



Nueces Delta Environmental Monitoring Project

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The views expressed herein are those of the authors and do not necessarily reflect the views of CBBEP or other organizations that may have provided funding for this project.

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Nueces Delta Salinity Effects from Pumping Freshwater into the Rincon Bayou

INTRODUCTION

This project's focus is monitoring the hydrological effects sourced from the Rincon Bayou Pipeline (RBP) in the Nueces Delta near Corpus Christi, Texas (**Figure 1**). This report will highlight trends in salinity changes throughout pumping events and provide a detailed look at the effects seen during the 2024-2025 sampling year (December 20, 2024, to August 31, 2025). The results of this study are used for the continual adaptation of a water management plan that will help water managers make decisions on quantity, timing, and duration of pipeline inflows that are most productive and important to the ecology of the Nueces Delta.

The Nueces Delta has been a scientific research focus due to its hypersaline condition (Matthews and Mueller 1987; Whitledge and Stockwell 1995; Montagna et al. 2002; Palmer et al. 2002; Montagna et al. 2009; Hill et al. 2011; Nueces BBEST 2011; Nueces BBASC 2012; Hodges et al. 2012). Because of watershed impoundments, riverbank modifications, and increased urbanization along the Nueces River, the Nueces Delta is no longer connected to the Nueces River, except through the Nueces River overflow channel that was permanently opened in 2001. Because of these factors, the majority of freshwater flow is diverted from the river directly to the bay, bypassing the delta. The only natural means of freshwater flow through the Nueces Delta is during severe flooding events or local heavy rainfall causing the flow to over bank into the delta (BOR 2000; Pulich et al. 2002; Hill et al. 2011). Decreased inflows into the delta and prolonged Texas droughts have caused frequent hypersaline conditions in the Nueces Delta. Freshwater inundation within the Nueces Delta over the past 30 years has been insufficient in volume and distribution to maintain a healthy marsh, the lack of sediment loading in the system is leading to the delta front eroding into Nueces Bay, the marsh plants are under stress, and the connectivity of aquatic habitat is threatened (Hodges et al. 2012).

In the 1990's, studies found these hypersaline conditions could harm the ecological and biological processes of the marsh and degrade the overall health of the Nueces Estuary. This impact evoked the state of Texas to develop an inflow criterion for freshwater inflows (Dunton and Alexander 2000; Montagna et al. 2002; Palmer et al. 2002). The resultant 2001 Agreed Order, from the Texas Commission on Environmental Quality (TCEQ), requires the City of Corpus Christi (City) to provide no less than 151,000 acre-feet (186,255,757 m³) per year to the Nueces Estuary (TCEQ 1995). Each month the City is required to "pass through" inflow to the Nueces Estuary equal to the measured instream flow into the Choke Canyon Reservoir/Lake Corpus Christi Reservoir System up to a target amount (TCEQ 1995). The target amount varies by month and is calculated based on the combined storage volume of the Reservoir System. The City may receive credits for excess flow from the previous month or from relief credits based on salinity measured at the SALT03 monitoring station in Nueces Bay (Montagna et al. 2009).

