

**Phase II Groundwater Resource Investigation
at the Padre Island National Seashore
- Interim Report.**

Report on Contract 001-7496-4000-NOZ-225Z-4-\$22,500.00
(Order # 1443PX749094191)

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Introduction

Work began on this contract in February 1995 after some modification to the original scope of work. A survey of the existing wells for elevation was considered to be critical to the development of a numerical groundwater flow model so a significant portion of the funding was budgeted for professional surveying services. After several meetings between National Park Service (NPS) officials, Center for Water Supply Studies (CWSS) personnel, Conrad Blucher Institute for Surveying Science personnel and commercial surveyors, it was agreed that a combination of GPS and conventional surveying techniques would be used to economically provide accurate elevations for the groundwater monitoring wells. The surveying was performed by Frontier Surveying Company.

On-going monthly sampling of existing monitoring wells has been difficult (logistically) at times and the addition of two transects of three wells each beyond the 40-mile marker would extend the time required for each sampling event (currently two days) to about four days. Because of this it was mutually agreed that one additional transect would be added between the 30-mile marker and the 40-mile marker at a point where there is cross-island access. Three additional wells will be installed on locations determined by the researchers to be significant to the ongoing research and acceptable to NPS officials.

Current status of work required by contract.

Installation of additional monitoring wells.

- MW-15-LM/R was installed on 23-Jun-95 to replace the vandalized MW-15-LM.
- MW-WTF-1 was installed 350' north west of MW-15-LM/R on 23-Jun-95 to extend the Yarborough Pass transect onto the wind tidal flats.
- MW-WTF-2 was installed 350' west of MW-25-LM on 27-Jul-95 to extend the Dunn Ranch transect onto the wind tidal flats.
- Sufficient supplies are currently stored at the park to install the remaining three wells at the 35-mile marker, and one well on the wind tidal flats to extend this transect.
- These wells will be installed as soon as weather permits.

Sampling of the 11 existing monitoring wells and the six wells to be installed will continue on at least a quarterly basis.

- Groundwater monitoring has continued as a monthly event except January and February of this year (logistical and health problems).
- Conductivity, pH, Salinity, Total Hardness, Sulfides, and water elevations have been recorded and are included with this report (**Table 2** through **Table 15**).
- In June we modified the technique for determining specific conductance since the probes previously employed frequently reached maximum scale. A 'cup' type conductivity meter (Presto-Tek Corp. Model DP-03) has been selected so that the

- water samples may be sufficiently diluted to remain below full scale.
- Conductivity measurements are being converted to parts per million NaCl equivalent and reported as salinity in parts per thousand.
- Total metal analyses are planned for later this year.

Acquire accurate aquifer parameters on 16 monitoring wells utilizing slug or bail-down tests with the hermit data logger.

- Aquifer parameters are being obtained using pumping tests in conjunction with the Hermit Data Logger.
- Data has been collected on MW-0-GM and is currently being processed for interpretation.
- Data has been collected on MW-0-LG and is currently being processed for interpretation.
- Data has been collected on MW-25-LM and is currently being processed for interpretation.

Depending on costs, the contractor will acquire accurate vertical elevations for the 16 monitoring wells located within the park.

- All monitoring wells existing in February 1995 have been surveyed using a combination of GPS technology and standard land surveying techniques by Frontier Surveying Company.
- Besides horizontal locations they have provided elevations for all the monitoring wells as stipulated above (Table 1).
- Installed numerous monuments with both horizontal and vertical references at the National Seashore (Table 16).
- Frontier Surveying Company also provided site coordinates and elevations of selected oil/gas wells located in or near the park (Table 16)

Initiate water level measurements in the parks surface ponds.

- Three ponds in the northern section of the park are currently being monitored monthly for changes in water elevation.
- This project will continue to expand.

