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]

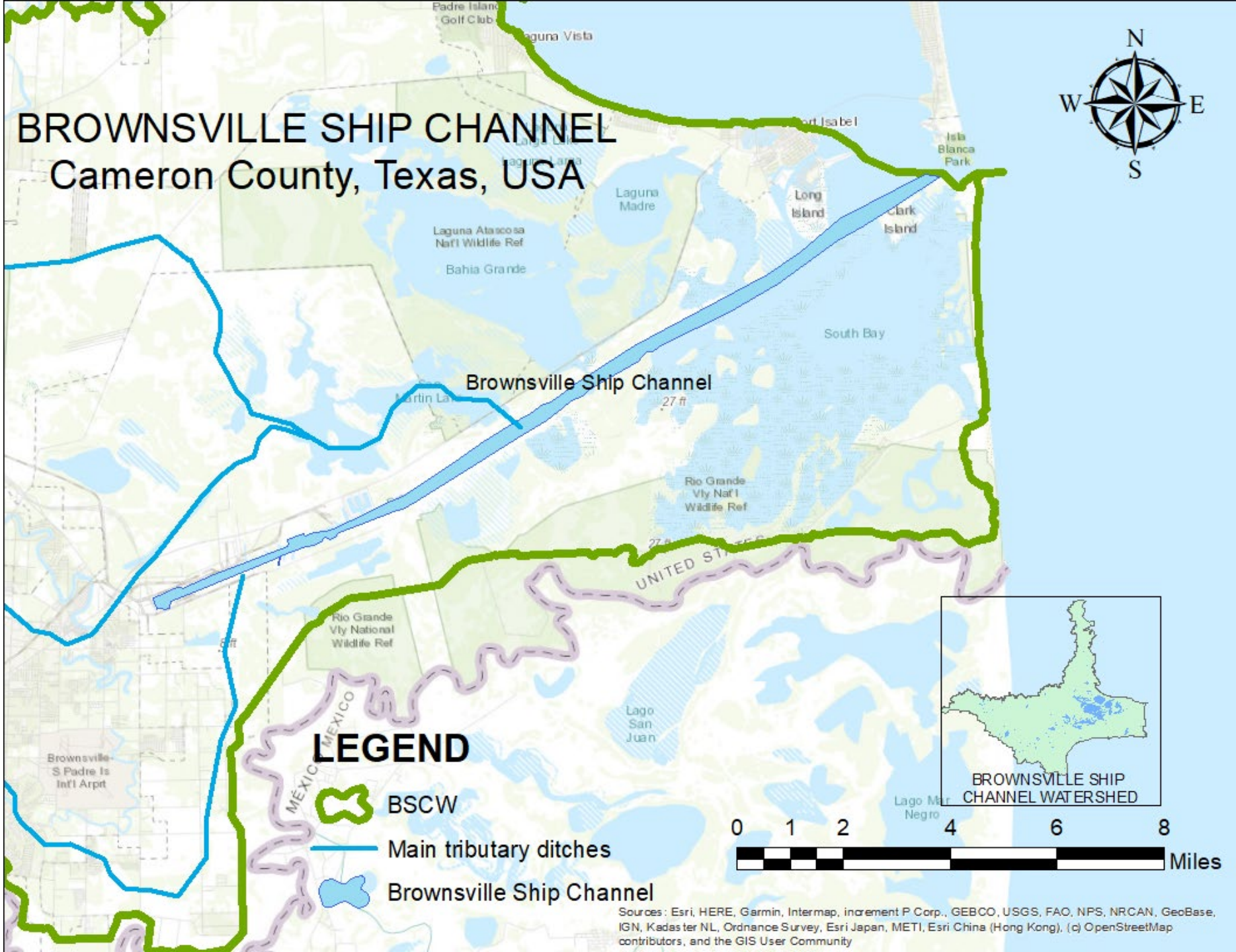
[1]It summarizes the condition of the state's surface waters, including concerns for public health, fitness for use by aquatic species and other wildlife, and specific pollutants and their possible sources.
[2]Screening level does not make it impaired waterway.