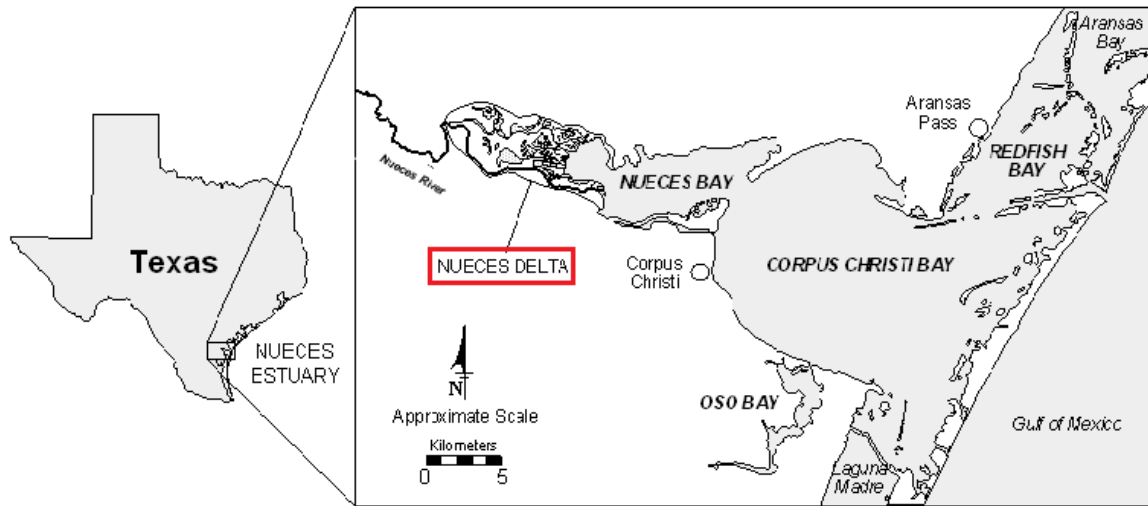


Figure 1. Location of the Nueces Delta within Texas and the Nueces Watershed.

To efficiently deliver freshwater to the Nueces Delta, the City built the Rincon Bayou pump station and pipeline (RBP) to divert up to the first 3,000 acre-feet (3,700,446 m³) of required “pass throughs” to the upper Rincon Bayou in the Nueces Delta. The RBP became operational in November 2007. The RBP pump station includes three 350 horsepower mixed flow submersible pumps capable of moving up to 60,000 gallons per minute with all three pumps operating (**Table 1; Figure 2**). The number of days to deliver a given volume of freshwater through the RBP depends on the number of pumps used.

Table 1. Capacity of the Rincon Bayou Pipeline

	Number of Rincon Bayou Pumps in Operation		
	1	2	3
Flow, gallons/minute	28,000	46,000	60,000
Flow, cubic feet/second	62	102	134
Flow, acre-feet/day	124	203	265
Total kW	230	455	675

This project’s principal objective is to maintain environmental data collection stations measuring water quality parameters in Nueces Bay as a result of the freshwater releases of the RBP. The data collected during this period is made available to CBBEP personnel in support of the Rincon Bayou Pipeline Management Plan which helps water managers make decisions on quantity, timing, and duration of pipeline inflow events that are most productive and significant to the ecology of the Nueces Delta. This report focuses on identifying the RBP freshwater inflows events in the Nueces Delta and provides data collected between December 20, 2024, and August 31, 2025.



A)



B)

Figure 2. View of RBP pumping facilities depicting A) the intake pumps located on the Nueces River above the Calallen Dam and B) the pipeline outfall in the Rincon Bayou. Photos taken by Jace Tunnell.

METHODS

The Coastal Bend Bays & Estuaries Program (CBBEP) contracts this salinity-monitoring project to the Conrad Blucher Institute for Surveying and Science (CBI) at Texas A&M University - Corpus Christi (TAMU-CC). This project includes three environmental data collection stations. Nueces Bay Weather Station (NUDEWX), Nueces Delta 2 (NUDE 2), and the Nueces Bay Water

Level (NUDEBAY), are all monitoring various conditions within the Nueces River Delta and bay. (Figure 3)



Figure 3. Map of the three environmental monitoring stations (NUDE2, NUDEWX, and NUDEBAY).

The Nueces Delta Weather Station (NUDEWX) is located on Rincon Bayou downstream from the RBP outfall (27.897582°N, -97.616524°W). The station measures wind speed (m/s), wind direction (°), barometric pressure (mbar), precipitation (mm), relative humidity (%), and solar radiation (cal/cm²/min). The CBI performs a monthly maintenance to NUDEWX including a rain gauge calibration check. NUDE2 is in the middle reach of Rincon Bayou and measures conductivity and water temperature while the NUDEBAY station measures water level (m), wind speed (m/s), wind gusts (m/s), wind direction (°), and barometric pressure (mbar).

NUDEBAY 185 was removed in August 2024 due to a shoreline expansion project that shored up the water level station. Typically, this station is serviced annually following standards established by NOAA CO-OPS (<http://tidesandcurrents.noaa.gov/>). NUDE 2 uses a of Hydrolab[®] CMS5 water quality datasonde interfaced with cellular IP modem and is serviced monthly. The station is polled by an automated computer program designed and implemented by the Information Technology staff at CBI. Data is stored in CBI's database and available via the project webpage at <https://lighthouse.tamucc.edu/stnlist/>. The Hydrolab[®] CMS5, at NUDE 2, measures water quality parameters: water temperature (°C), specific conductance (µS/cm), and salinity (ppt). Activities are performed in accordance with the Quality Assurance Project Plan (QAPP).

