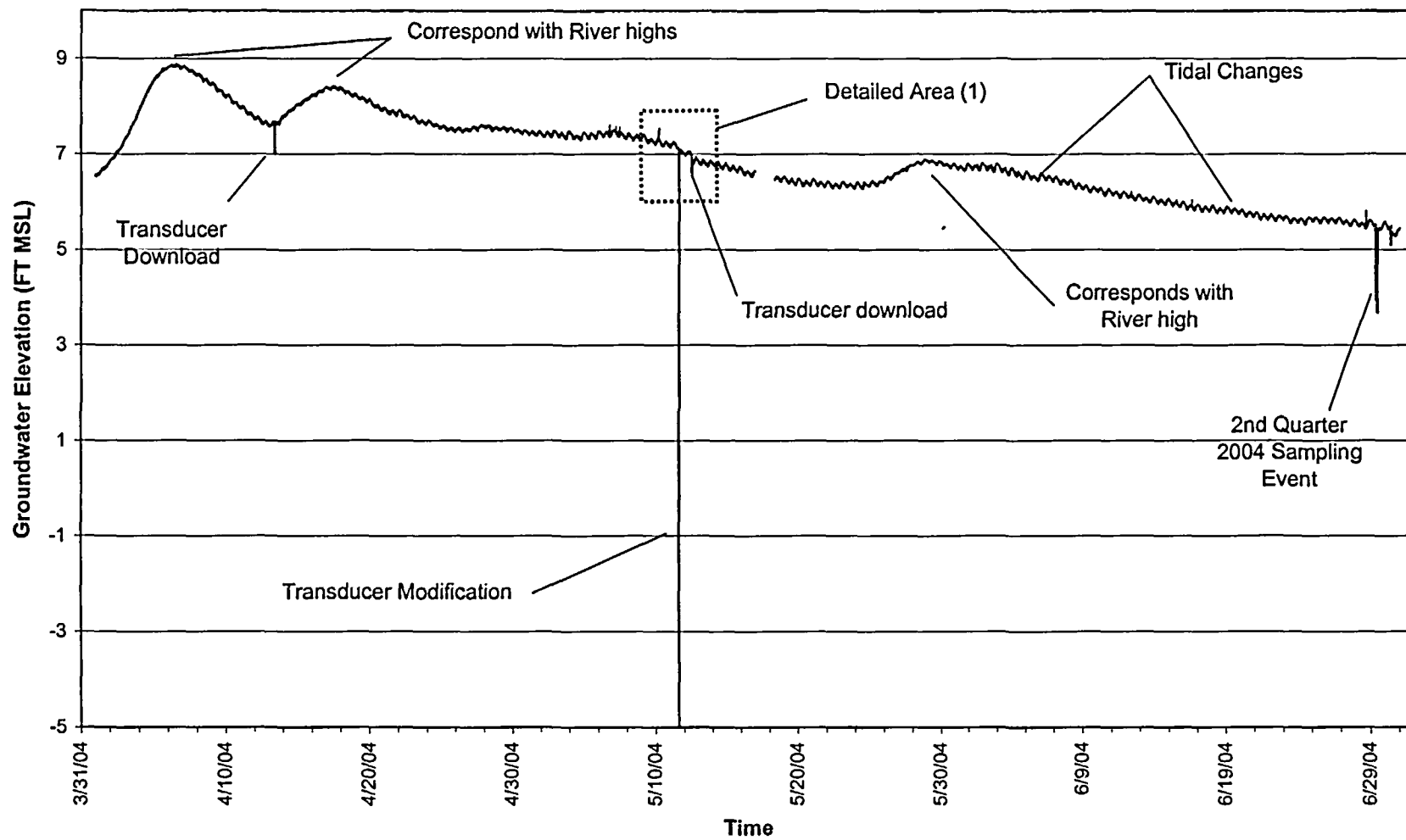


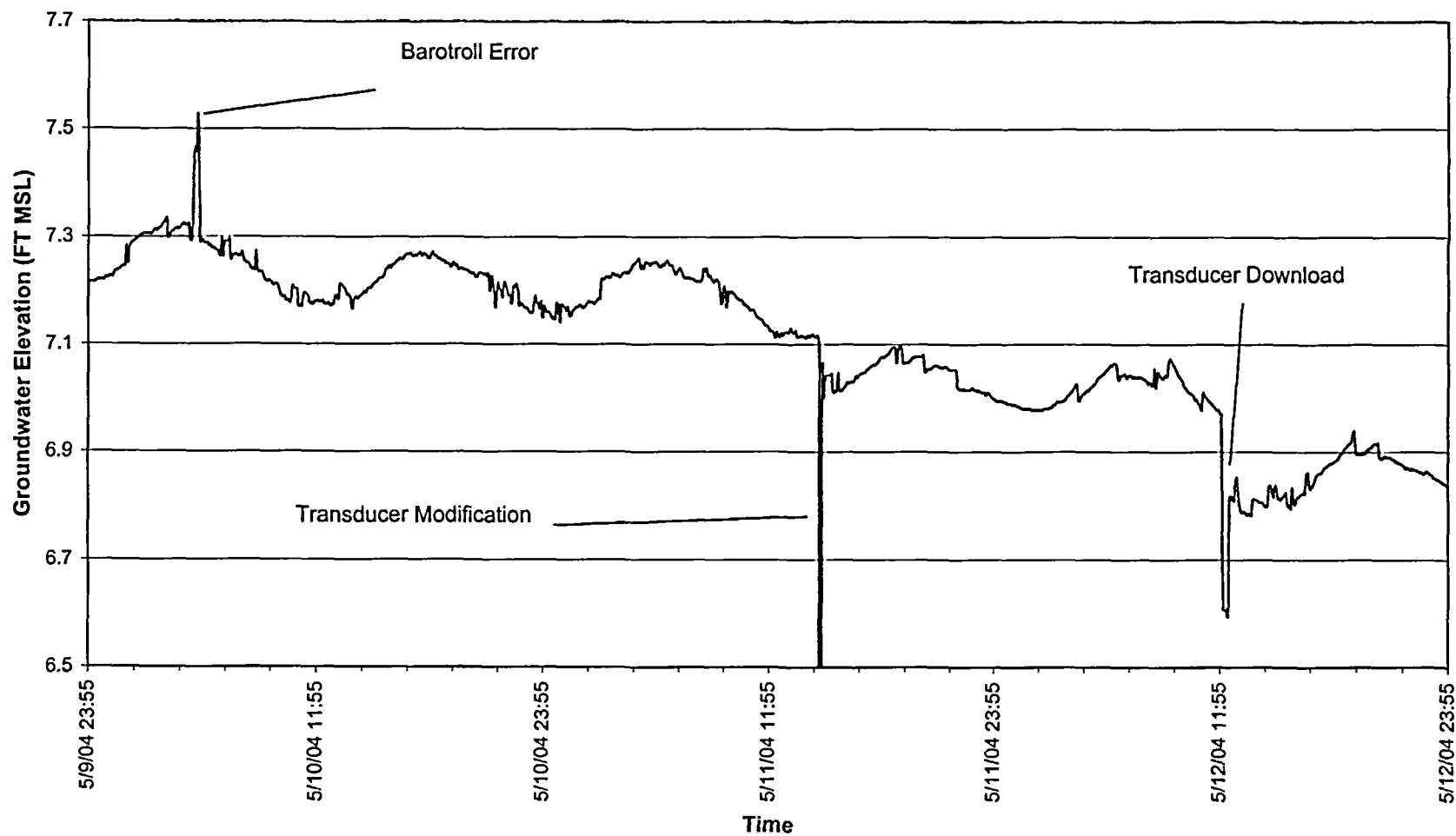
Groundwater at MW109D
2nd Quarter



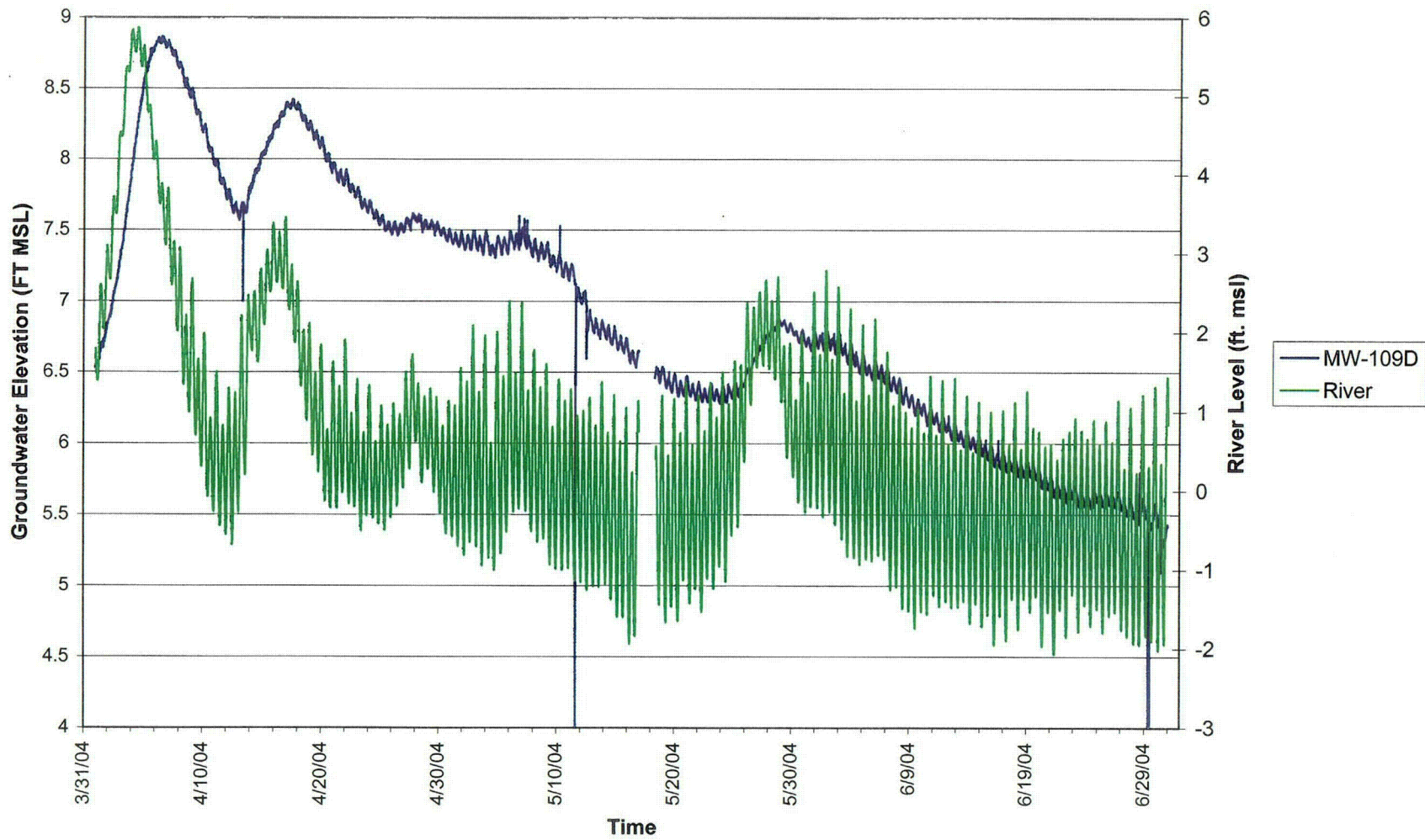
Groundwater at MW109D 2nd Quarter



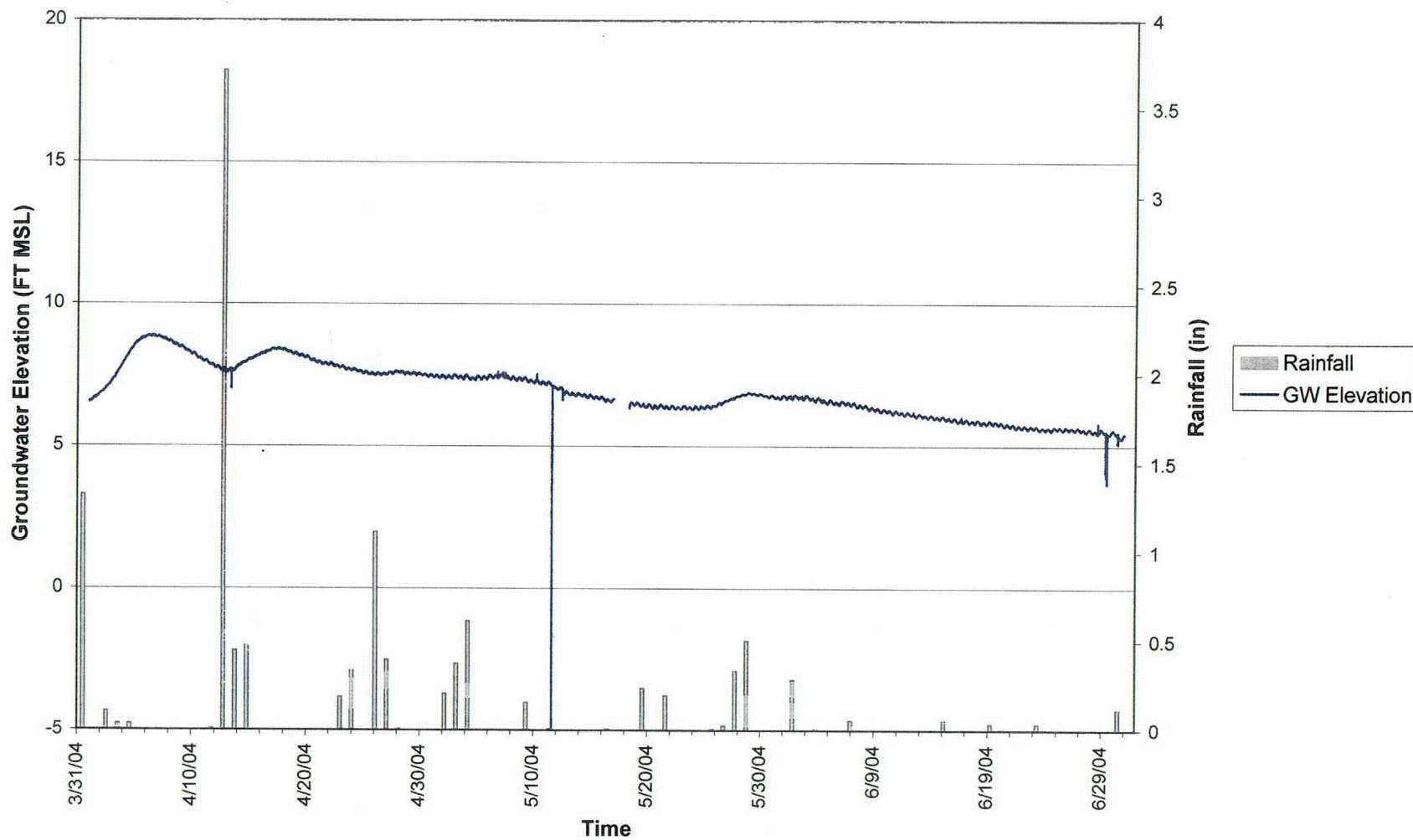
Detailed Area #1 of
Groundwater at MW109D
2nd Quarter



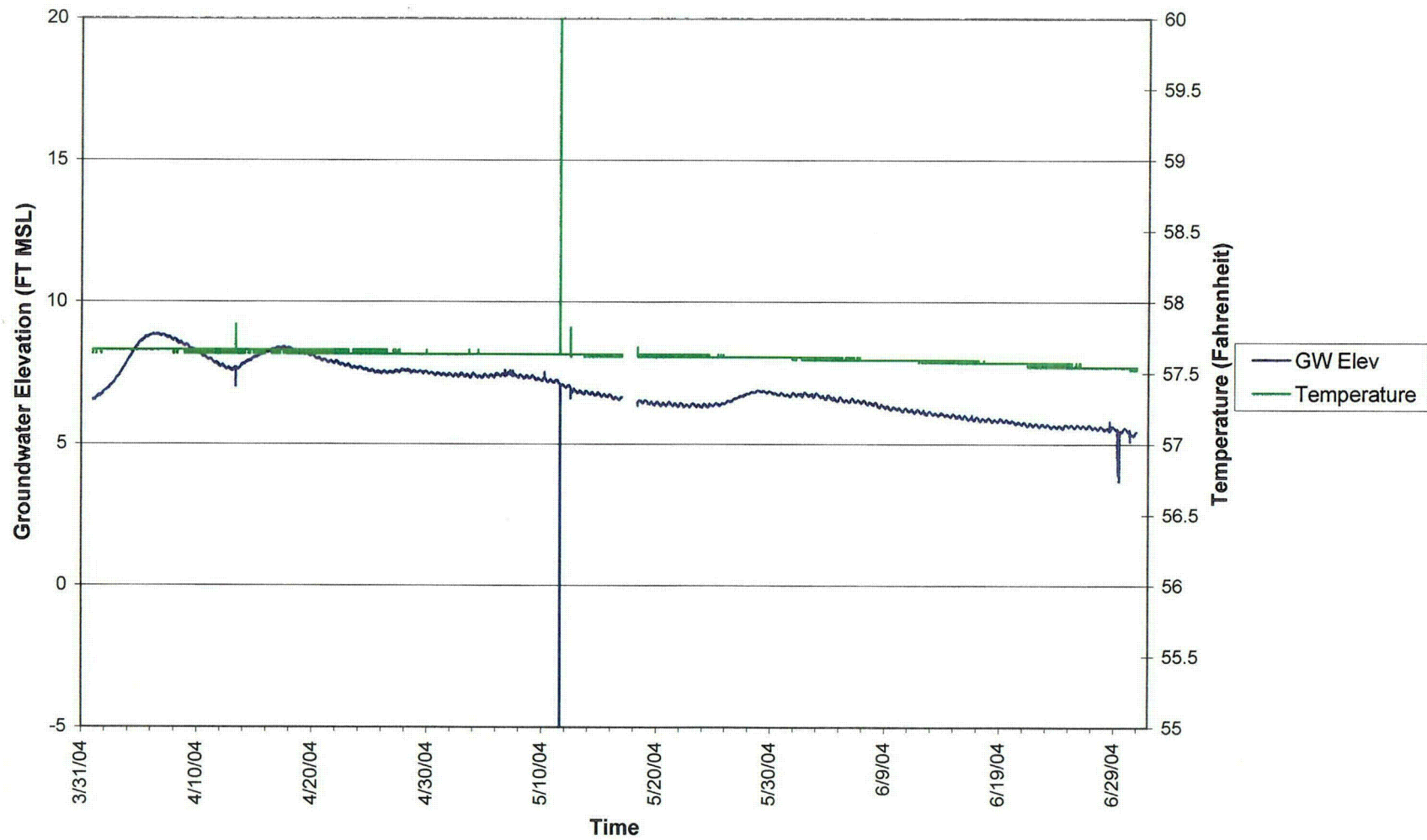
Groundwater at MW109D
2nd Quarter



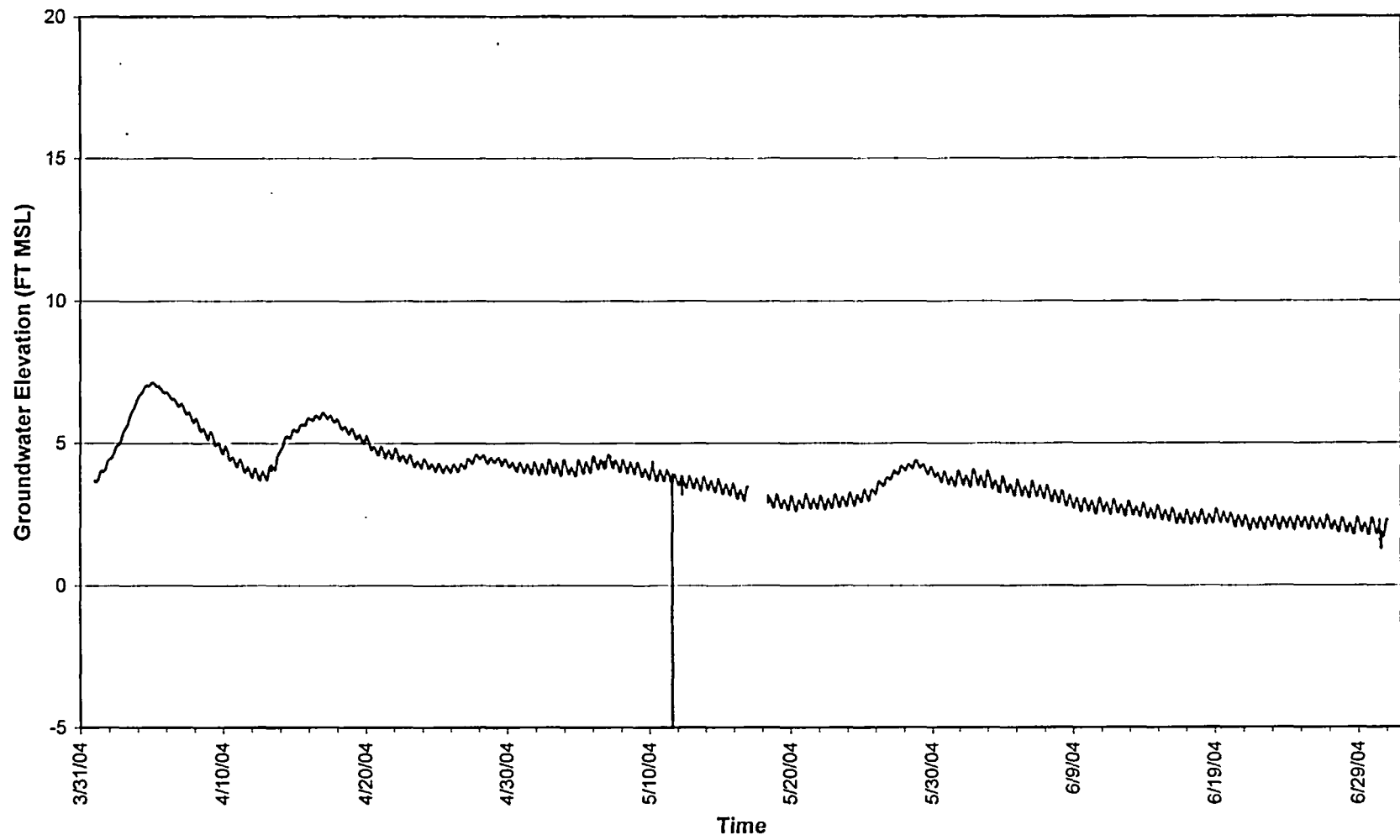
MW109D Groundwater and Daily Rainfall Totals
2nd Quarter



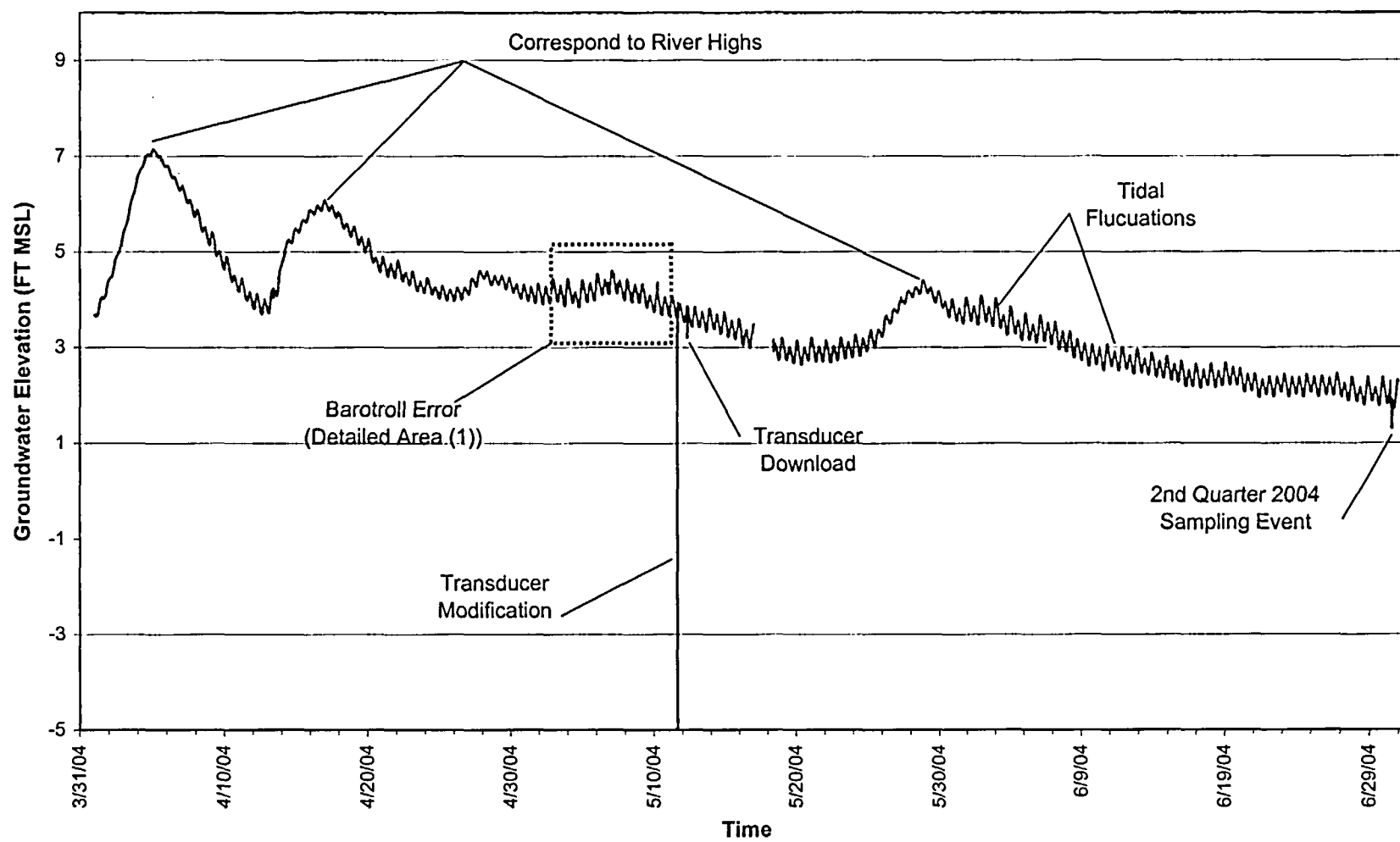
MW109D Groundwater Elevation and Temperature 2nd Quarter



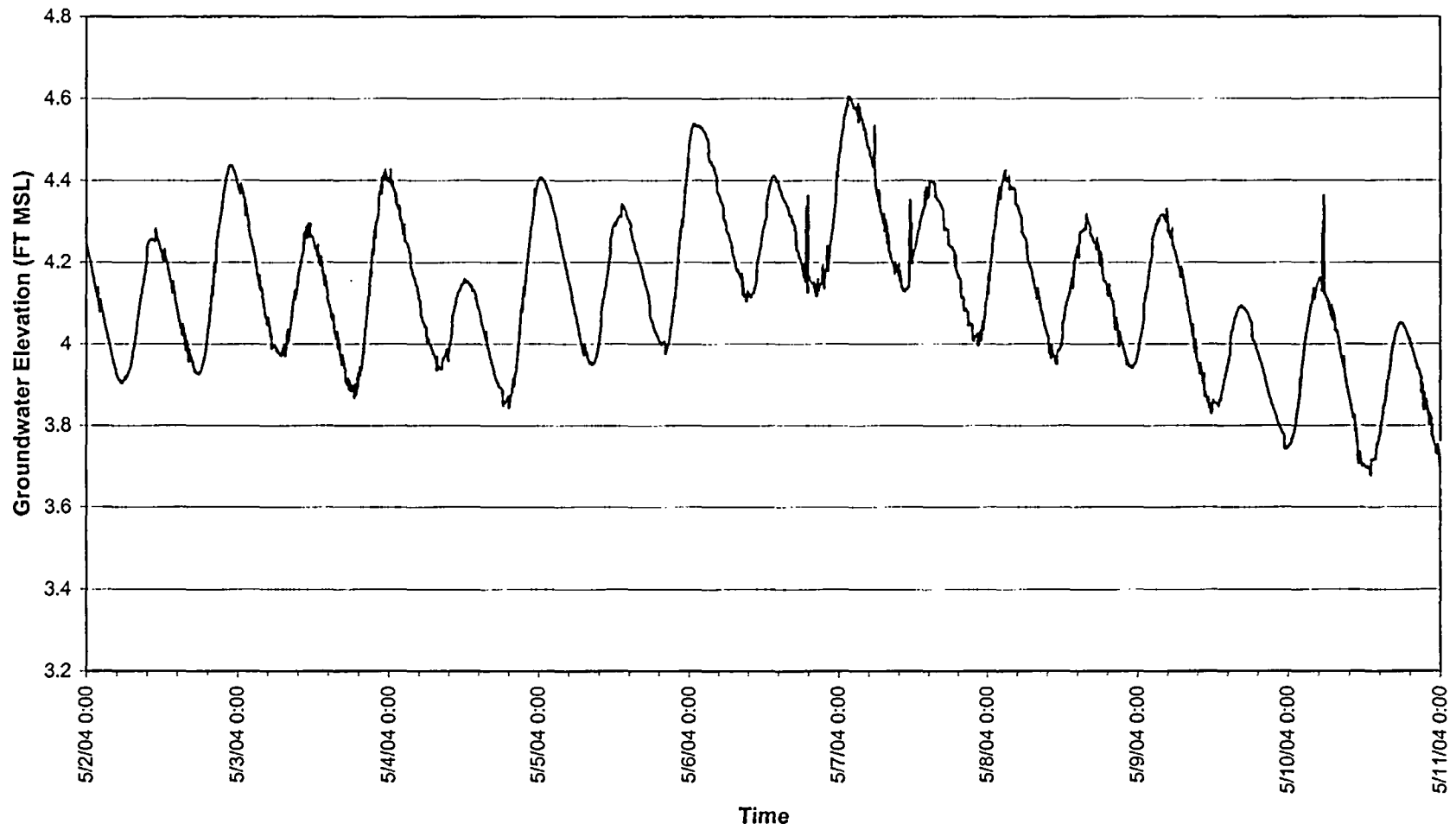
Groundwater at MW-110D
2nd Quarter



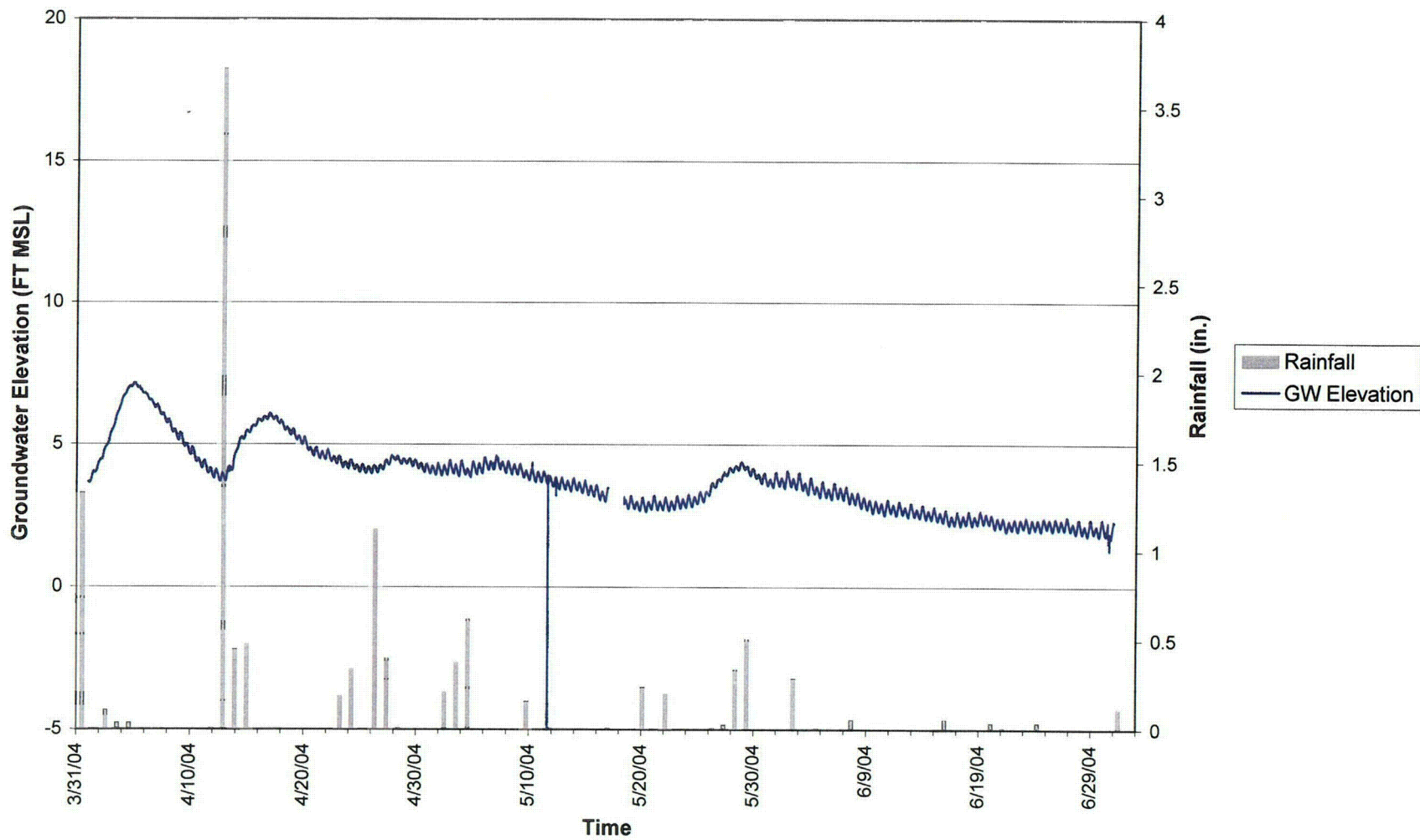
Groundwater at MW-110D 2nd Quarter



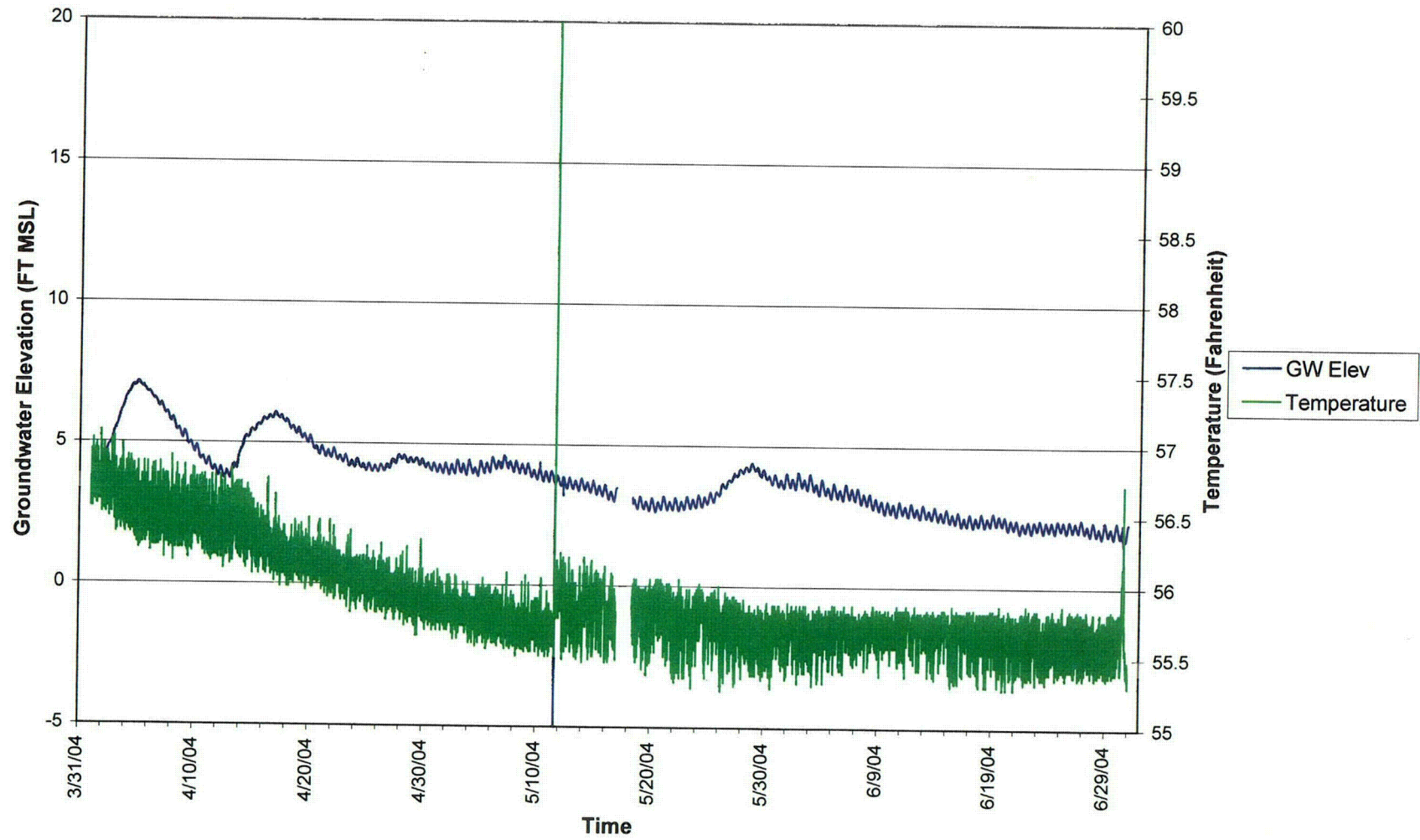
Detailed Area
Groundwater at MW-110D
2nd Quarter



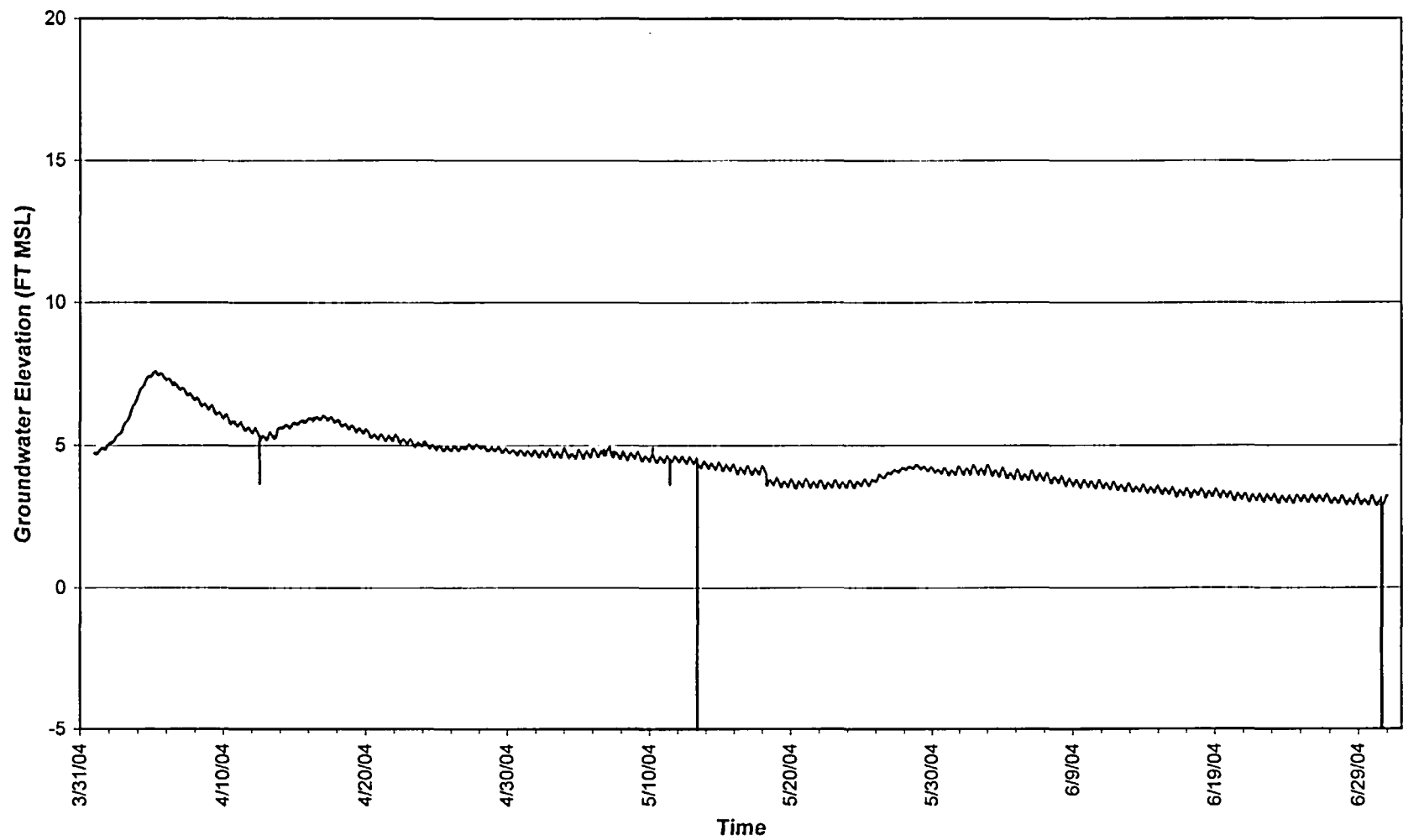
MW-110D Groundwater Elevation and Daily Rainfall Totals
2nd Quarter



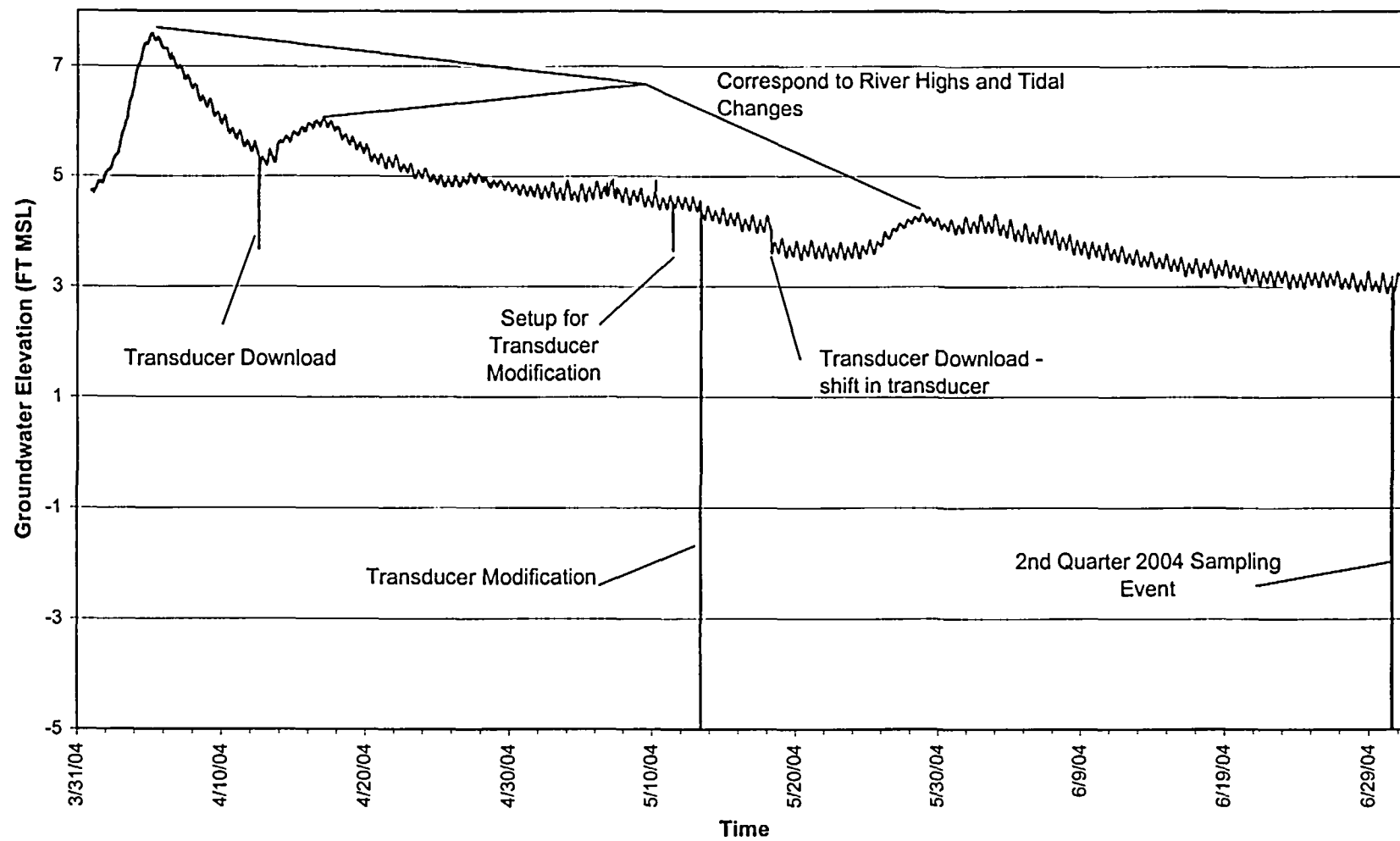
MW-110D Groundwater Elevation and Temperature 2nd Quarter



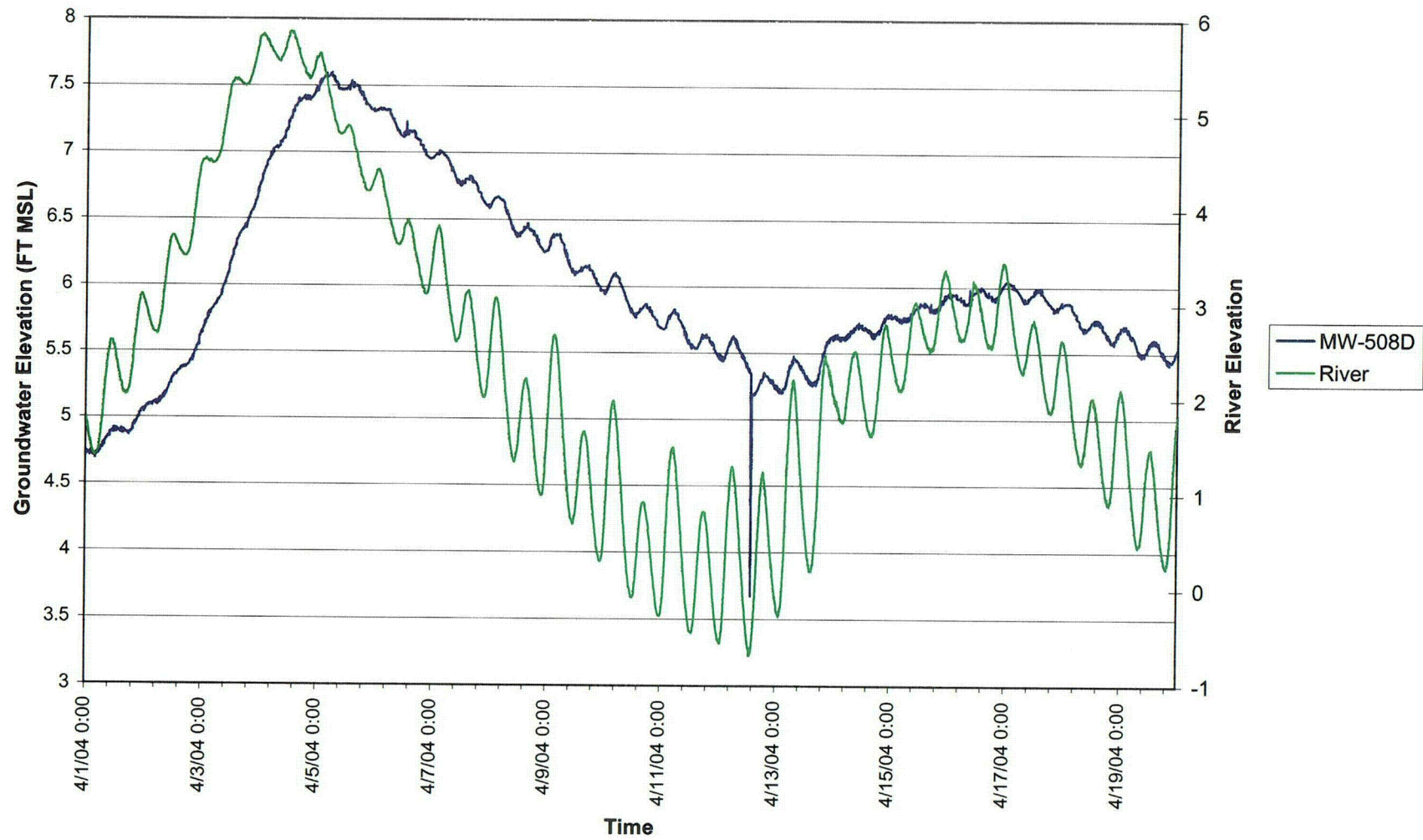
Groundwater at MW-508D
2nd Quarter



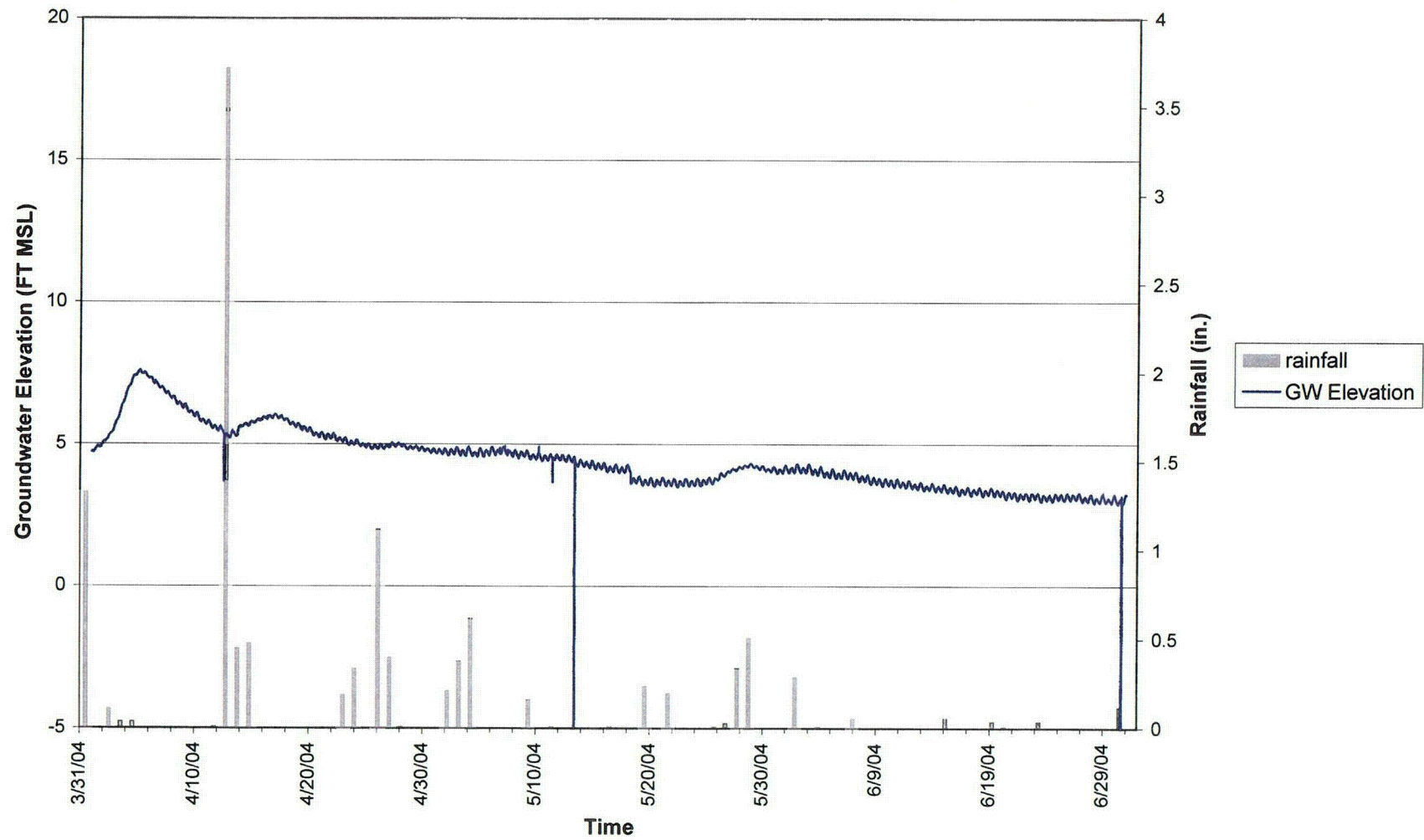
Groundwater at MW-508D
2nd Quarter



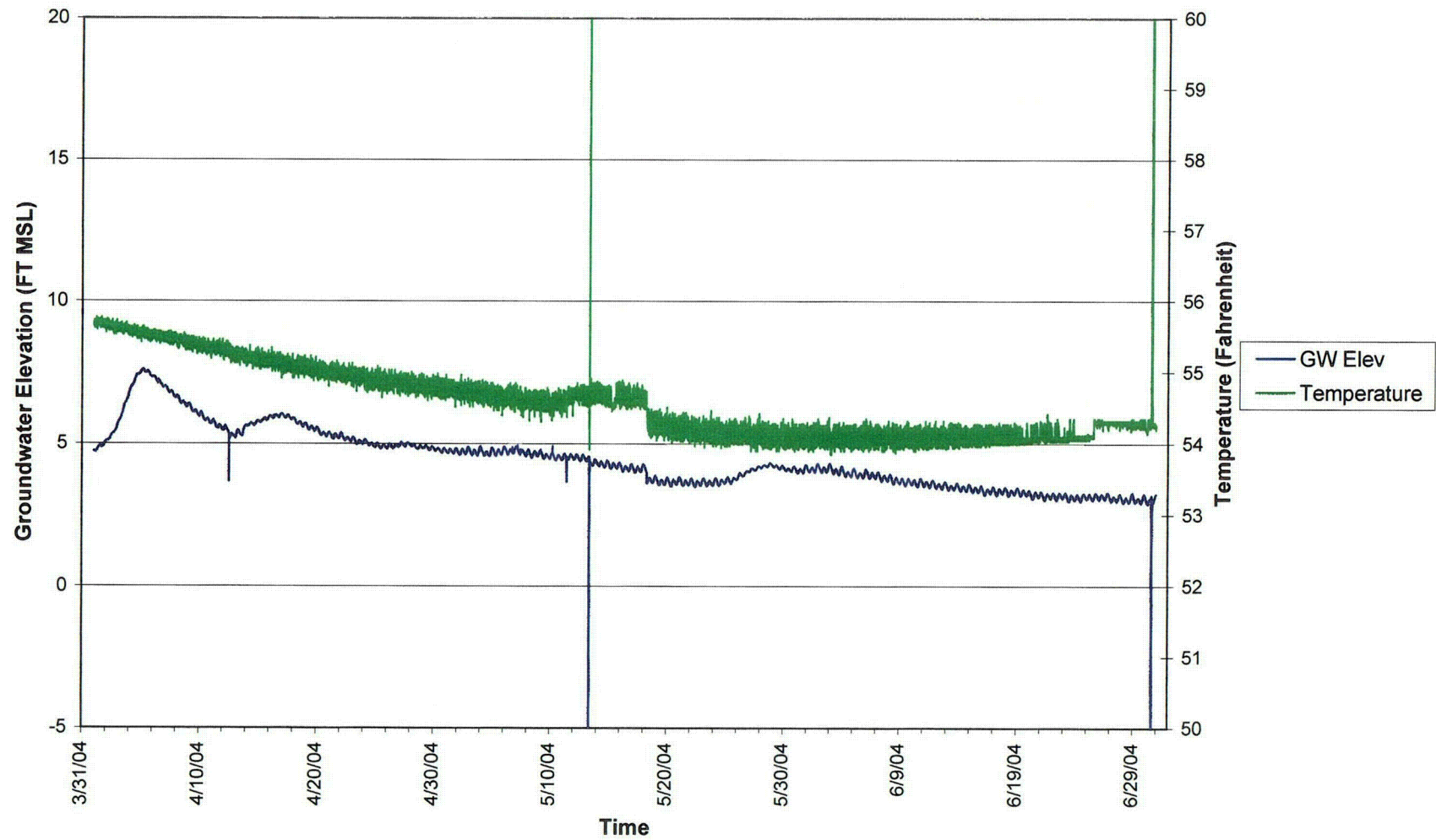
Groundwater at MW-508D and the River 2nd Quarter



MW-508D Groundwater Elevation and Daily Rainfall Totals
2nd Quarter



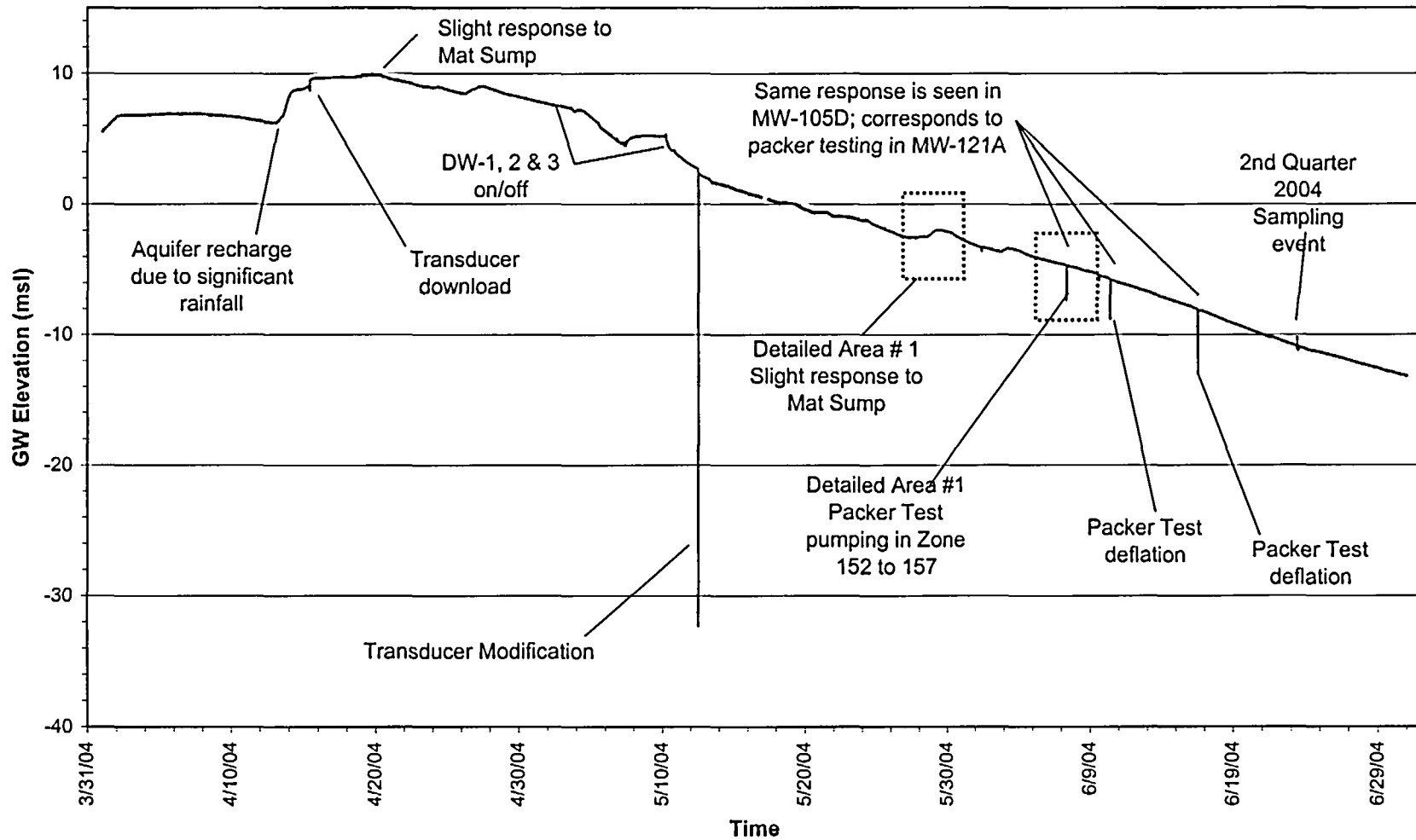
MW-508D Groundwater Elevation and Temperature 2nd Quarter



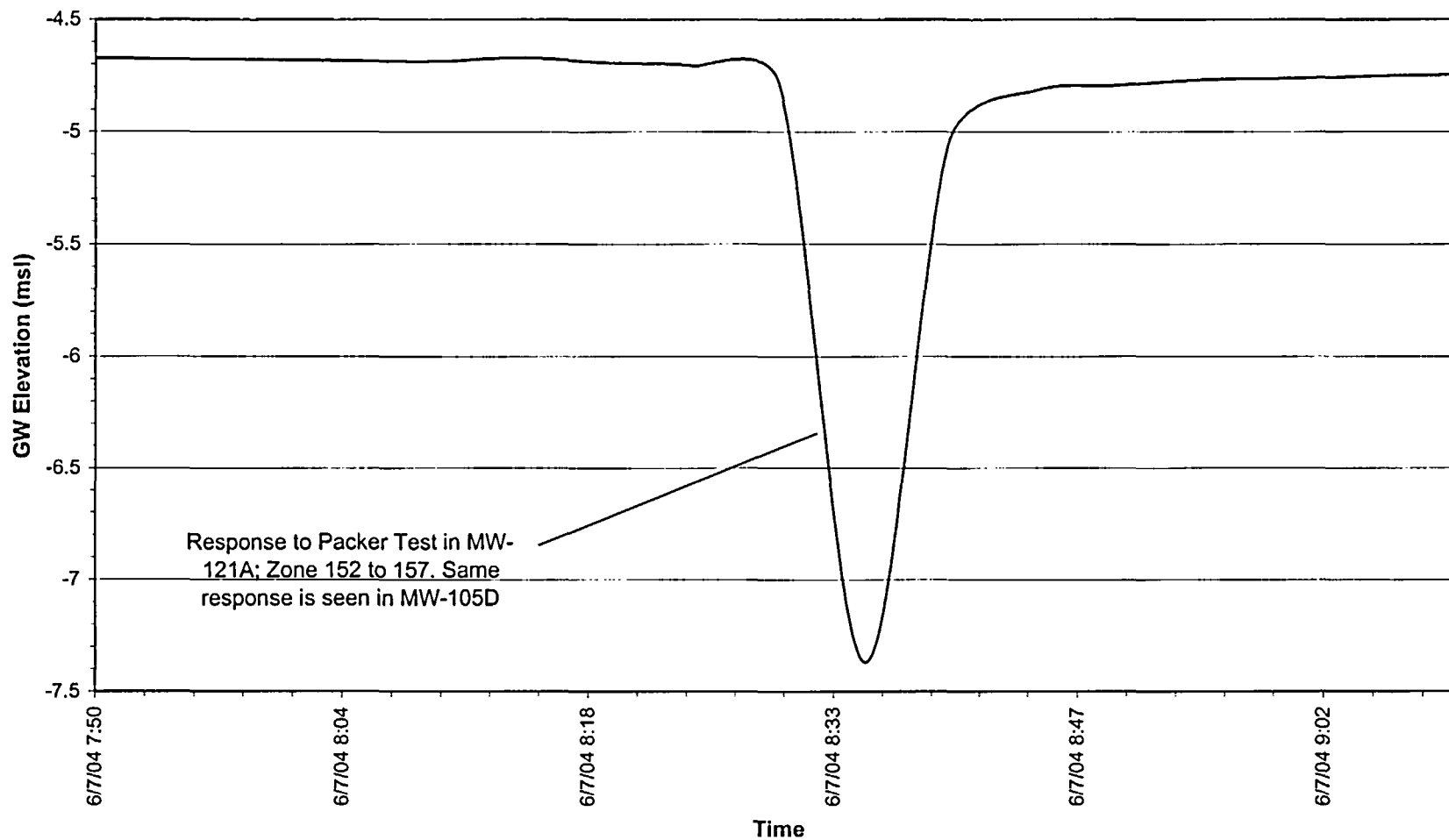
Groundwater Elevation at MW-101D
Second Quarter



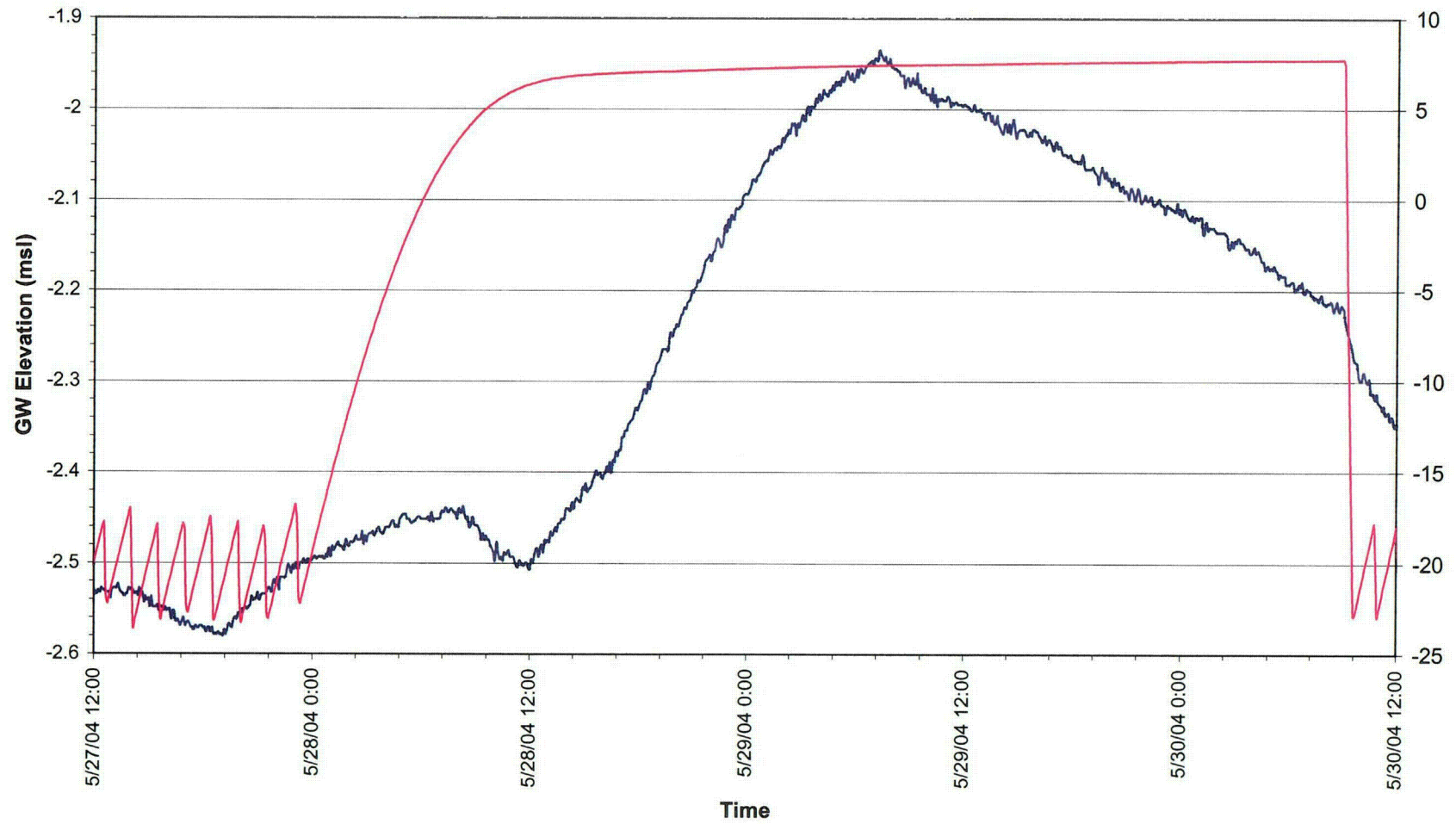
Groundwater Elevation at MW-101D Second Quarter



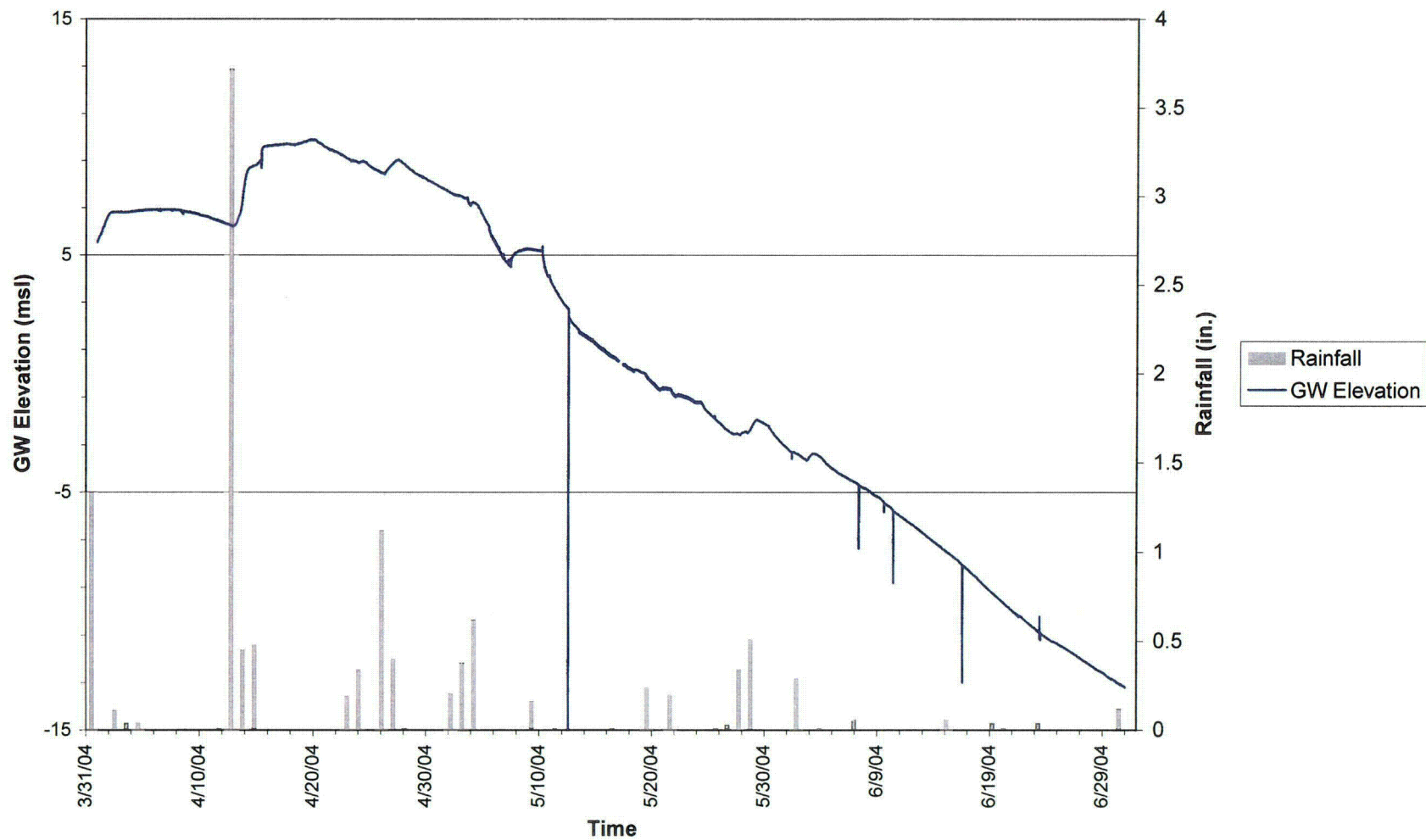
Detailed Area #2 of
Groundwater Elevation at MW-101D
Second Quarter



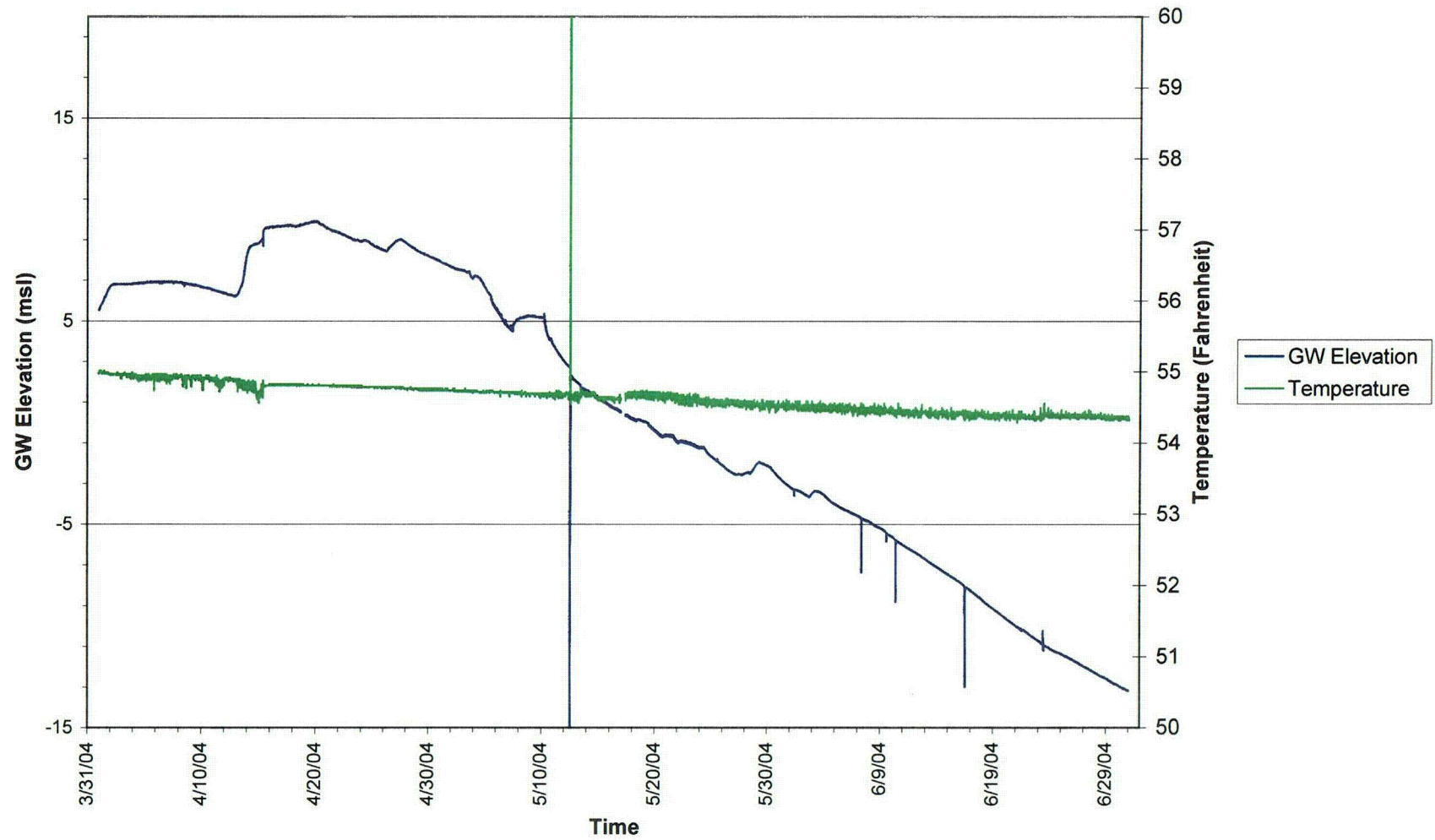
Detailed Area #1
Groundwater Elevation at MW-101D and the Mat Sump
Second Quarter



MW-101D Groundwater Elevation and Daily Rainfall Totals 2nd Quarter



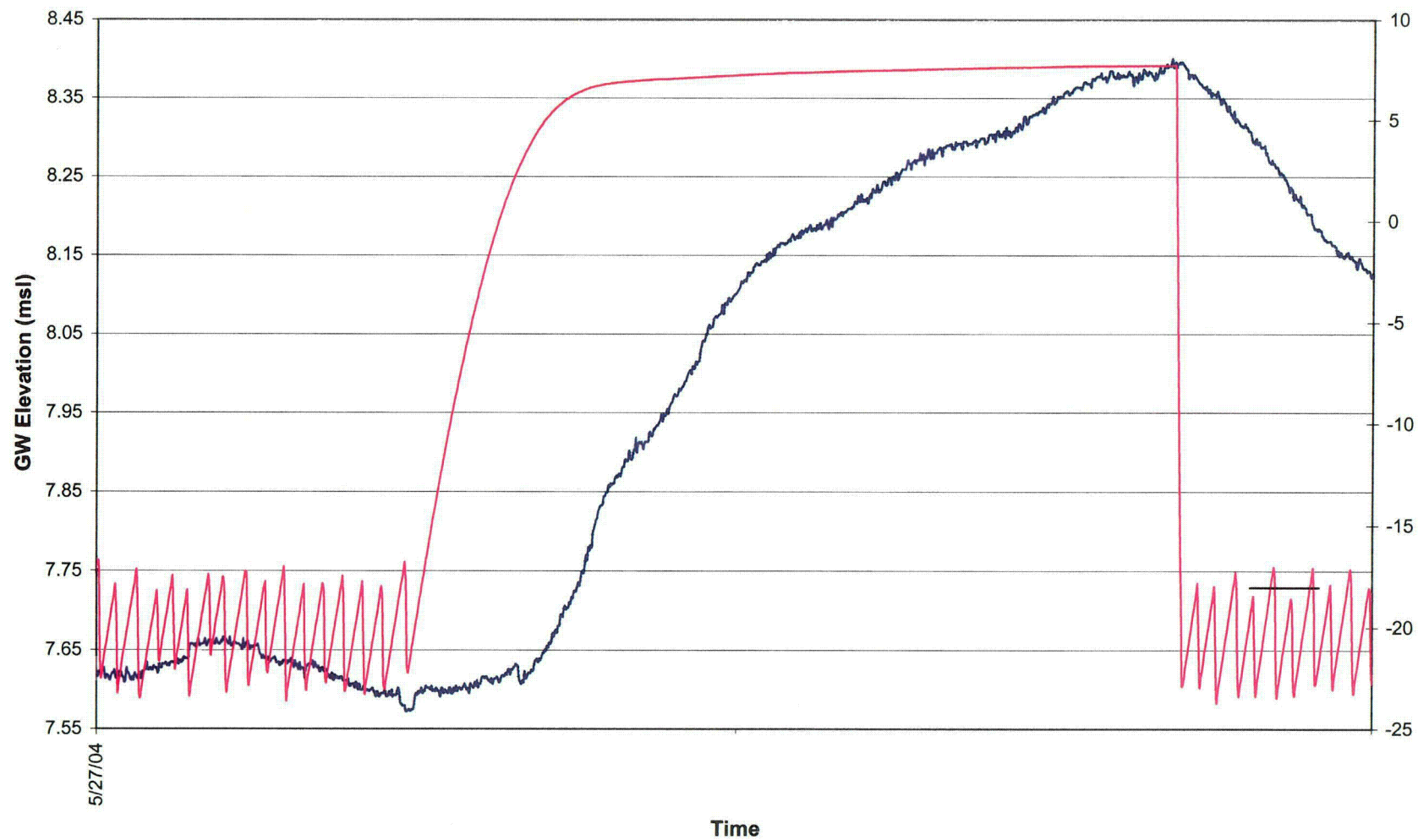
MW-101D Groundwater Elevation and Temperature 2nd Quarter



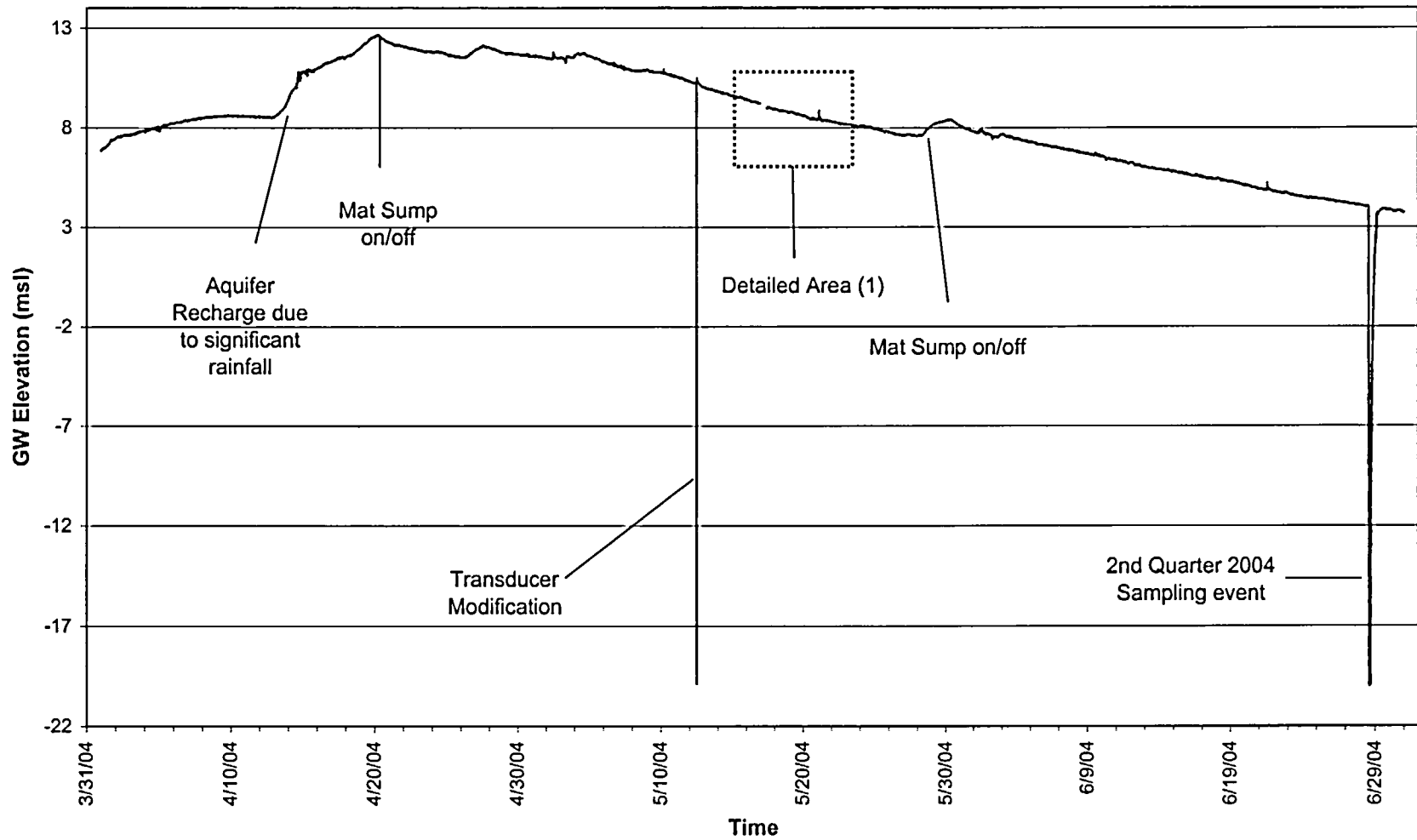
Groundwater Elevation MW-102D



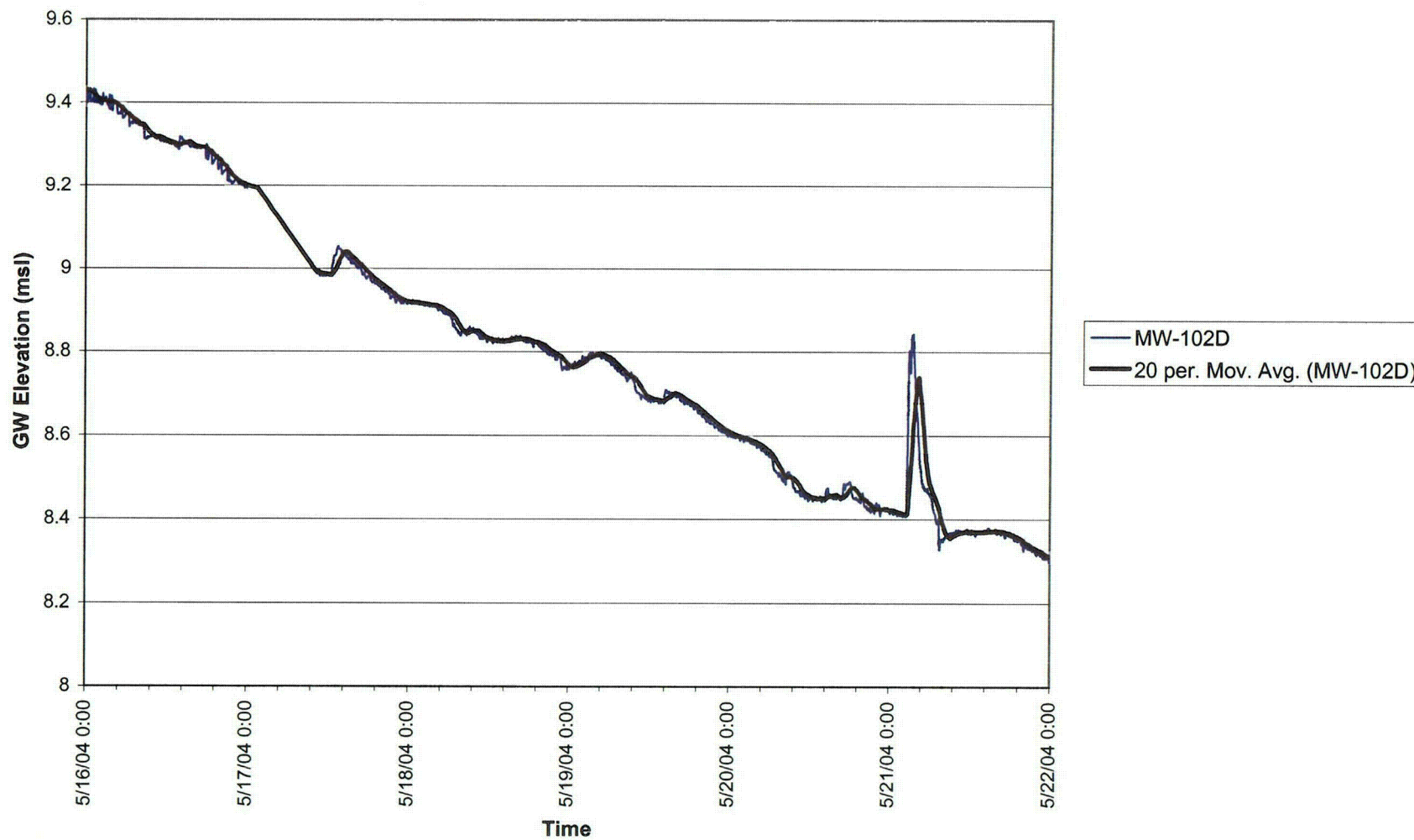
Groundwater Elevation MW-102D and the Mat Sump 2nd Quarter



