# 2016 Annual Nebraska Ordnance Plant Groundwater Report

for the

Platte West Water Production Facilities

Metropolitan Utilities District Omaha Nebraska

Project No. 92445

January 2017

# 2016 Annual Nebraska Ordnance Plant Groundwater Report

Prepared for

Metropolitan Utilities District Omaha Nebraska
Platte West Water
Production Facilities
Omaha, Nebraska

Project No. 92445

January 2017

prepared by

Burns & McDonnell Engineering Company, Inc.
Kansas City, Missouri 64114

# CERTIFICATION

## Metropolitan Utilities District Omaha Nebraska
## 2016 Annual Nebraska Ordnance Plant Groundwater Report
## Project No. 92445

## Certification

I hereby certify, as a Professional Engineer and Professional Geologist in the state of Nebraska, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by the Metropolitan Utilities District Omaha Nebraska or others without specific verification or adaptation by the Engineer.

____________________________________
Luca DeAngelis, P.E., P.G. (Nebraska)

Date:______________________________

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# LIST OF ABBREVIATIONS

## Abbreviation or Term

**Alluvium:** Unconsolidated terrestrial sediment composed of sorted or unsorted sand, gravel, and clay that has been deposited by water.

**ARM:** Absolute residual mean error. The ARM error represents the average of the absolute values of the differences between forecast and the corresponding observation.

**Aquifer:** An underground geological formation, or group of formations, containing water. Aquifers are sources of groundwater for wells and springs.

**bgs:** Below ground surface

**BMcD**: Burns & McDonnell

**CENWK:** Kansas City District Corps of Engineers

**CENWO:** Omaha District Corps of Engineers

**COCs:** Contaminants of Concern

**Drawdown:** The drop in the water table or level of water in the ground when water is being pumped from a well.

**EIS:** Environmental Impact Statement

**FEIS:** Final Environmental Impact Statement

**Flood plain:** The flat or nearly flat land along a river or stream or in a tidal area that is covered by water during a flood.

**FNOP:** Former Nebraska Ordnance Plant

**gpm:** Gallons per minute

**Hydraulic conductivity (K):** The rate at which water can move through a permeable medium. (i.e. the coefficient of permeability.)

**Hydrogeology:** The geology of ground water, with particular emphasis on the chemistry and movement of water.

**LPNNRD:** Lower Platte North Natural Resources District

**LWS:** Lincoln Water System

**mgd:** Million gallons per day

**MODFLOW:** Groundwater flow model developed by McDonald and Harbaugh (1988) with the USGS.

**MODPATH:** Groundwater particle tracking model developed by Pollock (1989) with the USGS.

**MUD:** Metropolitan Utilities District

**NDMC:** National Drought Mitigation Center

**NDNR:** Nebraska Department of Natural Resources

**NOAA:** National Oceanic and Atmospheric Administration

**NOPGR:** Nebraska Ordnance Plant Groundwater Report

**Potentiometric surface:** The surface to which water in an aquifer can rise by hydrostatic pressure.

**QCSR:** Quality Control Summary Report

**RDX:** Hexahydro-1,3,5-trinitro-1,3,5-triazine

**Riverbed conductance:** A numerical parameter used by MODFLOW to calculate the leakage between the river and the aquifer.

**ROD:** Record of Decision

**TCE:** Trichloroethylene

**Unconfined aquifer:** An aquifer containing water that is not under pressure; the water level in a well is the same as the water table outside the well.

**UNLCSD:** University of Nebraska – Lincoln Conservation and Survey Division

**USACE:** U.S. Army Corp of Engineers

**USEPA:** United States Environmental Protection Agency

**USGS:** U.S. Geological Survey

**VOCs:** Volatile Organic Compound

**WFCP**: Well Field Contingency Plan

# EXECUTIVE SUMMARY

The Metropolitan Utilities District (MUD), Omaha, Nebraska, was issued a Section 404 Individual Permit (Permit) in 2003, from the Omaha District Corps of Engineers (CENWO) for the development of the Platte West Water Production Facilities Project (Project). The Project consists of a well field and water treatment facility that develops groundwater from the Platte River alluvial aquifer for potable use within the Greater Omaha Metropolitan area. One of the Permit's requirements is the development of an annual report that summarizes the groundwater quality and elevation data which are collected from wells within the well field's groundwater monitoring network. An additional requirement of the permit is the semi-annual updating of an existing groundwater model and reporting of those updates. The general purpose of these Permit Conditions is to ensure that the operation of the well field does not impact the contaminant plumes or the remediation efforts at the Former Nebraska Ordnance Plant (FNOP).

The purpose of this document, the Nebraska Ordnance Plant Groundwater Report (NOPGR), is to fulfill this annual reporting requirement. The objective of the NOPGR is to use available hydrogeologic data, both physical and chemical, as well as groundwater modeling to evaluate the potential impact of the operations of the well field on the aquifer and, more specifically, on the contaminant plumes and remediation efforts at the FNOP. The first NOPGR was developed in 2008 to comply with the Permit condition and a NOPGR has been submitted annually since. Extensive post audit groundwater modeling work has been conducted to evaluate the performance of the groundwater model and these post audits are documented in the 2009 through 2013 NOPGRs. These model post audits showed that the groundwater modeling predictions presented in the *Phase II Platte West Well Field Groundwater Modeling Study* (Chatman and Associates, Inc., 2005) were reasonable approximations of how the aquifer would respond to the pumping from the well field.

The Project well field began pumping operations in February 2009 and has continued operations through the end of this reporting period (September 2016), completing the eighth calendar year of operation. The 2016 NOPGR reporting period was characterized by climactic conditions that led to relatively low water production from the Platte West well field. These climactic conditions included: precipitation that was above normal during the spring and summer of 2016, average monthly temperature for most of the year, and higher than average streamflow in the Platte River. As a result of these climatic conditions, the demand for water production from the Project facilities was lower than in previous years. The average annual pumping rate for the 2016 water year was 28.5 million gallons per day (mgd). As in past years, pumping on an annual basis was well below the permitted water use for the Project, as defined in Nebraska Department of Natural Resources (NDNR) water use permits. Water production for the 2016 USGS water year was the second lowest yearly total since the wellfield began operation and was again significantly below both the record high production year of 2011 (37.2 mgd for the 2011 USGS water year) and the regulated capacity of 52 mgd.

As with all previous NOPGR updates, continuous groundwater elevation monitoring was conducted at all of the monitoring wells that are located within the well field monitoring network. The monitoring network is shown on Figure 3-1 and consists of 38 monitoring wells that are equipped with pressure transducers. These monitoring wells are operated and maintained by one of three organizations: Lower Platte North Natural Resource District (LPNNRD), MUD, or the Kansas City District Corps of Engineers (CENWK). All data provided to Burns & McDonnell by MUD, CENWK, and the LPNNRD as of December 30, 2016 have been used to develop the hydrographs presented within this report.

The updated hydrographs show that water levels near the well field have generally rebounded from the low groundwater level elevations observed in 2012 and 2013. The rebound in groundwater elevation from the low points observed in 2012 and 2013 was also observed in a majority of the monitoring wells that are located further than one mile from the well field and closer to the FNOP site. The rebound in groundwater elevations is attributed to a combination of favorable climactic conditions, reduced regional irrigation pumping, and decreased well field pumping.

In addition to the updated monitoring well hydrographs, a potentiometric surface map for March 2016 was developed using approximately 190 monitoring wells that included data collected by CENWK, LPNNRD, and MUD. The potentiometric surface (presented on Figure 3-2) illustrates that the well field continues to remain hydraulically cross-gradient of the FNOP site.

As with all previous NOPGR updates, two rounds of groundwater sampling were conducted during this NOPGR reporting period (May and October 2016). None of the compounds assigned a cleanup goal in the FNOP Record of Decision (ROD) were detected above their reporting limit during either 2016 sampling event.

The groundwater model update completed for the 2016 NOPGR was developed by modifying the steady state model to reflect the average pumping rates (from 2009 through 2016) for each well. The model predicted steady state drawdown was then compared to the observed drawdown at monitoring wells that are located near the well field. The observed drawdown for these monitoring wells was calculated using the average water level observed in the monitoring well during the eight years of well field pumping. The average difference between the model predicted and observed drawdown for the nine monitoring wells located in Saunders County was 0.5 feet. The results from this model review showed that, when updated with real world pumping data, the steady state model developed a reasonable approximation of the drawdown observed at the monitoring wells located near the well field. This evaluation is consistent with previous NOPGR updates which indicated that the groundwater model is a reliable tool for evaluating the aquifer's response to pumping from the well field.

The hydraulic data collected as part of this and previous NOPGR updates continues to support the conclusion that the groundwater flow direction in the Todd Valley aquifer has not changed due to the operation of the well field. Well hydrographs and groundwater modeling performed support the conclusion that the hydraulic influence of the well field does not extend much beyond the location of wells MW94-3, MW94-5, MW94-6, MW06-27, and MW06-28, which are located approximately one mile from well field property boundary. The hydraulic and chemical data collected to date, as well as the modeling analyses performed, continue to support the conclusion that pumping from the Platte West well field is not adversely impacting the FNOP containment system efforts.

# 1.0 INTRODUCTION

The Metropolitan Utilities District (MUD) is responsible for providing potable water to the Greater Omaha (Nebraska) Metropolitan area. Based on the continuing growth in population and water demands in Greater Omaha, and constraints on supplies, MUD previously determined that a potential long-term shortage in water existed. To remedy this situation, the District studied various alternatives and selected a source of water from the Platte River valley west of Omaha as the best alternative, known as the Platte West Well Field (well field). Construction of the well field and associated water treatment facilities was completed in July 2008. The well field consists of 42 production wells that pump water from the Platte River alluvial aquifer. The completion of the Platte West water production facilities has increased MUD's peak day raw water capacity by 100 million gallons per day (mgd) to the current maximum of approximately 334 mgd. MUD maintains water rights from the Nebraska Department of Natural Resources (NDNR) that permit the use of surface water and groundwater for the well field. The use of Platte River surface water is permitted through an induced groundwater recharge permit (A-173178). Water Right A-17356, a ground water permit under the Municipal and Rural Domestic Ground Water Transfer Act, limits the combined pumping rate from the well field. The limits placed by this permit are: a maximum instantaneous pumping rate not to exceed 104 mgd and a total annual average pumping rate not to exceed 52 mgd.

The installation of transmission pipelines for the well field necessitated crossing the Platte River, Elkhorn River, and associated wetlands; therefore, MUD obtained a Clean Water Act Section 404 Permit (No. 199910085), referred to as Permit in this document. The Permit is administered by the Omaha District Corps of Engineers (CENWO). One of the Permit's requirements is an annual report concerning the Former Nebraska Ordnance Plant (FNOP). The FNOP site occupies approximately 17,250 acres located one-half mile south of Mead, in Saunders County, Nebraska. Groundwater contaminants in the form of explosives (associated with loading, assembling, and packing of munitions at four bomb load lines) and chlorinated solvents (associated with Atlas missile activities), underlie portions of the FNOP site. These groundwater contaminants are contained on site by a series of pumping wells, maintained by the United States Army Corps of Engineers (USACE). All but one (1) of the FNOP containment wells are installed in the Todd Valley aquifer, which is an ancestral channel of the Platte River that is filled primarily with alluvial sand. One FNOP containment well (EW-1R) is installed in the Platte River alluvial aquifer.

The purpose of this document, the Nebraska Ordnance Plant Groundwater Report (NOPGR), is to fulfill the annual reporting requirement. The objective of the NOPGR is to use available hydrogeologic data, both physical and chemical, as well as groundwater modeling to evaluate the impact of the operations of the well field on the aquifer and, more specifically, on the contaminant plumes and remediation efforts at the FNOP. The remainder of this section provides a general discussion of the project background and describes the overall purpose of work presented within this report.

## 1.1 Project Location

The well field is located on 2,230 acres of land in southeastern Nebraska encompassing both sides of the Platte River in Douglas and Saunders Counties. The raw water is delivered to a treatment plant in western Douglas County through a 3.5-mile long, 72-inch diameter pipeline. Treatment plant construction was completed in the summer of 2008. The treatment plant is located northeast of the intersection of Q and 216$^{th}$ Streets. The well field and study area locations are shown of Figure 1-1.

## 1.2 Permit Reporting Requirements

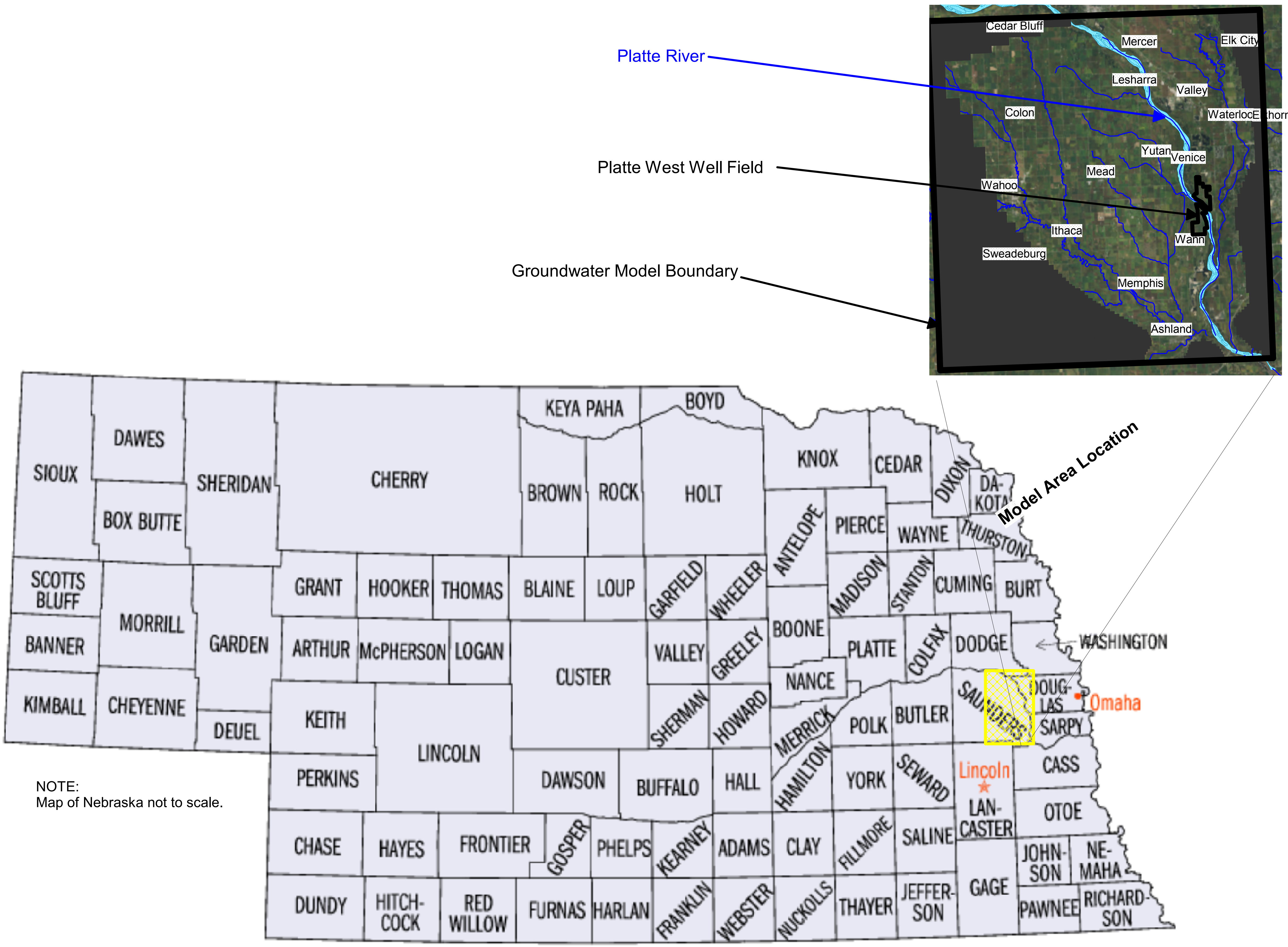
Section H of the Permit describes specific post-start up conditions that are required for operation of the well field. This NOPGR was developed to address Section H Permit Condition 62, which relates to the annual reporting of water quality and hydraulic data collected from wells within the well field's monitoring network. An additional requirement of the permit is semi-annual updating of an existing groundwater model and reporting of those updates in the annual groundwater report (NOPGR). The general purpose of the Permit Conditions described in Section H is to ensure that the operations of the well field do not impact the contaminant plumes or the remediation efforts at the FNOP. The following section presents a summary of Section H Permit Condition 62, as they relate to the development of the NOPGR:

- Condition 62a – MUD will collect potentiometric surface elevation data on a monthly basis, for a period of at least one year after the startup of the well field. The potentiometric data will be obtained from monitoring wells located in coordination with the USACE.
- Condition 62b – MUD will collect groundwater samples for chemical analysis on a semi-annual basis from monitoring wells located in coordination with the USACE.
- Condition 62c – MUD will update the existing groundwater model on a semi-annual basis using data collected from the monitoring program to evaluate the potential impact of the well field on the operations at the FNOP.
- Condition 62f – MUD will develop the NOPGR to summarize the activities described in the above conditions. The NOPGR will be submitted on an annual basis for review by the Corps of Engineers, with the first NOPGR due within one year of well field startup.

**METROPOLITAN**
UTILITIES DISTRICT

**Platte West Well Field**
**Nebraska Ordnance Plant**
**Groundwater Report**

**Figure 1-1**
**Platte West Well Field**
**Groundwater Model Boundaries**




NOTE:
Map of Nebraska not to scale.

BURNS McDONNELL

## 1.3 Summary of Previous Modeling

The groundwater modeling activities presented in this NOPGR are continuations of previous well field modeling activities that started in 1993 with the development of the Pre-Design model documented in the *Preliminary Engineering Study and Pre-Design Report* (HDR, 1993). The Pre-Design model was modified and improved during the Environmental Impact Statement (EIS) process, ultimately evolving into the model presented in the Final Environmental Impact Statement (FEIS) (Burns & McDonnell, 2002).

Prior to well field construction and startup, a more comprehensive groundwater modeling effort was undertaken by MUD. This effort used the results of the work presented in the FEIS as a point of departure to develop a groundwater model capable of depicting the influence, if any, of the well field on the FNOP contaminant plumes, the FNOP operating remedial system, and other area water users. The groundwater model was developed to simulate various operating scenarios and estimate the impact of an operational well field on water levels in the aquifer. This modeling effort was undertaken in phases, with the phases of work and associated major deliverables summarized below:

- Phase I - Well Field Installation and Assessment, completed December 2004.
- Phase II - Operations Assessment and Planning, January 2005 through December 2005.
- Phase III - Well Field Pre-Start-Up Support July 2005 through August 2008.
- Phase IV - Well Field Operations 2008 and Post Start-Up (ongoing).

The Permit describes specific numerical groundwater modeling tasks which are presented in Conditions 61 (c) and 62 (c) of Section H of the Permit. To date, three major groundwater modeling efforts have been developed to satisfy the requirements of the Permit and to develop an operational tool for MUD. The Phase I modeling effort is summarized in the *Well Field Groundwater Modeling Study* (Chatman and Associates, Inc., 2004). The Phase II modeling effort is summarized in the *Phase II Platte West Well Field Groundwater Modeling Study* (Chatman and Associates, Inc., 2005). These reports provide definition of the location and extent of the Platte Valley aquifer, from which the MUD well field obtains water, and of the Todd Valley aquifer, which contains the FNOP contaminant plumes and remedial system.

As part of the Phase III project activities, the transmissivity of the aquifer near the well field was better quantified by analyzing the 48-hour aquifer tests performed on 32 of the 42 new production wells. These tests were performed using a minimum of three (3) observation wells, and were analyzed using the

Cooper-Jacob distance drawdown method (Cooper-Jacob, 1946). The results of this analysis were presented as an Appendix to the 2008 NOPGR (Layne Christensen, 2009).

Also part of the Phase III activities, a detailed aquifer test and groundwater modeling exercise was performed to better quantify the degree of interconnection between the Platte River and the alluvial aquifer. The results of this activity were presented in *Induced Infiltration Aquifer Test - Riverbed Conductance Summary Report Saunders County Test* (Layne Christensen, 2008a), and were included as an Appendix to the 2008 NOPGR.

### 1.3.1 Phase IV Groundwater Model Post Audit

The following section describes the modeling and reporting activities which have taken place after the well field began operating in February 2009.

#### 1.3.1.1 2009 NOPGR Summary

The 2009 NOPGR (HDR, 2010) was structured as a model post audit to evaluate the ability of the groundwater model to reproduce the observed aquifer response to the first eight (8) months of well field pumping (February through September, 2009). During this period, the well field pumping rate averaged 36.8 mgd. To accomplish this objective, the monthly average flow rate for each of the 42 production wells was input into the model and the model was run to simulate transient conditions, using twelve one-month stress periods that represented the October 2008 to September 2009 reporting period. The model-predicted drawdown was compared to the observed drawdown at 19 monitoring well sites equipped with pressure transducers/data loggers.

The results of the 2009 NOPGR post audit showed that the groundwater model accurately predicted the impact of well field operations on the Platte Valley alluvial aquifer. The transient drawdown hydrographs generated for 19 monitoring wells showed that the model accurately reproduced both the observed rate of expansion and the overall magnitude of the cone of depression created by operating the well field. Most observed drawdown values fell near or within the appropriate contour interval of the model-predicted drawdown for the end of September 2009 pumping period (Figure 5-4 in 2009 NOPGR). The groundwater model post audit conducted as part of the 2009 NOPGR validated the ability of the groundwater model to accurately reproduce the impact of well field pumping on the water level elevations in the Platte Valley alluvial aquifer.

