

Real-Time Hydrological Monitoring to Estimate Flow and Pollutant Loads in Brownsville Ship Channel, South Texas

Iván René Santos Chávez, Ahmed Mahmoud, Ph.D.; and Abdoul Oubeidillah, Ph.D.; Andrew Ernest, Ph.D., PE
Civil Engineering Department, University of Texas Rio Grande Valley, Edinburg, TX 78539

INTRODUCTION

From 2010 to 2018, Brownsville Ship Channel (BSC) was listed as an impaired waterway due to bacteria by the Texas Integrated Report of Surface Water Quality for the Clean Water Act.

In 2020, the bacteria level decreased and BSC only has a warning for screening levels of concern due to depressed levels of dissolved oxygen.

Table 1

Brownsville Ship Channel history as impaired waterway

Texas Integrated Report of Surface Water Quality for the Clean Water Act ¹		Description
2010		Bacteria
2012		Bacteria
2014		Bacteria
2016		Bacteria
2018		Bacteria
2020	Depressed levels Dissolved Oxygen ²	

¹It summarizes the condition of the state’s surface waters, including concerns for public health, fitness for use by aquatic species and other wildlife, and specific pollutants and their possible sources.

²Screening level does not make it impaired waterway.

OBJECTIVE

Identify the water quality and qualify the flow from the three main tributary channels draining into the Brownsville Ship Channel.

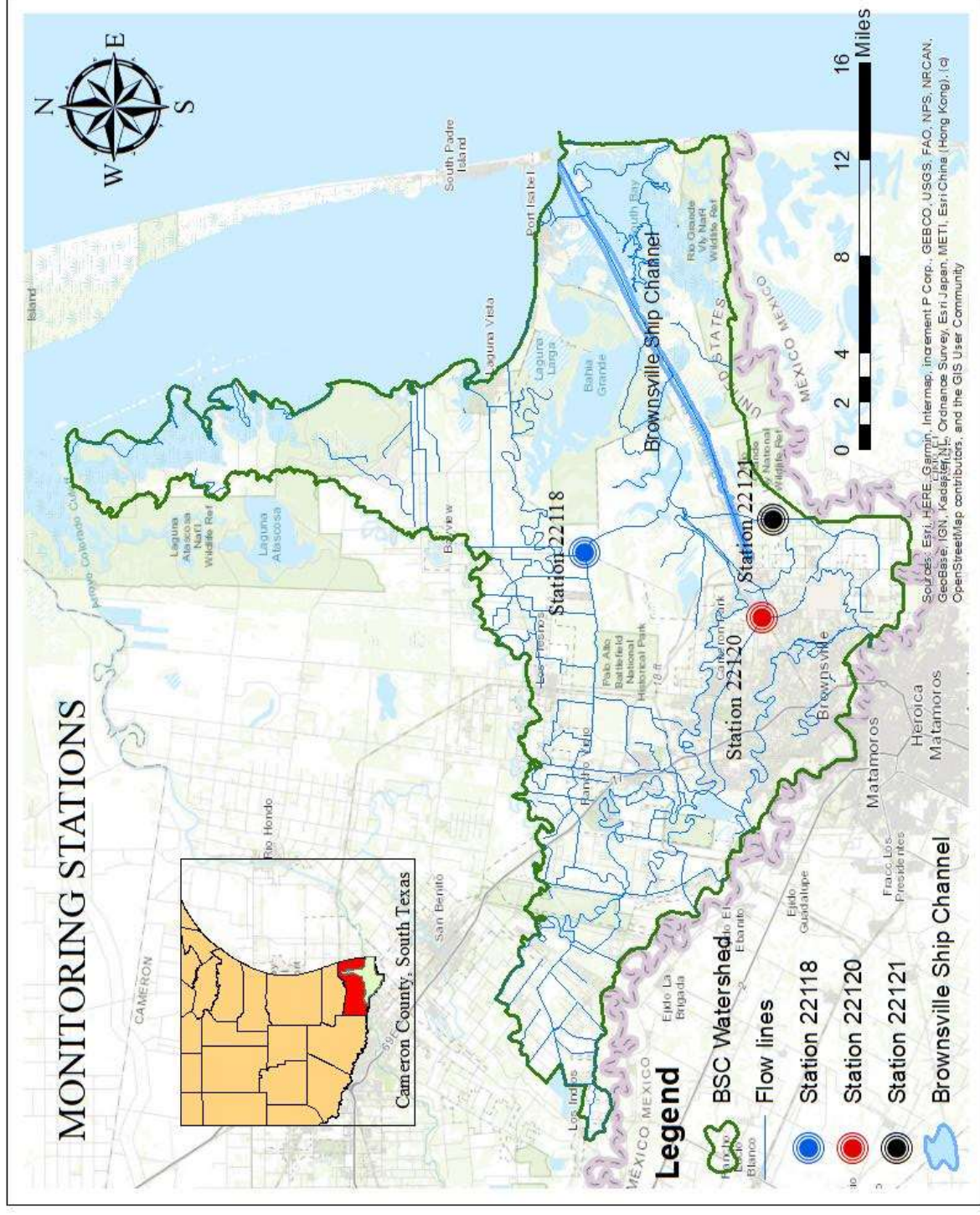
AREA OF STUDY

- Brownsville Ship Channel,
Cameron County, Texas,
USA.



MONITORING STATIONS

- Station 22118: Los
Fresnos, Cameron County.
- Station 22120: Brownsville
Public Works.
- Station 22121: Brownsville
Landfill.