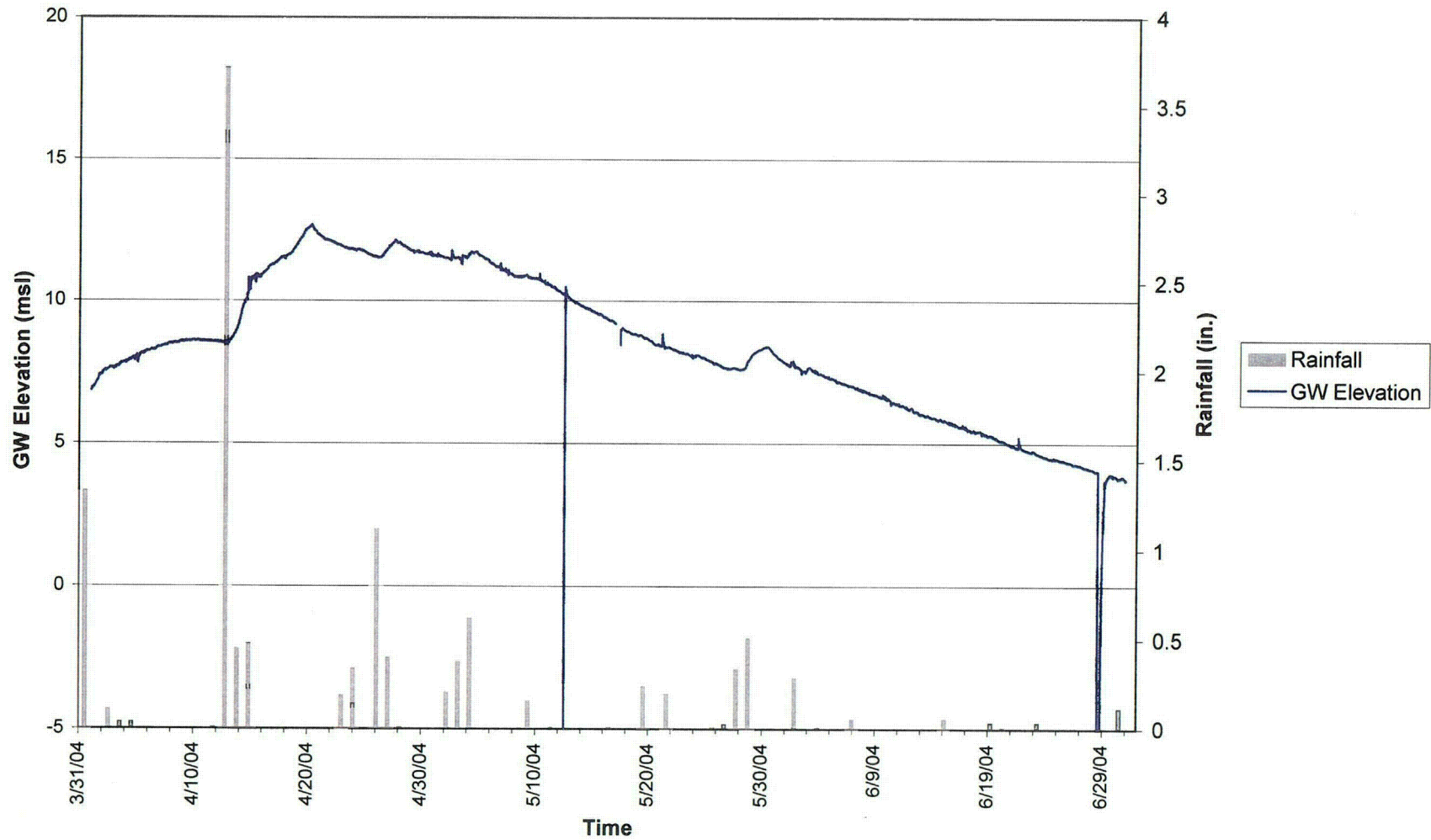
Groundwater Elevation MW-102D 2nd Quarter



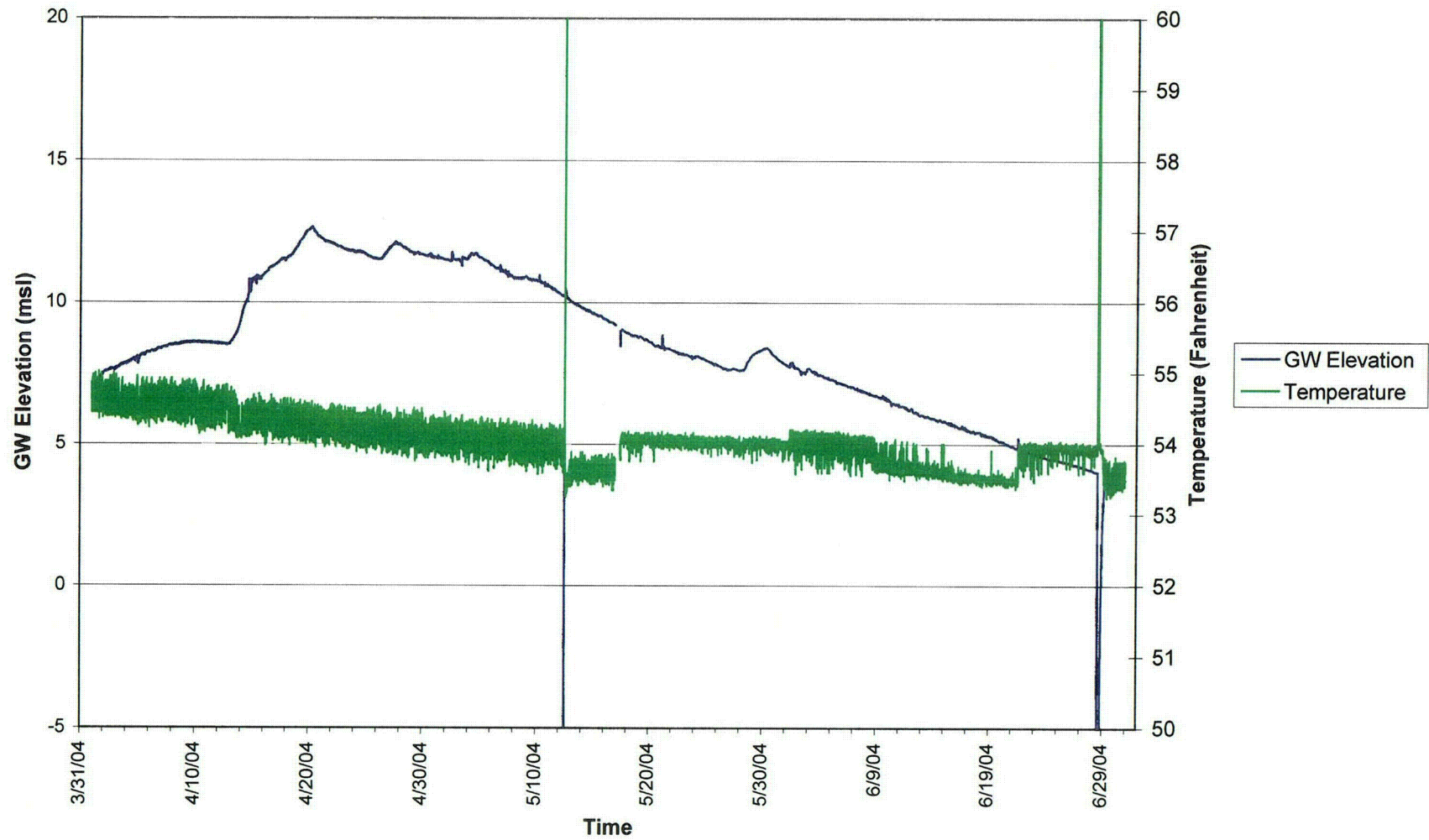
Groundwater Elevation MW-102D 2nd Quarter



MW-102D Groundwater Elevation and Daily Rainfall Totals
2nd Quarter



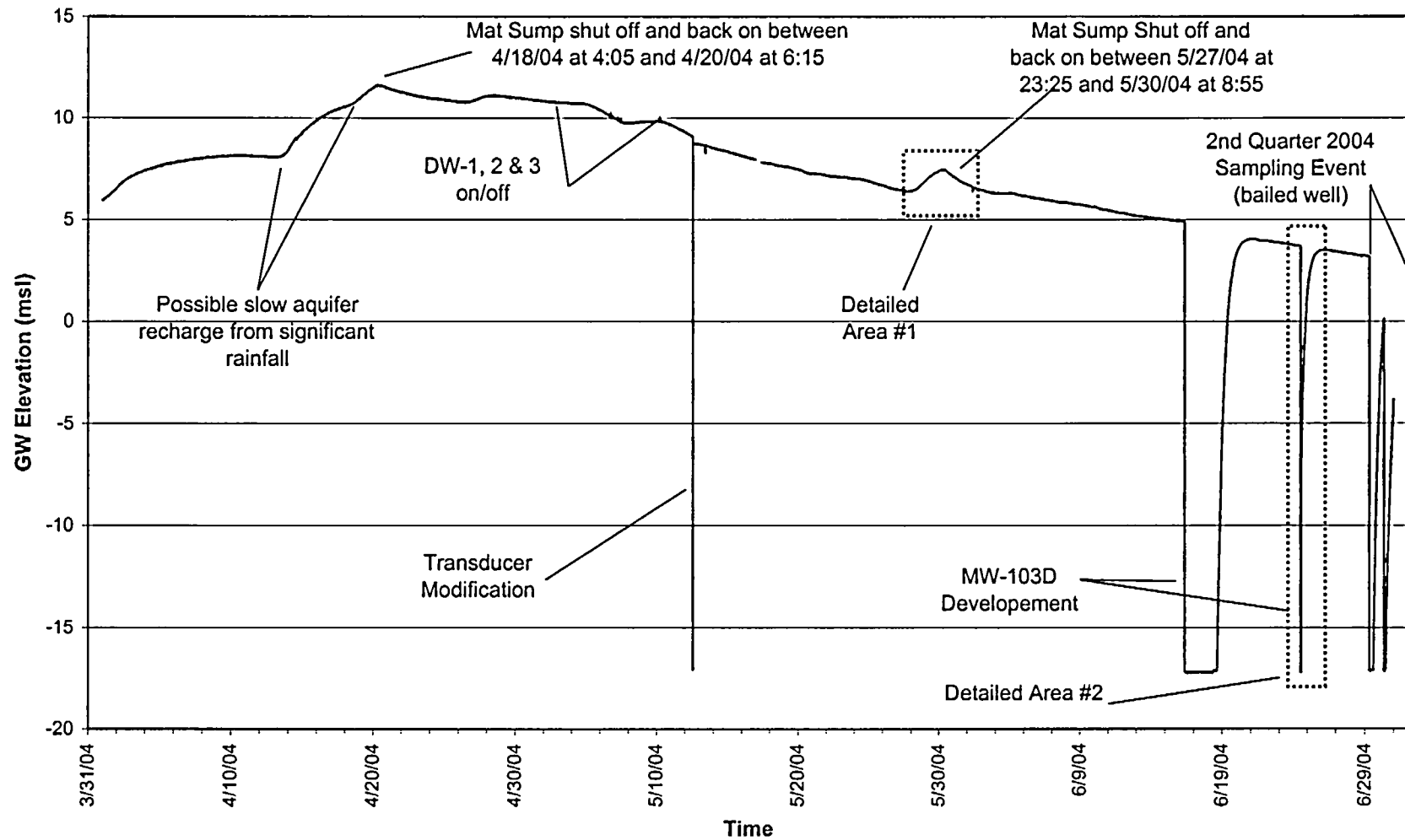
MW-102D Groundwater Elevation and Temperature 2nd Quarter



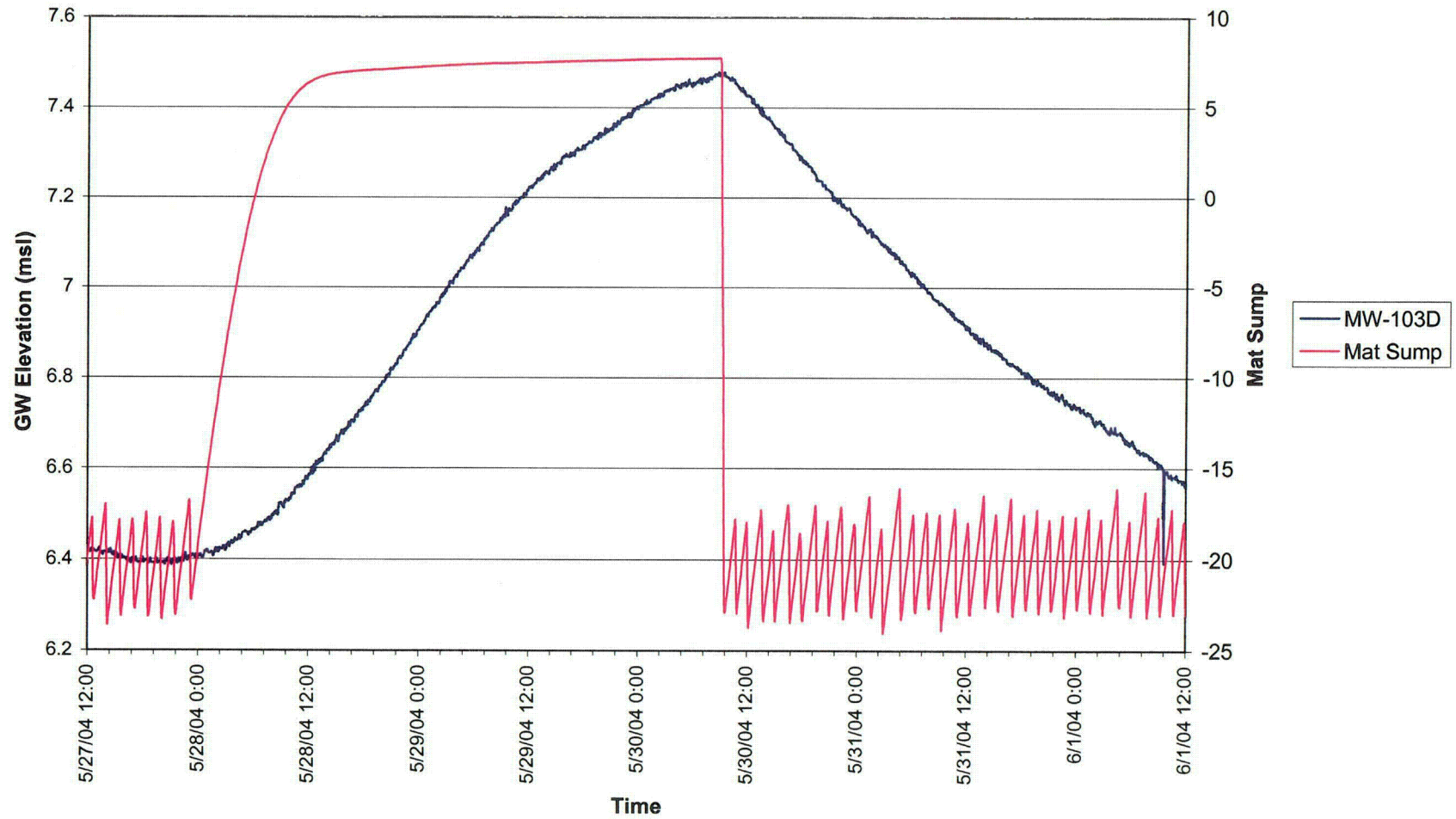
Groundwater Elevation at MW-103D
2nd Quarter



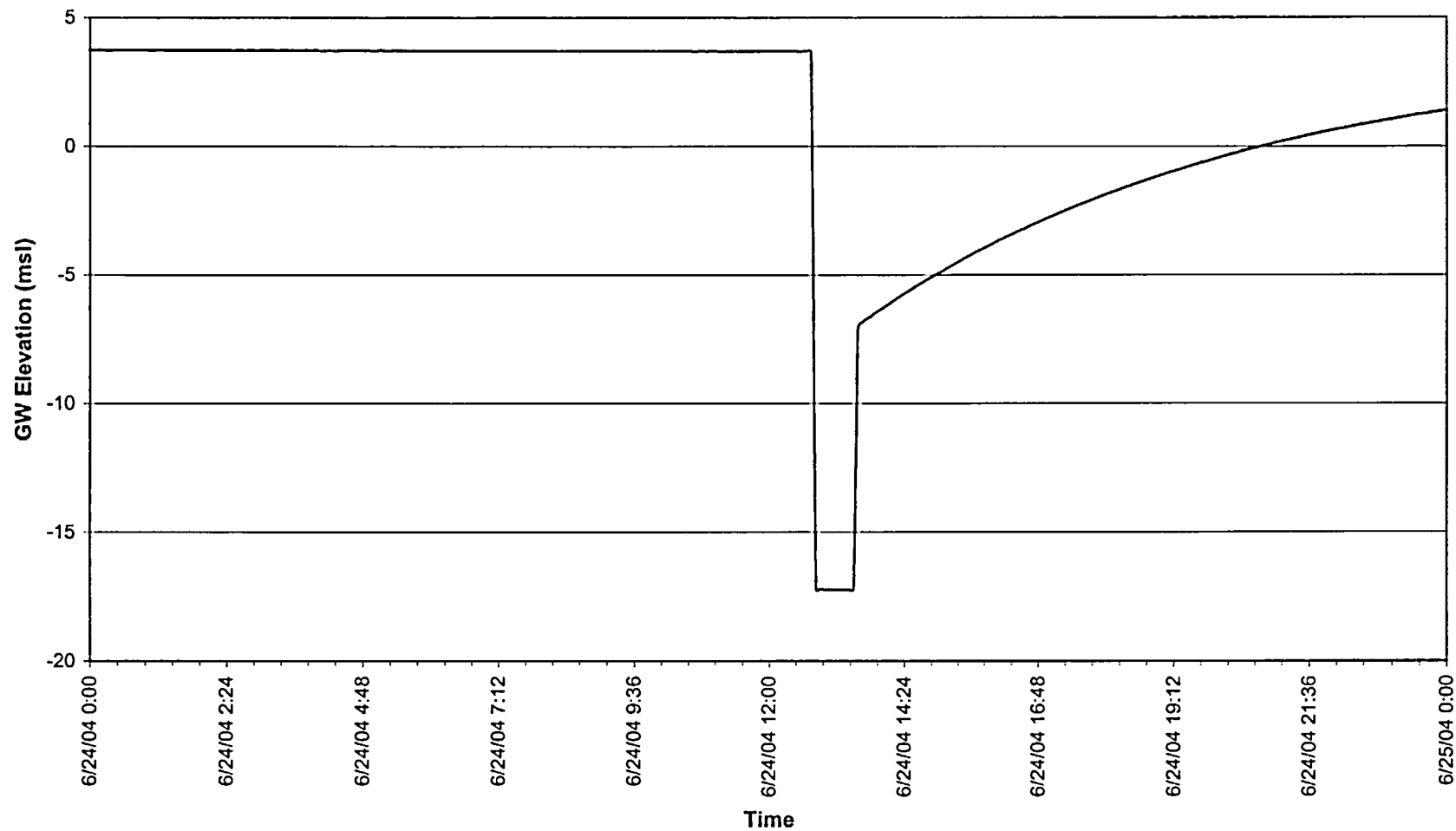
Groundwater Elevation at MW-103D 2nd Quarter



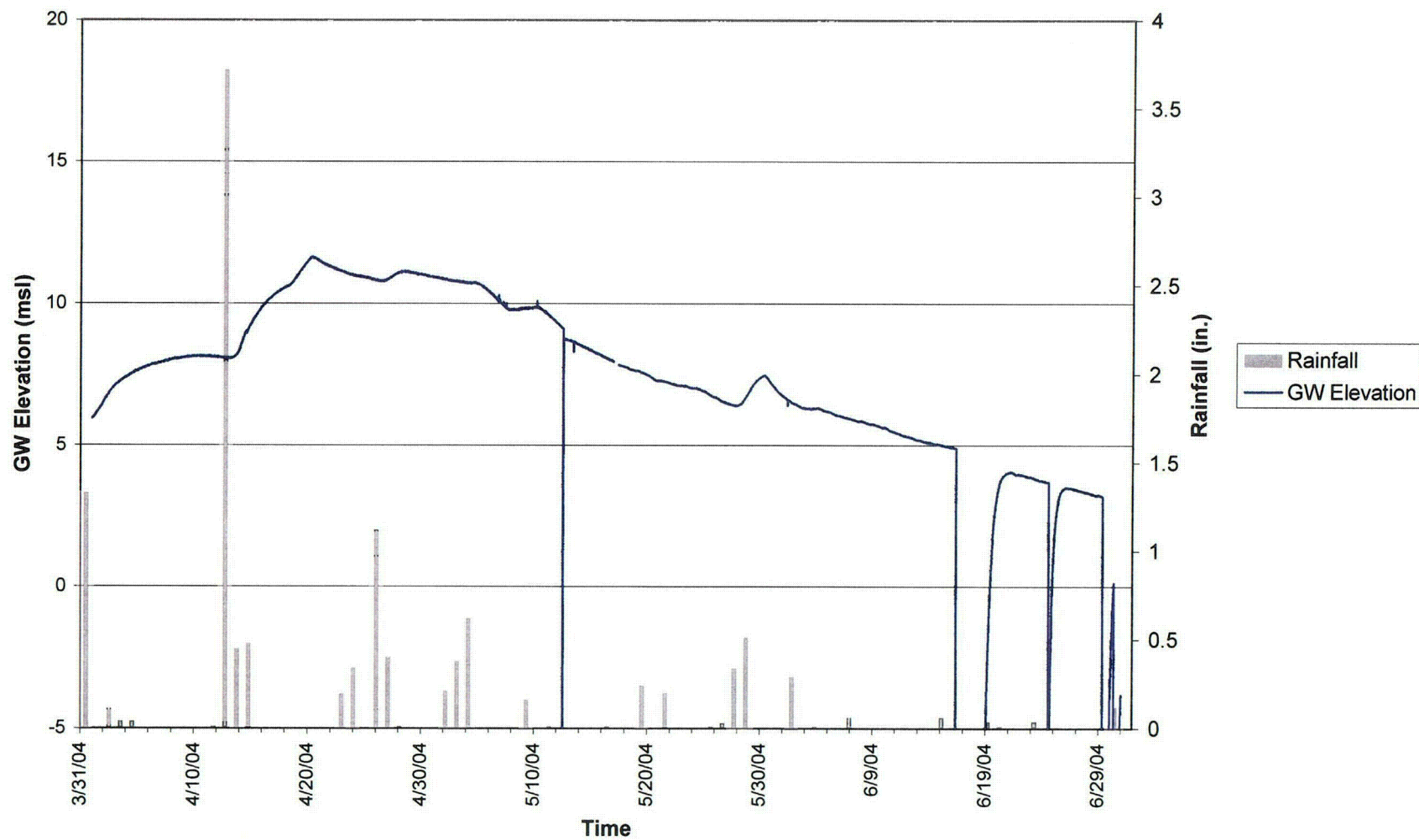
Detailed Area #1 of
Groundwater Elevation at MW-103D
2nd Quarter



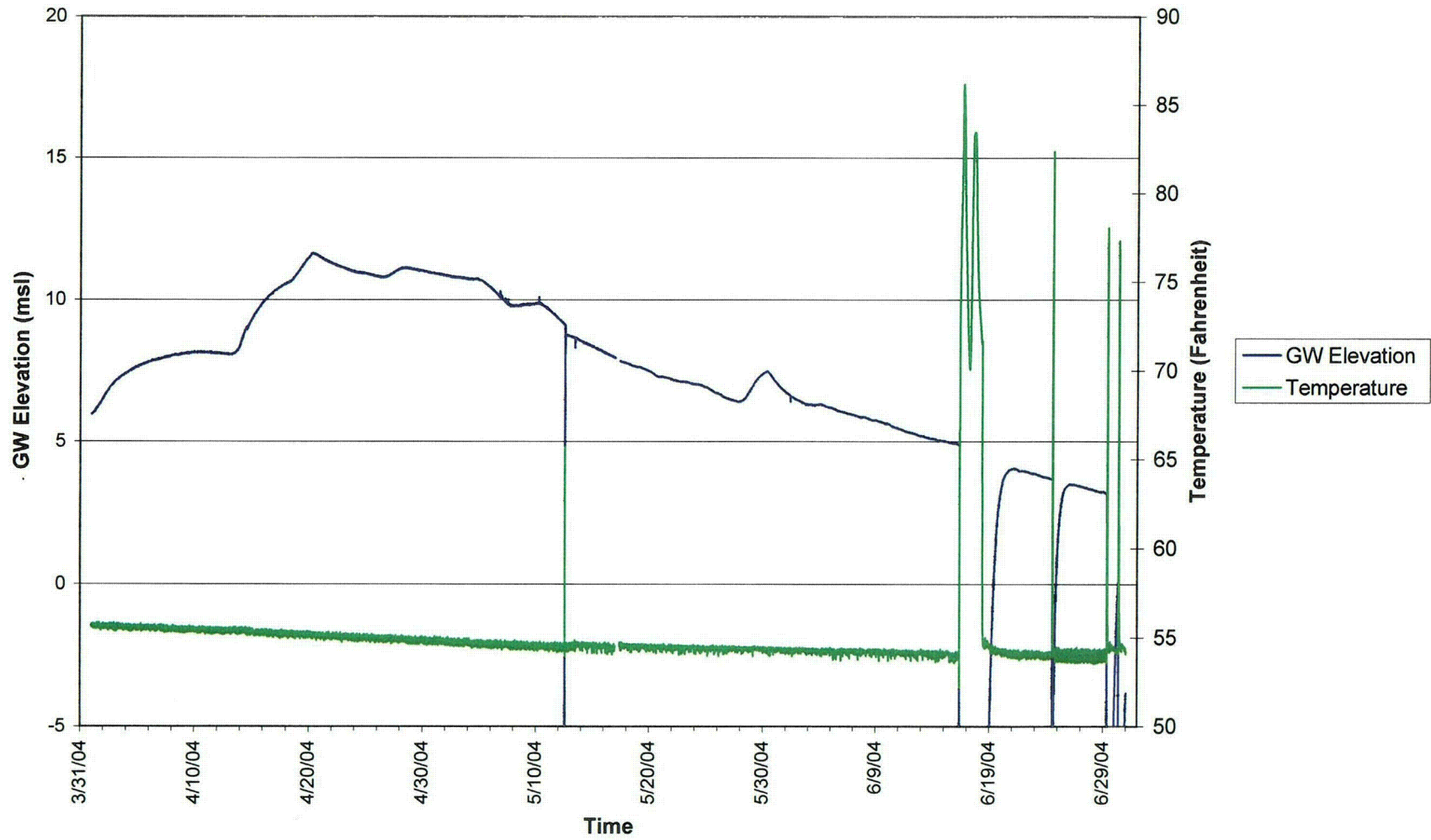
Detailed Area #2
Groundwater Elevation at MW-103D
2nd Quarter



MW-103D Groundwater Elevation and Daily Rainfall Totals
2nd Quarter



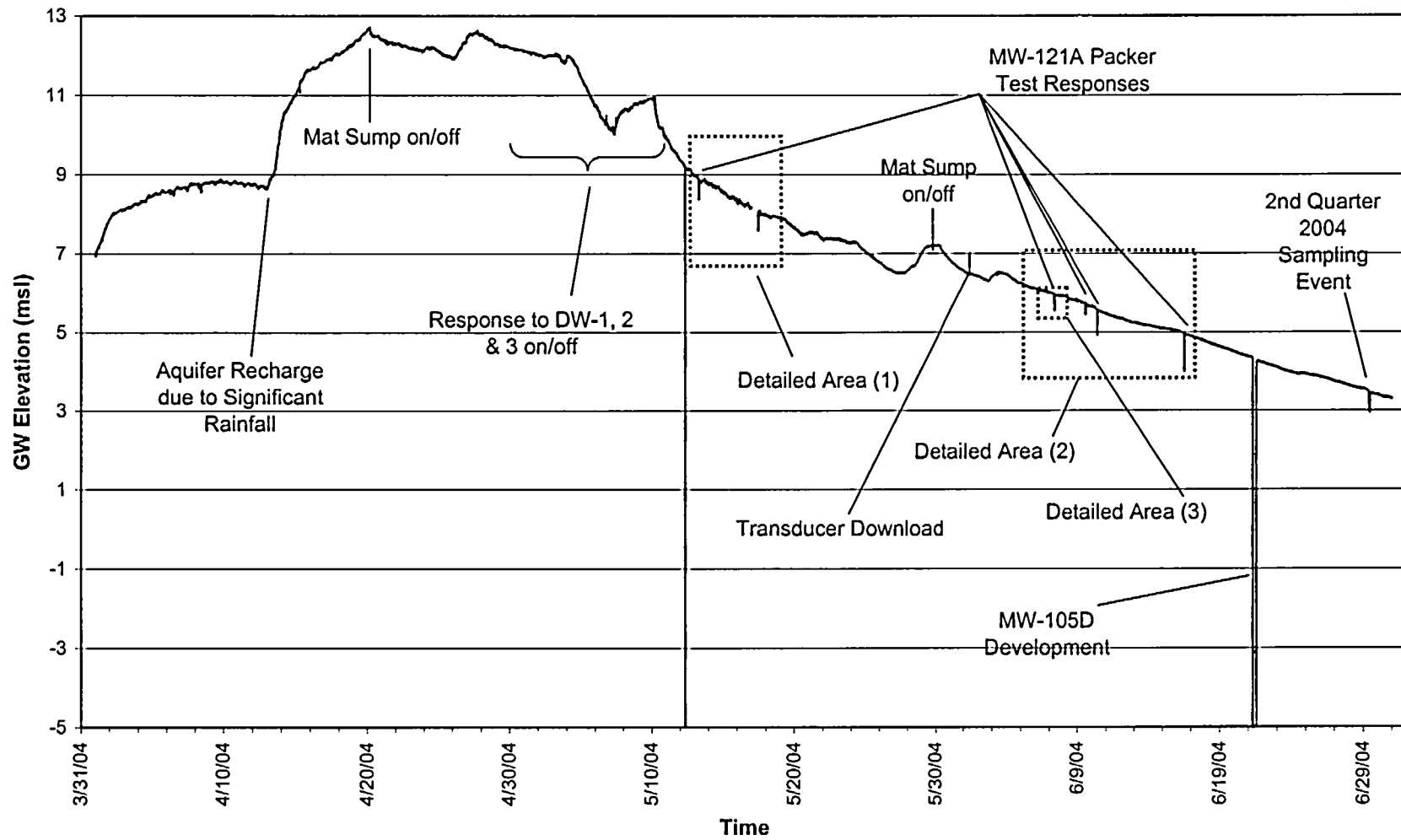
MW-103D Groundwater Elevation and Temperature 2nd Quarter



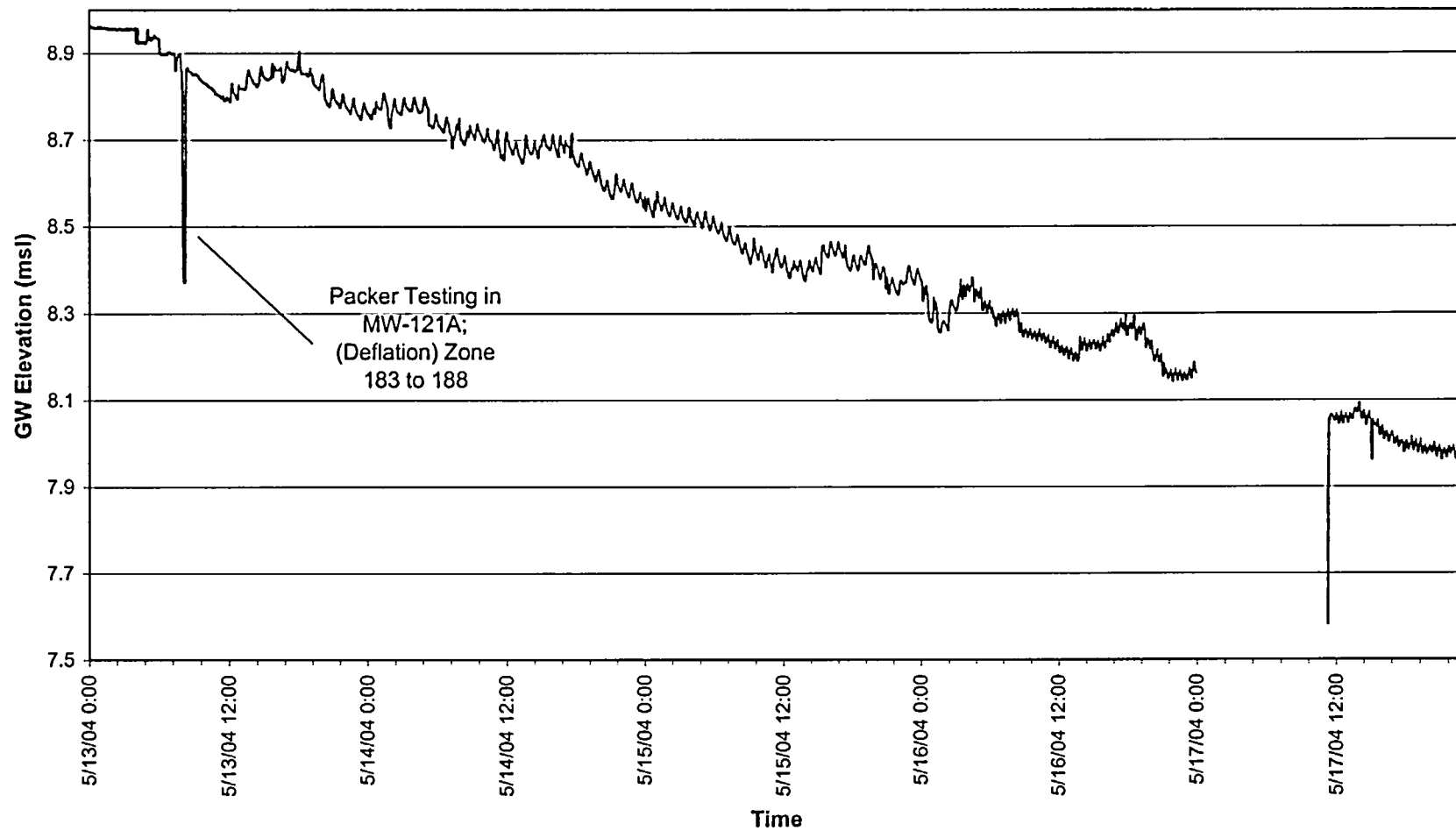
Groundwater Elevation at MW-105D
2nd Quarter



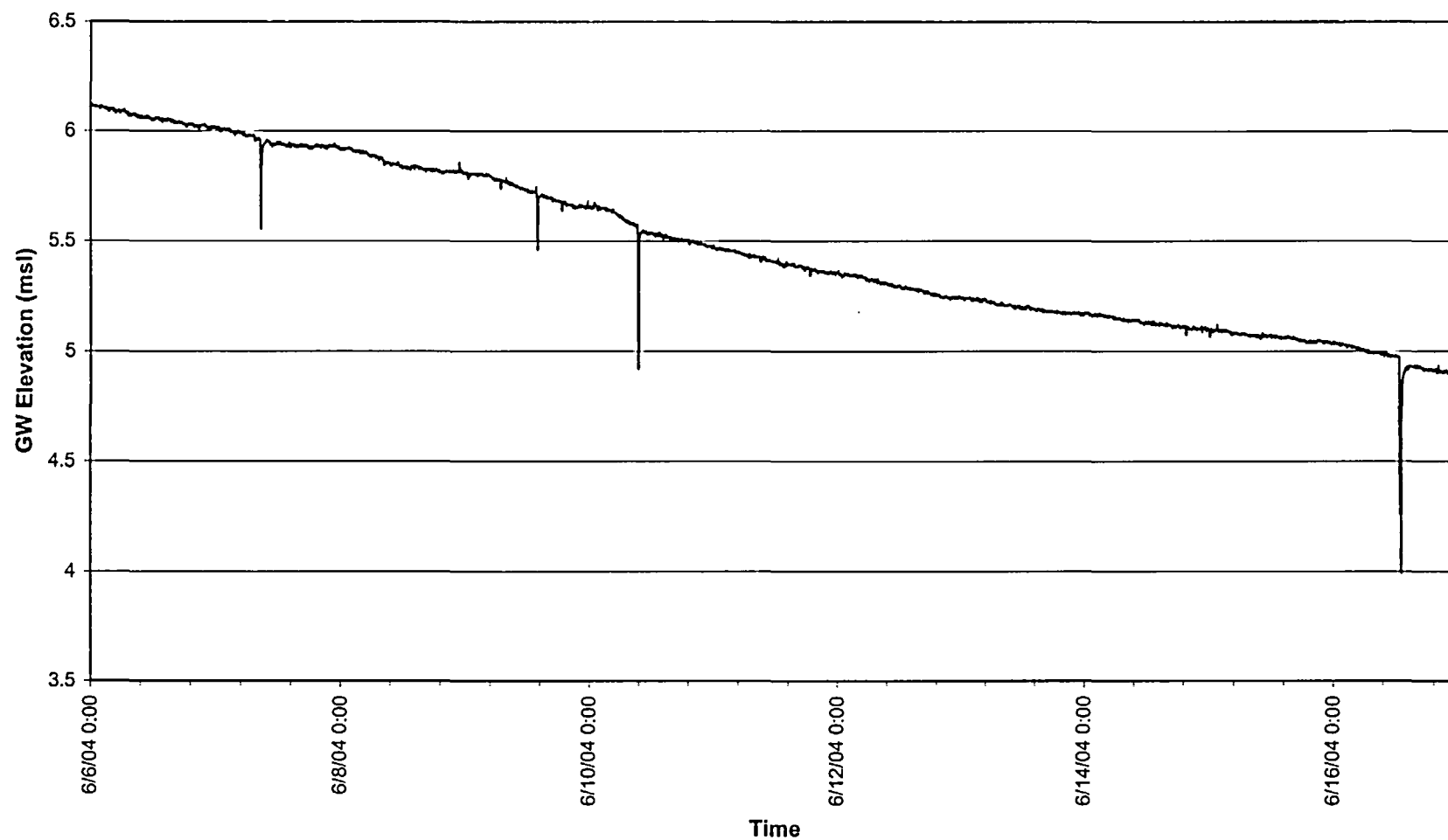
Groundwater Elevation at MW-105D 2nd Quarter



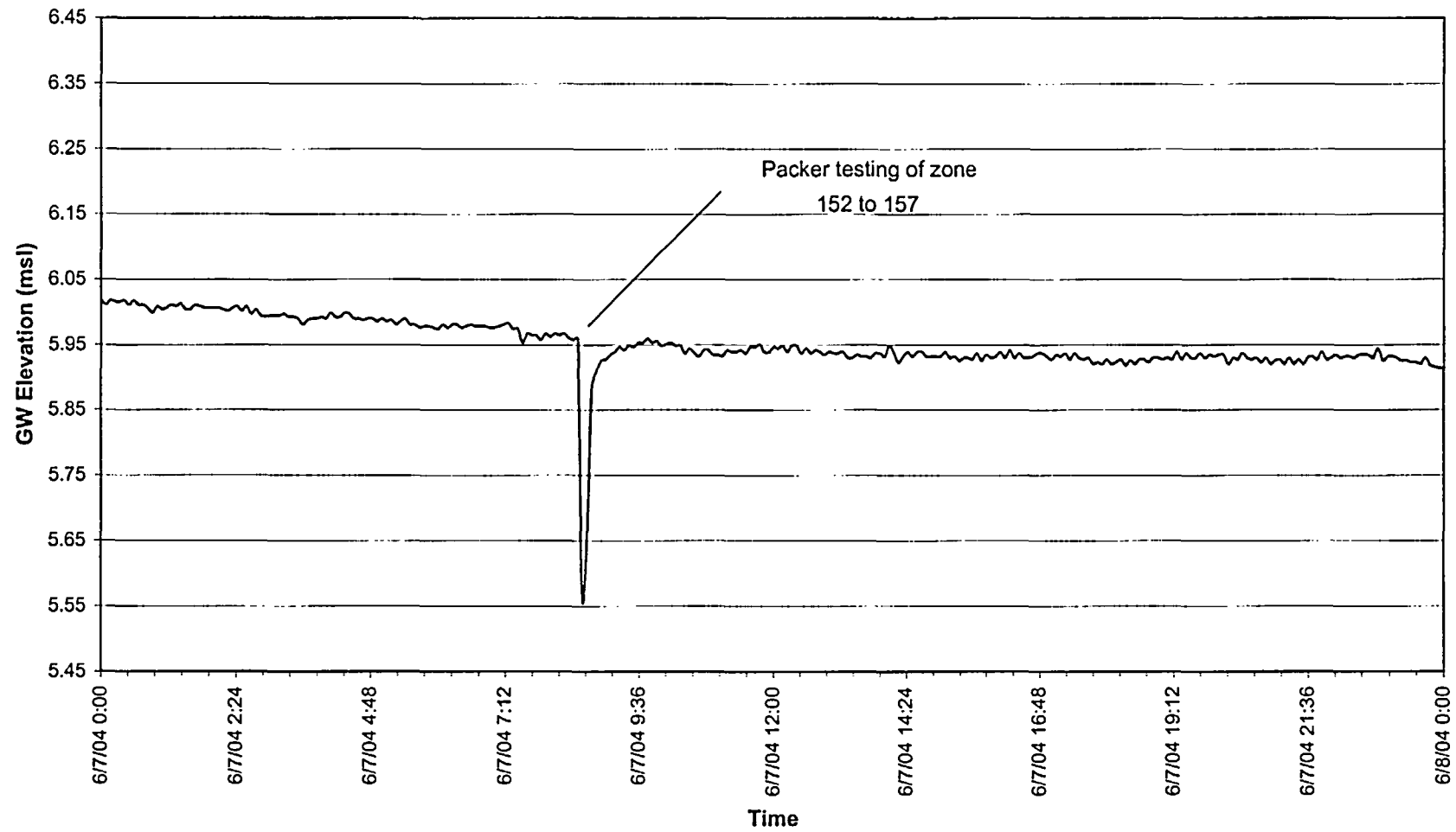
Detailed Area #1 of
Groundwater Elevation at MW-105D
2nd Quarter



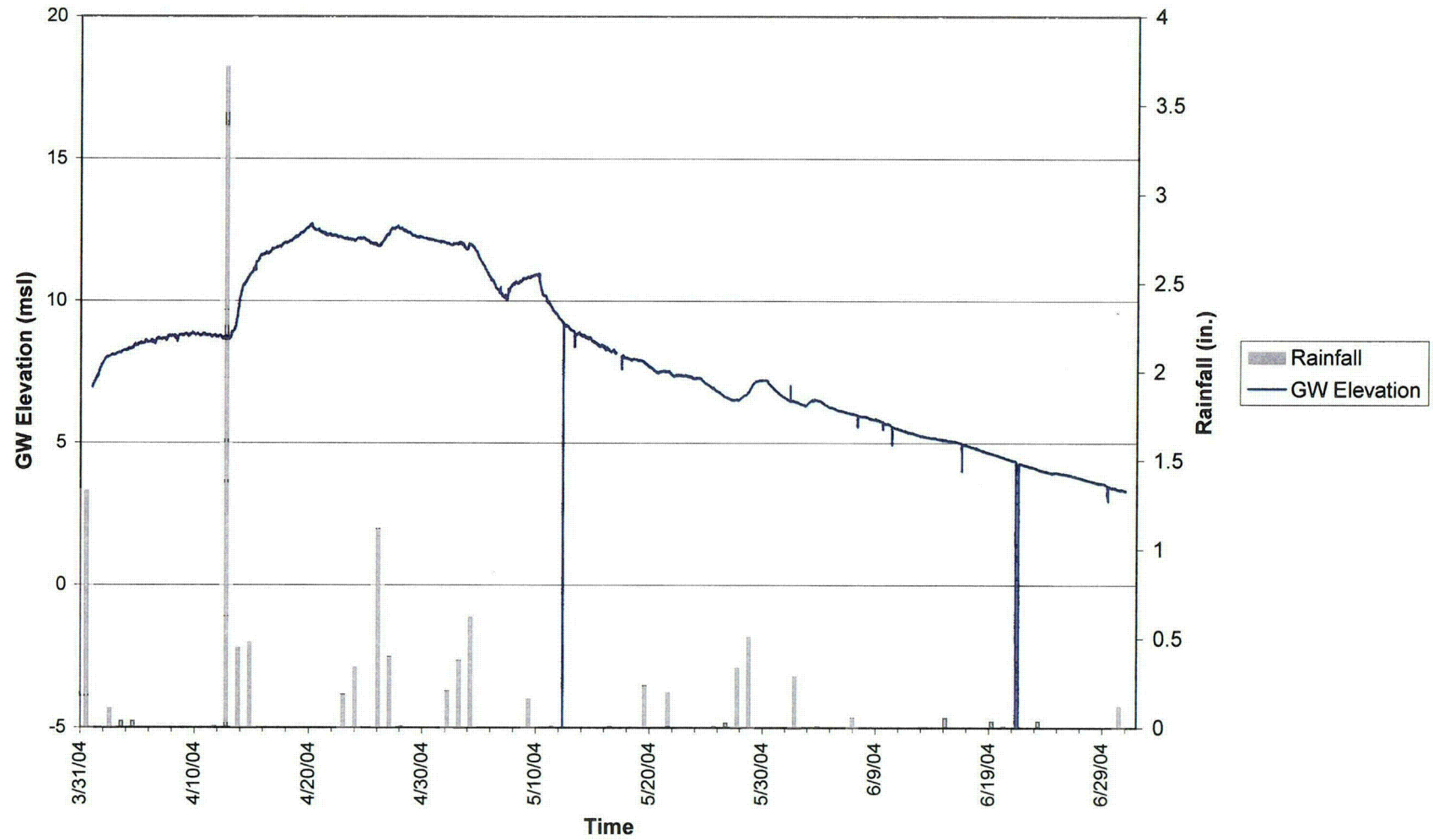
Detailed Area #2 of
Groundwater Elevation at MW-105D
2nd Quarter



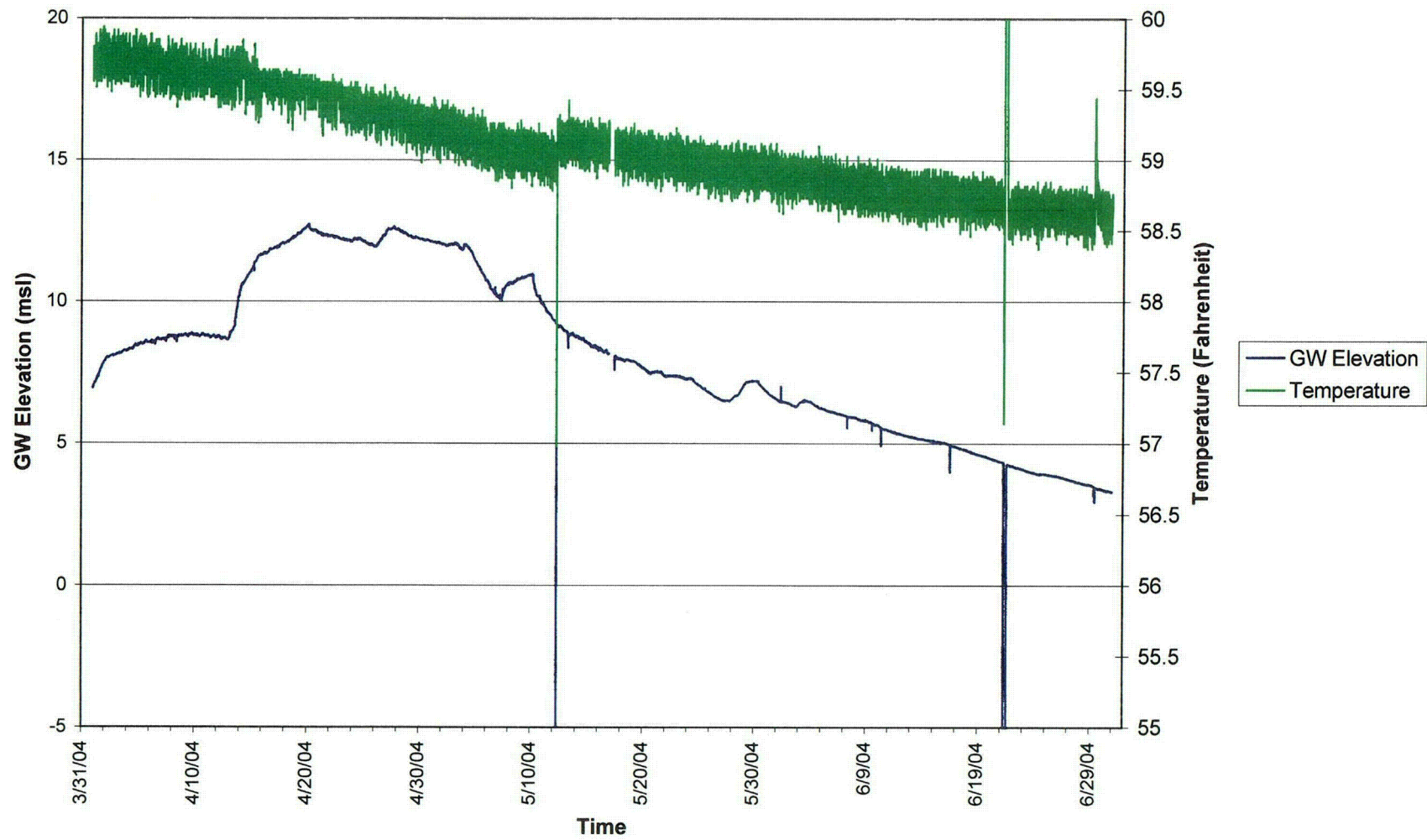
Detailed Area #3
Groundwater Elevation at MW-105D
2nd Quarter



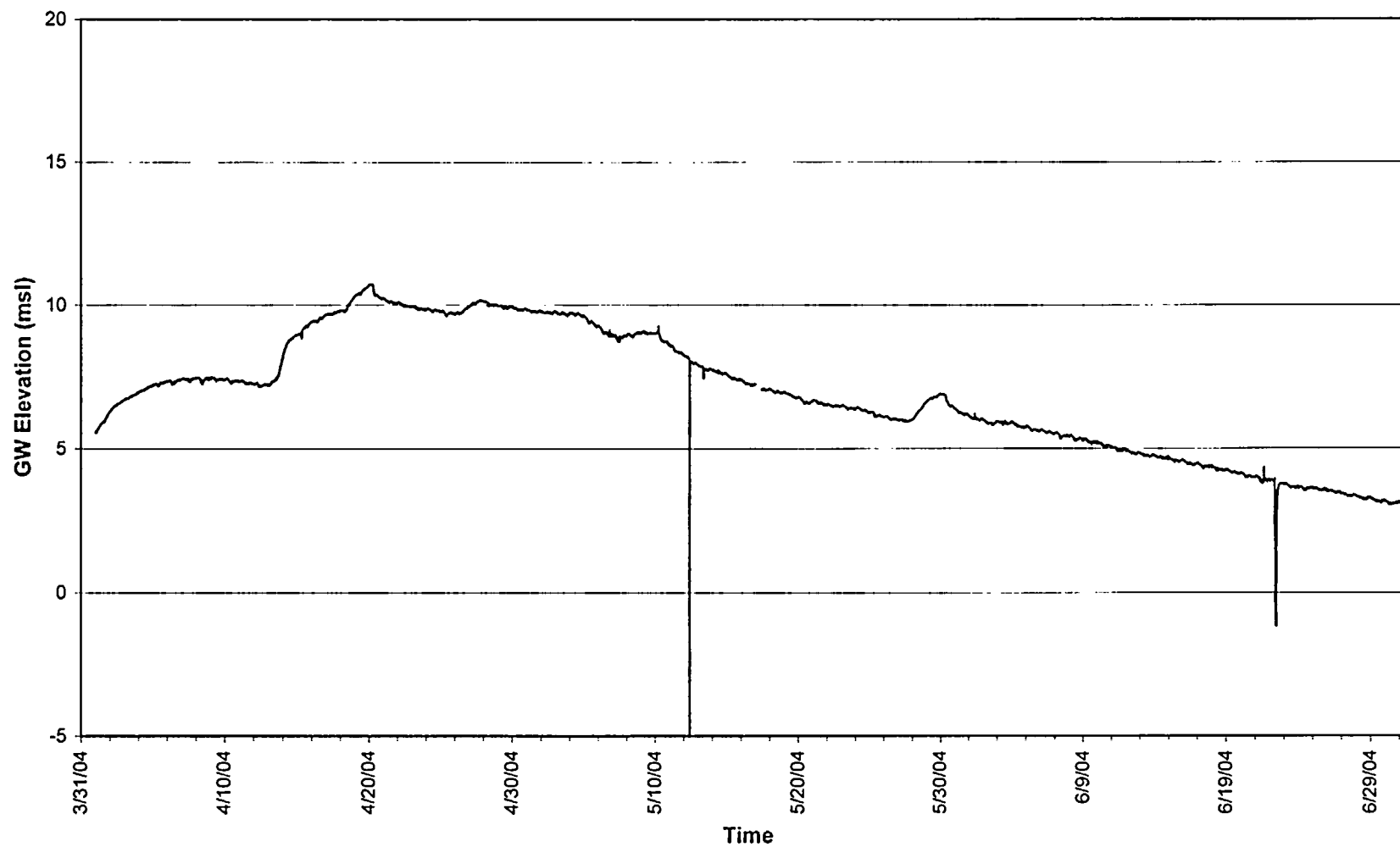
Groundwater Elevation at MW-105D 2nd Quarter



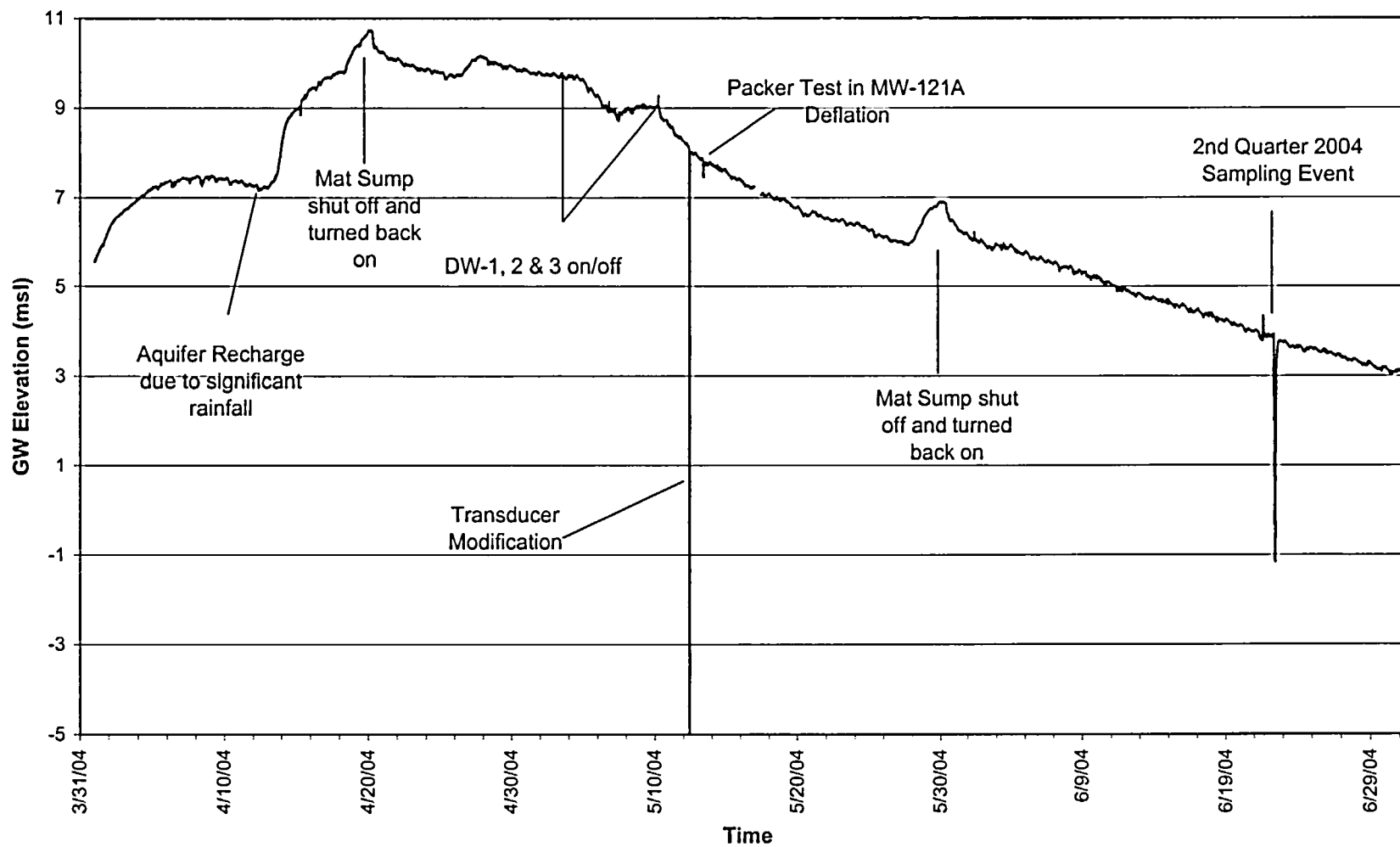
MW-105D Groundwater Elevation and Temperature 2nd Quarter



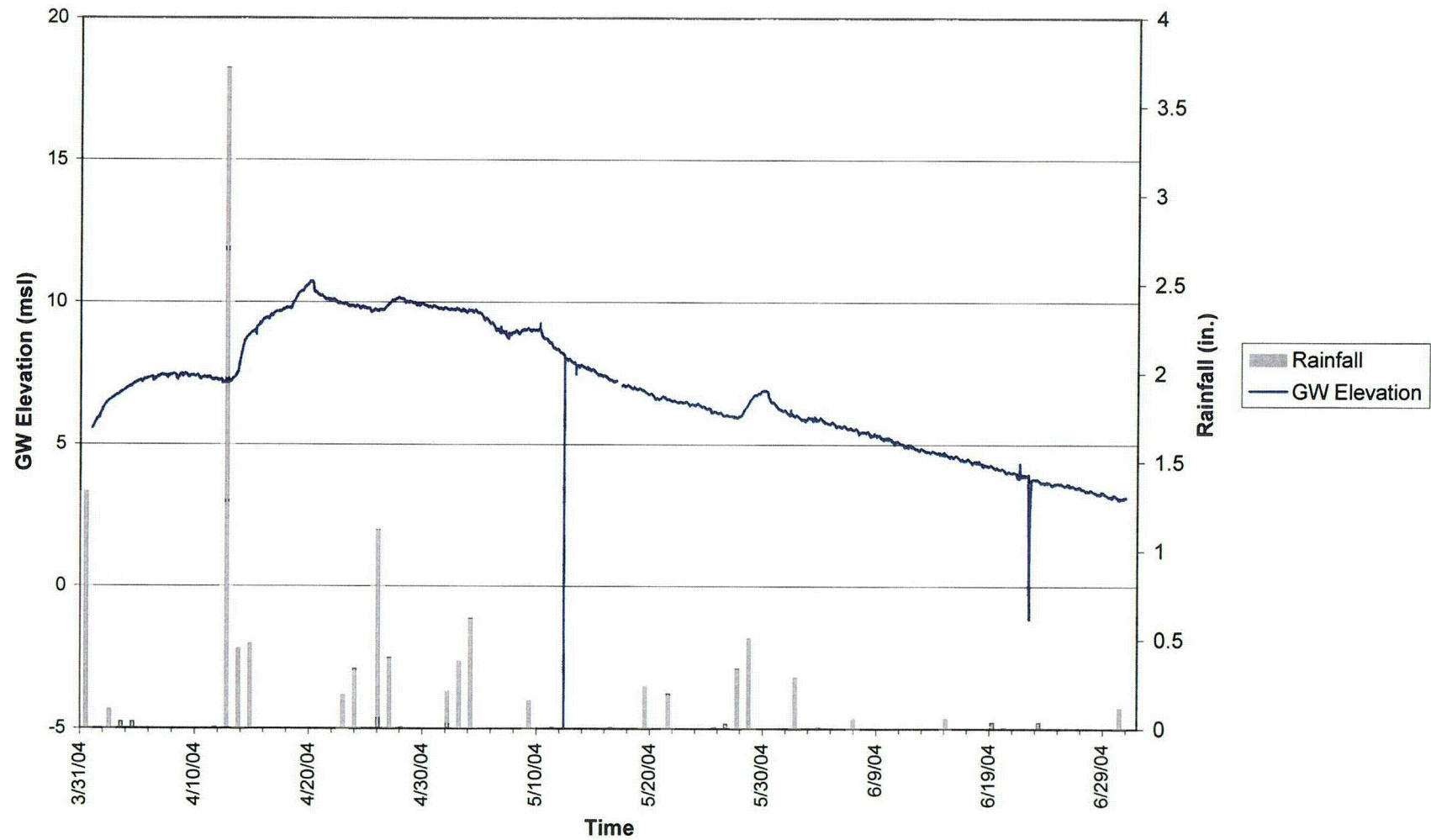
Groundwater Elevation at MW-106D
2nd Quarter



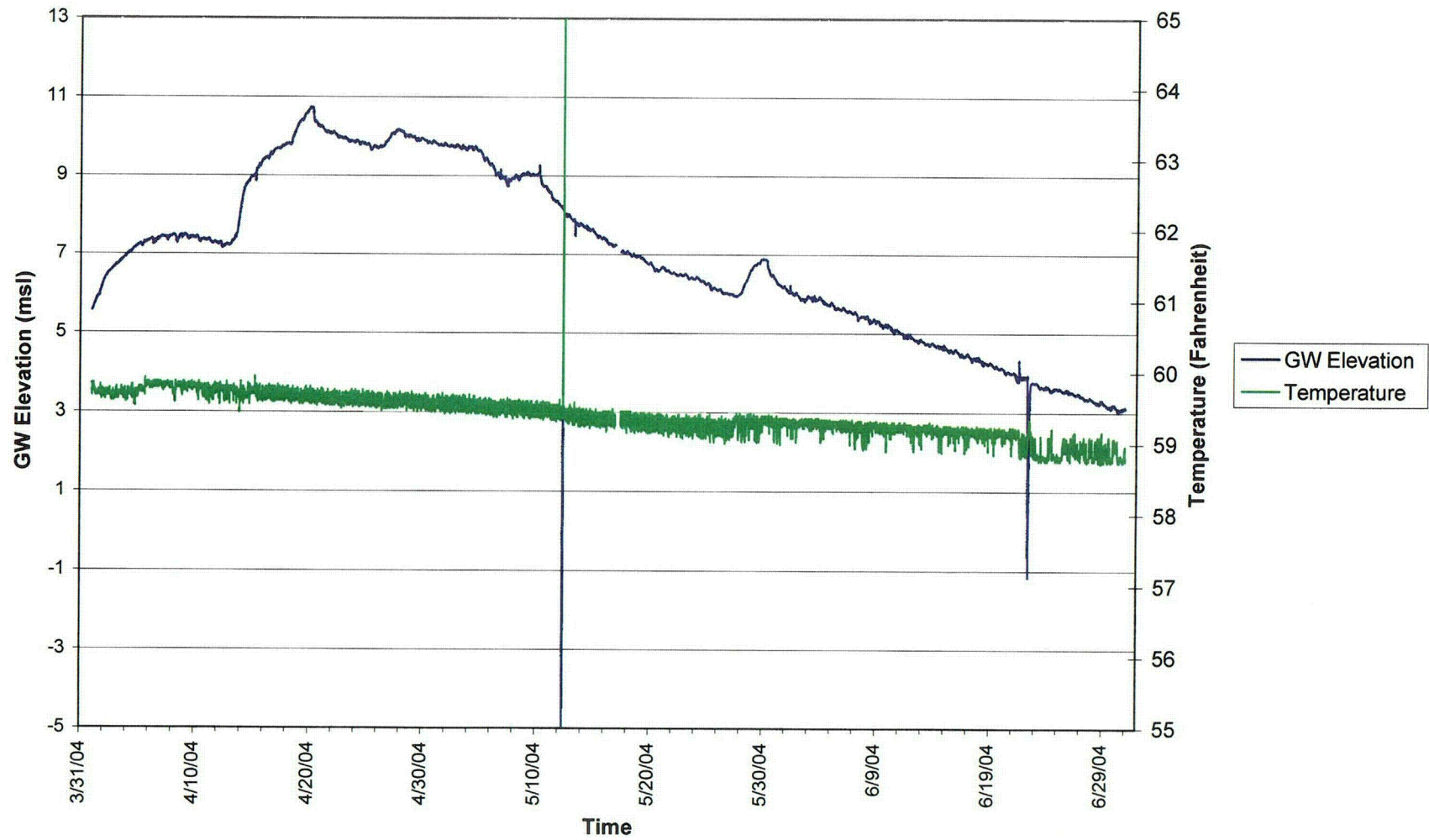
Groundwater Elevation at MW-106D 2nd Quarter



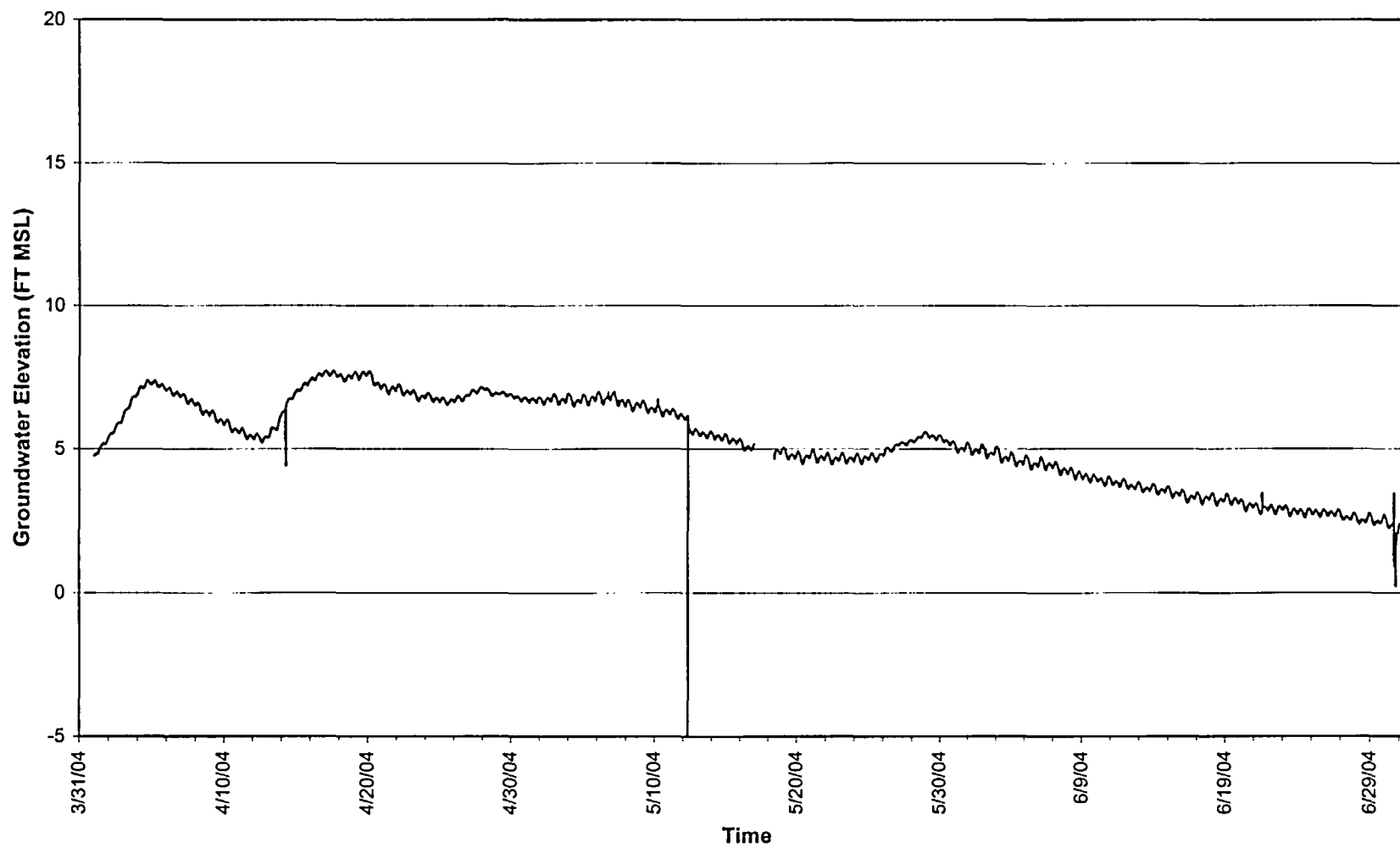
MW-106D Groundwater Elevation and Daily Rainfall Totals 2nd Quarter



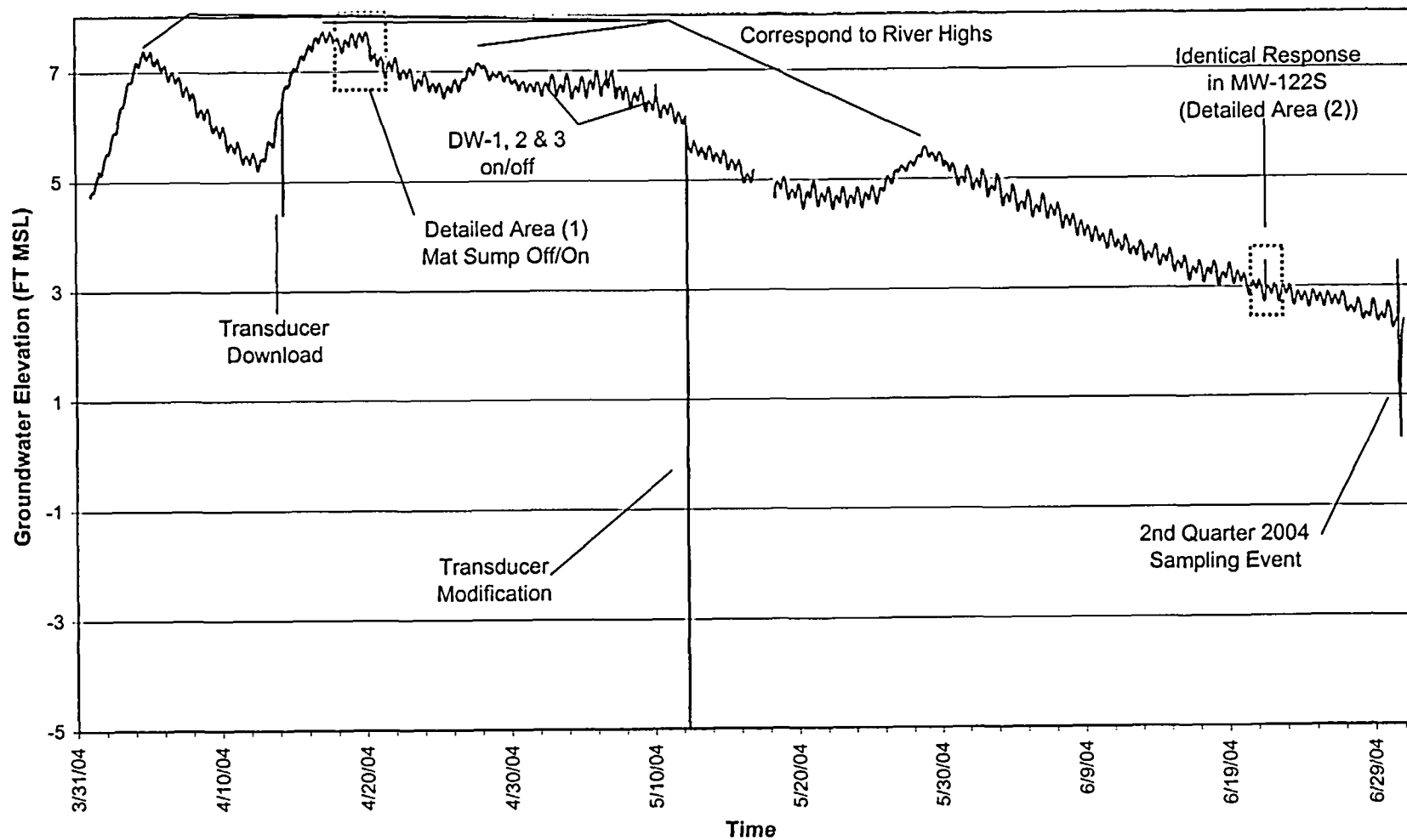
MW-106D Groundwater Elevation and Temperature 2nd Quarter



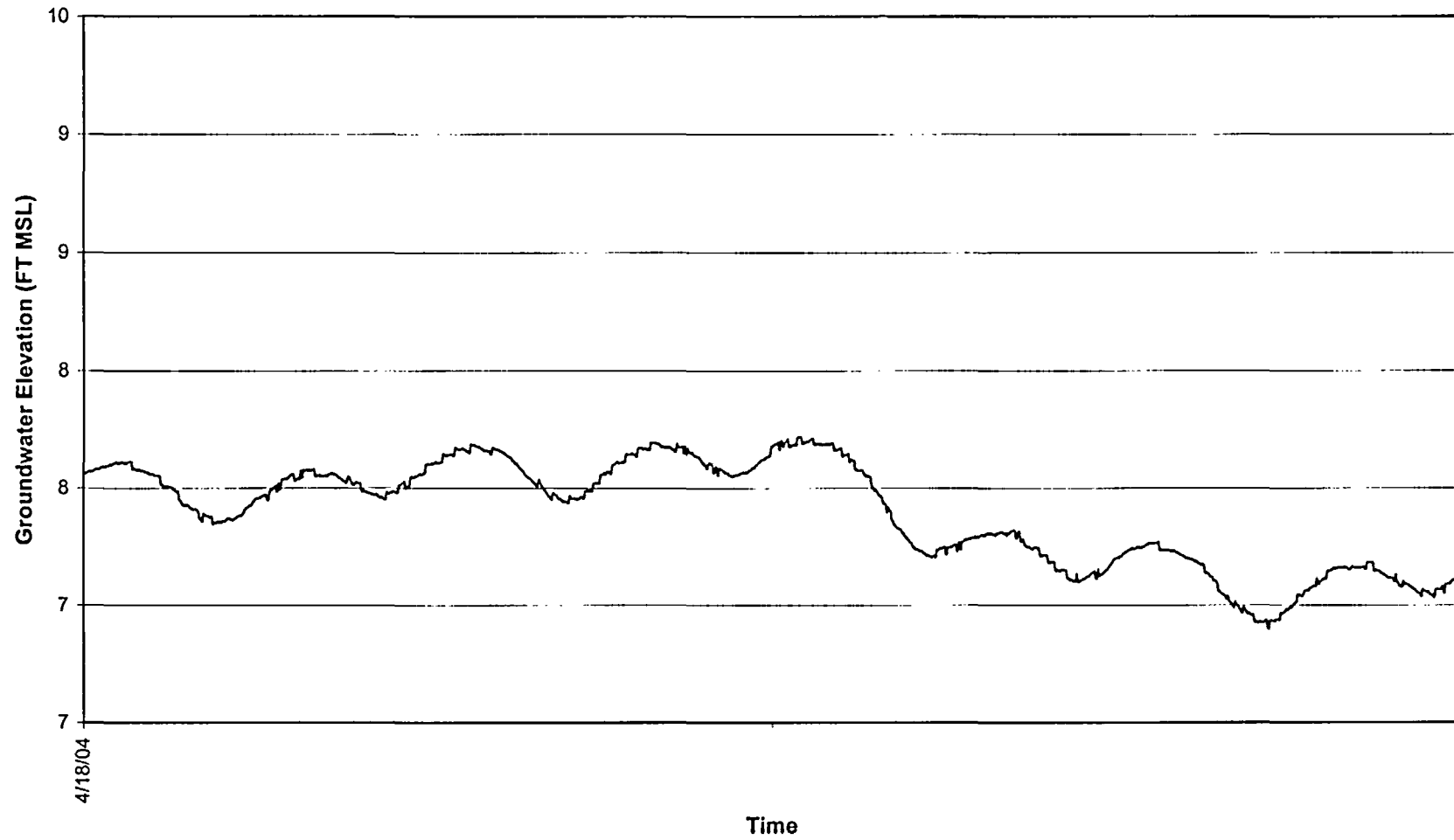
Groundwater at MW122D
2nd Quarter



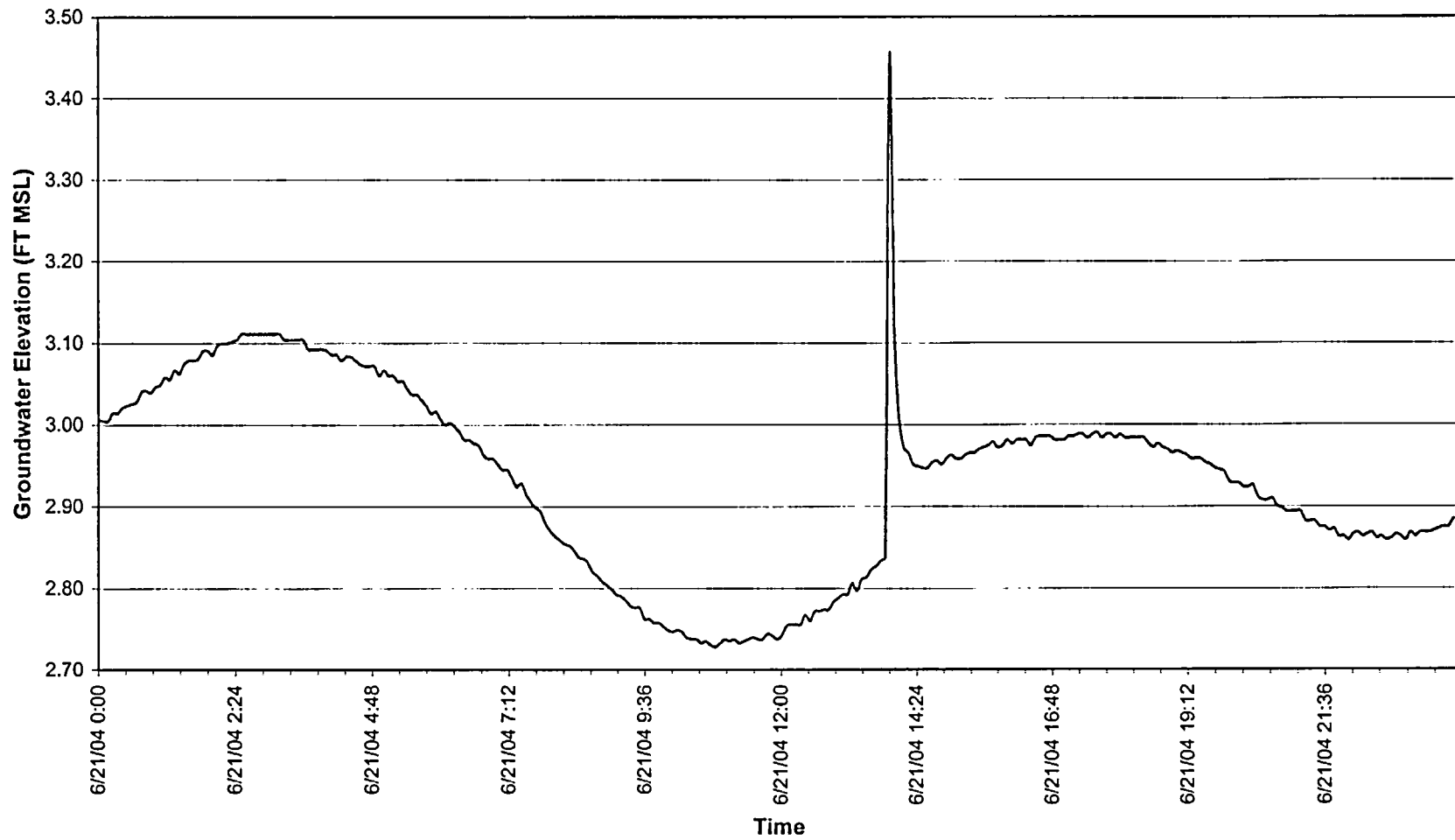
Groundwater at MW122D 2nd Quarter



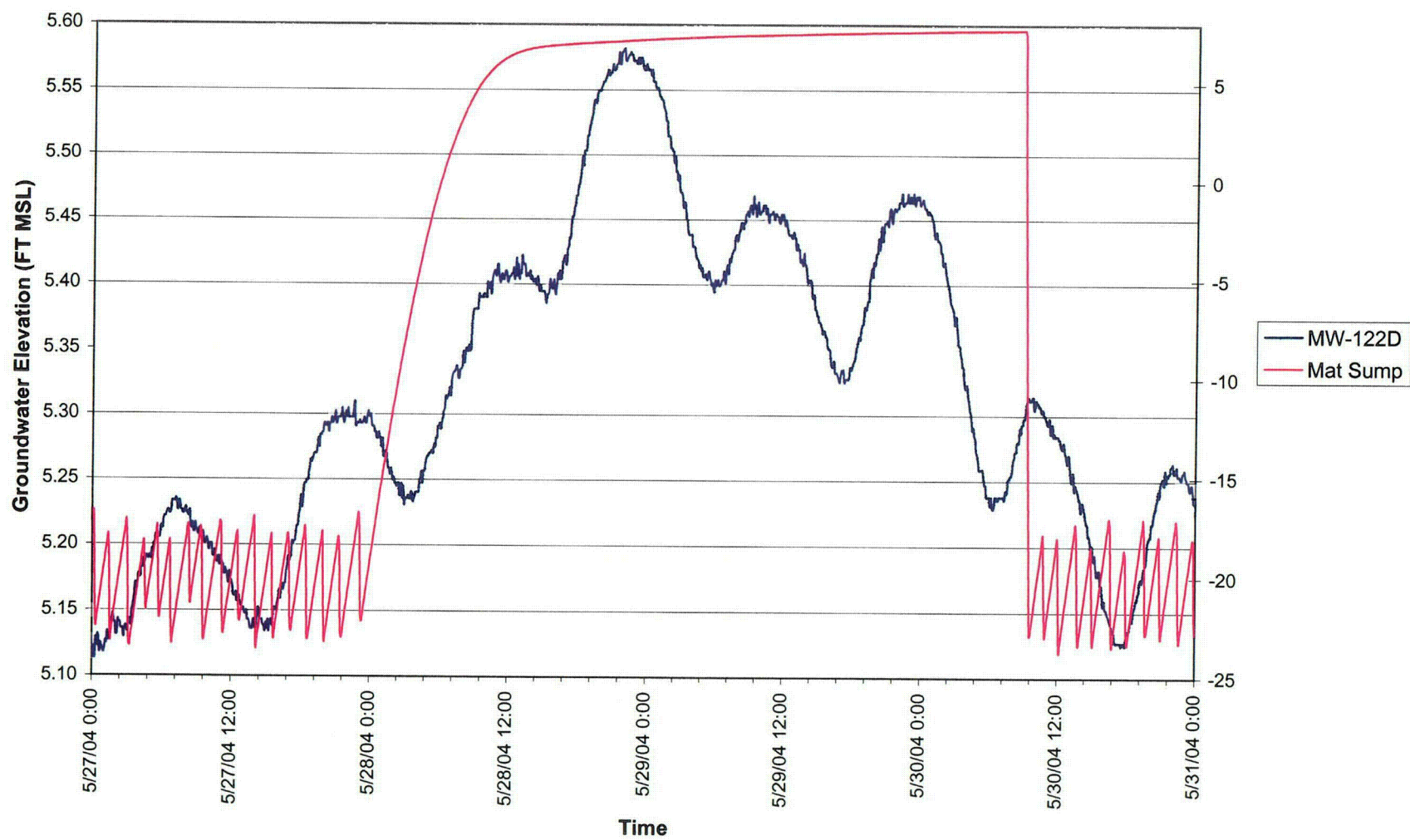
Detailed Area (1) of
Groundwater at MW122D
2nd Quarter



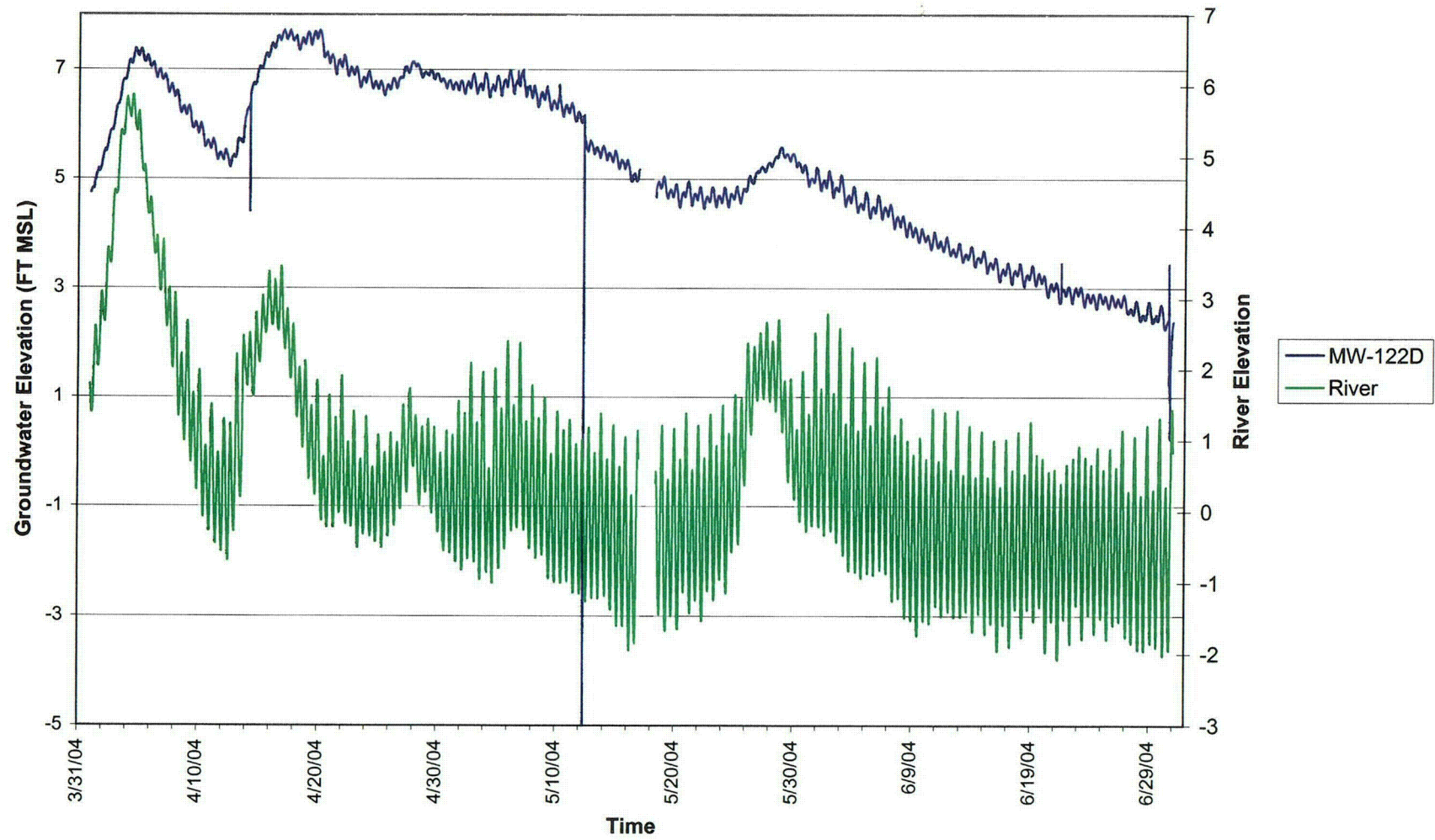
Detailed Area (2) of
Groundwater at MW122D
2nd Quarter