#### 1.3.1.2 2010 NOPGR Summary

The predictive capability of the model was further evaluated in the 2010 NOPGR (HDR, 2011). The 2010 NOPGR was conducted as an extension of the model post audit performed in 2009 by increasing the length of the model simulation to 24 one-month stress periods, representing the groundwater conditions from October 2008 to September 2010. To further test the predictive capabilities of the groundwater model MUD shut off all nine pumping wells located in Section 19 (in Saunders County) from the beginning of November 2009 through the end of February 2010. Before that time, the Section 19 wells had operated from February 11, 2009 through November 2009.

The observed aquifer recovery, and the model simulation of the prolonged shut down of the Section 19 wells, was presented in hydrographs that were summarized on Figure 5-3 of the 2010 NOPGR. These hydrographs illustrated the groundwater model's accurate reproduction of both the drawdown in the aquifer that was induced when the well field began operations in February 2009, and the recovery in the aquifer that occurred when all wells in Section 19 (Saunders County) were shut off from November 2009 through the end of February 2010. This extended model post audit confirmed that the groundwater model accurately predicts the magnitude and pattern of groundwater elevation changes around the well field. These analyses provide confirmation that the aquifer parameters and degree of interconnection between the river boundary and the aquifer used in the groundwater model are appropriate.

#### 1.3.1.3 2011 NOPGR Summary

Observed groundwater elevations, chemical sampling data, and updated groundwater model results for the 2011 water year were presented in the 2011 NOPGR (HDR, 2012). MUD addressed comments provided by the USACE on the draft of this document and the document was eventually approved as final.

#### 1.3.1.4 2012 NOPGR Summary

Observed groundwater elevations, chemical sampling data, and updated groundwater model results for the 2012 water year were presented in the 2012 NOPGR (HDR, 2013). USACE provided comments on the 2012 NOPGR report to MUD via email communication dated June 27, 2013. The 2013 NOPGR addresses the USACE comments on the 2012 NOPGR report. A final version of the 2012 NOPGR was not produced, with the intention of incorporating the 2012 report comments into the 2013 NOPGR.

#### 1.3.1.5 2013 NOPGR Summary

Observed groundwater elevations, chemical sampling data, and updated groundwater model results for the 2013 water year were presented in the 2013 NOPGR (HDR, 2014). Review comments were not provided by USACE.

#### 1.3.1.6 2014 NOPGR Summary

Observed groundwater elevations, chemical sampling data, and updated groundwater model results for the 2014 water year were presented in the 2014 NOPGR (HDR, 2015). The only significant change from previous NOPGR submittals was the inclusion of a revised Well Field Contingency Plan (WFCP). A review of the draft 2014 NOPGR, including the revised WFCP, was completed with CENWO and CENWK via conference call on May 27, 2015. MUD addressed the comments provided, which included a final revised WFCP, and submitted a final NOPGR (on June 2, 2015) that addressed the comments provided by the CENWO and CENWK representatives.

#### 1.3.1.7 2015 NOPGR Summary

Observed groundwater elevations, chemical sampling data, and updated groundwater model results for the 2015 water year were presented in the 2015 NOPGR (BMcD, 2016). The USACE reviewed the report and indicated there were no comments on the report, via email communication from CENWK staff dated January 22, 2015.

Following the submittal of the 2015 NOPGR, BMcD identified an error in the groundwater elevation hydrograph of monitoring well MW-110A. BMcD submitted a supplemental hydrograph for the well in March, 2016.

## 1.4 References to Previous Modeling Reports

As previously stated, the NOPGR is a submittal required by the Permit and is a continuation of a series of modeling studies and reports, of which the first report was developed in 2004. The NOPGRs are a summary of the hydrogeologic data collected during a one-year monitoring period and a summary of the update of an existing groundwater model. Given the ongoing nature of the modeling activities and the numerous modeling related submittals that have been completed during the life cycle of the well field project, it is not practical to include a detailed summary of all model construction, calibration, sensitivity, and post audit analyses performed from 2003 through 2015. If specific questions related to model construction, calibration, or sensitivity analysis arise during the review of the current NOPGR, it is assumed the reviewers of this document have access to copies of the previous groundwater modeling reports. The most comprehensive reference on model construction, model calibration, sensitivity analyses (both of calibration residuals and model predictions), and predictive analyses performed can be found in the Phase II modeling report, the *Platte West Well Field Groundwater Modeling Study* (Chatman and Associates, Inc., 2005). For ease of reference, copies of these documents were previously stored on the MUD website. Previous documents that are relevant to groundwater modeling include:

- Phase I Baseline Groundwater Modeling Report: *Well Field Groundwater Modeling Study* (Chatman and Associates, Inc., 2004);
- Phase II Groundwater Modeling Report: *Phase II Platte West Well Field Groundwater Modeling Study* (Chatman and Associates, Inc., 2005);
- 2008 NOPGR (Layne Christensen, 2009);
- 2009 NOPGR (HDR, 2010); and
- 2010 NOPGR (HDR, 2011).

### 1.4.1 Reporting Period

The reporting period for the 2016 NOPGR report coincides with the United States Geological Survey (USGS) Water Year, from October 1 of the previous year to September 30 of the current year. This reporting period was also used in past NOPGR reports with the exception of the 2012 NOPGR report, which used a reporting period of October 1 of 2011 through the end of August 2012.

# 2.0 WELL FIELD PUMPING

Intermittent well field pumping began in July 2008 from both the Douglas and Saunders County sides of the well field. Much of the well field pumping conducted in July and August 2008 was related to: filling plant basins, testing plant equipment, and shakedown testing of the overall well field, piping, and treatment process. Pumping associated with shakedown testing continued through the middle of October 2008. The well field did not operate from mid-November 2008 to mid-February 2009.

The well field began pumping operations on February 11, 2009 and has continued operations through the end of this reporting period (September 2016), completing the eighth calendar year of operation. Each supply well in the well field is equipped with an individual flow meter, which allows for accurate measurement of individual well flow rates. The well field Supervisory Control and Data Acquisition (SCADA) system tracks total flow from each well, in mgd. Those daily data are provided by MUD to Burns & McDonnell (BMcD) and are used to calculate the pumping rates input into the NOPGR modeling update. A chart illustrating the monthly well field pumping rate for the duration of well field operations, including the 2016 reporting period has been included as Figure 2-1.

As in past years, pumping on an annual basis was well below the regulated NDNR water use permits. Water production for the 2016 USGS water year was the second lowest yearly total since the wellfield began operation and was again significantly below both the record high production year of 2011 (37.2 mgd for the 2011 USGS water year) and the regulated capacity of 52 mgd. For the 2016 reporting period, the average monthly pumping rate fluctuated from a low of 19.1 mgd, recorded in March 2016, to a high of 44.4 mgd recorded in June 2016. The average annual pumping rate for the 2016 water year was 28.5 mgd. Average monthly flow rates are summarized in Table 2-1 below.

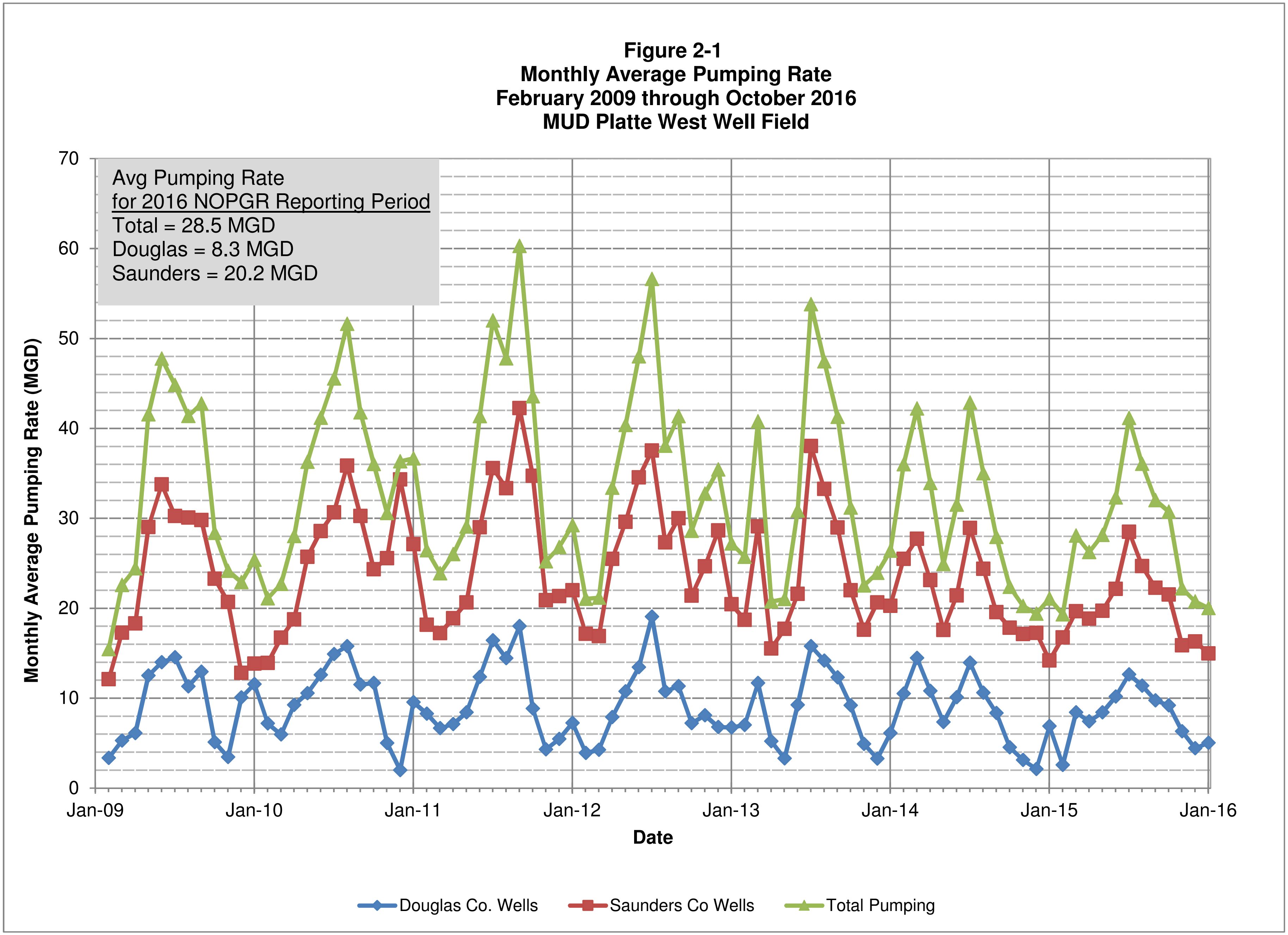


Figure 2-1
Monthly Average Pumping Rate
February 2009 through October 2016
MUD Platte West Well Field
Avg Pumping Rate
for 2016 NOPGR Reporting Period
Total = 28.5 MGD
Douglas = 8.3 MGD
Saunders = 20.2 MGD
Monthly Average Pumping Rate (MGD)
0
10
20
30
40
50
60
70
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Date
Douglas Co. Wells
Saunders Co Wells
Total Pumping

**Table 2-1: Average Well Field Pumping Rate by Month**

| Year | 2015 | | | 2016 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP |
| Douglas Co. Monthly Average Pumping (mgd) | 9.20 | 6.32 | 4.44 | 5.04 | 6.03 | 4.665 | 6.97 | 7.16 | 13.65 | 14.07 | 12.27 | 10.38 |
| Saunders Co. Monthly Average Pumping (mgd) | 21.53 | 15.88 | 16.31 | 14.98 | 14.27 | 14.48 | 16.77 | 17.99 | 30.80 | 29.96 | 26.19 | 22.90 |
| Totalized Well Field Monthly Average Pumping (mgd) | 30.7 | 22.2 | 20.8 | 20.0 | 20.3 | 19.1 | 23.7 | 25.2 | 44.4 | 44.0 | 38.5 | 33.3 |
| Percentage of Well Field Flow from Douglas Co. | 29.9% | 28.5% | 21.4% | 25.2% | 29.7% | 24.4% | 29.4% | 28.5% | 30.7% | 31.9% | 31.9% | 31.2% |

## 2.1 Pumping Distribution

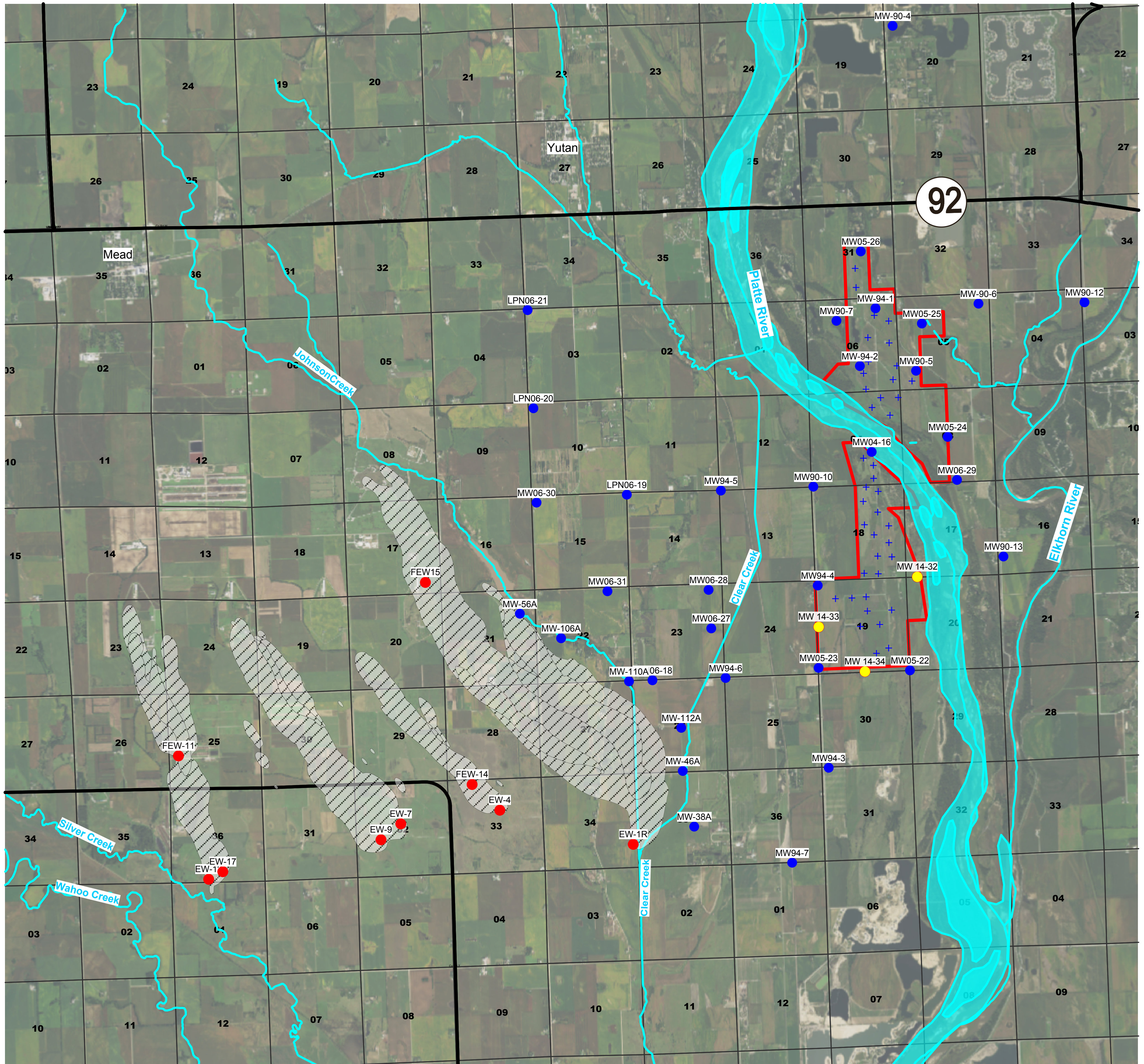
The operational plan for the well field was to simultaneously pump water from both the Douglas County and Saunders County sides of the well field at an approximate distribution of 35 and 65 percent of total pumping, respectively. This pumping distribution is not a condition of the Permit, but rather a design concept for how the well field and treatment plant would be operated. As shown in Table 2-1 above, the well field was operated with an average pumping distribution of approximately 29 percent of the total flow being supplied by the Douglas County side of the well field. As operated, the average daily pumping distribution was 8.3 mgd from the Douglas County wells and 20.2 mgd from the Saunders County wells. This pumping distribution will continue to fluctuate seasonally, depending on several variables including water demand, streamflow, and other climatic conditions.

# 3.0 HYDROLOGIC DATA ANALYSIS

The following section presents an analysis of the hydrologic data collected as part of the monitoring program associated with the operation of the well field. The data includes pre- and post-well field startup conditions and are comprised of water levels collected at observation wells and stream stage and flow data collected at existing USGS stream gages.

MUD began collecting water levels from monitoring wells located in Douglas, Sarpy, and Saunders Counties in 1990. The monitoring well network was expanded in Douglas and Saunders Counties in 1995, and later expanded again with the addition of new monitoring wells in 2004 through 2006. All monitoring wells currently located in MUD's groundwater monitoring network are illustrated on Figure 3-1. Initially, water levels were measured manually at regular time intervals using electronic water level indicators; however, in 2004 MUD began equipping all of their monitoring wells with pressure transducers/data loggers. Each pressure transducer/data logger collects and records a water level measurement at least once per day. Presently, MUD continues to make manual water level measurements, typically twice a year, to check the accuracy of the pressure transducers/data loggers. The more recent water level data collection program, initiated as part of the Permit operating conditions, supplements the historical data collected by MUD and was evaluated in context with the more than 20 years of historical water level data collected prior to operation of the well field. Appendix 3-1 includes updated historical hydrographs from eight (8) monitoring wells in Douglas County (MW90-4, MW90-5, MW90-6, MW90-7, MW90-12, MW90-13, MW94-1, and MW94-2) and six (6) monitoring wells in Saunders County (MW90-10, MW94-3, MW94-4, MW94-5, MW94-6, and MW94-7). Appendix 3-2 contains updated hydrographs from several monitoring wells (listed in Section 3.2.1 below) in Douglas and Saunders Counties, which include water level data beginning in 2007 or 2008. The updated hydrographs presented in Appendix 3-1 and Appendix 3-2 includes water level data through the end of the current NOPGR reporting period (September 2016).

The objective of the analysis presented in the NOPGR is to use the hydrologic data and analyses presented in this section to evaluate potential impacts to the FNOP contaminant plumes and hydraulic containment system which could occur as a result of well field pumping. Because the FNOP contaminant plumes and hydraulic containment system are located in Saunders County, and the Platte River forms a hydraulic divide between Saunders and Douglas Counties, only hydrologic data from Saunders County were incorporated into the analysis of well field impact. Data collected from the Douglas County side of the well field have been included in the NOPGR to evaluate the overall performance of the groundwater model. However, these data are not relevant to issues related to the FNOP site.




METROPOLITAN UTILITIES DISTRICT

## Platte West Well Field
## Nebraska Ordnance Plant
## Groundwater Report

## Figure 3-1
## Groundwater Monitoring Network

LEGEND:

MW94-5 — Transducer Equipped Monitoring Well

MW14-33 — New Monitoring (Sentry) Well

Platte West Well Field Water Supply Well

FNOP Containment/Focused Extraction Well (Operating During 2016)

FNOP Site Combined TCE and RDX Plumes

Note:
1) Transducers were installed in the New Monitoirng (Sentry) Wells in 2015.

MAP SCALE (feet)

0 3000 6000

1 inch = 6,000 feet

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## 3.1 New Monitoring (Sentry) Wells

Three new monitoring (sentry) wells, MW14-32, MW14-33, and MW14-34, were installed in October 2014 as part of the recommendations presented in the revised WFCP. The new monitoring wells were installed at the locations shown on Figure 3-1. The wells are located in close proximity to the well field where influence from irrigation pumping on groundwater levels is limited.

The new monitoring wells are equipped with pressure transducers and will be used as part of the WFCP hydraulic monitoring program. Pressure transducers were installed in August 2015, in wells MW14-32 and MW14-34, and in November 2015 in well MW14-33. The transducers in wells MW14-32 and 14-34 did not begin recording data until June 2016 due to a programming error when installed. All available water level data collected from these three new monitoring wells is presented in Section 3.2.3 Well Field Contingency Plan Levels.

## 3.2 New Hydrologic Data

Water level measurements were collected and recorded at all wells located in the monitoring network that was developed in cooperation with the USACE, as prescribed by Permit Condition 62a. The monitoring network is shown on Figure 3-1 and consists of 38 monitoring wells equipped with pressure transducers. The monitoring wells are operated and maintained by one of three organizations: Lower Platte North Natural Resource District (LPNNRD), MUD, or the USACE.

MUD began monitoring water levels at well MW90-09 again this year (Figure 3-2). This well is located in Douglas County, several miles northeast of the well field. Water level measurement was also resumed at well MW90-03, which is located south of Valley. This well is monitored by the USGS and the Papio Missouri NRD as part of a program to study aquifers levels. These data can be accessed on the groundwater section of the USGS website under site number 1757096202501. The following sections describe the hydrologic data that were utilized to evaluate the impact of the well field on the Platte Valley alluvial aquifer.

### 3.2.1 Hydrograph Interpretations

A water level hydrograph was plotted for each monitoring well equipped with a pressure transducer, and is included in Appendix 3-1 or Appendix 3-2. In Douglas County, these wells include: MW05-24, MW05-25, MW05-26, MW06-29, MW90-4, MW90-5, MW90-6, MW90-7, MW90-12, MW90-13, MW94-1, and MW94-2. In Saunders County, these wells include: MW04-16, MW05-22, MW05-23, MW06-27, MW06-28, MW06-30, and MW06-31, MW90-10, MW94-3, MW94-4, MW94-5, MW94-6, and MW94-7. Pressure transducer data from well MW06-27 are not included in this NOPGR because field staff could not successfully connect to (and communicate with) the pressure transducer in that well. Manual readings were still collected for MW06-27 during the reporting period and the water level hydrograph for the well is included in Appendix 3-2 with the Saunders County wells. Data for wells MW06-30 and MW06-31 were not available during the development of the 2016 NOPGR. No other significant equipment errors were observed during the 2016 water year in the wells that are maintained by MUD.