Other activities

Groundwater chemistry. Results from the Phase I Groundwater Resources Investigation indicated a zone of highly saline water located adjacent to the Laguna Madre. Additional testing is currently being performed on water from wells intersecting this zone for nutrient concentrations. Phosphate,

nitrate, and ammonia concentrations have been measured in MW-25-GM, MW-25-LG, MW-25-LM, MW-15-GF, MW-15-GM, MW-15-LG, MW-15-LM/R, MW-WTF1, MW-0-GM, MW-0-LG, MW-0-LM, MW-GW-A8, and MW-GW-A6. Phosphate and nitrate concentrations are within typical groundwater ranges however ammonia concentrations in the wells intersecting the saline zone are very high, ranging from 5 to 65 mg/L $\text{NH}_3\text{-N}$. This groundwater may represent a significant source of nitrogen to the Laguna Madre ecosystem. There are no obvious anthropogenic sources of ammonia in the area. It is suspected that nitrogen production from the algal mat covering the wind tidal flats may be the source.

- $\text{PO}_4^{3-}\text{-P}$ ranged from 0.04 mg/L to 2.00 mg/L.
- $\text{NO}_3\text{-N}$ ranged from 0.20 mg/L to 7.5 mg/L.
- $\text{NH}_3\text{-N}$ ranged from 0.03mg/L to 68.4 mg/L.

Summary

Most of the required work has been completed at this time, however additional wells must be installed and aquifer parameters must still be determined on several wells. This work should be completed by the end of October. Monitoring of the installed wells will continue on at least a Quarterly schedule. The final report has been scheduled for November 1995 but due to the late start on this phase of the project and the small amount of data that will be available (in November) on the new wells, it may be necessary to postpone delivery of the final report until sufficient data has been collected to confirm groundwater flow modeling results.

NAME	NAD 27 SP Zone 4205 (feet)		NAD 83 UTM Zone 0014 (meters)		ELEVATION	Remarks
	East	North	East	North	(feet)	
MW-GW-A8	2371308.96	595148.69	662601.59	3020705.16	6.79	Top of Casing
MW-GW-A6	2373101.29	597860.97	663144.50	3021534.13	5.50	Top of Casing
MW-25-LM	2361293.33	503256.90	659662.25	2992683.44	5.31	Top of Casing
MW-25-LG	2363037.70	503539.82	660193.60	2992771.80	5.59	Top of Casing
MW-25-GM	2364783.13	503818.71	660725.28	2992858.93	14.58	Top of Casing
MW-15-LG	2364494.75	562675.00	660565.08	3010798.43	8.71	Top of Casing
MW-15-GM	2368967.77	560631.88	661931.00	3010181.21	9.76	Top of Casing
MW-15-GF	2364766.75	561255.90	660649.74	3010366.21	5.63	Top of Casing
MW-0-LM	2384710.58	656191.44	666609.21	3039328.51	4.14	Top of Casing
MW-0-LG	2389324.66	656274.40	668015.49	3039359.70	11.05	Top of Casing
MW-0-GM	2395251.30	654175.59	669824.65	3038727.53	9.69	Top of Casing

Table 1 Locations and elevations of groundwater monitoring wells

Summary of Water Quality Data for MW-0-GM

Event	Date	pH (S.U.)	Elevation (feet MSL)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/27/95	7.50	4.69	19.80	0.00	205.00	2.00	13.20	0.55	2.65	23.60	20.70	22.23	None
Apr	4/29/95	7.50	4.89	29.20	0.20	140.00	3.00	18.60	0.70	4.98	23.40	2.10	21.61	None
May	5/31/95	7.50	4.79	35.40	0.00	1720.00	3.00	16.00	0.75	6.14	31.00	24.00	24.96	None
Jun	7/8/95	7.00	3.99	34.00	0.00	4860.00	NA	N/A	N/A	NA	N/A	N/A	24.30	Equipment malfunction
Jul	8/3/95	6.50	4.19	37.00	0.00	1300.00	0.88	N/A	N/A	1.58	N/A	N/A	NA	Salinity from Conductivity (NaCl eq)
Aug	9/2/95	7.00	4.19	37.40	0.00	550.00	0.45	N/A	N/A	0.80	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 2