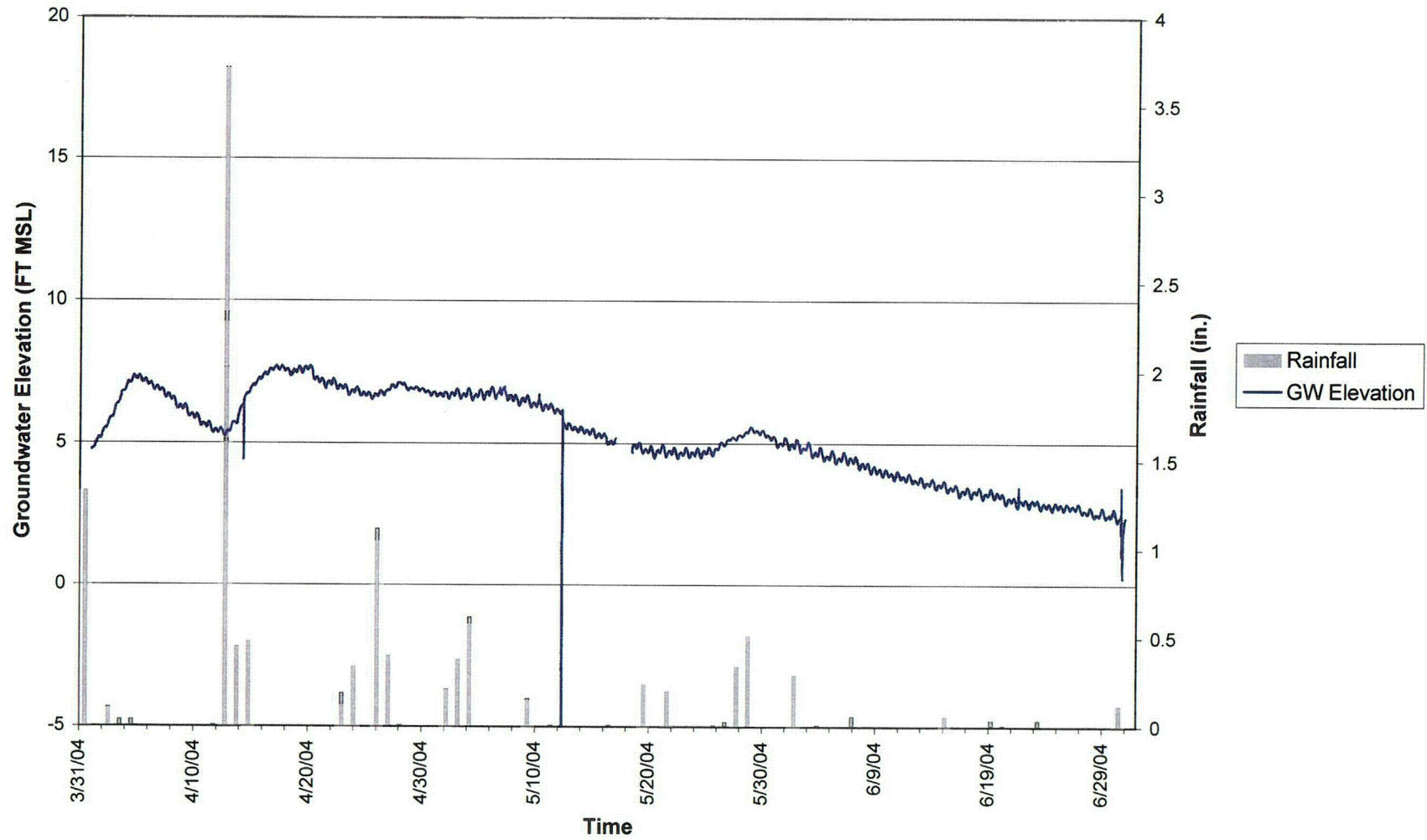
Groundwater at MW122D and the Mat Sump 2nd Quarter



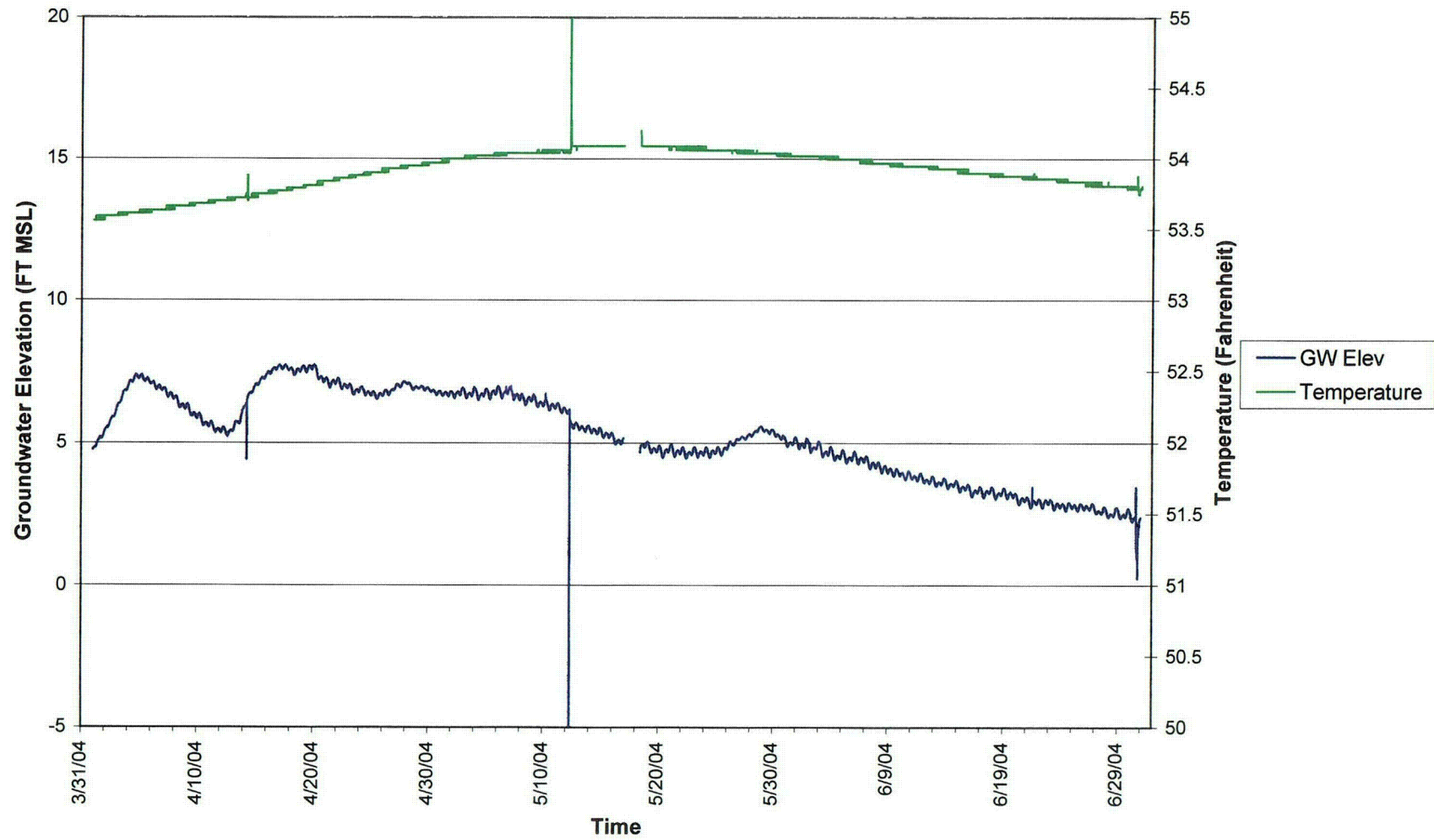
Groundwater at MW122D
2nd Quarter



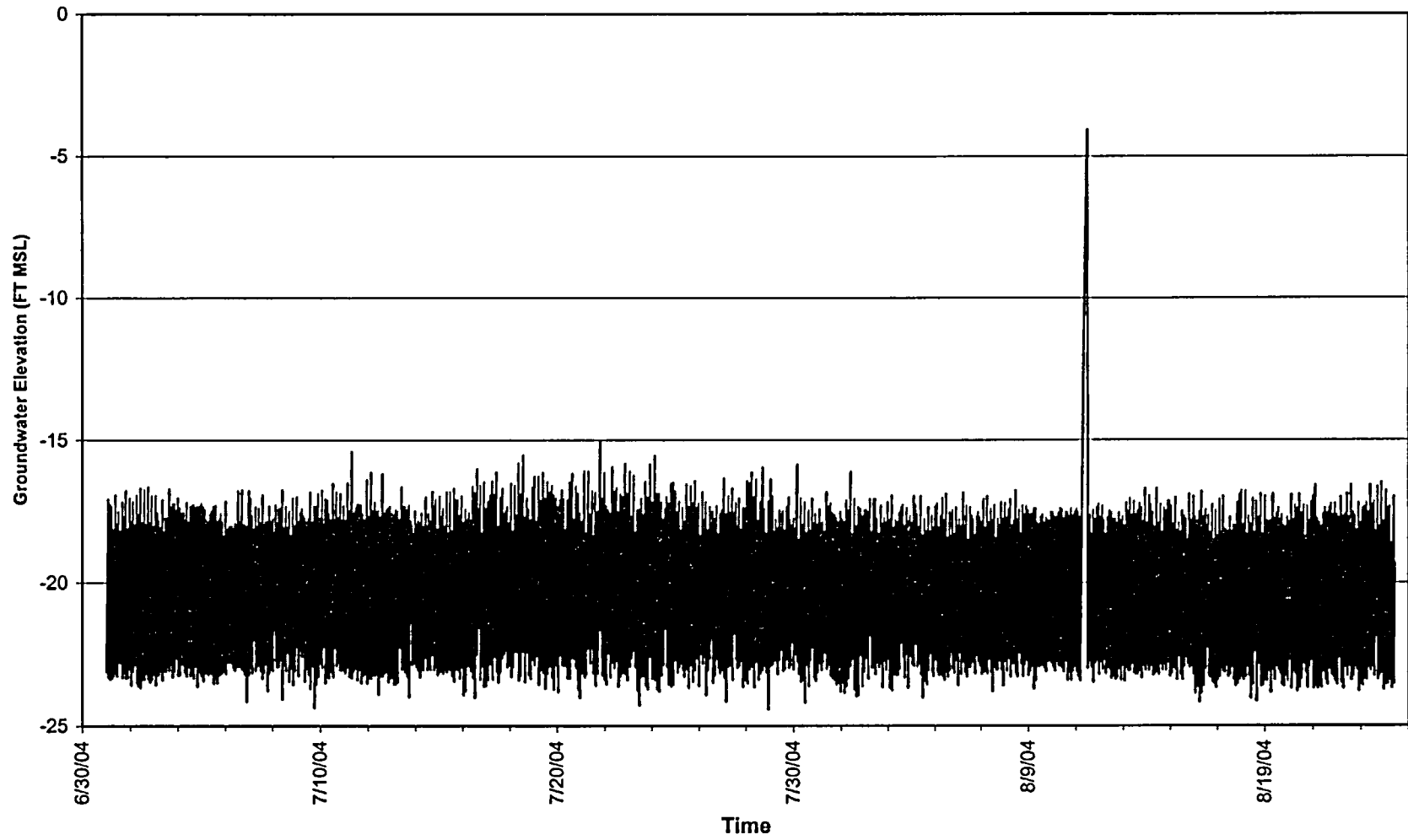
MW122D Groundwater Elevation and Daily Rainfall Totals
2nd Quarter



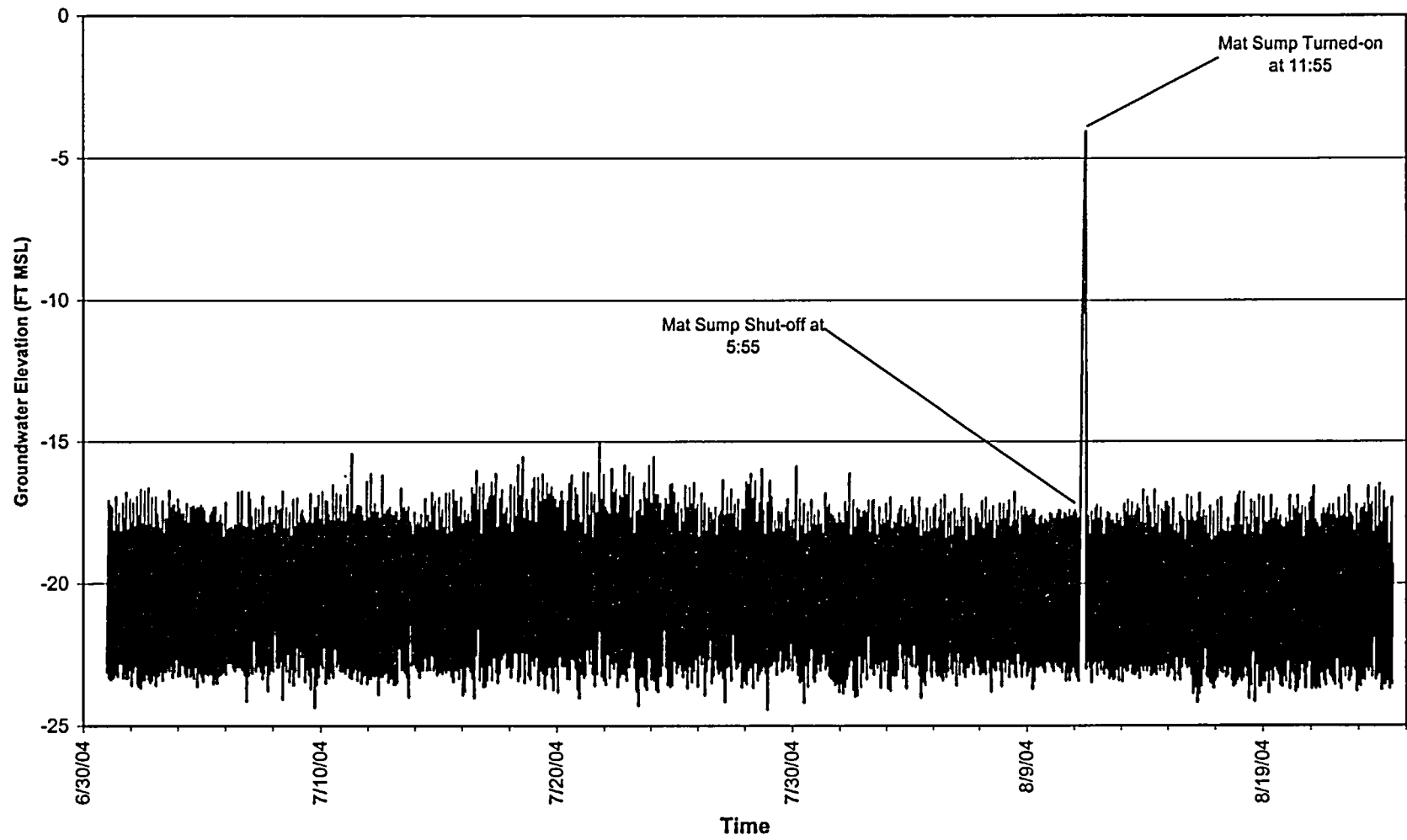
MW122D Groundwater Elevation and Temperature 2nd Quarter



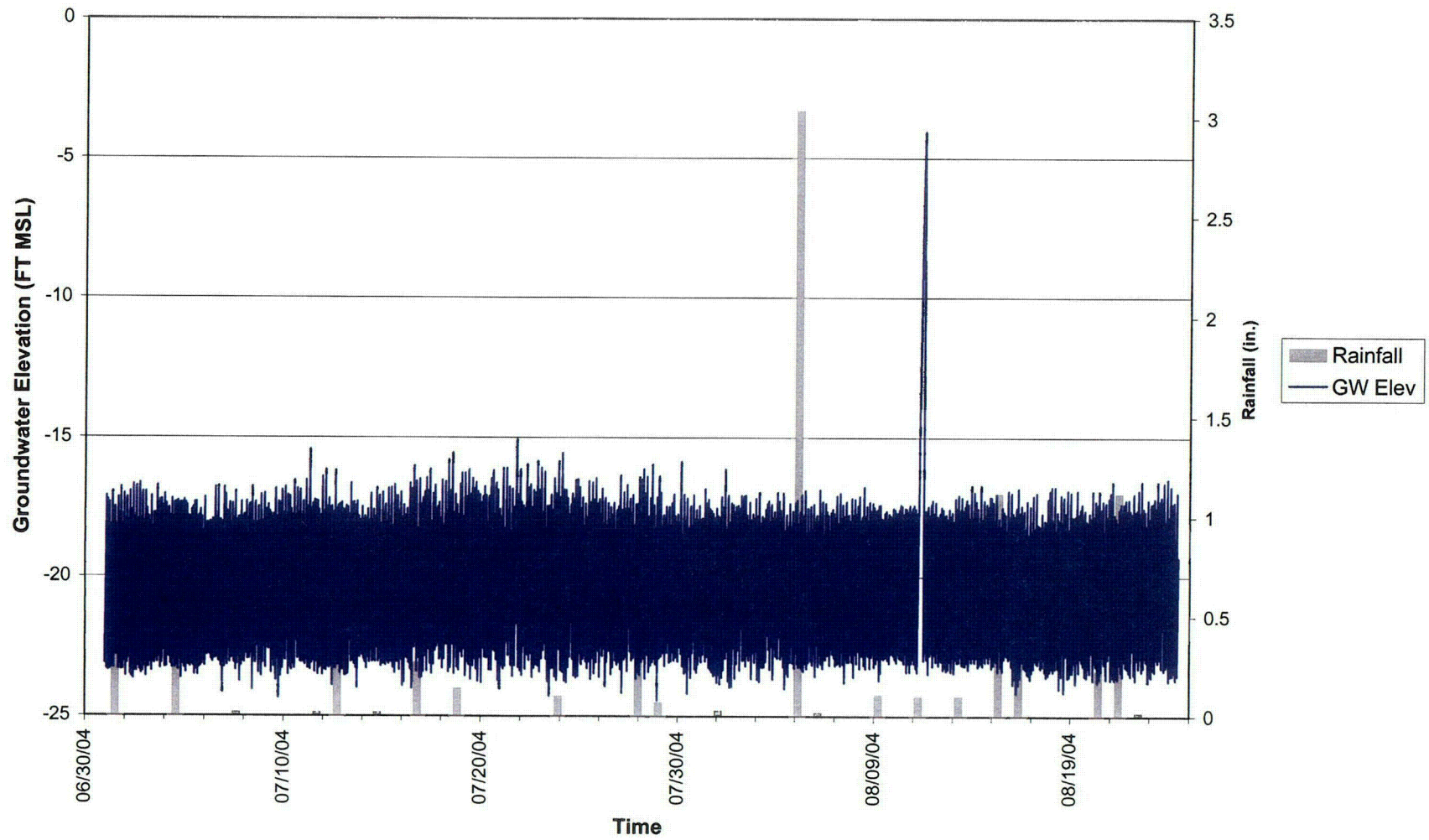
**Groundwater Elevation at the Mat Sump
3rd Quarter**



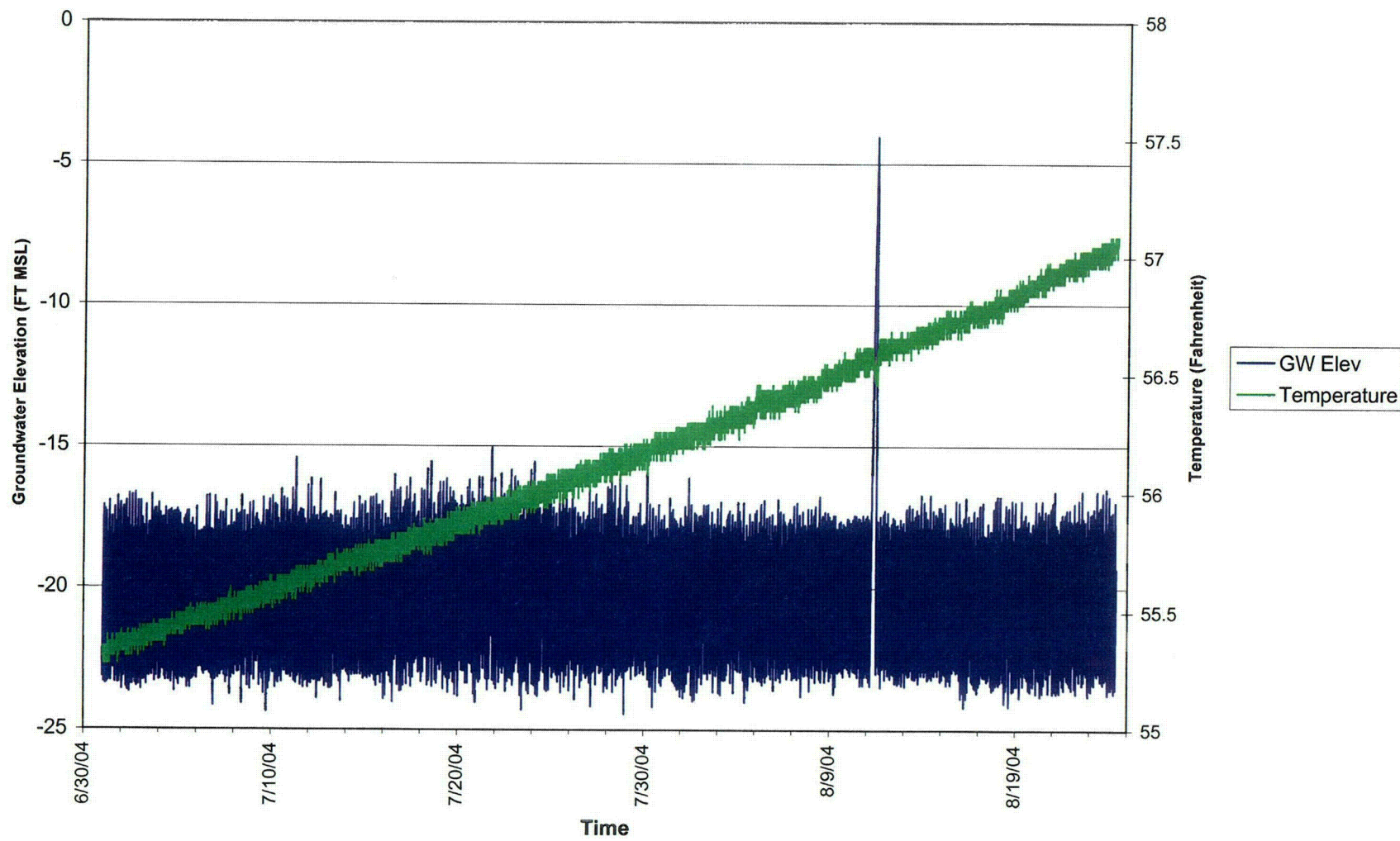
Groundwater Elevation at the Mat Sump 3rd Quarter



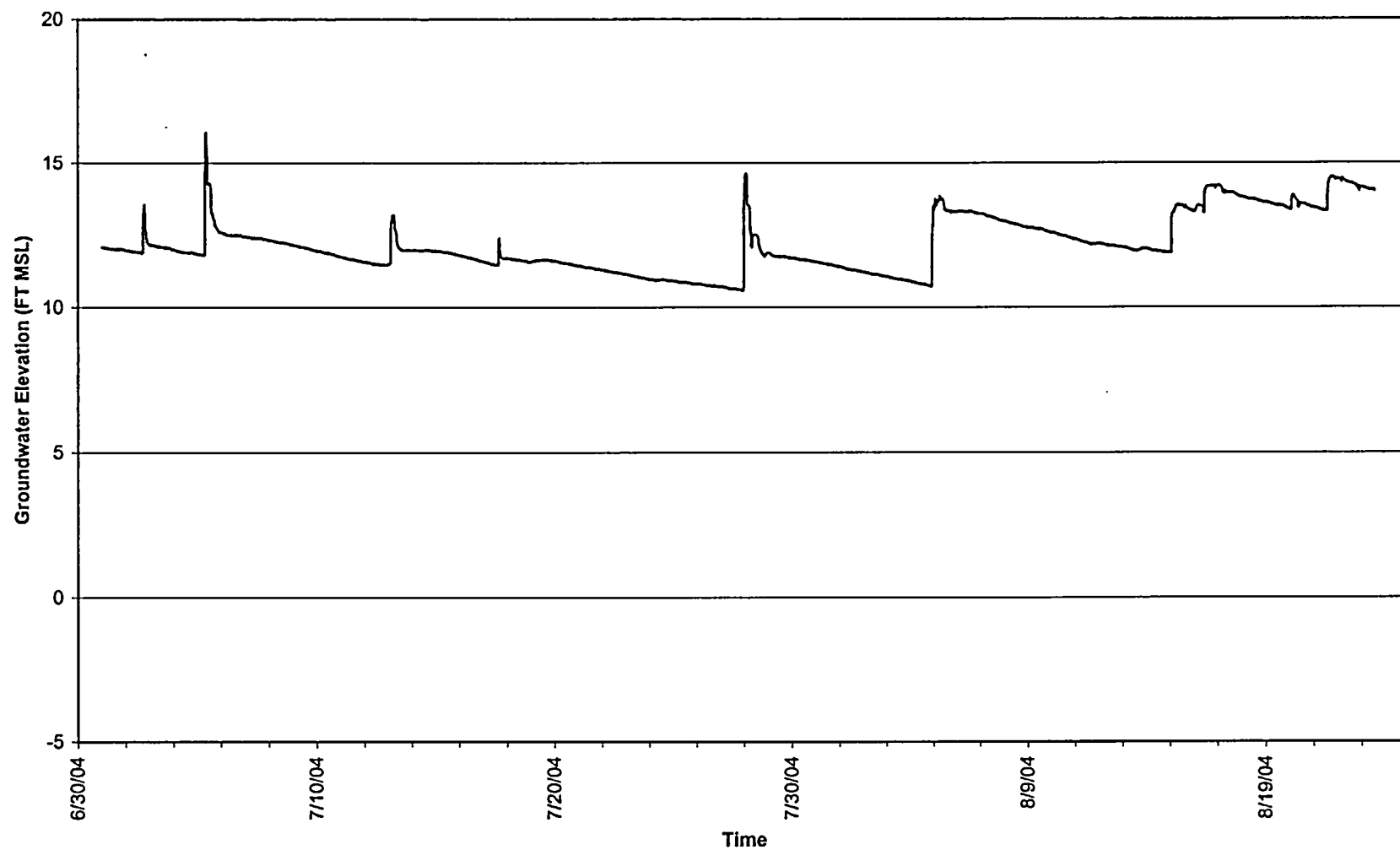
Mat Sump Water Elevation and Daily Rainfall Totals 3rd Quarter



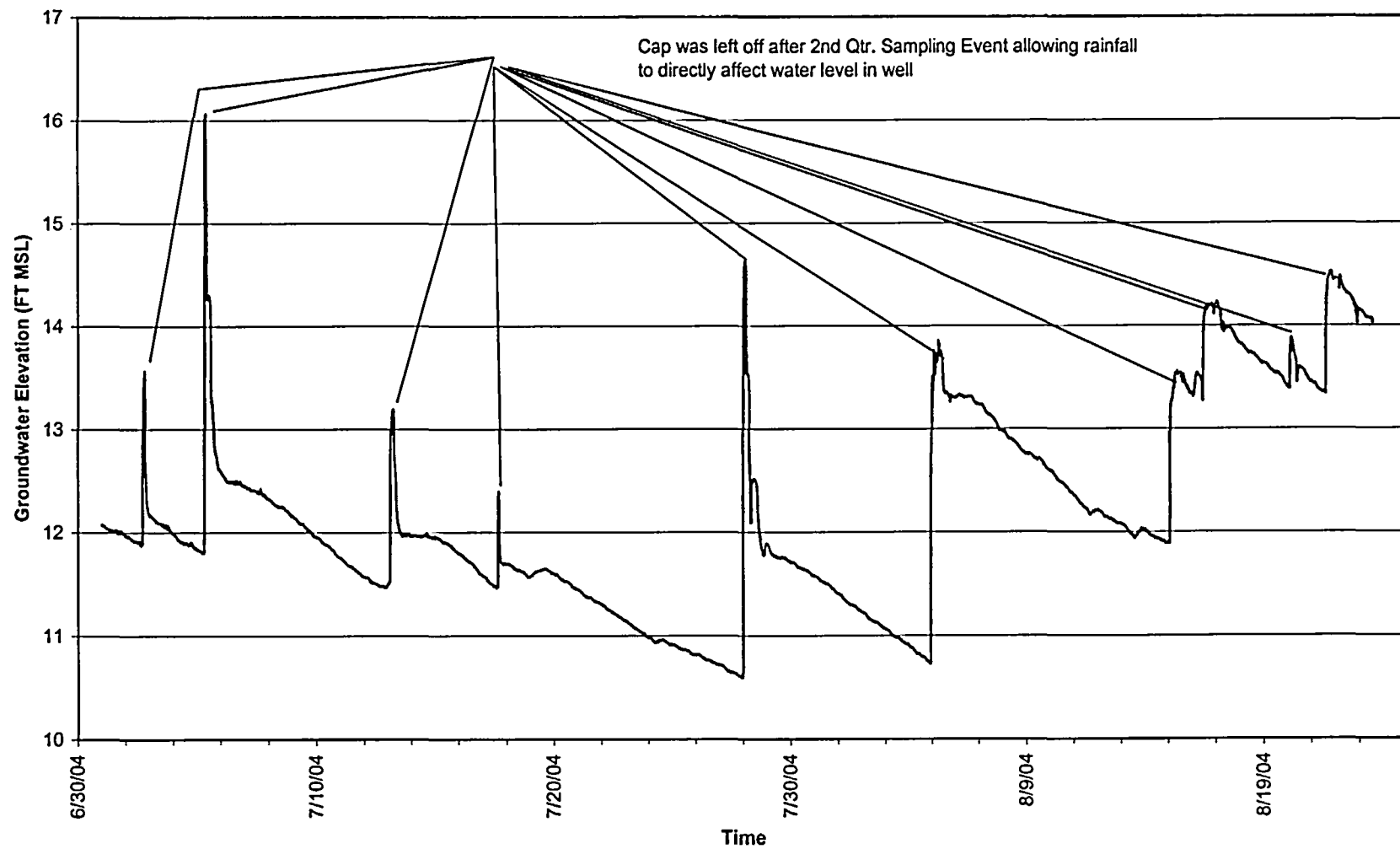
Mat Sump Groundwater Elevation and Temperature
3rd Quarter



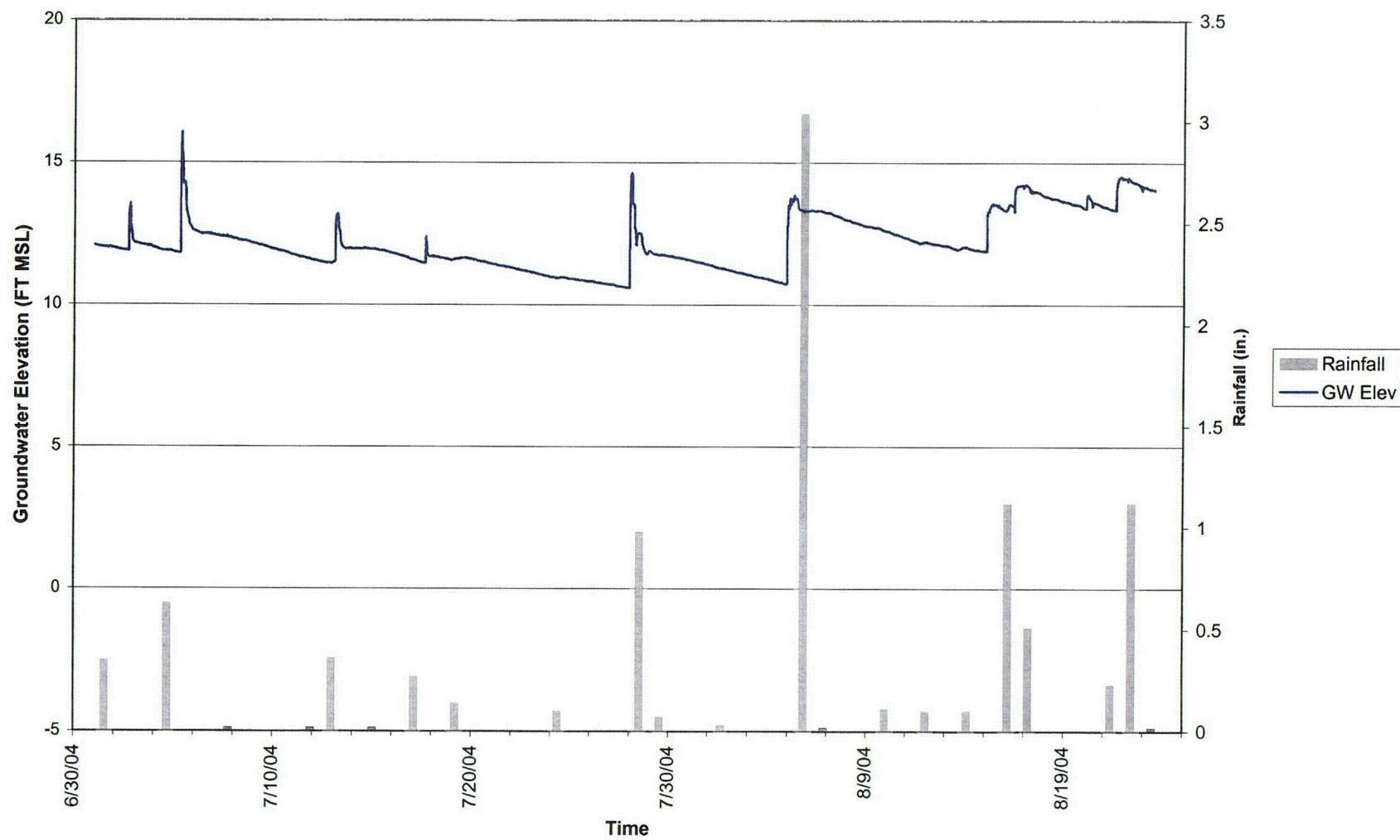
Groundwater Elevation at MW-100S
3rd Quarter



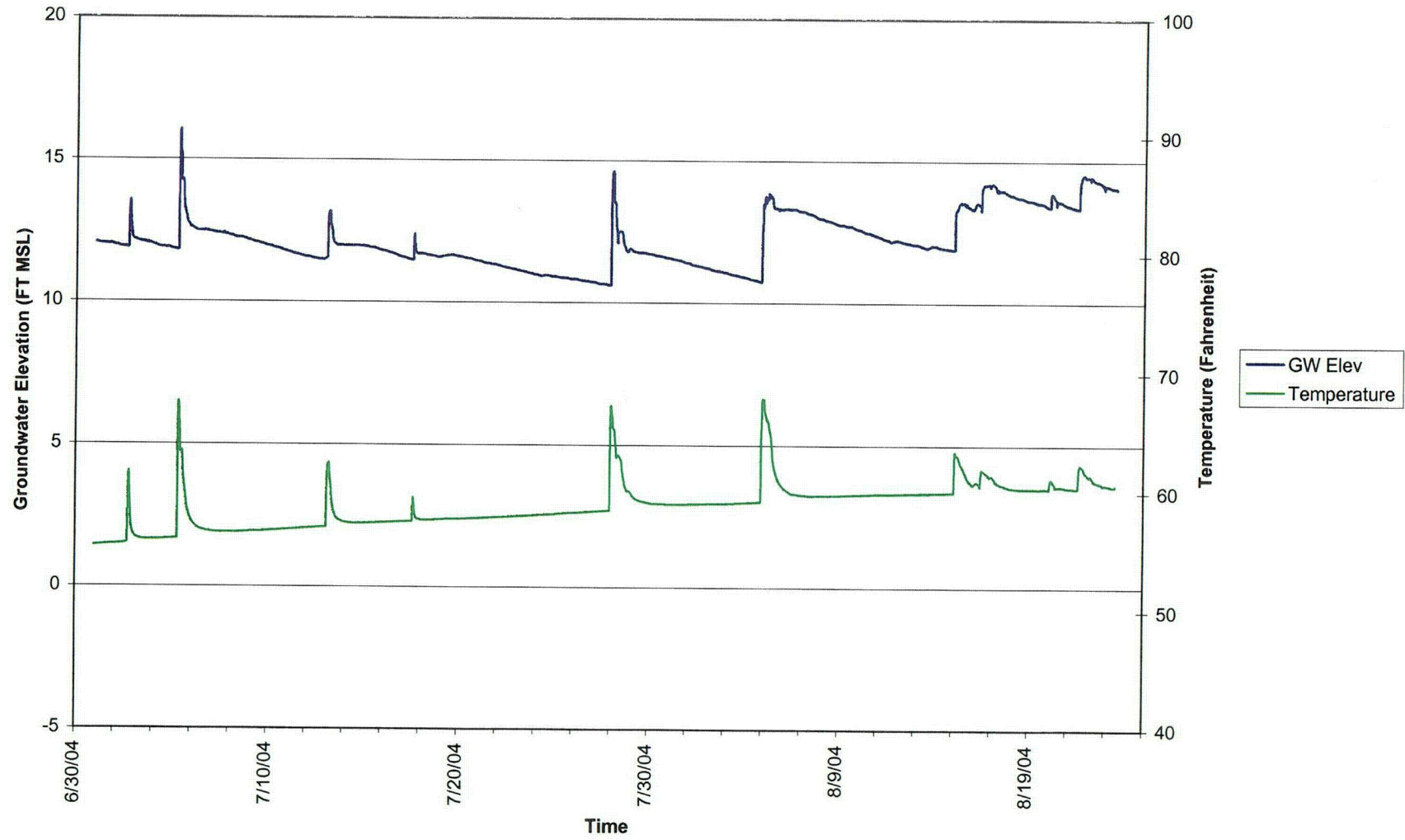
Groundwater Elevation at MW-100S
3rd Quarter



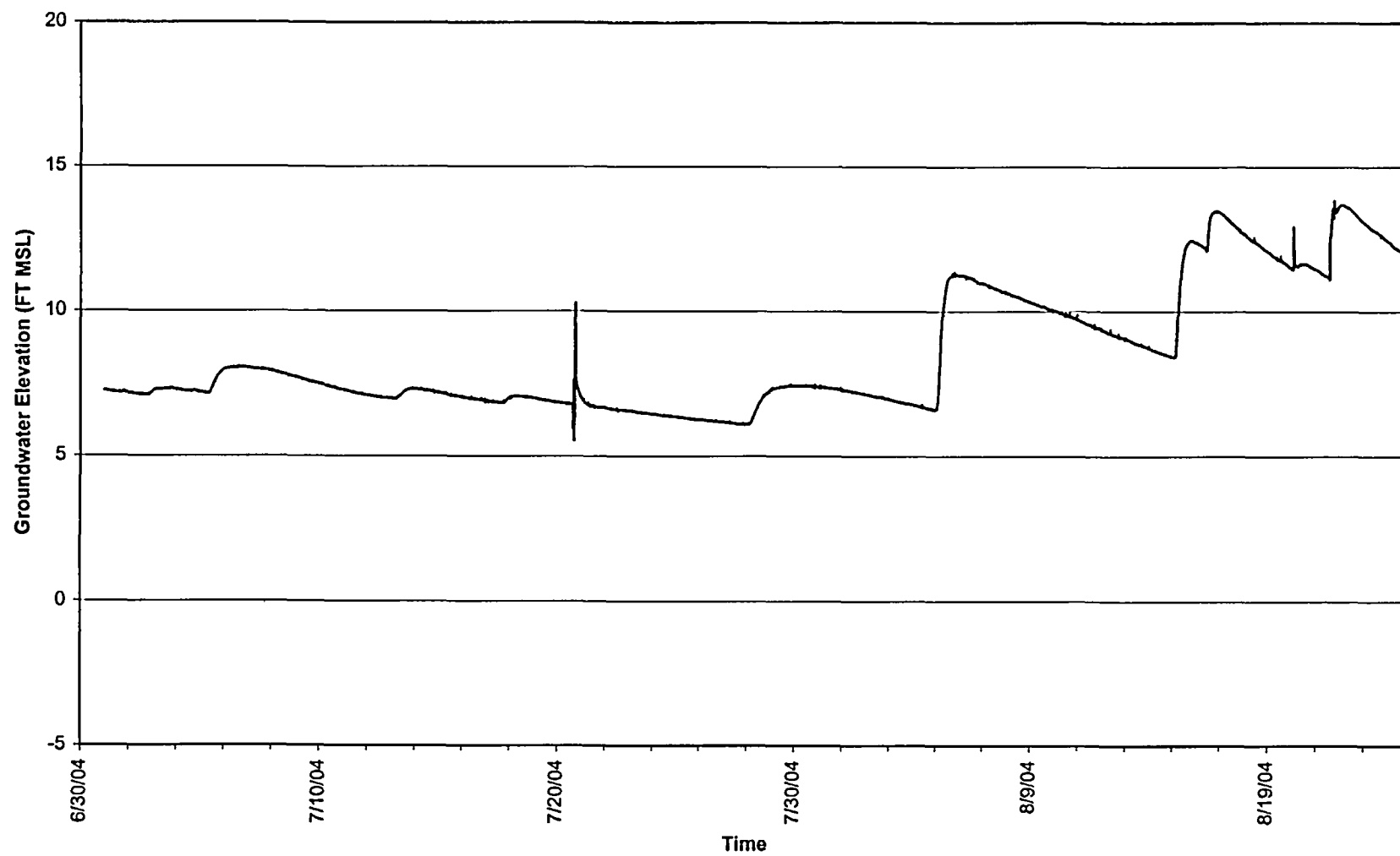
MW-100S Goundwater Elevation and Daily Rainfall Totals
3rd Quarter



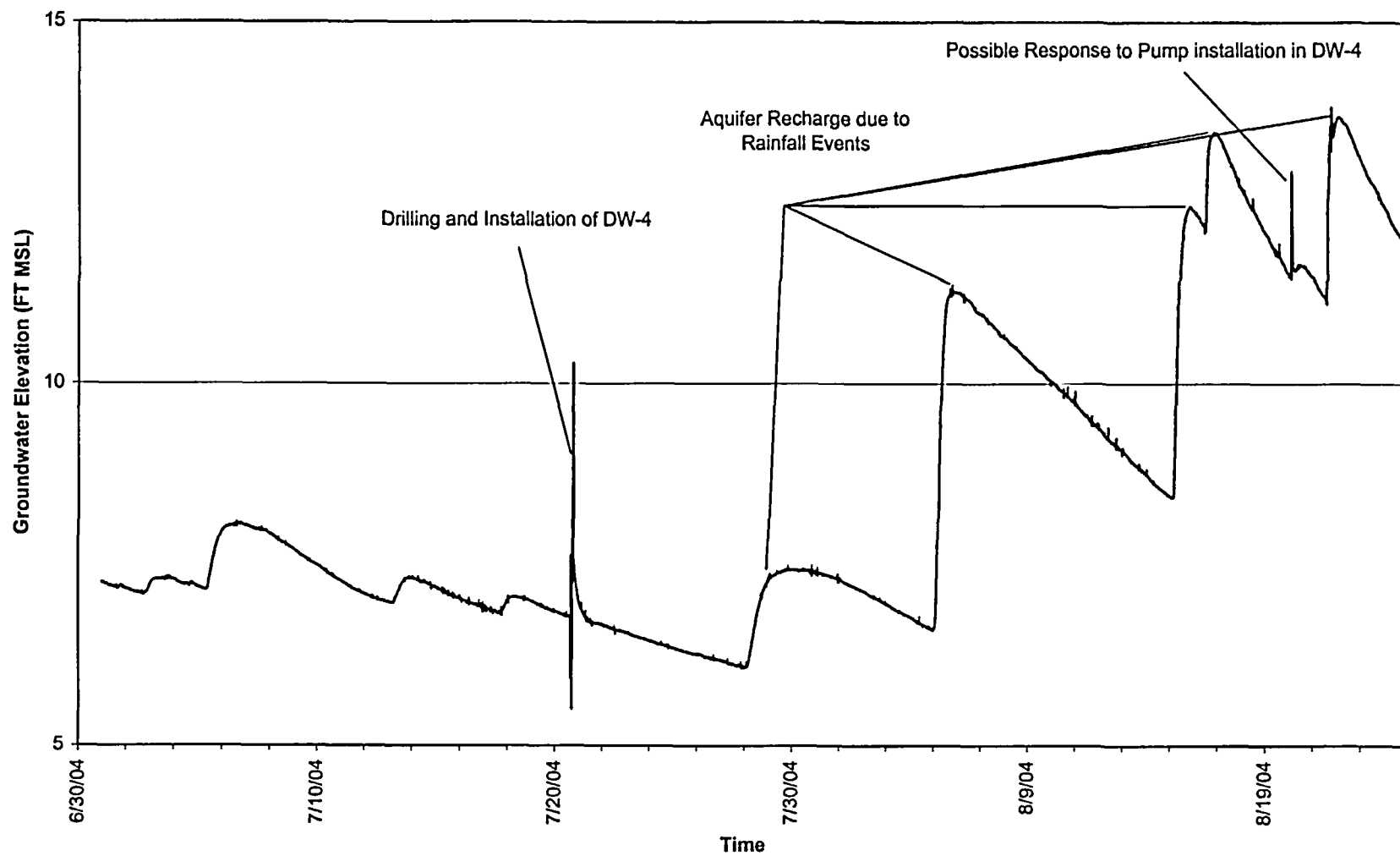
MW-100S Groundwater Elevation and Temperature
3rd Quarter



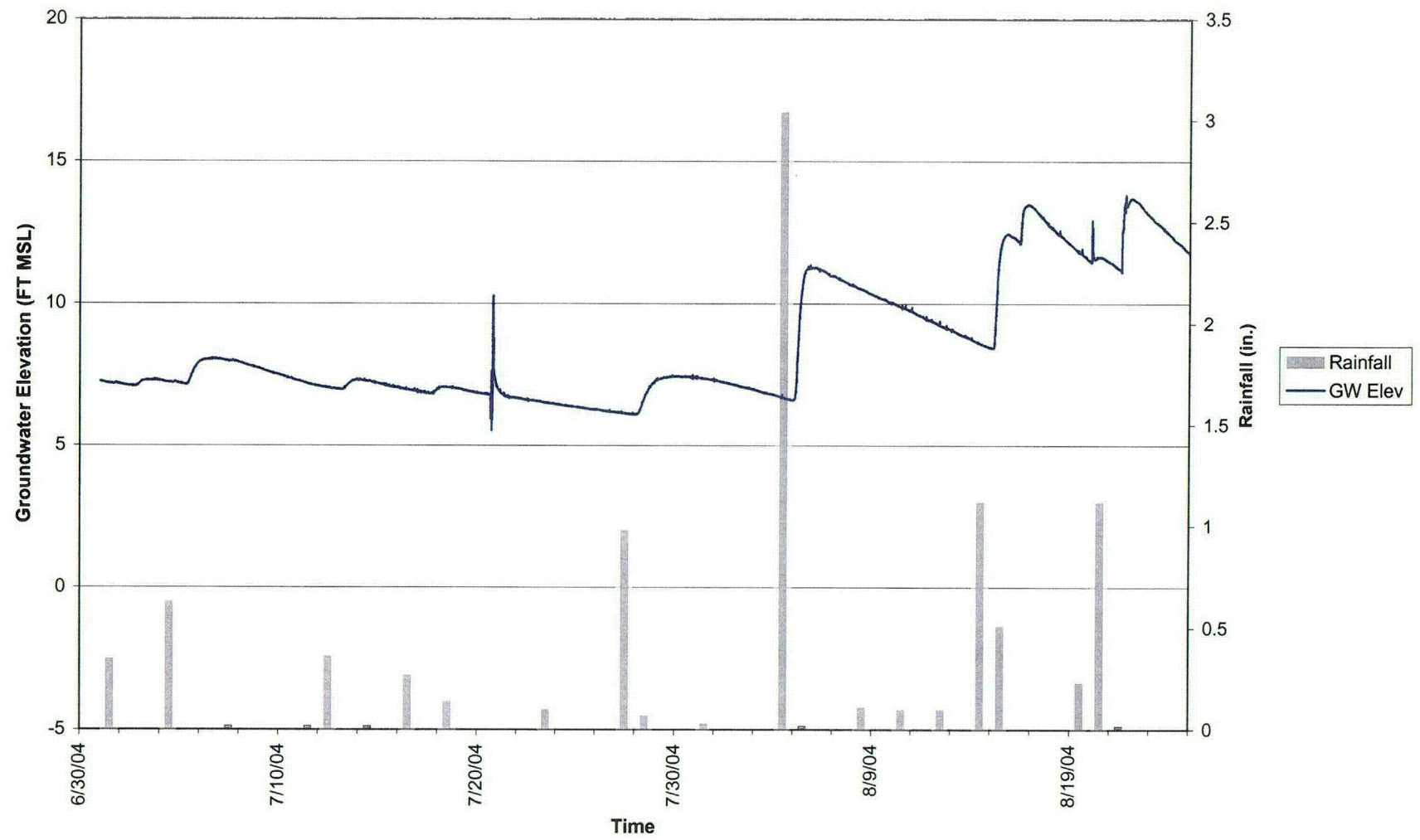
Groundwater Elevation at MW-104
3rd Quarter



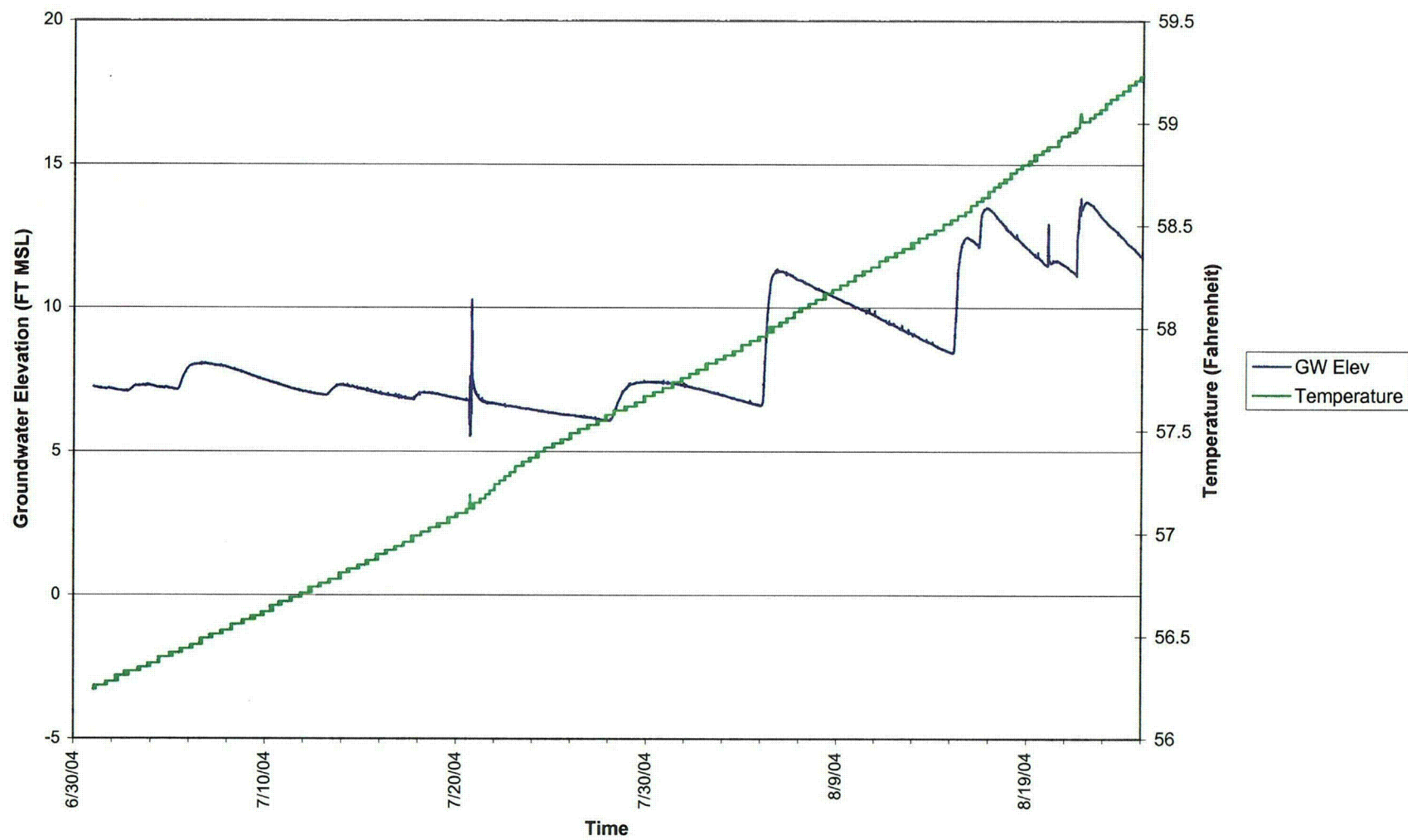
Groundwater Elevation at MW-104 3rd Quarter



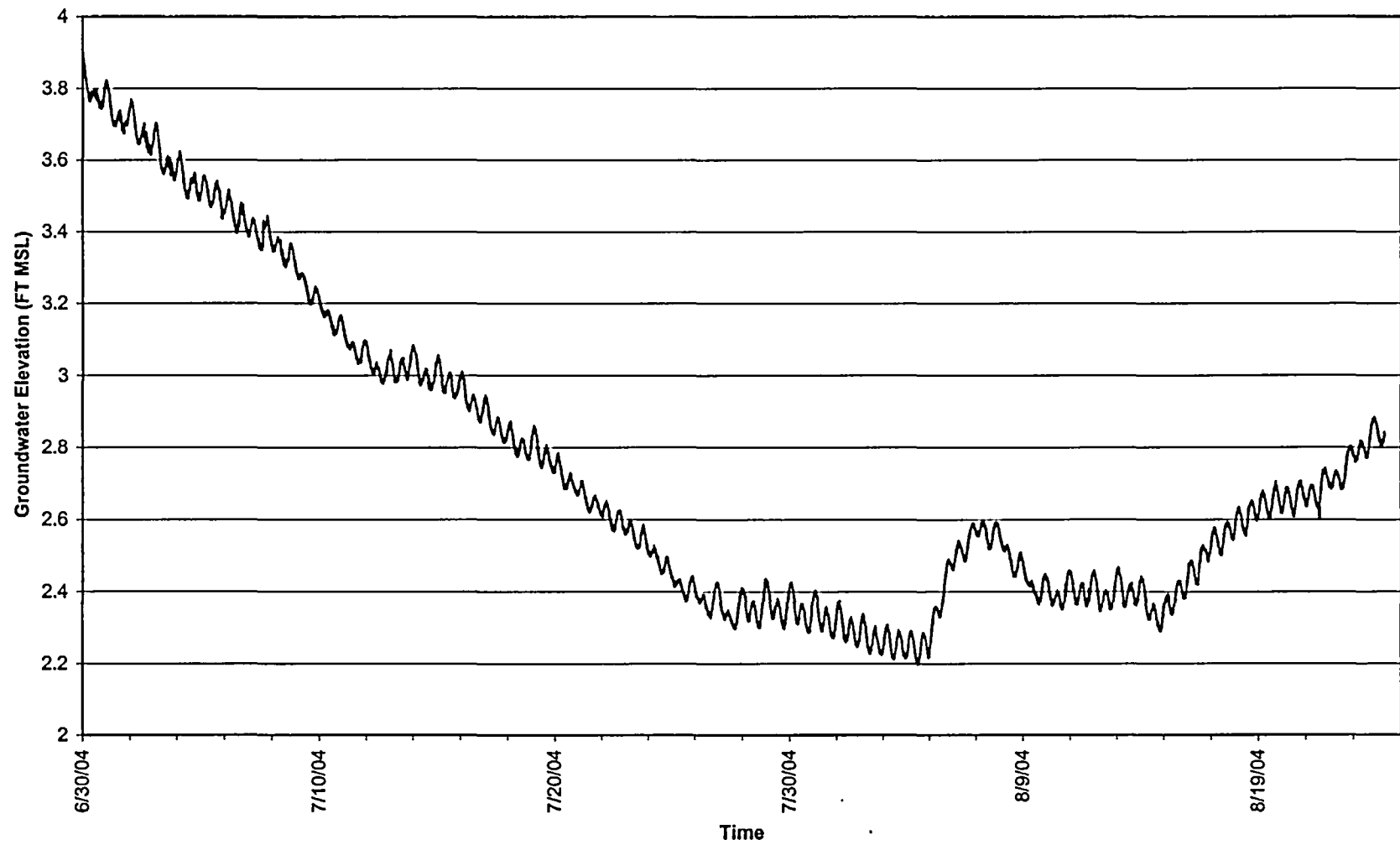
MW-104 Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



MW-104 Groundwater Elevation and Temperature
3rd Quarter



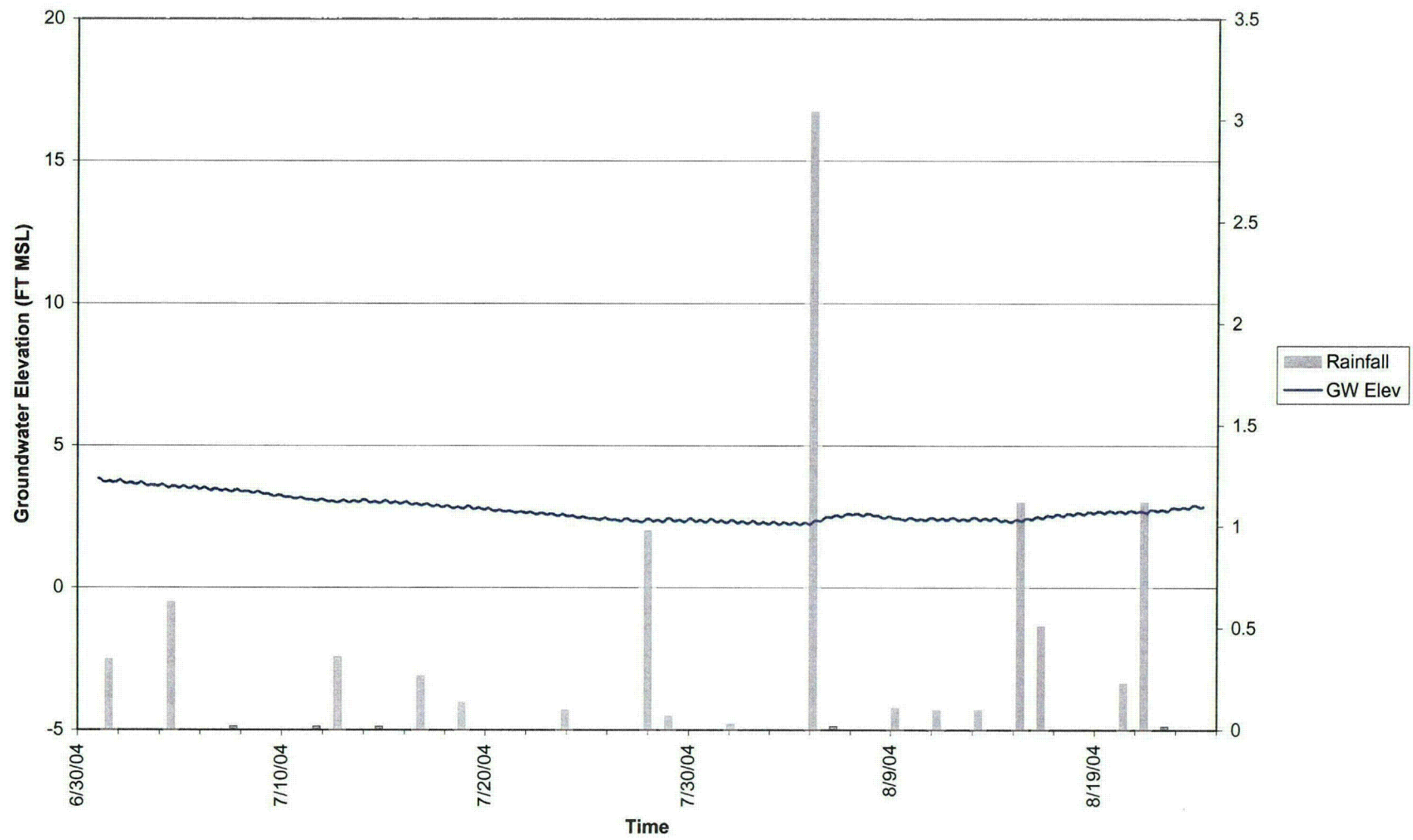
Groundwater Elevation at MW-107S
3rd Quarter



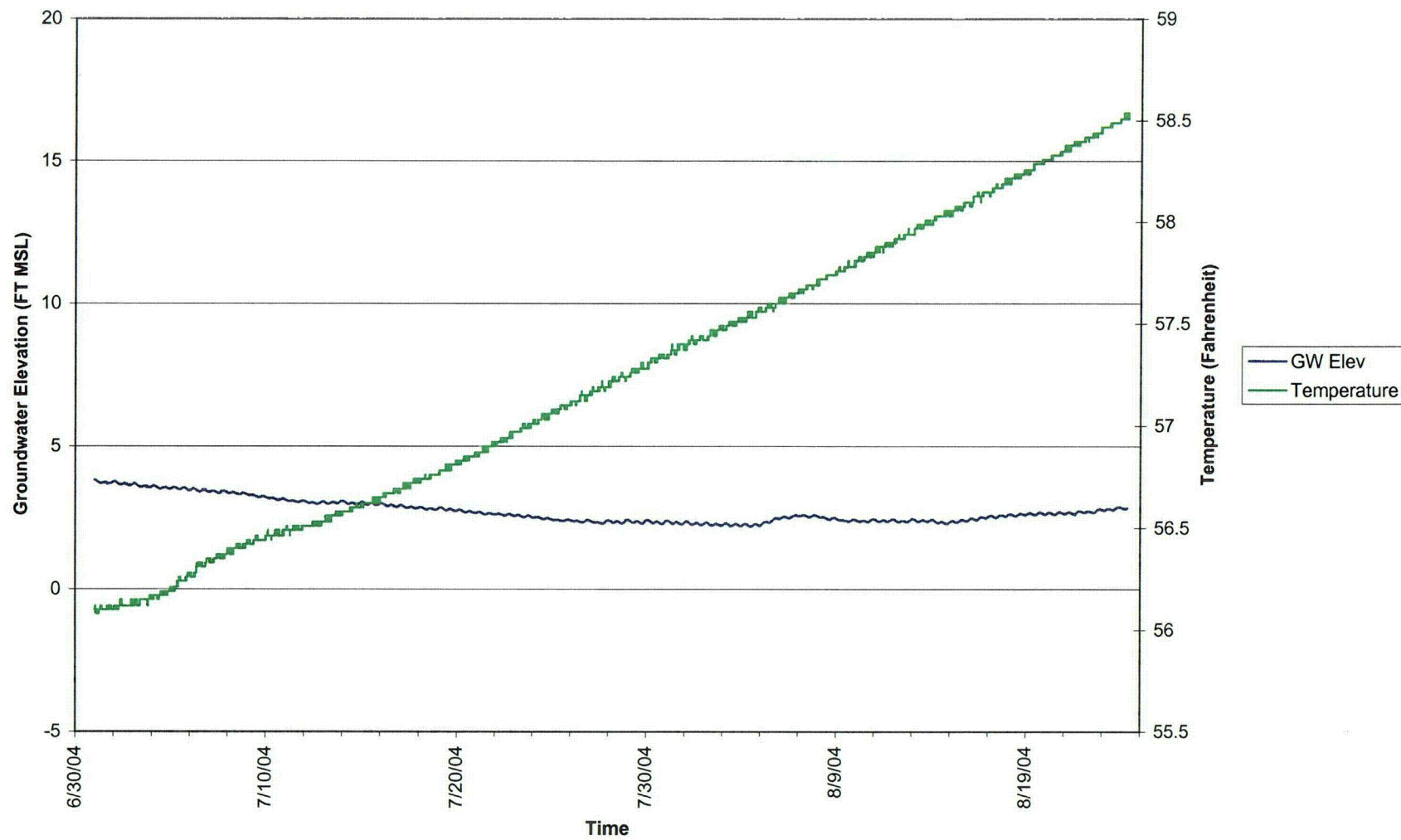
Groundwater Elevation at MW-107S
3rd Quarter



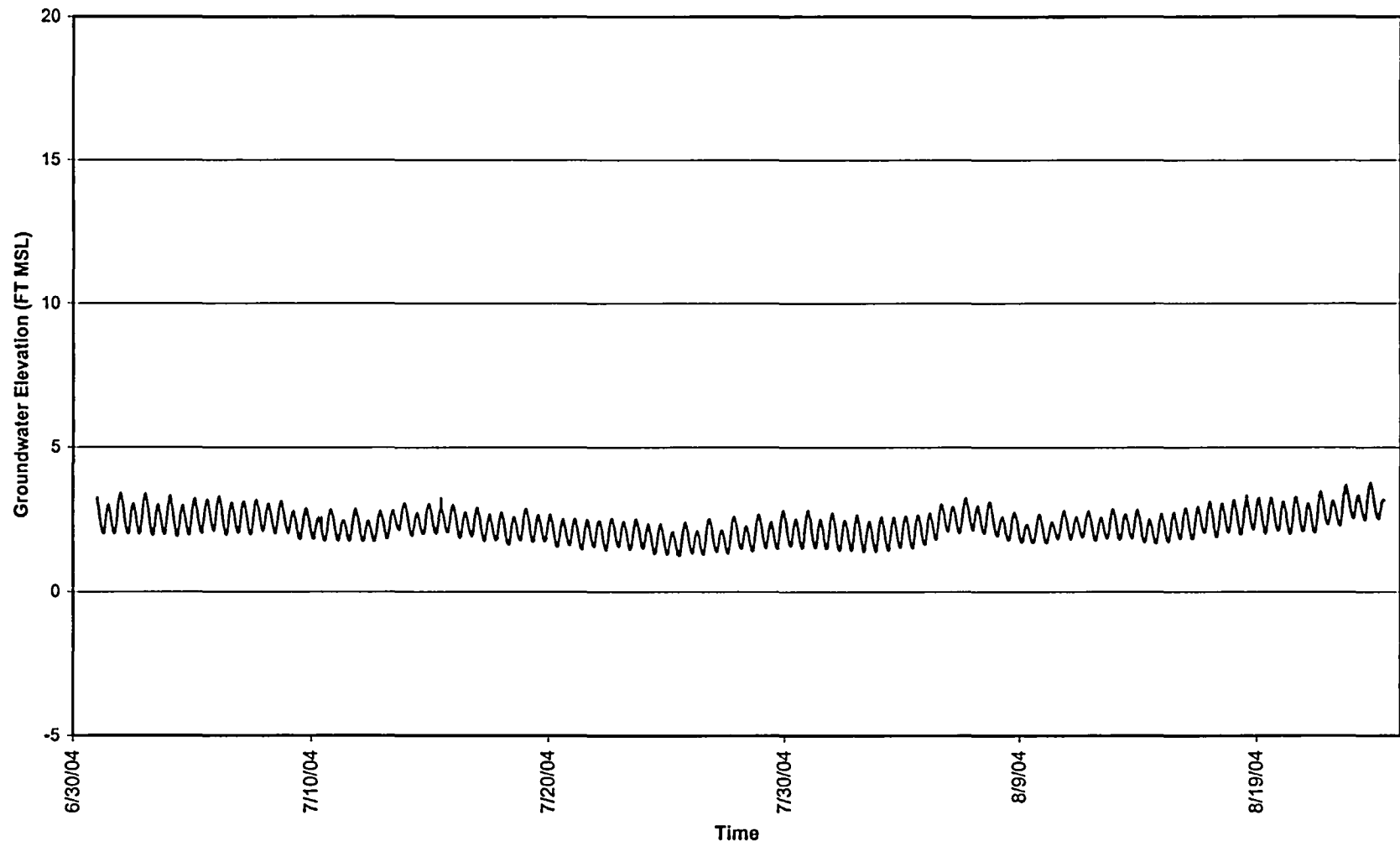
MW-107S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



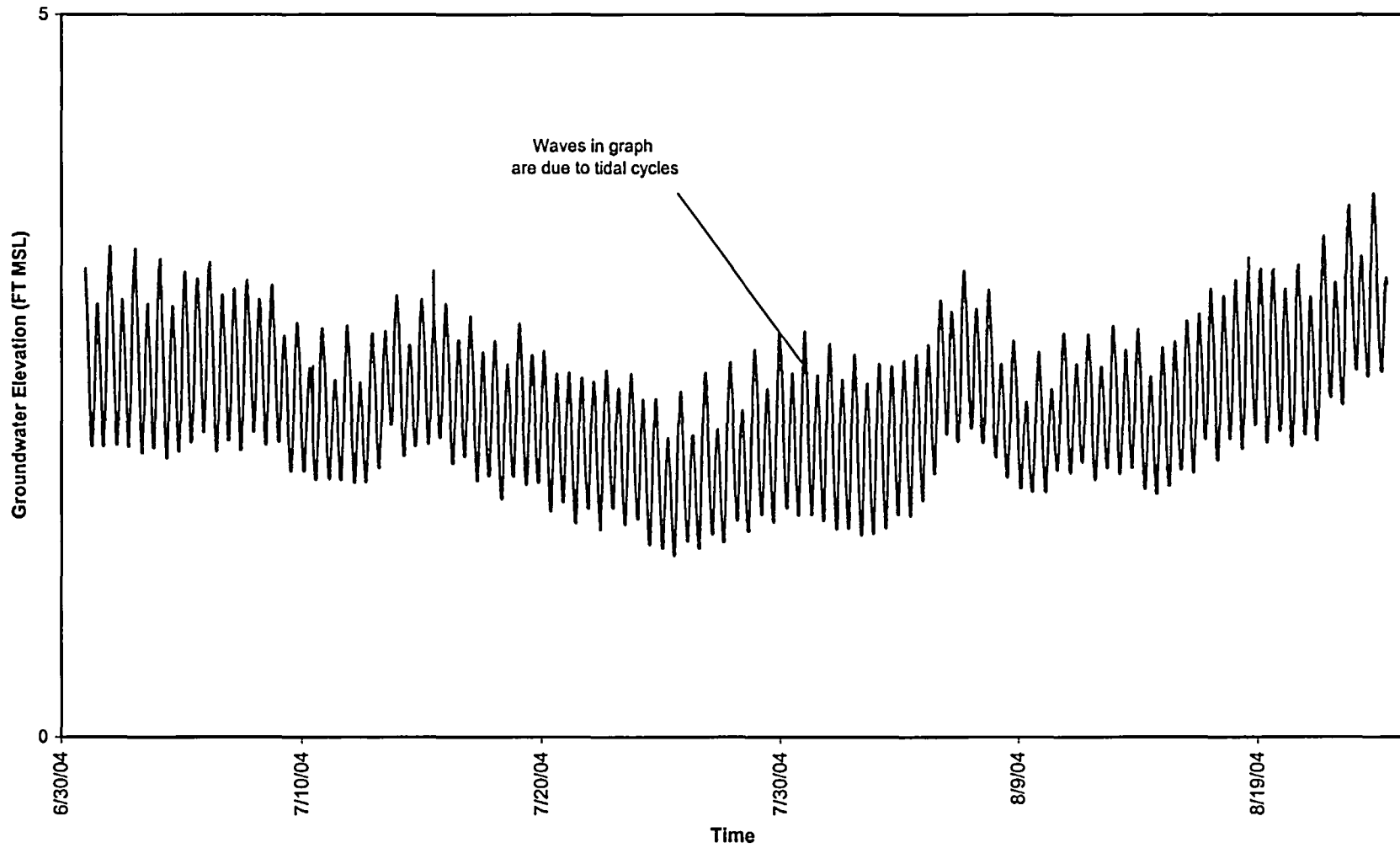
MW-107S Groundwater Elevation and Temperature
3rd Quarter



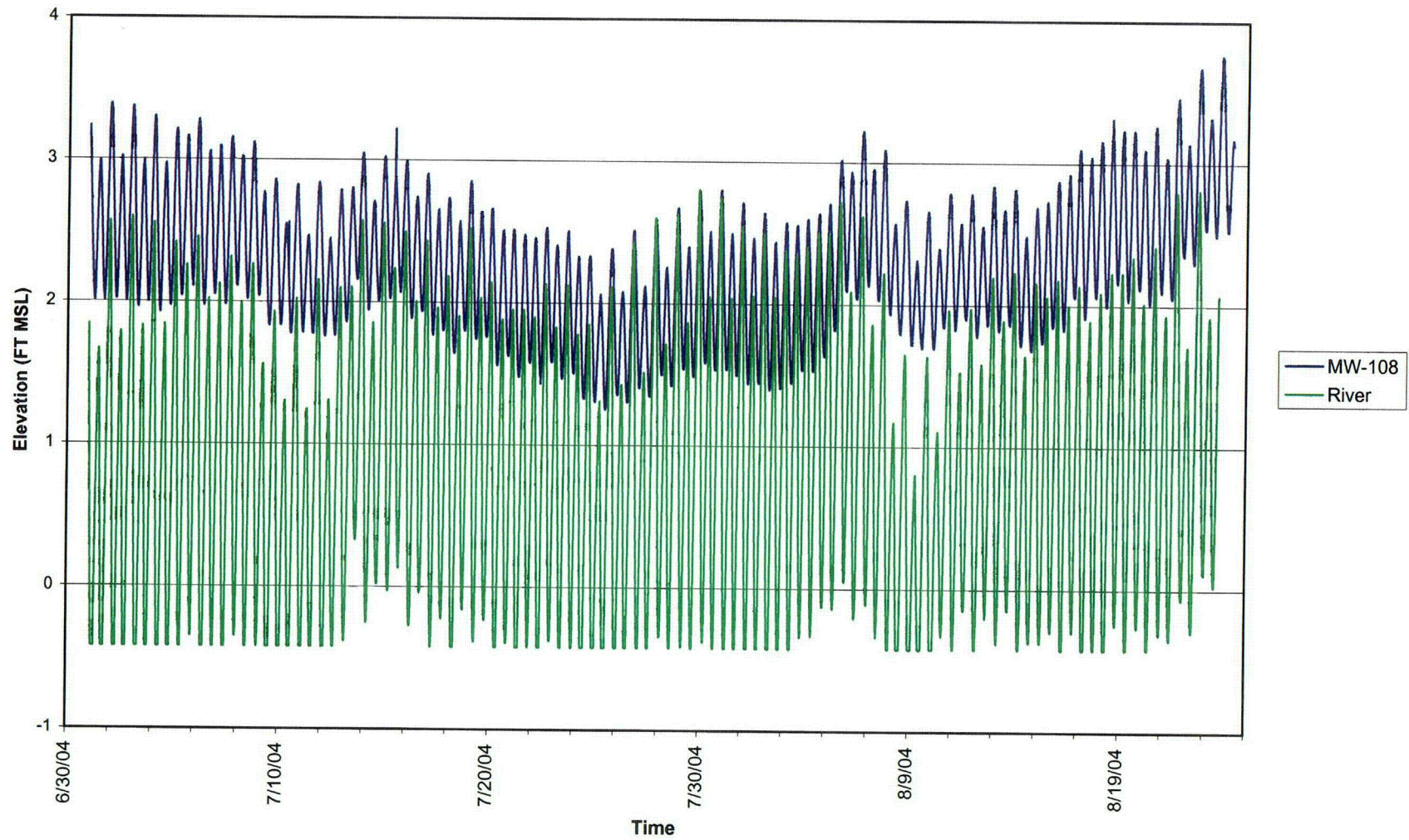
Groundwater Elevation at MW108S
3rd Quarter



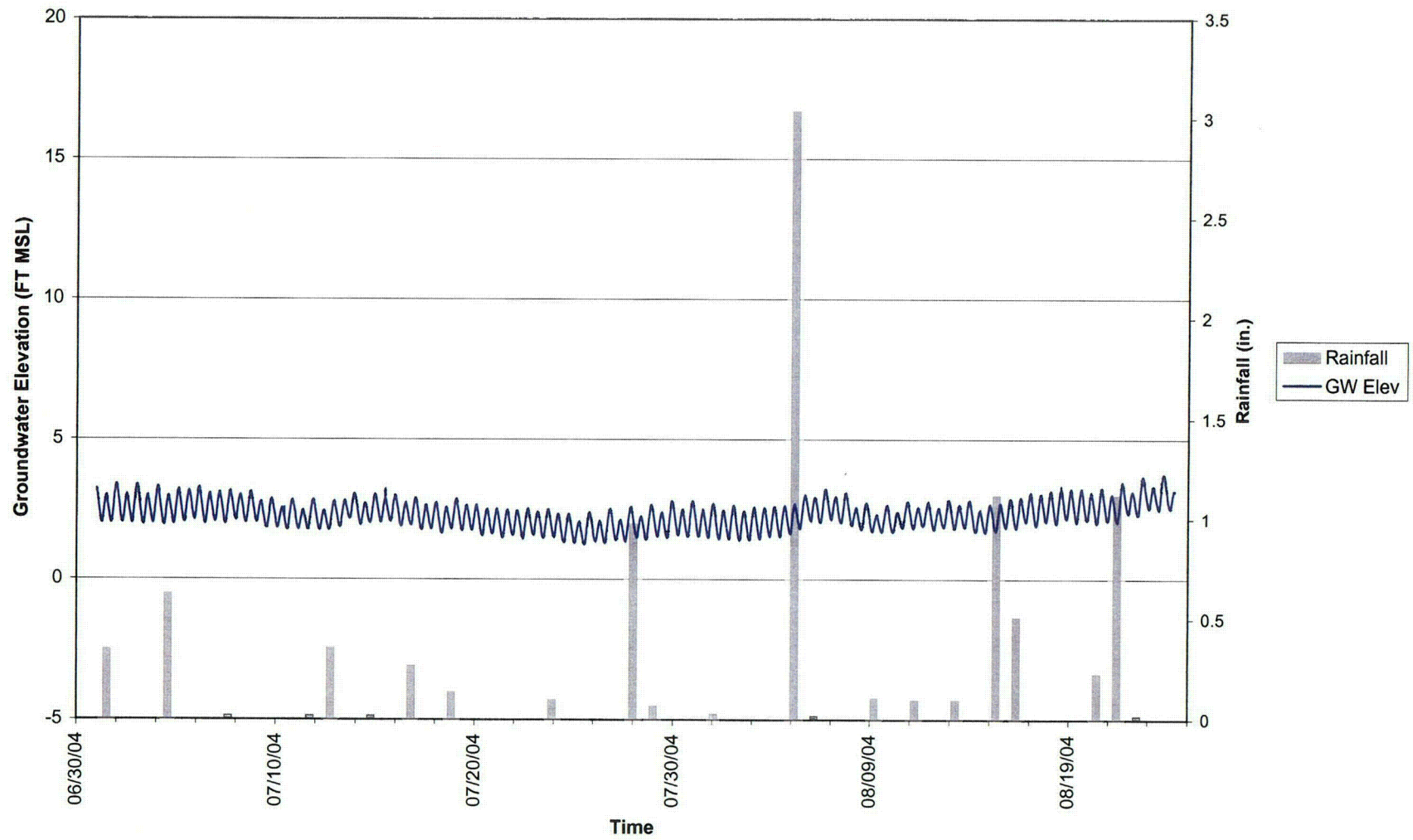
Groundwater Elevation at MW108S
3rd Quarter



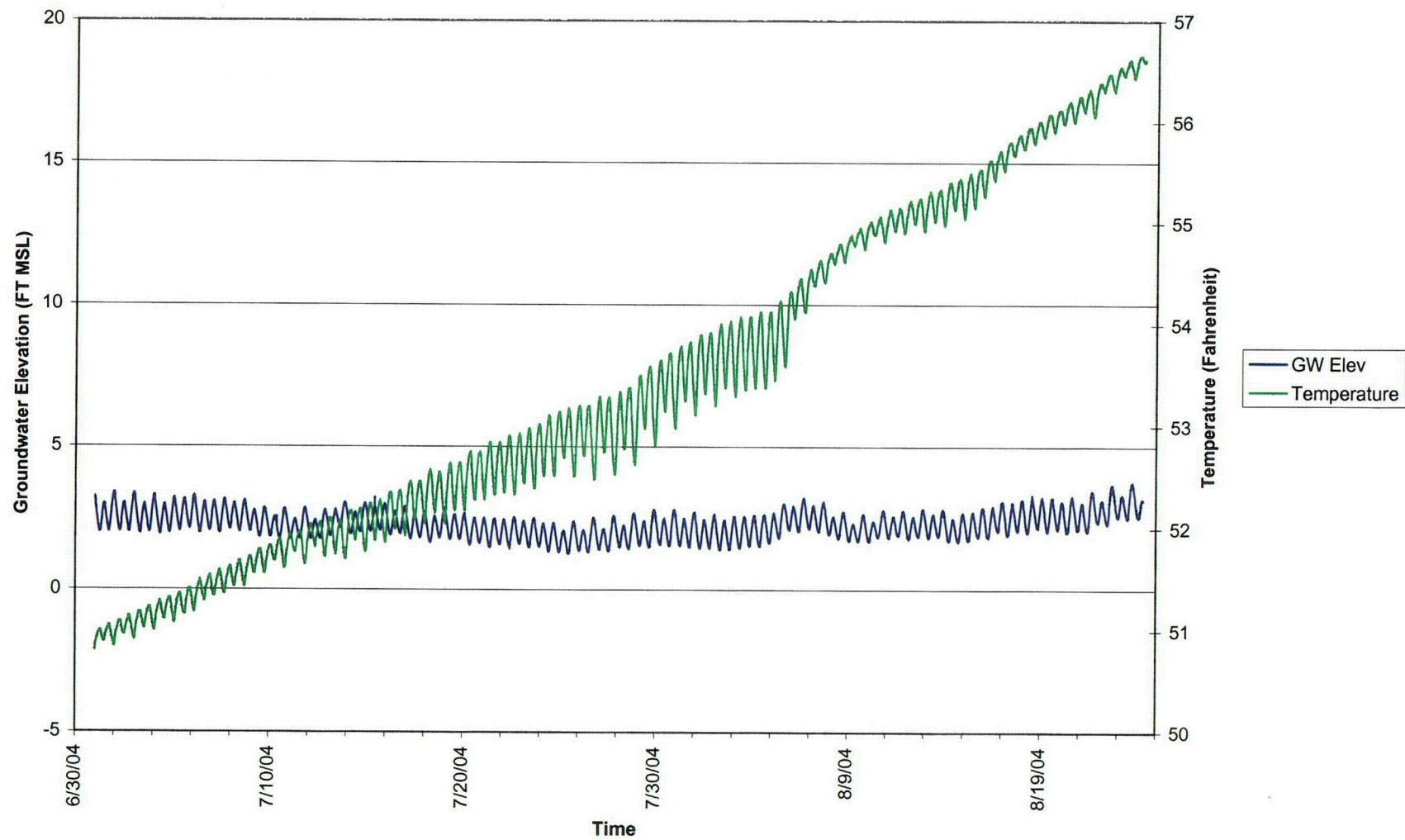
Groundwater Elevation at MW108S and River Levels
3rd Quarter



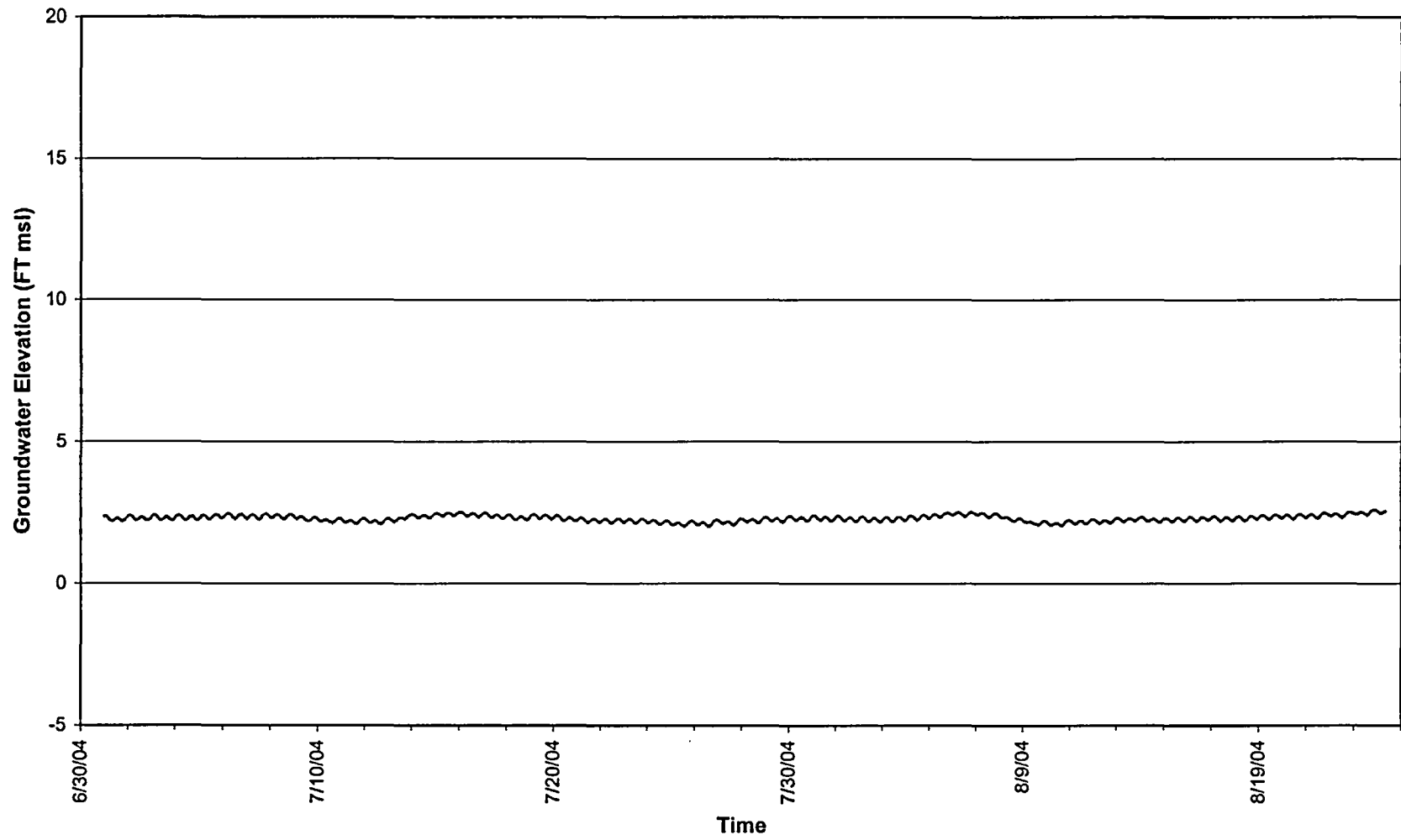
MW108S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