OBJECTIVE

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

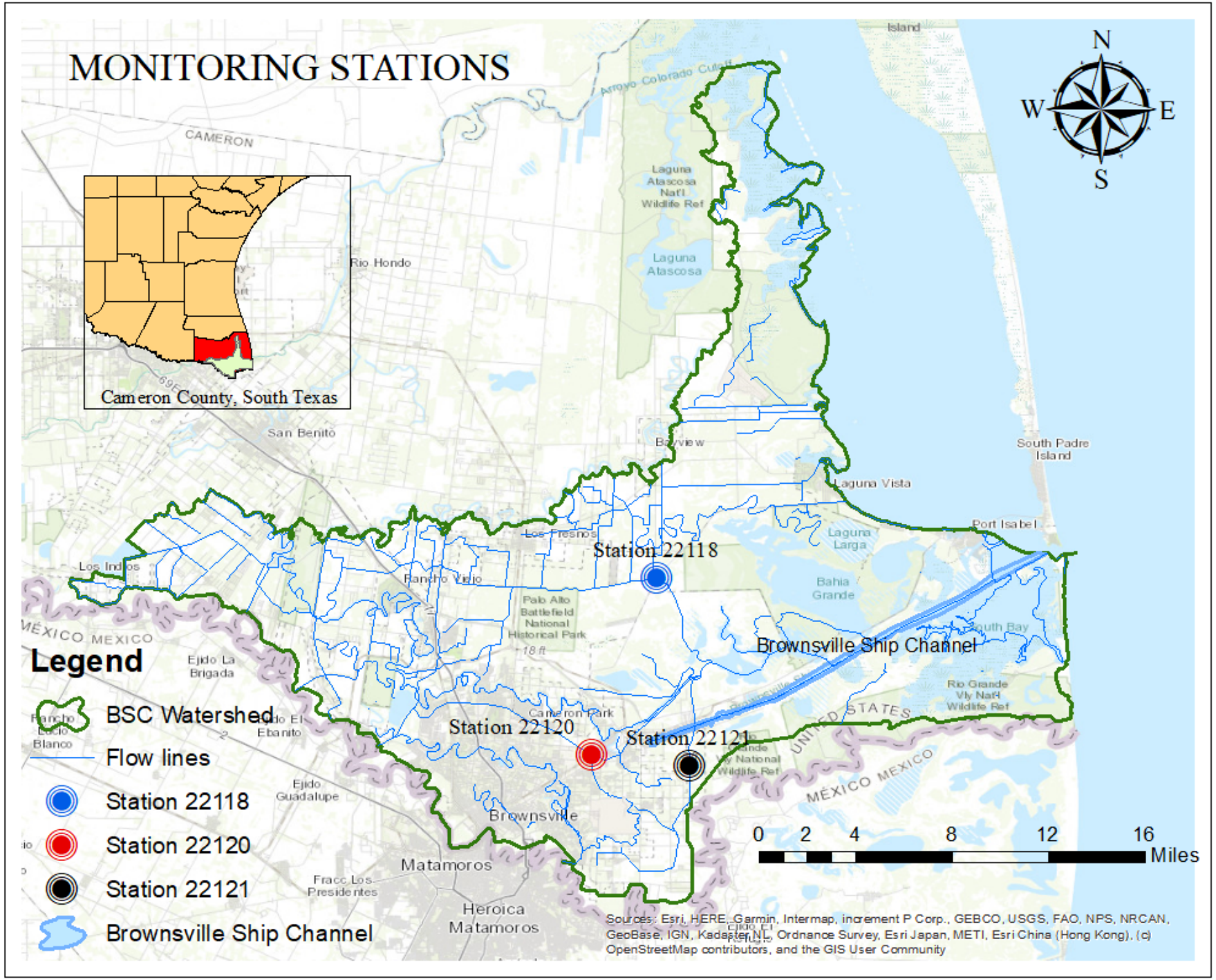
AREA OF STUDY

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



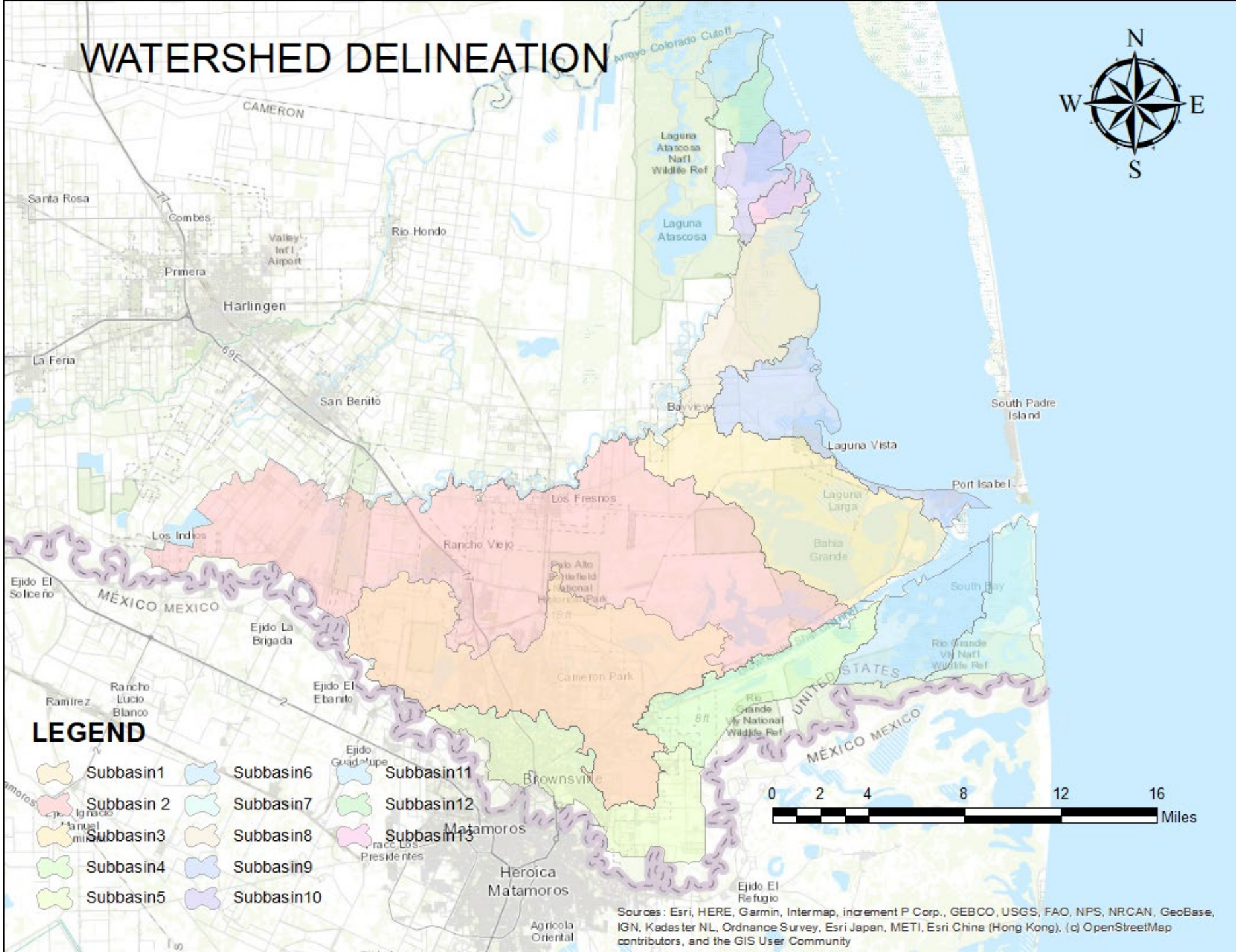
MONITORING STATIONS

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



WATERSHED DELINEATION

- Delineation conducted using South Texas Lidar DEM Lidar 2018
- BSCW contains thirteen sub-basins.



