IV. CHAPTER FOUR

4.1 HYDRODYNAMIC AND SALINITY MODELING OF THE COMBINED FEATURES OF THE SOUTH GRAND CHENIER HYDROLOGIC RESTORATION PROJECT (ME-20) AND THE LITTLE PECAN BAYOU HYDROLOGIC RESTORATION PROJECT (ME-17)

The South Grand Chenier Hydrologic Restoration Project (ME-20) and the Little Pecan Bayou Hydrologic Restoration Project (ME-17) are connected hydrologicaly and have similar goals and objectives.[1] The main goal of the two projects is to improve freshwater flows from north to south across Hwy. 82 within the Grand Chenier area. After the final model results for each project were presented by Fenstermaker, the contracting agencies (DNR, USFWS, and NRCS) have agreed to the need of setting up a combined model simulation. In the combined simulations, the proposed features of both projects will be implemented simultaneously. This simulation will provide a formal assessment of the impact of constructing both projects on the hydrology of the target area.

The federal and states agencies, with input from C.H. Fenstermaker and Associates Inc. as the engineering consultant for the two projects, have agreed on the following components to be incorporated in the combined model run.

Little Pecan Hydrologic Restoration Project (ME-17)

Alignment No. 2:

- Alignment No.2 uses an existing oil slip canal connecting to an existing trenasse shown in Figure 42.
- Two 5'X5' box culverts at all gravel road crossings (Figure 43)
- A Control structure 2-5'X5' at Highway 82 to stop flows from Grand Lake during long periods of rain.
- Flap gate structure at Highway 82 to prevent water flowing south to north across the highway.
- Staggered levees every 500 feet along the route of the freshwater introduction canal.
- Proposed breaches in the levee near the outlet of the conveyance channel (Figure 44).

[1] For detail information and description of the Little Pecan Bayou Hydrologic Restoration Project (ME-17), refer to the report prepared by C.H. Fenstermaker and Associates, Inc., dated December 2005, entitled "Hydrodynamic Modeling of the Little Pecan Hydrologic Restoration Project (ME-17)"

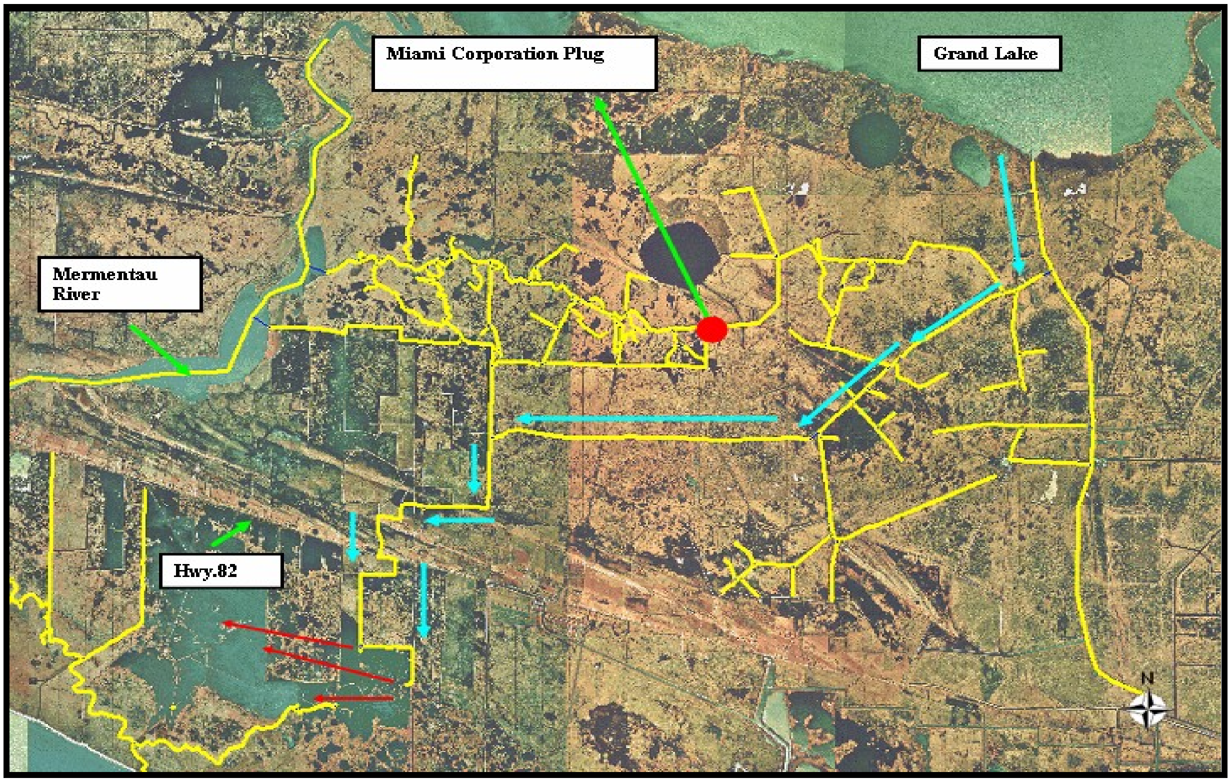

Figure 42: Alignment No.2 for the Little Pecan Hydrologic Restoration Project (ME-17)

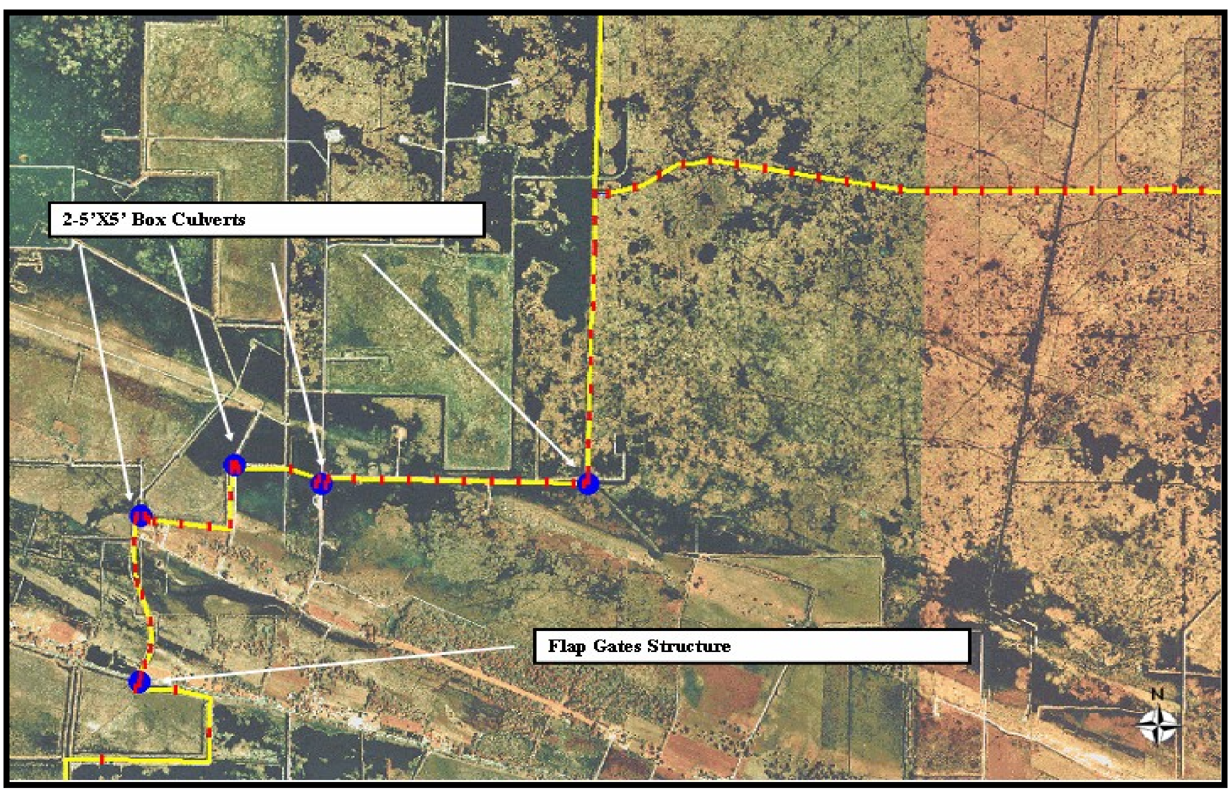

Figure 43: Culverts at Every Shell Road Crossing for the Little Pecan Hydrologic Restoration Project (ME-17)

Figure 44: Flow Movements Out of Alignment No.2 to the Marshes South Of Highway 82 for the Little Pecan Hydrologic Restoration Project (ME-17)

South Grand Chenier Hydrologic Restoration Project (ME-20)

Conceptual Run (Dr. Miller Canal component):

The conceptual run features were incorporated in the combined model with the exception of the BP canal. As shown in Chapter Three, the BP Canal freshwater introduction component did not prove to be effective in introducing fresher water to the target marsh areas. Therefore a decision was made by the agencies to exclude the BP canal component from the combined simulation.

Figure 45 illustrates the final combined model layout along with the projected flow movement out of the two freshwater introduction canals, namely the Dr Miller Canal (west) and Alignment No.2 (east). Figure 46 shows the openings and the proposed breaches that were made to facilitate the fresh water flow from the canals into the target areas. Table 5 below lists the coordinates and the dimensions of the proposed breaches.

Table 5

Opening Number	Dimensions (ft) *	Geographic Coordinates (State Plane, NAD83 Ft)	
	Width *	Easting	Northing
1	250	2793209	453554.8
2	250	2791553	453554.8
3	250	2790049	453777.3
4	250	2788670	453821.8
5	250	2787513	453910.8
6	250	2784976	452219.8
7	250	2789204	449416.2
8	250	2789070	447458.2
9	250	2794588	445722.7
10	250	2792541	445811.7
11	250	2789070	445856.2

*Width of the opening was governed by the grid size used in the model = 75 meters approximately equal 250 ft.

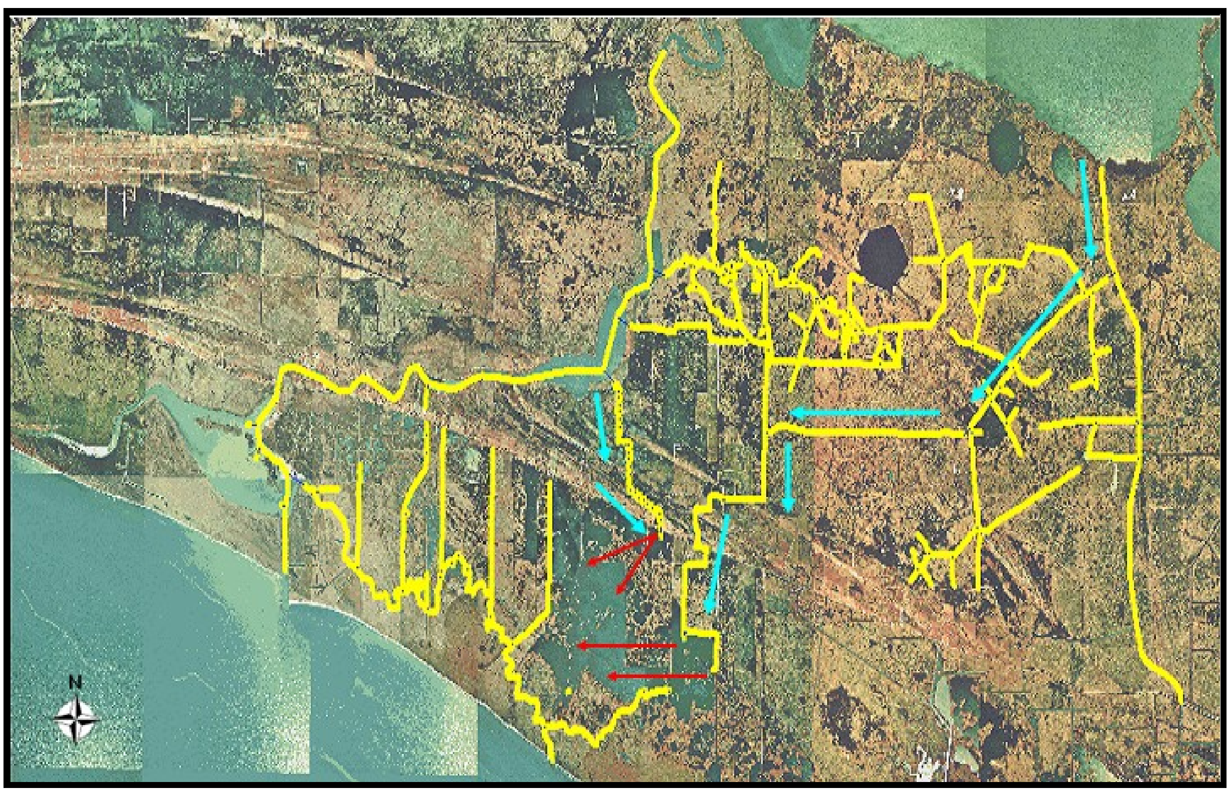

Figure 45: Combined Model layout

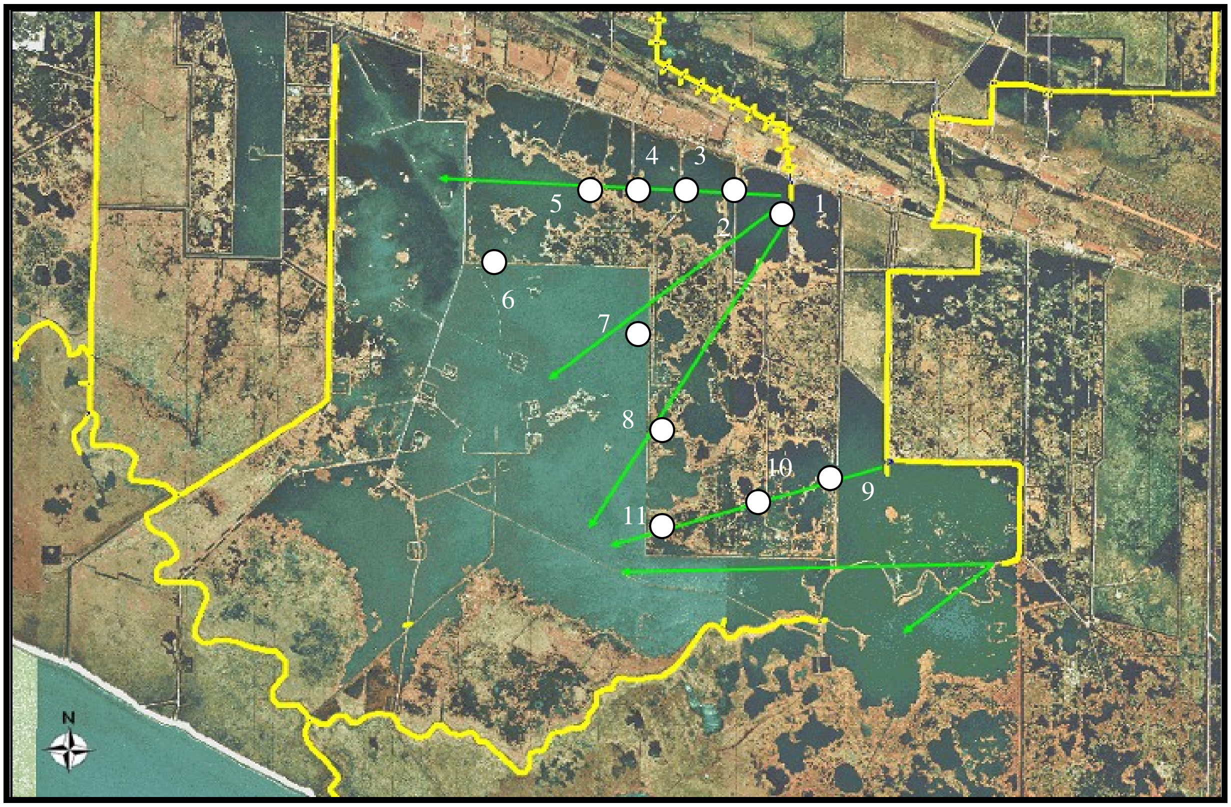

Figure 46: Breaches in the existing topography

4.1.1 Combined Model Results.

The combined model results are presented as time series plots shown in Figures A-117 through A-132, contour maps of average monthly water levels shown in Figures A-133 through A-137, average monthly differences in water levels shown in Figures A-138 through A-142, average monthly salinity shown in Figures A-143 through A-147, and average monthly differences in salinity shown in Figures A-148 through A-152. The time series graphs included the results of the Base Run Model (Existing conditions), as well as the results of each project (namely, S. Grand Chenier, and Little Pecan) when implemented separately. Such comparison will facilitate the process of evaluating the performance of the features of both projects when implemented simultaneously.

The time series of the controlling salinity in the Mermentau River is included in Figures A-117 through A-132 to identify if the intake control-structure of Dr. Miller canal was open or closed. As indicated in Chapter Three, the intake control-structure of Dr. Miller canal would be open whenever the salinity in the Mermentau River is less than 5 parts per thousand and closed otherwise.

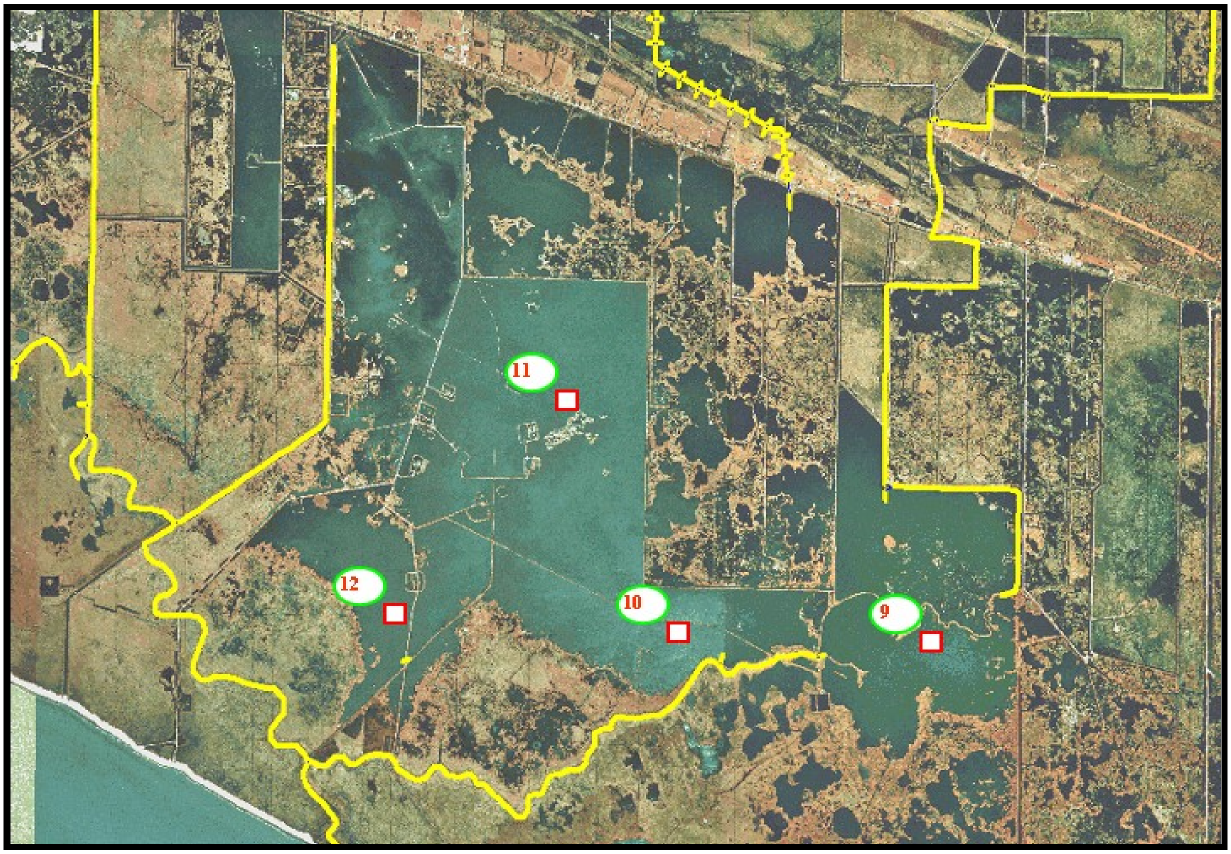

Figure 47: Points Used to Extract Results

4.1.2 Analysis of the Results

As expected, the results of the combined simulation are not simply a super-position of the results of each project implemented separately. There is a dynamic interaction between the two conveyance channels (namely Dr. Miller Canal and Alternate #2 of Little Pecan). A detailed discussion of the results is presented below.

Water Level results:

Time series plots and contour maps of the water levels and the increase in water level for points 9 through 12 (shown in Figures A-117 through A-125-refer to Figure 47 for points locations) shows that the South Grand Chenier model produced the largest increase in water levels during the first 15 days of January 2003. It should be noted that the gates at the Dr. Miller canal intake were opened at that time since the salinity in the Mermentau River was less than 5 parts per thousand. Once the salinity started to exceed 5 parts per thousand, the gates closed and the increase in water level started to dissipate (January 15th though the end of February 2003).

During the last month of the simulation period, the increase of the water level for the combined simulation was similar to that of each project separately. The increase was in the order of 0.3-0.4 ft, from 1.2 ft NAVD 88 to 1.5 ft NAVD 88).

It should be realized that the flow through each of the two conveyance channels (Dr. Miller and Little Pecan Alternate #2) is driven primarily by the difference in the head-water elevation and the water elevation in the target marsh area. As the water level in the target marsh area rises relative to the head-water, the flow rate (volume of water per unit time) passing through these conveyance channels will decrease. Since the target area receives water from two conveyance channels (in the combined run) the water level will rise in a different fashion and at a different rate from each project when implemented separately.

<u>Salinity:</u>

Time series plots and contour maps of salinities and difference in salinities for Point 9 through 12 indicated spatial and temporal variations in the magnitude of salinity reduction.

The model results showed that the Little Pecan Project, when running separately, produced favorable results for the areas near Point 9 (the eastern side of the target area), which is the closest to the outlet of the freshwater introduction canal for the Little Pecan Project. The South Grand Chenier Project produced favorable results for the areas near Point 11 (the western side of the target area), which are the closest to the outlet of Dr Miller Canal.

The combined run (as seen in Figure A-125 and A-127) resulted in a salinity reduction occurred over a larger spatial area expanding virtually from the eastern to the western edge of the target area. It appears that having two conveyance channels resulted in a wider spatial distribution of fresher water and also lasted longer. The magnitude of salinity reduction for the combined run, as shown in Figures A-143 through A-152, was in the order of 3 to 4 parts per thousand (from 5 to 1 parts per thousand in base salinity).

4.1.3 FINAL CONCLUSION AND CLOSING REMARKS:

The combined model simulation produced more favorable salinity reduction compared to either project alone. The salinity reduction of the combined simulation extended over a larger spatial area and lasted longer than each project separately.

Figure 48 below illustrates the boundaries of both projects and the overlap between them. As seen through the various contour plots found in the Appendix, the benefits extended beyond the project boundaries. Accordingly, the agencies may wish to revise the project boundaries.

In terms of water level increase, the combined simulation did not show significant increase beyond that of each project separately. It is recommended that the agencies fully investigate the results to assess the impact of the combined run on the ecology of the target areas.

At the end, it is worth mentioning here that the present modeling study did not include investigating any ecological or biological effects of the projects on the marshes.

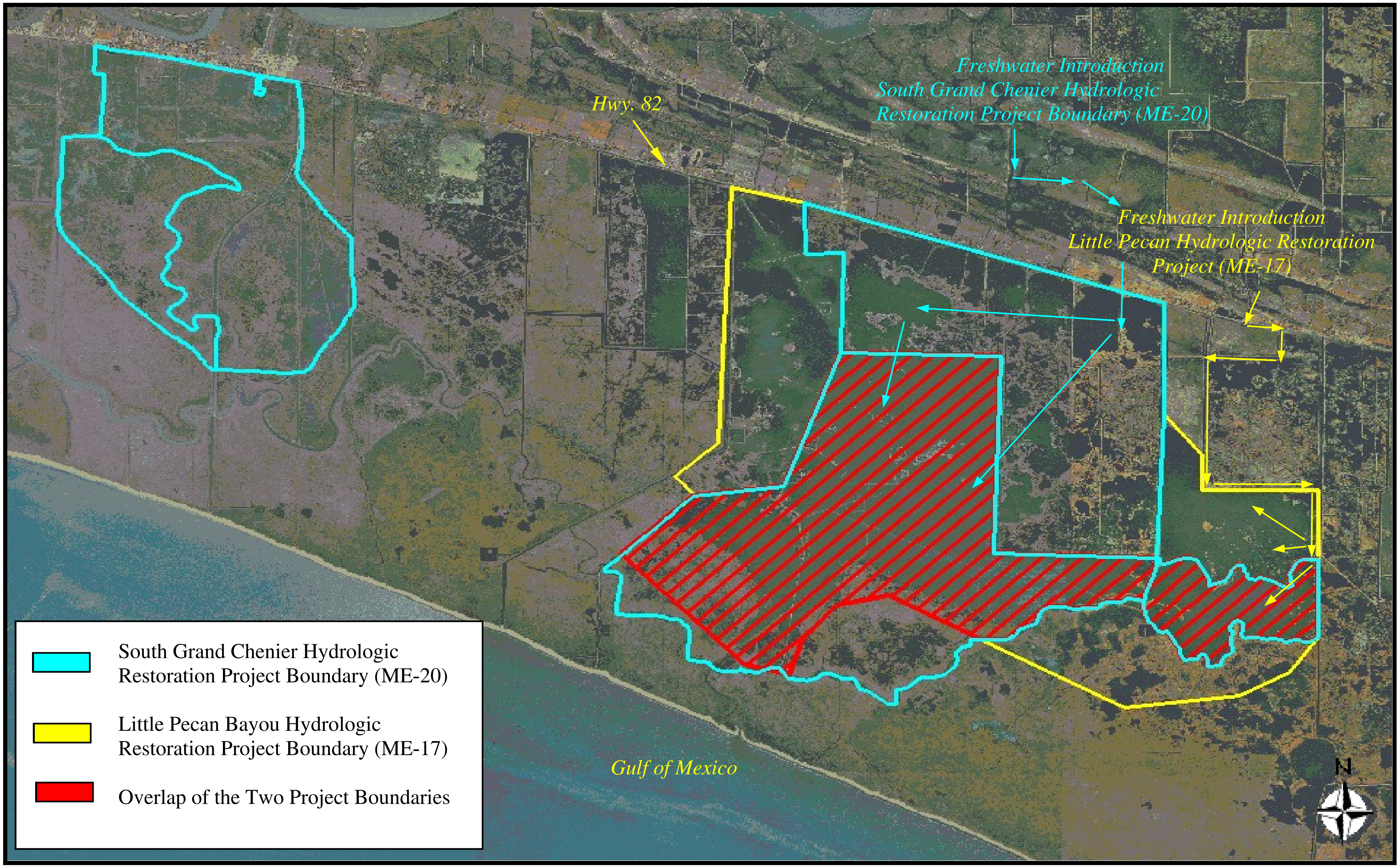

Figure 48: Overlap of Project Boundaries for both the South Grand Chenier Hydrologic Restoration Project (ME-20) and the Little Pecan Bayou Hydrologic Restoration Project (ME-17)

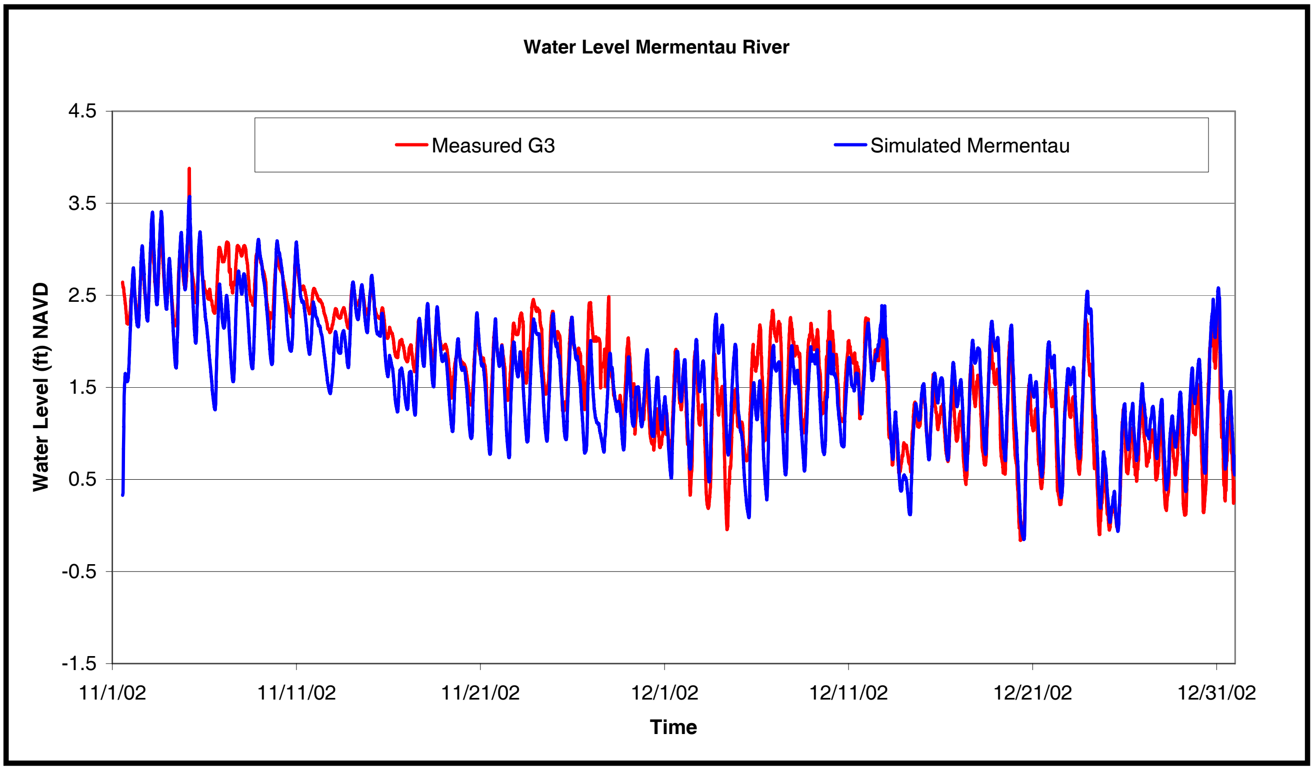

Figure A-1: Water Level Model Results Compared To Field Data At G3 Mermentau River (Calibration)

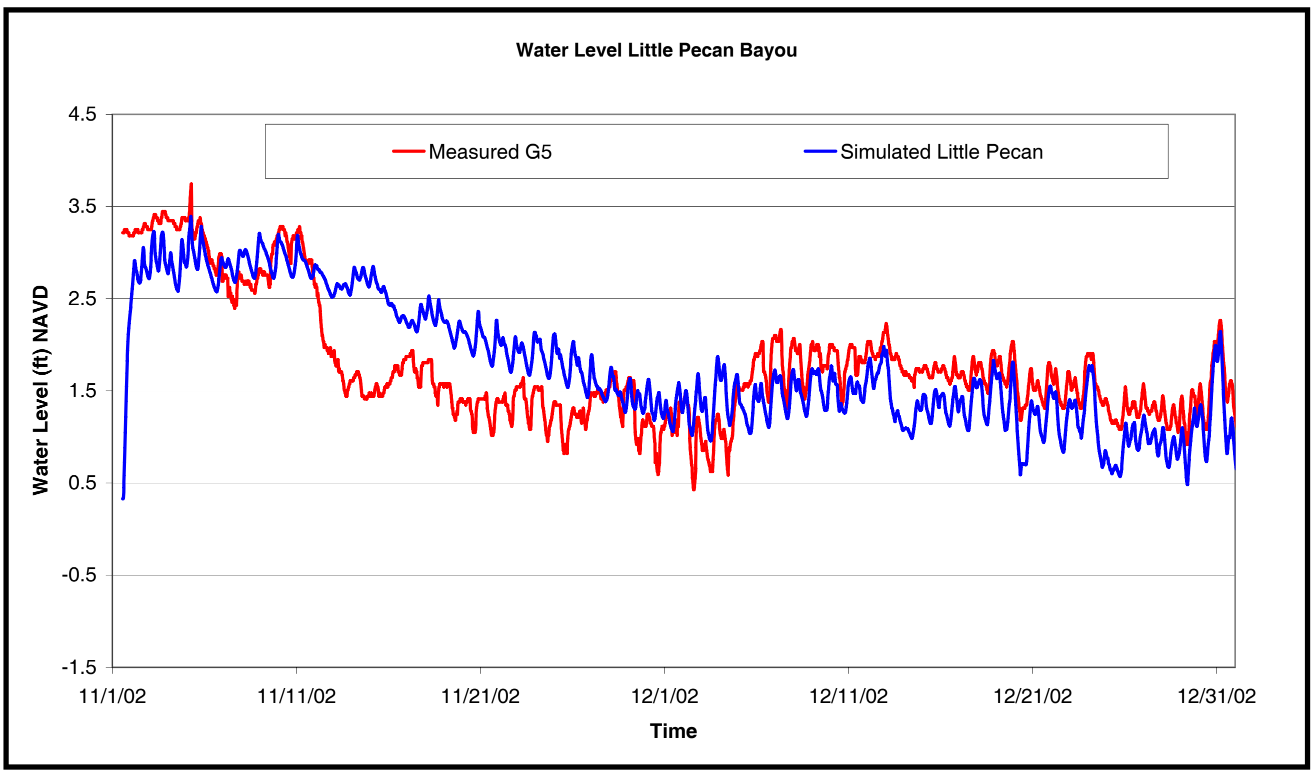

Figure A-2: Water Level Model Results Compared To Field Data At G5 Little Pecan Bayou (Calibration)

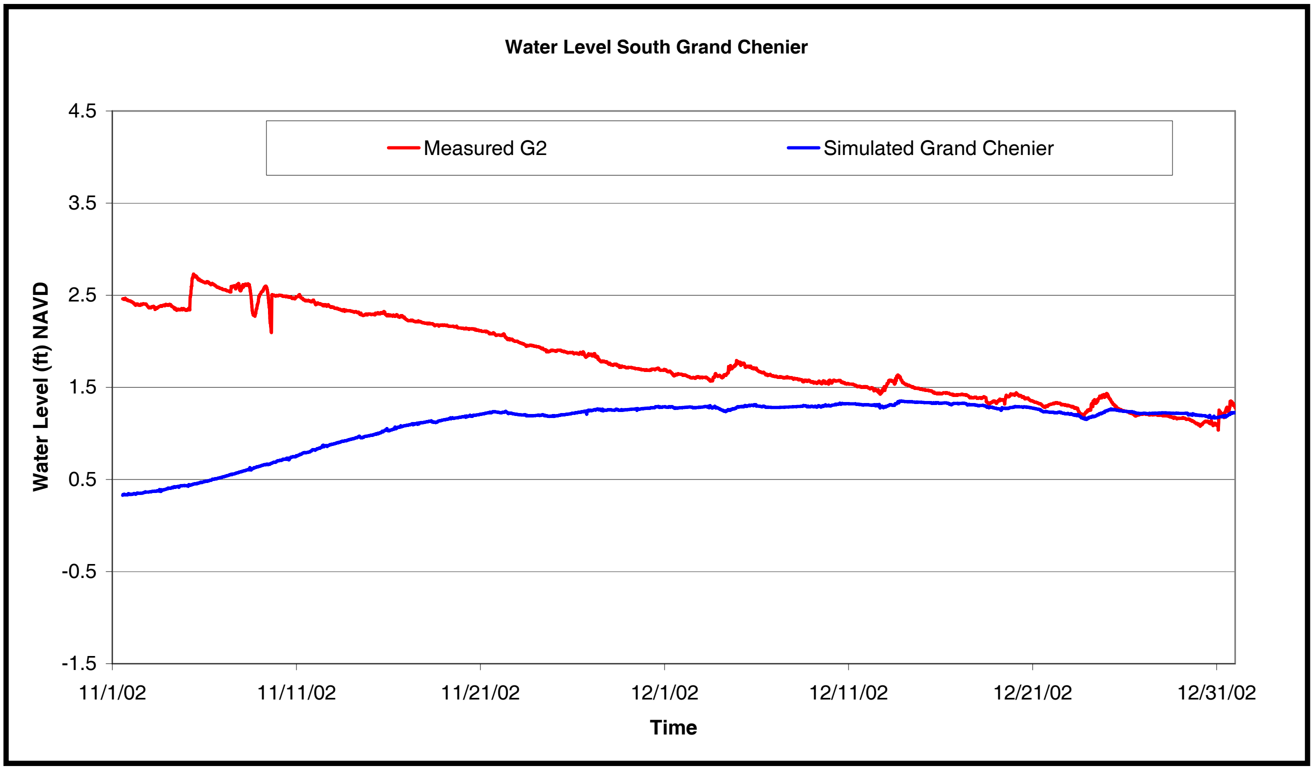

Figure A-3: Water Level Model Results Compared To Field Data At G2 Second Lake Cut (Calibration)