RESULTS AND DISCUSSION

The Nueces River Authority is no longer publishing historic pass thru reports on their website. A Freedom of Information Act (FOIA) has to be submitted, approved and delivered before the information is made available. The Daily Reservoir and Pass Thru Status Report is the only accessible information for the previous day. (Table 2 and Figure 5).

On December 16, 2024, the City of Corpus Christi implemented Stage 3 drought water restrictions, which remain in effect as of the date of this report. Pursuant to the Agreed Order, freshwater releases are not required under Stage 3 conditions. As of this report, there have been no known significant freshwater releases from the Rincon Bayou Pipeline during the reporting period.

Table 2. 2024-2025 Rincon Bayou Pumping Events

Year	Pumping Event	Dates of Event	Duration (days)	Avg. water level (m above MSL)	Acre-Feet Pumped
2024-2025	0	0	0	0	0

Local rainfall varied spatially at the National Weather Service (U.S. Dept of Commerce 2025) at Corpus Christi International Airport (CRP) at 27°46'22.43"N, 97°30'8.47"W and at NUDEWX at 27°53'50.47"N, 97°36'58.73"W with more rainfall frequently occurring at CRP (Table 3). NUDEWX is approximately 11 miles northwest of CRP and is located directly in the Nueces Delta. Despite the regional difference in rainfall, both locations still recorded similar rainfall trends and were representative of the general meteorological conditions in the Nueces Delta watershed.

Table 3

Total rainfall per 2024-2025 sampling year for NUDEWX and CRP.

2024-2025	
NUDEWX	12.7 in
CRP	13.24in

While drought conditions throughout Texas improved during the reporting period, the area of the Nueces Delta continued to experience abnormally dry conditions (Figure 4).

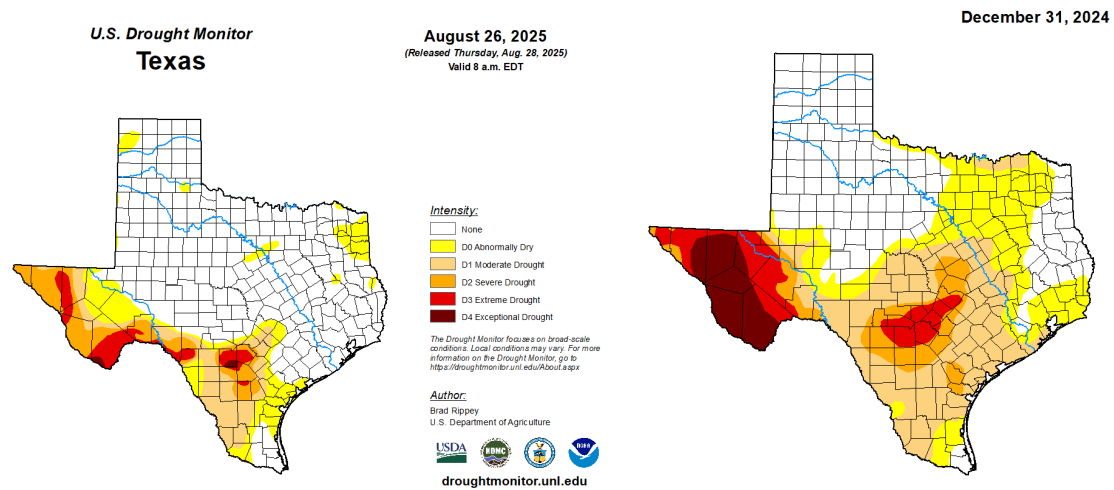


Figure 4. Drought condition figure throughout the state of Texas 2024-2025, which will generally be representative of drought conditions throughout the 2024-2025 reporting year.

The low amount of rainfall and abnormally dry conditions during the 2024-2025 sampling year led to low reservoir capacities throughout the reporting period. Capacities at Lake Corpus Christi varied between 35.4% in December 2024 and 17.5% in August 2025. The Choke Canyon reservoir levels varied between 19.0% in December 2024 and 12.1% in August 2025.

The highest level of rainfall was observed between March and April 2025 and June and July 2025. After these rainfall events, which led to a drop in salinity levels (Figure 7 and Figure 8) for a short period of time and then salinity levels gradually increased.