Summary of Water Quality Data for MW-0-LG

Event	Date	pH	Elevation	Air Temp	Sulfides	Hardness	Salinity	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
		(S.U.)	(feet MSL)	(deg C)	(mg/L)	(mg/L)	(ppt)	Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/27/95	7.00	7.39	21.80	0.20	360.00	7.00	0.70	0.41	0.66	22.30	20.70	21.48	None
Apr	4/29/95	6.50	7.05	31.40	0.20	580.00	2.00	0.69	0.63	0.65	22.30	21.50	21.77	None
May	5/31/95	5.50	7.15	28.60	0.00	2010.00	5.00	0.55	0.48	0.50	26.00	23.00	23.83	None
Jun	7/8/95	7.00	5.85	33.90	0.50	NA	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Jul	8/3/95	6.00	6.45	37.80	0.20	NA	0.37	N/A	N/A	0.66	N/A	N/A	NA	Salinity from Conductivity (NaCl eq)
Aug	9/2/95	NA	7.25	35.90	0.20	1420.00	0.33	N/A	N/A	0.59	N/A	N/A	NA	No pH
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 3

Summary of Water Quality Data for MW-0-LM

Event	Date	pH (S.U.)	Elevation (feet MSL)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/27/95	7.50	1.64	22.60	20.00	N/A	100.00	50.00	47.00	48.50	26.00	26.00	26.00	None
Apr	4/29/95	8.00	1.84	31.00	20.00	8100.00	80.00	50.00	30.00	40.00	27.00	26.00	26.50	None
May	5/31/95	7.80	2.14	26.50	20.00	46610.00	100.00	49.00	0.60	24.80	27.00	26.00	26.50	None
Jun	7/8/95	7.50	1.14	29.90	20.00	35400.00	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Jul	8/3/95	7.50	0.64	31.80	20.00	48900.00	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Aug	9/2/95	7.50	2.34	34.50	20.00	32030.00	61.60	N/A	N/A	110.00	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 4

Summary of Water Quality Data for MW-15-GM

Event	Date	pH	Elevation	Air Temp	Sulfides	Hardness	Salinity	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
		(S.U.)	(feet MSL)	(deg C)	(mg/L)	(mg/L)	(ppt)	Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/25/95	7.40	3.86	28.30	0.20	4810.00	3.00	1.35	1.30	1.31	24.00	23.50	23.79	None
Apr	4/29/95	7.50	4.46	34.00	0.20	1130.00	0.00	1.43	0.78	1.26	22.80	22.50	22.62	None
May	5/31/95	7.50	4.76	42.60	0.00	1080.00	2.00	1.35	1.25	1.30	27.00	24.50	25.58	None
Jun	7/8/95	7.50	3.74	31.50	0.00	1290.00	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Jul	8/4/95	7.50	3.76	34.00	0.00	NA	9.10	N/A	N/A	16.25	N/A	N/A	NA	Salinity from conductivity (NaCl)
Aug	9/2/95	7.50	5.56	27.80	0.00	3200.00	4.14	N/A	N/A	7.40	N/A	N/A	26.20	Missing bailer
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 5

Summary of Water Quality Data for MW-15-LG

Event	Date	pH	Elevation	Air Temp	Sulfides	Hardness	Salinity	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
		(S.U.)	(feet MSL)	(deg C)	(mg/L)	(mg/L)	(ppt)	Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/25/95	7.40	3.81	31.90	20.00	4454.00	23.00	50.00	17.80	28.59	23.50	22.00	22.46	None
Apr	4/29/95	7.50	3.51	36.00	20.00	5040.00	20.00	49.90	5.00	21.45	30.00	22.50	23.65	None
May	5/31/95	7.80	4.51	43.20	20.00	7700.00	33.00	50.00	0.50	23.88	29.00	23.00	25.33	None
Jun	7/7/95	7.00	2.43	34.50	20.00	20490.00	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Jul	8/4/95	7.50	1.83	34.00	20.00	16190.00	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Aug	9/2/95	7.75	4.01	34.00	20.00	7500.00	9.52	N/A	N/A	17.00	N/A	N/A	26.00	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 6