REAL-TIME MONITORING

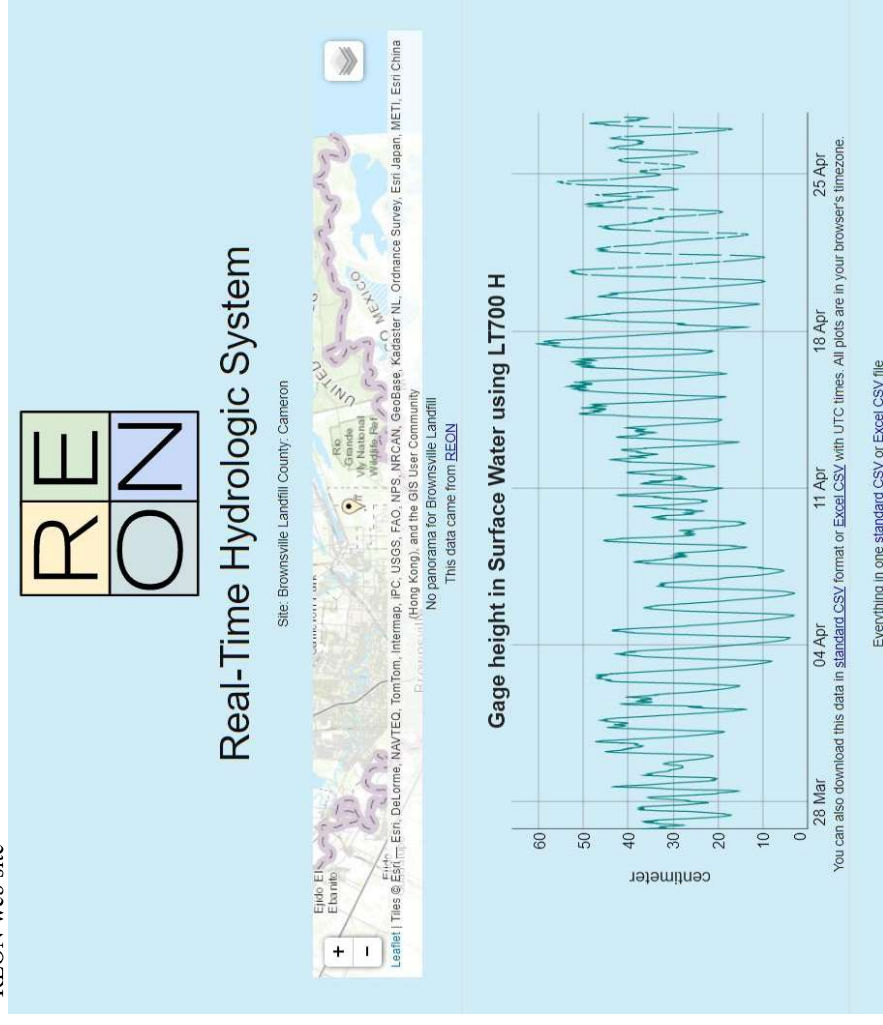
River and Estuary
Observatory Network
(REON)

www.rths.us

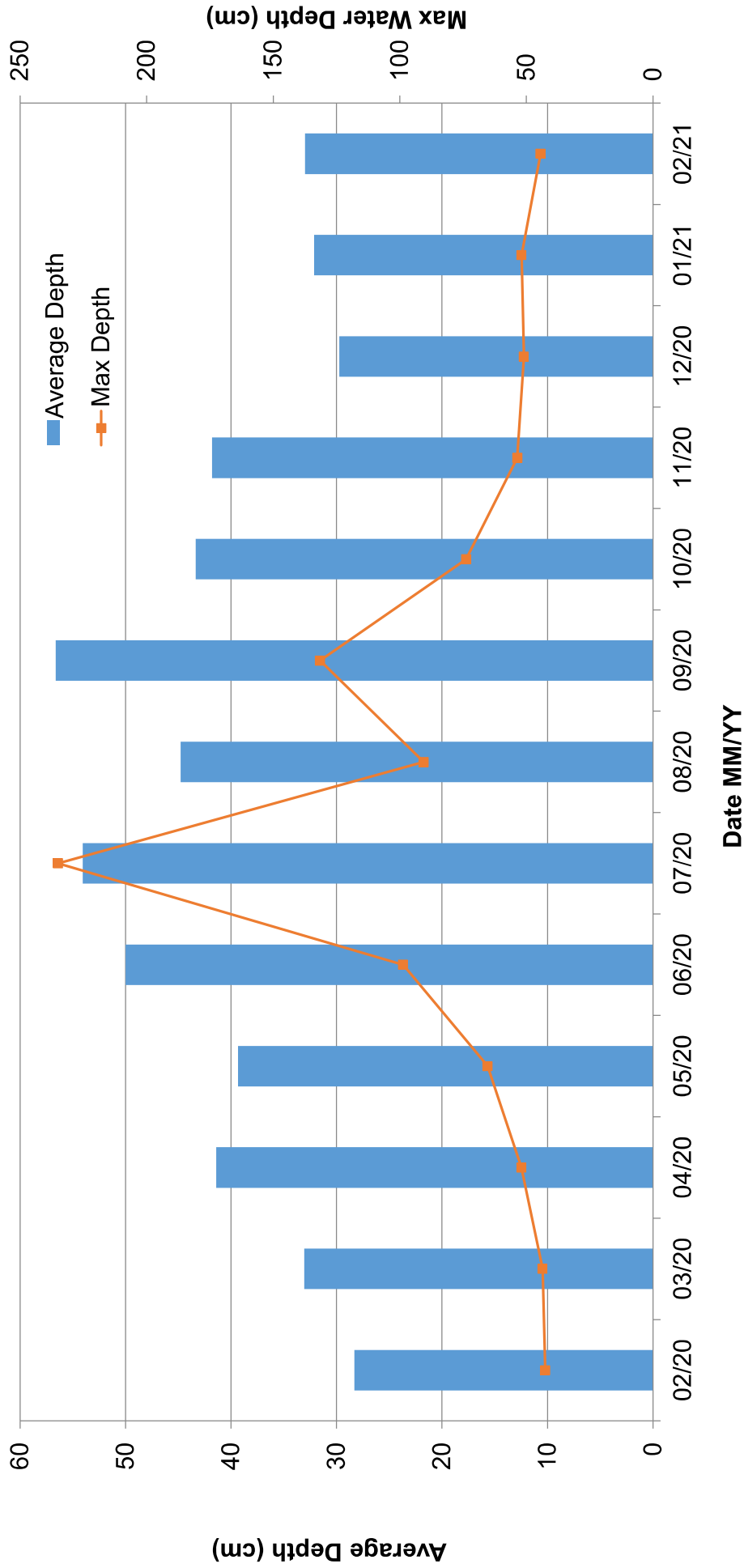
Real time monitoring
stations:

- Started operations in February 2020
- Data recorded every 5 minutes

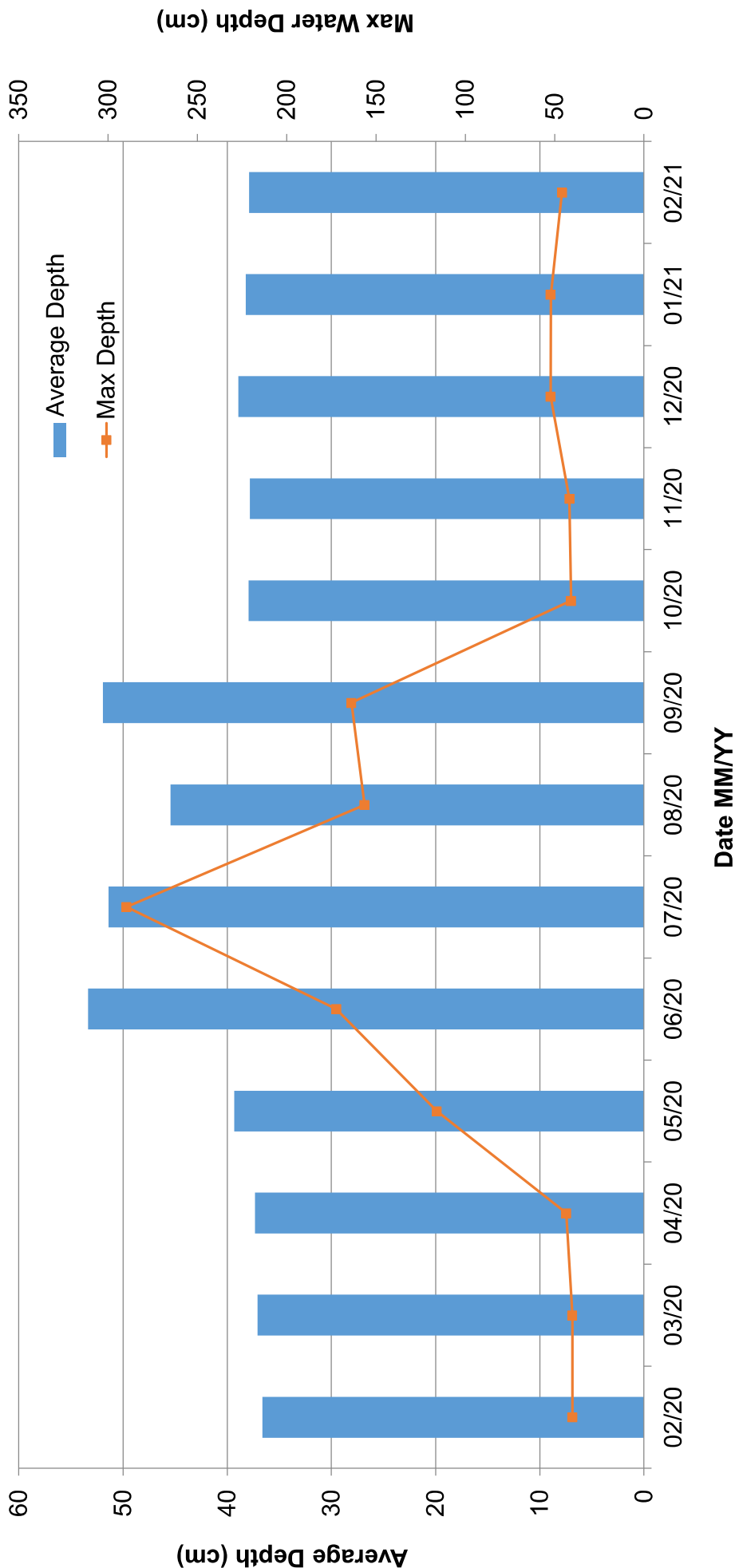
Figure 1
REON web site



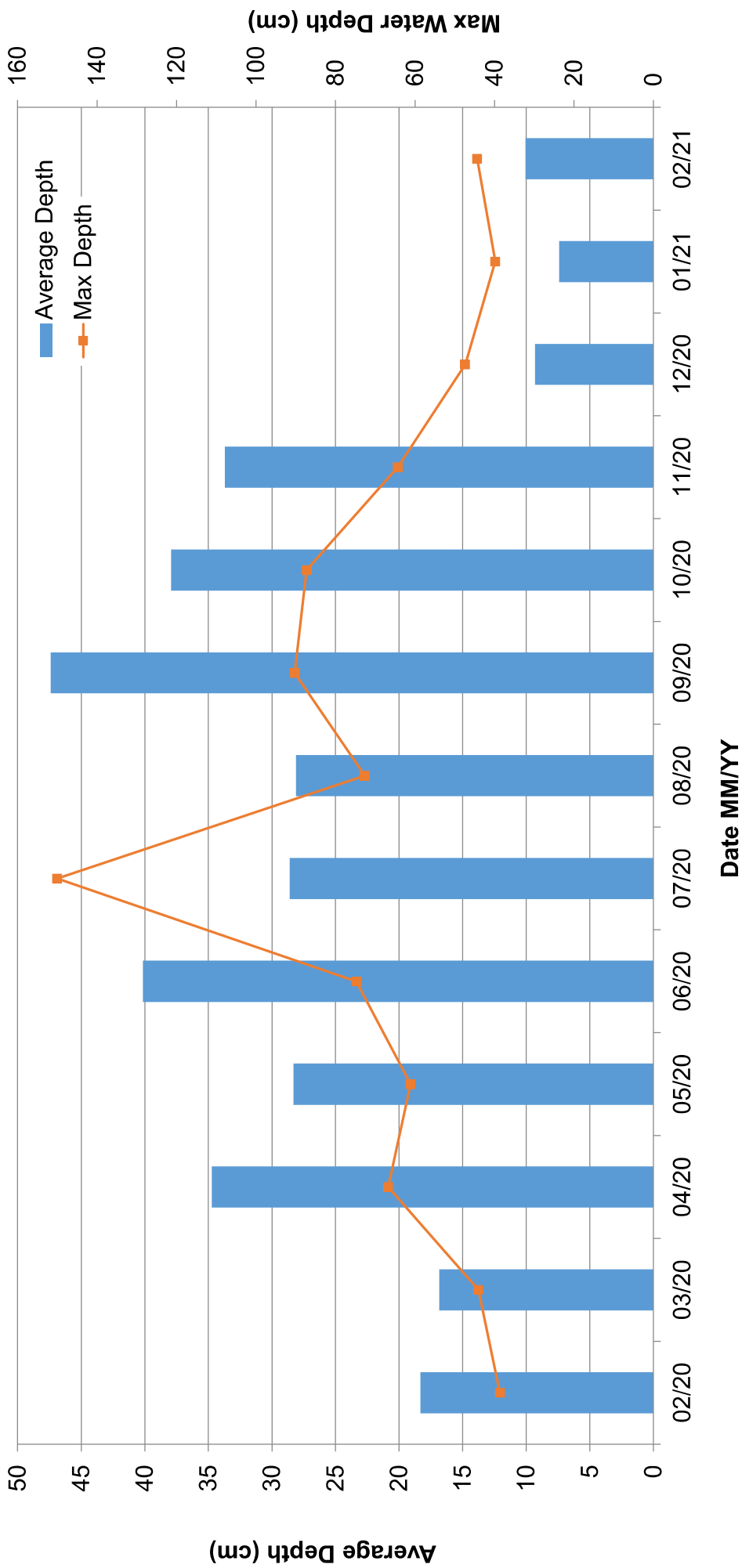
CCDD DITCH #2 (STATION 22118) RTHS RESULTS



PUBLIC WORKS (STATION 22120) RTHS RESULTS



BROWNSVILLE LANDFILL (STATION 22121) RTHS RESULTS



DATA COLLECTION

- EXO2 Multiparameter Sonde
- ADCP: Acoustic Doppler Current Profiler
- Samples for Lab



Figure 3
EXO2 Multiparameter Sonde



Figure 4
ADCP



Figure 5
Samples for Lab and Sonde EXO2 measurements



Figure 5
ADCP measurements

MONITORING RESULTS (22118)

Table 2
Results of monitoring events

Cameron County DD 1- Ditch #2 (Station 22118)					
Date	Feb-20	Sep-20	Mar-21	Apr-21	Average
Flow (m ³ /s)	0.9	0.362	0.269	0.15	0.42
Gage Height (ft)	0.84	1.5	0.65	0.9	0.97
Water Temp (°C)	17	26.901	15.5	26.49	21.47