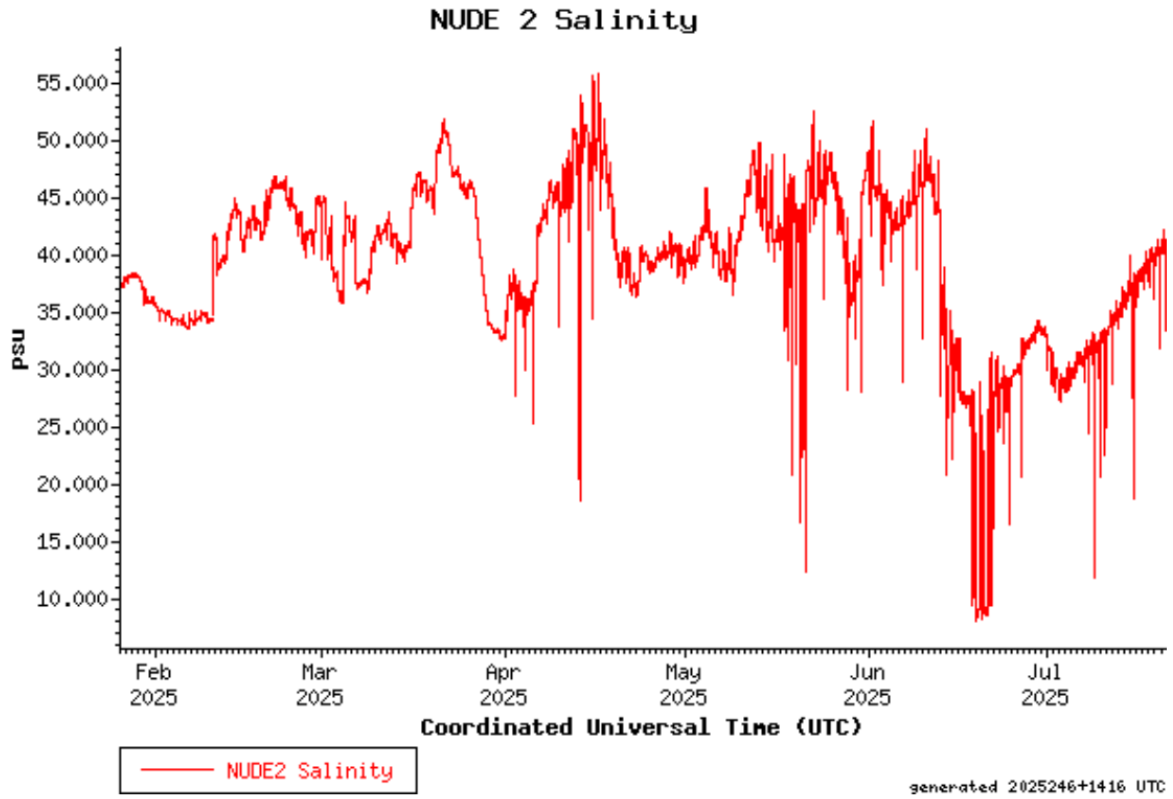


Figure 5. NUDE 2 Salinity readings throughout the reporting period

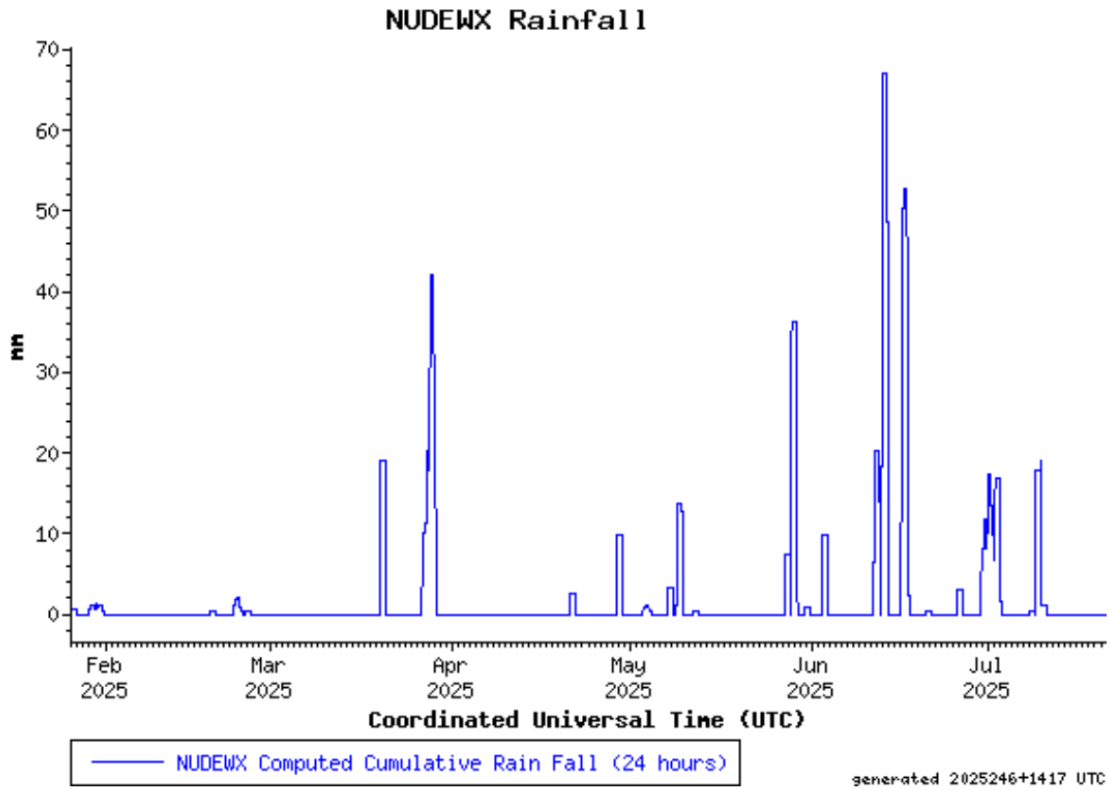


Figure 6. NUDEWX Computed cumulative rainfall over 24 hours throughout the reporting period.