Summary of Water Quality Data for MW-15-LM

Event	Date	pH (S.U.)	Elevation (feet b.g.)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Apr	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
May	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Jun	7/8/95	7.00	-2.90	40.50	20.00	39060.00	NA	N/A	N/A	NA	N/A	N/A	25.50	Well installed 6/23/95
Jul	8/4/95	7.00	-3.81	38.50	20.00	45170.00	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Aug	9/1/95	7.50	-0.61	34.50	20.00	26220.00	7.28	N/A	N/A	13.00	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 7

Summary of Water Quality Data for MW-25-GM

Event	Date	pH (S.U.)	Elevation (feet MSL)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/25/95	7.40	4.68	25.50	0.20	311.00	0.00	0.90	0.45	0.85	33.00	26.00	27.03	None
Apr	4/29/95	7.50	5.38	35.00	0.20	400.00	2.00	0.80	0.49	0.76	32.00	27.50	28.71	None
May	6/1/95	7.50	4.48	36.00	0.00	1120.00	3.00	0.93	0.65	0.86	28.00	25.50	26.43	None
Jun	7/8/95	7.50	2.88	33.90	0.00	1040.00	NA	N/A	N/A	NA	N/A	N/A	24.00	Equipment malfunction
Jul	8/4/95	7.50	3.58	34.00	0.00	1310.00	6.46	N/A	N/A	11.54	N/A	N/A	27.00	Salinity from Conductivity(NaCl)
Aug	9/1/95	7.50	3.69	NA	0.00	770.00	0.45	N/A	N/A	0.80	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 8

Summary of Water Quality Data for MW-25-LG

Event	Date	pH (S.U.)	Elevation (feet MSL)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/25/95	7.60	3.79	29.00	0.20	1821.00	8.00	15.00	0.00	10.95	28.50	22.50	23.51	Standing water around well
Apr	4/29/95	7.00	3.49	34.00	0.20	2990.00	8.00	13.00	0.00	9.54	36.00	25.00	26.59	None
May	6/1/95	7.50	4.19	31.00	0.00	3100.00	13.00	45.00	45.00	45.00	25.50	25.00	25.25	None
Jun	7/7/95	7.00	2.79	34.00	0.20	36220.00	NA	N/A	N/A	NA	N/A	N/A	25.50	Equipment malfunction
Jul	8/4/95	7.50	1.59	34.00	0.75	46000.00	NA	N/A	N/A	NA	N/A	N/A	28.10	Equipment malfunction
Aug	9/1/95	7.50	4.34	33.90	0.20	1330.00	1.79	N/A	N/A	3.20	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 9

Summary of Water Quality Data for MW-25-LM

Event	Date	pH (S.U.)	Elevation (feet MSL)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/25/95	7.70	3.11	30.00	2.00	4554.00	18.00	50.00	0.55	18.13	24.00	22.00	23.17	None
Apr	4/29/95	7.50	2.81	32.00	10.00	31220.00	25.00	50.00	27.00	38.50	25.00	23.00	24.00	None
May	6/1/95	7.00	3.31	36.00	12.50	60180.00	>100	50.00	0.70	33.07	29.00	25.50	27.25	Over-range conductivity and Salinity
Jun	7/7/95	8.00	1.46	31.70	1.50	50880.00	NA	N/A	N/A	NA	N/A	N/A	24.00	Equipment malfunction
Jul	8/4/95	7.30	1.46	38.30	7.50	33760.00	140.00	N/A	N/A	250.00	N/A	N/A	NA	Salinity from Conductivity (NaCl).
Aug	9/1/95	7.30	3.13	33.50	10.00	23330.00	61.60	N/A	N/A	110.00	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 10