Hydrographs were also generated for wells located in Saunders County that are not operated and maintained by MUD. These include wells MW06-18, MW06-19, MW06-20, and MW06-21, which are operated and maintained by the LPNNRD, and wells MW-38A, MW-46A, MW-56A, MW-106A, MW-110A, and MW-112A which are maintained by the USACE. These wells are all part of the well field monitoring well network, shown on Figure 3-1.

Manual water level elevations for the USACE wells were obtained from the FNOP water level database, which was transmitted to BMcD from CENWK. All data provided to BMcD by MUD, USACE, and the LPNNRD as of December 30, 2016 have been used to develop the hydrographs presented in this section.

##### 3.2.1.1.1 MW 110A

Following the submittal of the 2015 NOPGR, BMcD identified an error in the groundwater elevation hydrograph of monitoring well MW-110A. The error identified was a discrepancy between the transducer data collected after August 2012 and the manual water level measurements collected for this well.

The cause of the error in the hydrograph of monitoring well MW-110A was determined to be an inadvertent change to how the water level measurements are referenced by the pressure transducer. Specifically, beginning in August 2012, field staff inadvertently changed the water level reference to pounds per square inch (psi) of pressure above the transducer probe. Previously, the data was collected and reported as depth to water level (in feet), from the top of casing. Once the data collected from this well were updated to account for this change in reference measurement, the transducer data closely matched the field water level measurements. The hydrograph for MW 110A has been revised to account for this change.

#### 3.2.1.2 Response of Wells near Well Field

The updated hydrographs for the monitoring wells located less than one mile from the well field illustrate that groundwater levels near the well field have been in a general recovery phase since the Fall of 2013. This general recovery trend is evident in the hydrographs for MW90-10, MW94-3, MW94-4, MW04-16, MW05-22, MW05-23, MW90-5, MW94-1, and MW94-2. This recovery in groundwater levels near the well field is attributed to a combination of factors, including: continued recovery from the drought of

2012, higher than average precipitation and streamflow conditions in 2015, decreased well field pumping due to lower water demand (2015), and decreased regional irrigation pumping as a result of a cooler and wetter than average summer. Climatic conditions which contributed to the continued water level recovery are discussed later in this section.

#### 3.2.1.3 Response of Wells Over One Mile from Well Field

Monitoring wells located more than one mile from the boundary of the well field that are owned and operated by MUD include MW94-5, MW94-6, MW94-7, MW06-27 and MW06-28. The hydrographs developed for these wells illustrate that water level elevations approximately one mile from the well field have recovered (approximately) to pre-well field pumping levels (pre-February 2009). This recovery trend in the groundwater levels at these four monitoring well sites is largely attributed to the absence of an irrigation pumping signal for the summer of 2016. It appears that less irrigation was required during the summer of 2016 due to the higher than average precipitation observed during the spring and summer months. The decrease in irrigation pumping combined with favorable climatic conditions contributed to the rise in groundwater elevation near the well field.

The monitoring wells operated and maintained by the USACE and LPNNRD have historically shown impact from near-by irrigation pumping and have shown no signs of being impacted by well field operations. In most of these wells, pumping associated with the irrigation season causes the water level elevations to decline, followed by a period of water level recovery after the irrigation season is complete. Review of these hydrographs indicates that nearly all of the monitoring wells have experienced significant water level recovery since the sharp declines in water level elevation observed in the summer of 2012 through 2014, and water levels have recovered to pre-2012 drought conditions at some of the monitoring well sites. Specifically, the water level elevation in all four LPNNRD monitoring wells all appear to have fully rebounded to pre-2012 drought levels.

The groundwater level fluctuation observed at these monitoring well sites are highly influenced by the presence or absence of seasonal irrigation pumping or climatic conditions and are not related to the operation of the well field. This statement is supported by the hydraulic monitoring data and groundwater modeling presented within this (and previous) NOPGR updates.

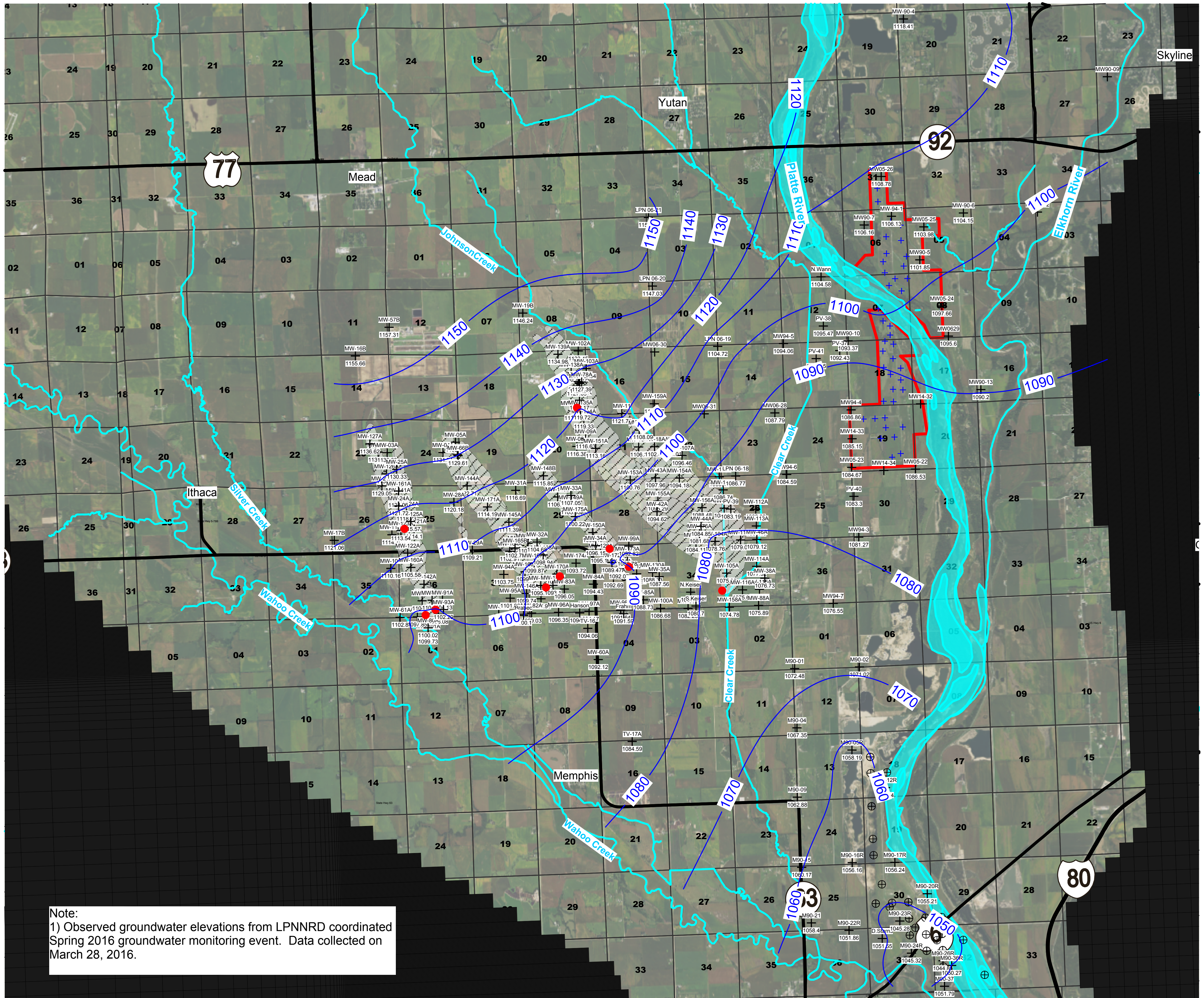
### 3.2.2 Potentiometric Surface Contour

Contours of the potentiometric surface of the Platte Valley alluvial aquifer and the Todd Valley aquifer were developed using data collected during the LPNNRD-coordinated water level monitoring event conducted at the end of March 2016. A potentiometric surface map is shown on Figure 3-2. Water level measurements are taken by the following organizations in an effort to better document the potentiometric surface within Saunders County:

- LPNNRD;
- MUD;
- Kansas City District Corps of Engineers (CENWK); and
- United States Geological Survey (USGS).

Approximately 190 monitoring wells were used to develop the potentiometric surface map of the study area, the locations of which are shown on Figure 3-2 along with the elevation of the measured water level. Previous NOPGR submittals included numerous potentiometric surface maps, including several developed before the well field was constructed, for comparison purposes. The magnitude and direction of the hydraulic gradient presented on Figure 3-2 continues to be very similar to previous potentiometric surface maps generated by others, including:

- Souders, 1967. Availability of Water in Eastern Saunders County, Nebraska;
- Nebraska Department of Natural Resources, 1995. Configuration of the Water Table, 1995;
- Chatman and Associates, Inc., 2005. Phase II Platte West Well Field Groundwater Modeling Study;
- URS, 2006. 2006 Groundwater Modeling Report Operable Unit No. 2; and
- Previous NOPGR studies.




Note:
1) Observed groundwater elevations from LPNNRD coordinated Spring 2016 groundwater monitoring event. Data collected on March 28, 2016.

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## Figure 3-2
## March 2016 Observed Potentiometric Surface (ft msl)

LEGEND:

- MW06-29 / 1095.6 — Observation Well with Measured Water Level Elevation in ft msl
- Interpreted Potentiometric Surface Elevation Contour (ft msl) Contour Interval = 10 feet
- FNOP Site Combined TCE and RDX Plumes

**Pumping Wellfields Operating During March 2016 Water Level Event**

- Platte West Well Field Boundary
- Platte West Well Field Well
- FNOP Containment/Focused Extraction Well (Operating During 2015)
- Ashland City Well/Lincoln Well Field Well

MAP SCALE (feet)

0 4000 8000

N

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The potentiometric surface of the Platte Valley and Todd Valley aquifers presented on Figure 3-2 illustrates that the well field continues to remain hydraulically cross-gradient of the FNOP site after eight years of continuous pumping from the MUD Saunders County wells. The pattern and shape of the potentiometric surface in the Todd Valley, where the majority of the FNOP site is located, has not changed due to the operation of the well field. Groundwater flow directions along the eastern perimeter of the FNOP site have not changed as a result of well field pumping.

The March 2016 potentiometric surface is nearly identical to that developed for the March 2012, March 2013, March 2014, and March 2015 water level events, with little to no change in the contour intervals near the MUD well field. When compared to the March 2015 potentiometric surface map, the data presented on Figure 3-2 show that water level elevations near the well field have risen by one to two feet, especially in areas immediately south of the well field.

### 3.2.3 Well Field Contingency Plan Levels

A WFCP was developed by MUD in 2008 to address one of the Permit requirements for the well field. The objective of the WFCP was to use hydraulic data from the monitoring network to evaluate potential impact on the FNOP site from well filed pumping. Water quality monitoring is also included in the WFCP; however, the focus of the WFCP is monitoring groundwater elevation data and comparing that data to predicted water level changes resulting from well field pumping.

During the development of the 2012, 2013, and 2014 NOPGR reports, MUD noted impacts on groundwater elevations observed within the monitoring network resulting from the increased development of center pivot irrigation within the Platte River alluvial aquifer. The impact of this increased irrigation pumping within the WFCP monitoring network prompted MUD to revisit the hydraulic monitoring trigger levels developed in the original WFCP (Layne Christensen, 2008b). As a result, MUD developed a revised WFCP that shifts the focus of the water level monitoring network to wells that are located closer to the Well Field. The objective of the revised WFCP was to modify the existing hydraulic monitoring program in a way that reduced the impact from local irrigation. The revised protocol for monitoring water level elevations around the Well Field was approved by CENWO and CENWEK in June 2015. The 2015 NOPGR was the first NOPGR to use the voluntary trigger values developed in the revised WFCP.

Groundwater elevation hydrographs for the four existing Sentry (formerly Priority One) monitoring wells (MW90-10, MW94-4, MW05-22, and MW05-23) and the three new Sentry monitoring wells (MW14-32, MW14-33, and MW14-34) are presented in Appendix 3-3. These hydrographs illustrate the historical groundwater elevations measured near the well field, along with each monitoring well's Tier I and Tier II trigger values. The groundwater elevations measured in the WFCP Sentry monitoring wells are much higher than the Tier I or Tier II groundwater elevations established for each respective well, meaning neither the Tier I or Tier II levels were triggered in 2015 or 2016. This is likely due to a combination of climatic and water demand related factors; primarily, decreased well field pumping and decreased regional irrigation pumping resulting from an above average precipitation and streamflow year.

## 3.3 Climatic Conditions and Streamflow

During this NOPGR reporting period, eastern Nebraska continued its sustained recovery from the 2012 drought, as determined by the National Drought Mitigation Center (NDMC, 2015). The recovery from the drought of 2012 was aided by a 2016 water year that was characterized by higher than average precipitation and average temperatures. Streamflow conditions for the 2016 water year were characterized as normal to above normal by the USGS, with no periods of below normal streamflow.

As a result of the wetter than average spring and summer, there was an overall decrease in the demand for water needed for municipal or irrigation use. This decrease in water demand, coupled with the recharge events from high streamflow conditions, contributed to the rise in groundwater level elevation observed near the well field.

### 3.3.1 Streamflow

Streamflow conditions within the study area were evaluated using data posted and distributed by USGS National Water Information System (USGS, 2016). To evaluate the streamflow conditions of local water bodies near the well field, hydrologic data was obtained from the following USGS gaging stations:

- Platte River – at Leshara;
- Platte River – at Venice (near the well field); and
- Elkhorn River – at Waterloo.

Hydrographs for each of the listed USGS gauge sites are provided in Appendix 3-4. Streamflow conditions in the Platte and Elkhorn Rivers were above normal conditions throughout the majority of the 2016 water year, with high streamflow observed during the summer months of 2016. The normal to above normal streamflow conditions contributed to the sustained recovery from the 2012 drought, and also contributed to the rebound observed in the groundwater elevations near the well field.

#### 3.3.1.1 Platte River

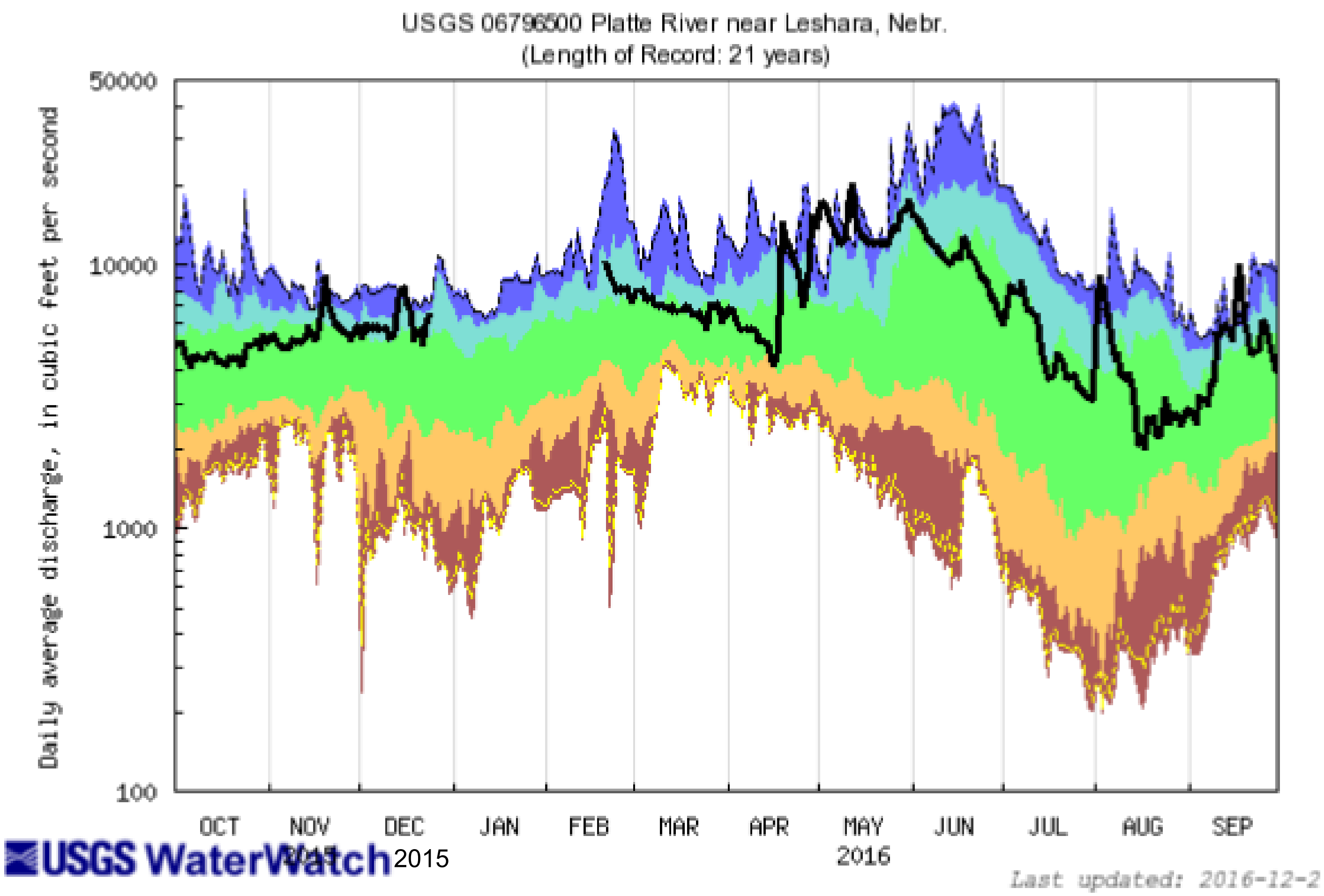
Using the USGS provisional data, the calculated mean flow for the 2016 water year for the stream gage on the Platte River near Leshara, NE (06796500) was over 6,716 cubic feet per second (cfs). According to the USGS flow duration curve for this station, this flow is significantly higher than the fifty percent exceedance flow of 4,420 cfs over the period of record (water years 1994 to 2015). The stream flow observed in 2016 is significantly higher than the median stream flow observed in the drought years of 2012 and 2013, which was 3,407 and 3,301 cfs, respectively (USGS water data report 2013). As shown on Figure 3-3, streamflow conditions for the Platte River during the 2016 water year can generally be characterized as normal to above normal. Streamflow in the summer months of 2016 was characterized as normal to above normal.

#### 3.3.1.2 Elkhorn River

The mean flow for the 2016 water year for the USGS gage on the Elkhorn River at Waterloo (06800500) was 2,976 cfs. This flow is higher than the 50 percent exceedance flow of 806 cfs over the period of record (water year 1928 to 2015) according to the USGS flow duration curve for this station. Stream flow conditions for the Elkhorn River during the 2016 water year can be characterized as above normal to much above normal during the majority of the year (Figure 3-4).