SpC (uS/cm)	12,128	15,088	11,522	11,521.91	12564.98
D.O. (mg/L)	7.72	16.489	7.265	8.74	10.05
pH	8.2	8.353	8.33	8.4	8.32
<i>E. coli</i> (MPN/100mL)	648	1046.2	547.5	727	742.18
TKN (mg/L)	2.2	1.66	1.62	1.6	1.77
NO ₂ +NO ₃ (mg/L)	5.8	<0.68	1.43	0.77	2.17
Total-P (mg/L)	1.8	0.851	1.16	0.844	1.16

MONITORING RESULTS (22120)

Table 3
Results of monitoring events

Brownsville Public Works (Station 22120)					
Date	Feb-20	Sep-20	Mar-21	Apr-21	Average
Flow (m ³ /s)	0.25	0.298	0.41	0.31	0.32
Gage Height (ft)	1.2	1.1	0.26	0.95	0.88
Water Temp (°C)	25.5	28.05	19.4	29.23	25.55
SpC (uS/cm)	6,808	5,637	7,253	3,819	5879.27
D.O. (mg/L)	5.68	9.41	13.57	13.55	10.55
pH	7.5	7.961	8.52	8.17	8.04
<i>E. coli</i> (MPN/100mL)	1120	1299.7	1986.3	816.4	1305.60
TKN (mg/L)	0.67	0.736	1.03	0.783	0.80
NO ₂ +NO ₃ (mg/L)	12	8.14	6.39	7.58	8.53
Total-P (mg/L)	2.9	2.16	1.94	3.66	2.67