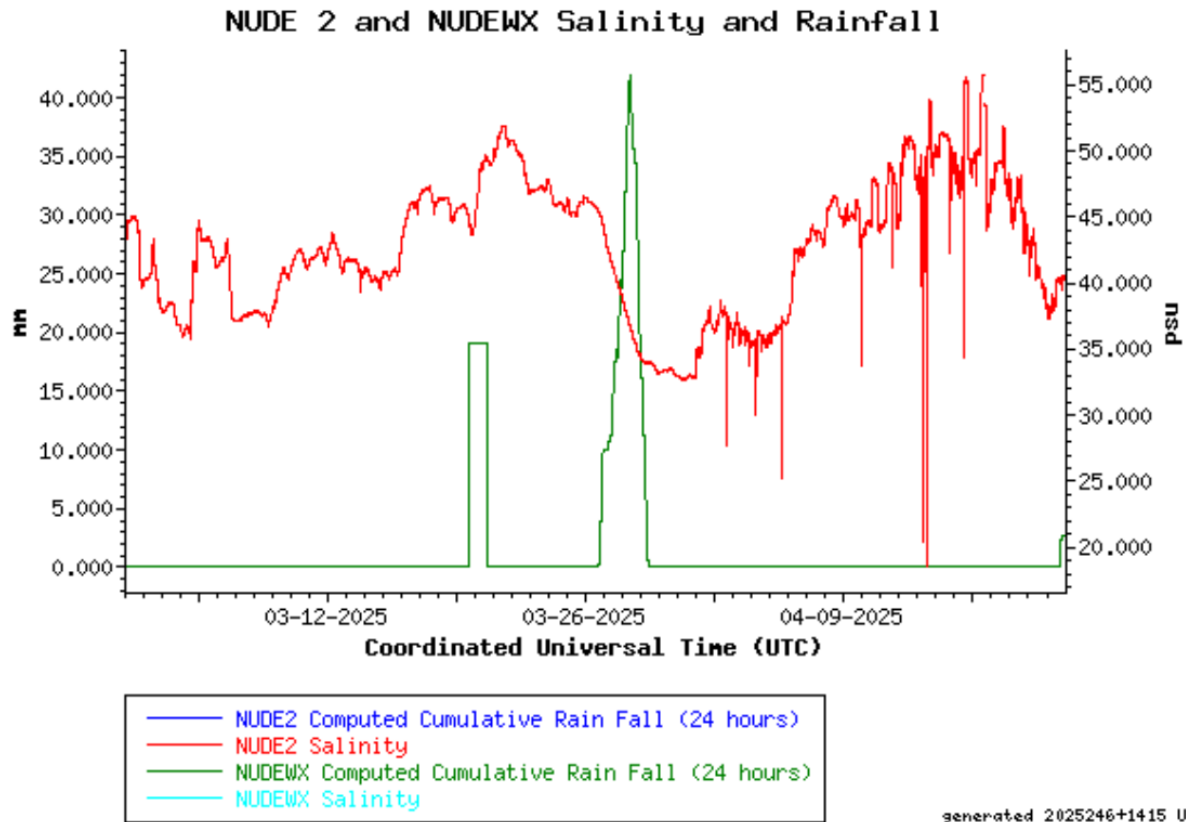


Figure 7. NUDE 2 salinity and NUDEWX in March and April 2025

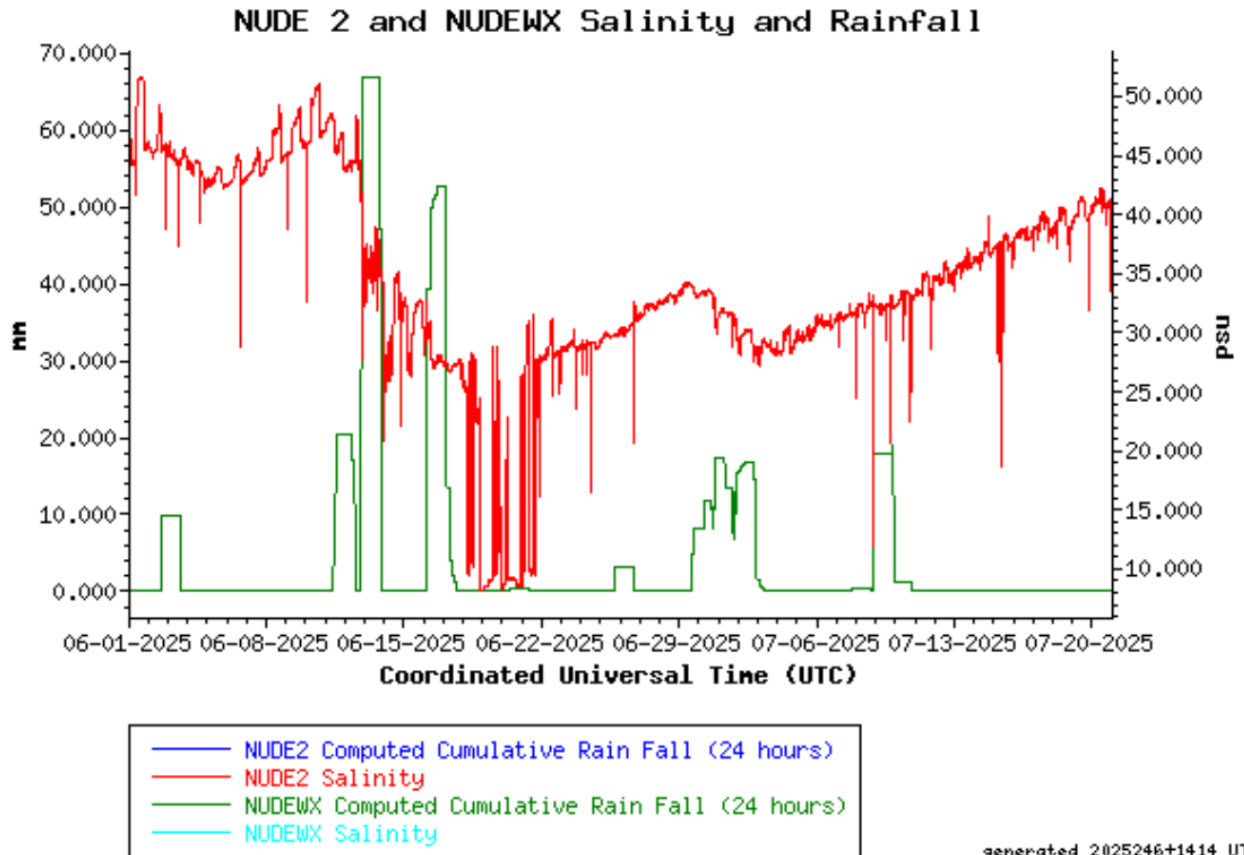


Figure 8. NUDE 2 salinity and NUDEWX in June and July 2025

CONCLUSIONS

Without the Rincon Bayou historic pass thru reports during the reporting period and the loss of the NUDEBAY water level and meteorological station, we can only look at salinity levels as they relate to rainfall. During the reporting period, salinity levels in the Nueces Delta showed variability influenced by regional climatic conditions. Higher salinities were observed during late spring and summer, while lower salinities occurred during rain events reflecting greater freshwater contributions. Overall, the data indicates that the system experienced periods of elevated salinity stress during the spring and early summer months, which may have implications for estuarine habitats and species sensitive to salinity fluctuations. Continued monitoring will be important to track long-term patterns and assess the ecological impacts of these changes.

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