



## PHASE II TECHNICAL MEMORANDUM #1

TO: Joan Taylor and Cynthia Gianfrancesco/RIDEM

FROM: Steve Andrus (GZA), Edward Summerly (GZA)

DATE: May 1, 2008

FILE NO: 32795.12-C

SUBJECT: Piezometric Monitoring for Bedrock Aquifer Assessment

The Charbert Manufacturing facility ceased production in early March of 2008. To monitor the recovery of the overburden aquifer to a natural state and re-evaluate the groundwater flows both on and around the Site GZA proposed piezometric monitoring in the GZA January 29, 2008 *Phase II Bedrock Aquifer Evaluation Work Plan* (Work Plan). The purpose of this memorandum is to document the results of the proposed monitoring and evaluate whether there have been any significant changes in groundwater elevations and groundwater flow patterns since production ended. The production wells had supplied approximately 150,000 to 200,000 gallon per day which was used in the facility and discharged to the infiltration lagoons located on the southern portion of the property.

### Piezometric Monitoring

GZA began piezometric monitoring at the Charbert facility on February 13, 2008. GZA has been on site every two weeks collecting manual groundwater readings at the 52 groundwater monitoring wells and 10 surface water locations as presented in the Work Plan. To date GZA has collected 6 rounds of groundwater elevations and the results have been compiled in Table 1, attached. Select well readings have also been plotted in hydrographs, (Hydrographs 1 to 5, attached). The February 13, 2008 readings were collected approximately two weeks prior to the facility shutdown and groundwater contours were developed from the measurements, see Figure 1 attached. From Table 1, the seasonal high groundwater appears to have occurred in late March, so groundwater contours of the March 21, 2008 readings were also developed and are shown in Figure 2, attached.

In the above reference Work Plan GZA had proposed using GeoKon automated

data collectors to collect groundwater reading from the existing bedrock wells. Unknown to GZA at that time, the computer program that operated the proposed data collectors is too old to be operated by our existing computers; and is no longer supported by the manufacturer therefore, daily groundwater readings from each zone have been collected manually. The work plan also called for installing pressure transducers and automated data collectors in production wells EW-3 and EW-4 and in groundwater monitoring wells GZ-3, GZ-7, GZ-19 and GZ-20 to record groundwater elevations continuously. The transducer results are consistent with the bi-weekly manual readings.

Both sets of groundwater contours show a pattern similar to groundwater contours developed as part of the site investigation in June 2005. The groundwater flow remains generally from the north to the south with the flow moving either east or west to the adjacent rivers as the groundwater moves down the peninsula. Although the groundwater was approximately 2 to 2.5 feet higher in March than in February, the flow pattern shows little change other than the cone of depression around the production (extraction) wells appears to have recovered to a natural state. There remains a significant mound in groundwater elevations around the lagoons which still contain a significant volume/height of wastewater.

The daily data reading from the bedrock wells have been compiled into hydrographs (Hydrographs 6 to 8, attached) and compared with daily rainfall information. The bedrock wells have had approximately the same change in elevations as the overburden wells and reached the high point in March as well.

At this time, we do not see any changes in groundwater elevations that would suggest that a significant change in contaminant distribution is occurring. We will continue to monitor groundwater levels biweekly through the end of June and document those readings in a second Technical Memorandum. Please feel free to call Ed or Steve at (401) 421-4140 (or via email at *esummerly@gza.com* or *stephen.andrus@gza.com*) with any questions or comments.

cc: Mary Morgan, Richmond Town Clerk  
Clarks Memorial Library – Charbert Repository

Attachments: Tables  
Hydrographs 1 through 8  
Figure 1 – February 13, 2008 Groundwater Contours  
Figure 2 – March 23, 2008 Groundwater Contours

