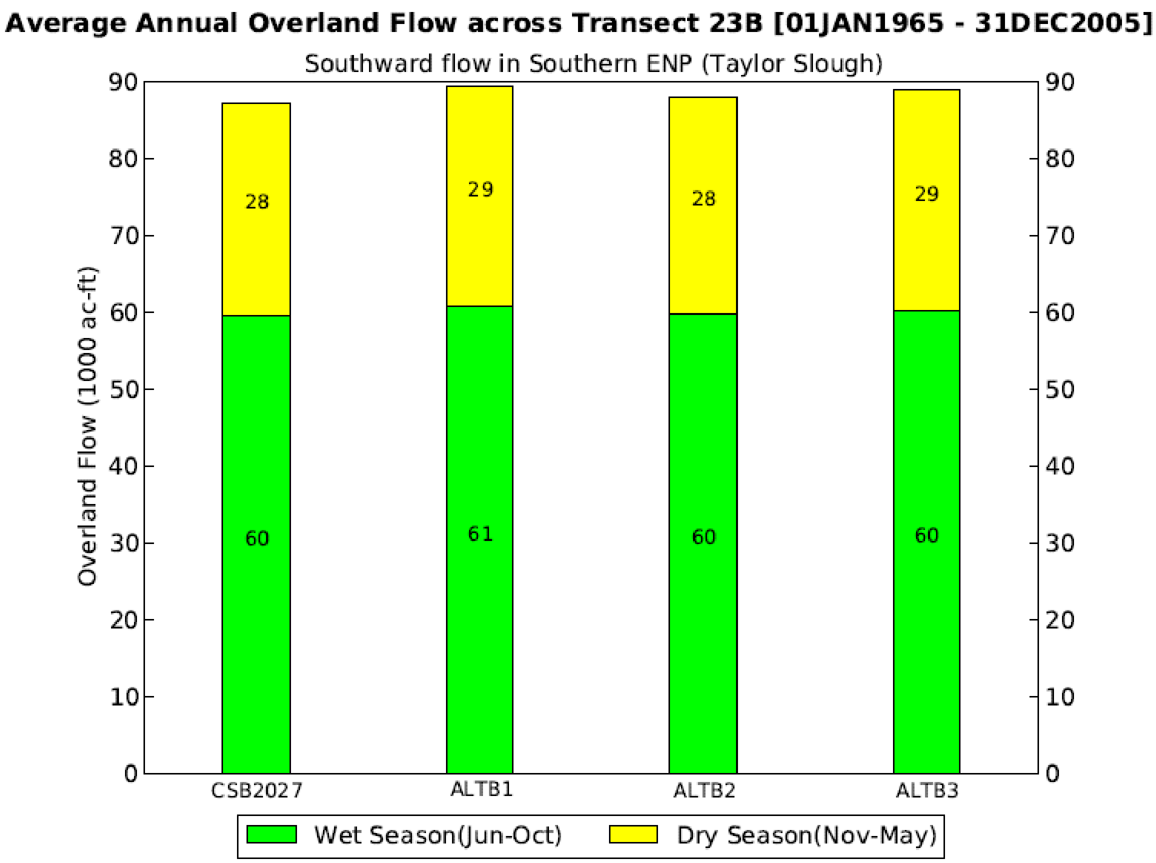


Figure 4.10: Flow differences between CSB2027 and Alternatives in Taylor Slough.

Table 4.1. Average annual (kac-ft) surface water discharges at coastal structures toward Biscayne Bay

	CSB2027	ALTB1	ALTB2	ALTB3
NorthBay	488.9	488.1	486.7	479.4
CentralBay	104.3	105.6	104.3	103.9
SouthBay	257.1	254.8	252.8	252.4

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Appendix A – Tables of Assumptions

RSMGL:

- **CSB2027**

Interagency Modeling Center

Regional Simulation Model Glades-LECSA (RSMGL)
2027 Central Everglades South Baseline (CSB2027)
Table of Assumptions

Note: RSMBN boundary inflows to the WCAs are taken from the 2026 Interim Goals & Targets (IGIT) "Run 1" scenario which includes C43 and IRL reservoirs, Restoration Strategies, etc… See IGIT assumptions table for additional detail.

Feature	
Meteorological Data	• The climatic period of record is from 1965 to 2005 • Rainfall file used: rain_v3.0_beta_tin_14_05.bin • Reference Evapotranspiration (RET) file used: RET_48_05_MULTIQUAD_v1.0.bin (ARCADIS, 2008)
Topography	• United States Geological Survey (USGS) High-Accuracy Elevation Data Collection (HAEDC) and Everglades Depth Estimation Network (EDEN) surveys for the Water Conservation Areas (1, 2A, 2B, 3A, and 3B), the Big Cypress National Preserve and Everglades National Park. SFWMD LiDAR datasets available for the Feeder Canal and L28 Annex western basins. • US Army Corps of Engineers (USACE) Digital Elevation Model (DEM) interim version 2017, for the northwestern portions of BCNP, Seminole natural areas and Western Basins (Feeder Canal and C139 Annex). The Western Everglades Restoration Project (WERP) LiDAR project of 2017 covered parts of Hendry and Collier counties, not covered previously by any modern topo data, and a 50-ft WERP DEM was derived. The DEM had some overlap with the original HAEDC/EDEN survey in the western portions of BCNP, south of the L28 Interceptor canal near the 'L28 GAP' area. • Local topographic updates made where reservoirs are introduced (STA1-E, C4 Impoundment and C-111 reservoirs).
Tidal Data	• Tidal data from two primary (Naples and Virginia Key) and five secondary NOAA stations (Flamingo, Everglades, Palm Beach, Delray Beach and Hollywood Beach) were used to generate a historic record to be used as sea level boundary conditions for the entire simulation period.
Land Use and Land Cover	• Land Use and Land Cover Classification for the Lower East Coast urban areas (east of the Lower East Coast Flood Protection Levee) use 2008-2009 Land Use coverage as prepared by the SFWMD, consumptive use permits as of 2011 were used to update the land use in areas where it did not reflect the permit information. • Land Use and Land Cover Classification for the natural areas (west of the Lower East Coast Flood Protection Levee) is the same as the Calibration Land Use and Land Cover Classification for that area. • Modified at locations where reservoirs are introduced (STA1-E, C4 Impoundment, Lakebelt Lakes and C-111 Reservoirs). • Land Use and Land Cover classification for the western basins, BCNP and natural areas west of the L28 levee were based on the

Feature	
	2012 land use coverage prepared by the SFWMD as updated for the Western Everglades Restoration Project (WERP).
Water Control Districts (WCDs)	• Water Control Districts in Palm Beach and Broward Counties and in the Western Basins assumed.
Western Basins	• L-28 Tie-back Levee gaps modeled as a combined weir. • Surface Flows from the Okaloacoochee (OK) slough into the north western model domain estimated using the RSM-DWM. • S190, S140, Westweir, USSO and PC17A canal structures simulated explicitly. • Seminole Water Management Areas (WMA1, WMA2, WMA3 WMA4), Garcia Farms ponds, Pond3 and Pond 5N and Pond 5S, modeled as impoundments. • Jetport runway modeled as no-flow boundary with 2 transverse culverts modeled as weirs • Western Basins local drainage and water supply functions including within Seminole and Miccosukee areas were modeled explicitly using project water control structures (pumps and culverts) along canals.
Seminole Big Cypress Reservation	• Big Cypress Reservation irrigation demands and runoff were estimated using the AFSIRS method based on Seminole Compact Work Plan acreage. • The 2-in-10 demand set forth in the Seminole Compact Work Plan equals 2,606 MGM. • AFSIRS modeled 2-in-10 demands equaled 2,659 MGM. Type of crop and water thru G409 were used to set seasonal distribution of demand, then all demands increased to Compact level. • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per the District's Final Order and Tribe's Resolution establishing the Big Cypress Reservation entitlement, tribal rights to these quantities are preserved. • LOWSM applies to this agreement.
Lake Belt Lakes	• Based on 2005 Lake Belt Lake coverage obtained from USACE.
Everglades Construction Project Stormwater Treatment Areas	• STA-1E: 5,132 acres total treatment area. • A uniform bottom elevation equal to the spatial average over the extent of STA-1E is assumed.
Comprehensive Everglades Restoration Plan Projects	• Broward County Water Preserve Areas (BWPAs) C-11 Impoundment modeled as an above ground reservoir with area 1221 acres and maximum depths 4.3. Operations in RSM model attempt to represent project intent and outcomes consistent with the 2012 BWPA Project Implementation Report. • C-111 Spreader Canal Project includes the as-built Frog Pond Detention Area and the Aerojet canals as well as the G737 structure per the SFWMD Florida Bay plan. The S199 and S200 pumps are operated per the SFWMD's operating permit and are constrained from Mar 15 – Jun 30 based on stage at the EVER4

Feature	
	and NTS-1, respectively for the protection of the CSSS Critical Habitat. • Biscayne Bay Coastal Wetlands project features were not explicitly modeled due to the scale of the regional model.
Water Conservation Area 1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge)	• Current C&SF Regulation Schedule (last updated in 1995). Includes regulatory releases to tide through LEC canals • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 14 ft. The bottom floor of the schedule (Zone C) is the area below 14 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow. • Structure S10E connecting LNWR to the northeastern portion of WCA-2A is no longer considered part of the simulated regional System
Water Conservation Area 2A & 2B	• Current C&SF regulation schedule (last updated in 1989). Includes regulatory releases to tide through LEC canals • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels in WCA-2A are less than minimum operating criteria of 10.5 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow.

Water Conservation Area 3A & 3B	• Combined Operational Plan (COP) proposed 2020 regulation schedule for WCA-3A, as per RSM-GL modeled Alternative Q.
	• Apply Tamiami Trail Flow Formula for inflows into ENP (as in COP Alternative Q) when WCA-3A stage is below Zone A of the regulation schedule.
	• A simplified version of the EHW (not using projected stages) is simulated, but never triggers operation of S334 during the simulation period.
	• Modeling retains the following updates previously incorporated with the 2012 ERTP Regulation Schedule RSM simulations:
	  ◦ Priority use of S-333 for WCA-3A deliveries, followed by S-12D, S-12C, S-12B,S-12A
	  ◦ S-12 A&B gate overtopping if headwater stage > 11.0 ft, NGVD, simulated as a weir.
	  ◦ Updated S-12 effective rating curves based on historical observations compared to 3A-28 (Site 65)
	• S-333N modeled as a 1150 cfs spillway operated per July 2018 FDEP permit.
	• Include S-152 operations (design capacity 750 cfs) per Decomp Physical Model, Phase 2
	  ◦ Assumes September 1 through May 31 operations of S-152 with flow limitation based on actual performance of S-152 (modeled structure design capacity of 400 cfs with 0.5 feet of head
	  ◦ May be operated when L-67A Canal stage at S-151 headwater exceeds 9.3 feet NGVD (surrogate for DPM Phase 2 water quality constraints)

Feature	
	• Closed if WCA-3B Site 71 stage exceeds 8.5 feet NGVD • Flows in the model are routed to a cell east of L67C • Includes regulatory releases to tide through LEC canals. Documented in Water Control Plan (USACE, June 2006) • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 7.5 ft in WCA-3A - defined as when 3-69W marsh gauge falls below 7.5 ft (consistent with COP Alternative Q) or L-67A canal stage at the S333HW falls below 7.0 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow.
Everglades National Park	• Water deliveries to Everglades National Park are based on the COP proposed Tamiami Trail Flow Formula (when WCA-3A stage is below Zone A of the regulation schedule) and the COP proposed 2020 regulation schedule for WCA-3A (Zone A), as per RSM-GL modeled Alternative Q. • L-29 stage constraint for operation of S-333 assumed to be 8.5 ft, NGVD incorporating a 90 day FDOT duration constraint. • No G-3273 constraint for operation of S-333 • The one mile Tamiami Trail Bridge as per the 2008 MWD Tamiami Trail Limited Reevaluation Report is modeled as a one mile weir. Located east of the L67 extension and west of the S334 structure. • Western 2.6-mile Tamiami Trail Bridge, modeled as a 2.6 miles long weir, and is located east of Osceola Camp and west of Frog City. • Tamiami Trail culverts east of the L67 Extension are simulated where the bridge is not located. • 5.5 miles remain of the L-67 Extension Levee. • S-355A & S-355B are operated when a positive head exists across the structures. • S-356 (500 cfs capacity) is operated to manage seepage & stages in the L-31N Canal, per COP Alternative Q. • Partial depth, 5 miles long seepage barrier south of Tamiami Trail (along L-31N), representative of the seepage reduction barrier installed by the Miami-Dade Limestone Product Association. • Full construction of C-111 project reservoirs consistent with the as-built information from USACE plus addition of contract 8, contract 8A, and contract 9 features. A uniform bottom elevation equal to the spatial average over the extent of each reservoir is assumed. • S-332D seasonal pumping limits per the COP proposed Alternative Q: no constraint from 15 July – 30 November ; 325 cfs from 01–31 January; 250 cfs from 01 February – 14 July • 8.5 SMA project feature as per federally authorized Alternative 6D of the MWD/8.5 SMA Project (USACE, 2000 GRR); operations per COP Alternative Q. • Outflow assumed from 8.5 SMA detention cell to the C-111 North Detention Area.

Feature	
	• An additional length of seepage canal and the S-357N structure is assumed in the model
Other Natural Areas	• Flows to Biscayne Bay are simulated through Snake Creek, North Bay, the Miami River, Central Bay and South Bay
Pumpage and Irrigation	• Public Water Supply pumpage for the Lower East Coast was updated using 2010 consumptive use permit information as documented in the C-51 Reservoir Feasibility Study; permits under 0.1 MGD were not included • Residential Self Supported (RSS) pumpage are based on 2030 projections from the SFWMD Water Supply Bureau. • Industrial pumpage are based on 2030 projections from the SFWMD Water Supply Bureau. • Irrigation demands for the six irrigation land-use types are calculated internally by the model. • Seminole Hollywood Reservation demands are set forth under VI. C of the Tribal Rights Compact. Tribal sources of water supply include various bulk sale agreements with municipal service suppliers.
Canal Operations	• C&SF system and operating rules proposed for COP Alternative Q • Includes S-335 operations to discharge from L-30 Canal (and WCA3A as defined by Alterative Q+) to help maintain the hydraulic ridge between natural and developed areas and provide water to Taylor Slough • Includes operations to meet control elevations in the primary coastal canals for the prevention of saltwater intrusion • Includes existing secondary drainage/water supply system • C-4 Flood Mitigation Project • Western C-4, S-380 structure retained open • C-11 Water Quality Treatment Critical Project (S-381 and S-9A). o S9/S9A operations modified for performance consistency with SFWMM ECB. • S-25B and S-26 pumps are not modeled since they are used very rarely during high tide conditions and the model uses a long-term average daily tidal boundary • Northwest Dade Lake Belt area assumes that the conditions caused by currently permitted mining exist and that the effects of any future mining are fully mitigated by industry • ACME Basin A flood control discharges are sent to C-51, west of the S-155A structure, to be pumped into STA-1E. ACME Basin B flood control discharges are sent to STA-1E through the S-319 structure • Structures S-343A and S-343B are closed Oct. 1 to July 14; • S-12A and S-12B are closed Oct. 1 to July 14; the WCA-3A high-water exit strategy during October and November (per the 2016 ERTP Biological Opinion) is included in the model (i.e. S-12A/B conditionally open in October depending on WCA-3A average stage; S-12B conditionally open in November dependent on WCA-3A average stage).

Feature	
	• No seasonal closure at S-344 per proposed COP Alternative Q (open when WCA-3A stage is above Zone A). • South Dade Conveyance System operations will follow COP Alternative Q.

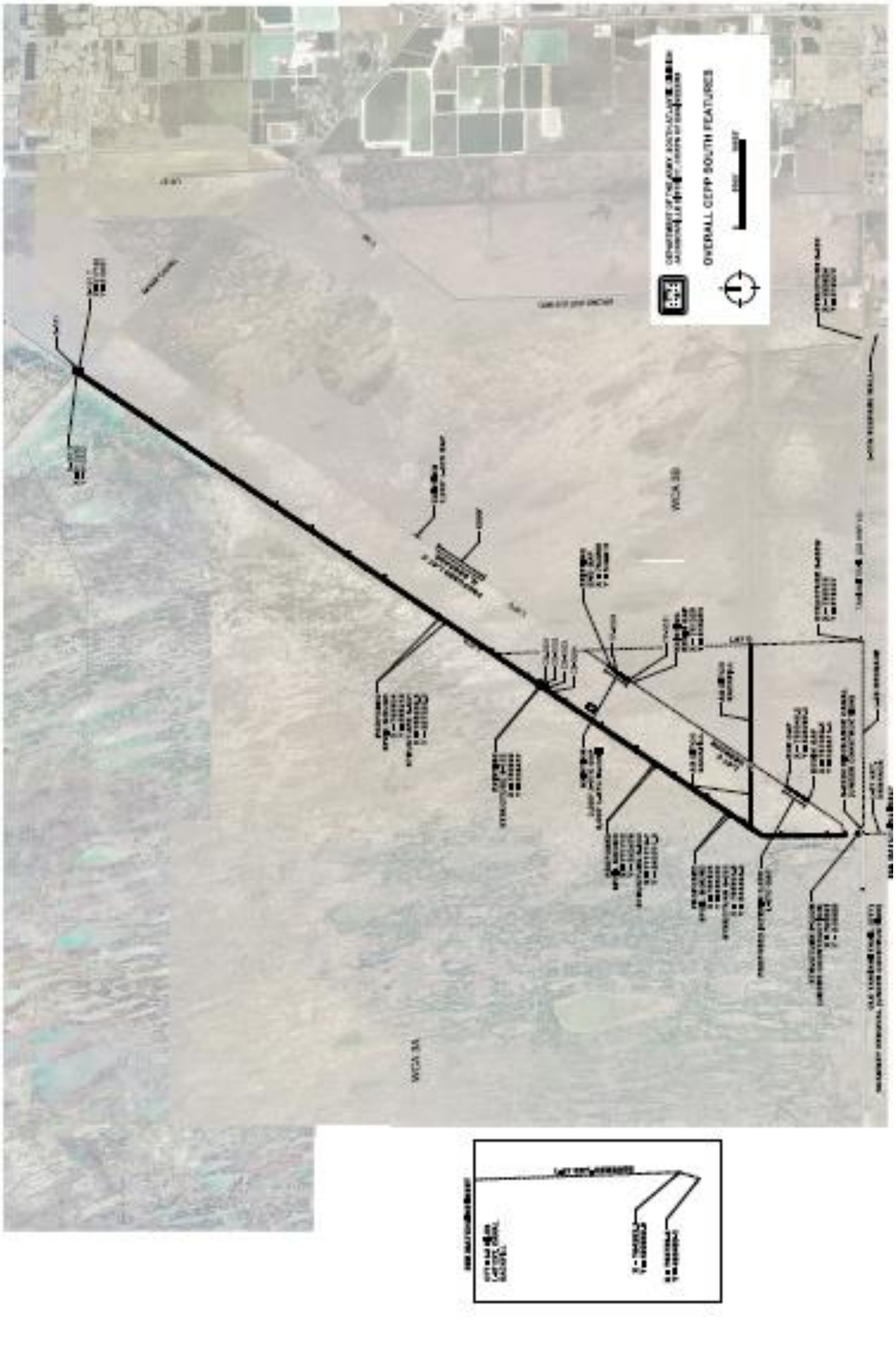
Canal Configuration	• Canal configuration same as calibration except only 5.5 miles remain of the L-67 Extension Canal and CERP project modifications.
	• Additional canals including Tamiami Trail Borrow Canal and Loop Road borrow canals added during WERP & ERTP updates.
	  • Tamiami Trail Borrow Canal, 32 miles
	    o Additional structures: 40 Bridges, modeled as weirs
	    o A plug is assumed between S-12B and S-12C at Shark Valley Tram Road
	  • Loop Road, 23 miles
	    o Additional structures: 56 Culverts, modeled as 17 weirs
	  • Old Tamiami Trail Borrow, North Feeder, West Feeder, Wingate Mills, Lardcan canals explicitly modeled.

Lower East Coast Service Area Water Shortage Management	• Lower east coast water restriction zones and trigger cell locations are equivalent to SFWMM ECB implementation. An attempt was made to tie trigger cells with associated groundwater level gages to the extent possible. The Lower East Coast Subregional (LECsR) model is the source of this data. • Periods where the Lower East Coast is under water restriction due to low Lake Okeechobee stages were extracted from the corresponding RSMBN ECB simulation.

Notes

- The RSM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g. use available input-driven options to represent more complex project operations).
- The boundary conditions along the northern boundary of the RSMGL model were provided from either the South Florida Water Management Model (SFWMM) or the RSM Basins Model (RSMBN). The SFWMM was the source of the northern boundary groundwater/surface water flows, while the RSMBN was the source of the northern boundary structural flows.
- CSB2027 assumptions were updated from the WERP ECB scenario.

Appendix B – Preliminary Project Design Features Provided by CEPP-South Team



Interagency Modeling Center

Central Everglades Planning Project South (CEPP-South) Pre-Project Flood Assessment Model Documentation Report

IMC MSR Central Everglades Planning Project: South Features **April 24, 2020**

1.0 Overview

Identification

The Central Everglades Planning Project South (CEPP-South) is one phase of the overarching Central Everglades Project, an effort undertaken as part of the overall Comprehensive Everglades Restoration Plan (CERP) (**USACE, 1999**), a program led by the United States Army Corps of Engineers (USACE) with the South Florida Water Management District (SFWMD) as local sponsor. The Central Everglades Project (**USACE, 2014**) was authorized by Congress in the 2016 Water Resource Development Act (WRDA) and as individual phases of the project are implemented, modeling support is provided through the CERP Interagency Modeling Center (IMC) to assist with ongoing planning and preliminary design efforts including project validation steps and refinement of project and system operating protocols. Modeling workflow and coordination were performed in a manner consistent with the procedures outlined in IMC Modeling Services Request (MSR) “Central Everglades Planning Project: South Features” dated June 10, 2019.

Scope and Objectives

Modeling support for CEPP-South focused on working with the larger project planning team and other interested parties to incorporate the latest project feature information and to formulate and test operational strategies associated with this phase of the plan. This effort focused on defining an appropriate planning baseline condition (circa 2027), improving the representation of project features in IMC model application relative to previously supported efforts and evaluating a variety of operational strategies to explore potential effects of the project. Modeling products were developed at the appropriate level of detail to provide information to all necessary evaluations required for plan development and documentation in the project National Environmental Policy Act (NEPA) documents (**USACE, 2020a**).

From a modeling deliverable perspective, the entirety of the CEPP-South modeling support can be summarized by reviewing the following two Model Documentation Reports (MDRs):

1. CEPP-South Pre-Project Planning Support – Reviews the modeling work associated with the application of the Regional Simulation Model Glades-LECSA (RSMGL) covering baseline development and alternative simulation. (**IMC, 2020a**)
2. CEPP-South Pre-Project Flood Assessment Support – Reviews the modeling work associated with the application of the Miami-Dade Regional Simulation Model

(MDRSM) covering baseline development and alternative simulation. (this document, **IMC, 2020b**)

This CEPP-South Pre-Project Flood Assessment MDR describes the assumptions, model implementation steps and observed outcomes associated with the baseline and alternatives simulations performed with the MDRSM. In CEPP-South, the MDRSM is utilized as a complement to the RSMGL model and provides higher spatial and temporal resolution in key areas on the southern portion of the south Florida system, in particular the 8.5 Square Mile Area and southern Dade county in the L31 and C111 basins. These MDRSM model simulations were predominantly used by the CEPP-South project team to explore the potential flooding or savings clause effects of a range of operational strategies that could be pursued concurrent with the infrastructure improvements authorized in the plan. This document will focus on the modeling details of these scenarios; information on the use and rationale for the definition of these conditions is contained in the CEPP-South Environmental Assessment (**USACE, 2020a**).

2.0 Basis

Project Assumptions

This CEPP-South Pre-Project Flood Assessment MDR describes the assumptions, model implementation steps and observed outcomes associated with MDRSM modeling of the following scenarios:

- CEPP South Baseline Condition 2027 (CSB2027)
- CEPP South Alternative B1 (ALTB1)
- CEPP South Alternative B2 (ALTB2)
- CEPP South Alternative B3 (ALTB3)

In general, the framing of the assumptions and requirements for the MDRSM is the same as that for the RSMGL used in broader planning support (**IMC, 2020a)**. Additionally, the MDRSM utilizes the RSMGL for Everglades boundary conditions. However due to the scale of the MDRSM, modeling implementation details will be unique and are described in detail in Section 3.

While more detail can be found in the companion CEPP-South Pre-Project Planning Support MDR (**IMC, 2020a**), a brief description of the scenarios and **Figure 2.1** illustrating the CEPP South infrastructure features are provided below for reference in this document.

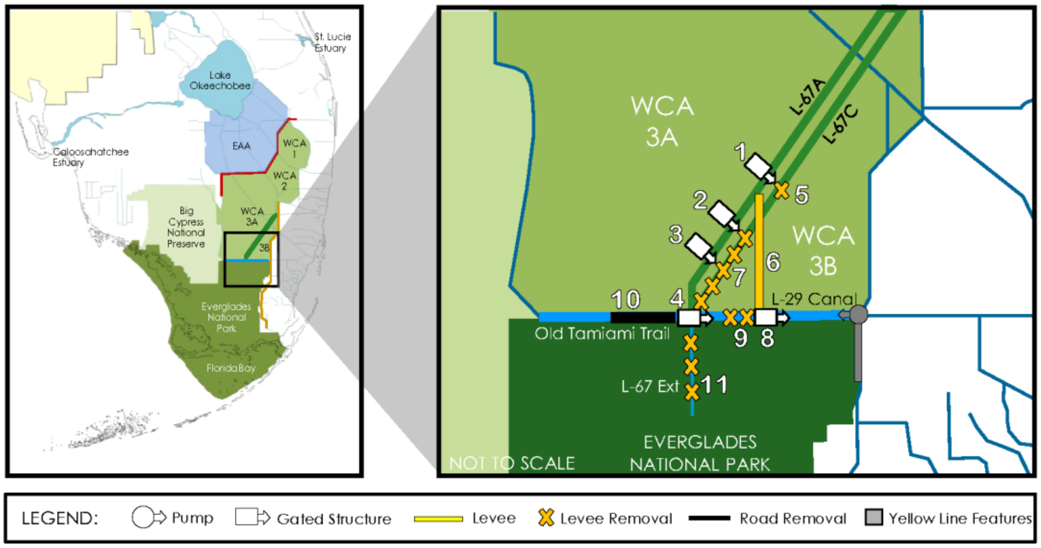
- CSB2027 baseline scenario attempts to model future projected hydrologic conditions associated with a time frame circa 2027 and includes, relative to existing conditions, additional representations of planned future project activities, including state, federal and CERP projects.
- Alternatives B1, B2 and B3 are all defined with a common set of CEPP South infrastructure and differing operational strategies for flows along the L67 and Tamiami Trail as follows:

- ALTB1 attempts to mimic the operational intent of the original, as authorized, complete CEPP plan including Rainfall Driven Operations (RDO) as defined in the 2012 plan.
- ALTB2 explores whether the operational intent of the COP effort including the Tamimi Trail Flow Formula (TTFF) could be leveraged to operate the CEPP-South infrastructure.
- ALTB3 provided an opportunity to explore a new RDO scheme specific to CEPP-South.

Model Limitations and Intended Use of Results

The primary modeling products of CEPP-South were evaluated based on outputs from the Regional Simulation Model (RSM (**SFWMD, 2005a** and **2005b**). The RSM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g., use available input-driven options to represent more complex project operations). The RSMBN (**SFWMD et al., 2009a,b,c,d**) and RSMGL (**SFWMD, 2010** and **2011**) models were reviewed through the USACE validation process for engineering software, as part of the CEPP project. The RSM models were classified as “allowed for use” for South Florida applications in August 2012. The MDRSM model development and model calibration were completed by SFWMD in April 2018 (**Arteaga et al., 2018**), and the model calibration was subsequently independently reviewed by both the IMC and through the USACE Agency Technical Review.

BLUE AND GREEN LINES
DISTRIBUTION AND CONVEYANCE



#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-631	Gated Culvert	500	Delivers water from WCA 3A to 3B, east of L-67D Levee
2	S-632	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
3	S-633	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
4	S-333 (N)	Gated Spillway w/new canal	1150	Delivers water from L-67A Canal to L-29 Canal; supplements existing S-333 gated spillway
5		L-67C Levee Removal Gap		Gap, ~ 6000 feet (corresponding to S-631)
6	L-67D	Blue Shanty Levee		Levee, ~ 8.5 miles, connecting from L-67A to L-29 (6 feet high, 14-foot crest width, 3:1 side slopes)
7		L-67C Levee Removal		Complete removal of ~ 8 miles from New Blue Shanty Levee (L-67D)south to intersection of L-67A/L-67C; L-67C canal is not backfilled
8	S-355W	Gated Spillway	1230	Maintains water deliveries to eastern L-29 Canal
9		Levee Removal (L-29)		Removal of ~ 4.3 miles between L-67A and Blue Shanty Levee intersection with L-29 Levee
10		Removal of remnants of Old Tamiami Trail roadway		Removal of ~ 6 miles of roadway west of L-67 Extension
11		L-67 Extension Levee Removal and Canal Backfill)		Complete removal of ~ 5.5 miles of remaining L-67 Extension, including S-346 culvert
12		L-356 Pump Station Modifications	1,000	Increases pump capacity

Figure 2.1. CEPP-South project features.

3.0 Simulation

Modeling Tools Used

RSM Version "mpi_upgrade_5613" was used to run the MDRSM model.
Release date 4/01/2020, SVN version #5613

Model Set Up

The CEPP-South scenarios were developed using the MDRSM model as shown in **Figure 3.1**. The MDRSM modeling was updated from previously performed regional modeling in support of the USACE's Combined Operational Plan (COP) (**USACE, 2020b,c**), specifically Alternative Qm as modeled by MDRSM (consistent with the May 30, 2019 release of model data). The MDRSM simulates three individual water years (May-Apr) that are representative of a broad range of hydrologic conditions for south Florida: a) wet year 2005-2006, b) average year 2006-2007, and c) dry year 2010-2011. In all CEPP-South MDRSM scenarios, the Everglades boundary conditions were kept consistent with those defined by the "IMC-extended" RSMGL as used in COP ALTQm. Although this does not fully reflect the project planning conditions in the northern part of the system, this simplifying assumption is conservative from a "flood assessment" perspective and is not expected to affect the necessary evaluations intended with the MDRSM. This assumption will also facilitate more direct comparisons of the CEPP-South efforts to previous COP conclusions.

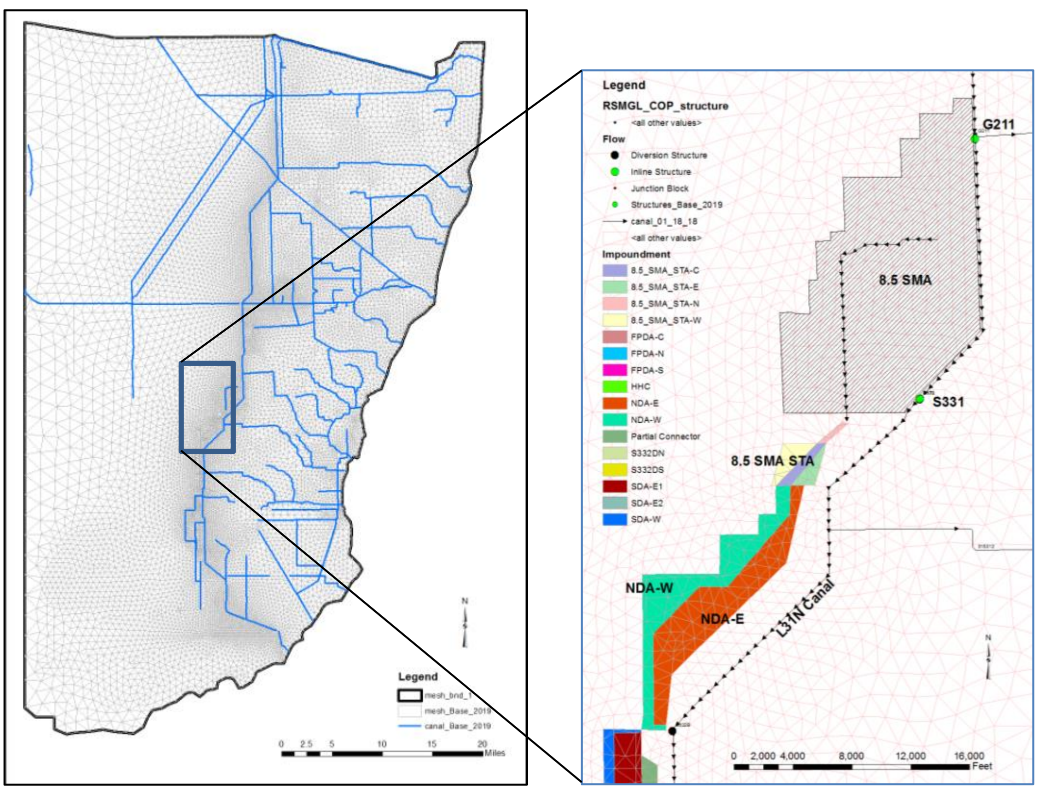


Figure 3.1. CEPP-South MDRSM Model Boundary (Left) and Inset of Detailed Features (Right).

MDRSM CEPP-South Baseline 2027 (CSB2027) Scenario

In order to represent the assumed 2027 conditions, the following updates were made to the MDRSM as follows:

- The Broward County Water Preserve Areas (BWPAs) C-11 Impoundment modeled as an above ground reservoir with area of 1850 acres and maximum depth of 3.23 ft. RSM representation of operations were adjusted to reflect the MDRSM depth regimes, but were operationally consistent with the Interim Goals and Targets modeling (**SFWMD and IMC, 2019a)** and attempt to represent project intent and outcomes consistent with the 2012 BWPA Project Implementation Report (**USACE and SFWMD, 2012**).
- Updated S332D to extend allowable discharges of 250 cfs through Dec 31st, consistent with COP (**USACE, 2020c**) "Alternative Q+" or ALTQ+.
- Several model enhancements relative to the COP (**USACE, 2020c**) Alternative Qm starting point were made to improve the CEPP-South MDRSM modeling including:
    - Mesh realignment to match model nodes with the geographical location of the Blue Shanty project features in WCA3B. This allows the model to best represent the feature while maintaining a consistent mesh for comparison between baseline and alternative scenarios.
    - Additional error trapping added to the source code to avoid duplicate structure operations being specified in the input.
    - The Water Conservation Area 3A special assessor code was quality checked and corrected the unit conversion (relative to COP version of this code) affected the Tamiami Trail operational targets (greatest effects at S12A and S12B).
    - The gate opening rates were refined across the system to enhance stability and reduce operational oscillations.

Infrastructure Updates Common to all MDRSM CEPP-South Alternatives

In order to represent the CEPP-South project features, changes as listed below were made to the MDRSM CSB2027 to develop the alternative scenarios. All alternatives utilized the same assumptions for infrastructure and many relevant project features are illustrated in **Figure 3.2.** Operations were varied across the alternative as described in subsequent sections. Locations and other detail for representing project features in the model were identified based on reference to preliminary project design drawings provided by the project team and included in **Appendix A**.

- Structure S152 capacity set to zero.
- Added the Blue Shanty (L67D) levee (from L67A to L29).
- Added S631, S632 and S633 structures, each with 500 cfs design capacity. S631 is subject to the Site71 tailwater constraint and S632 and S633 are subject to the L29 west tailwater constraints.
- L67C levee removed south and west of the Blue Shanty levee. 6000' L67C levee gap north and east of the Blue Shanty levee to convey flows from S631.
- Removed L29 levee between S333 and Blue Shanty levee.

- Added L29 divide structure (S355W) in L29 canal near terminus of Blue Shanty levee. The structure acts as a water supply structure attempting to maintain 7.0’ in the eastern reach.
- The same L29 constraint to S333/S333N/S356 was applied as follows: 8.5’ for Jan and Oct-Dec and 8.25’ for Feb-Sep.
- Increased S356 pump capacity to 1000 cfs.
- Removed the L67ext canal and levee.
- Incorporated S333N into CEPP-South alternative operational calculations. S333N is no longer constrained by DEP permit.

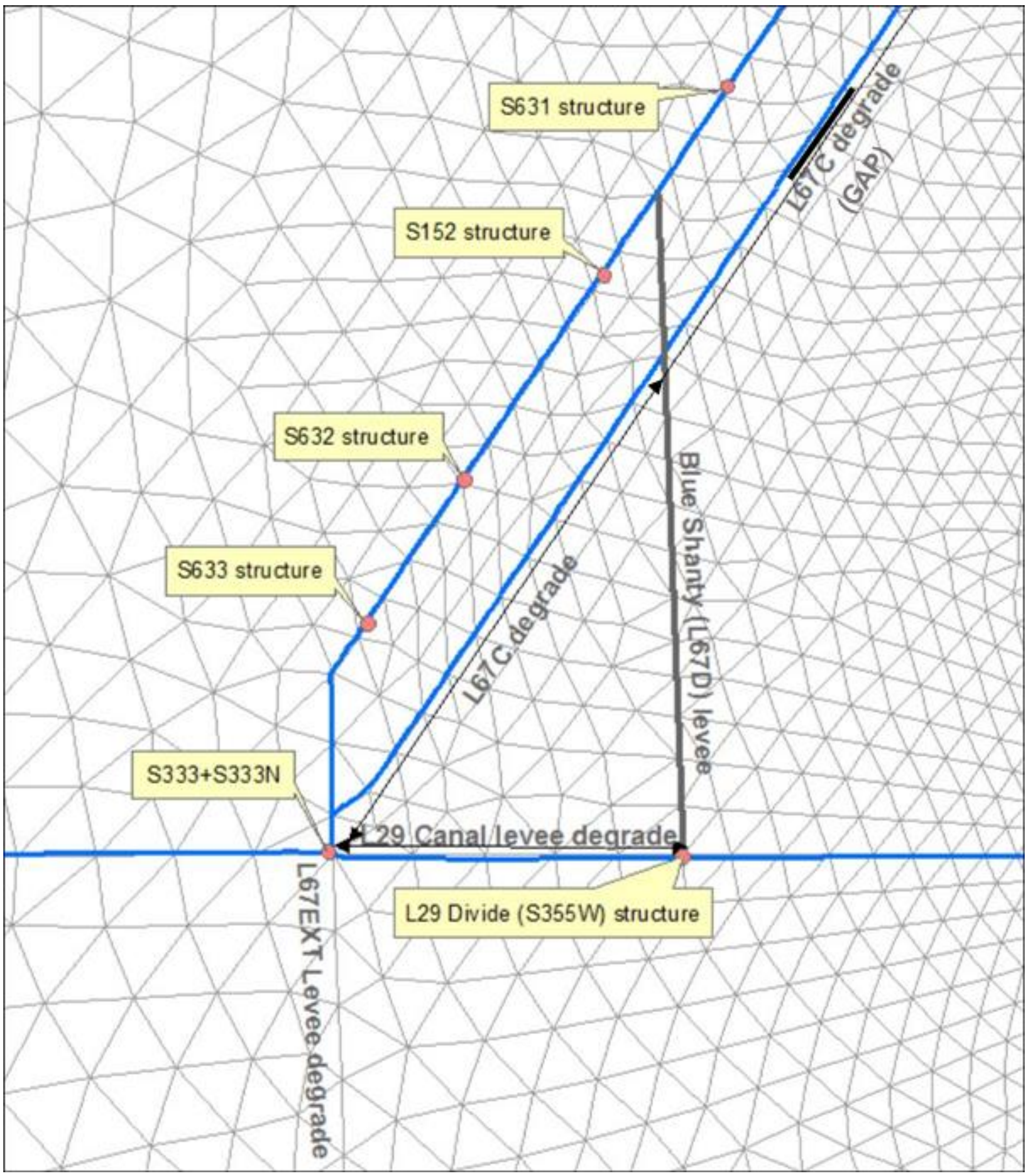


Figure 3.2: Modeling details for MDRSM representation of select CEPP-South project features.

<u>MDRSM CEPP-South Alternative B1 (ALTB1) Scenario</u>

ALTB1 attempts to mimic the operational intent of the original, as authorized, complete CEPP plan and as such, it utilizes the RDO logic used in the previous CEPP modeling and informed by iModel optimization from the original CEPP effort in 2012 (**SFWMD and IMC, 2014d**). For MDRSM modeling purposes, these operations were represented by modifying the regulation schedule and WCA special assessor as originally simulated in the COP ECB19RR scenario. Specifically, operational target time-series consistent with the RSMGL CEPP-South ALTB1 (and CEPP ALT42) scenario were used to replace the rainfall plan target of the 2012 ERTP (**USACE, 2011)** schedule (**Figure 3.3**) as well as to set targets for S631, S632 and S633. S333 and S333N were independently modeled with S333 having initial priority and the S12's delivering the remainder of the schedule discharges in east to west priority. Since the corresponding RSMGL datasets were only simulated through rainfall year 2005, "MDRSM-extended" operational target inputs were estimated for the 2006-2011 timeframe by independently emulating the rainfall to operational target-timeseries relationship observed in the ALTB1 RSMGL input datasets.

<u>MDRSM CEPP-South Alternative B2 (ALTB2) Scenario</u>

ALTB2 explores whether the operational intent of the COP effort could be leveraged to operate the CEPP-South infrastructure and as such, it utilizes the COP operations consistent with Alternative Q (**USACE, 2020c**), including the TTFF, but redistributes the target flow to both the Blue Shanty (S632 and S633) and Tamiami Trail (S333, S333N and S12's).

- ALTB2 operations per COP ALTQ (schedule with only Zone A and TTFF); the TTFF target flows are calculated the same but spatially distributed as follows:
    - 1st priority = 25% TTFF target to S632 subject to structure capacity
    - 2nd priority = 25% TTFF target to S633 subject to structure capacity
    - Remaining TTFF target volume sent in priority / available capacity order from east to west to S333, S333N and the S12's.
- S631 is operated per the S152 criteria from the CSB2027 & COP ALTQ.

<u>MDRSM CEPP-South Alternative B3 (ALTB3) Scenario</u>

ALTB3 provided an opportunity to explore a new RDO scheme specific to CEPP-South and leveraging the latest ecological targets available as described in detail for the RSMGL ALTB3 development (**IMC, 2020a**). Mechanistically, ALTB3 is modeled exactly the same as ALTB1 but uses different "MDRSM-extended" iModel optimization outcomes (flow target time-series). As in ALTB1 process, these targets were estimated for the 2006-2011 timeframe by independently emulating the rainfall to operational target-timeseries relationship observed in the ALTB3 RSMGL input datasets. As in ALTB1, these targets and the WCA3A regulation schedule defined operations for S631, S632, S633, S333, S333N and the S12's.

4.0 Results

Final CEPP-South modeling products were distributed to the project team using the SFWMD's secure FTP location for. Since files are not permanently retained in the FTP location, all posted model outcomes will be archived into the Statewide Model Management System (SMMS) which can be accessed through the system's main interface at:

https://www.sfwmd.gov/science-data/mms

or directly via:

https://apps.sfwmd.gov/smmsviewer/

Project files can be identified in the system using the "Project" tab and selecting CEPP-South from the available dropdown.

While the CEPP-South modeling products have been archived in the above systems, **Table 4.1** below lists more specific information including model version, inputs used and detailed archival location. Version numbers and "svnroot" paths refer to a model version control system found on the SFWMD network that is not generally accessible.

Table 4.1 Version information and model file locations for MDRSM

MDRSM CSB2027 04032020	**RSM_mpi_upgrade_5613 and xml v15834**
Input: …svnroot/trunk/rsm_imp_CEPP_South/models/mdrsm/CSB2027/input **Output:** /nw/hesm_nas/projects/CEPP_South/models/mdrsm/040320/mdrsm/CSB2027/output_avg /nw/hesm_nas/projects/CEPP_South/models/mdrsm/040320/mdrsm/CSB2027/output_dry /nw/hesm_nas/projects/CEPP_South/models/mdrsm/040320/mdrsm/CSB2027/output_wet	
MDRSM ALTB1 04032020	**RSM_mpi_upgrade_5613 and xml v15822**
Input: …svnroot/trunk/rsm_imp_CEPP_South/models/mdrsm/ALTB1/input **Output:** /nw/hesm_nas/projects/CEPP_South/models/mdrsm/040320/mdrsm/ALTB1/output_avg /nw/hesm_nas/projects/CEPP_South/models/mdrsm/040320/mdrsm/ALTB1/output_dry /nw/hesm_nas/projects/CEPP_South/models/mdrsm/040320/mdrsm/ALTB1/output_wet	
MDRSM ALTB2 04032020	**RSM_mpi_upgrade_5613 and xml v15834**
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MDRSM ALTB3 04032020	**RSM_mpi_upgrade_5613 and xml v15834**
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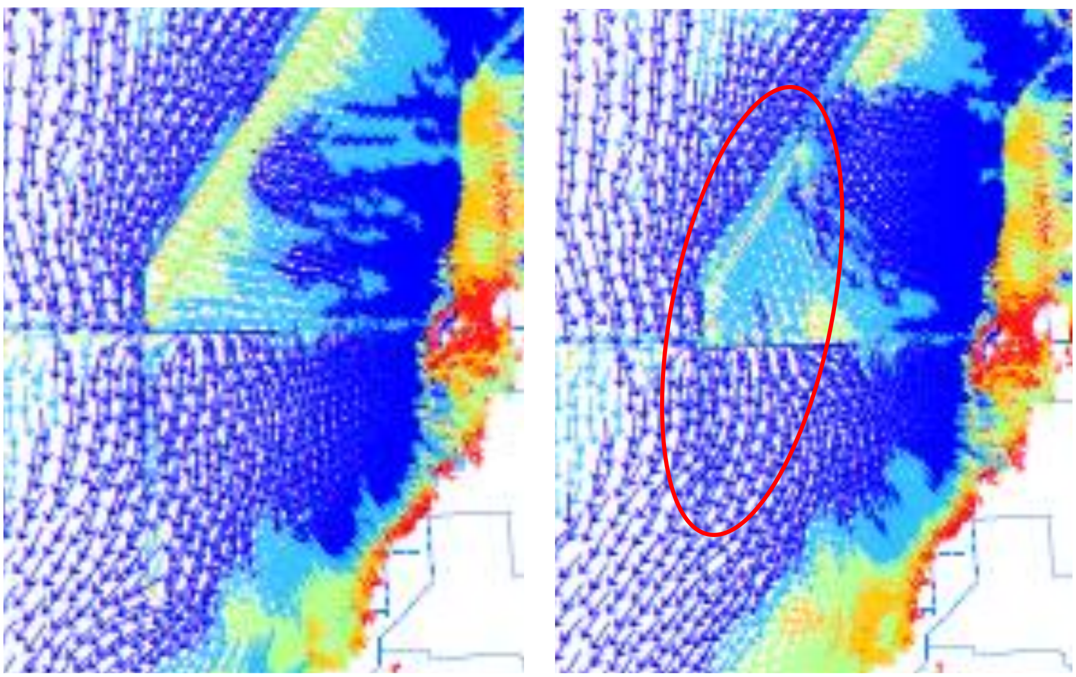
Review of Local and Regional Level Results

The MDRSM modeling scenarios were reviewed from the perspective of ensuring that localized effects of project implementations were observed as expected and that regional performance was considered reasonable. Specific checks on RSM outputs included the following:

- Review of localized modeling stages and flow vectors in the vicinity of the CEPP-South project features indicates that the MDRSM is physically performing as intended with utilization of the Blue Shanty flowway and increased sheetflow where the L67 extension is removed relative to the CSB2027 as evidenced in the highlighted portion of **Figure 4.1**.
- A detailed review of the operational rules for the CEPP South operations indicates that intended operations are being reflected in the modeling. For example, **Figure 4.2** illustrates that for the ALTB1 scenario, the input target RDO flows (shown on the middle graph of the figure) when combined with consideration of Zone A stages (causing flow in the wet season) result in desired gate opening operations (shown on the middle graph of the figure) and resulting flows (shown on the bottom graph of the figure).
- Results of the MDRSM along the L29 were examined in detail and compared with corresponding RSMGL trends as shown in **Figure 4.3**. These comparisons indicate a general agreement between the two models for relative differences between east (S334 headwater) and west (S333 tailwater) portions of the canal in both the baseline and with-project (including the L29 divide) conditions. It was observed that the MDRSM tends to promote slightly more flow out of the Blue Shanty flowway toward central Shark River Slough rather than east toward the ridge and 8.5 Square Mile Area when compared to RSMGL.
- As can be seen in **Figure 4.4**, the effect of the CEPP-South infrastructure and alternative operations can be seen in Northeast Shark River Slough. Due to a limited upstream water budget (no CEPP “new water”) combined with a maximum water level constraint for L29 common to all scenarios, these changes are largely realized as timing shifts and a general lowering of stages later in the dry season in the alternatives. No significant changes in peak stages during the wet season or during storm events were observed in MDRSM, but it is important to note that since the model tends to promote flow to the west out of the Blue Shanty flowway, project outcomes may still be affected by unregulated flow out of the Blue Shanty (due to direct rainfall on the feature) in a manner that the model is not indicating.
- Some of the marginally lower stages in Shark River Slough observed in the alternatives result in a less frequent triggering of high discharge S357 operations and can result in higher groundwater stages within the 8.5 Square Mile Area in the alternatives compared the baseline during storm recovery periods (as shown in **Figure 4.5**). Despite these outcomes, all alternatives generally show reduced peak stages and inundation duration in the 8.5 Square Mile Area as shown in **Figure 4.6**.
- Similar to corresponding RSMGL results and resulting from the limited upstream water budget assumed in CEPP-South (no “new water” component of CEPP), all MDRSM alternatives show reduced stages and flows in the southern portion of the system as the dry season progresses compared to the CSB2027 as shown in **Figures 4.7 and 4.8**. These trends as displayed are somewhat exaggerated in scale due to MDRSM’s simulation of individual water years rather than long-term

simulations. For reference the corresponding COP planning results are provided illustrating that the changes result in similar flows to those observed in the COP ECB19RR scenario as shown in **Figure 4.9**.

In summary, the CEPP-South MDRSM scenarios provided to the project team are deemed to adequately represent the intended planning conditions and provide a reasonable basis of comparison for the necessary evaluations required by the project team.



CSB27 ALTB2

Figure 4.1: Comparison of wet year average annual flow vectors for CSB2027 and ALTB2 illustrating effects of CEPP-South infrastructure updates.

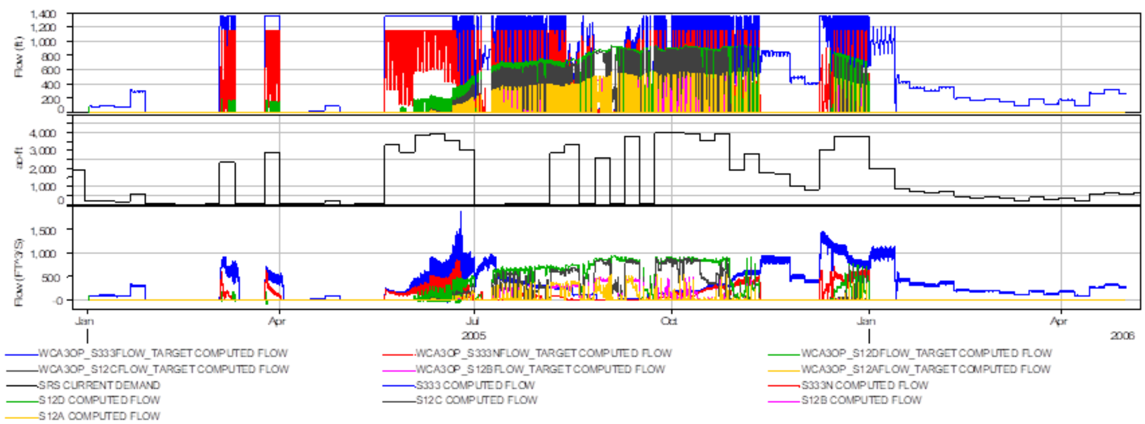


Figure 4.2: Operations details for WCA special assessor for ALTB1.