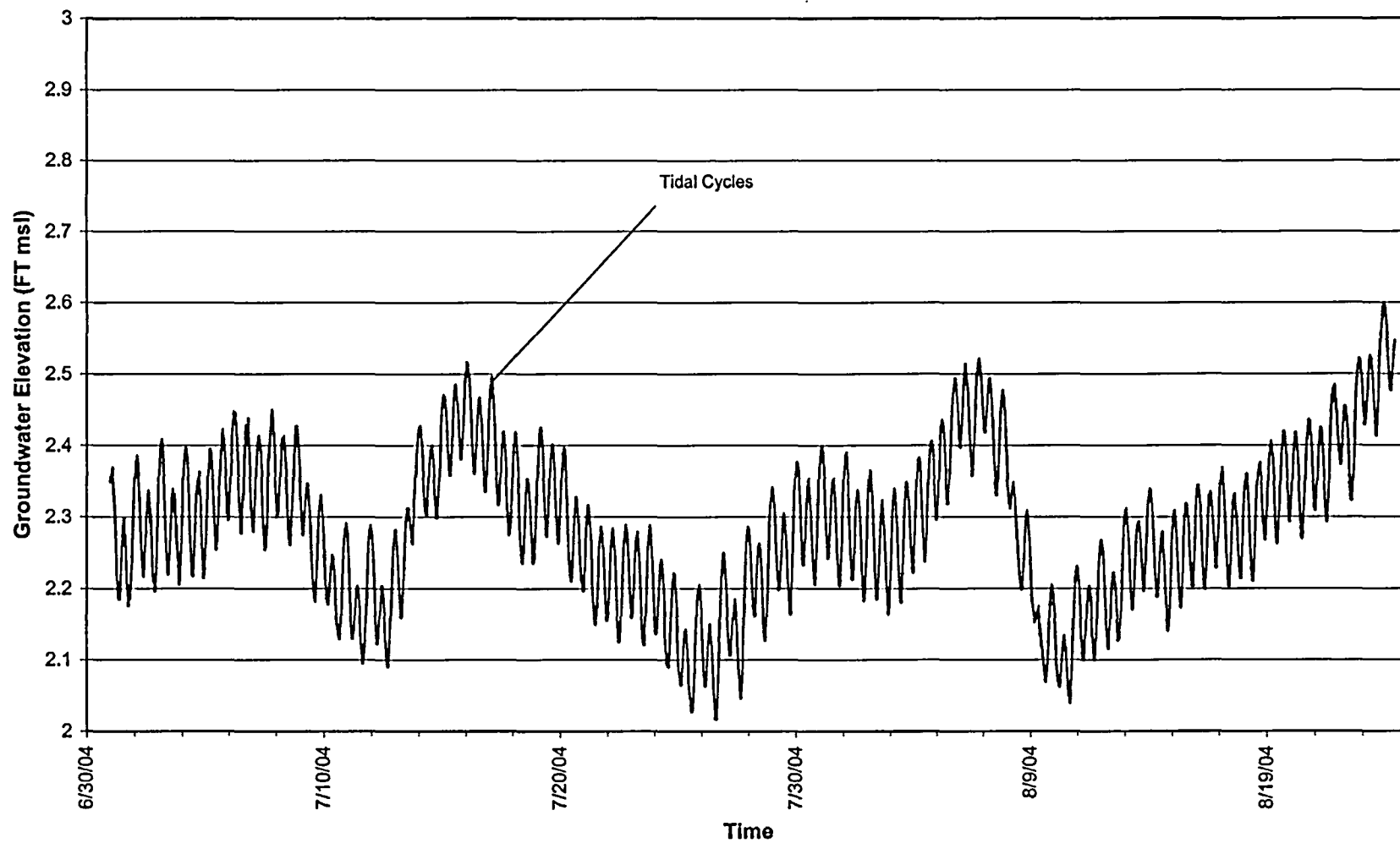
MW108S Groundwater Elevation and Temperature
3rd Quarter



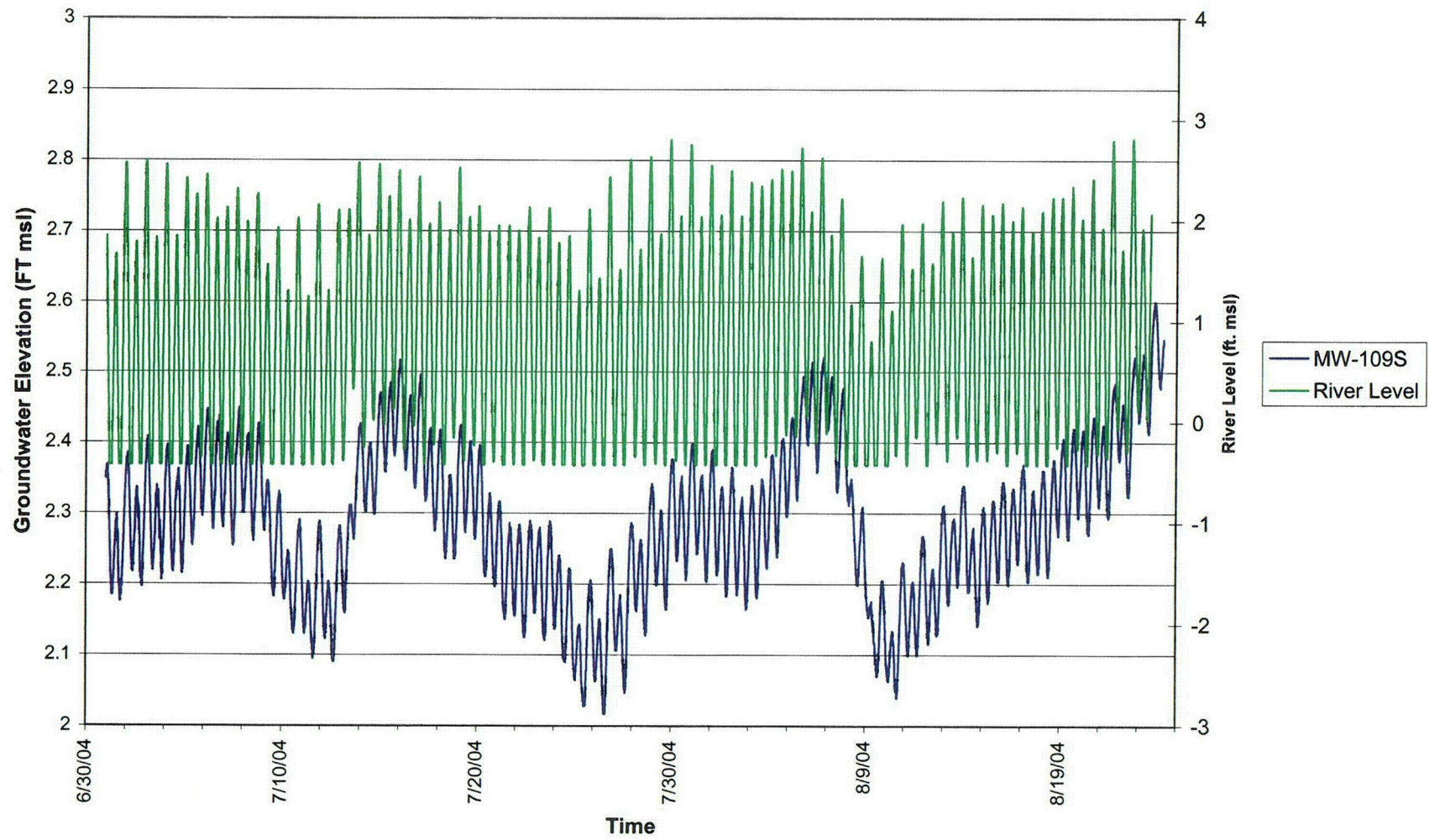
Groundwater Elevation at MW-109S
3rd Quarter



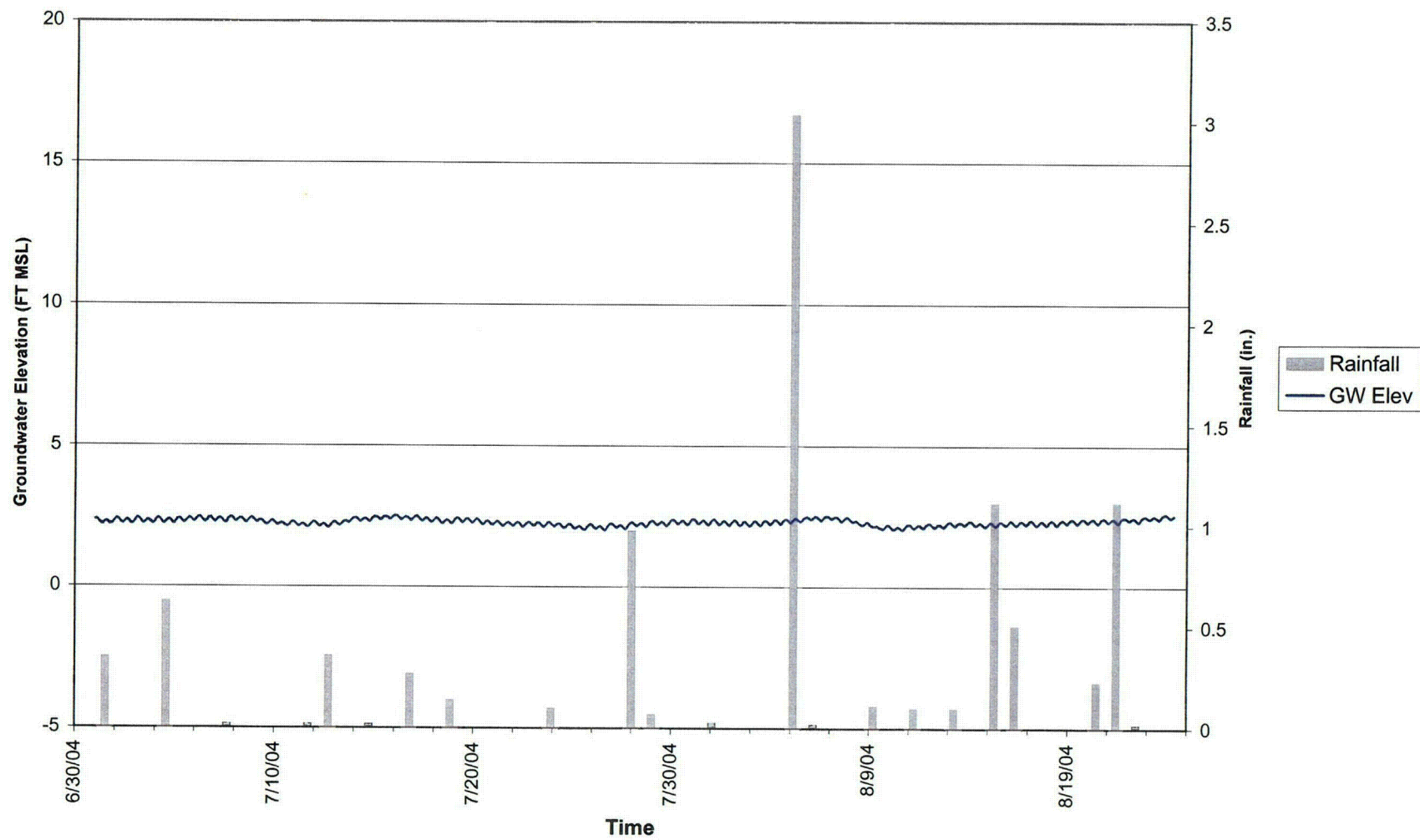
Groundwater Elevation at MW-109S
3rd Quarter



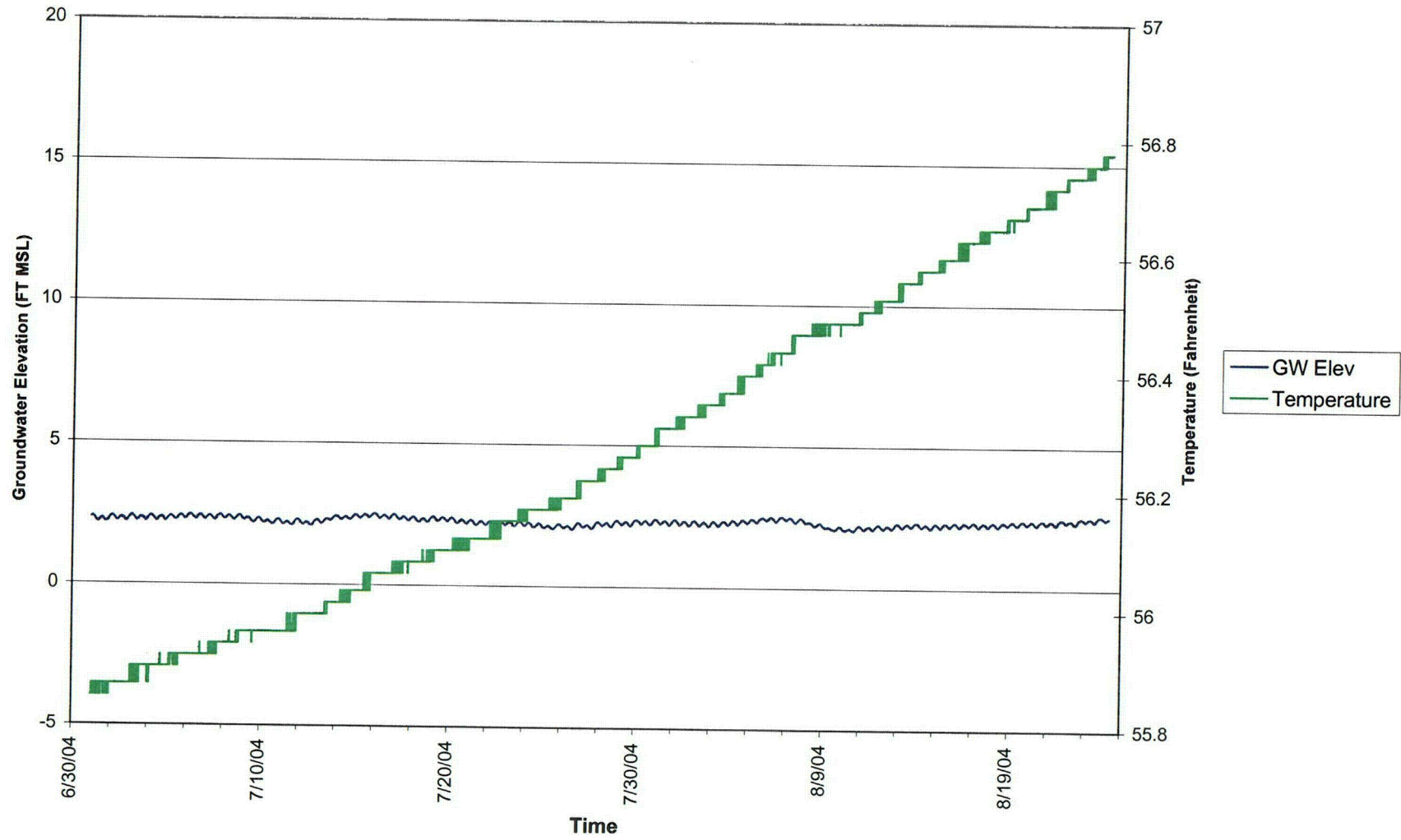
Groundwater Elevation at MW-109S
3rd Quarter



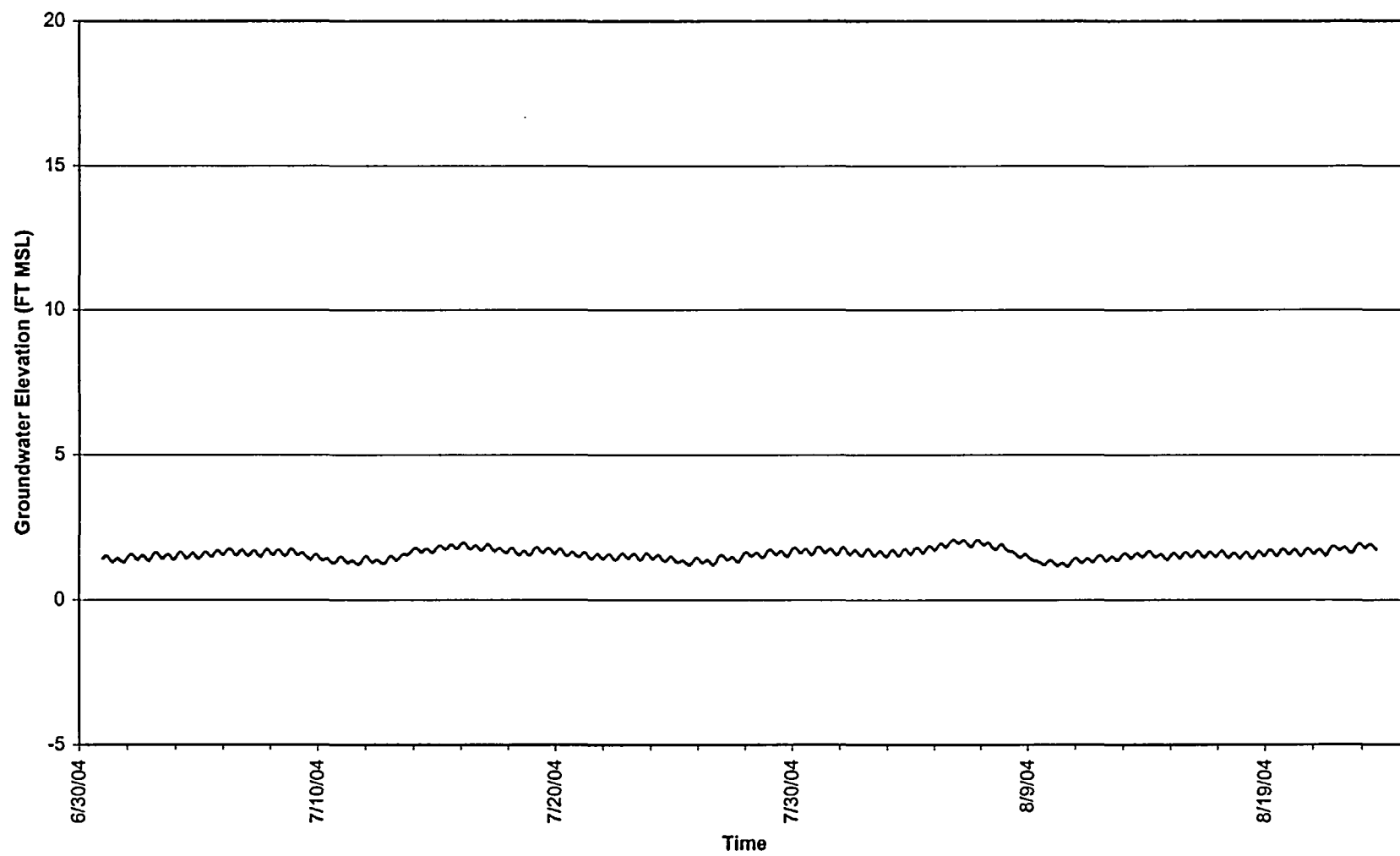
MW-109S Groundwater Elevation and Daily Rainfall Totals 3rd Quarter



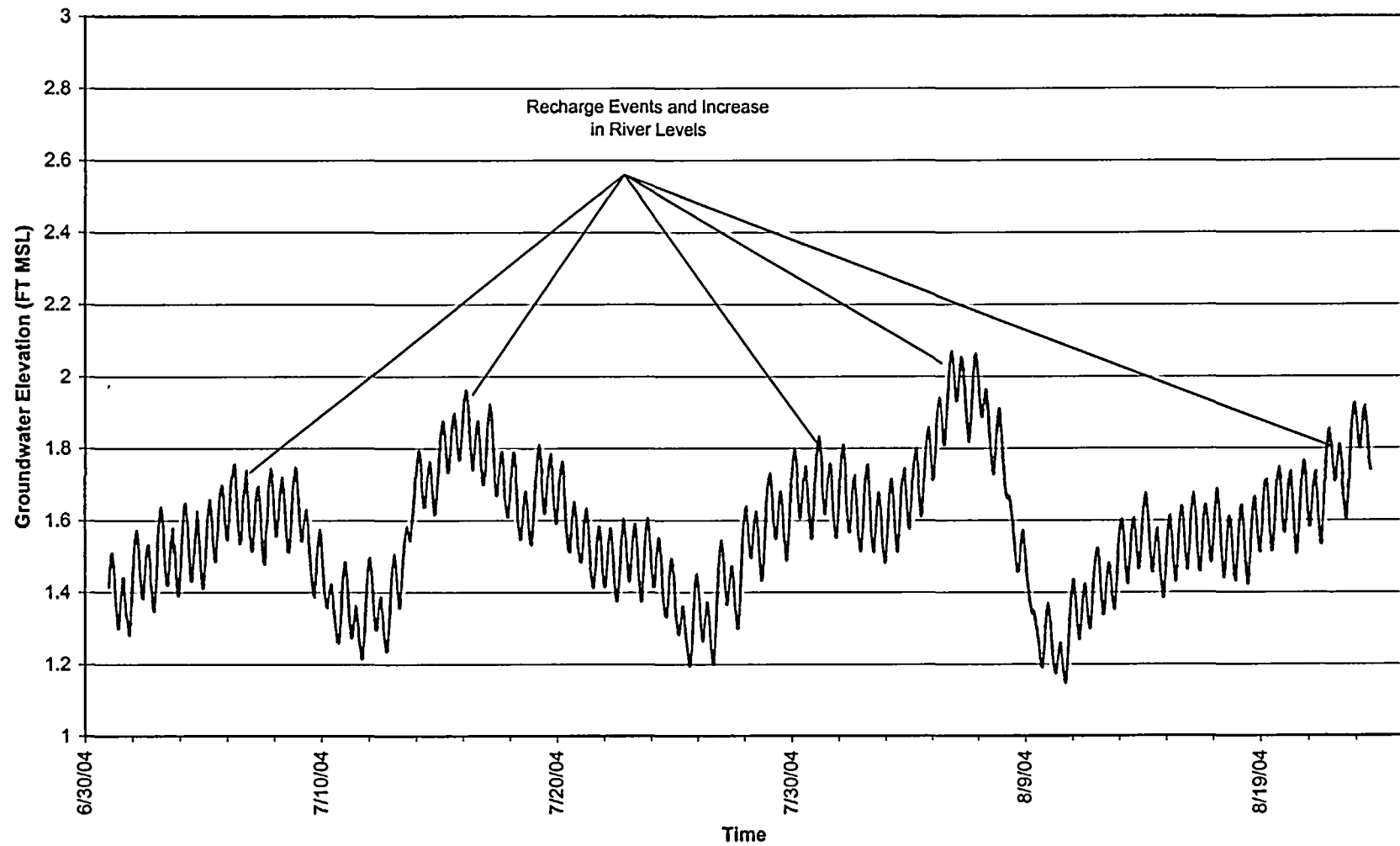
MW-109S Groundwater Elevation and Temperature
3rd Quarter



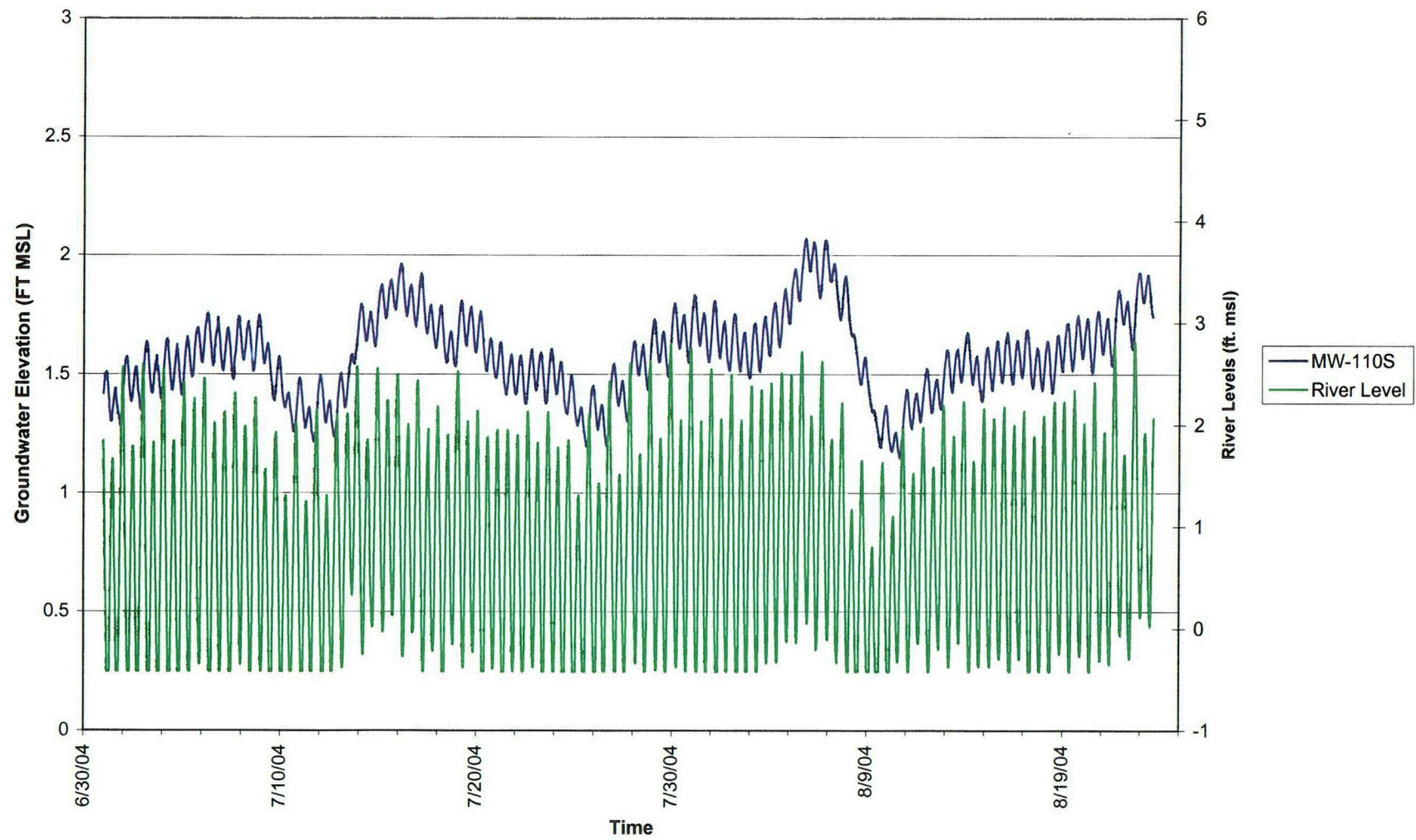
Groundwater Elevation at MW110S
3rd Quarter



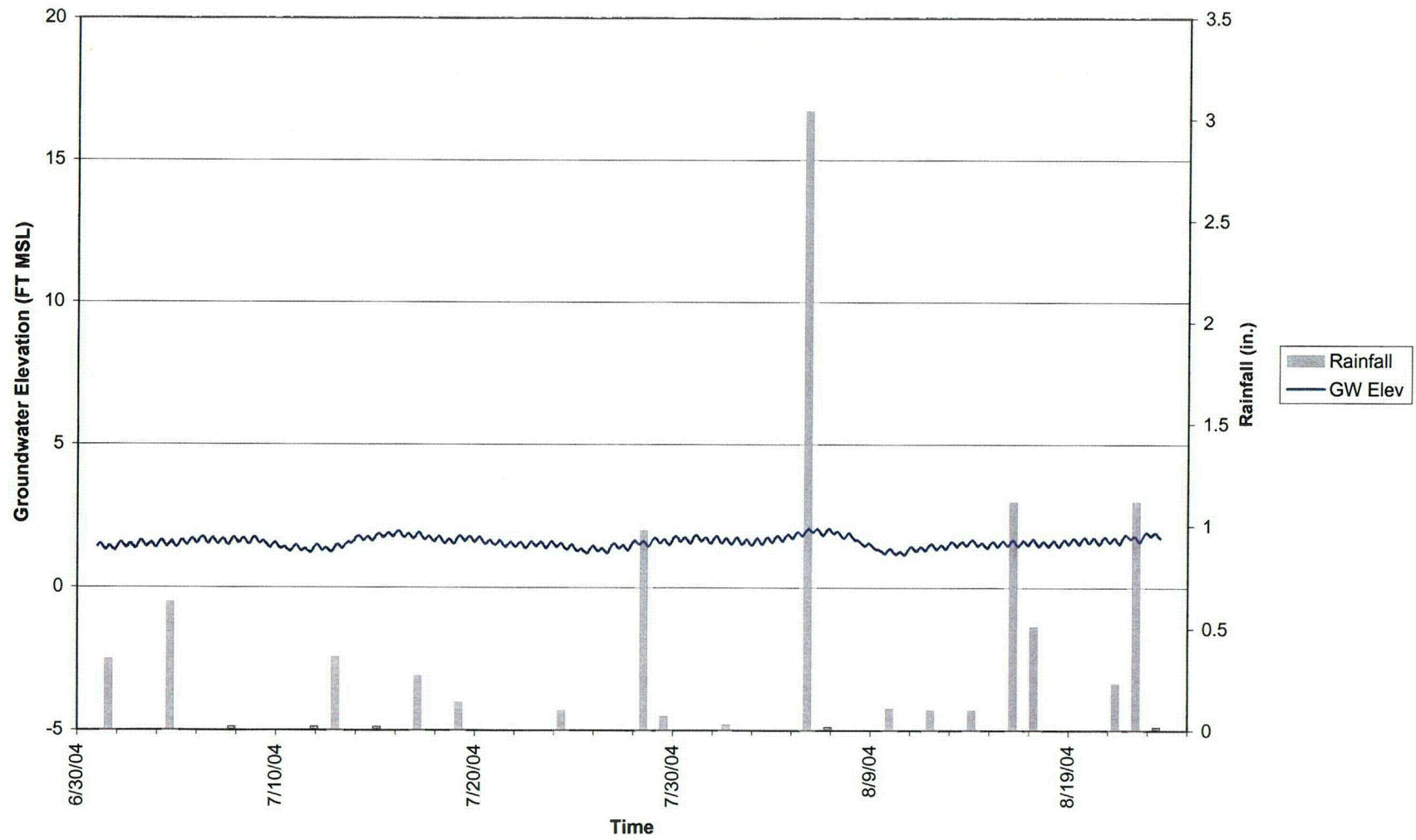
Groundwater Elevation at MW110S
3rd Quarter



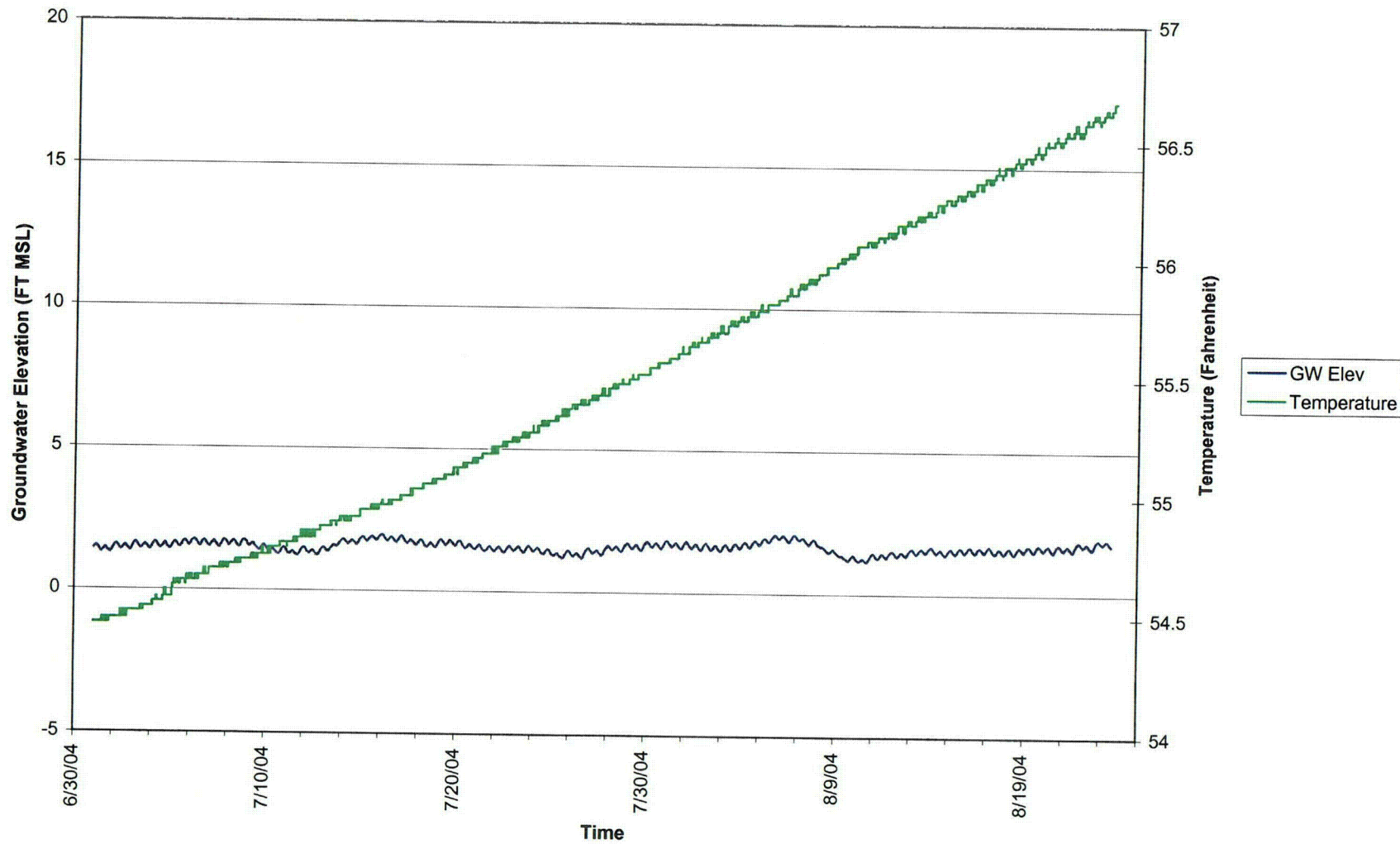
Groundwater Elevation at MW110S and River Levels
3rd Quarter



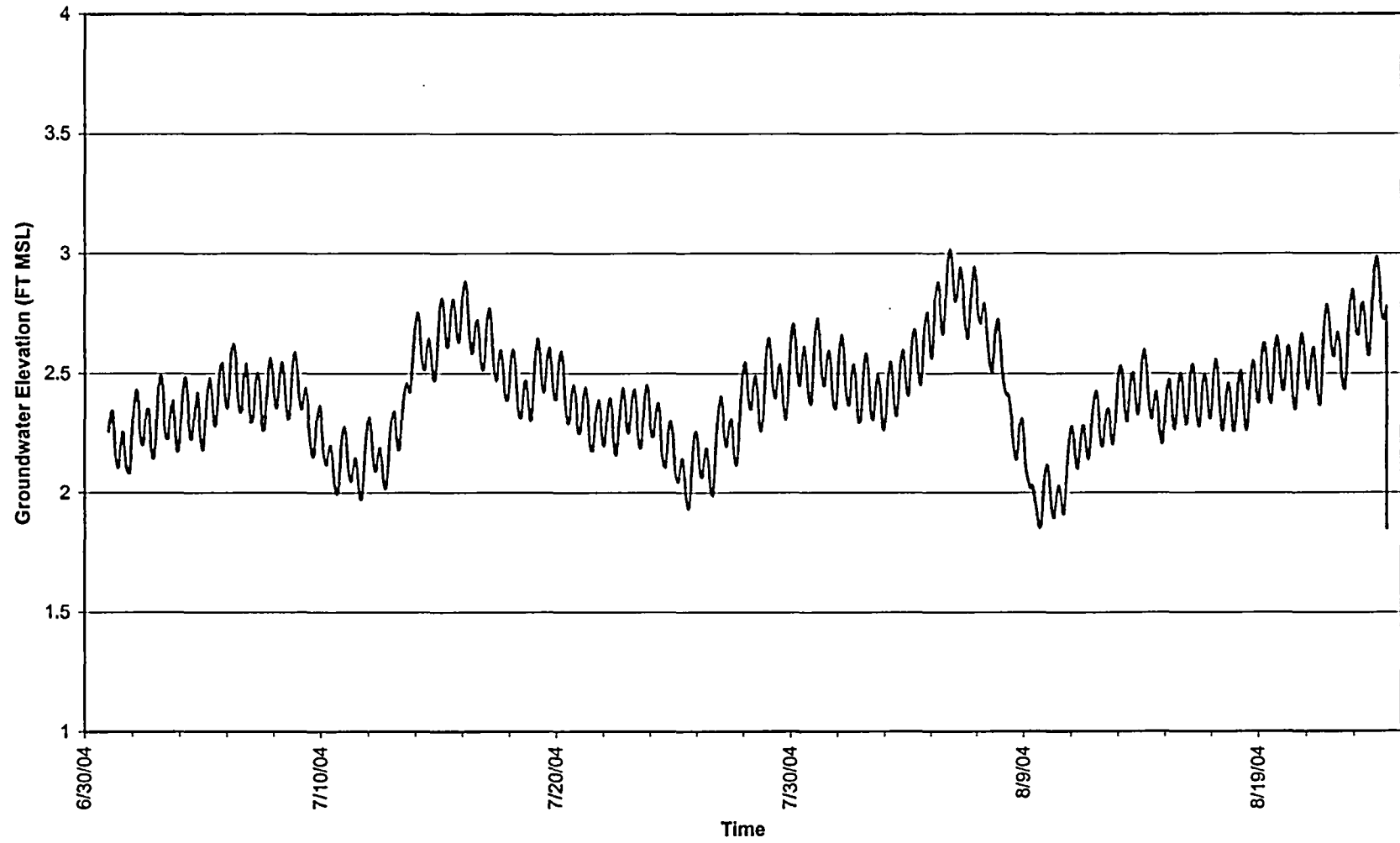
MW110S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



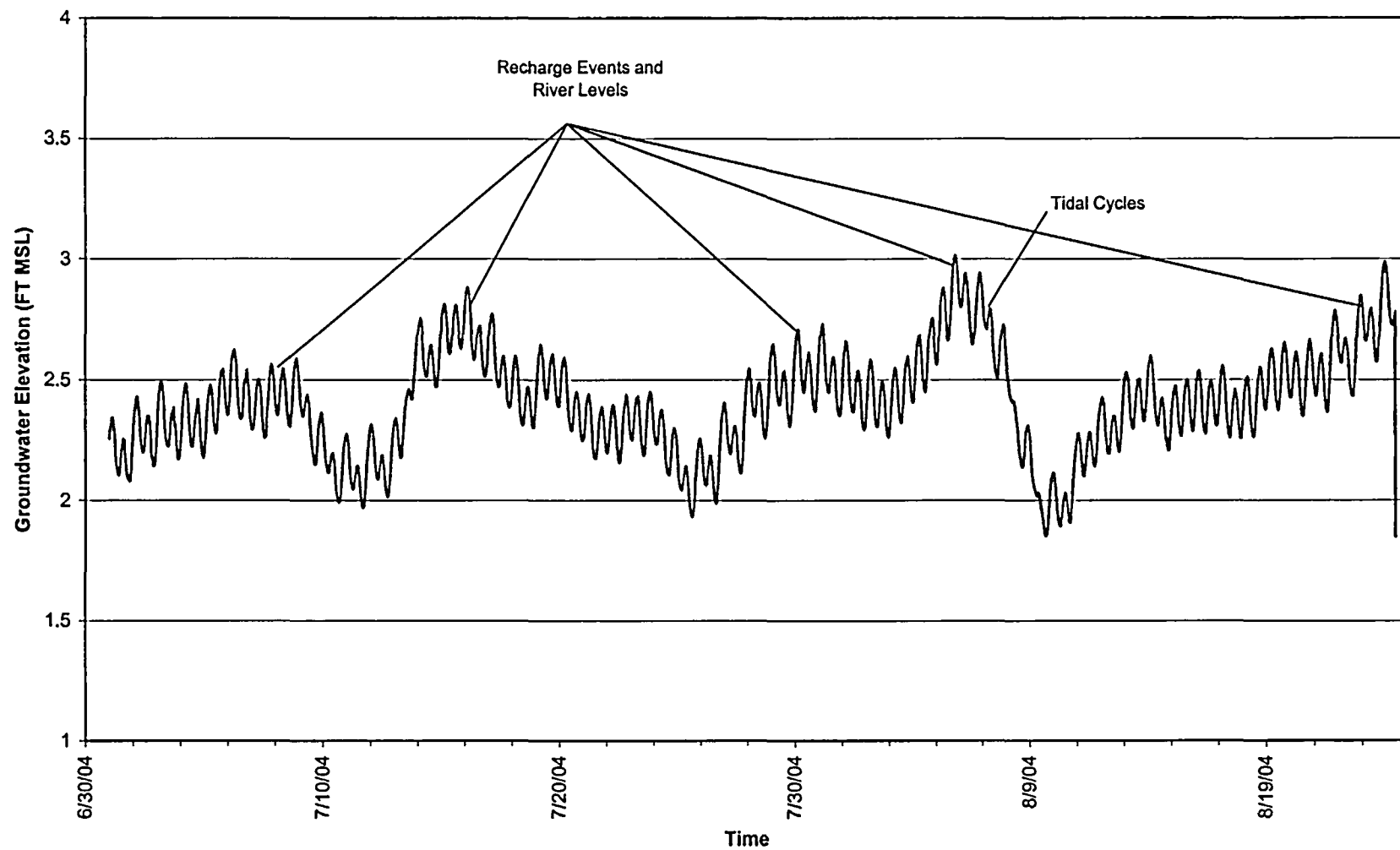
MW110S Groundwater Elevation and Temperature
3rd Quarter



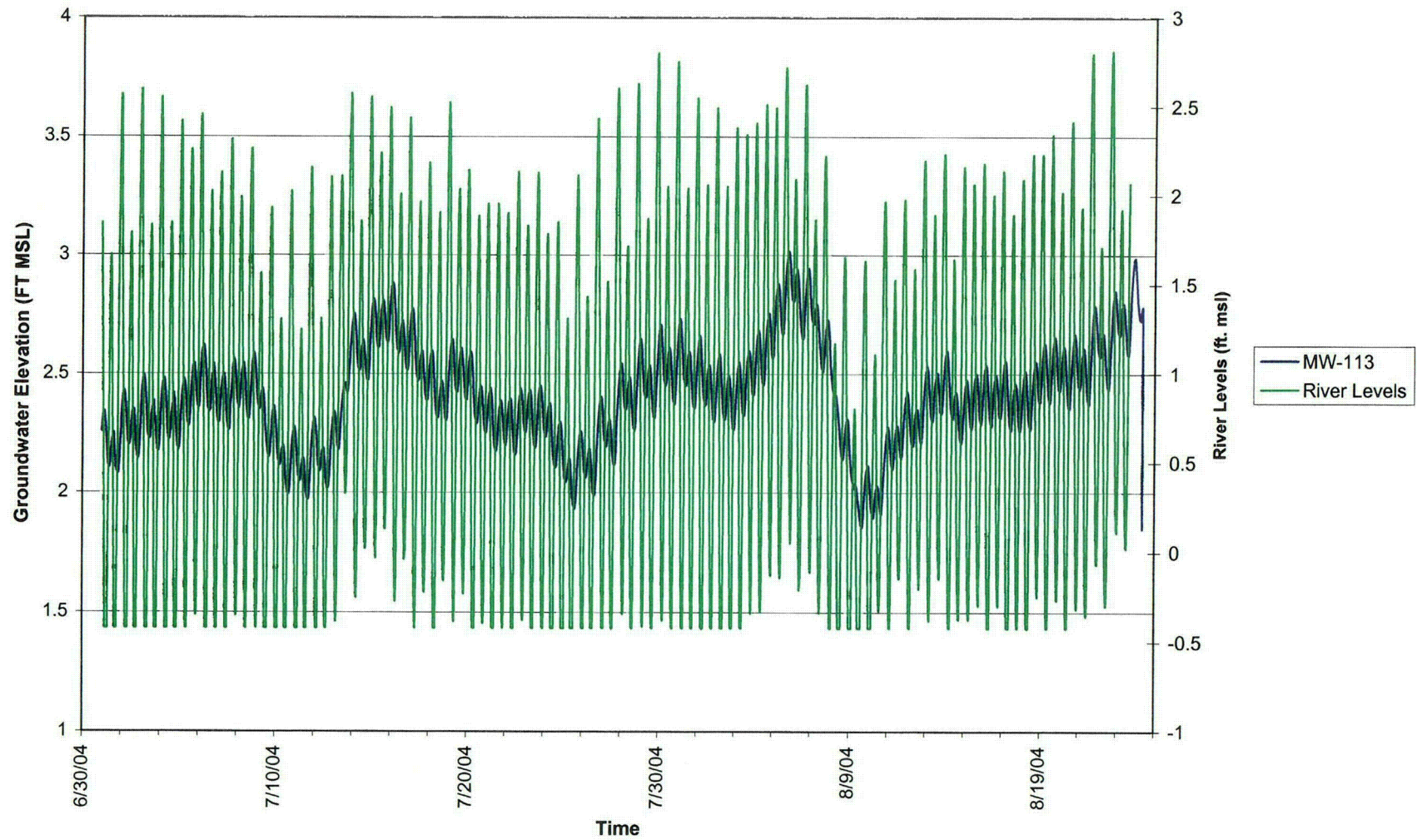
Groundwater Elevation at MW113S
3rd Quarter



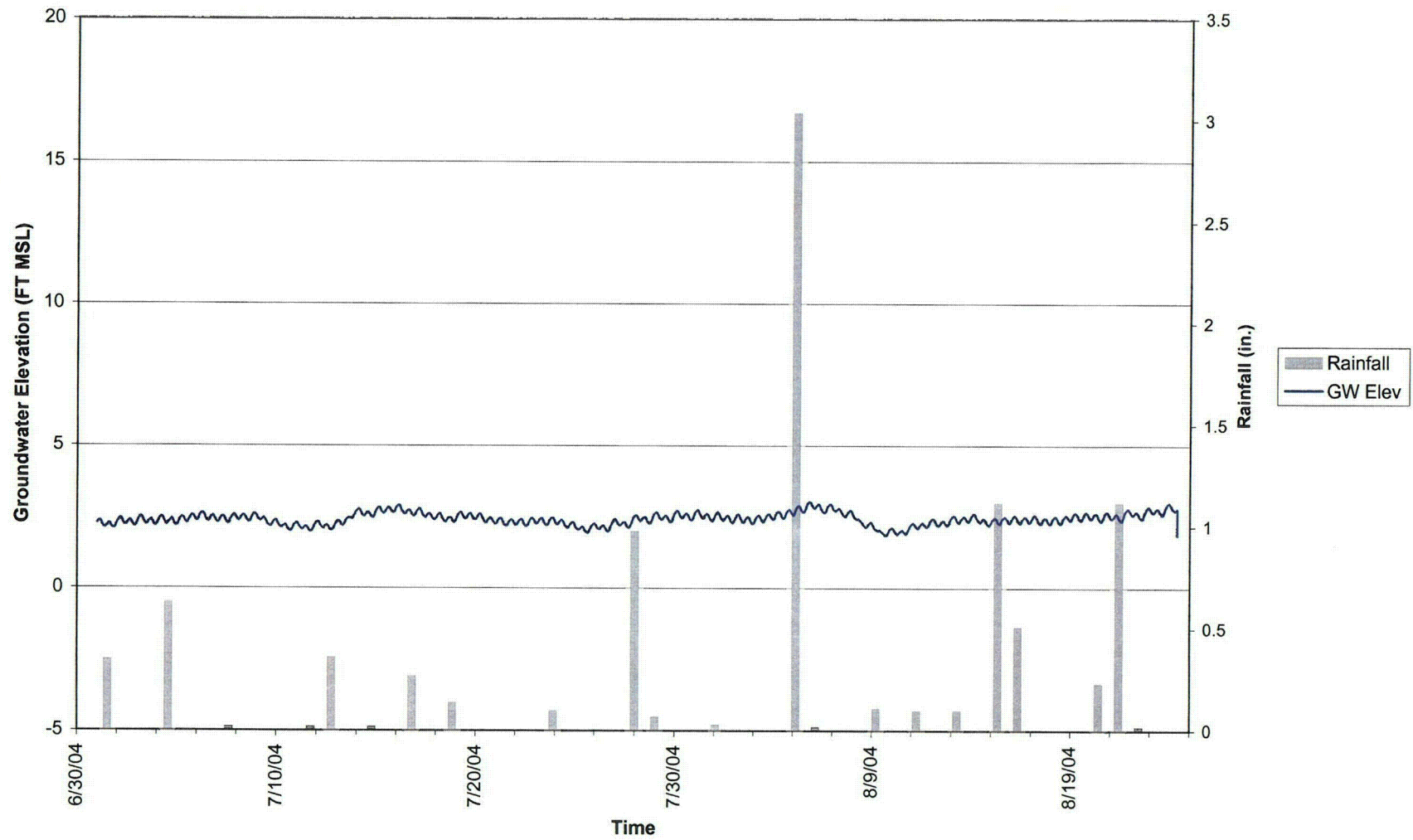
Groundwater Elevation at MW113S
3rd Quarter



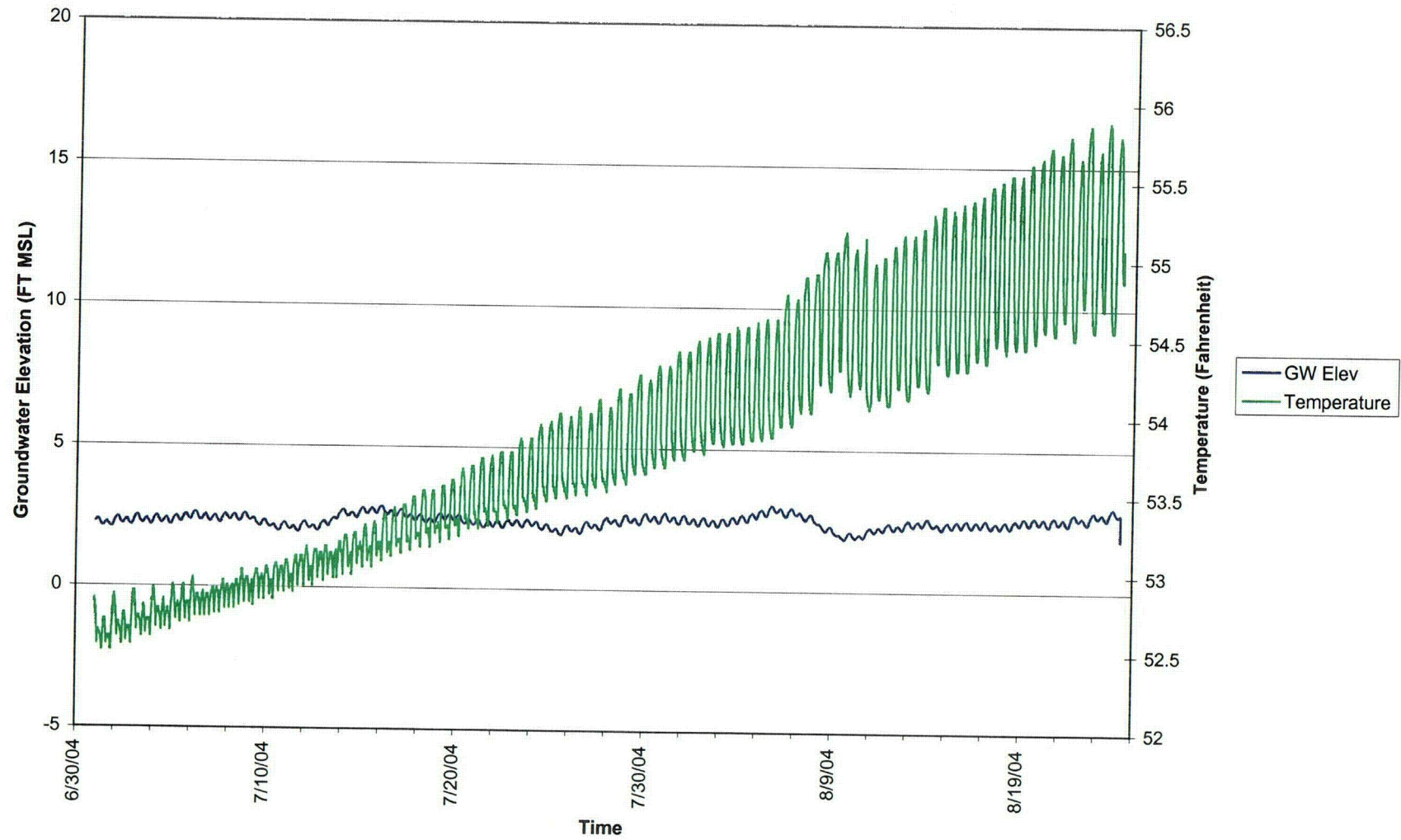
Groundwater Elevation at MW113S
3rd Quarter



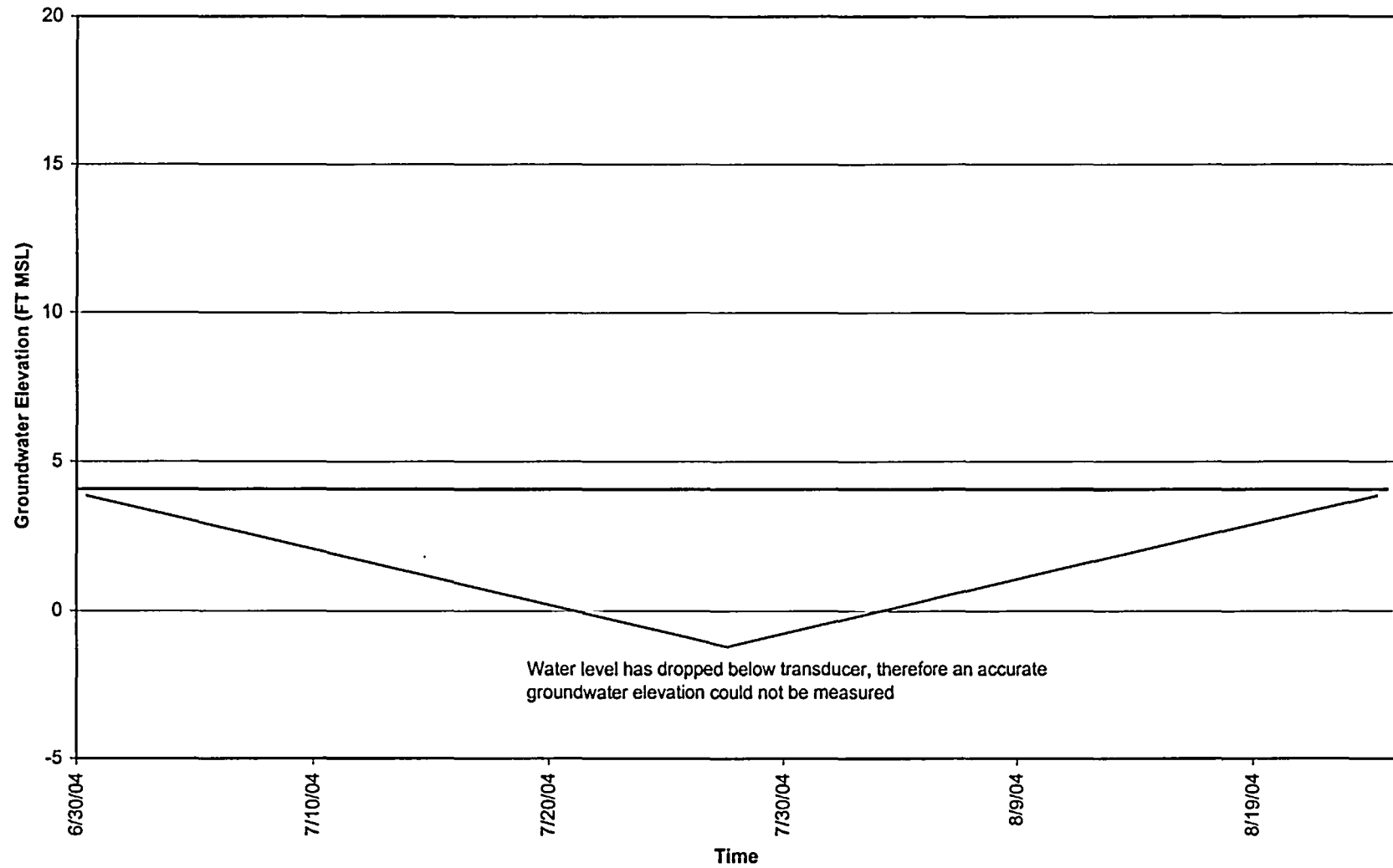
MW113S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



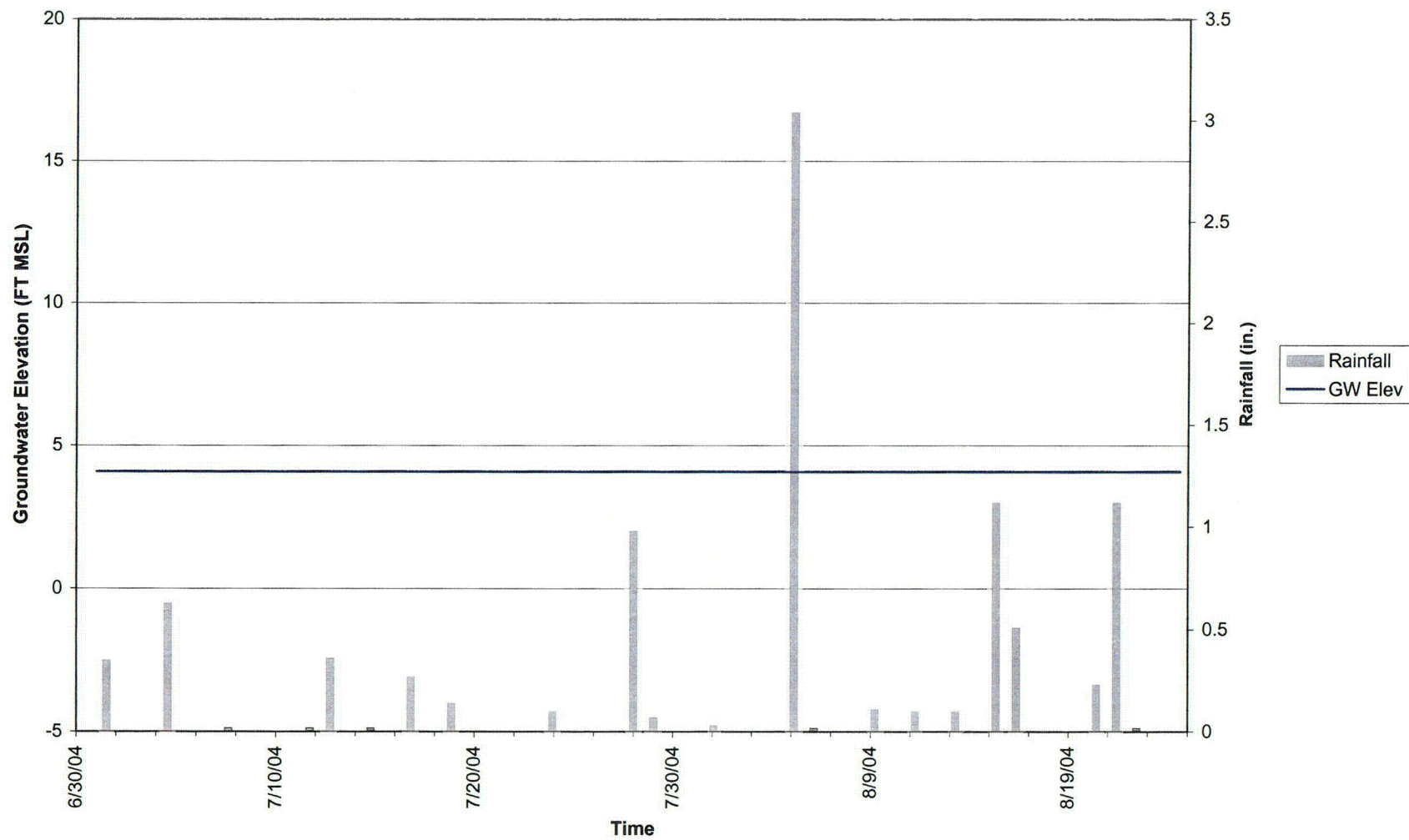
MW113S Groundwater Elevation and Temperature
3rd Quarter



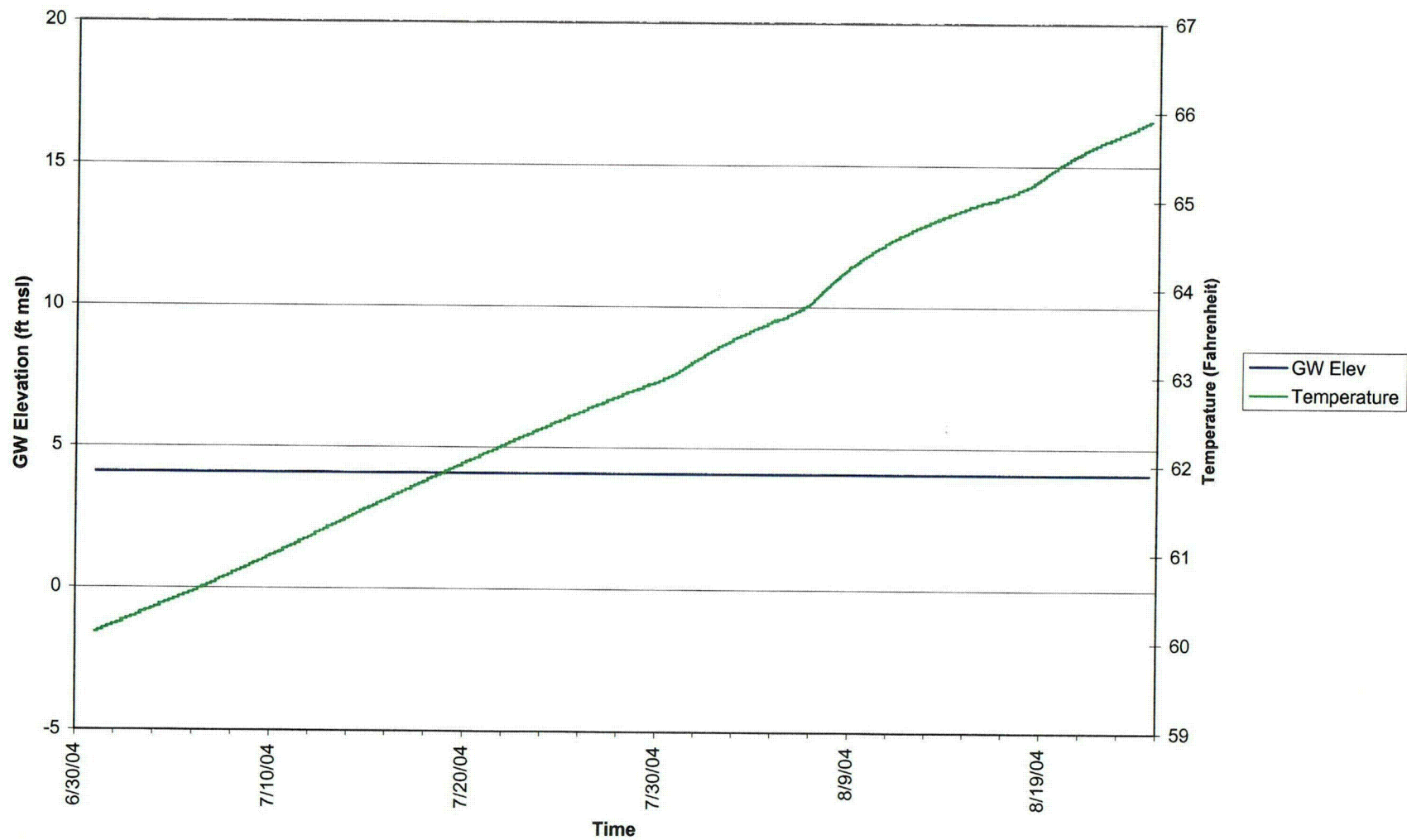
Groundwater Elevation at MW-114S
3rd Quarter



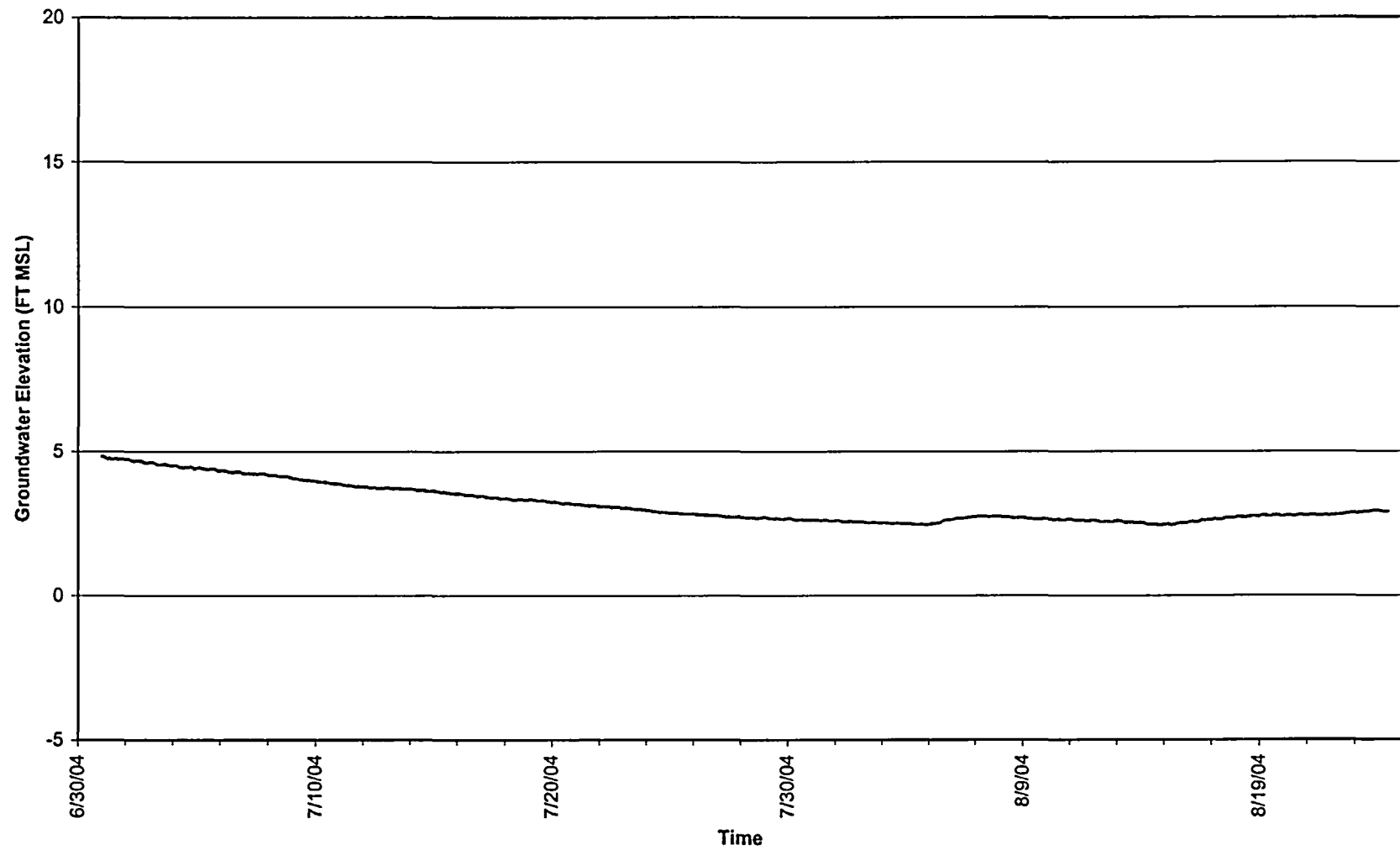
MW-114S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



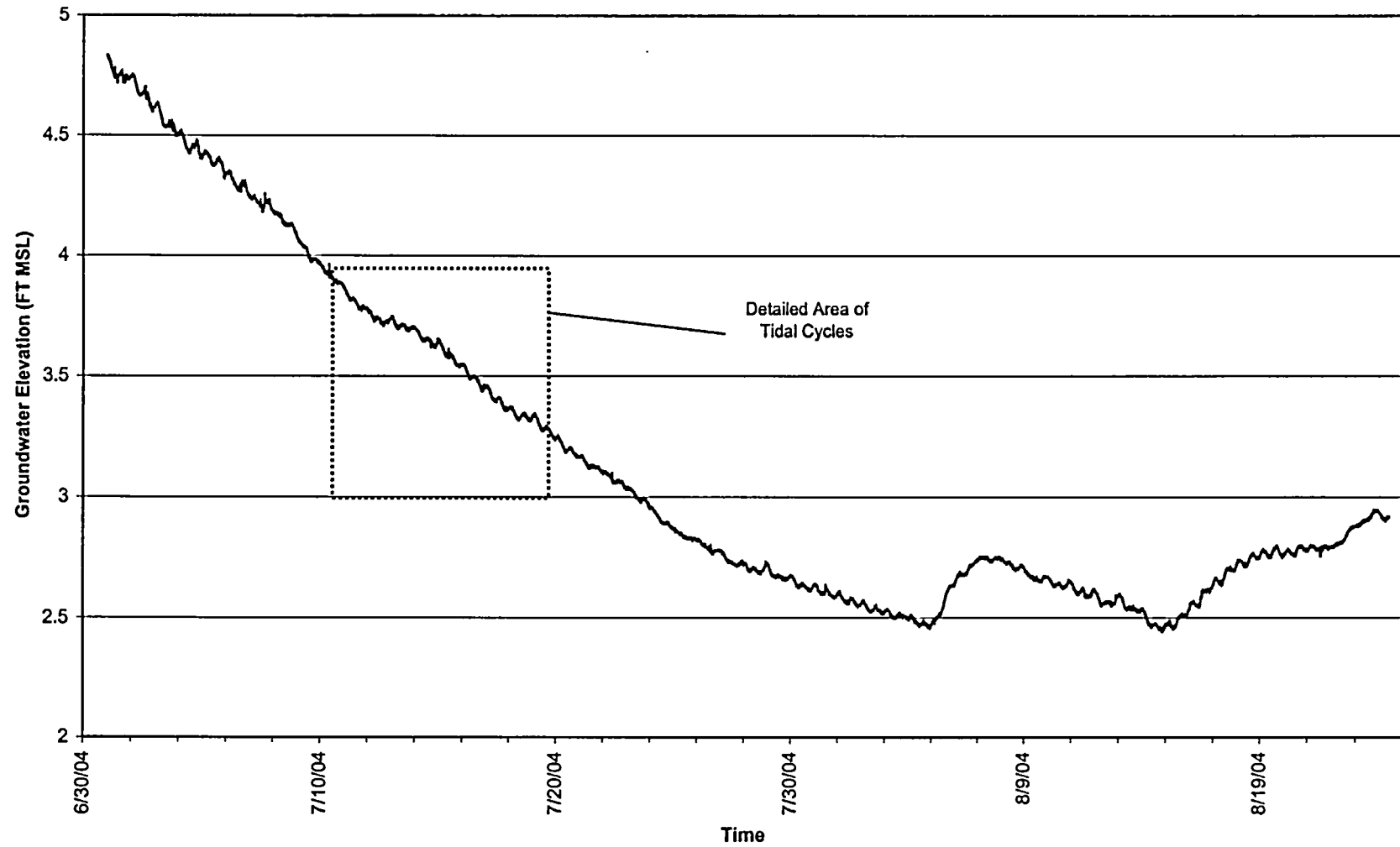
MW-114S Groundwater Elevation and Temperature
3rd Quarter



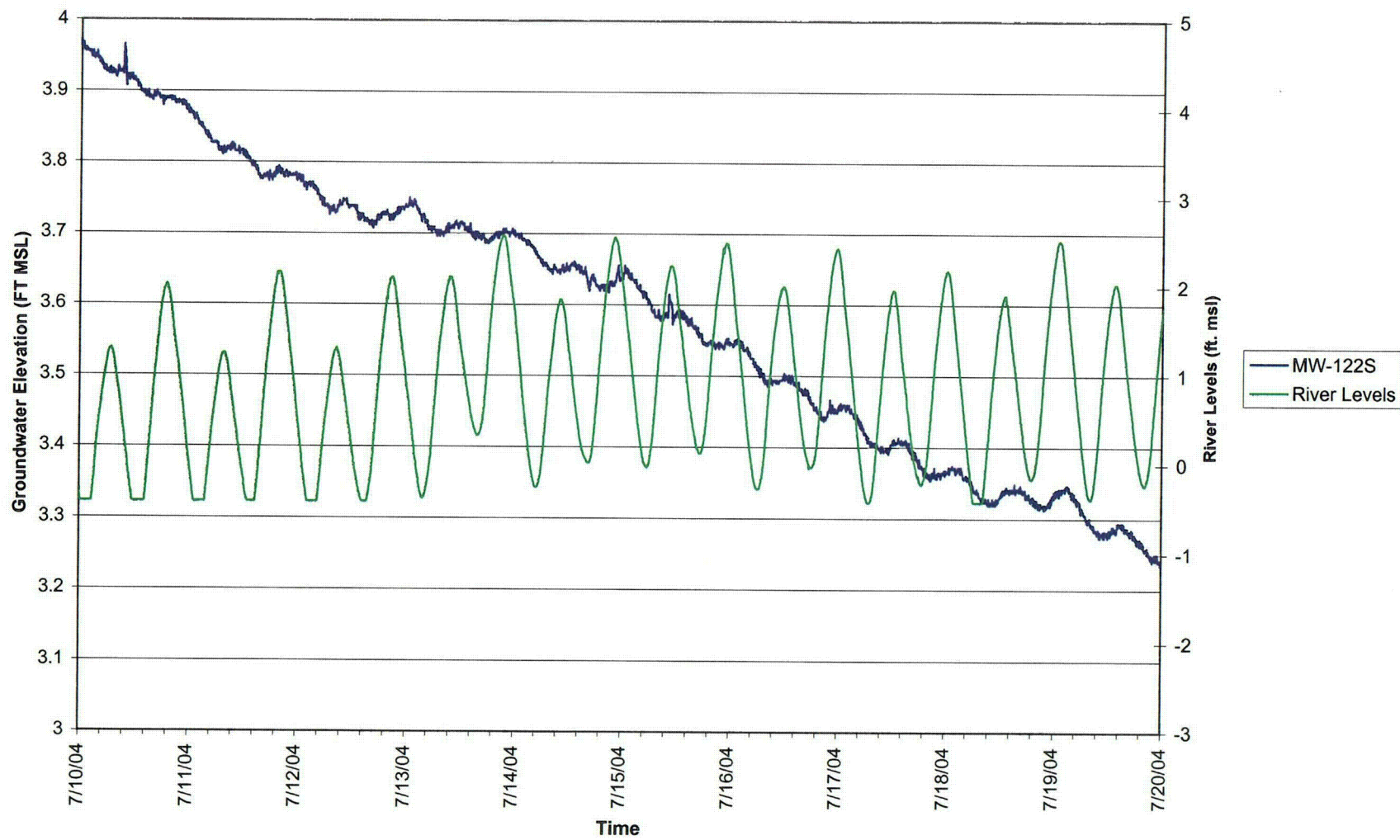
Groundwater Elevation at MW-122S
3rd Quarter



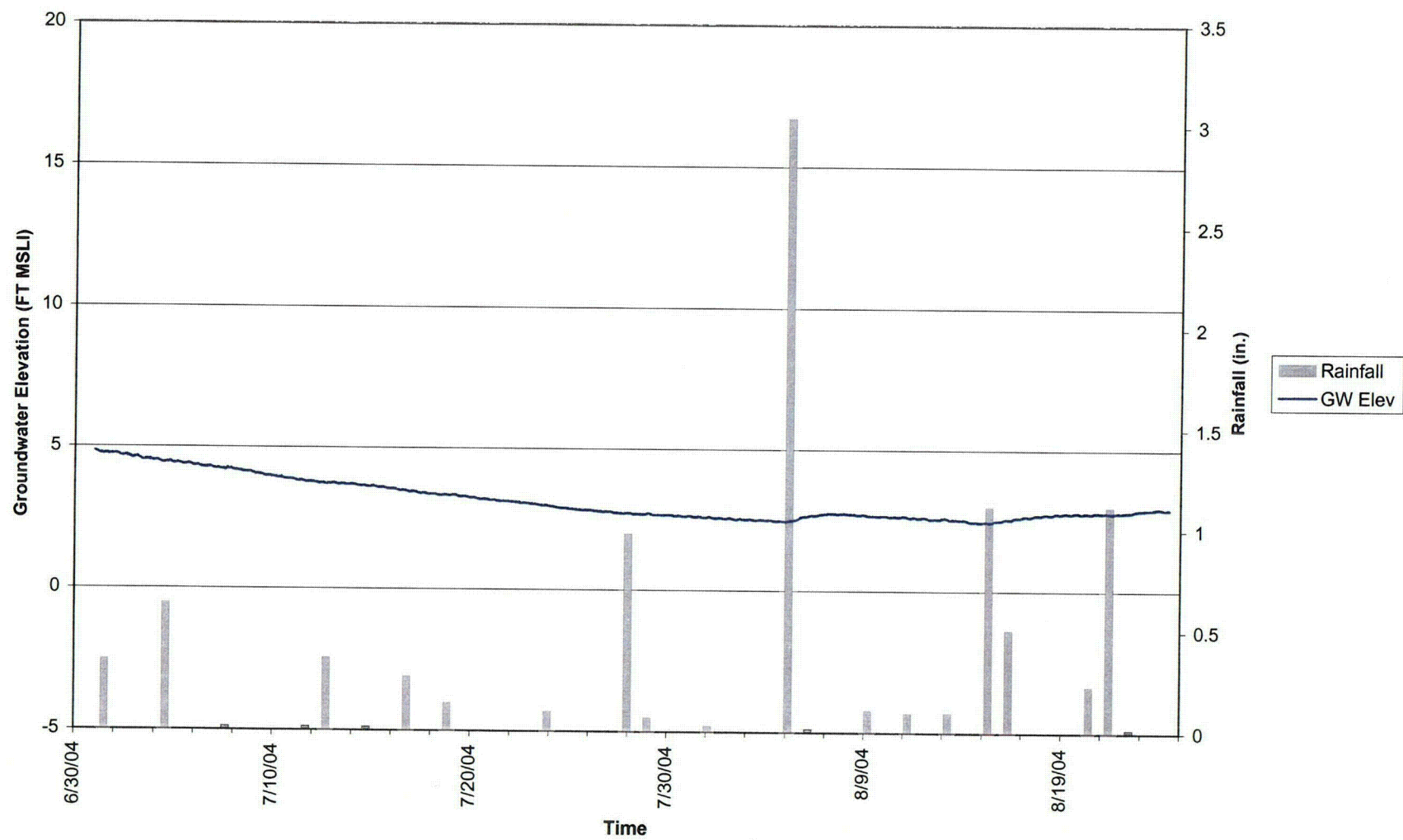
Groundwater Elevation at MW-122S
3rd Quarter



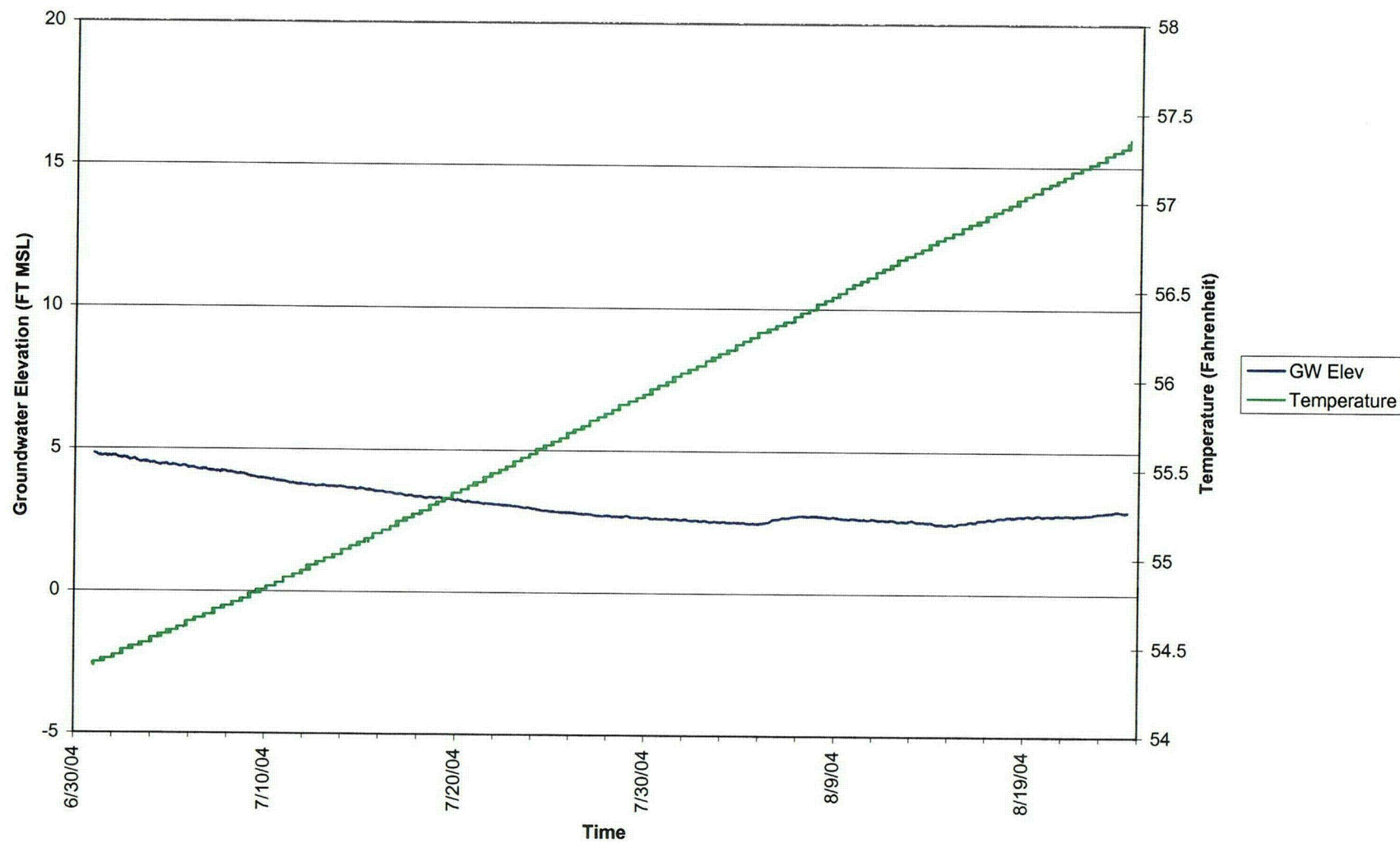
Groundwater Elevation at MW-122S and River Levels
3rd Quarter



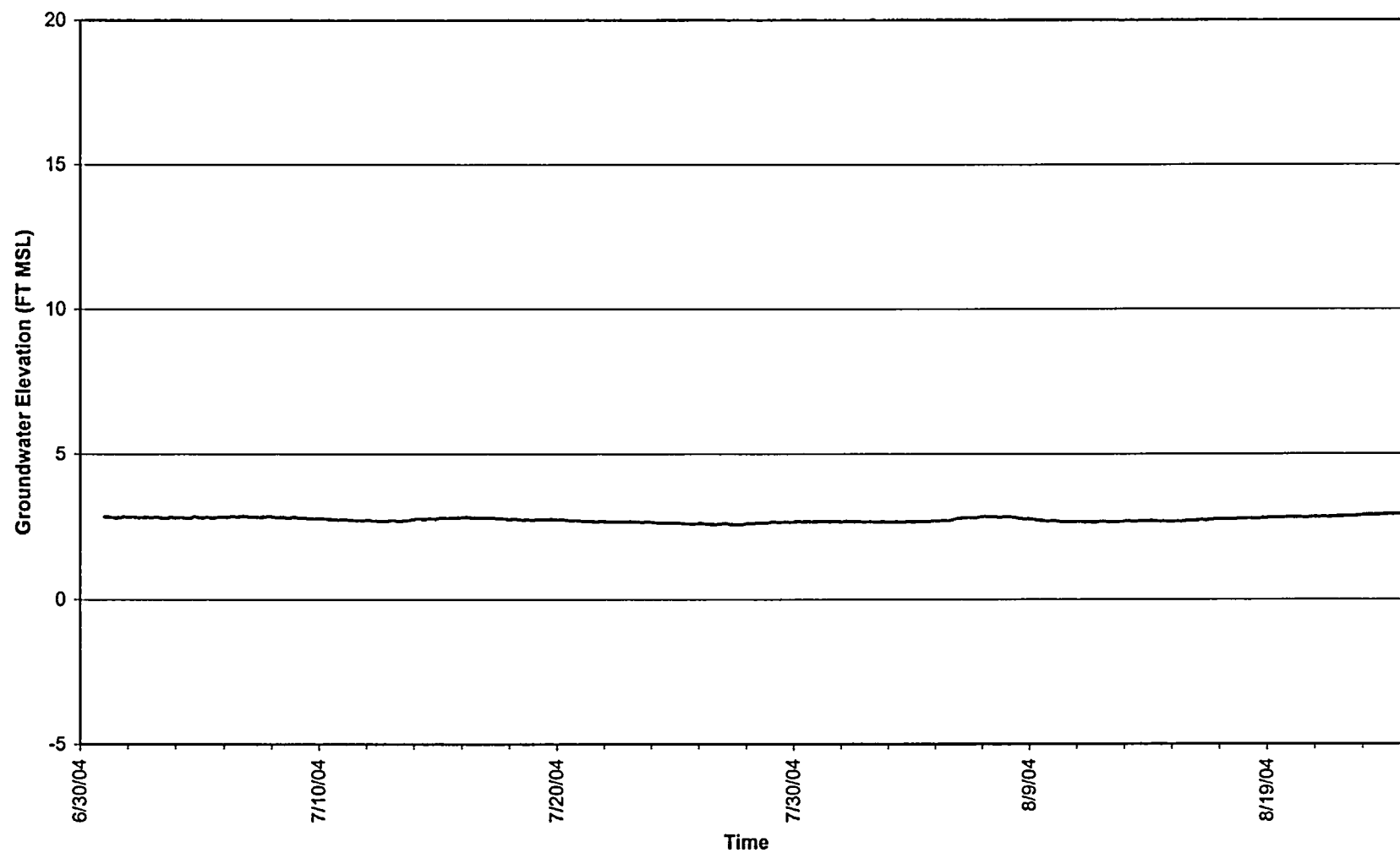
MW-122S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