**TABLE 1**

**GROUNDWATER DEPTHS AND ELEVATIONS - JANUARY 2008 THRU APRIL 2008**

*Phase II Bedrock Aquifer Study  
Charbert Facility  
Alton, Rhode Island*

WELL ID	DEPTH/SCREEN	GZA DATUM <sup>(1)</sup>	GZA DATUM ELEV. (MSL)	GROUND AND SURFACE WATER ELEVATIONS														WELL ID
				1/4/08		2/13/08		2/22/08		3/6/08		3/21/08		4/3/08		4/18/08		
				DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	
RIZ-1	15/10	TOC	50.24	6.8	43.4	9.9	43.3	5.9	44.4	5.9	44.3	4.3	45.9	5.2	44.8	5.5	45.1	RIZ-1
RIZ-3	15/10	TPVC	48.64	7.2	41.4	7.8	40.9	6.5	42.2	6.5	42.2	4.8	43.8	5.8	42.4	6.2	42.8	RIZ-3
RIZ-5	15/10	TPVC	46.58	5.6	41.0	5.8	40.7	4.9	41.7	5.7	40.9	3.3	43.3	4.5	42.0	4.6	42.1	RIZ-5
RIZ-6	15/10	TPVC	46.31	4.0	42.3	4.1	42.2	3.2	43.2	3.0	43.3	1.9	44.5	2.9	43.0	3.4	43.4	RIZ-6
RIZ-7	15/10	TOC	47.02	5.9	41.1	6.2	40.8	5.2	42.3	5.4	41.6	4.3	42.7	5.5	41.1	5.9	41.6	RIZ-7
RIZ-10	22/10	TPVC	64.45			15.9	48.5	15.9	48.5	17.0	47.5	16.3	48.1	17.9	46.4	18.0	46.6	RIZ-10
RIZ-13	24/10	TPVC	46.56			5.6	41.0	4.3	42.3	5.1	41.0	3.5	42.6	4.2	41.5	4.7	42.3	RIZ-13
RIZ-14	19.5/10	TPVC	62.61	16.7	46.0	14.9	47.7	13.9	48.7	13.6	49.0	12.8	49.8	13.1	49.3	13.4	49.5	RIZ-14
RIZ-15	19.6/10	TPVC	62.51	15.9	46.6	12.1	50.4	11.7	50.8	11.5	51.0	11.5	51.0	12.0	50.0	12.5	50.5	RIZ-15
RIZ-18	19.3/10	TPVC	65.94	19.4	46.5	18.0	47.9	17.1	48.8	16.8	49.2	15.9	50.0	16.8	49.8	16.1	49.1	RIZ-18
RIZ-19	20/10	TPVC	63.85	17.5	46.4	16.0	47.9	15.0	48.9	14.6	49.3	13.8	50.1	14.0	49.7	14.1	49.9	RIZ-19
RIZ-20	19.3/10	TPVC	60.79	15.1	45.7	13.3	47.5	12.1	48.7	12.1	48.7	11.8	49.0	12.3	48.2	12.6	48.5	RIZ-20
RIZ-21	19/10	TPVC	52.85	11.6	41.3	12.0	40.9	10.8	42.0	10.8	42.1	9.0	43.8	10.0	42.5	10.4	42.9	RIZ-21
MW-2A	20/10	TPVC	63.59			7.5	56.1	8.0	55.6	8.7	54.9	8.9	54.7	9.9	56.8	6.8	53.7	MW-2A
MW-4A	15/10	TPVC	58.43	10.6	47.8	6.9	51.6	6.6	51.9	6.6	51.9	6.4	52.0	7.0	51.1	7.3	51.4	MW-4A
GP-15	20/10	TPVC	60.87			13.6	47.2	13.0	47.9	12.6	48.3	11.7	49.1	11.8	49.1	11.8	49.1	GP-15
GP-16	17/10	TPVC	55.59	7.9	47.7	8.0	47.6	6.8	48.8	6.7	48.9	5.4	50.2	6.3	48.9	6.7	49.3	GP-16
GP-17	37/10	TPVC	73.88	27.6	46.3	27.1	46.8	27.8	46.1	26.3	47.6	25.4	48.5	25.1	48.9	24.9	48.8	GP-17
GP-18	25/10	TPVC	59.11			12.7	46.4	WELL NOT FOUND		10.3	48.8	9.5	49.6	9.8	49.2	10.0	49.3	GP-18
GP-19	22/10	TPVC	62.08	15.9	46.2	13.5	48.6	12.7	49.4	12.5	49.6	11.9	50.2	12.3	49.4	12.7	49.8	GP-19
GP-20	22/10	TPVC	67.65			15.9	51.8	15.9	51.8	16.4	51.2	17.5	50.1	19.3	47.1	20.5	48.4	GP-20
GP-21	21/10	TPVC	64.85			12.4	52.4	12.3	52.5	12.9	51.9	12.7	52.1	13.4	51.5	13.3	51.5	GP-21
GP-22	15/12	TPVC	48.55	7.0	41.6	7.5	41.0	6.3	42.2	6.4	42.2	4.6	44.0	5.5	42.7	5.9	43.1	GP-22
GP-25	15/12	TPVC	47.98	3.5	44.5	2.8	45.2	2.9	45.1	3.0	45.0	3.1	44.9	3.5	44.2	3.7	44.5	GP-25
GP-26	16/12	TPVC	49.23	7.9	41.4	8.2	41.0	7.1	42.1	7.0	42.2	5.6	43.7	6.6	42.7	6.5	42.7	GP-26
GP-27A	20/10	TPVC	52.16	9.9	42.3	10.3	41.9	9.1	43.1	WELL OBSTRUCTED		WELL OBSTRUCTED		WELL OBSTRUCTED		WELL OBSTRUCTED		GP-27A
GP-27B	34/10	TPVC	52.21	10.3	41.9	10.4	41.8	9.4	42.9	9.4	42.8	7.7	44.5	8.7	43.2	9.0	43.5	GP-27B
GP-28	15/12	TPVC	46.69	6.1	40.6	6.3	40.4	5.2	41.5	5.1	41.6	3.8	42.9	5.0	41.6	5.1	41.7	GP-28
GP-29	22/10	TPVC	66.90			19.3	47.6	19.0	47.9	19.7	47.2	19.4	47.5	20.4	47.2	19.7	46.5	GP-29
GP-30	37/10	TPVC	63.16	14.1	49.1	12.3	48.5	11.3	49.4	11.0	49.7	10.3	50.4	10.6	49.9	10.9	50.2	GP-30
PT-1	15/10	TPVC	51.77	10.0	41.7	7.4	41.4	9.2	42.6	9.2	42.6	7.6	44.2	8.6	42.8	9.0	43.2	PT-1
PT-2	15/10	TPVC	53.20	12.6	40.6	12.3	41.0	11.1	42.1	11.1	42.1	9.7	43.5	10.6	42.2	11.0	42.7	PT-2
PT-4	15/10	TPVC	48.12	7.6	40.6	8.4	39.7	8.4	39.7	8.1	40.0	6.0	42.1	7.1	40.5	7.6	41.0	PT-4
PT-5	15/10	TPVC	47.10	5.8	41.3	6.2	40.9	5.3	41.8	5.2	41.9	3.4	43.7	4.4	42.3	4.8	42.7	PT-5
CB-9	15/10	TPVC	49.35	8.0	41.4	8.5	40.9	7.3	42.1	7.3	42.1	6.6	42.8	6.6	42.4	7.0	42.4	CB-9
CB-12	15/10	TPVC	61.33			7.8	53.6	7.6	53.7	7.9	53.4	8.4	53.0	9.1	51.9	9.4	52.2	CB-12

**TABLE 1**

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*Phase II Bedrock Aquifer Study  
Charbert Facility  
Alton, Rhode Island*