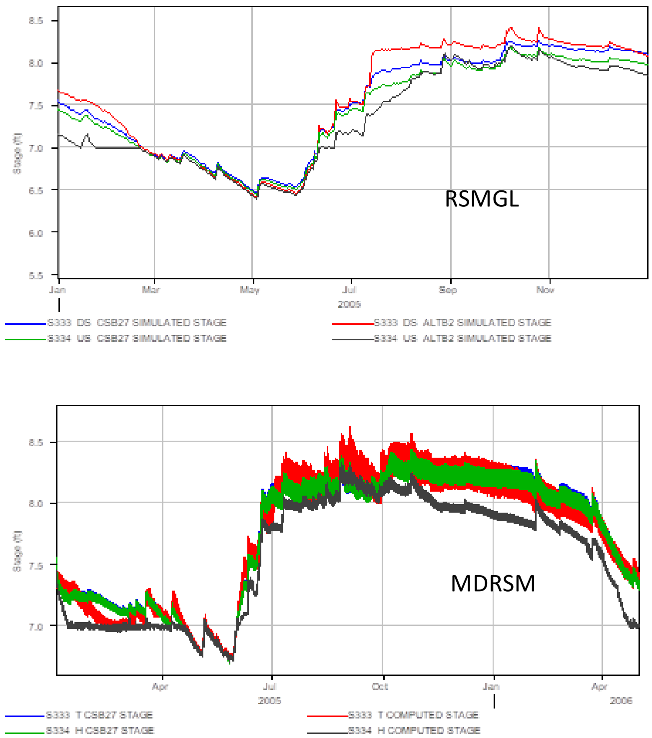


Figure 4.3: Comparison of L29 canal stages between RSMGL and MDRSM (note that MDRSM uses an extended period of simulation).

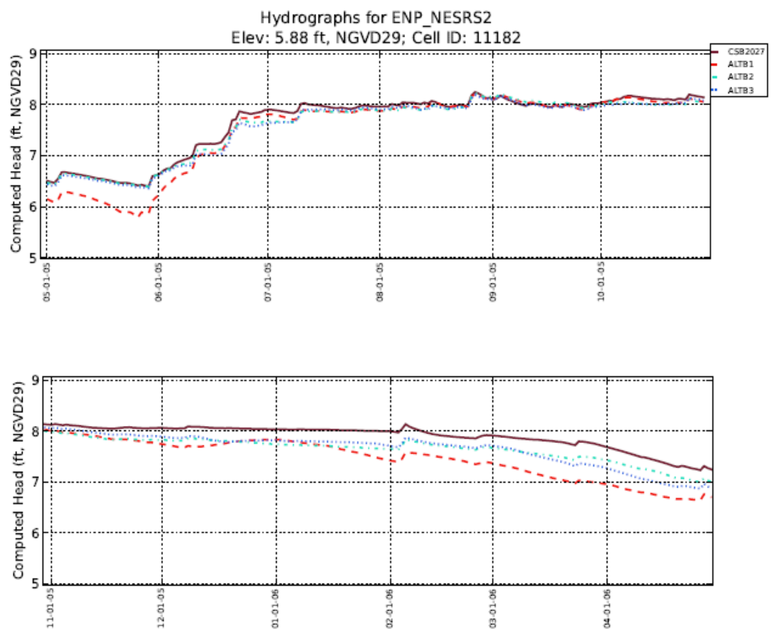


Figure 4.4: Stages in Northeast Shark River Slough of Everglades National Park in CEPP-South, MDRSM.

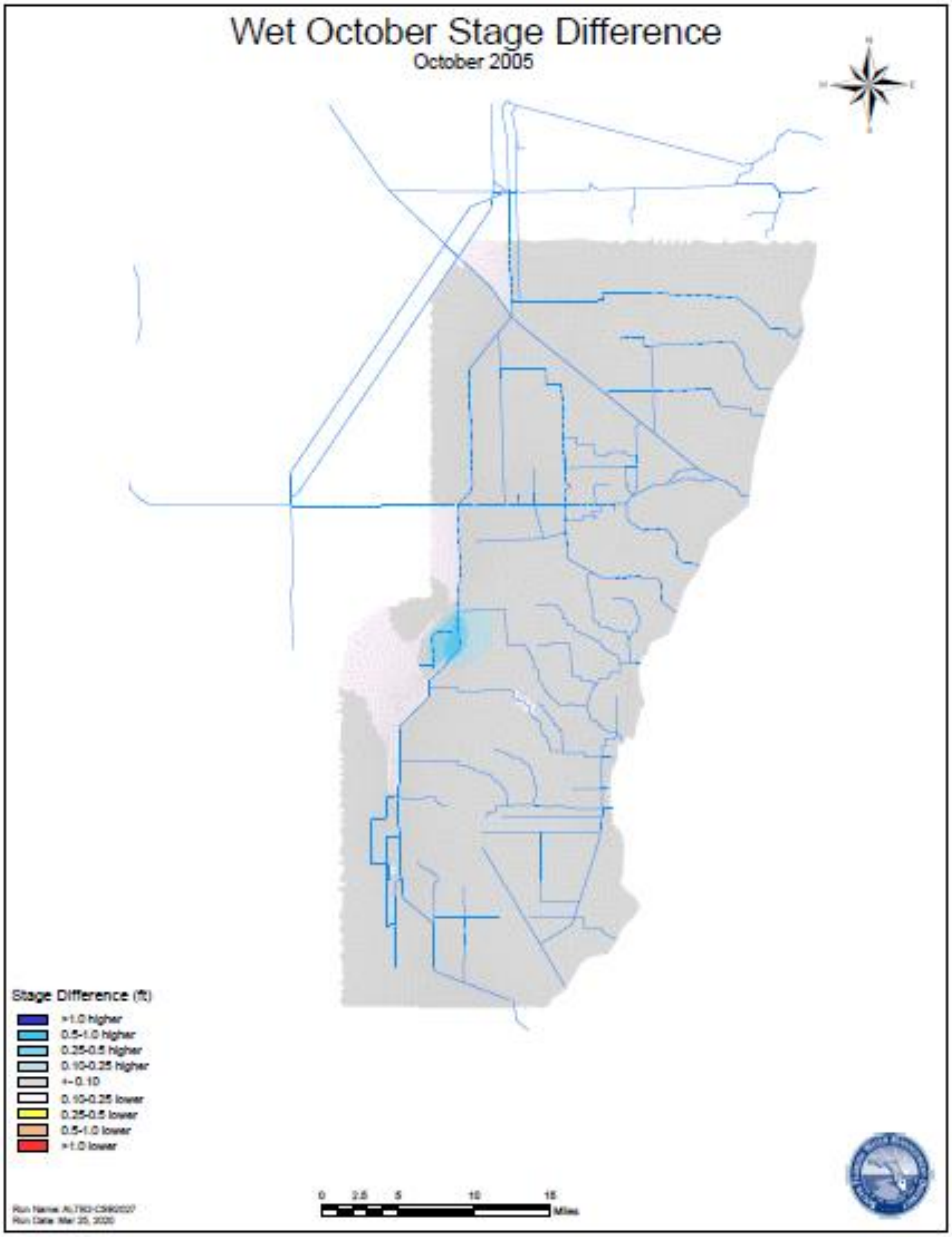


Figure 4.5: Wet year October stage differences ALTB2 minus CSB2027.

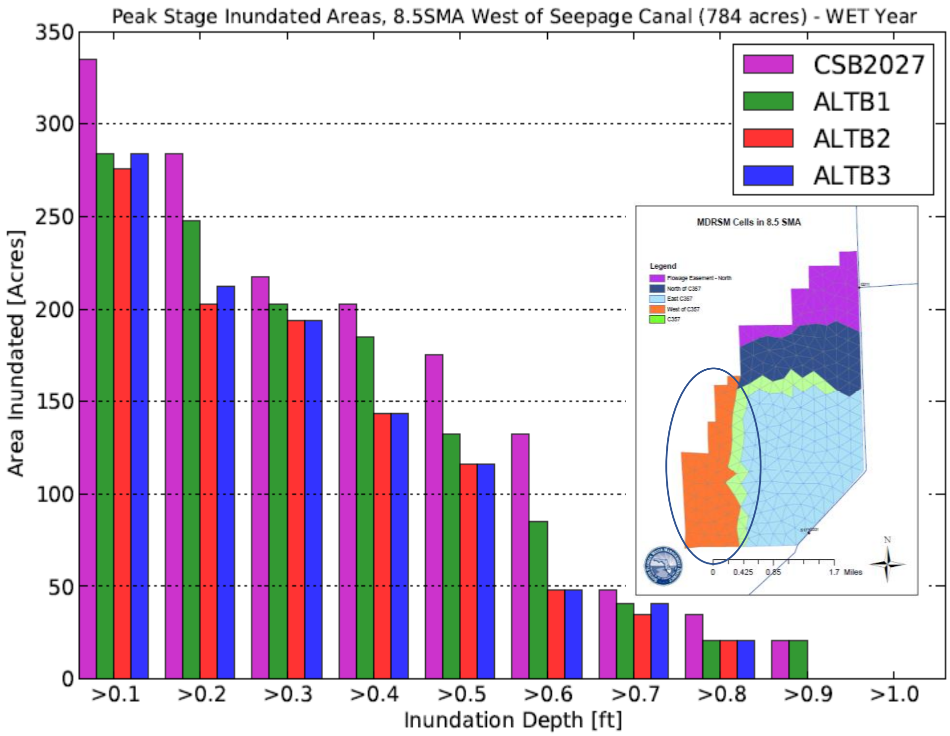


Figure 4.6: 8.5 Square Mile Area inundation in CEPP-South.

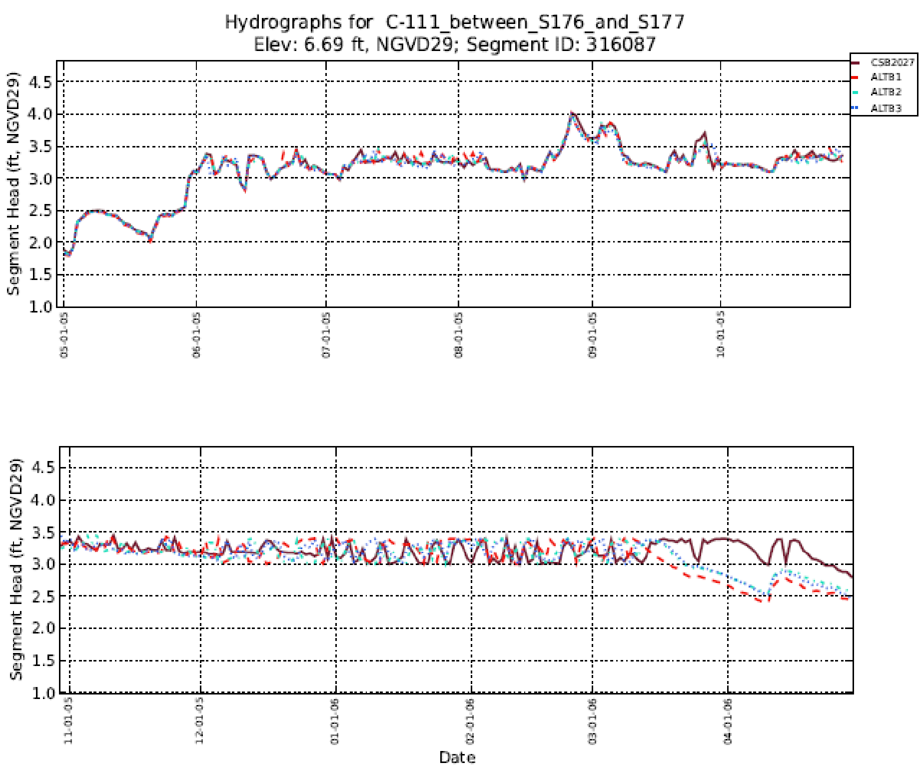


Figure 4.7: C111 Canal stages in CEPP-South, MDRSM.

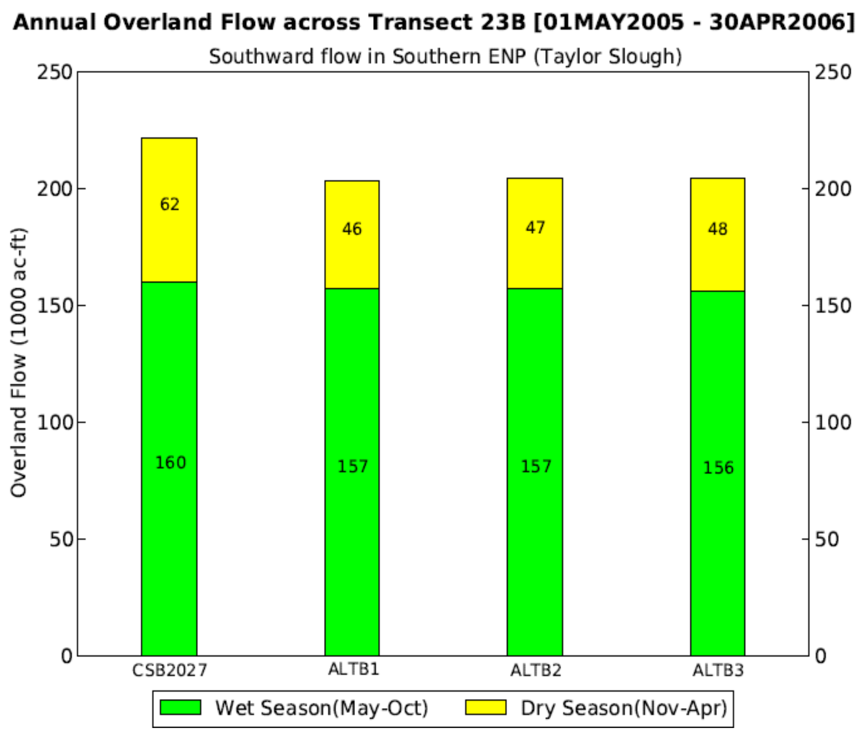


Figure 4.8: Taylor Slough Transect Flows in CEPP-South, MDRSM.

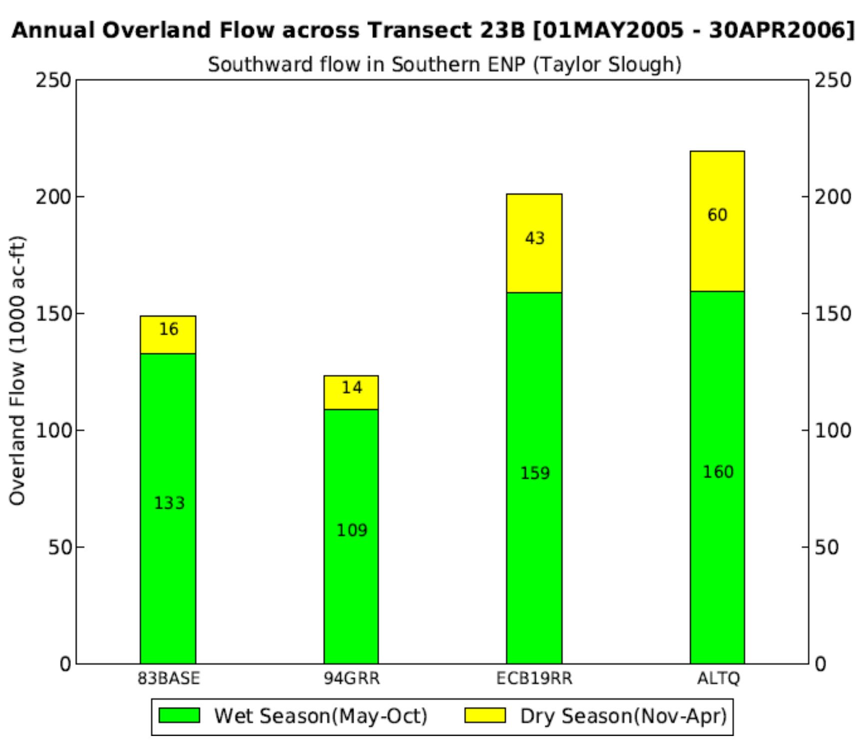


Figure 4.9: Taylor Slough Transect Flows in COP, MDRSM (for reference).

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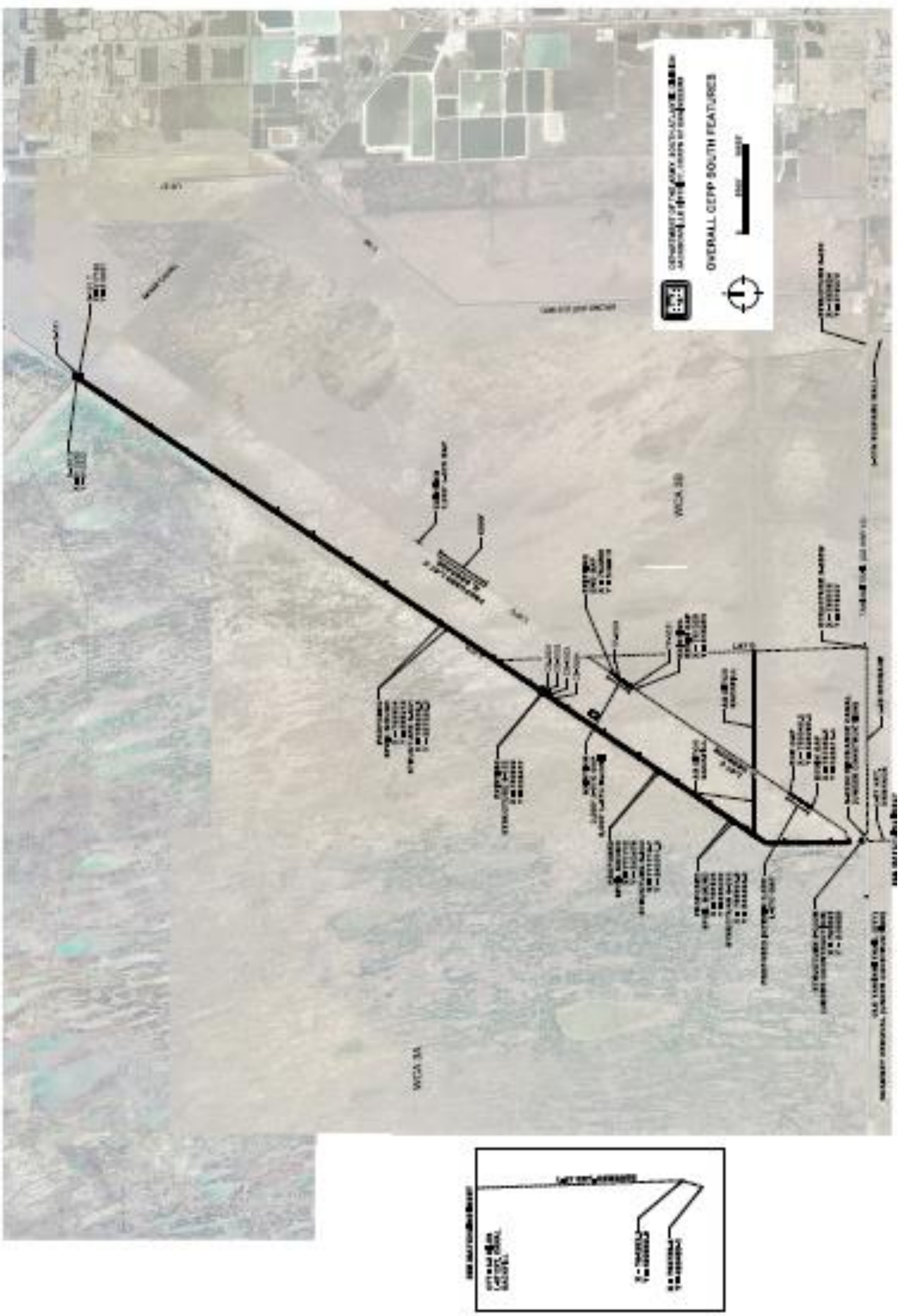
Appendix A – Preliminary Project Design Features Provided by CEPP-South Team



Interagency Modeling Center

Regional Simulation Model Basins (RSMBN)
Table of Assumptions for 2027 Pre-Project Base Conditions
(CSB2027) for CEPP-South DPOM
(Note: same simulation as RECOVER IGIT:
2026 Incremental Run)

Feature	
Climate	• The climatic period of record is from 1965 to 2005 • Rainfall estimates have been revised and updated for 1965-2005 • Revised evapotranspiration methods have been used for 1965-2005
Topography	The Topography dataset for RSM was updated in 2009 using the following datasets: • South Florida Digital Elevation Model, USACE, 2004 • High Accuracy Elevation Data, US Geological Survey 2007 • Loxahatchee River LiDAR Study, Dewberry and Davis, 2004 • St. Lucie North Fork LiDAR, Dewberry and Davis, 2007 • Palm Beach County LiDAR Survey, Dewberry and Davis, 2004 Stormwater Treatment Area stage-storage-area relationships from G. Goforth spreadsheets.
Land Use	• Lake Okeechobee Service Area (LOSA) Basins were updated using consumptive use permit information as of November 2016, as reflected in the LOSA Ledger produced by the SFWMD Water Use Bureau • C-43 Groundwater irrigated basins – Permitted as of 2010, the dataset was updated using land use, aerial imagery and 2010 consumptive use permit information • Dominant land use in EAA is sugar cane other land uses consist of shrub land, wet land, ridge and slough, and sawgrass
LOSA Basins	• Lower Istokpoga, North Lake Shore and Northeast Lake Shore demands and runoff estimated using the AFSIRS model and assumed permitted land use (see land use assumptions row).

Lake Okeechobee	• Lake Okeechobee Regulation Schedule 2008 (LORS 2008)
	  o Includes Lake Okeechobee regulatory releases to tide via L8/C51 canals
	  o Lake Okeechobee regulatory releases limited to 1,550 cfs for Miami Canal and 1,350 cfs for North New River Canal based on studies performed by USACE (2014).
	  o A regional hydrologic surrogate for the 2010 Adaptive Protocol operations utilized. This attempts to mimic desired timing of releases without estimating salinity criteria
	• Lake Okeechobee Water Shortage Management (LOWSM) Plan
	• Interim Action Plan (IAP) for Lake Okeechobee (under which backpumping to the lake at S-2 and S-3 is to be minimized)
	• “Temporary” forward pumps as follows:
	  o S354 – 400 cfs
	  o S351 – 600 cfs

Feature	
Lake Okeechobee (cont.)	○ S352 – 400 cfs ○ All pumps reduce to the above capacities when Lake Okeechobee stage falls below 10.2 ft and turn off when stages recover to greater than 11.2 ft. • No reduction in EAA runoff associated with the implementation of Best Management Practices (BMPs); No BMP makeup water deliveries to the WCAs • Operational intent is to treat LOK regulatory releases to the south through STA-3/4 and A1 FEB (online as of July 2015). • Backpumping of 298 Districts and 715 Farms into lake minimized
Northern Lake Okeechobee Watershed Inflows	• Headwaters Revitalization schedule (in addition for stages up to 54 FT, the flows are ramped up to 11000 CFS) for Kissimmee Chain of Lakes using the UKISS model. • Kissimmee River Restoration (Contracts 2B2, 10, 12a) complete. • Fisheating Creek, Istokpoga & Taylor Creek / Nubbin Slough Basin Inflows calculated from historical runoff estimates.
Caloosahatchee River Basin	• Caloosahatchee River Basin irrigation demands and runoff estimated using the AFSIRS model and assumed permitted land use as of February 2012. (see land use assumptions row) • Public water supply daily intake from the river is included in the analysis. • Maximum reservoir height of 41.7 ft NGVD with a 9,379-acre footprint in Western C43 basin with a 175,800 acre-feet effective storage. • Proposed reservoir meets estuary demands while C-43 basin supplemental demands for surface water irrigation are met by Lake Okeechobee.
St. Lucie Canal Basin	• St. Lucie Canal Basin demands estimated using the AFSIRS model and assumed permitted land use as of February 2012 (see land use assumptions row). • Excess C-44 basin runoff is allowed to backflow into the Lake if lake stage is below 14.5 ft before being pumped into the C-44 reservoir. • Basin demands include the Florida Power & Light reservoir at Indiantown. • Indian River Lagoon South Project features ○ As-built Ten-mile Creek Reservoir and STA: 2,368 acre-feet maximum storage capacity at 4 ft maximum operating depth on 658 acre effective footprint (2 ft maximum depth on STA); receives excess water from North Folk Basin; operations per TMC Preliminary Operating Plan (SFWMD, June 2015). ○ C-44 reservoir: 50,246 acre-feet storage capacity at 5.18 feet maximum depth on 12,125 acre (9,700 effective acres – 80%) footprint; C44 reservoir releases water back to Lake Okeechobee when Lake stages are below the bottom of the Baseflow Zone. ○ C-23/C-24 reservoir: 24,648 acre-feet storage capacity at 12 ft maximum depth on 2,568 acre (2054 effective acres – 80%) footprint. 60% of the original 2004 IRL-S PIR Footprint for North

<table>
<tr><th>Feature</th><th></th></tr>
<tr><td>St. Lucie Canal Basin (cont.)</td><td>Reservoir footprint, per RECOVER guidance (February 2019) for 2025-2026 Interim Goals and Interim Targets scenario.
o C-23/C-24 STA: 1793 acre-feet storage capacity at 1.5 maximum depth on 1494 acre (1195 effective acres – 80%) footprint, per RECOVER guidance (February 2019) for 2025-2026 Interim Goals and Interim Targets scenario.
o All proposed reservoirs meet estuary demands.
o IRL operations assumed are consistent with the March 2010 St. Lucie River Water Reservation Rule update.
• Excess C23 basin water not needed to meet estuary demands can be diverted to the C44 reservoir if capacity exists.
• C44 reservoir can discharge to C44 canal and backflow to Lake Okeechobee when the lake is below the Baseflow zone.
o The C-44 excess basin runoff can be pumped to C44 Reservoir when:
▪ LOK stage is above 14.5’ or
▪ LOK stage is less than or equal to 14.5’ and S308 is making Regulatory Releases.
o The C-44 Reservoir water can be discharged to:
▪ a) estuary (to meet estuary target),
▪ b) water supply to the C44 basin when there is a basin demand,
▪ c) flood control to LOK (S308) and S80 (only under extreme C44 Reservoir high stage levels).</td></tr>
<tr><td>Seminole Brighton Reservation</td><td>• Brighton reservation demands were estimated using AFSIRS method based on existing planted acreage.
• The 2-in-10 demand set forth in the Seminole Compact Work plan equals 2,262 MGM (million gallons per month). AFSIRS modeled 2-in-10 demands equaled 2,383 MGM.
• While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per Table 7, Agreement 41-21 (Nov. 1992), tribal rights to these quantities are preserved.
• LOWSM applies to this agreement.</td></tr>
<tr><td>Seminole Big Cypress Reservation</td><td>• Big Cypress Reservation irrigation demands and runoff were estimated using the AFSIRS method based on existing planted acreage.
• The 2-in-10 demand set forth in the Seminole Compact Work Plan equals 2,606 MGM.
• AFSIRS modeled 2-in-10 demands equaled 2,659 MGM.
• While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per the District’s Final Order and Tribe’s Resolution establishing the Big Cypress Reservation entitlement, tribal rights to these quantities are preserved.
• LOWSM applies to this agreement.</td></tr>
</table>

Feature	
Seminole Big Cypress Reservation (cont.)	
Everglades Agricultural Area	• Model water-body components as shown in Figure 2. • Simulated runoff from the North New River – Hillsboro basin apportioned based on the relative size of contributing basins via S7 route vs. S6 route. • G-341 routes water from S-5A Basin to Hillsboro Basin. • RSMBN CSB2027 EAA runoff and irrigation demand compared to SFWMM ECB simulated runoff and demand from 1965-2005 for reasonability.
Everglades Construction Project Stormwater Treatment Areas	• STAs are simulated as single waterbodies • STA-1E: 6,546 acres total area • STA-1W: 7,488 acres total area • S-5A Basin runoff is to be treated in STA-1W first and when conveyance capacities are exceeded, rerouted to STA-1E • STA-2: cells 1,2 & 3: 7,681 acres total area • STA-2N: cells 4,5 & 6; refers to Comp B-North; 6,531 acres total area • STA-2S: cells 7 & 8; refers to Comp B-South; 3,570 acres total area • STA-3/4: 17,126 acres total area • STA-5N: includes cells 1 & 2: 5,081 acres total area • STA-5S: includes cells 3, 4 & 5; uses footprint of Compartment C: 8,469 acres total area • STA-6: expanded with phase 2: 3,054 acres total area • Assumed operations of STAs: o 0.5 ft minimum depth below which supply from external sources is triggered; o 4 ft maximum depth above which inflows are discontinued; and o Inflow targets established for STA-3/4, STA-2N and STA-2S based on DMSTA simulation; met from local basin runoff, LOK regulatory discharge and available A1-FEB storage. o STA-3/4, STA-2N and STA-2S receive Lake Okeechobee regulation target releases approximately at 60,000 acre-feet annual average for the entire period of record.

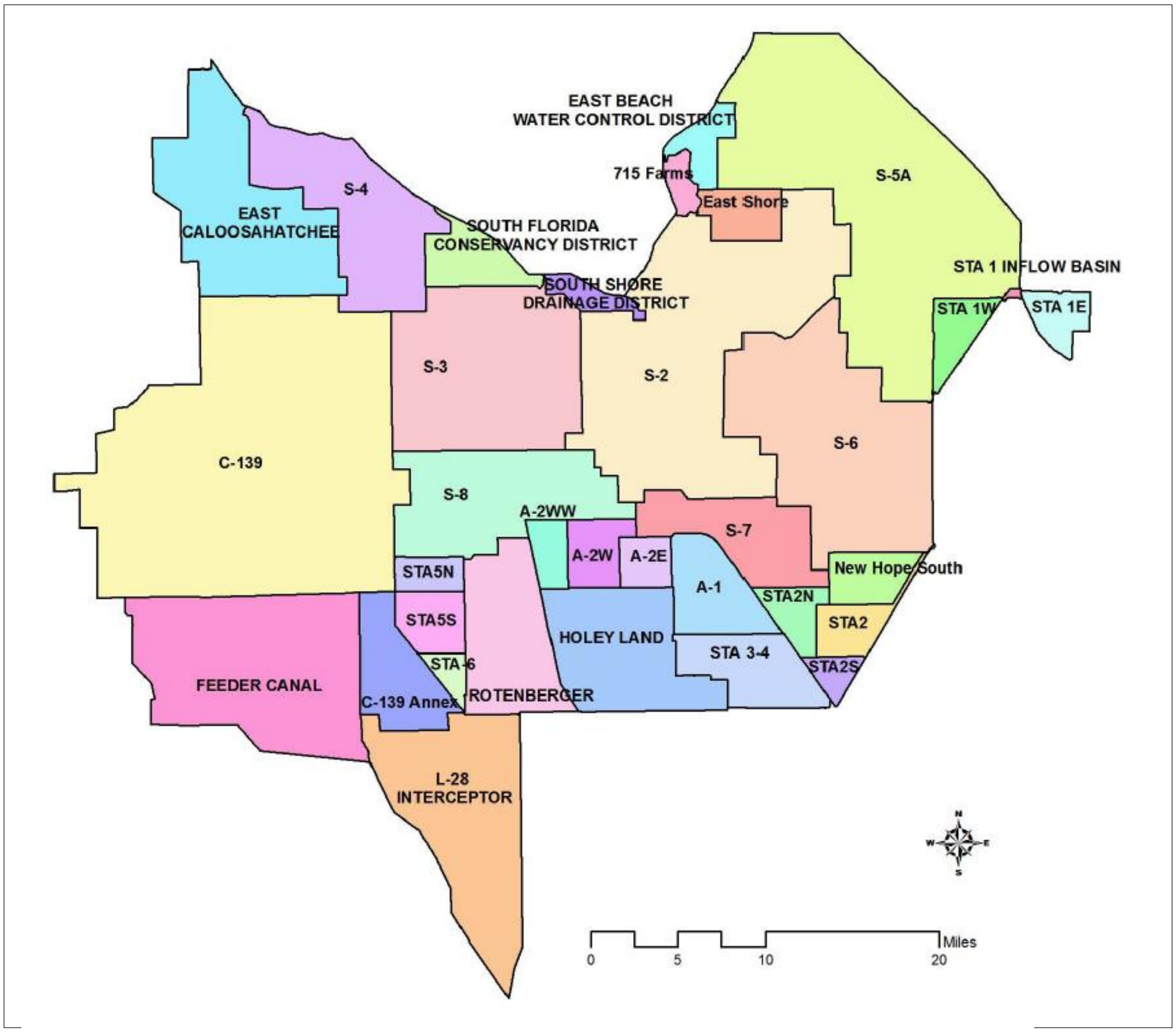
Feature	
Everglades Construction Project Stormwater Treatment Areas (cont.)	• A 15,853-acre Flow Equalization Basin (A1-FEB) located north of STA-3/4 with assumed operations as follows: o FEB inflows are from excess EAA basin runoff above the established inflow targets at STA-3/4, STA-2N, and STA-2S, and from LOK flood releases south. o FEB outflows are used to help meet established inflow targets (as estimated using the Dynamic Model for Stormwater Treatment Areas) at STA-3/4, STA-2N, and STA-2S if EAA basin runoff and LOK regulatory discharge are not sufficient. o No supplemental water supply provided to FEB; 0.5 ft minimum depth below which no releases are allowed o 3.8 ft maximum depth above which inflows are discontinued o Assumed inlet pump from STA-3/4 supply canal to FEB with capacity equal to combined capacity of G-372 and G-370 structures. o Outflow weir, with similar discharge characteristics as STA-3/4 outlet structure, discharging into lower North New River canal. Structure capacities and water quality operating rules are consistent with modeling assumptions assumed during the A-1 FEB EIS application process.
Holey Land Wildlife Management Area	• G200 inflow structure, total of 300 cfs, operated to send lower Miami canal water into Holey Land. • G-372HL inflow structure for fire protection used for keeping the water table from going lower than half a foot below land surface elevation. • Operations are per the Holey Land Wildlife Management Area Draft Project Operations Manual (SFWMD, October 2015)
Rotenberger Wildlife Management Area	• Operational Schedule as defined in the Operation Plan for Rotenberger WMA (SFWMD, March 2010)
Public Water Supply and Irrigation	• Regional water supply demands to maintain Lower East Coast canals as simulated from RSMGL CSB2027.
Western Basins	• C139 basin runoff is modeled as follows: G136 flows is routed to Miami Canal; G342A-D flows routed to STA5N; G508 flows routed to STA5S; G406 flows routed to STA6. • C139 basin demand is met primarily by local groundwater. • C139 Annex flows routed to L28. •
Water Shortage Rules	• Reflects the existing water shortage policies as in South Florida Water Management District Chapters 40E-21 and 40E-22, FAC, including Lake Okeechobee Water Shortage Management Plan (LOWSM).

Notes:

- The RSM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g. use available input-driven options to represent more complex project operations).

- The boundary conditions along the eastern and southern boundaries of the RSMBN model were provided from either the South Florida Water Management Model (SFWMM) or the RSM Glades-LECSA Model (RSMGL). The SFWMM was the source of the eastern boundary groundwater/surface water flows, while the RSMGL was the source of the southern boundary structural flows.

- Use RSM code version "EAA_reservoir_5493" *{see 11/19/19 email from Raul}*



Water-Body Components:
Miami Water-Body = S3 + S8 + A-2WW
NNR/HILLS Water-Body = S2 + S6 + S7 + New Hope South
WPB Water-Body = S-5A
A-1FEB = A-1

Figure 1. RSMBSN Basin Definition within the EAA for CSB2027

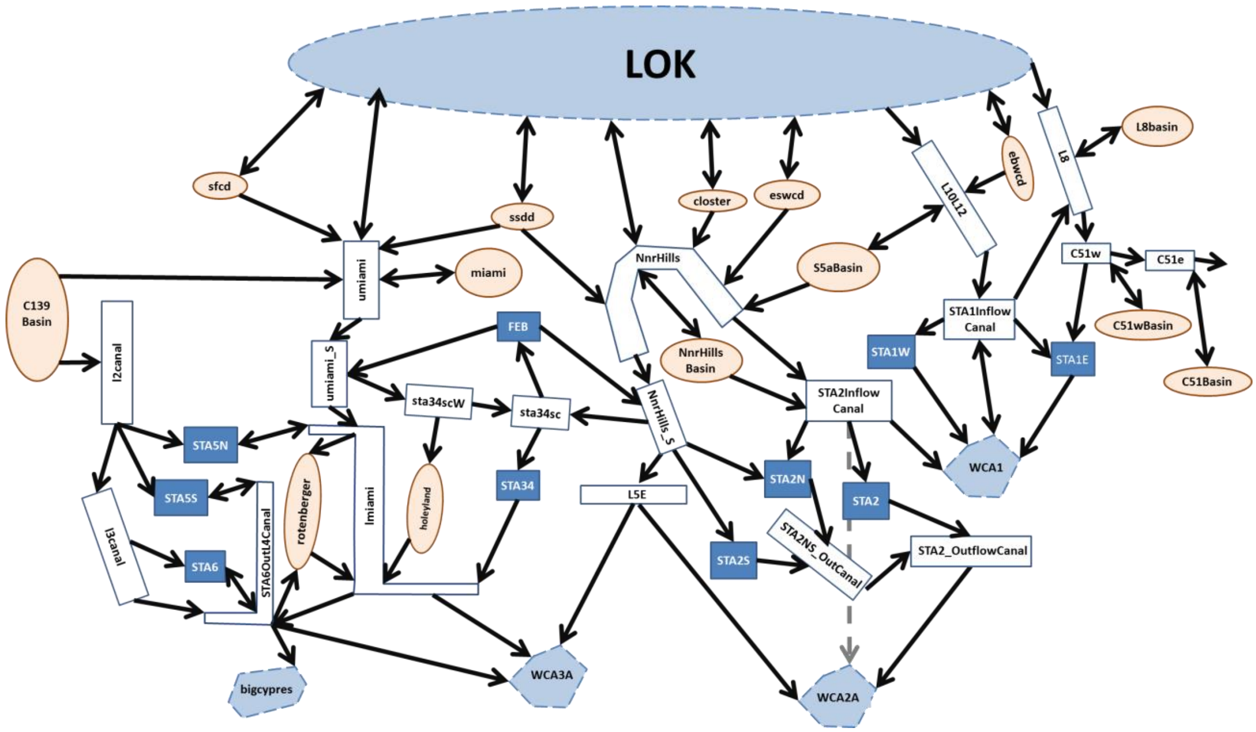


Figure 2 RSMBSN Link-Node Routing Diagram for CSB2027

APPENDIX E
HYDRAULICS & HYDROLOGY

ANNEX 2
SUPPLEMENTAL HYDROLOGIC MODELING RESULTS, RSM-GL AND MD-RSM

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H-7 SUPPLEMENTAL HYDROLOGIC MODELING RESULTS

H-7.1 REGIONAL SIMULATION MODEL FOR EVERGLADES AND LOWER EAST COAST SERVICE AREAS (RSM-GL)