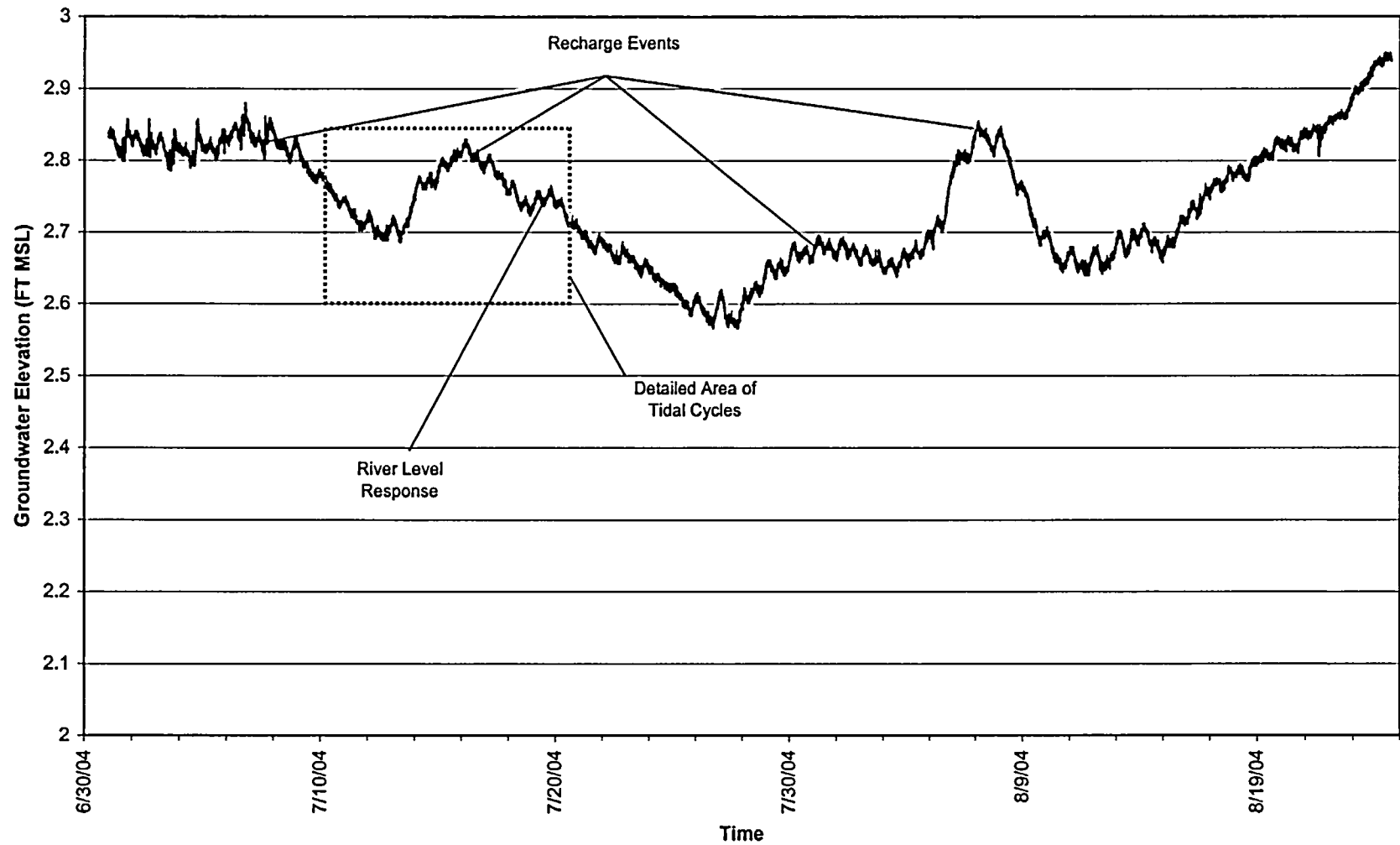
MW-122S Groundwater Elevation and Temperature
3rd Quarter



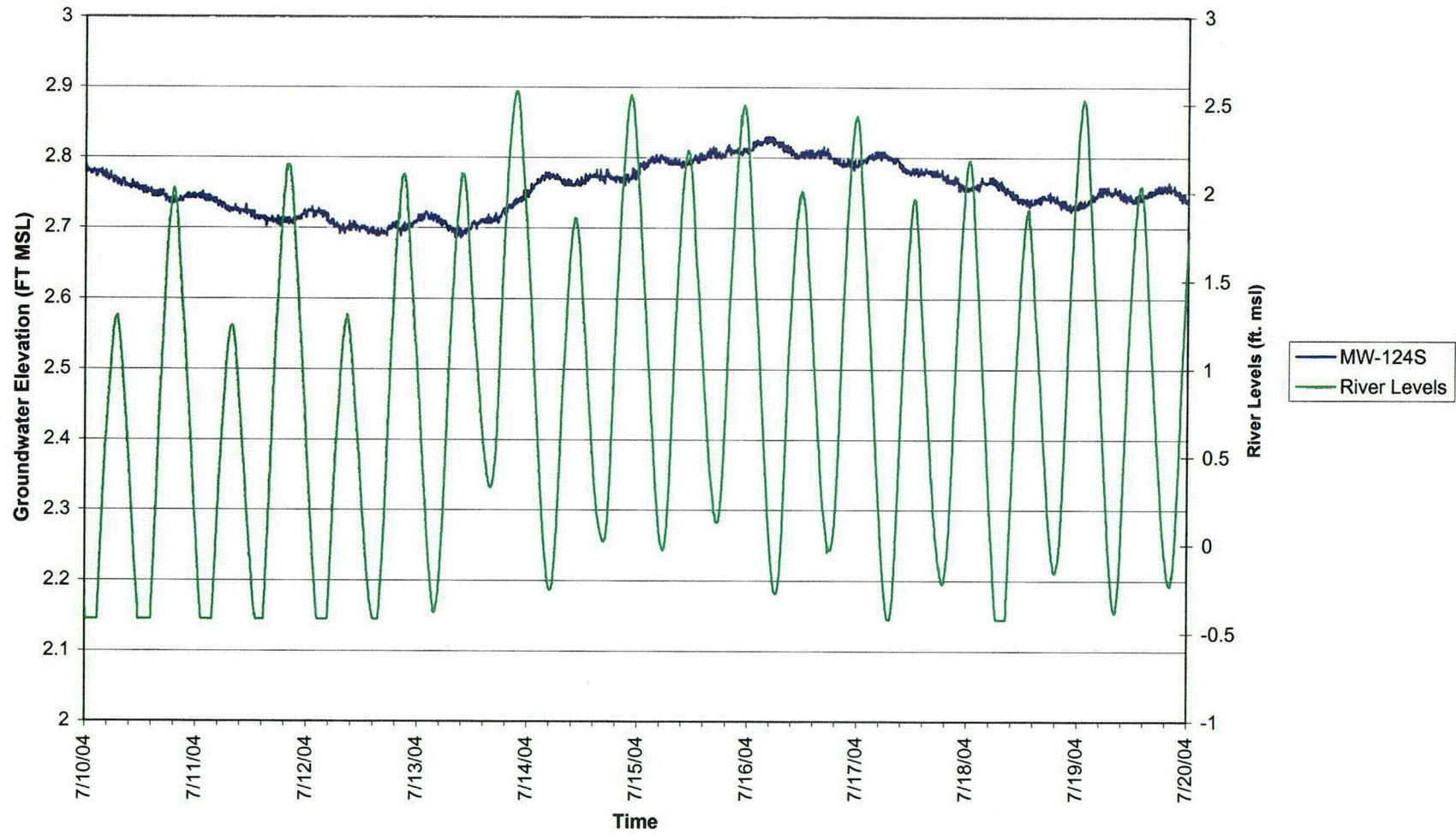
Groundwater Elevation at MW-124S
3rd Quarter



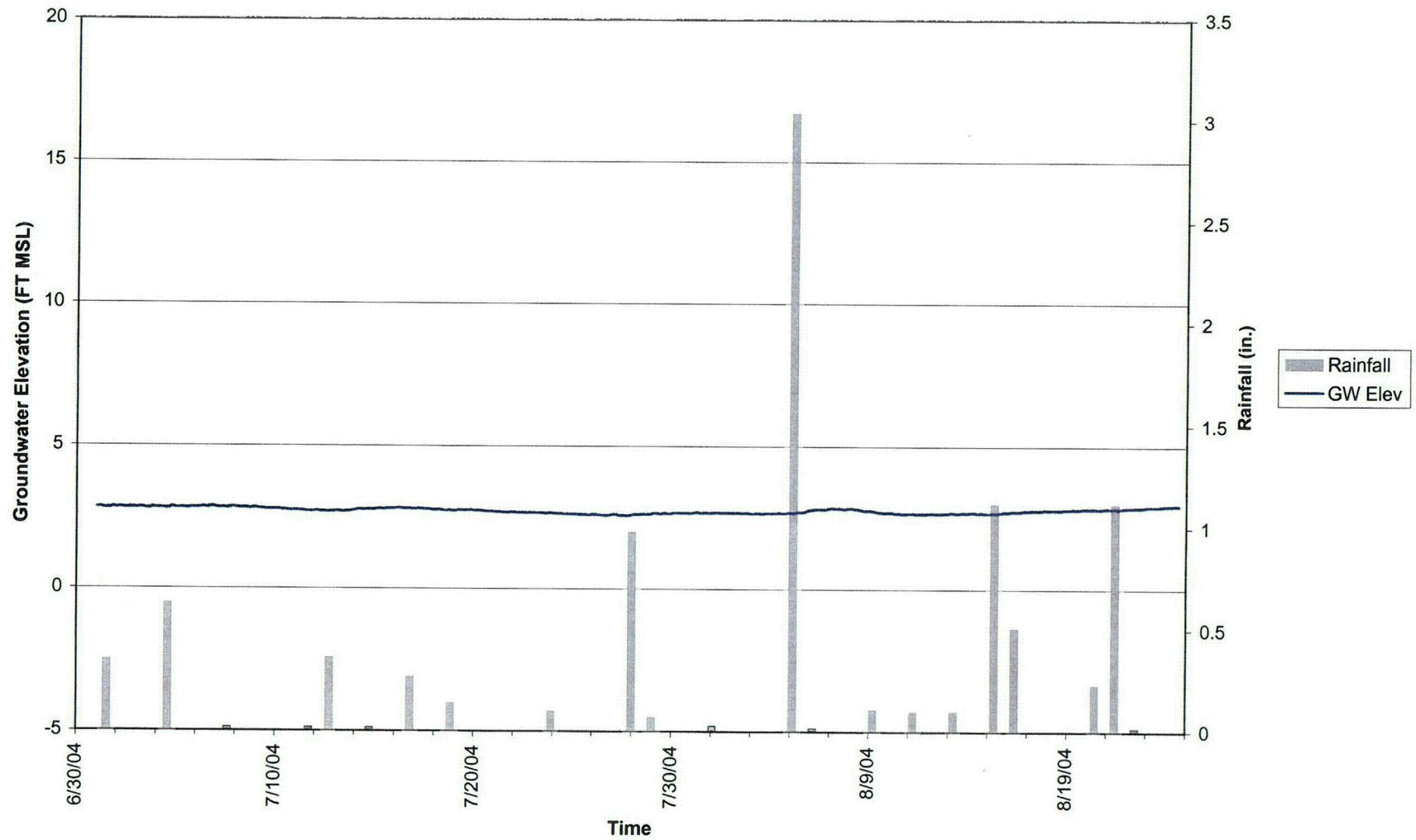
Groundwater Elevation at MW-124S 3rd Quarter



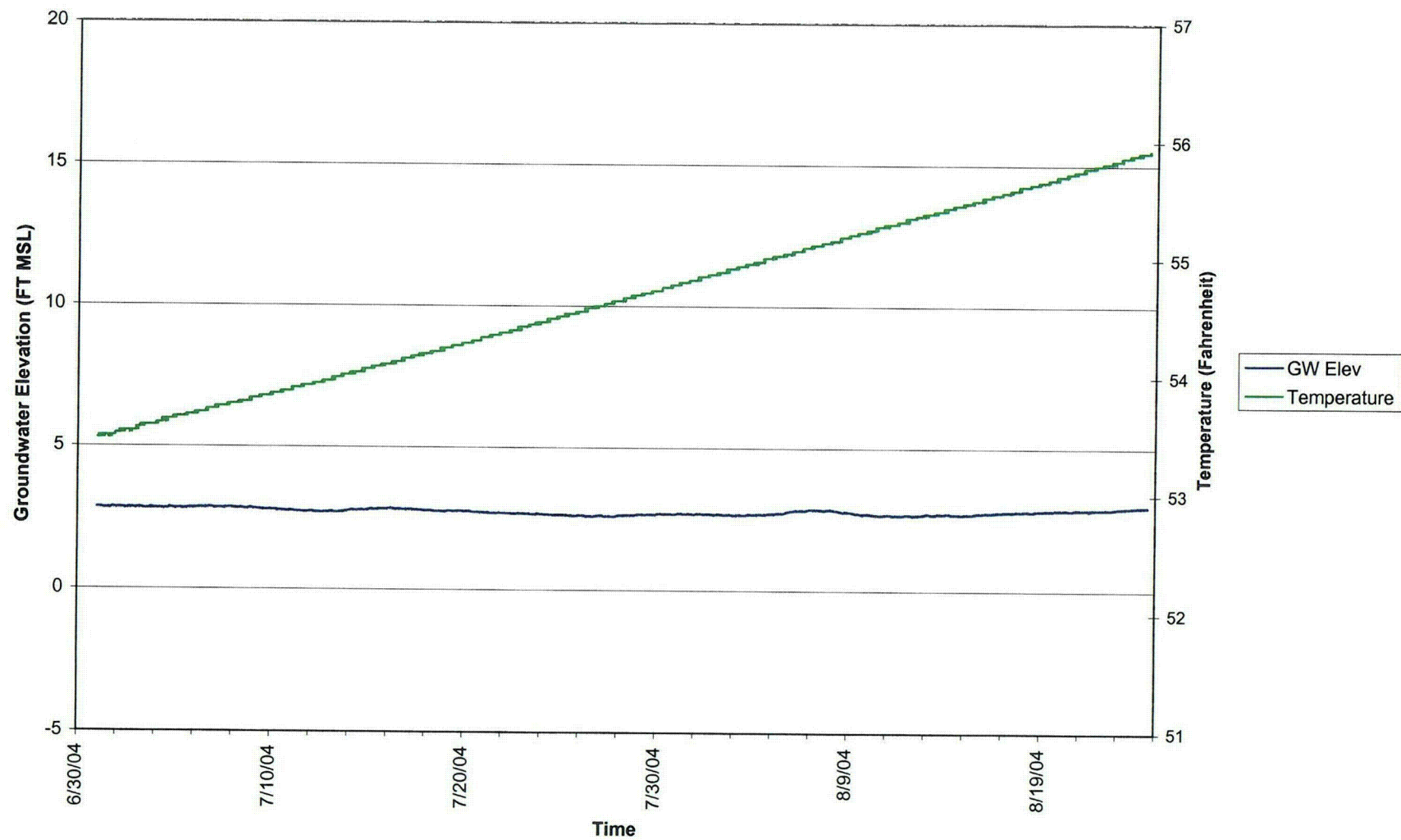
Detailed Area
Groundwater Elevation at MW-124S and River Levels
3rd Quarter



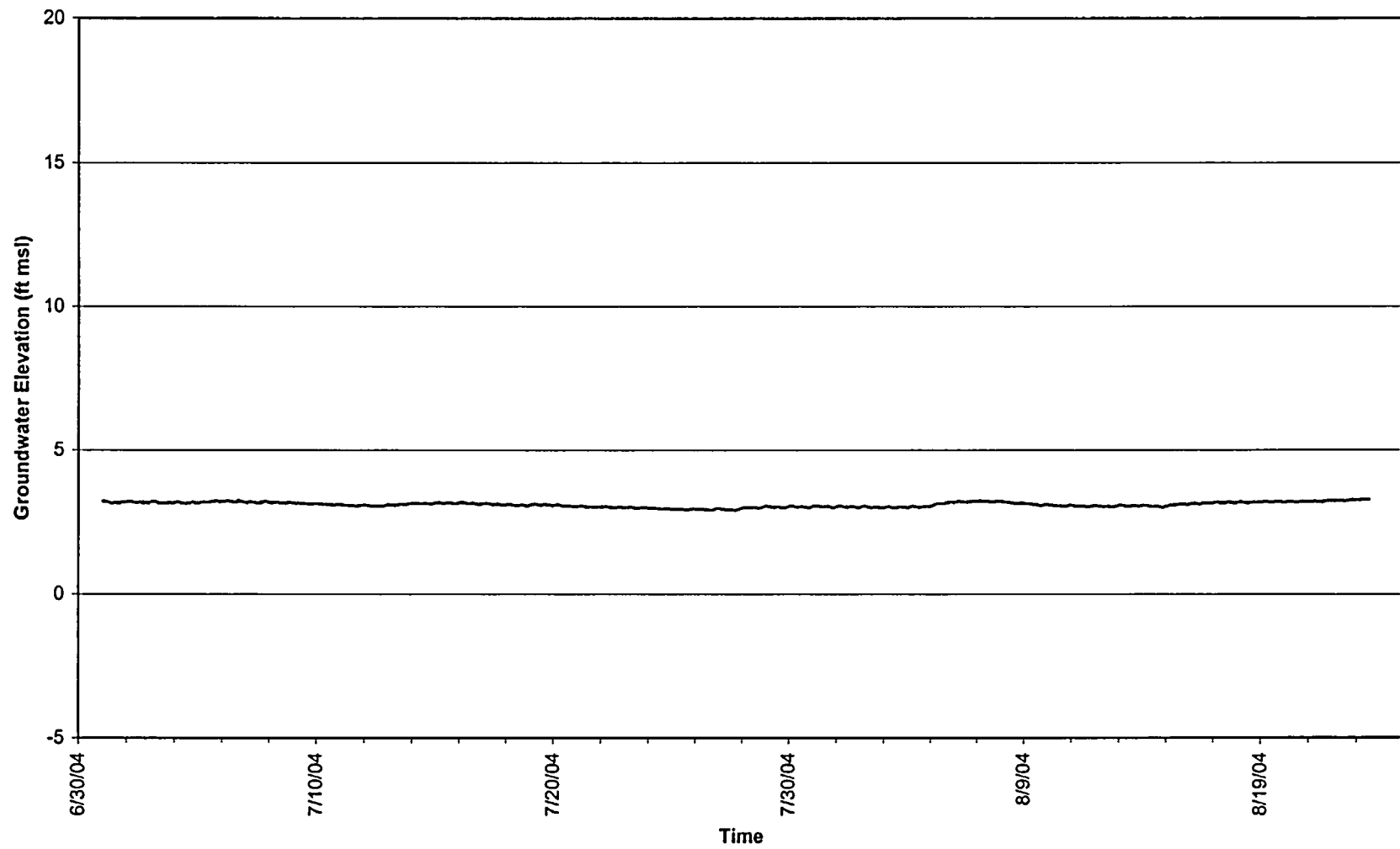
MW-124S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



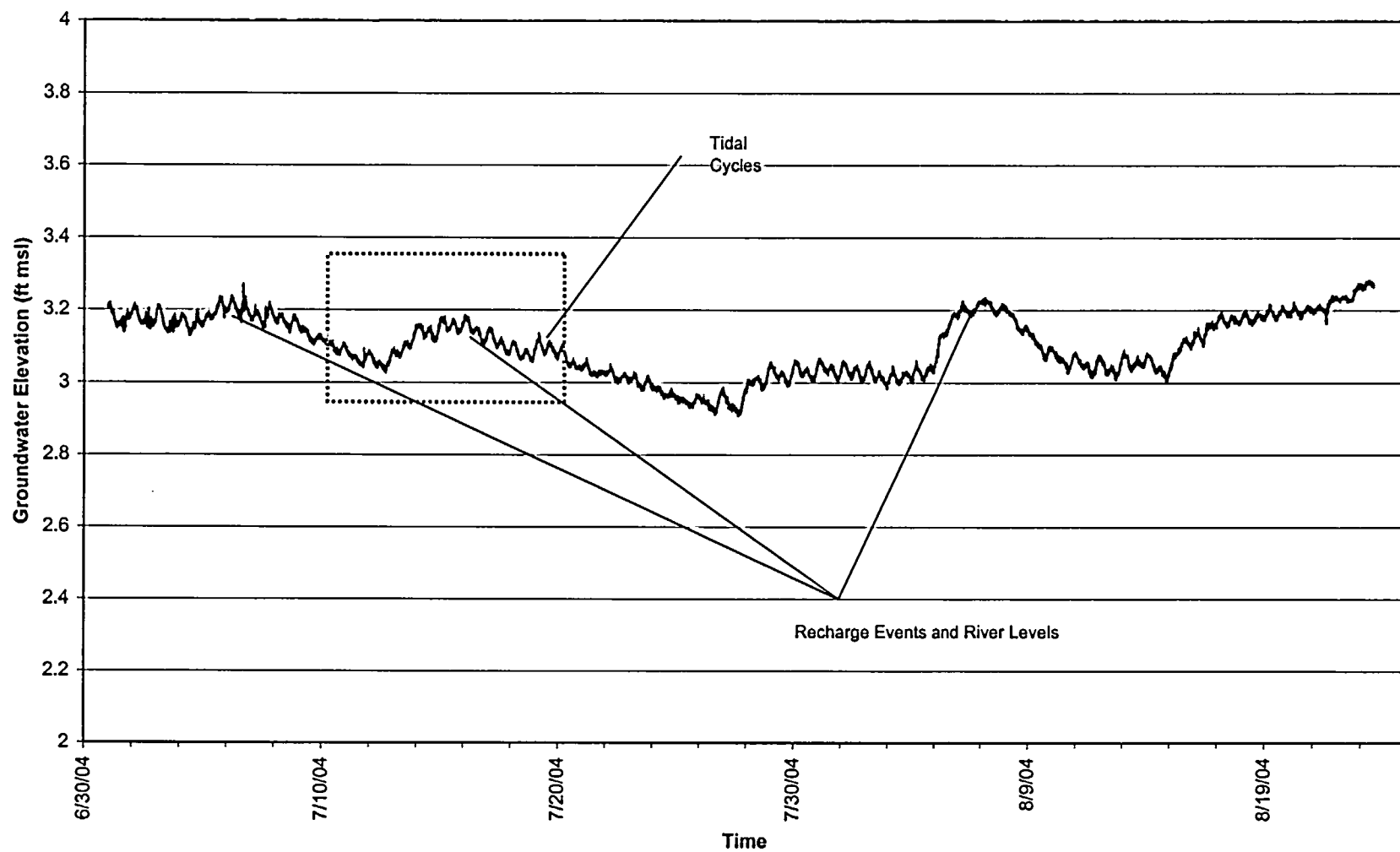
MW-124S Groundwater Elevation and Temperature
3rd Quarter



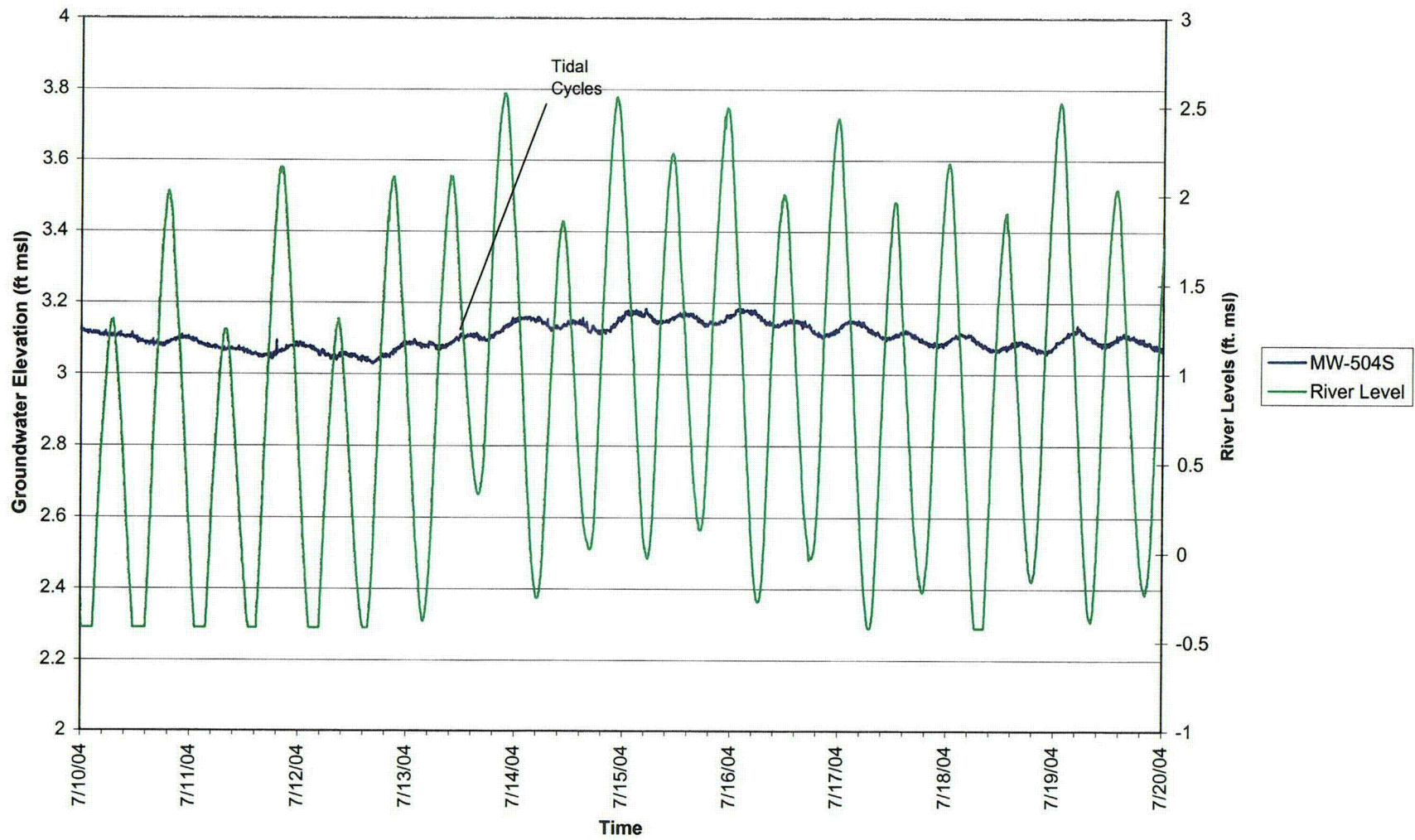
Groundwater Elevation at MW-504S
3rd Quarter



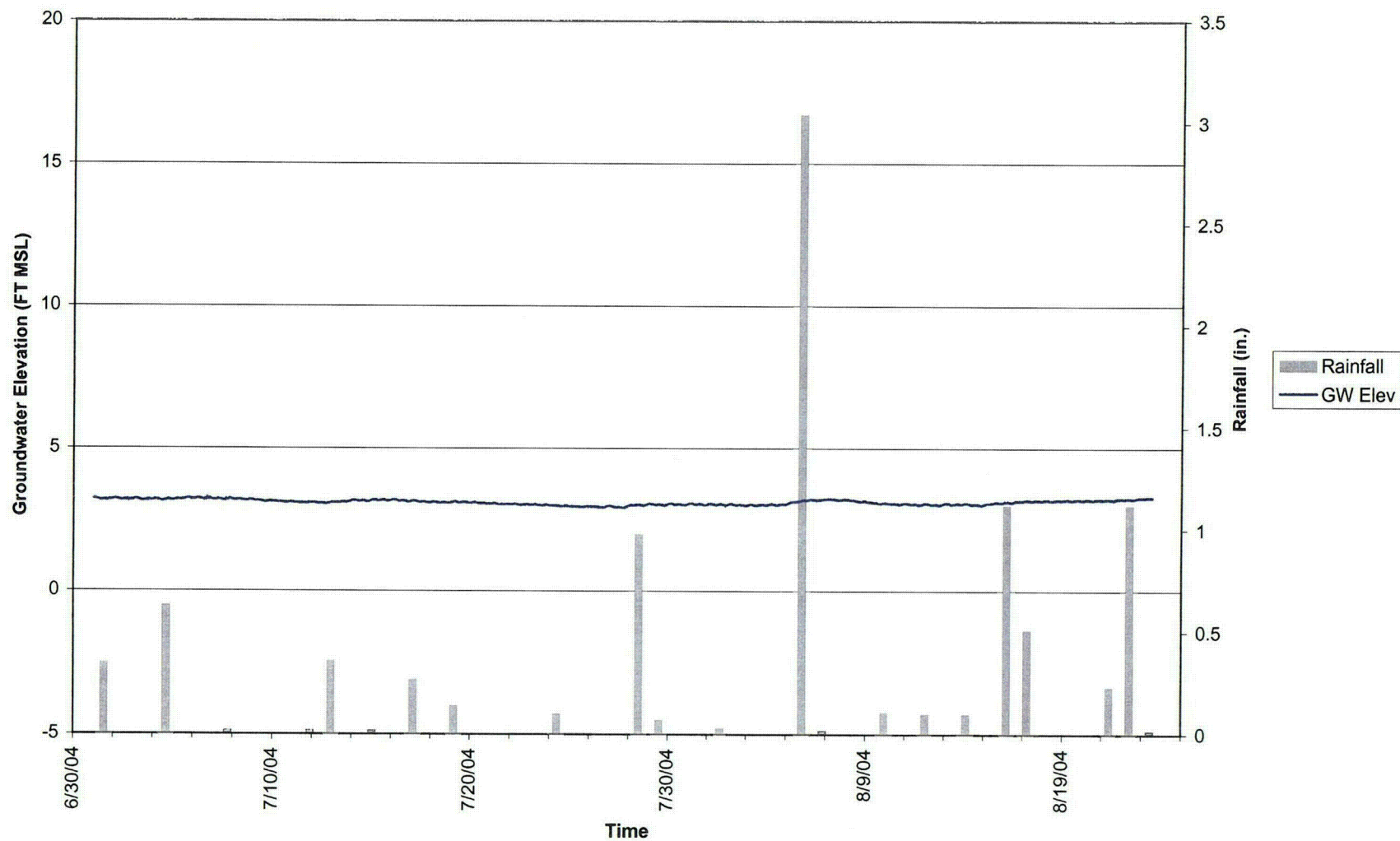
Groundwater Elevation at MW-504S
3rd Quarter



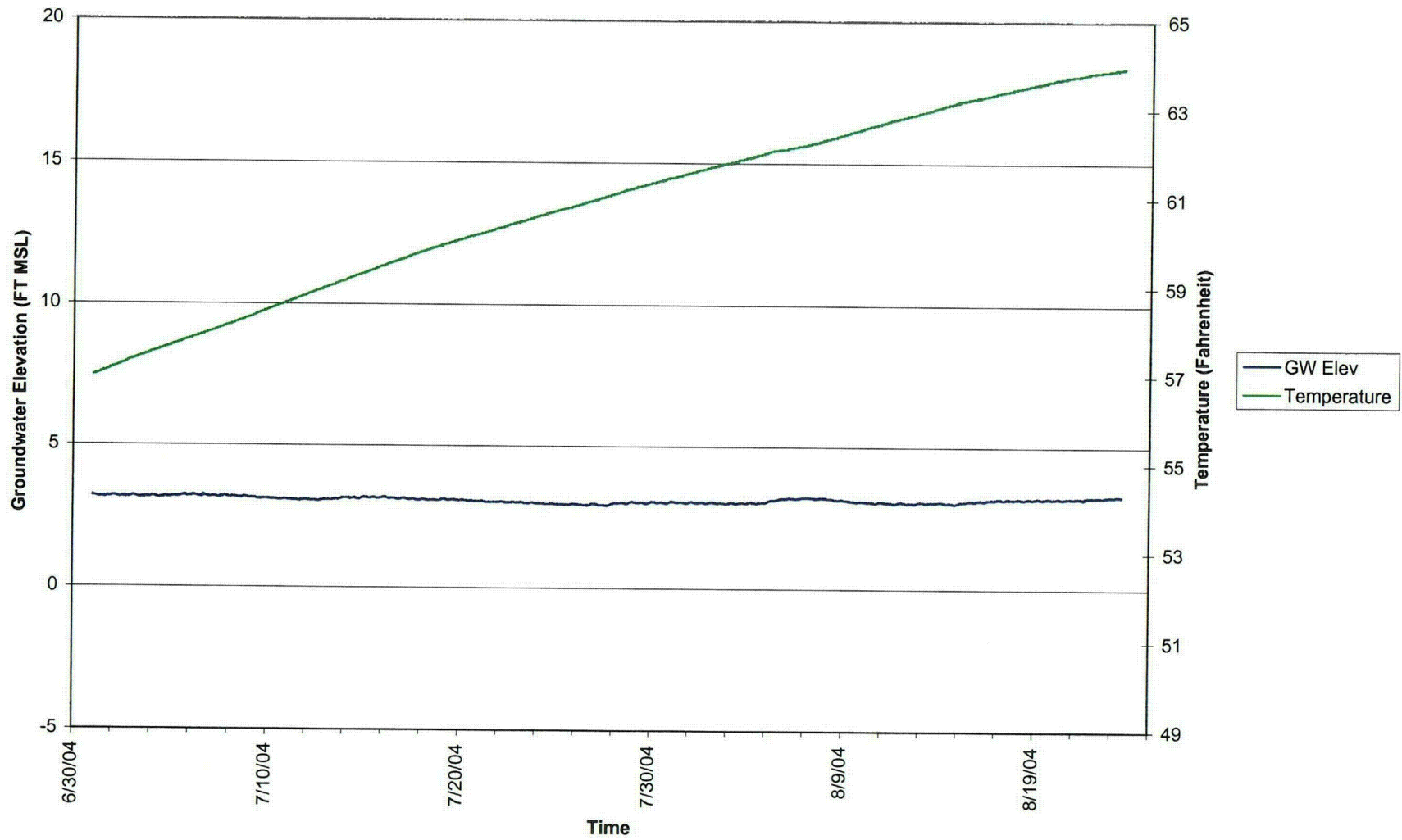
Groundwater Elevation at MW-504S
3rd Quarter



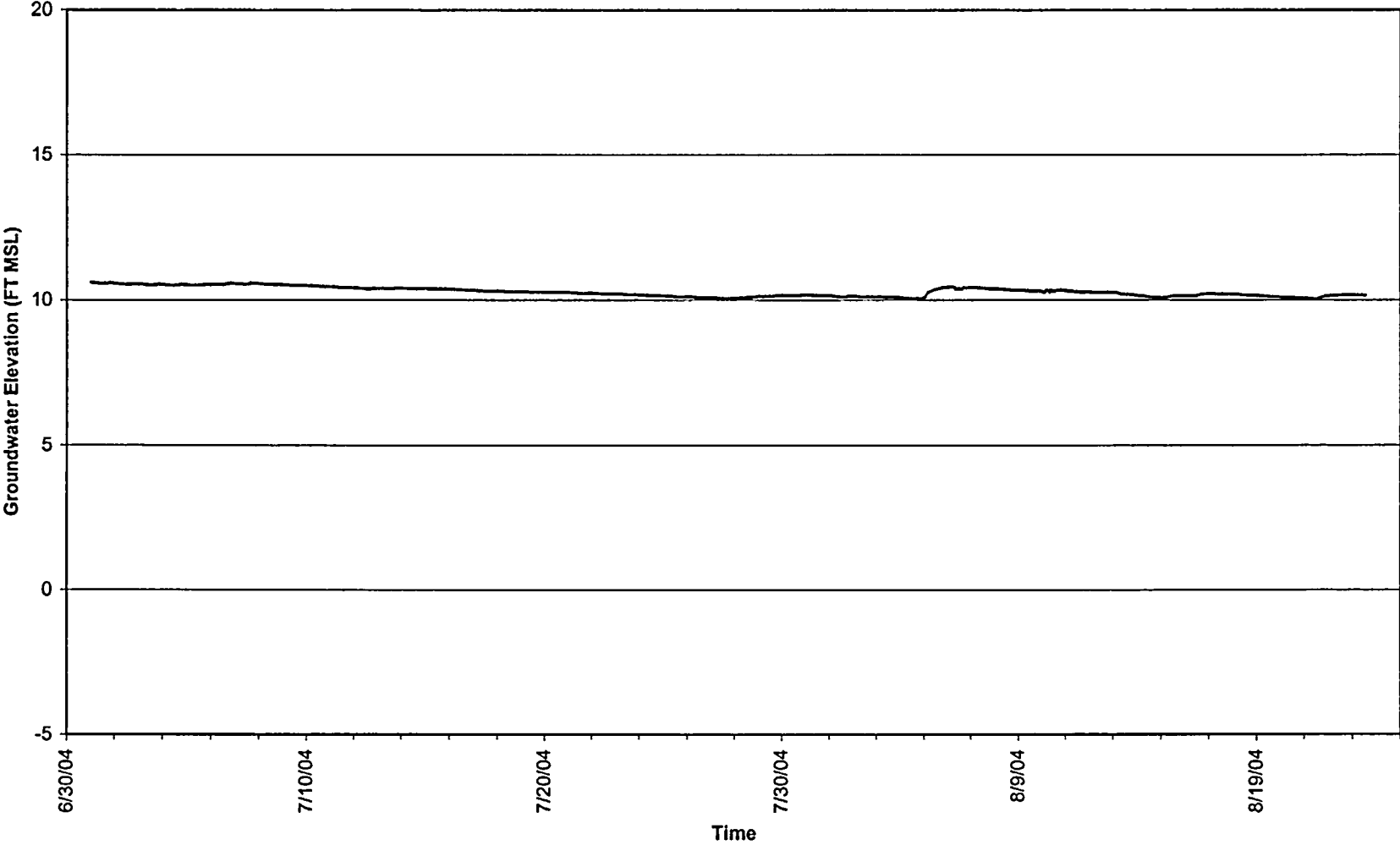
MW-504S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



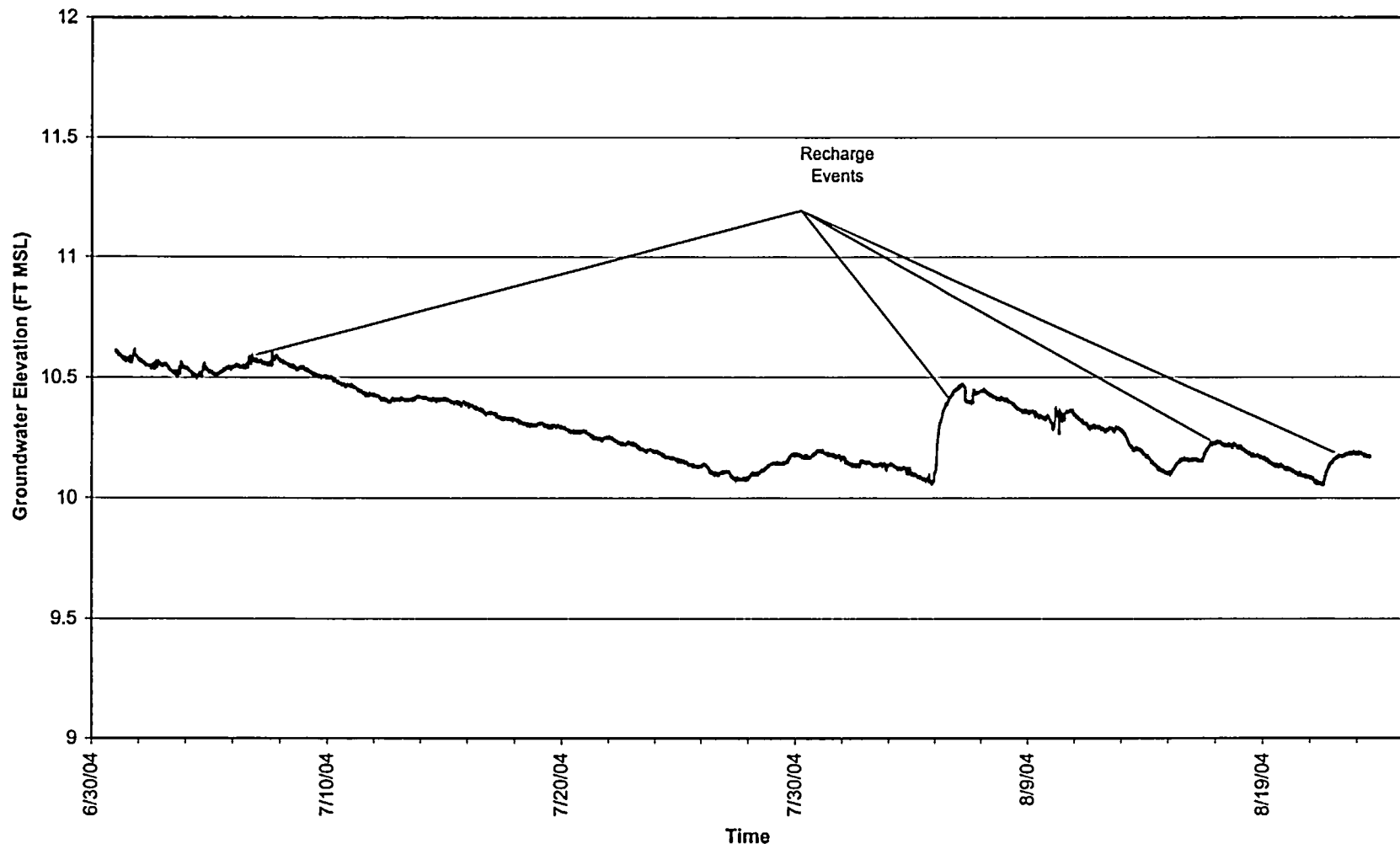
MW-504S Groundwater Elevation and Temperature
3rd Quarter



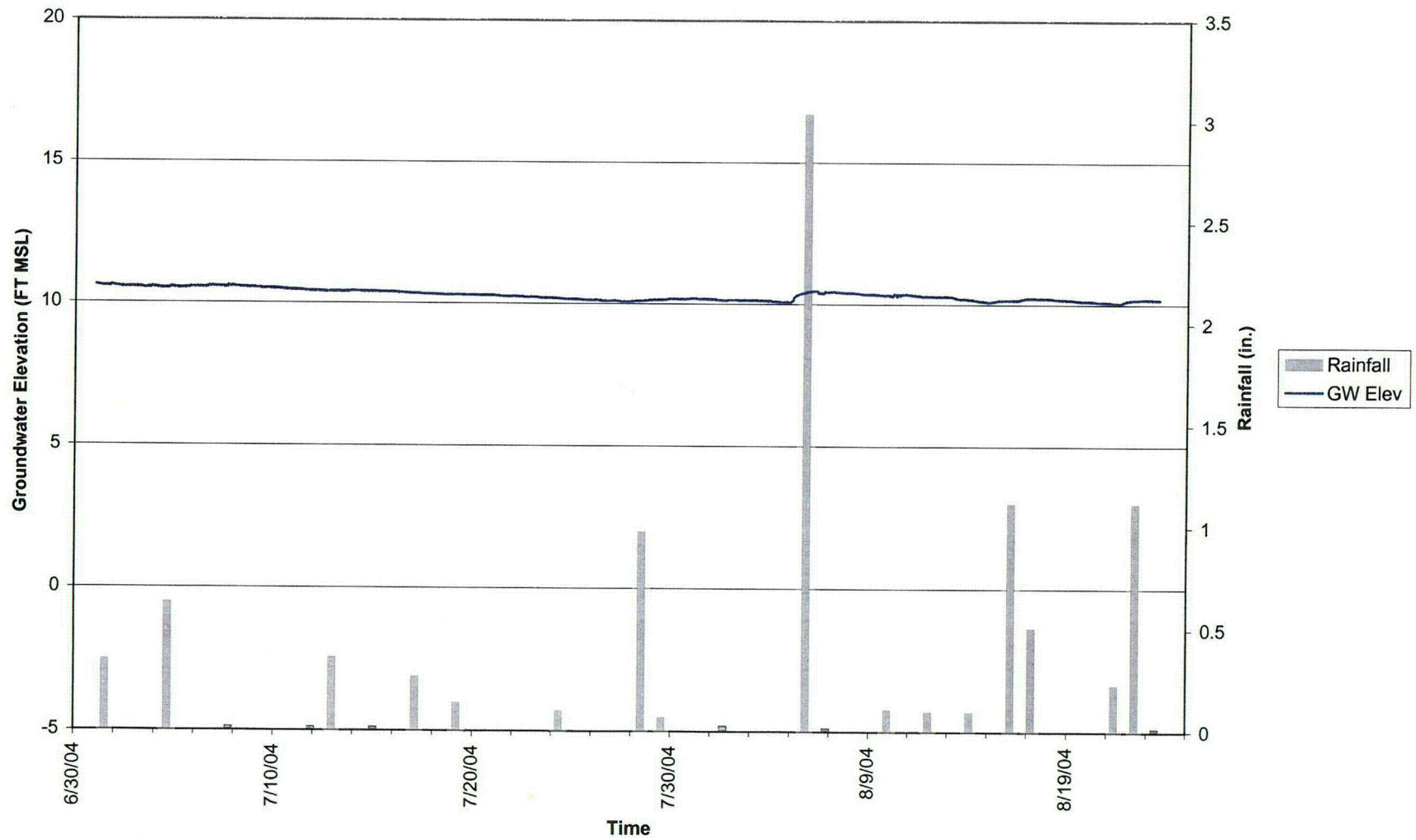
Groundwater Elevation at MW-508S
3rd Quarter



Groundwater Elevation at MW-508S
3rd Quarter

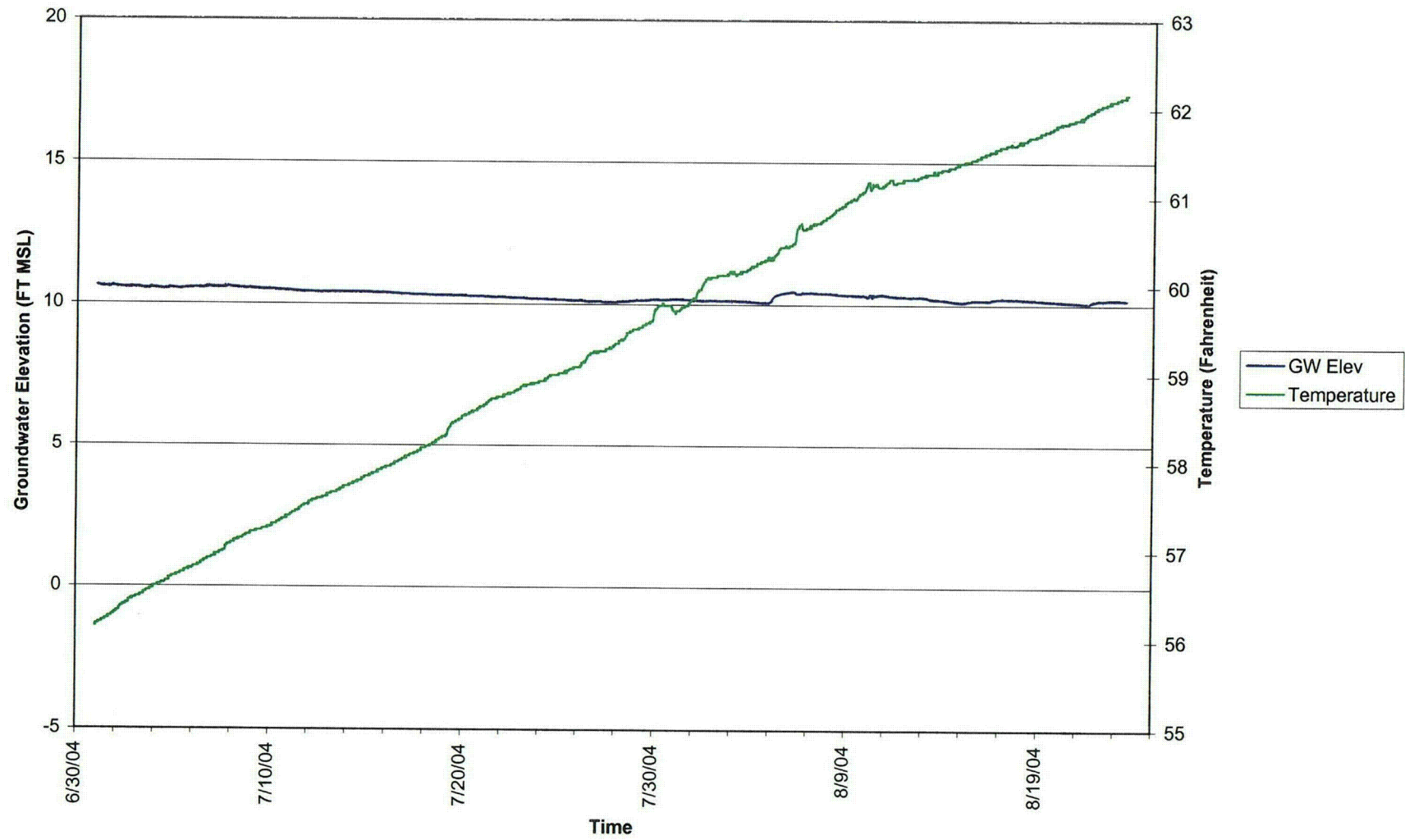


MW-508S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter

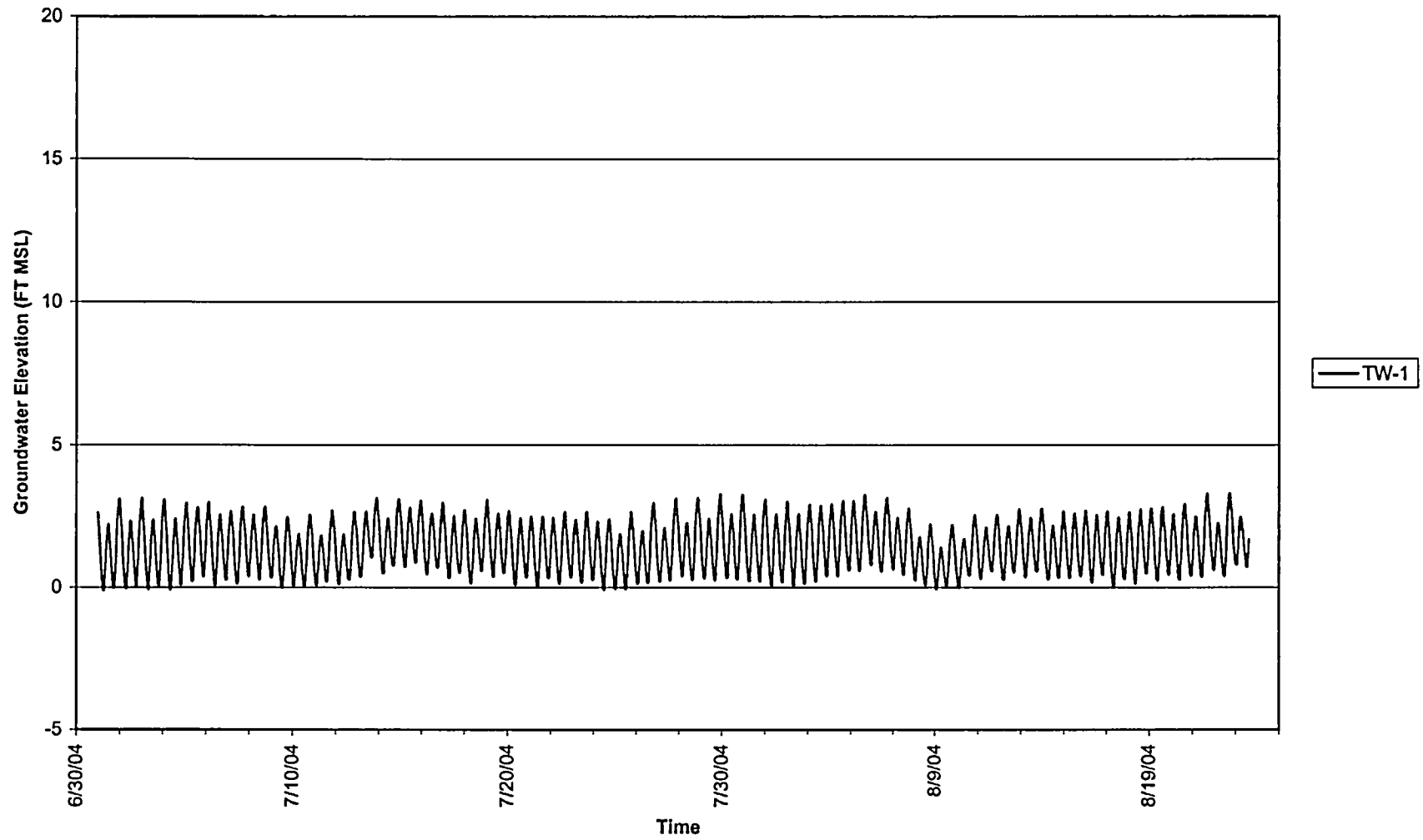


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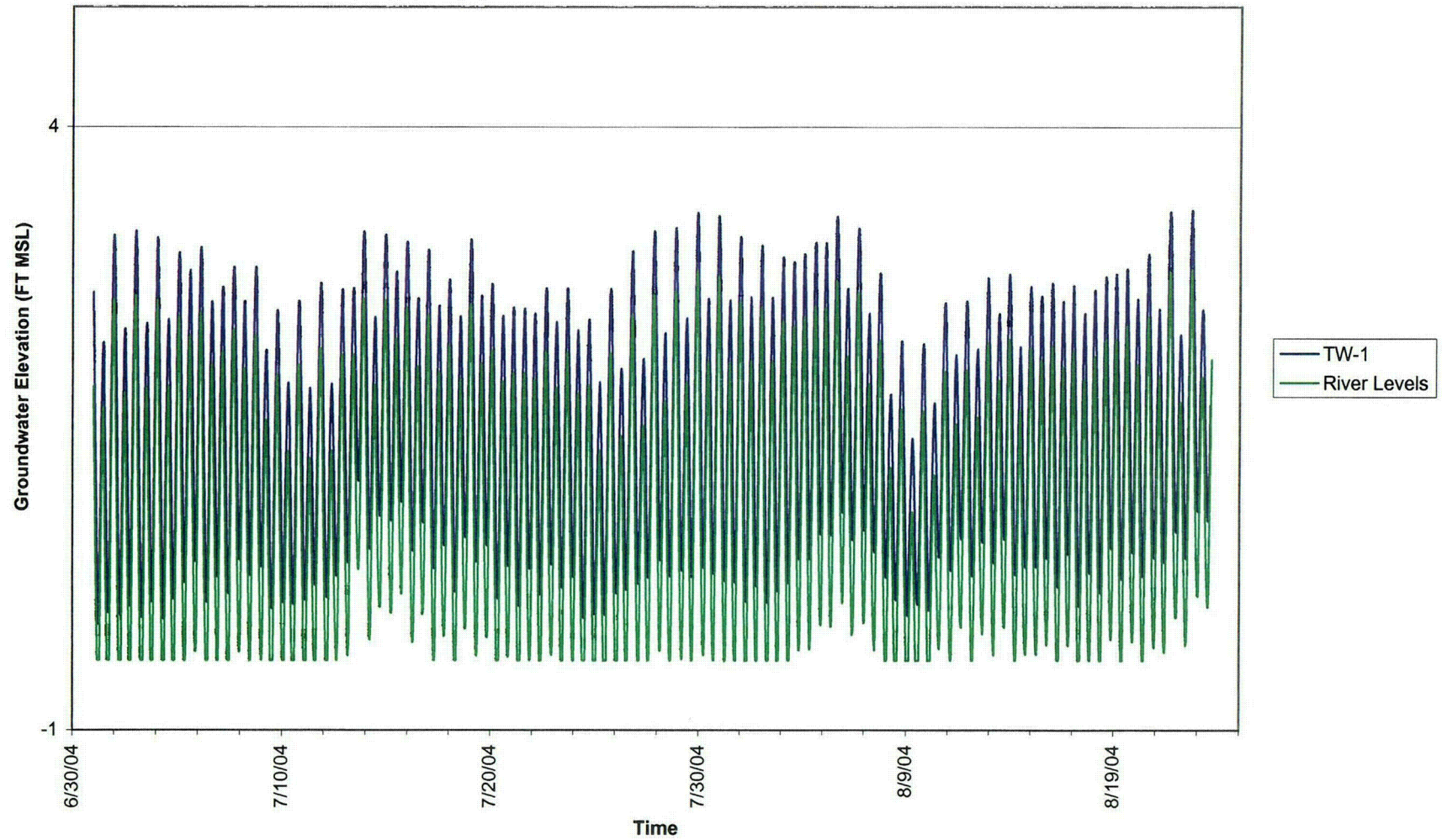
MW-508S Groundwater Elevation and Temperature
3rd Quarter



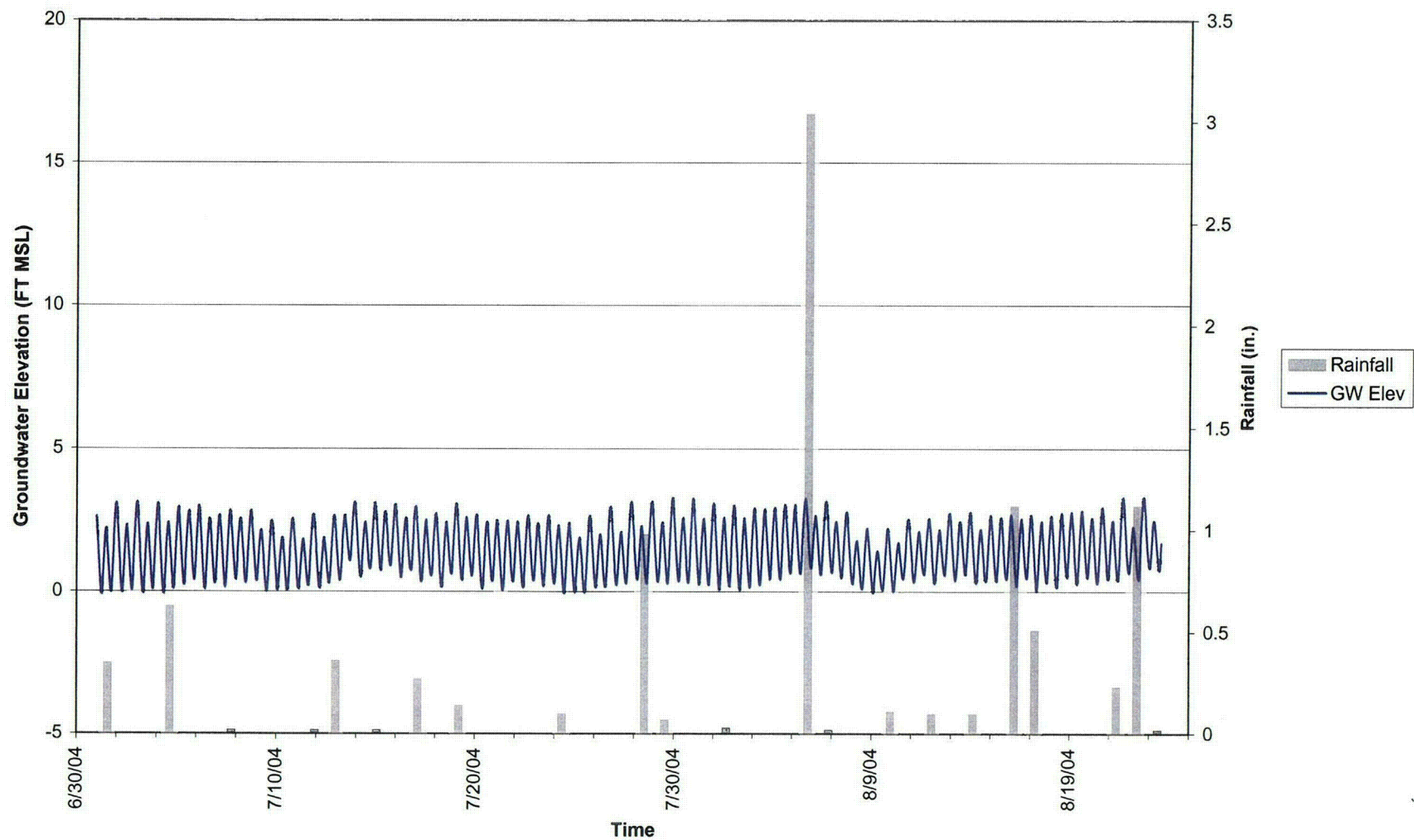
Groundwater Elevation at TW-1
3rd Quarter



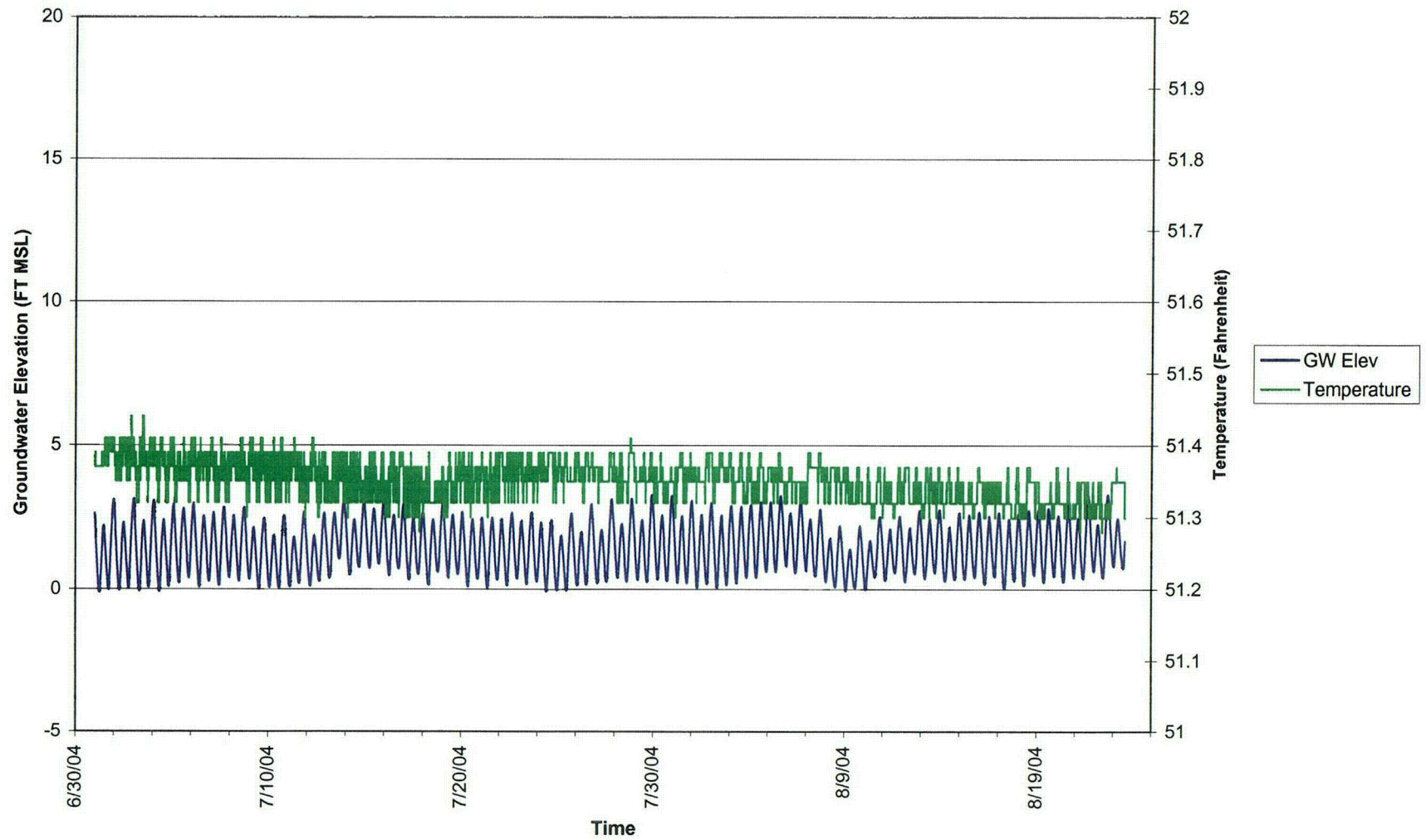
Groundwater Elevation at TW-1
3rd Quarter



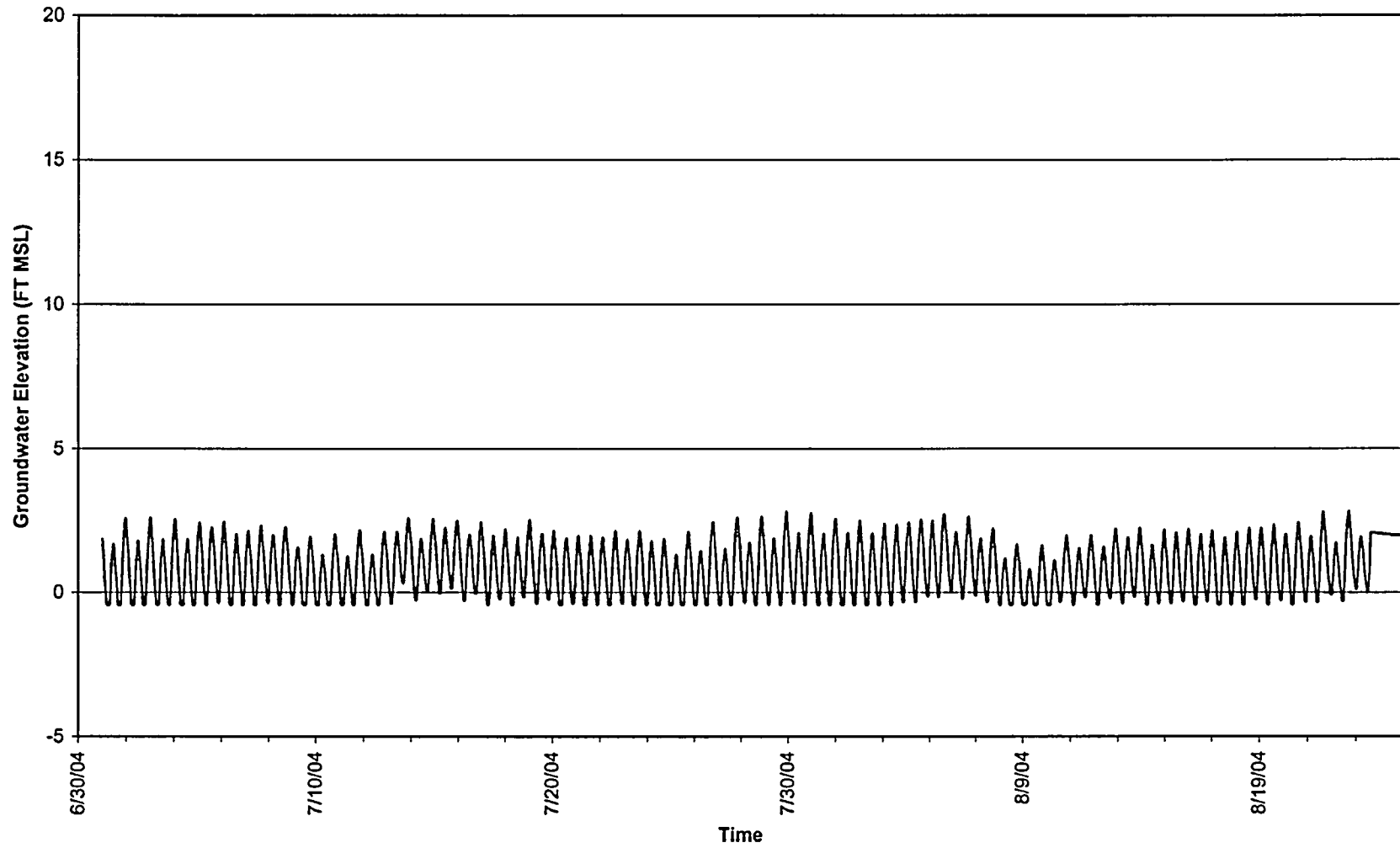
TW-1 Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



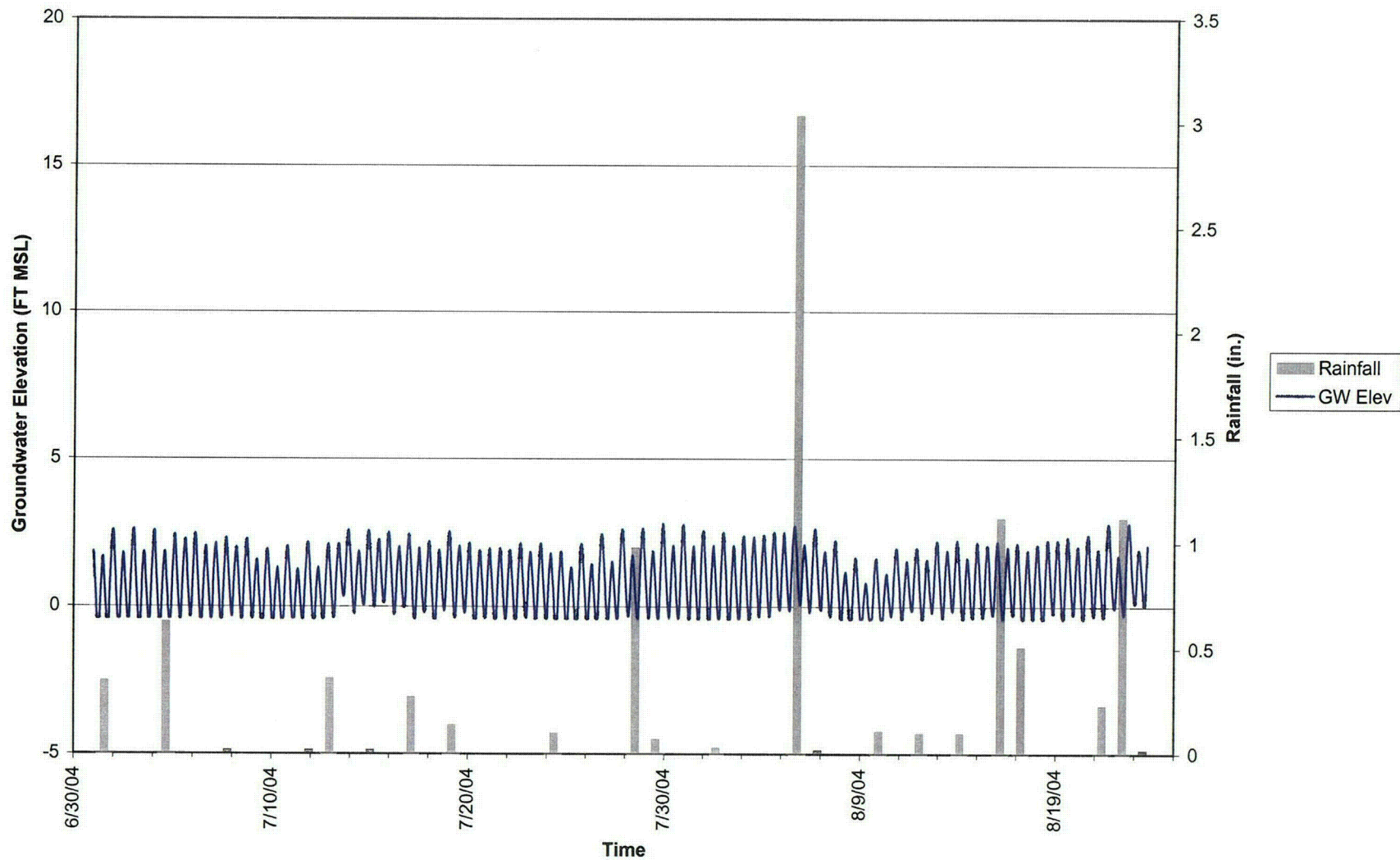
TW-1 Groundwater Elevation and Temperature
3rd Quarter



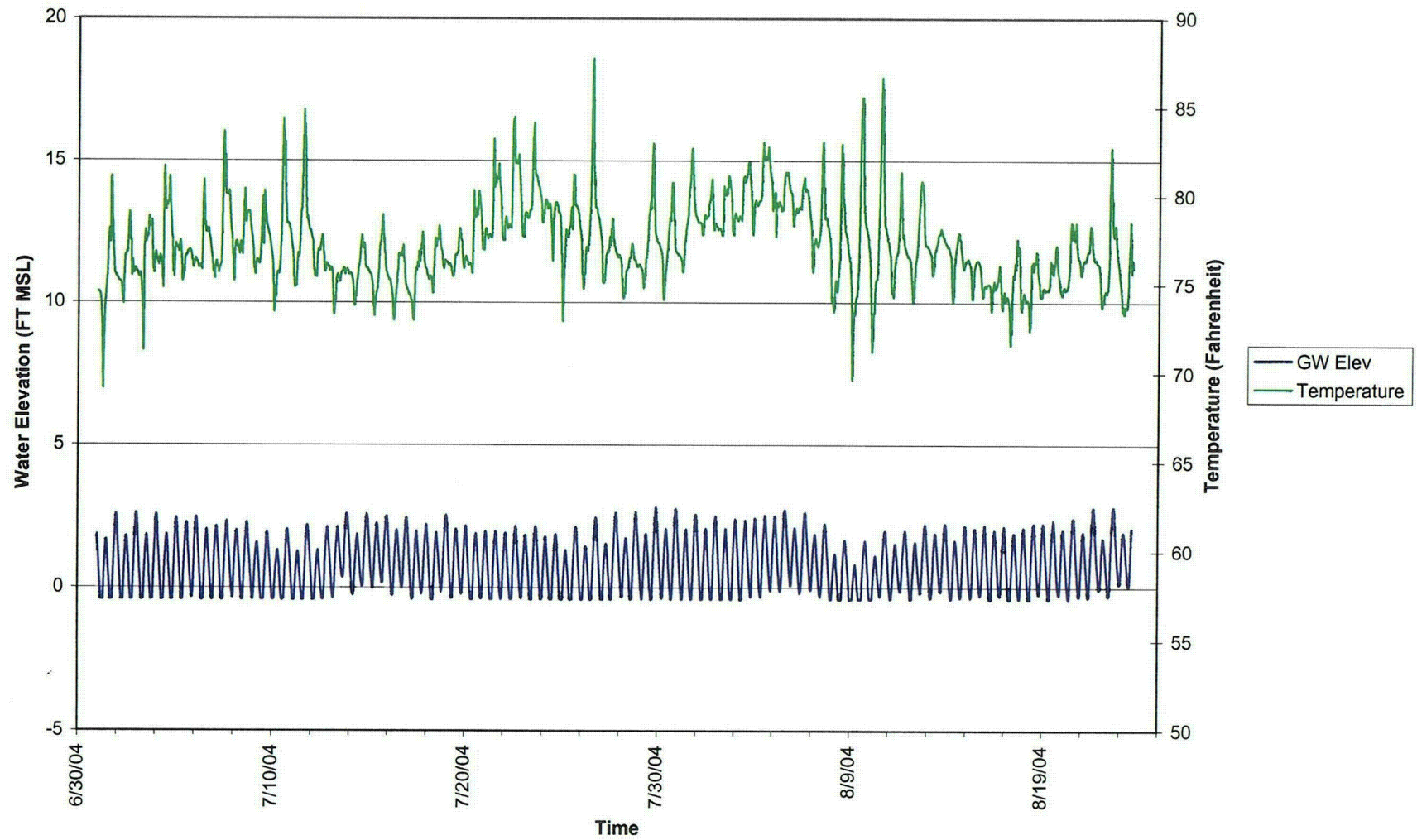
Connecticut River Elevation at the Boat Dock
3rd Quarter



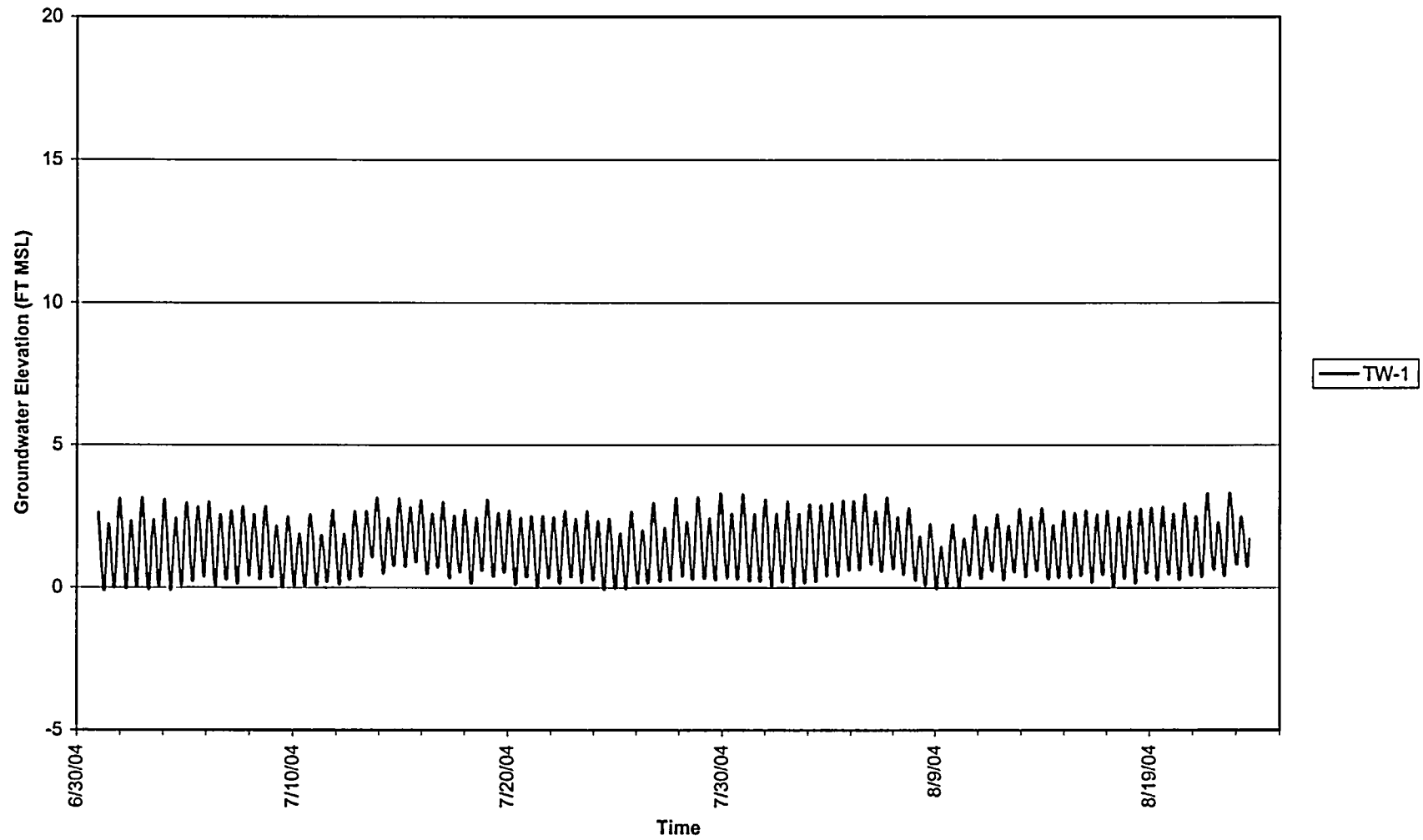
Connecticut River Elevations and Daily Rainfall Totals 3rd Quarter



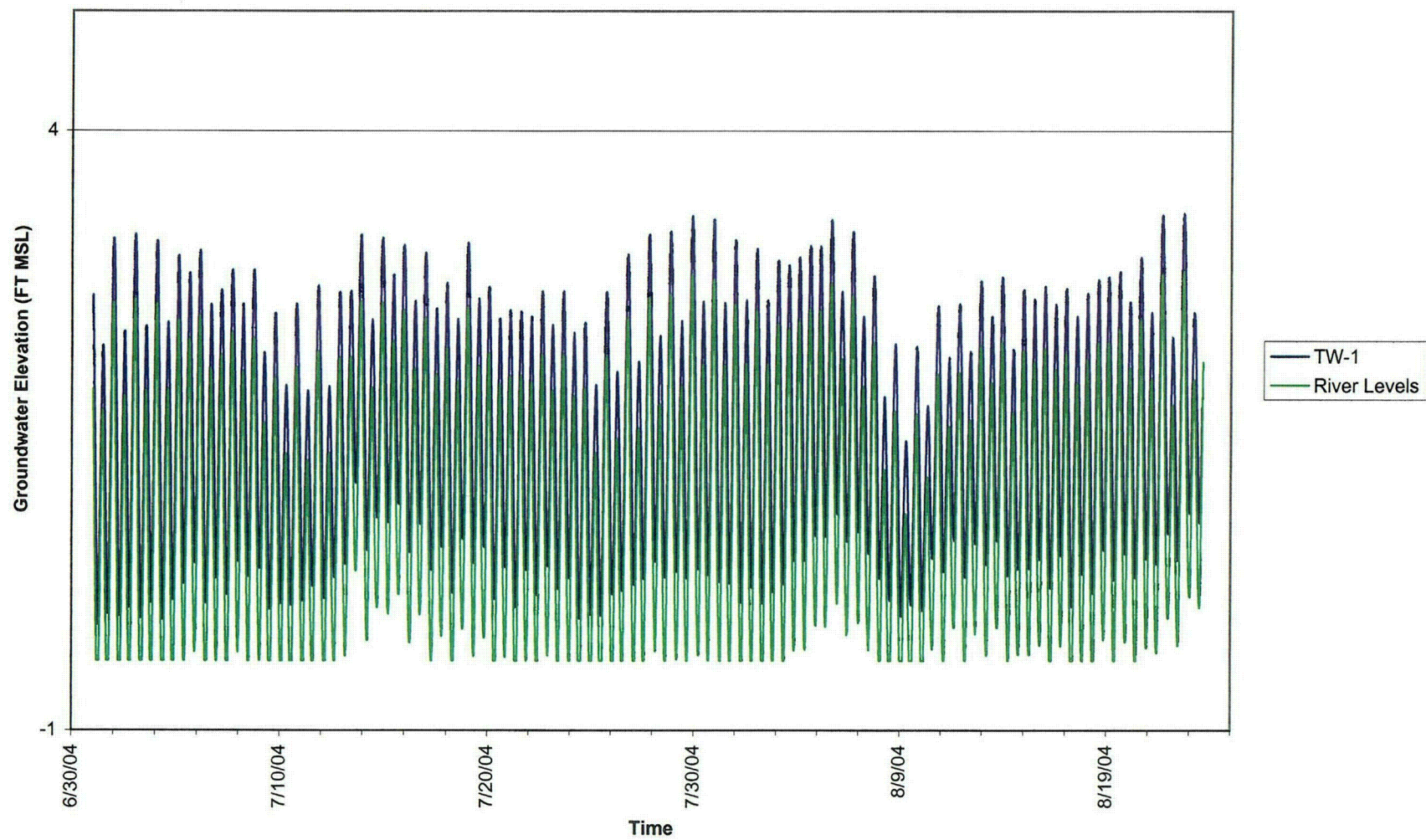
Connecticut River Elevations and Temperature 3rd Quarter



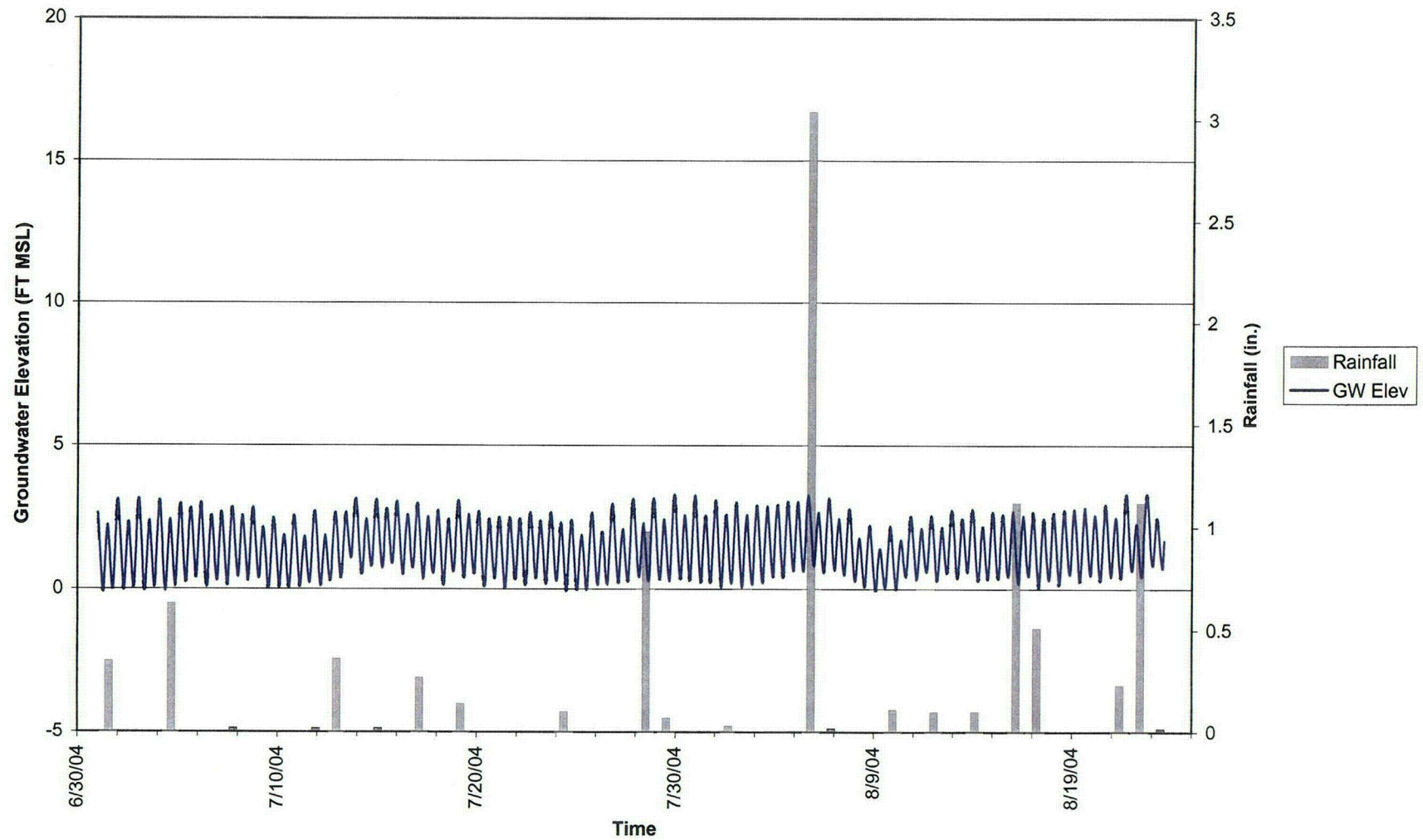
Groundwater Elevation at TW-1
3rd Quarter