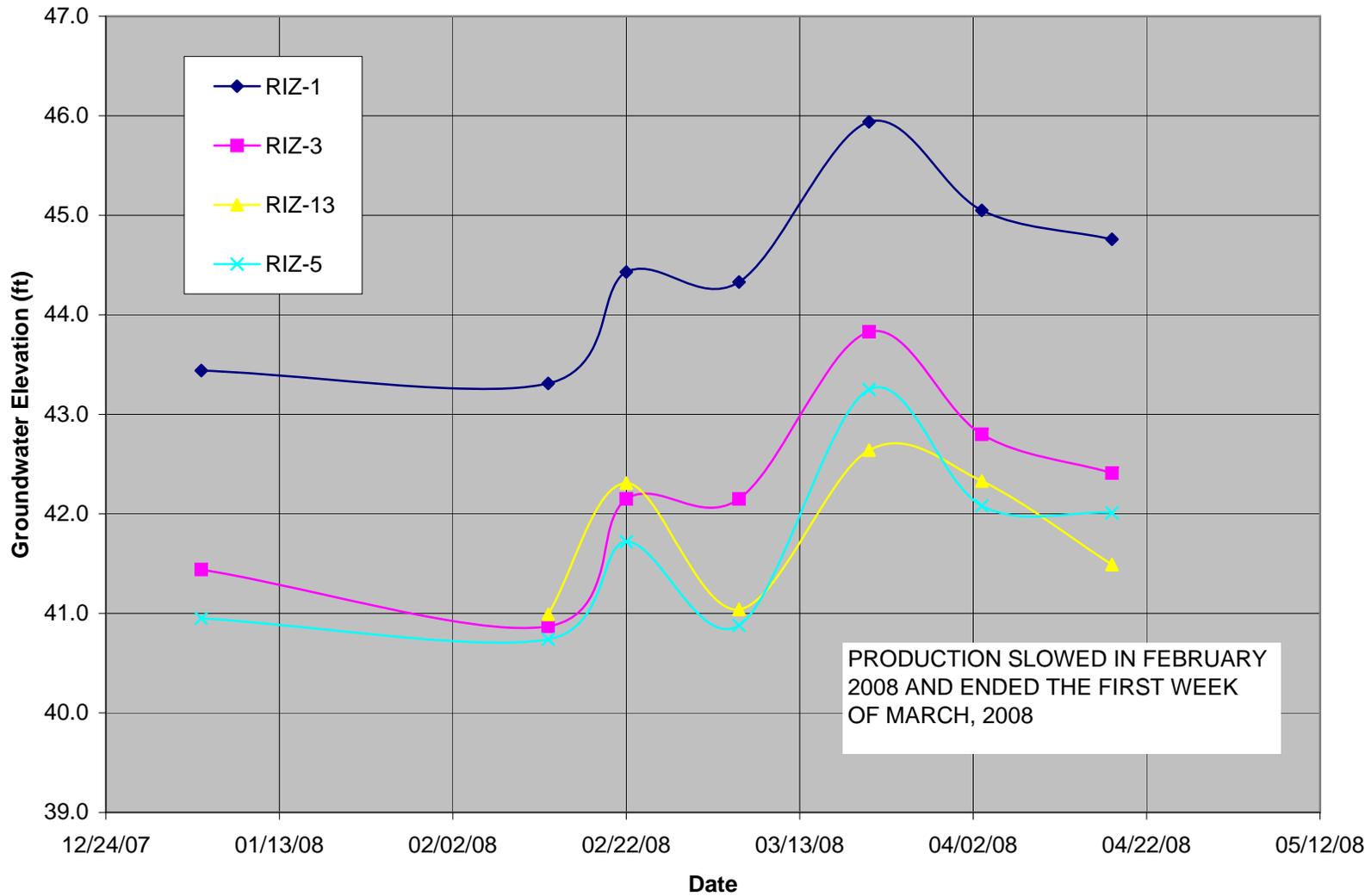
WELL ID	DEPTH/SCREEN	GZA DATUM <sup>(1)</sup>	GZA DATUM ELEV. (MSL)	GROUND AND SURFACE WATER ELEVATIONS														WELL ID
				1/4/08		2/13/08		2/22/08		3/6/08		3/21/08		4/3/08		4/18/08		
				DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	DEPTH	ELEV.	
GZ-1	54/10	TOC	56.47	15.3	41.2	15.0	41.5	13.8	42.9	13.9	42.8	12.5	44.2	13.3	43.0	13.7	43.4	GZ-1
GZ-2	83/10	TPVC	61.45	19.5	42.0	18.6	42.8	17.6	43.9	17.7	43.8	16.5	45.0	17.2	43.9	17.5	44.3	GZ-2
GZ-3	40/10	TPVC	49.14	7.8	41.3	8.1	41.0	7.0	42.1	7.0	42.1	5.5	43.6	6.6	42.5	6.6	42.6	GZ-3
GZ-4A	77/10	TPVC	59.01			17.1	41.9	WELL NOT FOUND		16.1	43.0	14.6	44.5	15.3	43.4	15.6	43.7	GZ-4A
GZ-5	39/10	TPVC	65.59			19.6	46.0	19.3	46.1	19.5	46.1	19.0	46.6	19.7	45.6	20.0	45.9	GZ-5
GZ-6	44/10	TPVC	48.32	15.3	33.1	7.1	41.2	6.0	42.4	5.9	42.4	4.2	44.1	5.2	42.7	5.6	43.1	GZ-6
GZ-7	43/10	TPVC	49.78	9.5		8.5	41.3	7.5	42.3	7.4	42.3	6.0	43.7	7.0	43.0	6.8	41.2	GZ-7
GZ-8	51/10	TPVC	52.17	7.8	44.4	10.2	42.0	9.1	43.1	9.1	43.0	7.4	44.8	8.4	43.4	8.8	43.8	GZ-8
GZ-9	22/10	TOC	65.89			15.0	50.9	14.6	51.3	15.1	50.8	14.7	51.2	15.2	50.5	15.4	50.7	GZ-9
GZ-10	22/10	TOC	58.56			14.3	44.3	13.7	44.9	14.1	44.5	13.5	45.1	14.3	44.1	14.5	44.3	GZ-10
GZ-11	28/5	TPVC	62.68			19.4	43.3	18.6	44.1	18.8	43.9	18.0	44.7	18.8	43.6	19.1	43.9	GZ-11
GZ-12	15/10	TPVC	62.89			DRY		DRY		DRY		14.8	48.1	14.8	48.0	14.9	48.1	GZ-12
GZ-13	15/10	TPVC	64.02			DRY		19.4	44.6	19.1	44.9	18.1	46.0	18.9	44.6	19.5	45.1	GZ-13
GZ-14	35/10	TPVC	65.61			21.8	43.8	21.2	44.4	21.2	44.4	20.6	45.1	21.2	44.0	21.6	44.4	GZ-14
GZ-15	25/10	TPVC	62.57			18.5	44.1	17.7	44.9	17.8	44.8	17.1	45.5	17.7	44.5	18.1	44.9	GZ-15
GZ-16	25/10	TPVC	63.42			18.6	44.9	17.6	45.8	17.7	45.7	17.1	46.4	17.7	45.3	18.1	45.7	GZ-16
GZ-17	25/10	TPVC	63.75			18.3	45.4	12.0	51.7	12.4	51.4	12.2	51.5	12.7	50.6	13.1	51.0	GZ-17
GZ-18	25/10	TPVC	64.30			18.4	45.9	17.8	46.5	18.0	46.3	17.3	47.0	18.0	45.9	18.4	46.3	GZ-18
GZ-19	30/5	TPVC	50.04	9.0	41.1	9.3	40.7	8.2	41.8	8.1	41.9	6.7	43.3	7.9	41.9	8.1	42.2	GZ-19
GZ-20	30/5	TPVC	48.97	7.9	41.1	8.1	40.9	7.1	41.9	7.0	42.0	6.6	42.4	6.8	41.9	7.0	42.2	GZ-20
GZ-21	20/10	TPVC	52.61	11.9	40.7	12.3	40.3	11.4	41.3	11.1	41.5	9.8	42.8	10.9	41.2	11.4	41.7	GZ-21
GZ-22	30/5	TPVC	52.71	12.1	40.6	12.5	40.2	11.6	41.1	11.3	41.4	9.9	42.8	11.1	41.1	11.6	41.7	GZ-22
GZ-23	20/10	TPVC	49.55	9.0	40.5	6.3	40.3	8.3	41.2	8.1	41.5	6.8	42.7	8.0	41.0	8.6	41.5	GZ-23
PD-1	WOOD RIVER	DRILL HOLE	53.53	4.0	49.5	3.9	49.7	3.5	50.0	2.5	51.0	2.0	51.5	2.5	51.0	2.5	51.0	PD-1
PD-2	WOOD RIVER	DRILL HOLE	54.43	13.9	40.5	14.0	40.4	13.3	41.2	12.4	42.0	11.6	42.8	13.2	40.6	13.8	41.2	PD-2
SW-1	WOOD RIVER	BOLT TOP POST	44.36	3.3	41.1	4.4	40.0	1.0	43.1	0.5	43.9	0.0	44.4	1.8	43.8	0.6	42.6	SW-1
SW-2	PAWCATUCK RIVER	TOP OF REBAR	42.33	0.8	41.6	0.1	42.3	0.6	42.4	-0.3	43.2	-0.5	43.5	-0.3	42.8	0.2	43.2	SW-2
SW-3	WOOD RIVER	TOP OF REBAR	39.83	0.3	39.6	-0.1	39.9	0.3	40.2	-0.1	40.6	-0.3	40.8	0.3	39.5	1.0	40.2	SW-3
SW-6	PAWCATUCK RIVER	TOP OF REBAR	40.43			1.6	38.9	1.0	39.4	0.8	39.7	-0.5	40.0	0.8	38.4	2.0	39.7	SW-6
LAGOON 1					63.0		61.0		63.0		63.0		62.0			62.0	58.0	LAGOON 1
LAGOON 2					63.5		60.0		60.0		59.0		58.0			53.0	60.0	LAGOON 2
LAGOON 3					63.5		62.5		61.0		61.0		62.0			60.0	60.0	LAGOON 3
EW-1	34/10	TOC	51.58	9.9	41.7	9.9	41.7	8.7	42.9	8.7	42.8	7.2	44.4	8.1	43.1	8.5	43.5	EW-1
EW-2	34/10	TOC	52.68	11.0	41.7	17.3	35.4	10.1	42.5	10.1	42.6	8.4	44.2	9.3	42.9	9.8	43.3	EW-2
EW-3	35/10	TOC	48.86	8.2	40.7	17.2	31.7	16.8	32.1	16.6	32.2	5.8	43.1	6.9	41.5	7.4	42.0	EW-3
EW-4	40/10	TOC	47.72					13.6	34.1	6.1	41.6	4.4	43.3	5.4	42.3			EW-4
OEW-2	49/ UK	TOC	60.46	18.70	41.8	17.3	43.2	16.9	43.6	17.0	43.5	15.7	44.8	16.5	43.6	16.8	44.0	OEW-2

1. TOC indicates Top of Casing, TPVC indicates Top of PVC Pipe.
2. PD indicates Pond Water.
3. SW indicates Surface Water.
4. EW indicates Extraction Well.
5. OEW indicates Old Extraction Well.
6. CB indicates Clayton Boring.