REAL-TIME MONITORING

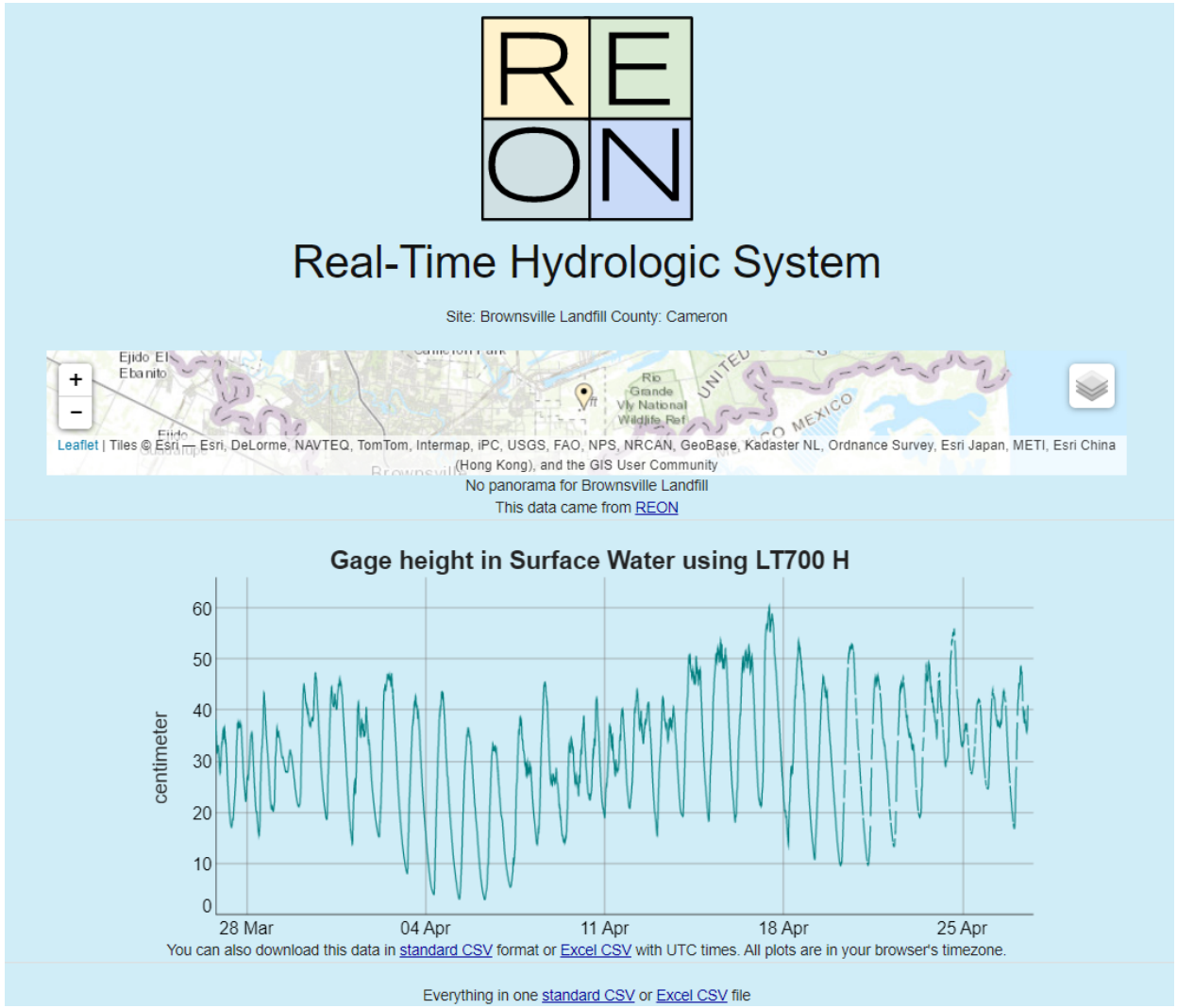
River and Estuary Observatory Network (REON)