Summary of Water Quality Data for MW-15-GF

Event	Date	pH (S.U.)	Elevation (feet MSL)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/25/95	7.70	3.43	26.50	20.00	14210.00	55.00	50.00	0.00	30.34	35.00	24.00	27.38	Max conductivity
Apr	4/29/95	7.50	2.63	32.40	20.00	9050.00	85.00	50.00	18.50	47.91	29.40	25.00	27.80	Max conductivity
May	5/31/95	7.50	3.93	41.30	20.00	16040.00	83.00	40.00	39.00	39.50	31.50	24.50	28.67	None
Jun	7/8/95	7.50	2.16	34.20	20.00	20030.00	NA	N/A	N/A	NA	N/A	N/A	26.00	Equipment malfunction
Jul	8/4/95	7.00	1.13	34.00	20.00	15770.00	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Aug	9/2/95	7.30	3.83	26.80	NA	16000.00	20.16	N/A	N/A	36.00	N/A	N/A	26.00	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 11

Summary of Water Quality Data for MW-GW-A6

Event	Date	pH (S.U.)	Elevation (feet MSL)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/25/95	7.60	3.90	26.00	10.00	3280.00	11.00	50.00	9.00	21.79	28.50	22.00	22.94	None
Apr	4/29/95	7.50	3.30	31.60	10.00	3550.00	5.00	50.00	4.50	20.60	34.00	22.50	23.59	None
May	5/31/95	7.00	4.00	33.80	20.00	4380.00	20.00	49.50	0.10	18.21	42.50	23.00	26.27	None
Jun	7/8/95	7.50	2.33	34.10	10.00	3640.00	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Jul	8/3/95	7.50	1.70	34.90	20.00	4120.00	9.88	N/A	N/A	17.65	N/A	N/A	NA	Salinity + TDS from Conductivity
Aug	9/2/95	7.75	3.30	28.90	10.00	1640.00	6.16	N/A	N/A	11.00	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 12

Summary of Water Quality Data for MW-GW-A8

Event	Date	pH (S.U.)	Elevation (feet MSL)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	3/25/95	7.40	3.39	30.90	2.00	16032.00	65.00	50.00	39.00	44.50	30.00	29.00	29.50	Max. cond @ 3.8'
Apr	4/29/95	7.50	2.79	33.20	1.00	14310.00	80.00	50.00	39.00	44.50	31.00	26.00	28.50	Water grey
May	5/31/95	8.30	3.29	41.50	2.00	19240.00	83.00	48.00	43.00	45.50	36.00	24.50	30.83	None
Jun	7/8/95	7.50	1.58	34.90	0.50	14750.00	NA	N/A	N/A	NA	N/A	N/A	NA	Equipment malfunction
Jul	8/3/95	6.50	2.29	36.40	0.50	41500.00	34.72	N/A	N/A	62.00	N/A	N/A	NA	Salinity from Conductivity (NaCl)
Aug	9/2/95	7.30	3.04	34.00	1.00	12870.00	39.76	N/A	N/A	71.00	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 13

Summary of Water Quality Data for MW-WTF1

Event	Date	pH (S.U.)	Elevation (feet b.g.)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Apr	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
May	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Jun	7/8/95	7.00	-4.72	32.20	20.00	58390.00	NA	N/A	N/A	NA	N/A	N/A	NA	Well installed 6/23/95
Jul	8/4/95	6.50	-4.61	33.90	20.00	71040.00	123.20	N/A	N/A	220.00	N/A	N/A	NA	Salinity calculated from cond.
Aug	9/1/95	6.50	-3.12	35.00	20.00	37940.00	17.36	N/A	N/A	31.00	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 14

Summary of Water Quality Data for MW-WTF2

Event	Date	pH (S.U.)	Elevation (feet b.g.)	Air Temp (deg C)	Sulfides (mg/L)	Hardness (mg/L)	Salinity (ppt)	Conductivity (mMhos/cm)			Temperature (deg. C)			Remarks
								Maximum	Minimum	Average	Maximum	Minimum	Average	
Jan	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Feb	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Mar	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Apr	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
May	no event	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	None
Jun	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Jul	8/4/95	6.50	-4.67	38.40	7.50	47480.00	NA	N/A	N/A	NA	N/A	N/A	NA	Well installed 7/27/95
Aug	9/1/95	7.00	-2.93	33.60	9.00	28910.00	38.08	N/A	N/A	68.00	N/A	N/A	NA	None
Sep	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Oct	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Nov	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None
Dec	no event	no data	no data	no data	no data	no data	no data	N/A	N/A	no data	N/A	N/A	no data	None