7. UK indicates Unknown.
8. PT indicates Pump Test.
9. MW indicates Monitoring Well (UIC).
10. Yellow highlighted values represent apparent seasonal high groundwater levels.
11. Blue highlighted values indicate well apparently being pumped at the time the reading was taken.
12. Orange highlighted values are estimates. Bolded values represent estimated high water.
13. Bolt on support brace for USGS staging gage.
14. Lagoon elevations are based on visual observation of known elevation and water level.

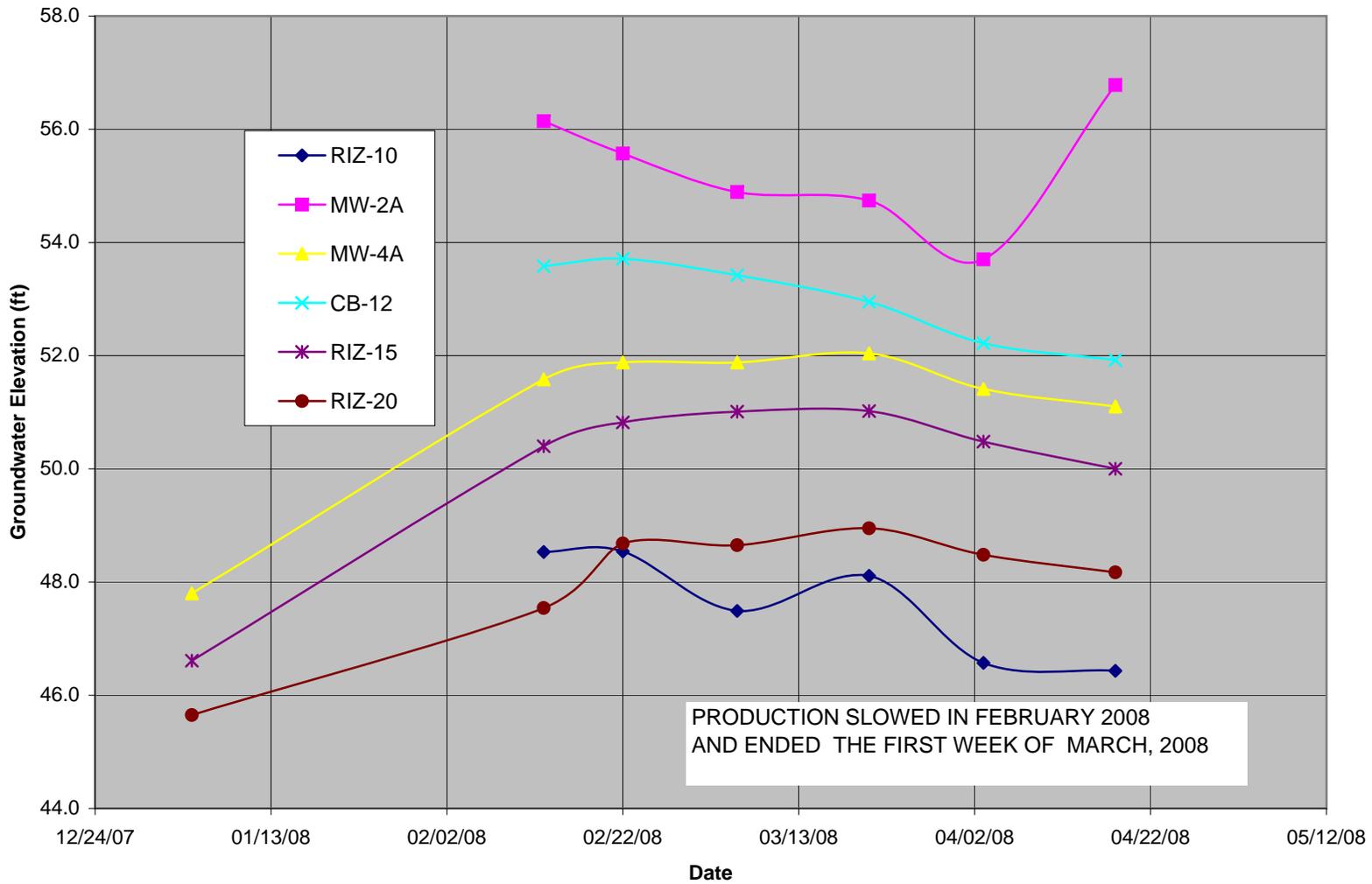
**GRAPH 1**  
**Hydrographs of Facility Area**  
RIZ-1, RIZ-3, RIZ-5, RIZ-10

CHARBERT FACILITY  
Alton, Rhode Island



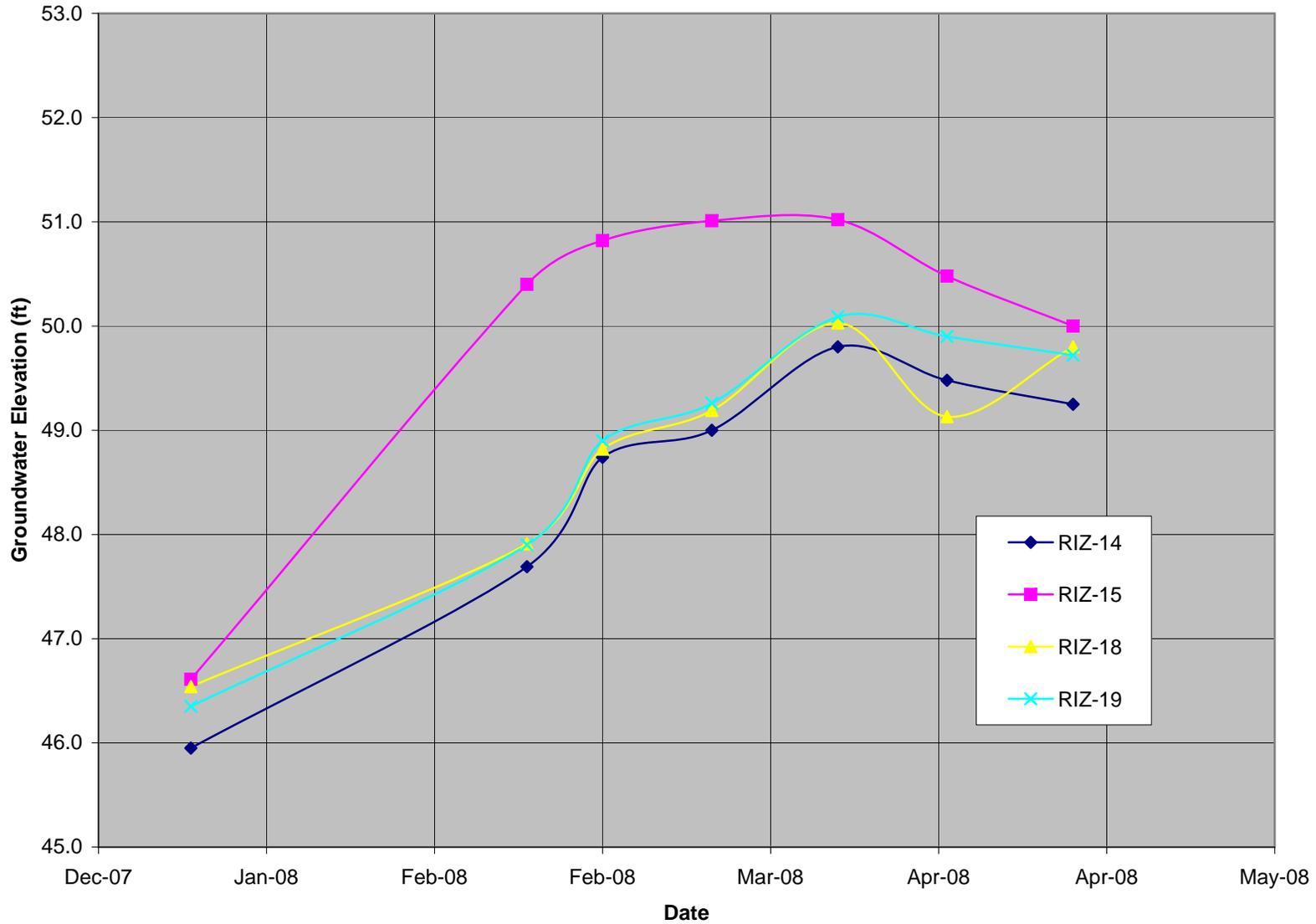
**GRAPH 2**  
**Hydrographs of the Lagoon Area**  
 RIZ-10, RIZ-15, RIZ-20, MW-2A, MW-4A, CB-12