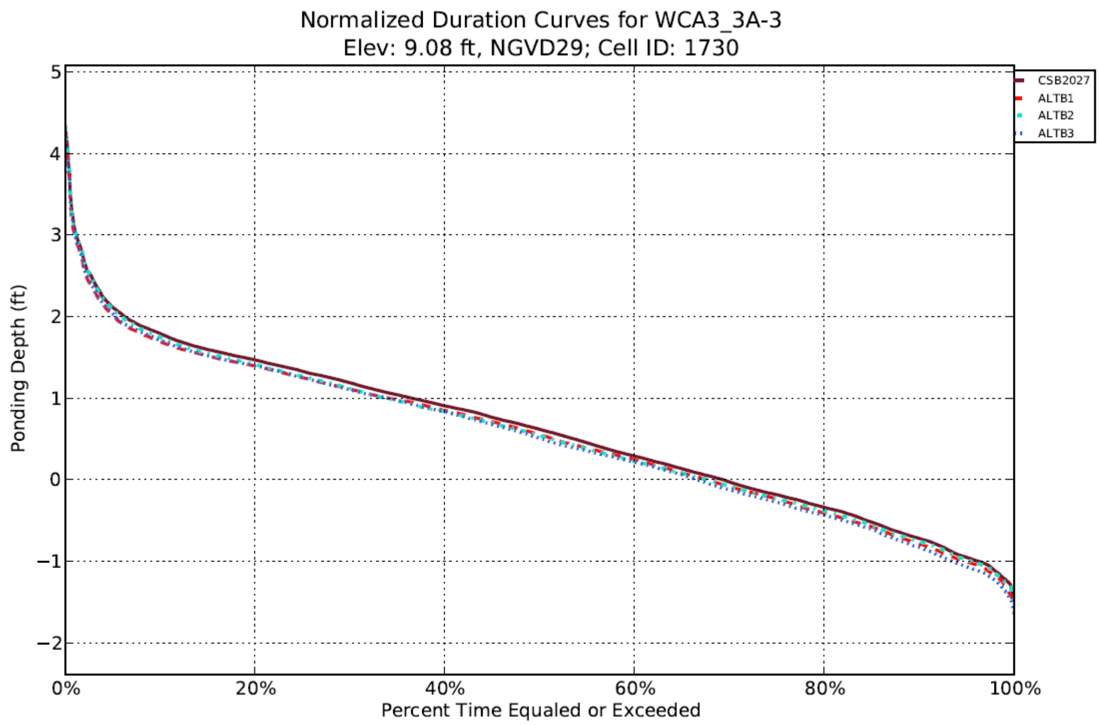

Figure 1. Depth Duration Curves for WCA3_3A-3 for all Alternatives

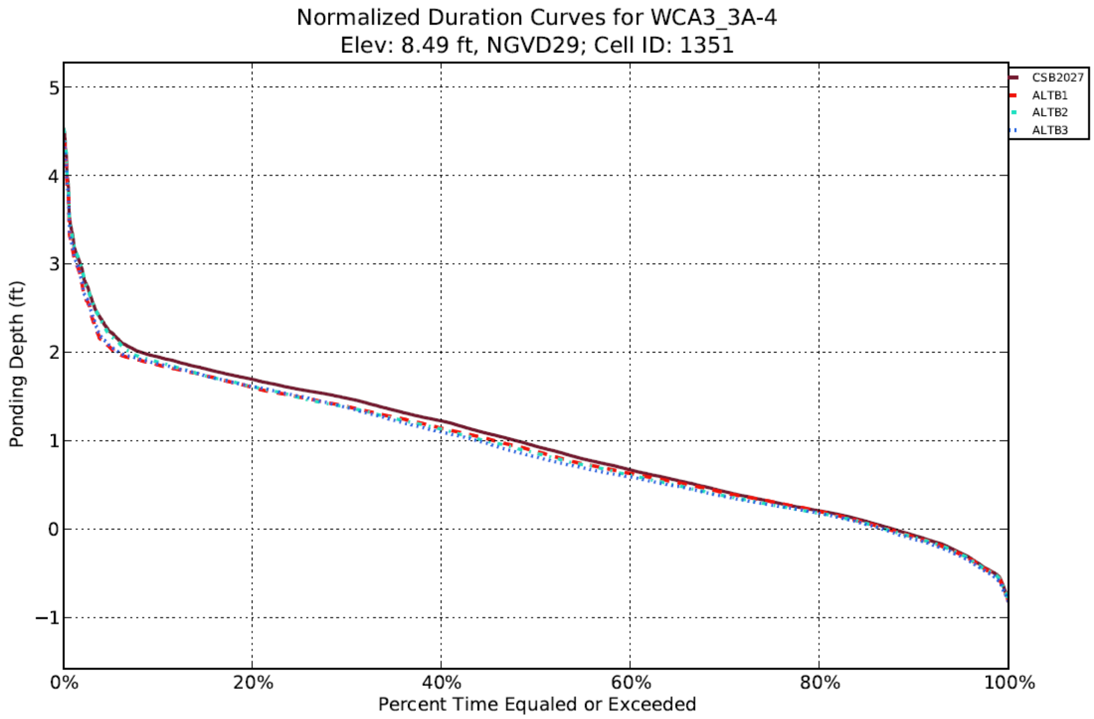

Figure 2. Depth Duration Curves for WCA3_3A-4 for all Alternatives

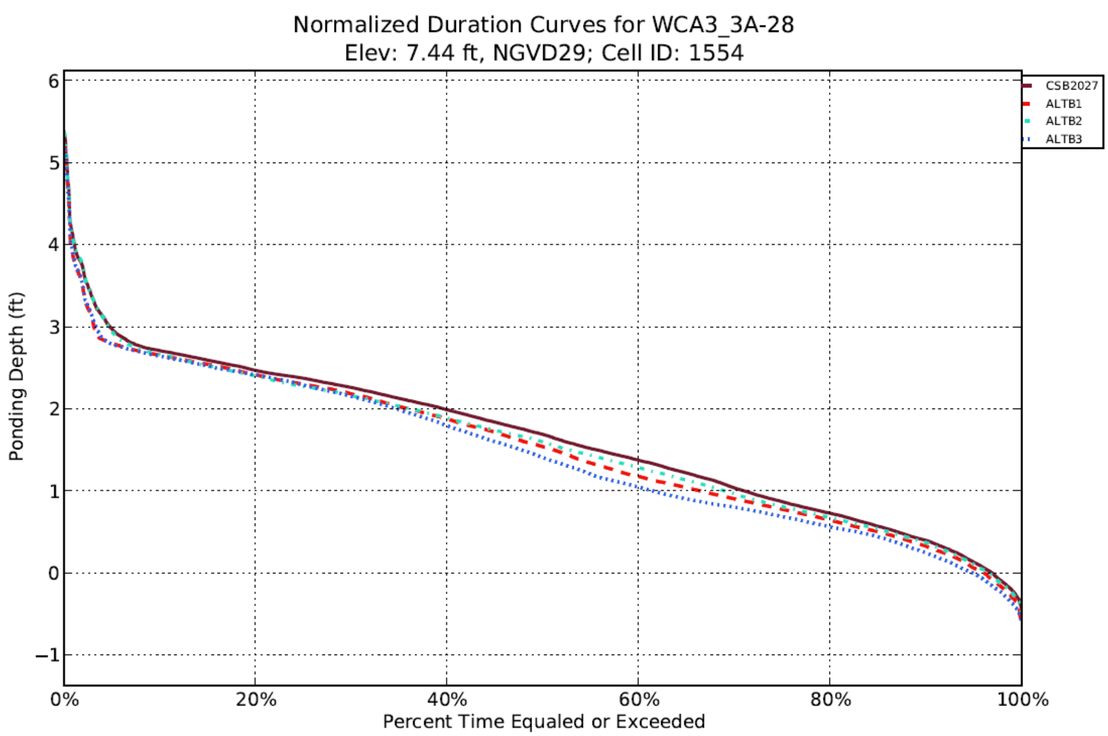

Figure 3. Depth Duration Curves for WCA3_3A-28 for all Alternatives

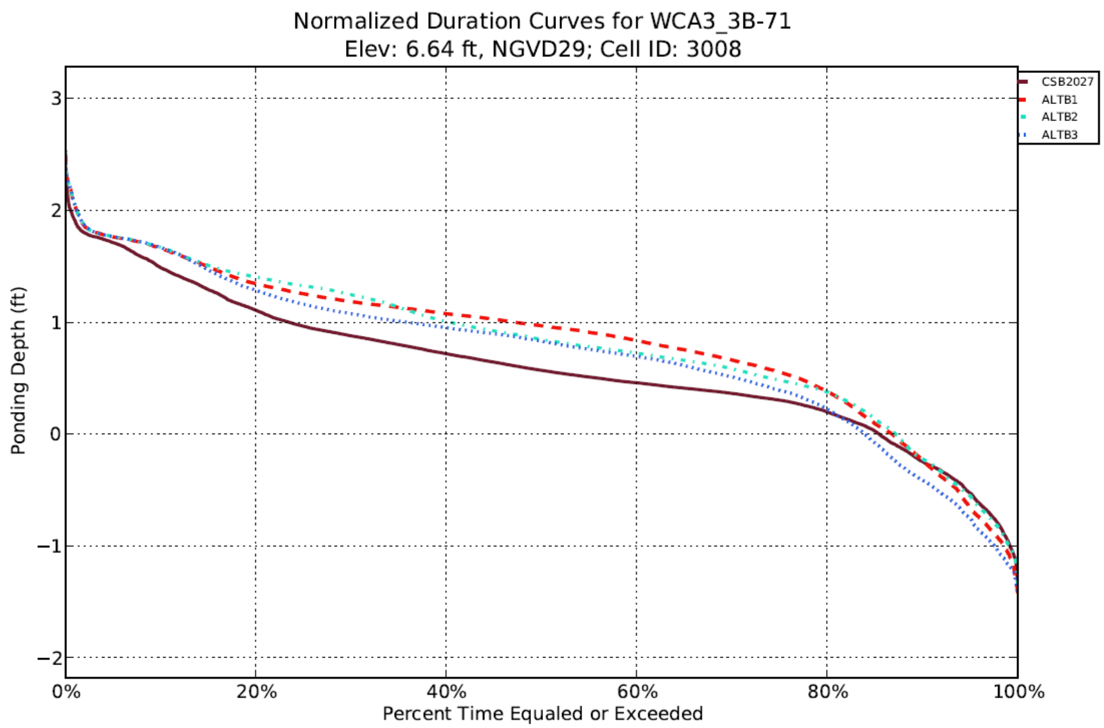

Figure 4. Depth Duration Curves for WCA3_3B-71 for all Alternatives

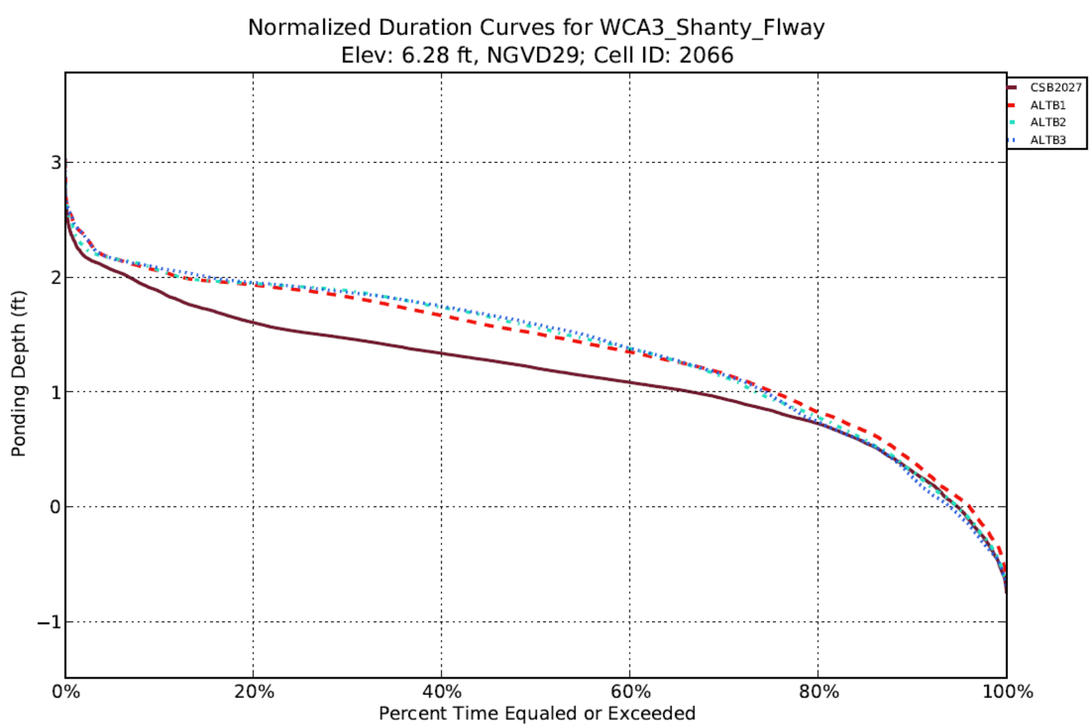

Figure 5. Depth Duration Curves for WCA3_Shanty_Flway for all Alternatives

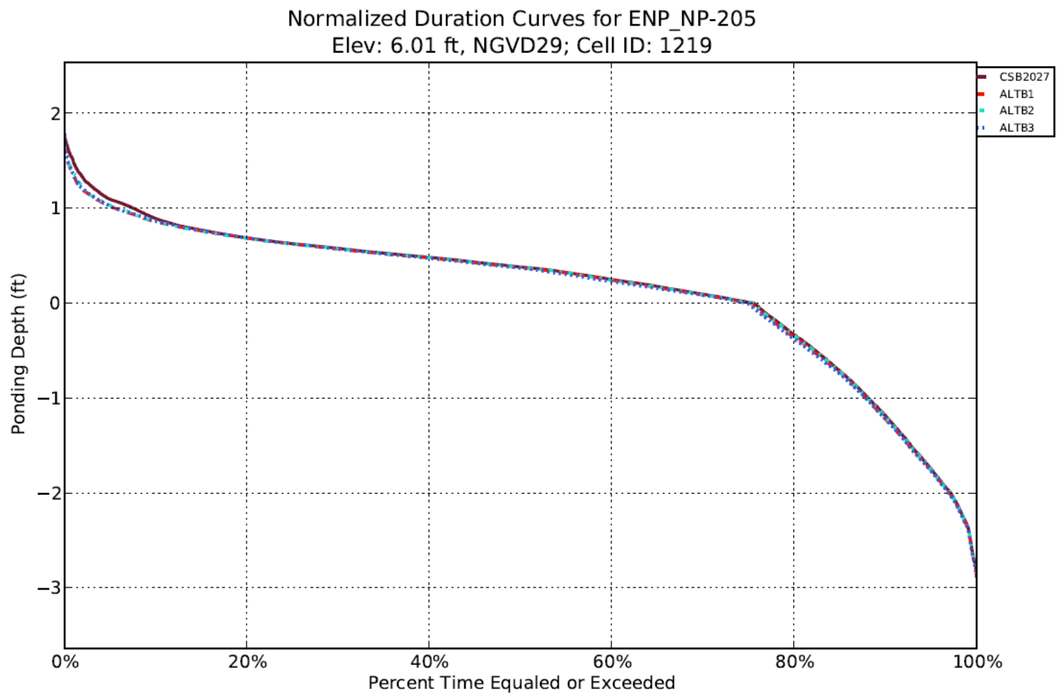

Figure 6. Depth Duration Curves for ENP_NP-205 for all Alternatives

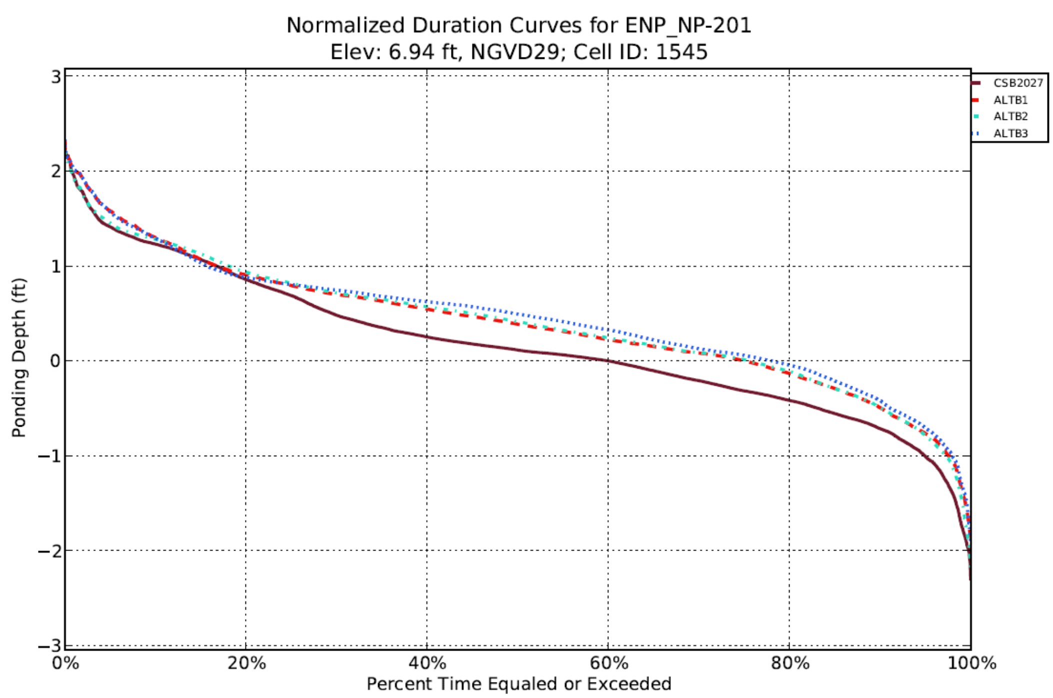

Figure 7. Depth Duration Curves for ENP_NP-201 for all Alternatives

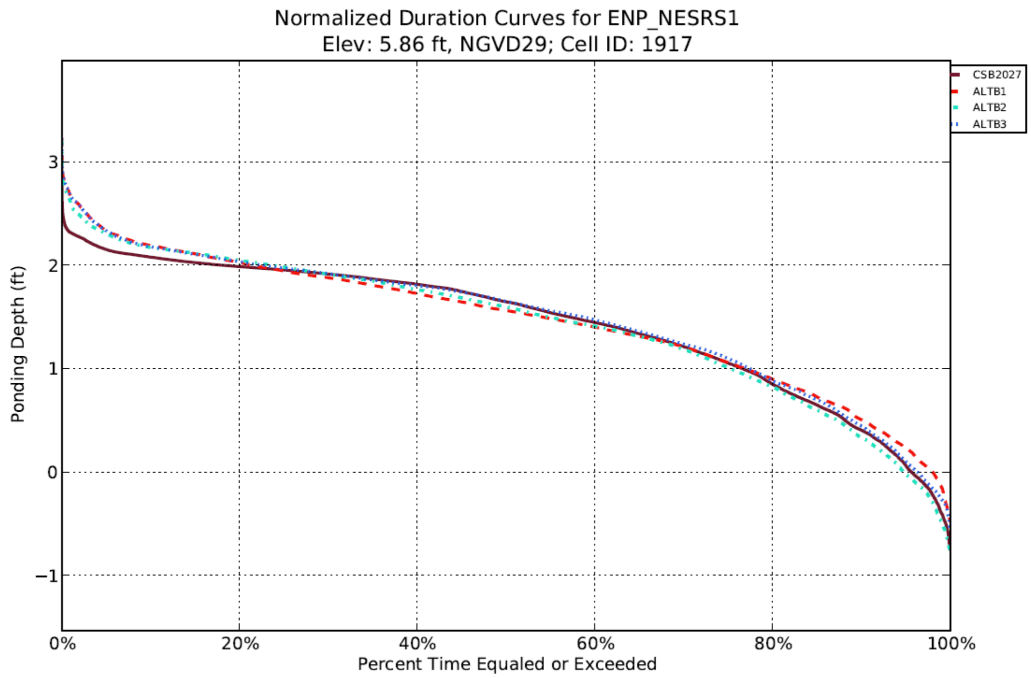

Figure 8. Depth Duration Curves for ENP_NP-NESRS1 for all Alternatives

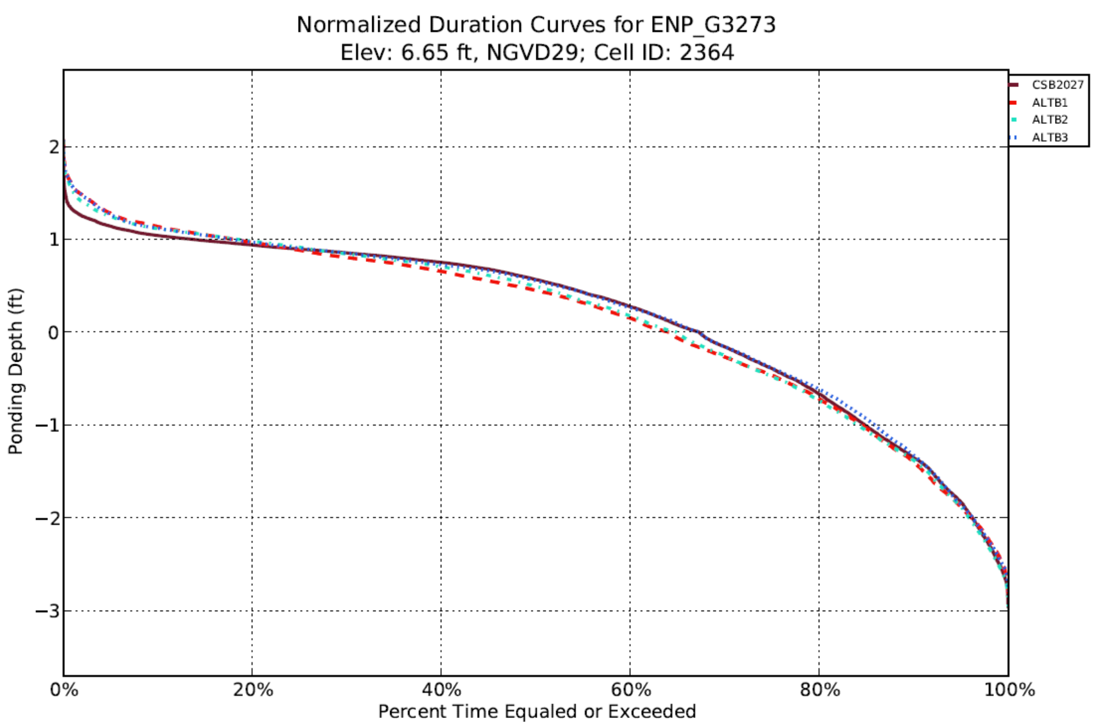

Figure 9. Depth Duration Curves for ENP_G3273 for all Alternatives

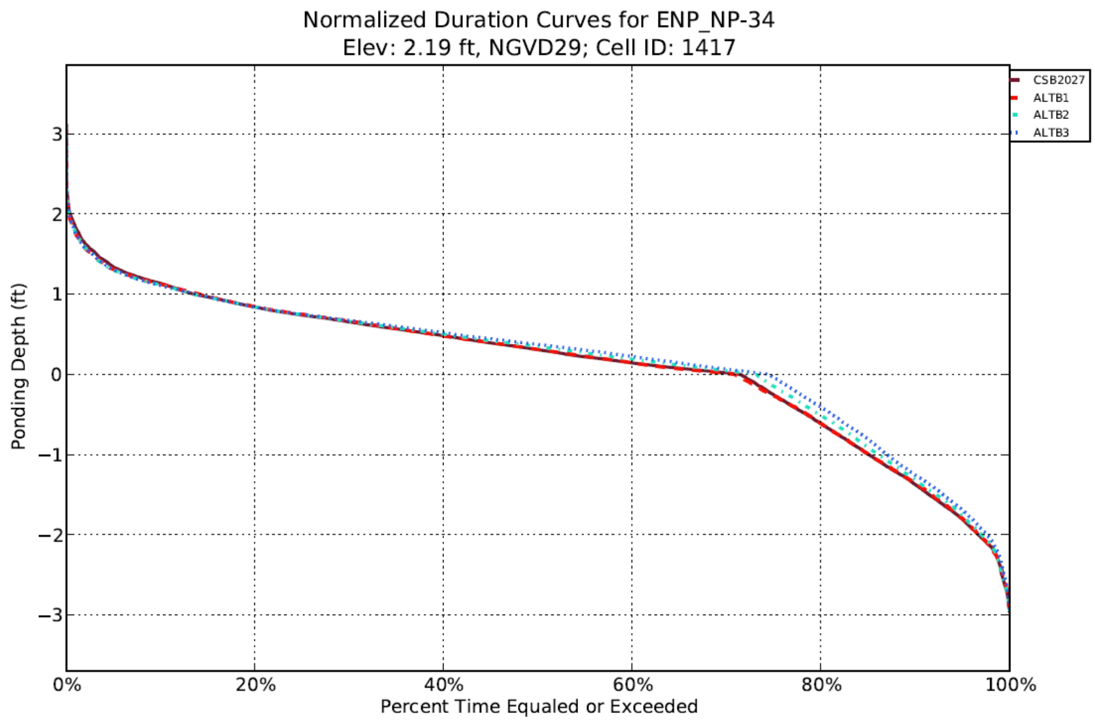

Figure 10. Depth Duration Curves for ENP_NP-34 for all Alternatives

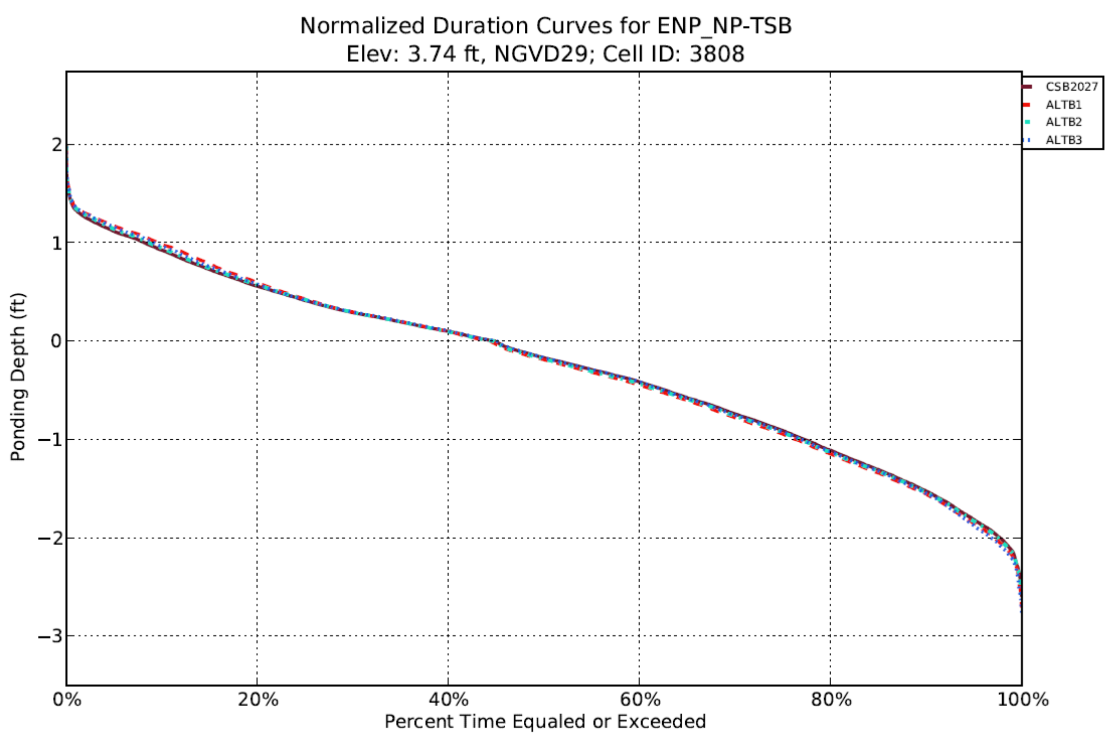

Figure 11. Depth Duration Curves for ENP_NP-TSP for all Alternatives

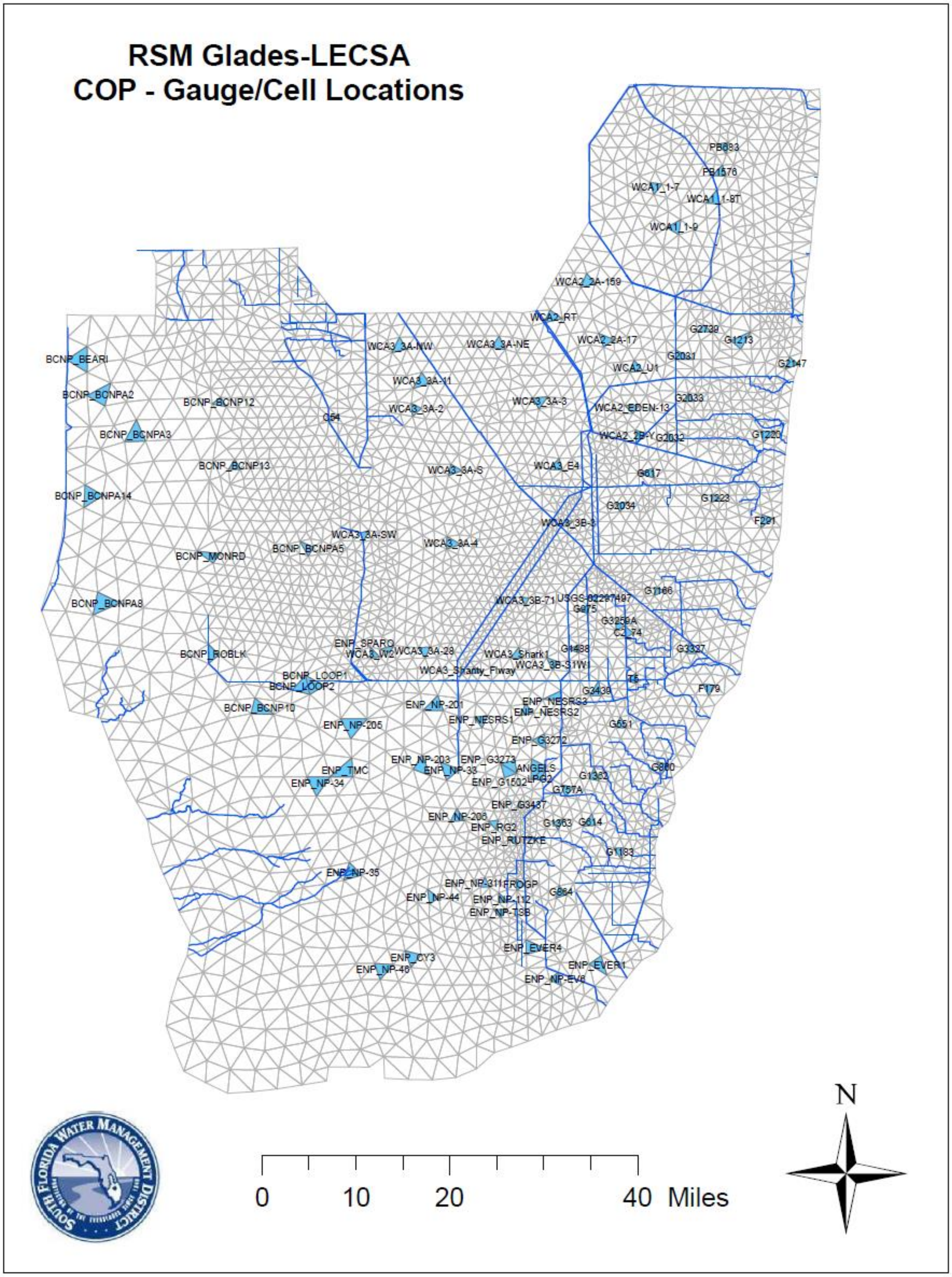

Figure 12. Map of RSM-GL Monitoring Gauge Locations

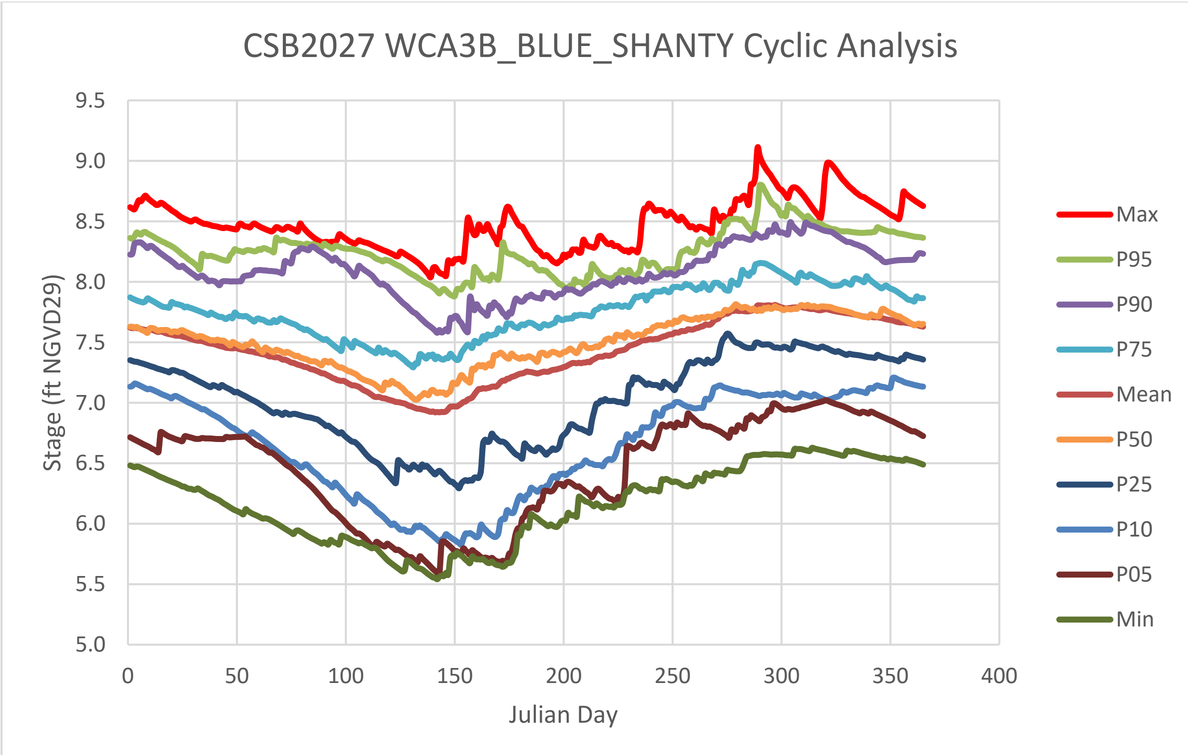

Figure 13. CSB2027 WCA3B_BLUE_SHANTY Intra-annual Stage Cyclic Analysis

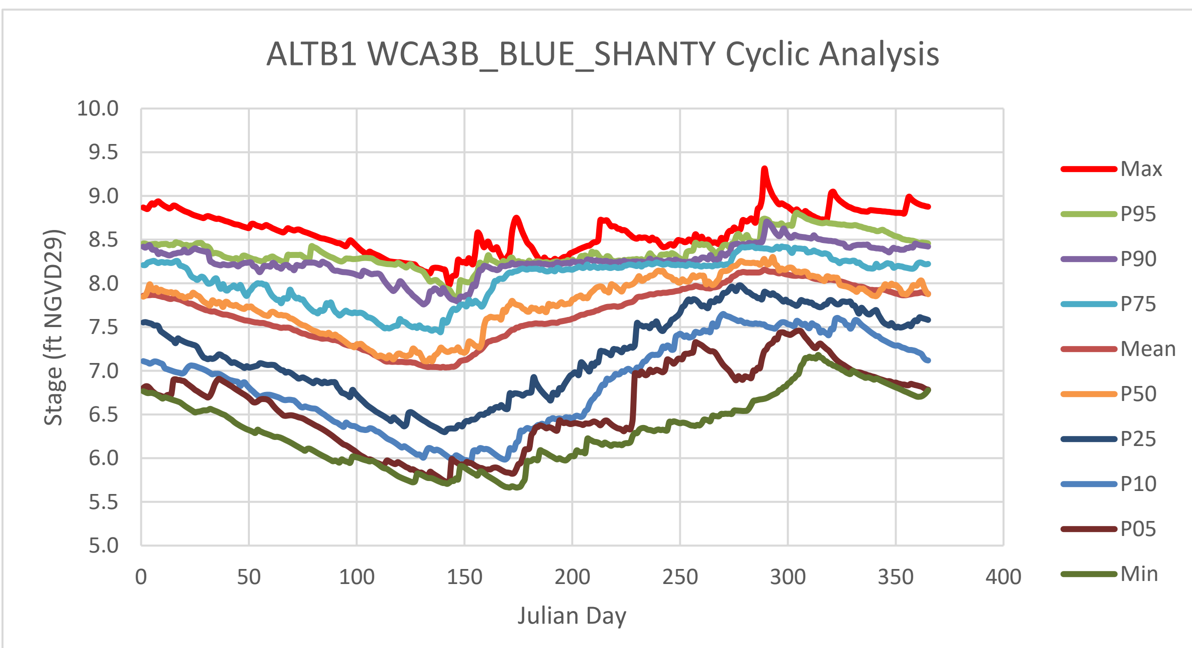

Figure 14. ALTB1 WCA3B_BLUE_SHANTY Intra-annual Stage Cyclic Analysis

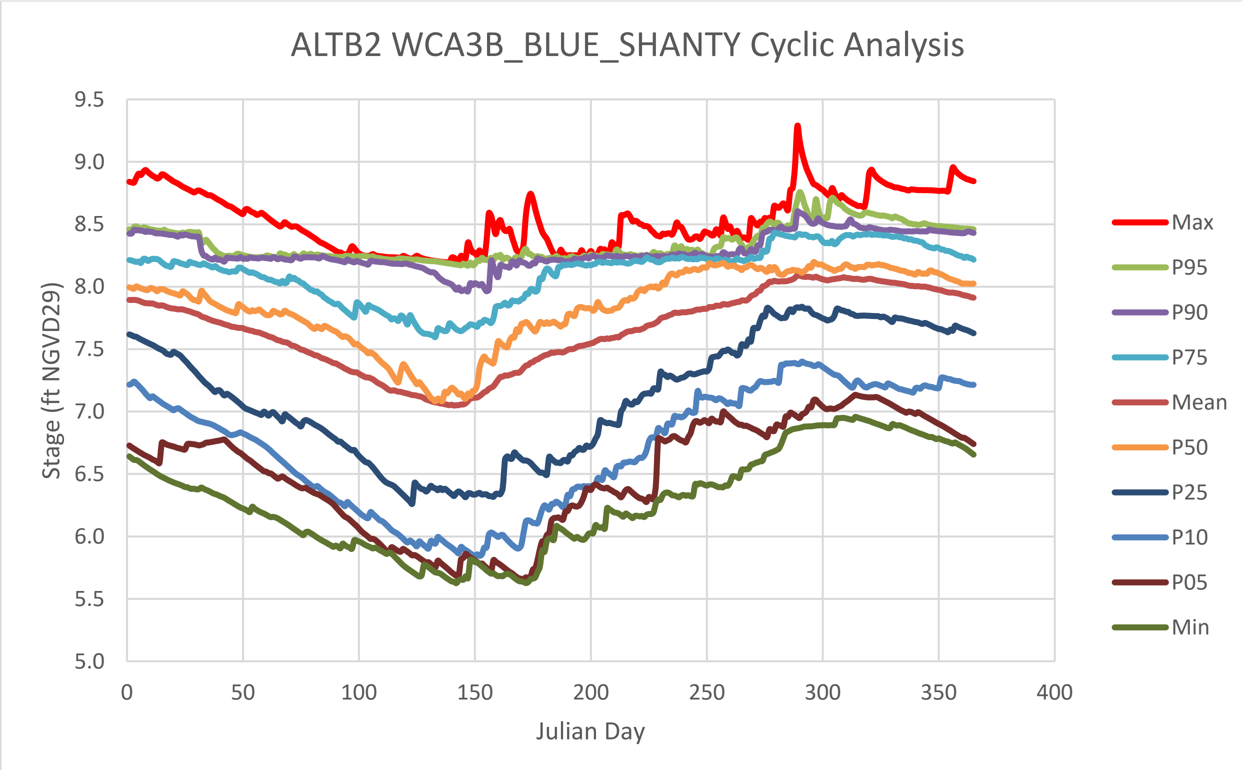

Figure 15. ALTB2 WCA3B_BLUE_SHANTY Intra-annual Stage Cyclic Analysis

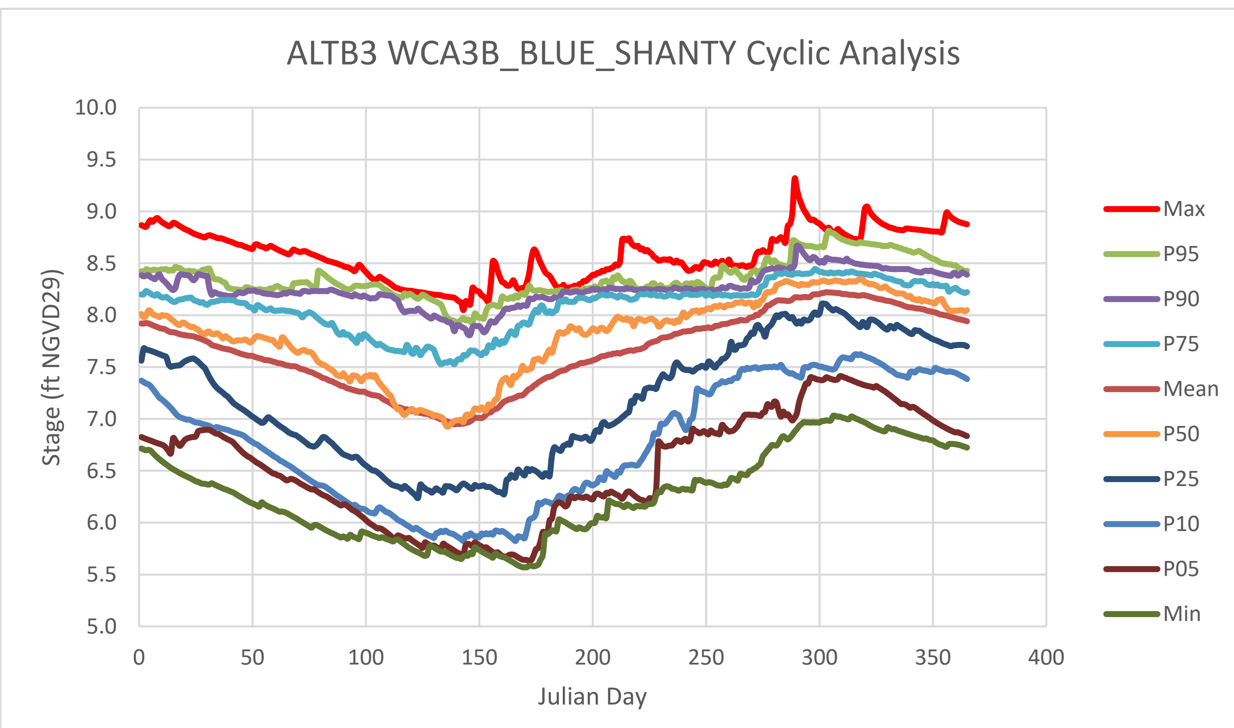

Figure 16. ALTB3 WCA3B_BLUE_SHANTY Intra-annual Stage Cyclic Analysis

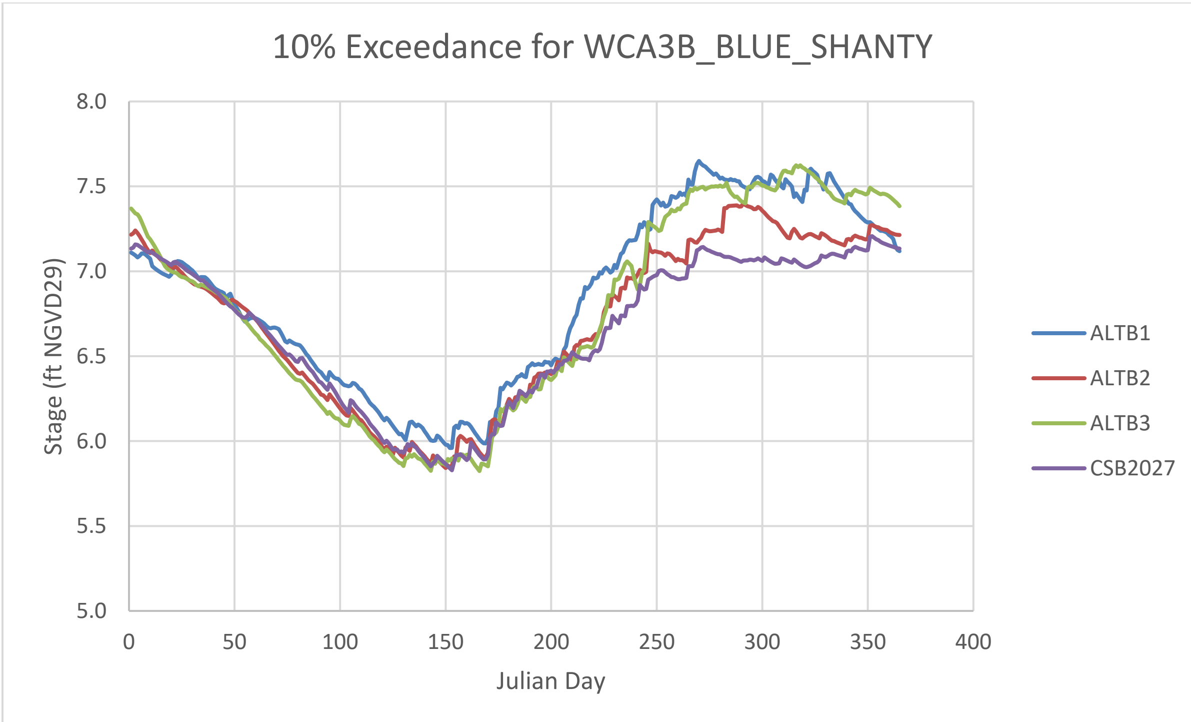