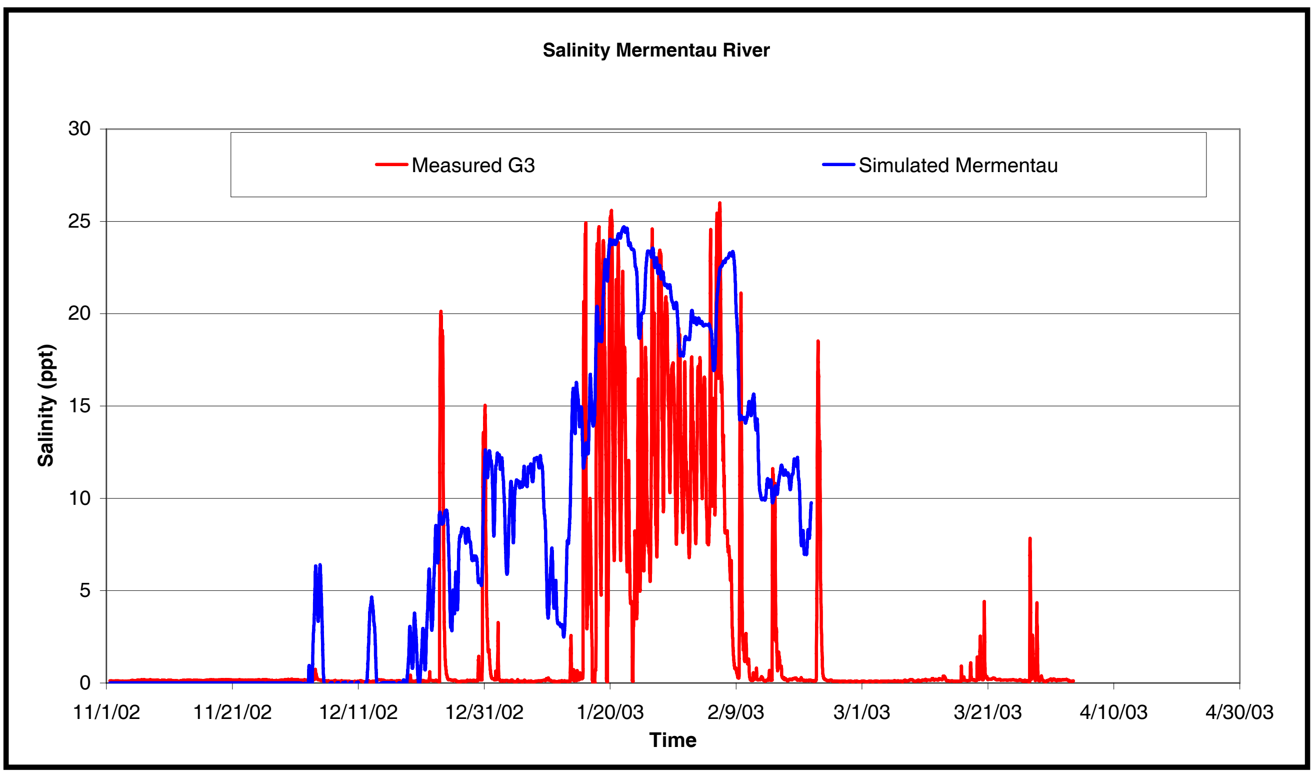

Figure A-4: Salinity Model Results Compared To Field Data At G3 Mermentau River (Calibration)

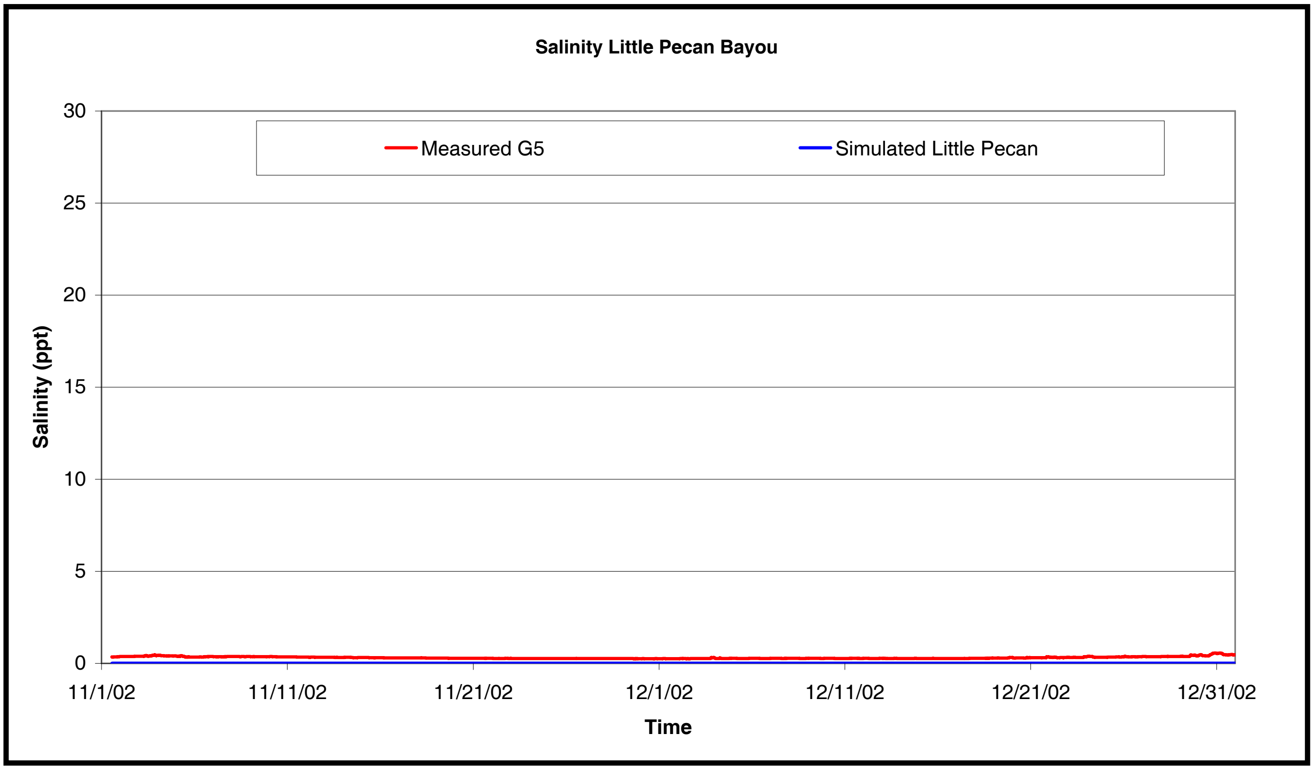

Figure A-5: Salinity Model Results Compared To Field Data At G5 Little Pecan Bayou (Calibration)

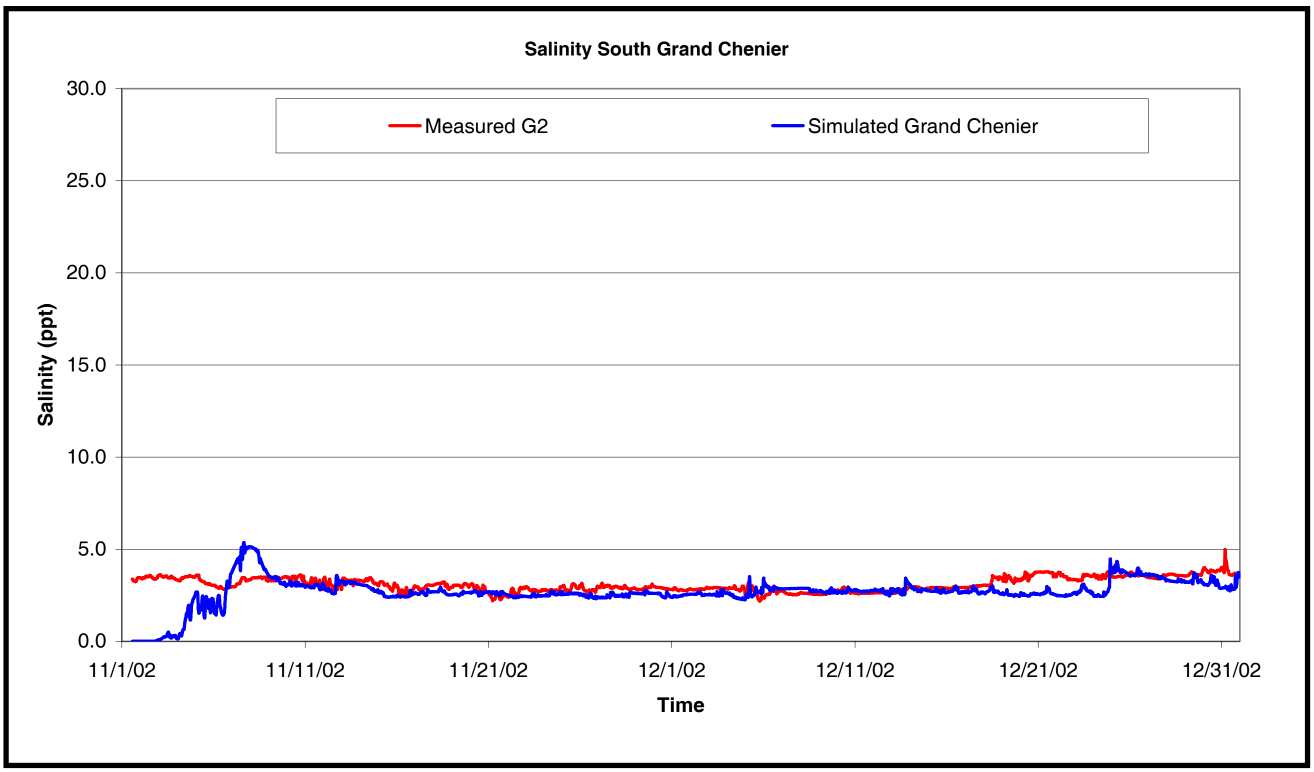

Figure A-6: Salinity Model Results Compared To Field Data At G2 Second Lake Cut (Calibration)

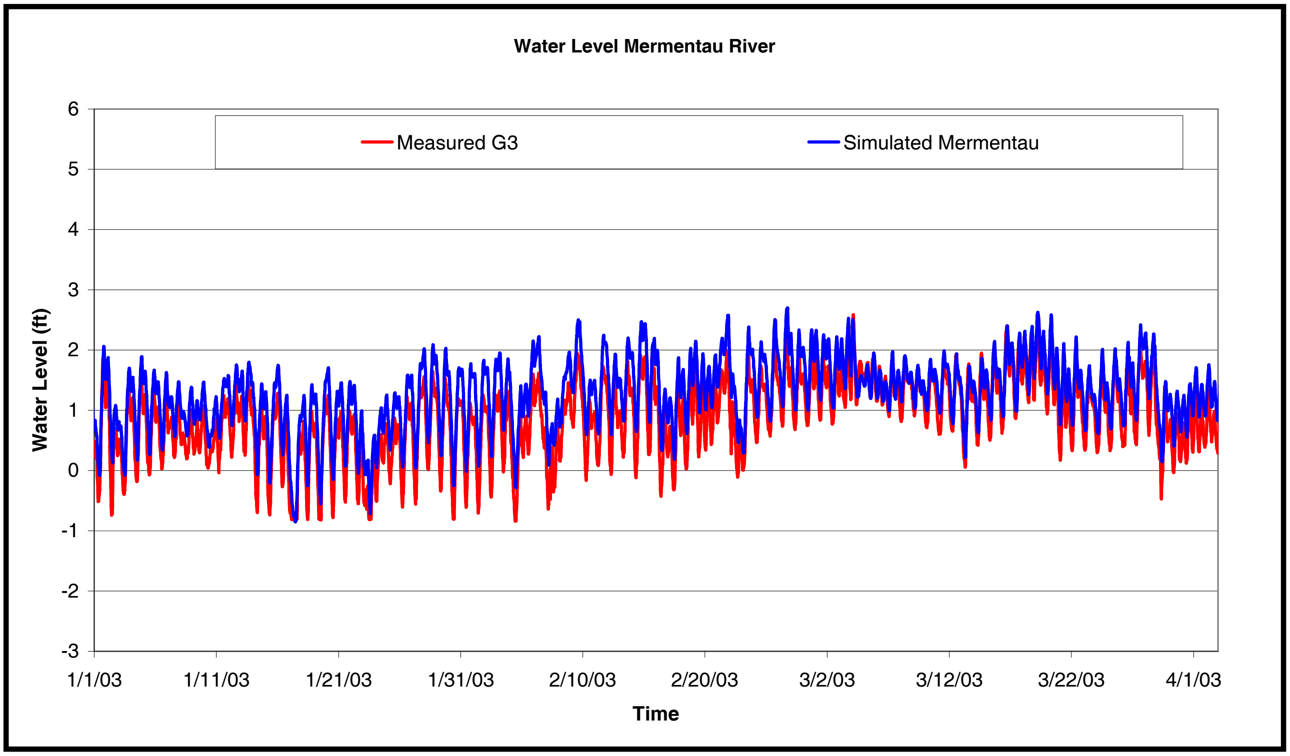

Figure A-7: Water Level Model Results Compared To Field Data At G3 Mermentau River (Validation)

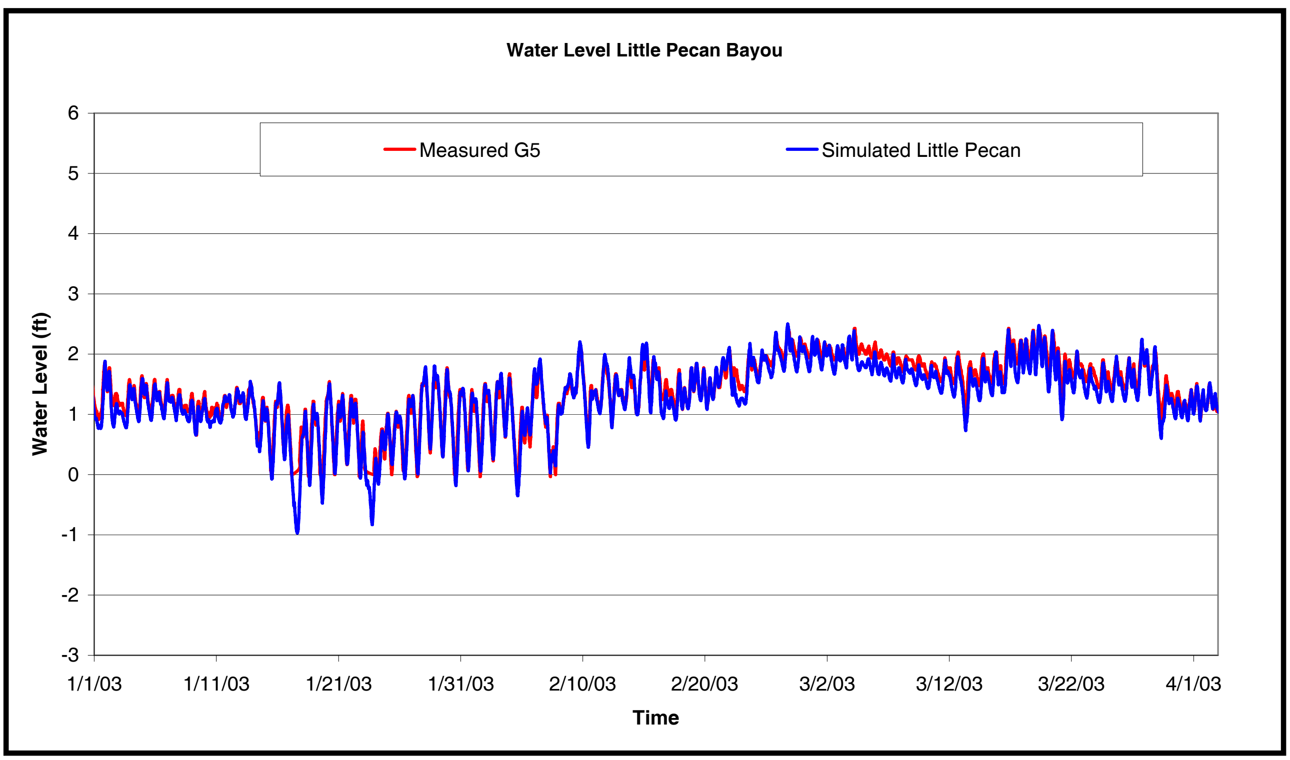

Figure A-8: Water Level Model Results Compared To Field Data At G5 Little Pecan Bayou (Validation)

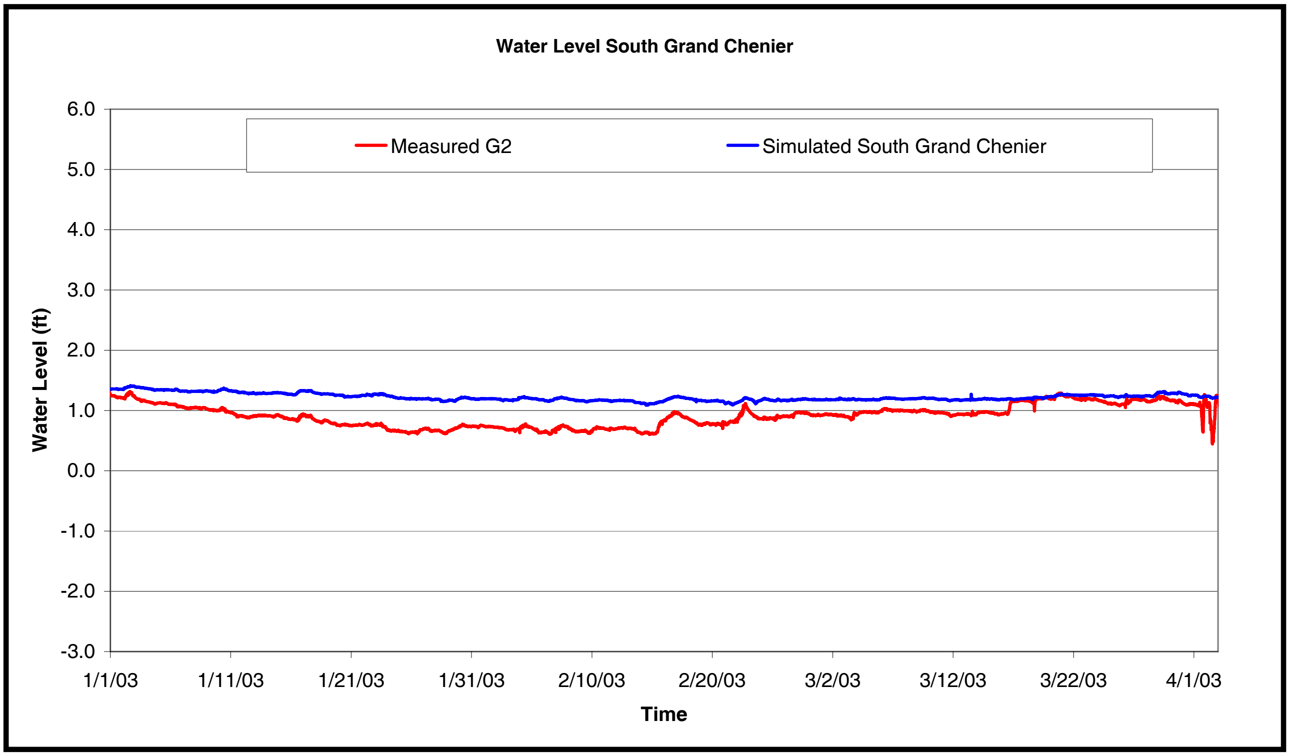

Figure A-9: Water Level Model Results Compared To Field Data At G2 Second Lake Cut (Validation)

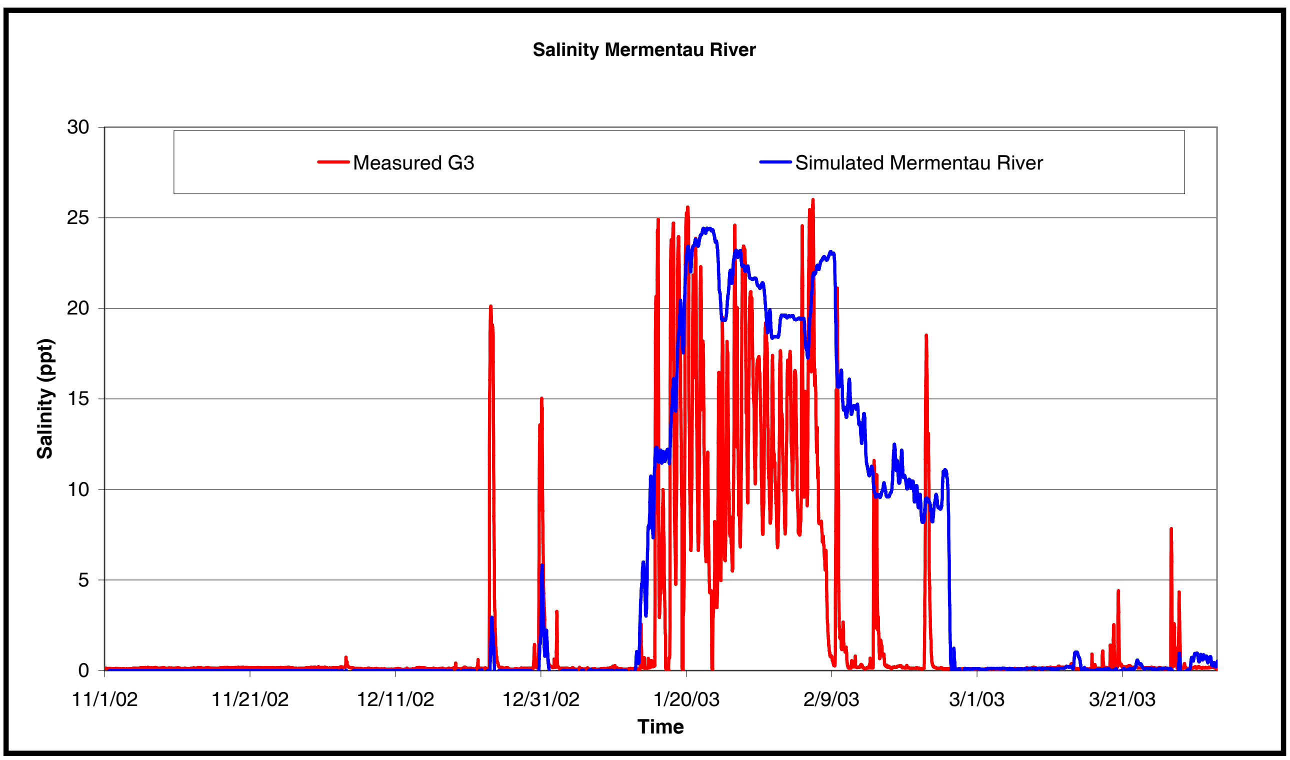

Figure A-10: Salinity Model Results Compared To Field Data At G3 Mermentau River (Validation)

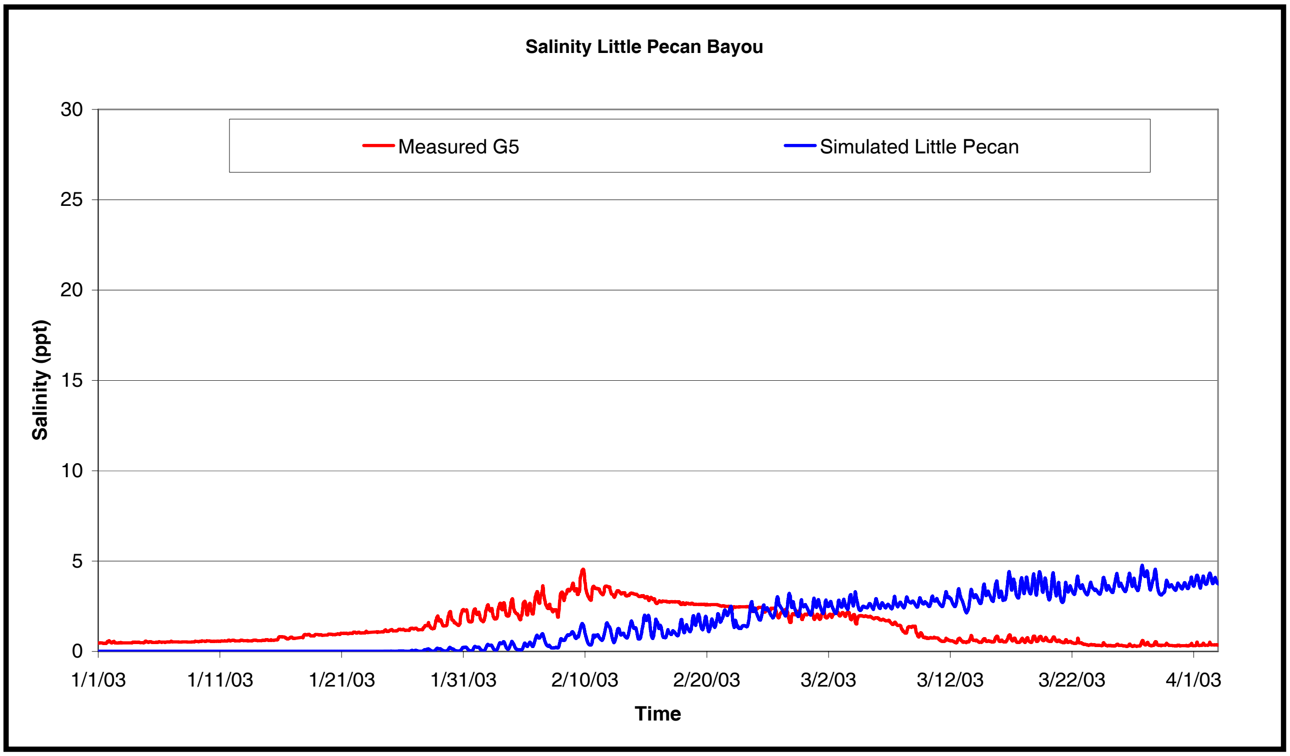

Figure A-11: Salinity Model Results Compared To Field Data At G5 Little Pecan Bayou (Validation)

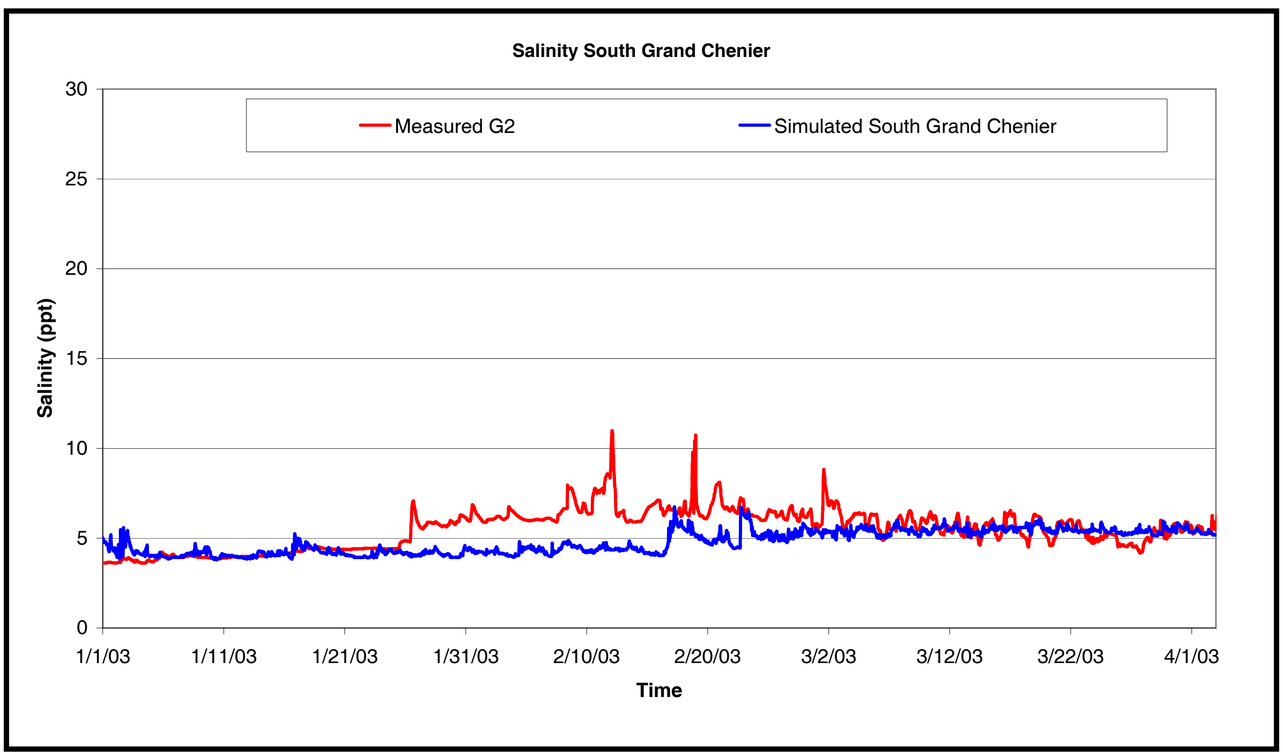

Figure A-12: Salinity Model Results Compared To Field Data At G2 Second Lake Cut (Validation)

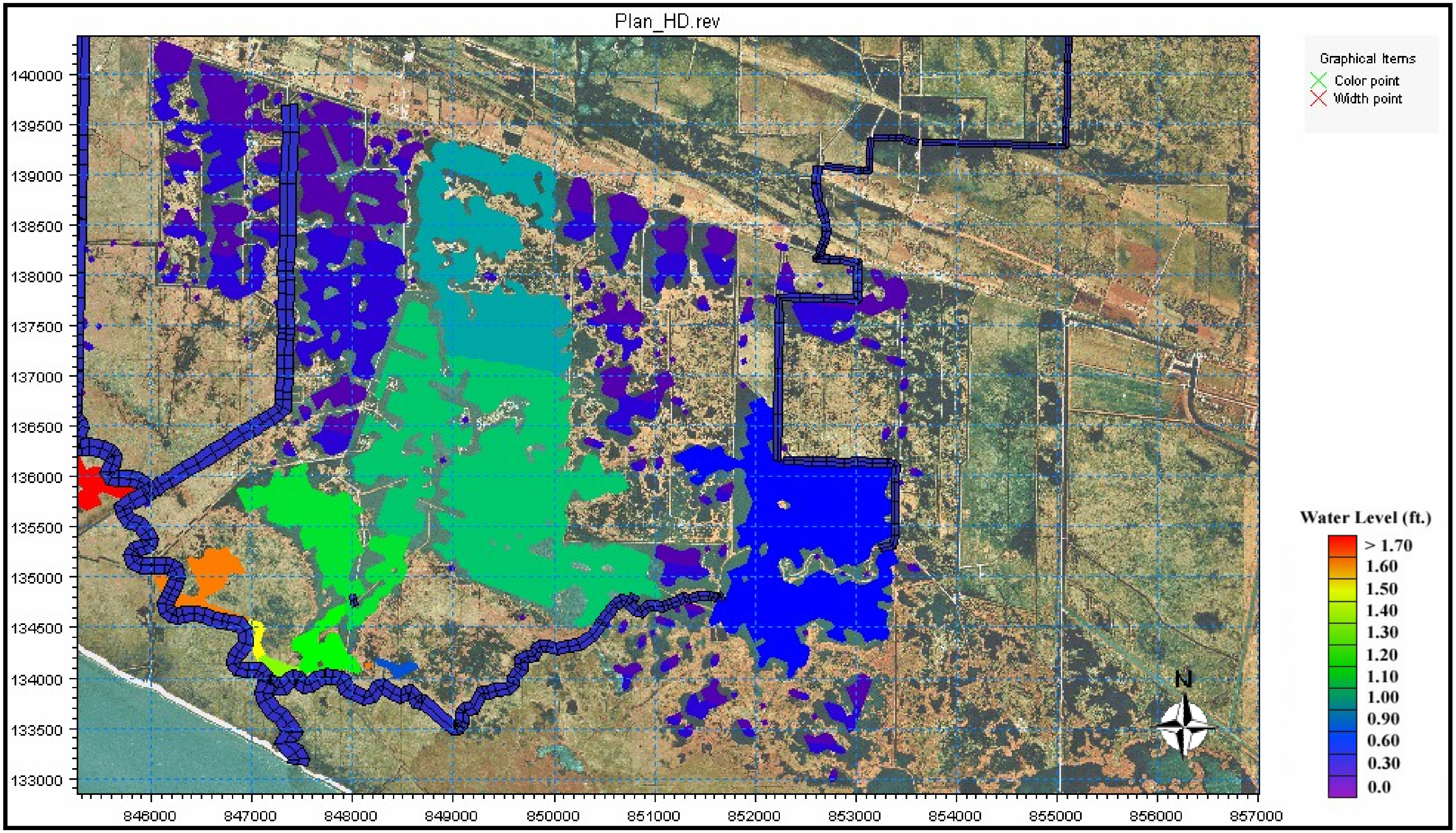

Figure A-13: Water Level Contour Map For The South Grand Chenier Area At 11/15/02 4:00

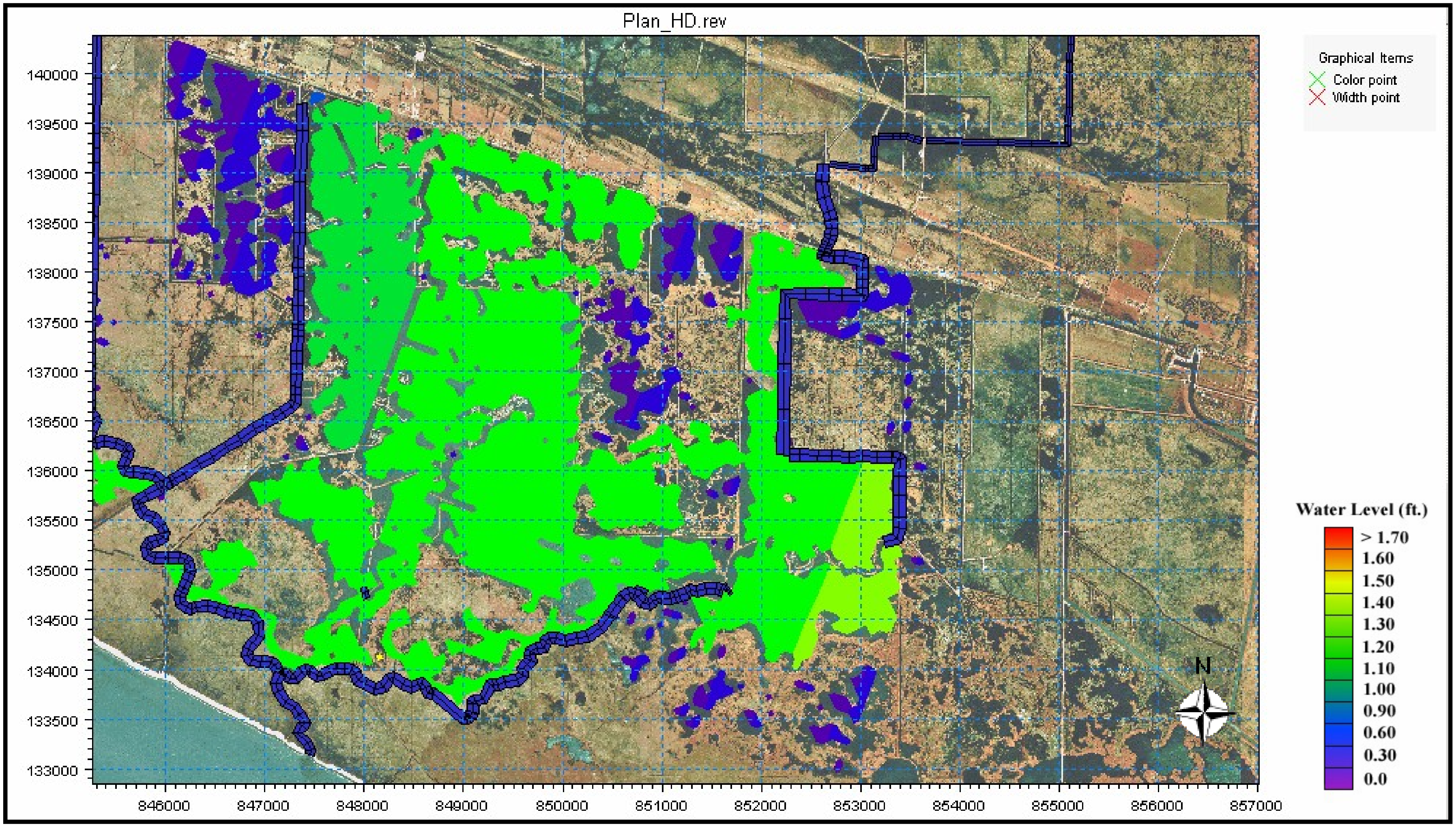

Figure A-14: Water Level Contour Map For The South Grand Chenier Area At 01/03/03 3:00 AM