### 3.3.2 Precipitation and Temperature

Additional hydrological data collected during the 2016 NOPGR included monthly total precipitation and monthly average ambient air temperature. The monthly total precipitation and monthly average ambient air temperature were both obtained from the weather station at Fremont Municipal Airport in Fremont, Nebraska. The 2016 precipitation and temperature data and the historical average monthly precipitation and temperature have been graphed over time (Figure 3-5). As shown, the observed precipitation was above normal in spring and summer of 2016. Average ambient air temperature in 2016 fell within the expected monthly high and low temperature range, based on historical averages.




| Explanation - Percentile classes | | | | | |
|---|---|---|---|---|---|
| lowest-10th percentile | 10-24 | 25-75 | 76-90 | 90th percentile -highest | Flow |
| Much below normal | Below normal | Normal | Above normal | Much above normal | |

Note:
Source of graph is:
http://waterwatch.usgs.gov/

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**Figure 3-3**
**Duration Hydrograph for the Platte River at Leshara**

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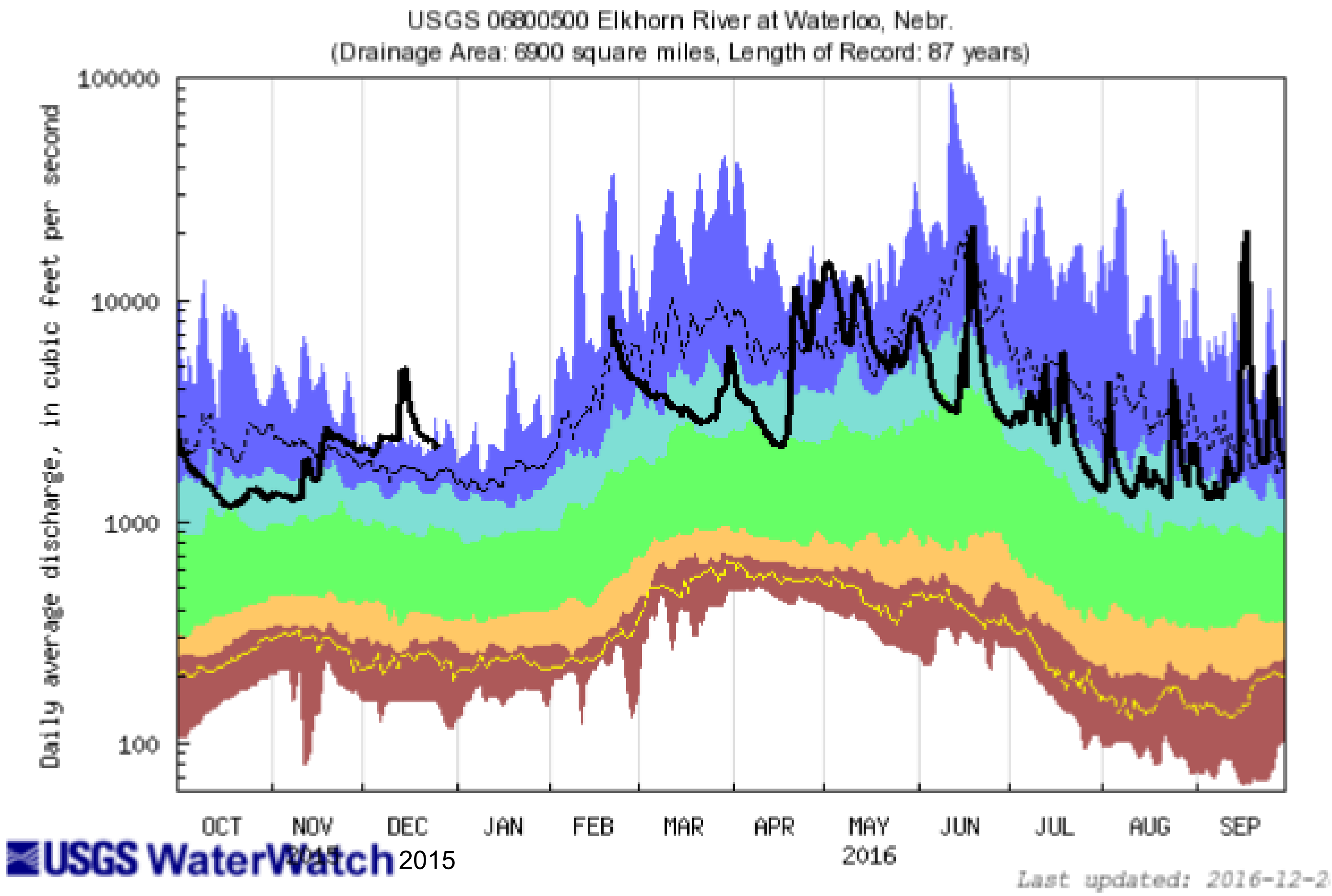


| Explanation - Percentile classes | | | | | |
|---|---|---|---|---|---|
| lowest-10th percentile | 10-24 | 25-75 | 76-90 | 90th percentile -highest | Flow |
| Much below normal | Below normal | Normal | Above normal | Much above normal | |

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**Figure 3-4**
**Duration Hydrograph for the Elkhorn River at Waterloo**

Note:
Source of graph is:
http://waterwatch.usgs.gov/

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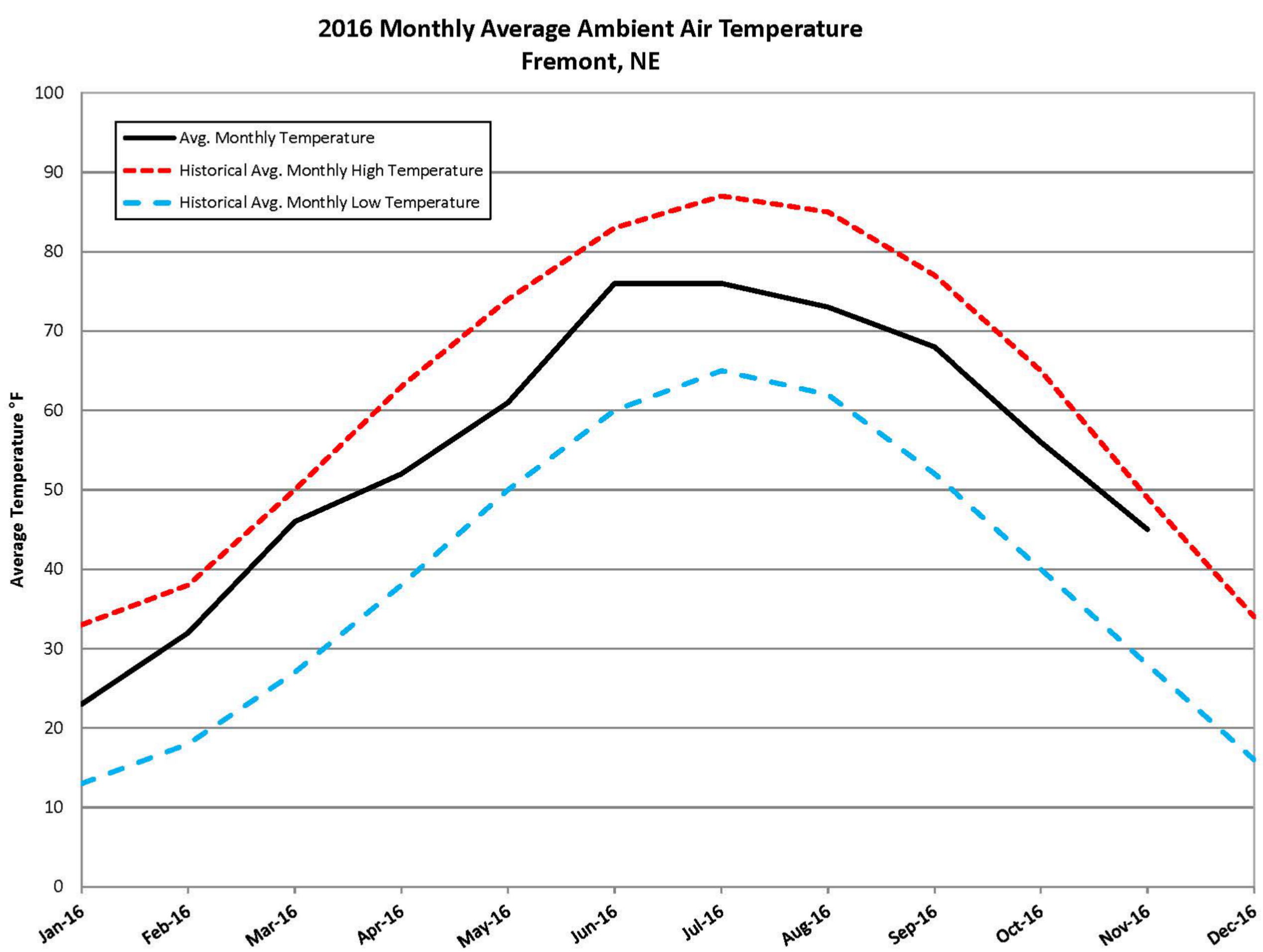
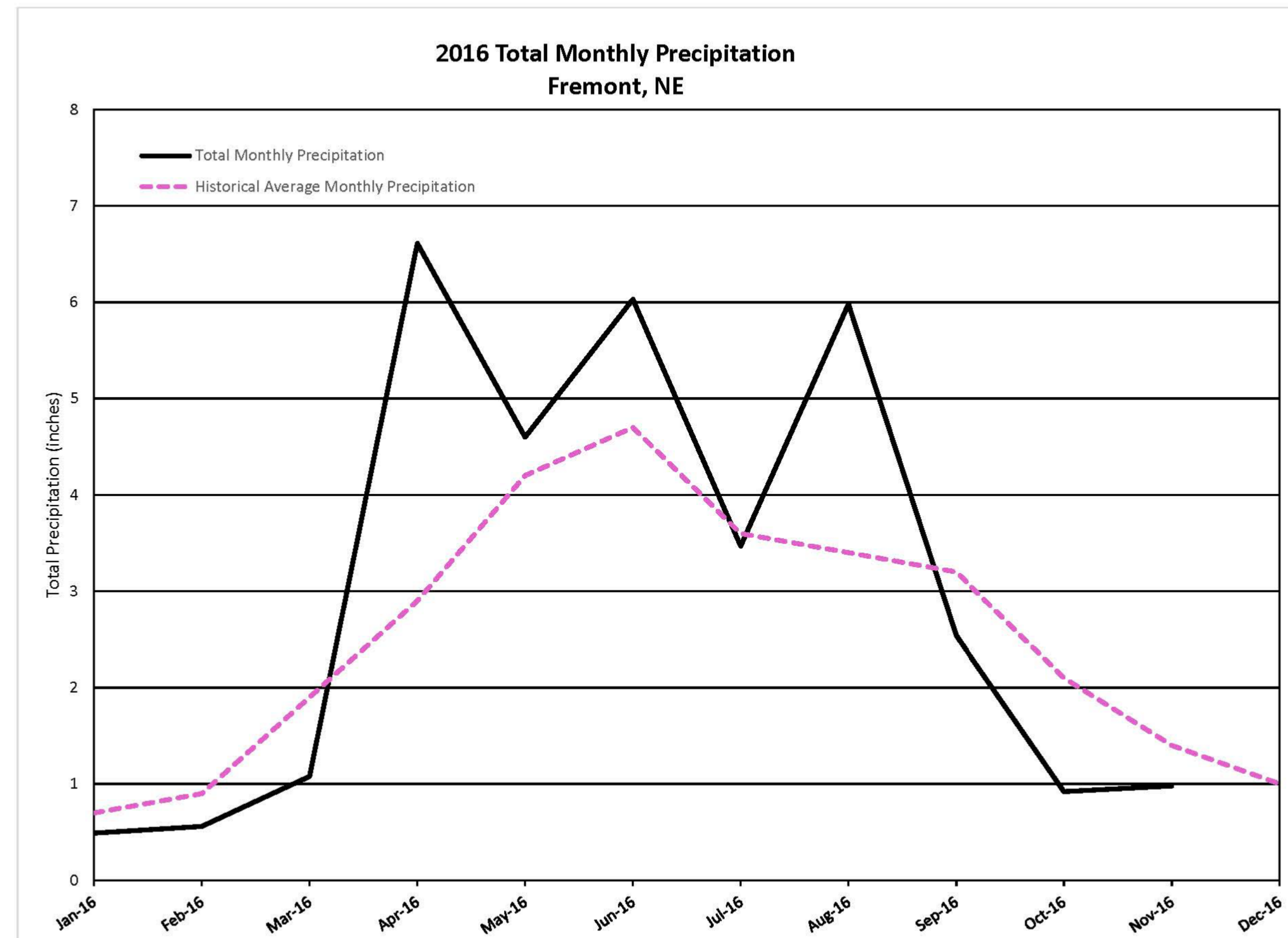
Figure 3-5
Climatic Data Near Well Field

## Monthly Temperature




## Monthly Precipitation




Note:
The Temperature and Precipitation Data Shown Were Collected from a Weather Station at the Fremont Municipal Airport in Fremont, Nebraska.

# 4.0 WATER QUALITY DATA ANALYSIS

The following section presents an analysis of the groundwater quality data collected as part of the monitoring program associated with the operation of the well field. The groundwater quality data collected includes pre- and post-well field startup data and consists of groundwater samples collected from wells that are part of the monitoring network that was developed in coordination with the USACE. The objective of the analysis presented in this NOPGR is to evaluate the potential impact of well field operations on the travel path of the FNOP contaminant plumes and the remediation efforts at the FNOP site.

## 4.1 Baseline FNOP Plume

A total of seven chemicals were assigned cleanup goals for the FNOP site by the United States Environmental Protection Agency (USEPA) in the Record of Decision (ROD) document. Three of these chemicals are classified as volatile organic compounds (VOCs) and the other four chemicals are classified as explosives. Trichloroethylene (TCE) is the most commonly detected VOC at the site and is used as an indicator for VOCs at the site. Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) is the most commonly detected explosive compound in groundwater at the FNOP site and is used as an indicator for explosives in groundwater at the site. Site-specific cleanup goals and details on the use of RDX and TCE as indicator compounds to define the extent of groundwater contamination at the FNOP site can be found in the 2009 Containment Evaluation (ECC, 2010).

As required by the Permit, MUD requested and obtained the most recent interpretation of the extent of the FNOP contaminant plumes. This interpretation of the current understanding of the extent of the FNOP plumes, as provided by CENWK for 2016, is presented in Appendix 4-1. Email correspondence with the FNOP project manager confirmed that this interpretation was appropriate for use in the 2016 NOPGR.

### 4.1.1 Historical Water Quality Data

A groundwater quality monitoring program was initiated by MUD in 2005 to collect background and pre-well field startup groundwater chemistry data from wells located within MUD's groundwater monitoring network. These data are summarized in the following monitoring reports:

- 2005 Annual Groundwater Monitoring Report (MUD, 2006);
- 2006 Annual Groundwater Monitoring Report (MUD, 2007); and
- 2007 Annual Groundwater Monitoring Report (MUD, 2008).

The post-startup groundwater chemistry data collection program supplements the historical data collected by MUD since 2005 and was evaluated in context with the data collected prior to the well field startup.

### 4.1.2 2016 NOPGR Water Quality Data

Under an agreement with MUD, Olsson Associates (OA) conducted two rounds of groundwater sampling during this reporting period: May 2016 and October 2016. The wells sampled by OA include wells: MW06-18 A and B, MW06-30 A and B, and MW06-31 A and B. The locations of these wells are shown on Figure 3-1. The MW-39 well cluster consisting of MW-39A and MW-39D was abandoned in 2012 after an evaluation of the FNOP monitoring well network by CENWK; therefore, this well cluster is no longer sampled by MUD. The groundwater samples collected from the wells were analyzed for VOCs and for explosives. All laboratory analyses were performed by Test America, Inc. of Burlington, Vermont.

The results of both the May 2016 and October 2016 sampling events are summarized by OA in a Quality Control Summary Report (QCSR), which are included in Appendix 4-2. Complete sampling results are presented in Tables 3-3 and 3-4 of the QCSRs. A summary of the sampling events is presented below:

- May 2016 event - there were no unqualified VOC or explosive compounds detected above the reporting limits, except for 4-Nitrotoluene. 4-Nitrotoluene was detected in samples MW06-031A and MW06-030A at concentrations exceeding its reporting limit. 4-Nitrotoluene is not a Chemical of Concern (COC) listed in the ROD for the FNOP site.

- October 2016 event - there were no unqualified VOC or explosive compounds detected above the reporting limits.

The FNOP indicator compounds or contaminants of concern (COCs), TCE and RDX, were not detected above their reporting limit in any of the samples collected during either sampling event. Additionally, none of the other compounds assigned a cleanup goal in the ROD were detected above their reporting limit during either 2016 sampling event.

# 5.0 GROUNDWATER MODEL SIMULATIONS

As discussed in Section One, a groundwater flow model was developed to help predict the impact of the Platte West well field once it began operating. The model updates performed as part of the 2016 NOPGR incorporate the well field pumping and hydrologic data presented in Sections Two and Three of this report to evaluate the impact of well field operations on the potentiometric surface of the Platte Valley and Todd Valley aquifers.

## 5.1 Model Period Structure

The accuracy of the groundwater model was demonstrated in the 2009 through 2013 NOPGR modeling evaluations, which were developed as model post audits and were performed under transient conditions. In 2014, the NOPGR groundwater modeling evaluation was modified to simulate steady state conditions. This change was made because well field pumping has remained fairly consistent from year to year, and the cone of depression generated from well field pumping was relatively stable.

The groundwater model update performed as part of the 2016 NOPGR is consistent with the procedure used to update the groundwater model in the 2014 and 2015 NOPGR. The model update was performed using time weighted average pumping rates for each of the well field production wells and the model was run assuming steady state conditions. This was done because the well field has operated for over eight years at fairly constant average annual pumping rate, as summarized below in Table 5-1.

**Table 5-1: Average Annual Total Well Field Pumping by Calendar Year**

| Calendar Year | Average Annual Pumping (mgd) |
|---|---|
| 2009 | 32.4 |
| 2010 | 34.7 |
| 2011 | 36.6 |
| 2012 | 35.5 |
| 2013 | 32.2 |
| 2014 | 30.2 |
| 2015 | 28.2 |
| 2016 | 29.8 |

As a result of the fairly consistent pumping rate, the drawdown induced by pumping from the well field has stabilized at most of the monitoring well sites located near the well field and is approaching a quasi-steady state condition. For this report, quasi-steady state is described as a condition where the water level (or drawdown) changes caused by well field pumping are negligible with time.

The hydrographs presented in Section 3.2.1.1 show the water level declines observed in the monitoring wells located near the well field boundary have reached a reasonably stable condition, confirming the quasi-steady condition. Therefore, it is possible to compare the range of drawdown observed at these wells compared to the drawdown predicted by a steady state model that is run using the average pumping rate of the well field over the eight year operating period. This analysis is presented in the Section 5.2.

## 5.2 Quasi-Steady State Evaluation

BMcD updated the steady state groundwater model to include well specific eight year pumping rates and then compared the model predicted drawdown values to the range of drawdown observed in the near well field monitoring wells. The well field has operated for over eight years at an average 32.5 mgd total pumping rate with 23.4 mgd coming from the Saunders County wells. After a period of initial drawdown, water level elevations at the near well field monitoring wells have stabilized to within a range of observed values that is smaller than the initial drawdown observed. This provides an opportunity to bracket the range of drawdown observed at each near well field monitoring well and to use that observed data as a way to test the predictive capability of the Phase II steady state groundwater model. The following procedure was used to update the steady state model:

1. Revised the pumping rate for each MUD production well to reflect the eight (8) year annual average pumping rate for that well.
2. Input the 2016average pumping rate for the NOPGR containment wells and focused extraction wells.
3. Ran the model assuming steady state conditions.
4. Subtracted the resulting groundwater elevation field in the groundwater model from the initial head conditions (no pumping) to obtain model predicted drawdown at 32.5 mgd.
5. Compared the model predicted drawdown to the observed range of drawdown for the monitoring wells located near the well field.

No changes were made to the model parameterization of the steady state model other than what is described above. The Phase II steady state model was developed assuming normal streamflow (and steady) conditions in the Platte River, which at the development of that model was a streamflow of approximately 4,600 cfs at the Leshara gage.

### 5.2.1 Steady State Model Results

Over the eight year period from 2009 through 2016, water level elevations in the Platte River alluvial aquifer were influenced by many factors including climatic conditions, variable streamflow in the Platte

River, local irrigation pumping and other factors that cannot be simulated in steady state models. However, the temporal changes in the water level elevations of the monitoring wells that are located near the well field can be bracketed within a range of observed values using visual inspection and statistical analysis.

A comparison between the drawdown predicted using the modified Phase II model and the range of long-term drawdown observed in these wells was performed to qualitatively evaluate the accuracy of the steady state model. A summary of the model predicted steady state drawdown, for monitoring wells located near the well field, is presented in Table 5-2. This table summarizes the observed drawdown at these wells using statistical analysis, as summarized below:

a. The water level elevation measured for each monitoring well on February 9, 2009. This water level elevation represents the pre-pumping water surface elevation for each monitoring well and is similar to the pre-pumping elevation in the steady state model.
b. The mean and median water level elevation for each monitoring well over a period of February 11, 2009 through September 30, 2016.
c. The standard deviation of the water level elevation for each monitoring well over a period of February 11, 2009 through September 30, 2016.

Assuming a normal distribution, 68 percent of the measured water level elevations collected during the period from February 11, 2009 through September 30, 2016 should fall within the measured average water elevation plus or minus one (1) standard deviation. This statistical approach provides a method to quantitatively evaluate the long term average drawdown by simply performing a calculation of a minus b (where a and b are defined in the list above). The mean water level was used to calculate the long term average drawdown for each monitoring well. The seasonal observed drawdown at each monitoring well can also be calculated by adding c to the calculation of a minus b (where a, b, and c are defined in the list above).

**Table 5-2**
**Comparison of Model Predicted and Observed Steady State Drawdown**
**32.5 MGD Simulation Using Average Eight Year Pumping Rate and Water Level Elevations**

| | | | | Statistical Analysis of Measured Water Levels | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Monitoring Well ID** | **Computed Pre-pumping Steady State Water Level Elevation (ft msl)** | **Computed Water Level Elevation for Steady State 32.5 MGD Simulation** | **Model Predicted Drawdown Steady State 32.5 MGD Simulation** | **Water Level Elevation Before Startup - February 10, 2009 (ft msl)** | **Water Level Elevation - End of 2016 NOPGR Period (ft msl)** | **Mean Water Level Elevation - Post Startup (ft msl)** | **Median Water Level Elevation - Post Startup (ft msl)** | **Standard Deviation of Water Level Elevation Post Startup (feet)** | **Average Eight Year Drawdown (feet)** | **Seasonal Eight Year Drawdown (feet)** | **Difference Between Model Predicted and Average Eight Year Drawdown (feet)** |
| **Saunders County Monitoring Wells** | | | | | | | | | | | |
| MW 05-22 | 1,088.70 | 1,085.57 | 3.13 | 1,087.56 | 1,084.88 | 1084.21 | 1,083.89 | 1.48 | 3.35 | 4.82 | -0.21 |
| MW 05-23 | 1,086.97 | 1,082.96 | 4.01 | 1,085.77 | 1,083.54 | 1,082.33 | 1,081.98 | 1.92 | 3.43 | 5.36 | 0.58 |
| MW 06-27 | 1,086.28 | 1,084.41 | 1.87 | 1,086.94 | 1085.87* | 1,085.19 | 1,085.40 | 1.25 | 1.75 | 3.01 | 0.12 |
| MW 06-28 | 1,088.69 | 1,086.76 | 1.93 | 1,088.43 | 1,087.41 | 1,087.19 | 1,087.36 | 1.07 | 1.24 | 2.32 | 0.69 |
| MW 90-10 | 1,098.35 | 1,093.76 | 4.59 | 1,095.62 | 1,091.43 | 1,091.80 | 1,091.82 | 1.67 | 3.82 | 5.50 | -0.77 |
| MW 94-3 | 1,081.88 | 1,080.48 | 1.40 | 1,080.23 | 1,080.78 | 1,079.60 | 1,079.49 | 1.52 | 0.63 | 2.15 | -0.77 |
| MW 94-4 | 1,091.54 | 1,084.82 | 6.72 | 1,090.36 | 1,085.13 | 1,084.17 | 1,084.19 | 2.24 | 6.20 | 8.44 | -0.52 |
| MW 94-5 | 1,097.09 | 1,095.26 | 1.83 | 1,094.56 | 1,093.96 | 1,093.09 | 1,093.23 | 1.19 | 1.47 | 2.66 | -0.36 |
| MW 94-6 | 1,083.68 | 1,081.87 | 1.81 | 1,083.83 | 1,083.45 | 1,082.51 | 1,082.63 | 1.39 | 1.31 | 2.71 | -0.49 |
| **Douglas County Monitoring Wells** | | | | | | | | | | | |
| MW 05-25 | 1,104.08 | 1,101.08 | 3.00 | 1,104.03 | 1,103.33 | 1,102.59 | 1,102.97 | 1.67 | 1.45 | 3.11 | -1.55 |
| MW 90-5 | 1,102.52 | 1,098.43 | 4.10 | 1,102.34 | 1,099.79 | 1,099.59 | 1,099.85 | 1.81 | 2.74 | 4.55 | -1.36 |
| MW 90-6 | 1,102.95 | 1,101.30 | 1.66 | 1,103.61 | 1,103.98 | 1,103.08 | 1,103.23 | 1.35 | 0.53 | 1.88 | -1.12 |
| MW 90-7 | 1,106.74 | 1,104.54 | 2.20 | 1,106.72 | 1,105.36 | 1,104.99 | 1,105.34 | 1.38 | 1.73 | 3.11 | -0.47 |
| MW 94-1 | 1,106.02 | 1,102.82 | 3.21 | 1,106.55 | 1,105.41 | 1,104.84 | 1,105.09 | 1.58 | 1.71 | 3.29 | -1.49 |
| MW 94-2 | 1,104.83 | 1,100.76 | 4.07 | 1,105.16 | 1,103.28 | 1,102.57 | 1,102.86 | 1.65 | 2.58 | 4.23 | -1.48 |

Notes:
*Closest data available to end of 2016 NOPGR period: manual reading from 11/10/2016
1) End of 2016 NOPGR period is September 30, 2016
2) Eight year average pumping rate of 32.5 MGD (total well field)

As summarized in Table 5-2 and shown on Figure 5-1, the model predicted steady state drawdown for monitoring wells located within one (1) mile of the well field is generally in good agreement with the observed drawdown calculated using the average post startup water level. For the monitoring wells located on the Saunders County side of the well field, the difference between the model-predicted steady state drawdown and the drawdown calculated using the average post startup water level ranges from 0.12 to 0.77 feet. The absolute residual mean error of these drawdown residuals is 0.5 feet for the nine Saunders County monitoring wells. This comparison shows that the range of observed drawdown in the near well field monitoring wells (after eight years of pumping) is very close to, and generally less than, what was predicted using the Phase II steady state model once the individual pumping rates were adjusted to reflect their eight year average.