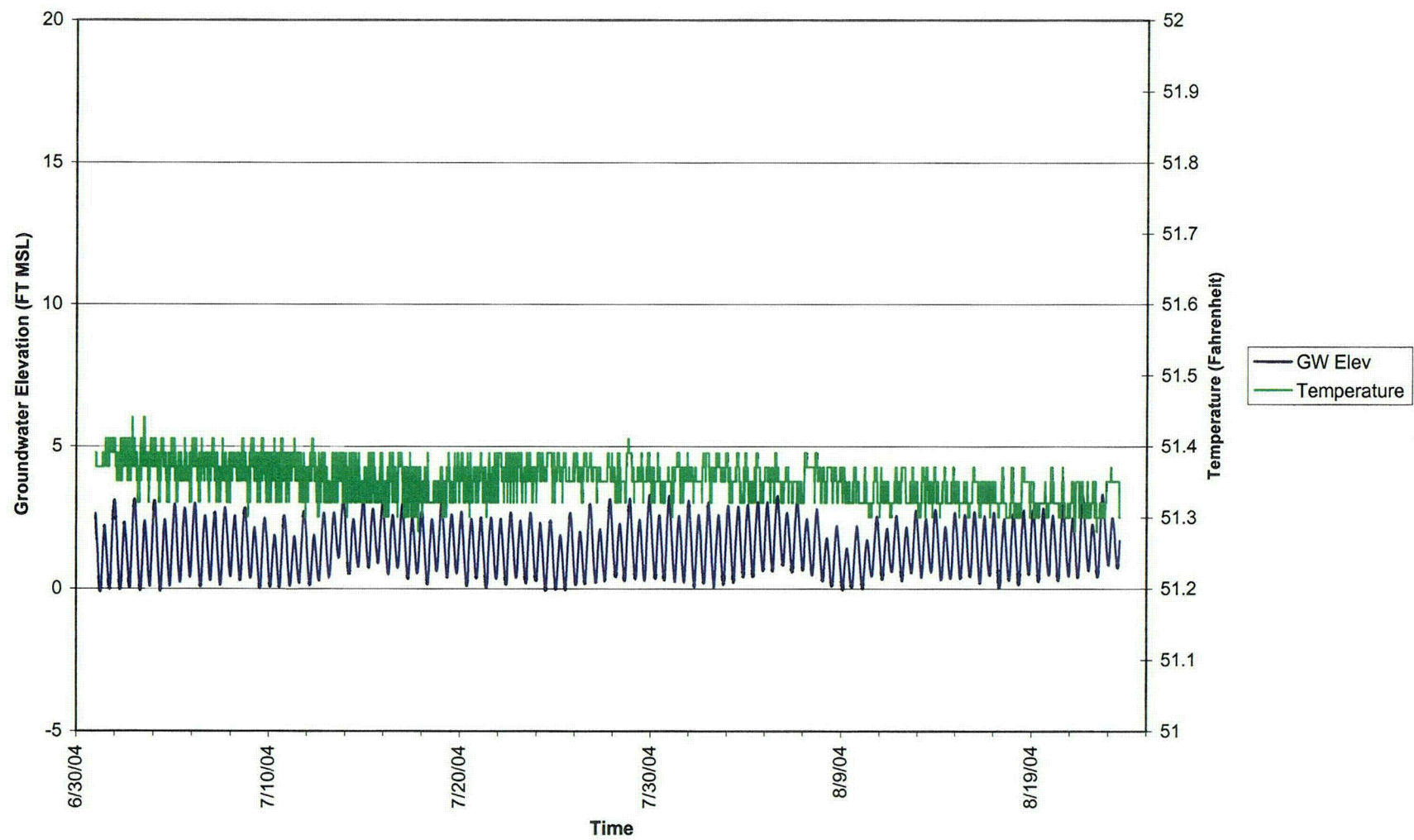
Groundwater Elevation at TW-1
3rd Quarter



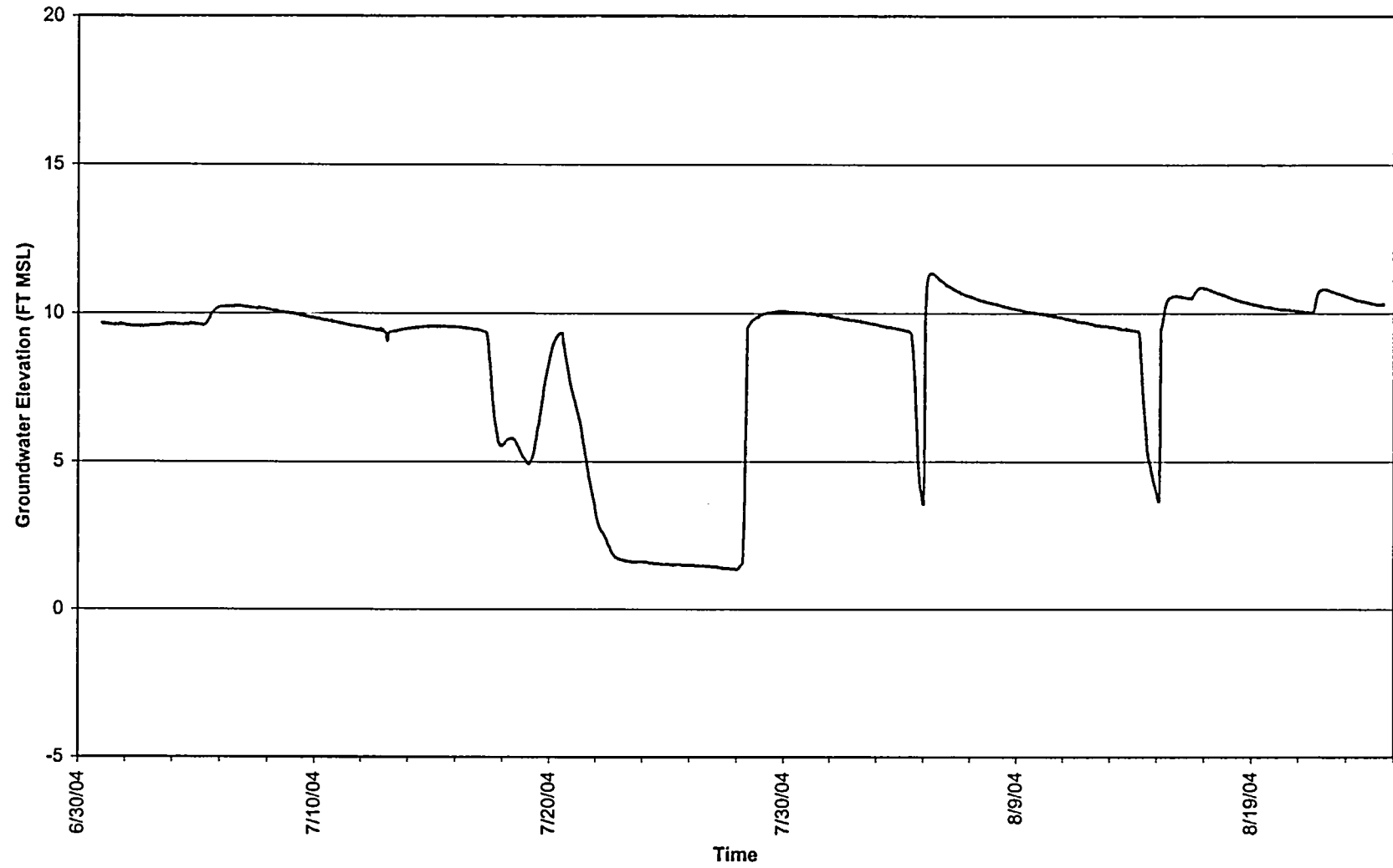
TW-1 Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



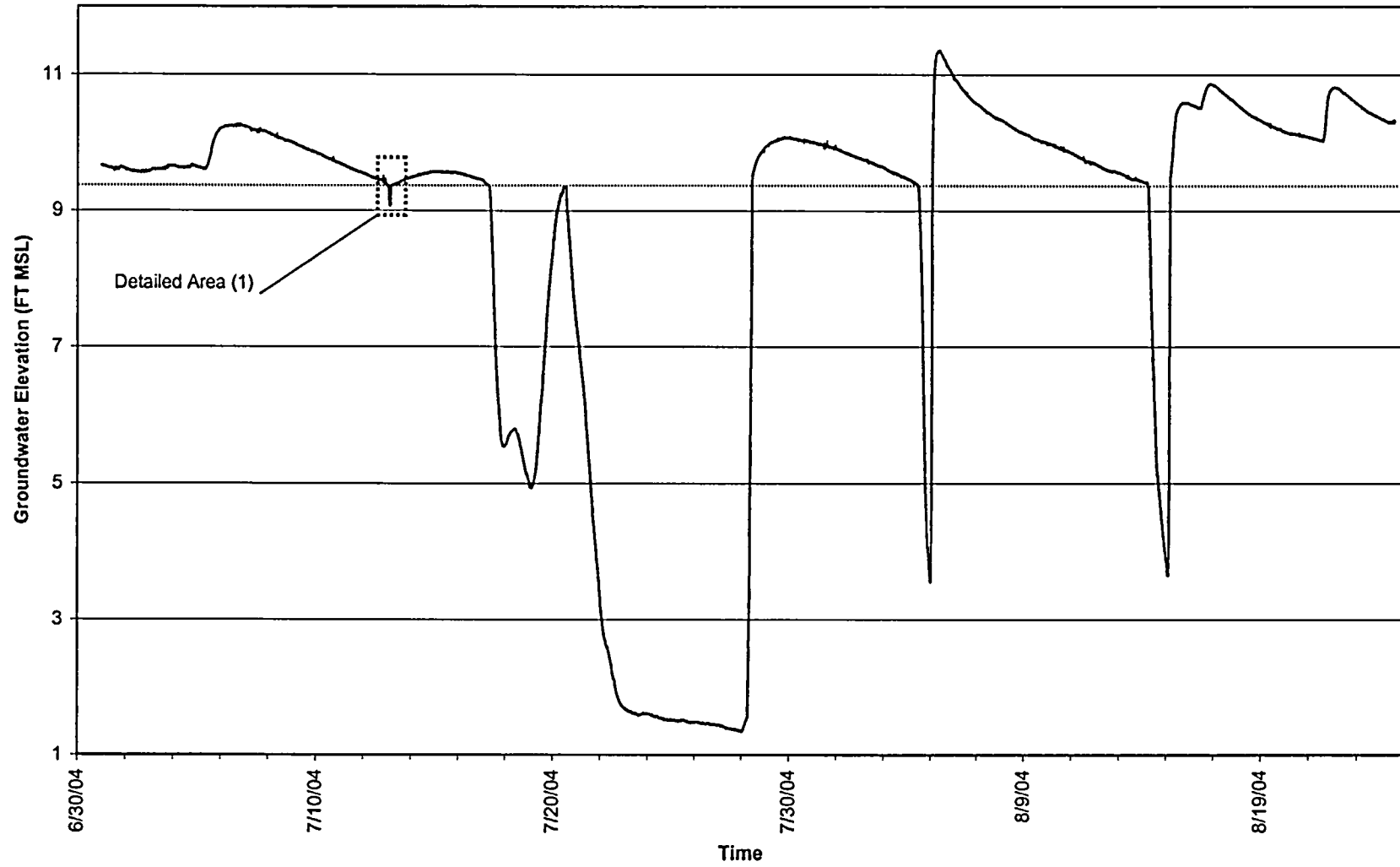
TW-1 Groundwater Elevation and Temperature
3rd Quarter



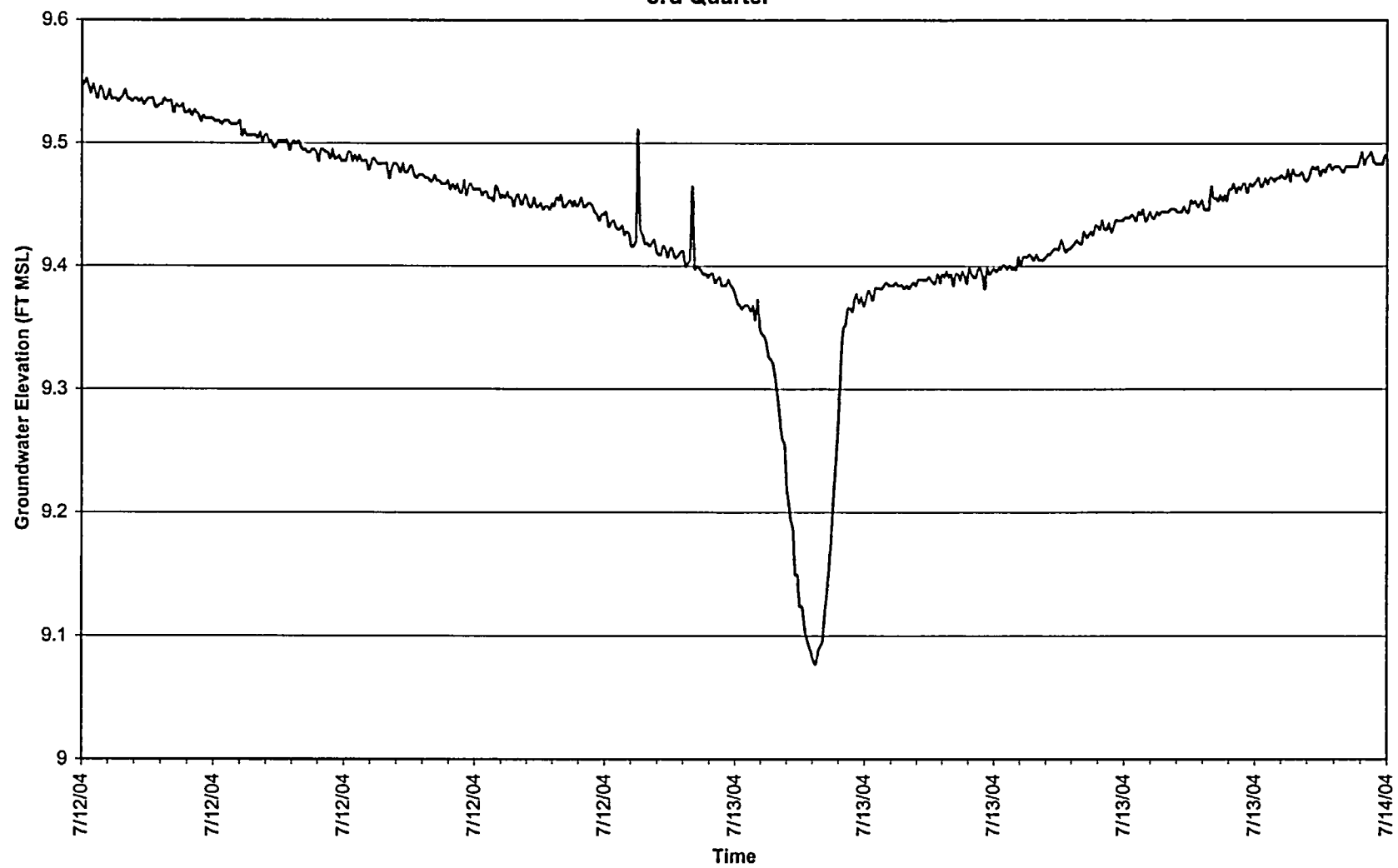
Groundwater Elevation at MW-101S
3rd Quarter



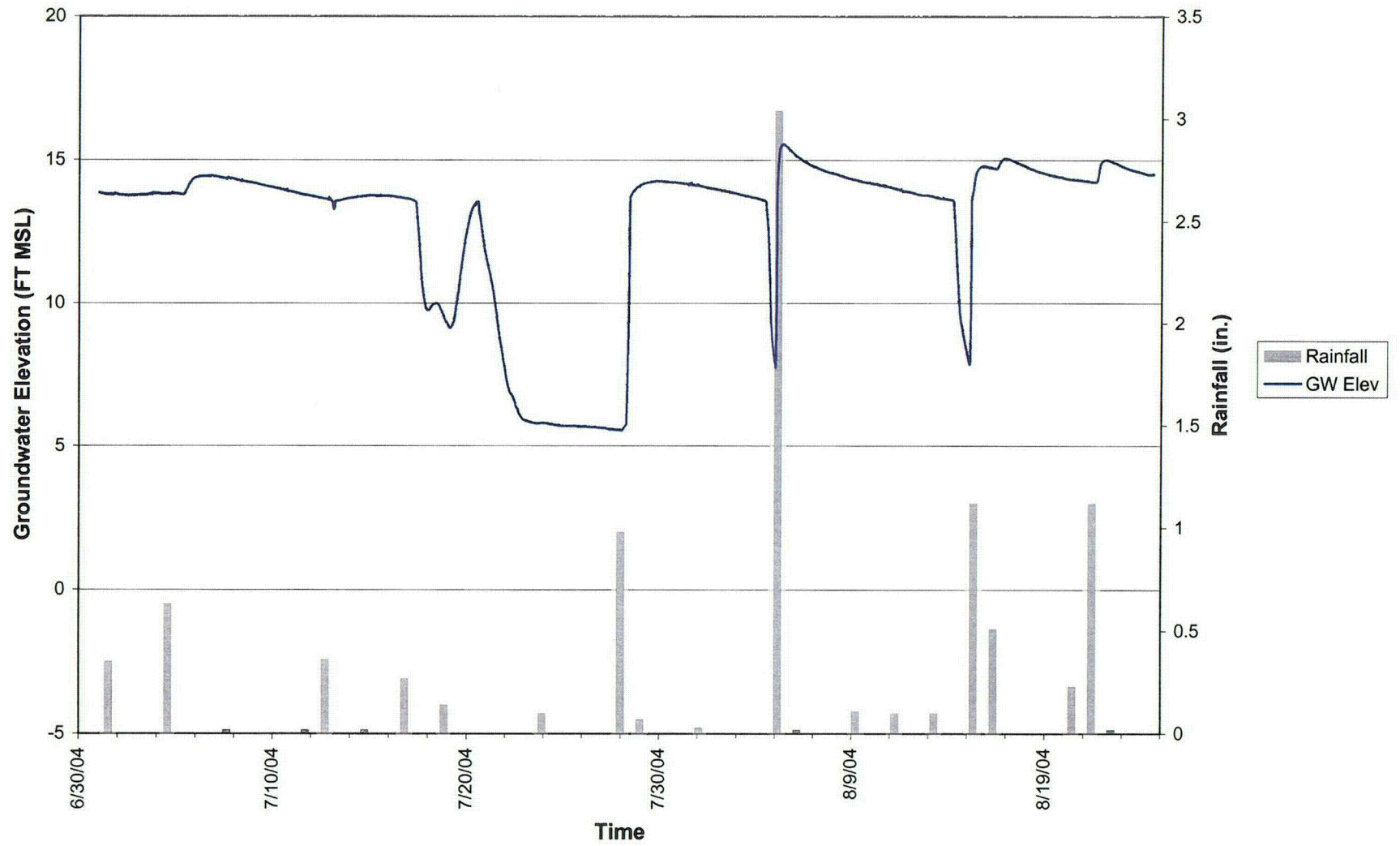
Groundwater Elevation at MW-101S
3rd Quarter



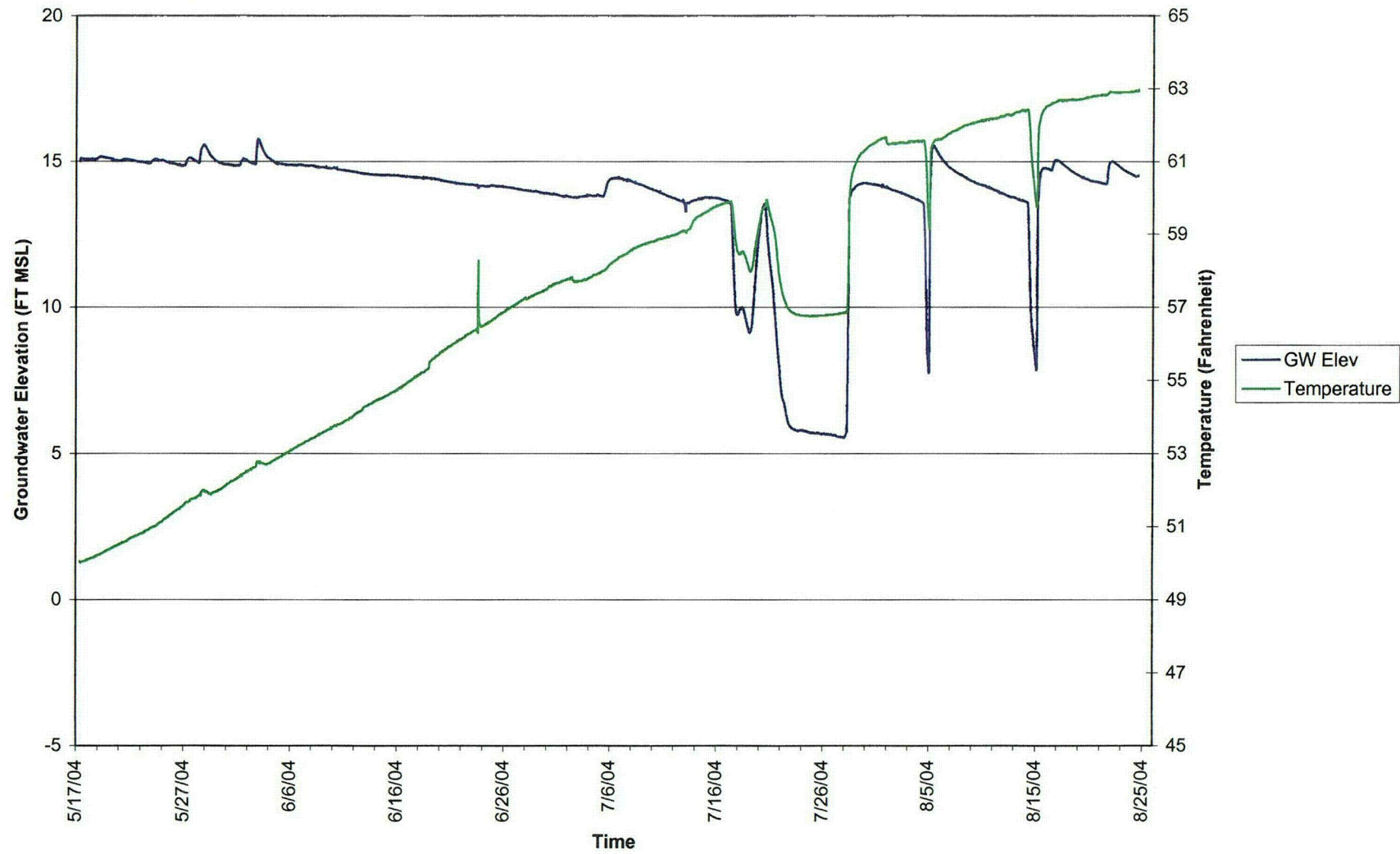
Detailed Area
Groundwater Elevation at MW-101S
3rd Quarter



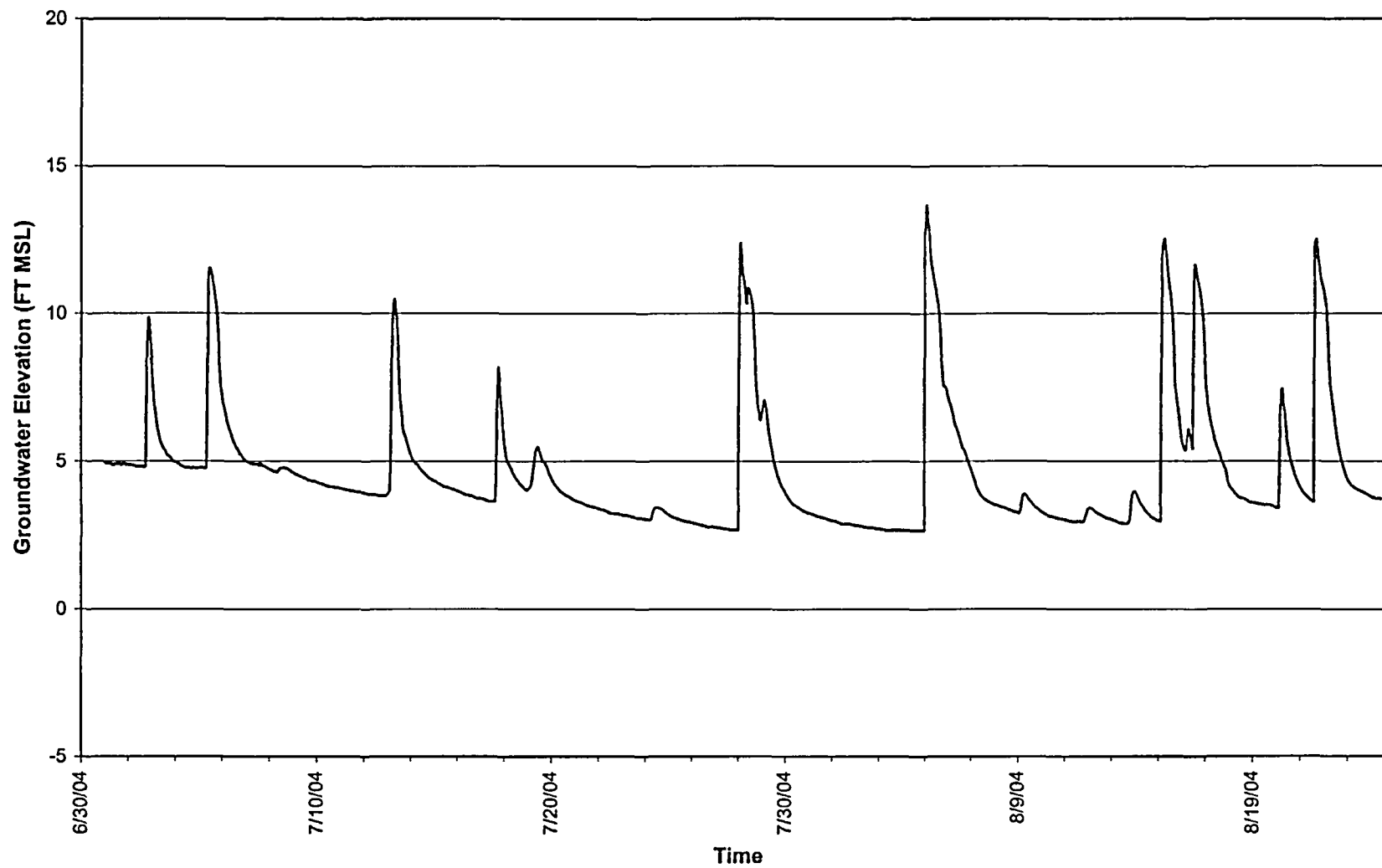
MW-101S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



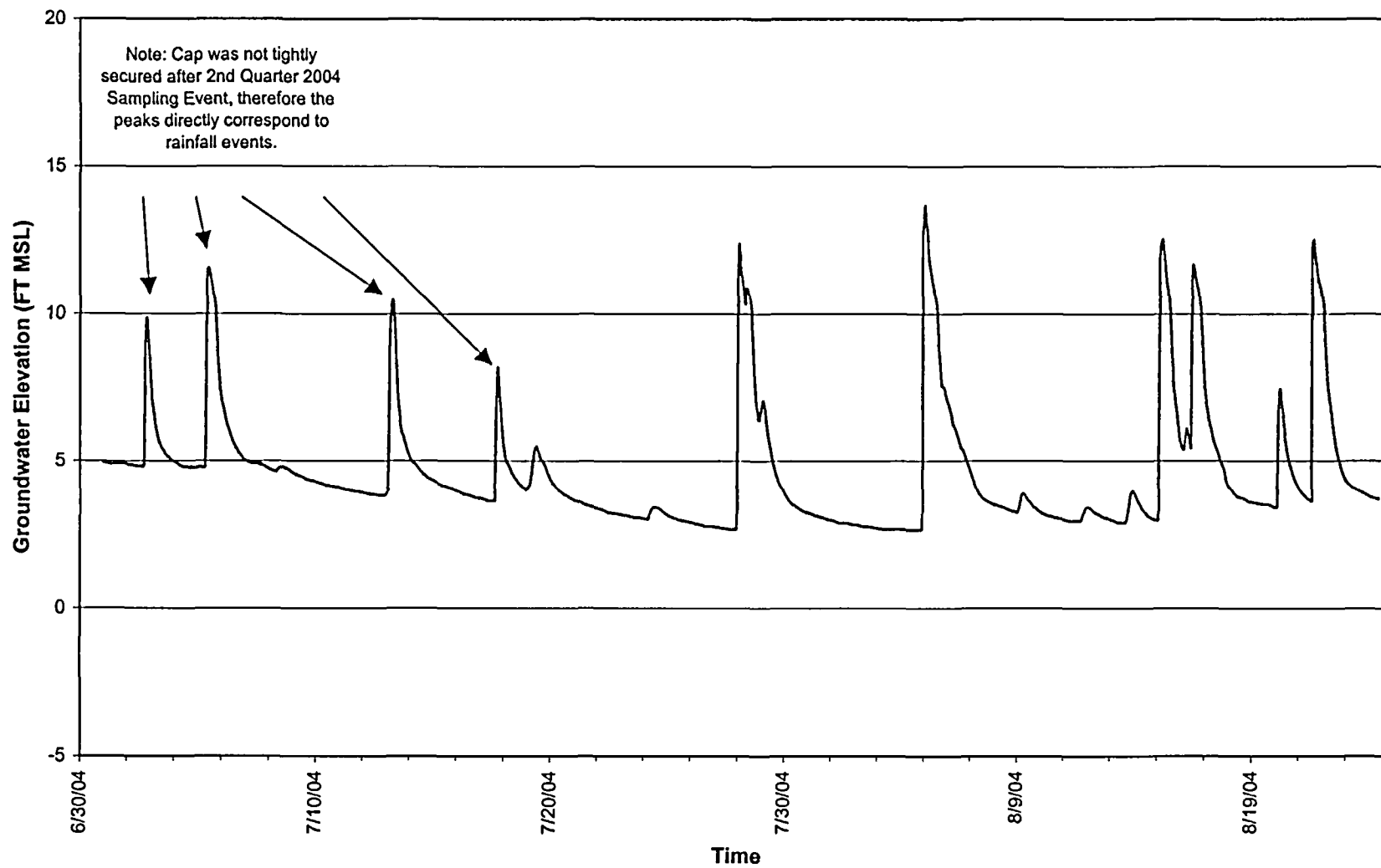
MW-101S Groundwater Elevation and Temperature
3rd Quarter



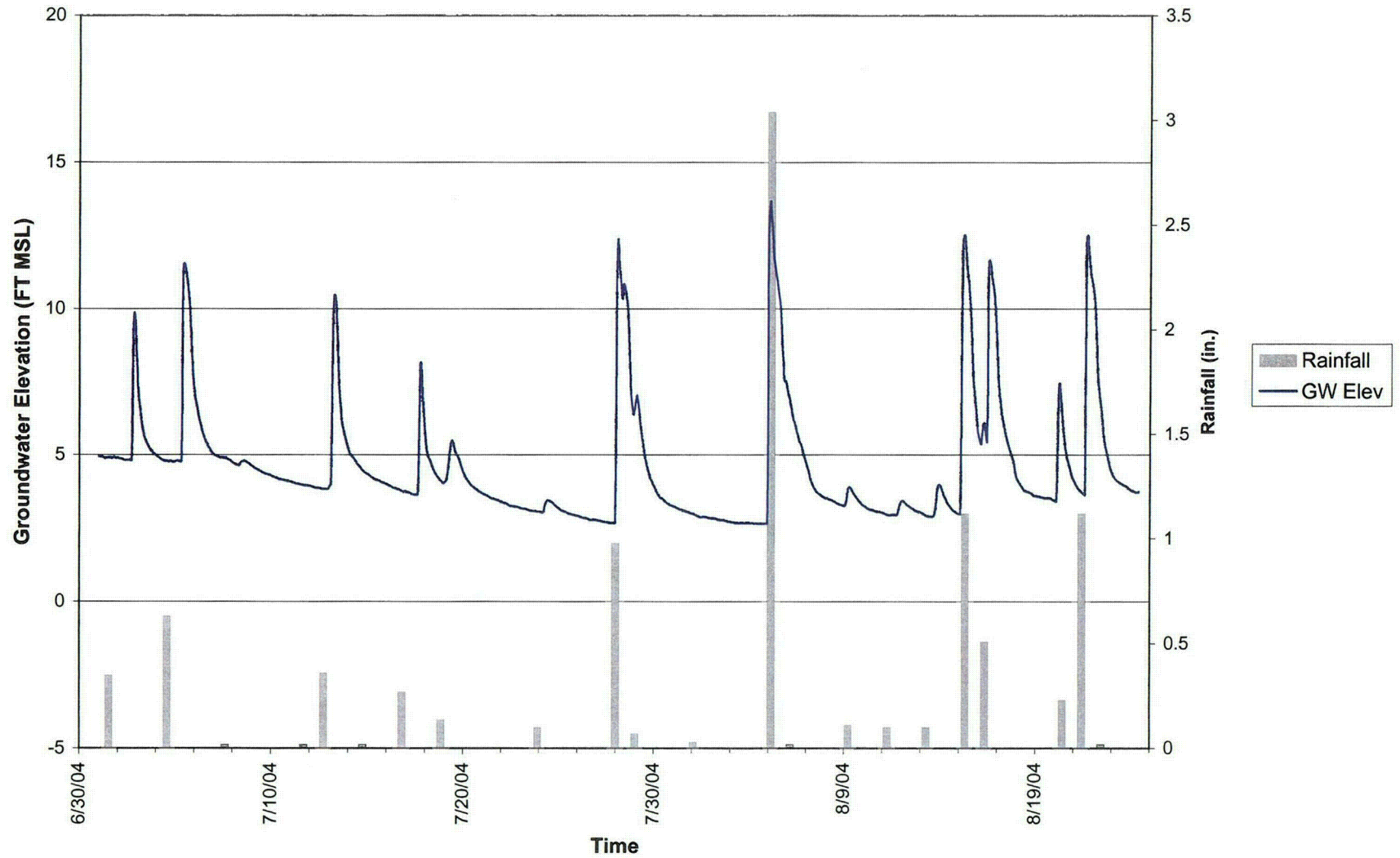
Groundwater Elevation at MW-102S
3rd Quarter



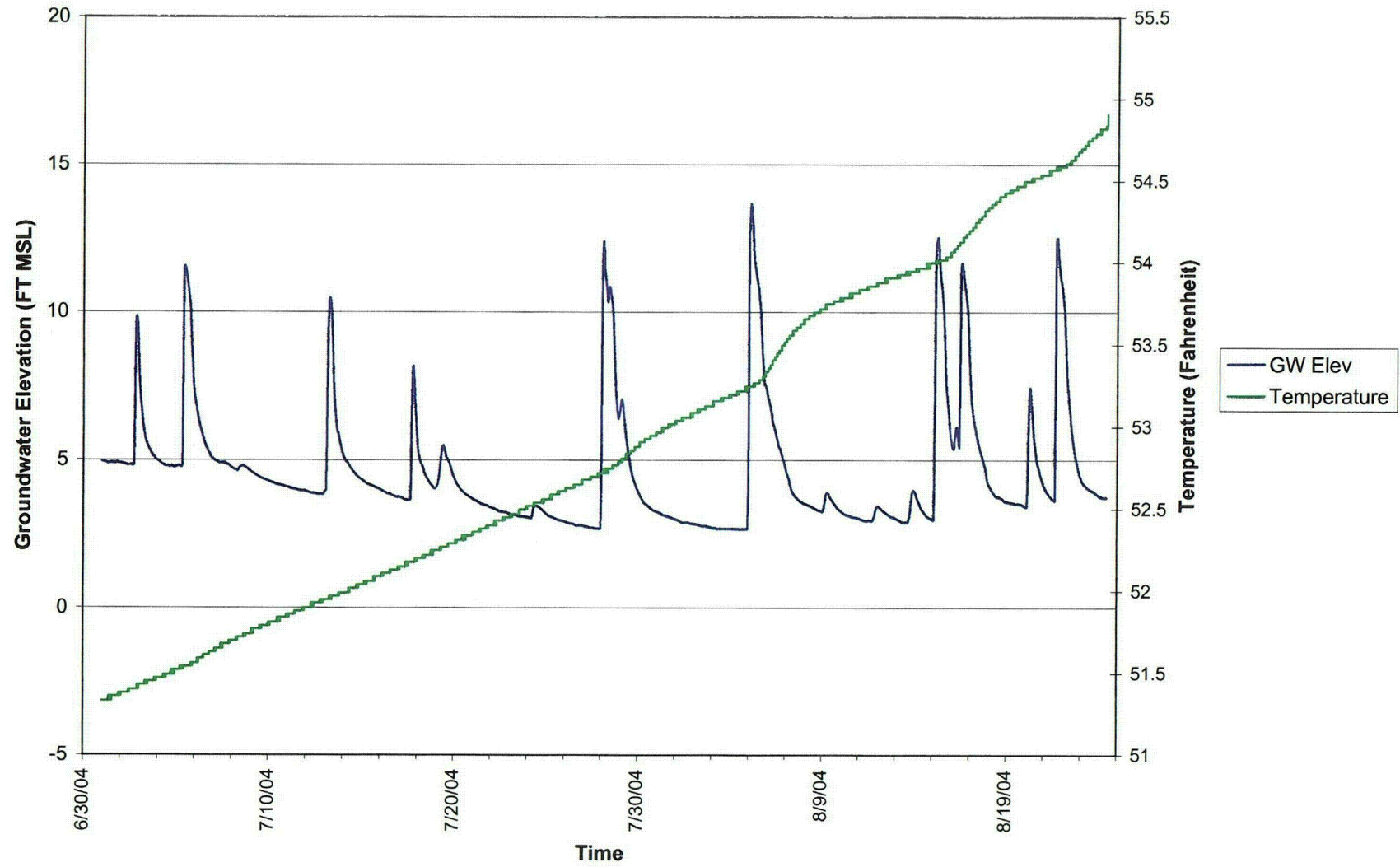
Groundwater Elevation at MW-102S 3rd Quarter



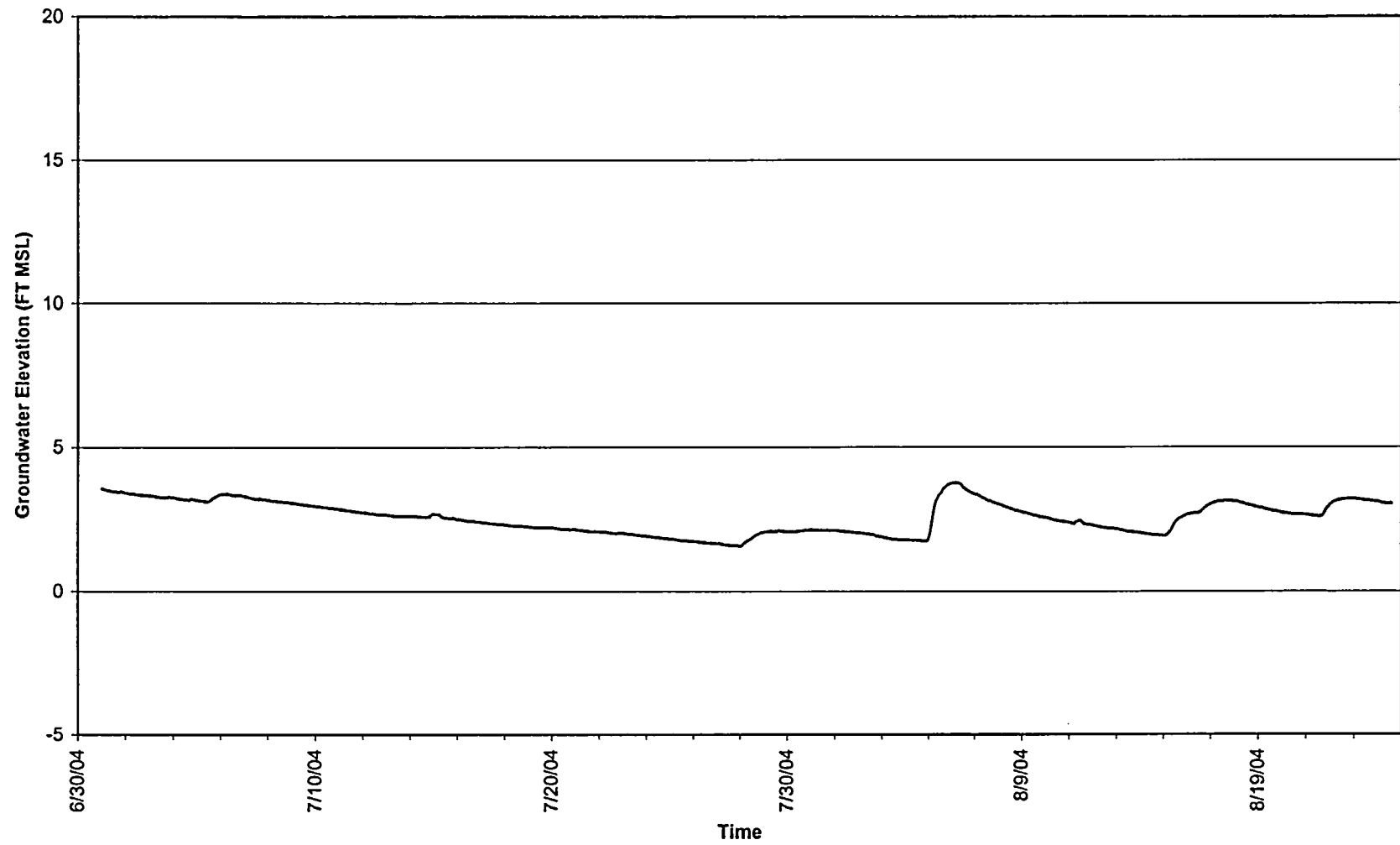
MW-102S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



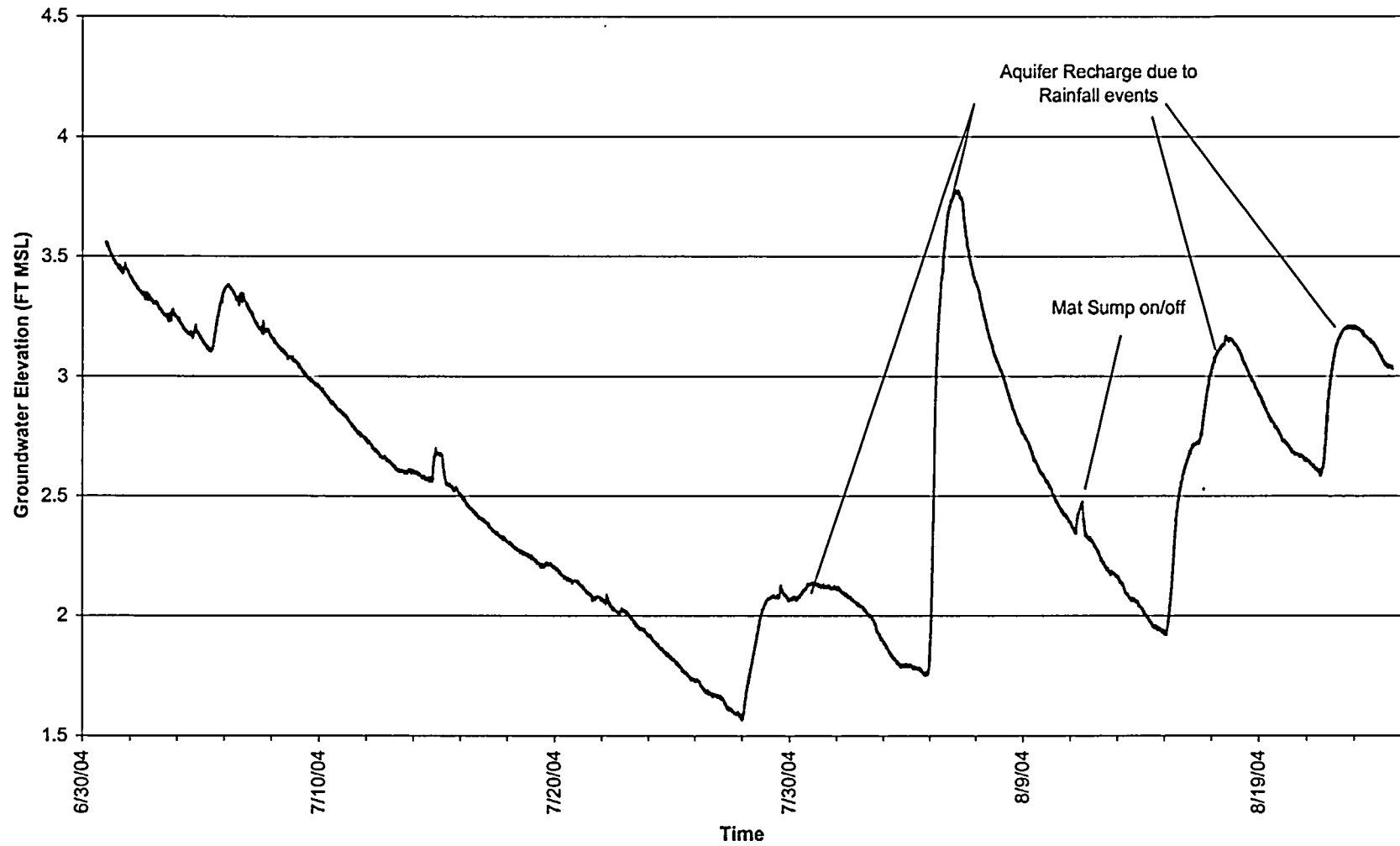
MW-102S Groundwater Elevation and Temperature
3rd Quarter



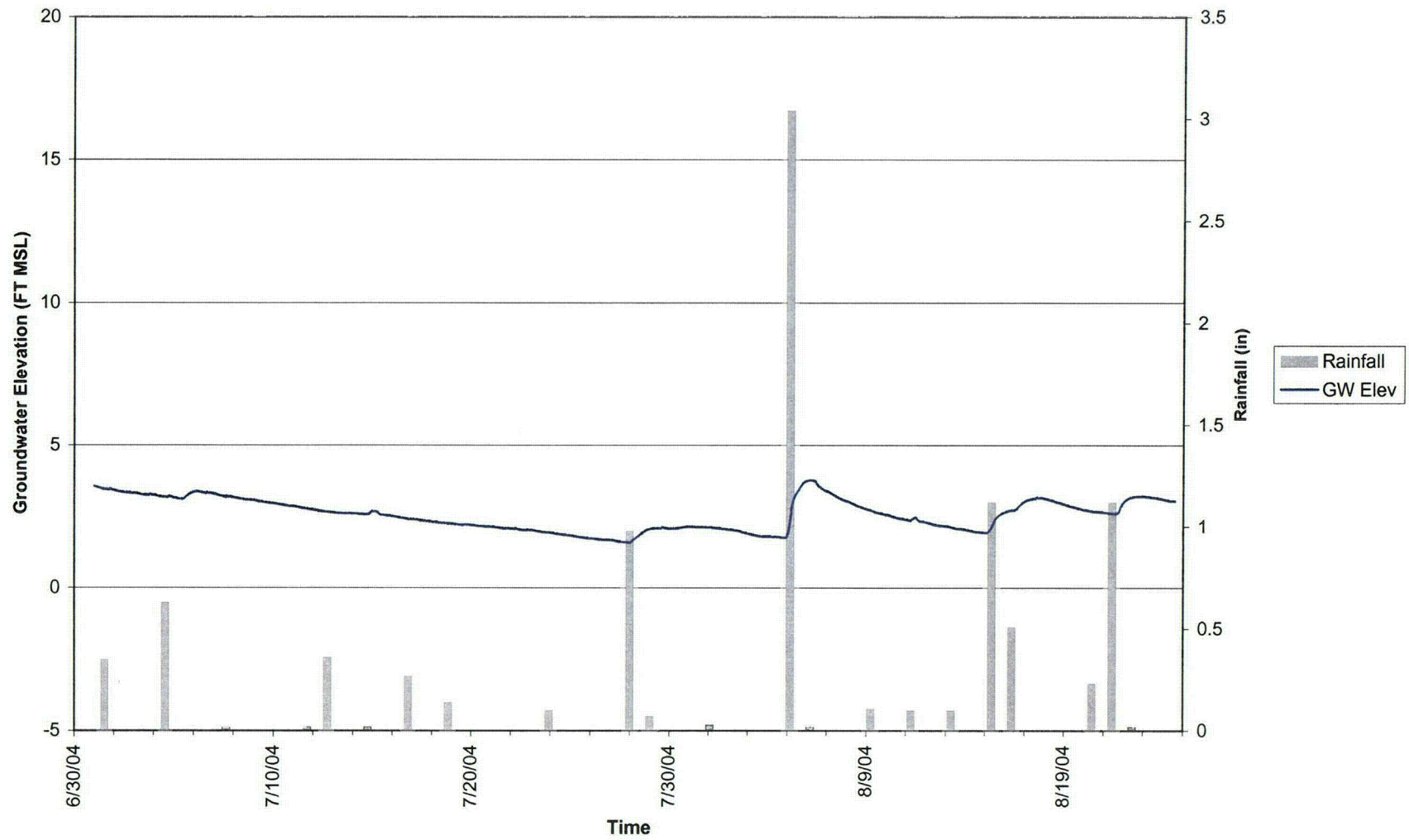
Groundwater Elevation at MW-103S
3rd Quarter



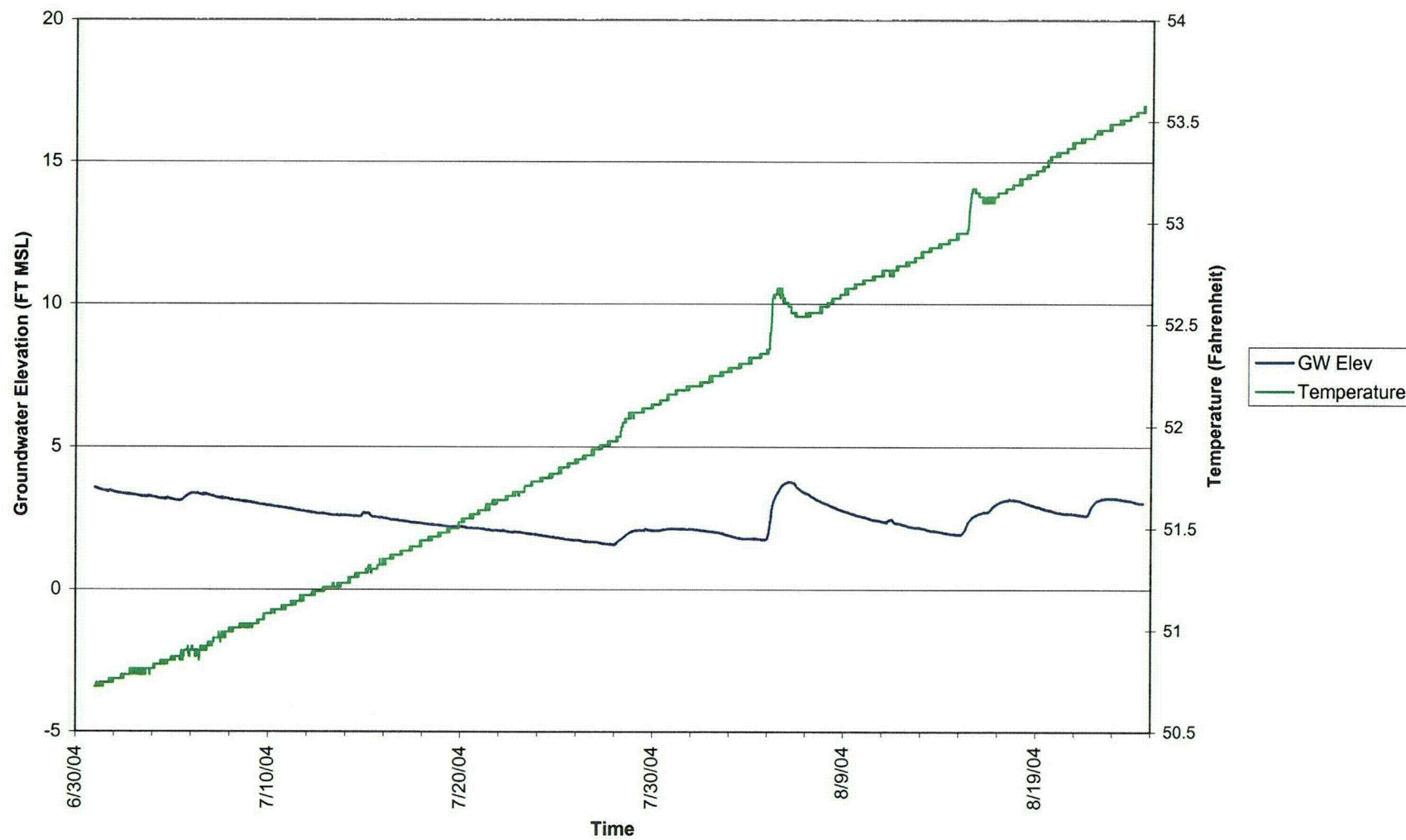
Groundwater Elevation at MW-103S
3rd Quarter



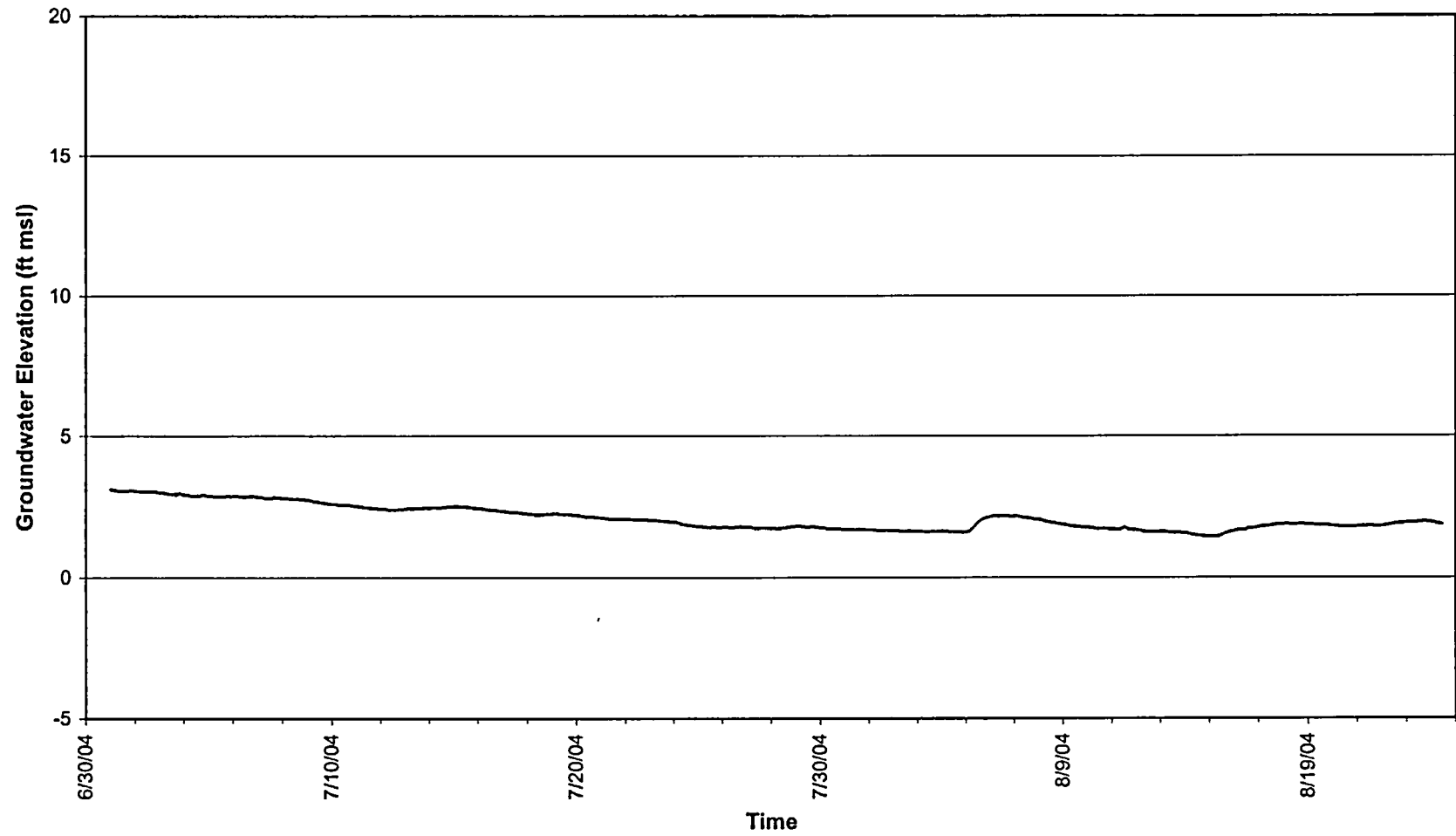
MW-103S Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



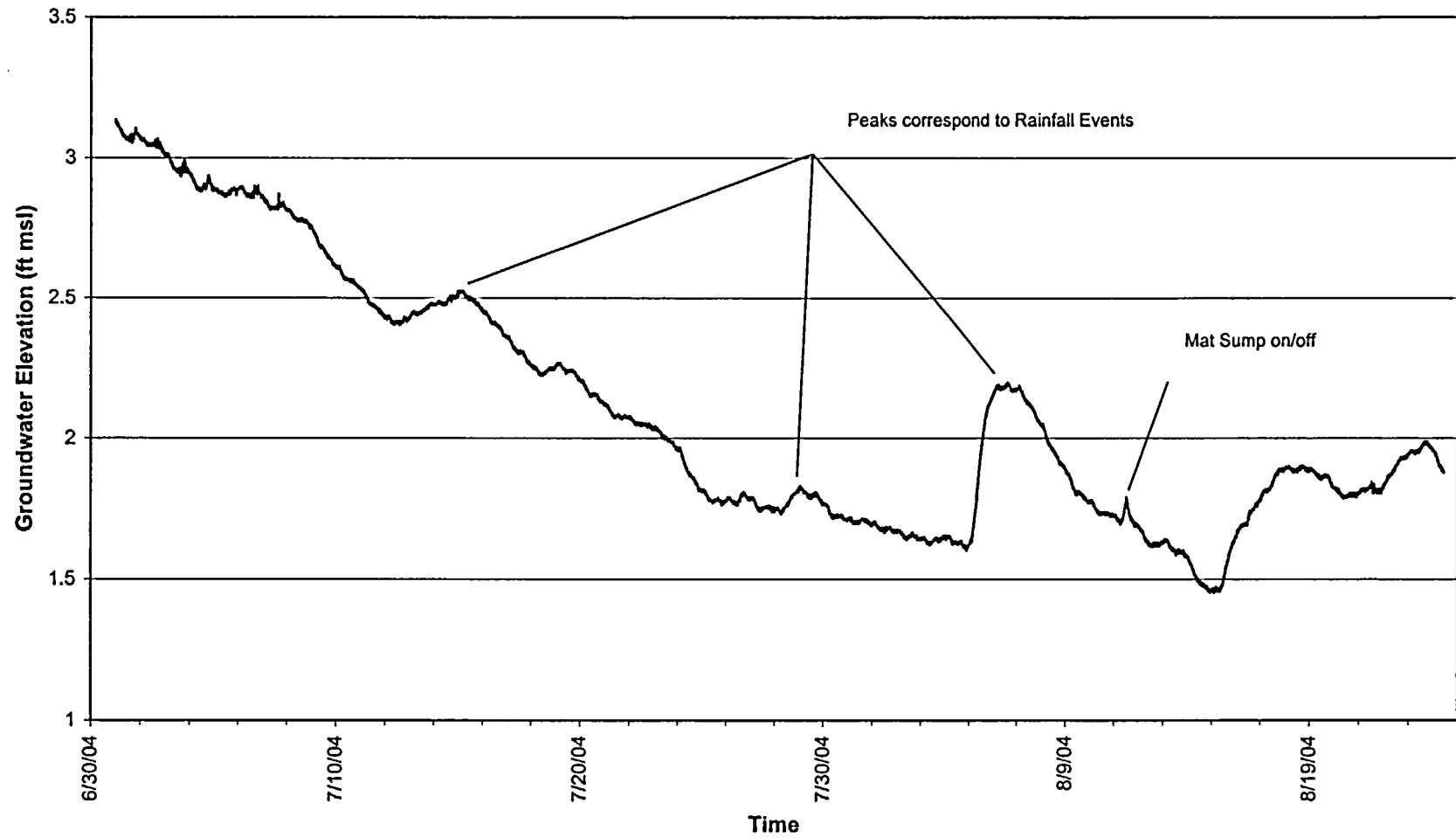
MW-103S Groundwater Elevation and Temperature
3rd Quarter



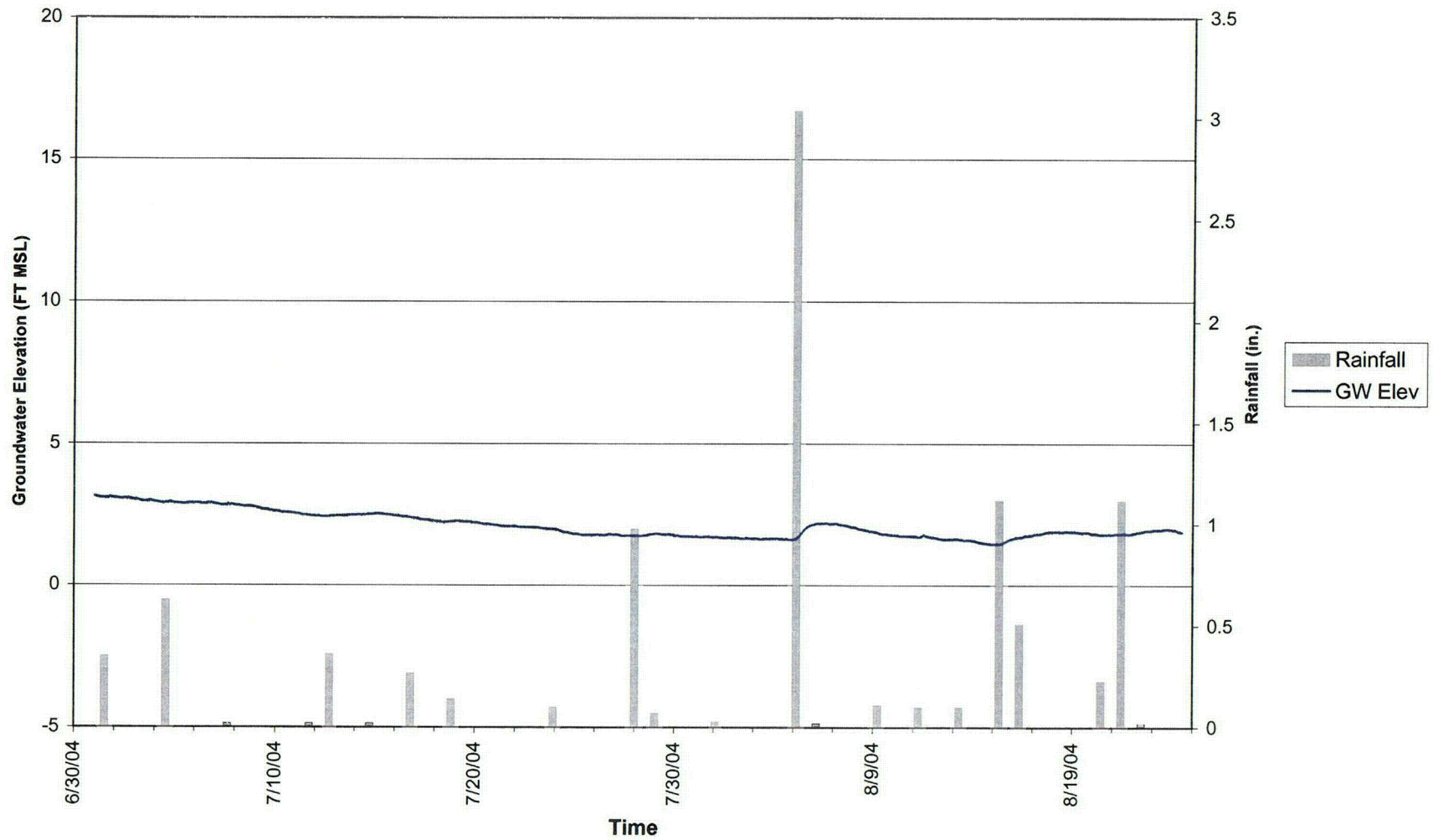
Groundwater Elevation at MW-106S
3rd Quarter



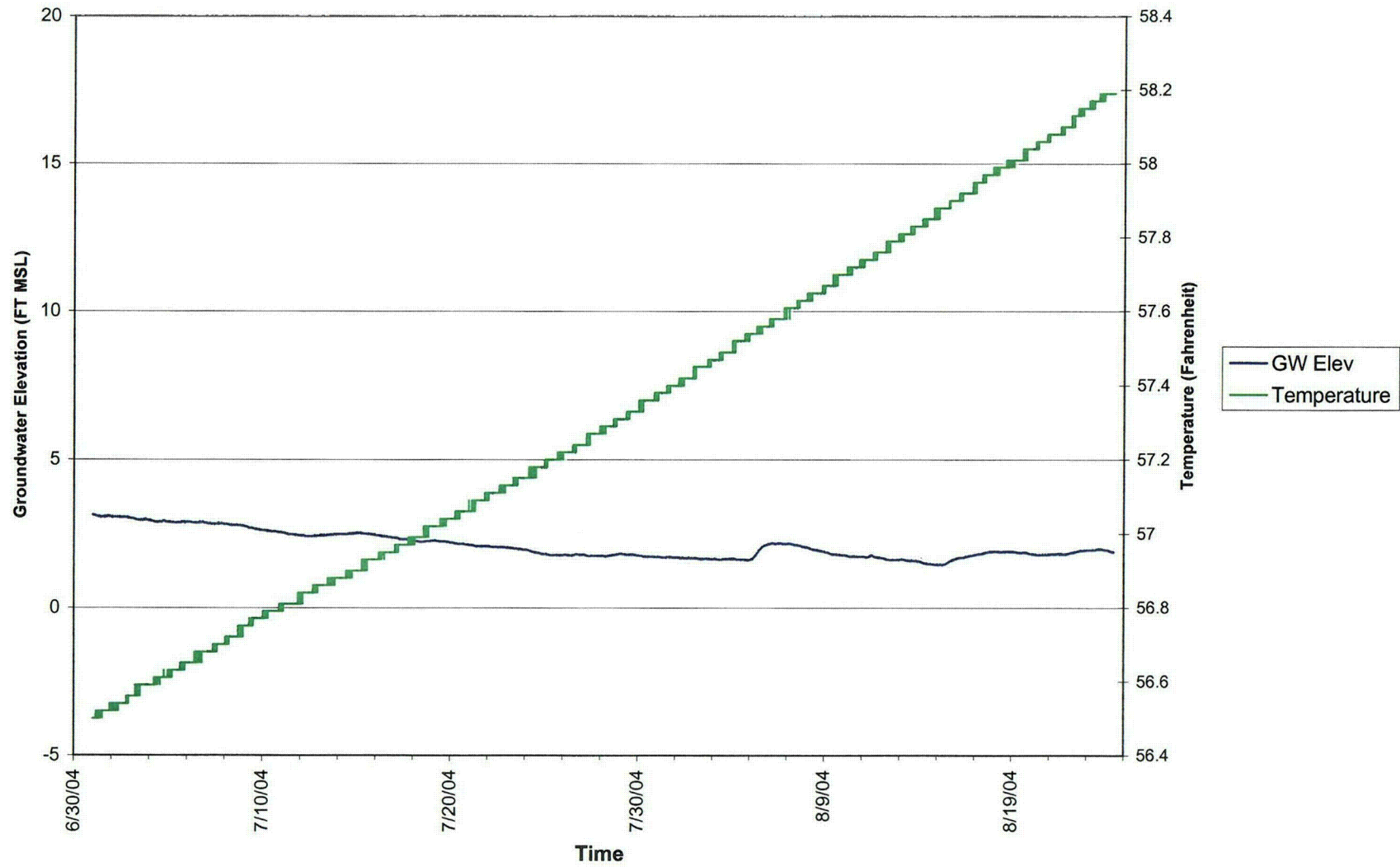
Groundwater Elevation at MW-106S 3rd Quarter



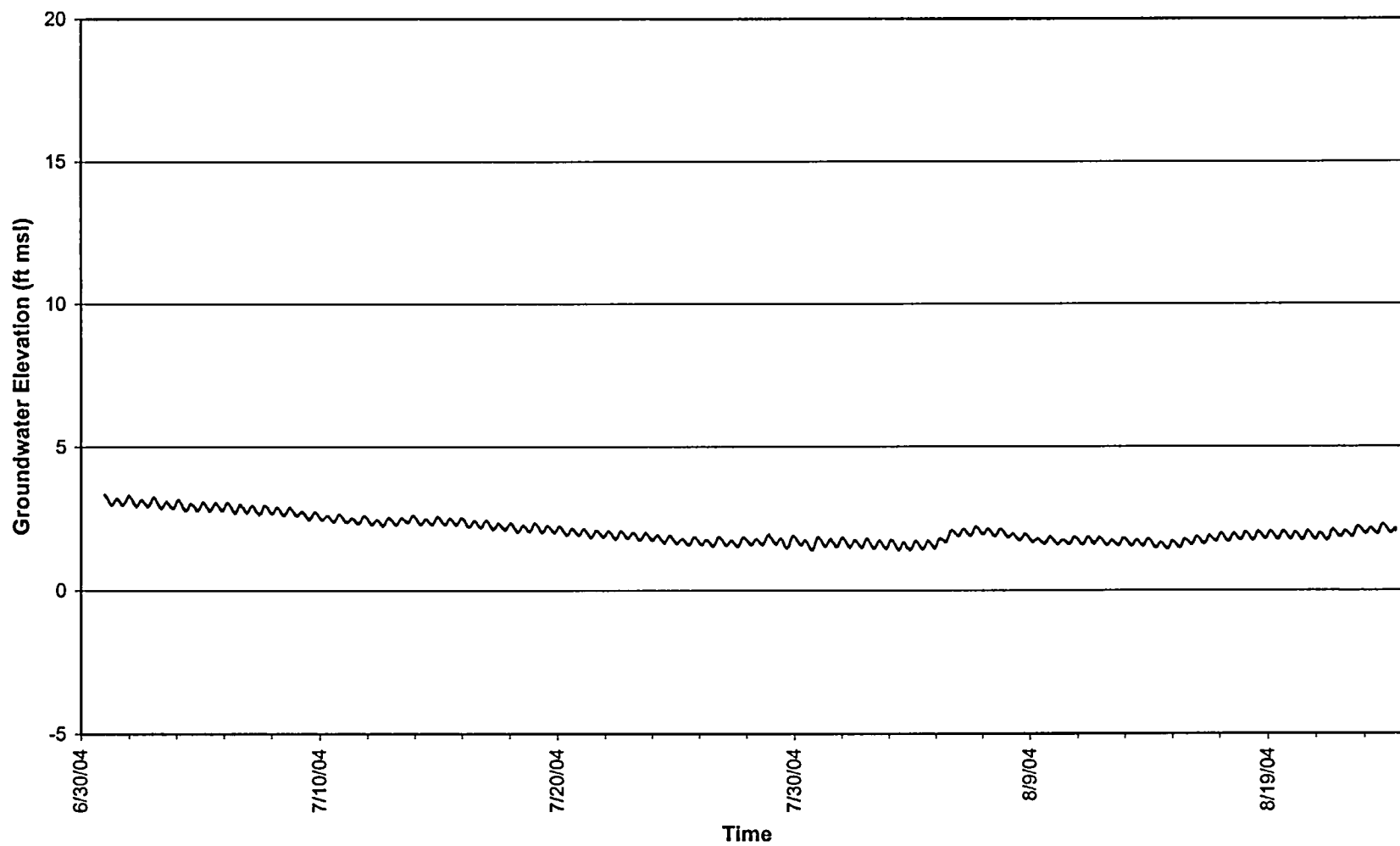
MW-106S Groundwater Elevation and Daily Rainfall Totals 3rd Quarter



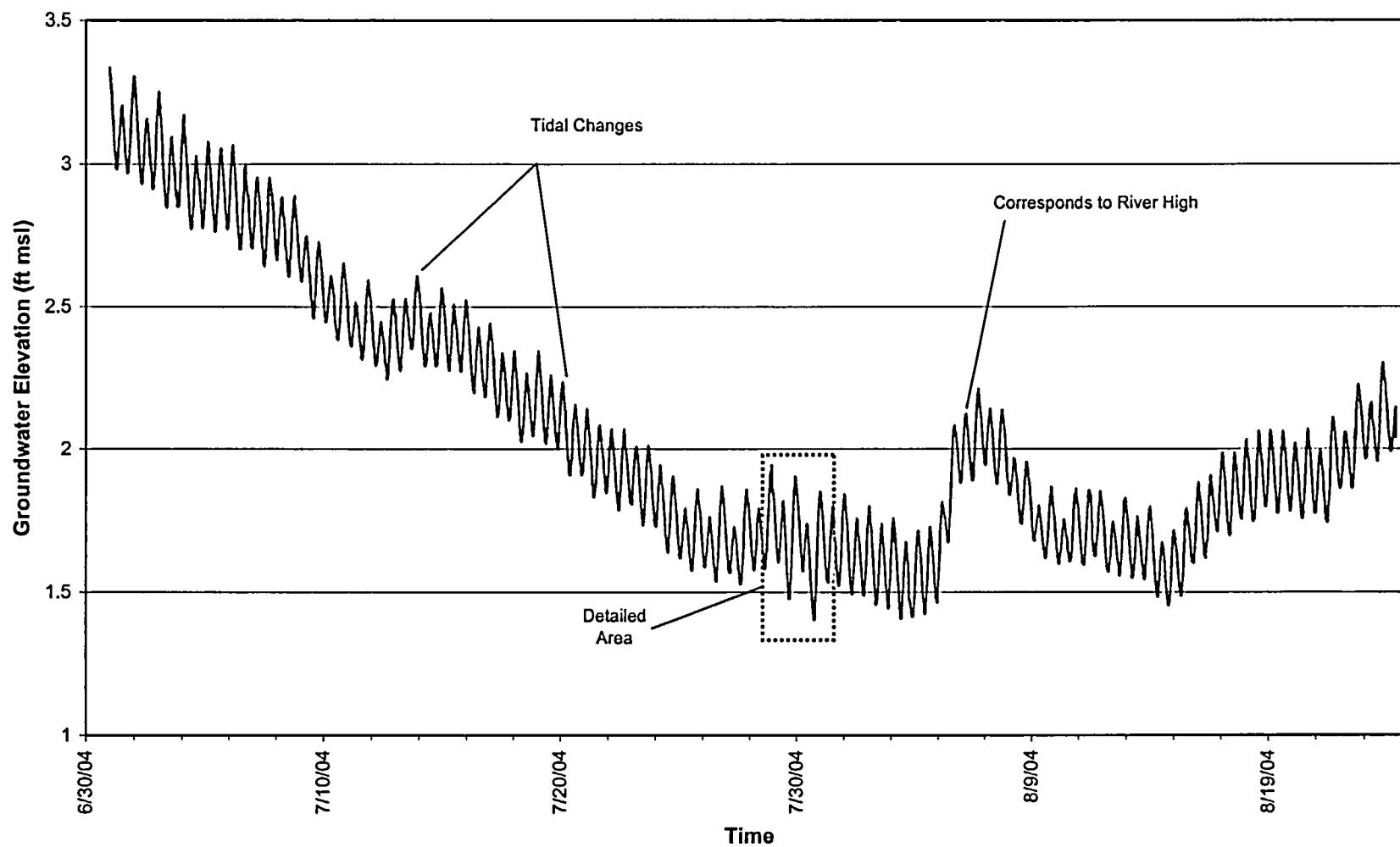
MW-106S Groundwater Elevation and Temperature
3rd Quarter



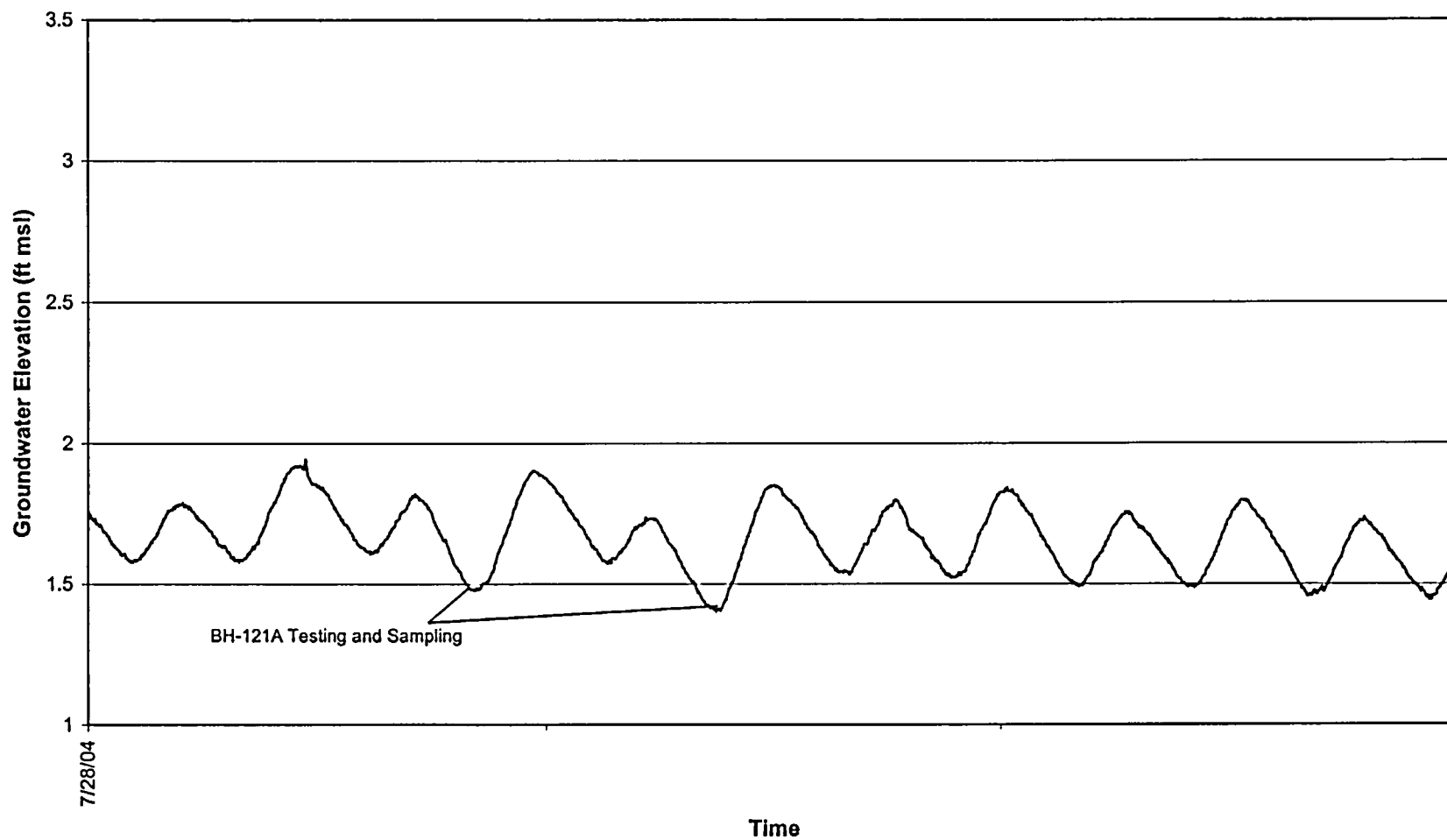
Groundwater Elevation at MW-107D
3rd Quarter



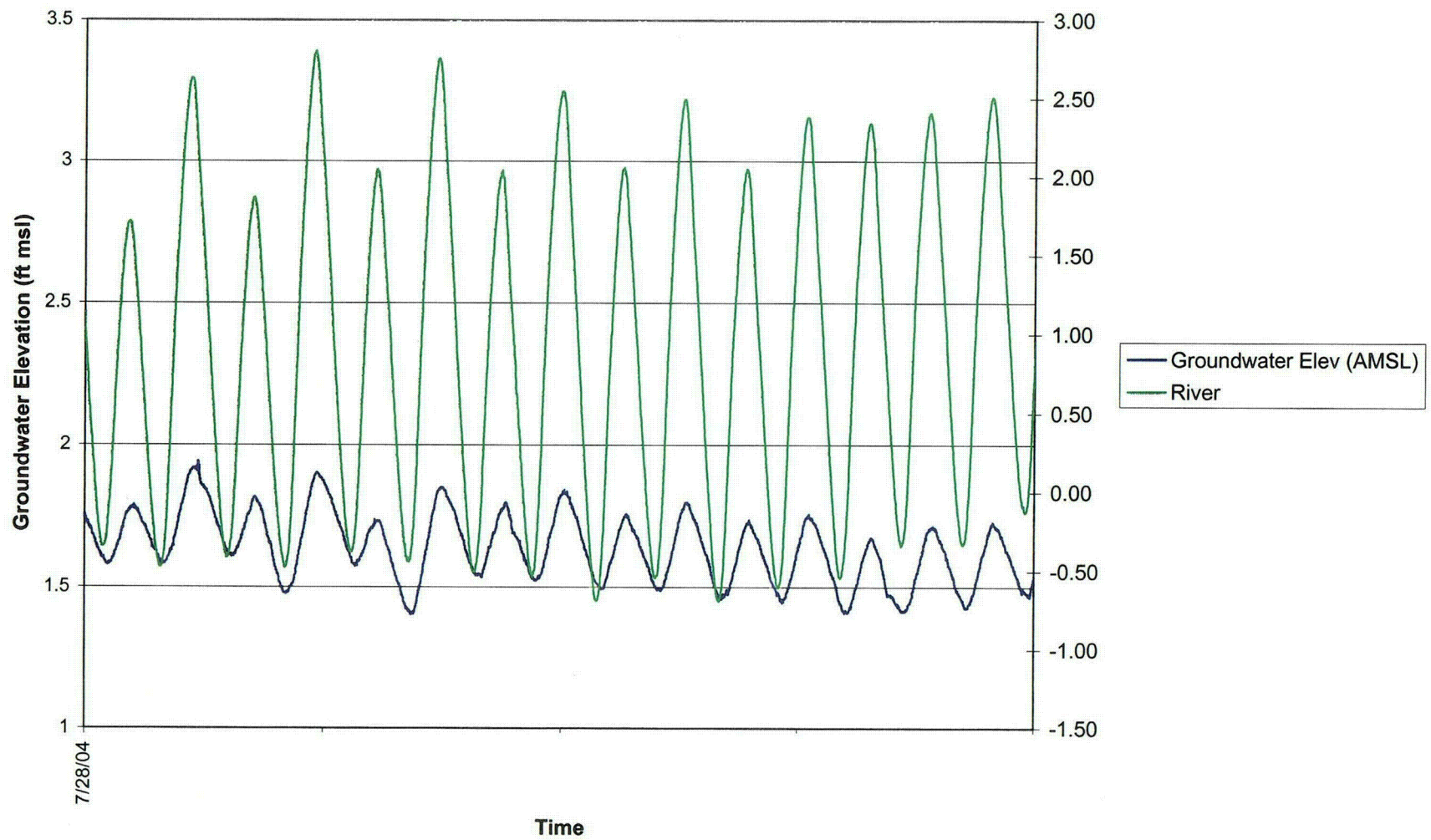
Groundwater Elevation at MW-107D 3rd Quarter



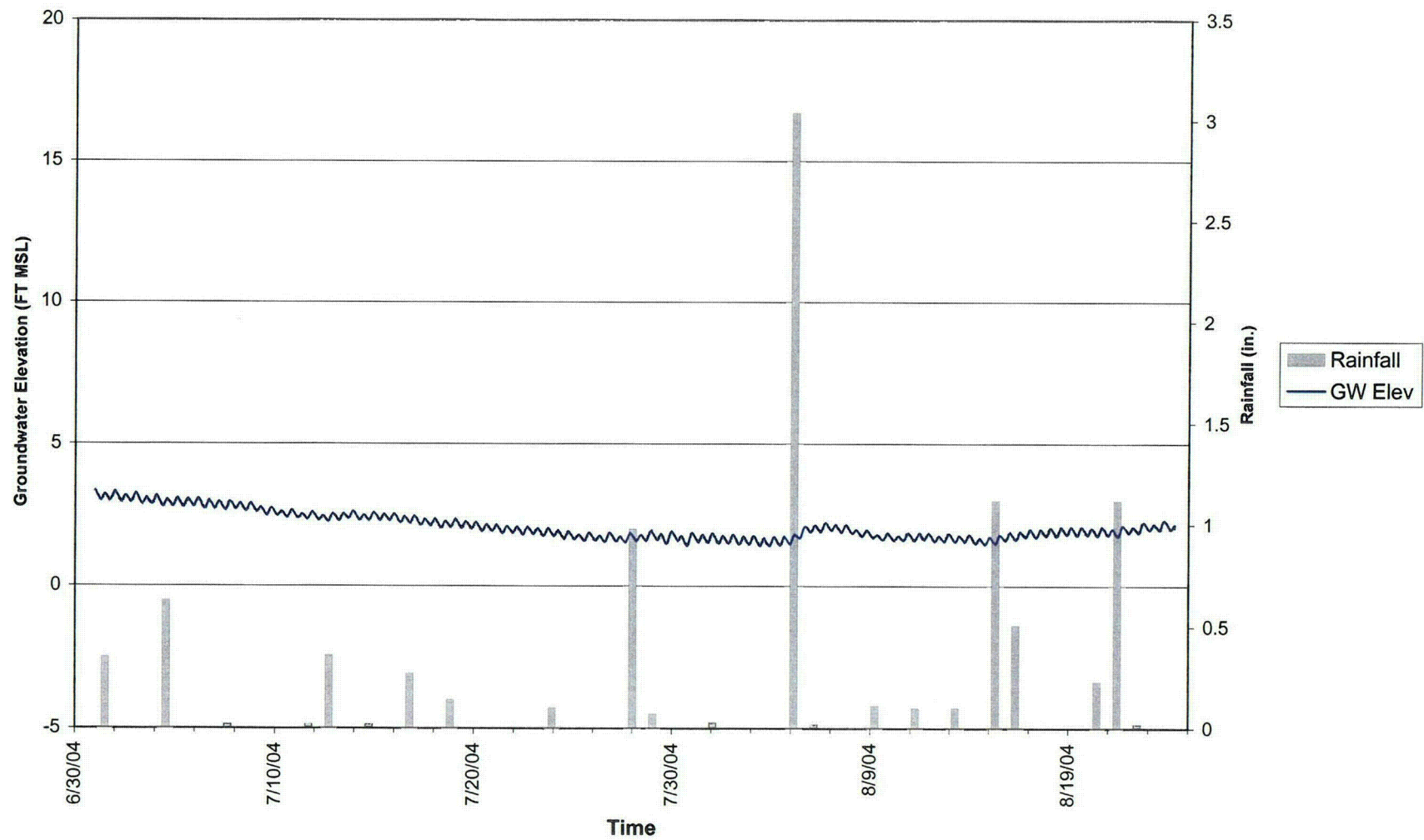
Detailed Area
Groundwater Elevation at MW-107D
3rd Quarter