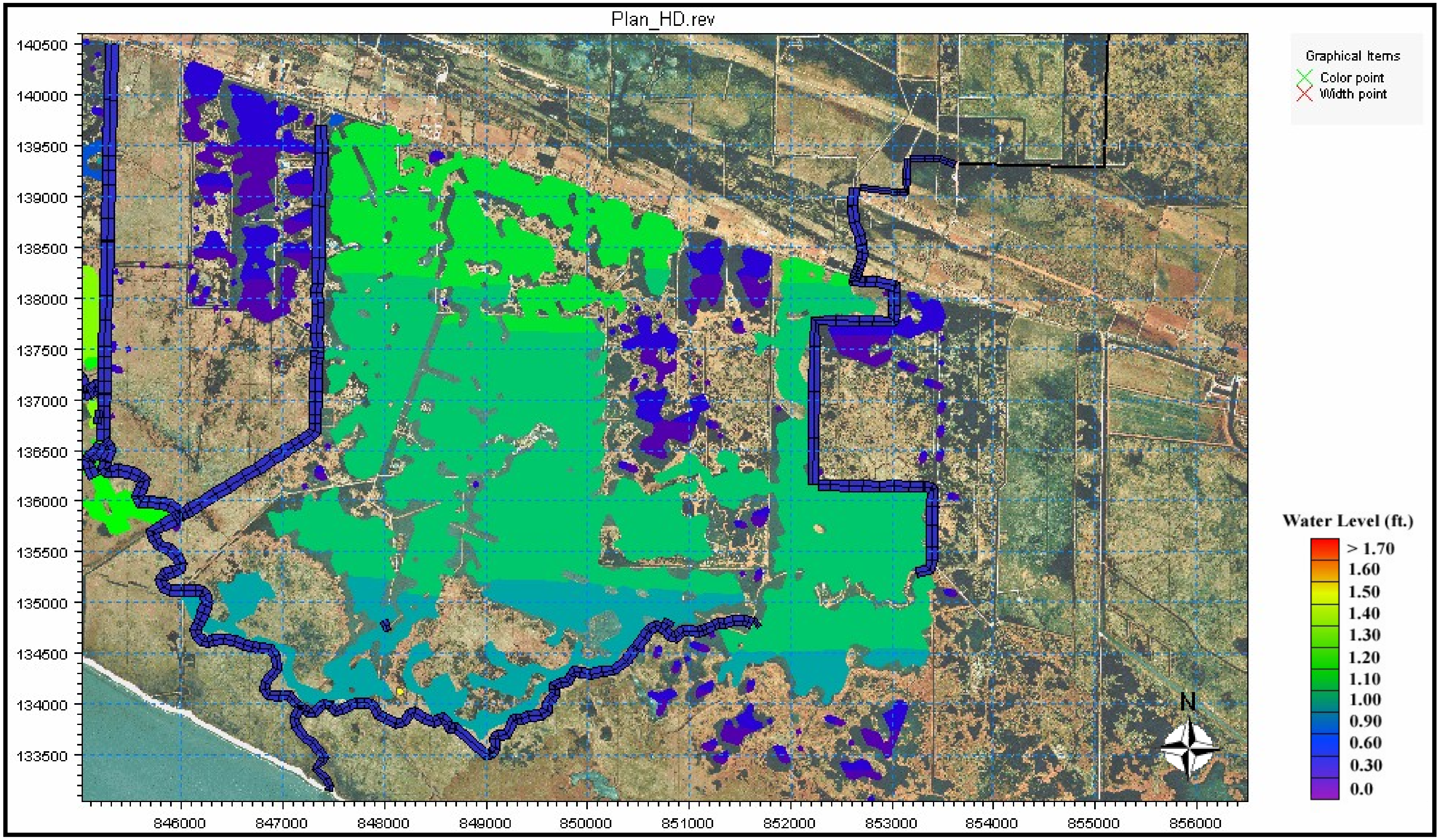

Figure A-15: Water Level Contour Map For The South Grand Chenier Area At 02/03/03 09:00 AM

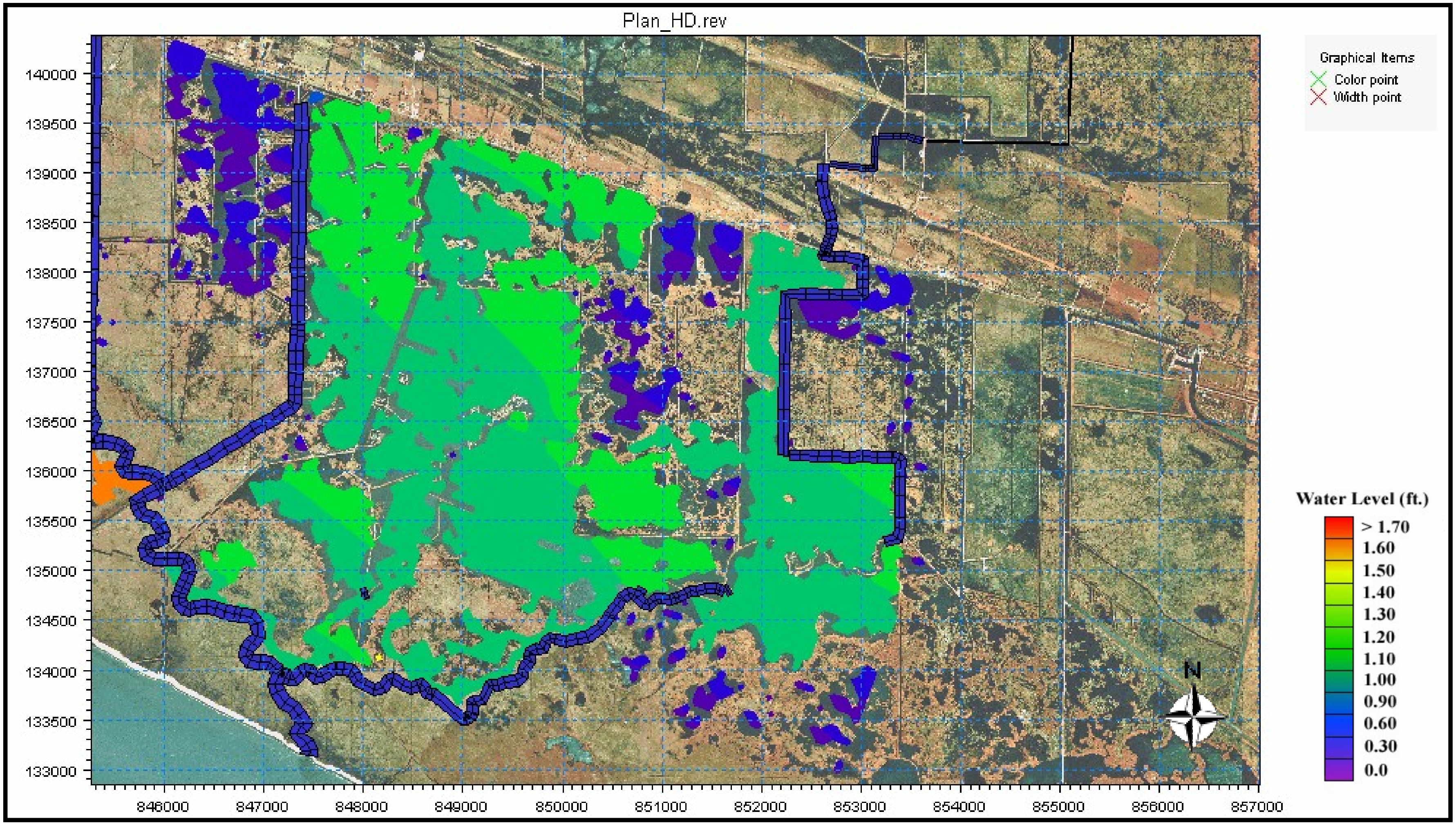

Figure A-16: Water Level Contour Map For The South Grand Chenier Area At 03/18/03 3:00 PM

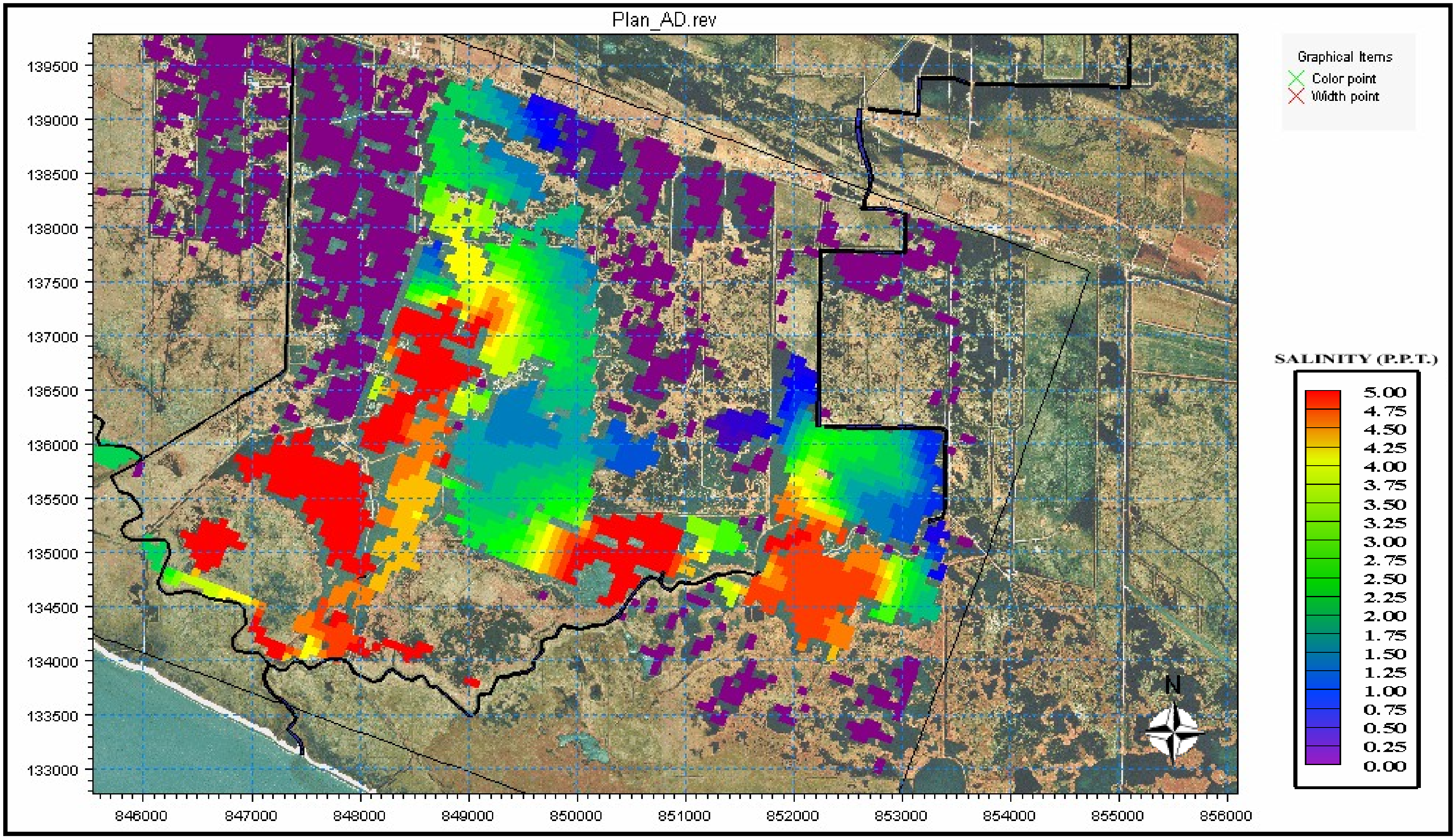

Figure A-17: Salinity Contour Map For The South Grand Chenier Area At 11/15/02 4:00 AM

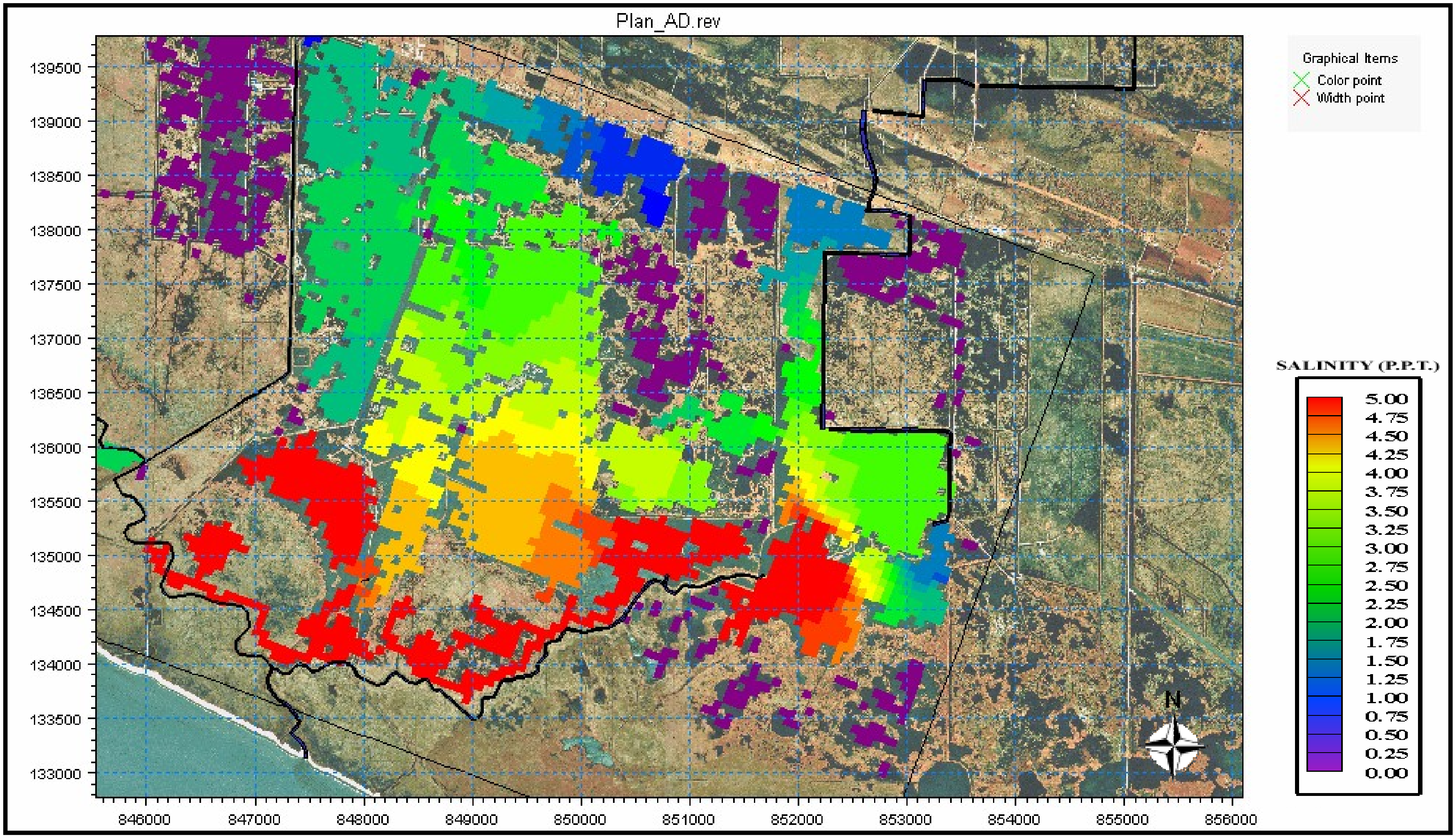

Figure A-18: Salinity Contour Map For The South Grand Chenier Area At 01/03/03 3:00 AM

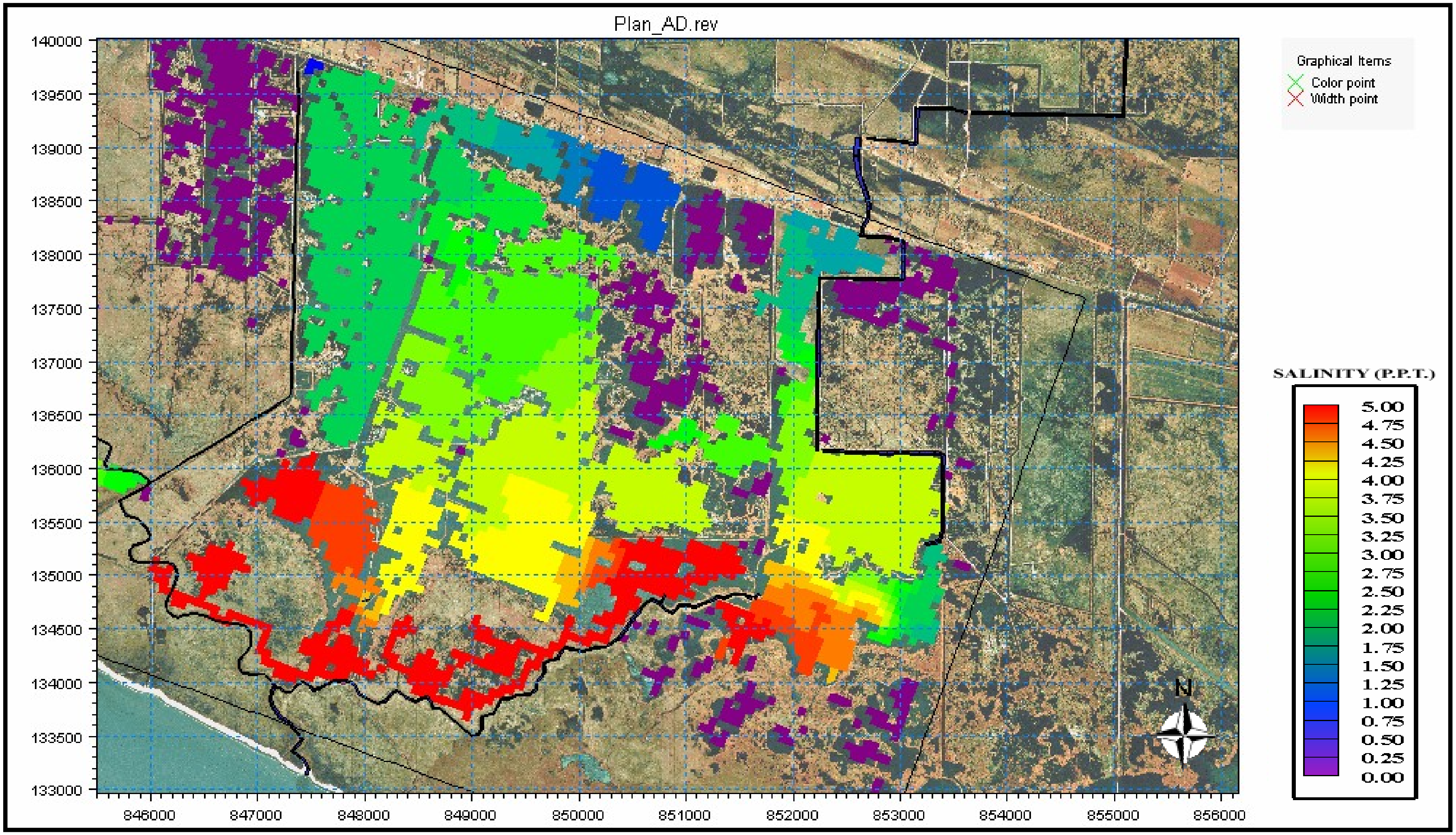

Figure A-19: Salinity Contour Map For The South Grand Chenier Area At 02/03/03 3:00 AM

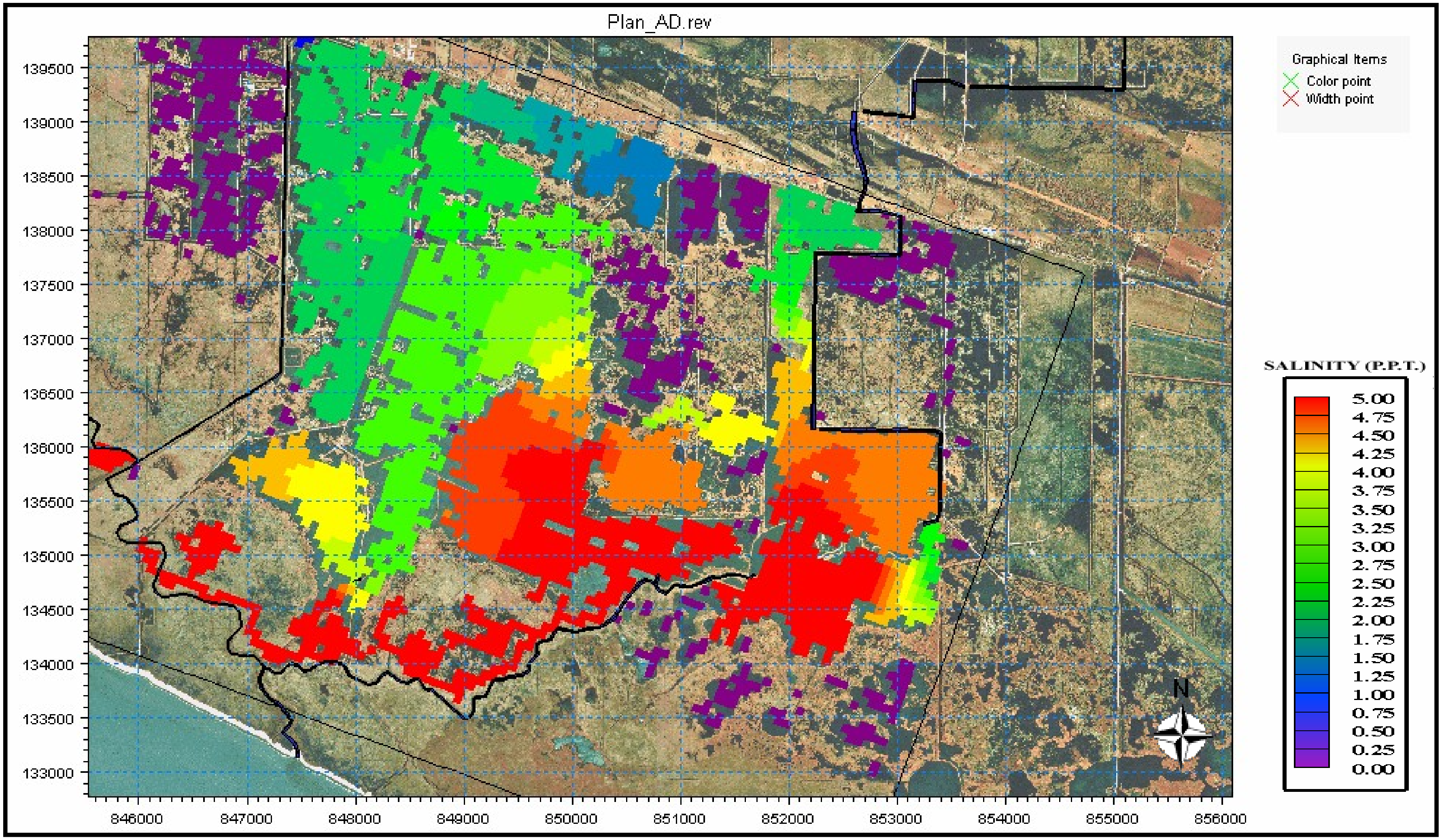

Figure A-20: Salinity Contour Map For The South Grand Chenier Area At 03/18/03 3:00 PM

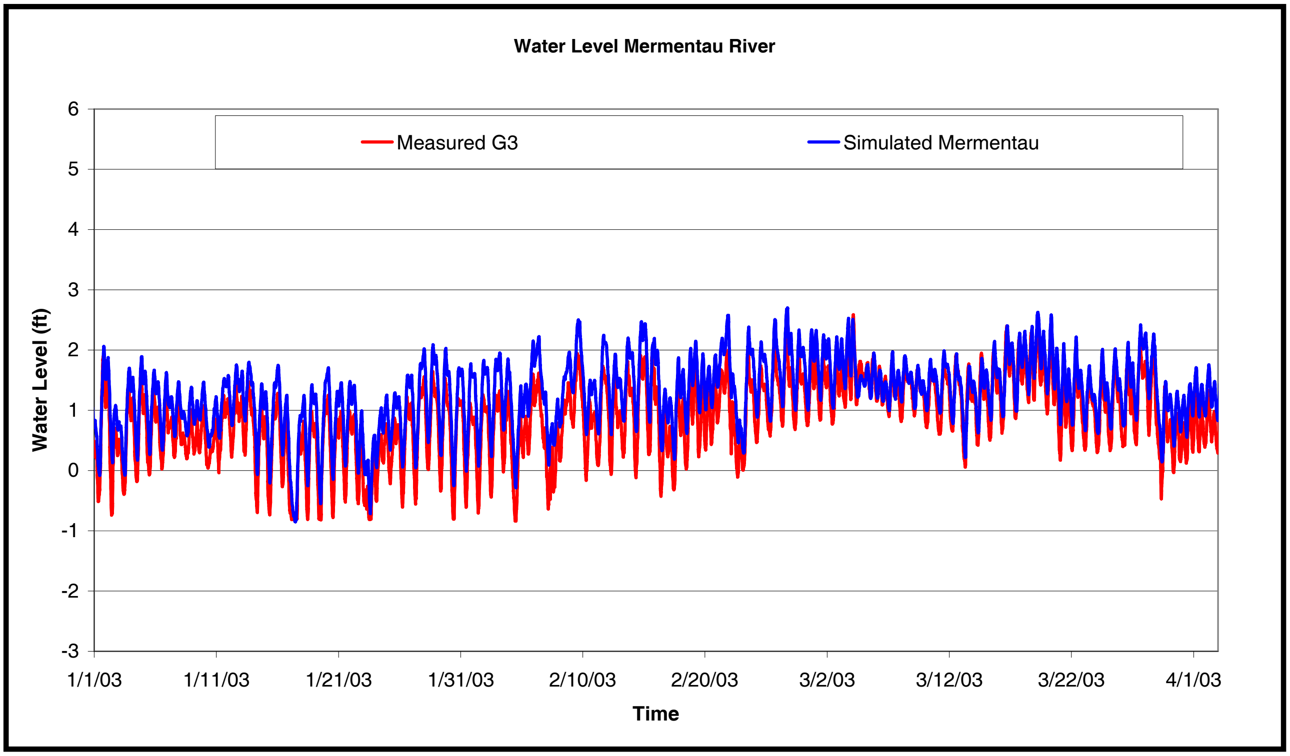

Figure A-21: Water Level model Results compared to field data at G3 Mermentau River (Validation) [After removing the link]

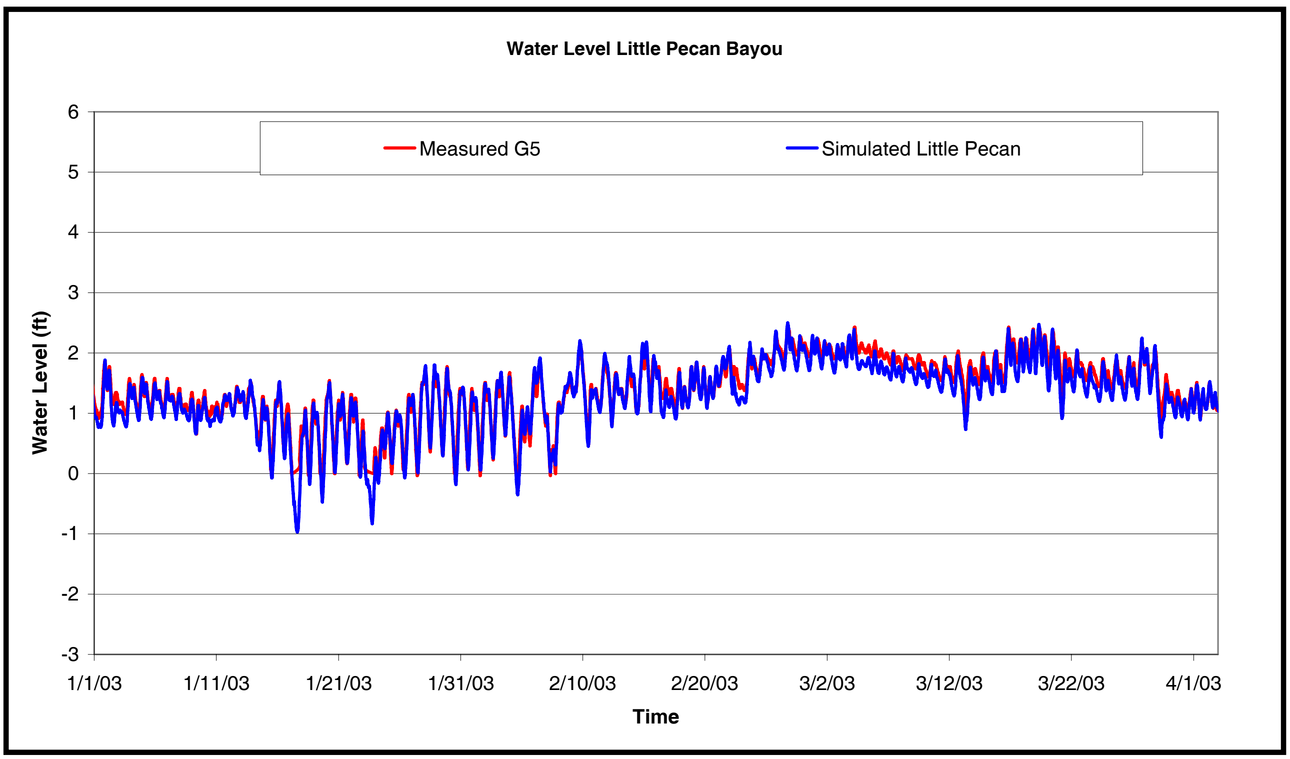

Figure A-22: Water Level model Results compared to field data at G5 Little Pecan Bayou (Validation) [After removing the link]

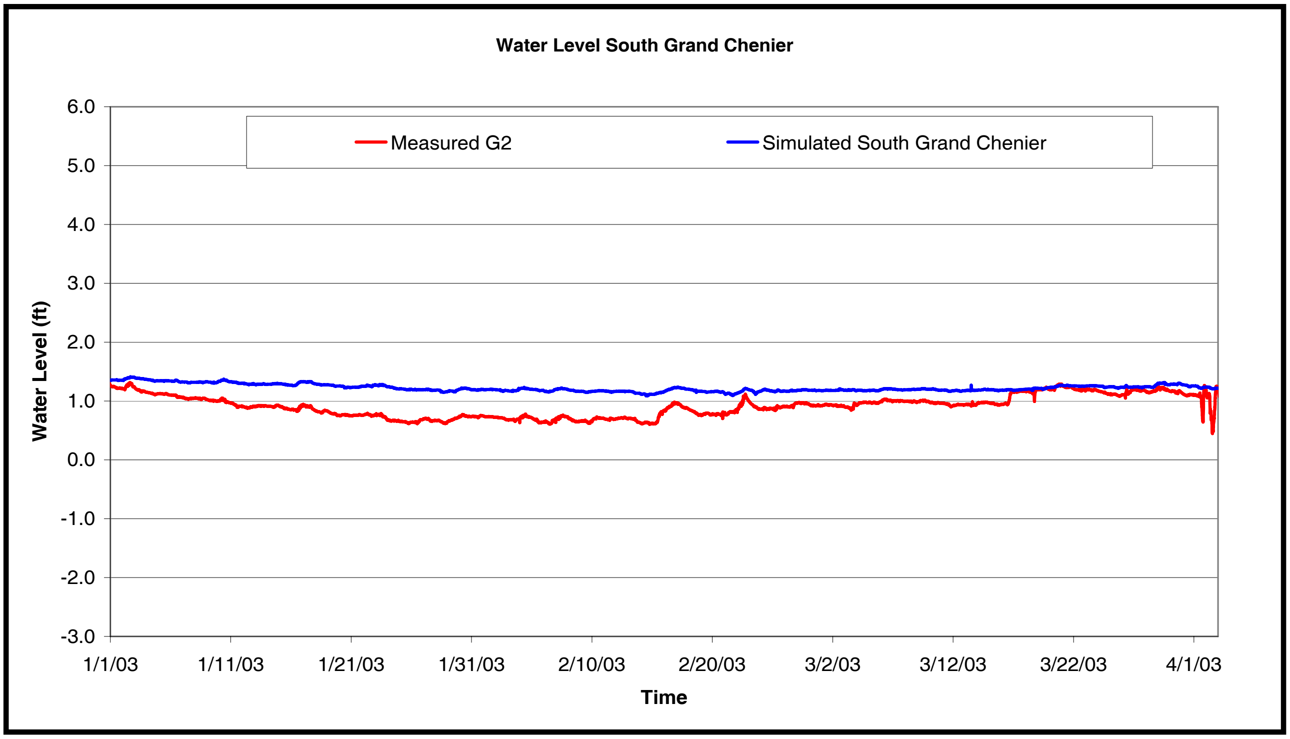

Figure A-23: Water Level model Results compared to field data at G2 Second Lake cut (Validation)
[After removing the link]

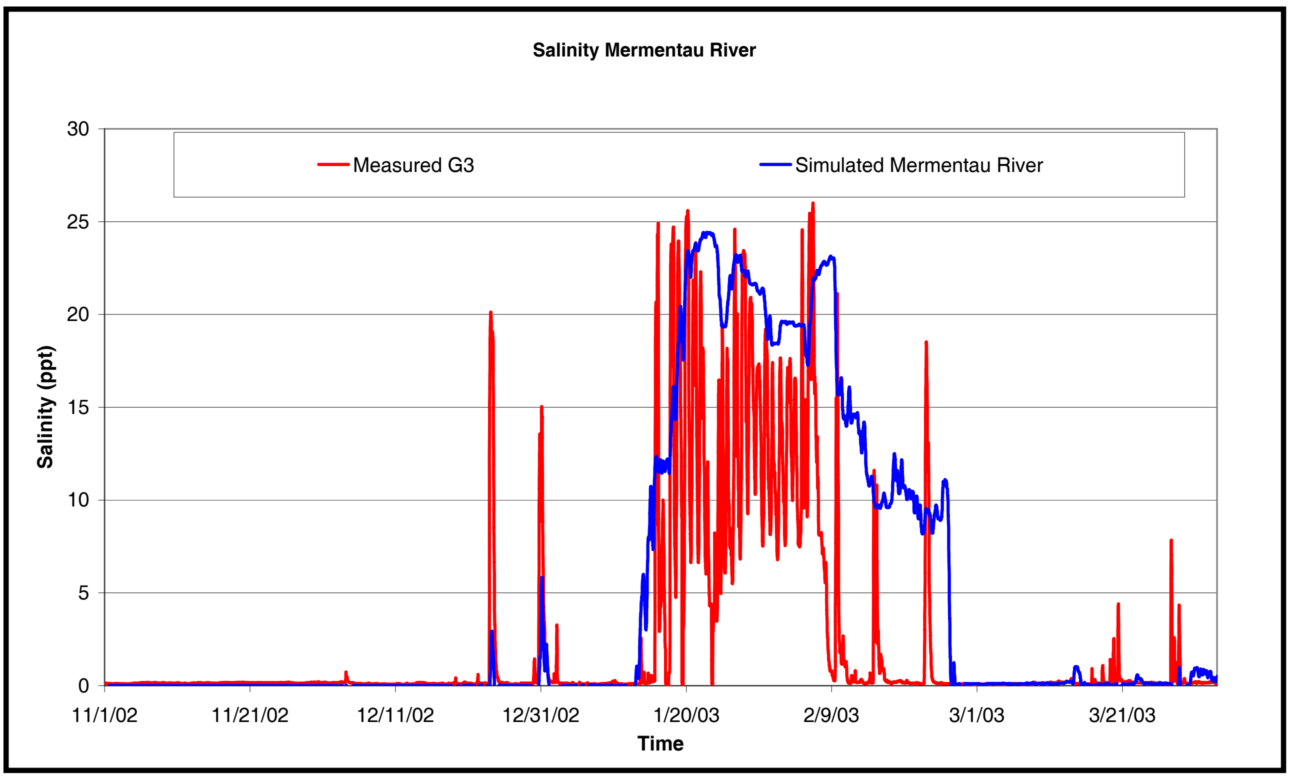

Figure A-24: Salinity model Results compared to field data at G3 Mermentau River (Validation)
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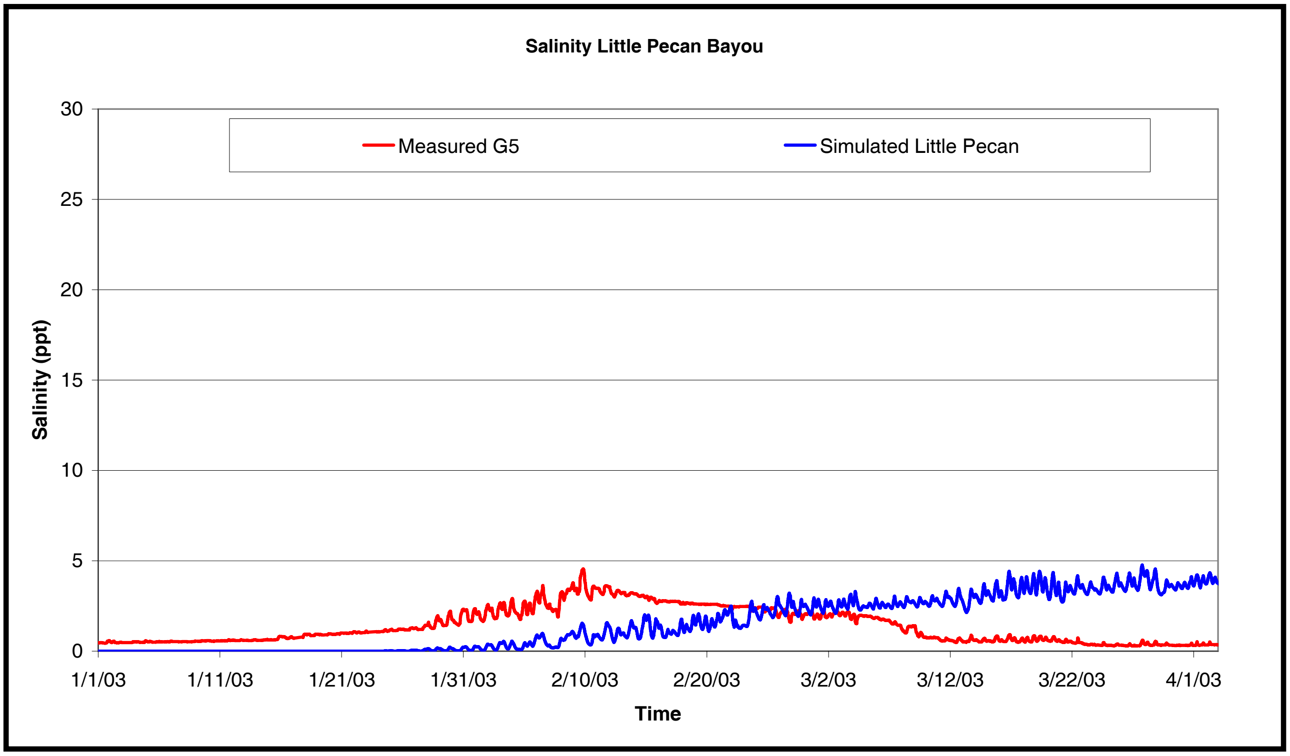