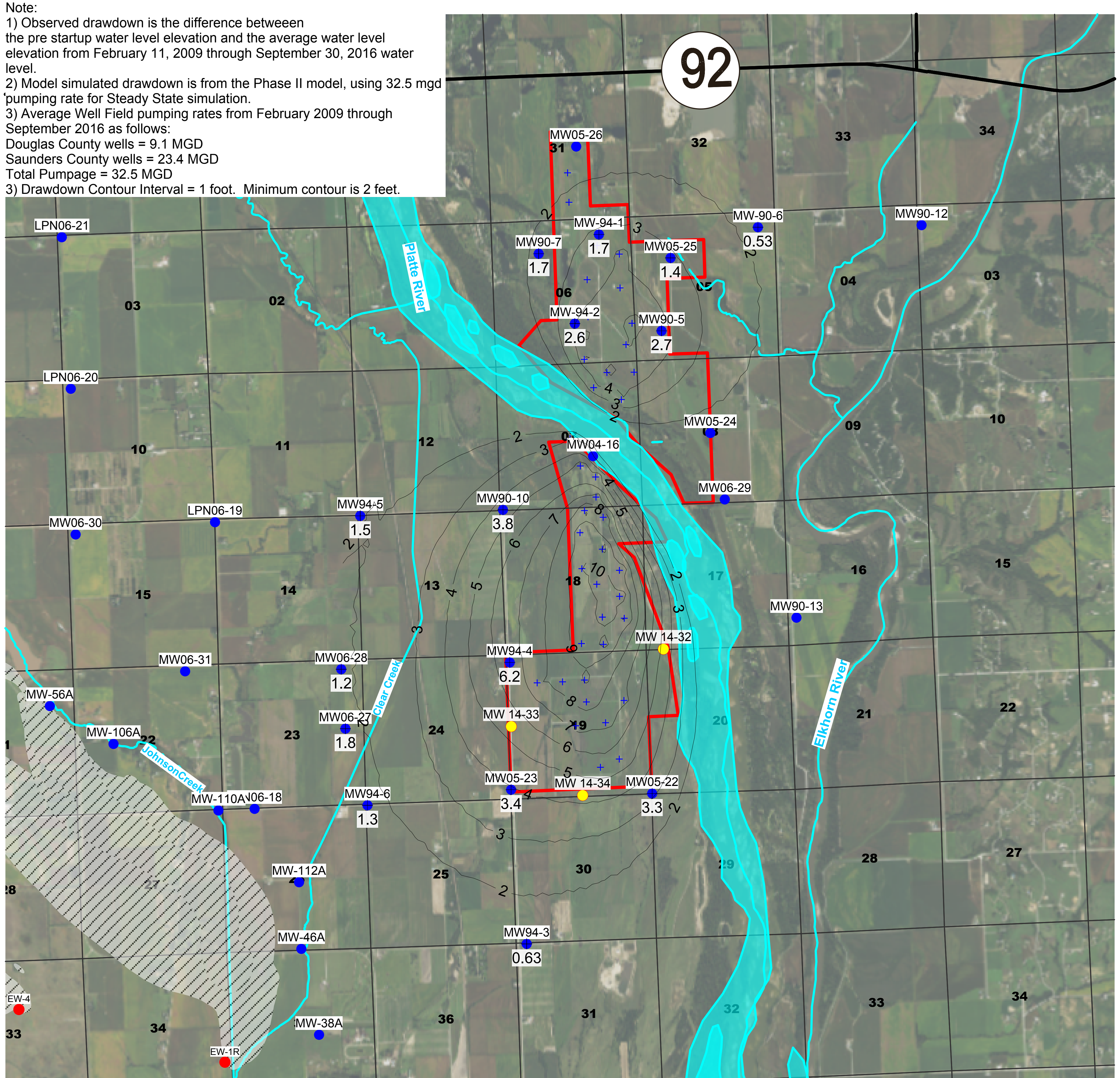
The maximum operating conditions simulated in the Phase II steady state model (CAI, 2005) assumed a total well field pumping rate of 52 mgd, with the Saunders County wells operating at approximately 33 mgd. The 52 mgd pumping rate is the permitted maximum annual average pumping rate for the well field. Over the first eight years of well field pumping, the Saunders County wells have been operated at approximately 70 percent of that modeled steady state condition which represented the maximum design condition of the well field.

## 5.3 Particle Tracking

NOPGR reports from 2009 through 2014 included a particle tracking simulation, performed using the MODPATH code, to illustrate the model-predicted travel path of hypothetical groundwater particles located along the perimeter of the FNOP contaminant plumes. The particle tracking simulation was performed using transient conditions for the full length of well field operations through the 2014 reporting period, and included the reported pumping from the FNOP wells and Platte West well field wells from October 2008 to September 2014. These simulations showed that operation of the well field did not alter the well-documented historical flow path of the contaminant plumes located on the eastern edge of the FNOP site.

Since the 2016 well field pumping rate was the second lowest recorded to date, a particle tracking simulation was not performed as part of the 2016 NOPGR. Particle tracking will be revisited in future NOPGR updates if there is a substantial increase in well field pumping relative to the peak year pumping that was experienced in 2011.

Note:
1) Observed drawdown is the difference betweeen the pre startup water level elevation and the average water level elevation from February 11, 2009 through September 30, 2016 water level.
2) Model simulated drawdown is from the Phase II model, using 32.5 mgd pumping rate for Steady State simulation.
3) Average Well Field pumping rates from February 2009 through September 2016 as follows:
Douglas County wells = 9.1 MGD
Saunders County wells = 23.4 MGD
Total Pumpage = 32.5 MGD
3) Drawdown Contour Interval = 1 foot. Minimum contour is 2 feet.




# Platte West Well Field
# Nebraska Ordnance Plant
# Groundwater Report

## Figure 5-1
## Comparison of Observed Well Field Drawdown and Model Predicted Steady State Drawdown

LEGEND:

MW05-22 3.4 — Transducer Equipped Observation Well with Measured Drawdown(using long term average water level elevation) in feet

MW14-33 — New Monitoring (Sentry) Well

Platte West Well Field Well

FNOP Containment/Focused Extraction Well (Operating During 2016)

FNOP Site Combined TCE and RDX Plumes

Model Predicted Drawdown (ft msl) - 32.5 mgd steady state simulations with 8 year average pumping rates. Contour Interval is one foot.

MAP SCALE (feet)

0 4000 8000

METROPOLITAN UTILITIES DISTRICT

BURNS & McDONNELL

## 5.4 Forecasted Operations

The intent of the forecast models was to simulate the response of the aquifer based on projected pumping rates from MUD and also based on projected climatic conditions. Actual well field pumping rates vary depending on water demand. As of the development of this report MUD anticipates operating the well field in a manner that is consistent with previous years.

NOPGR reports from 2009 through 2013 included a section for forecasted modeling simulations; however, forecast, modeling simulations were not included beginning with the 2014 NOPGR. The projected well field pumping rates for 2017 are less than the peak year pumping that was experienced in 2011. The five (5) years of operational data presented in the 2009 through 2014 NOPGRs provide real world data on the aquifer response to this type of pumping stress from the well field and developing forecast model simulations would provide little to no benefit. Therefore, because no significant increase in well field pumping is anticipated, forecast model simulations were not developed for this NOPGR. Forecast modeling will be revisited in future NOPGR updates if there is a substantial increase projected in well field pumping.

# 6.0 SUMMARY AND CONCLUSIONS

The 2016 NOPGR is a continuation of the annual reporting structure developed for the previous NOGPRs (2008 through 2015). The objective of the NOPGR is to use available hydrogeologic data, both physical and chemical, as well as groundwater modeling to evaluate the impact of the operations of the well field on the aquifer and, more specifically, on the contaminant plumes and remediation efforts at the FNOP. The 2016 NOPGR included a summary of well field pumping data, an evaluation of water level measurements collected from the CENWK and MUD monitoring well networks, a summary of the semi-annual groundwater sampling results, and an update of the groundwater flow model. By including all of these components in the 2016 NOPGR, MUD has developed a document that meets the requirements of the Permit.

## 6.1 Climatic Conditions and Well Field Pumping

The 2016 NOPGR reporting period was characterized by climatic conditions that led to low water production from the Platte West well field. These climatic conditions included higher than average precipitation and average temperatures. As a result of the cooler and wetter than average spring and summer, there was an overall decrease in the demand for water needed for municipal or irrigation use. This decrease in water demand, coupled with the recharge events from high streamflow conditions, contributed to the rise in groundwater level elevation observed near the well field.

## 6.2 Groundwater Levels

Hydrographs for the monitoring wells located less than one mile from the well field illustrate that groundwater levels near the well field have been in a general recovery phase since Fall 2013. These updated hydrographs also show that water levels near the well field have rebounded from low groundwater level elevations observed in 2012 and 2013. The rebound in groundwater elevations near the well field is attributed to a combination of climatic and pumping conditions, including: higher than average precipitation (2016), average monthly temperatures (2016), higher than average streamflow in the Platte River, decreased regional irrigation pumping, and decreased well field pumping.

The rebound in groundwater elevation from the low points observed in 2012 and 2013 was also observed in a majority of the monitoring wells that are located further than one mile from the well field and closer to the FNOP site. The general rebounding trend occurred even though the majority of these wells continue to clearly indicate an irrigation cycle signature, although the impact from irrigation pumping was less in 2016 than in previous years. An irrigation pumping cycle causes the water level elevation in the monitoring well to decline sharply and rapidly, followed by a period of water level recovery after the irrigation season is complete. Careful review of these hydrographs shows that nearly each of these wells experienced a sharp, short term, decline in water level elevation due to irrigation pumping in the summer 2012, 2013, and 2014, followed by a period of incomplete water level recovery. In contrast to that, in 2015 and 2016, the decline in water level observed in many of these monitoring wells was much less than in previous years and the recovery from irrigation pumping was much quicker and more complete than in previous years. The overall recovery trend in the groundwater elevations of these wells was likely aided by a shorter and less intense irrigation season, due to the higher than average precipitation observed in 2016.

The short term water level declines that have historically been observed in the monitoring wells that are located further than one mile from the well field are a result of local irrigation pumping and are not related to the operation of the well field. This statement is supported by the hydraulic monitoring data and groundwater modeling presented within this (and previous) NOPGR updates.

### 6.2.1 Potentiometric Surface

A potentiometric surface map was developed using approximately 190 monitoring wells which included data collected by CENWK, LPNNRD, and MUD. The potentiometric surface of the Platte Valley and Todd Valley aquifers presented on Figure 3-2 illustrates that the well field remains hydraulically cross-gradient of the FNOP site. The March 2016 potentiometric surface is nearly identical to that developed for previous water level events conducted in March (see the March 2012, March 2013, March 2014, and March 2015 examples), with little to no change in the contour intervals near the MUD well field. From this analysis, it can be concluded that the groundwater flow directions along the eastern perimeter of the FNOP site have not changed as a result of well field pumping.

## 6.3 Summary of Model Performance

The predictive capability of the groundwater model was evaluated by updating the steady state model to reflect the average pumping rates (from 2009 through 2016) for each well. Next, model predicted steady state drawdown was compared to an observed range of drawdown at monitoring wells that are located near the well field. The results from this model review showed that, when updated with real world pumping data, the steady state model developed a reasonable approximation of the drawdown observed at the monitoring wells located near the well field. This evaluation is consistent with previous NOPGR updates which indicated that the groundwater model is a reliable tool for evaluating the aquifer's response to pumping from the well field.

### 6.3.1 Groundwater Elevation and Chemical Sampling

Groundwater elevation and groundwater chemical sampling data collected from the MUD monitoring well network were evaluated and summarized as part of the 2016 NOPGR. The following presents a summary of those data.

#### 6.3.1.1 Summary of Contingency Plan Water Levels

As noted in Section 3, a revised WFCP was developed in 2014 to address the increased irrigation pumping within the WFCP monitoring network. The revised WFCP established new hydraulic trigger elevations for the sentry monitoring wells located near the well field. The 2016 water level elevations were higher than the Tier I and Tier II trigger levels for all of the sentry monitoring wells that are part of the WFCP monitoring network, meaning neither Tier I or Tier II levels were triggered in 2016.

#### 6.3.1.2 Summary of Chemical Sampling

Two rounds of groundwater sampling were conducted during this NOPGR reporting period, in May and October 2016. The FNOP indicator compounds or contaminants of concern (COCs), TCE and RDX, were not detected above their reporting limit in any of the samples collected during either sampling event. Additionally, none of the other compounds assigned a cleanup goal in the ROD were detected above their reporting limit during either 2016 sampling event.

## 6.4 Conclusions

The hydraulic data collected as part of this and previous NOPGR updates continues to support the conclusion that the groundwater flow direction in the Todd Valley aquifer has not changed due to the operation of the well field. The interpreted potentiometric surfaces from October 2008, March 2009, March 2010, March 2011, March 2012, August 2012, March 2013, March 2014, March 2015, and March 2016 demonstrate that the well field continues to remain hydraulically up-gradient and cross-gradient of the FNOP site.

Well hydrographs and groundwater modeling performed support the conclusion that the hydraulic influence of well field does not extend much beyond the location of wells MW94-3, MW94-5, MW94-6, MW06-27, and MW06-28. As summarized in Table 5-2 and Figure 5-1, both the observed data and groundwater modeling performed as part of this NOPGR indicate that the drawdown which can be attributed to well field pumping ranges from approximately one (1) to two (2) feet at these monitoring well locations. These observations are also consistent with the steady state groundwater modeling predictions developed as part of the Phase II model (CAI, 2005), which was constructed as part of the well field design process.

Regular chemical groundwater monitoring has been performed at several key monitoring wells located between the well field and the FNOP site. To date, no detections of the FNOP COCs (TCE and RDX) have been observed in these wells that are above reporting limits or have been validated through confirmation sampling.

The post audit presented in the 2009 and 2010 NOPGR and the current period analysis presented in the 2011, 2012, 2013, 2014, 2015, and 2016 NOPGR reports have shown that the groundwater modeling predictions presented in the *Phase II Platte West Well Field Groundwater Modeling Study* (Chatman and Associates, Inc., 2005) were reasonable approximations of how the aquifer would respond to the pumping from the Platte West well field. The hydraulic and chemical data collected to date, as well as the modeling analyses performed, support the conclusion that pumping from the Platte West well field is not adversely impacting the FNOP containment system efforts.

## 6.5 Future Updates

Future submittals of the NOPGR will remain consistent with the format of this submittal unless comments are provided which require a re-evaluation of the report format.

# 7.0 REFERENCES

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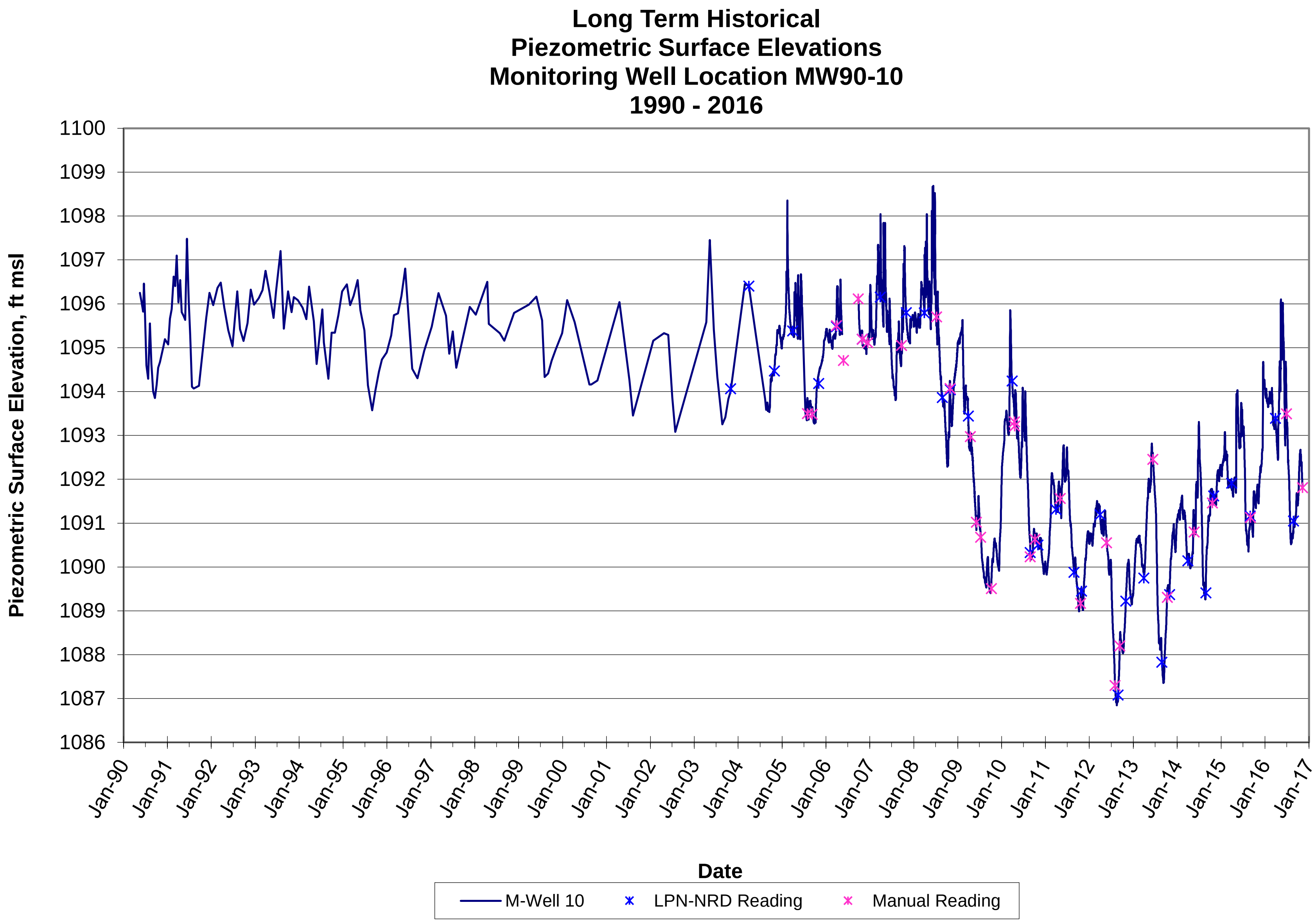
# APPENDIX 3-1 - LONGTERM HISTORICAL MONITORING WELL HYDROGRAPHS