CHARBERT FACILITY  
 Alton, Rhode Island



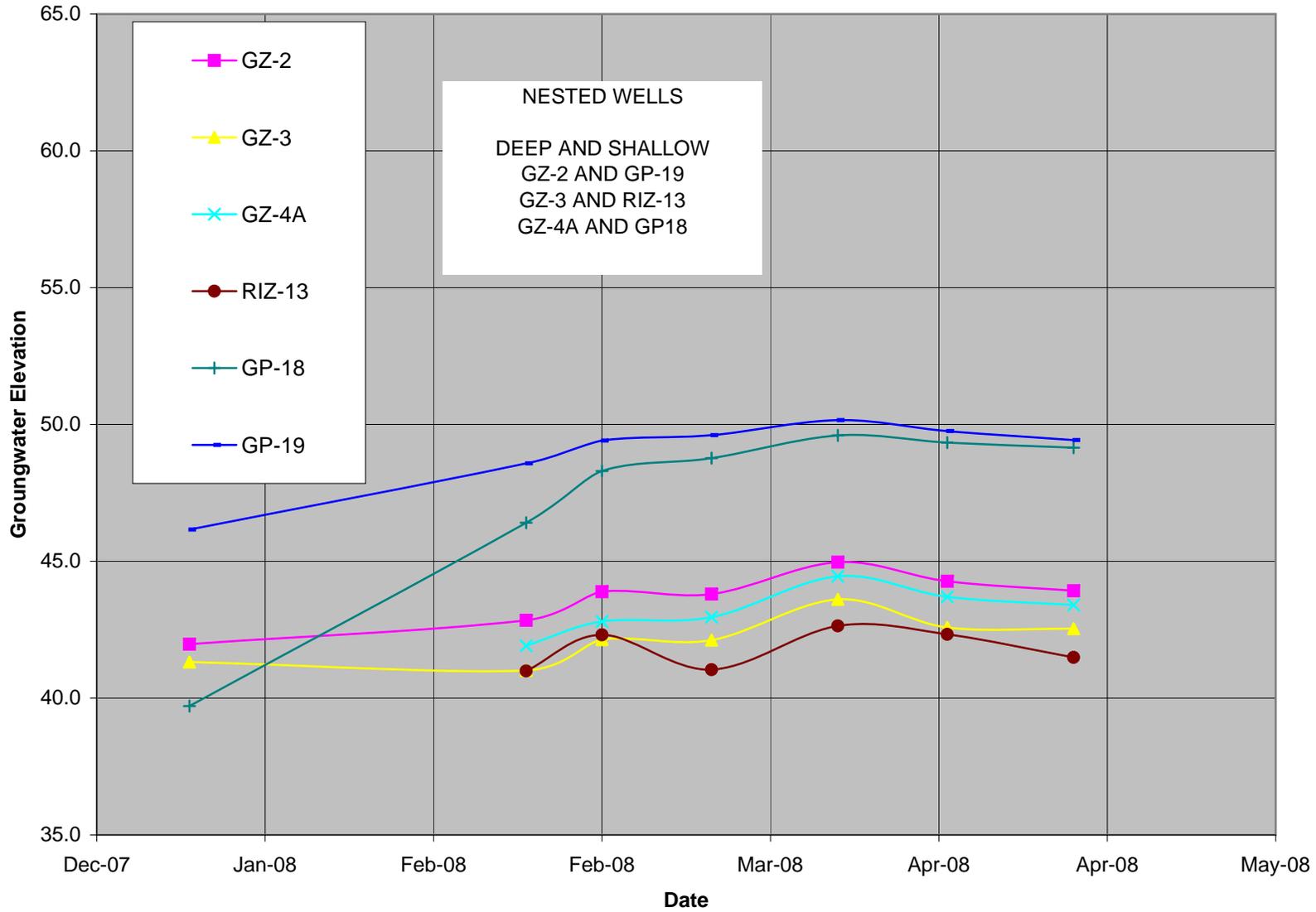
**GRAPH 3**  
**Hydrographs of Northeast Property Corner**  
RIZ-14, RIZ-15, RIZ 18, RIZ 19