Figure 17. 10% Stage Exceedance for WCA3B_BLUE_SHANTY for all Alternatives

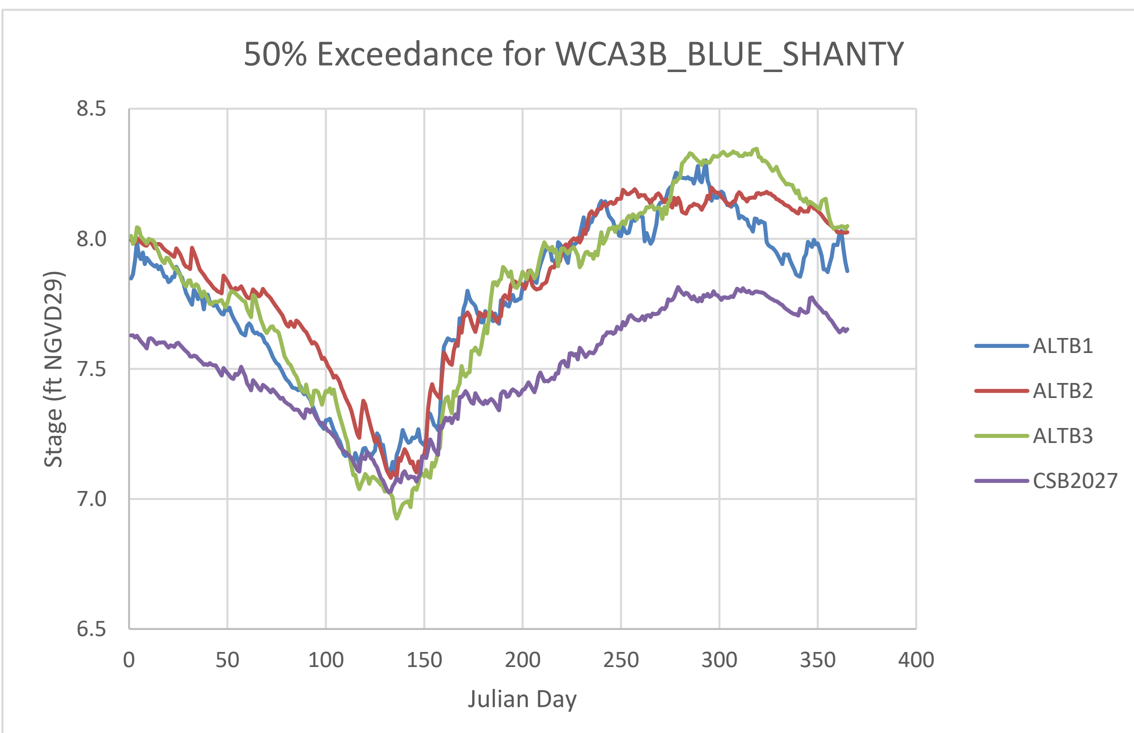

Figure 18. 50% Stage Exceedance for WCA3B_BLUE_SHANTY for all Alternatives

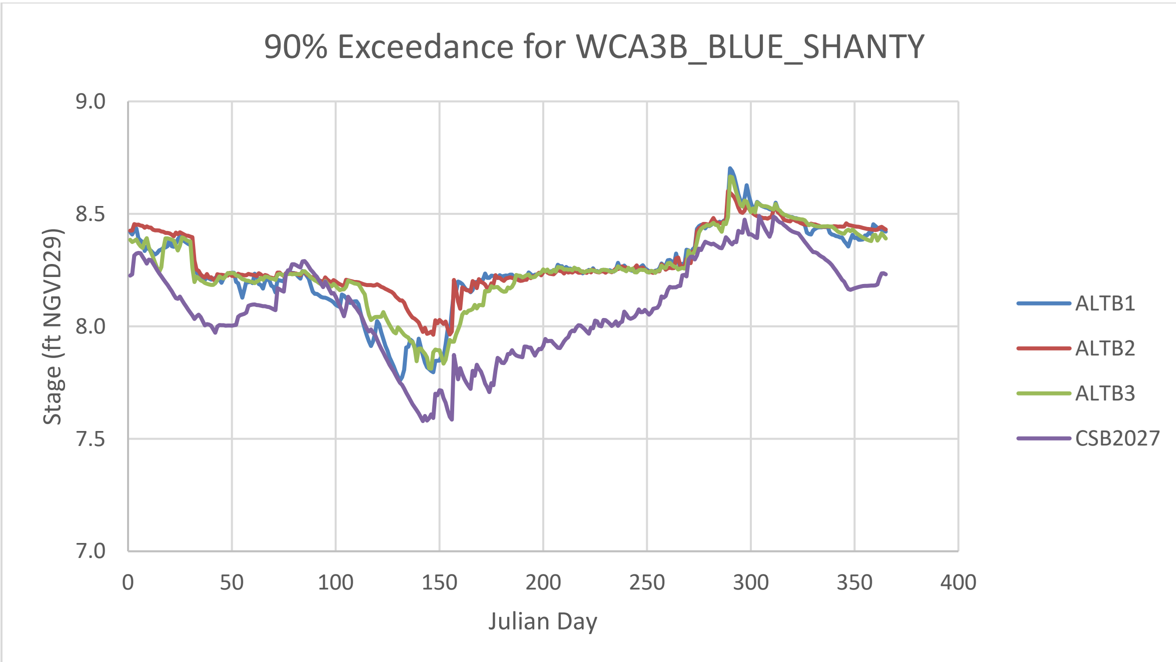

Figure 19. 90% Stage Exceedance for WCA3B_BLUE_SHANTY for all Alternatives

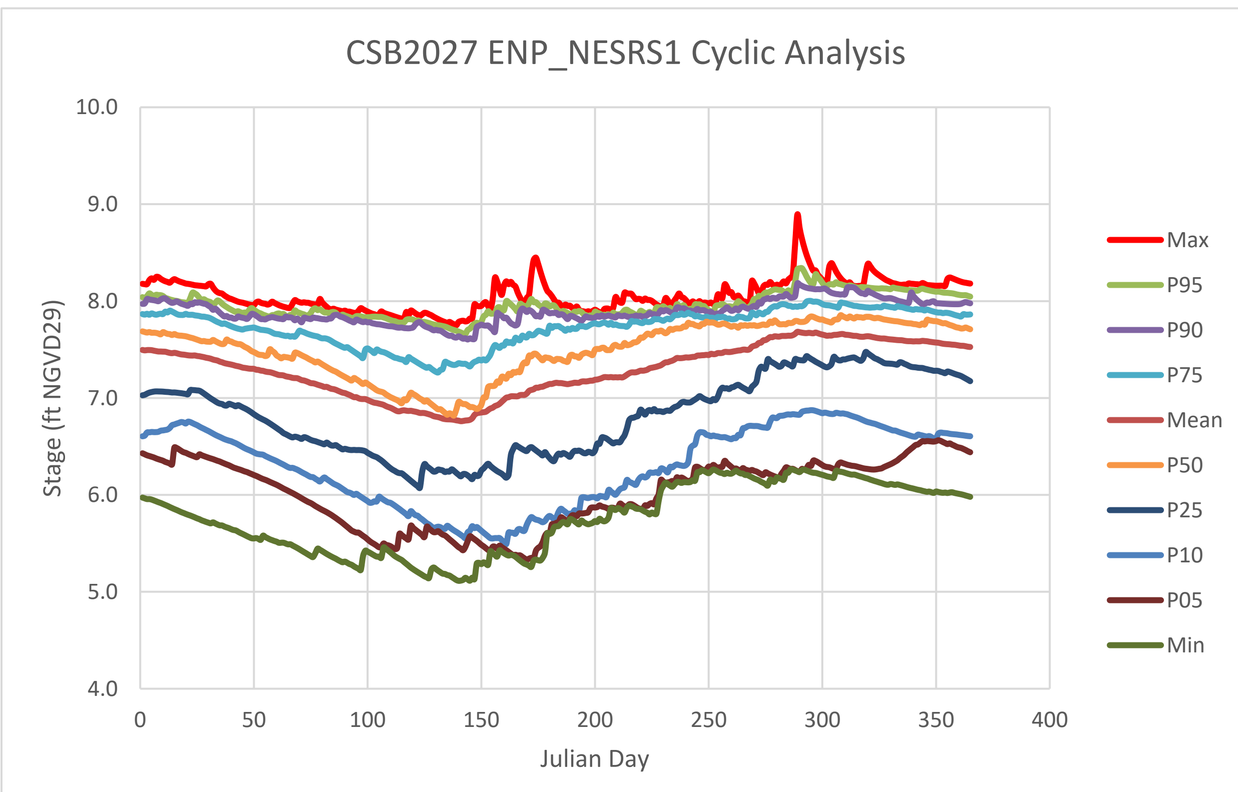

Figure 20. CSB2027 ENP_NESRS1 Intra-annual Stage Cyclic Analysis

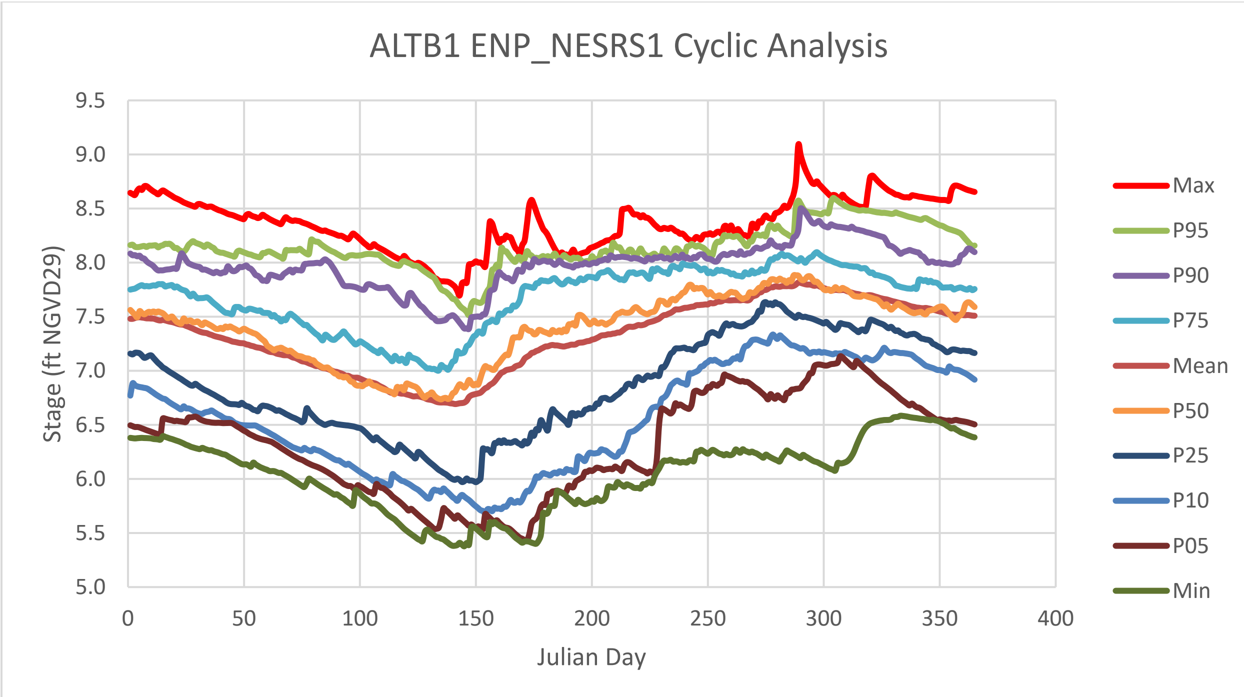

Figure 21. CSB2027 ENP_NESRS1 Intra-annual Stage Cyclic Analysis

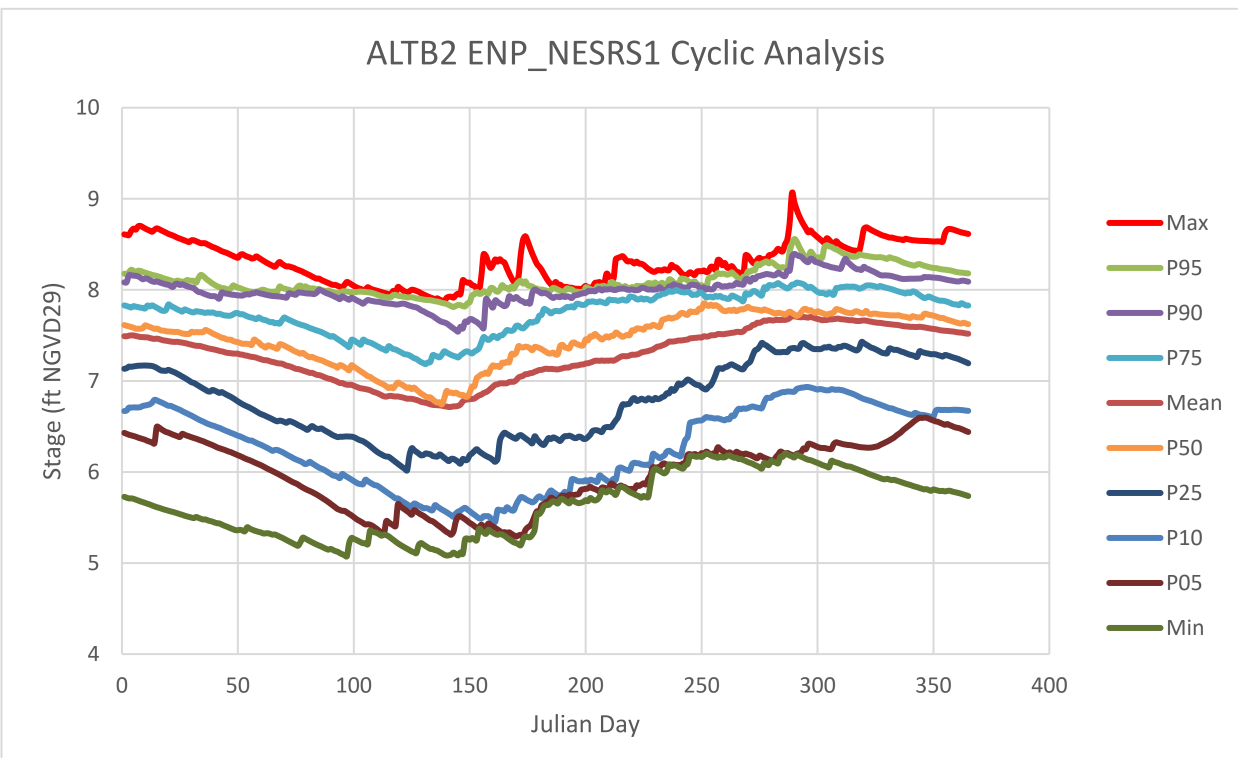

Figure 22. ALTB2 ENP_NESRS1 Intra-annual Stage Cyclic Analysis

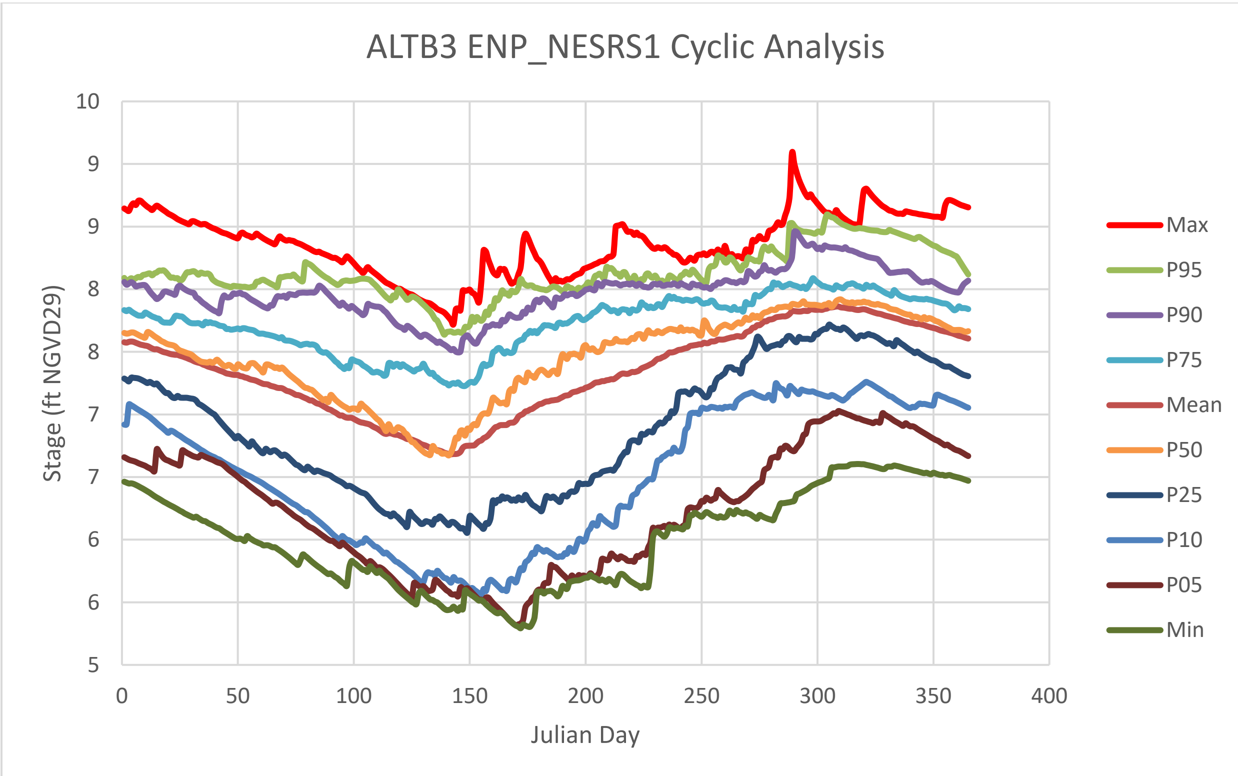

Figure 23. ALTB3 ENP_NESRS1 Intra-annual Stage Cyclic Analysis

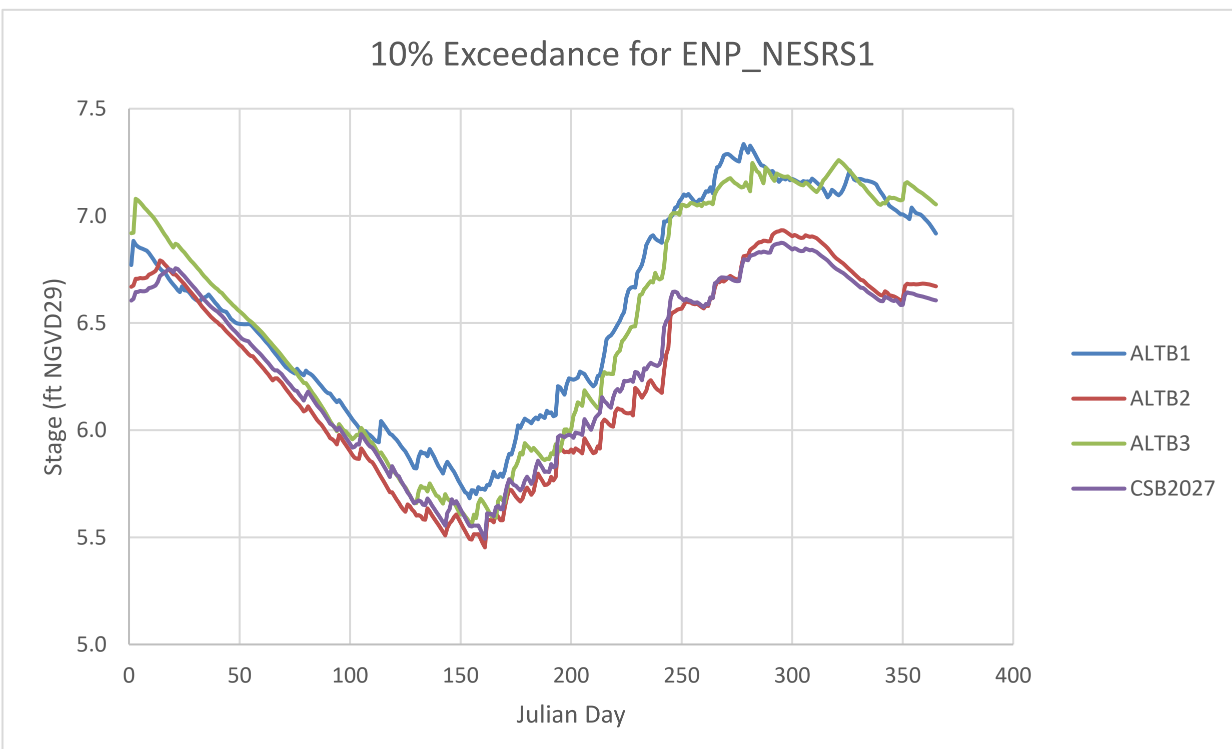

Figure 24. 10% Stage Exceedance for ENP_NESRS1

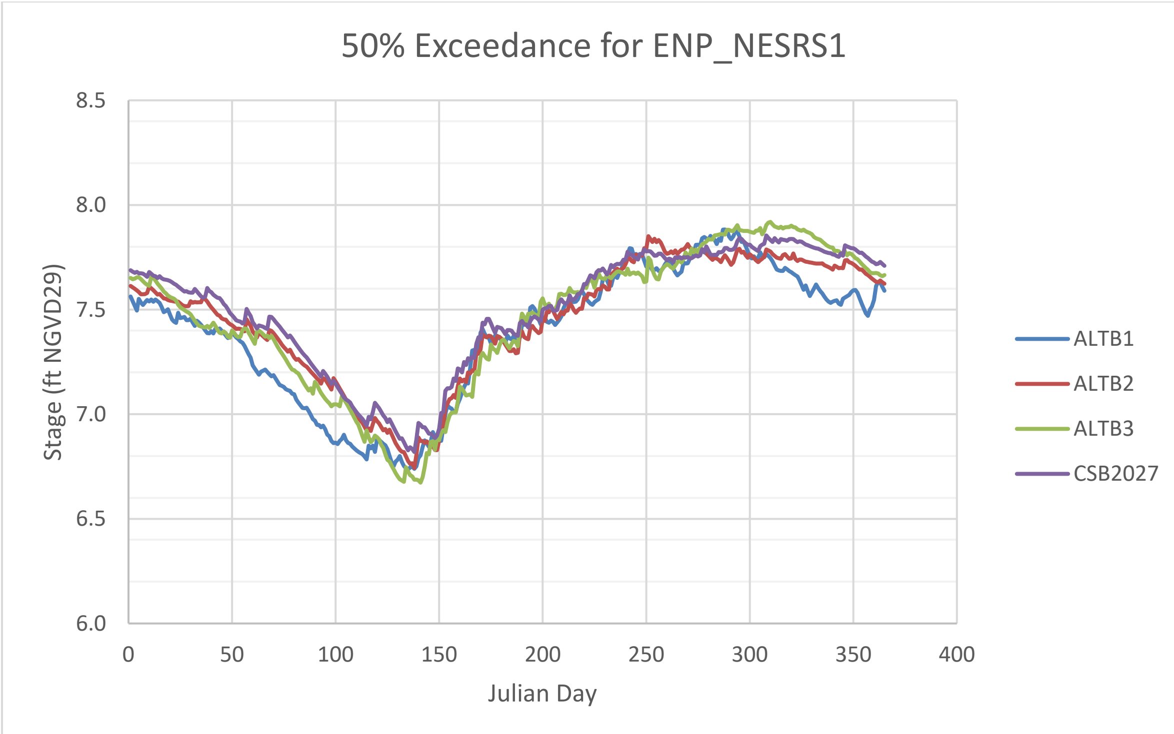

Figure 25. 50% Stage Exceedance for ENP_NESRS1

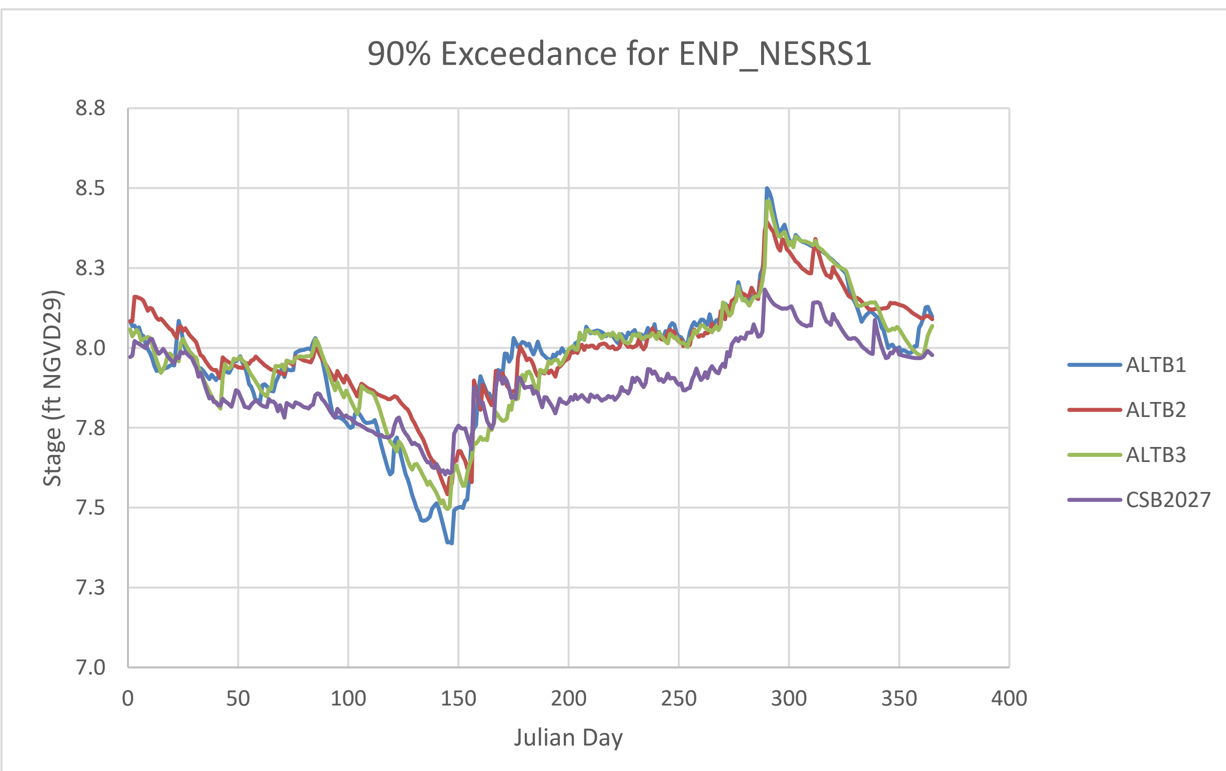

Figure 26. 90% Stage Exceedance for ENP_NESRS1

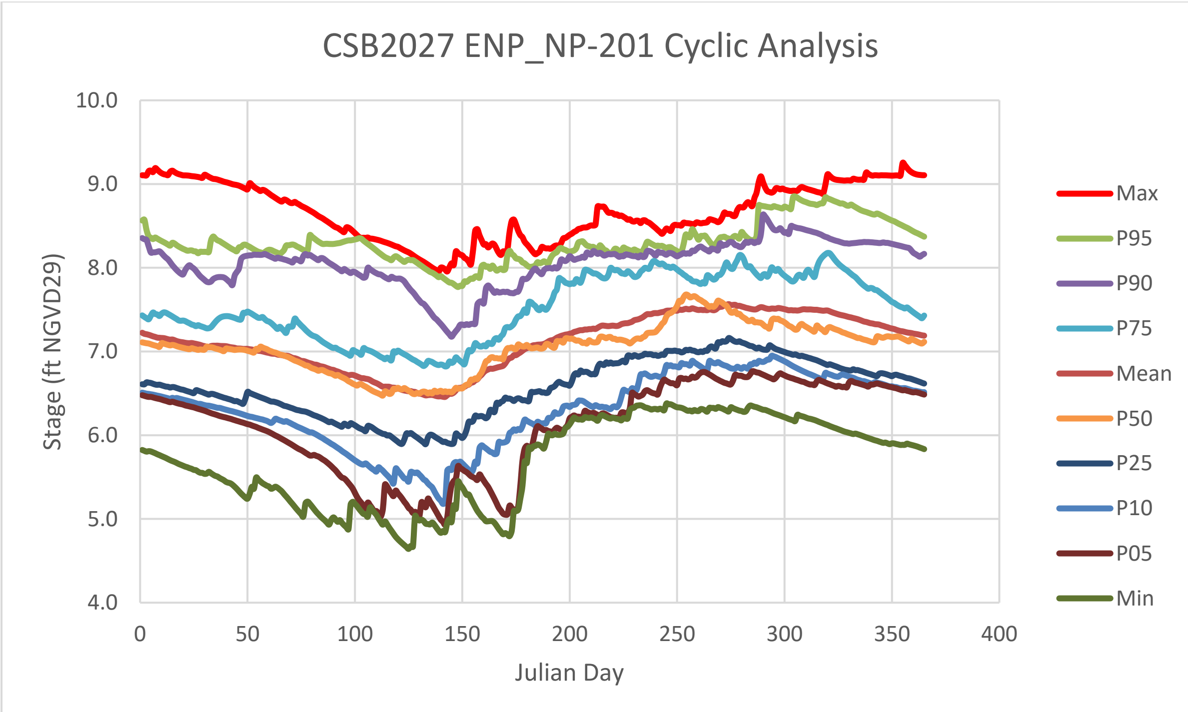

Figure 27. CSB2027 ENP_NP-201 Intra-annual Stage Cyclic Analysis

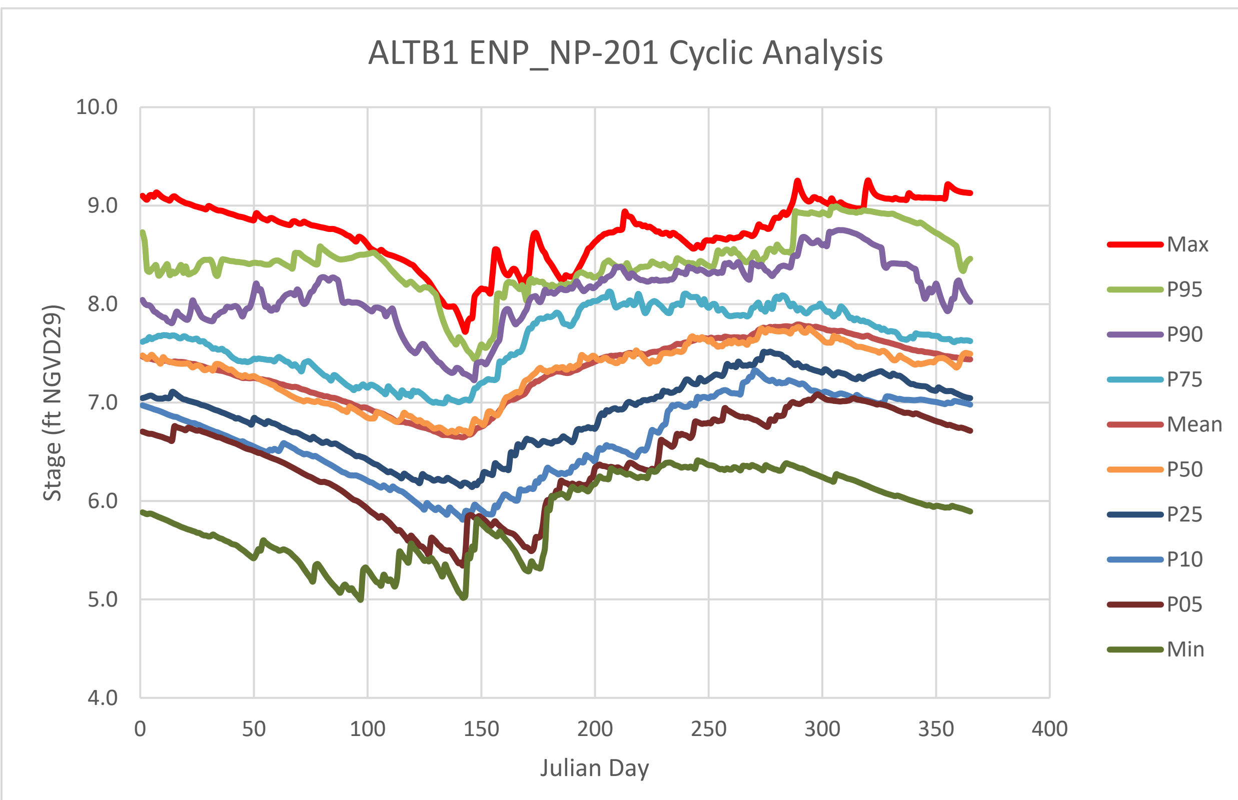

Figure 28. CSB2027 ENP_NP-201 Intra-annual Stage Cyclic Analysis

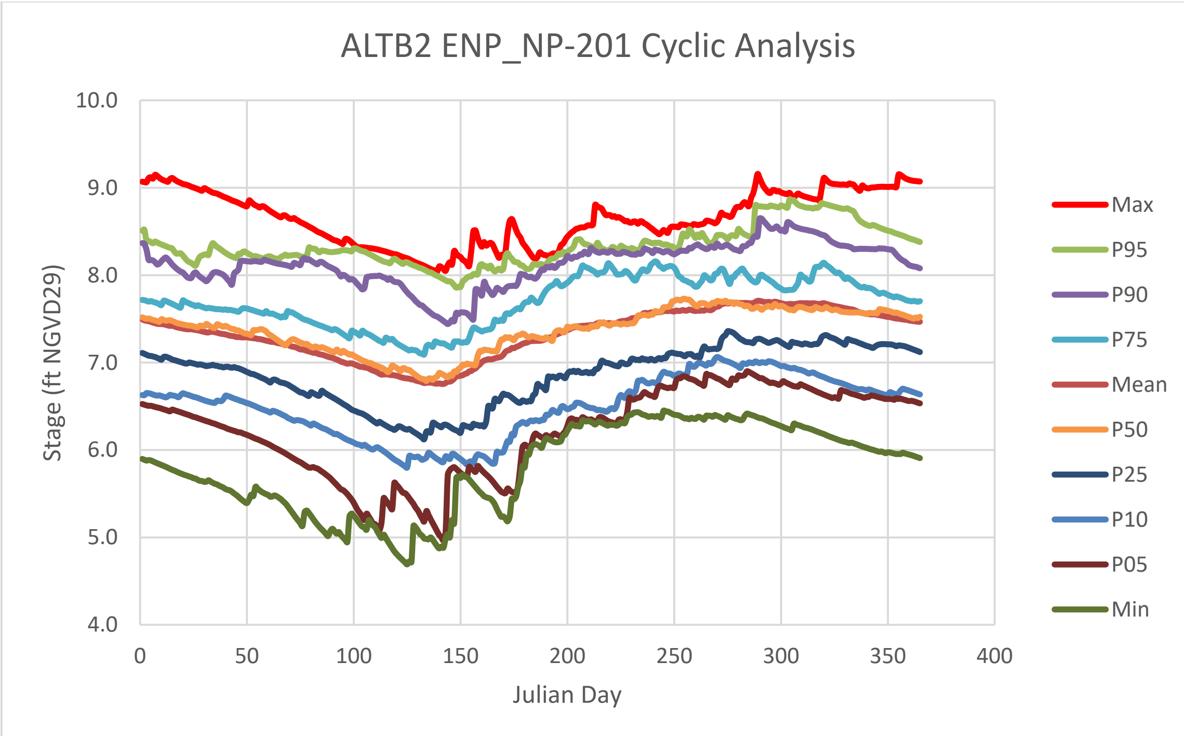

Figure 29. ALTB2 ENP_NP-201 Intra-annual Cyclic Analysis

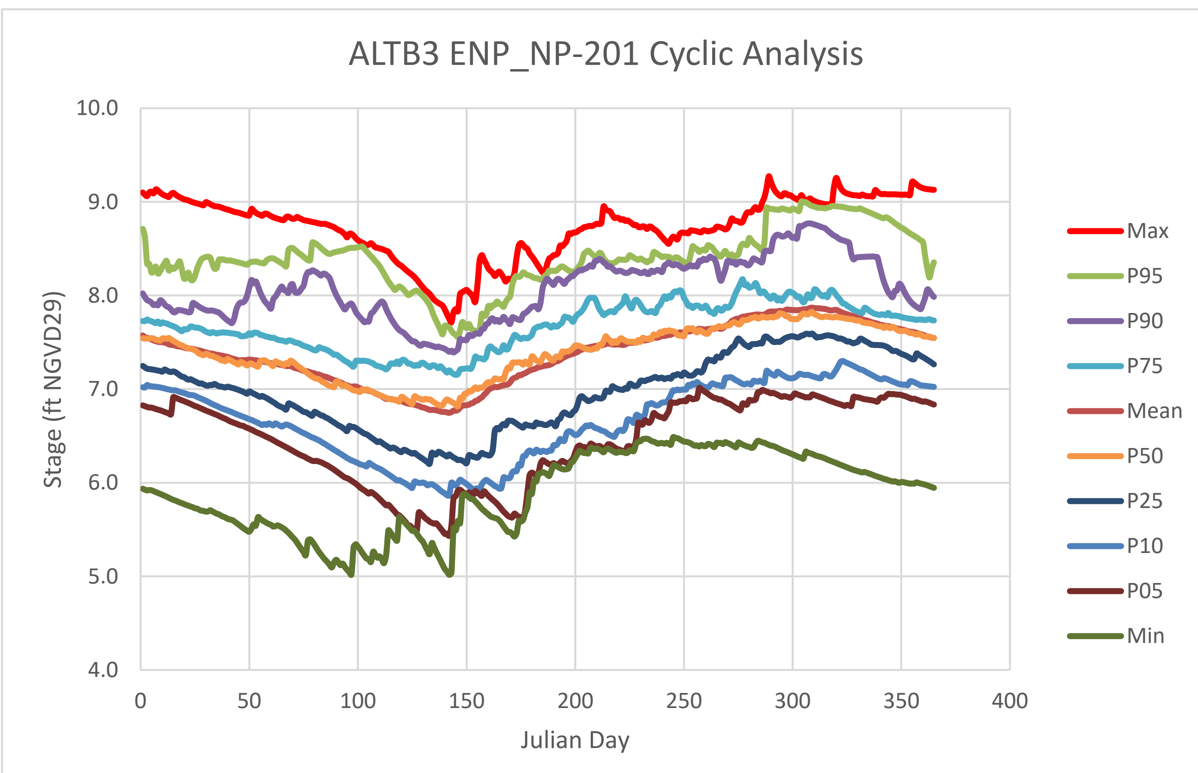

Figure 30. ALTB3 ENP_NP-201 Intra-annual Cyclic Analysis

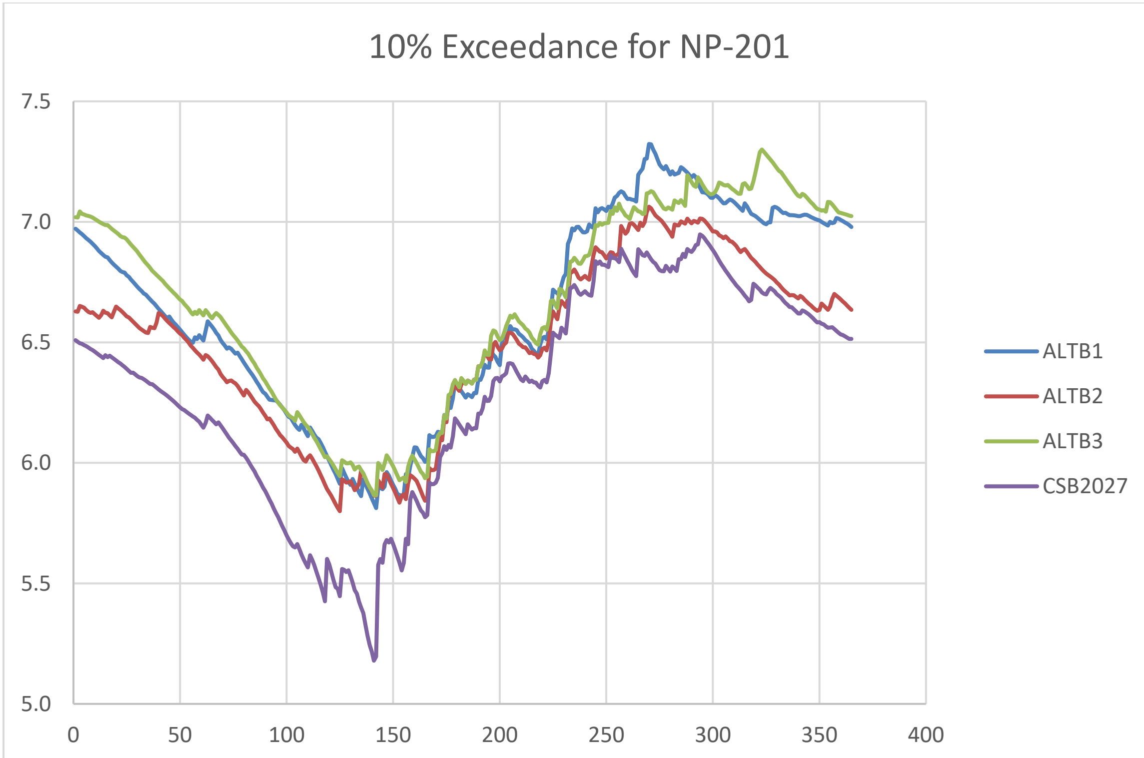

Figure 31. 10% Stage Exceedance for NP-201

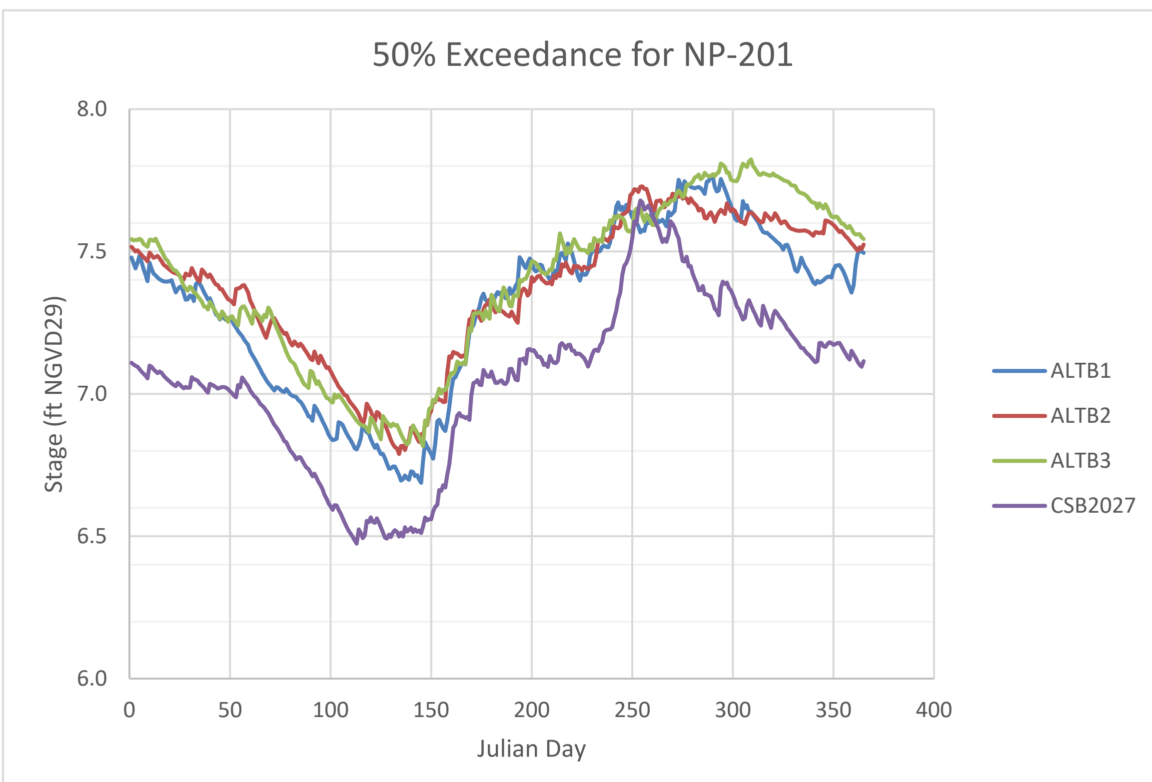

Figure 32. 50% Stage Exceedance for NP-201

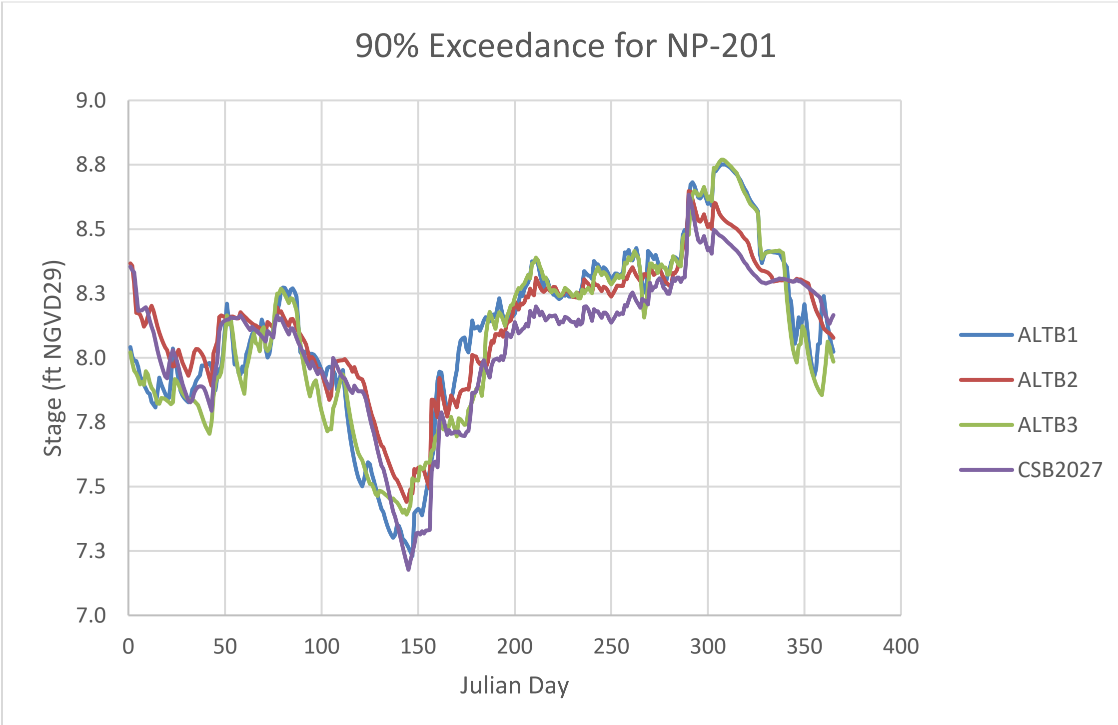

Figure 33. 90% Stage Exceedance for NP-201

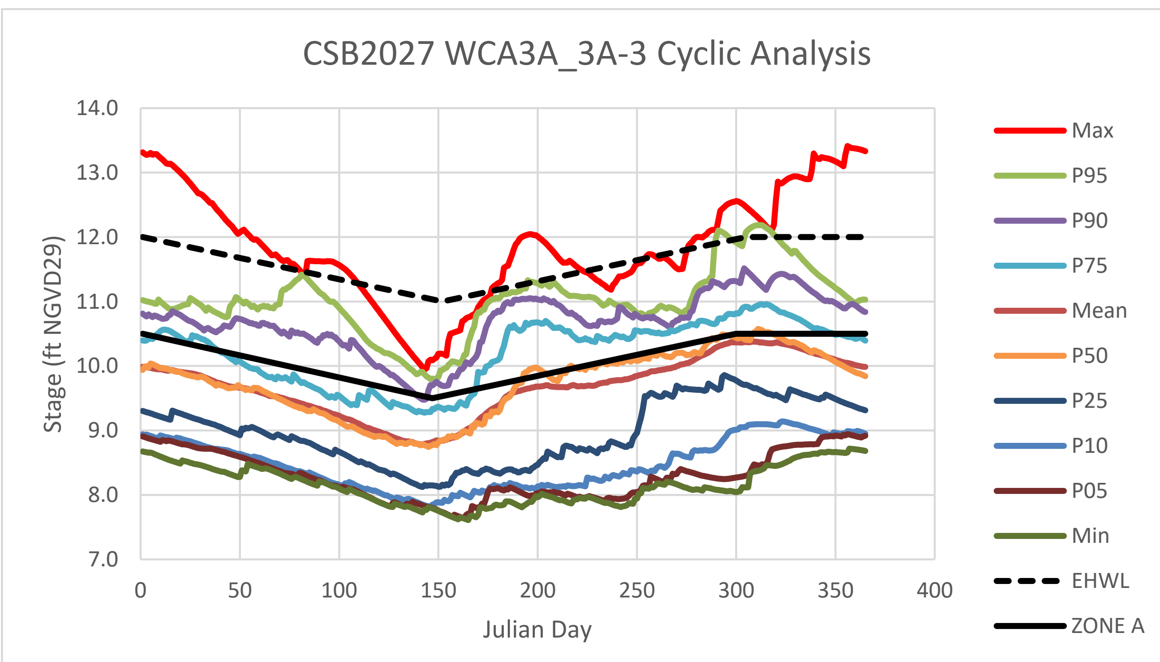

Figure 34. CSB2027 WCA3A_3A-3 Intra-annual Cyclic Analysis