Figure A-25: Salinity model Results compared to field data at G5 Little Pecan Bayou (Validation) [After removing the link]

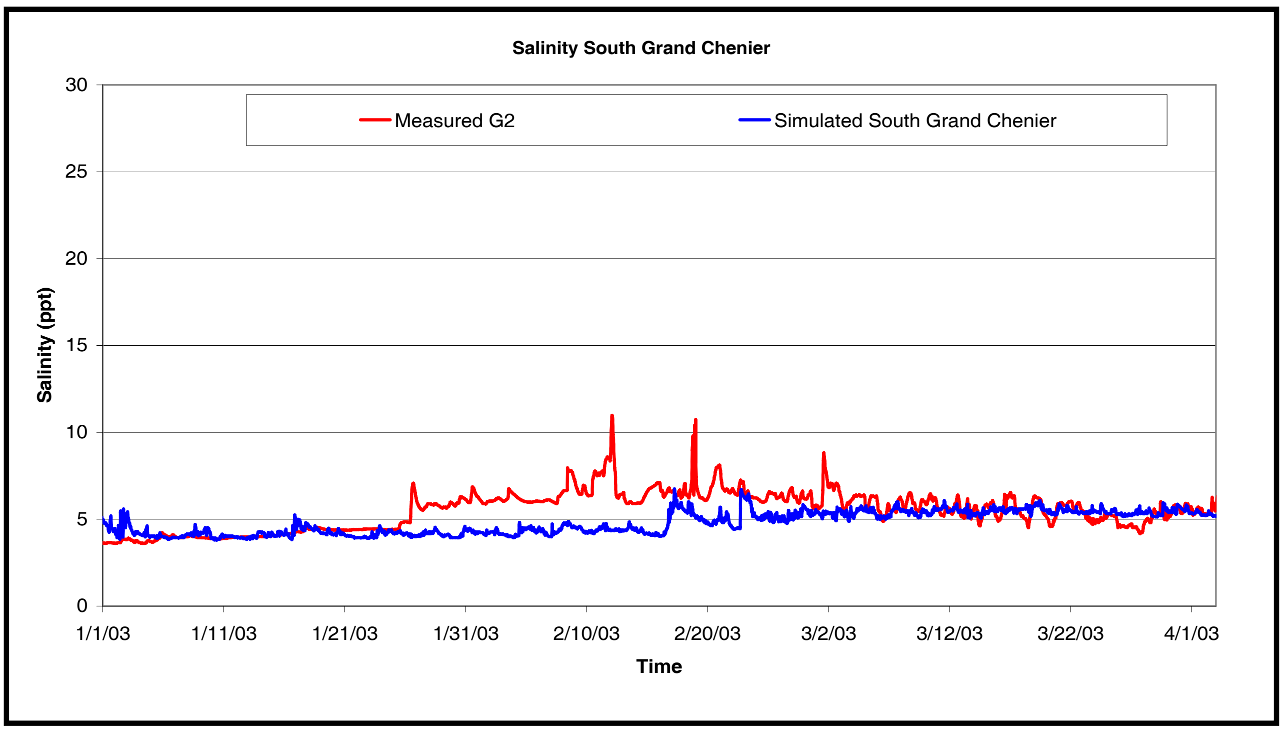

Figure A-26: Salinity model Results compared to field data at G2 Second Lake cut (Validation) [After removing the link]

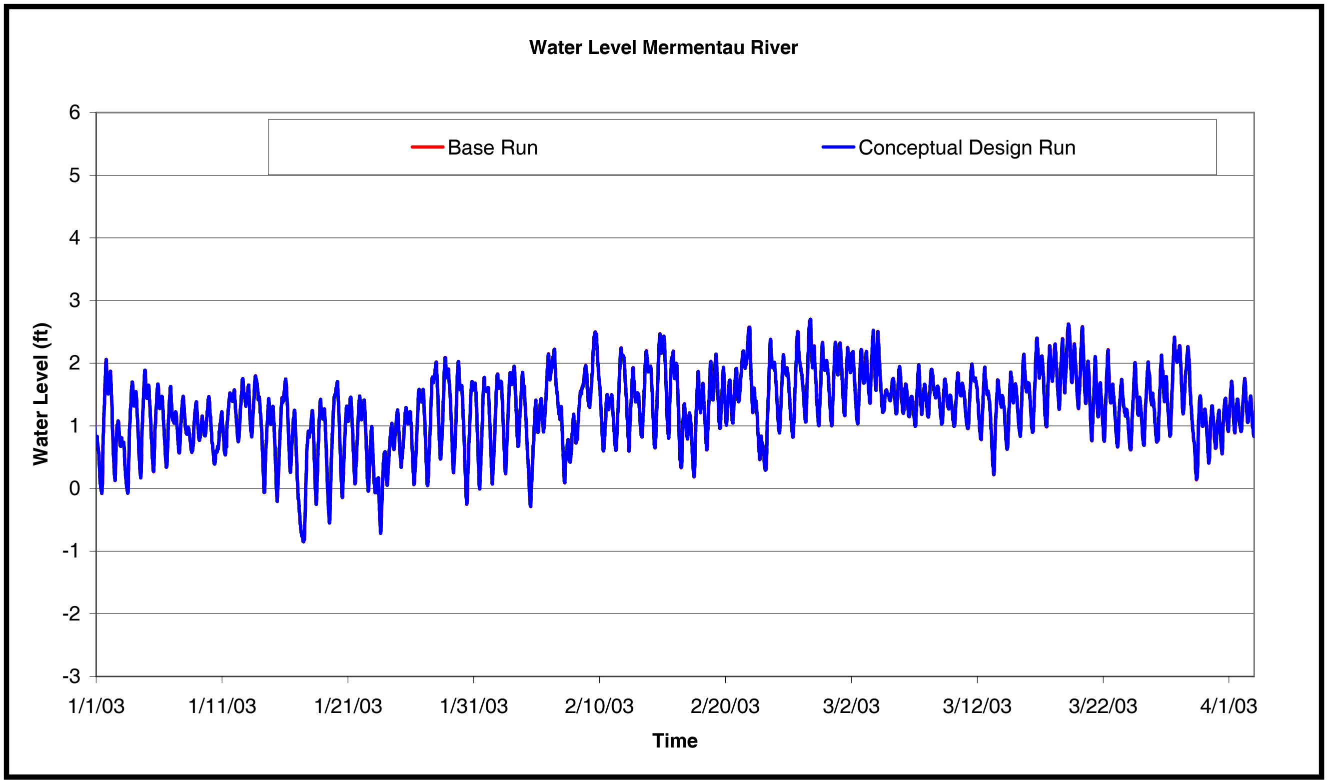

Figure A-27: Water Level Base Run results vs. Conceptual design Run at the Mermentau River.

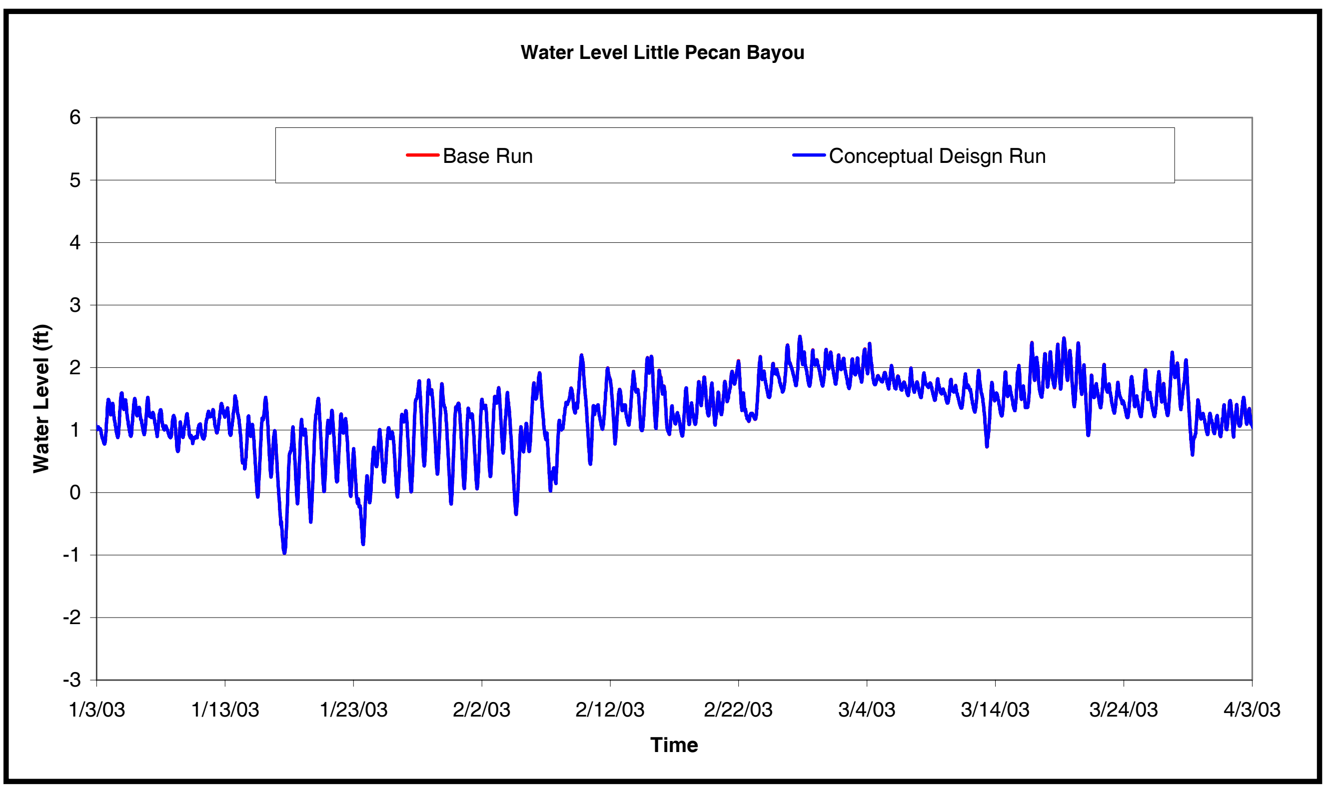

Figure A-28: Water Level Base Run results vs. Conceptual design Run at Little Pecan Bayou.

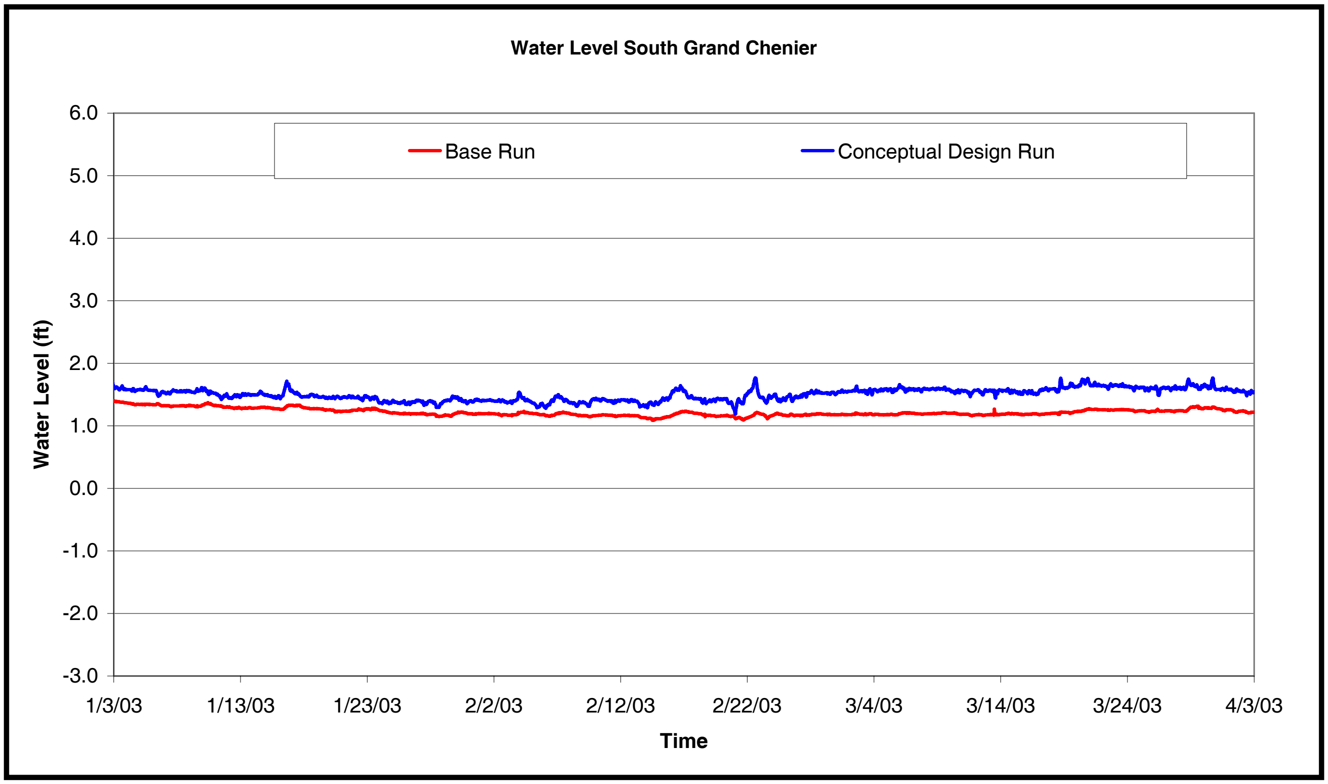

Figure A-29: Water Level Base Run results vs. Conceptual design Run at Second Lake

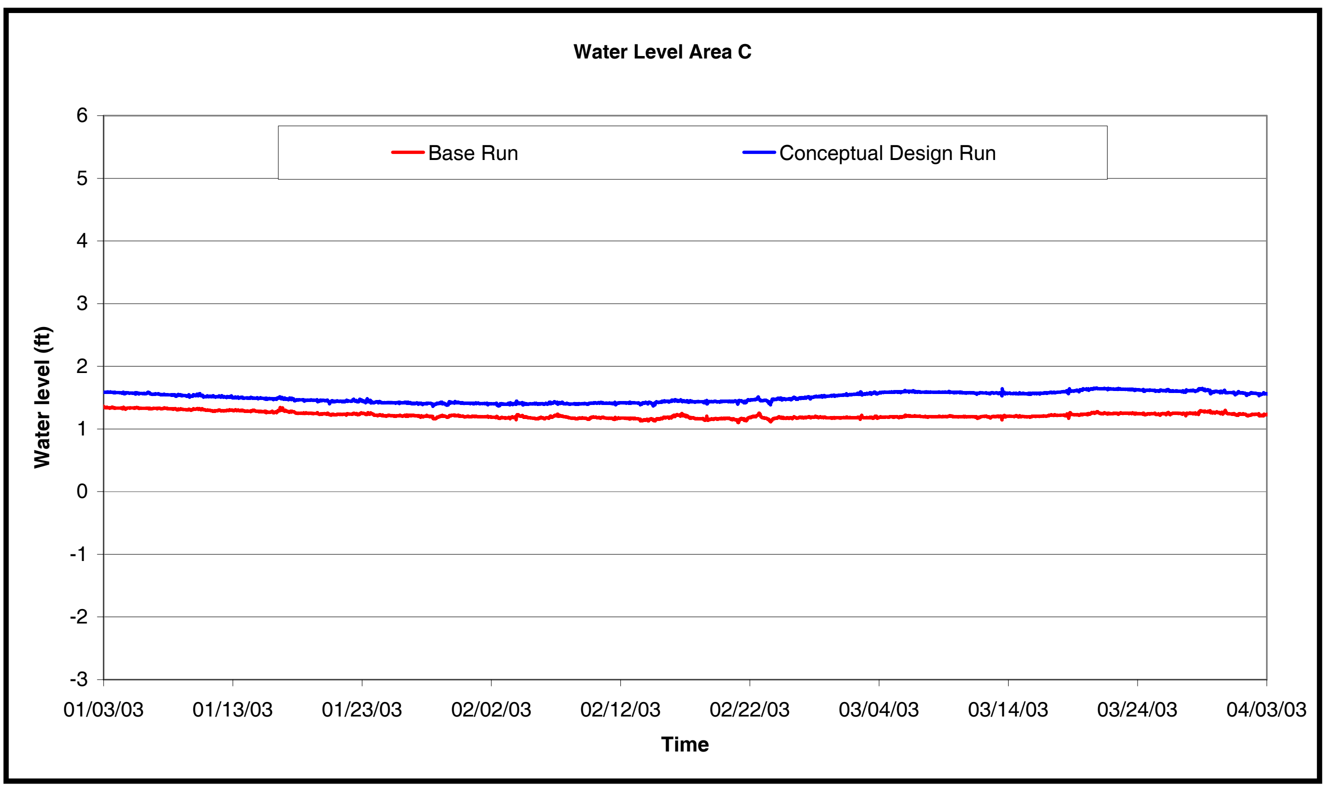

Figure A-30: Water Level Base Run results vs. Conceptual design Run at Area C

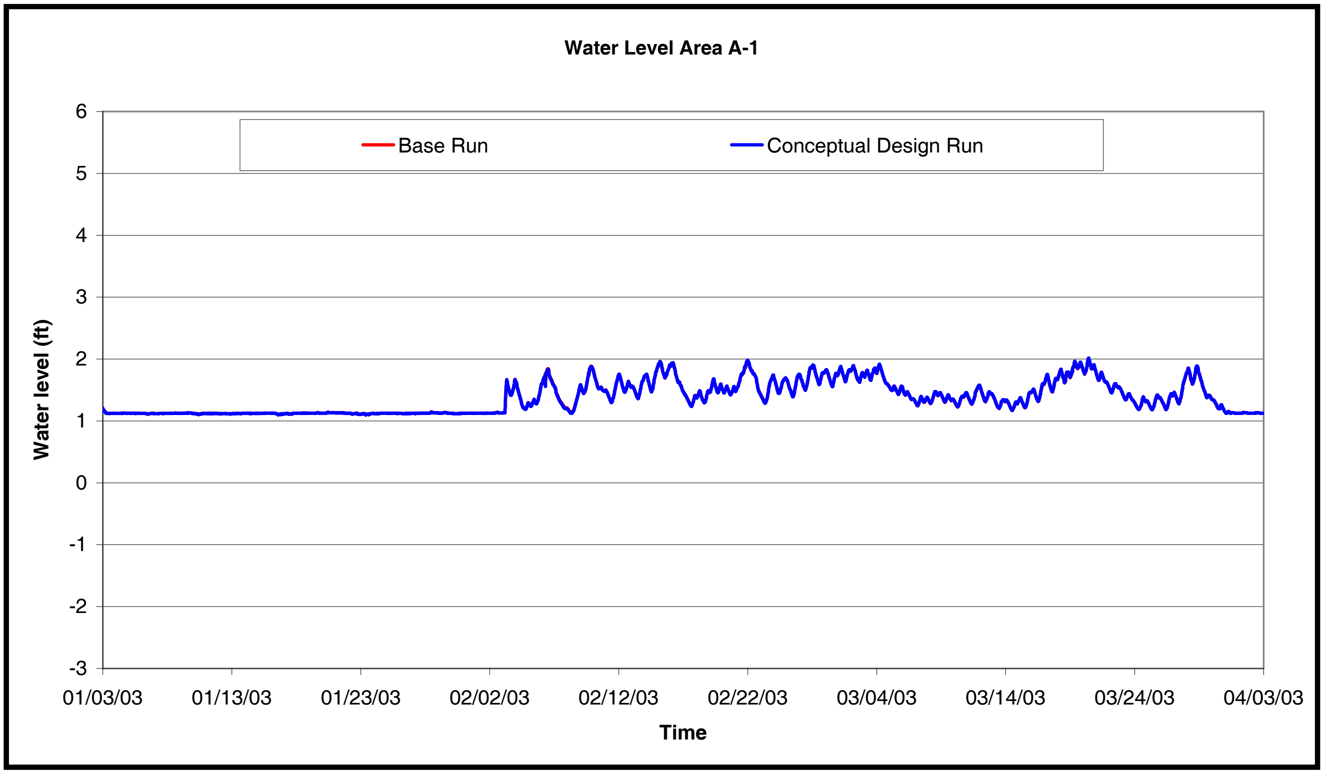

Figure A-31: Water Level Base Run results vs. Conceptual design Run at Area A1

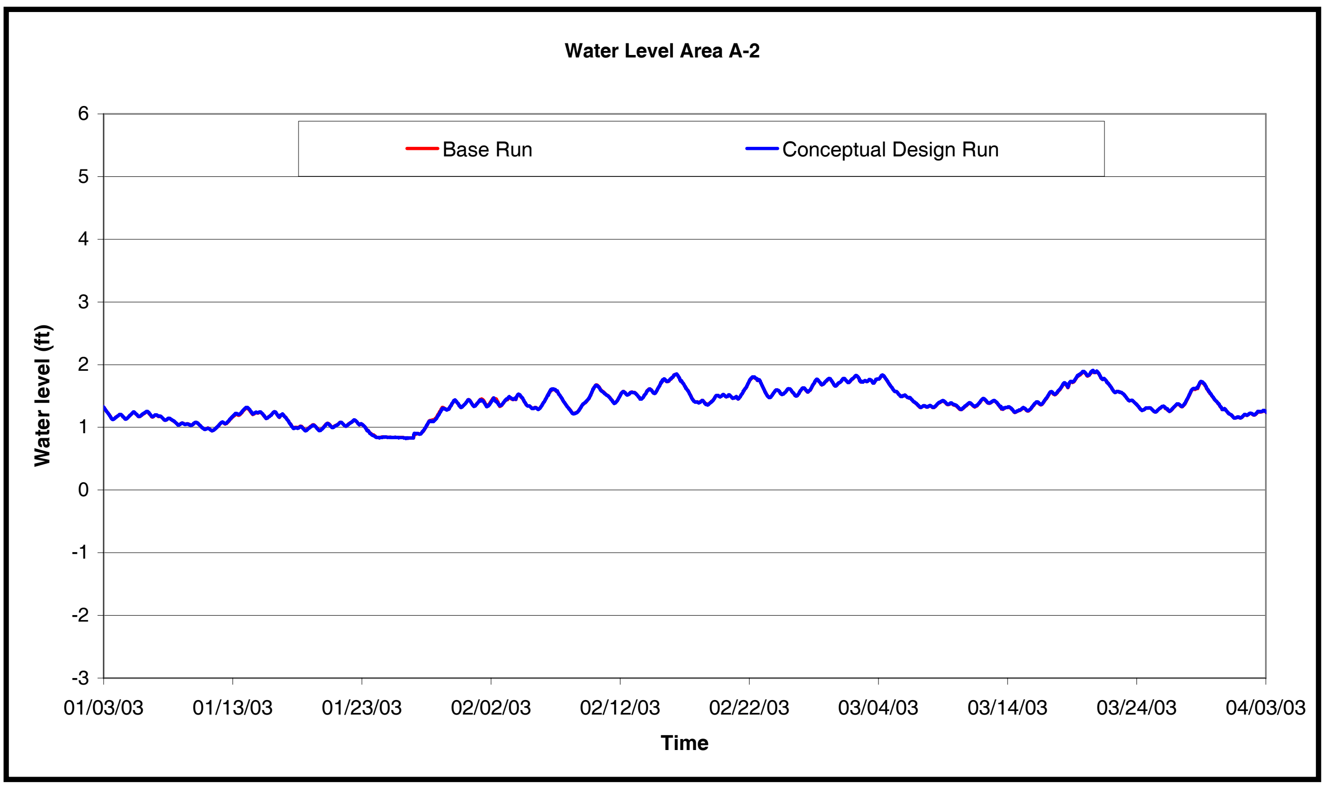

Figure A-32: Water Level Base Run results vs. Conceptual design Run at Area A2

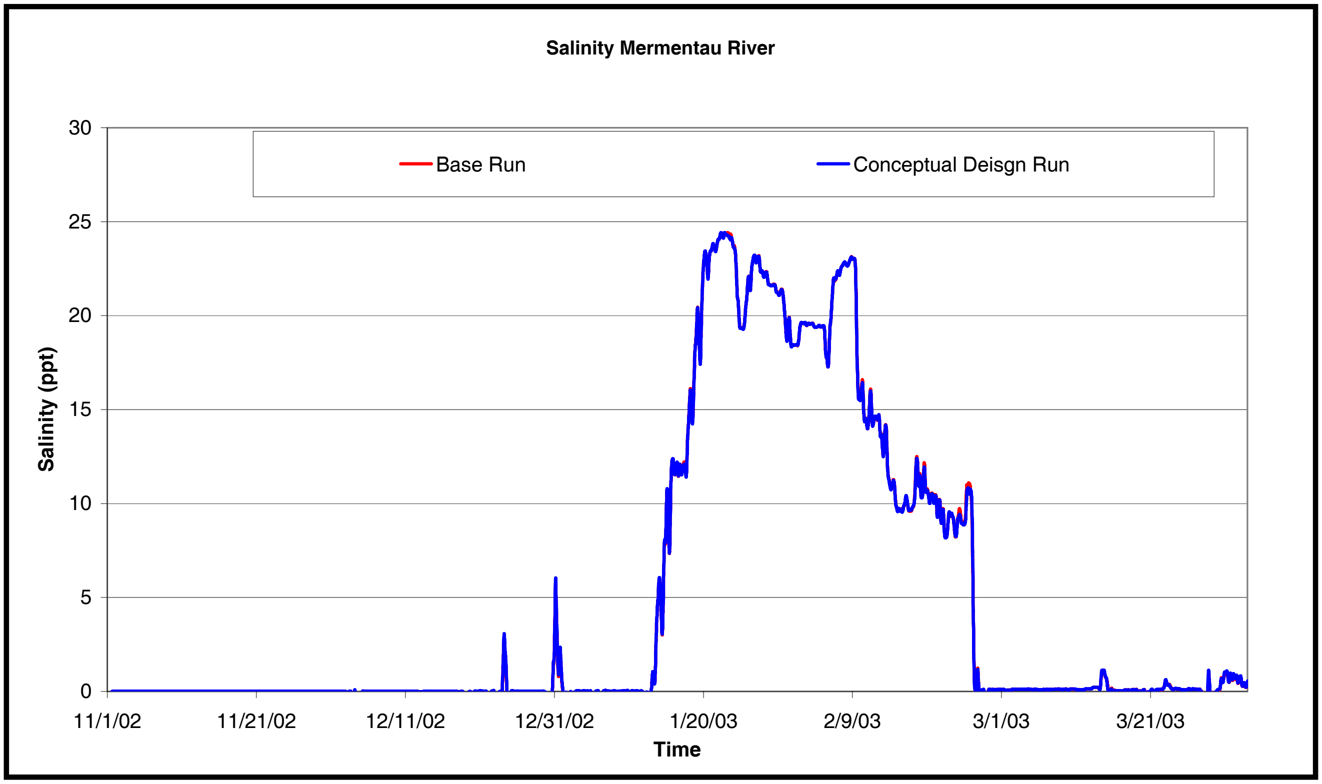

Figure A-33: Salinity Base Run results vs. Conceptual design Run at the Mermentau River.

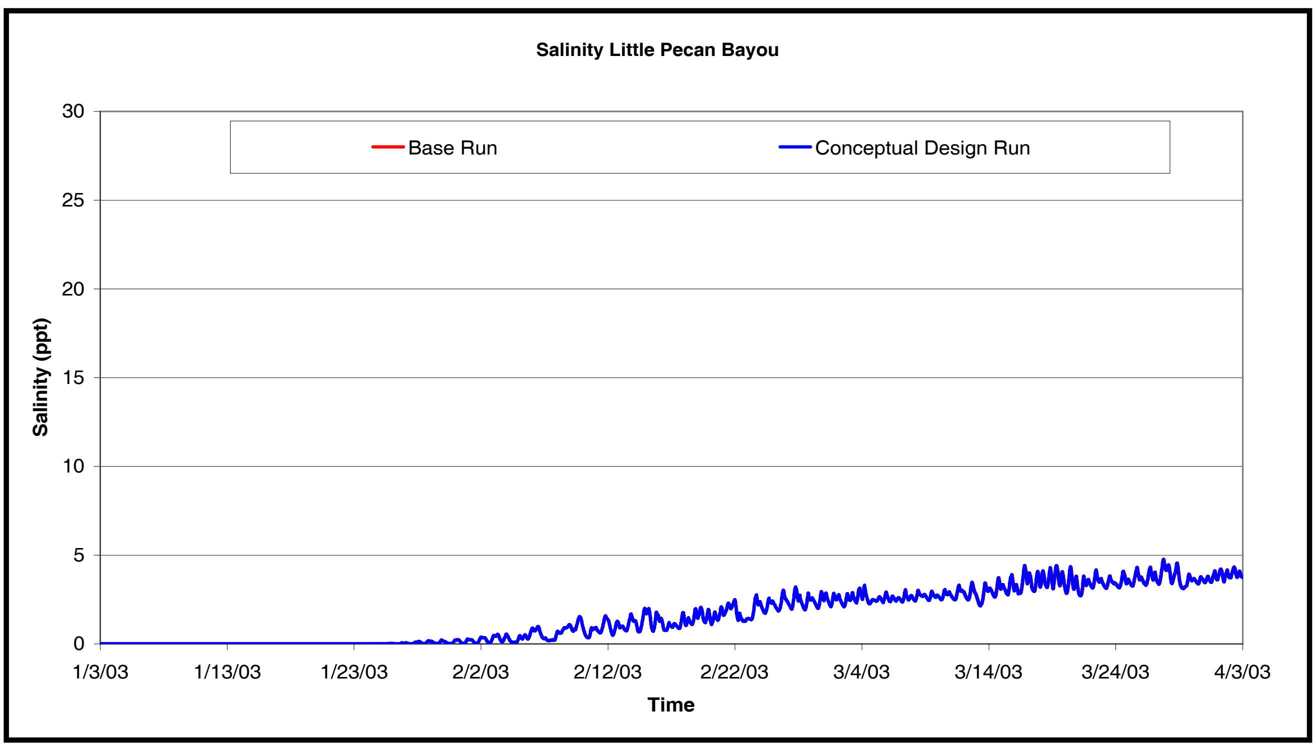

Figure A-34: Salinity Base Run results vs. Conceptual design Run at Little Pecan Bayou.

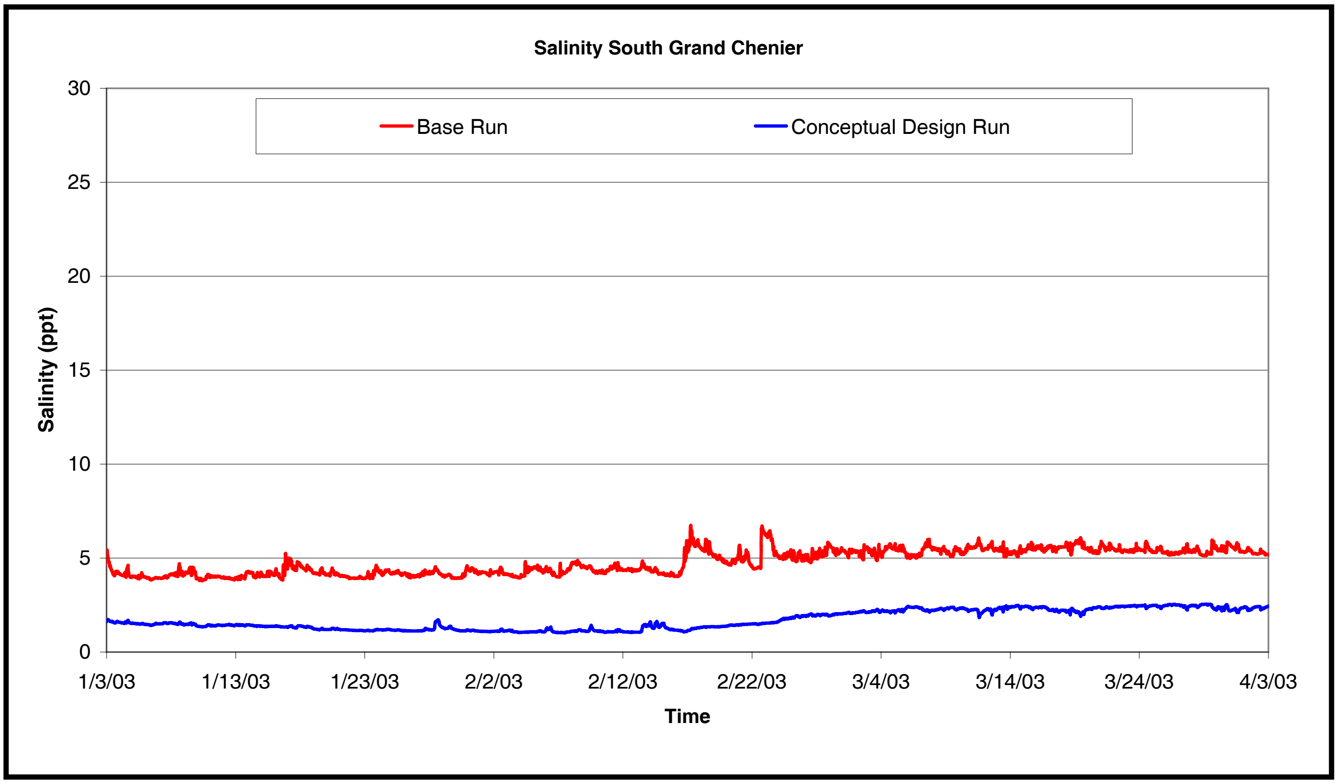

Figure A-35: Salinity Base Run results vs. Conceptual design Run at Second Lake.