CHARBERT FACILITY  
Alton, Rhode Island



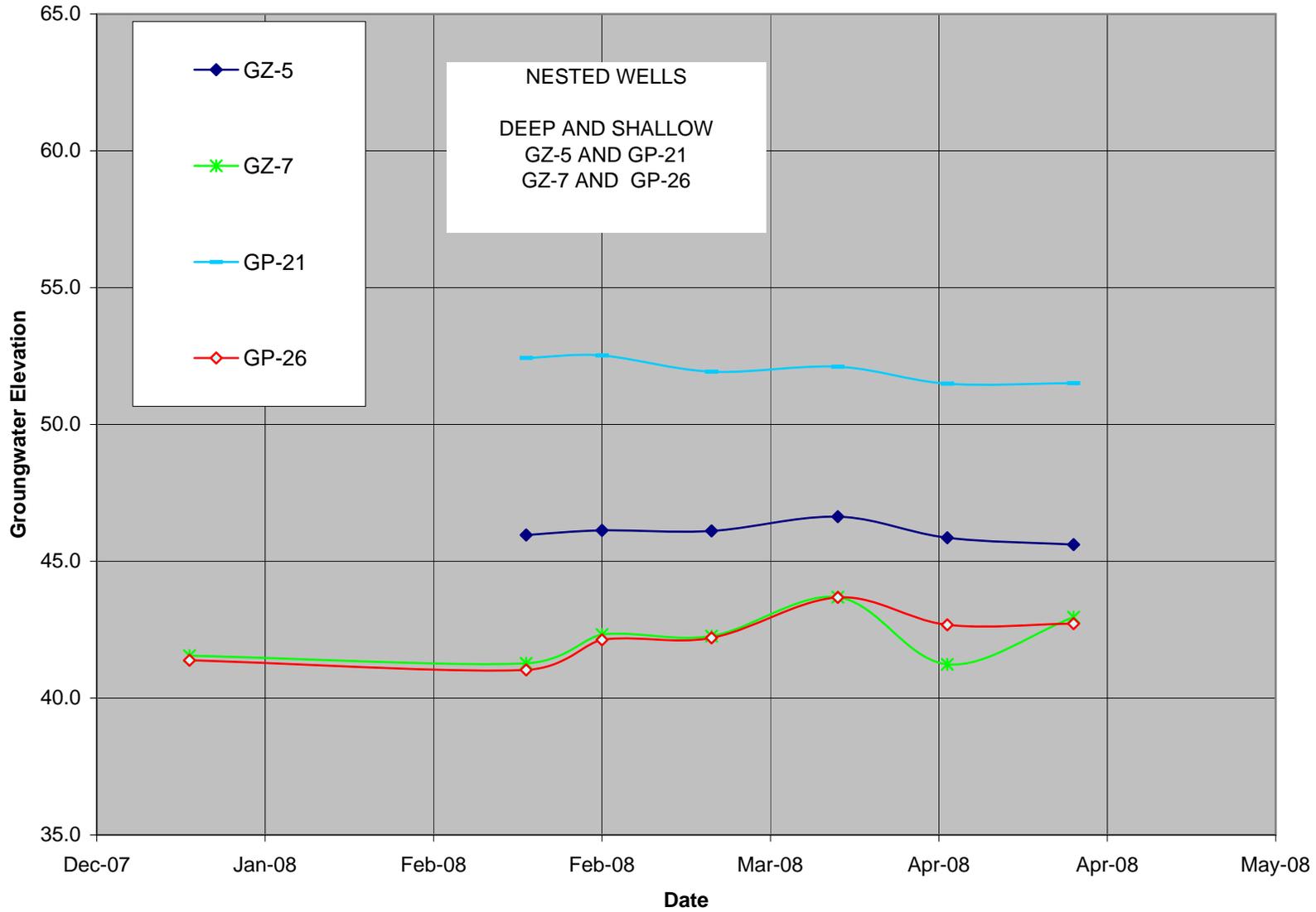
**GRAPH 4**  
**Hydrographs of GZA Nested Shallow/Deep Wells**