www.rths.us

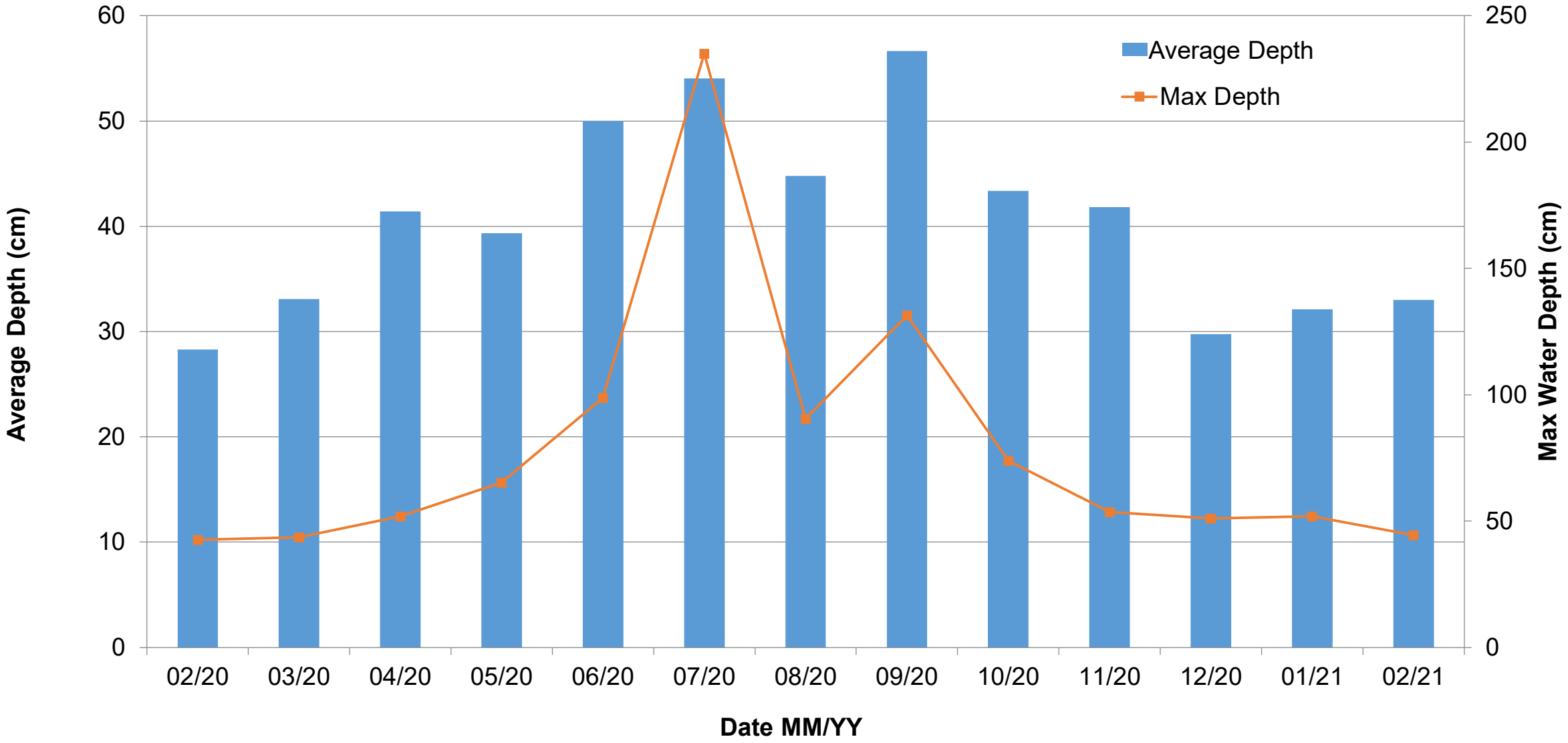
Real time monitoring stations:

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

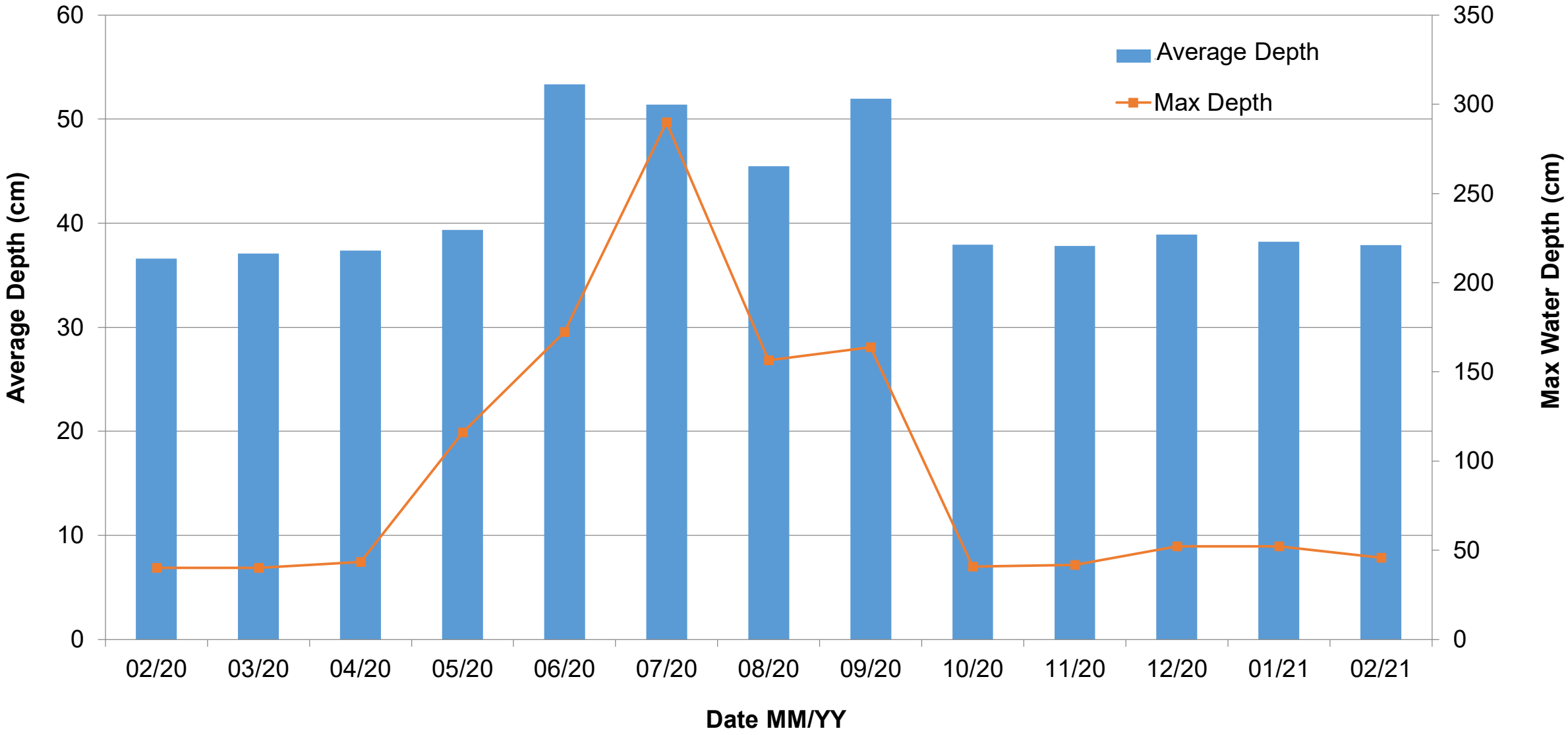
Figure 1
REON web site



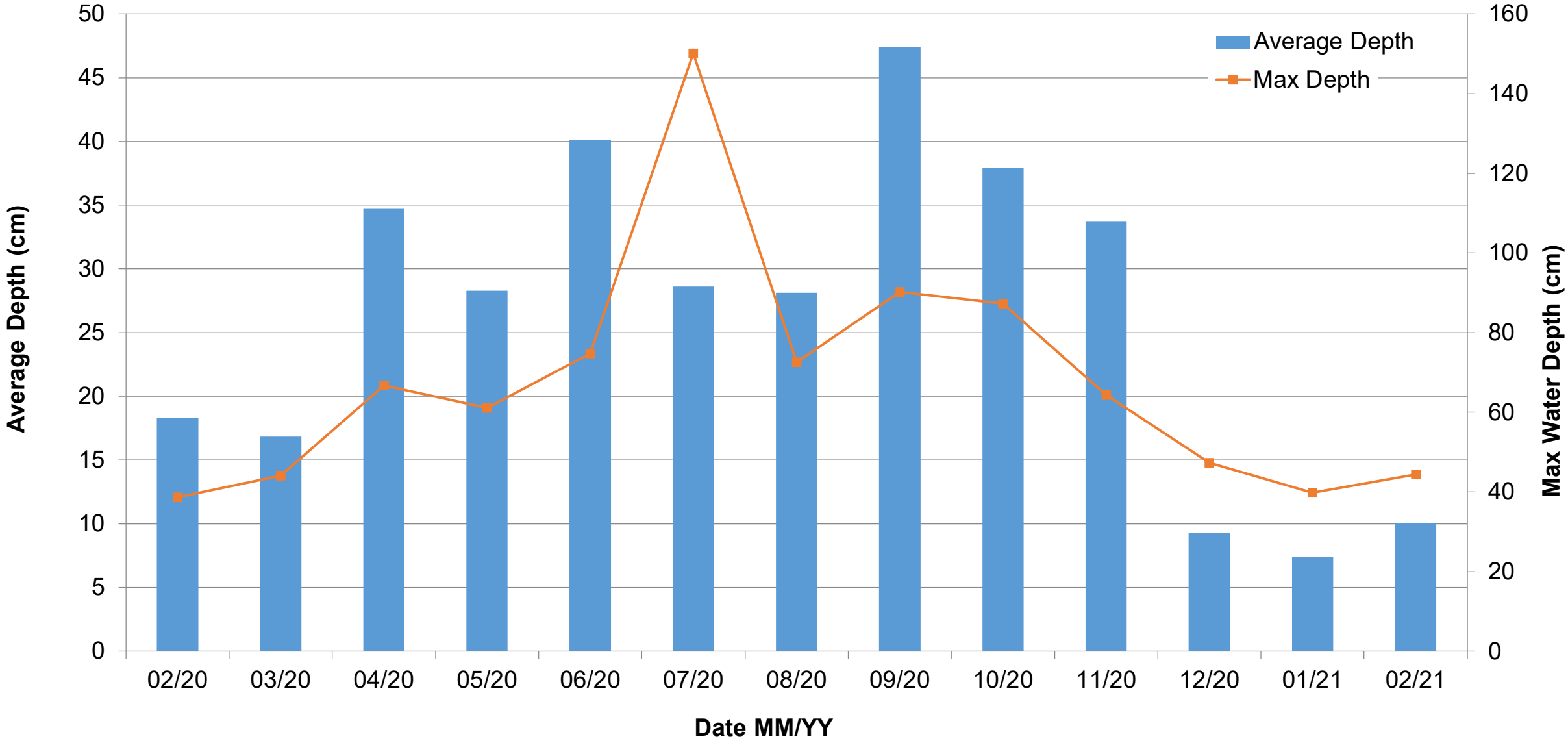
CCDD DITCH #2 (STATION 22118) RTHS RESULTS