# Saunders County Wells



Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW90-10
1990 - 2016
Piezometric Surface Elevation, ft msl
1100
1099
1098
1097
1096
1095
1094
1093
1092
1091
1090
1089
1088
1087
1086
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
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Jan-13
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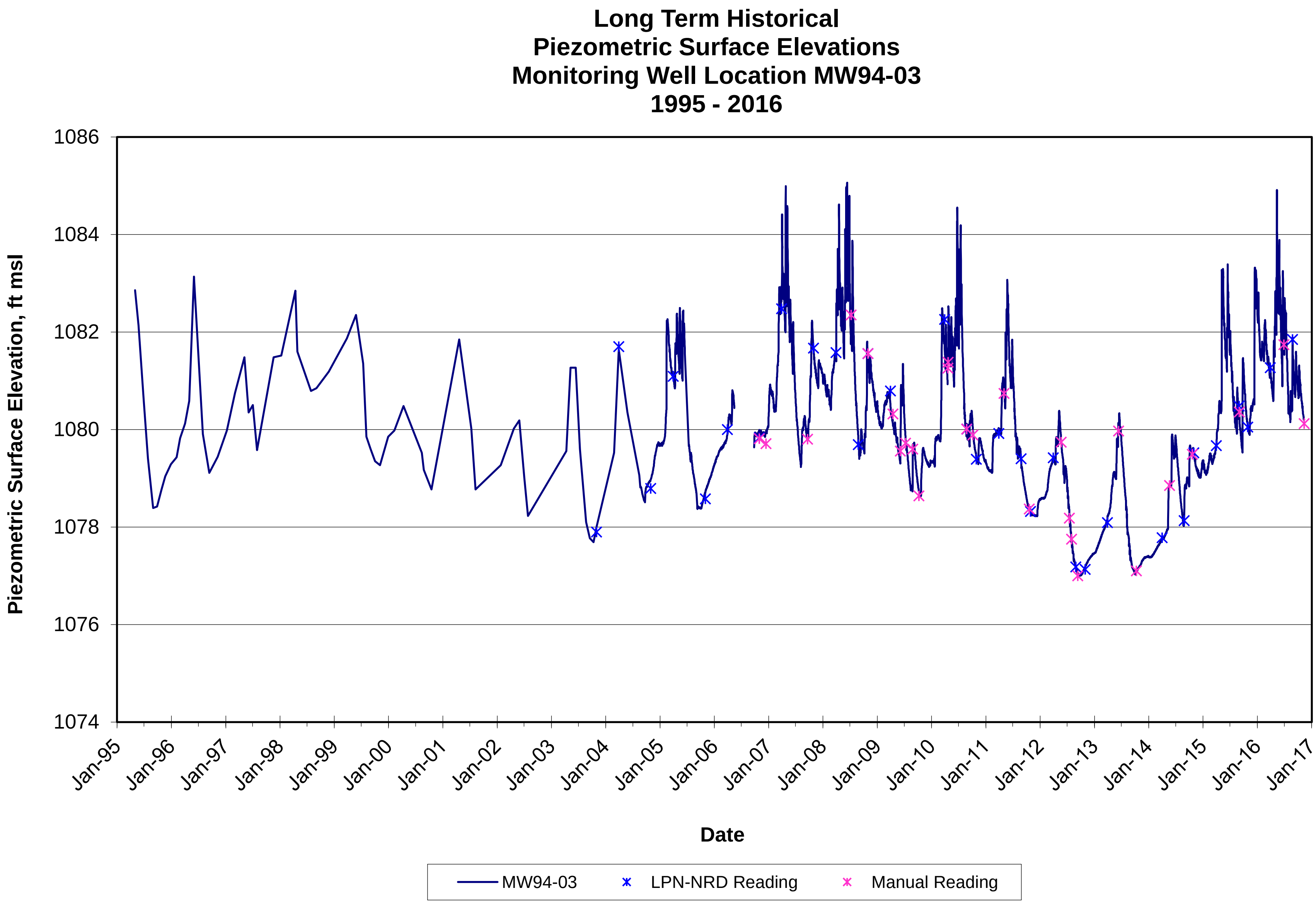
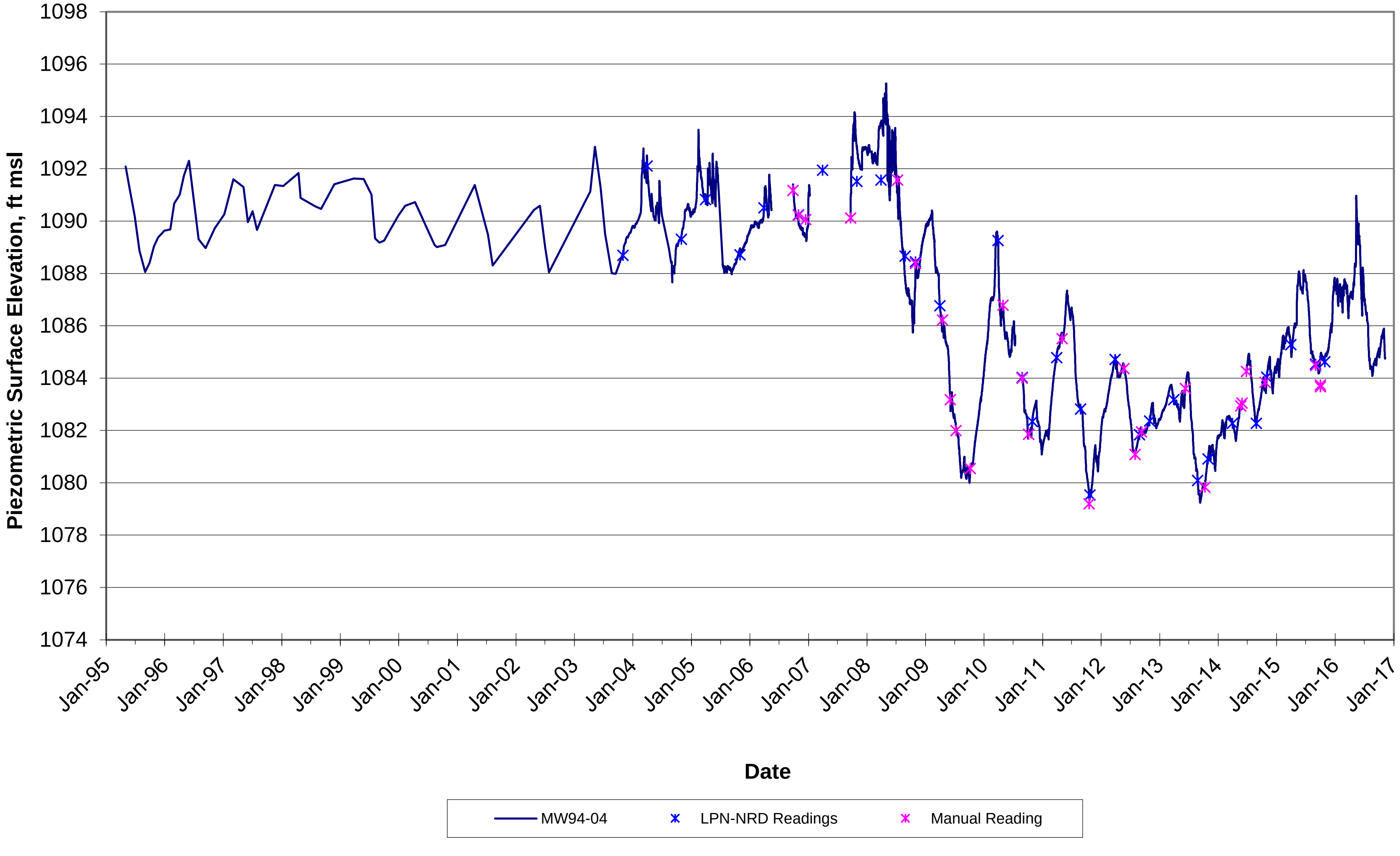
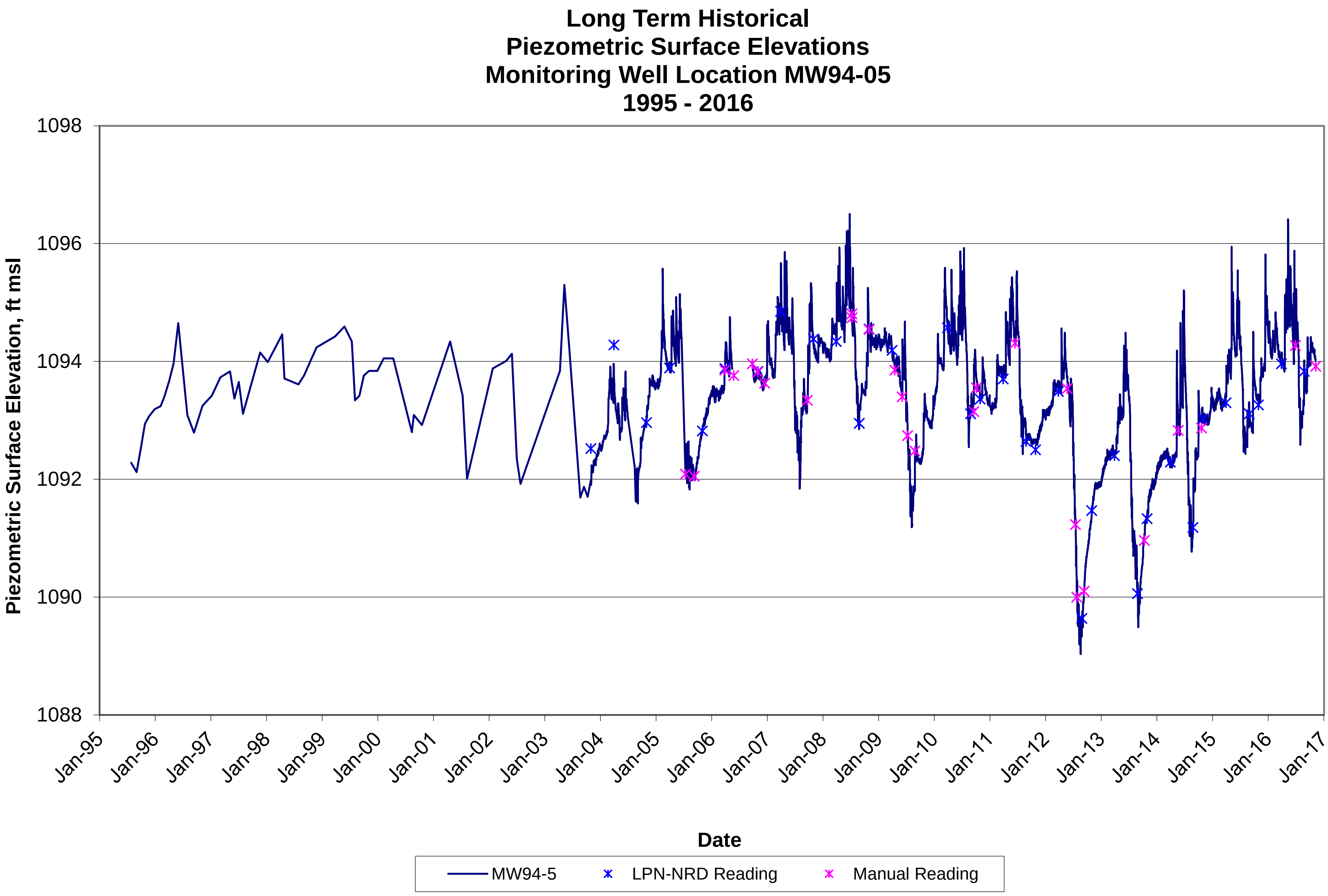
Jan-15
Jan-16
Jan-17
Date
M-Well 10
LPN-NRD Reading
Manual Reading



Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW94-03
1995 - 2016
1086
1084
1082
1080
1078
1076
1074
Piezometric Surface Elevation, ft msl
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Date
MW94-03
LPN-NRD Reading
Manual Reading

**Long Term Historical**
**Piezometric Surface Elevations**
**Monitoring Well Location MW94-04**
**1995 - 2016**





Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW94-05
1995 - 2016
Piezometric Surface Elevation, ft msl
1098
1096
1094
1092
1090
1088
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
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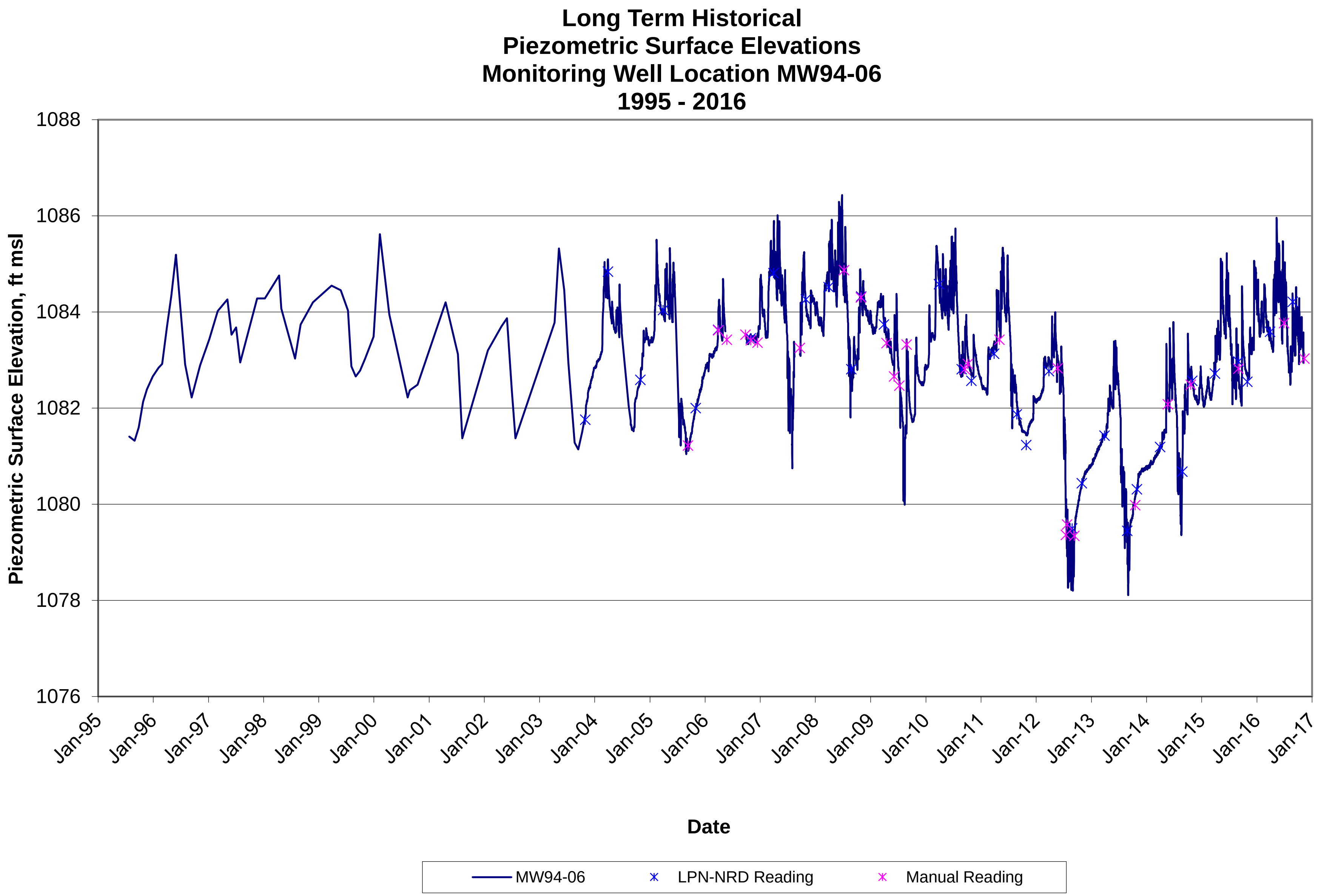
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Date
MW94-5
LPN-NRD Reading
Manual Reading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Piezometric Surface Elevations
Monitoring Well Location MW94-06
1995 - 2016
Piezometric Surface Elevation, ft msl
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1086
1084
1082
1080
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1076
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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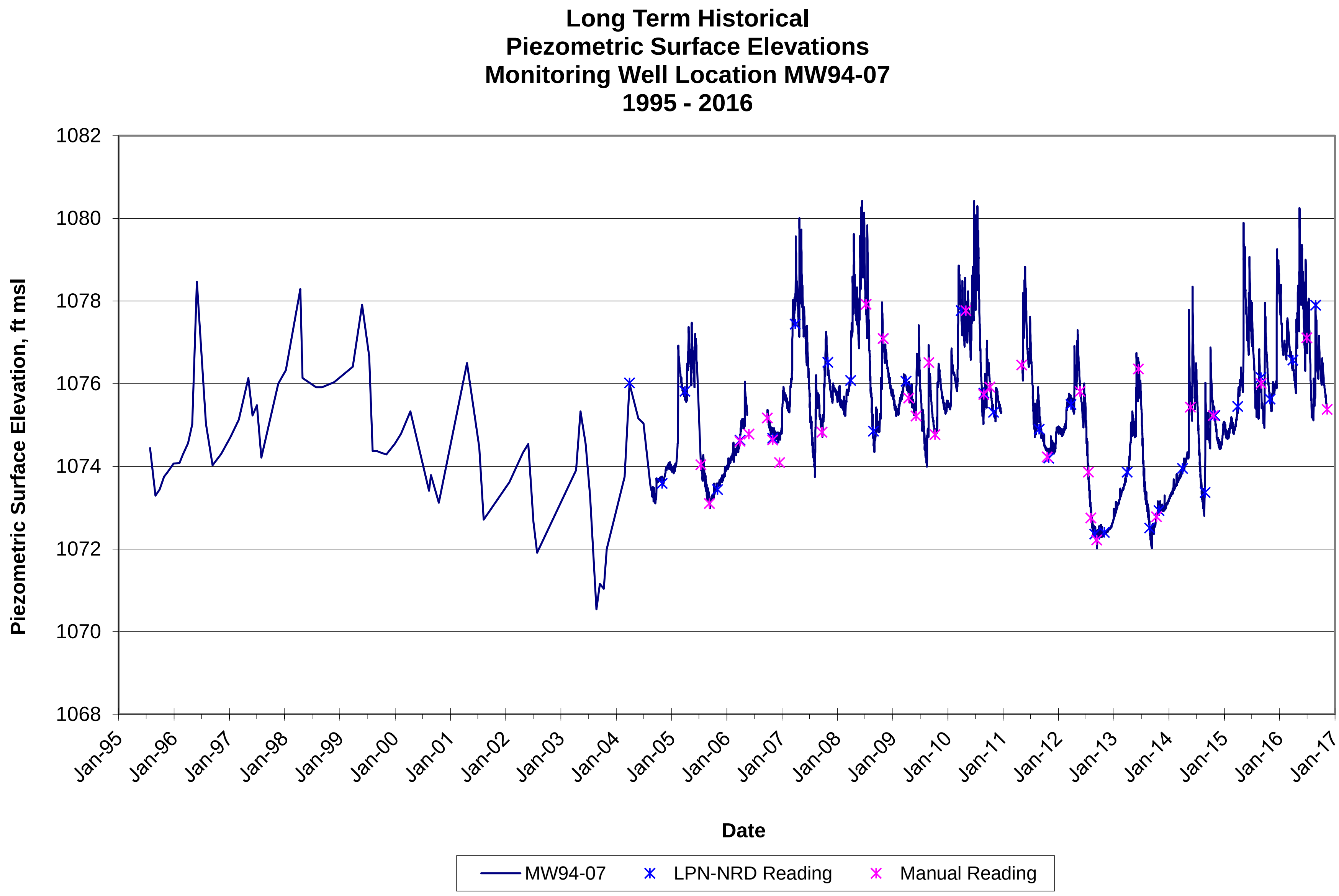
Manual Reading



Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW94-07
1995 - 2016
1082
1080
1078
1076
1074
1072
1070
1068
Piezometric Surface Elevation, ft msl
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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Jan-09
Jan-10
Jan-11
Jan-12
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Jan-14
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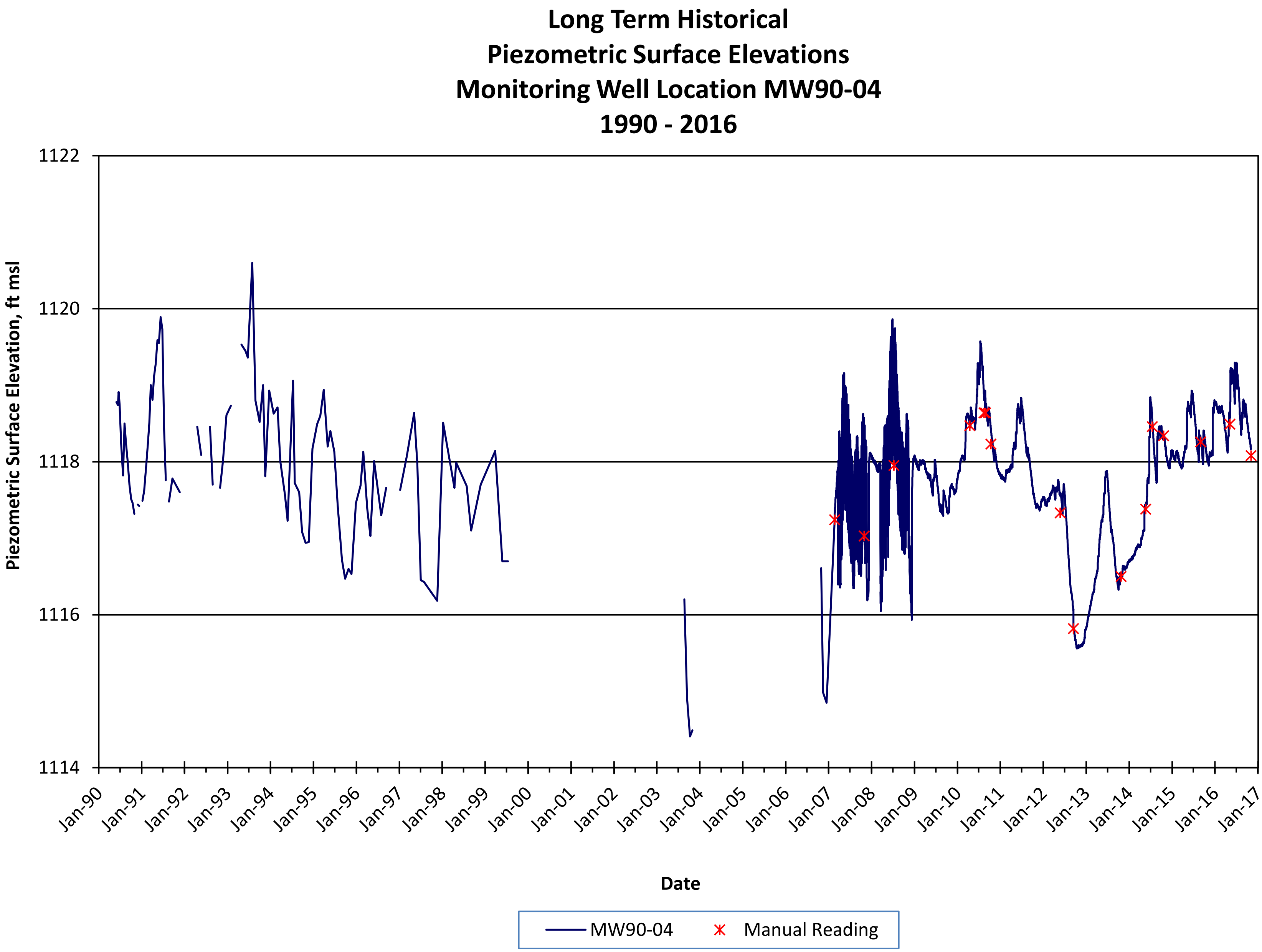
Jan-16
Jan-17
Date
MW94-07
LPN-NRD Reading
Manual Reading