Table 15

NAME	NAD 27 SP Zone 4205 (feet)		NAD 83 UTM Zone 0014 (meters)		ELEVATION		Remarks
	East	North	East	North	(feet)		
Valley	2373645.56	607223.46	663298.64	3024388.59			Trig Station
Union	2371200.87	583602.96	662583.09	3017185.77			Trig Station
Thunder	2366138.45	558447.95	661071.32	3009512.03			Trig Station
Sunn	2364779.98	560771.48	660654.37	3010218.57	11.31		Monument
Sunmark	2389964.69	658505.08	668207.72	3040040.45			
Sun 9	2363159.00	557663.00	660164.14	3009269.08			
Sun 8	2362753.00	560008.00	660037.49	3009983.35			
Sun 4	2360394.00	550982.00	659329.62	3007229.26			
Sun 2	2357882.00	548548.00	658566.96	3006484.27			
Std of Texas	2384893.54	655770.14	666665.51	3039200.33			
Savanna	2365037.46	543675.19	660753.98	3005007.82			Trig Station
Samedan 1	2370331.13	571614.39	662332.93	3013530.46			
Ranger	2389523.87	648161.68	668086.57	3036887.10	13.83		Trig Station
Rainbow	2362335.59	523042.80	659955.78	2998715.60			Trig Station
Quail	2393370.10	654536.71	669250.78	3038835.20	9.94		Trig Station
Peerless	2361968.08	480325.50	659895.73	2985694.59			Trig Station
Mon 5	2379783.43	608899.59	665167.38	3024907.21	5.84		Mile Marker
McMoran 3	2401701.11	690147.88	671744.41	3049700.47			
Malaquite	2389437.54	641420.76	668068.84	3034832.28	11.32		Trig Station
M 7.5	2377184.67	599046.03	664387.65	3021900.47	5.94		Mile Marker
M 30	2365365.34	481458.32	660929.87	2986043.99	9.64		Mile Marker
M 27.5	2364925.02	494699.27	660779.62	2990079.42	8.19		Mile Marker
M 25	2364898.22	507818.24	660755.49	2994078.16	8.60		Mile Marker
M 20	2366126.86	533806.38	661098.18	3002001.07	9.70		Mile Marker
M 17.5	2367361.33	546876.85	661458.36	3005986.58	8.17		Mile Marker
M 12.5	2371172.42	572795.10	662587.89	3013891.39	14.26		Mile Marker
M 10	2374077.08	586309.19	663456.39	3018014.24	6.37		Mile Marker
Lorz	2388697.61	637806.63	667847.90	3033729.70	22.44		Trig Station
Keyho	2365141.22	523042.80	660810.95	2998719.03			Trig Station
Hall	2413767.11	700393.00	675408.93	3052838.82	8.48		Trig Station
Goody	2368662.53	561628.30	661836.73	3010484.55	38.24		Trig Station
Dunn	2363037.70	503539.82	660193.60	2992771.80	5.59		Trig Station
Corral	2364183.47	463352.44	660591.46	2980523.72			Trig Station
Carri	2363522.89	564793.13	660266.22	3011442.84			
B-8	2400455.20	671044.70	671389.22	3043876.12			
B-7	2400834.40	672912.11	671502.41	3044445.81			
B-6	2401475.00	669655.16	671701.84	3043453.89			
B-5	2396230.36	671057.36	670101.45	3043874.54			
B-4	2397876.70	675569.80	670597.47	3045252.07			
B-3	2398476.70	673069.84	670783.56	3044490.85			
B-2	2398977.87	668571.48	670942.09	3043120.37			
B-1	2399977.87	666839.43	671249.12	3042593.70			
A-5	2365840.00	586194.00	660945.85	3017968.85			
A-4	2368819.00	590473.00	661848.50	3019276.85			
A-2	2382243.70	618006.10	665905.80	3027686.08	12.80		Ground
A-1	2380817.50	612922.80			12.60		Ground

Table 16 Location of monuments, 'trig stations', selected oil/gas wells.