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
E. coli (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
E. coli (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

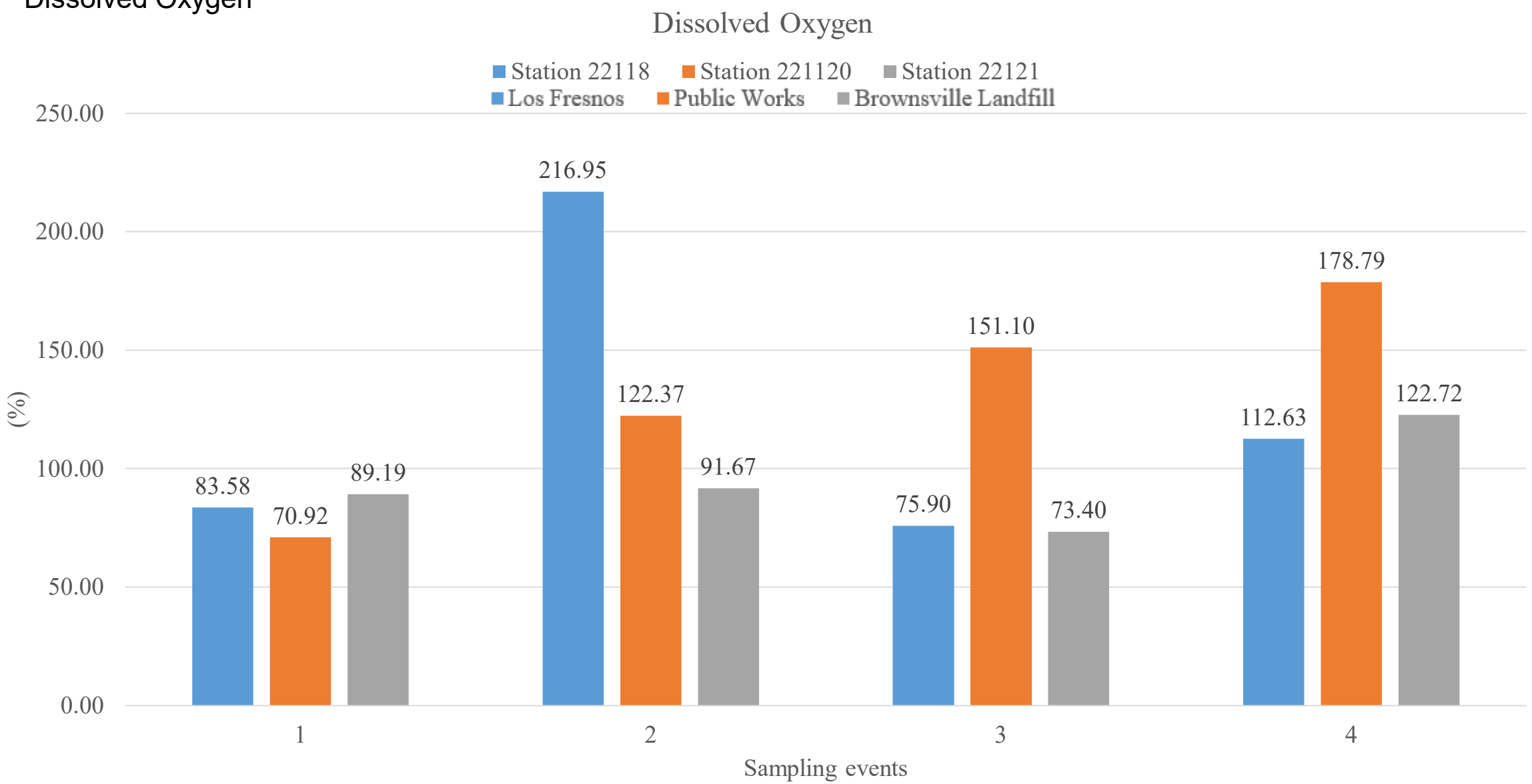
MONITORING RESULTS (22120)