CHARBERT FACILITY  
 Alton, Rhode Island

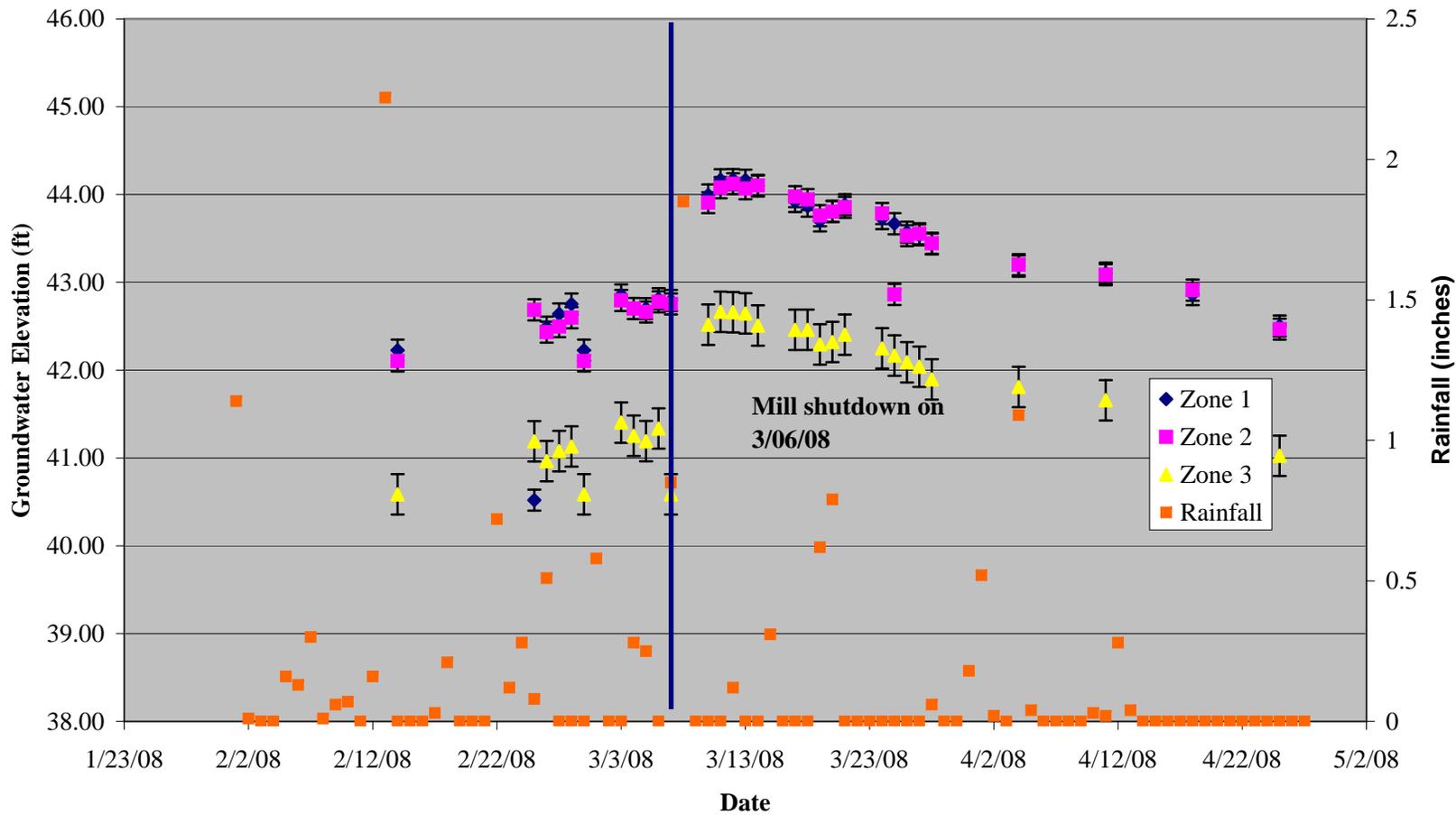


**GRAPH 5**  
**Hydrographs of GZA Nested Shallow/Deep Wells**

CHARBERT FACILITY  
 Alton, Rhode Island



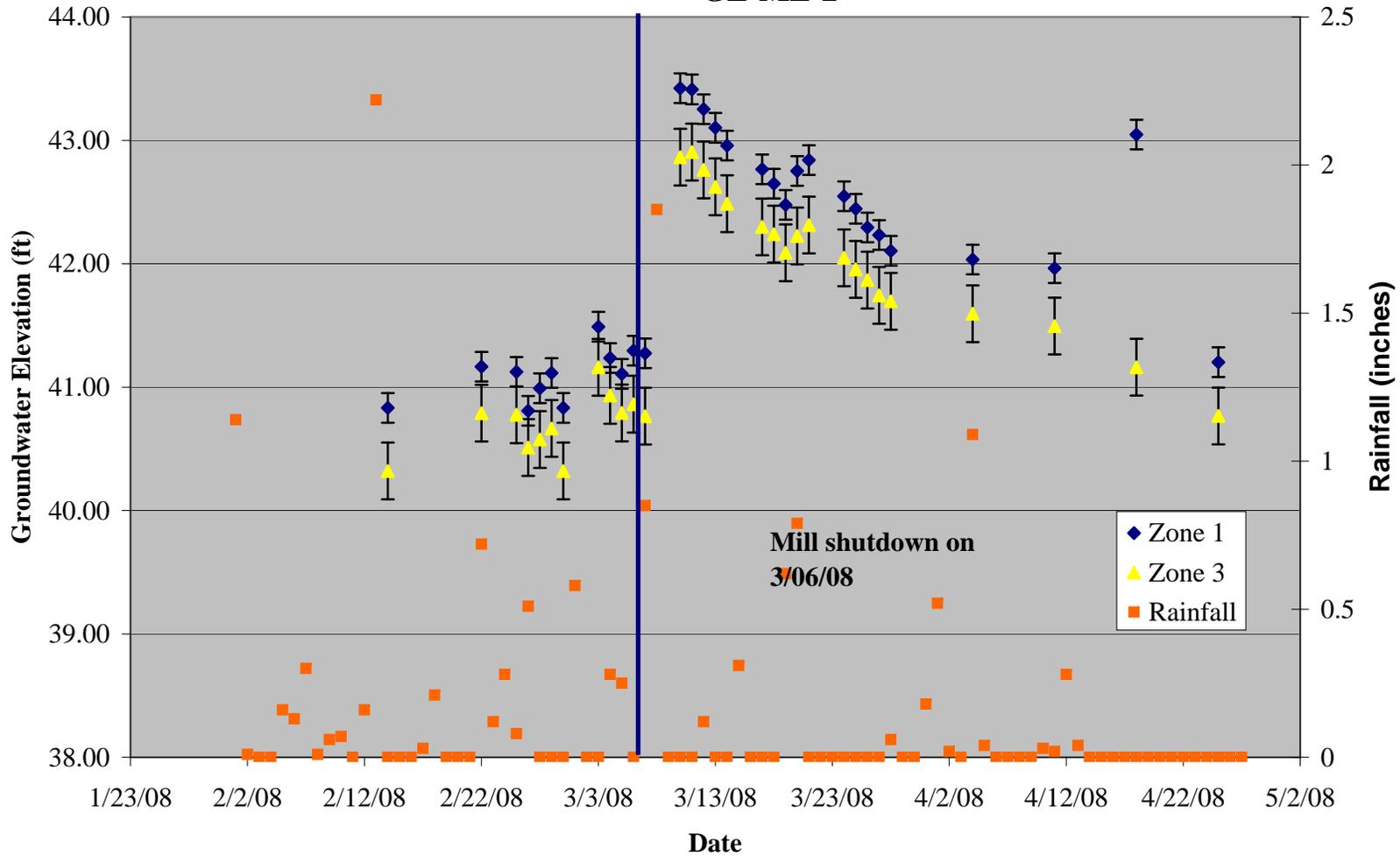
**GRAPH 6**  
**Groundwater Elevations with Transducer Error Bars**  
**February and March 2008**  
**Charbert Bedrock Aquifer Evaluation**  
**GZ-ML-1**



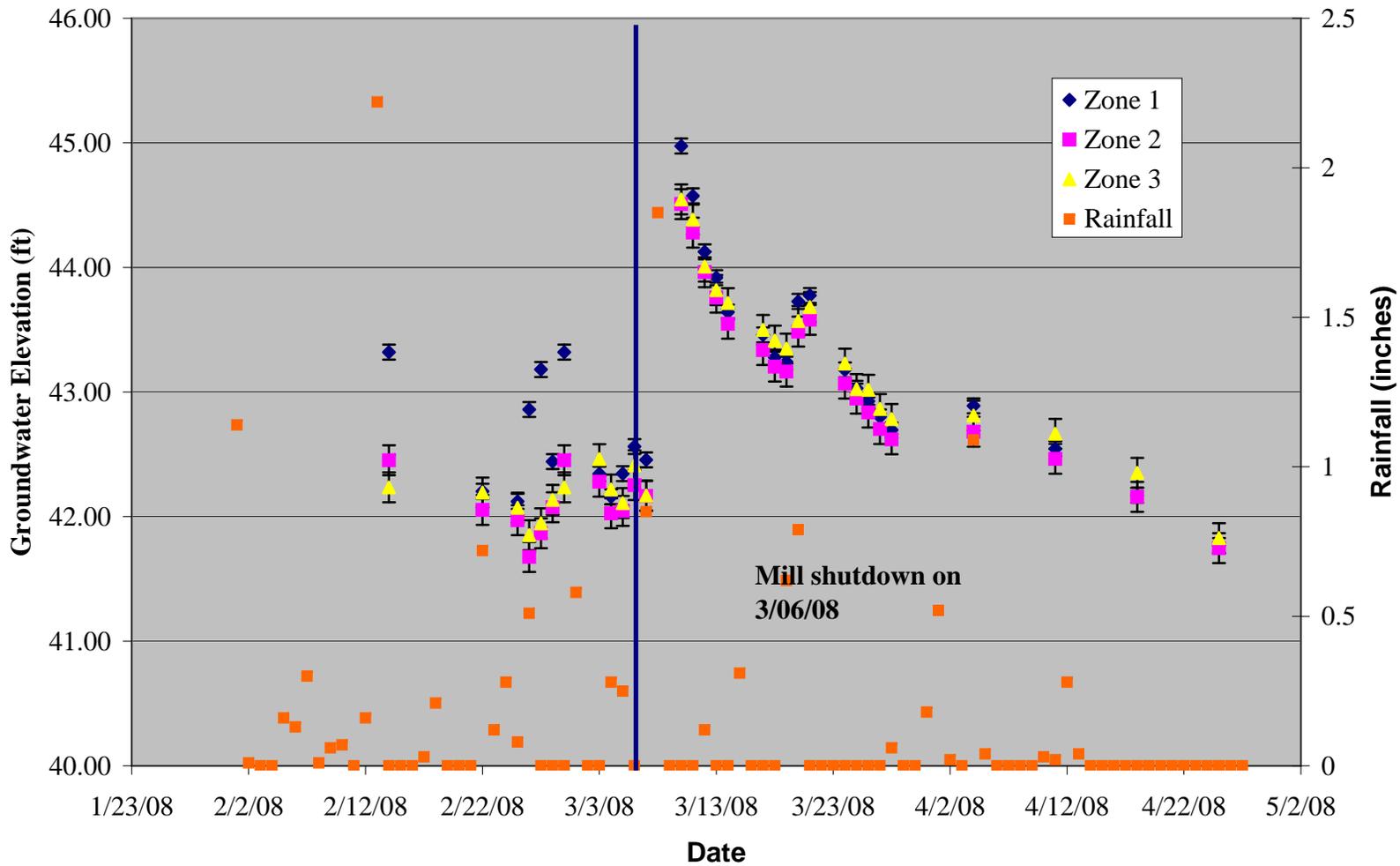
**GRAPH 7**  
**Groundwater Elevations with Transducer Error Bars**  
**February and March 2008**

**Charbert Bedrock Aquifer Evaluation**

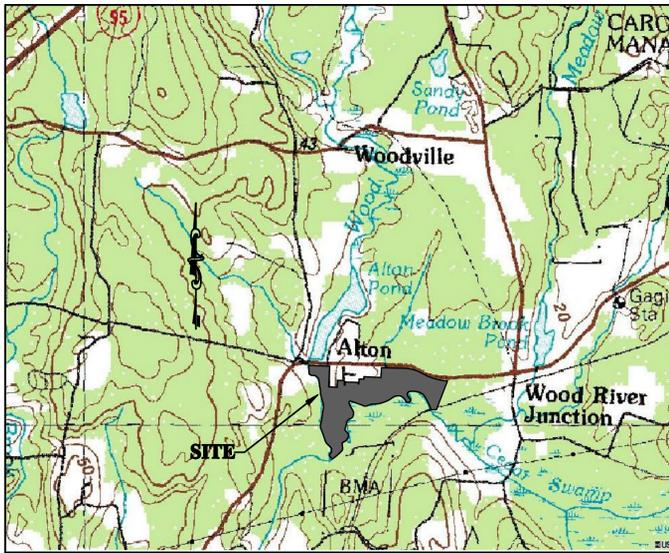
**GZ-ML-2**



**GRAPH 8**  
**Groundwater Elevations with Transducer Error Bars**  
**February and March 2008**  
**Charbert Bedrock Aquifer Evaluation**  
**GZ-ML-3**