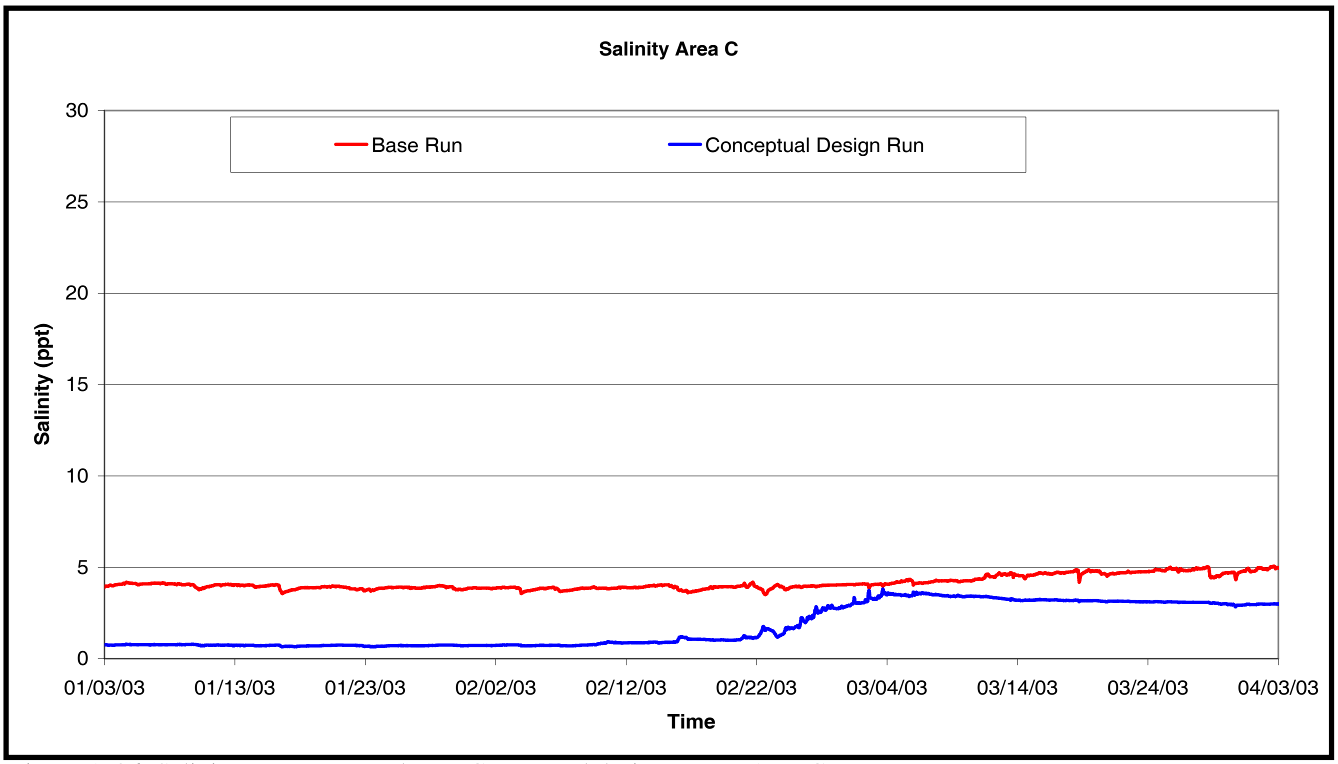

Figure A-36: Salinity Base Run results vs. Conceptual design Run at Area C.

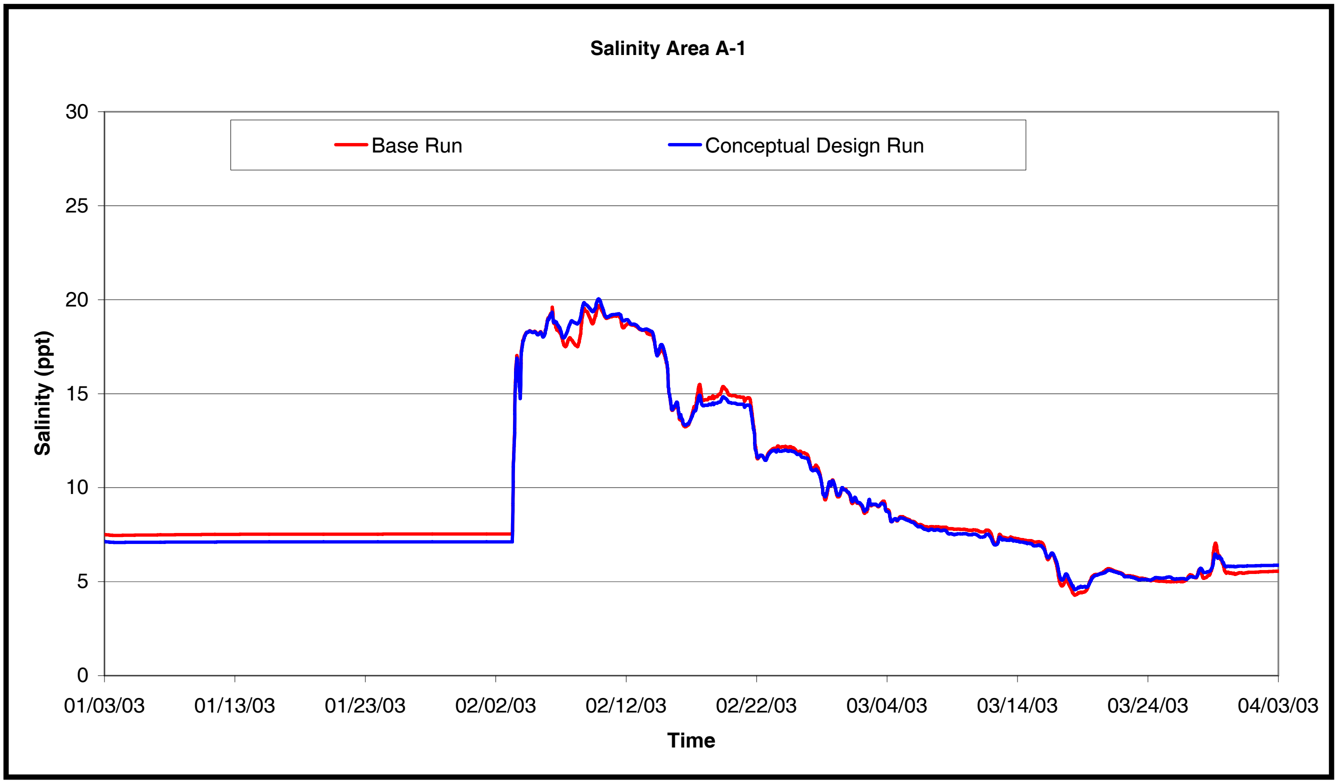

Figure A-37: Salinity Base Run results vs. Conceptual design Run at Area A-1.

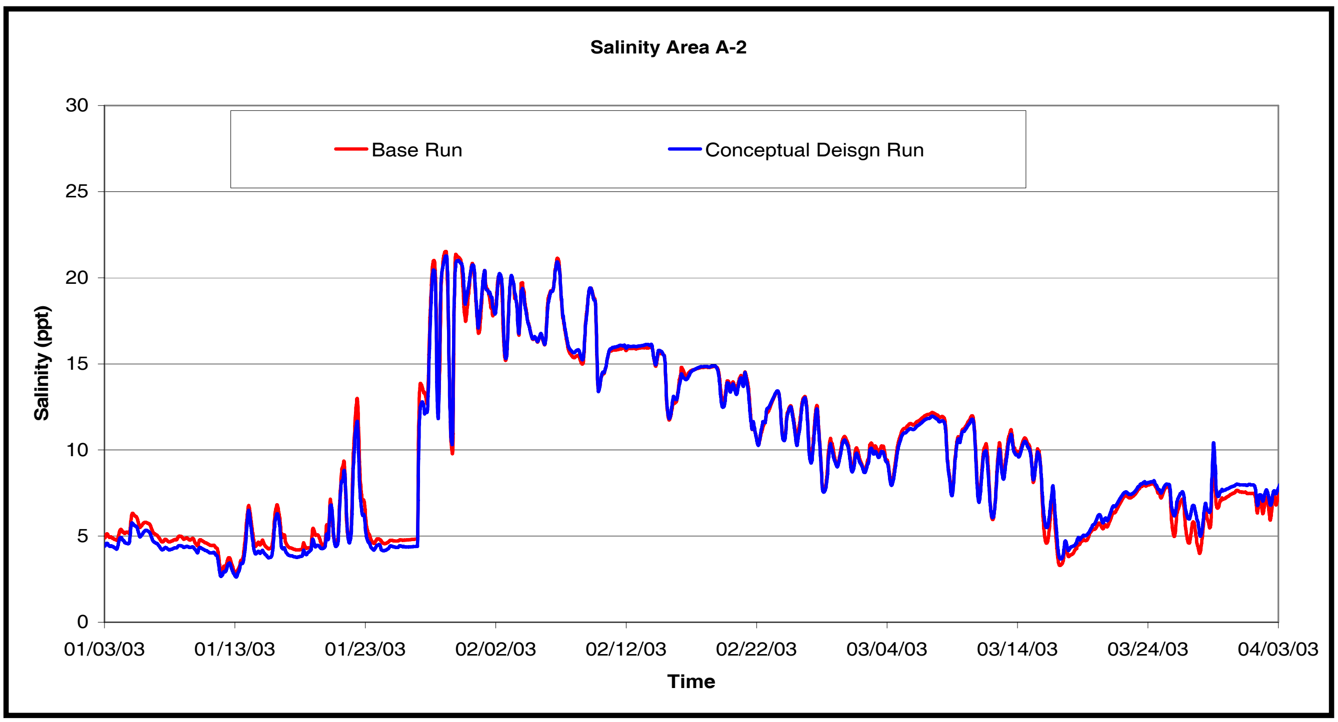

Figure A-38: Salinity Base Run results vs. Conceptual design Run at Area A-2

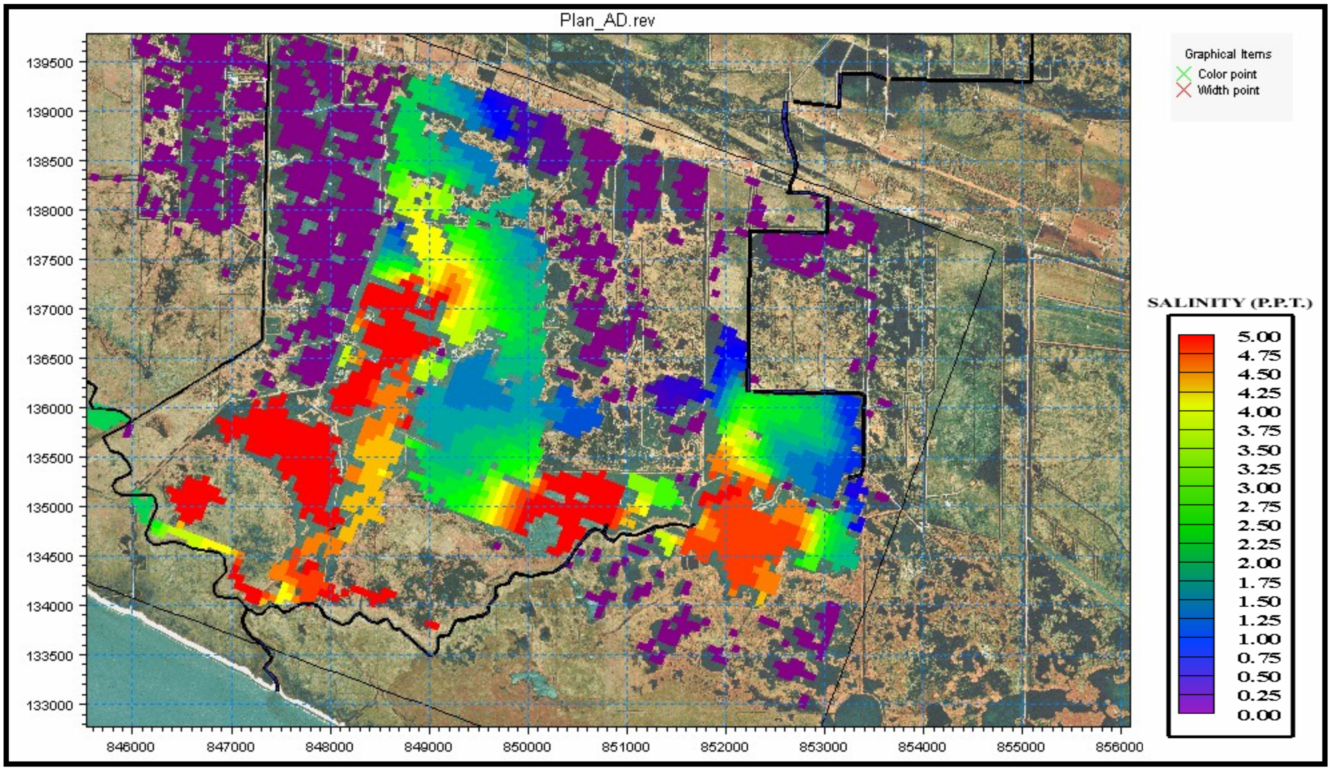

Figure A-39: Salinity Contour map for the South Grand Chenier area at 11/15/02 4:00 AM (Base Run)

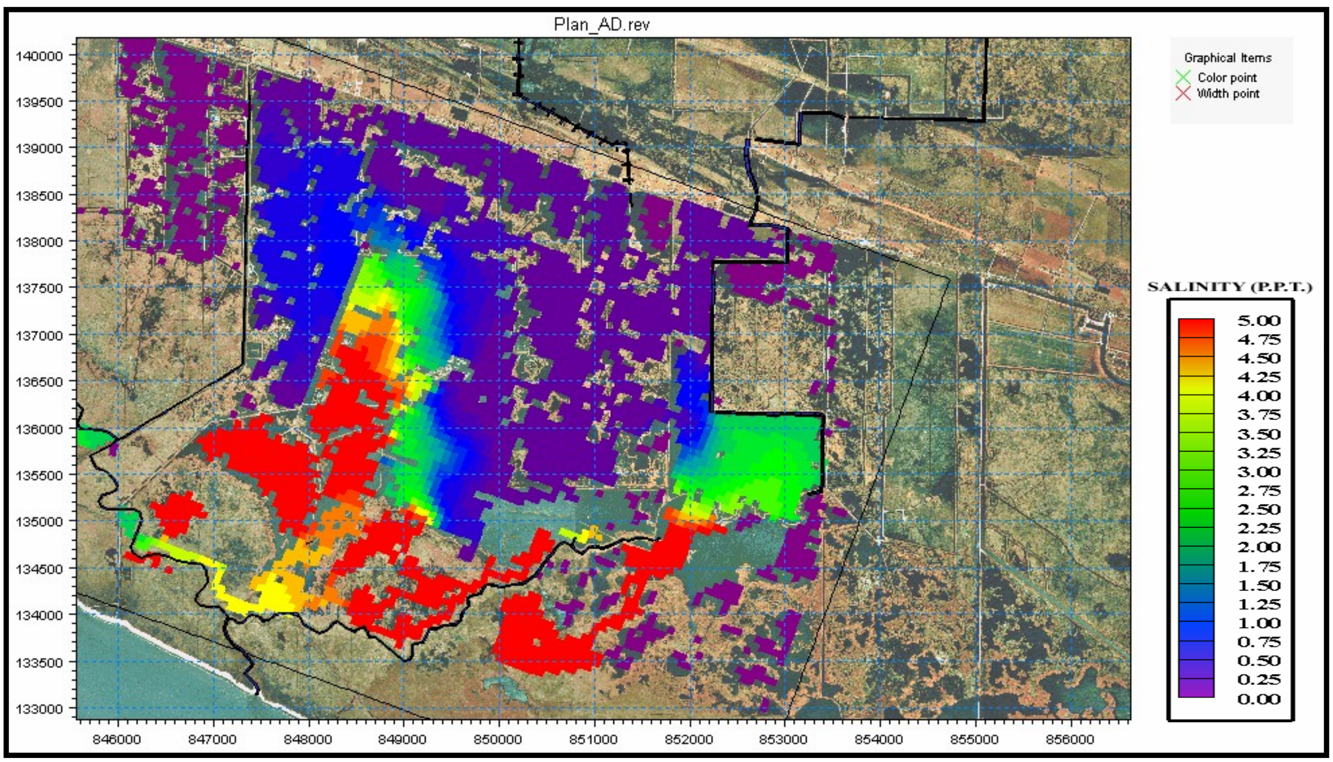

Figure A-40: Salinity Contour map for the South Grand Chenier area at 11/15/02 4:00 AM (Conceptual Design Run)

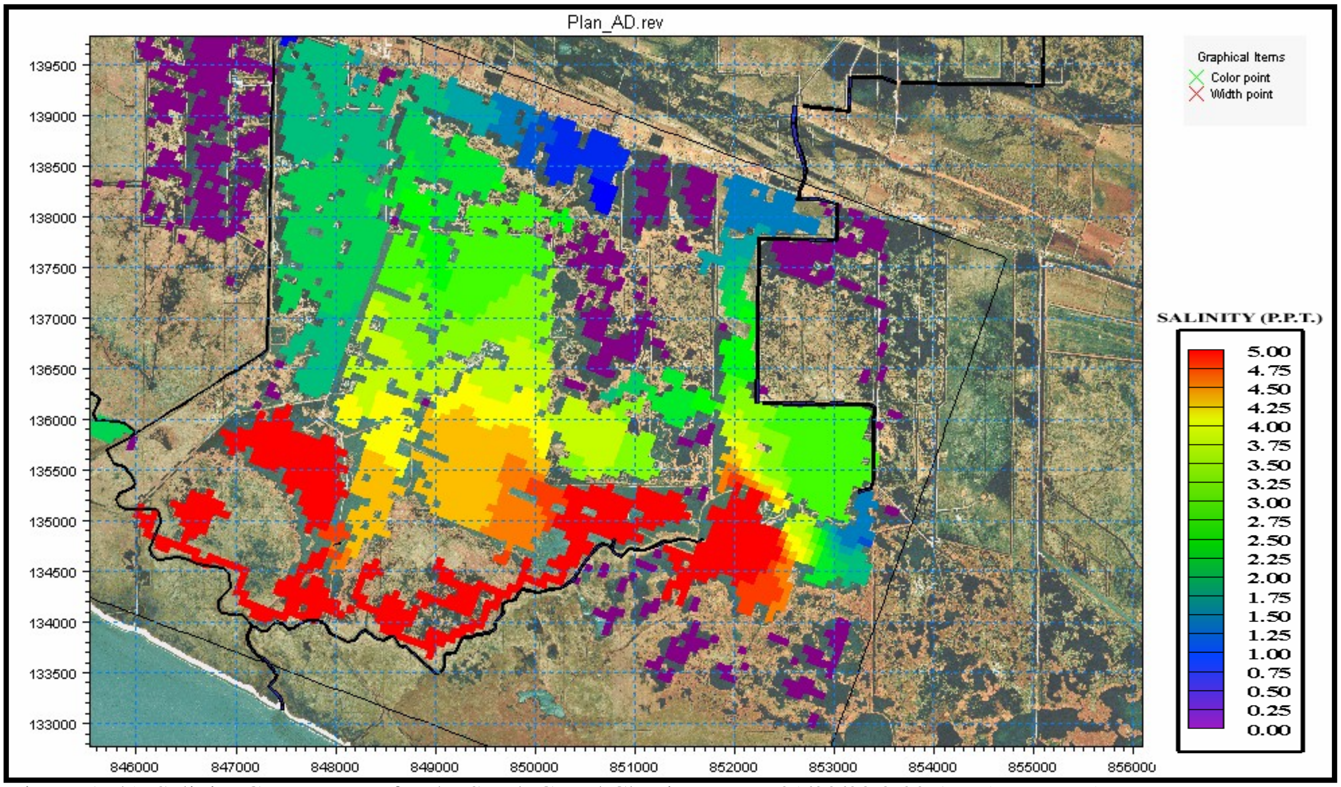

Figure A-41: Salinity Contour map for the South Grand Chenier area at 01/03/03 3:00 AM (Base Run)

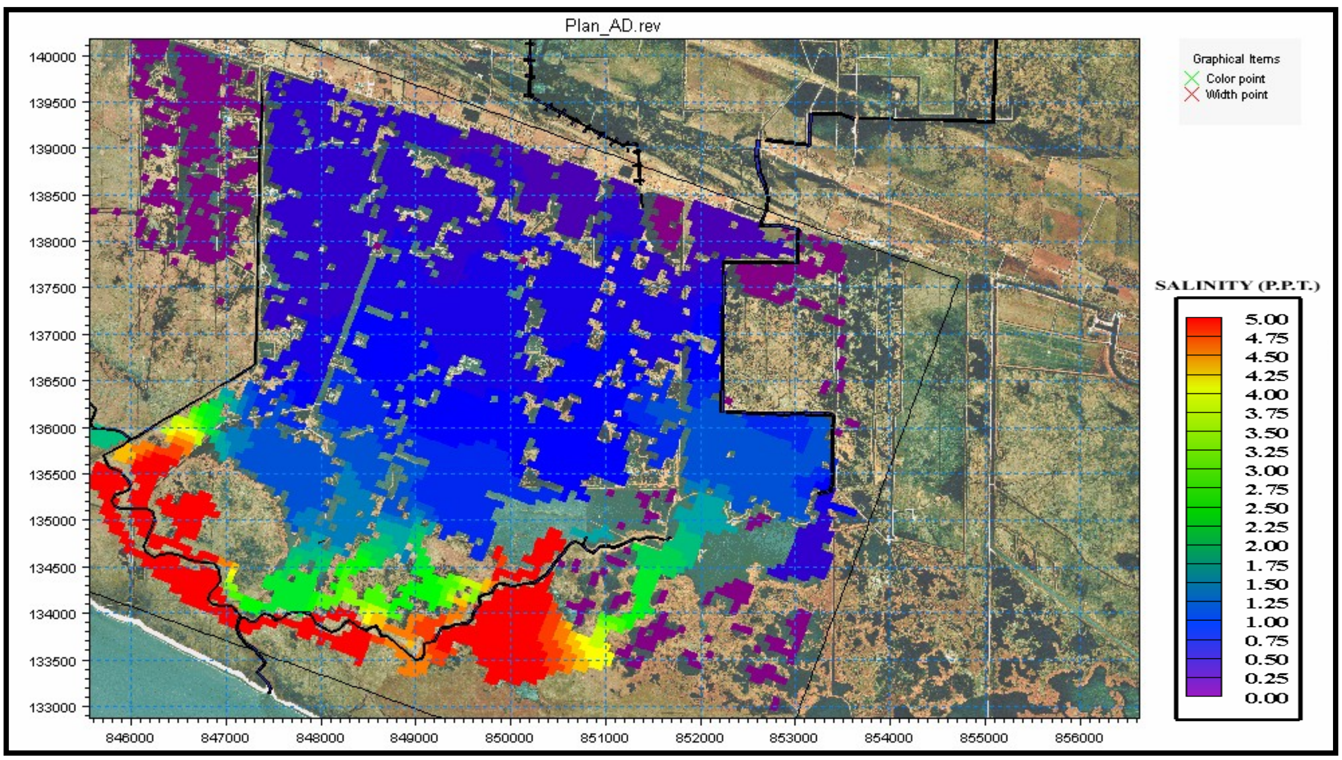

Figure A-42: Salinity Contour map for the South Grand Chenier area at 01/03/03 3:00 AM (Conceptual Design Run)

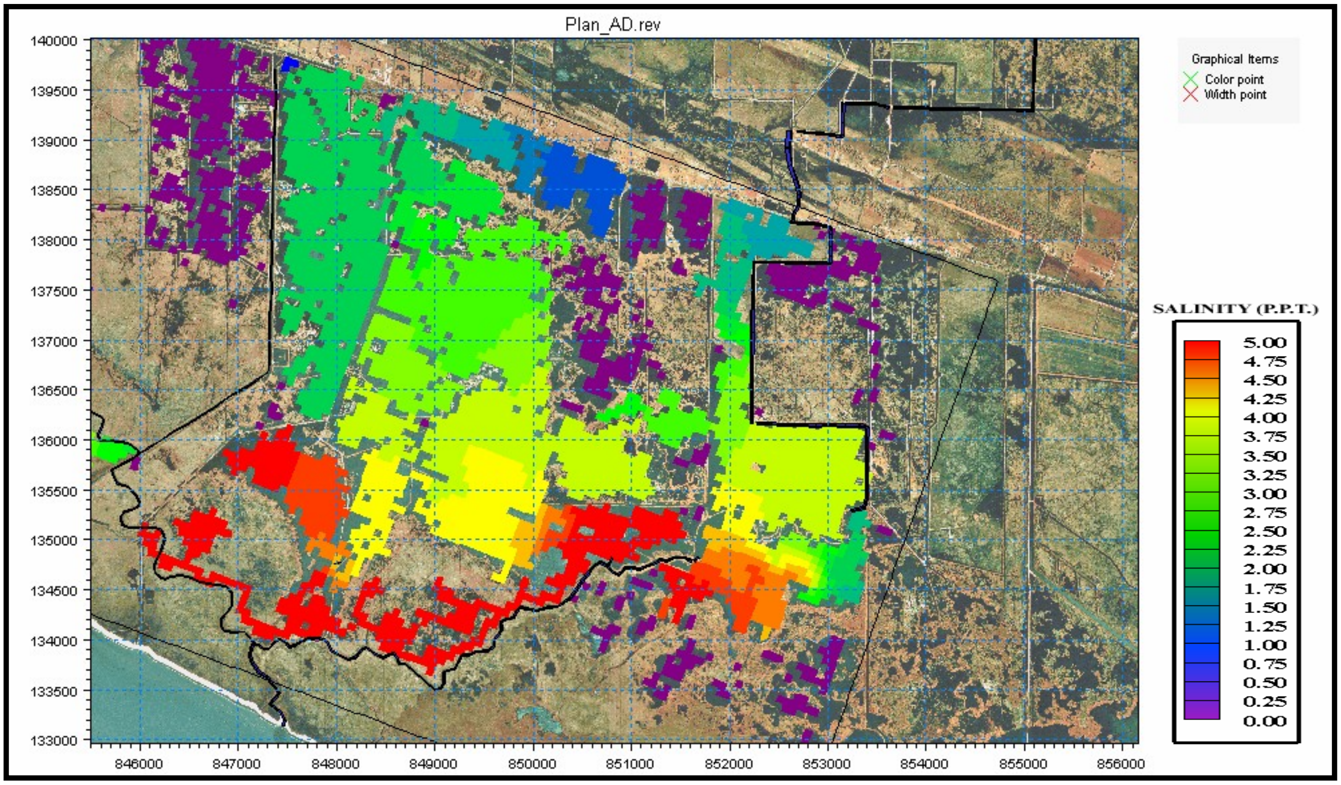

Figure A-43: Salinity Contour map for the South Grand Chenier area at 02/03/03 9:00 AM (Base Run)

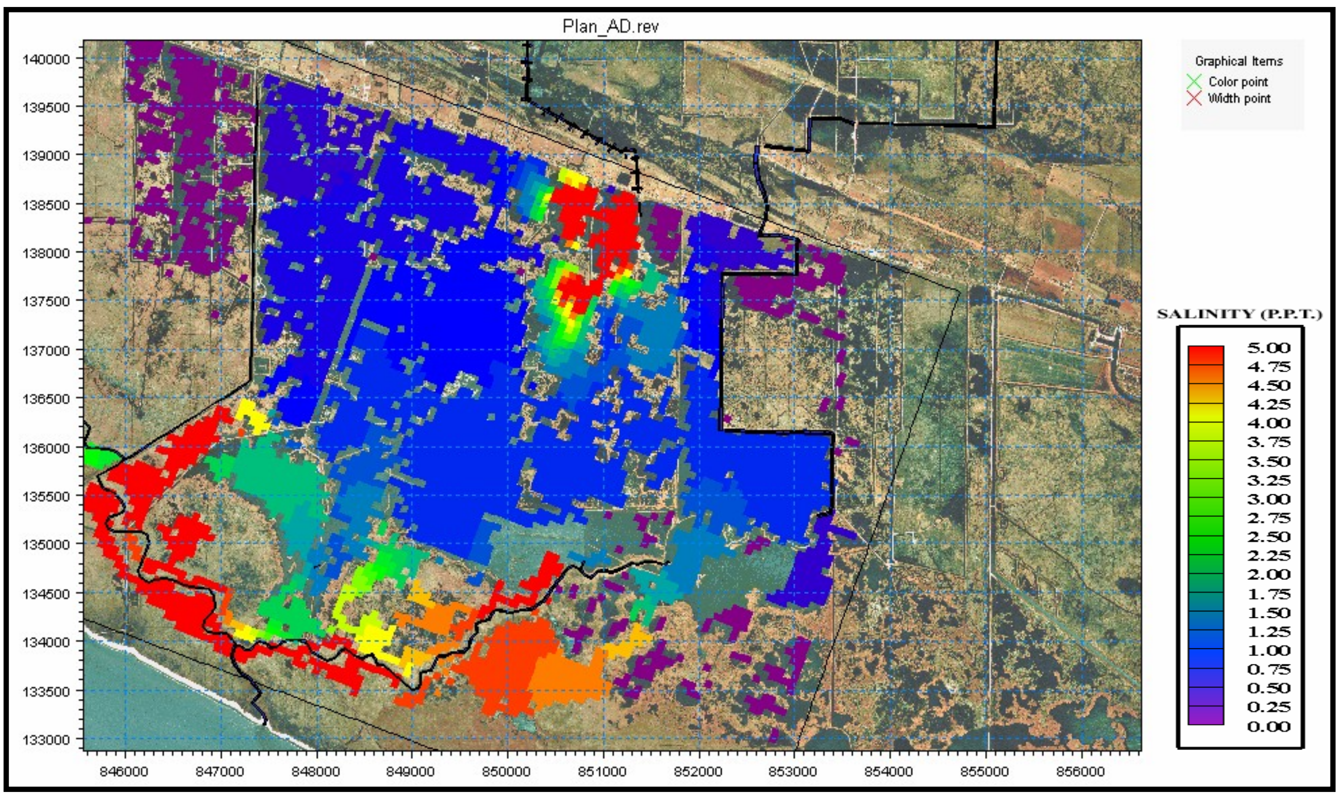

Figure A-44: Salinity Contour map for the South Grand Chenier area at 02/03/03 9:00 AM (Conceptual Design Run)

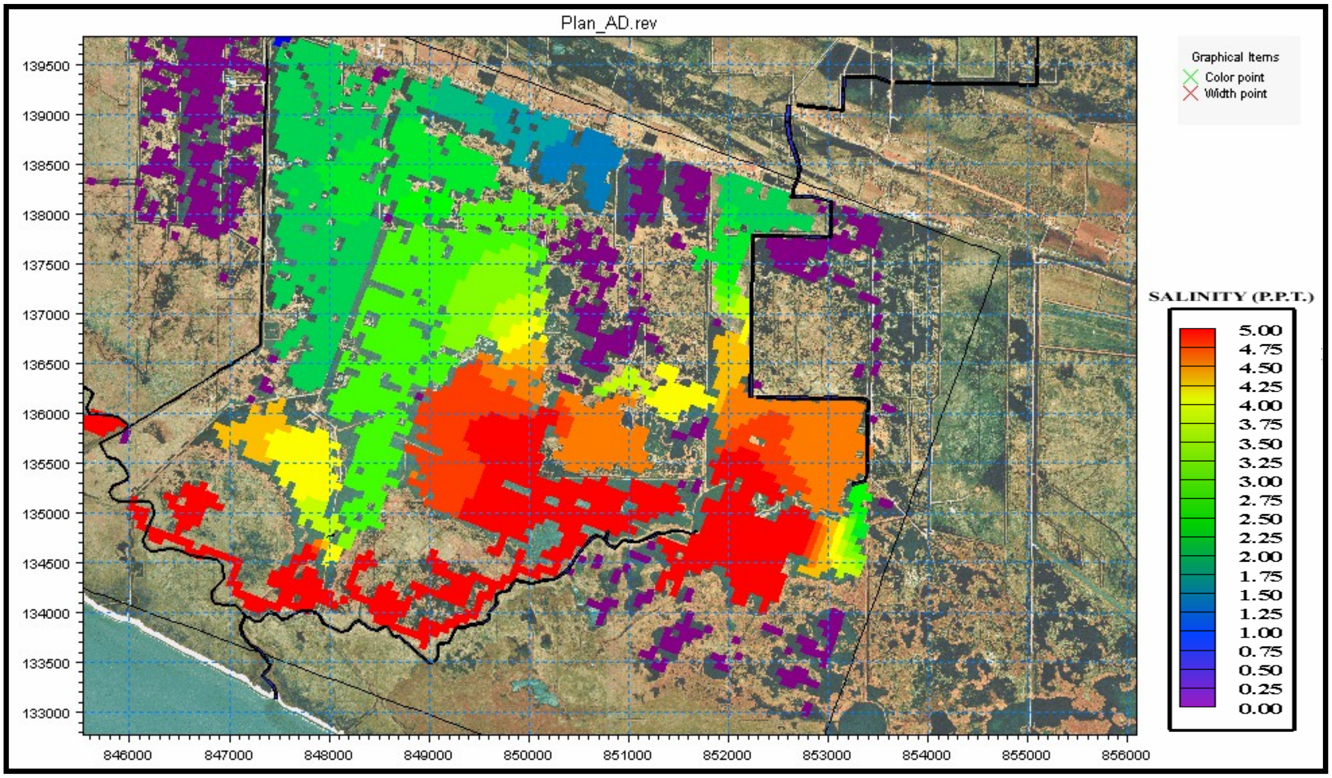

Figure A-45: Salinity Contour map for the South Grand Chenier area at 03/18/03 3:00 PM (Base Run)

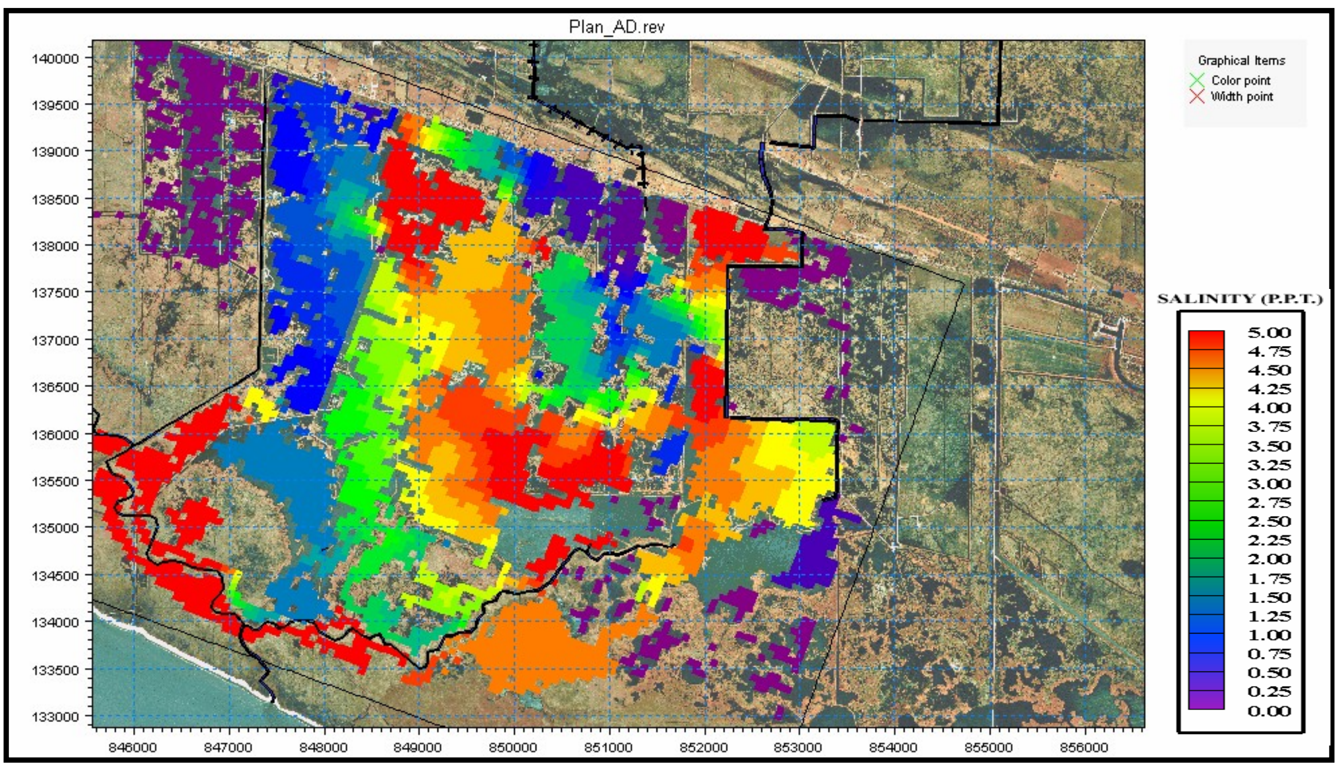

Figure A-46: Salinity Contour map for the South Grand Chenier area at 03/18/03 3:00 PM (Conceptual Design Run)