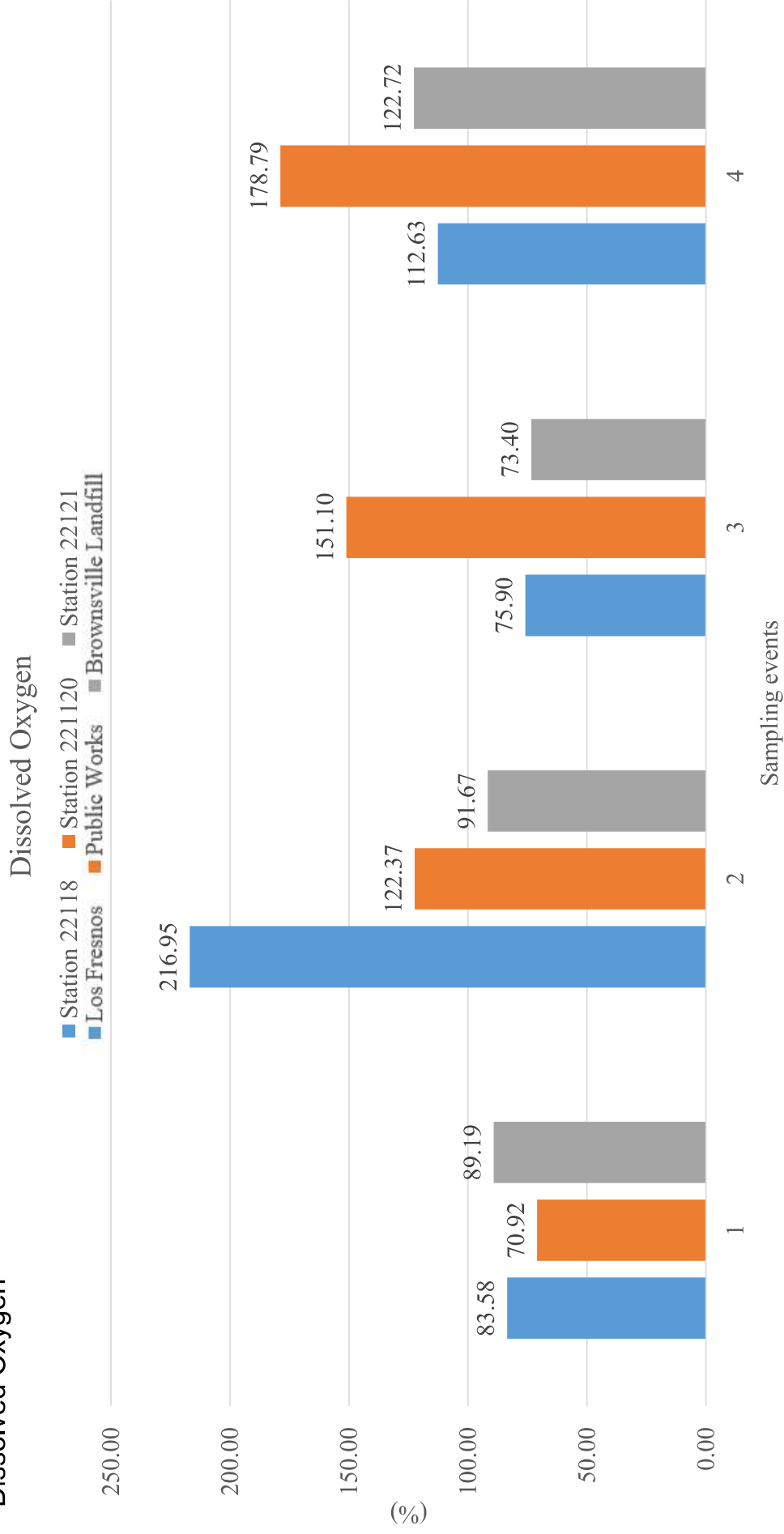
MONITORING RESULTS (22120)

Table 4
Results of monitoring events

City of Brownsville Landfill (Station 22121)					
Date	Feb-20	Sep-20	Mar-21	Apr-21	Average
Flow (m ³ /s)	0.2	0.228	0.05	0.55	0.26
Gage Height (ft)	0.28	2.1	1.1	1.3	1.20
Water Temp (°C)	18.2	25.6	16.259	27.81	21.97
SpC (uS/cm)	6,026	2,236	6,152	9,551.98	5991.50
D.O. (mg/L)	8.22	7.438	7.06	9.36	8.02
pH	8	8.063	7.99	8.18	8.06
<i>E. coli</i> (MPN/100mL)	980	>2419.6	>2419.6	>2419.6	2059.70
TKN (mg/L)	64	1.05	2.02	1.55	17.16
NO ₂ +NO ₃ (mg/L)	1.1	<0.68	2.34	1.26	1.35
Total-P (mg/L)	0.12	0.292	0.144	0.389	0.24