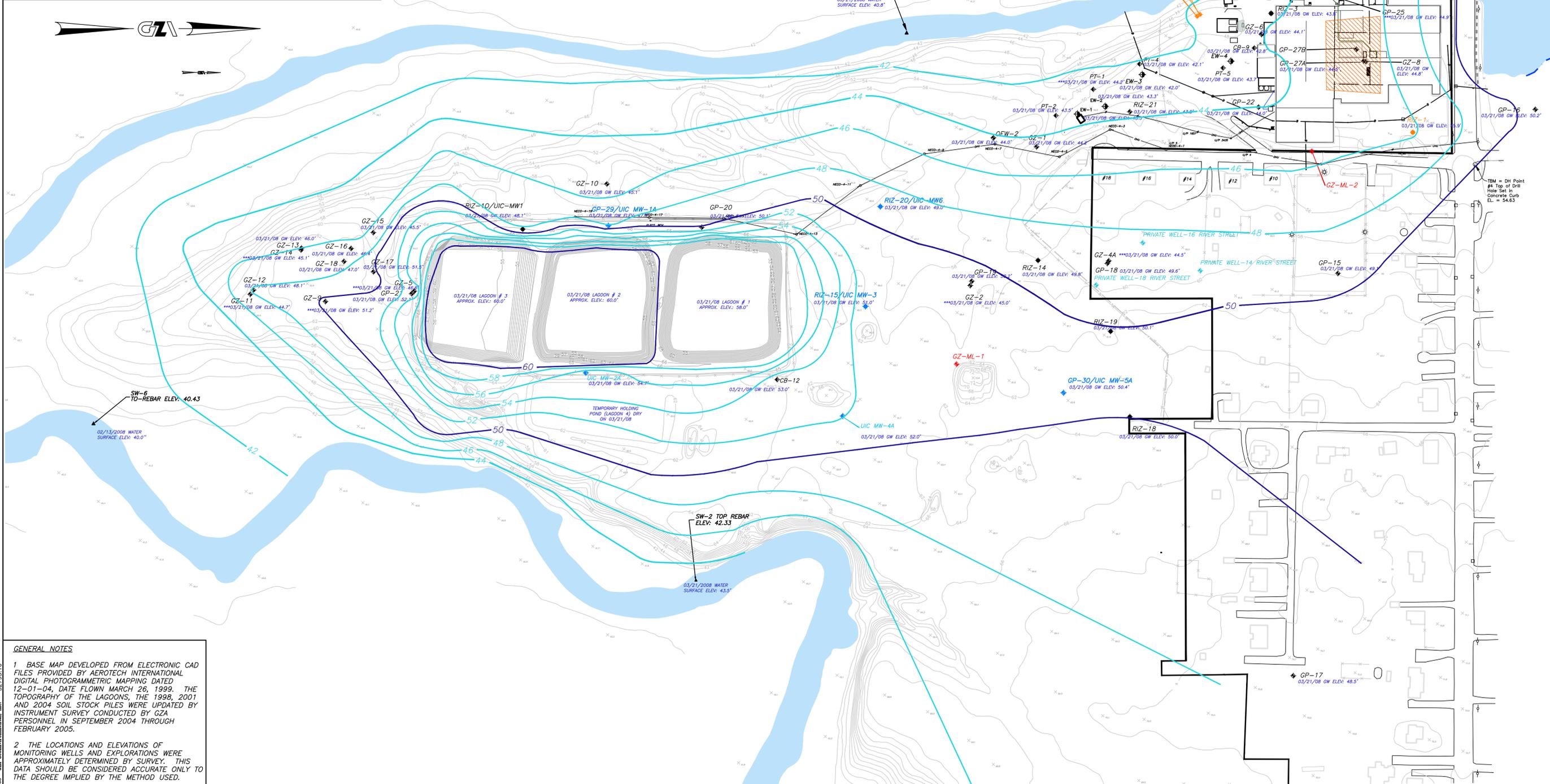






**LEGEND**

- SS SEWER LINE
- MW INDUSTRIAL WASTEWATER LINE
- E UNDERGROUND ELECTRICAL LINE
- OK STORM WATER DRAINAGE LINE
- OL OIL LINE
- SM EXISTING SEWER FORCE MAIN
- OHU OVERHEAD UTILITY
- U UTILITY POLE
- CL CHAIN LINK FENCE
- EO EXISTING SURFACE CONTOURS
- EDGE OF RIVER
- 50 INFERRED SHALLOW GROUNDWATER CONTOUR ELEVATIONS 03-21-2008 (MAJOR)
- 48 INFERRED SHALLOW GROUNDWATER CONTOUR ELEVATIONS 03-21-2008 (MINOR)
- GZ GZA MONITORING WELL
- GZ-ML GZA MULTI-LEVEL MONITORING WELL
- GP GZA GEOPROBE
- EW EXTRACTION (PRODUCTION) WELL
- CB CLAYTON TEMPORARY WELL
- RIZ RIZZO MONITORING WELL
- SW SURFACE WATER MONITORING STATION
- Q-118 FIELD DELINEATED EDGE OF WETLAND
- 03/21/08 GW ELEV: 44.3' GW OR SW ELEVATION USED TO CREATE CONTOURS FOR 03-21-2008
- \*\*\*03/21/08 GW ELEV: 50.9' GW OR SW ELEVATION NOT USED TO CREATE CONTOURS FOR 03-21-2008
- AREA OF SOIL VAPOR EXTRACTION AND AIR SPARGE REMEDIATION



**GENERAL NOTES**

1 BASE MAP DEVELOPED FROM ELECTRONIC CAD FILES PROVIDED BY AEROTECH INTERNATIONAL DIGITAL PHOTOGRAMMETRIC MAPPING DATED 12-01-04, DATE FLOWN MARCH 26, 1999. THE TOPOGRAPHY OF THE LAGOONS, THE 1998, 2001 AND 2004 SOIL STOCK PILES WERE UPDATED BY INSTRUMENT SURVEY CONDUCTED BY GZA PERSONNEL IN SEPTEMBER 2004 THROUGH FEBRUARY 2005.

2 THE LOCATIONS AND ELEVATIONS OF MONITORING WELLS AND EXPLORATIONS WERE APPROXIMATELY DETERMINED BY SURVEY. THIS DATA SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

PROJECT NO. 32795.16	FIGURE NO. 2
PROJ MGR: SMA DESIGNED BY: EAS REVIEWED BY: EAS OPERATOR: SMA CHECKER: ALF DATE: MAR., 2008	CHARBERT FACILITY ALTON, RHODE ISLAND POST-CLOSURE GROUNDWATER TABLE CONTOURS AND MONITORING LOCATIONS 03/21/2008
GZA GeoEnvironmental, Inc. Engineers and Scientists 530 BROADWAY PROVIDENCE, RHODE ISLAND 02909 (401) 751-8613 www.gza.com	SCALE: 1" = 100' 0 50 100 200
REV. NO.	DESCRIPTION
BY	DATE