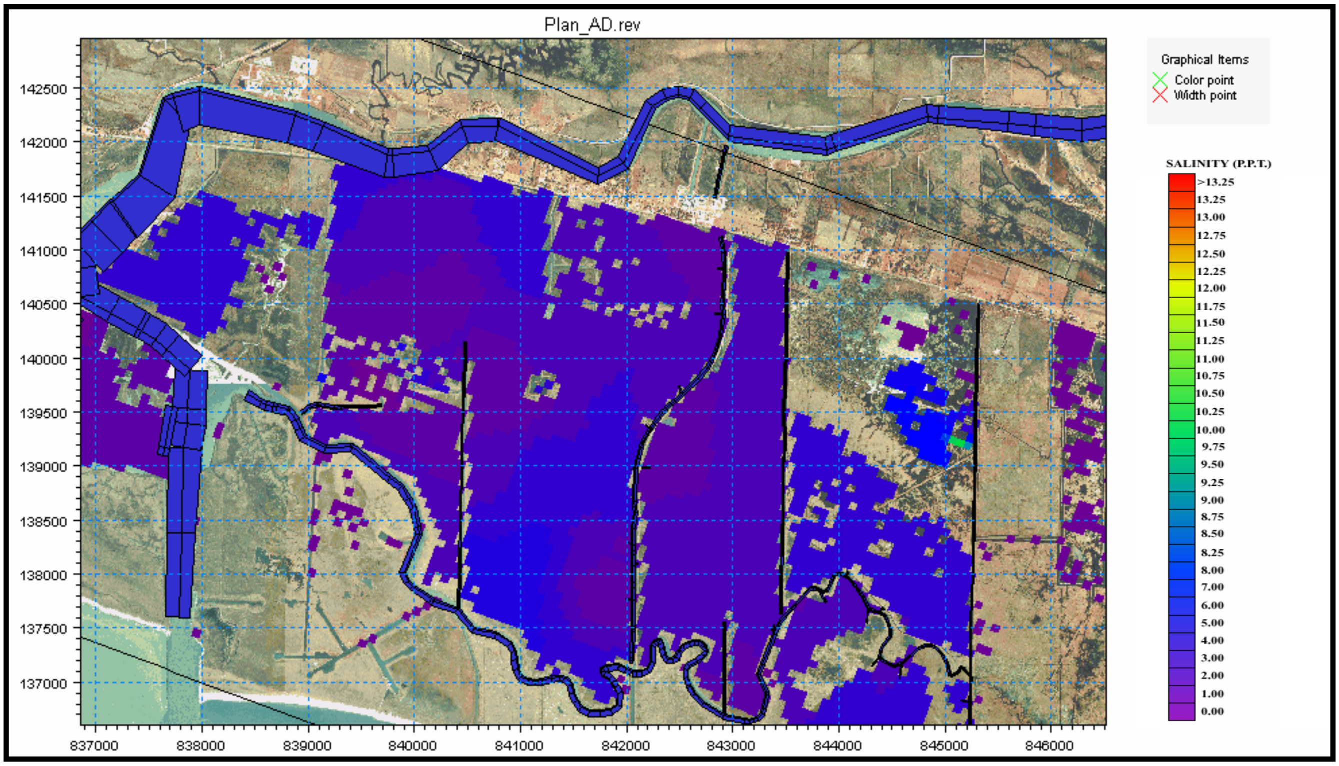

Figure A-47: Salinity Contour map for the South Grand Chenier area at 11/15/02 4:00 AM (Base Run)

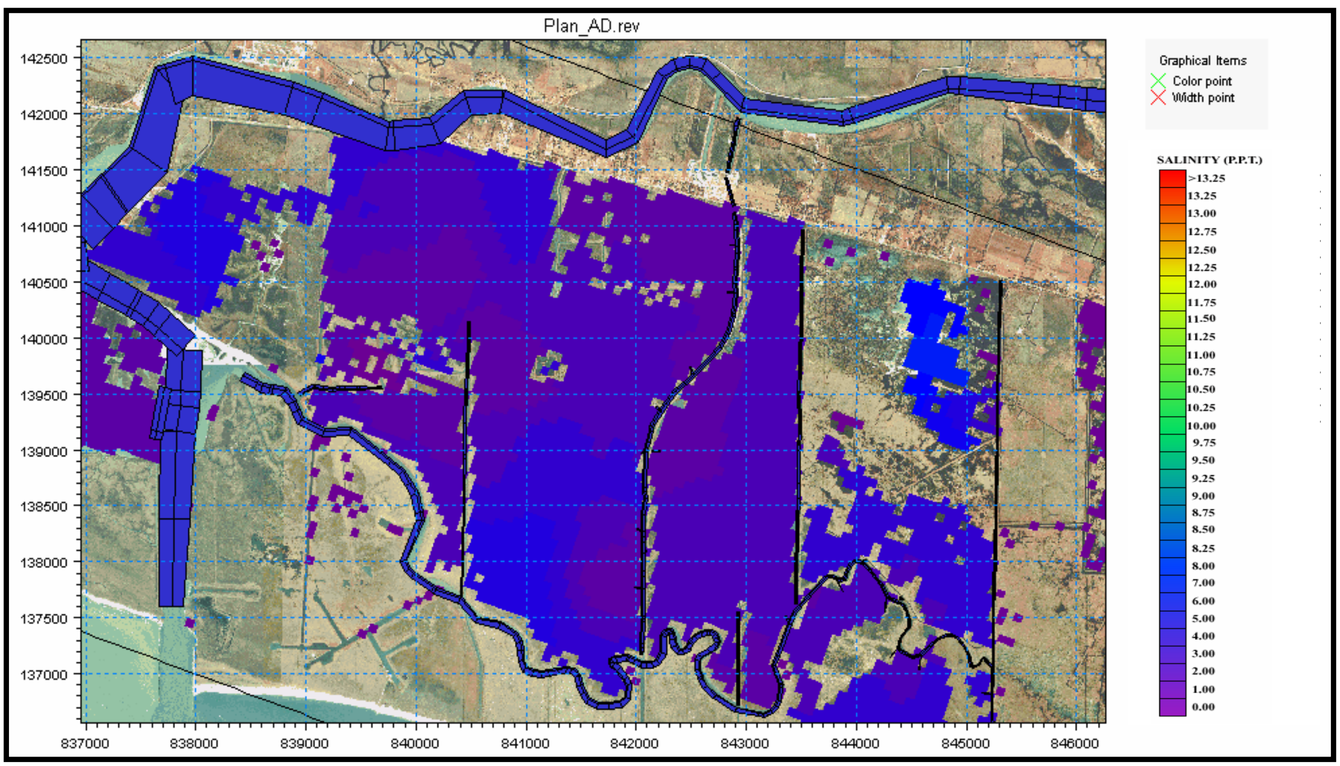

Figure A-48: Salinity Contour map for the South Grand Chenier area at 11/15/02 4:00 AM (Conceptual Design Run)

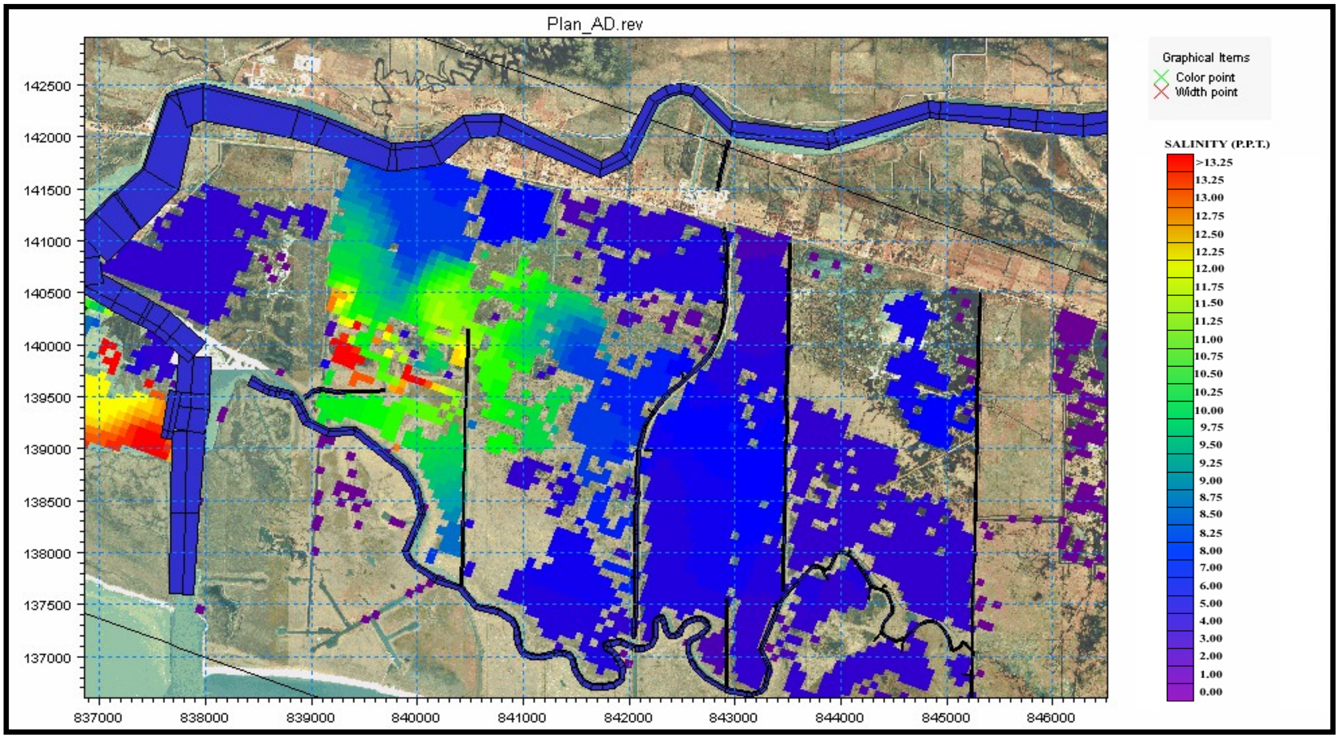

Figure A-49: Salinity Contour map for the South Grand Chenier area at 01/03/03 3:00 AM (Base Run)

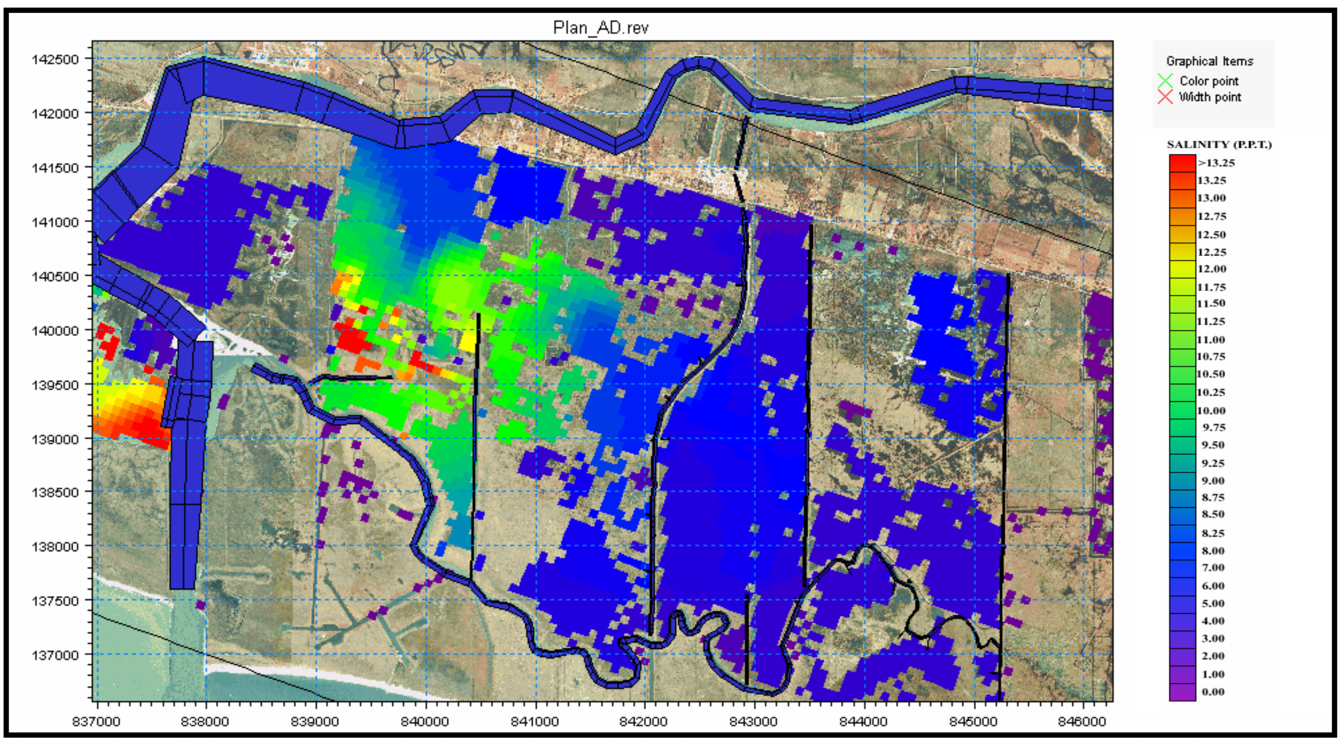

Figure A-50: Salinity Contour map for the South Grand Chenier area at 01/03/03 3:00 AM (Conceptual Design Run)

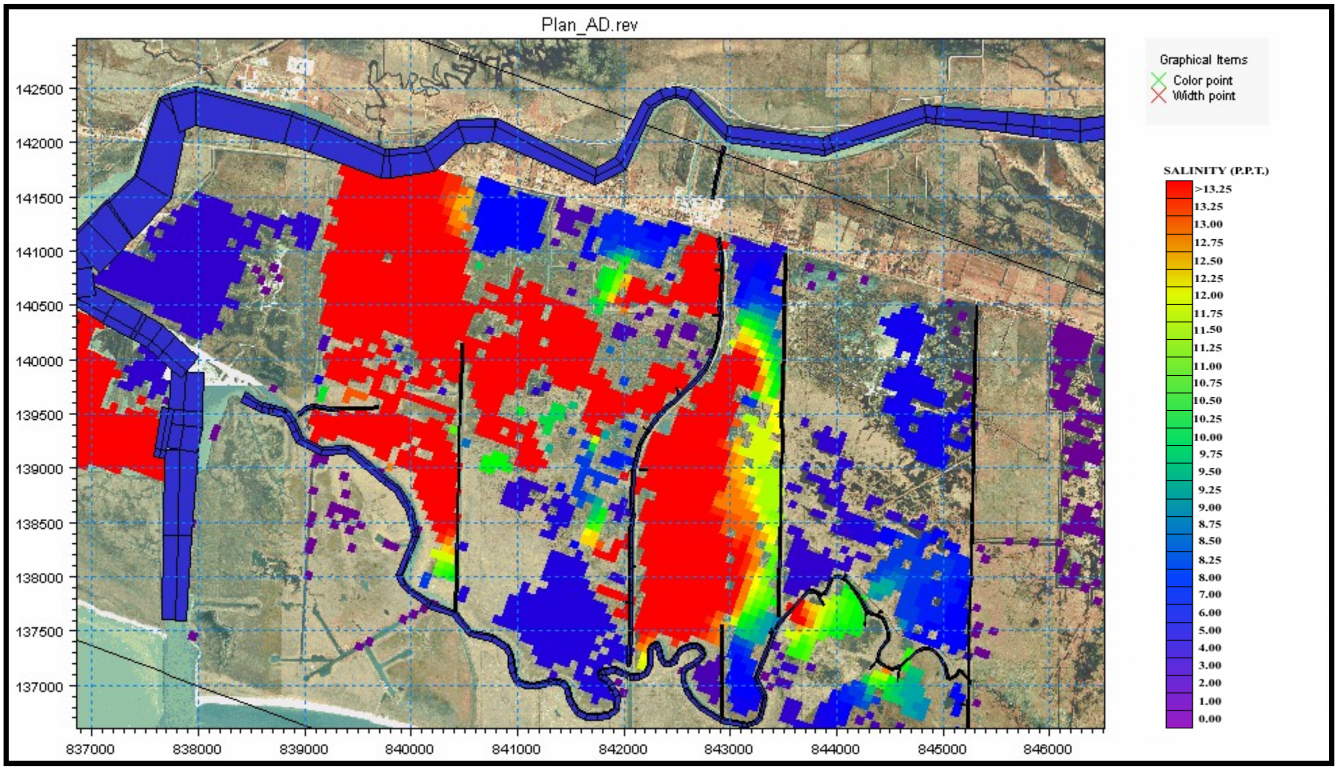

Figure A-51: Salinity Contour map for the South Grand Chenier area at 02/03/03 9:00 PM (Base Run)

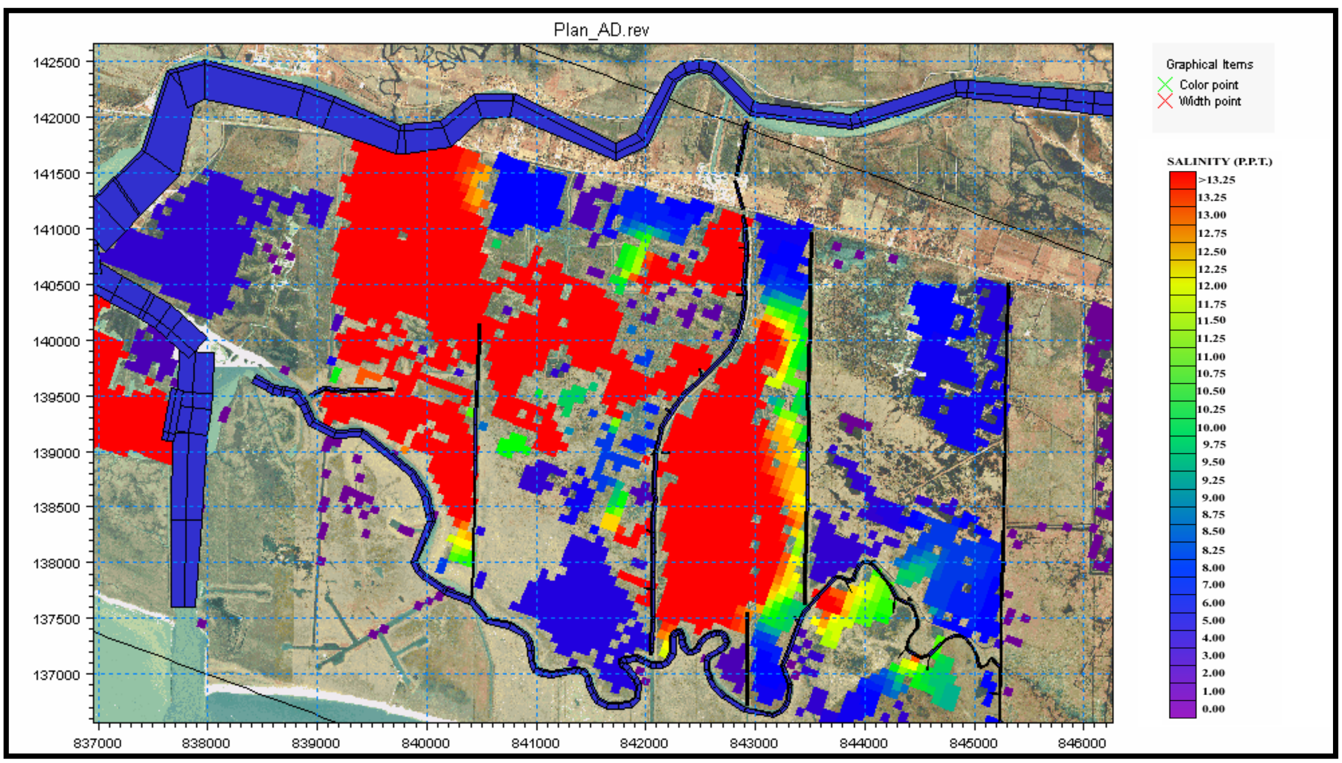

Figure A-52: Salinity Contour map for the South Grand Chenier area at 02/03/03 9:00 PM (Conceptual Design Run)

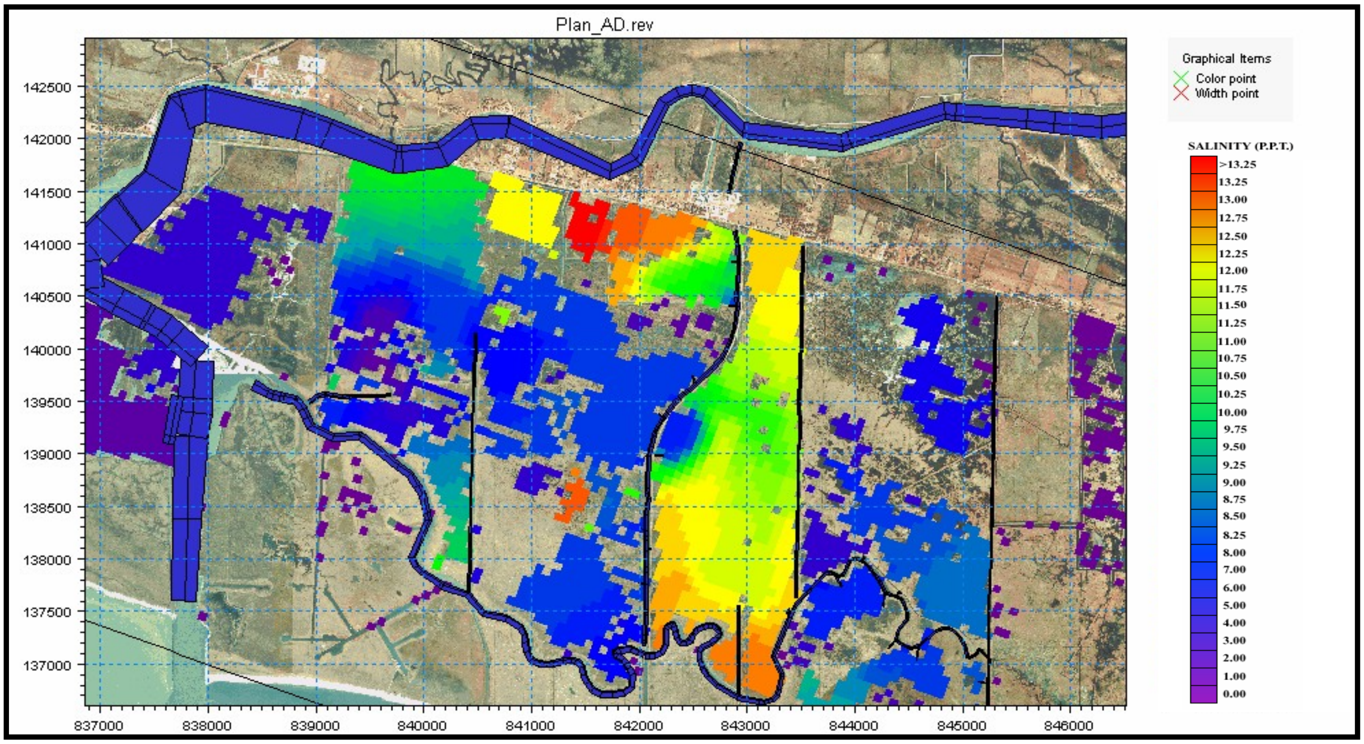

Figure A-53: Salinity Contour map for the South Grand Chenier area at 03/18/03 3:00 PM (Base Run)

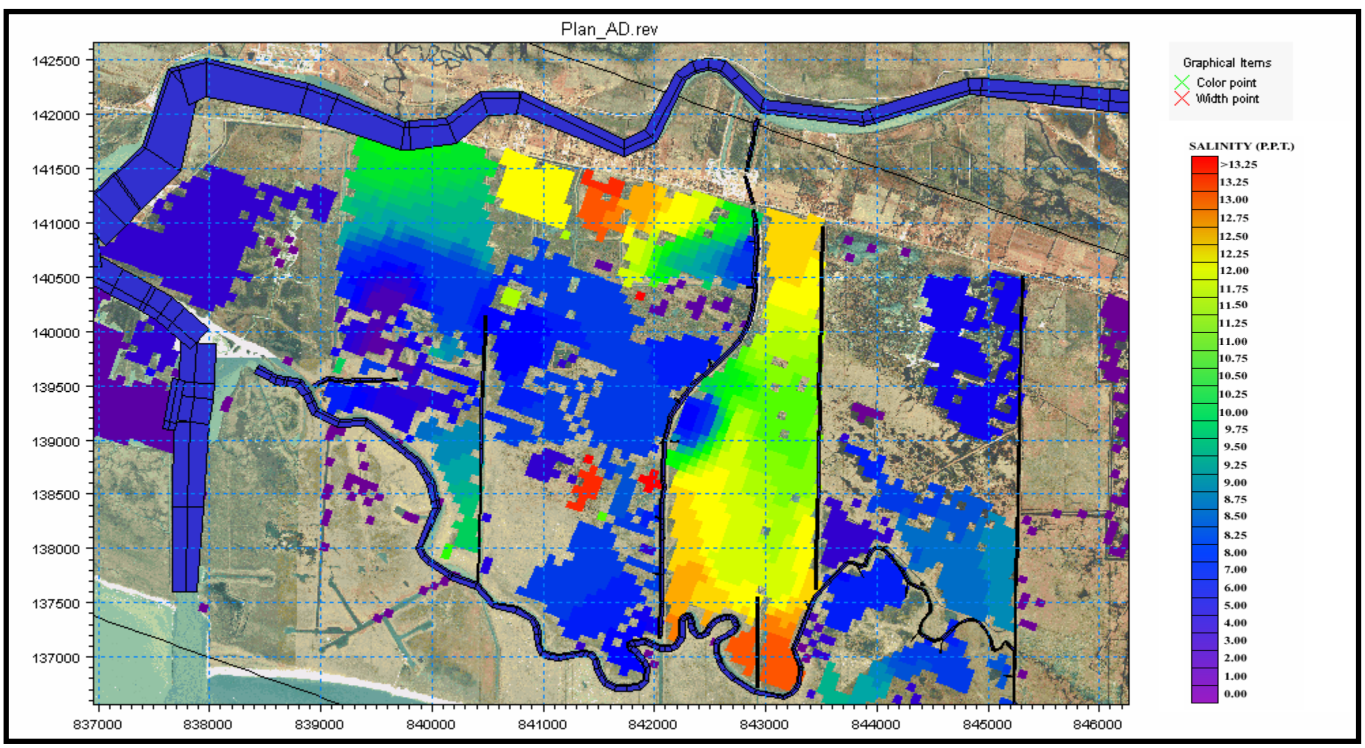

Figure A-54: Salinity Contour map for the South Grand Chenier area at 03/18/03 3:00 PM (Conceptual Design Run)

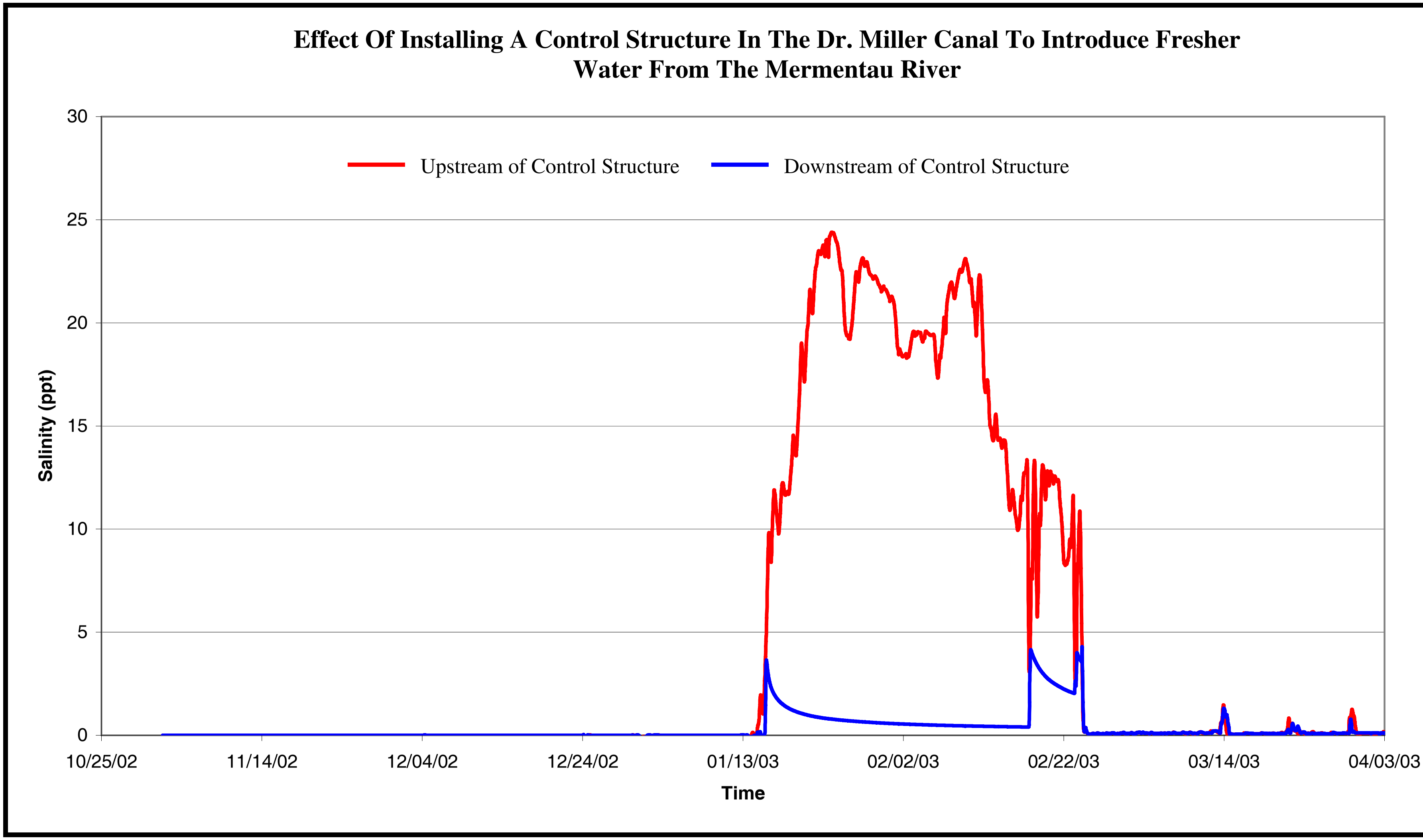

Figure A-55: Salinity U/S and D/S the control structure in Dr. Miller canal (After Project Component has been implemented)

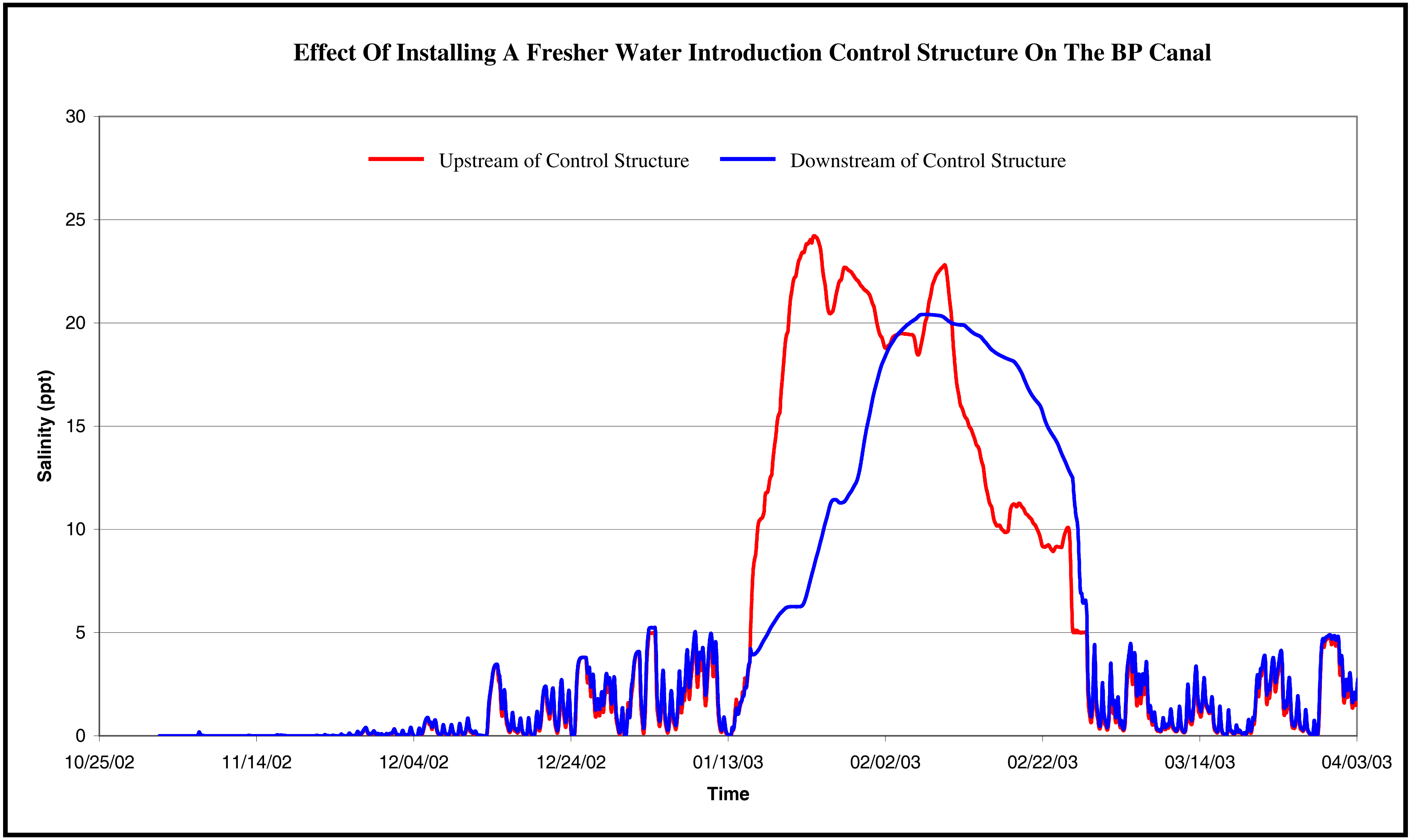

Figure A-56: Salinity U/S and D/S the control structure in BP canal (After Project Component has been implemented)