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 (℃)	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
E. coli (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

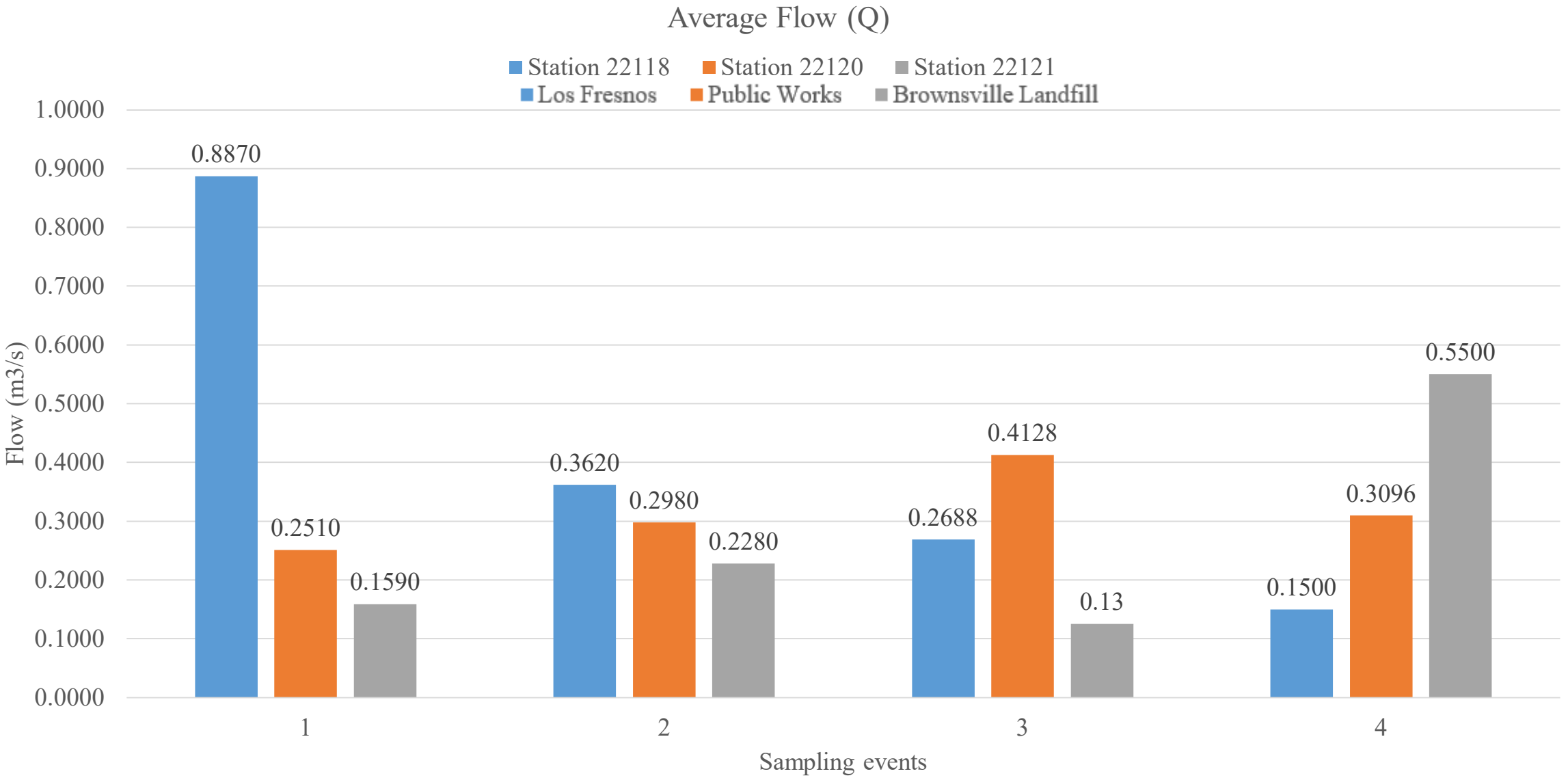
RESULTS

Dissolved Oxygen



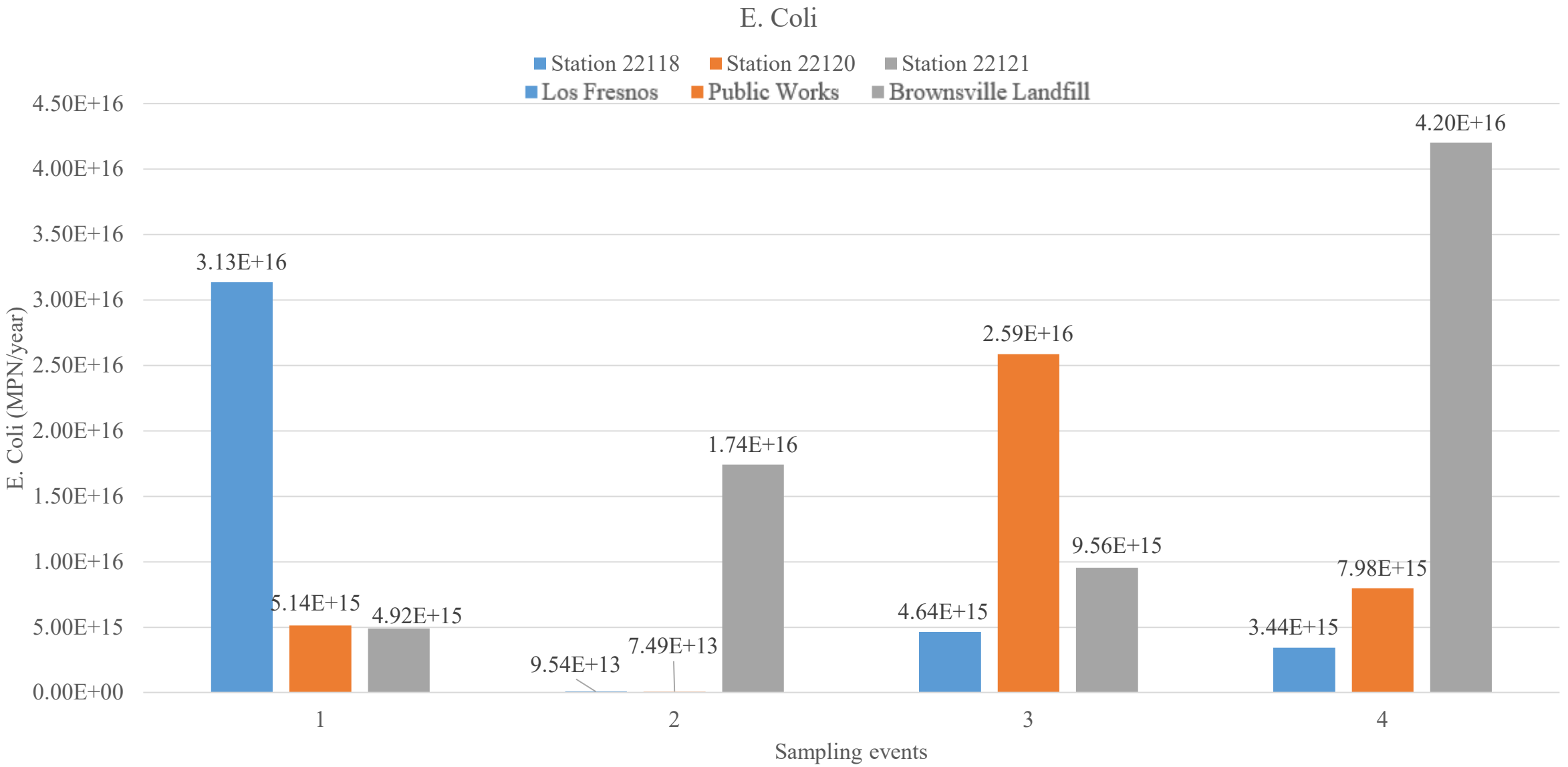
RESULTS

Average Flow (Q)