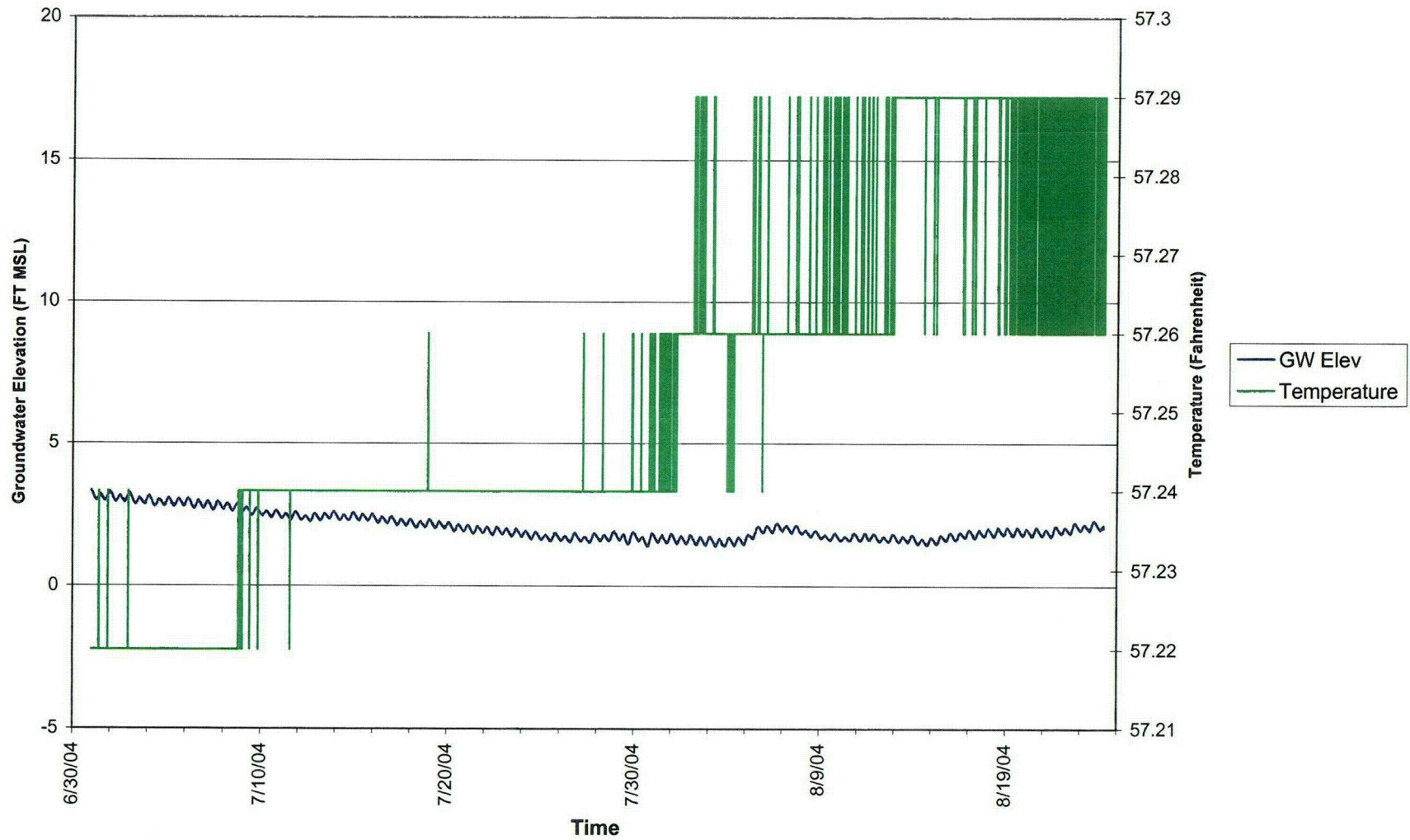
Groundwater Elevation at MW-107D and River Level 3rd Quarter



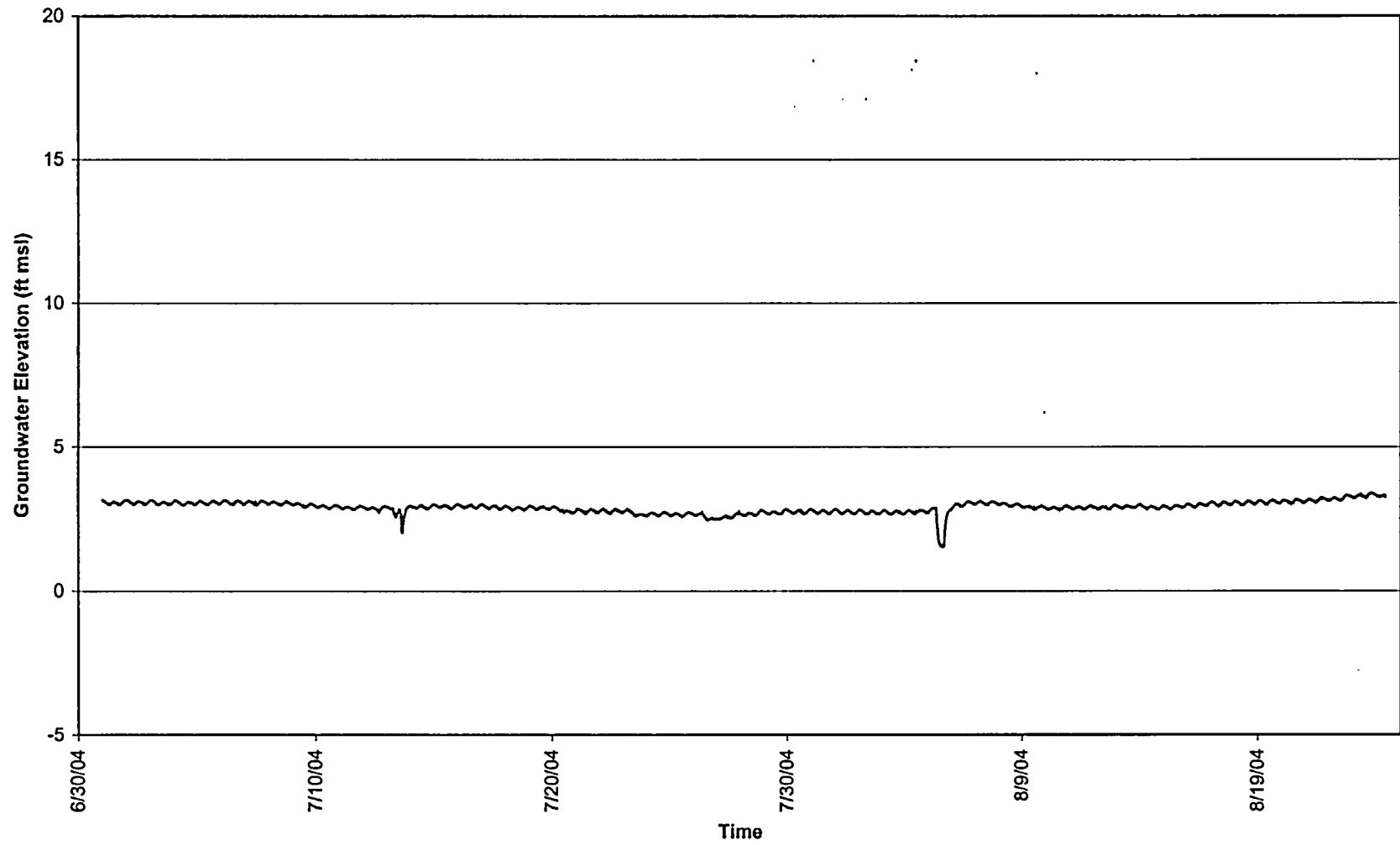
MW-107D Groundwater Elevation and Daily Rainfall Totals 3rd Quarter



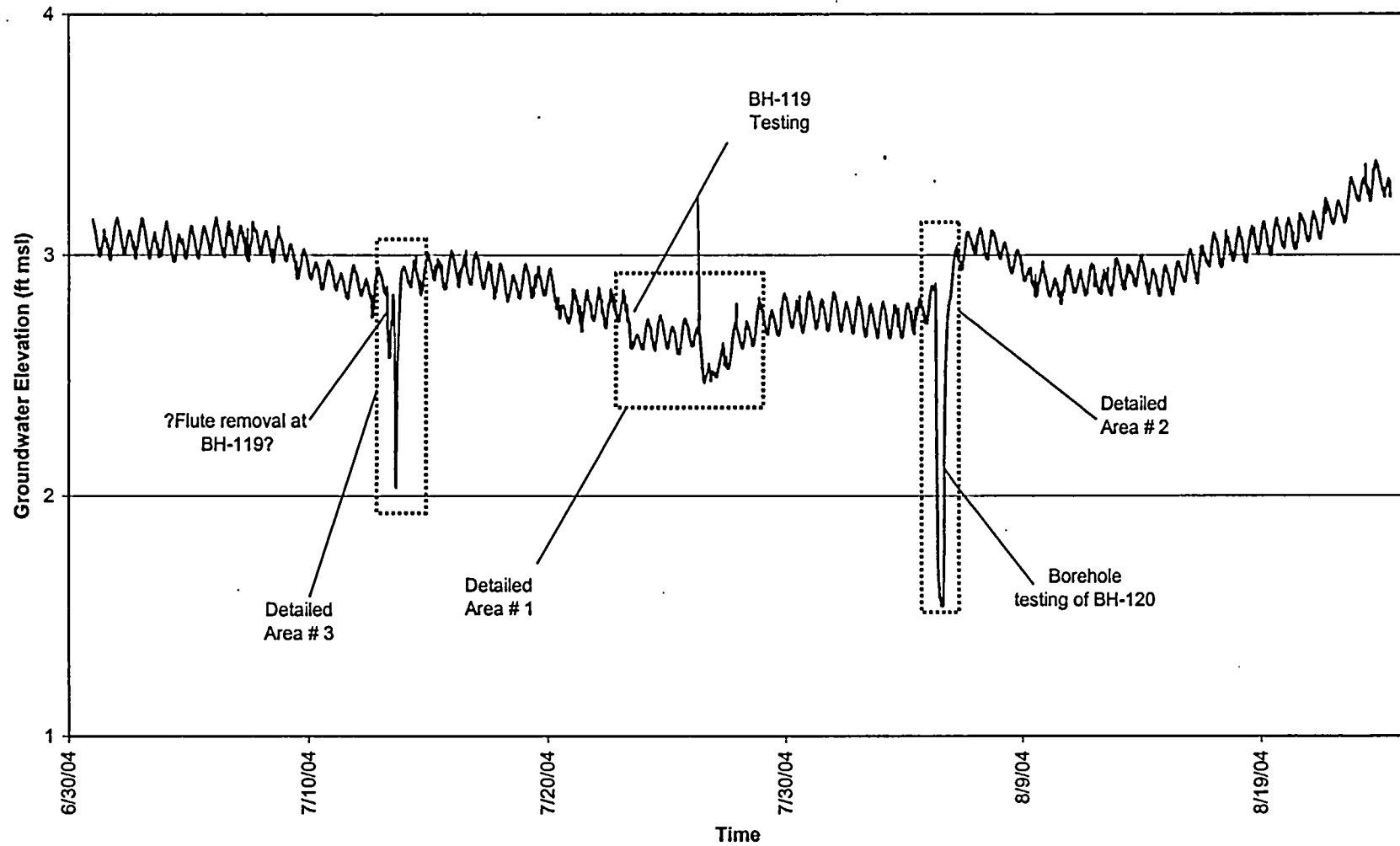
MW-107D Groundwater Elevation and Temperature
3rd Quarter



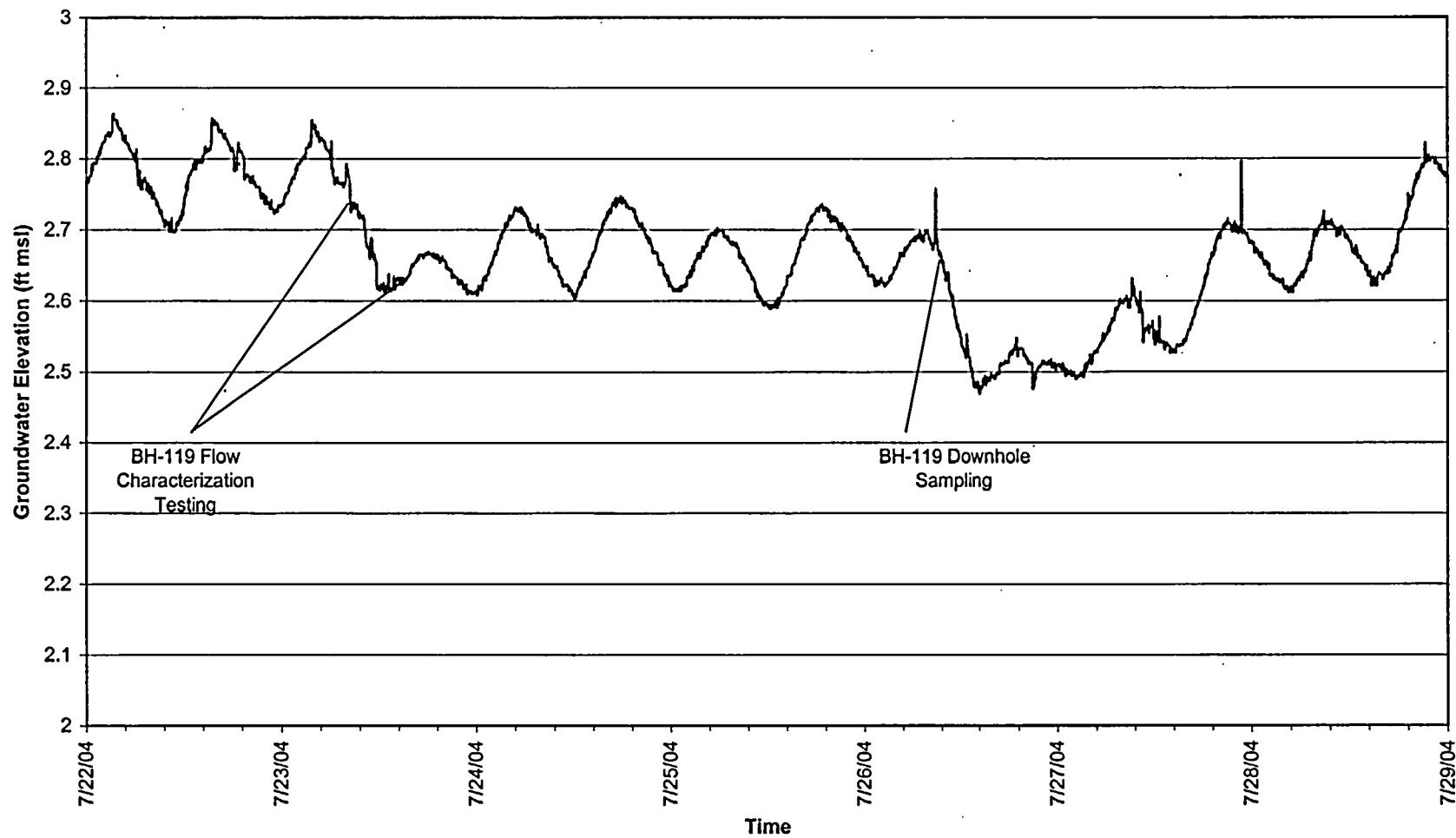
Groundwater Elevation at MW109D
3rd Quarter



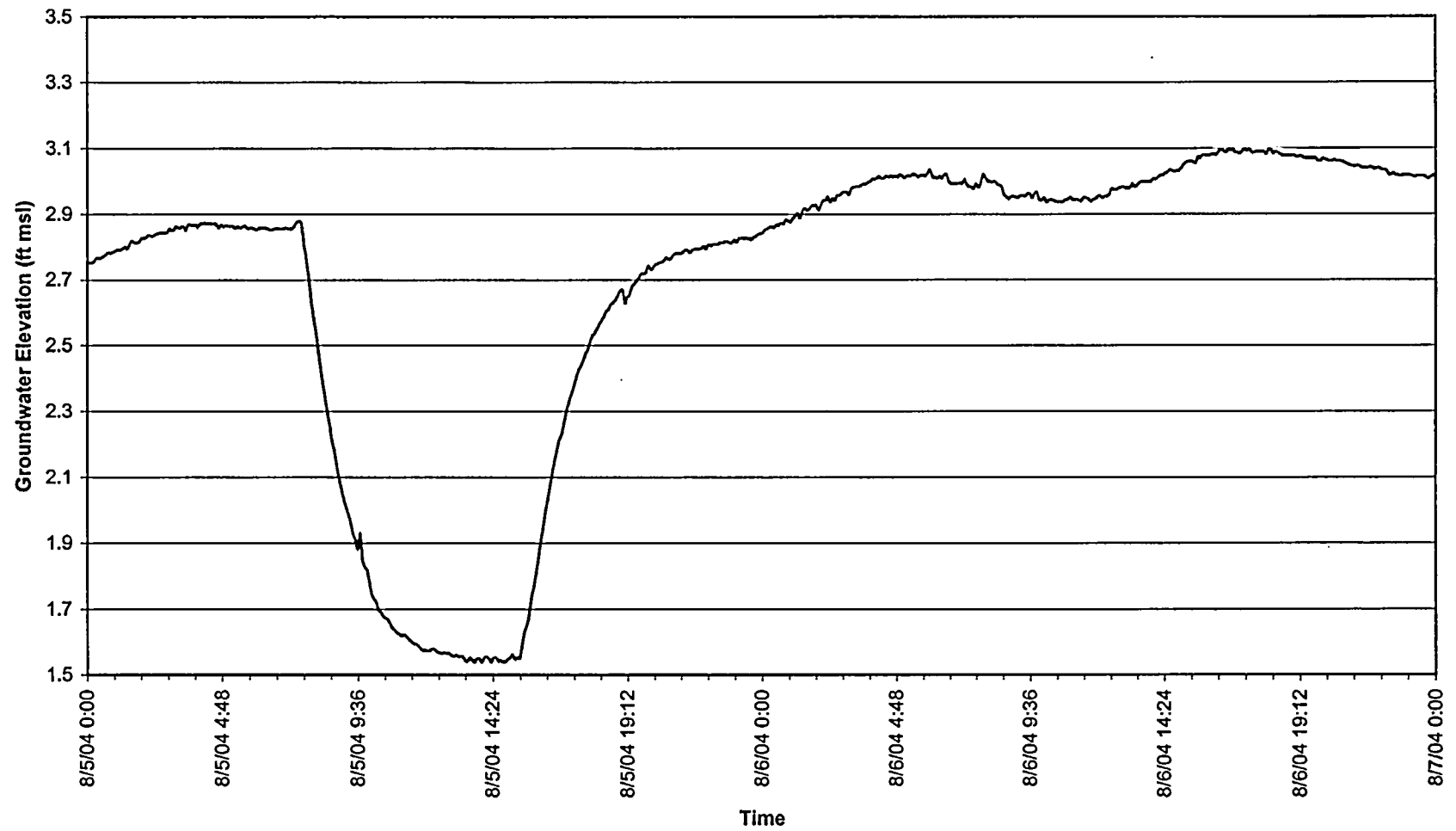
Groundwater Elevation at MW109D
3rd Quarter



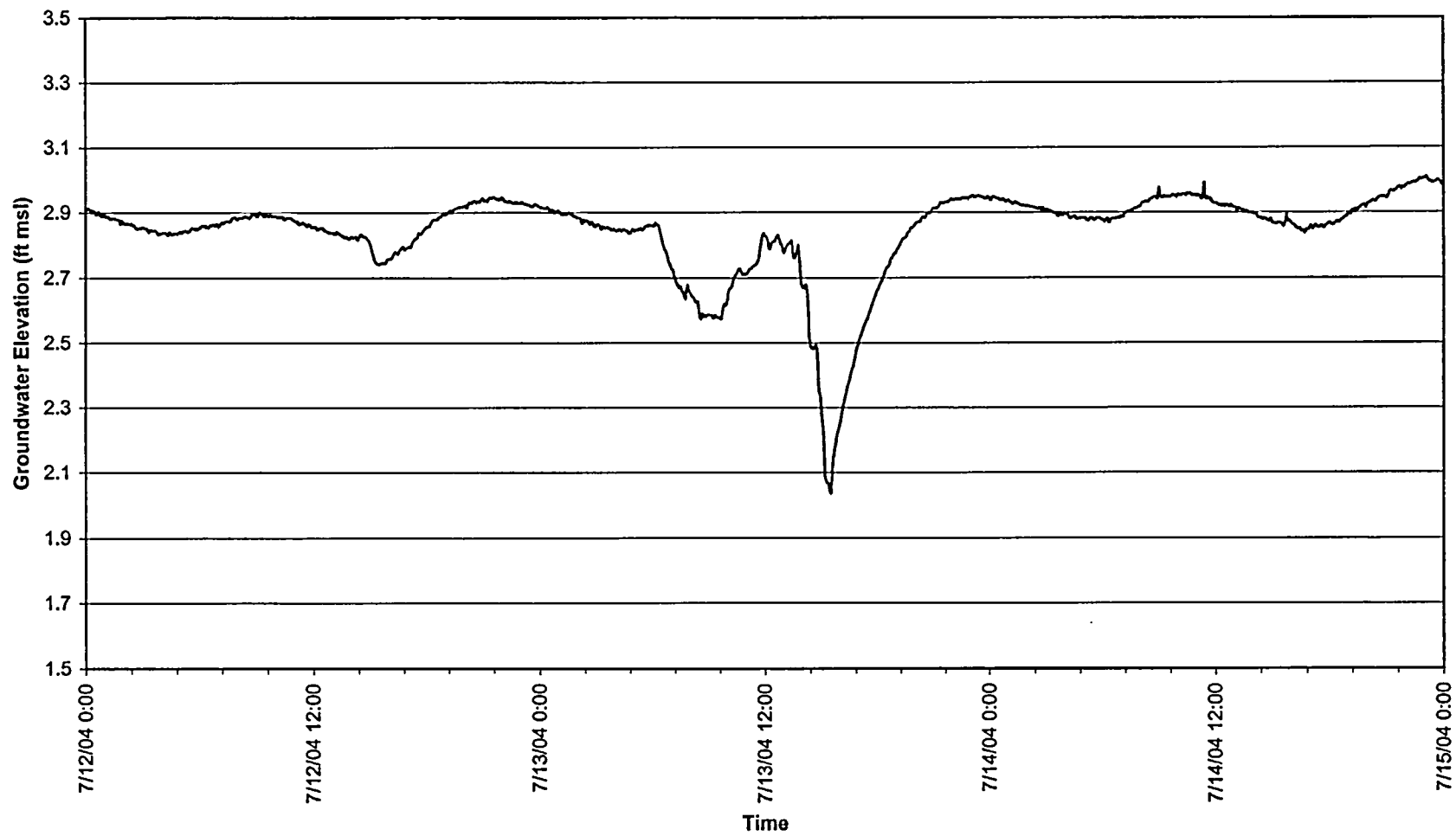
Detailed Area # 1
Groundwater Elevation at MW109D
3rd Quarter



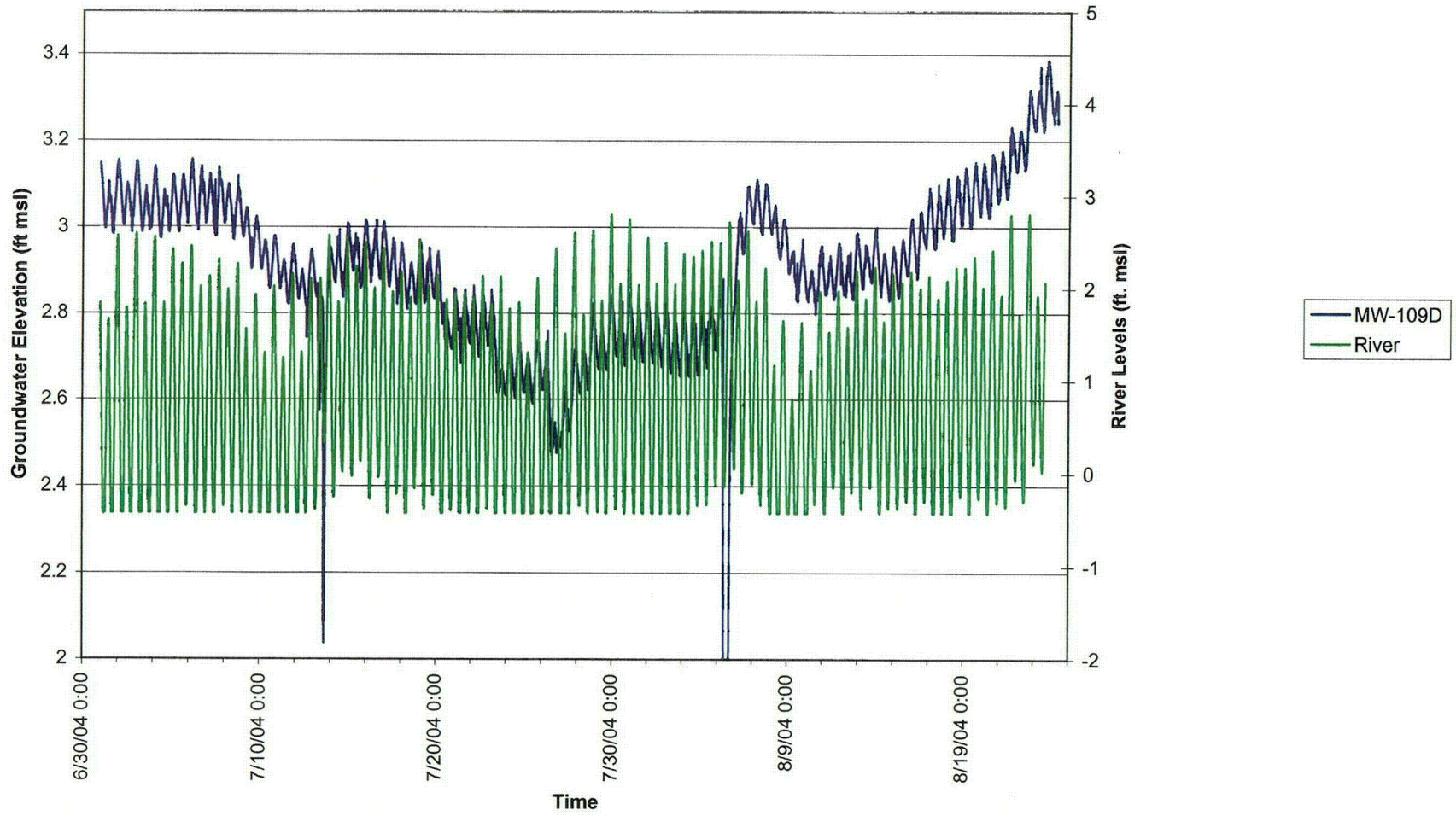
Detailed Area #2
Groundwater Elevation at MW109D
3rd Quarter



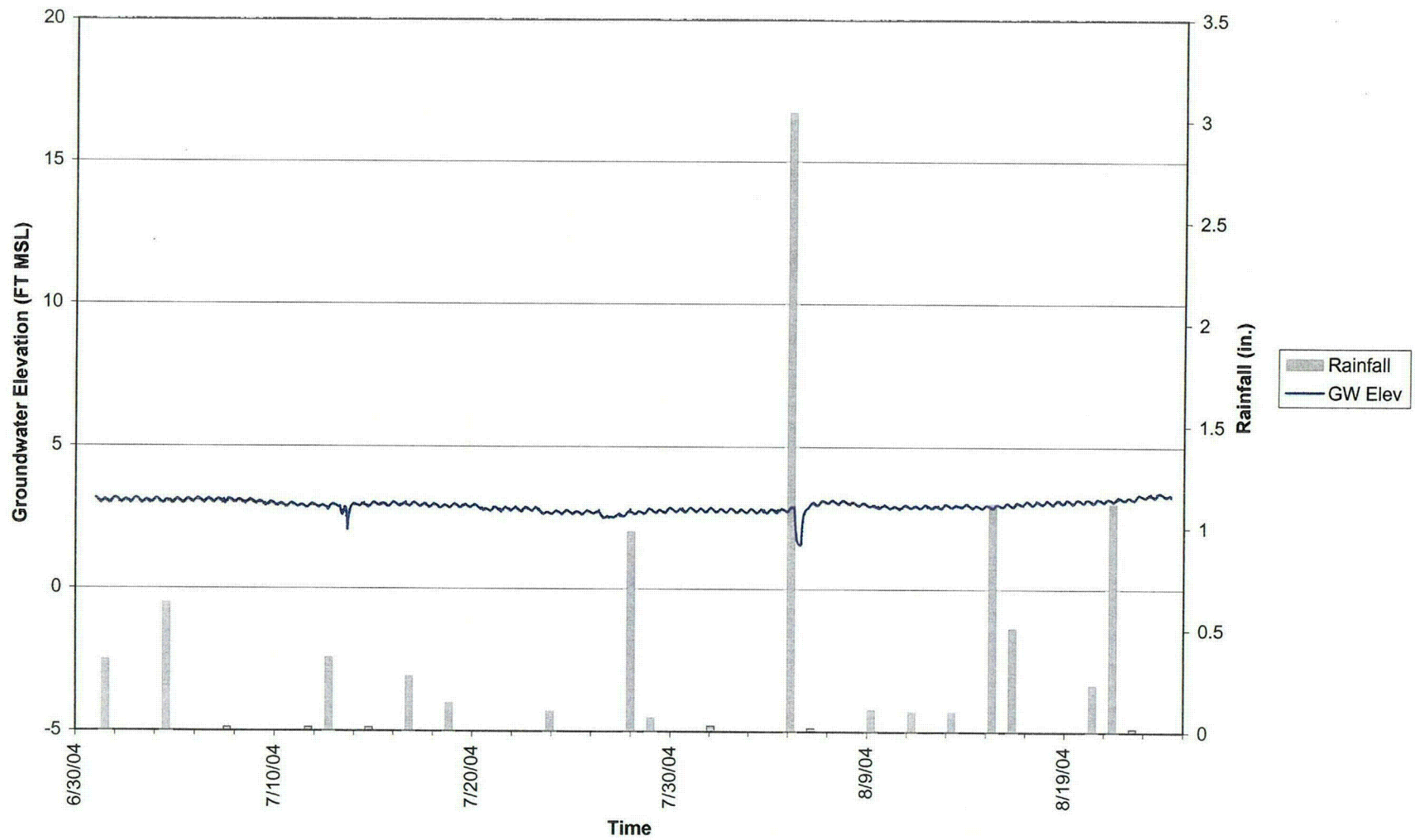
Detailed Area #3
Groundwater Elevation at MW109D
3rd Quarter



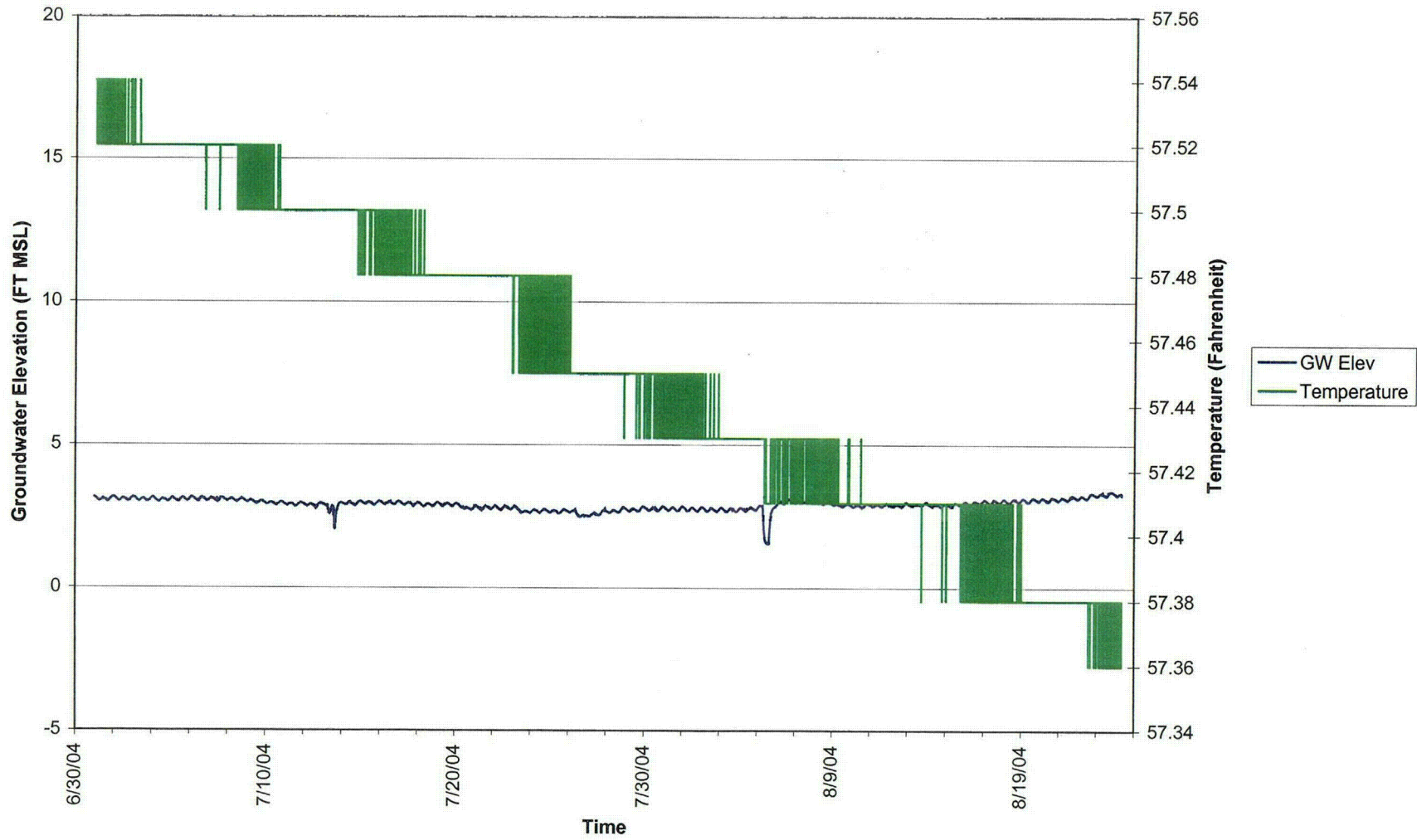
Groundwater Elevation at MW109D and River Levels
3rd Quarter



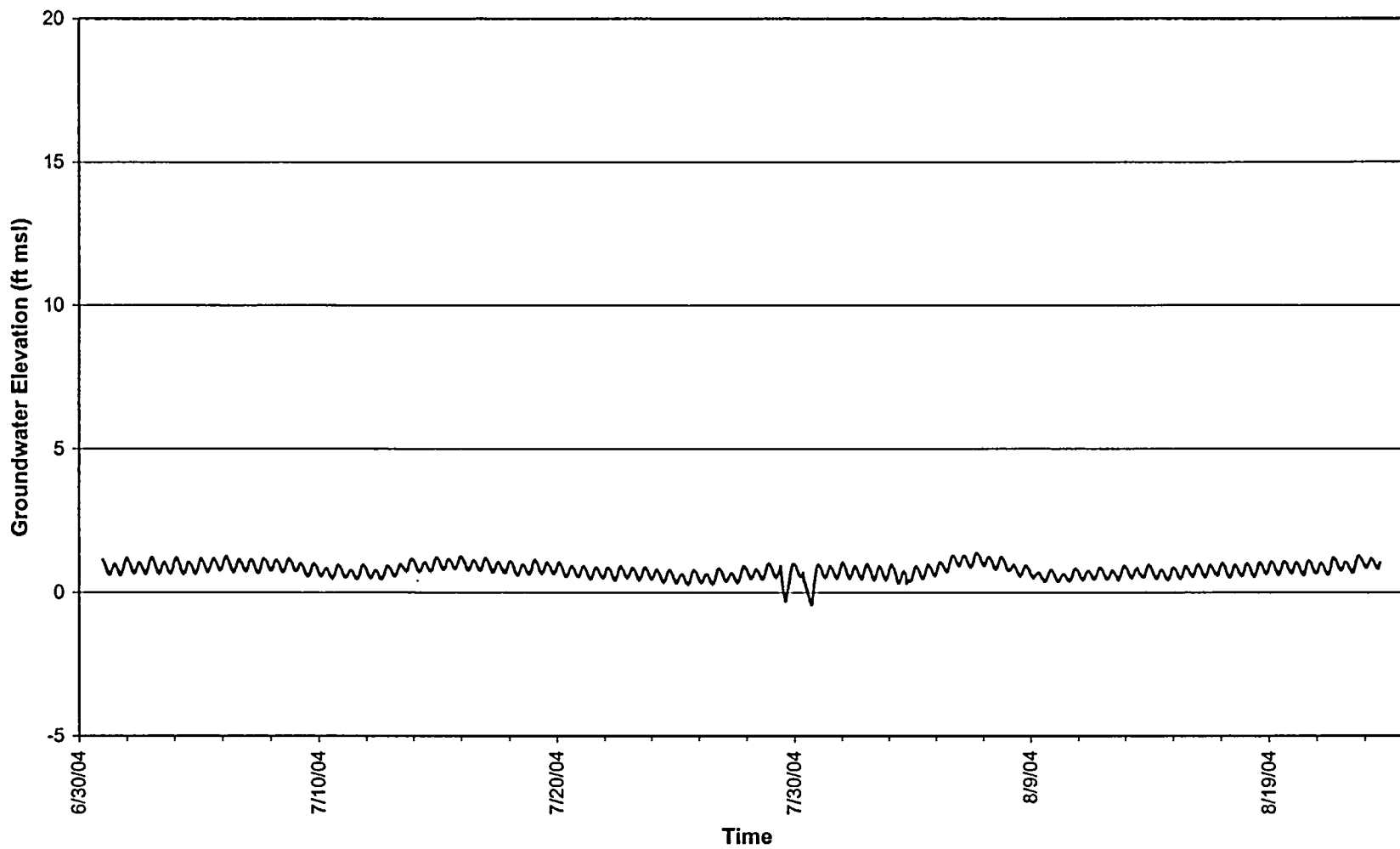
**MW-109D Groundwater Elevation and Daily Rainfall Totals
3rd Quarter**



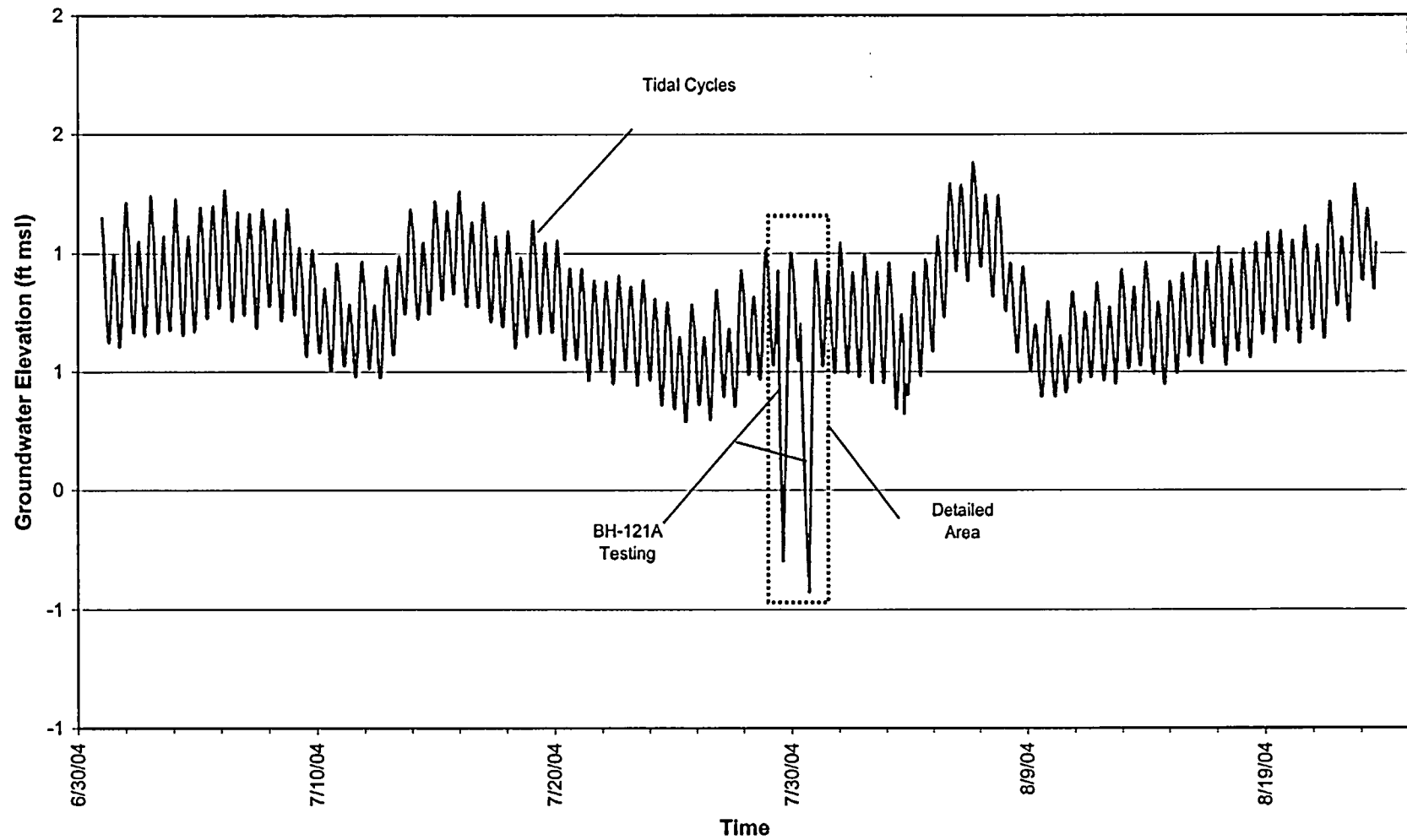
MW-109D Groundwater Elevation and Temperature
3rd Quarter



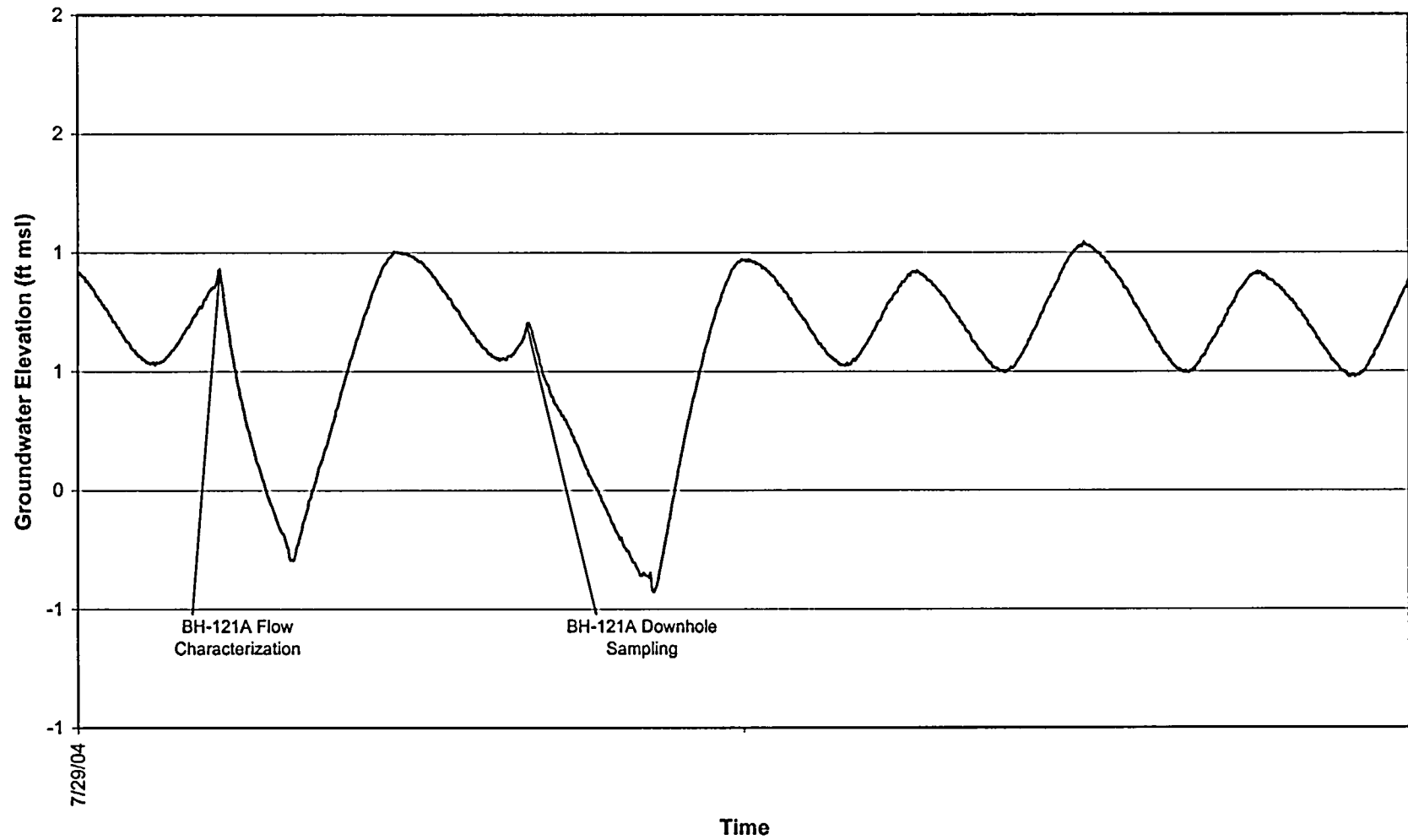
Groundwater Elevation at MW-110D
3rd Quarter



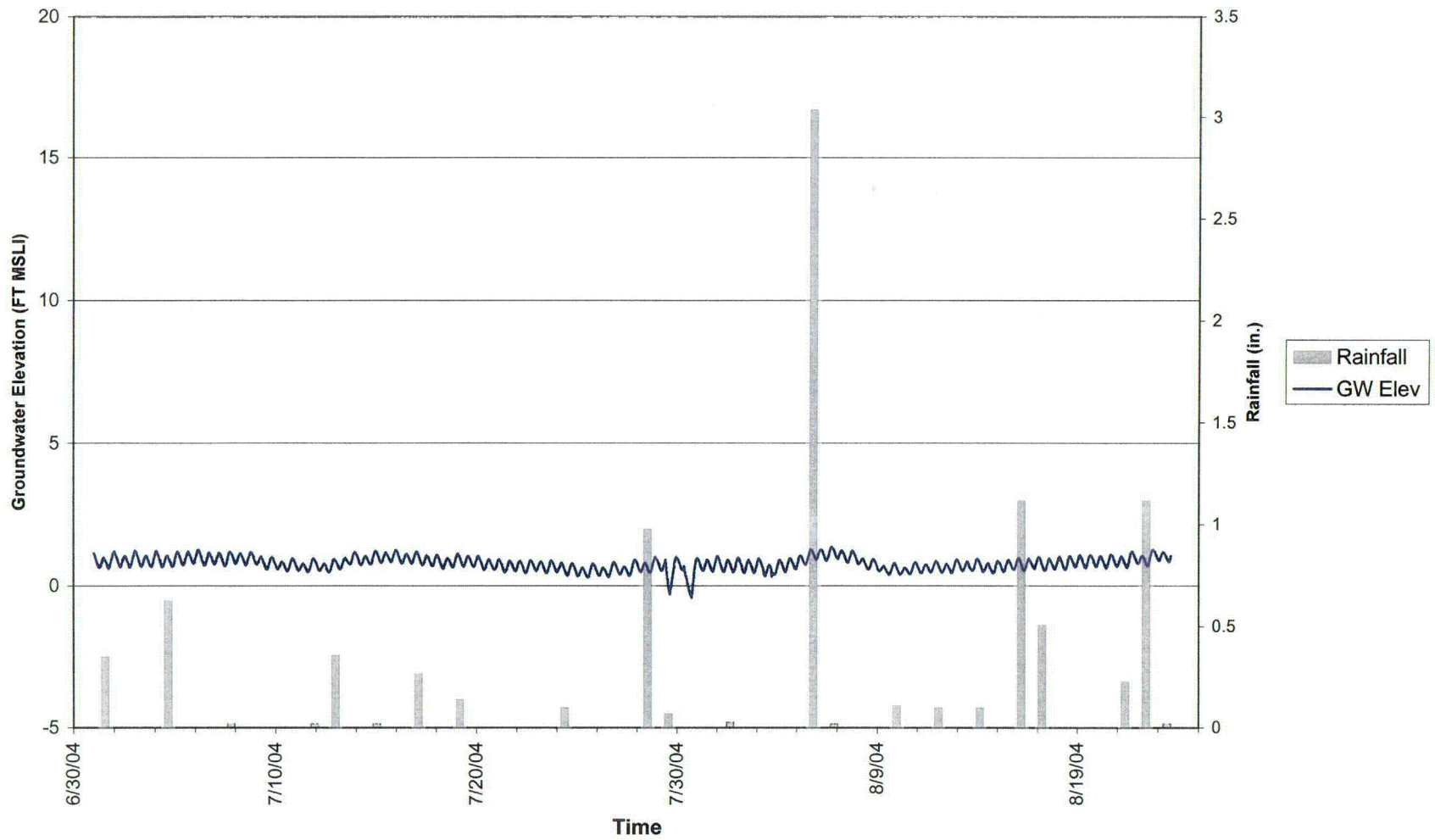
Groundwater Elevation at MW-110D 3rd Quarter



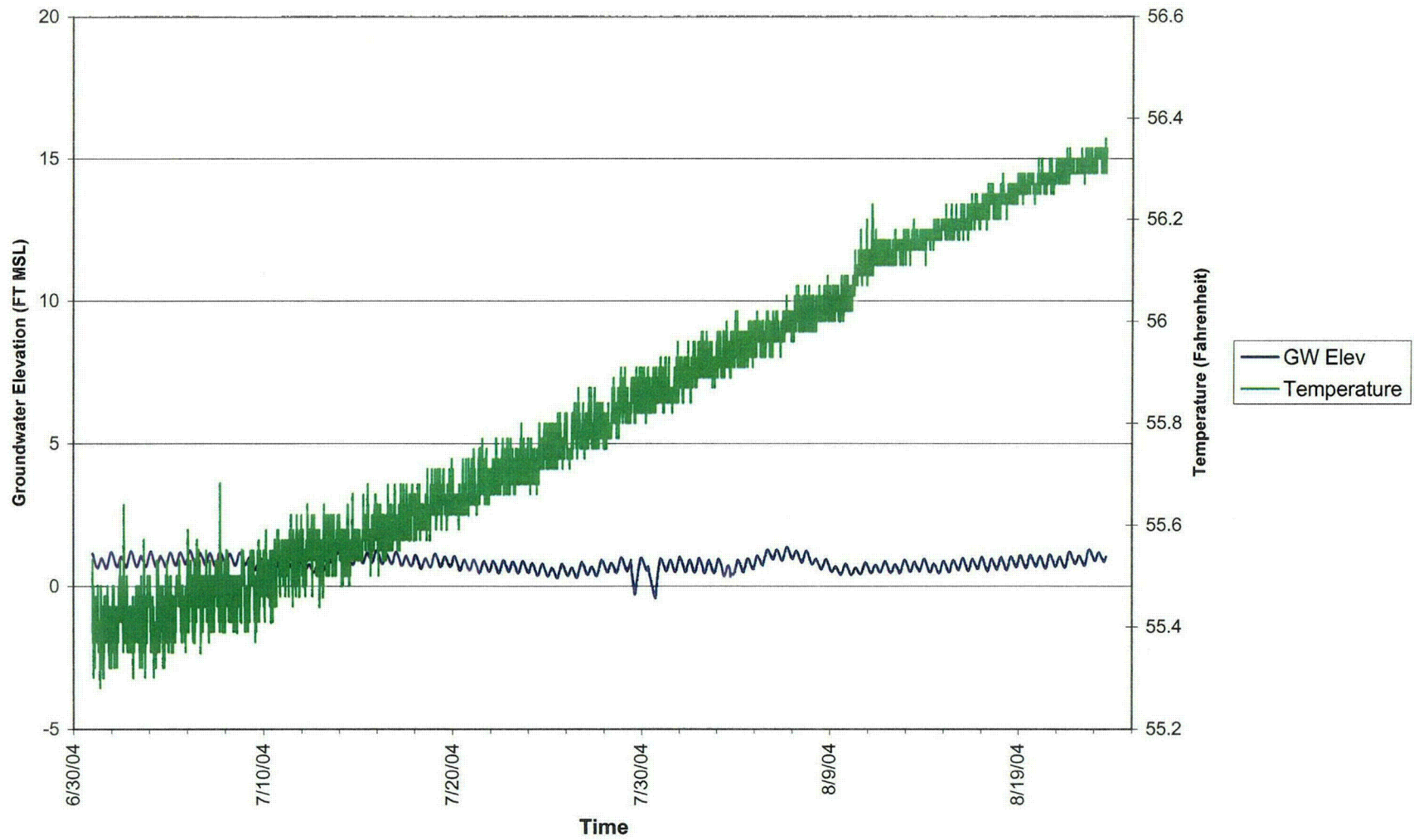
Groundwater Elevation at MW-110D
3rd Quarter



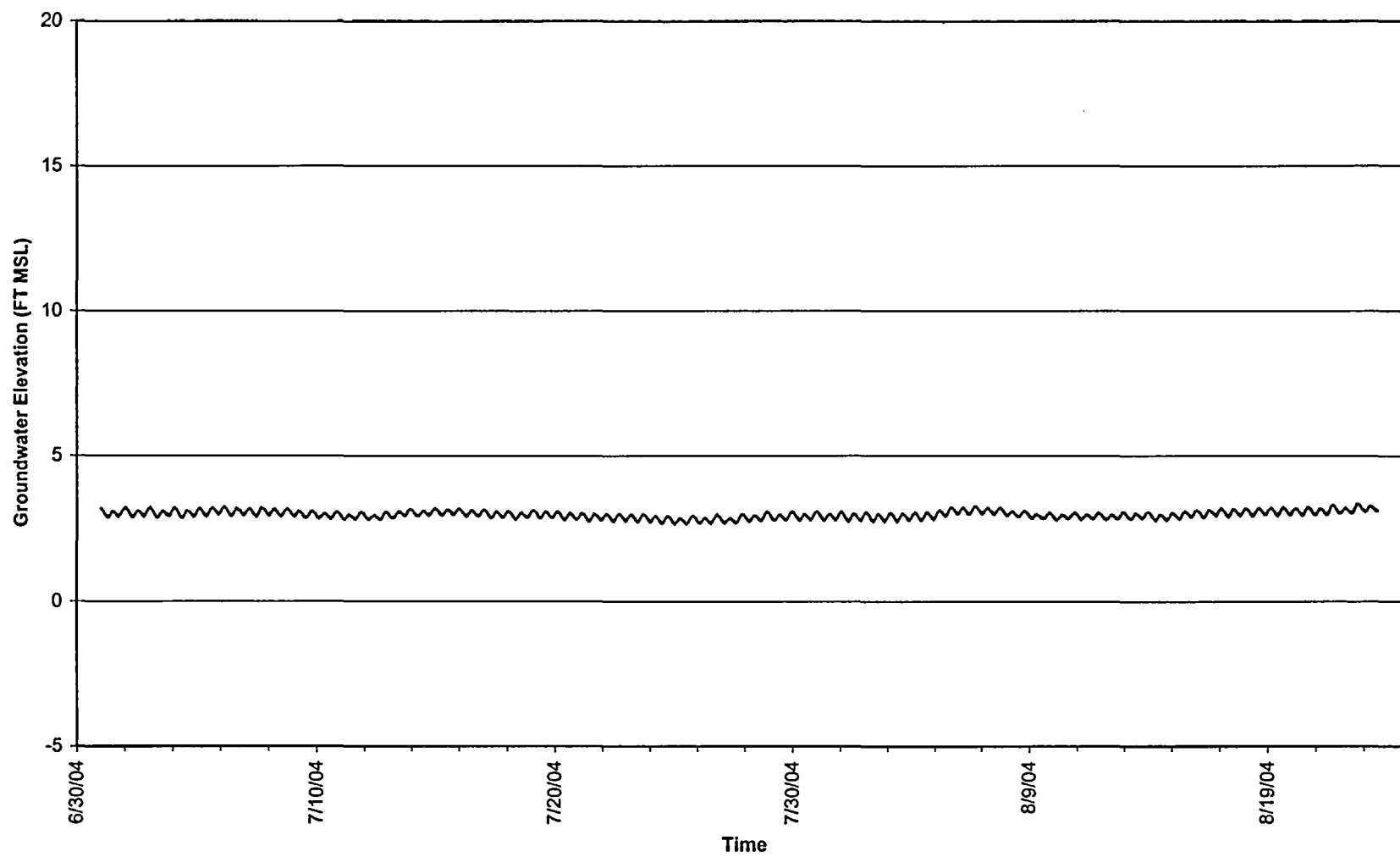
MW-110D Groundwater Elevation and Daily Rainfall Totals 3rd Quarter



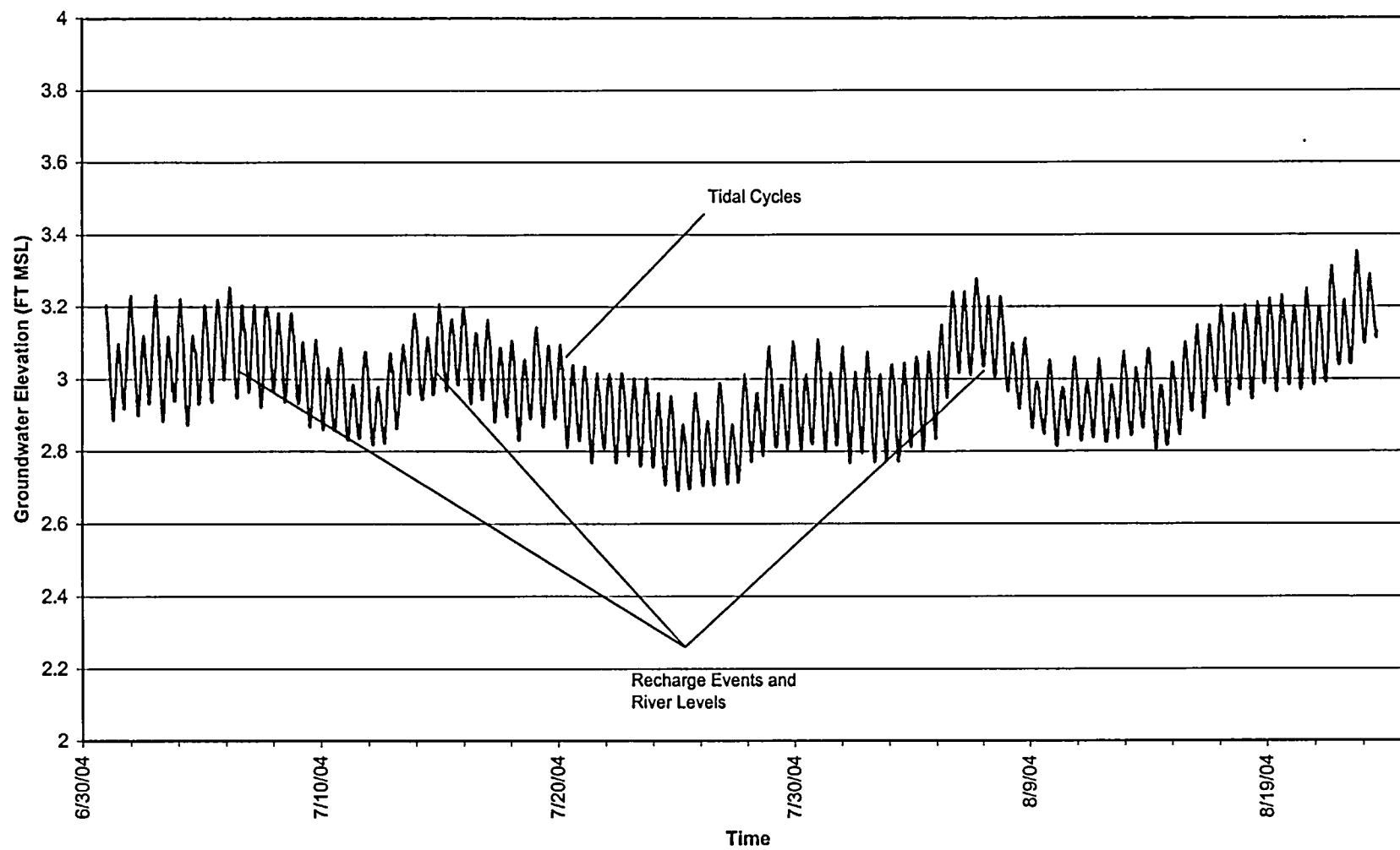
MW-110D Groundwater Elevation and Temperature
3rd Quarter



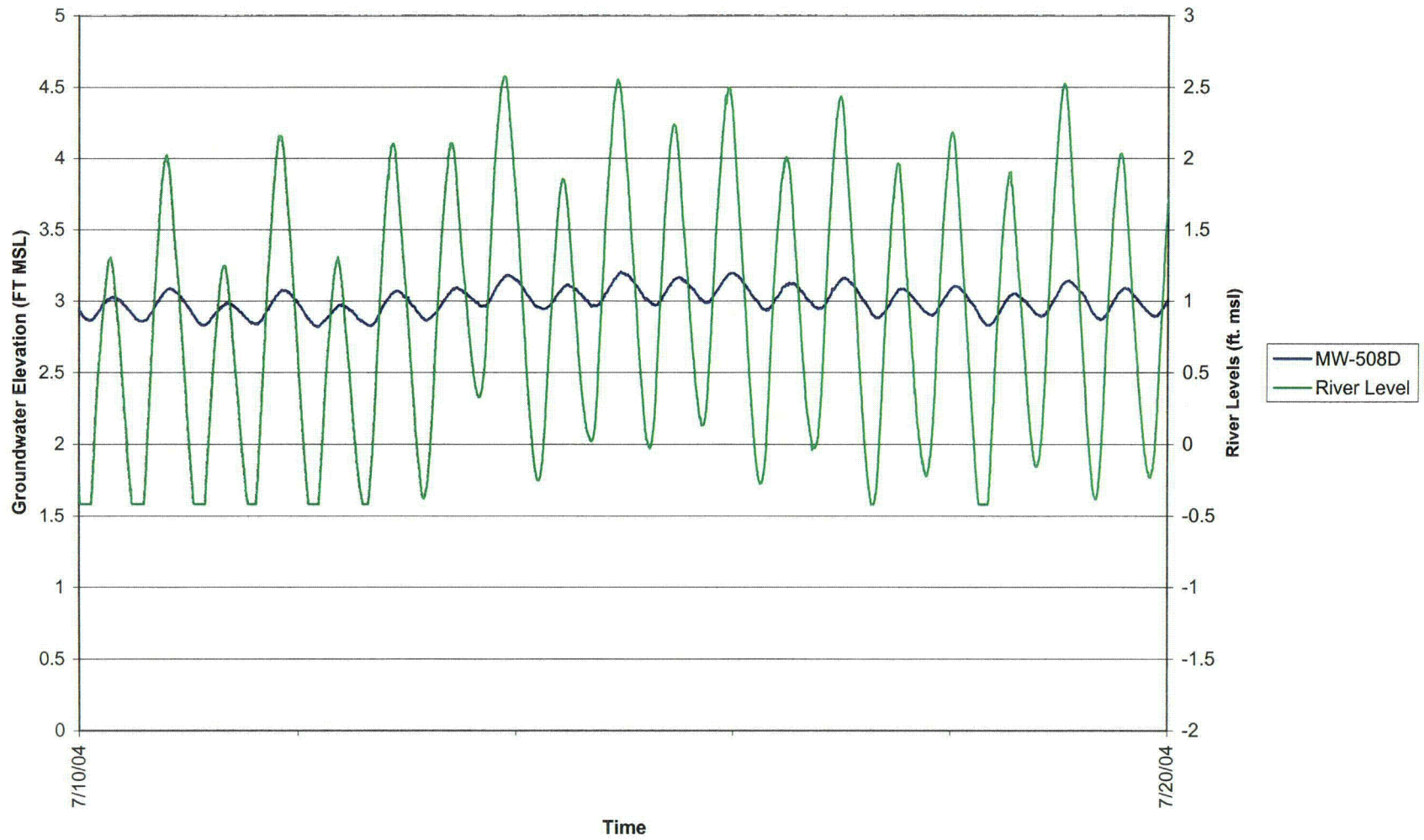
Groundwater Elevation at MW-508D
3rd Quarter



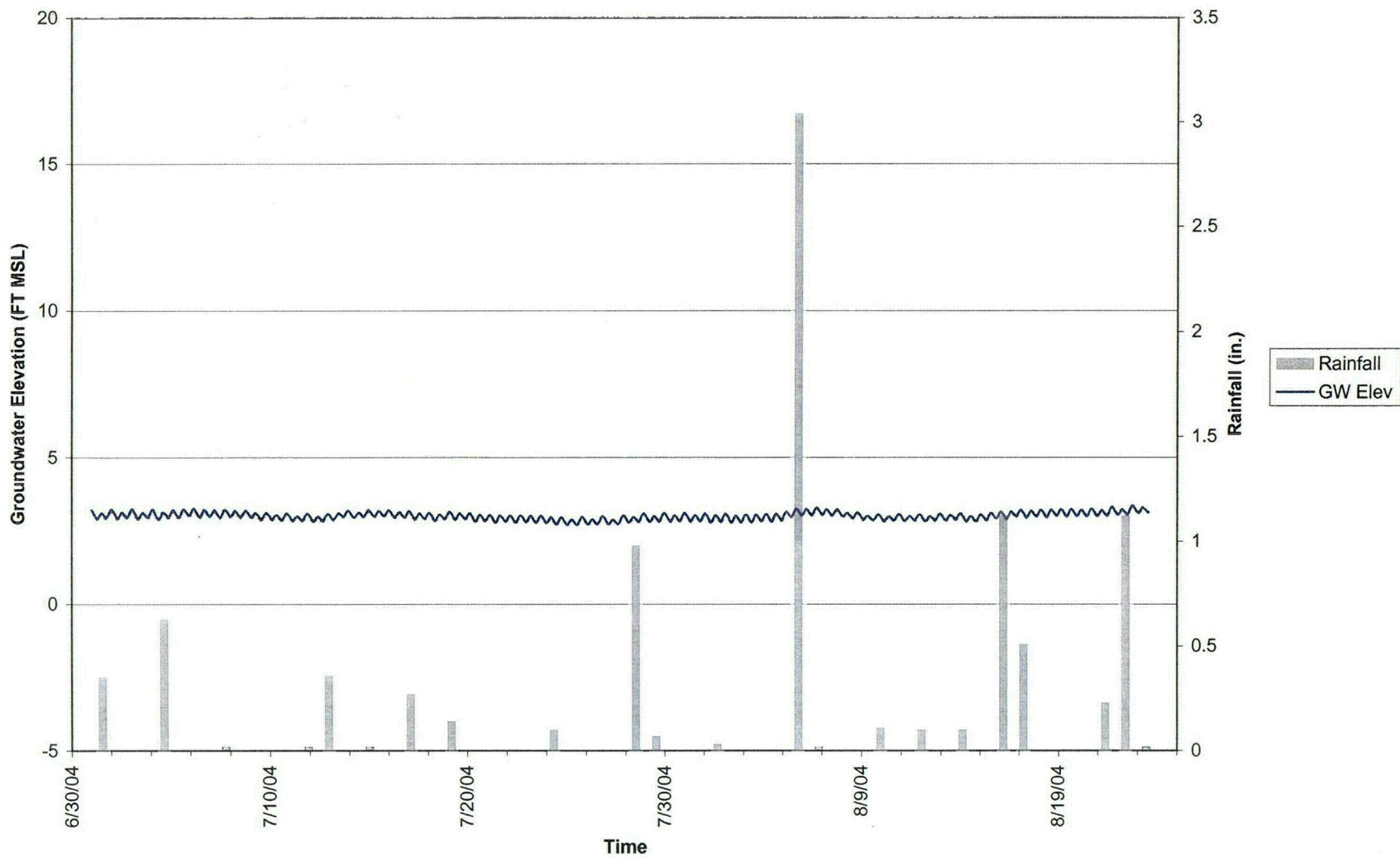
Groundwater Elevation at MW-508D
3rd Quarter



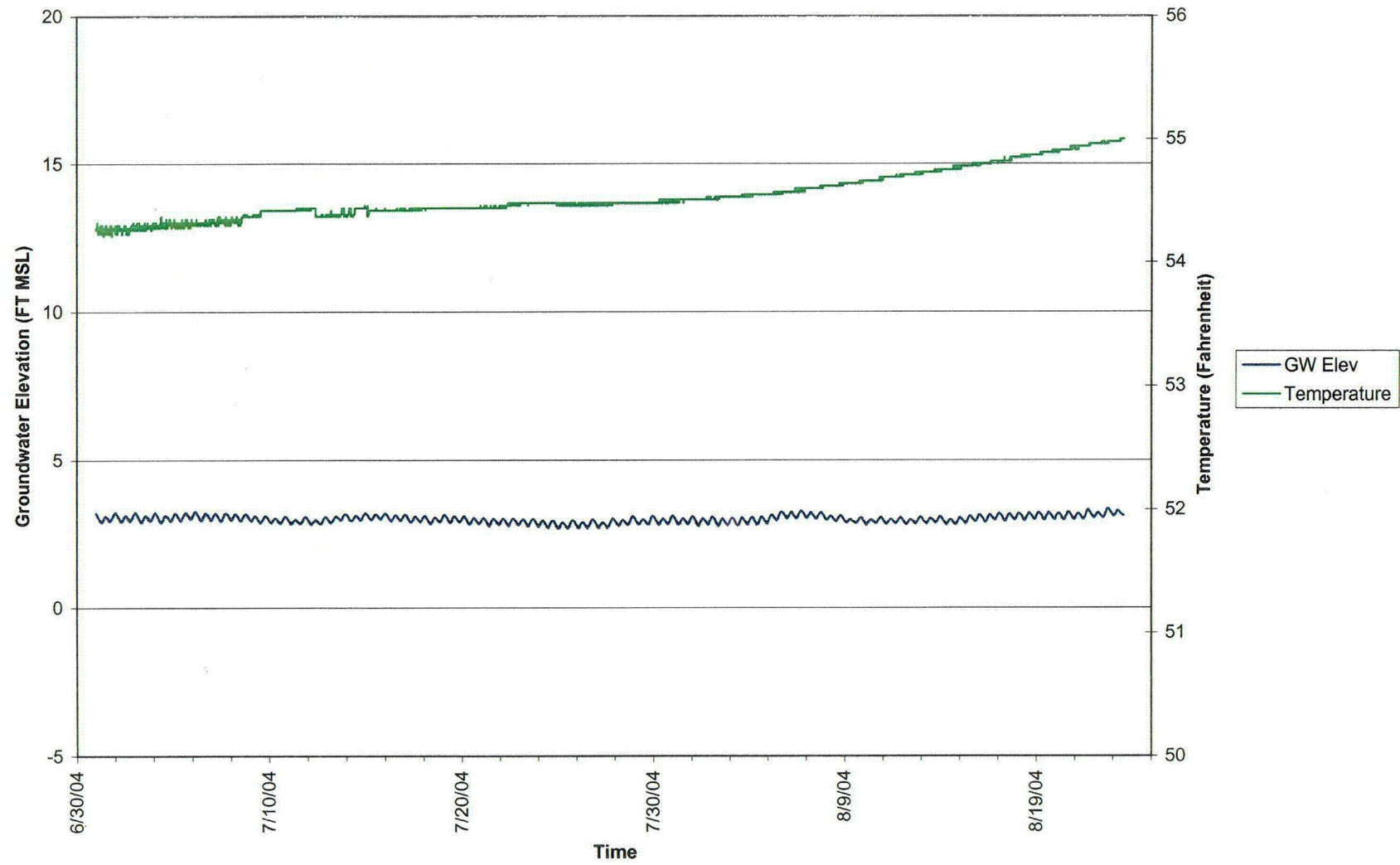
Groundwater Elevation at MW-508D and River Levels
3rd Quarter



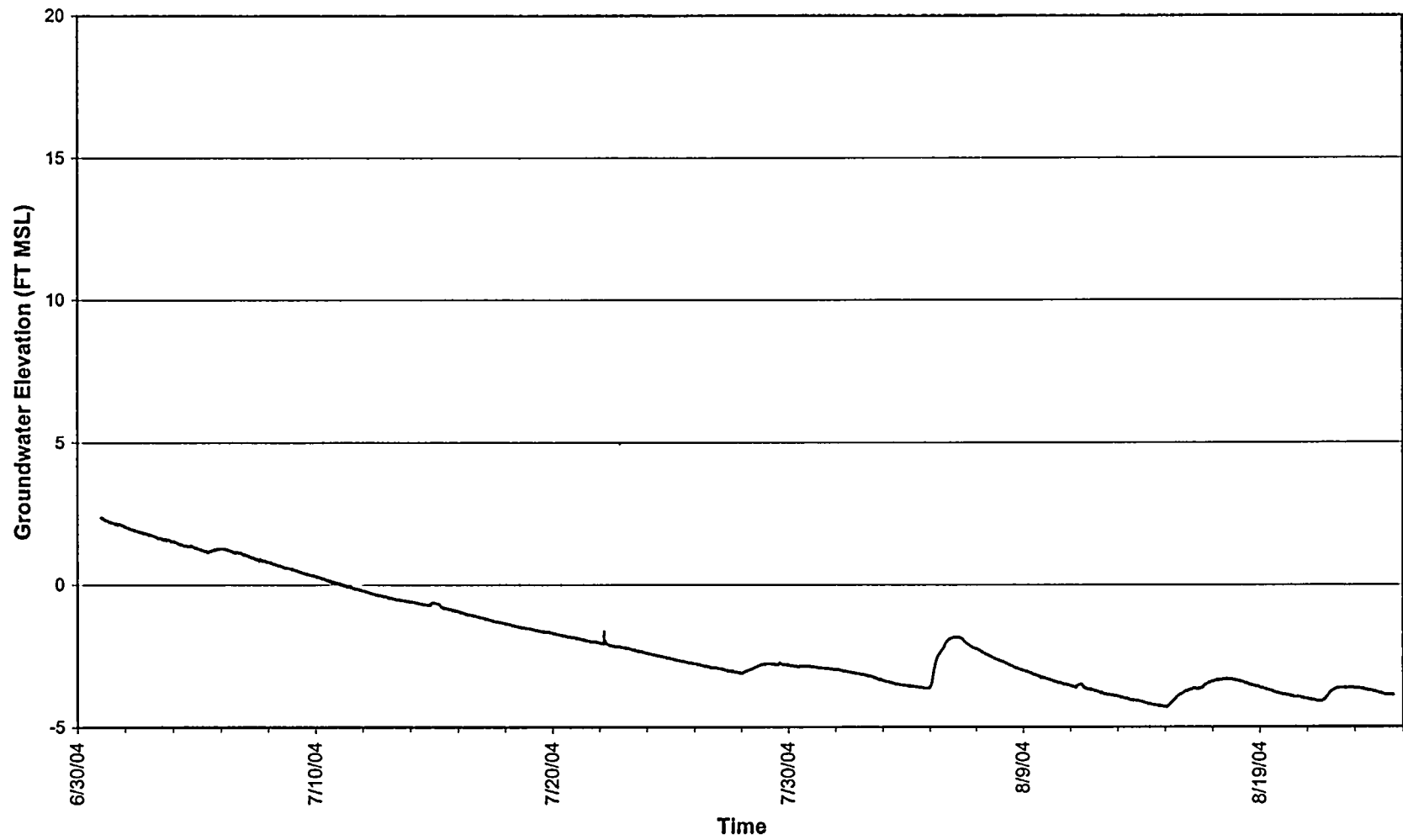
MW-508D Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



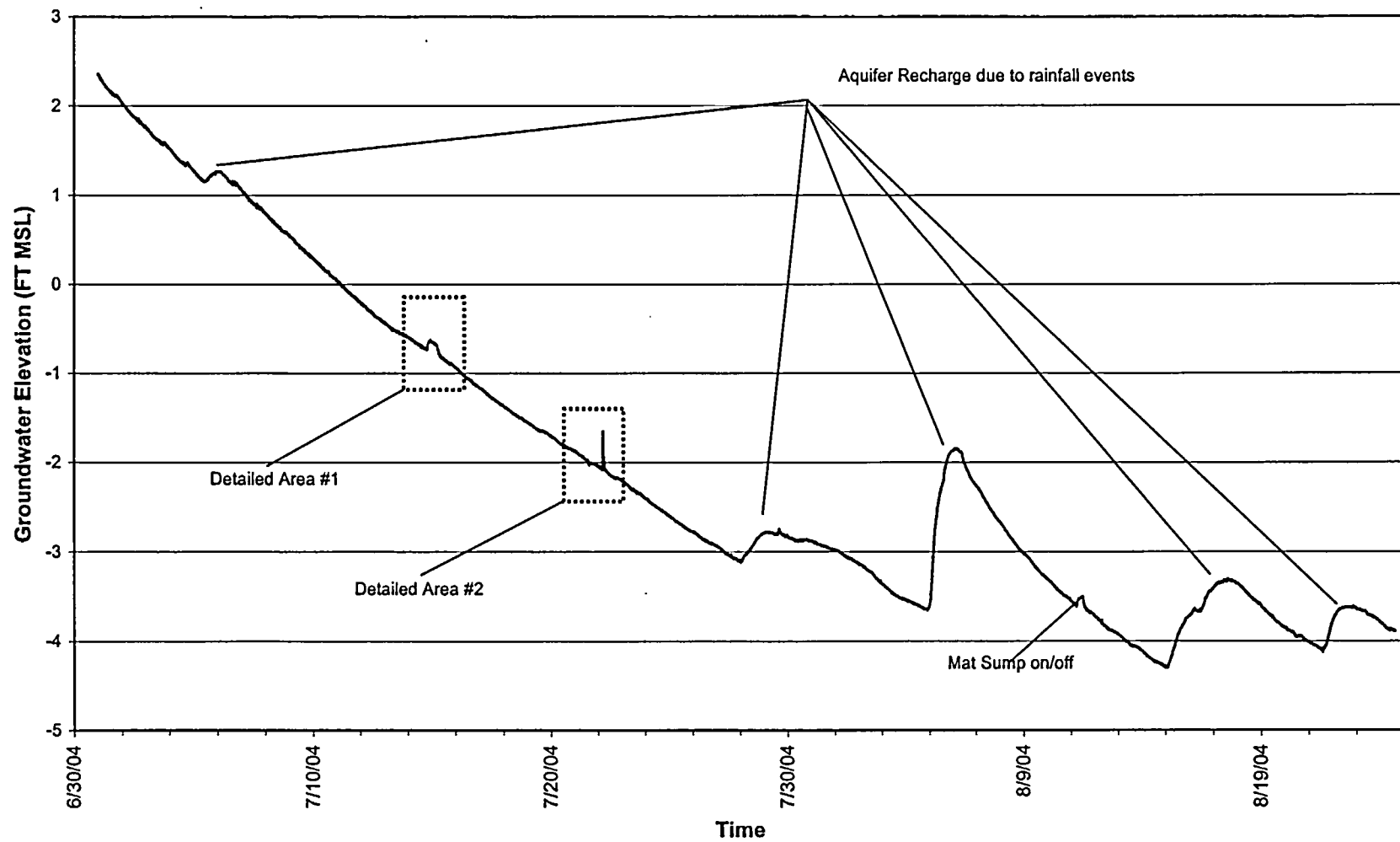
MW-508D Groundwater Elevation and Temperature
3rd Quarter



Groundwater Elevation at MW-101D
3rd Quarter



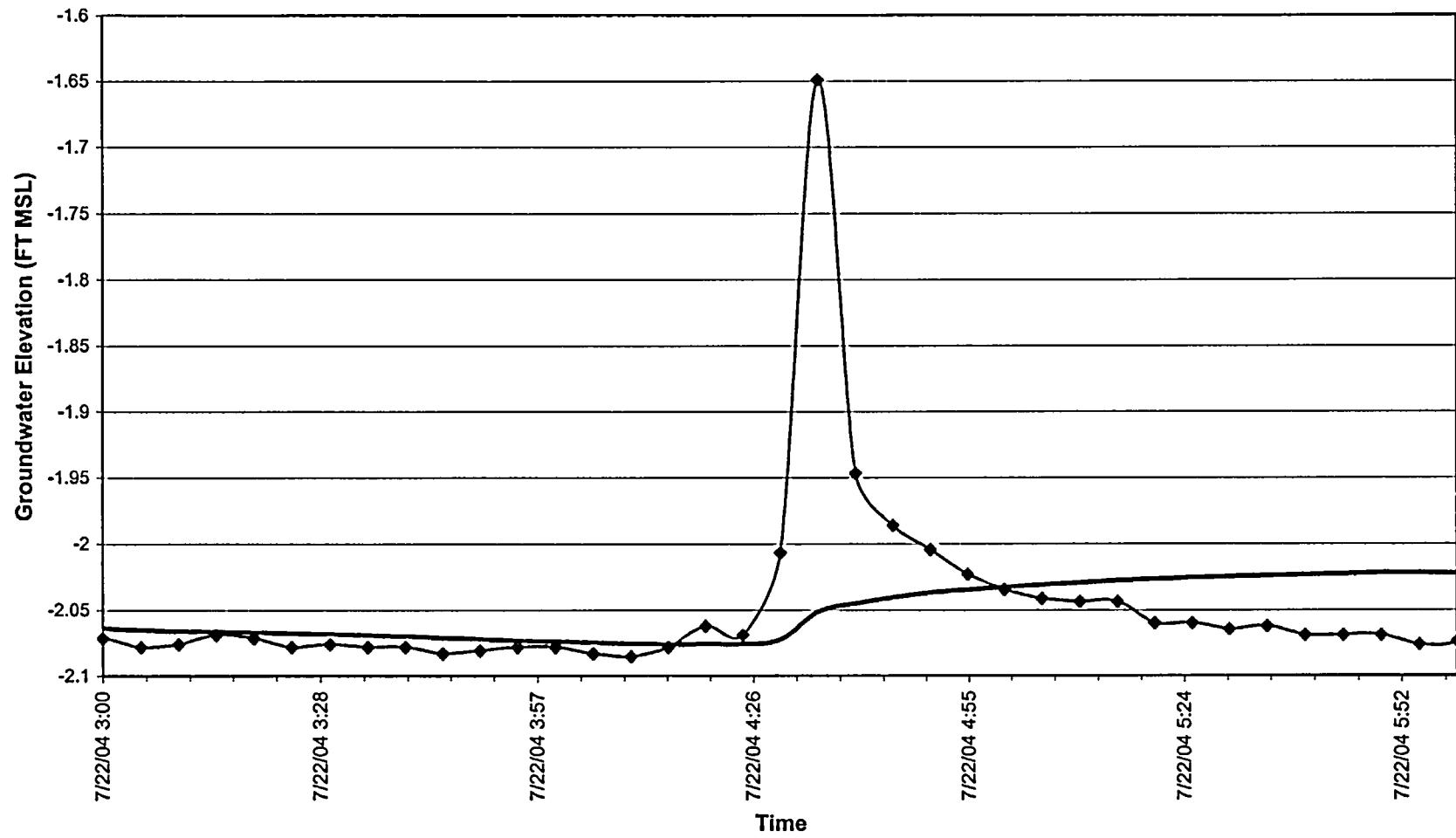
Groundwater Elevation at MW-101D 3rd Quarter



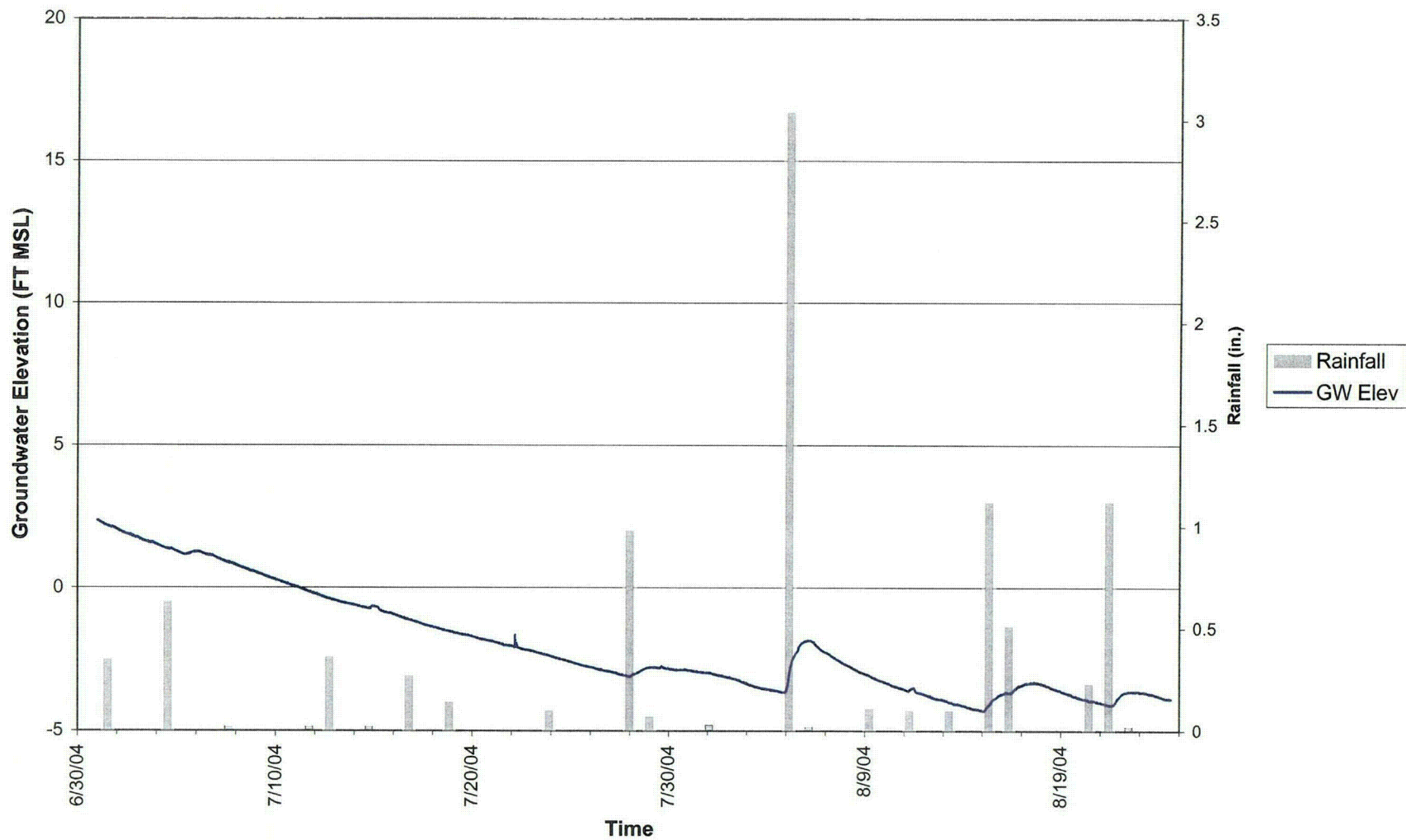
Detailed Area #2
Groundwater Elevation at MW-101D
3rd Quarter