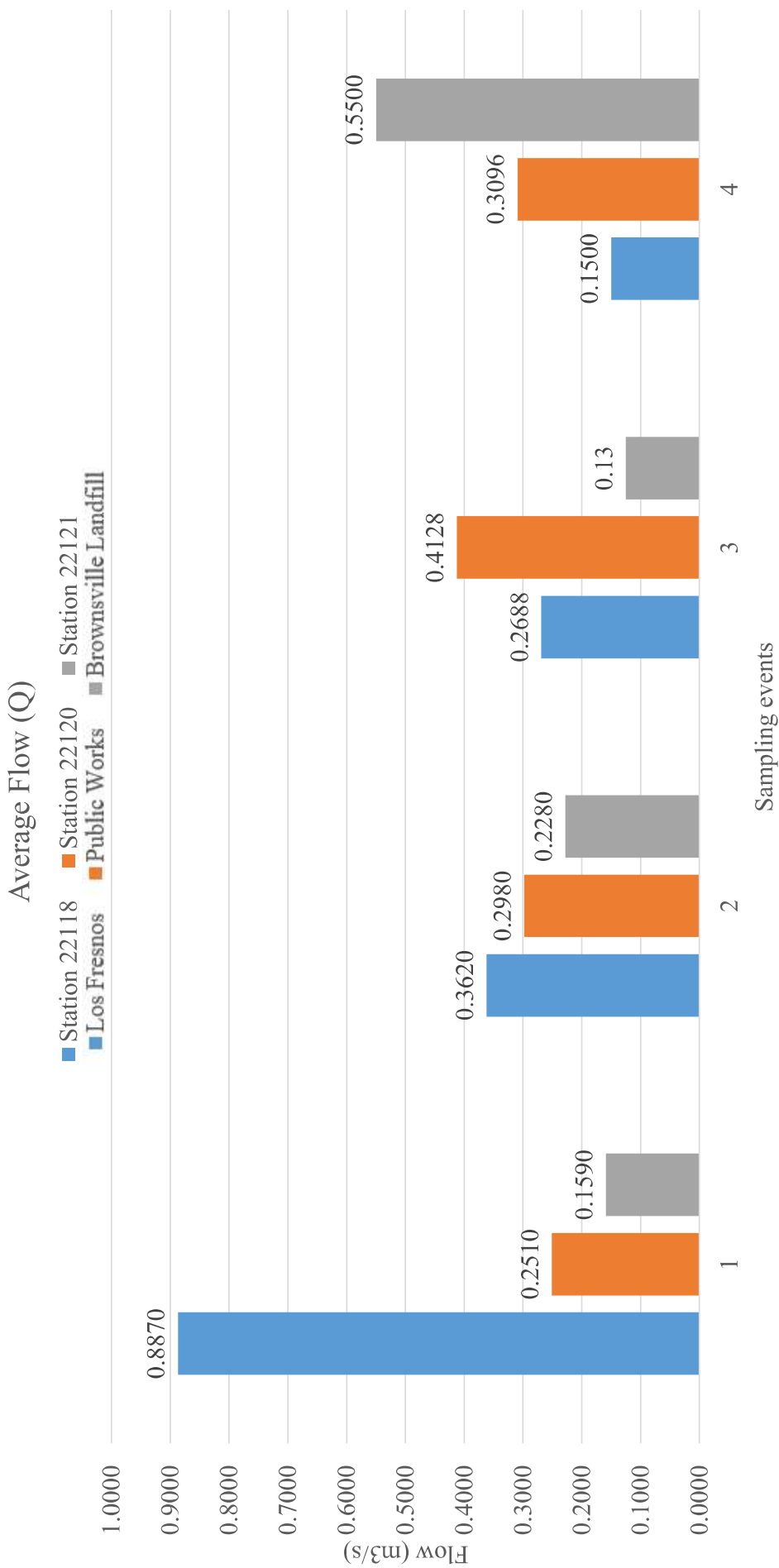
RESULTS

Dissolved Oxygen



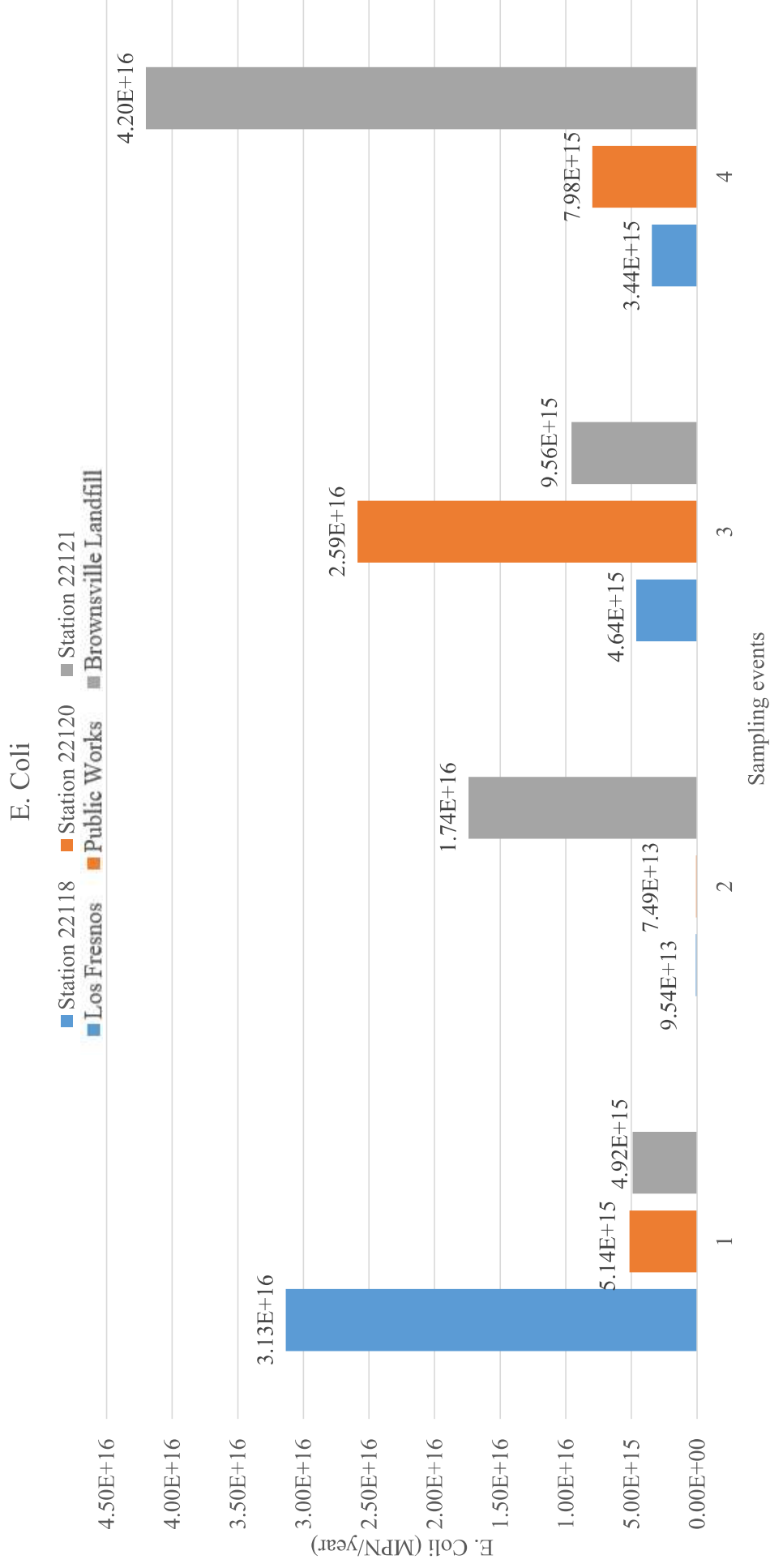
RESULTS

Average Flow (Q)