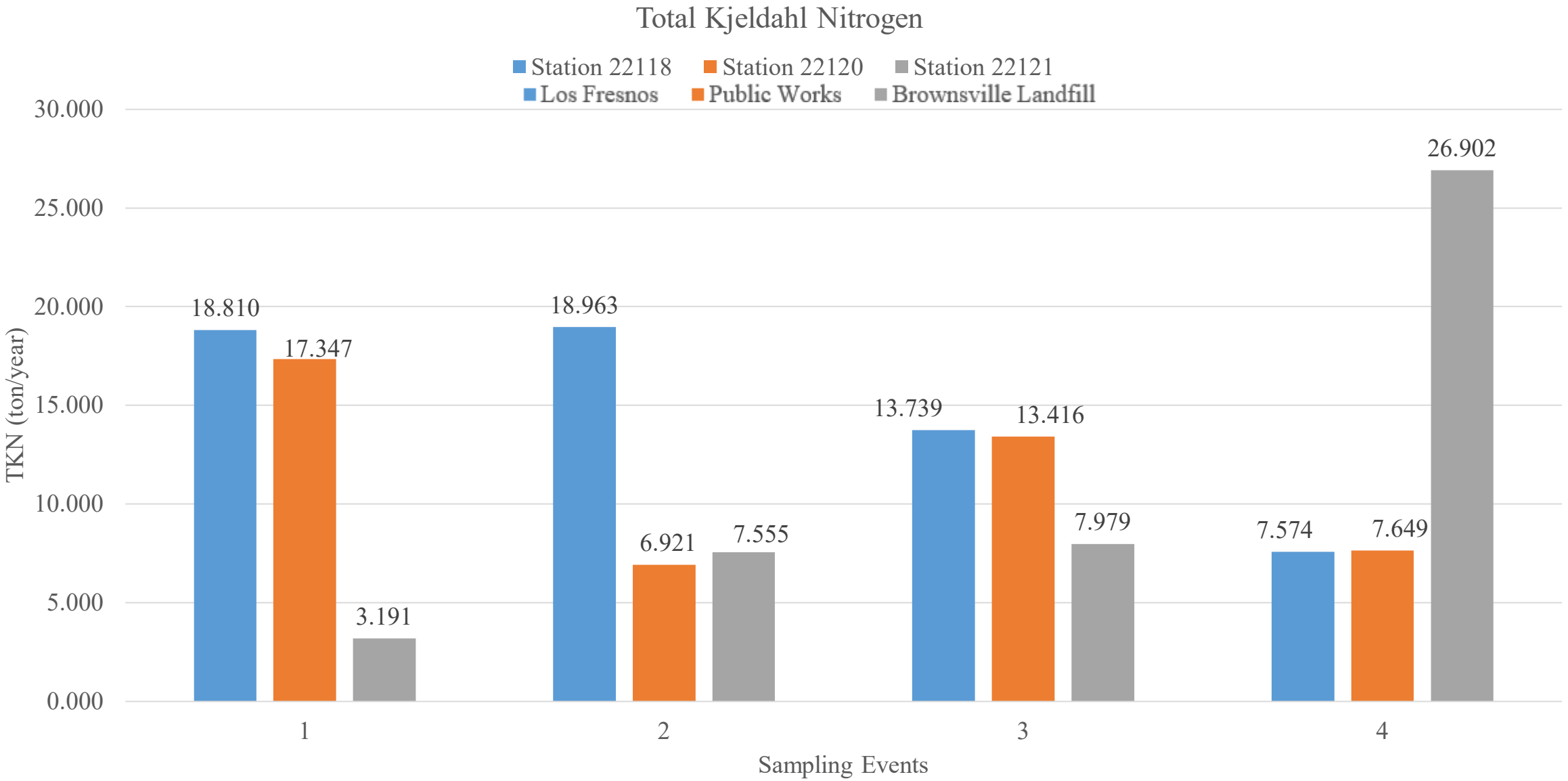
RESULTS

E. Coli loads discharging to BSC



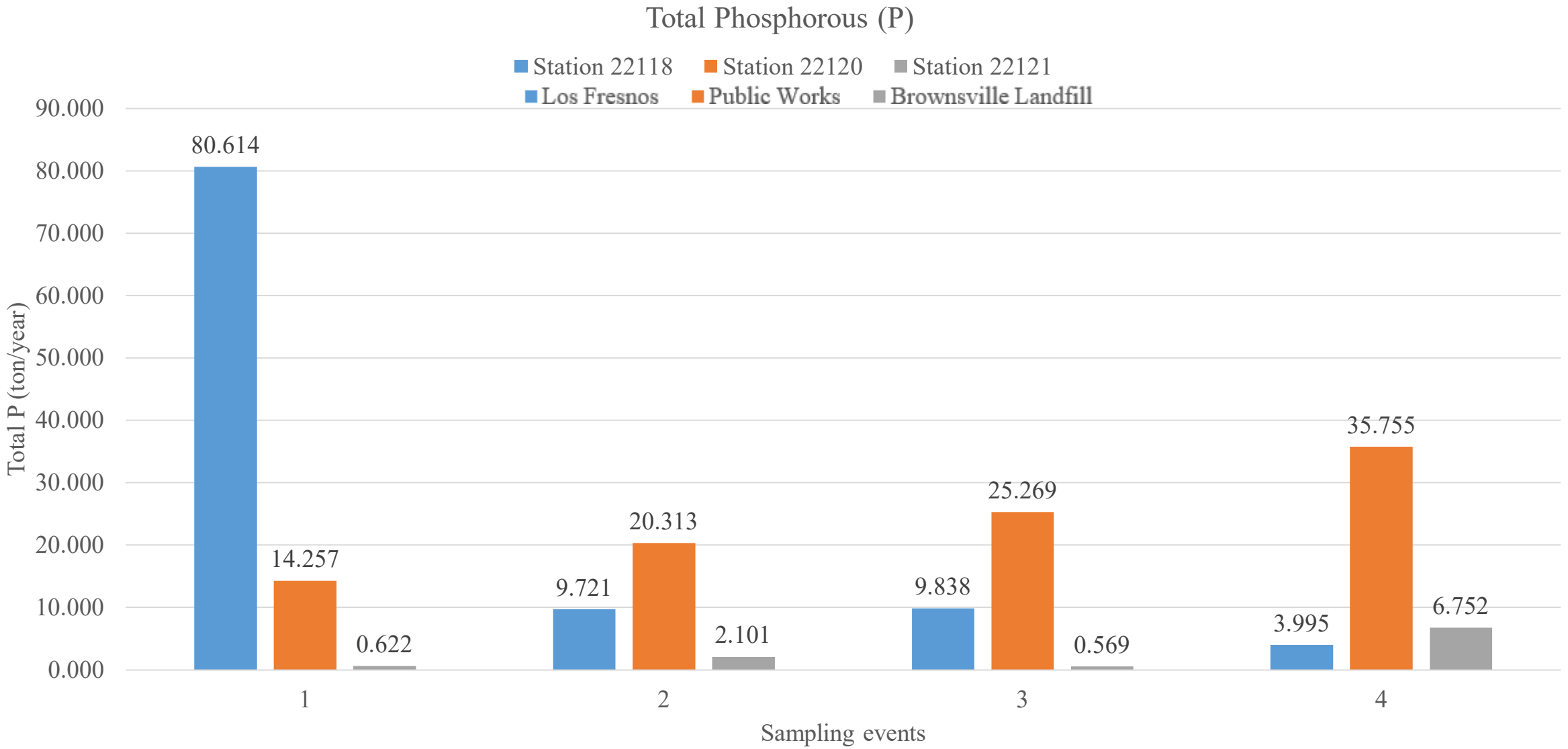
RESULTS

TKN loads discharging to BSC



RESULTS

Phosphorous loads discharging to BSC



RESULTS

NO2+NO3 loads discharging to BSC