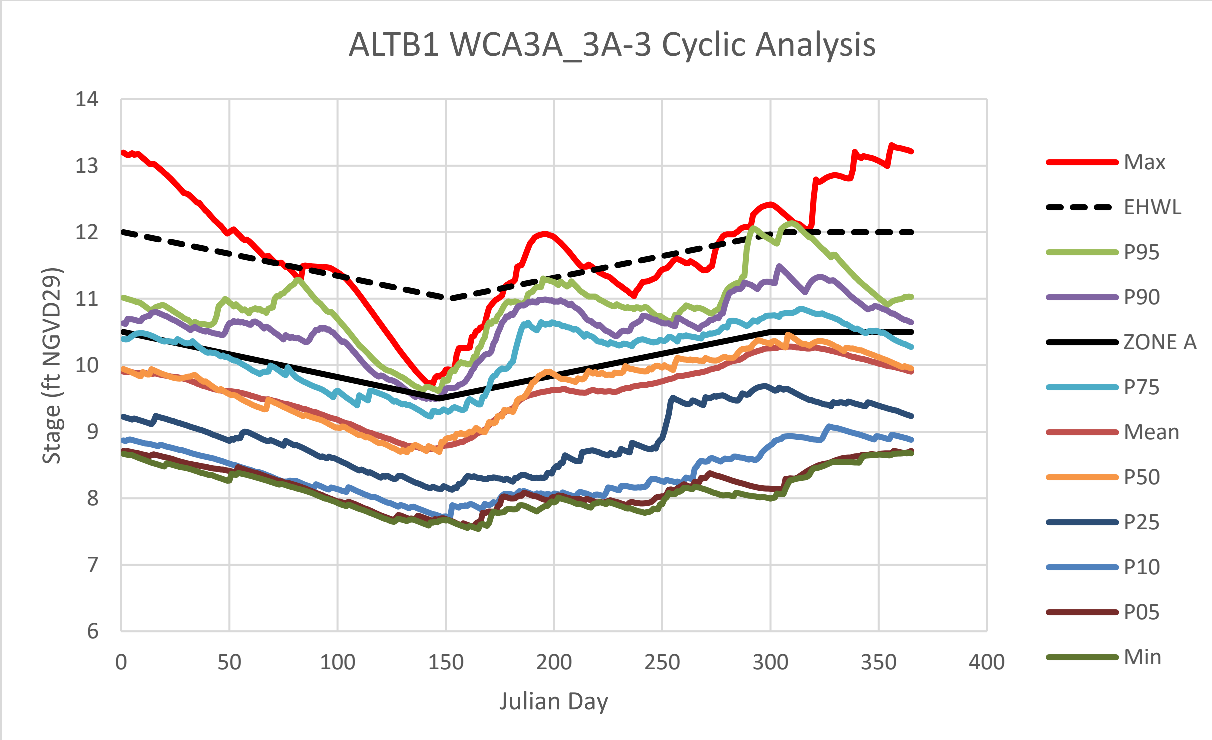

Figure 35. ALTB1 WCA3A_3A-3 Intra-annual Cyclic Analysis

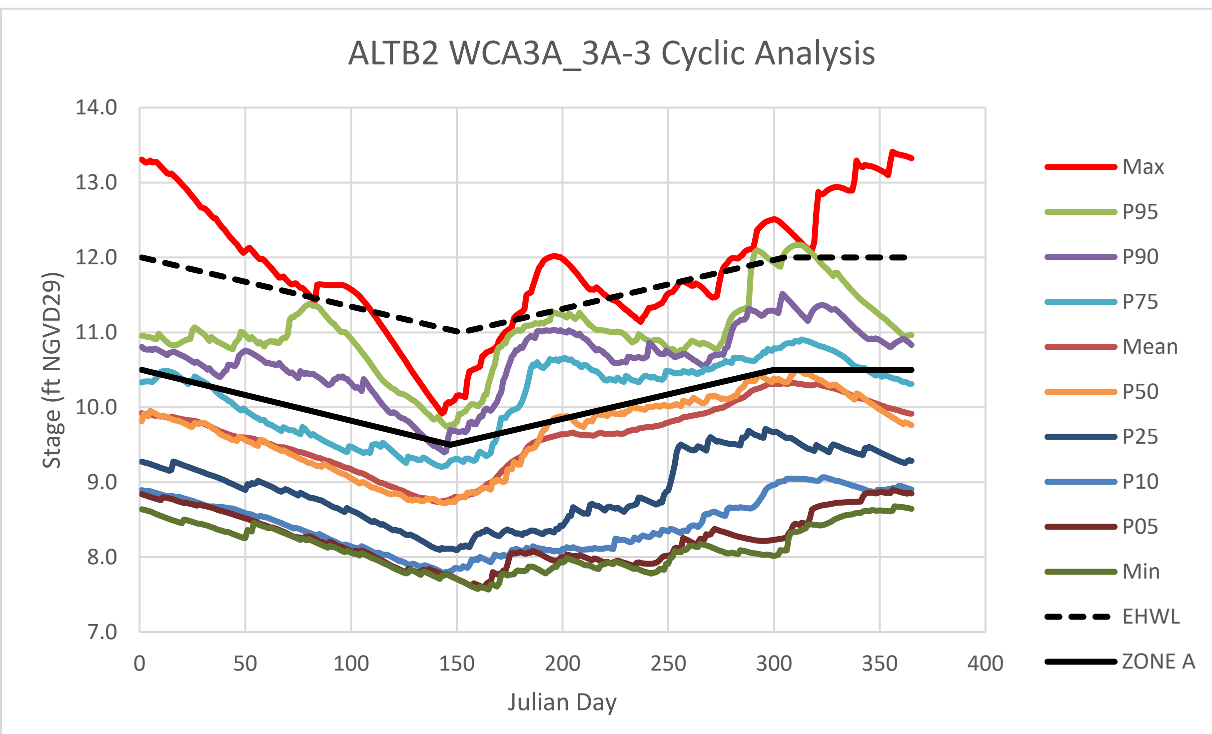

Figure 36. ALTB2 WCA3A_3A-3 Intra-annual Cyclic Analysis

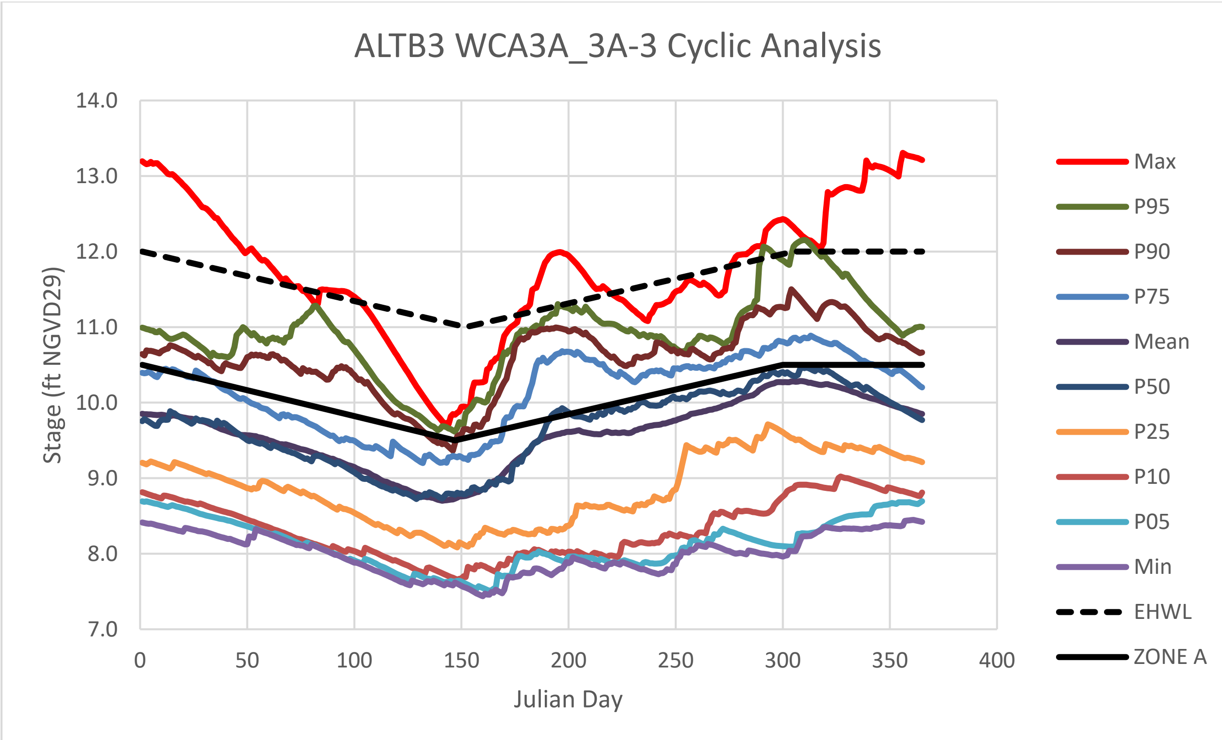

Figure 37. ALTB3 WCA3A_3A-3 Intra-annual Cyclic Analysis

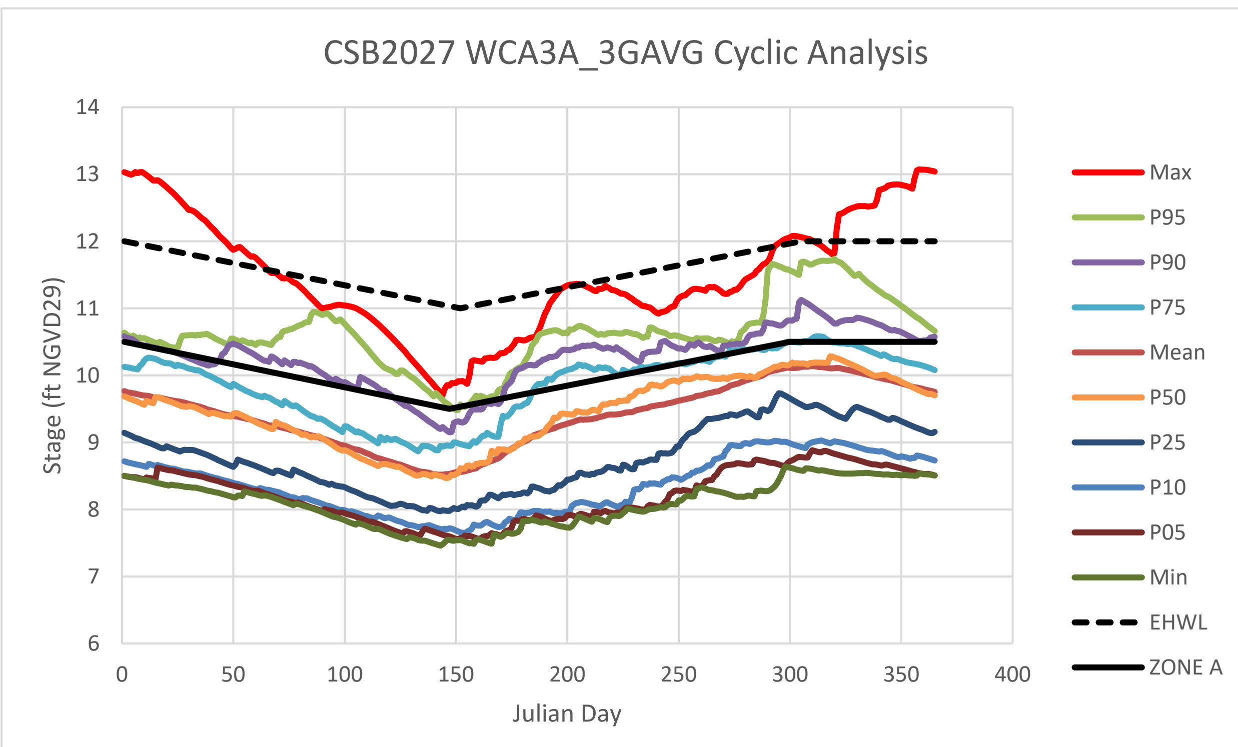

Figure 38. CSB2027 WCA3A_3GAVG Intra-annual Cyclic Analysis

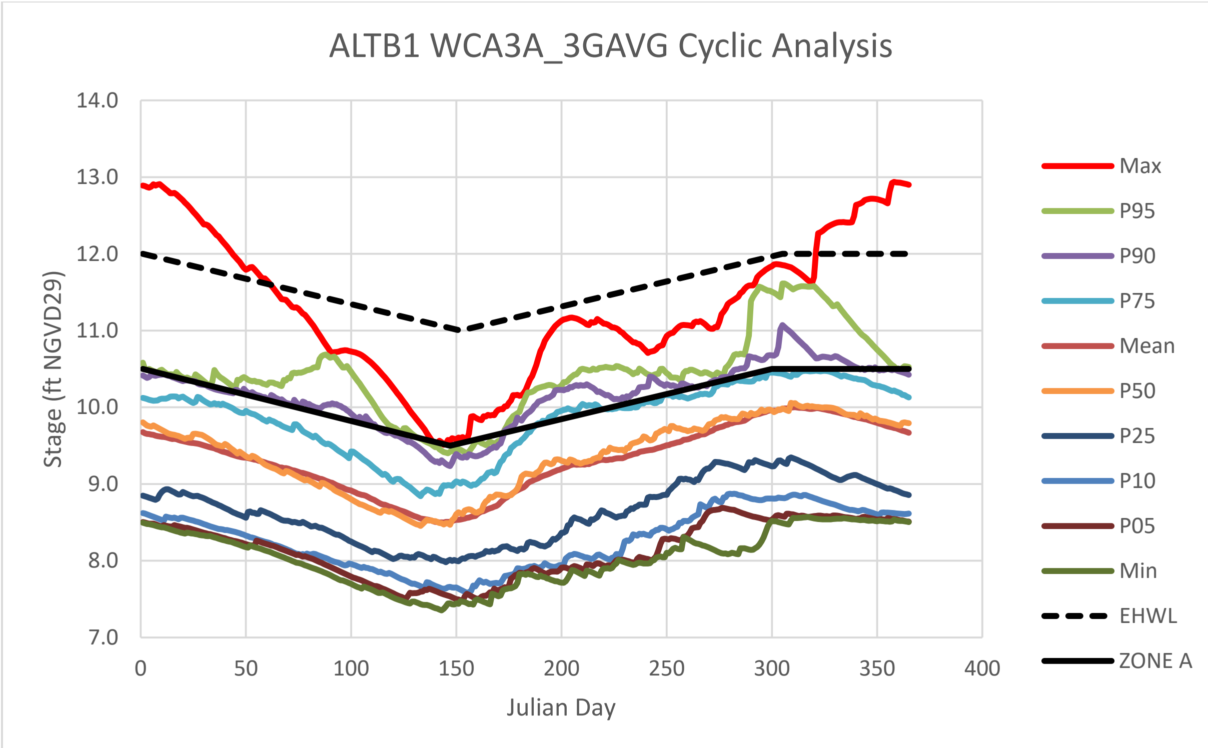

Figure 39. ALTB1 WCA3A_3GAVG Intra-annual Cyclic Analysis

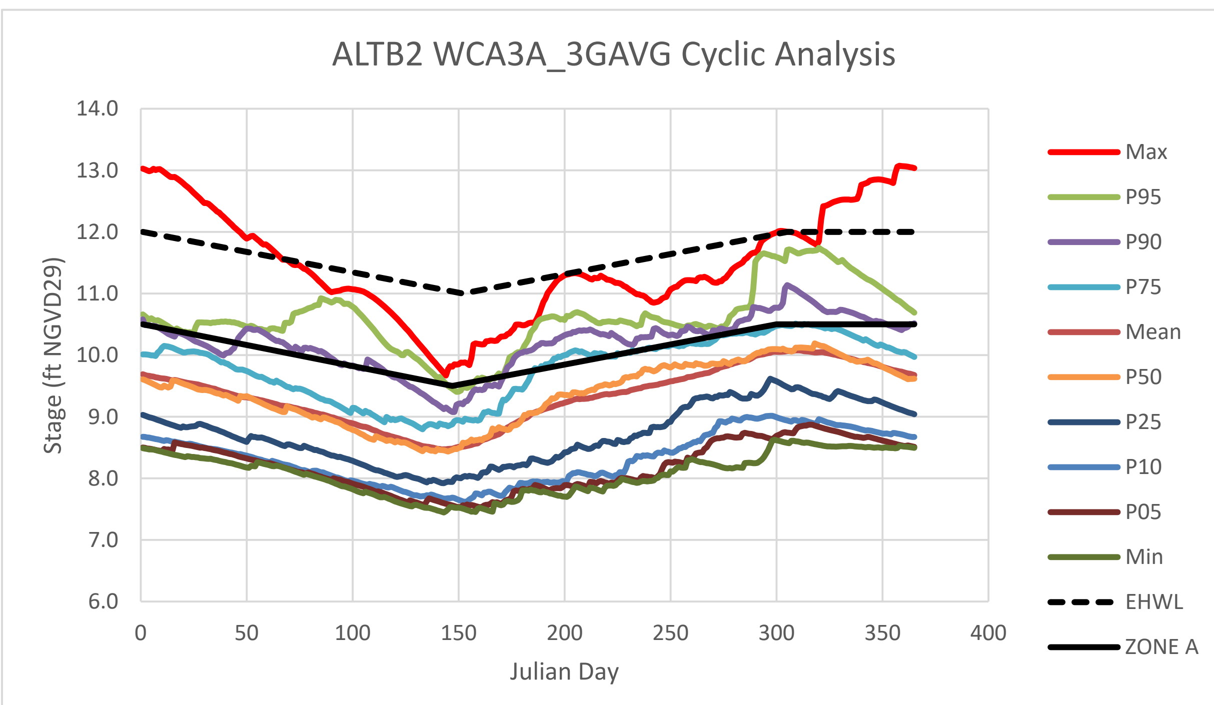

Figure 40. ALTB2 WCA3A_3GAVG Intra-annual Cyclic Analysis

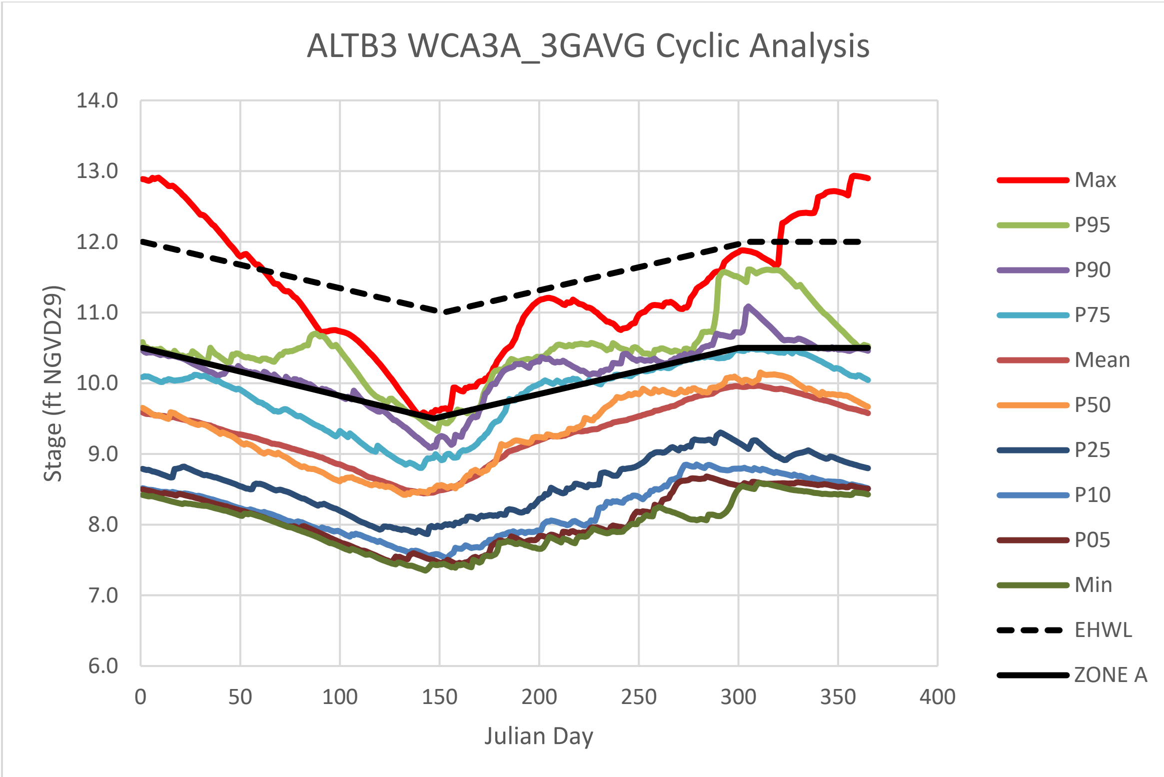

Figure 41. ALTB3 WCA3A_3GAVG Intra-annual Cyclic Analysis

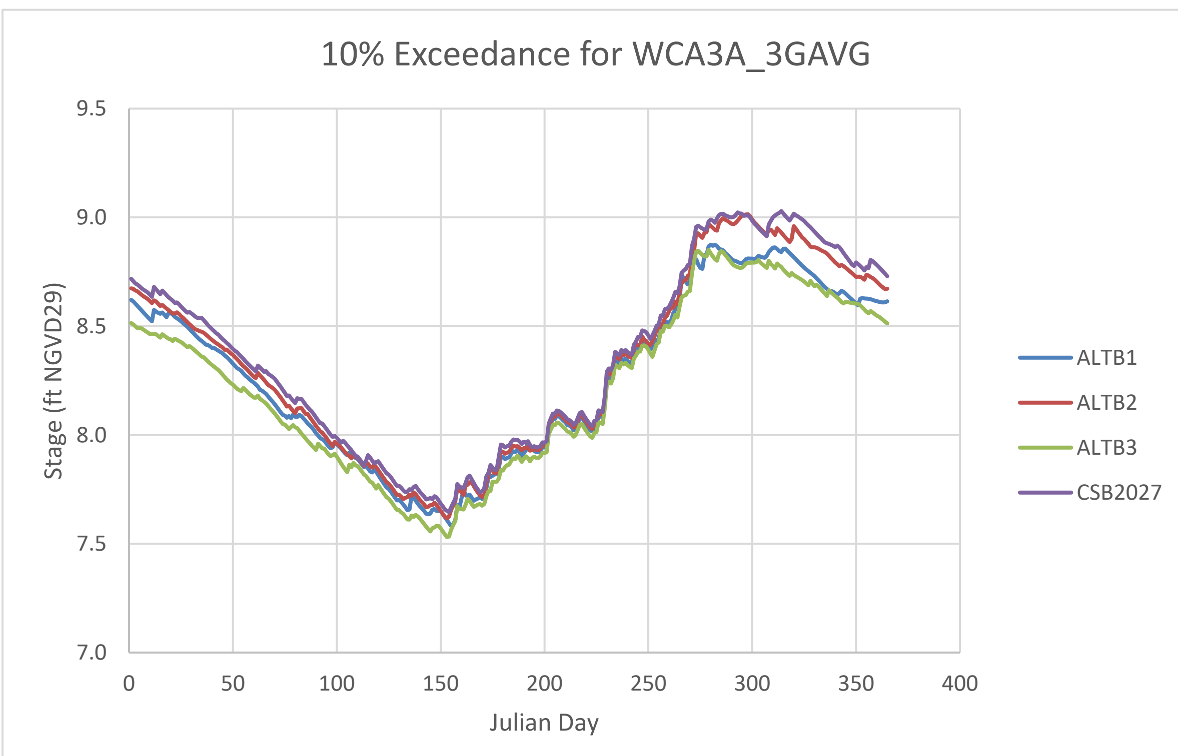

Figure 42. 10% Stage Exceedance for WCA3A_3GAVG

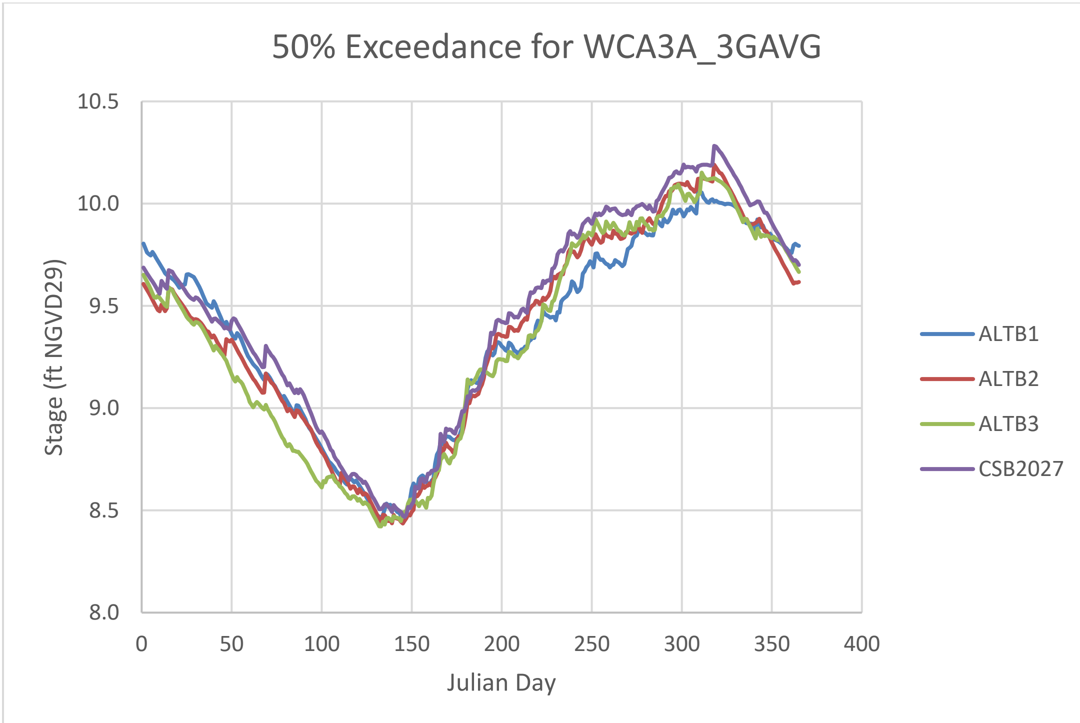

Figure 43. 50% Stage Exceedance for WCA3A_3GAVG

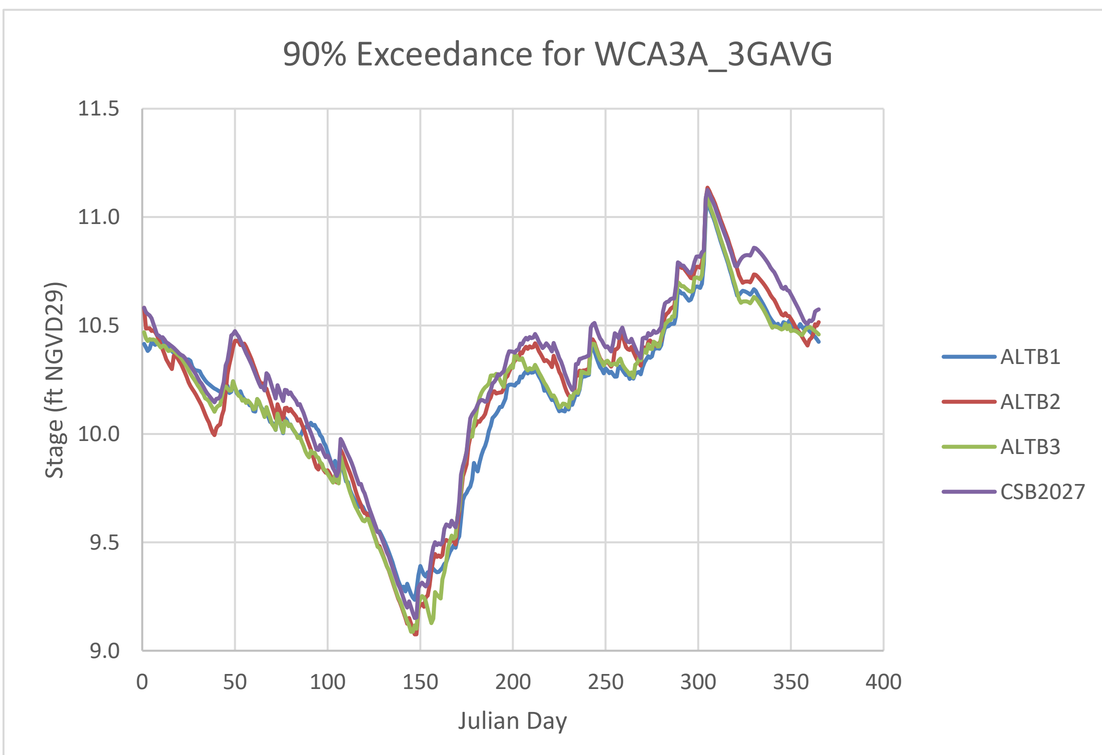

Figure 44. 00% Stage Exceedance for WCA3A_3GAVG

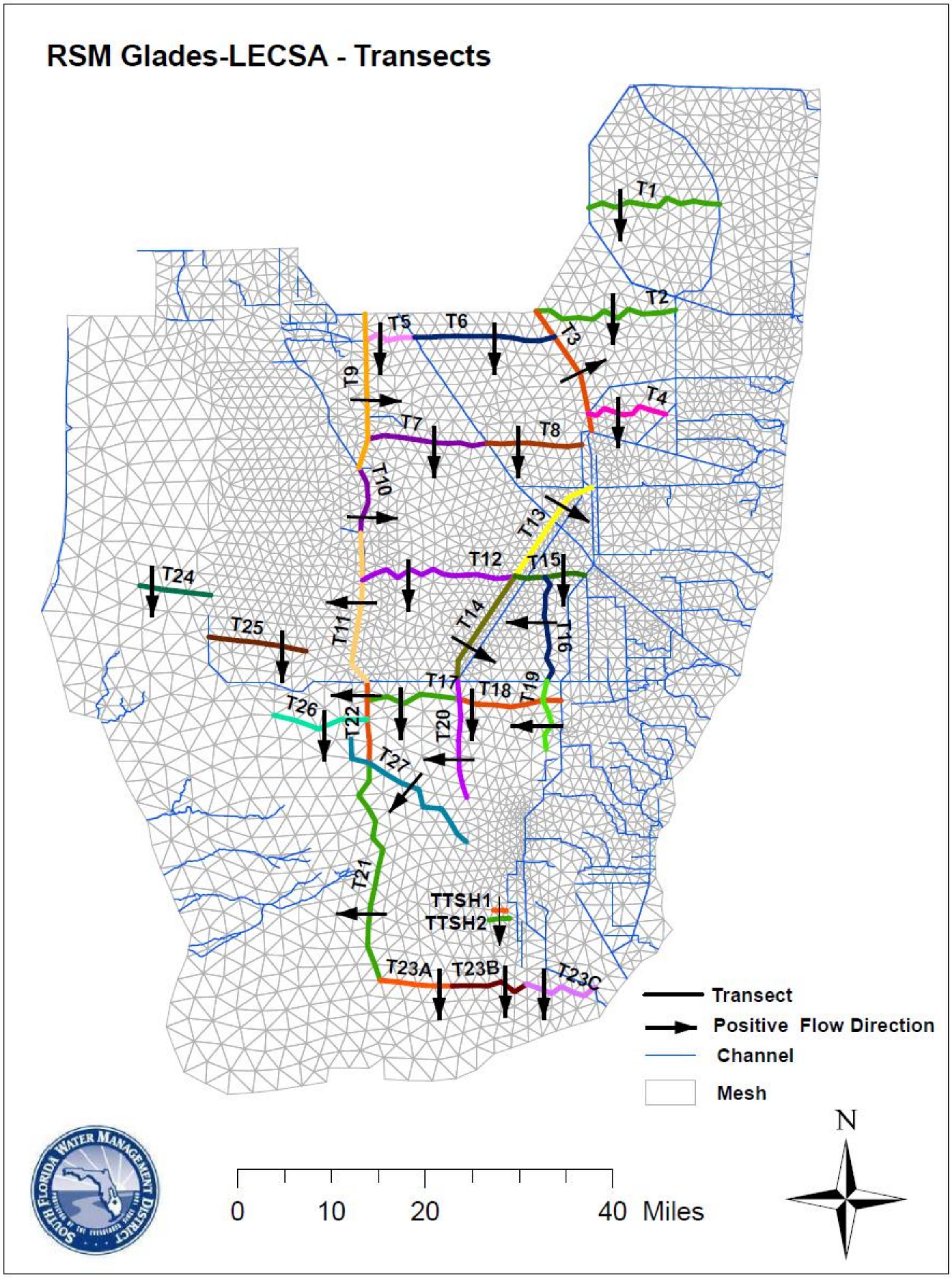

Figure 45. Map of RSM-GL Transect Locations

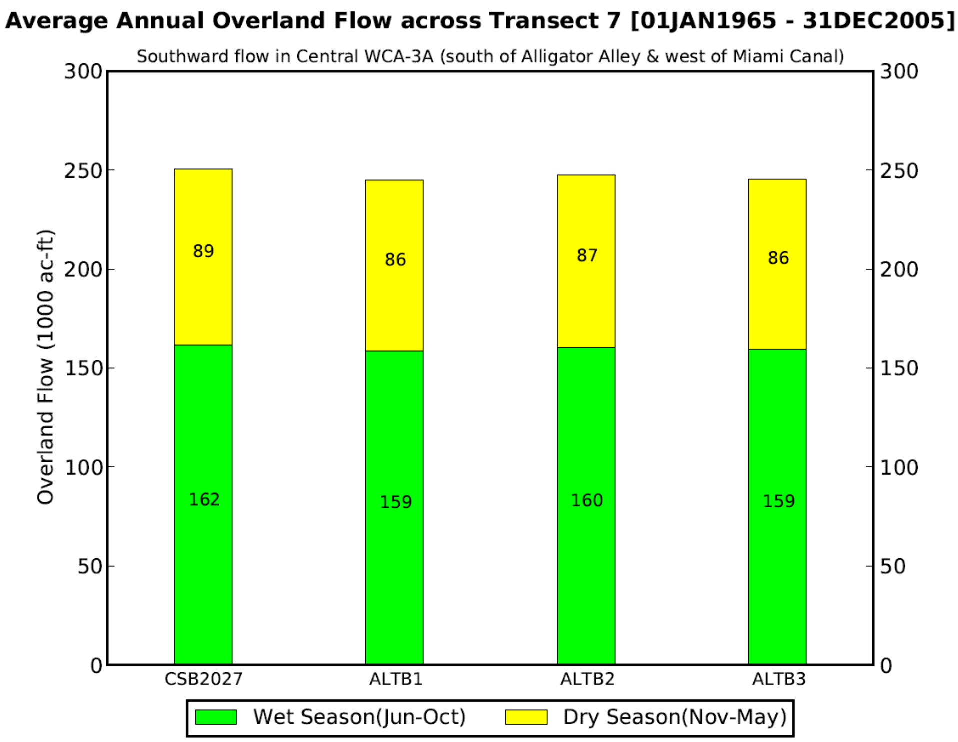

Figure 46. Average Annual Overland Flow Across Transect 7

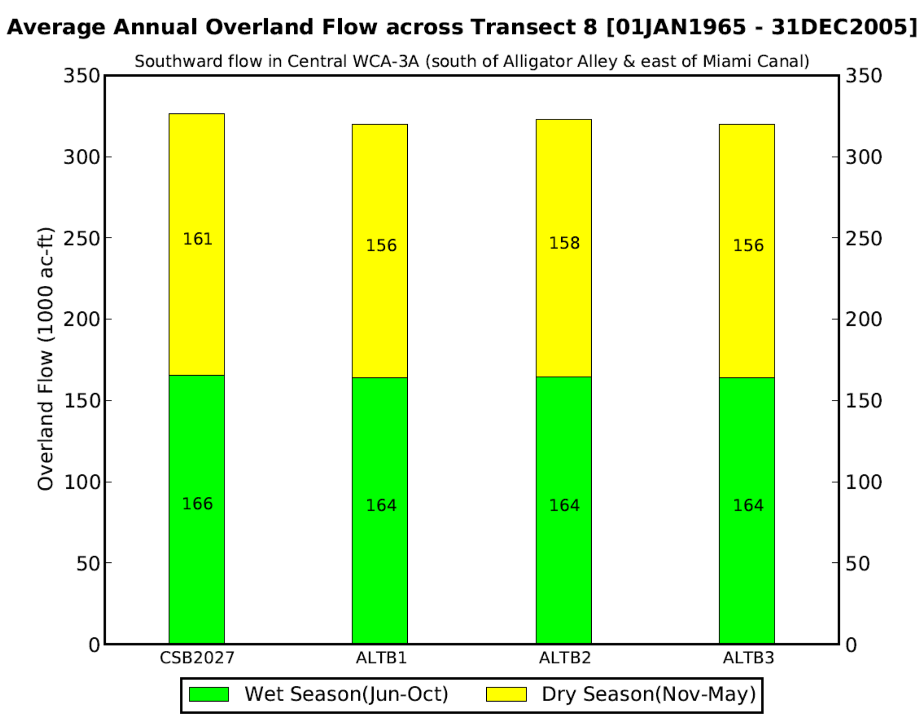

Figure 47. Average Annual Overland Flow Across Transect 8

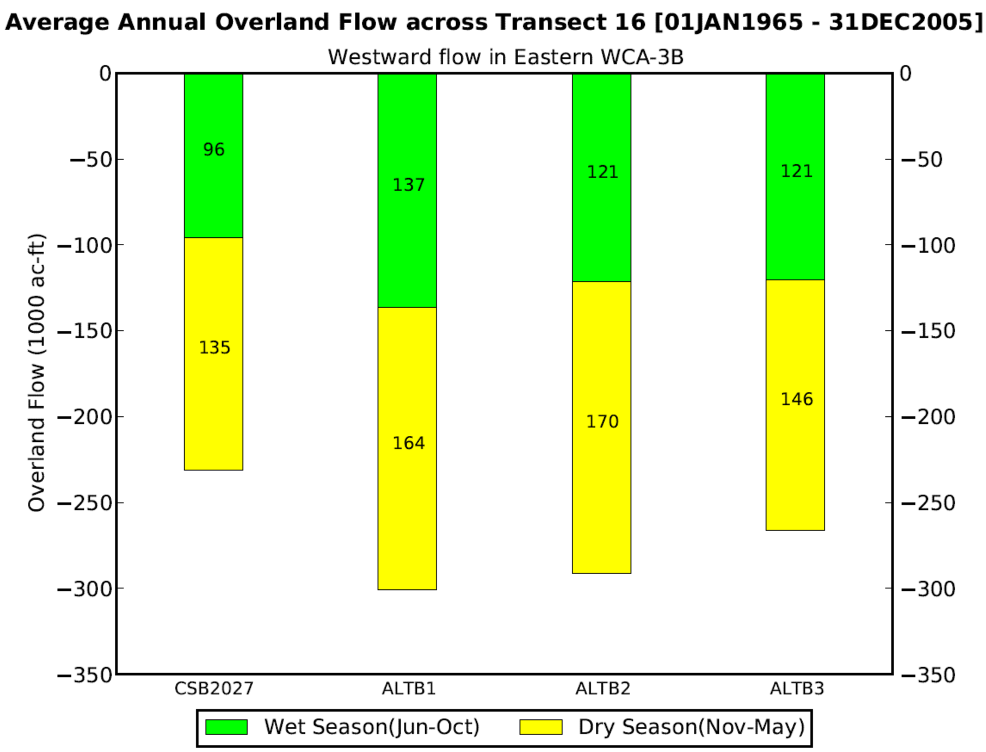

Figure 48. Average Annual Overland Flow Across Transect 16

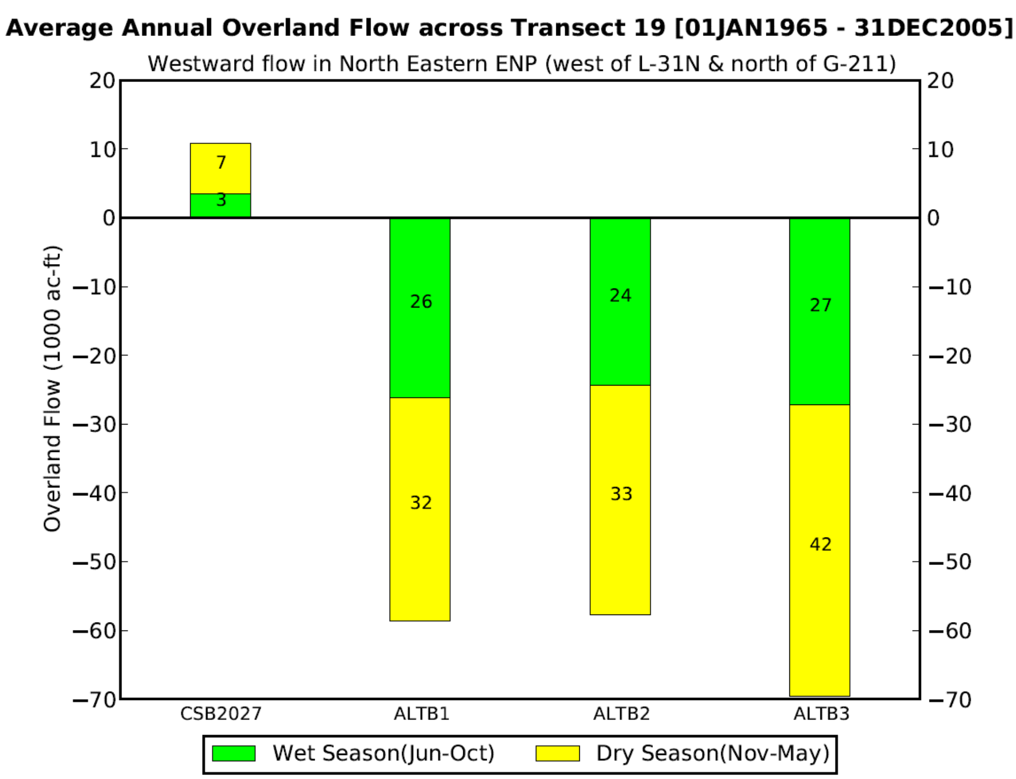

Figure 49. Average Annual Overland Flow Across Transect 19

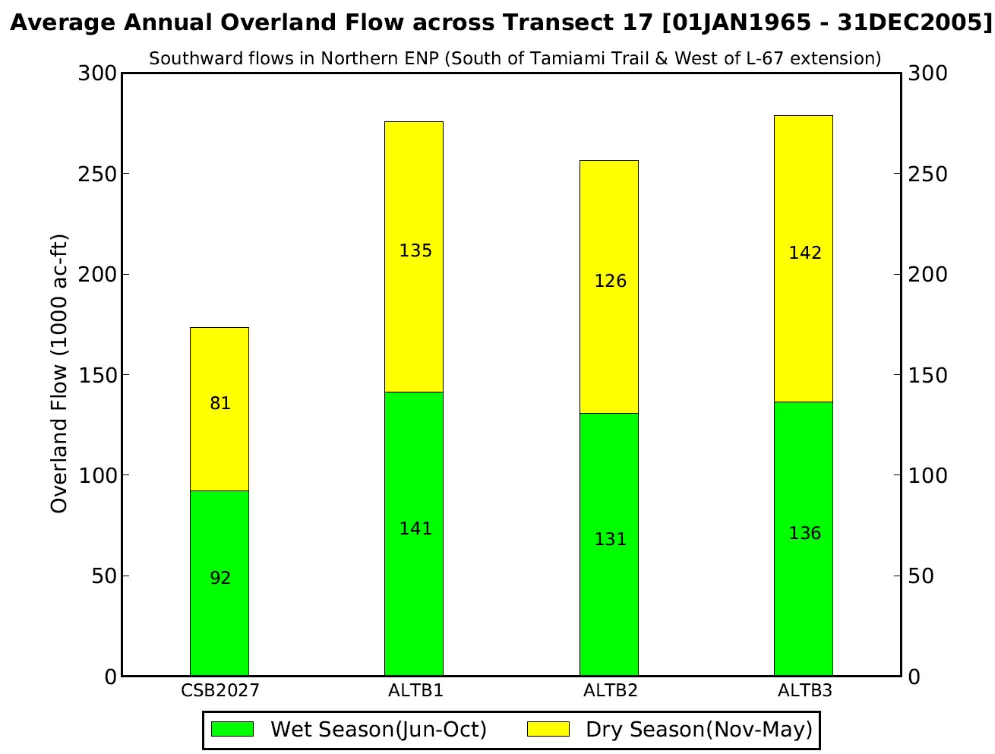

Figure 50. Average Annual Overland Flow Across Transect 17

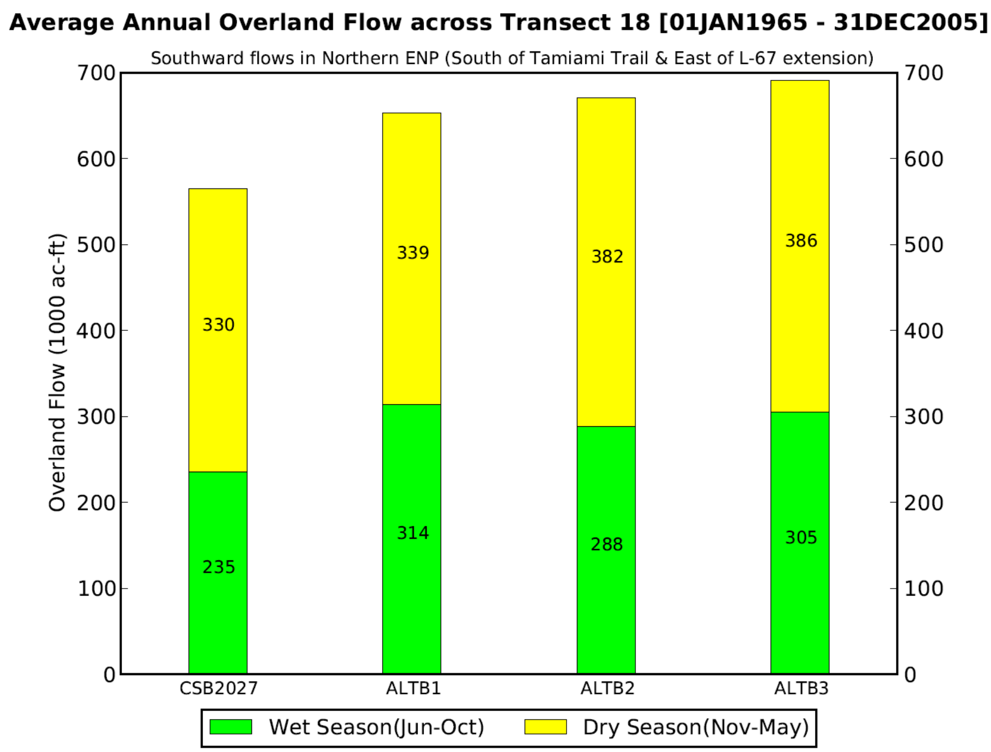

Figure 51. Average Annual Overland Flow Across Transect 18

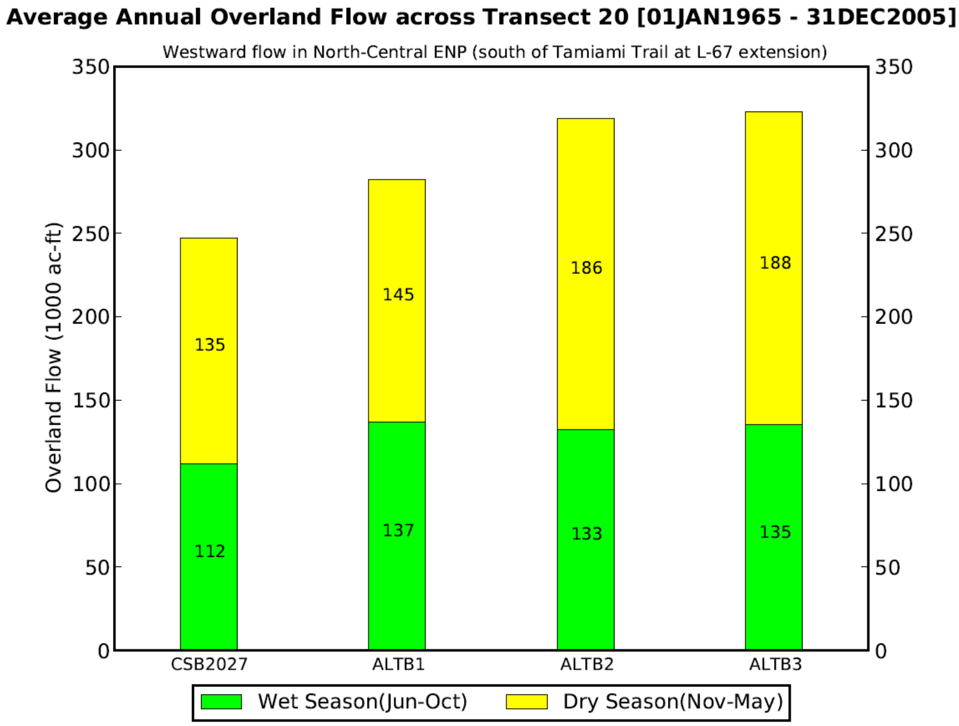

Figure 52. Average Annual Overland Flow Across Transect 20

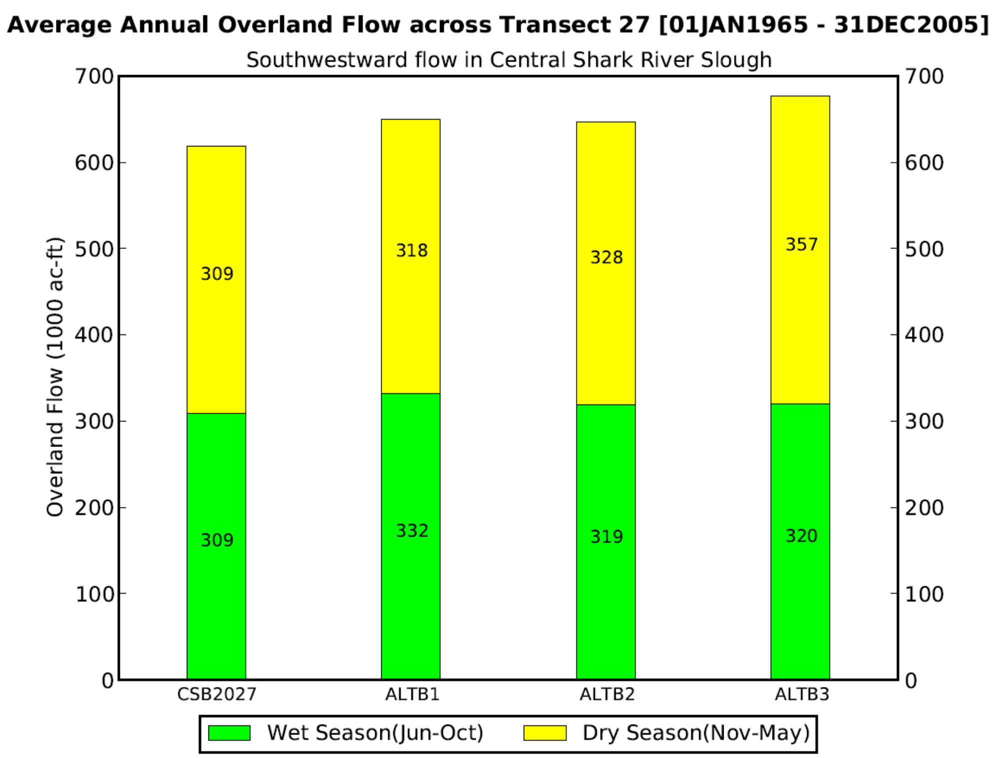