# Douglas County Wells



Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW90-04
1990 - 2016
Piezometric Surface Elevation, ft msl
1122
1120
1118
1116
1114
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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Jan-08
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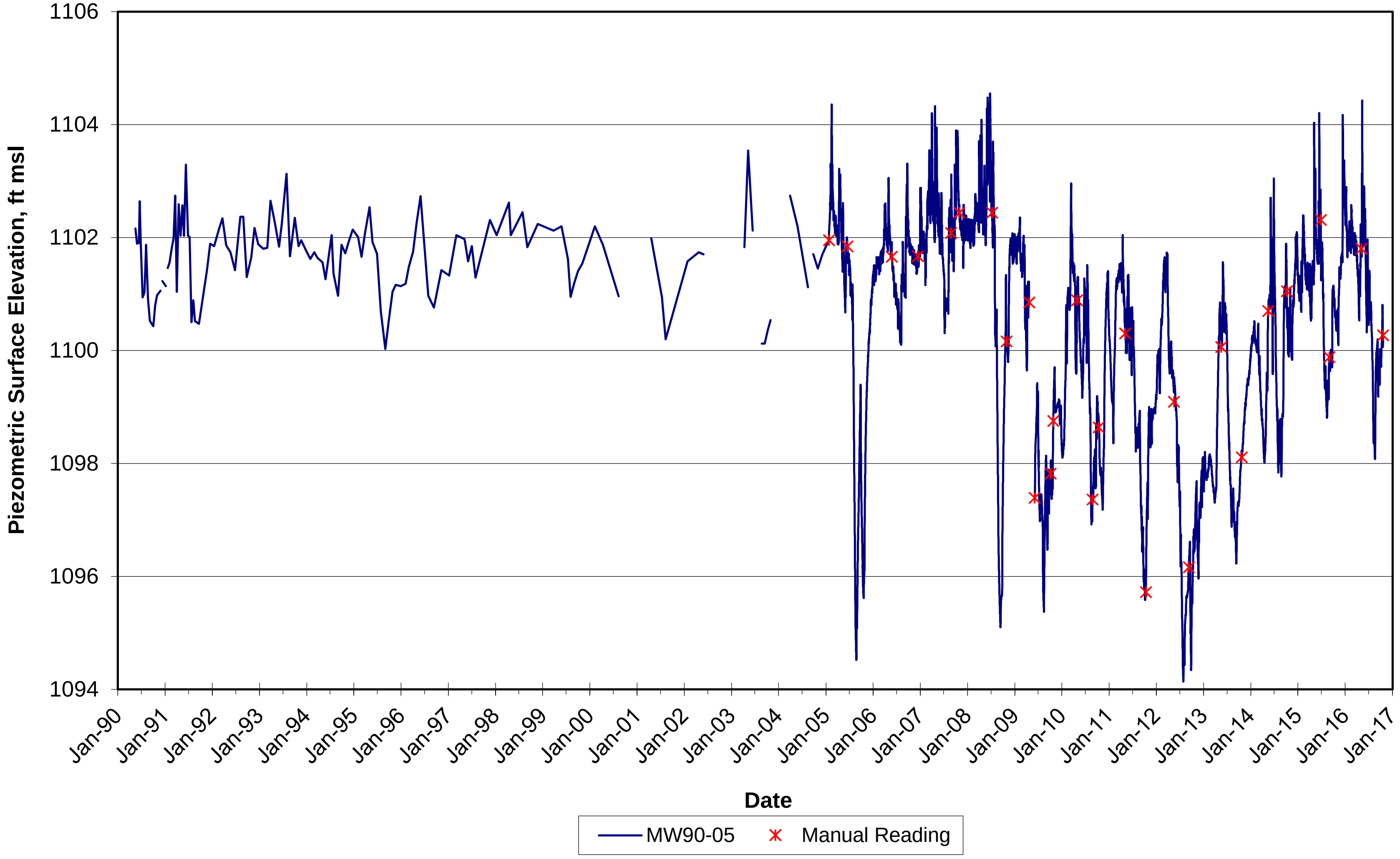
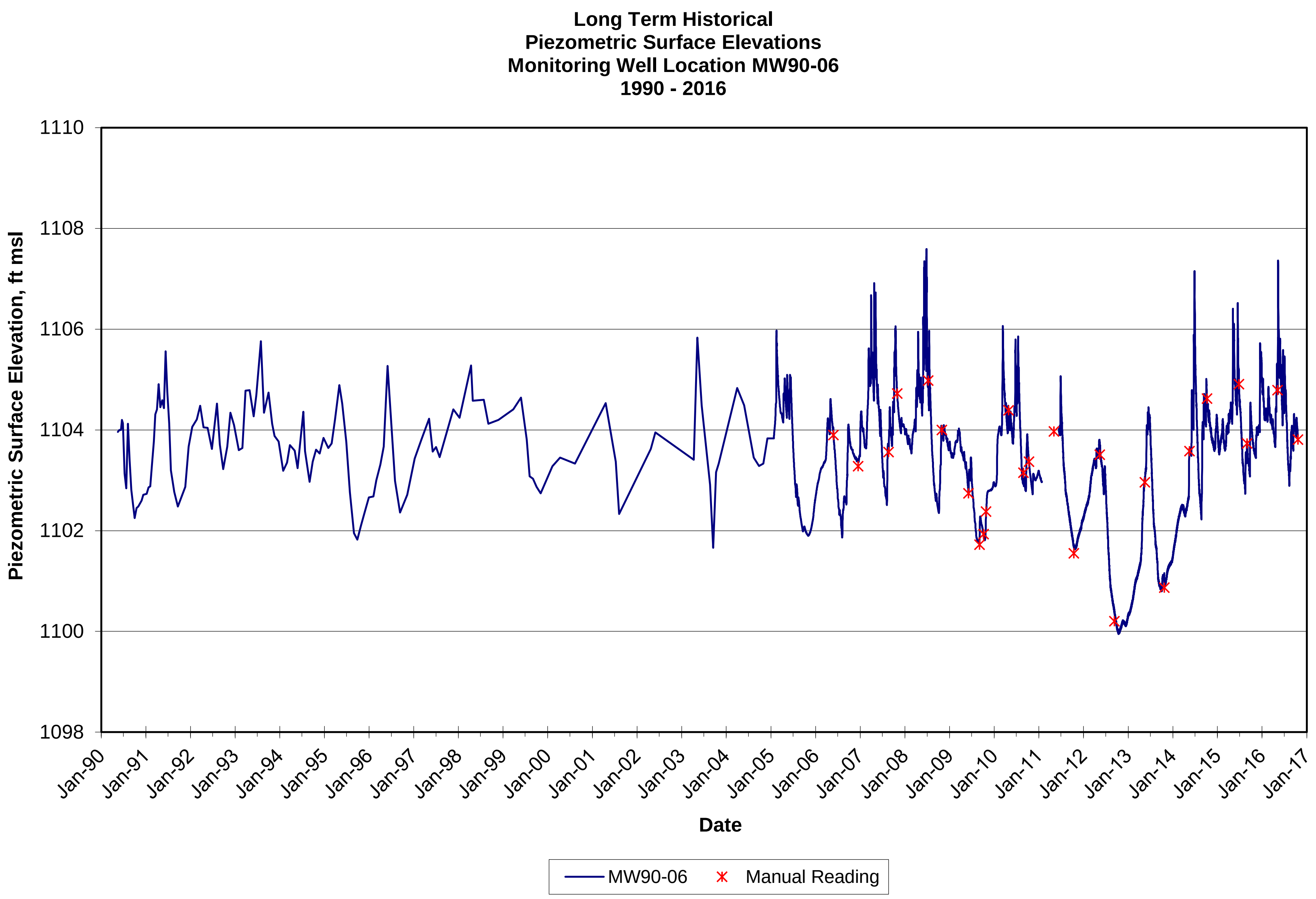
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Date
MW90-04
Manual Reading

**Long Term Historical**
**Piezometric Surface Elevations**
**Monitoring Well Location MW90-5**
**1990 - 2016**





Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW90-06
1990 - 2016
Piezometric Surface Elevation, ft msl
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1108
1106
1104
1102
1100
1098
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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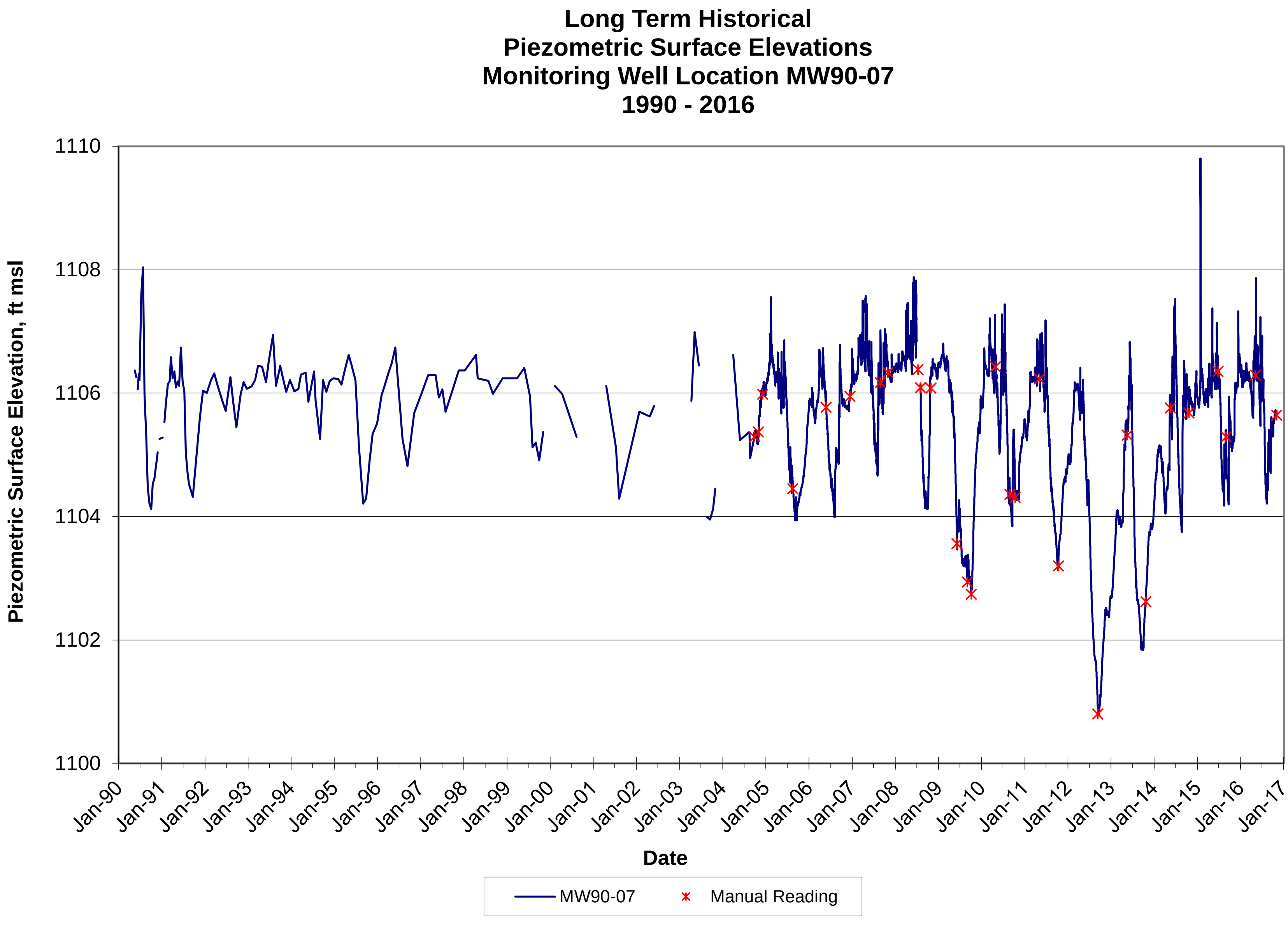
Date
MW90-06
Manual Reading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Piezometric Surface Elevations
Monitoring Well Location MW90-07
1990 - 2016
Piezometric Surface Elevation, ft msl
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1108
1106
1104
1102
1100
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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Jan-09
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Jan-12
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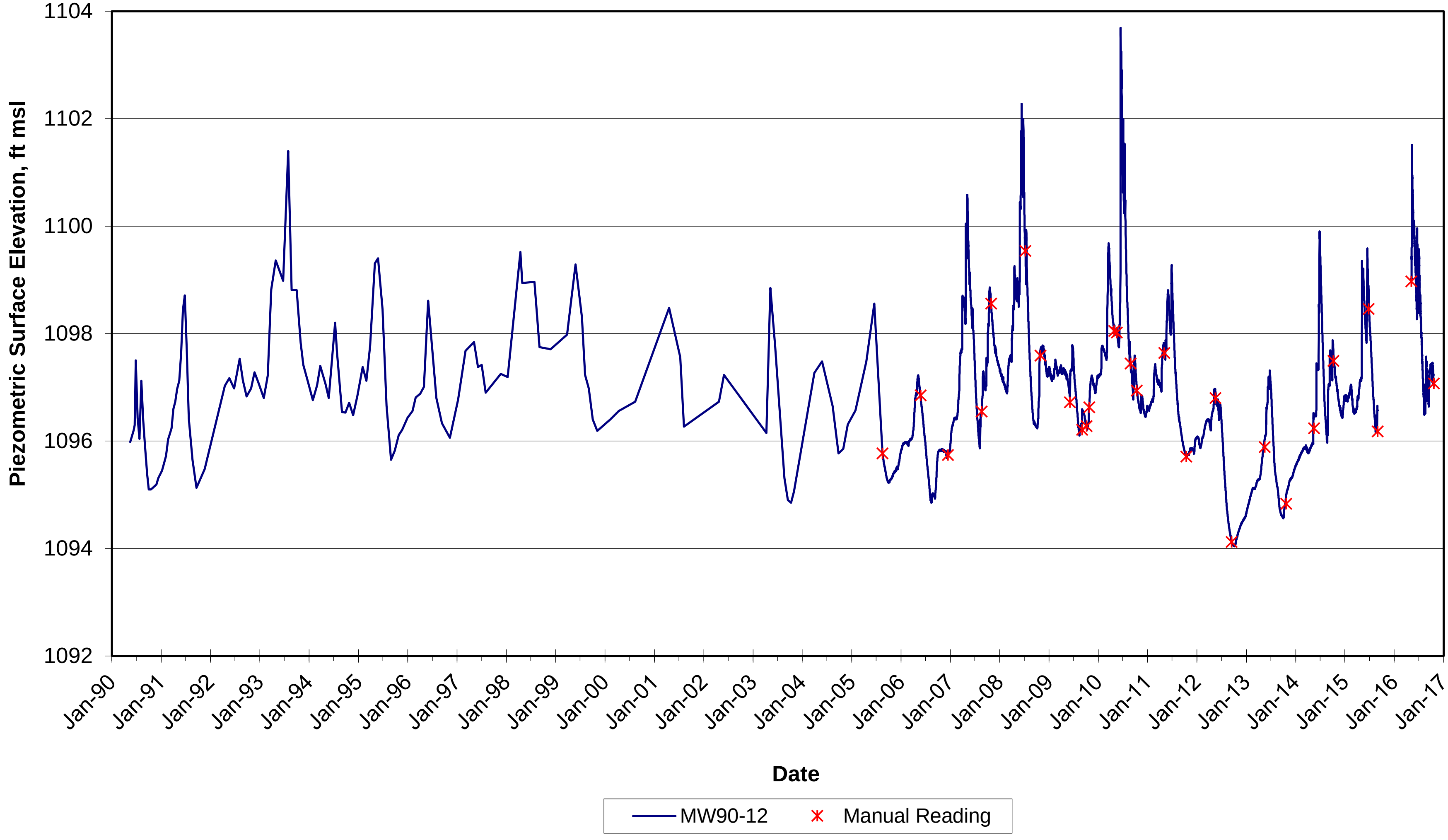
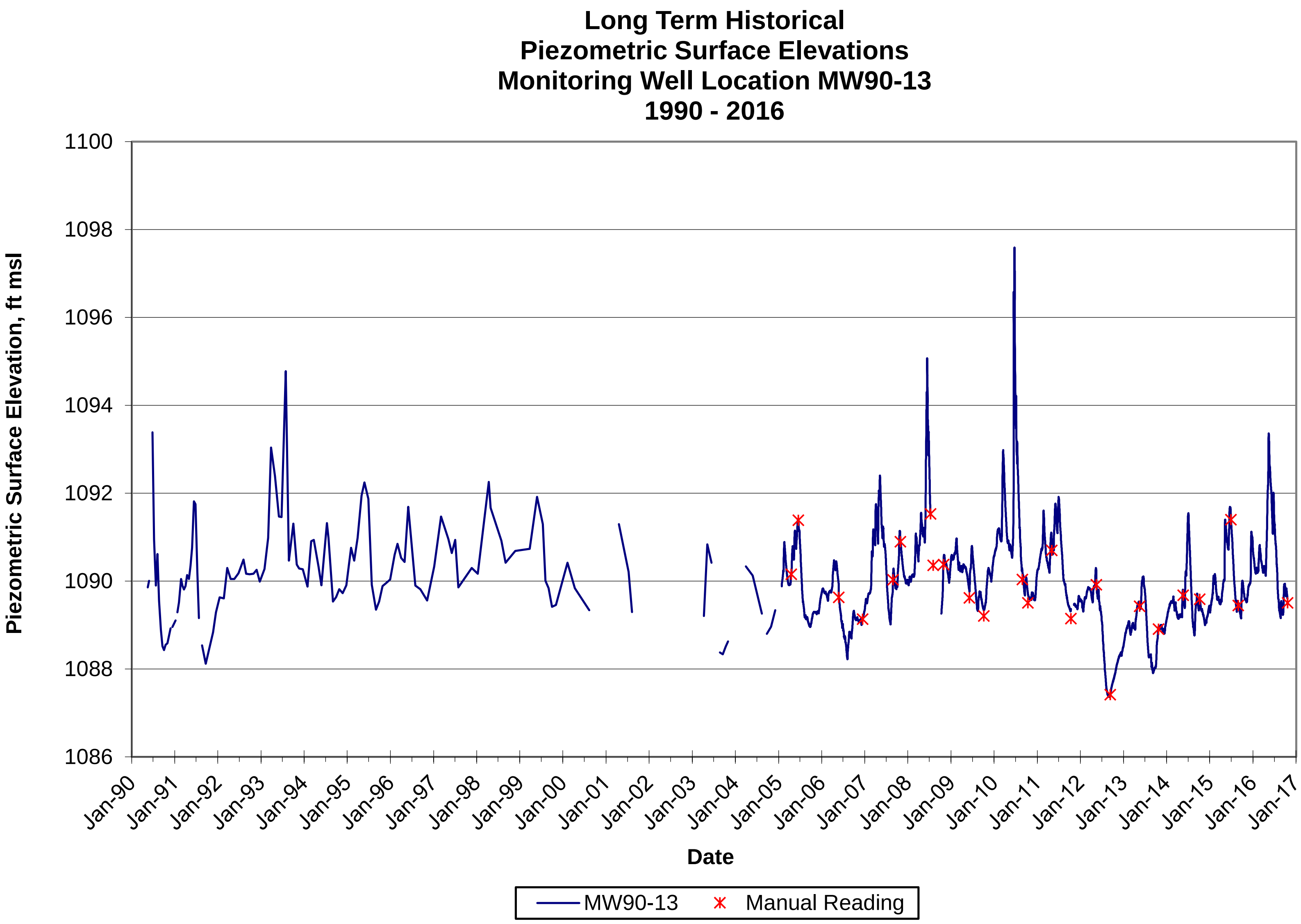
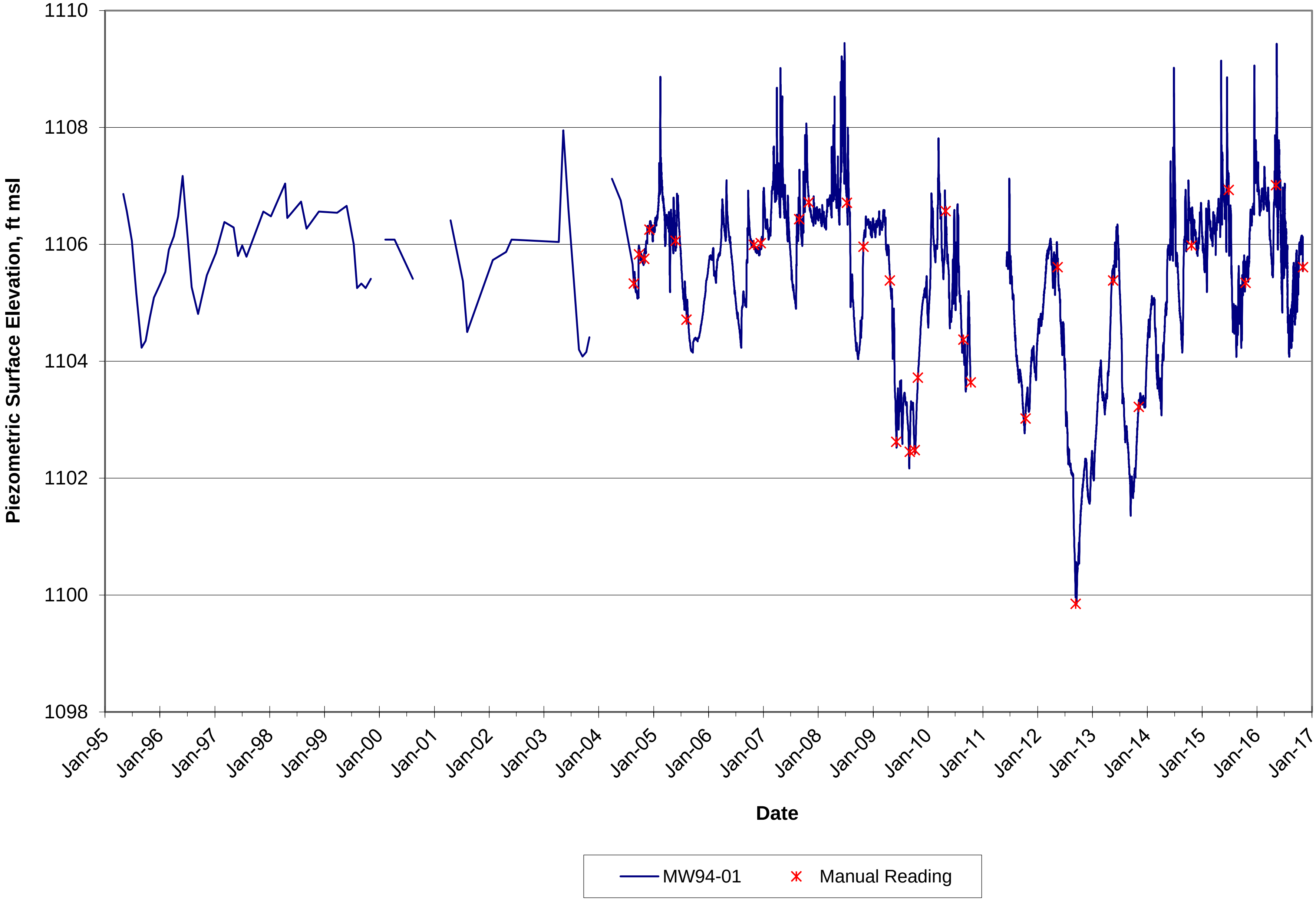
Date
MW90-07
Manual Reading