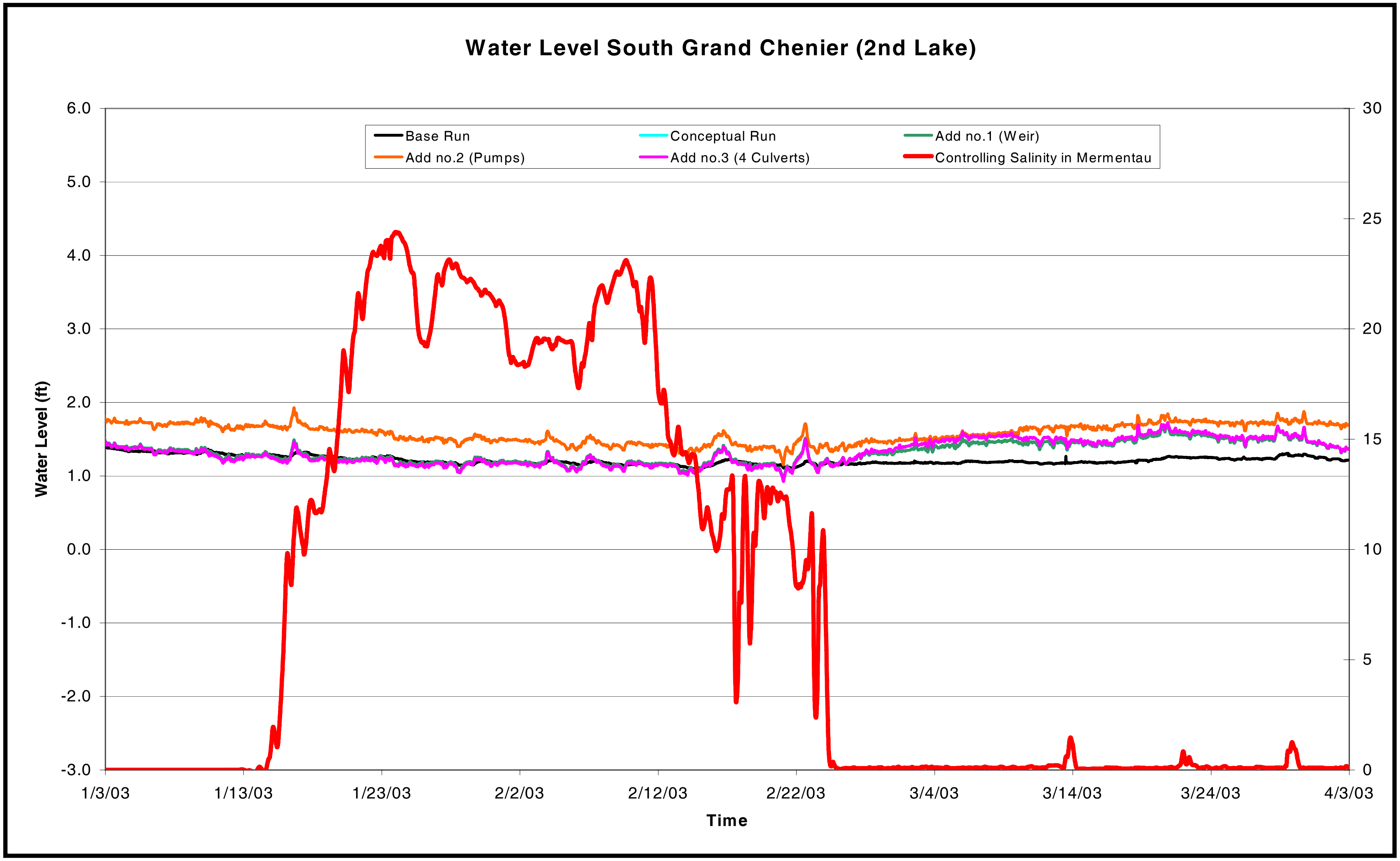

Figure A-57: Water level results at Second Lake Cut

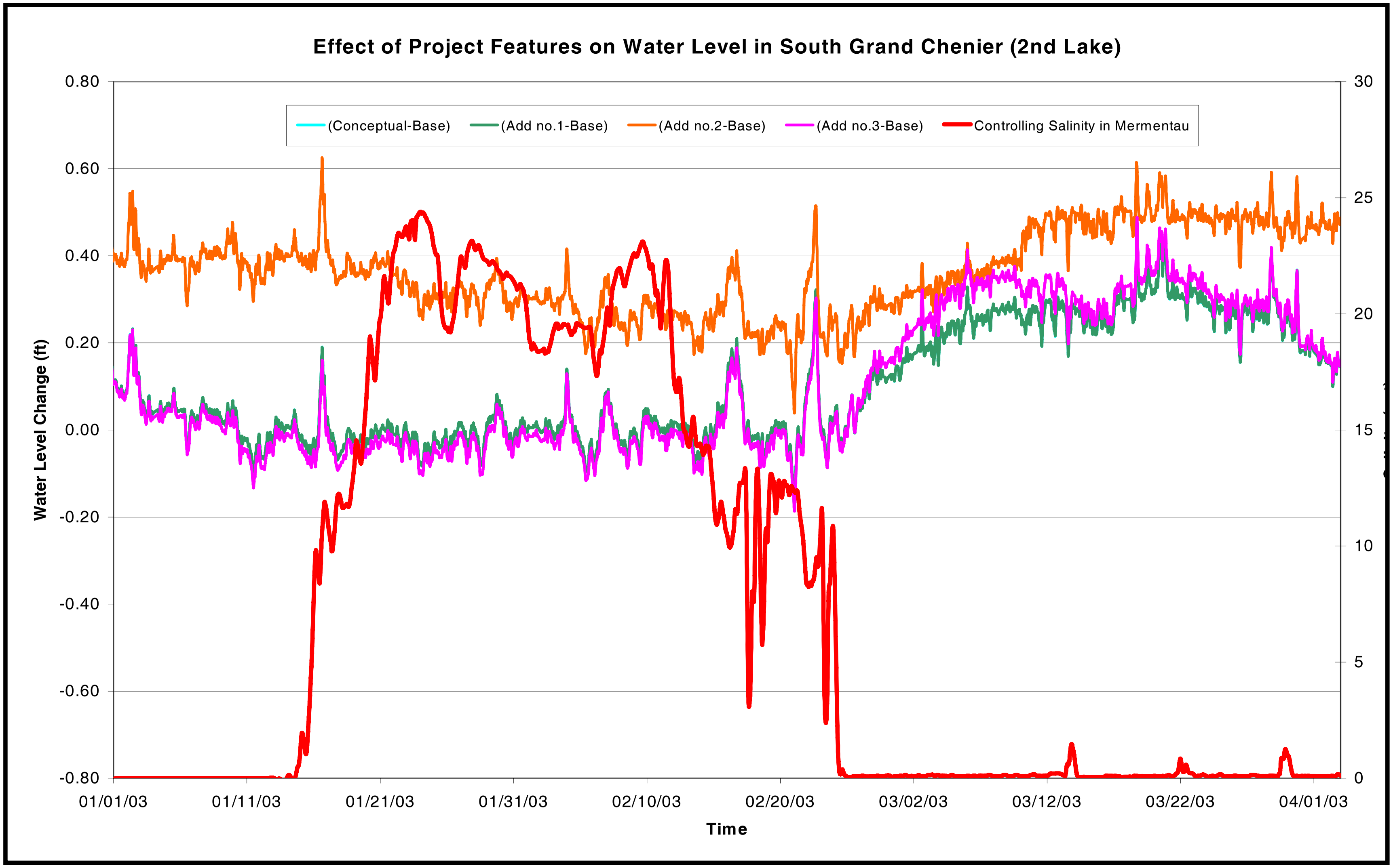

Figure A-58: Change in Water level at Second Lake Cut

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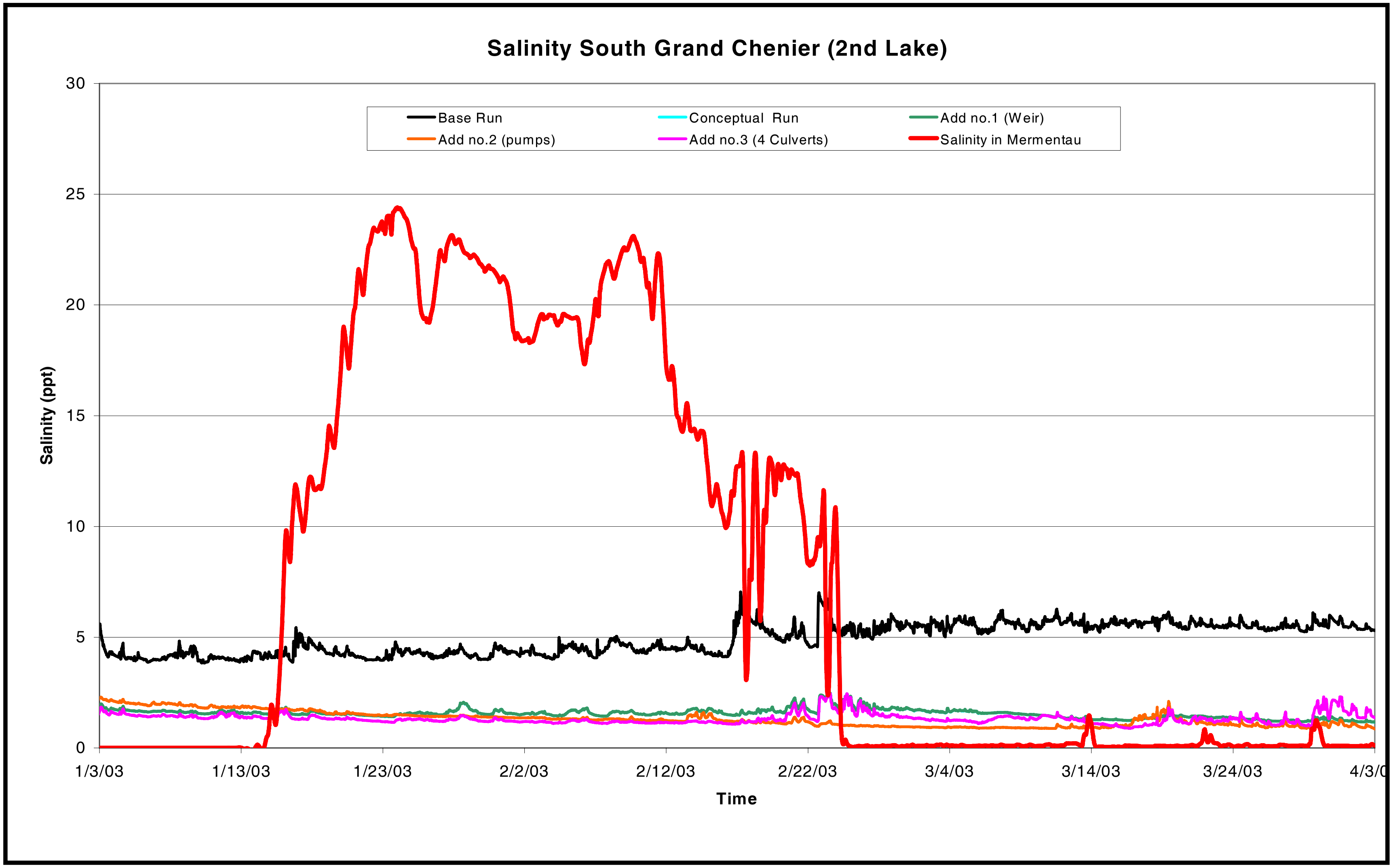

Figure A-59: Salinity results at Second Lake Cut

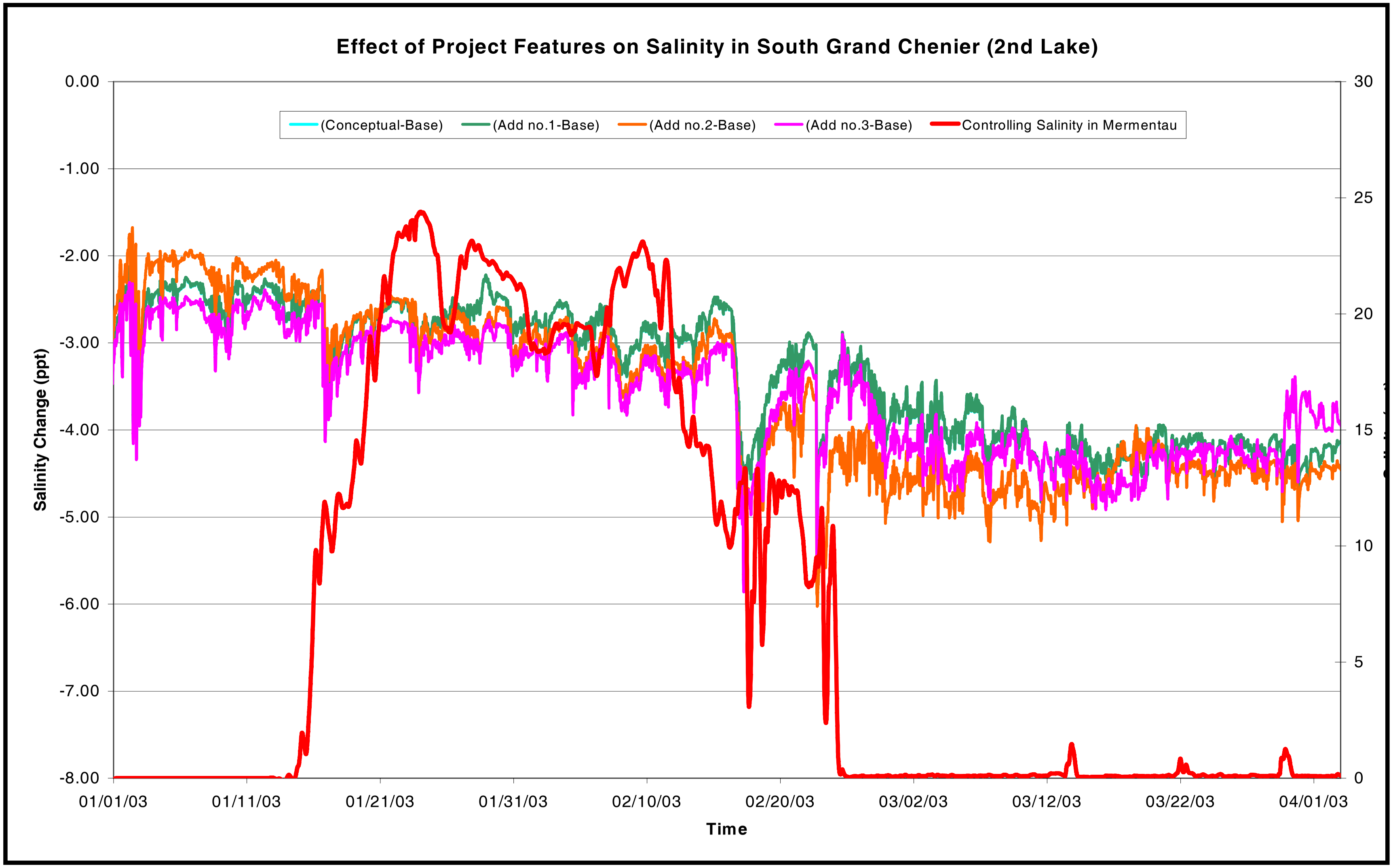

Figure A-60: Change in Salinity at Second Lake Cut

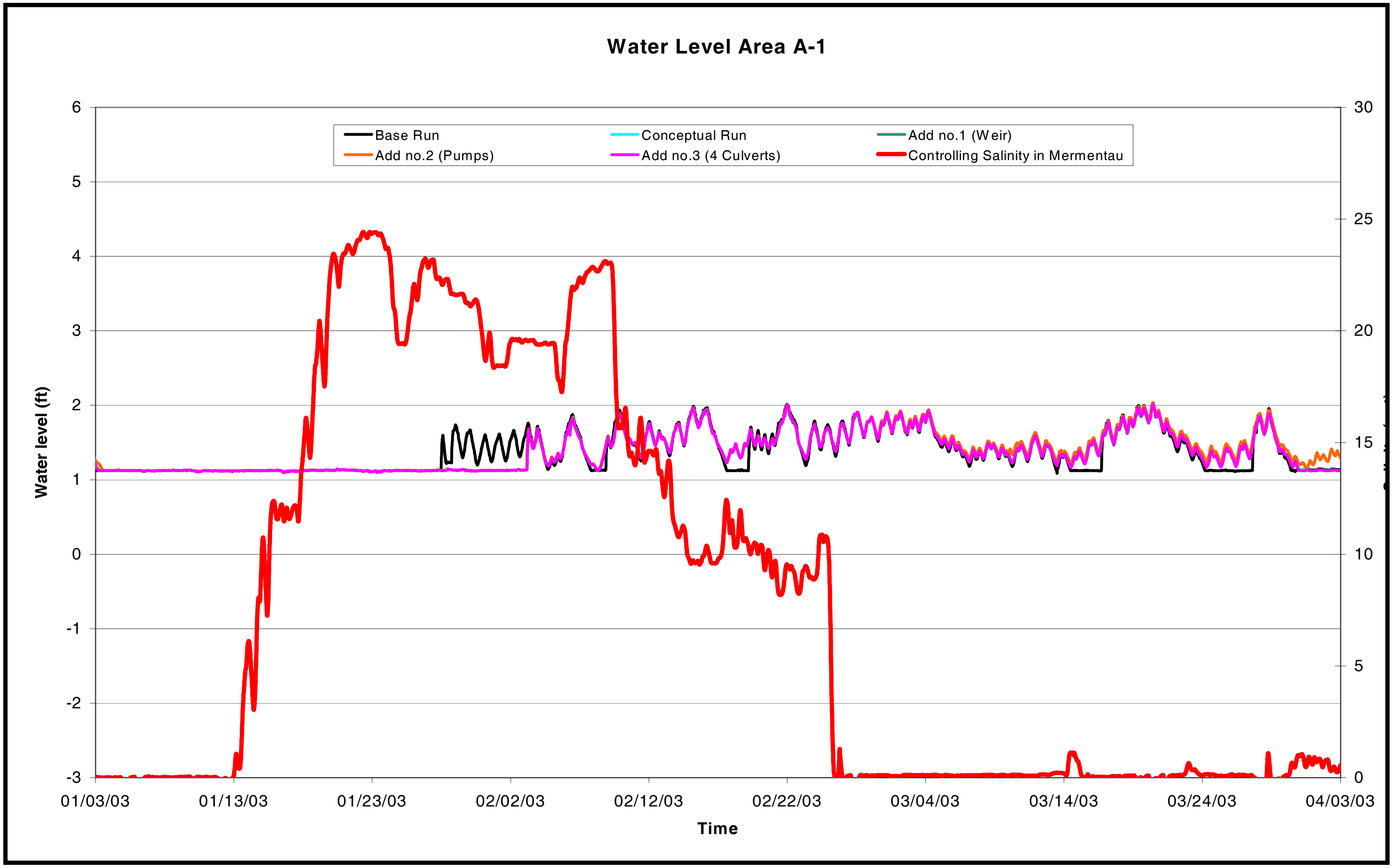

Figure A-61: Water level results at Area A-1

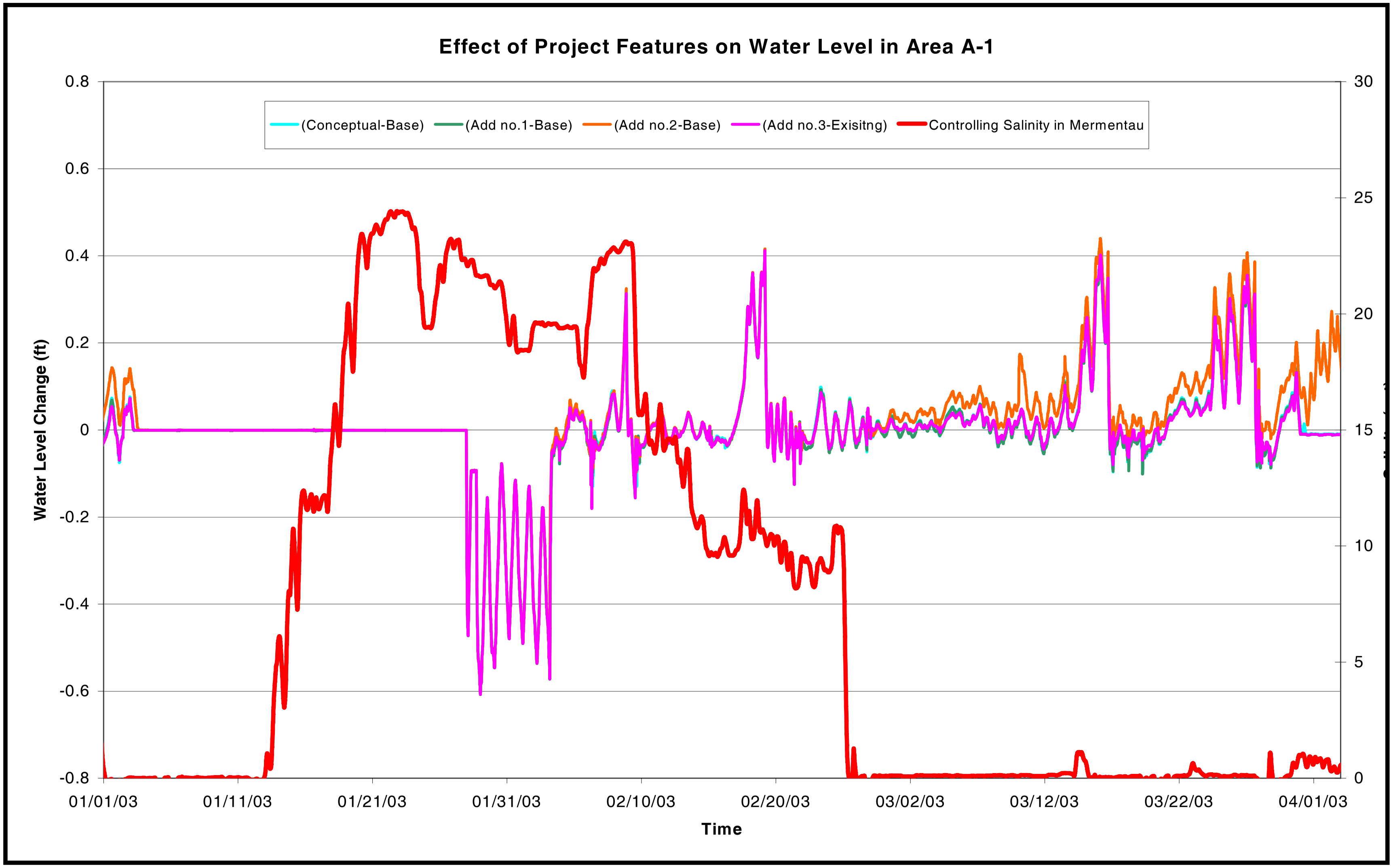

Figure A-62: Change in water level at second Area A-1

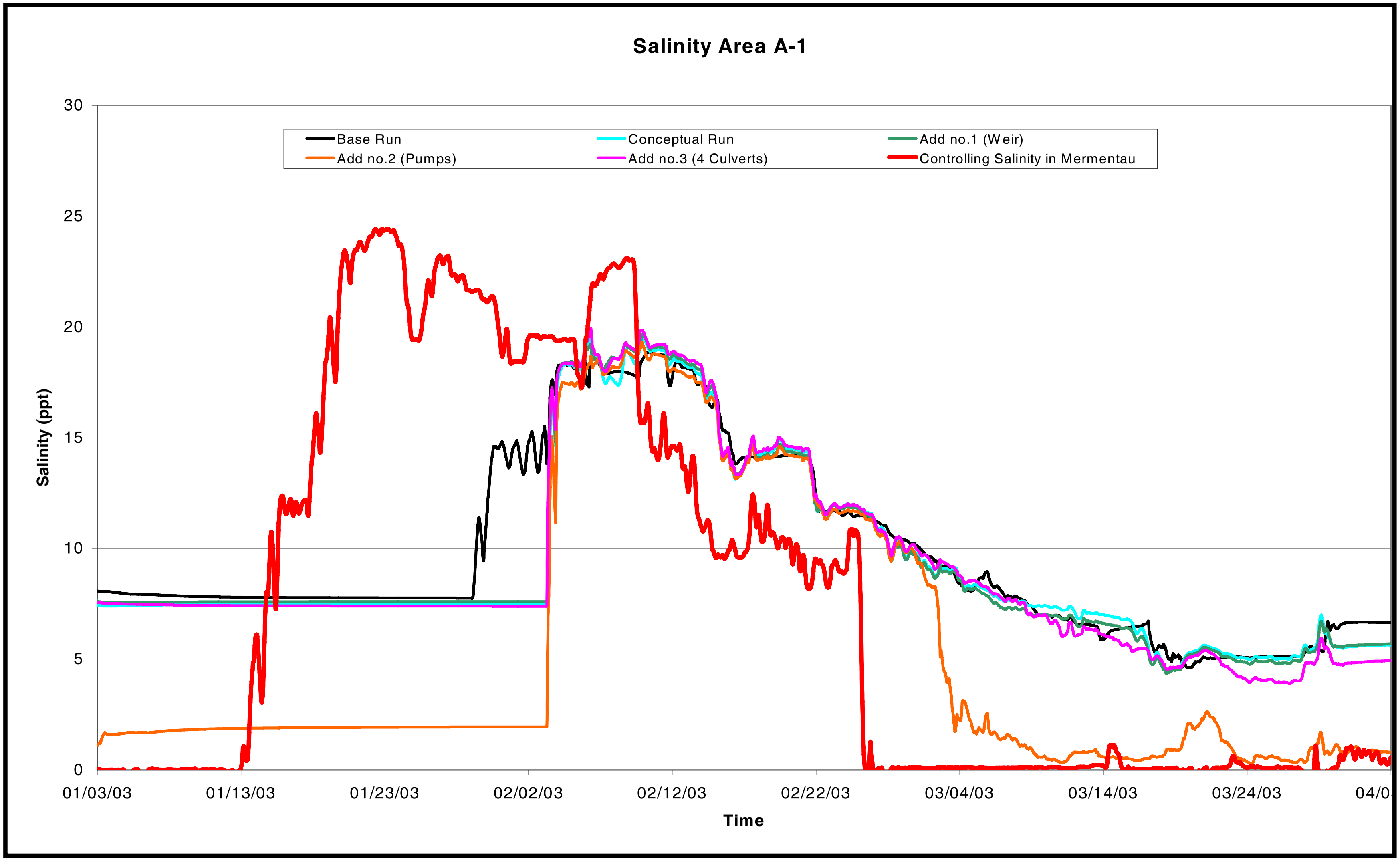

Figure A-63: Salinity results at Area A-1

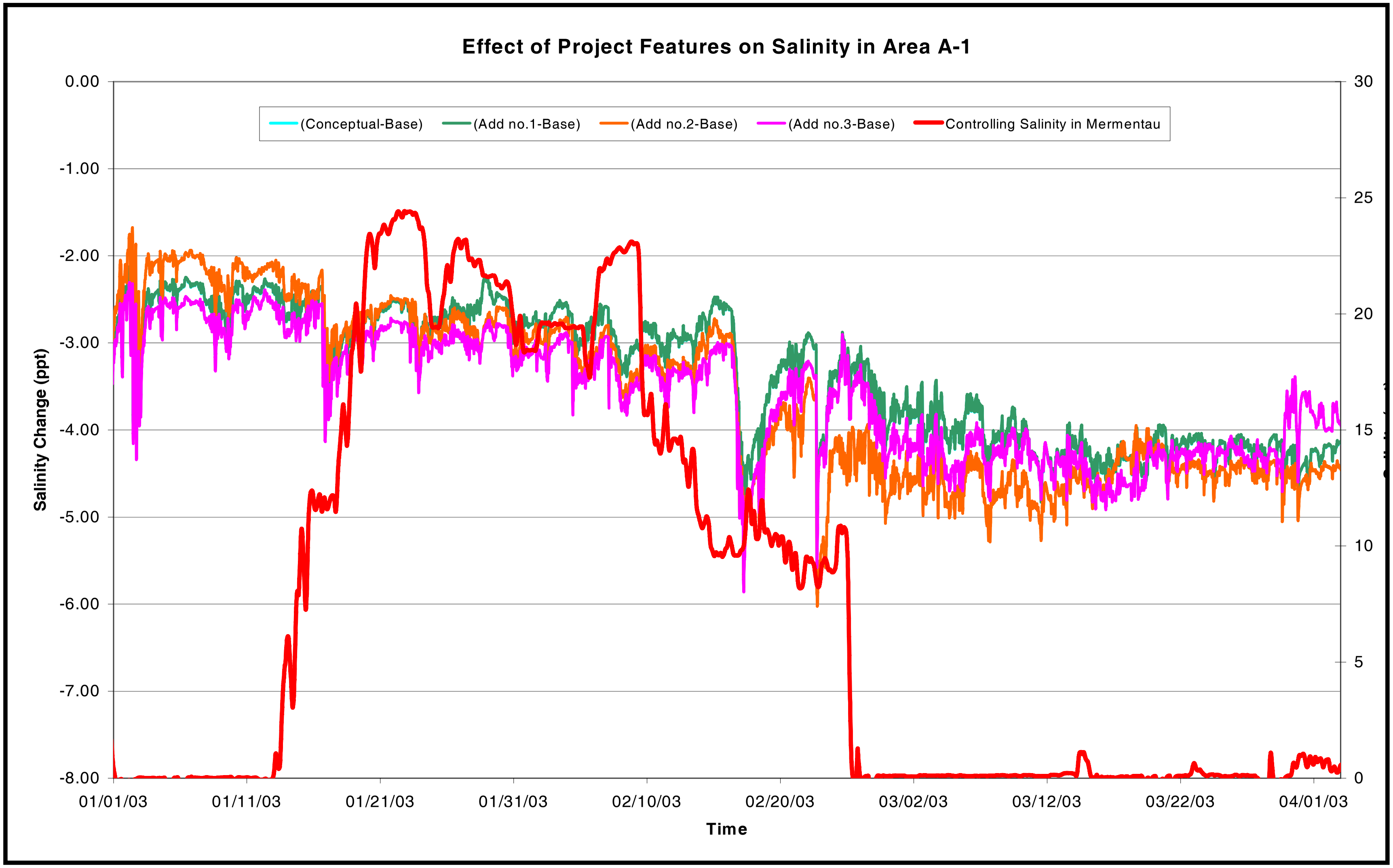

Figure A-64: Change in Salinity at Area A-1

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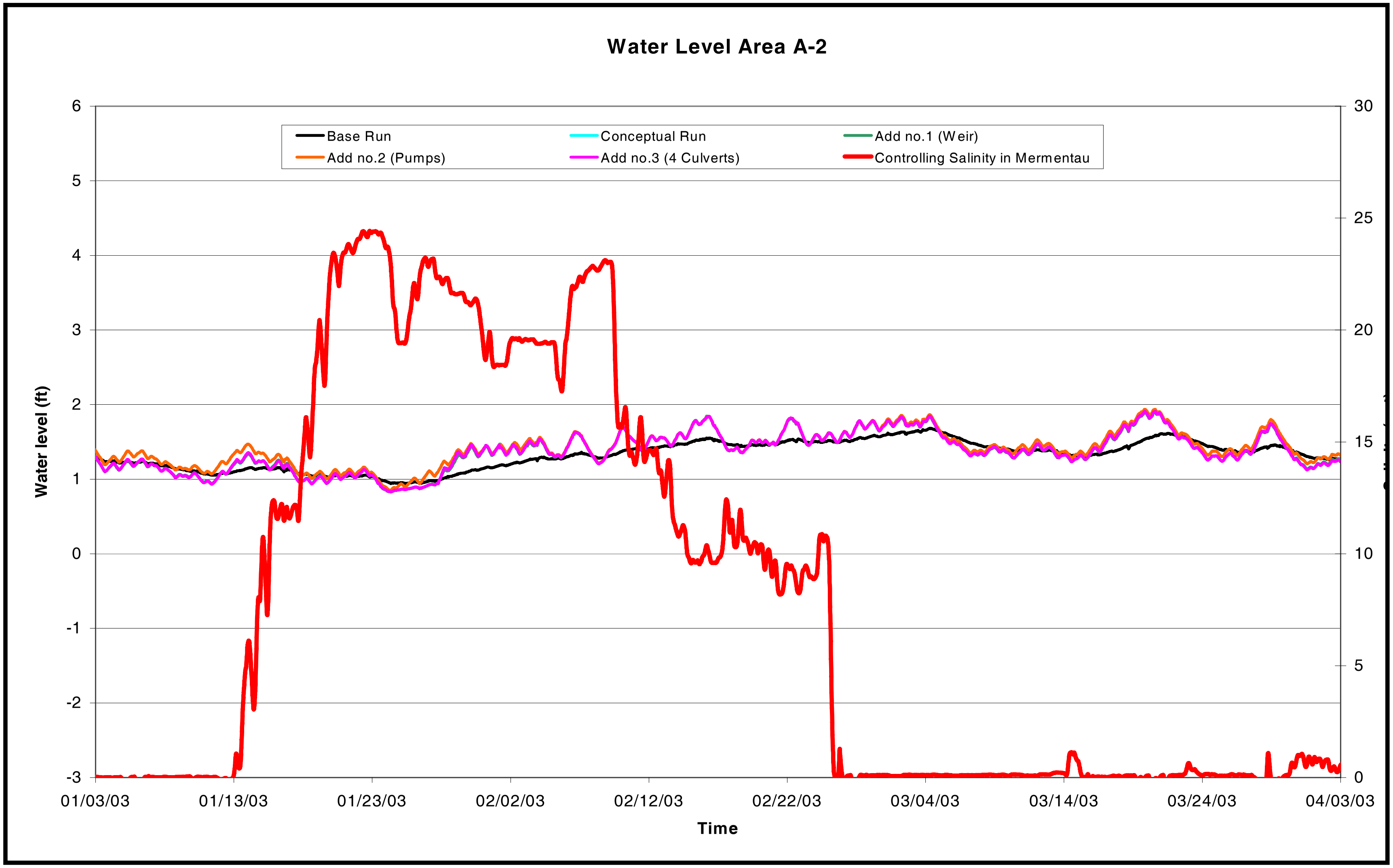