Figure 53. Average Annual Overland Flow Across Transect 27

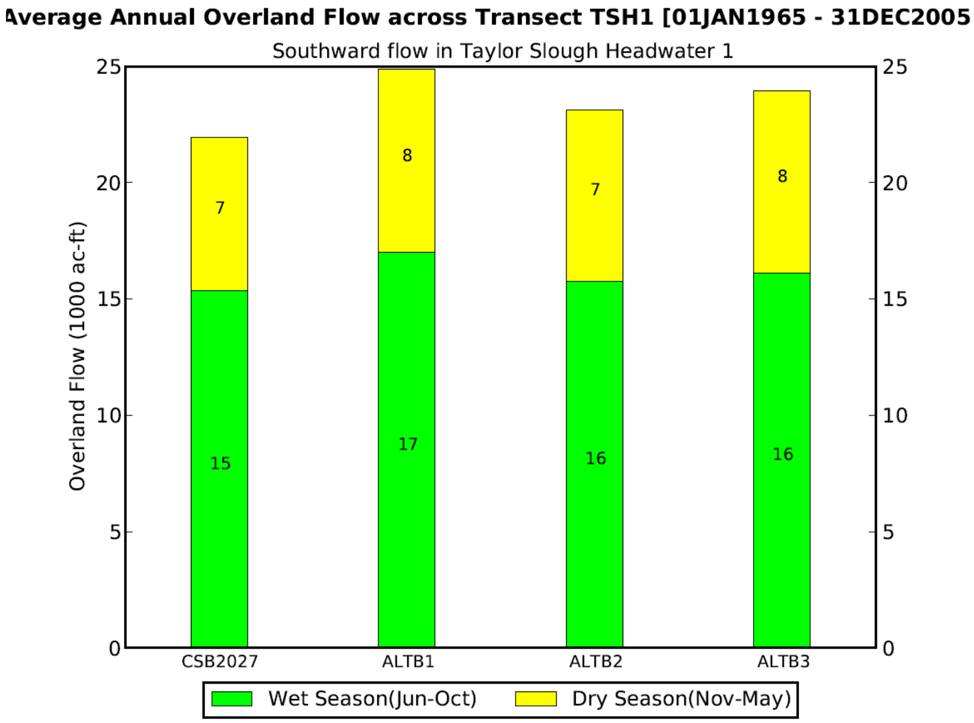

Figure 54. Average Annual Overland Flow Across Transect TSH1

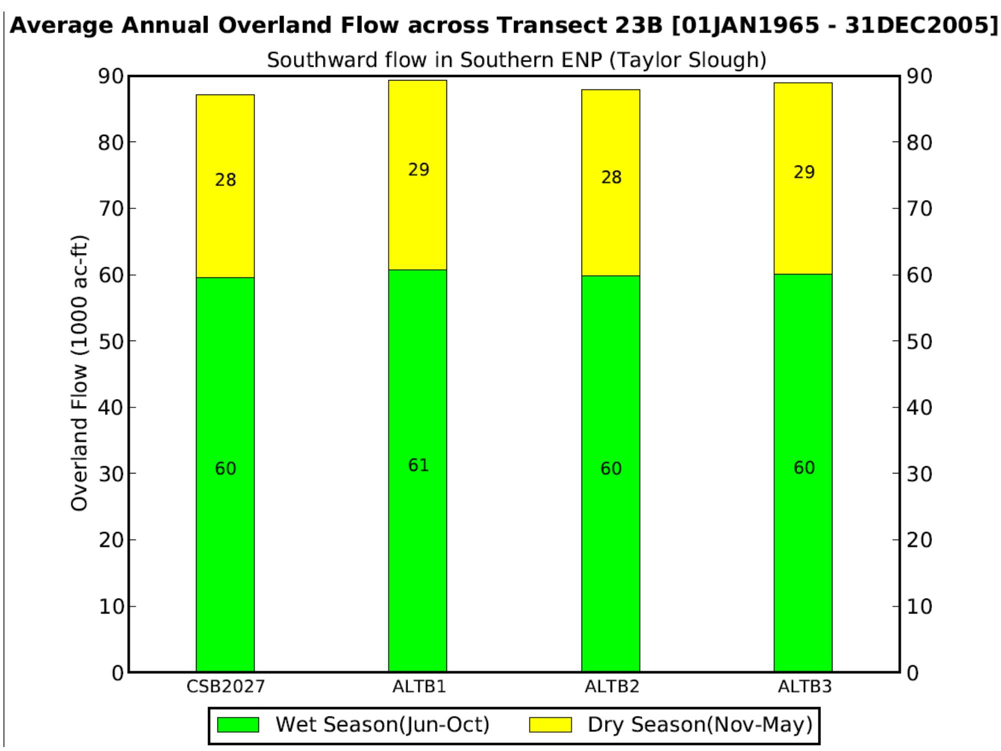

Figure 55. Average Annual Overland Flow Across Transect 23B

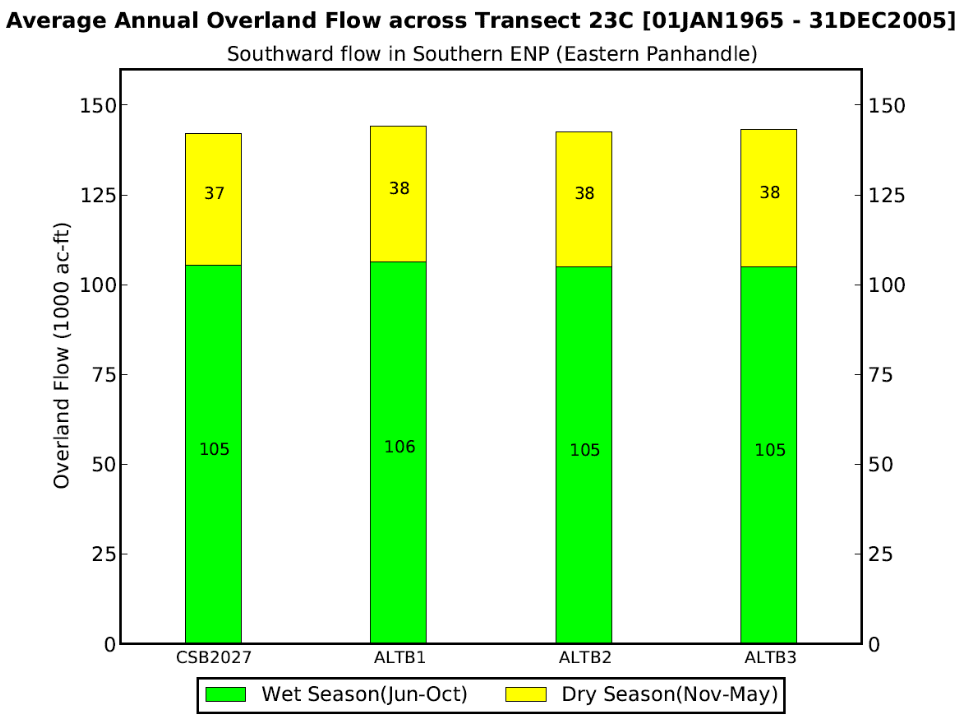

Figure 56. Average Annual Overland Flow Across Transect 23C

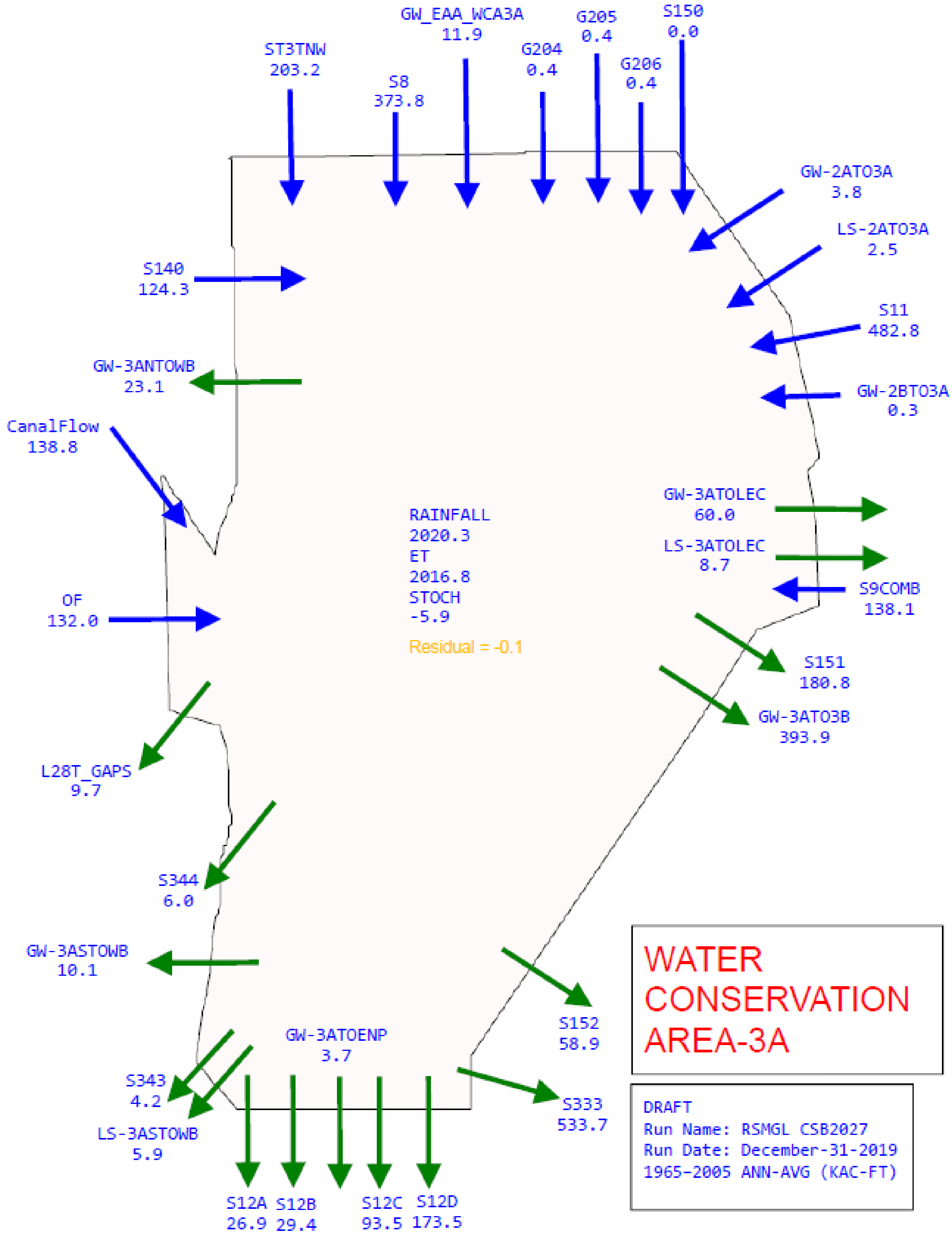

Figure 57. WCA-3A Water Budget for CSB2027

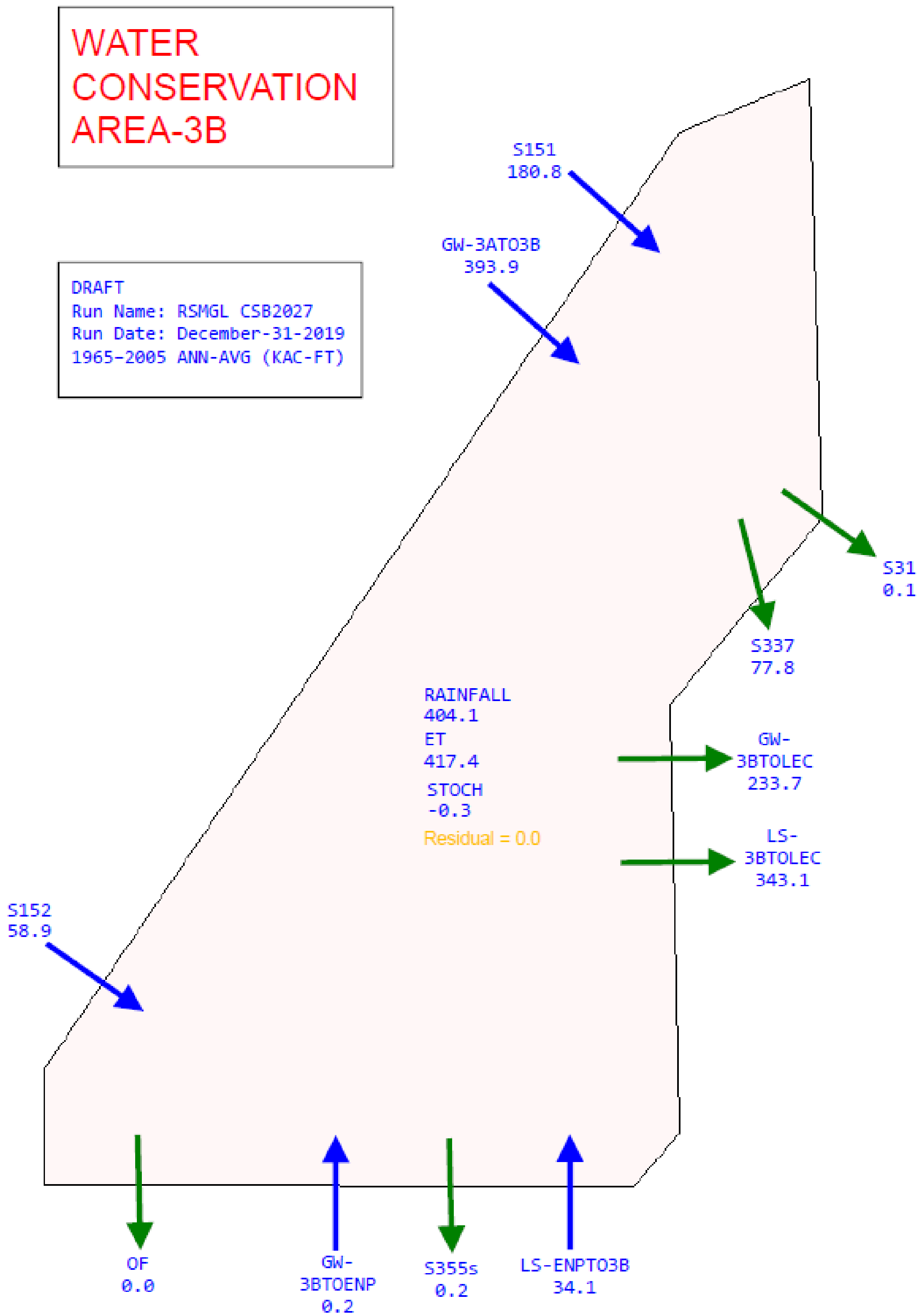

Figure 58. WCA-3B Water Budget for CSB2027

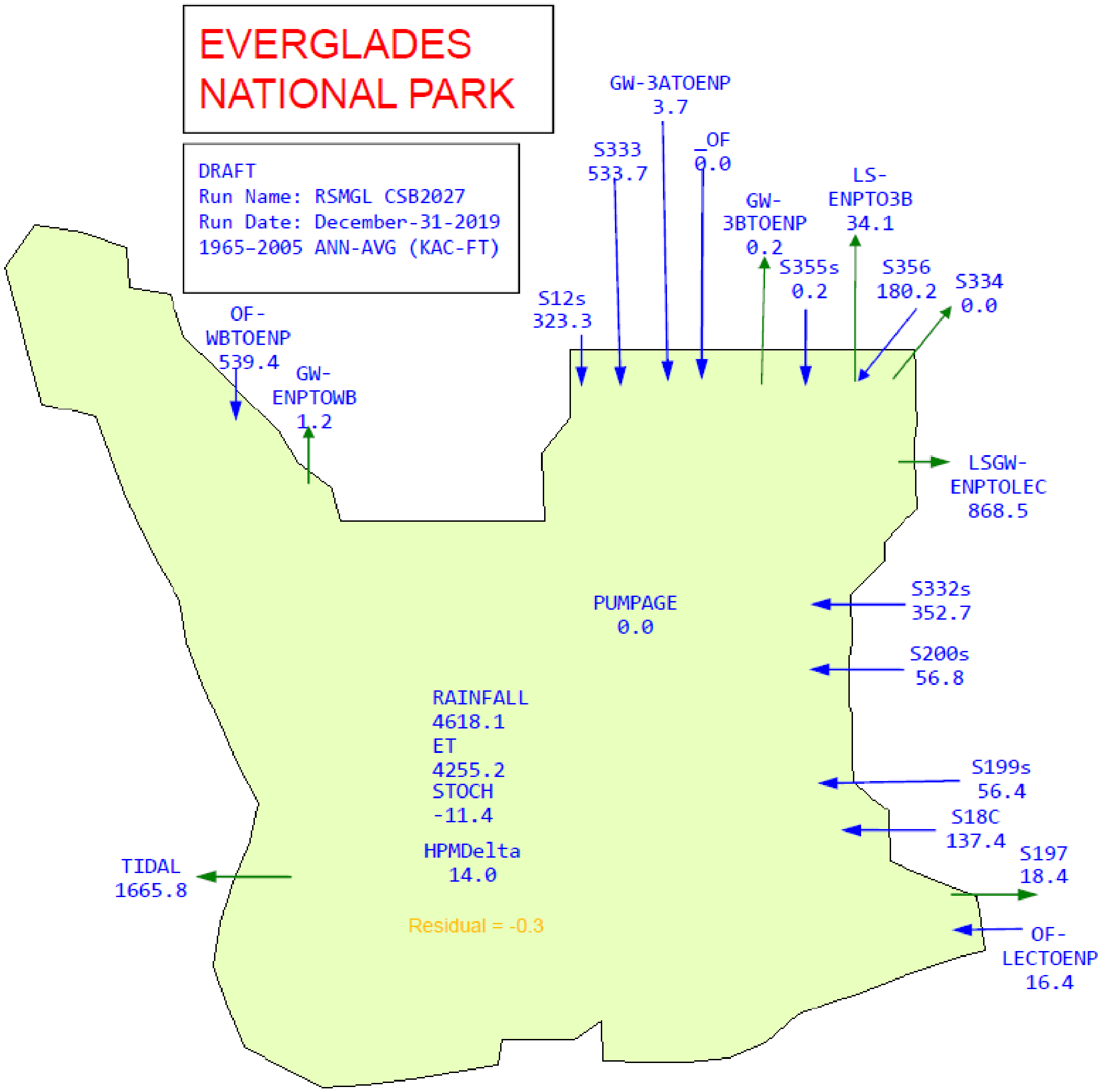

Figure 59. ENP Water Budget for CSB2027

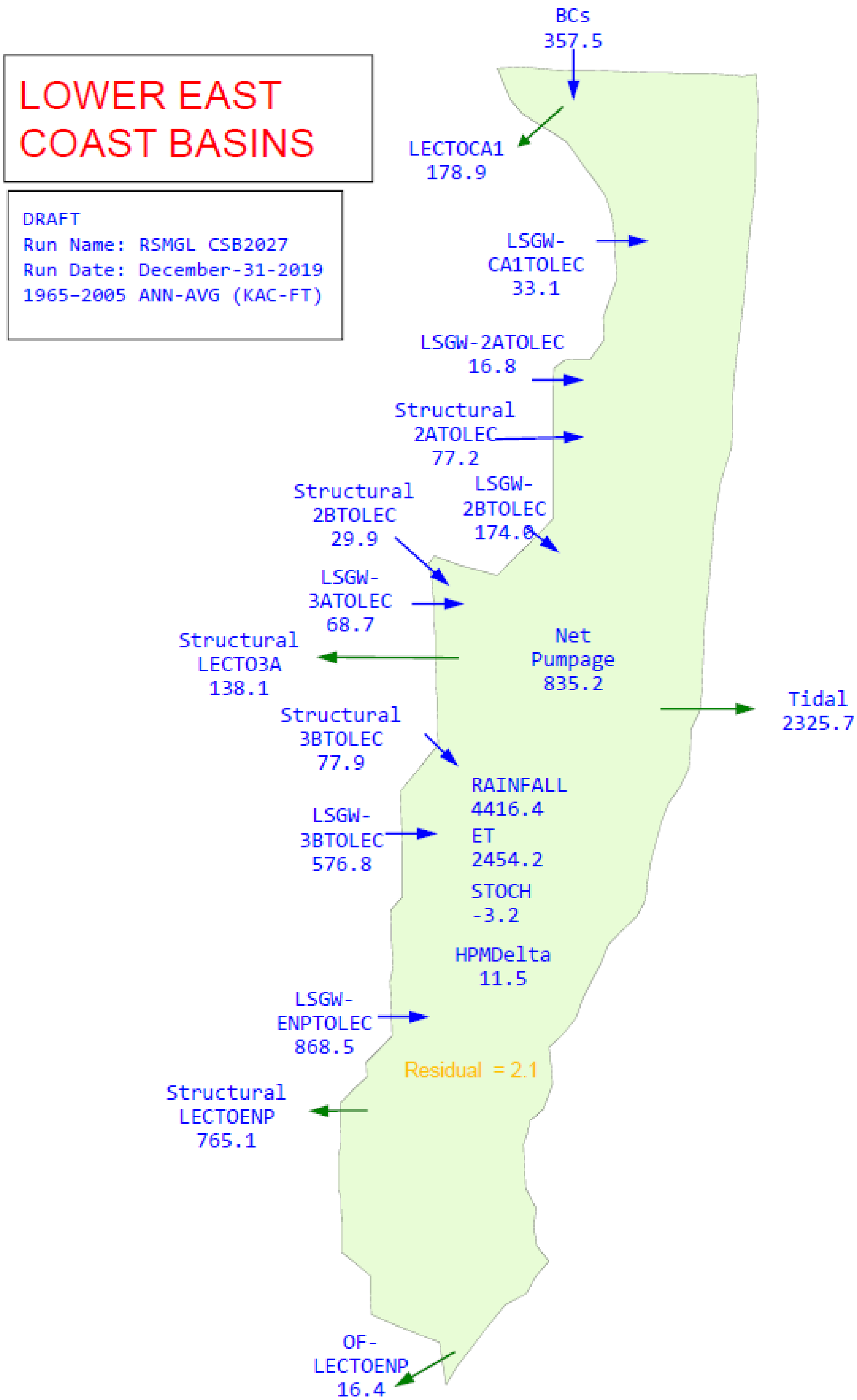

Figure 60. WCA-3A Lower East Coast Water Budget for CSB2027

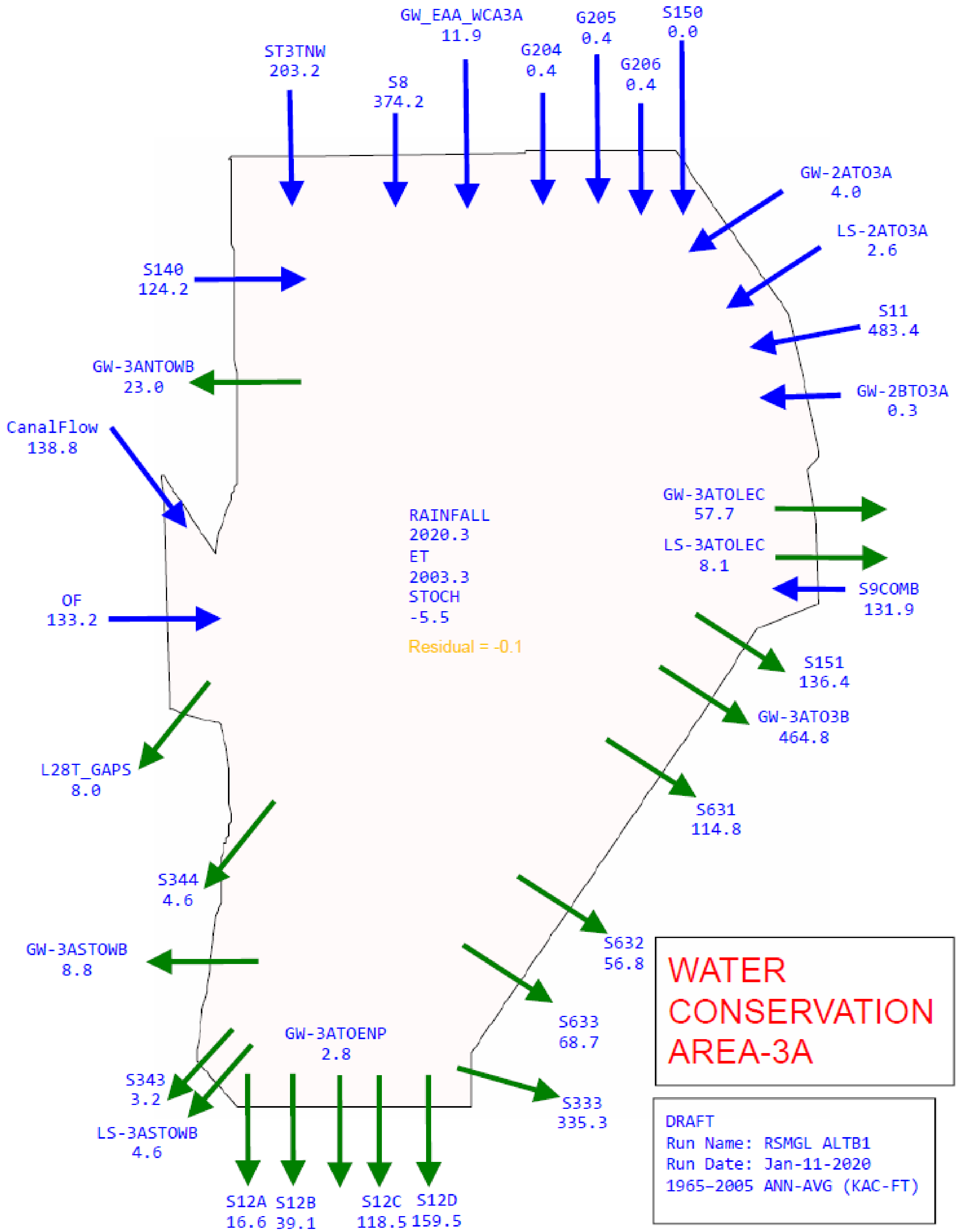

Figure 61. WCA-3A Water Budget for ALTB1

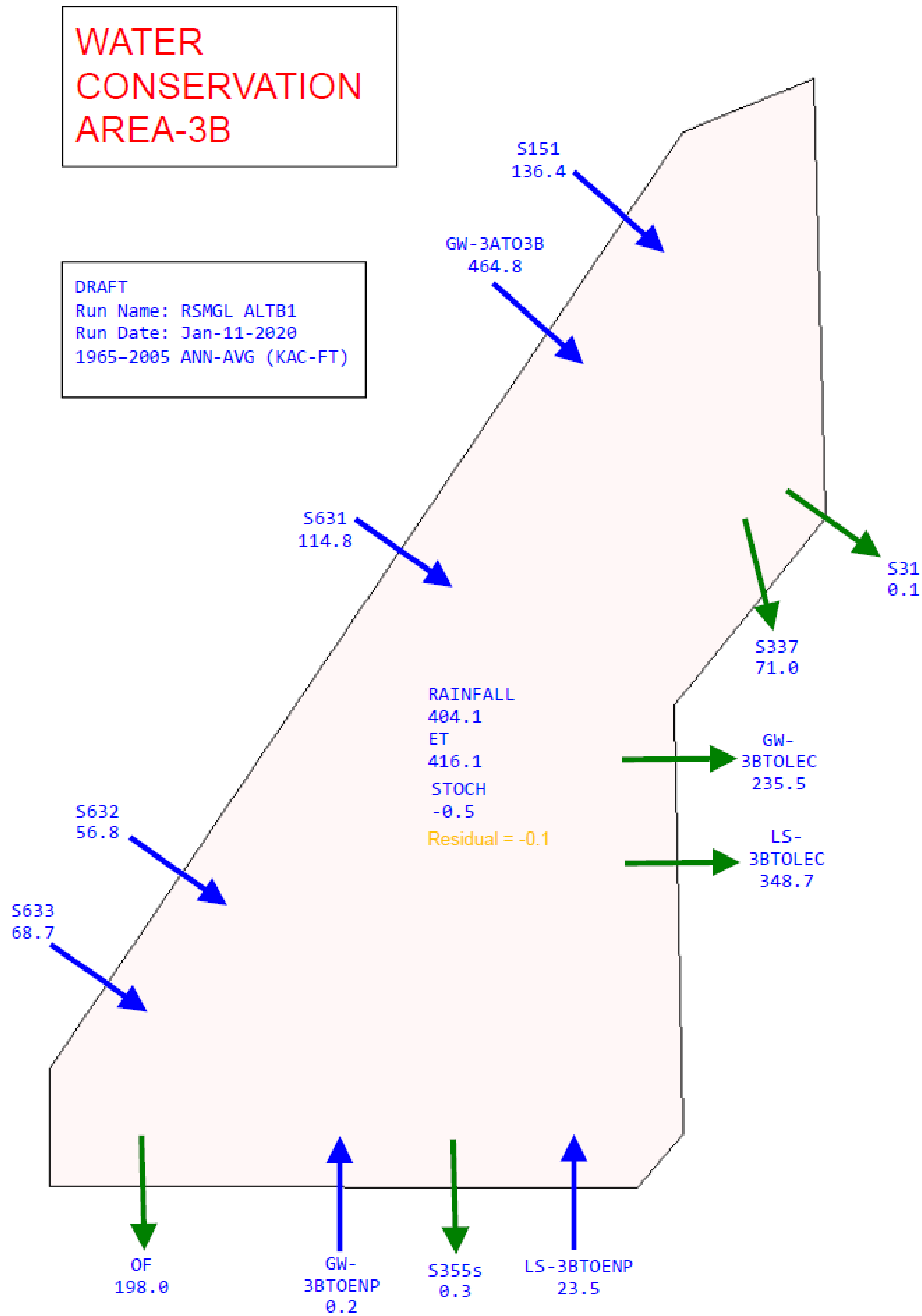

Figure 62. WCA-3B Water Budget for ALTB1

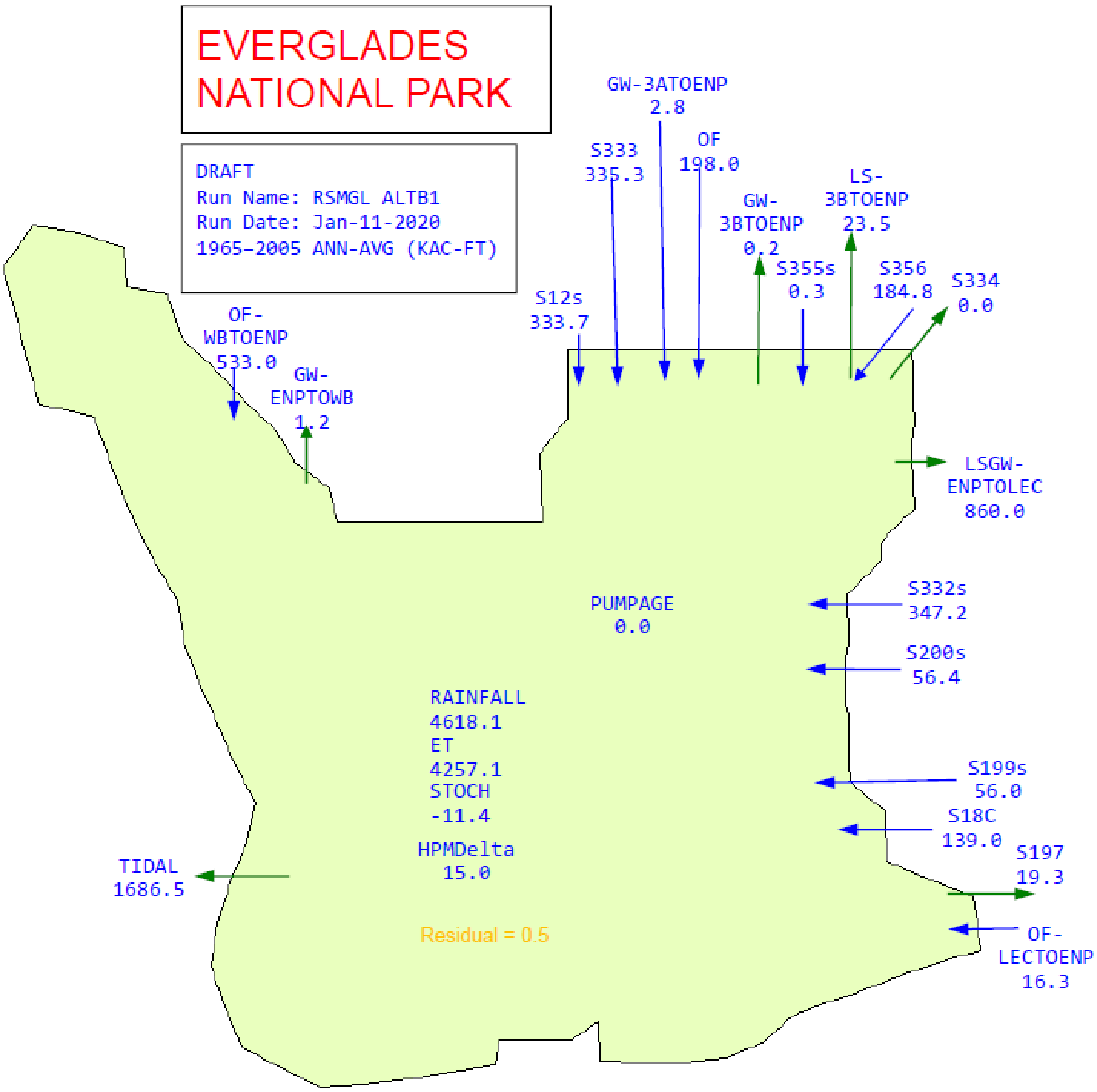

Figure 63. ENP Water Budget for ALTB1

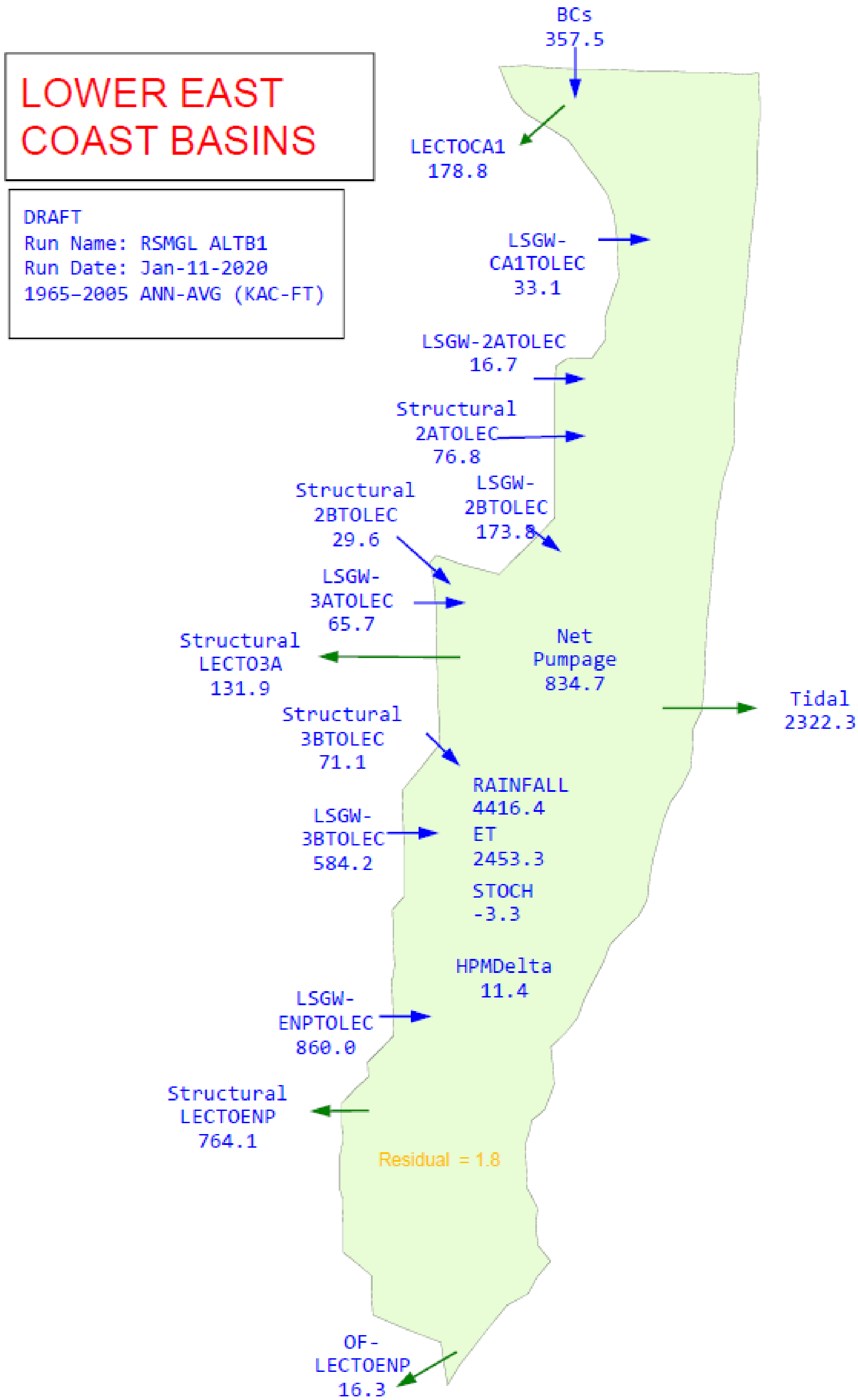

Figure 64. Lower East Coast Water Budget for ALTB1

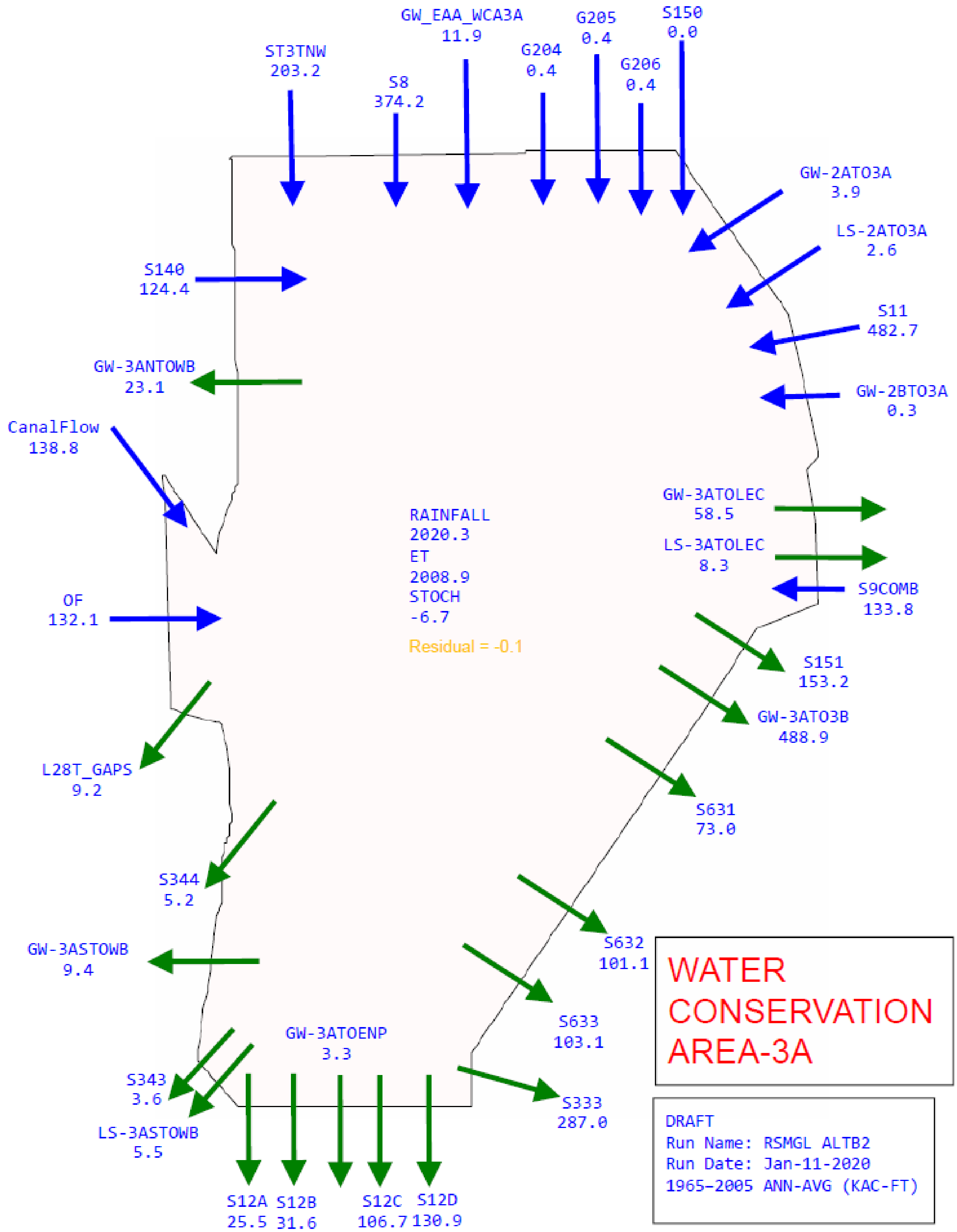

Figure 65. WCA-3A Water Budget for ALTB2

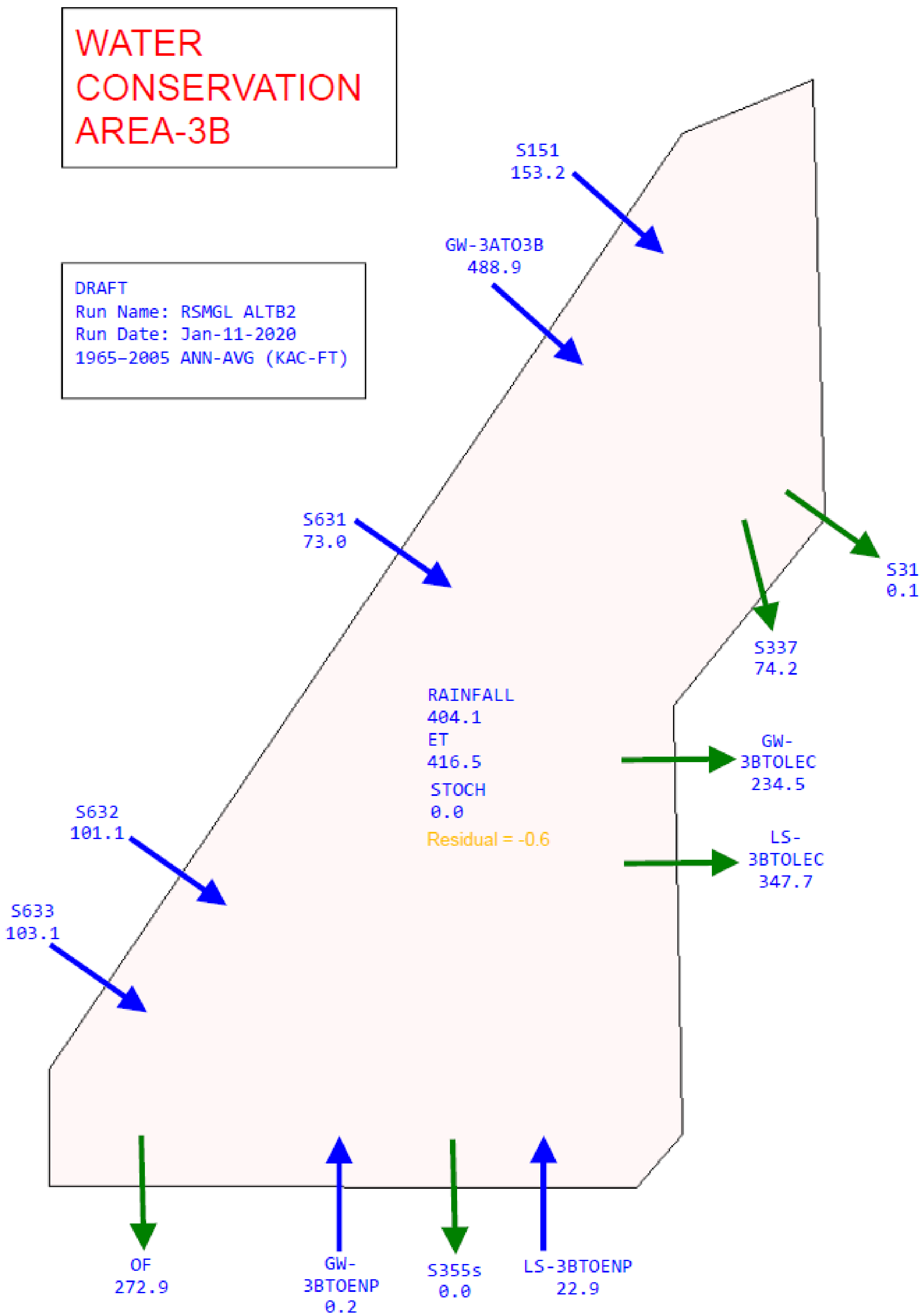

Figure 66. WCA-3B Water Budget for ALTB2

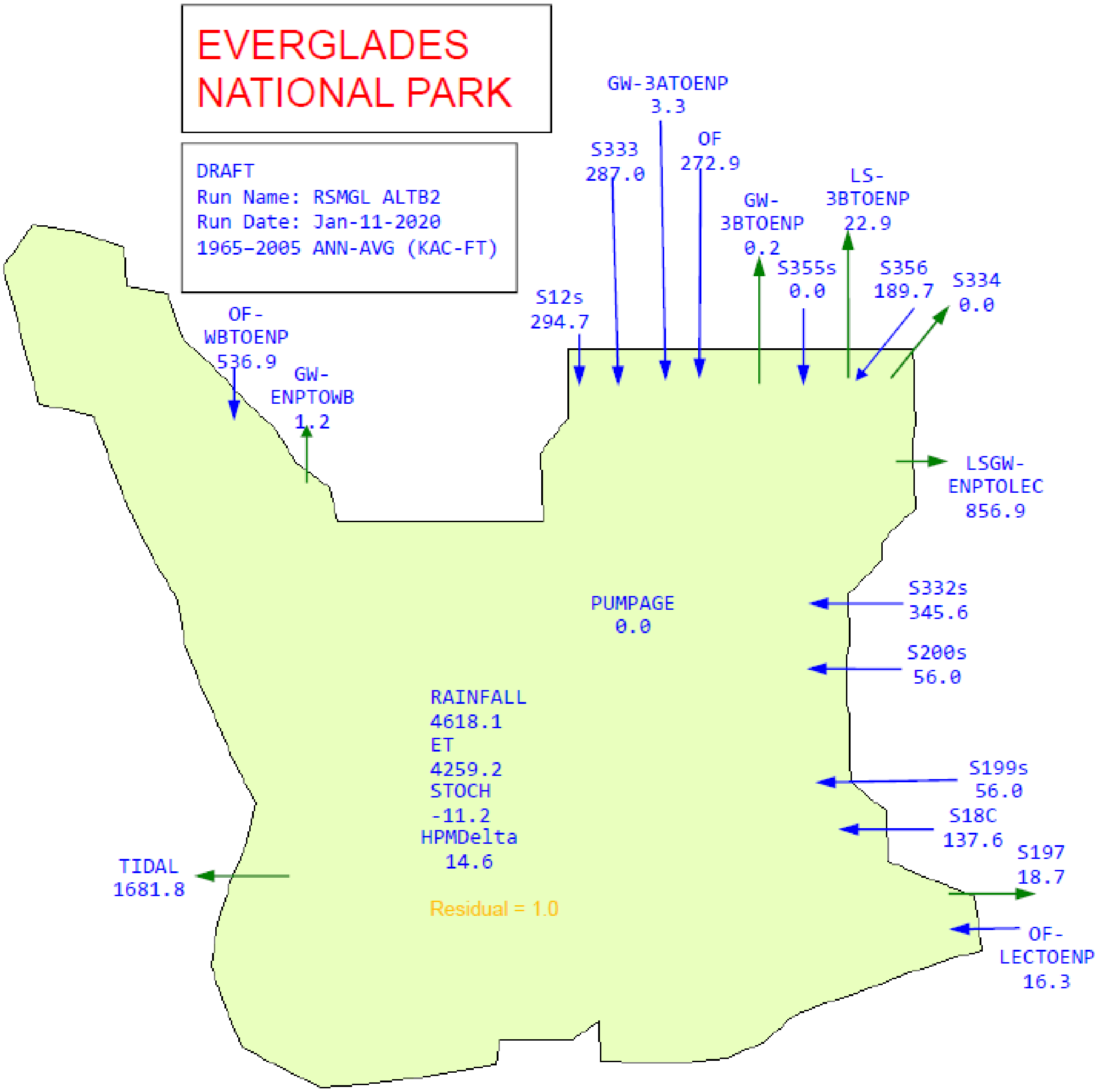

Figure 67. ENP Water Budget for ALTB2

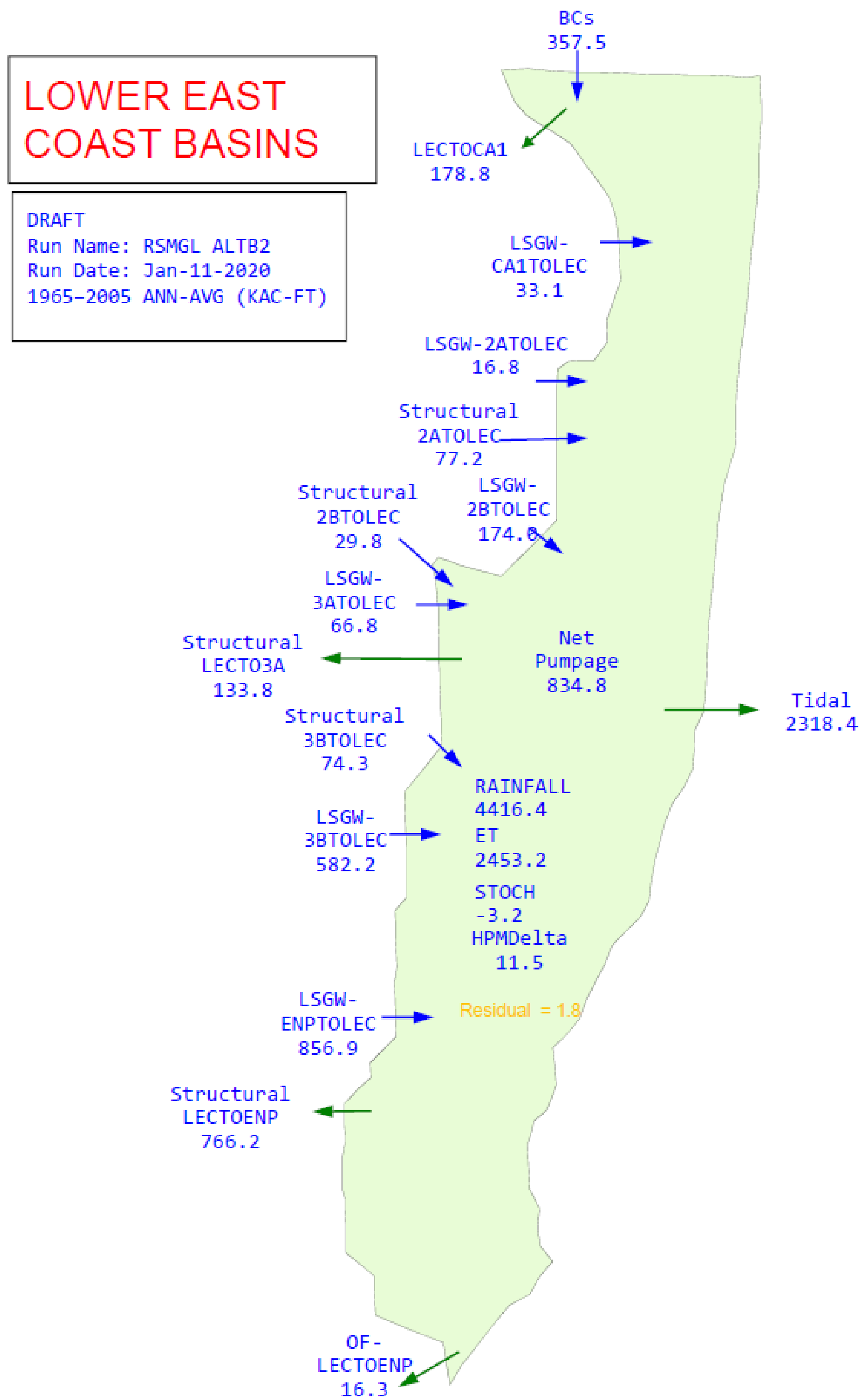

Figure 68. Lower East Coast Water Budget for ALTB2

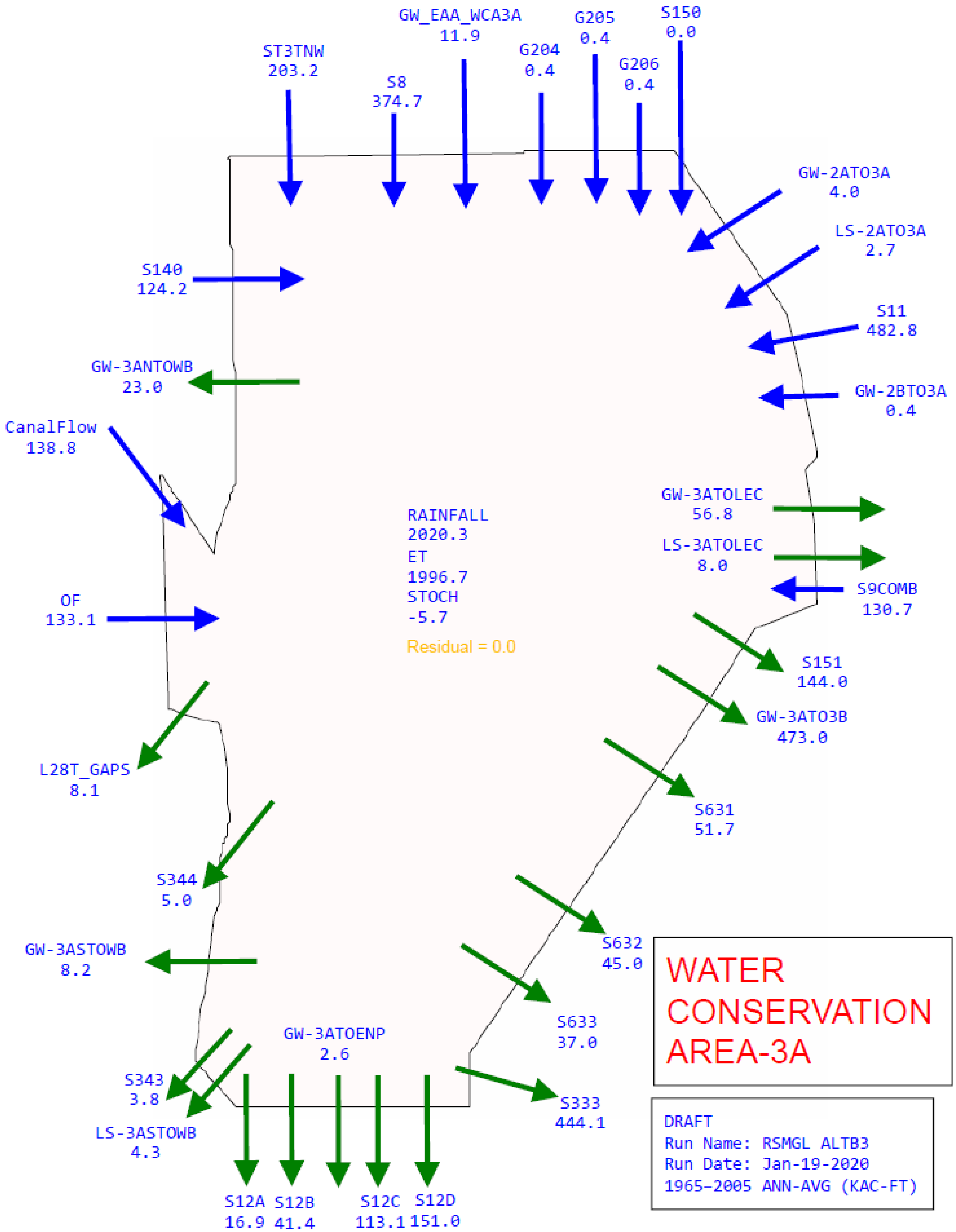

Figure 69. WCA-3A Water Budget for ALTB3

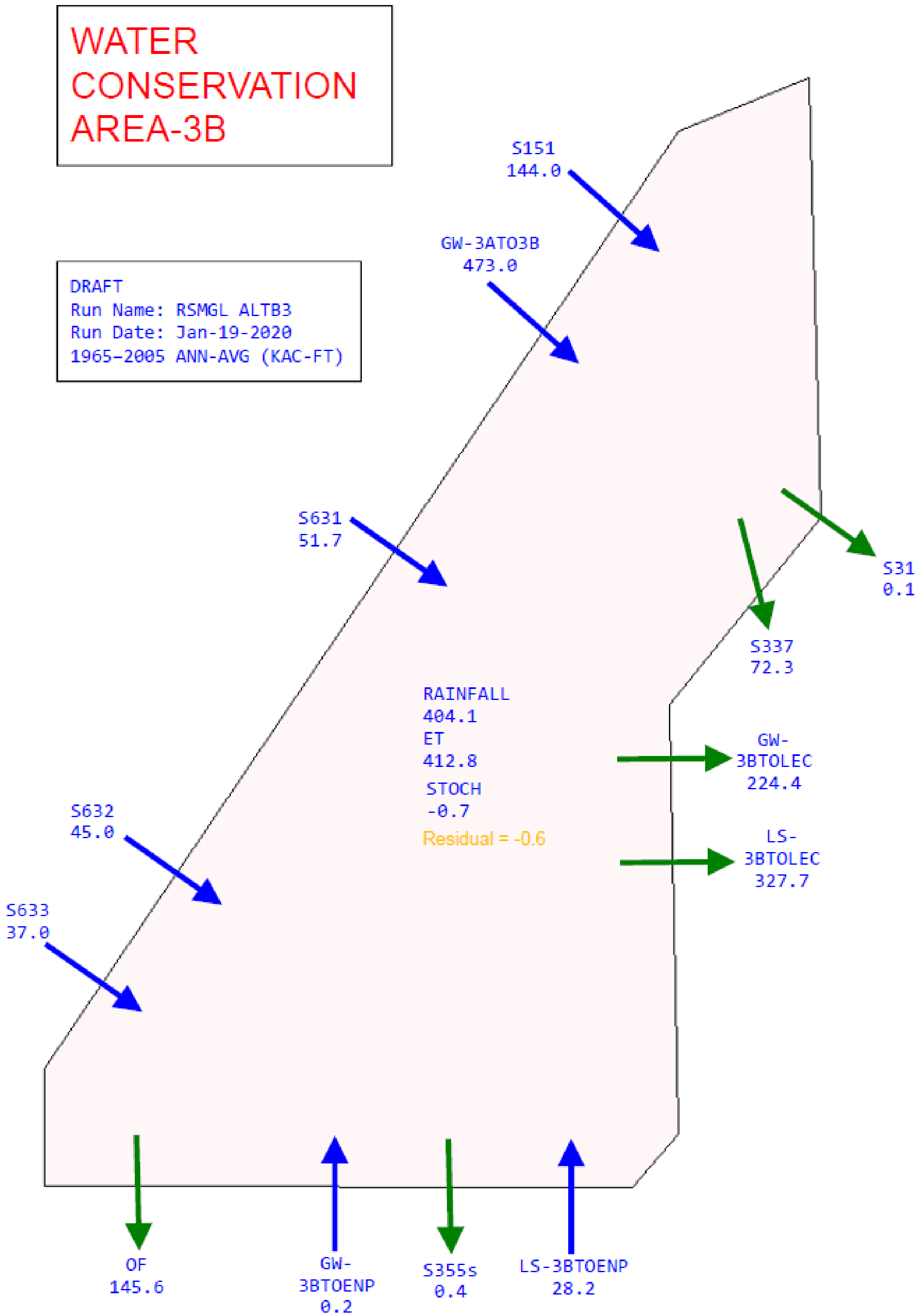

Figure 70. WCA-3B Water Budget for ALTB3

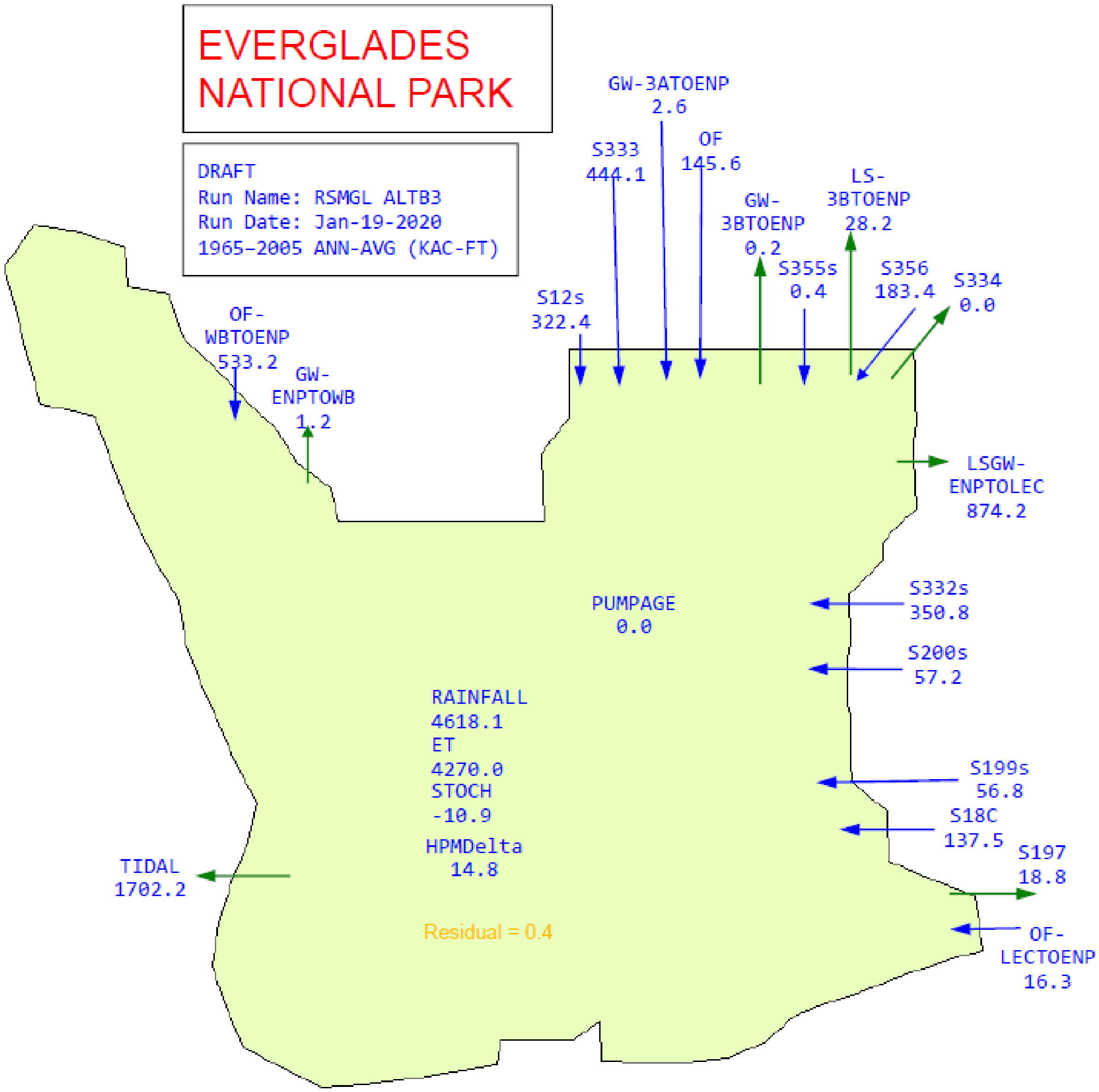

Figure 71. ENP Water Budget for ALTB3

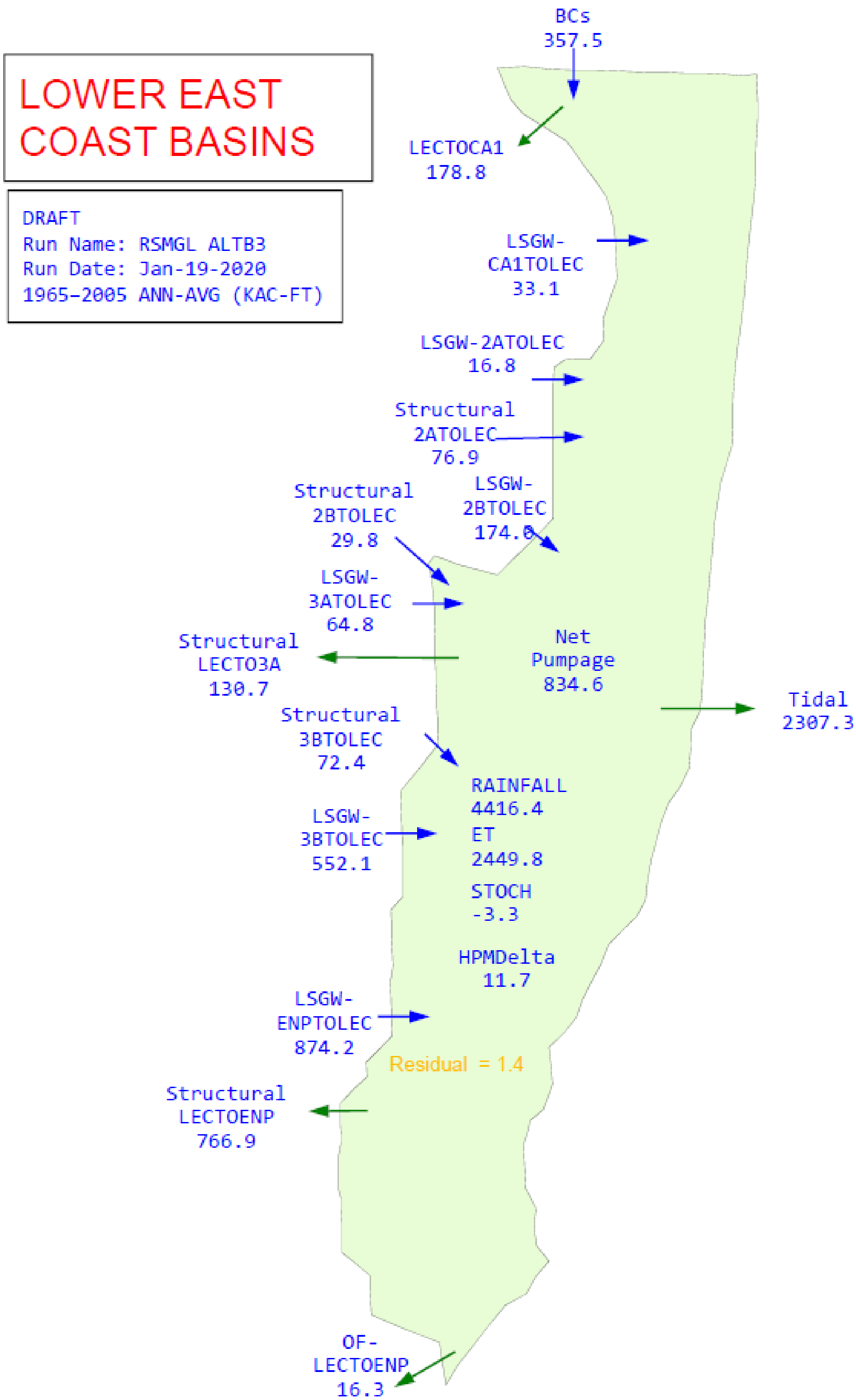

Figure 72. Lower East Coast Water Budget for ALTB3

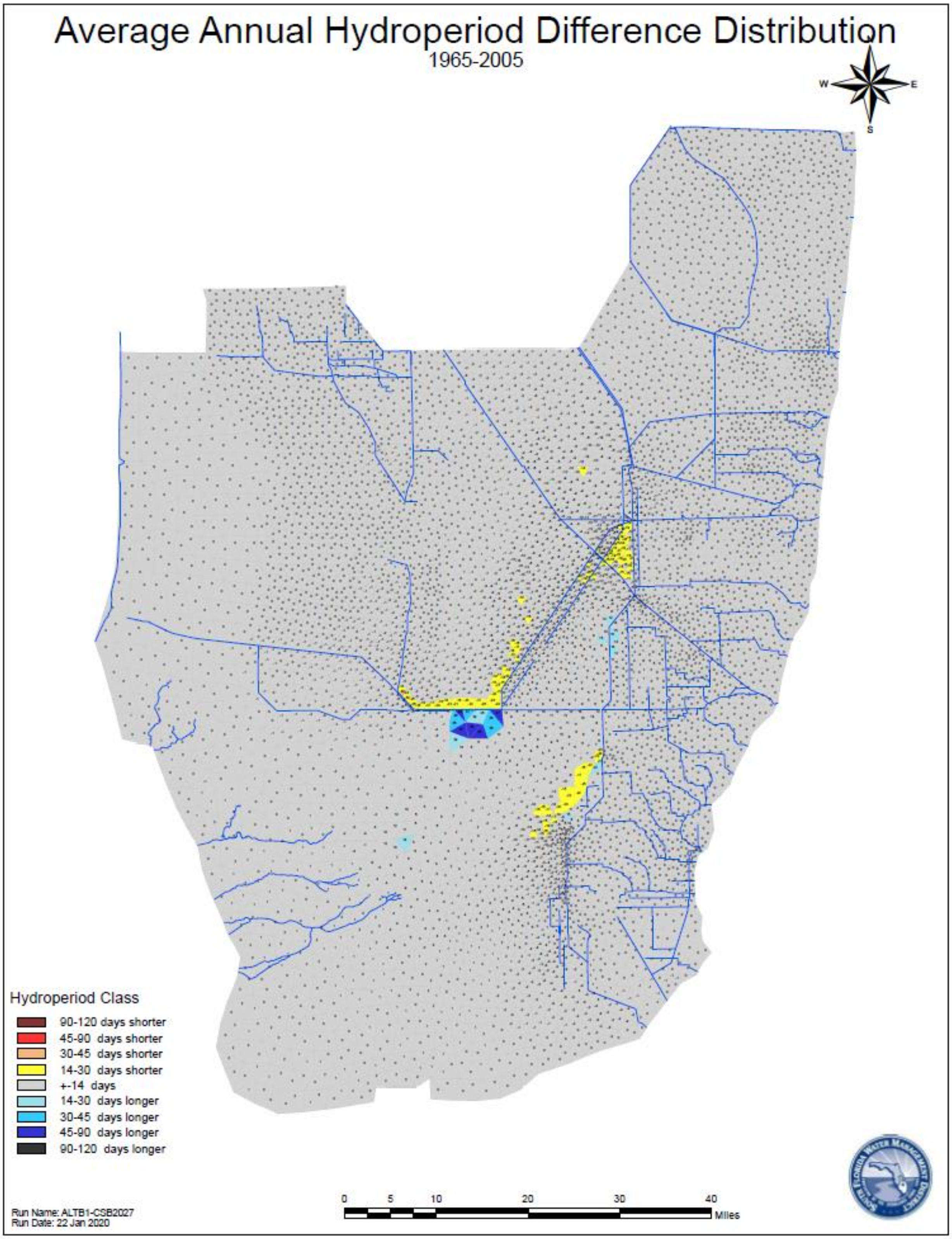