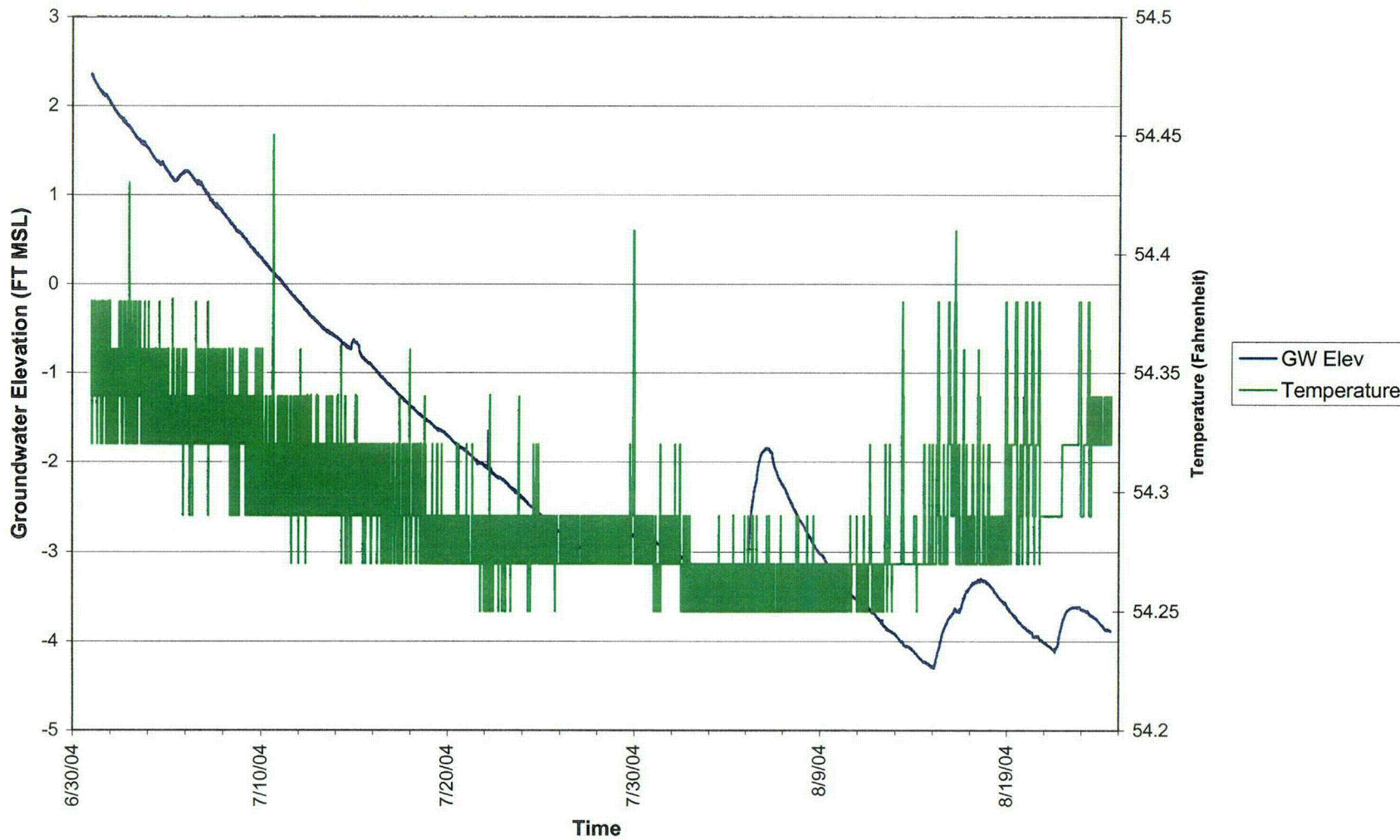
Detailed Area #2
Groundwater Elevation at MW-101D
3rd Quarter



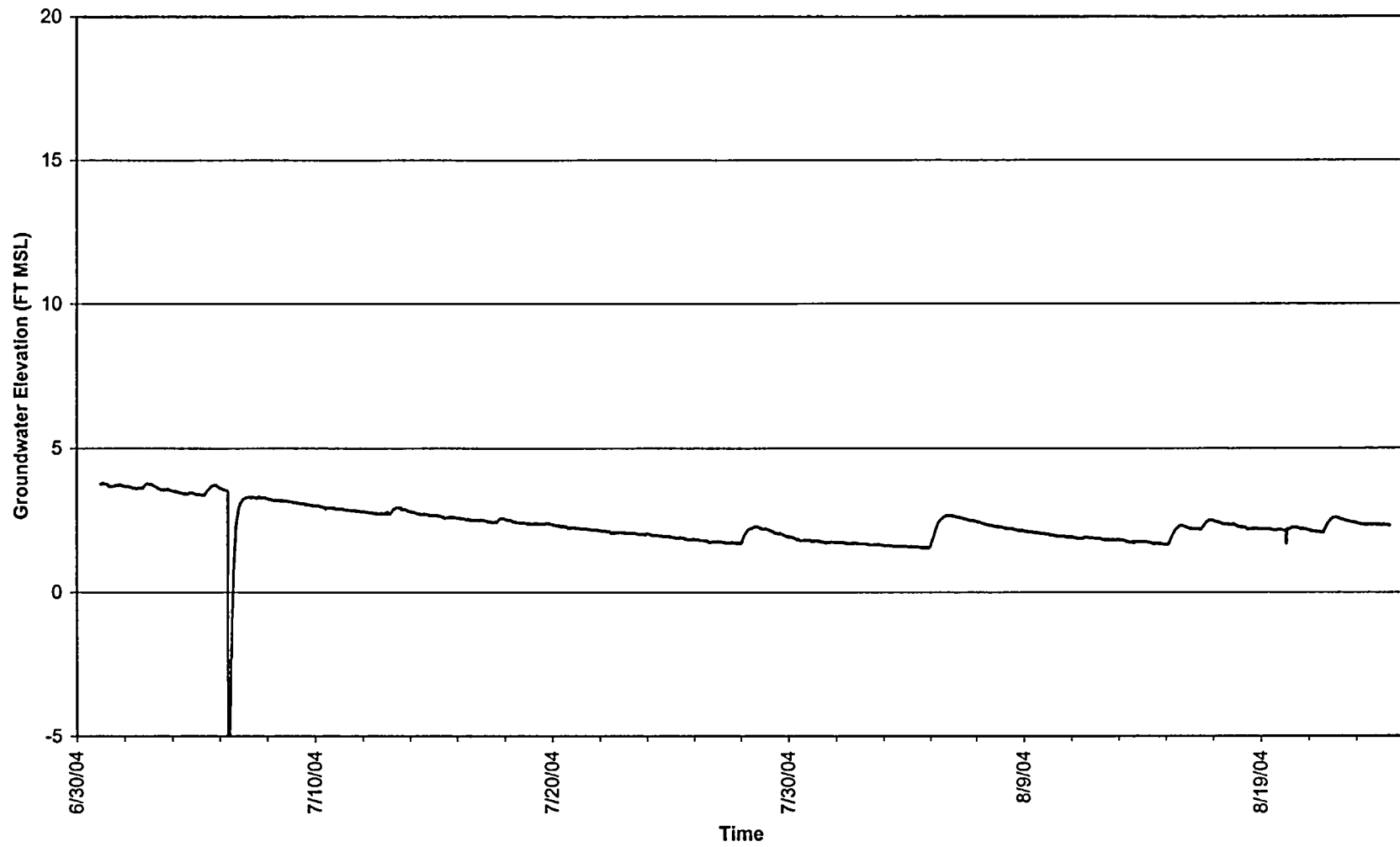
MW-101D Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



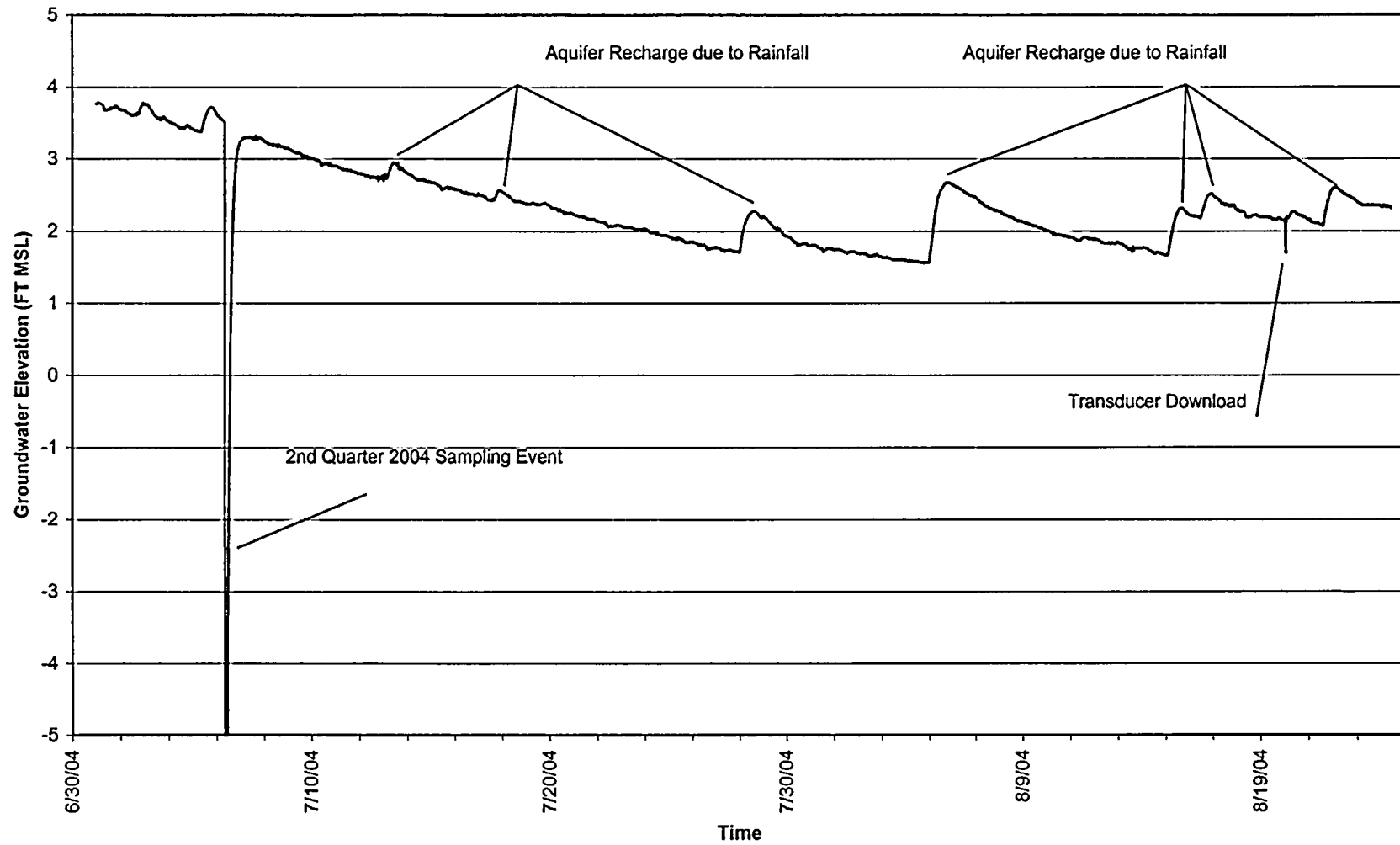
MW-101D Groundwater Elevation and Temperature
3rd Quarter



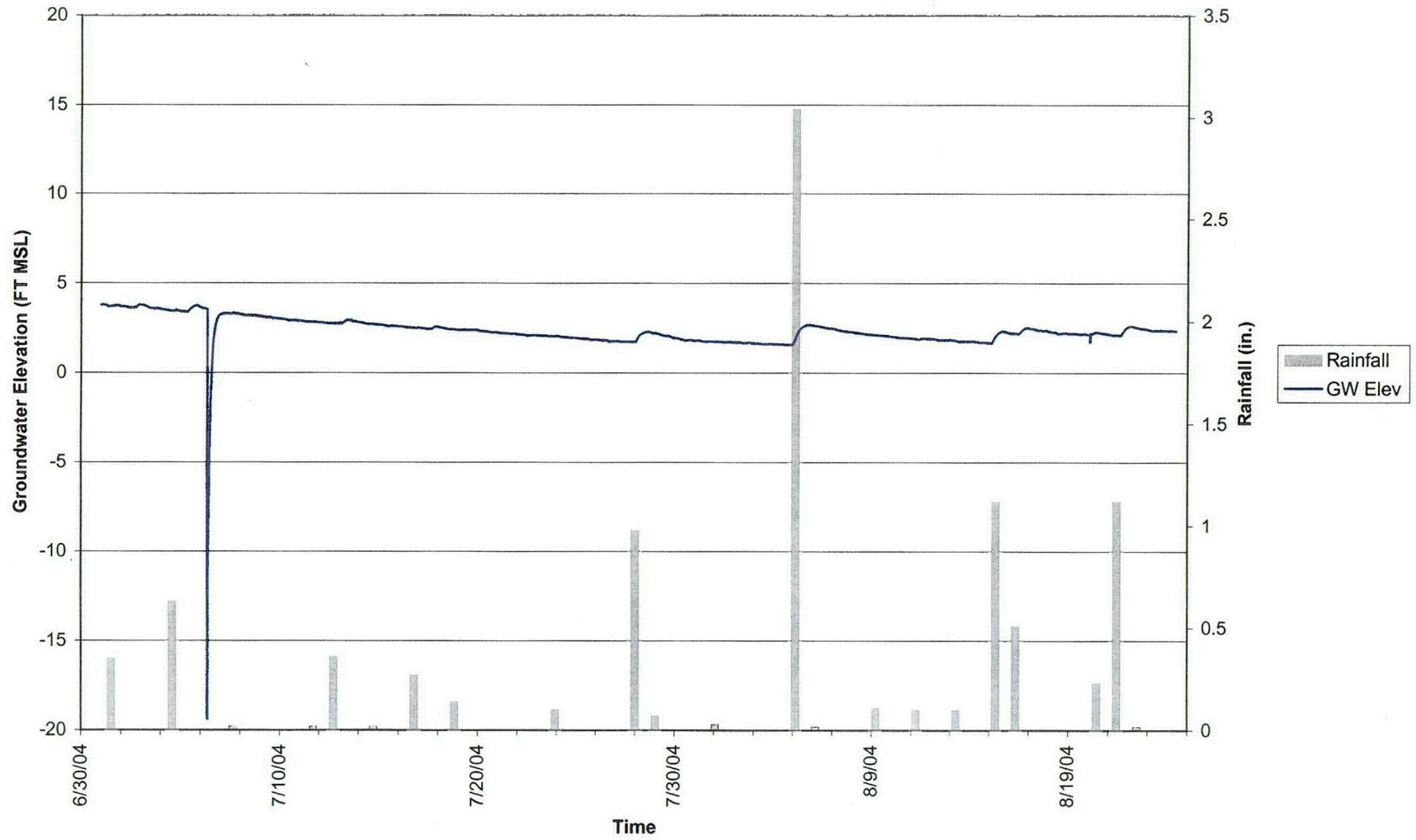
Groundwater Elevation at MW-102D
3rd Quarter



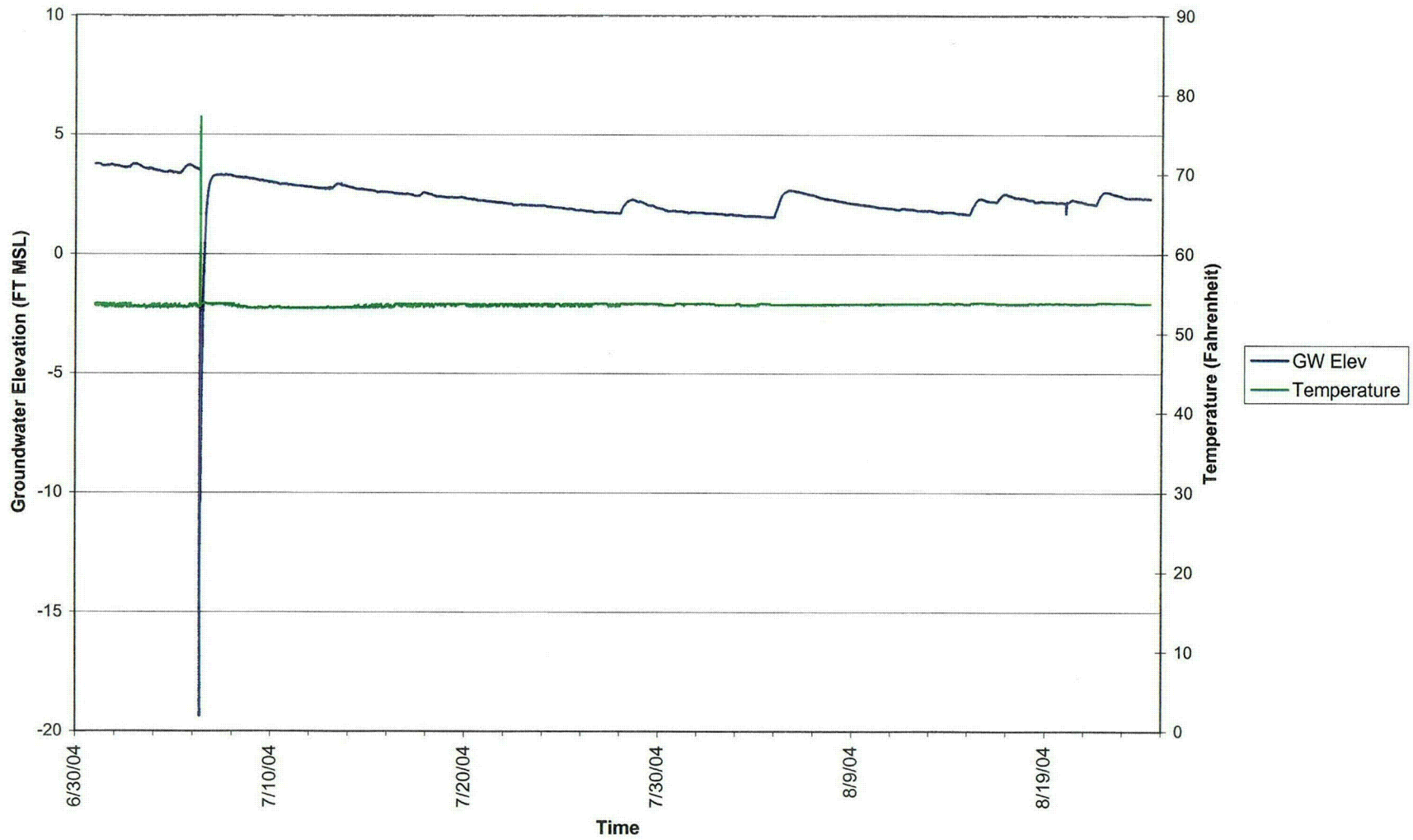
Groundwater Elevation at MW-102D
3rd Quarter



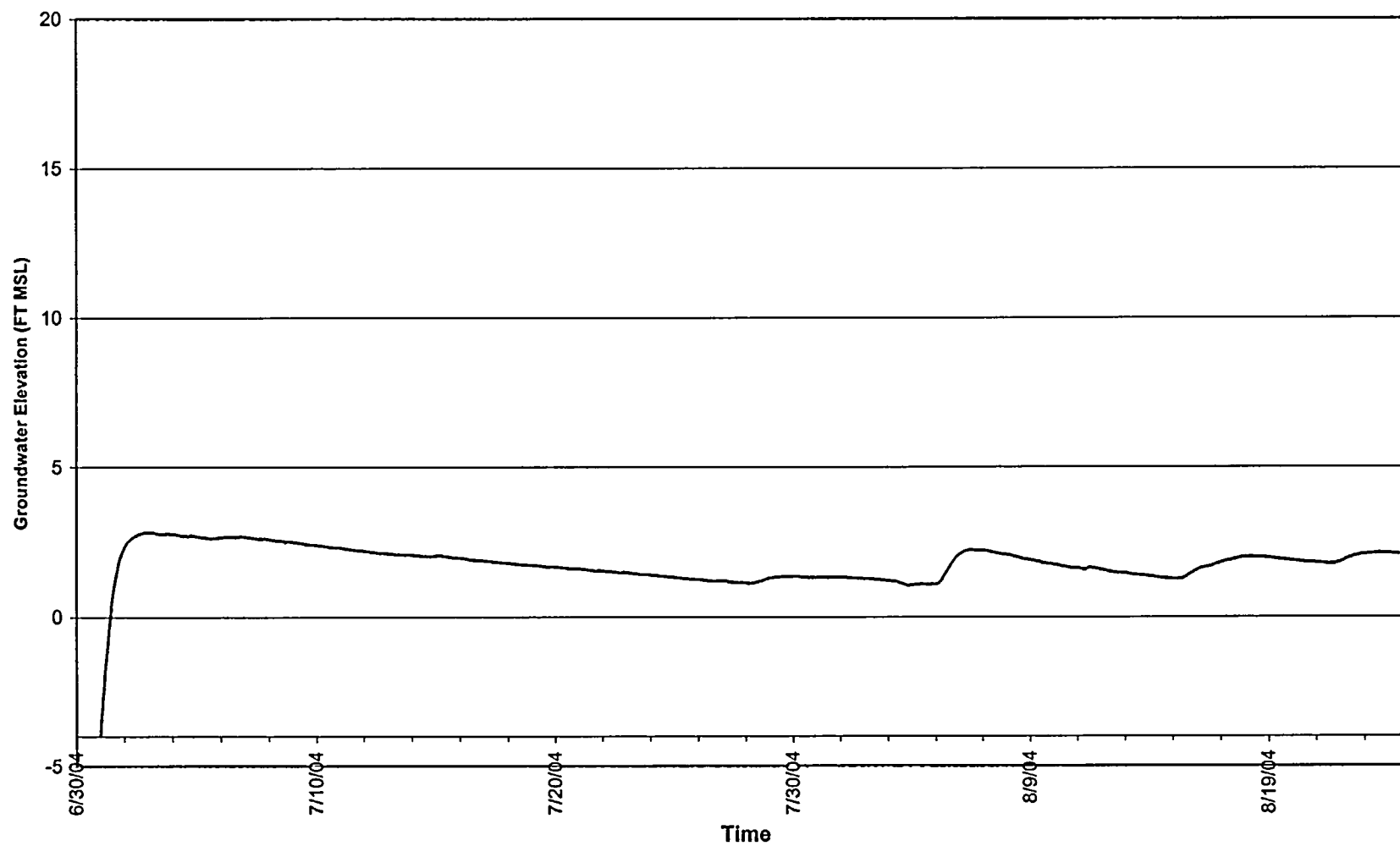
MW-102D Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



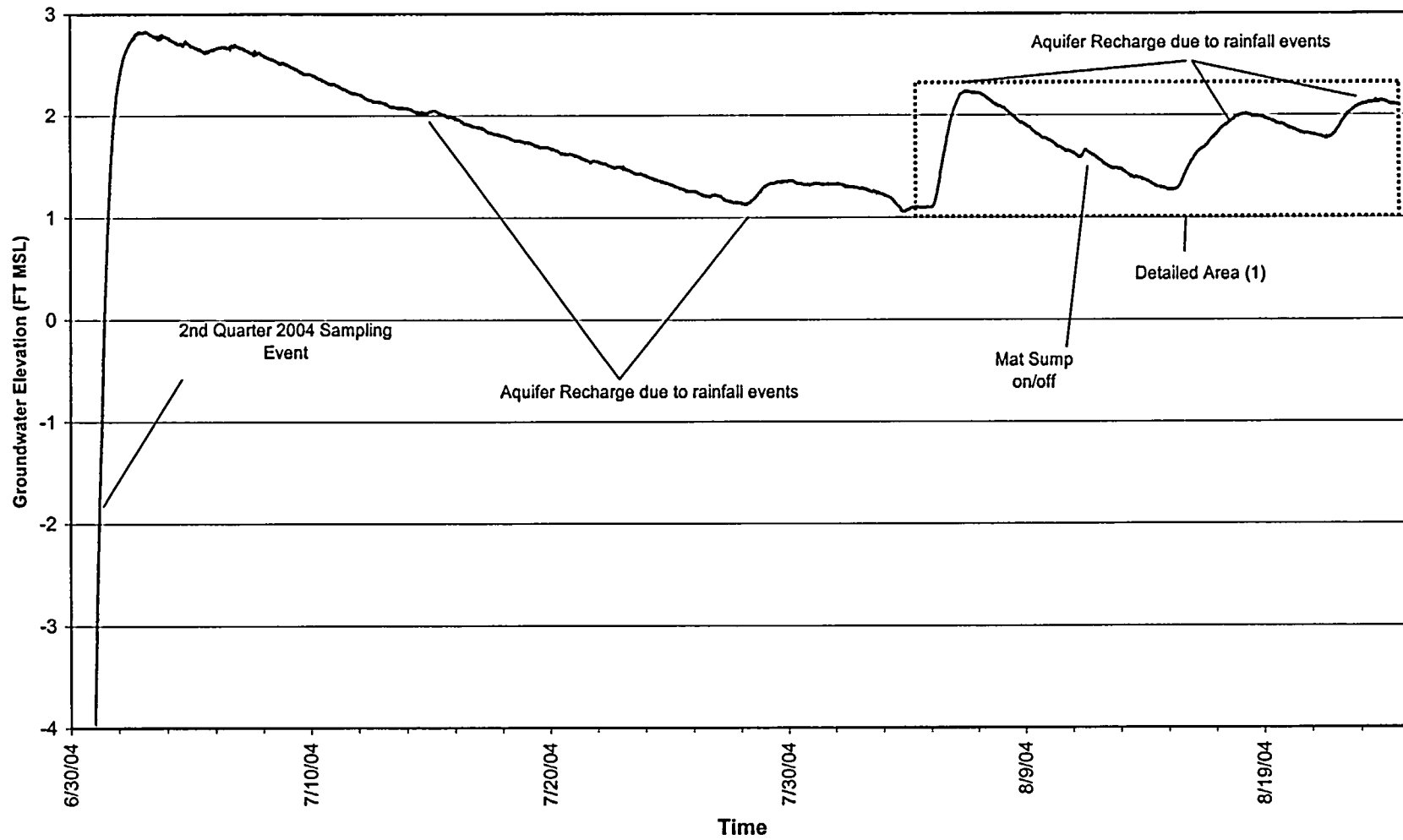
MW-102D Groundwater Elevation and Temperature
3rd Quarter



Groundwater Elevation at MW-103D
3rd Quarter



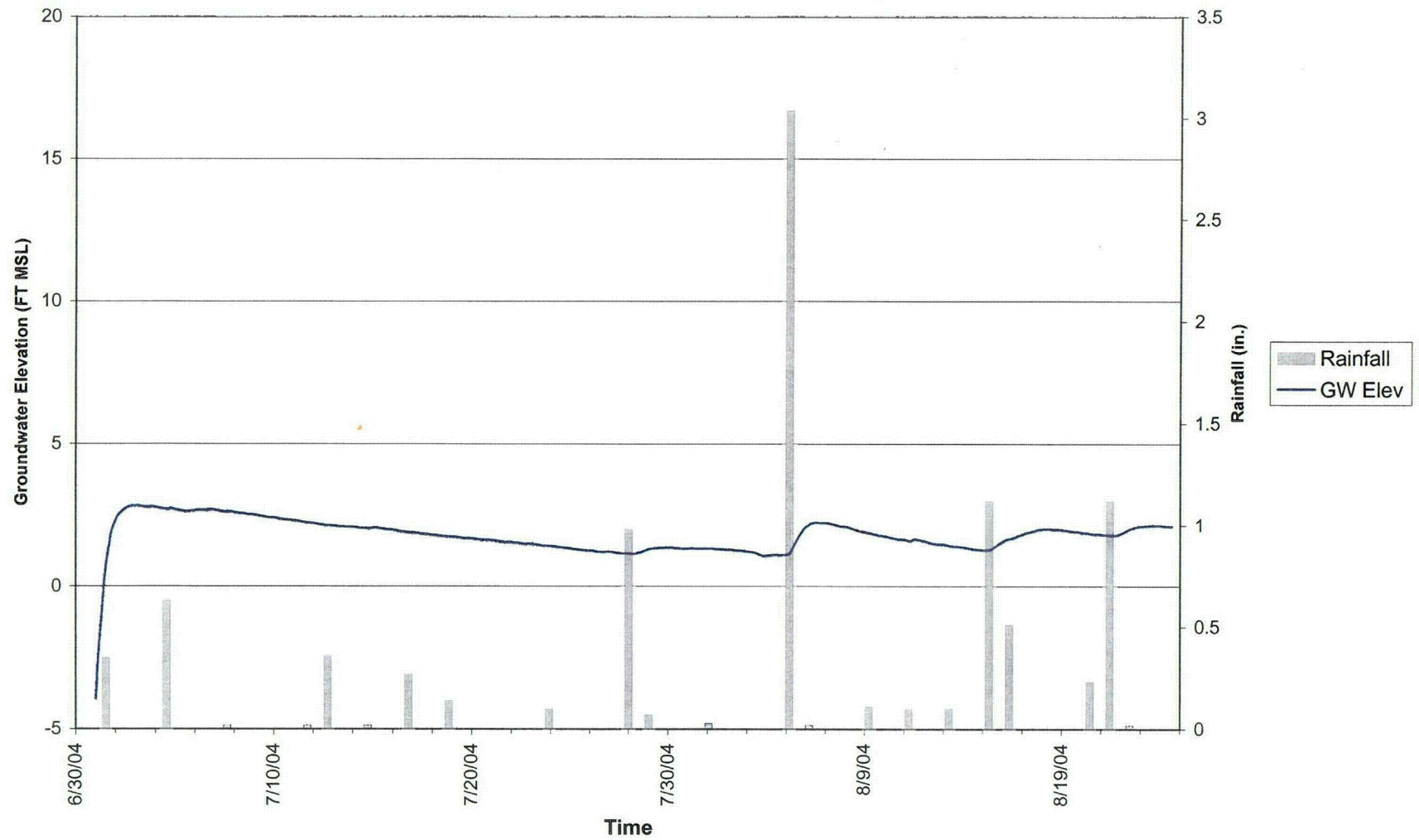
Groundwater Elevation at MW-103D 3rd Quarter



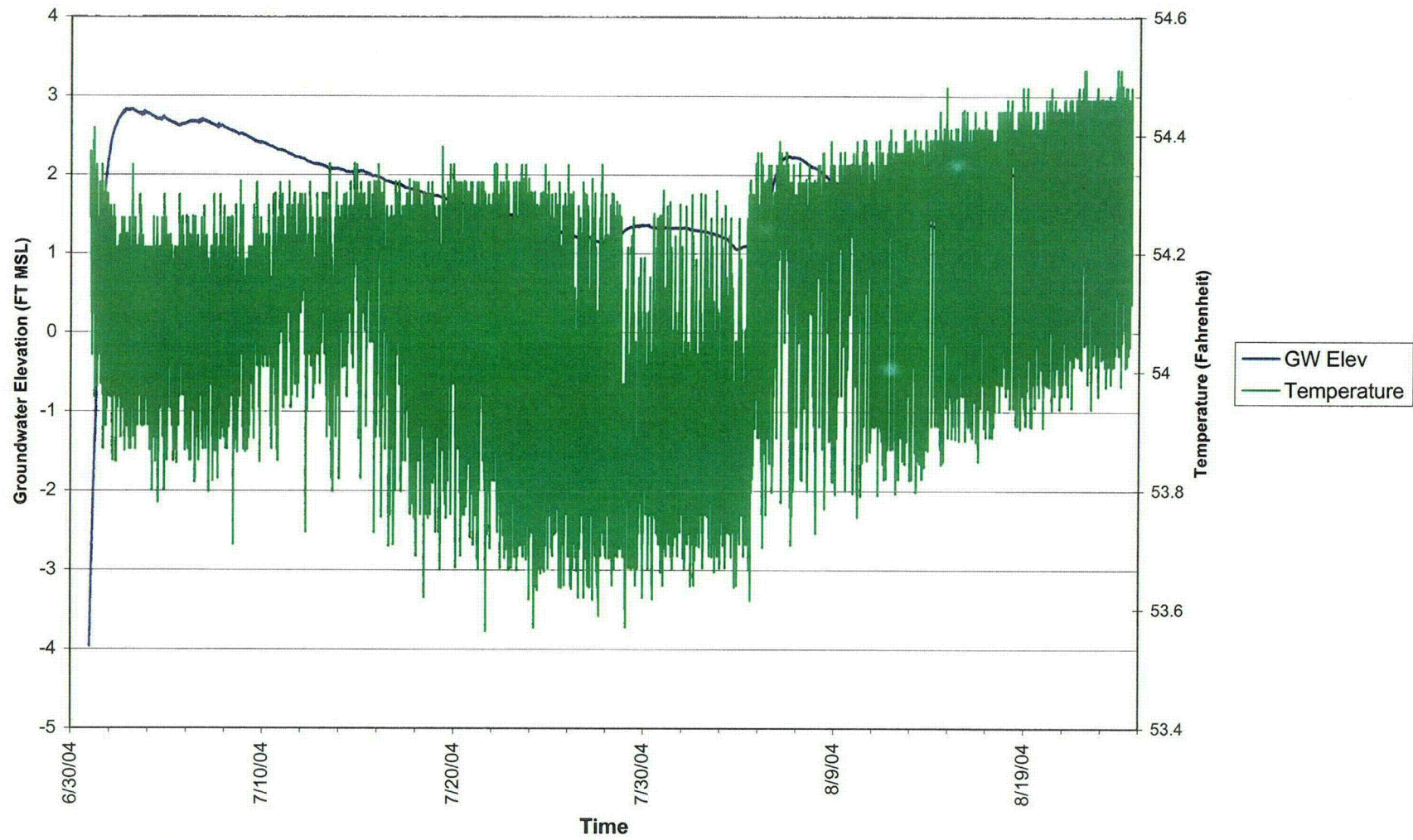
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3rd Quarter



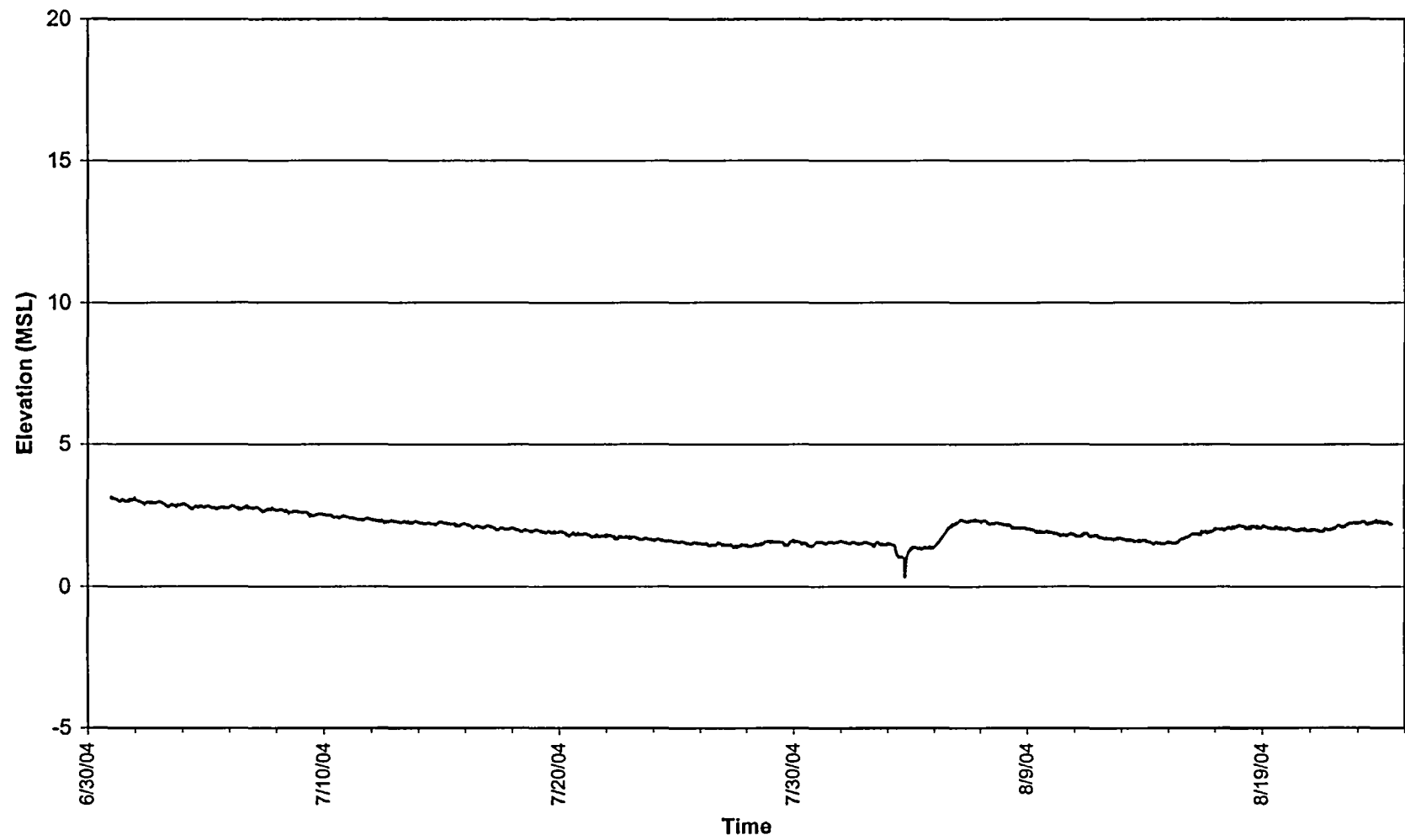
MW-103D Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



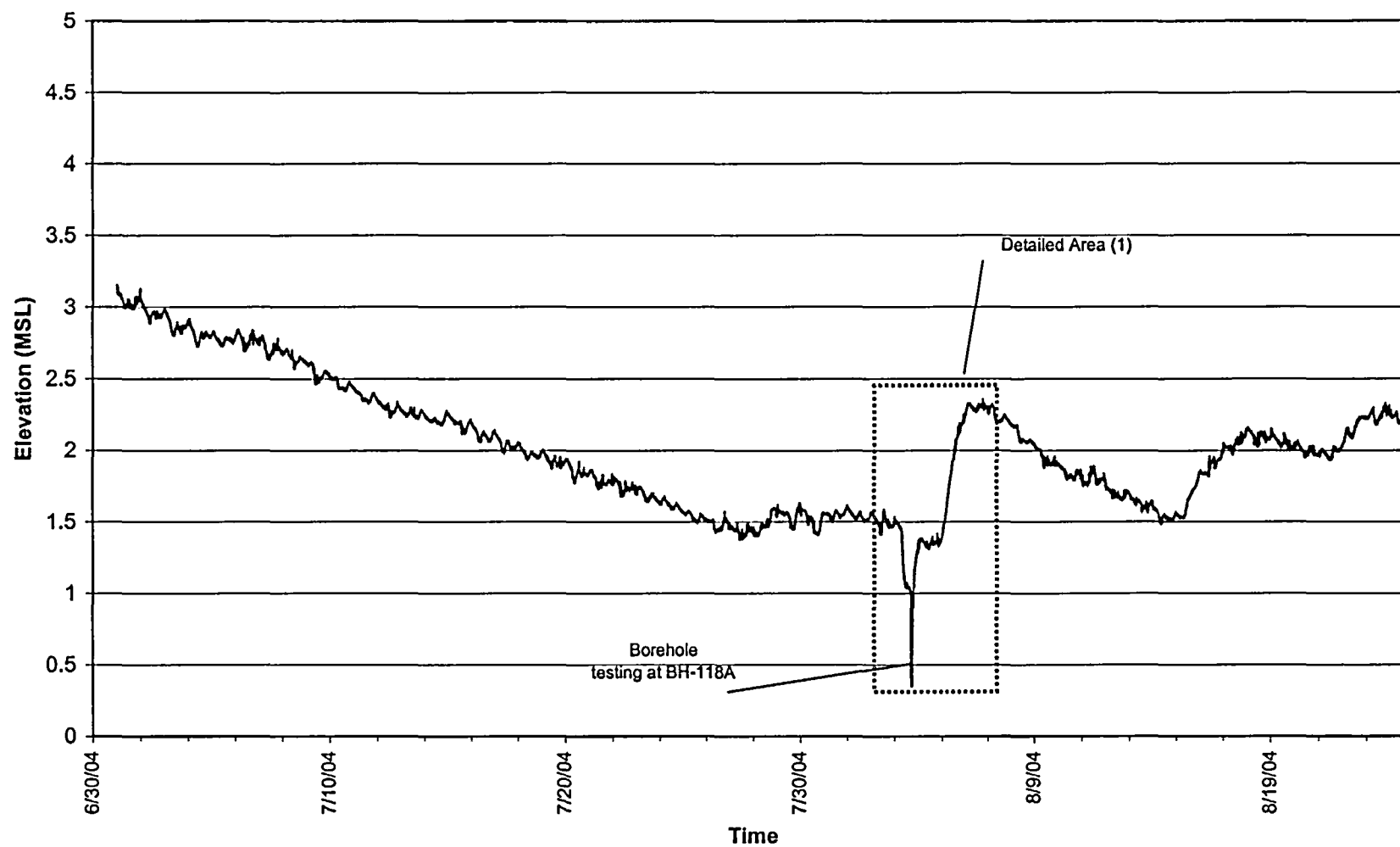
MW-103D Groundwater Elevation and Temperature
3rd Quarter



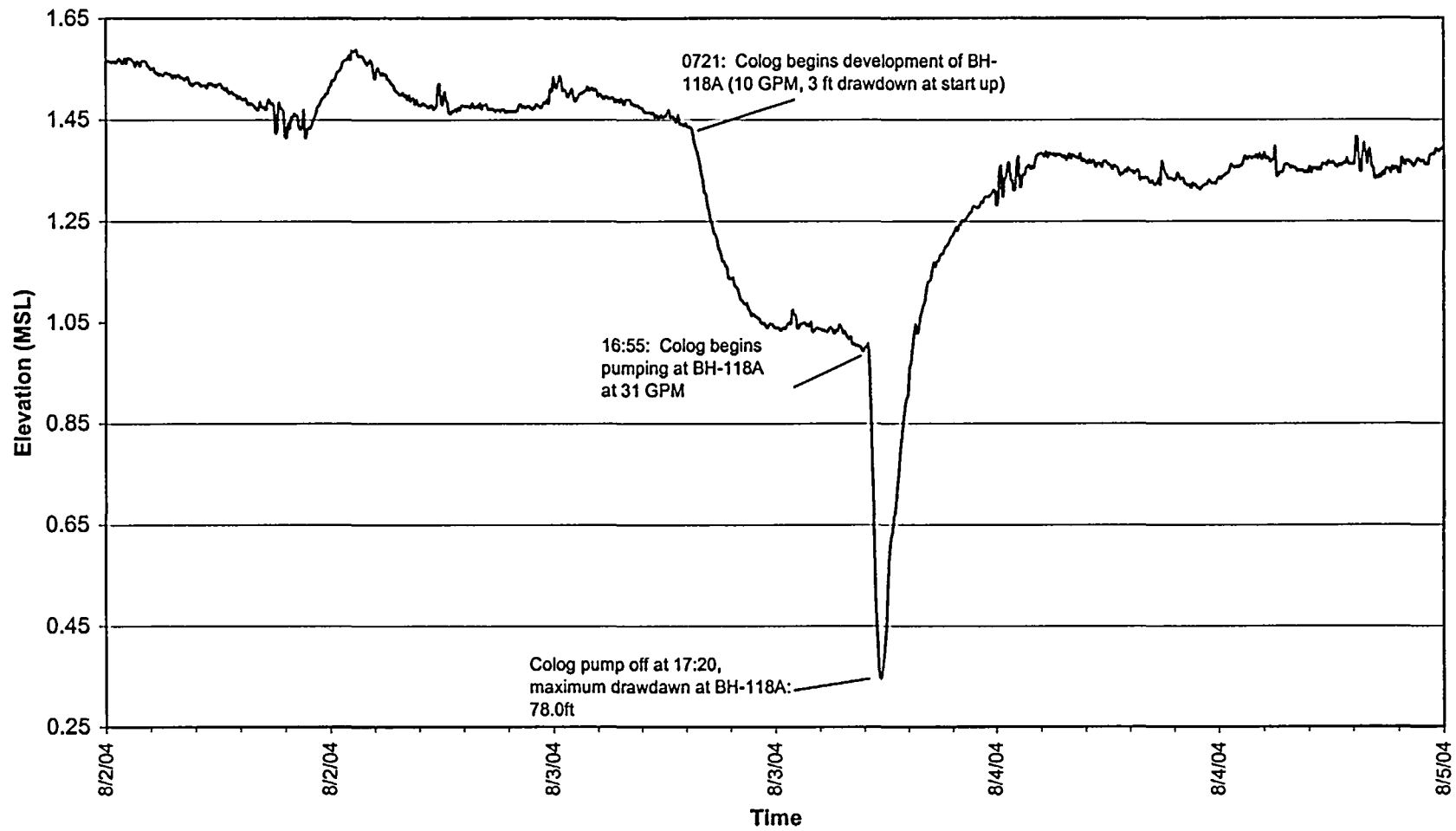
Groundwater Elevation at MW-106D
3rd Quarter



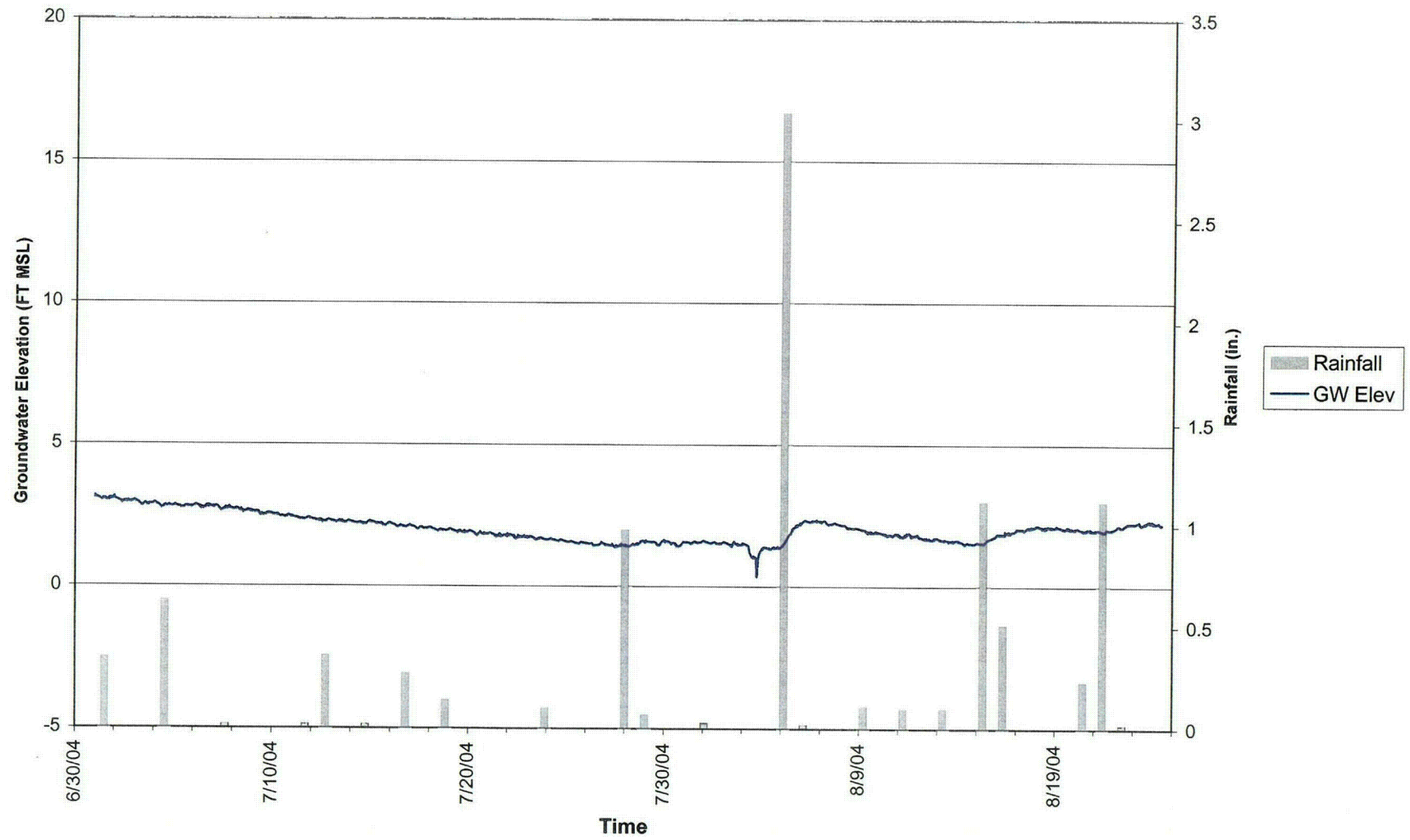
Groundwater Elevation at MW-106D
3rd Quarter



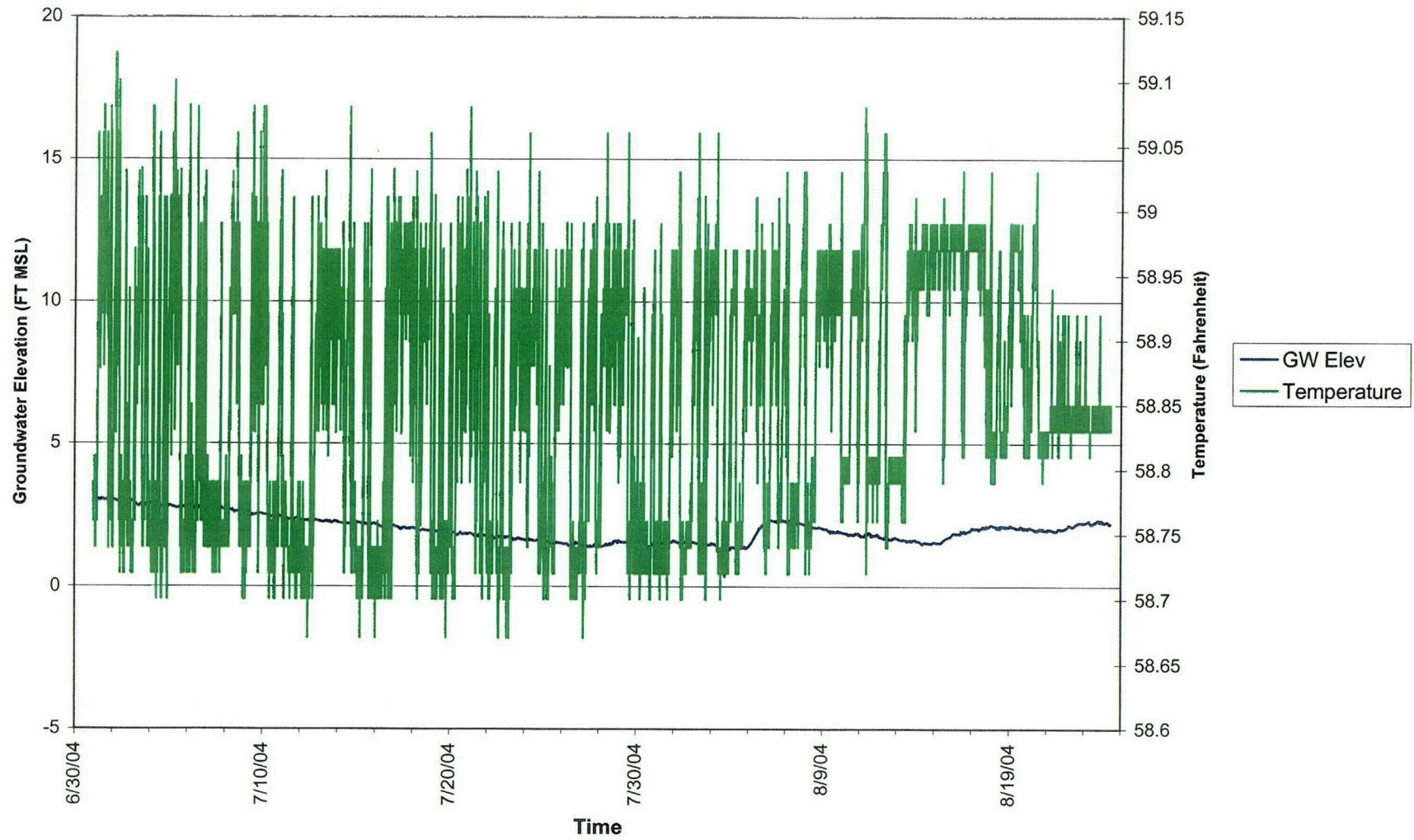
**Detailed Area of
Groundwater Elevation at MW-106D
3rd Quarter**



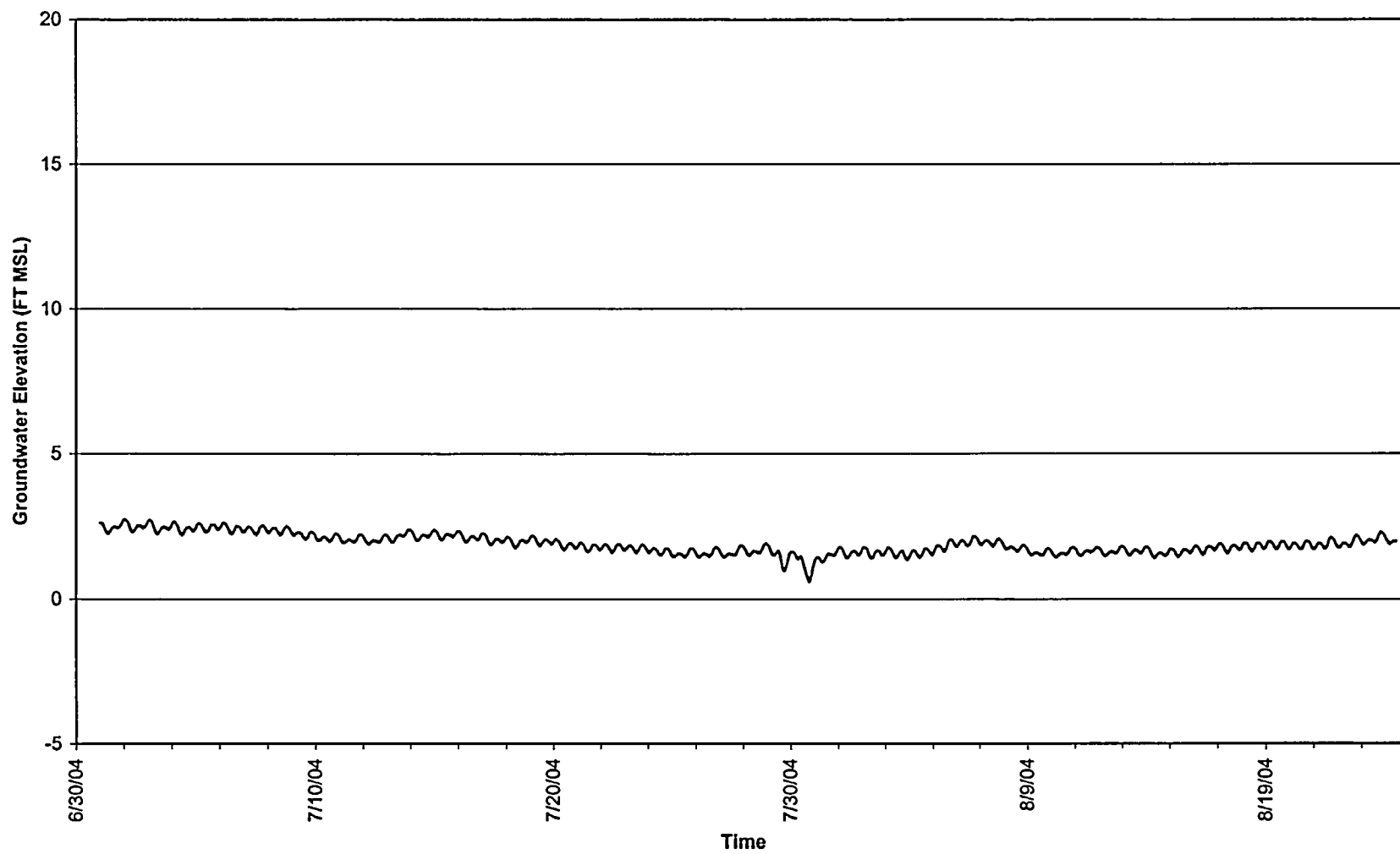
MW 106D Water Elevation and Daily Rainfall Totals
3rd Quarter



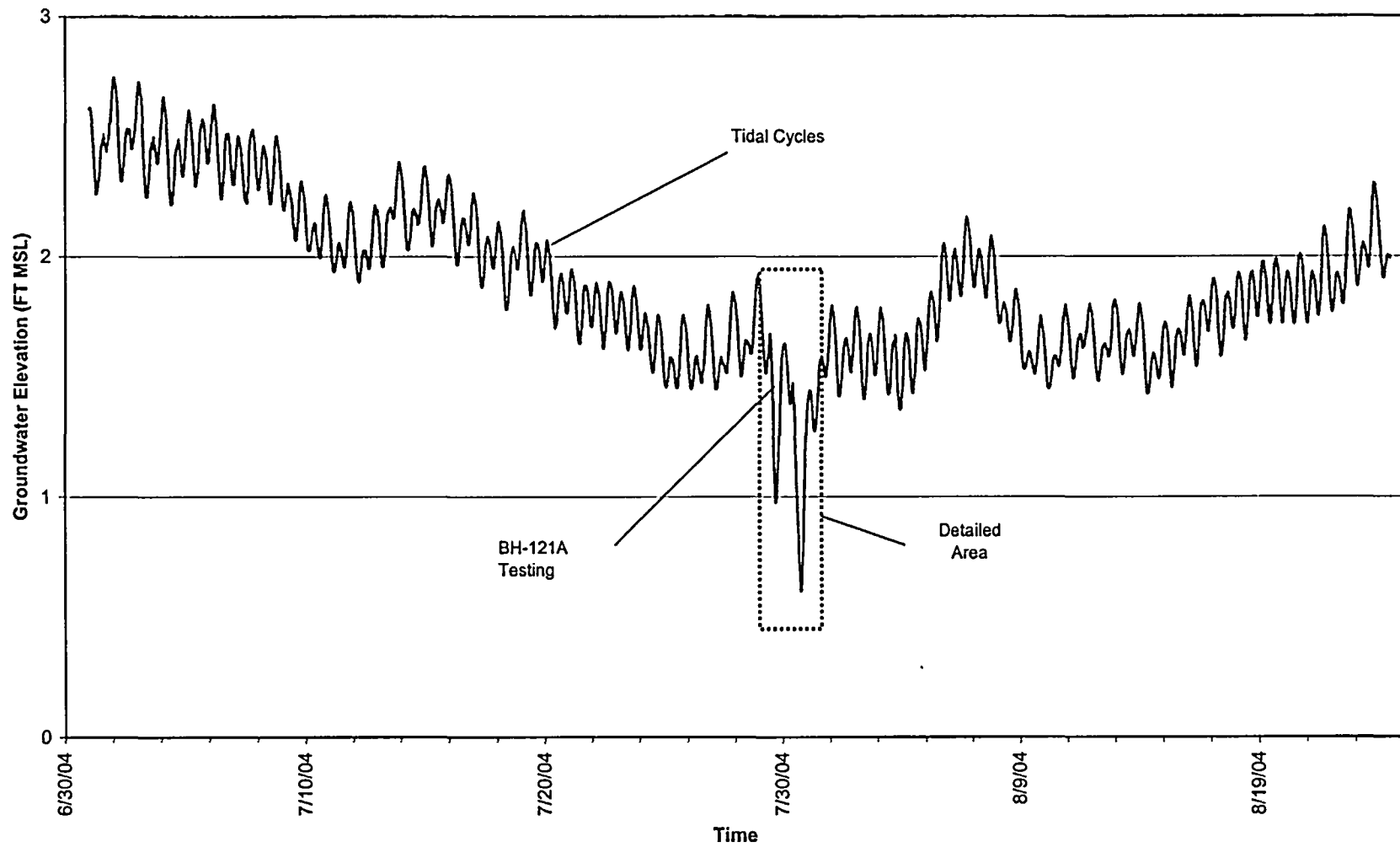
MW 106D Groundwater Elevation and Temperature
3rd Quarter



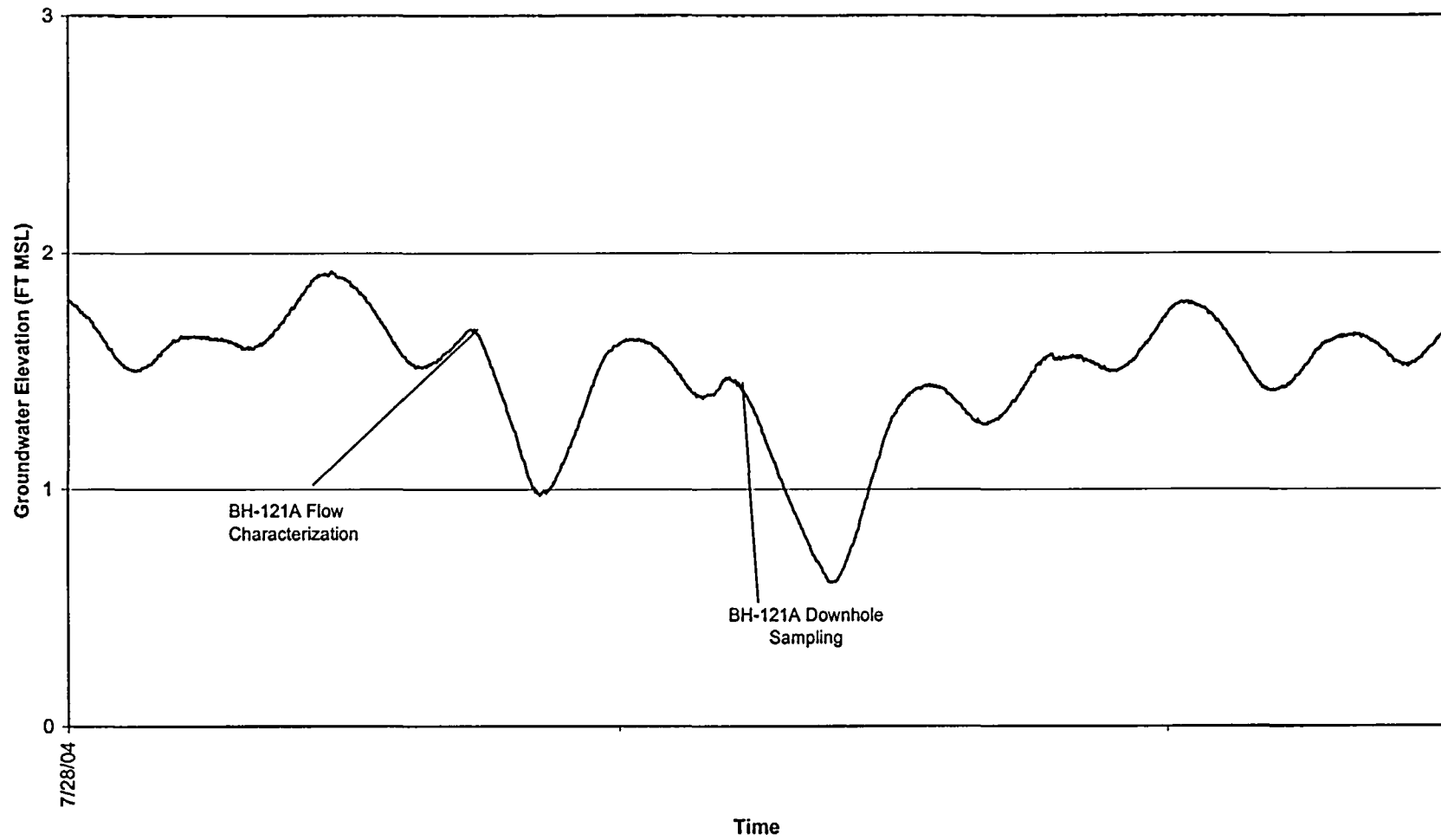
Groundwater Elevation at MW-122D
3rd Quarter



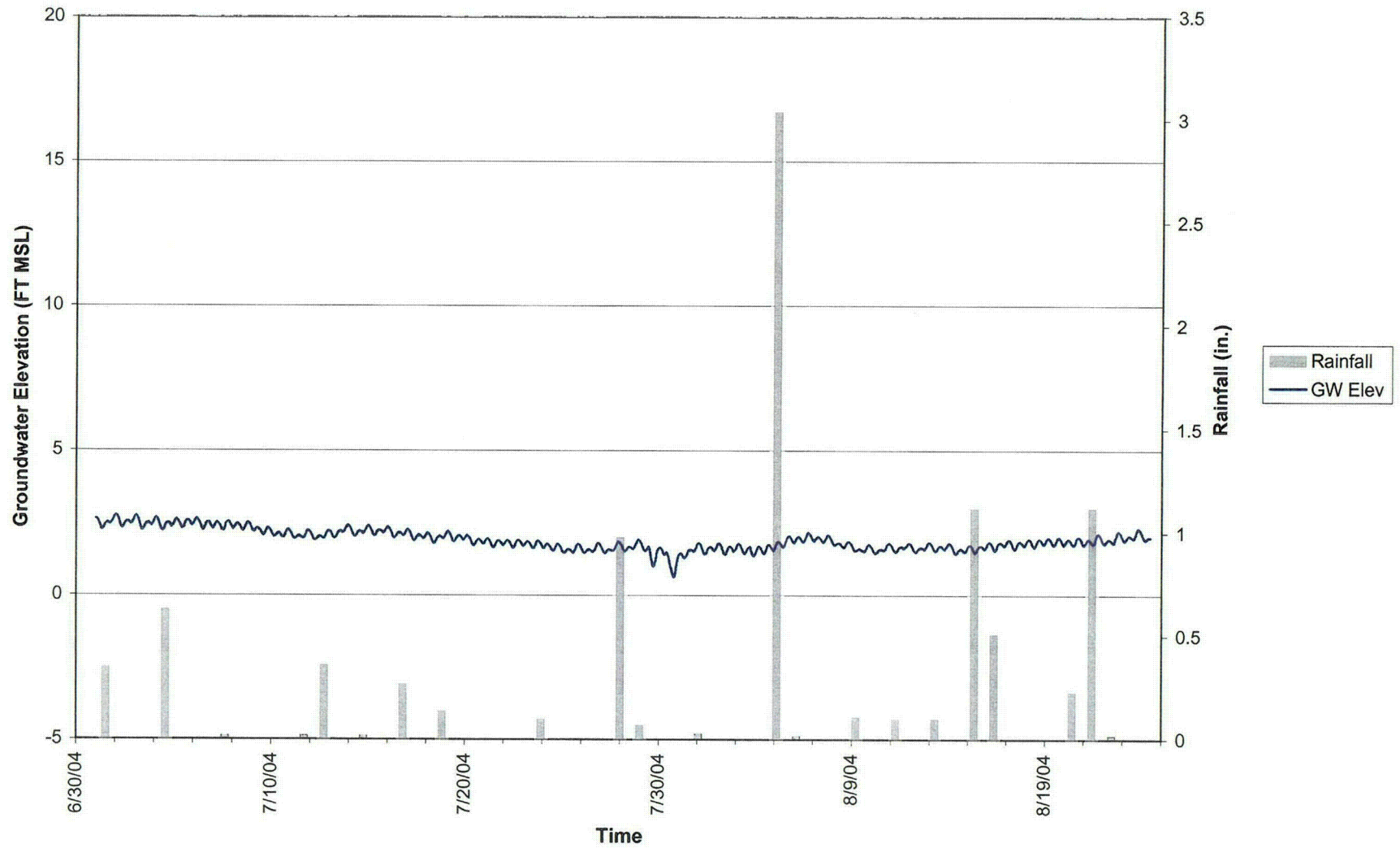
Groundwater Elevation at MW-122D
3rd Quarter



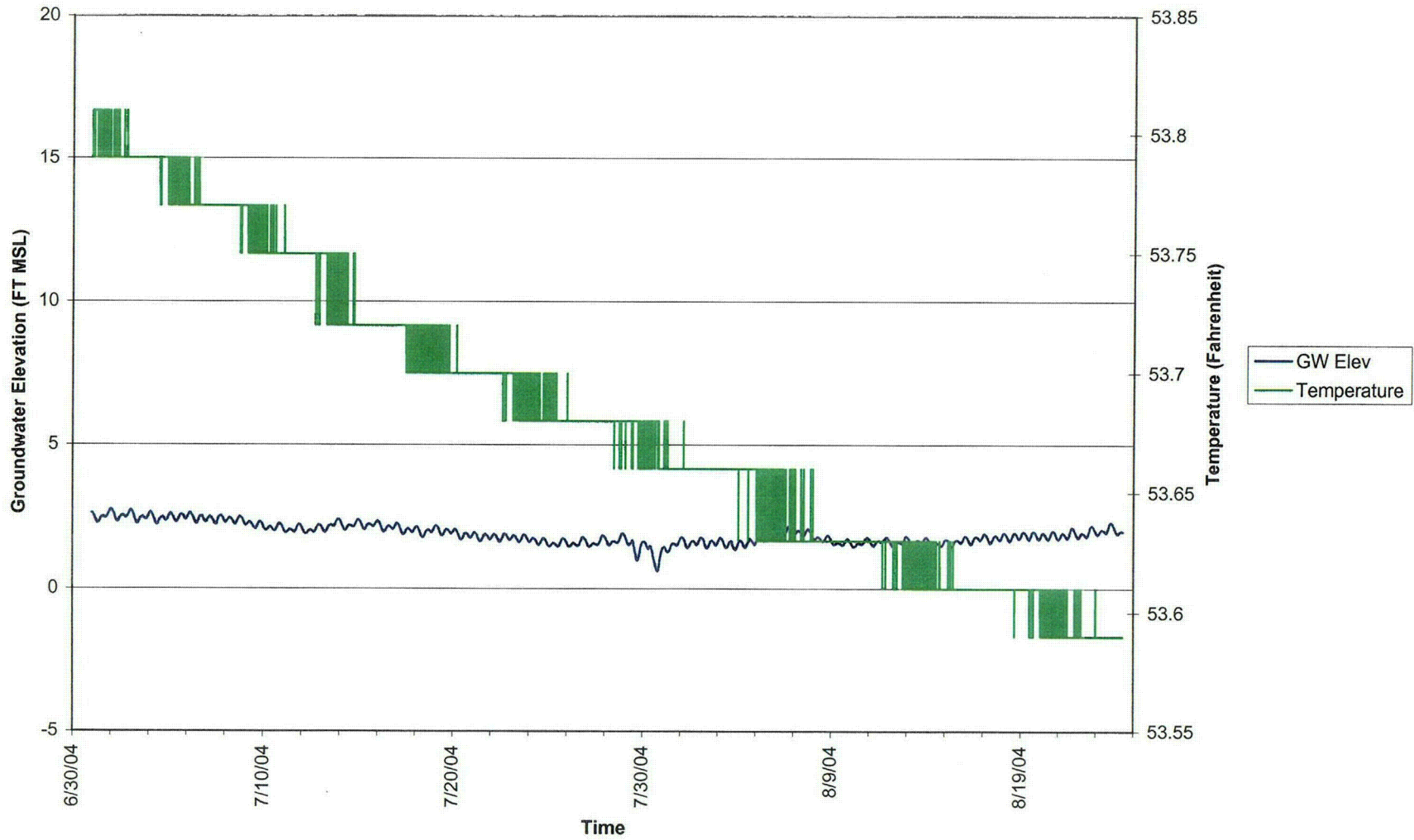
Detailed Area
Groundwater Elevation at MW-122D
3rd Quarter



MW-122D Groundwater Elevation and Daily Rainfall Totals
3rd Quarter



MW-122D Groundwater Elevation and Temperature
3rd Quarter



Appendix 7
Data Quality Assessment of Long-Term Hydrographs

Data Quality Assessment of Long Term Water Level Analysis

The following is a data quality assessment (DQA) of the long-term water level analysis performed at Connecticut Yankee Atomic Power Company Haddam Neck Plant (HNP). The data set was generated from 28 HNP monitoring wells, one surface-water station (Connecticut River), and the mat sump. Water levels at all of these stations were monitored using dedicated data-logging pressure transducers (transducers) on a continuous basis during an approximate 7-month period between January and August 2004. The data were evaluated against criteria for measurement precision, accuracy, representativeness, completeness, and comparability to determine data validity and usability. The following summarizes the results of the DQA, as well as recommended corrective actions.

Summary of Data Collection Activities

Water levels and temperature were monitored at 28 HNP monitoring wells, one surface water station (Connecticut River), and the mat sump using transducers on a continuous basis during an approximate 7-month period between January and August 2004. The long-term water level analysis was used to meet the following data needs:

- Identify aquifer responses to various onsite activities including; recharge responses due to precipitation, mat sump and dewatering well pumping, tidal changes, general river stage variations in the Connecticut River, packer testing, well installations, well development, sampling events, and hydrophysical logging.
- Determine the apparent groundwater flow direction across the site within the three identified hydrostratigraphic units.
- Provide information for aquifer tests.
- Calculate the vertical pressure differences between the identified hydrostratigraphic units across the site.

In addition, transducers recorded water temperature, which was subsequently compared to water levels at the same frequency.

The instruments selected in this measurement system are Mini-troll™ data-logging transducers manufactured by In-situ, Inc. The transducer system was installed in the last week of January 2004. The transducers were suspended at the lowest expected water level to be encountered in the well. Initially the transducers were attached to the well's cap. The system was subsequently modified to minimize transducer movement during well access.

The transducers were initially set up to record measurements on one-minute intervals. To optimize the memory capacity of the transducers, they were subsequently re-programmed

to record measurements on five-minute intervals in May 2004. The transducers were downloaded on a quarterly basis and as needed between the routine downloads.

Transducer measurements were converted from pressure (in psig) to a final groundwater elevation value (in ft MSL). The reading is a combination of the water column pressure and the atmospheric pressure above the transducer. A barometric pressure transducer is used to correct the transducer pressure for barometric fluctuations. The following calculations were performed to determine the groundwater elevation at each of the transducer locations:

Barometric Pressure correction to achieve the corrected PSI value:

$$\text{Corrected PSI} = \text{Total PSI (initial transducer reading)} - \text{Atmospheric PSI (barometric pressure transducer)}$$

Corrected PSI is then converted to a water column height:

$$\text{Height of water column above transducer (ft)} = \text{Corrected PSI} * 2.3067 \text{ ft/PSI}$$

A hand-measured depth to water measurement (DTW) is added to the height of the water column to determine the transducer depth:

$$\text{Transducer Depth (ft bgs)} = \text{Length of water column (ft)} + \text{DTW}$$

The transducer depth, calculated from the DTW collected at the time of download, is then subtracted from the length of the water column, to achieve a DTW at every 5-minute interval:

$$\text{DTW at every 5-minute interval (ft bgs)} = \text{Transducer Depth (ft)} - \text{Length of water column (ft)}$$

The DTW subtracted from the surveyed top of casing elevation (TOC) results in the groundwater elevation:

$$\text{Groundwater Elevation (ft AMSL)} = \text{TOC} - \text{DTW}$$

The transducer data and data reduction calculations are maintained in Microsoft Excel™ spreadsheets. The resulting reduced data sets were subsequently plotted as hydrographs displaying the change in water level elevation (normalized to Mean Sea Level) over time. The hydrographs were inspected for hydraulic responses that appear to be temporarily related to known on-site transient events.

Summary of Data Collected

Groundwater flow through unconsolidated material and fractures in the underlying bedrock is affected by a variety of natural processes and forces. Precipitation, drainage, infiltration and tides cause a variety of short-term and seasonal fluctuations in the location and direction of flow of groundwater.

The screen intervals of monitoring wells at the HNP can be subdivided into 3 groups: those screened in the unconsolidated deposits overlying bedrock, those in shallow bedrock or

screened across the unconsolidated deposits/bedrock boundary, and those in deep bedrock. The shallow bedrock, that within 10 feet of the bedrock surface, as a general rule, appears to be more highly fractured and partially weathered, and provides a more permeable pathway for groundwater flow than deep bedrock. Bedrock at a depth greater than 10 feet below bedrock surface appears to be less transmissive in comparison. Figures 4-3 through 4-26 in the Task 2 Supplemental Characterization Report (CH2M HILL, 2004) show inferred groundwater flow directions for these three units. The localized depression in groundwater elevation caused by operation of the containment mat sump is apparent in all three figures.

The data collected throughout the three quarters were compiled into detailed hydrographs for each transducer location. Four or more hydrographs are presented in Appendix B in the Task 2 Supplemental Characterization Report (CH2M HILL, 2004) for each location; one graph of the observed groundwater elevation, one hydrograph of the groundwater elevation versus temperature, one hydrograph of the groundwater elevation versus total daily rainfall and one or more hydrographs of the observed groundwater elevation with annotations correlating recorded pressure transients to specific known events.

Results of Data Quality Assessment

The data were assessed for precision, accuracy, representativeness, completeness, and comparability. The individual assessment parameters are discussed in the following subsections.

Precision

Precision is the measurement of the repeatability of a measurement or measurement technique. In other words, precision is the degree to which multiple measurements collected in the same manner result in the same answer. Two ways to confirm the precision of the data collected is to observe the hydrographs to see if the data "flows" together, and to determine the amount in which the transducers electronic readings drift over time.

The hydrographs reveal that the transducers, for the most part, precisely collected measurements. The water levels over time uniformly decrease and increase, indicating that very accurate measurements were being downloaded at every five minute interval.

Accuracy

Accuracy refers to the degree to which a measurement technique or method can reflect a known value or be compared to a known value or standard. Accuracy is typically expressed in terms of how close a measured value comes to the value of a known standard using the same technique. All of the transducers were factory-calibrated to known pressure standards and the calibration records are kept in project files. To achieve accurate top of casing (TOC) elevations, the transducer locations were surveyed by a licensed surveyor in November 2003. The surveyed values were used to calculate the final groundwater elevation values presented in the hydrographs in Appendix B of the Task 2 Supplemental Characterization Report (CH2M HILL, 2004).

Inspection of the hydrograph from MW-101D indicated a temporal trend of water level that was inconsistent with nearby wells and did not indicate expected responses to on-site stresses. The transducer was tested by raising it to the ground surface and recording the

indicated atmospheric pressure. The indicated pressure at ground surface was not consistent with atmospheric pressure, indicating a calibration shift in the transducer. The water level data for MW-101D were subsequently identified as inaccurate and are not used in any water level analysis.

An atmospheric pressure check will be initiated as part of regular transducer data collection to verify calibration status of the instruments. The transducer/data logger from MW-101D will be returned to the manufacturer for recalibration.

Representativeness

Representativeness refers to the degree to which a data set is actually a sample of a population. In this case representativeness refers to the degree to which the measurements collected from the transducers can be utilized to portray the overall site. The data set was generated from 28 HNP monitoring wells, one surface-water station (Connecticut River), and the mat sump. Of the 28 monitoring wells, 14 are screened in the unconsolidated hydrostratigraphic unit (unconsolidated), 8 are screened in the shallow bedrock hydrostratigraphic unit (shallow bedrock), and 6 are screened in the deep bedrock hydrostratigraphic unit (deep bedrock).

The 14 unconsolidated monitoring wells are placed throughout the site, providing a thorough depiction of the groundwater in the unconsolidated unit.

There are fewer shallow bedrock wells, however they are placed throughout the site, providing adequate representation of the shallow bedrock unit.

Of the six deep bedrock wells, only five deep bedrock wells that were used in the long-term water level analysis due to the transducer malfunctions in MW-101D (discussed in the Precision section). Groundwater flow in the deep bedrock is characterized in a limited portion of the HNP, as deep bedrock monitoring wells are only present in the central and northern portions of the industrial area. Data collection during the long-term water level analysis is comprehensive with respect to the unconsolidated and shallow bedrock units, and is less comprehensive in the deep bedrock unit. In addition, groundwater flow in the deep bedrock is dominated by fracture flow. Orientation of fractures and interception of fractures by wells define the apparent adequacy of deep bedrock water level monitoring.

Groundwater levels at HNP rise and fall on a daily or seasonal basis in response to recharge events (i.e., precipitation/snowmelt) and other hydraulic effects such as tides, groundwater extraction and borehole testing activities. During periods of minimal recharge that can occur during a prolonged mid-winter freeze or mid-summer drought, groundwater levels in an aquifer will typically decline because of the natural, ongoing base-flow contributions to local or regional discharge zones such as streams, rivers, or lakes. The natural decline (or antecedent trend) in groundwater levels during periods with little or no recharge is expected to vary on a site-wide basis, due to differences in aquifer characteristics and hydraulic properties.

The long-term water level analysis that was conducted over the past three quarters was able to, for the most part, adequately portray most of these groundwater responses. In a few cases, rainfall events occurred at the same time that the mat sump and dewatering well

operations were interrupted. As a result to these onsite activities occurring simultaneously, well responses were masked.

In summary, the water level monitoring data are considered to be representative of the conditions within the HNP industrial area.

Completeness

Completeness refers to the ability of the data set to encompass the entirety of the target system. The data should be sufficient to answer the questions that prompted the data collection in the first place. The water level data collected from the instrumented wells were complete with the following exceptions:

- The river froze, which caused the battery in the river transducer to shut down, ultimately preventing data collection between approximately February 23 and April 12. Inspection of the hydrograph for well TW-1 indicated that the well exhibited a temporal response identical to the river. By examination, a fixed off-set from the river fluctuations was identified for well TW-1. As a result, adjusted water elevation data from TW-1 were used as a surrogate to complete the hydrographs for the river during this period of time in the first and second quarters. The Connecticut River continued to exhibit clear tidal fluctuations during this time.
- The large data shifts observed over three quarters in MW-101D are apparently caused by calibration drift. The data from that transducer are not considered usable for water level analysis.
- During a time period of approximately thirty-six hours in the middle of May, the data-logging in all 30 transducers was halted. At installation, the transducers had been programmed to download measurements every minute, and when they were halted, they were reset to download data every 5-minutes. This gap is seen in the hydrographs presented in Appendix B of the Task 2 Supplemental Characterization Report (CH2M HILL, 2004). This brief interruption does not impair usability of the data.

Completeness was calculated as:

$$C = \frac{N_v}{N_p} \times 100$$

Where: C = Completeness of the data set, presented as a %

N_v = The number of valid, usable, measurements collected in the data set

N_p = The number of valid, usable, measurements planned, or initially identified for collection

Approximately 95% of the transducer data was able to be used as part of the data set.

Comparability

Comparability refers to the degree to which a data set, or single datum can be compared to another measurement for the purposes of assessing change over time or space. The object of the comparability assessment is to ensure that the present data set can be compared to previous and/ or subsequent measurements. Two types of assessment were made to evaluate comparability. First, the transducer hydrographs for sequential data download events were compared to the previous event. Secondly, transducer measurements were compared to independent hand measurements collected during regularly-scheduled groundwater sampling events.

The sequential data sets collected from the transducers compare very well and are considered comparable for subsequent measurement. The comparison to hand measurements does not indicate consistent comparability. The cause of the difference (as shown in Table 1) is not apparent. The hand measurements were collected by multiple individuals at different times. The observed differences between the instrument measurements and the hand measurements indicate the need to perform a series of frequent hand measurements under rigorously-controlled conditions to assess the comparability of the measurement sets. The reason for the apparent variability in comparability between the transducer and hand measurements is not apparent.

Groundwater at HNP is a dynamic system, and the water levels are constantly changing; therefore it is essential to collect a rigorously-controlled set of measurements to fully assess comparability.

Table 1. Comparison of Manual Depth to Water and Transducer Depth to Water

Well ID	Manual DTW (ft TOC)	Transducer DTW (ft TOC)	Absolute Difference (ft)
MW-100S	3.53	4.01	0.48
MW-101D	--	--	
MW-101S	6.31	6.35	0.04
MW-102D	14.35	15.69	1.34
MW-102S	15.3	13.94	1.36
MW-103D	16.99	17.07	0.08
MW-103S	16.38	16.8	0.42
MW-104	11.93	12.50	0.57
MW-105D	15.81	16.40	0.59
MW-105S	16.18	16.37	0.19
MW-106D	16.12	16.76	0.64
MW-106S	16.79	12.69	4.1
MW-107D	15.84	16.78	0.94
MW-107S	15.3	15.96	0.66
MW-108	7.82	8.23	0.41
MW-109D	17.16	14.83	2.33
MW-109S	17.26	18.38	1.12
MW-110D	20.78	20.52	0.26
MW-110S	21.16	22.47	1.31
MW-113	12.43	13.53	1.1
MW-114	16.44	16.01	0.43
MW-122D	15.93	17.02	1.09
MW-122S	13.16	14.28	1.12
MW-124	17.74	17.77	0.03
MW-504	13.26	13.27	0.01
MW-508D	14.5	14.55	0.05
MW-508S	7.29	8.42	1.13
TW-1	16.07	17.87	1.8

Notes:

DTW = Depth to Water

Ft TOC = feet below top of casing

Data Quality Assessment Summary

Overall, the data quality assessment procedure indicates that the water level data are acceptable for utilizing in the ongoing hydrogeological characterization at the HNP. The following activities are recommended facilitate assessment of precision, accuracy, representativeness, completeness, and comparability of future measurements:

- The transducer in MW-101D will be sent back to the manufacturer for calibration and/or repair.
- An atmospheric pressure reading will be collected from each transducer, quarterly to confirm calibration.
- Additional deep bedrock monitoring wells may be instrumented to more fully represent and analyze the deep bedrock unit at the HNP.
- A series of regularly-scheduled manual water level measurements will be collected on a bi-weekly basis for approximately 6 months to assess comparability of the monitoring system. These measurements will include consistent hand measurement techniques and time records synchronized to the transducer clocks.
- Transducer/data logger batteries will be changed and the instruments inspected before winter.