Figure A-65: Water level results at Area A-2

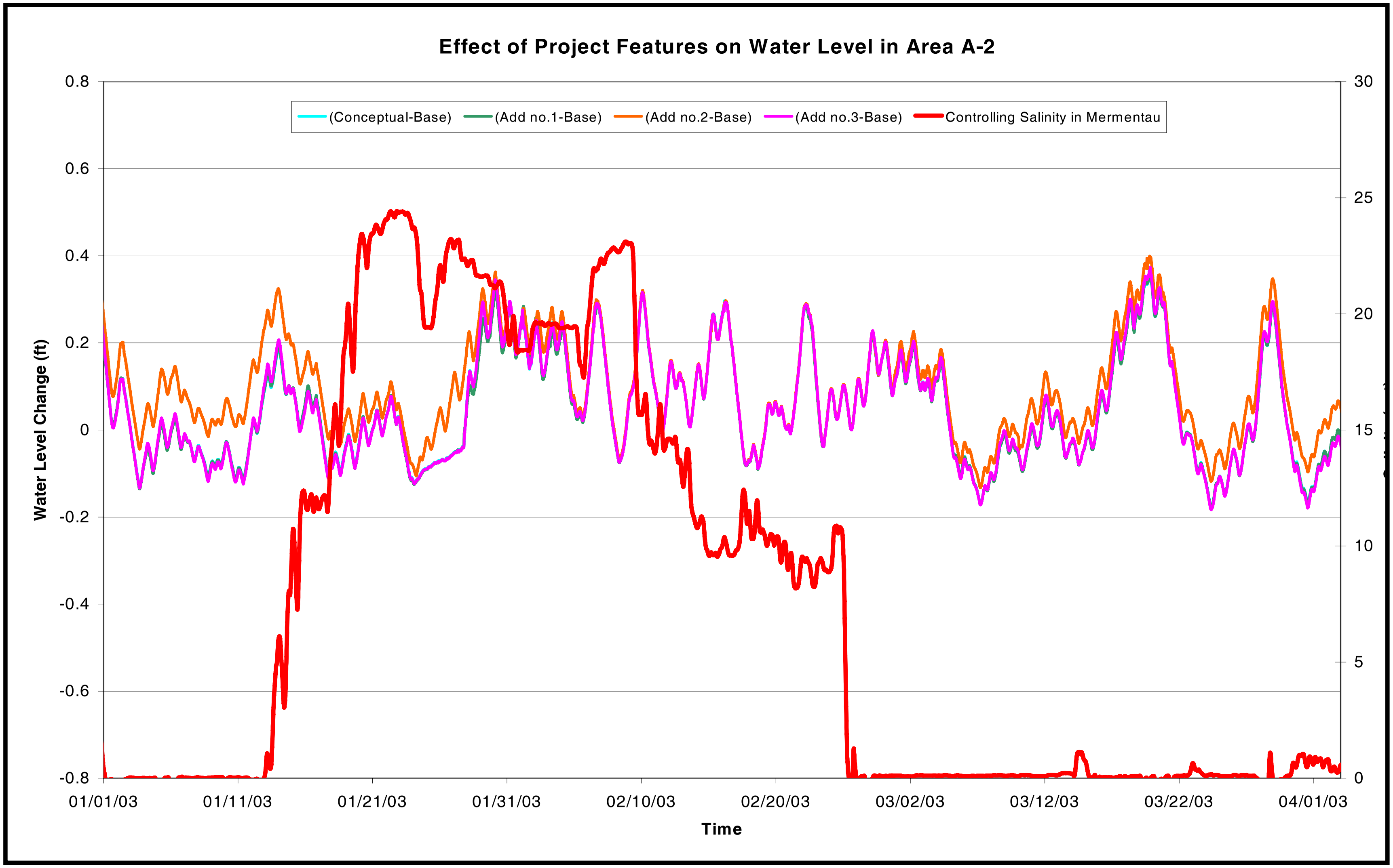

Figure A-66: Change in water level at Area A-2

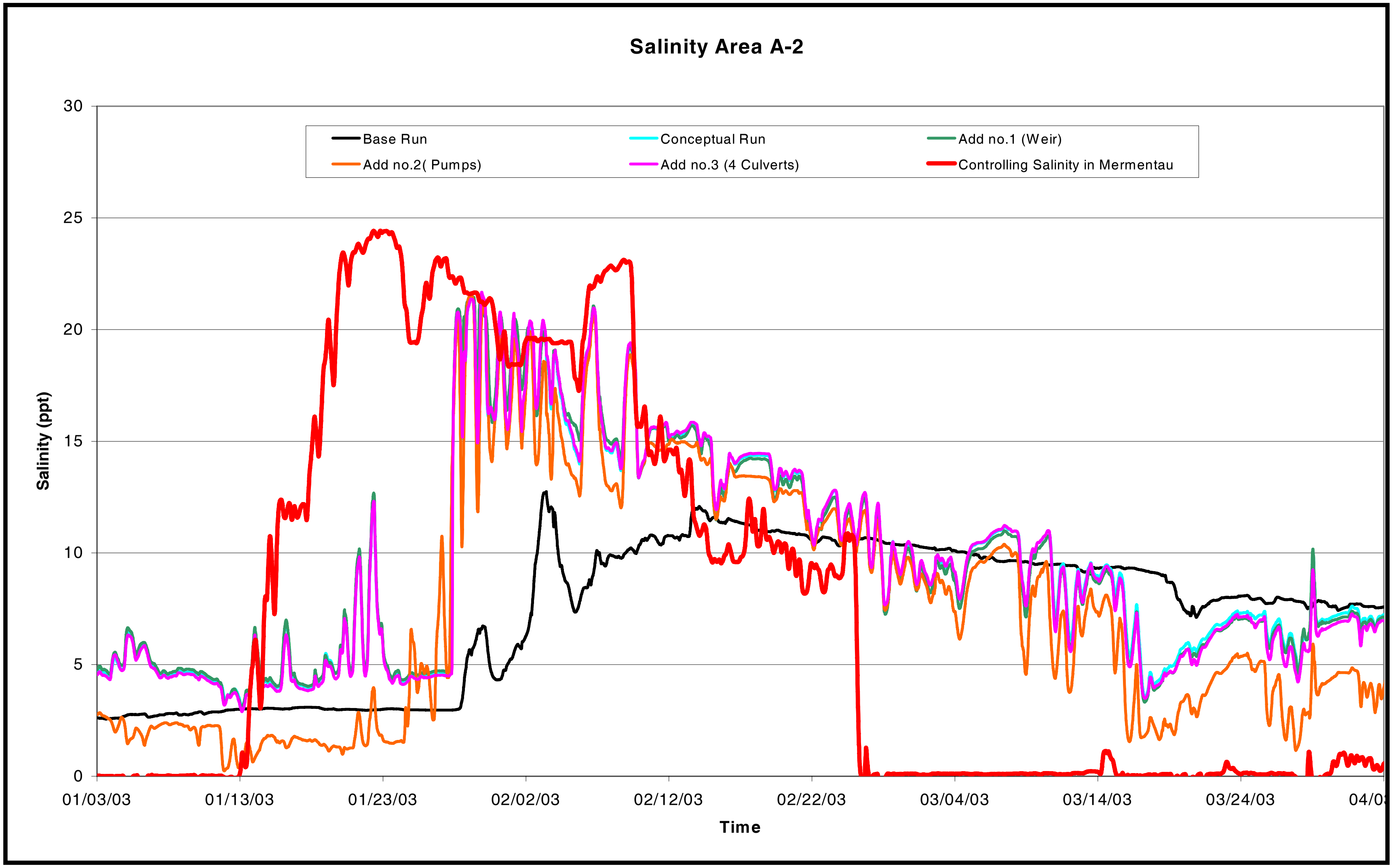

Figure A-67: Salinity results at Area A-2

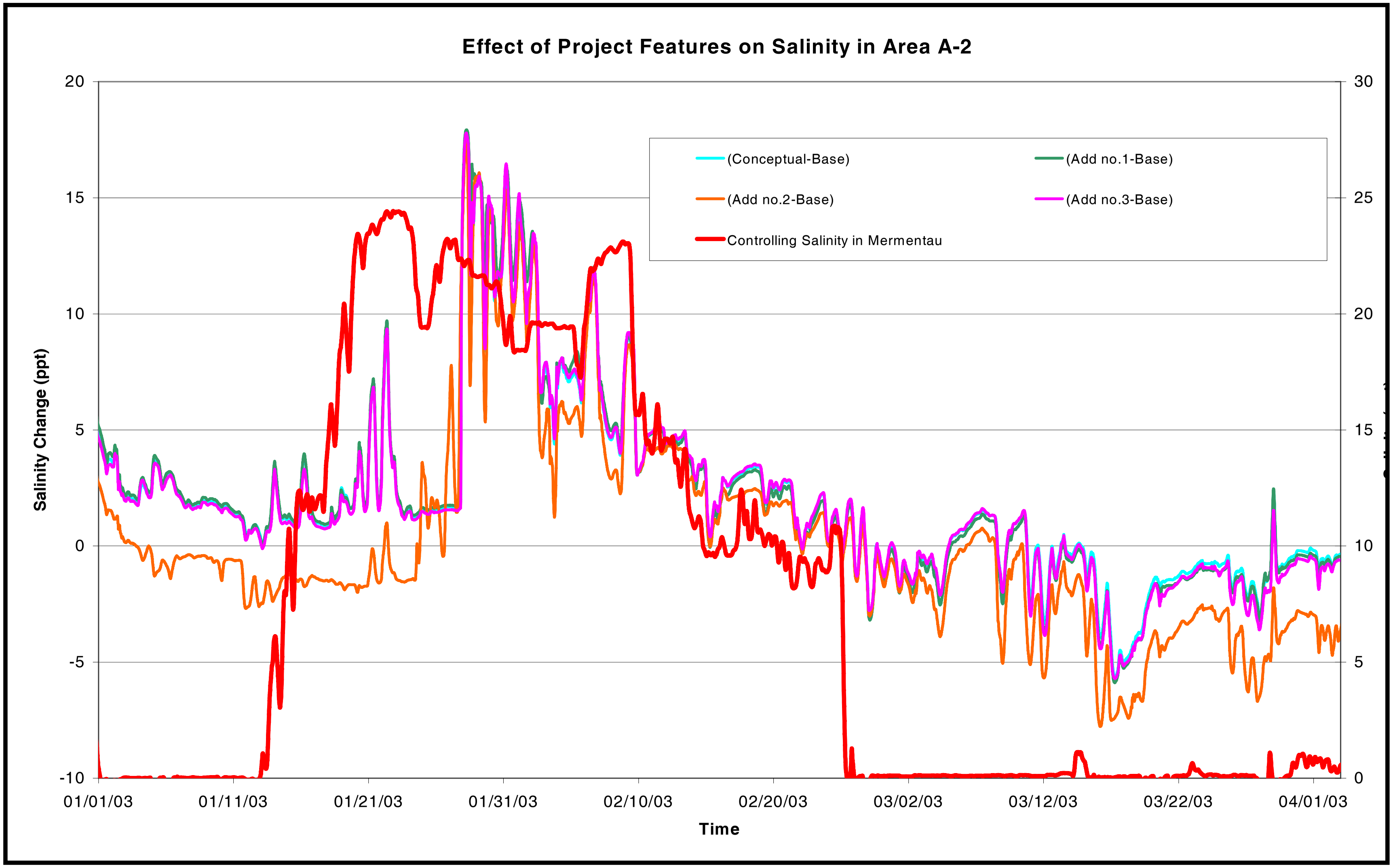

Figure A-68: Change in Salinity at Area A-2

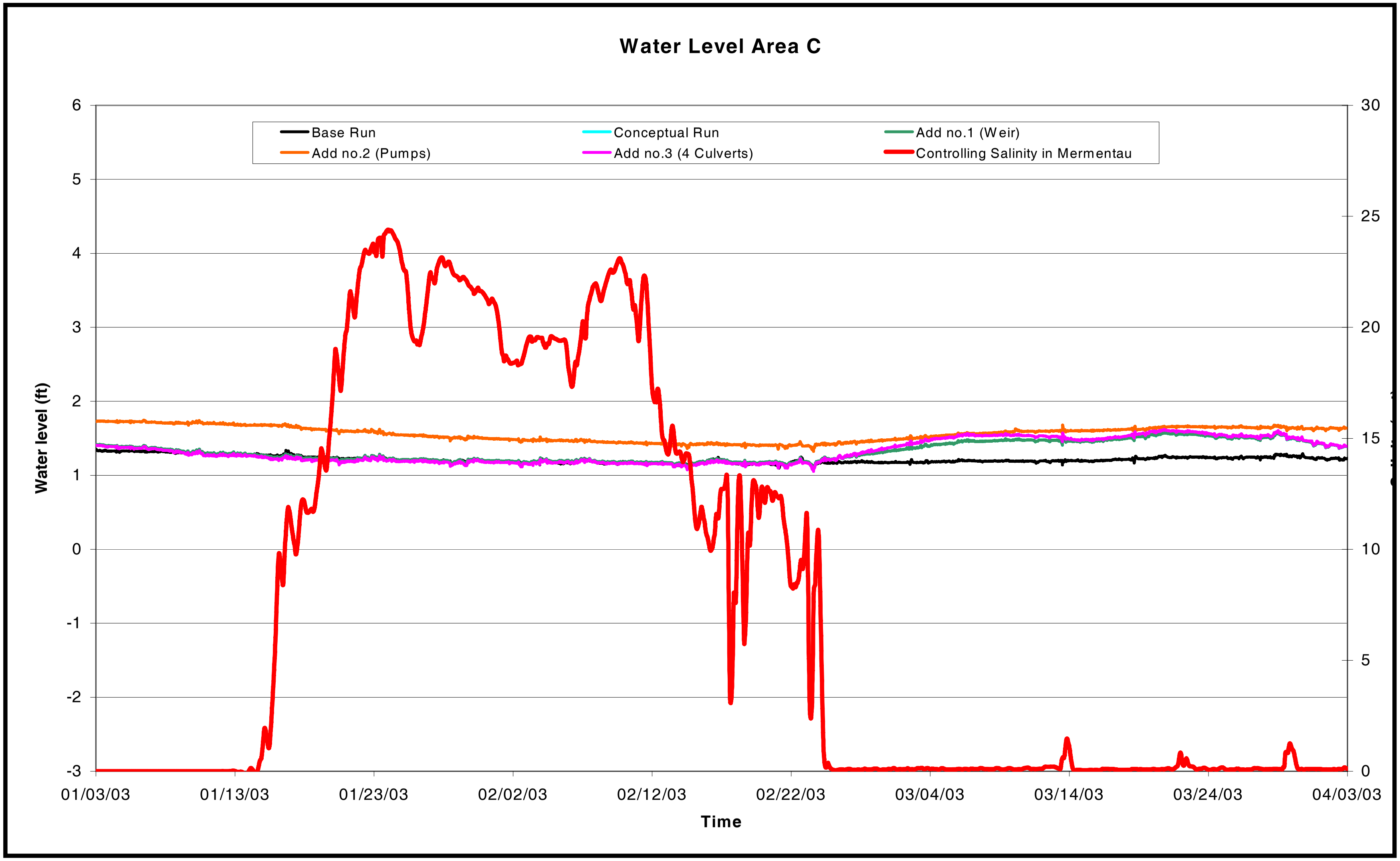

Figure A-69: Water level results at Area C

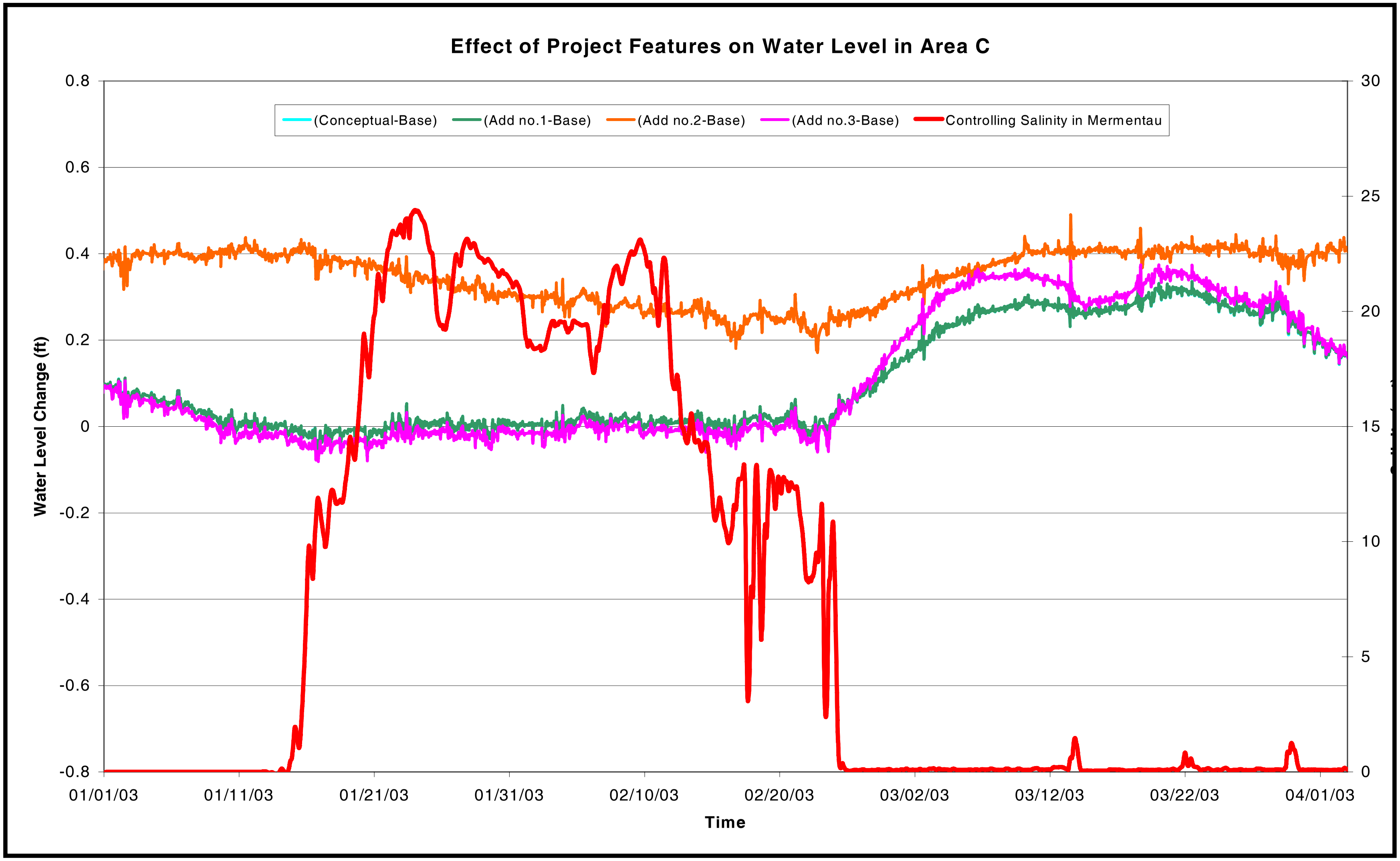

Figure A-70: Change in Water Level at Area C

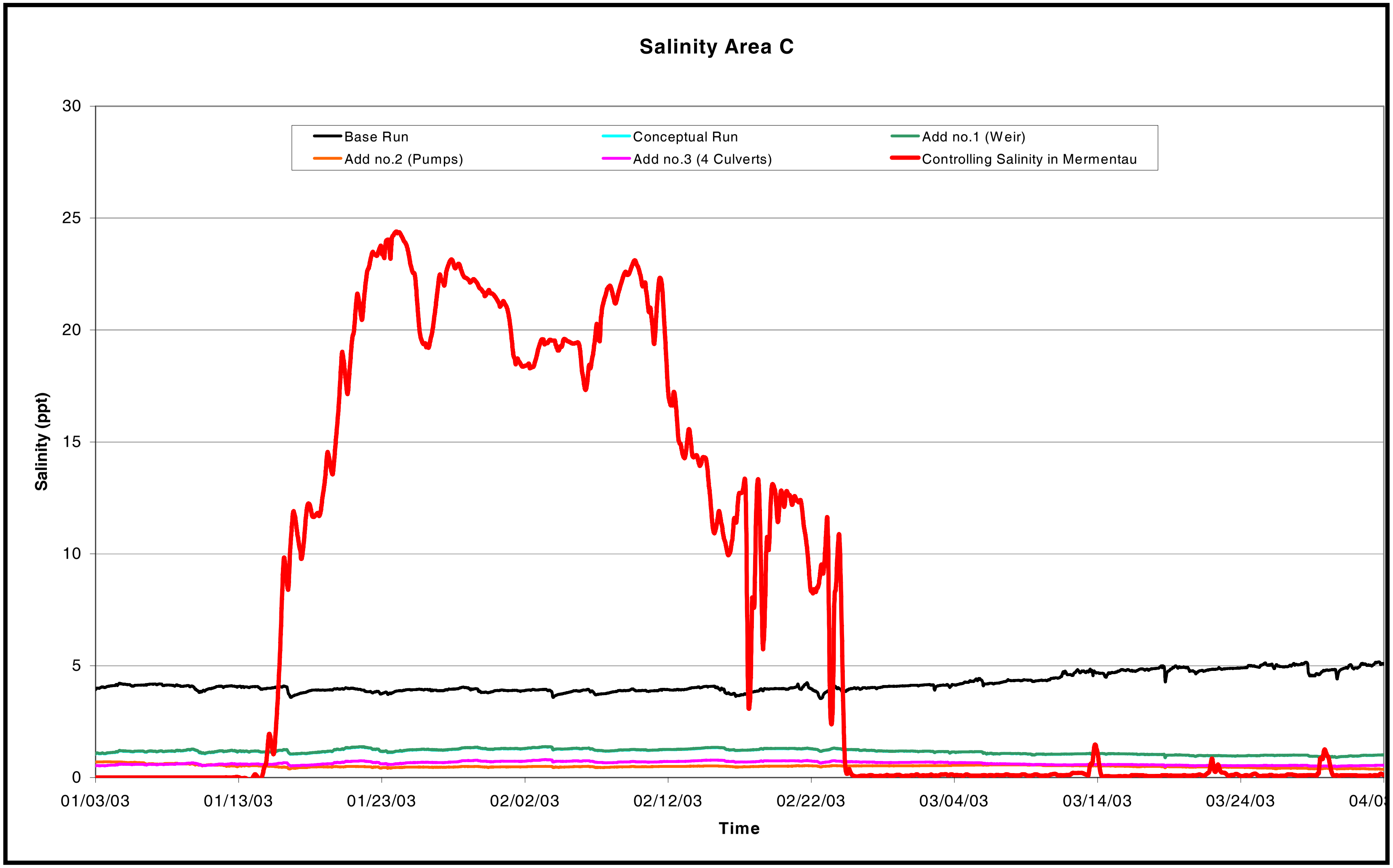

Figure A-71: Salinity results at Area C

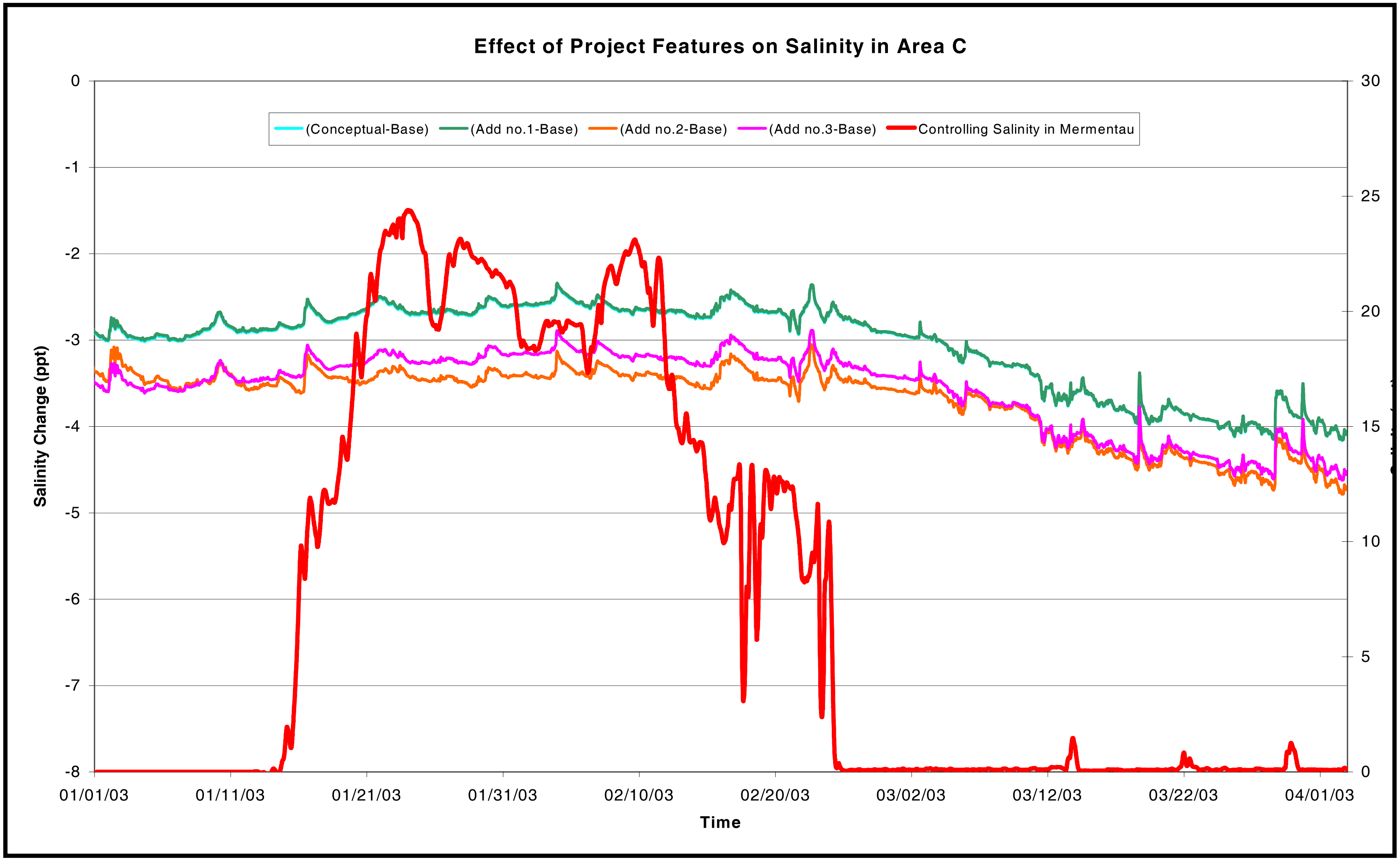

Figure A-72: Change in Salinity at Area C

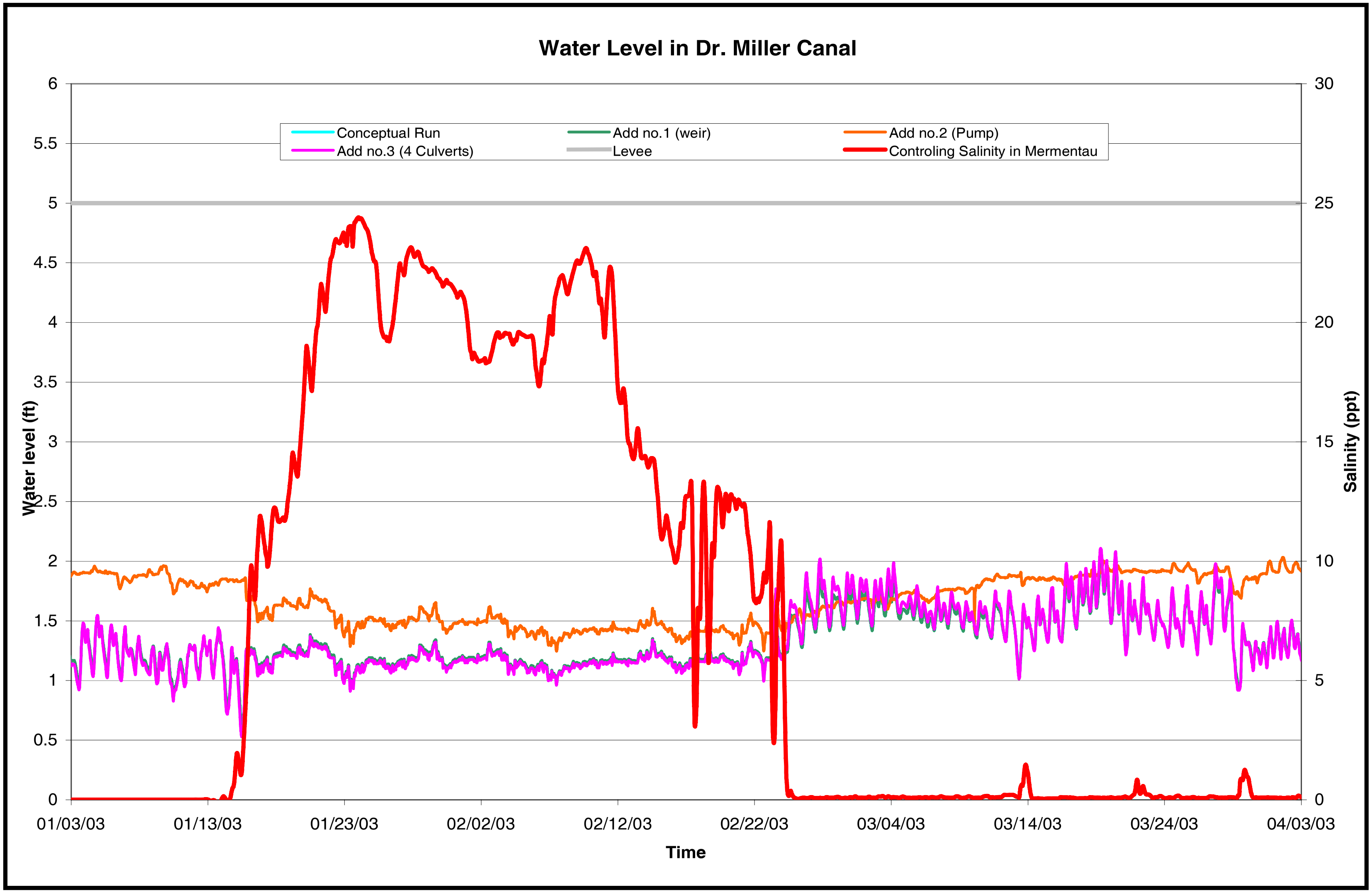

Figure A-73: Water level results along Dr Miller canal

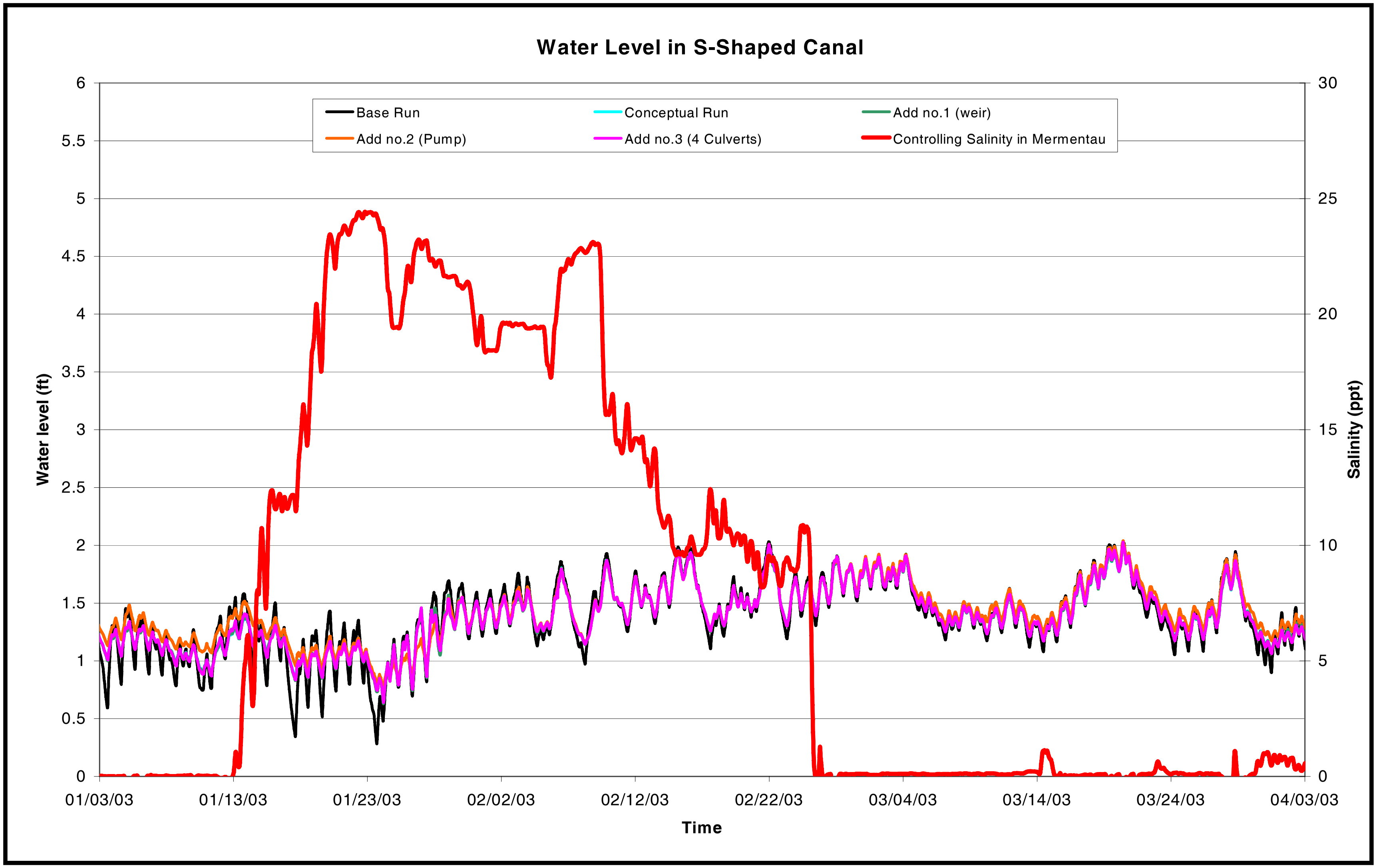

Figure A-74: Water level results along the S-Shaped canal

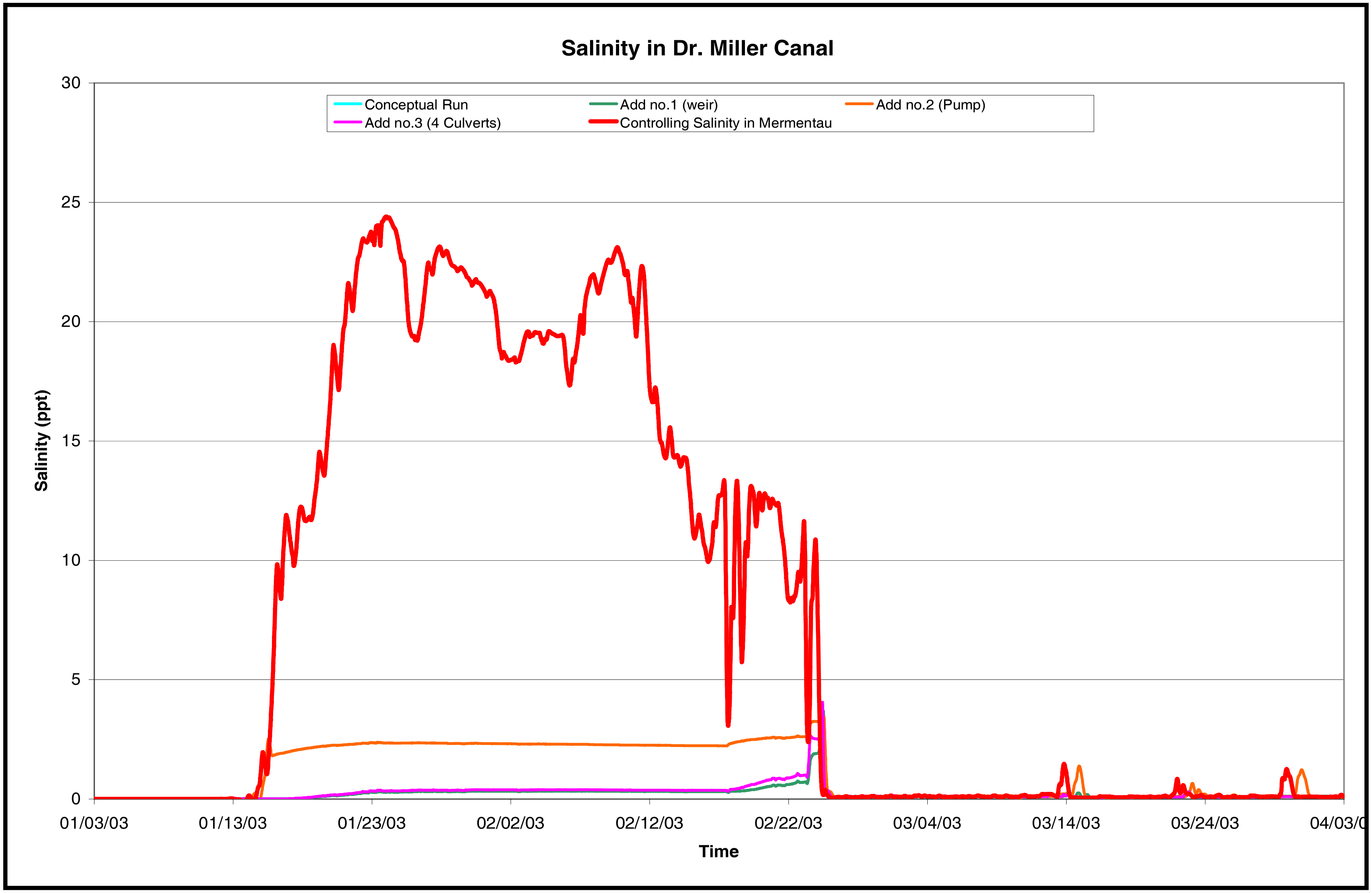

Figure A-75: Salinity results along Dr Miller canal

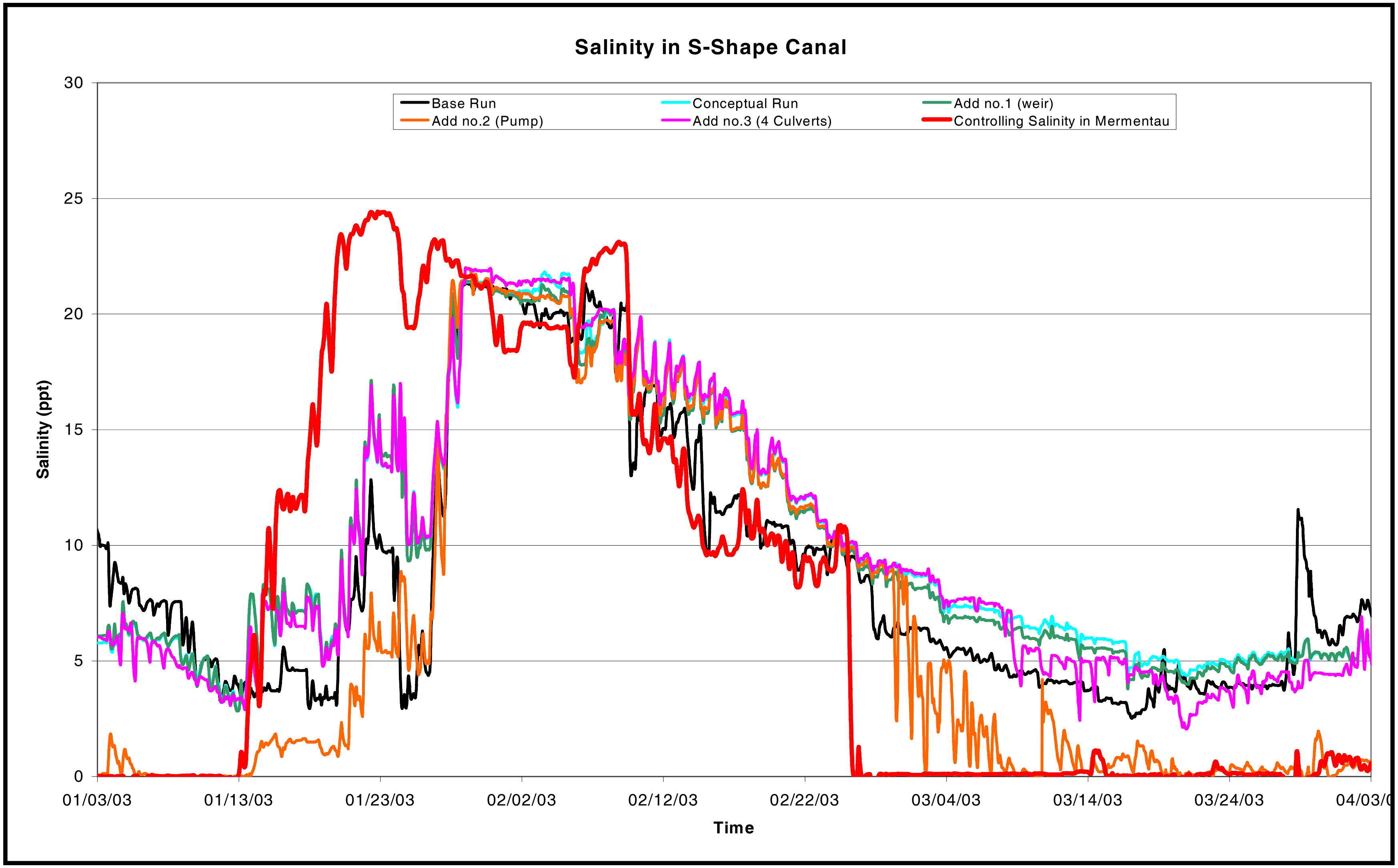

Figure A-76: Salinity results along S-Shaped Canal