RESULTS

E. Coli loads discharging to BSC

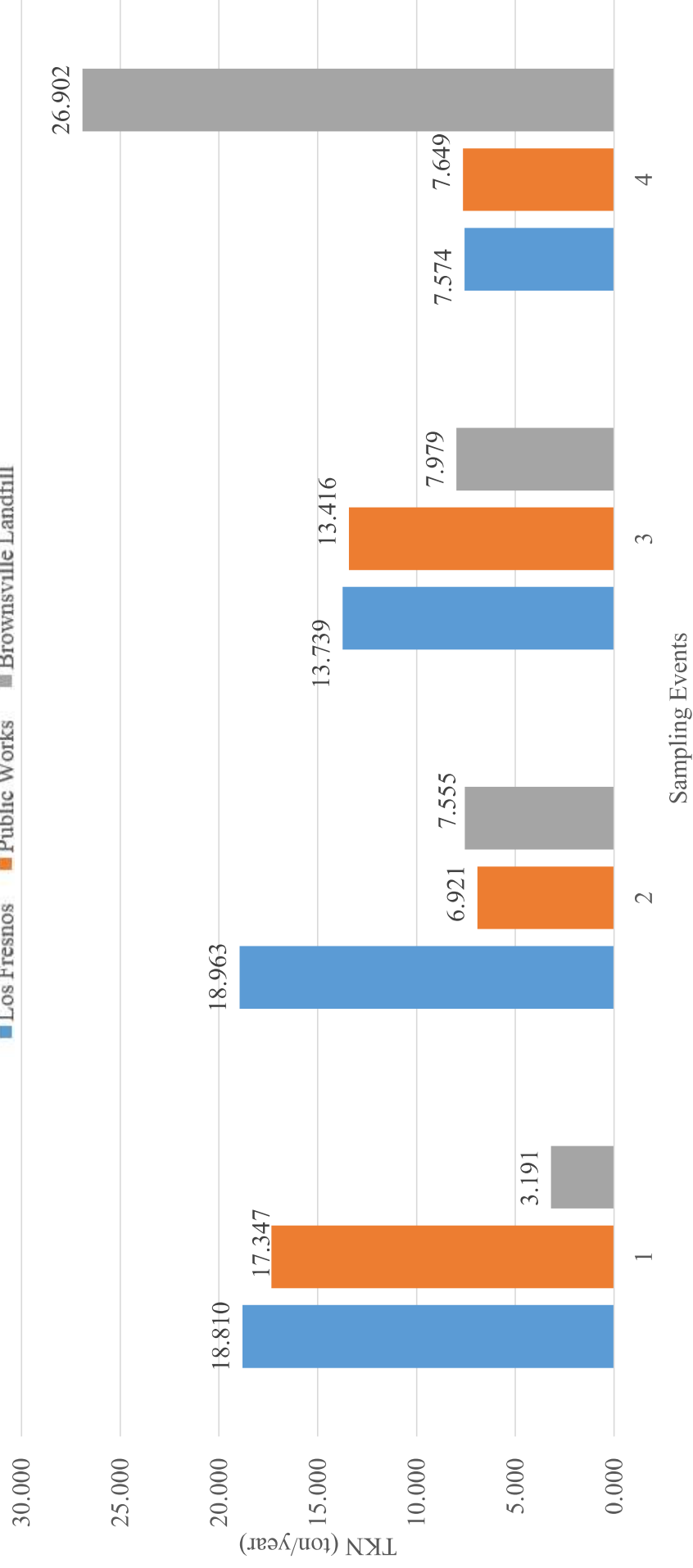


RESULTS

TKN loads discharging to BSC

Total Kjeldahl Nitrogen

■ Station 22118 ■ Station 22120 ■ Station 22121
■ Los Fresnos ■ Public Works ■ Brownsville Landfill