Figure 73. Average Annual Hydroperiod Difference Distribution for ALTB1-CSB2027

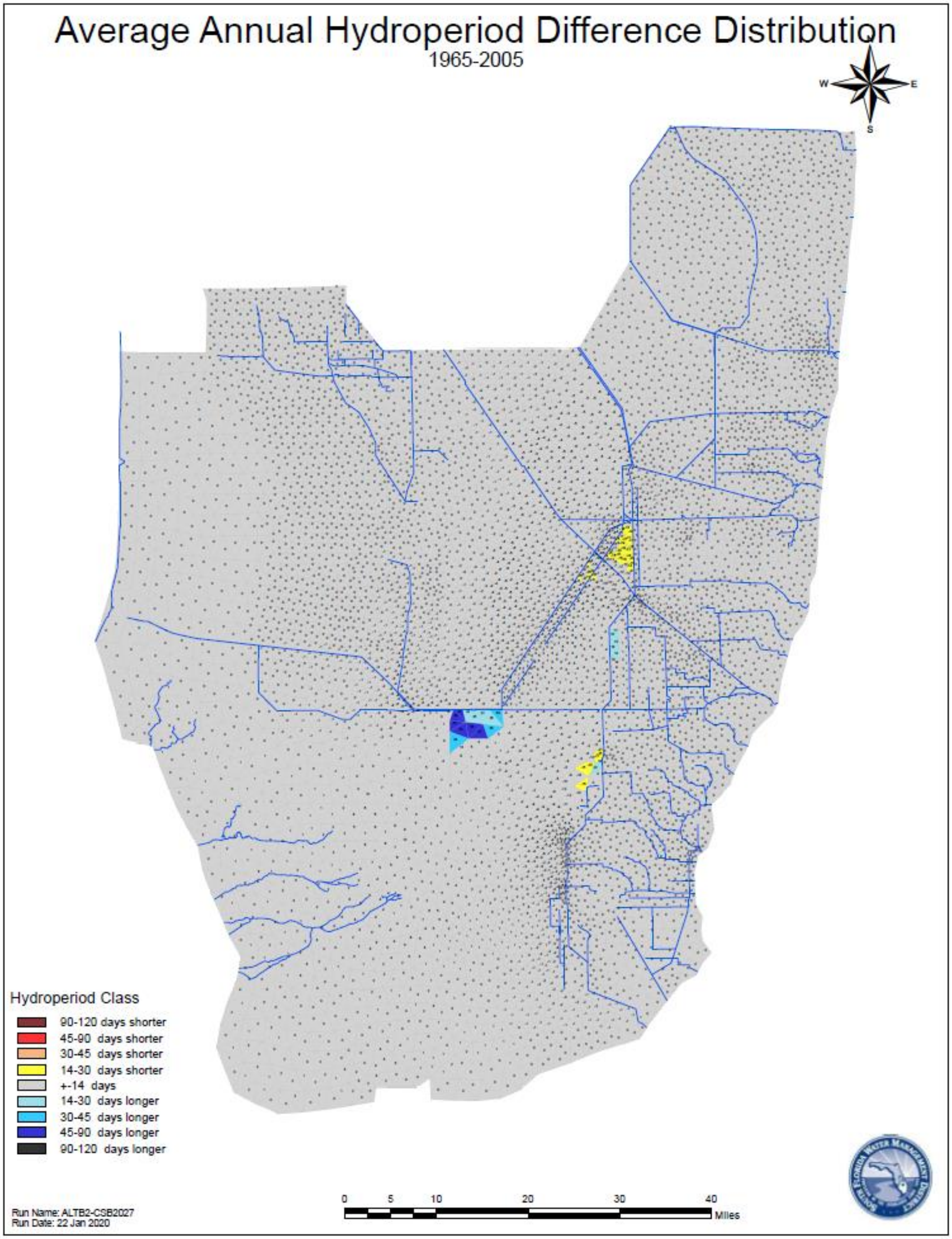

Figure 74. Average Annual Hydroperiod Difference Distribution for ALTB2-CSB2027

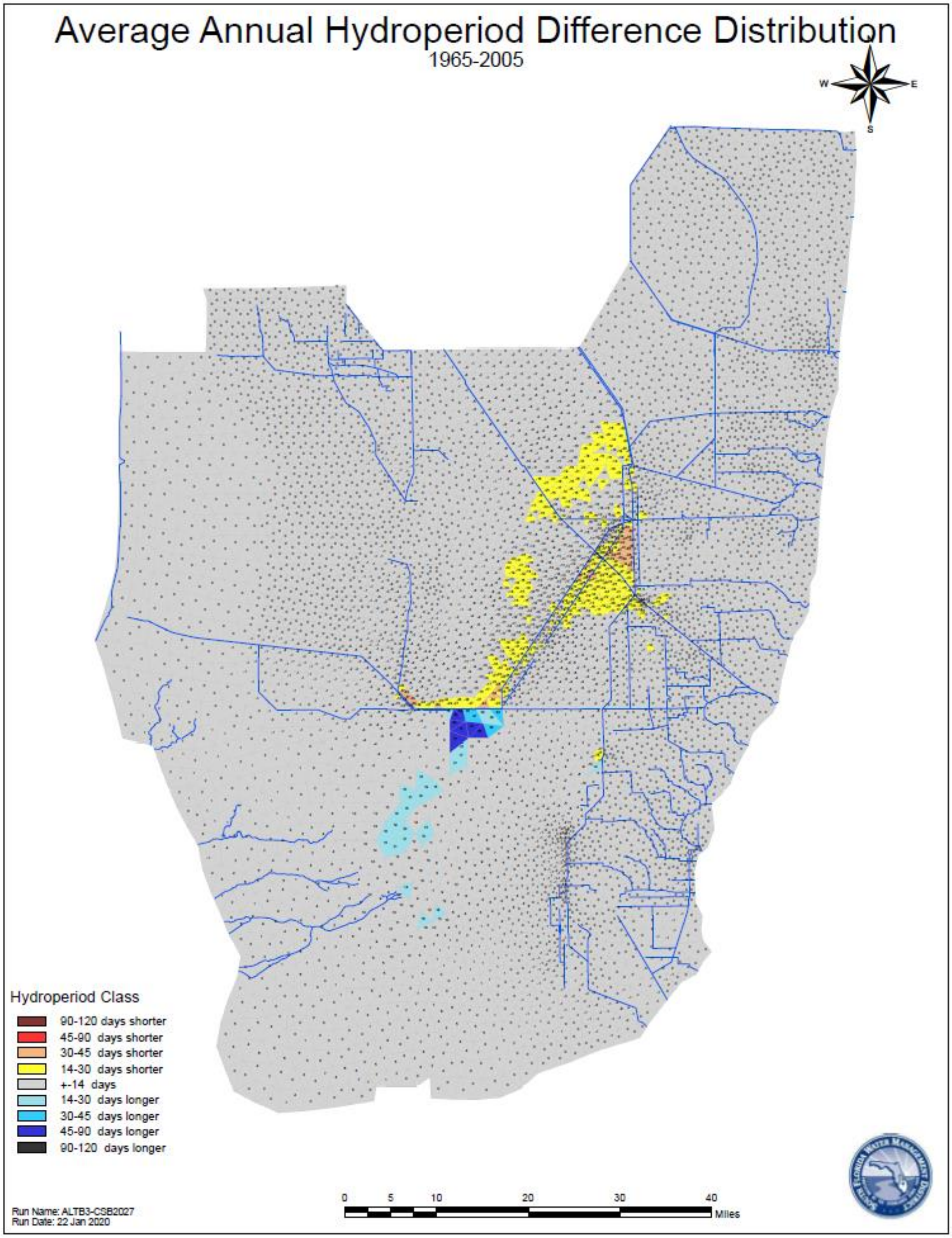

Figure 75. Average Annual Hydroperiod Difference Distribution for ALTB3-CSB2027

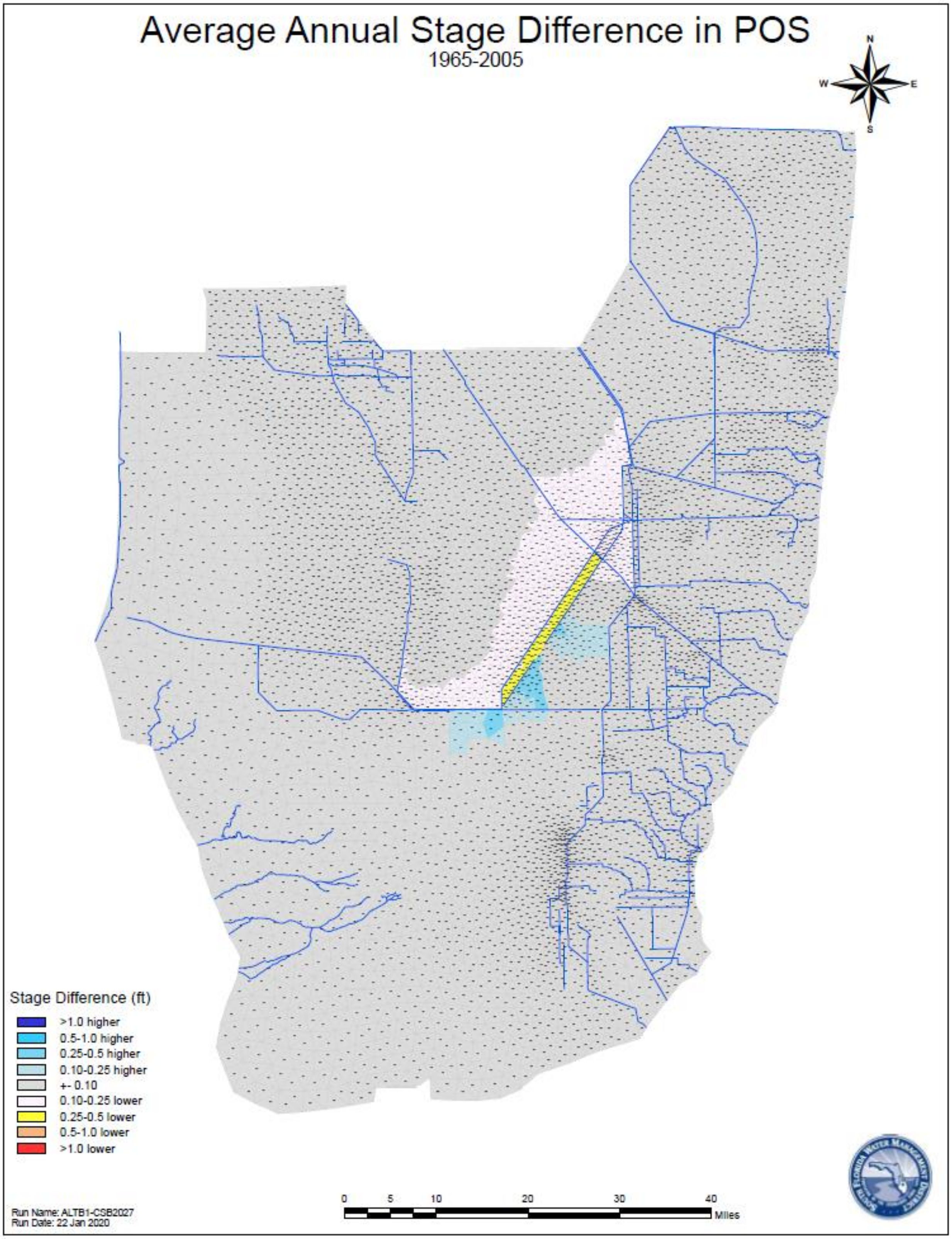

Figure 76. Average Annual Stage Difference for ALTB1-CSB2027

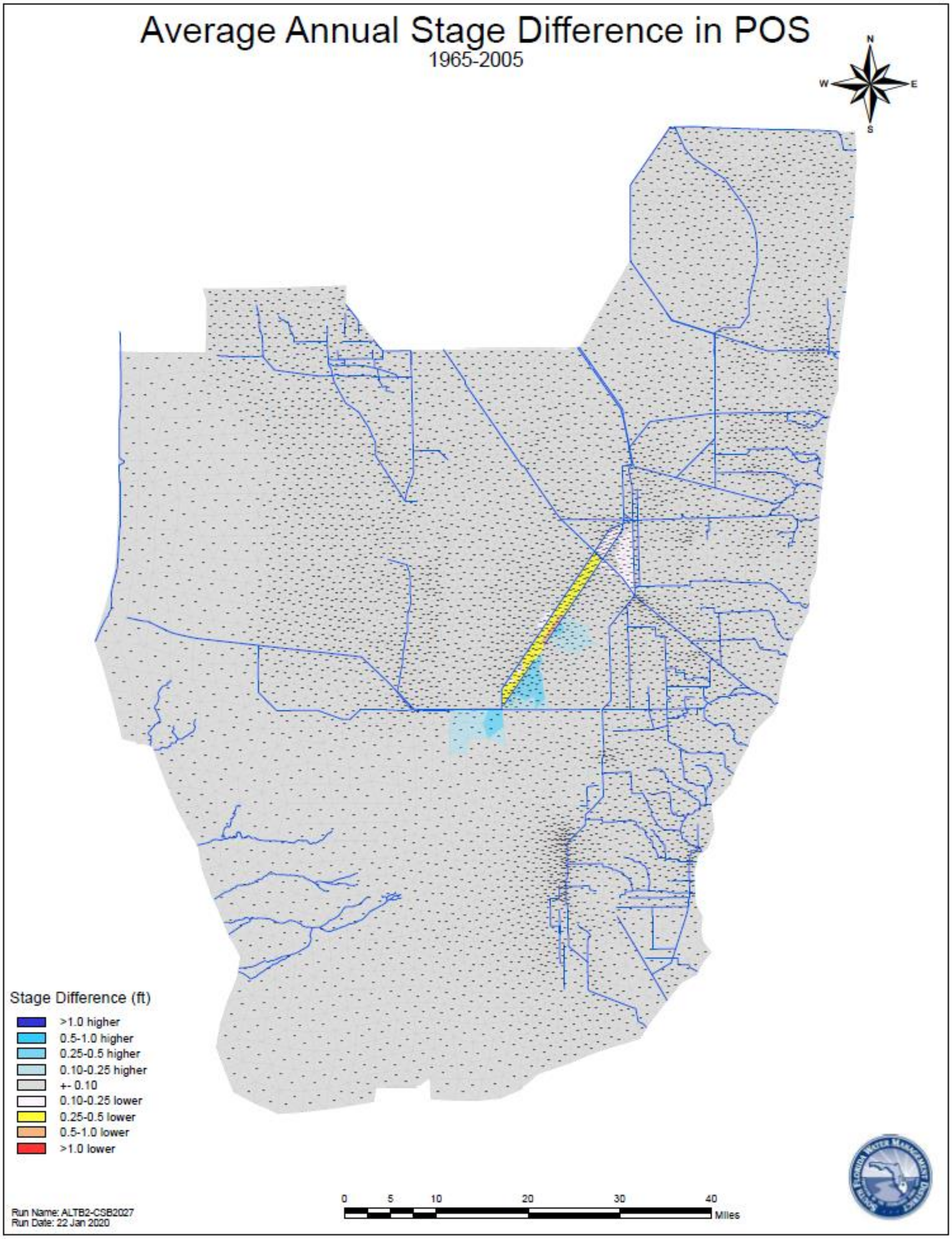

Figure 77. Average Annual Stage Difference for ALTB2-CSB2027

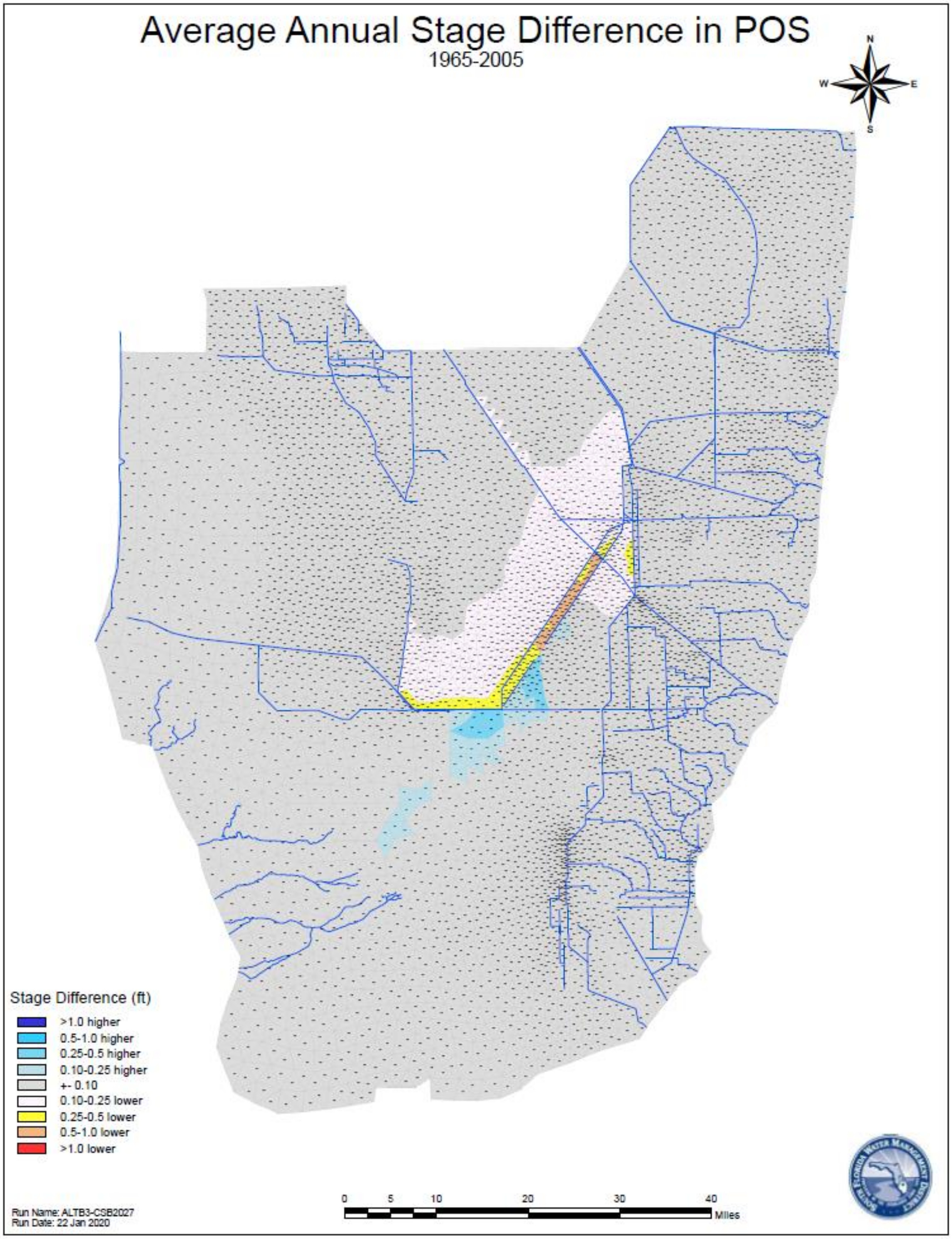

Figure 78. Average Annual Stage Difference for ALTB3-CSB2027

H-7.2 MIAMI-DADE REGIONAL SIMULATION MODEL (MD-RSM)

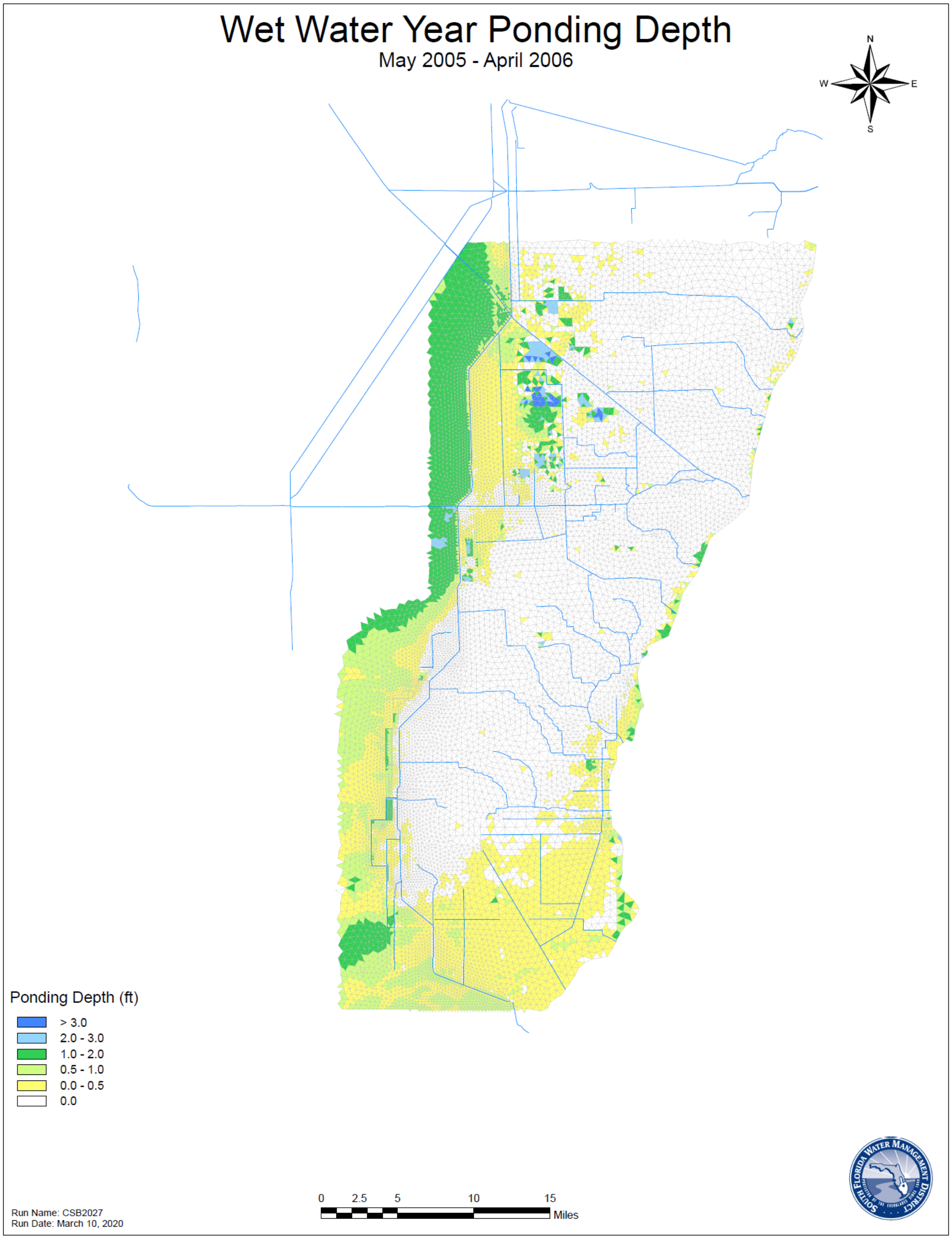

Figure 79. MD-RSM Average Annual Depth Map for Wet Water Year 2006, CSB2027

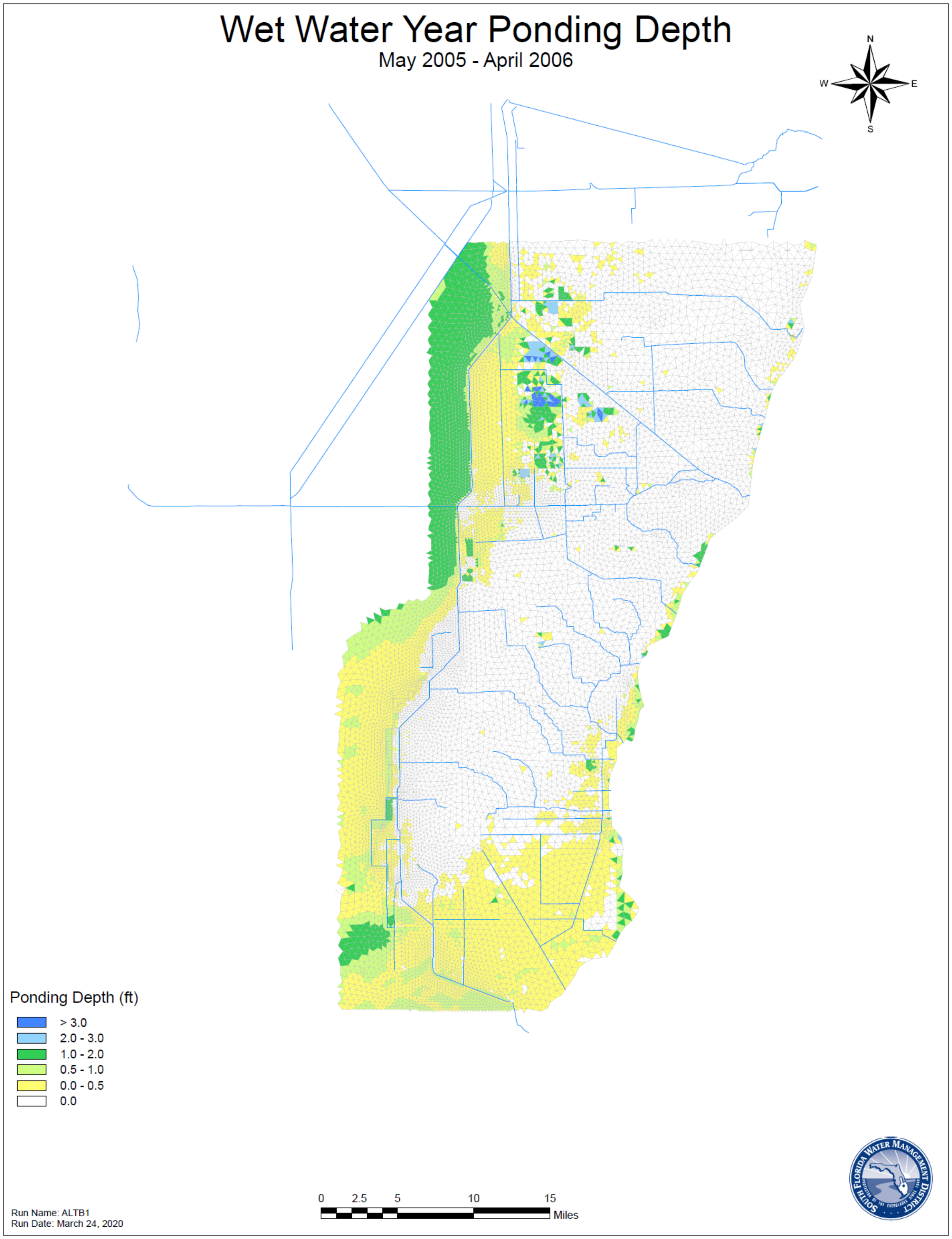

Figure 80. MD-RSM Average Annual Depth Map for Wet Water Year 2006, ALTB1

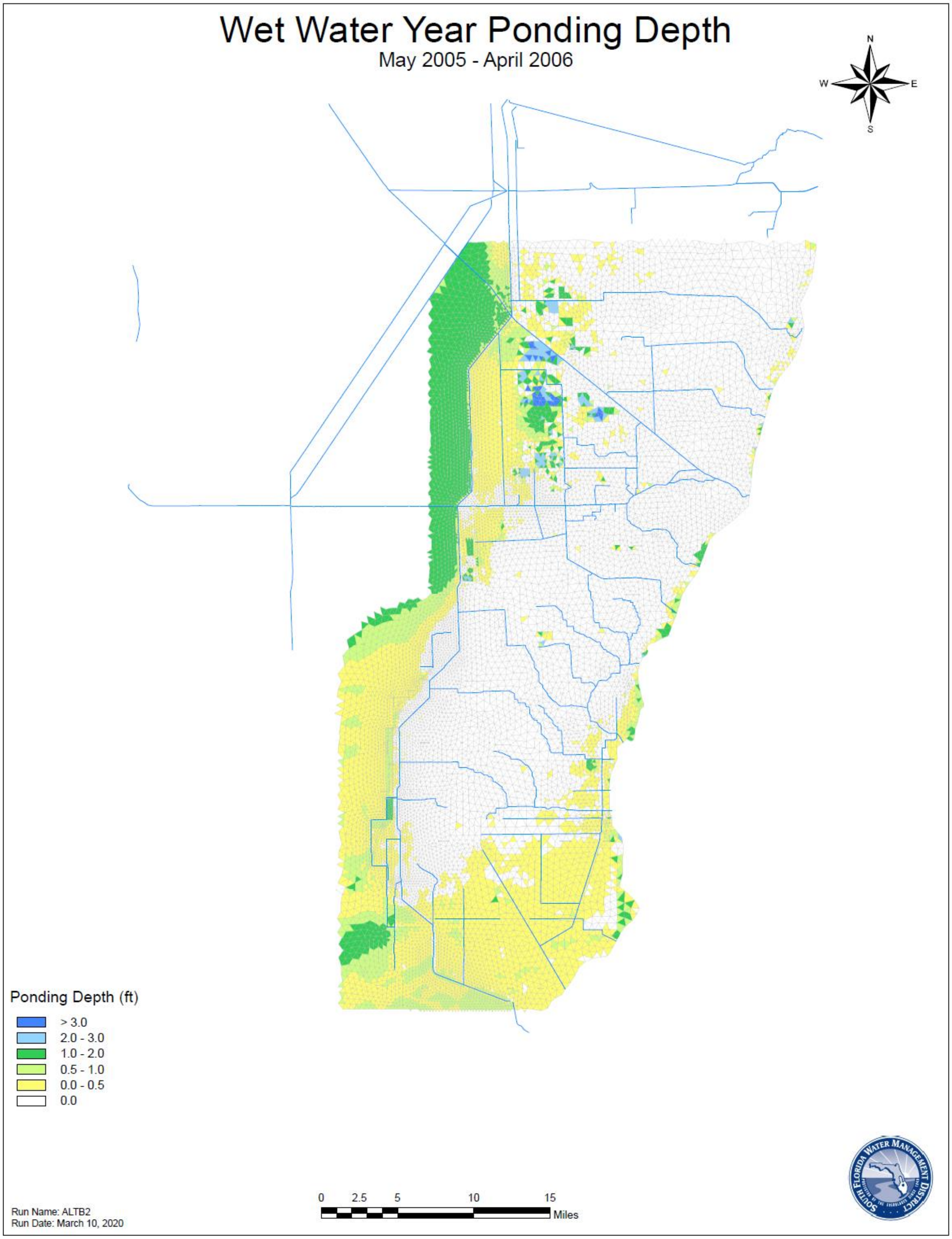

Figure 81. MD-RSM Average Annual Depth Map for Wet Water Year 2006, ALTB2

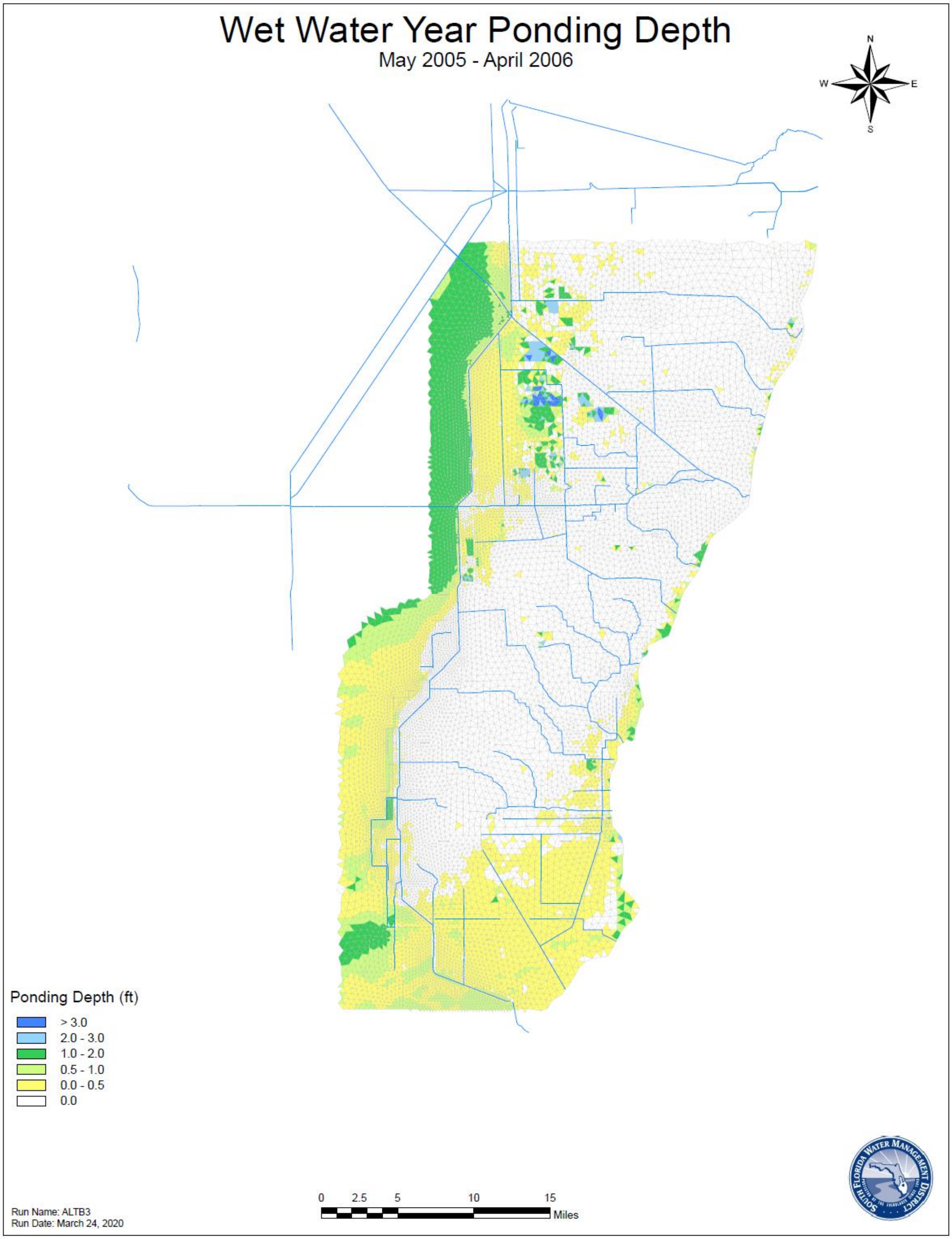

Figure 82. MD-RSM Average Annual Depth Map for Wet Water Year 2006, ALTB3

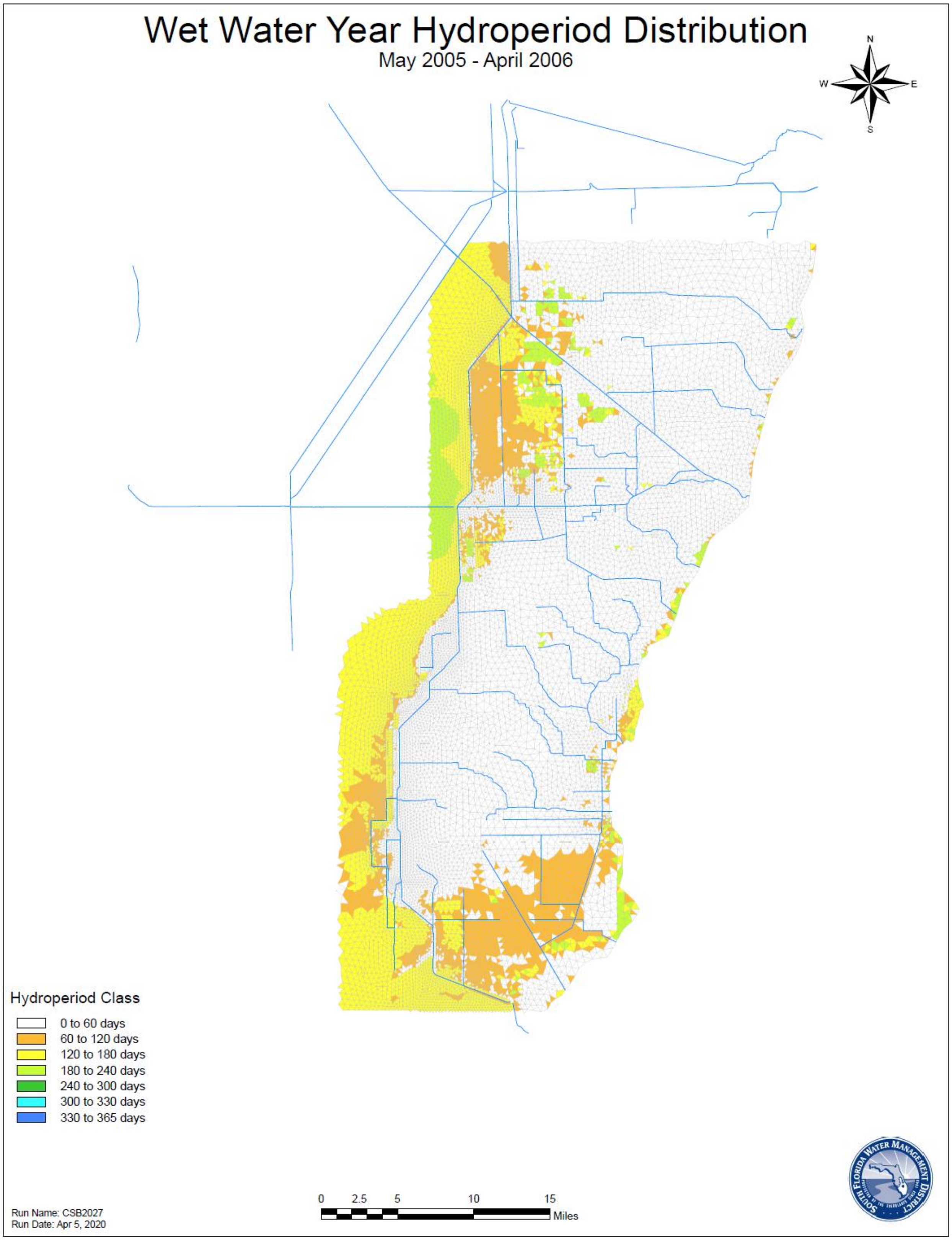

Figure 83. MD-RSM Annual Hydroperiod Map for Wet Water Year 2006, CSB2027

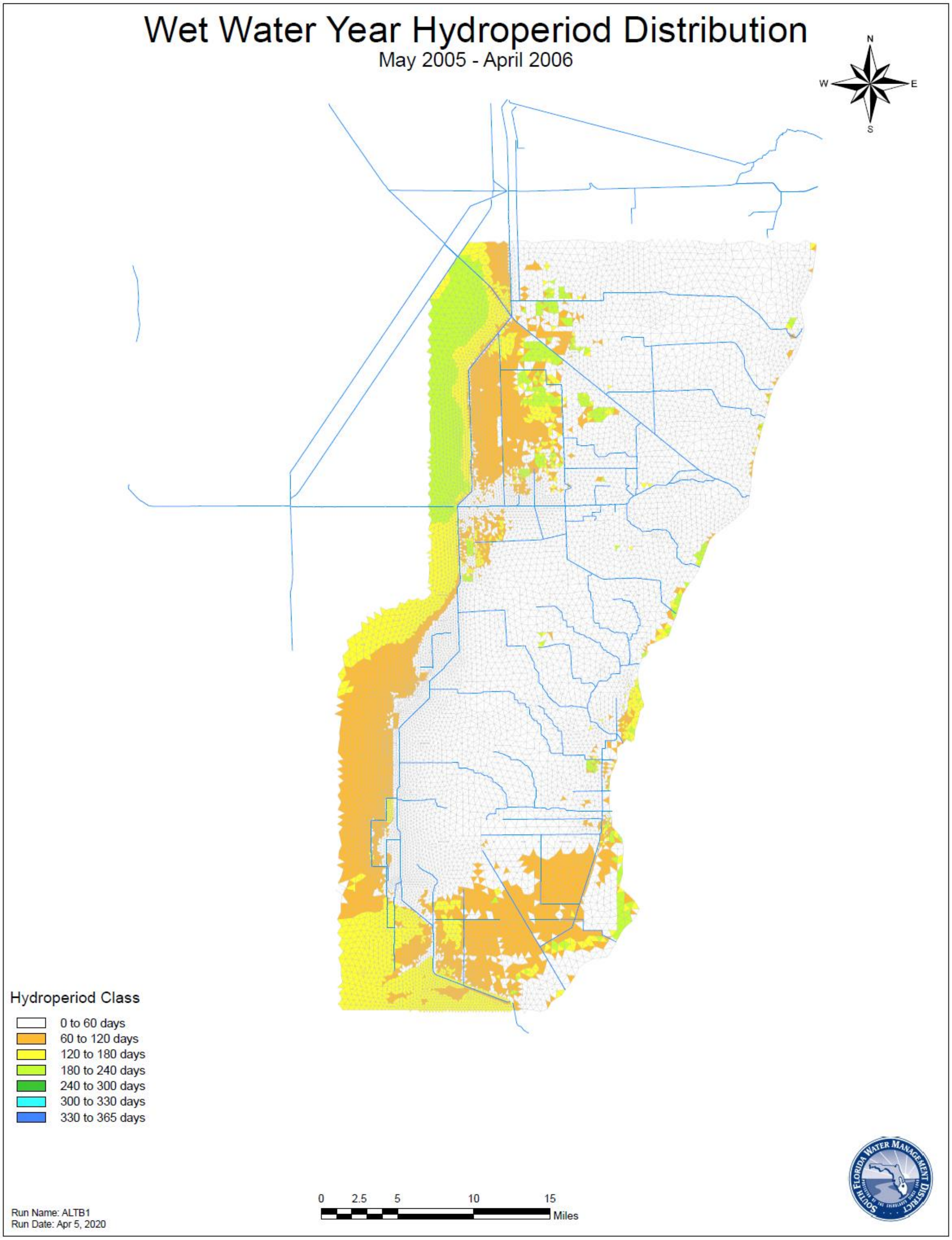

Figure 84. MD-RSM Annual Hydroperiod Map for Wet Water Year 2006, ALTB1

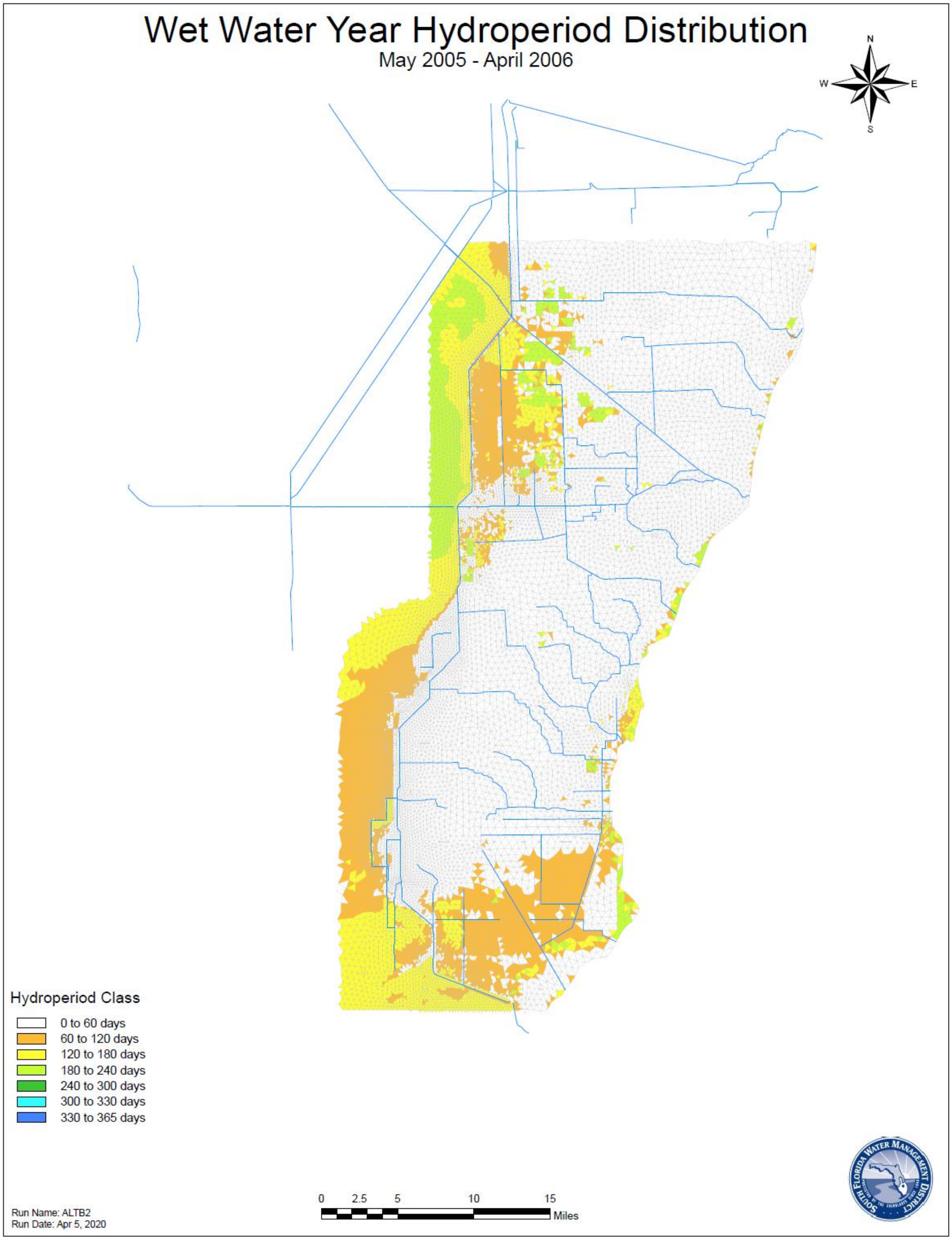

Figure 85. MD-RSM Annual Hydroperiod Map for Wet Water Year 2006, ALTB2

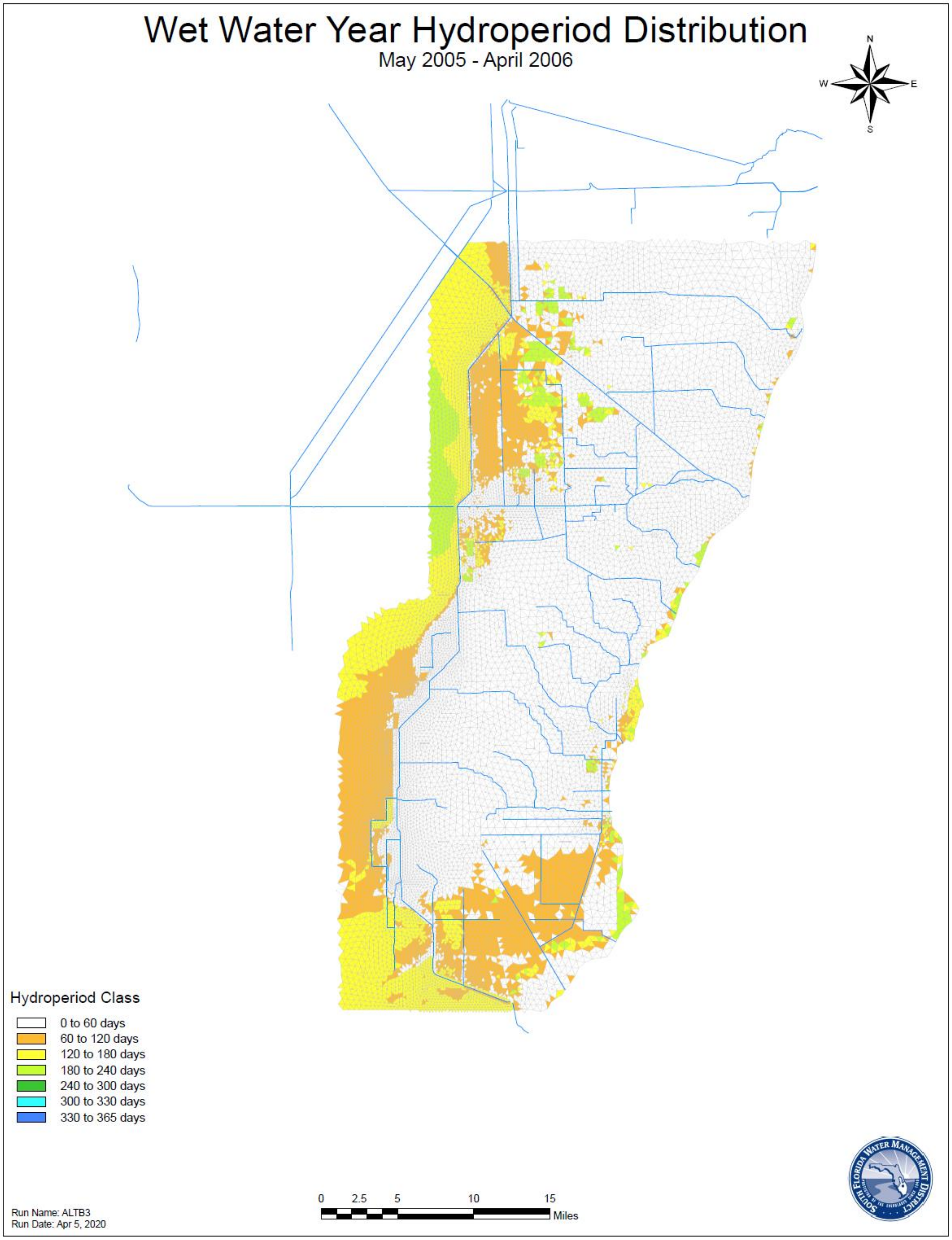

Figure 86. MD-RSM Annual Hydroperiod Map for Wet Water Year 2006, ALTB3

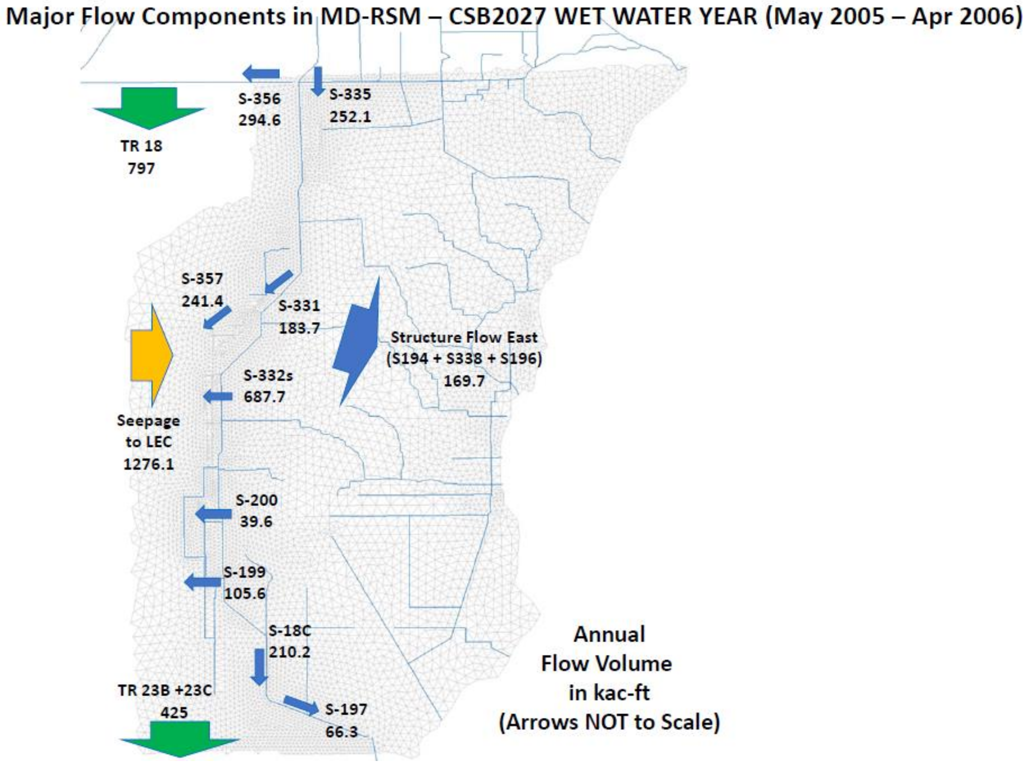

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Figure 87. MD-RSM Annual Water Budget for Wet Water Year 2006, CSB2027

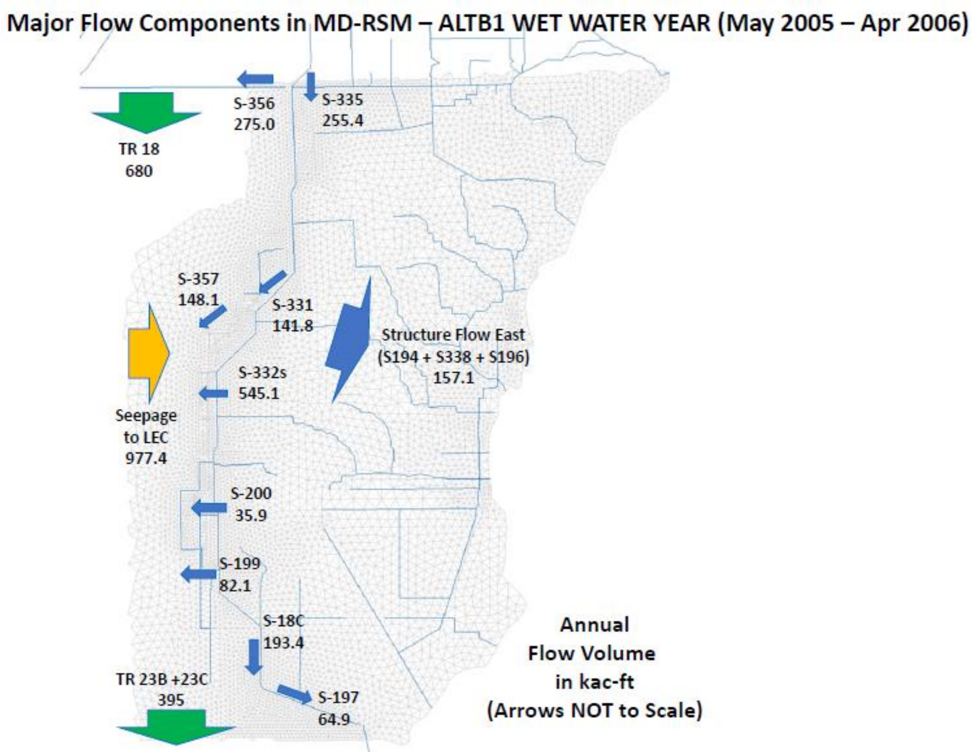

Figure 88. MD-RSM Annual Water Budget for Wet Water Year 2006, ALTB1

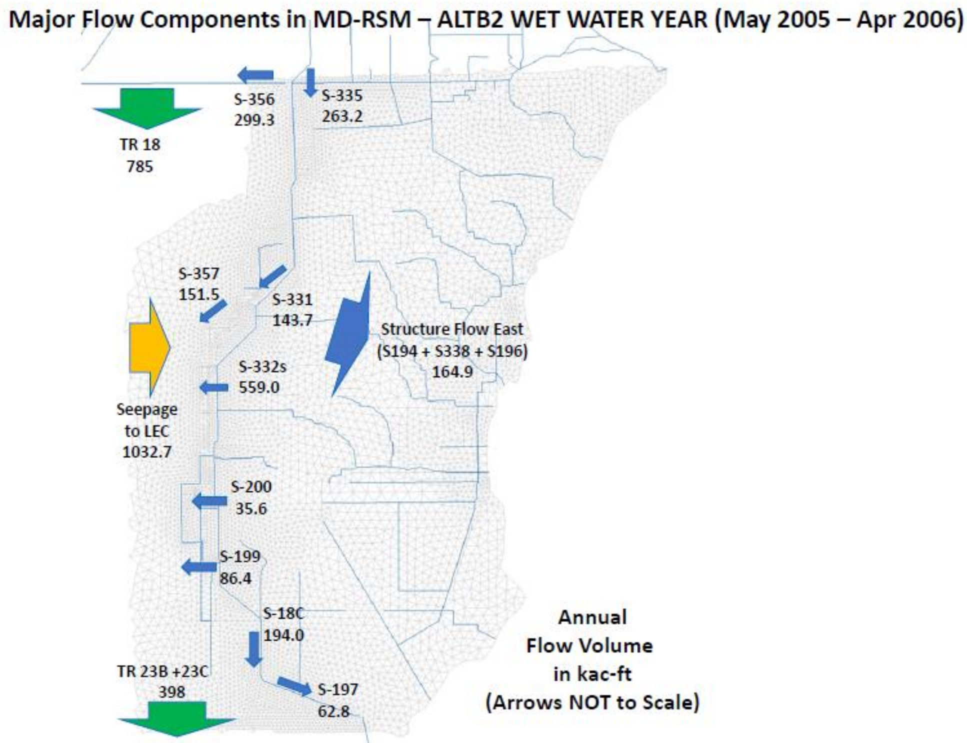

Figure 89. MD-RSM Annual Water Budget for Wet Water Year 2006, ALTB2

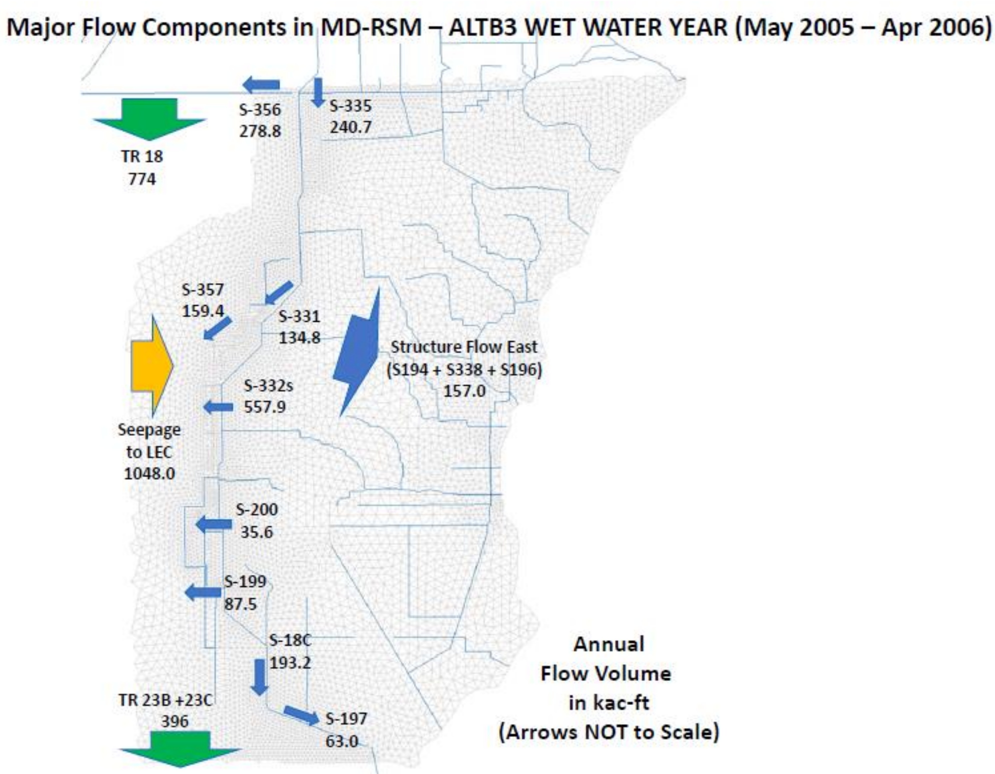

Figure 90. MD-RSM Annual Water Budget for Wet Water Year 2006, ALTB3

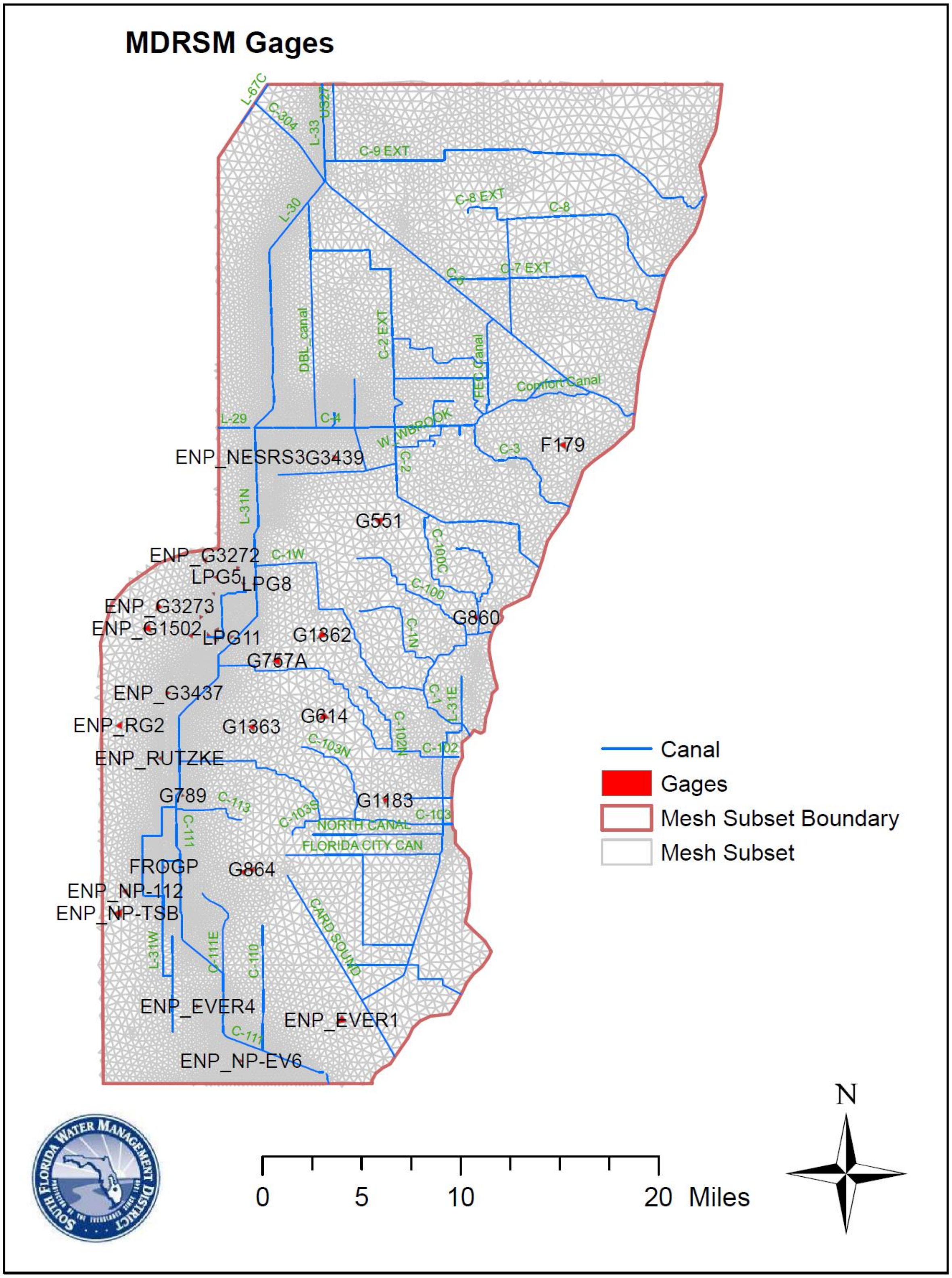

Figure 91. Map of MD-RSM Monitoring Gauge Locations

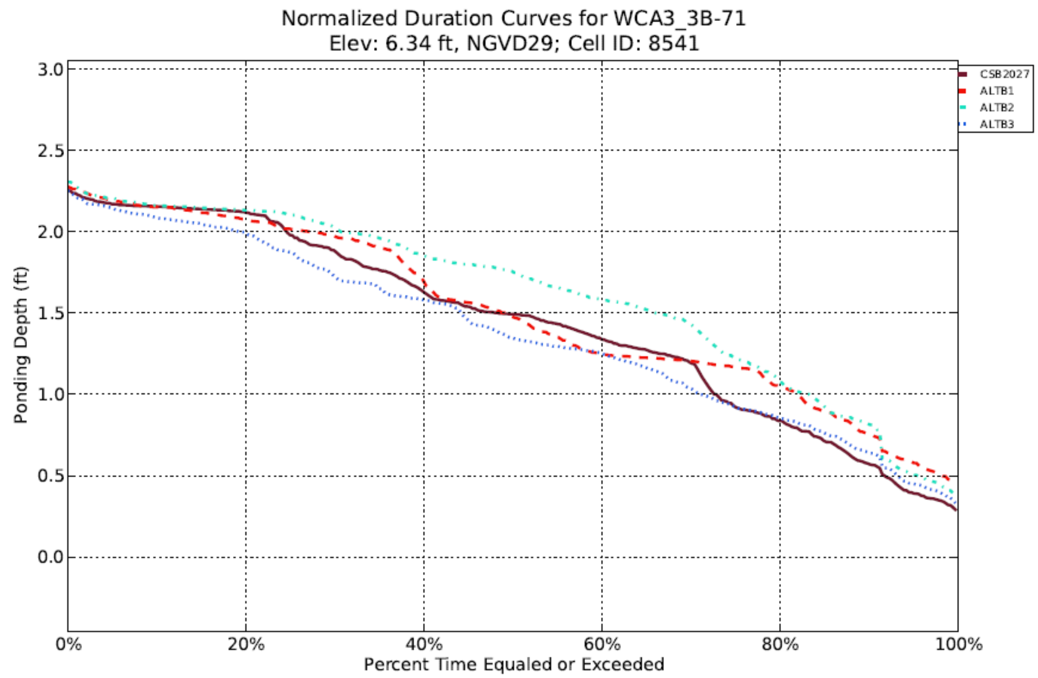

Figure 92. Stage Duration for MD-RSM Wet Water Year at WCA 3B-71, All Alternatives

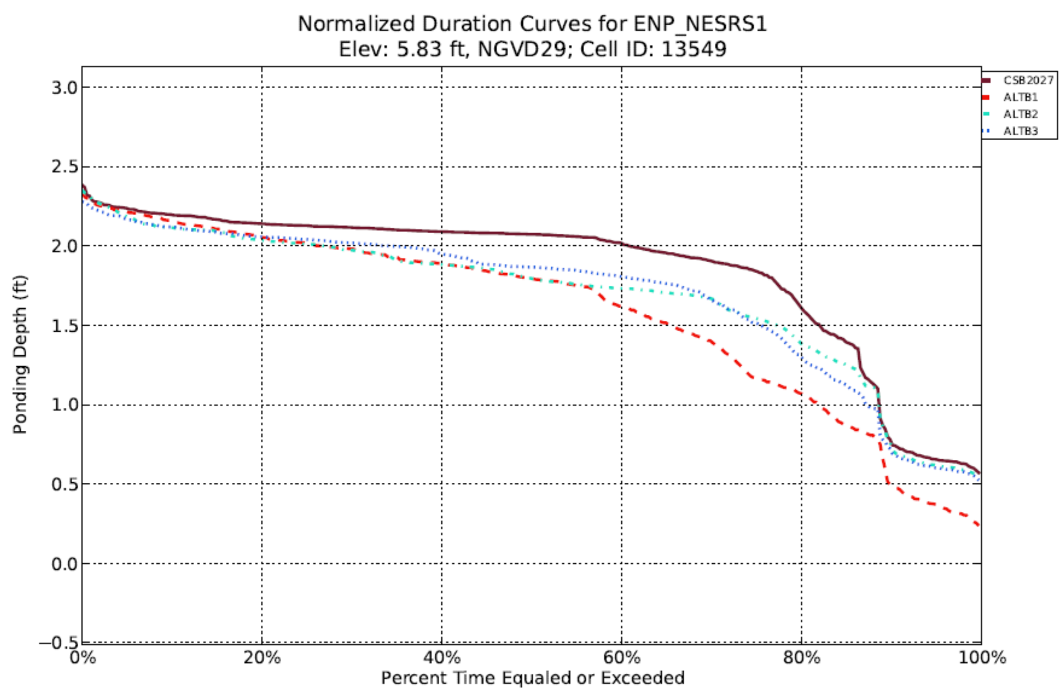

Figure 93. Stage Duration for MD-RSM Wet Water Year at NESRS-1, All Alternatives

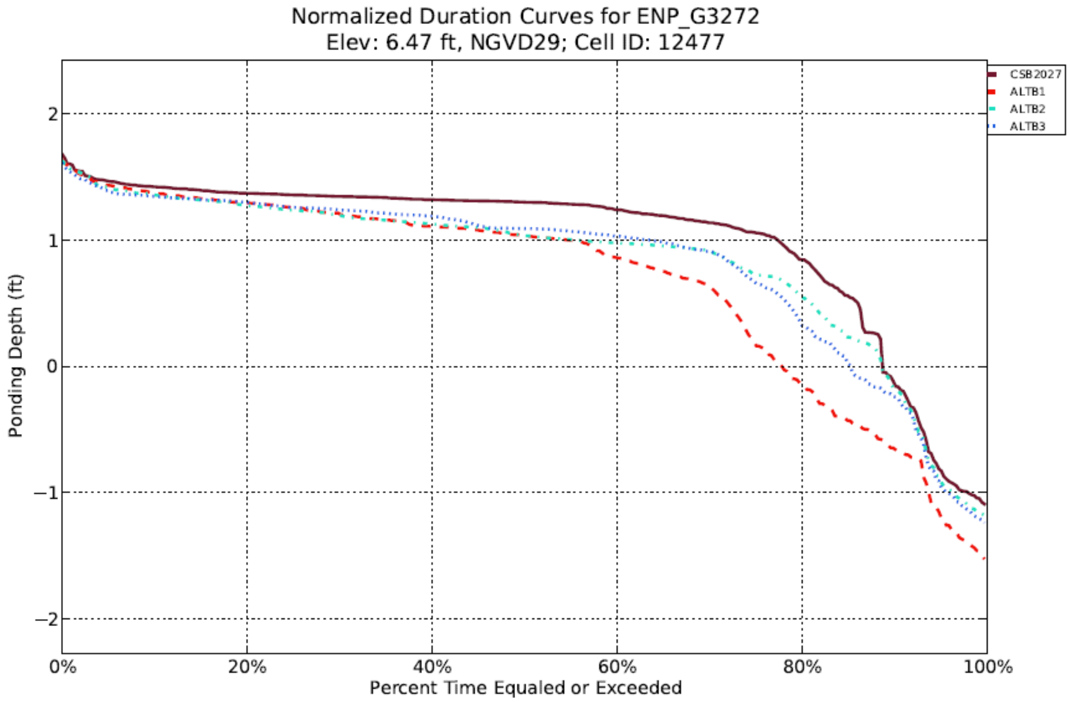

Figure 94. Stage Duration for MD-RSM Wet Water Year at G-3272, All Alternatives

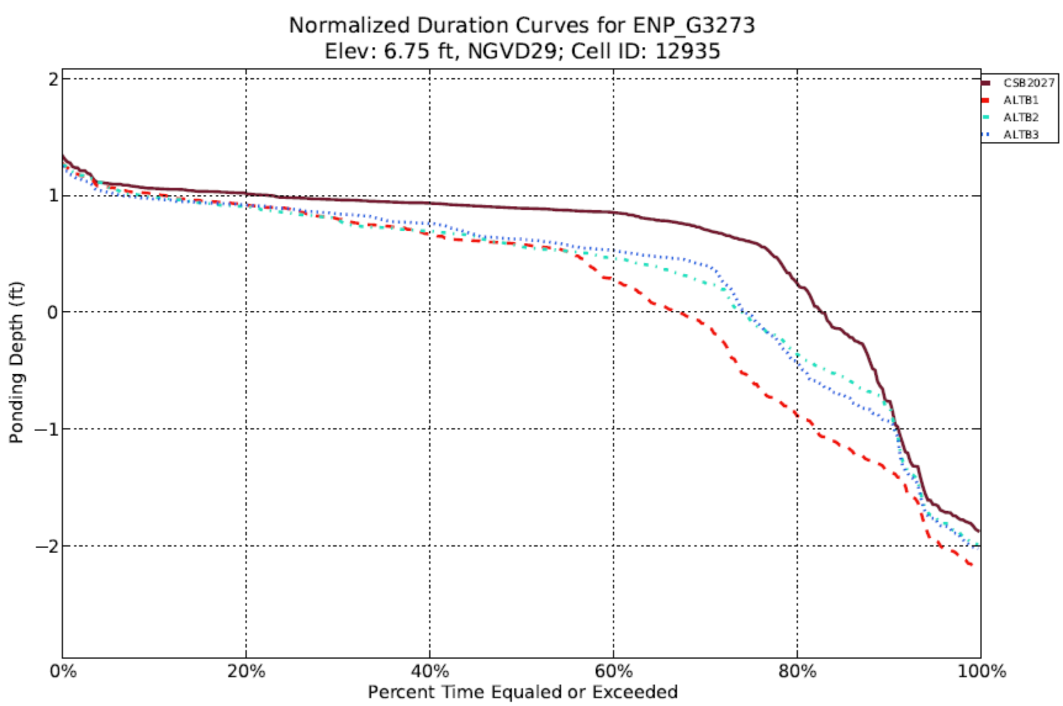

Figure 95. Stage Duration for MD-RSM Wet Water Year at G-3273, All Alternatives

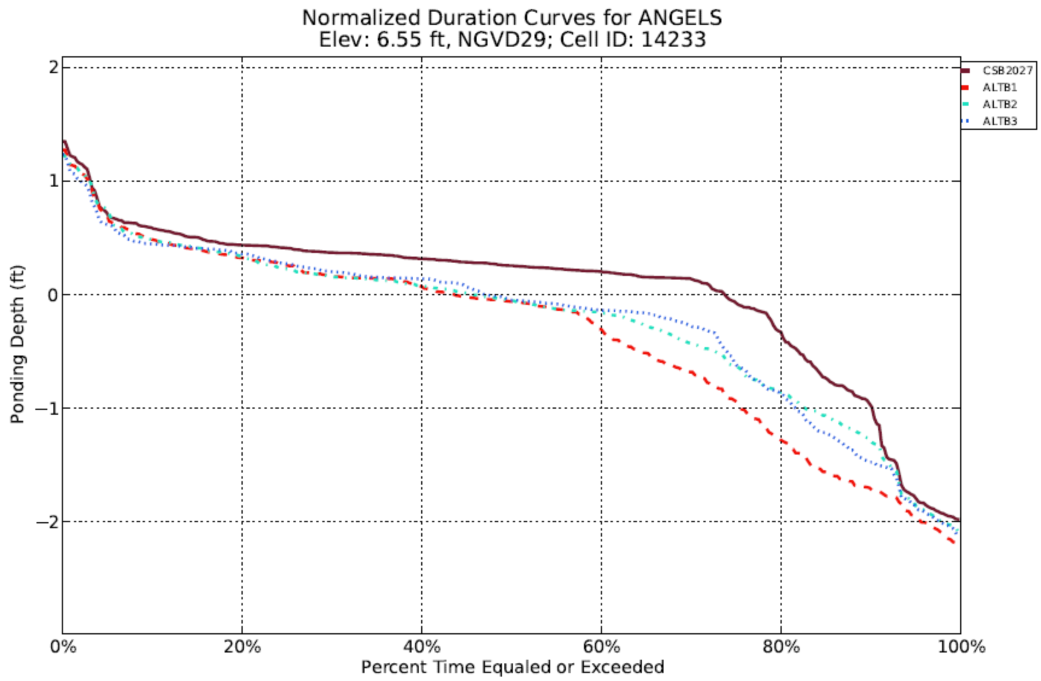

Figure 96. Stage Duration for MD-RSM Wet Water Year at Angels Well, All Alternatives

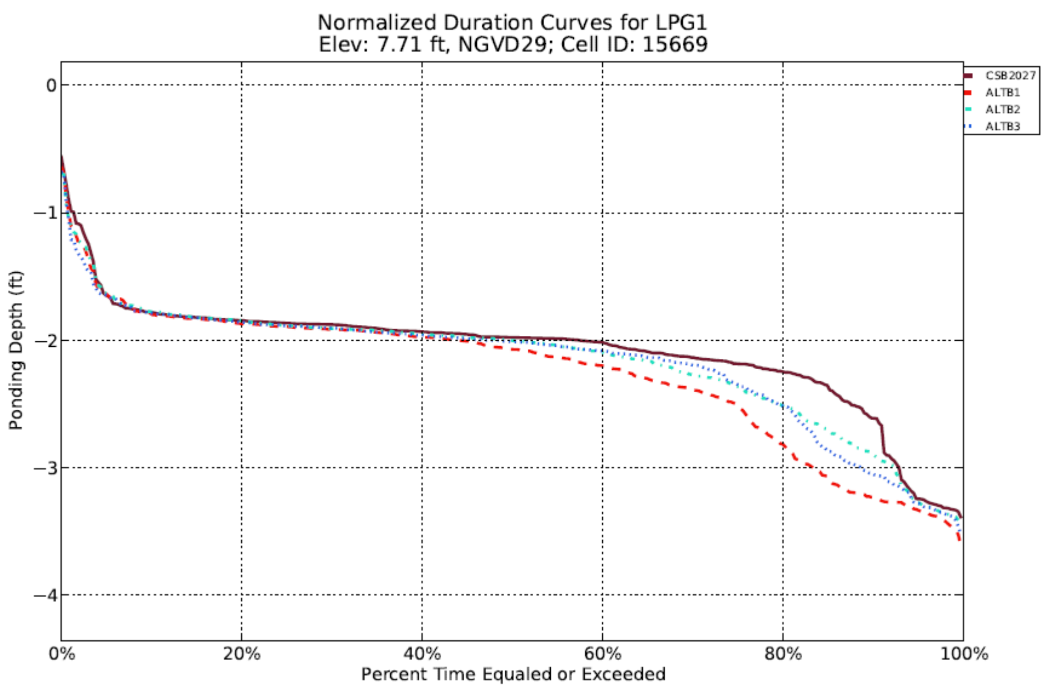

Figure 97. Stage Duration for MD-RSM Wet Water Year at LPG-1, All Alternatives

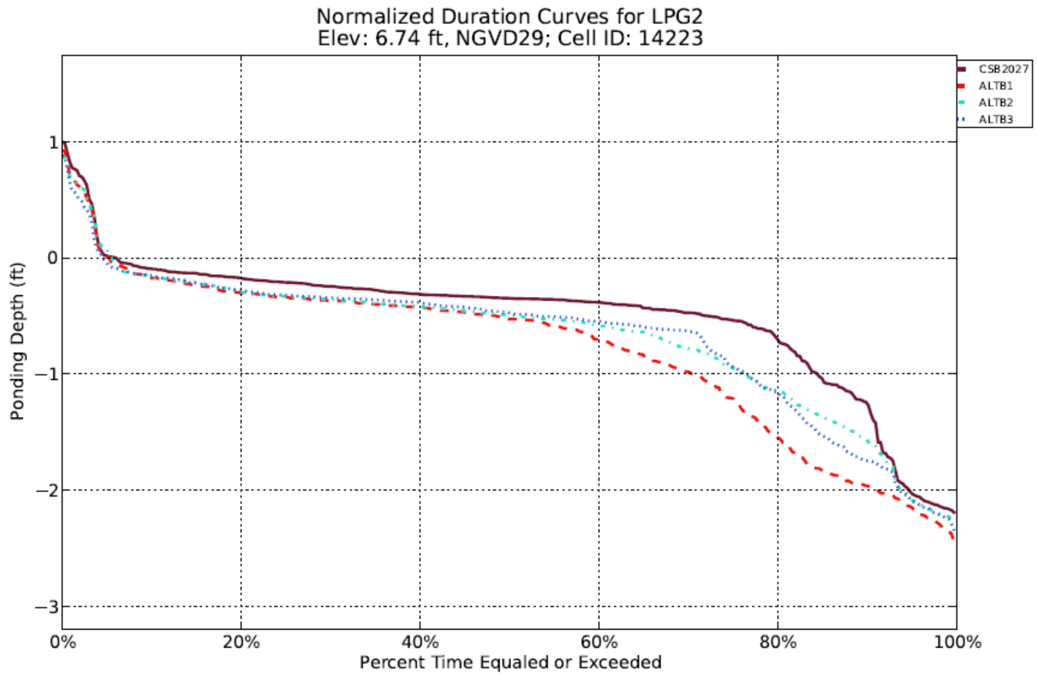

Figure 98. Stage Duration for MD-RSM Wet Water Year at LPG-2, All Alternatives

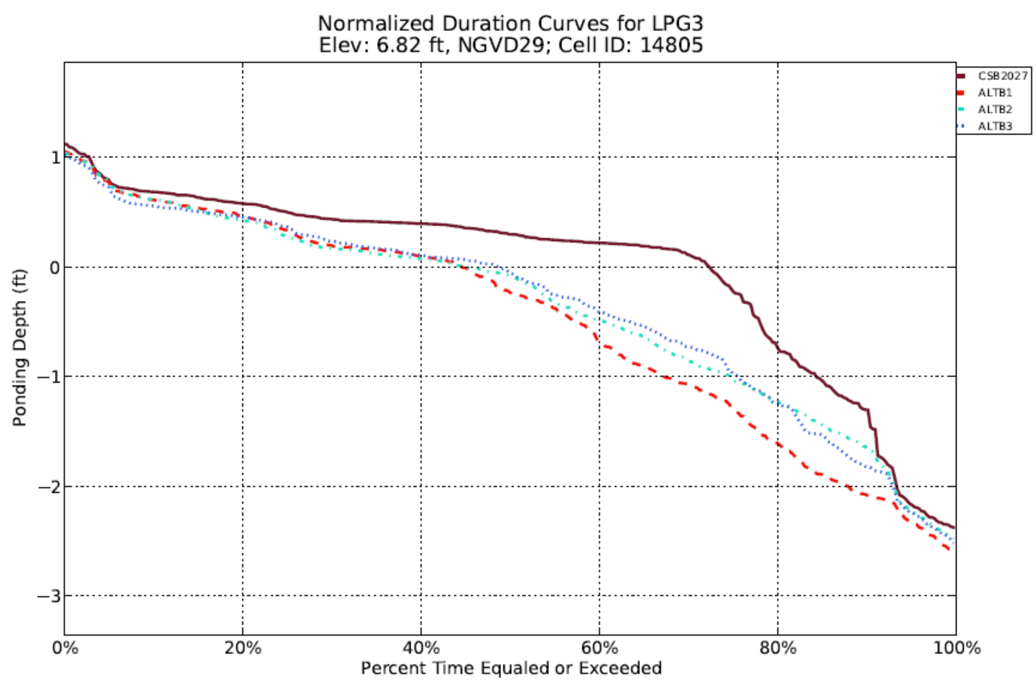

Figure 99. Stage Duration for MD-RSM Wet Water Year at LPG-3, All Alternatives

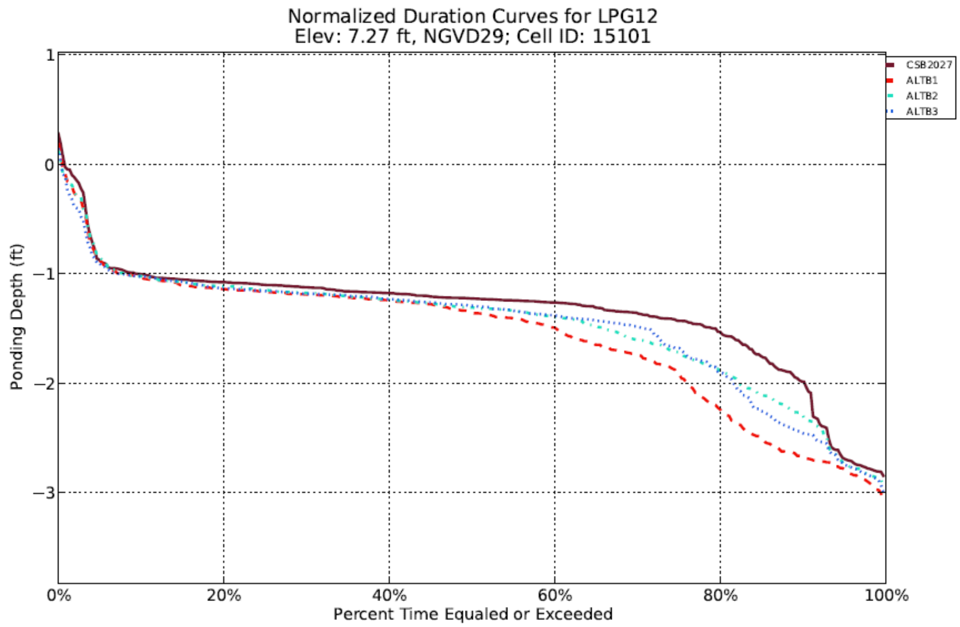

Figure 100. Stage Duration for MD-RSM Wet Water Year at WCA LPG-12, All Alternatives

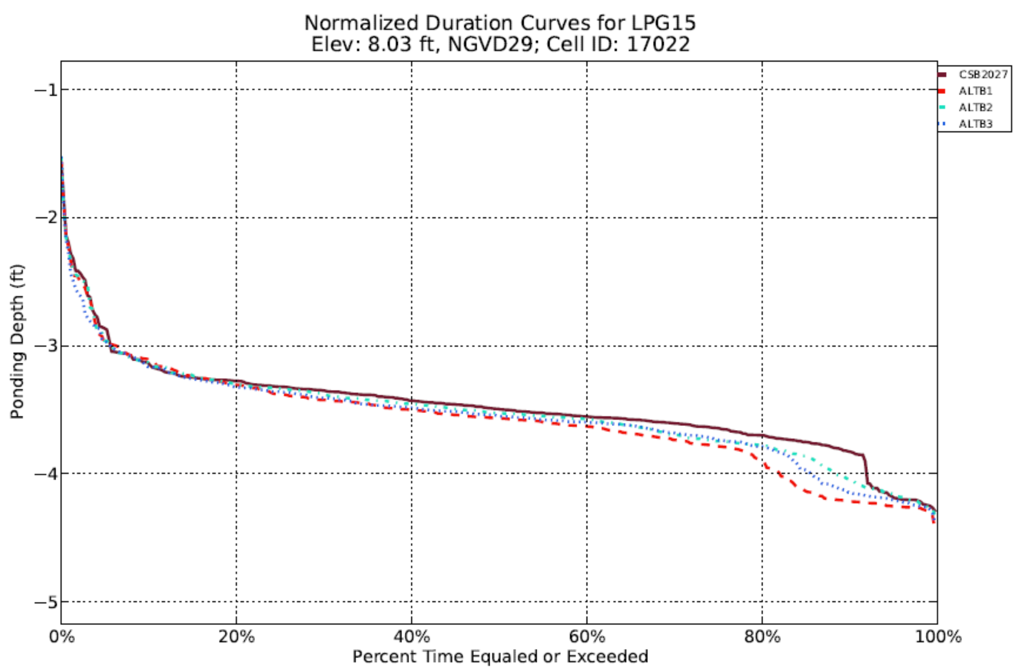

Figure 101. Stage Duration for MD-RSM Wet Water Year at LPG-16, All Alternatives

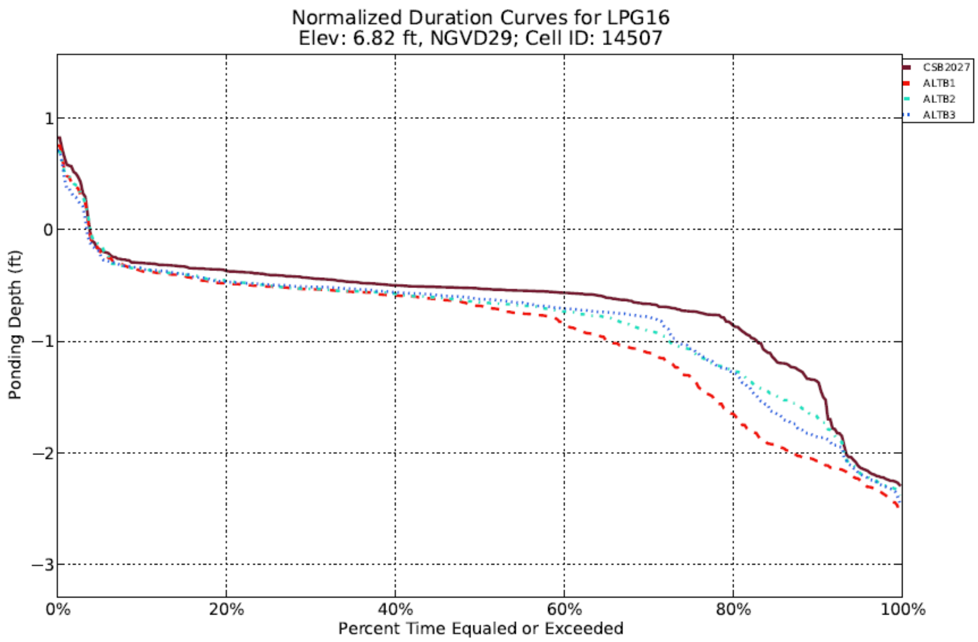

Figure 102. Stage Duration for MD-RSM Wet Water Year at LPG-16, All Alternatives

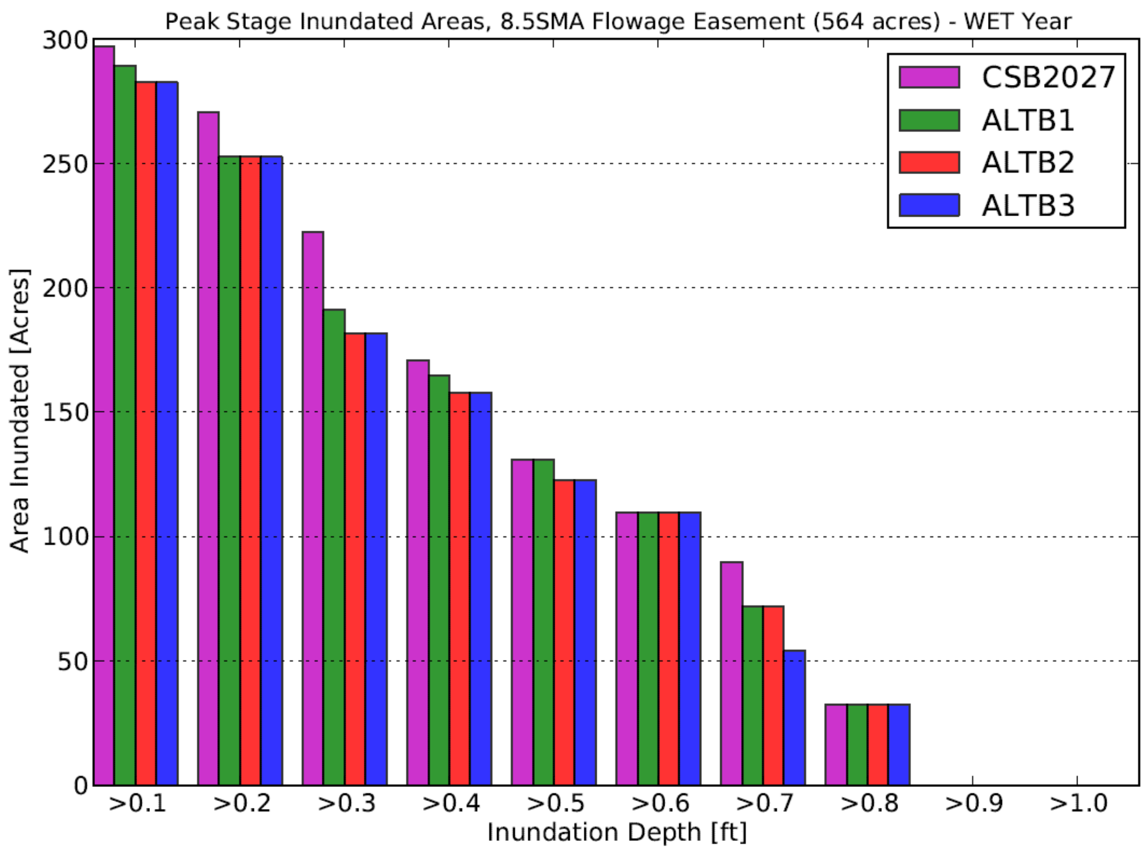

Figure 103. MD-RSM Peak Stage Inundation Areas for 8.5 SMA Flowage Easement Sub-Basin with Depth Classifications Ranging from Greater than 0.1 feet up to Greater than 1.0 feet (0.1 foot Increments), All Alternatives in the 2005-2006 Wet Year.

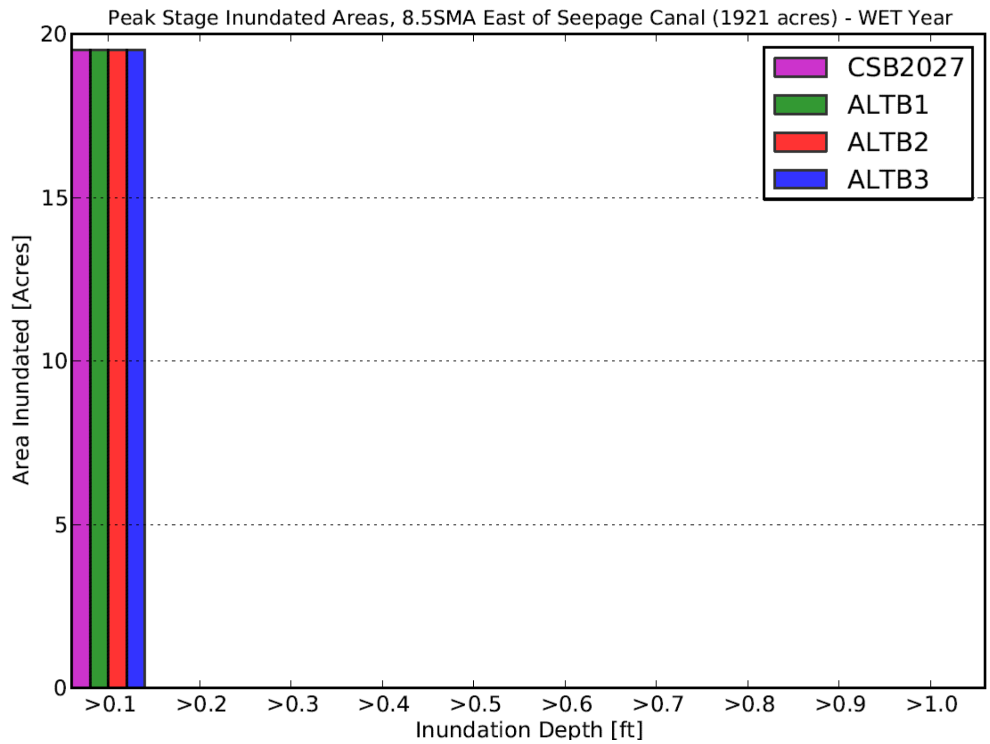

Figure 104. MD-RSM Peak Stage Inundation Areas for 8.5 SMA East of Seepage Canal Sub-Basin with Depth Classifications Ranging from Greater than 0.1 feet up to Greater than 1.0 feet (0.1 foot Increments), All Alternatives in the 2005-2006 Wet Year.

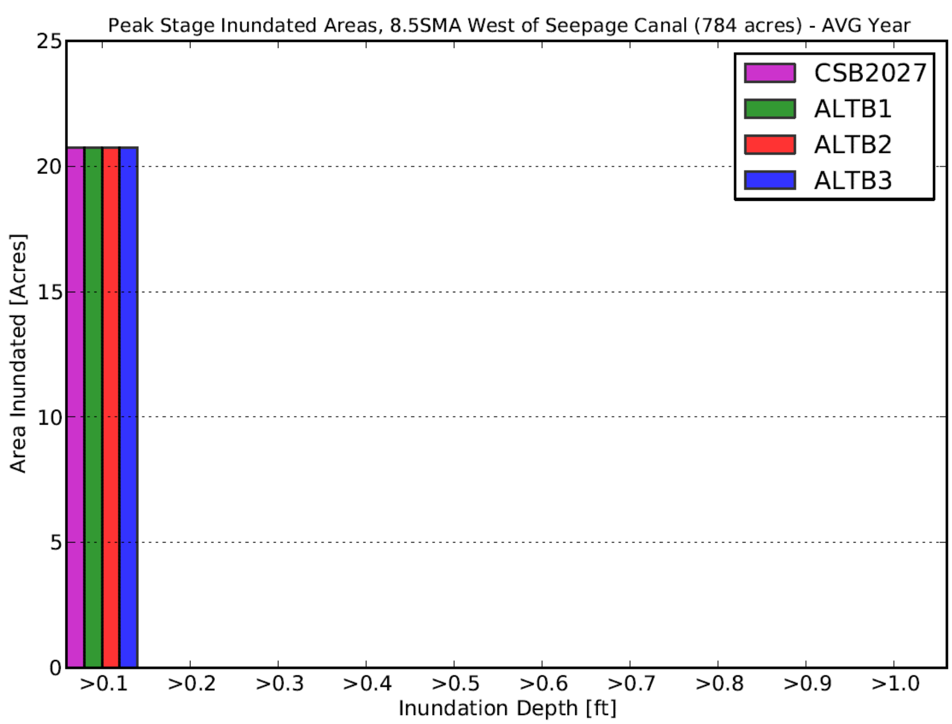

Figure 105. MD-RSM Peak Stage Inundation Areas for 8.5 SMA West of Seepage Canal Sub-Basin with Depth Classifications Ranging from Greater than 0.1 feet up to Greater than 1.0 feet (0.1 foot Increments), All Alternatives in the 2006-2007 Average Year.

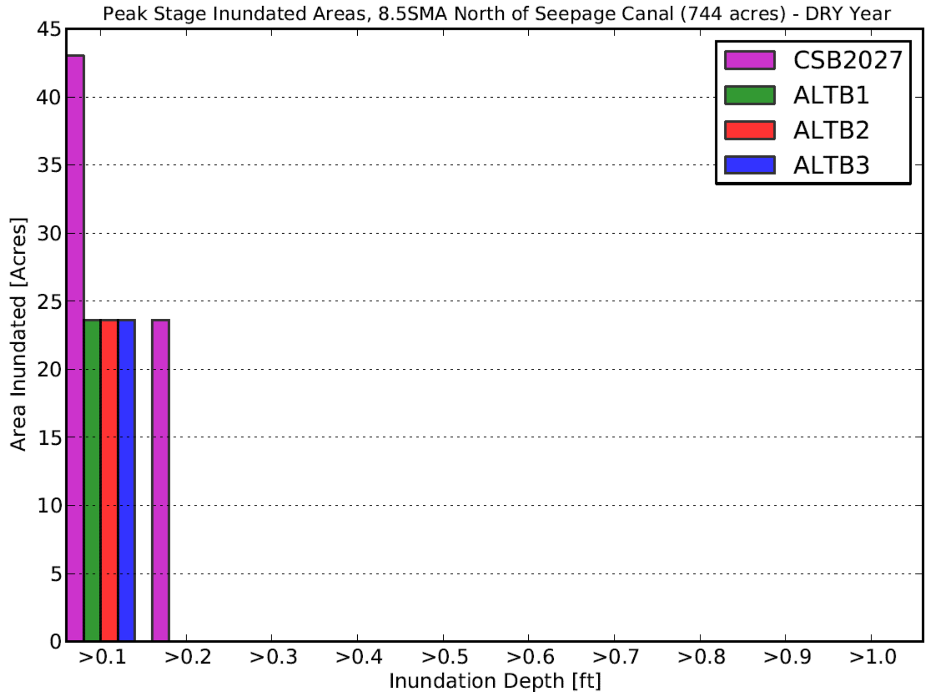

Figure 106. MD-RSM Peak Stage Inundation Areas for 8.5 SMA North of Seepage Canal Sub-Basin with Depth Classifications Ranging from Greater than 0.1 feet up to Greater than 1.0 feet (0.1 foot Increments), All Alternatives in the 2011-2012 Dry Year.

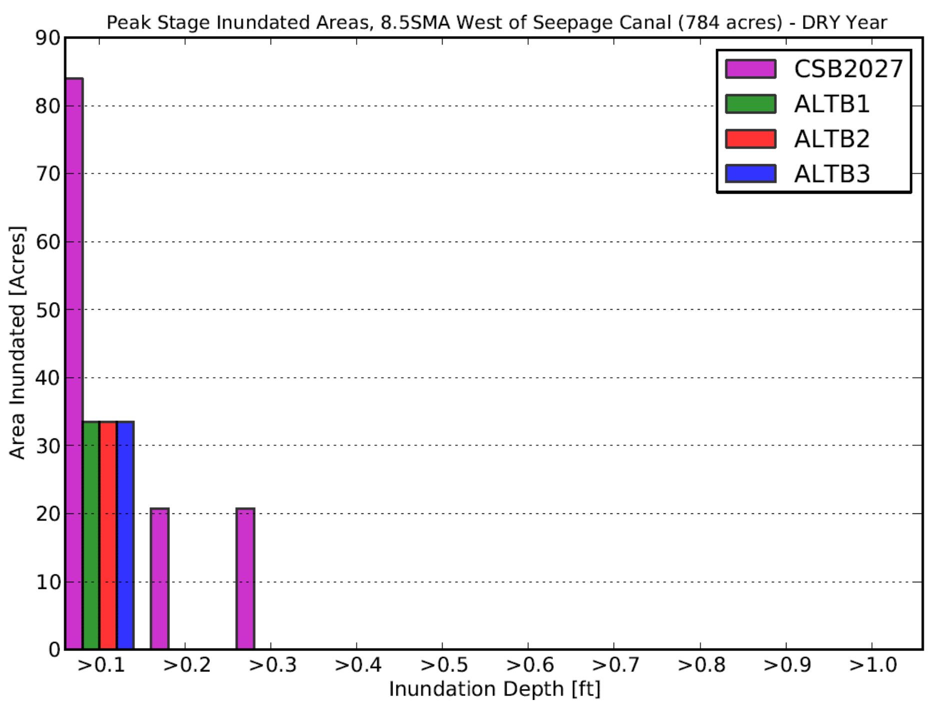

Figure 107. MD-RSM Peak Stage Inundation Areas for 8.5 SMA West of Seepage Canal Sub-Basin with Depth Classifications Ranging from Greater than 0.1 feet up to Greater than 1.0 feet (0.1 foot Increments), All Alternatives in the 2011-2012 Dry Year.