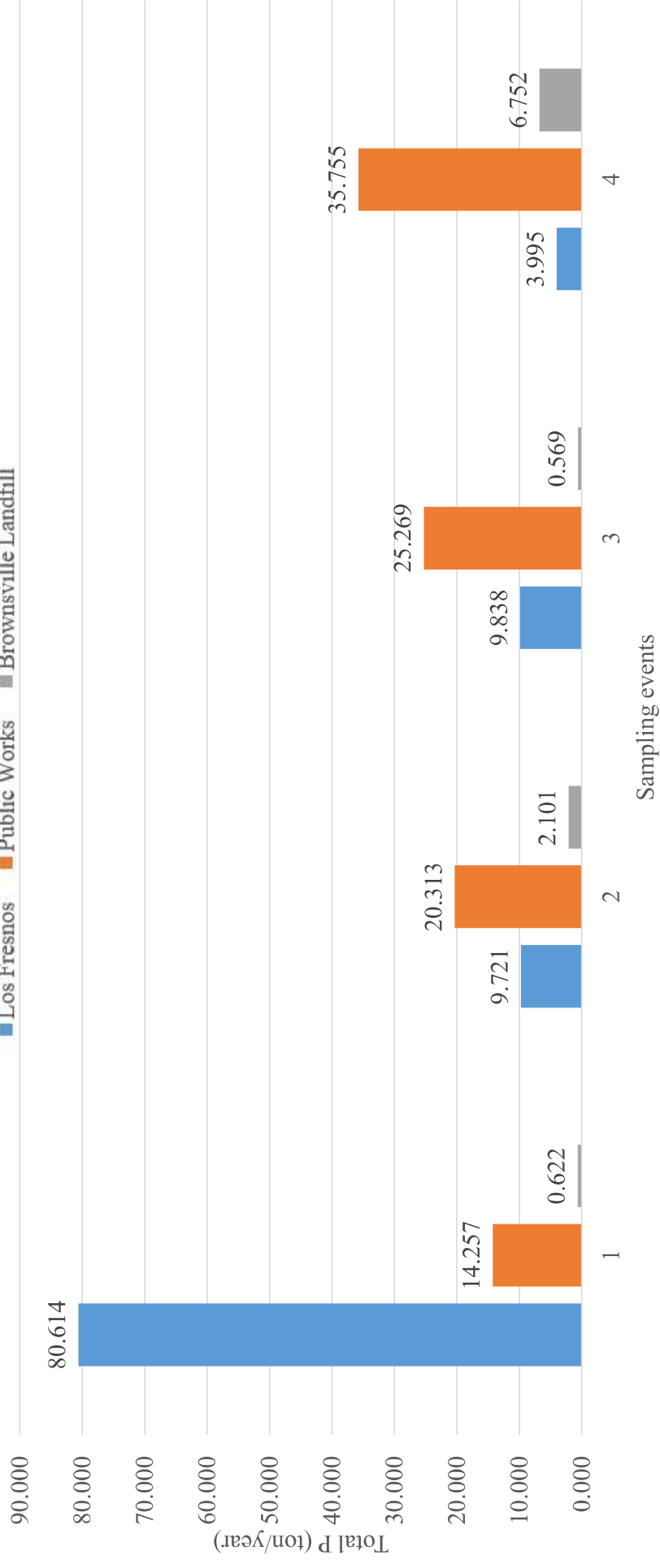


RESULTS

Phosphorous loads discharging to BSC

Total Phosphorous (P)

- Station 22118
- Station 22120
- Station 22121
- Los Fresnos
- Public Works
- Brownsville Landfill

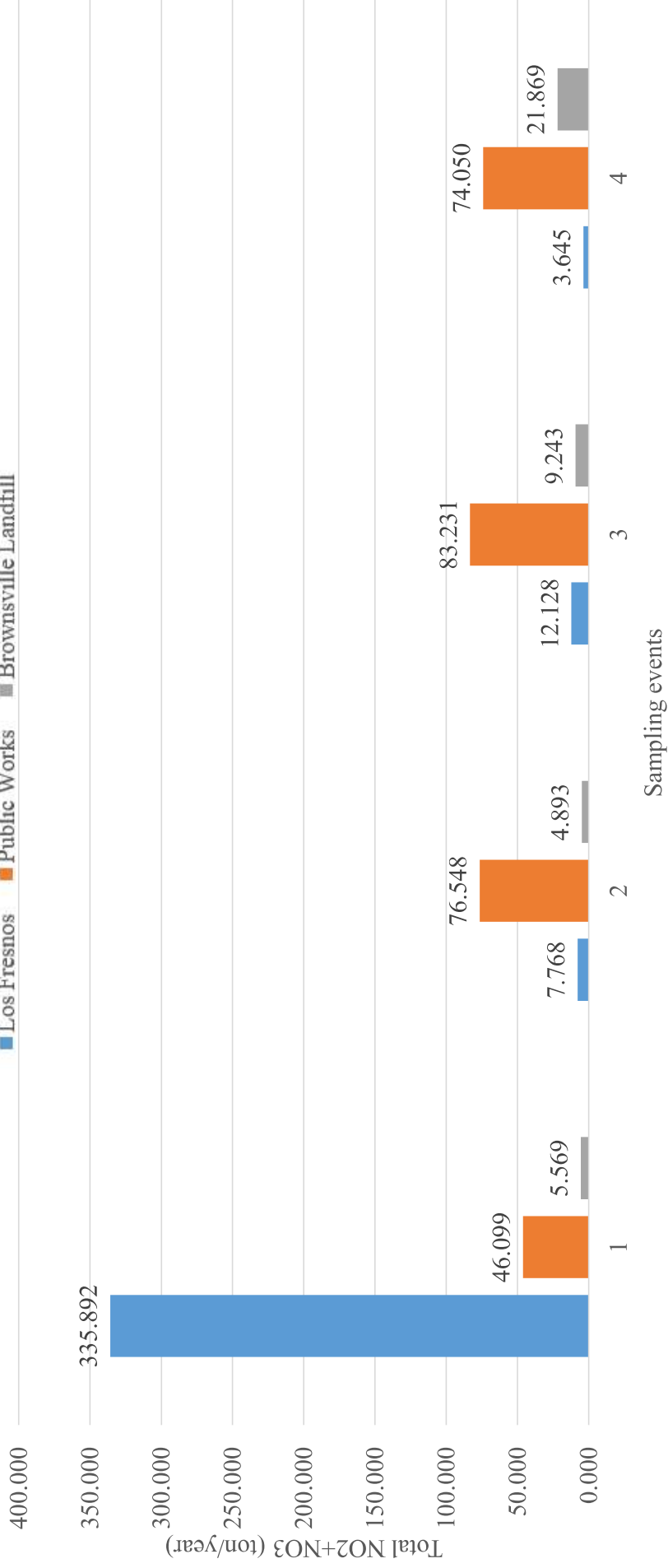


RESULTS

NO2+NO3 loads discharging to BSC

Total Total Nitrite (NO2) + Nitrate (NO3)

■ Station 22118 ■ Station 21120 ■ Station 21121
■ Los Fresnos ■ Public Works ■ Brownsville Landfill



CONCLUSIONS

- Water depth and measured flow at Ditch No. 2 (station 22118) showed the highest flow volume among the three ditches, as well as the highest values for nitrogen and phosphorus.
- In terms of water quality, the three sites showed elevated levels of nitrate-nitrite, total phosphorus, and bacterial concentrations.

PREPARED IN COOPERATION WITH THE TEXAS COMMISSION ON
ENVIRONMENTAL QUALITY AND U.S. ENVIRONMENTAL PROTECTION AGENCY

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement (582-18- 80206) to the Texas Commission on Environmental Quality. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.