## Long Term Historical
## Piezometric Surface Elevations
## Monitoring Well Location MW90-12
## 1990 - 2016

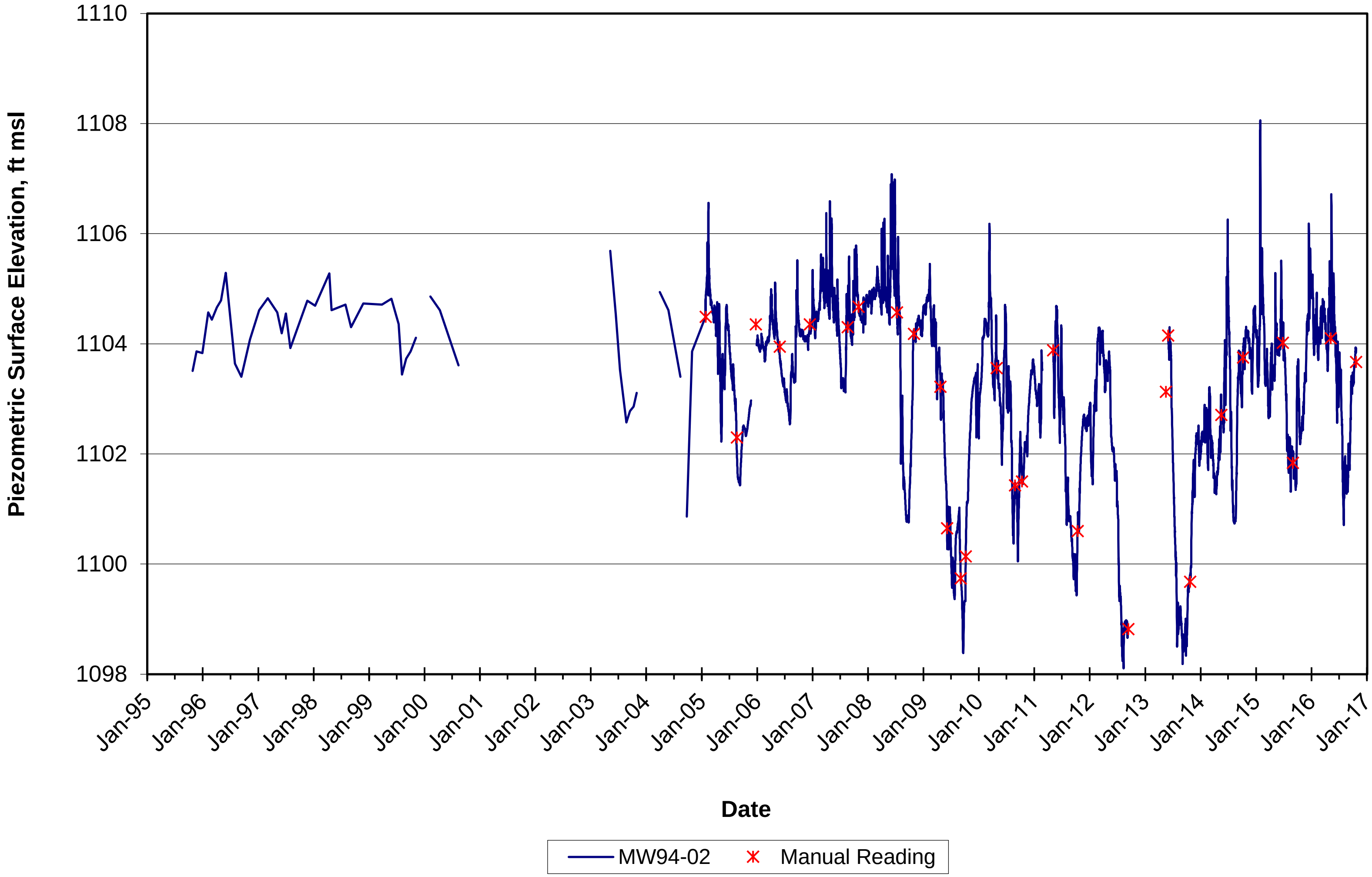



Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW90-13
1990 - 2016
Piezometric Surface Elevation, ft msl
1100
1098
1096
1094
1092
1090
1088
1086
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Date
MW90-13
Manual Reading

# Long Term Historical
# Piezometric Surface Elevations
# Monitoring Well Location MW94-01
# 1995 - 2016



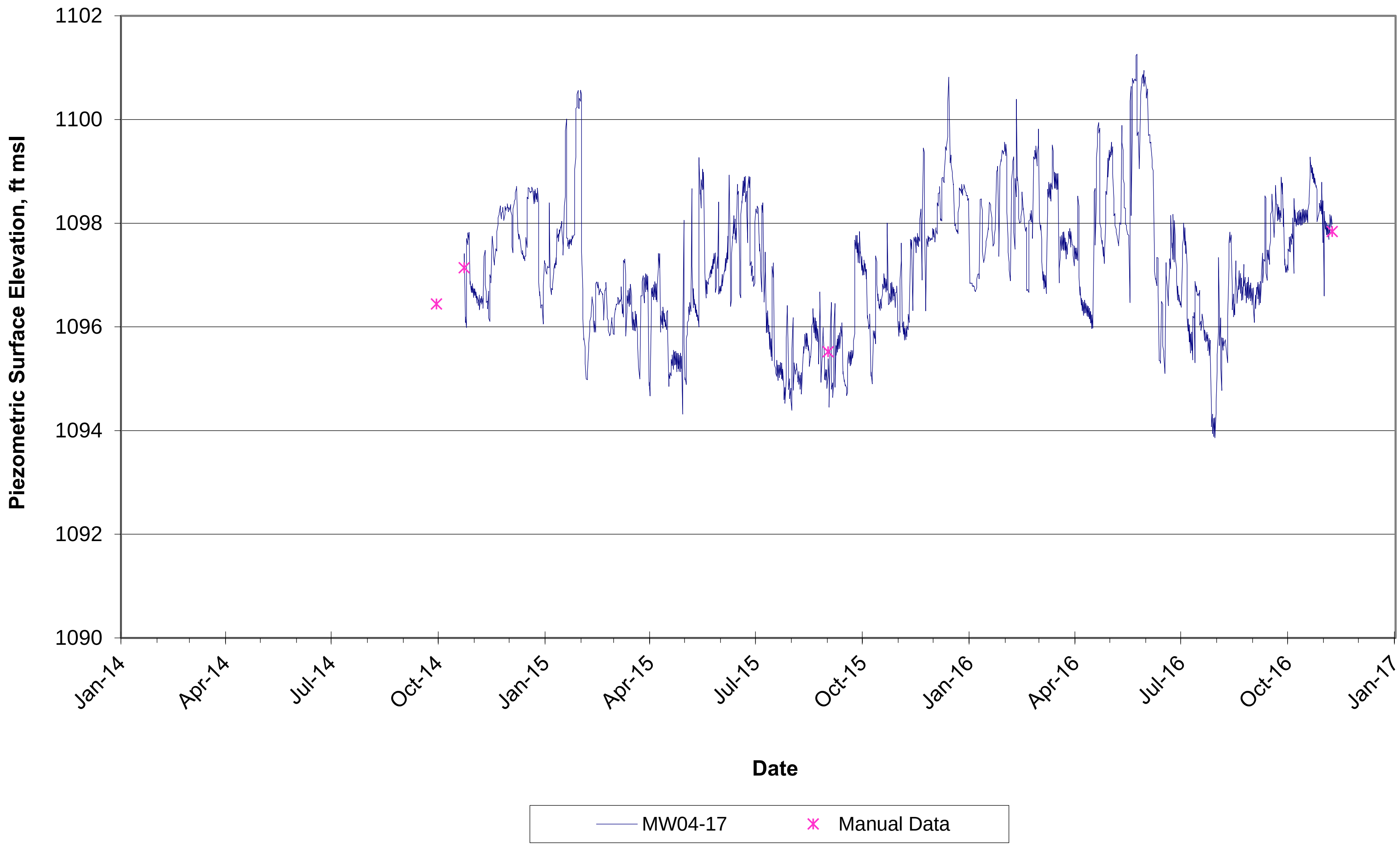
## Long Term Historical Piezometric Surface Elevations Monitoring Well Location MW94-02 1995 - 2016

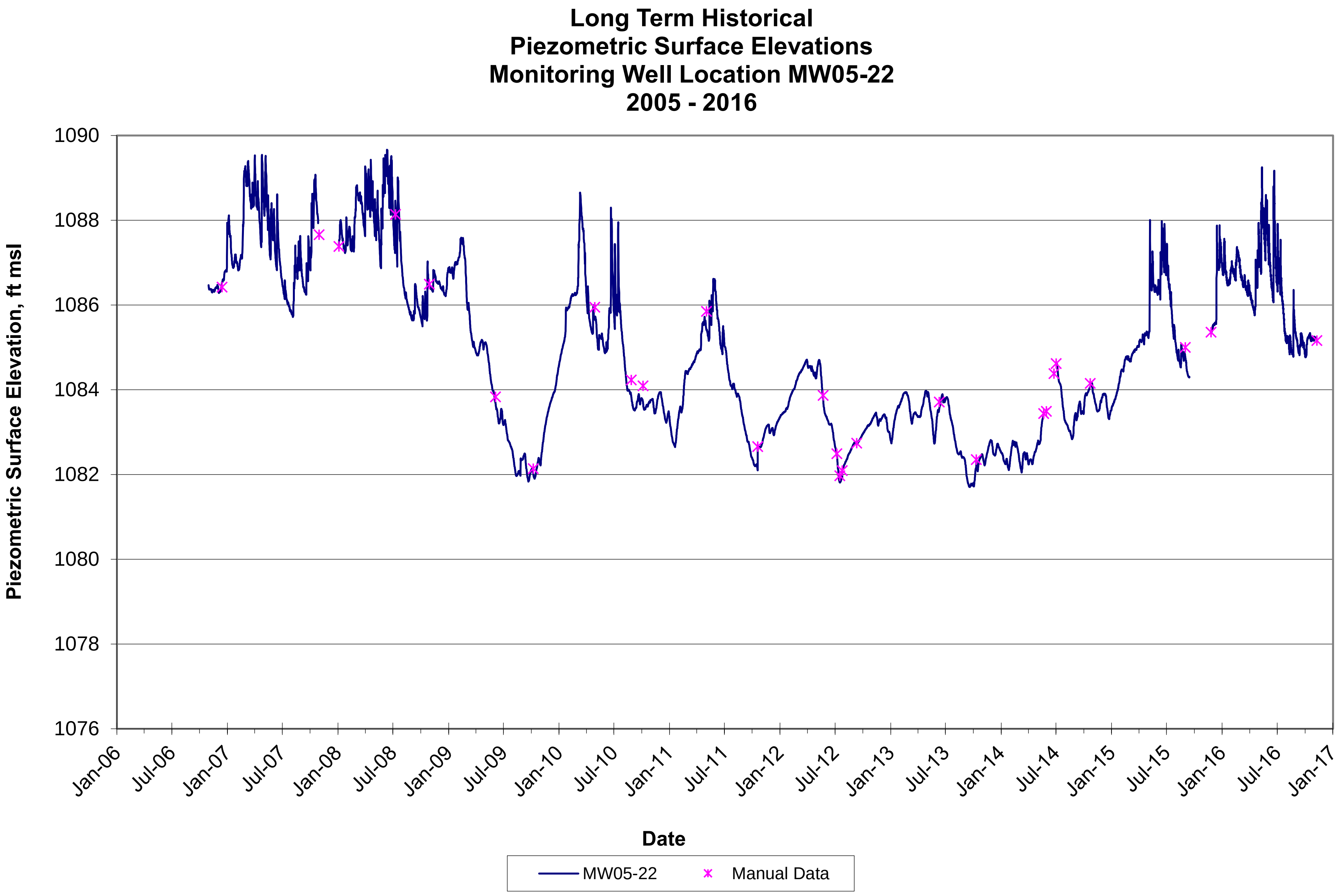


# APPENDIX 3-2 - 2008 – 2015 DATA MONITOING WELL HYDROGRAPHS

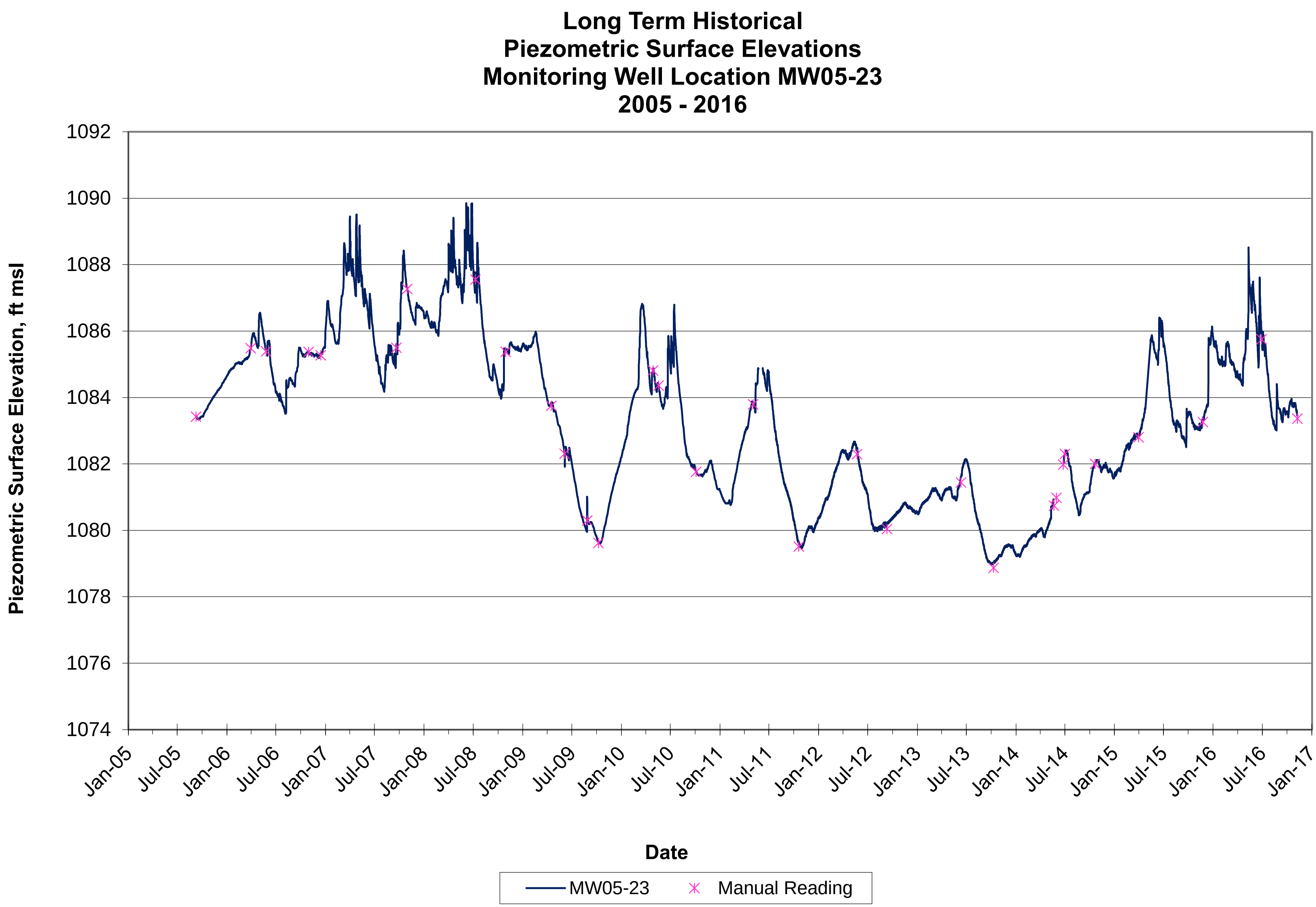
# Saunders County Wells

## Piezometric Surface Elevations
## Monitoring Well Location MW04-16
## 2014 - 2016

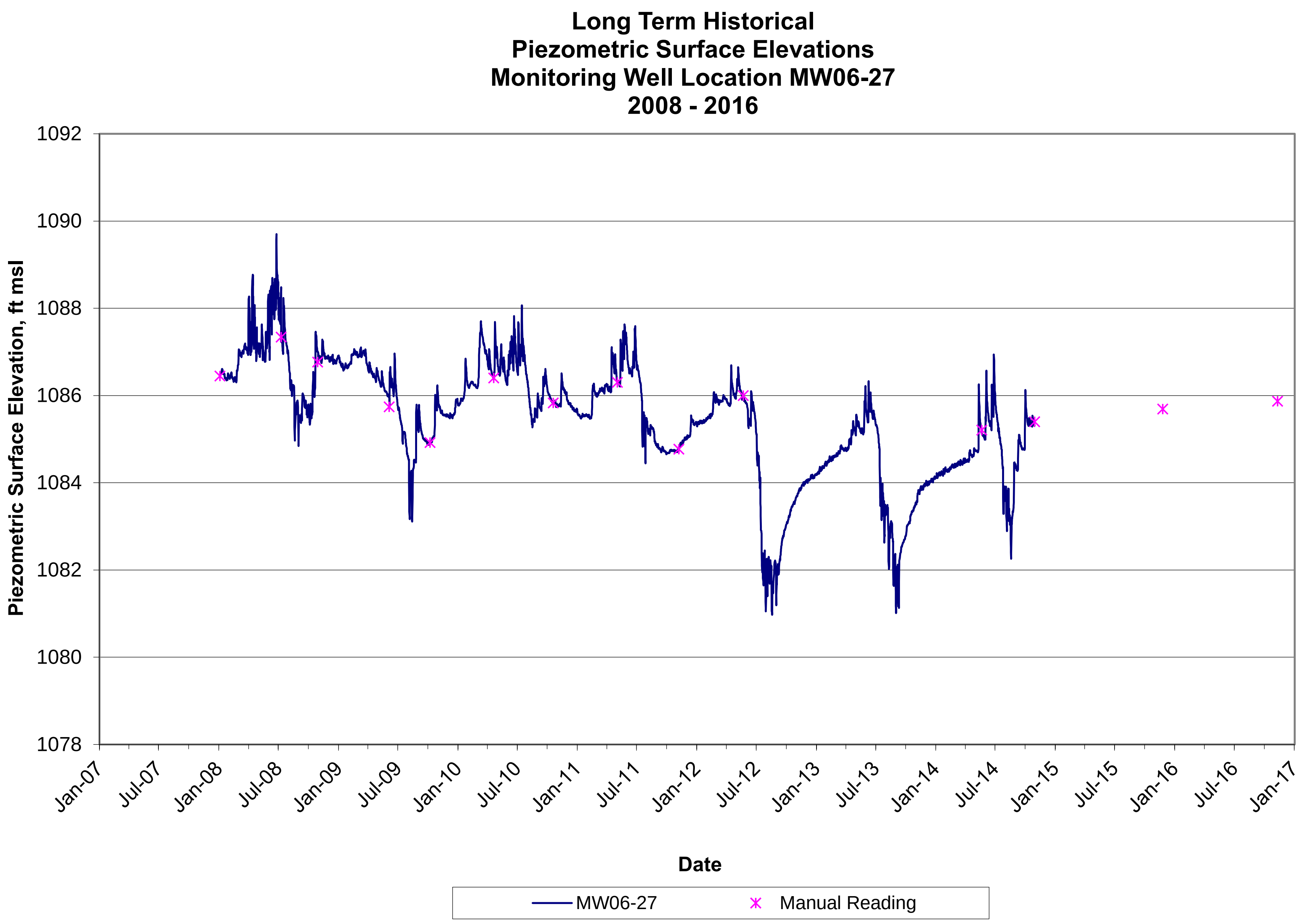




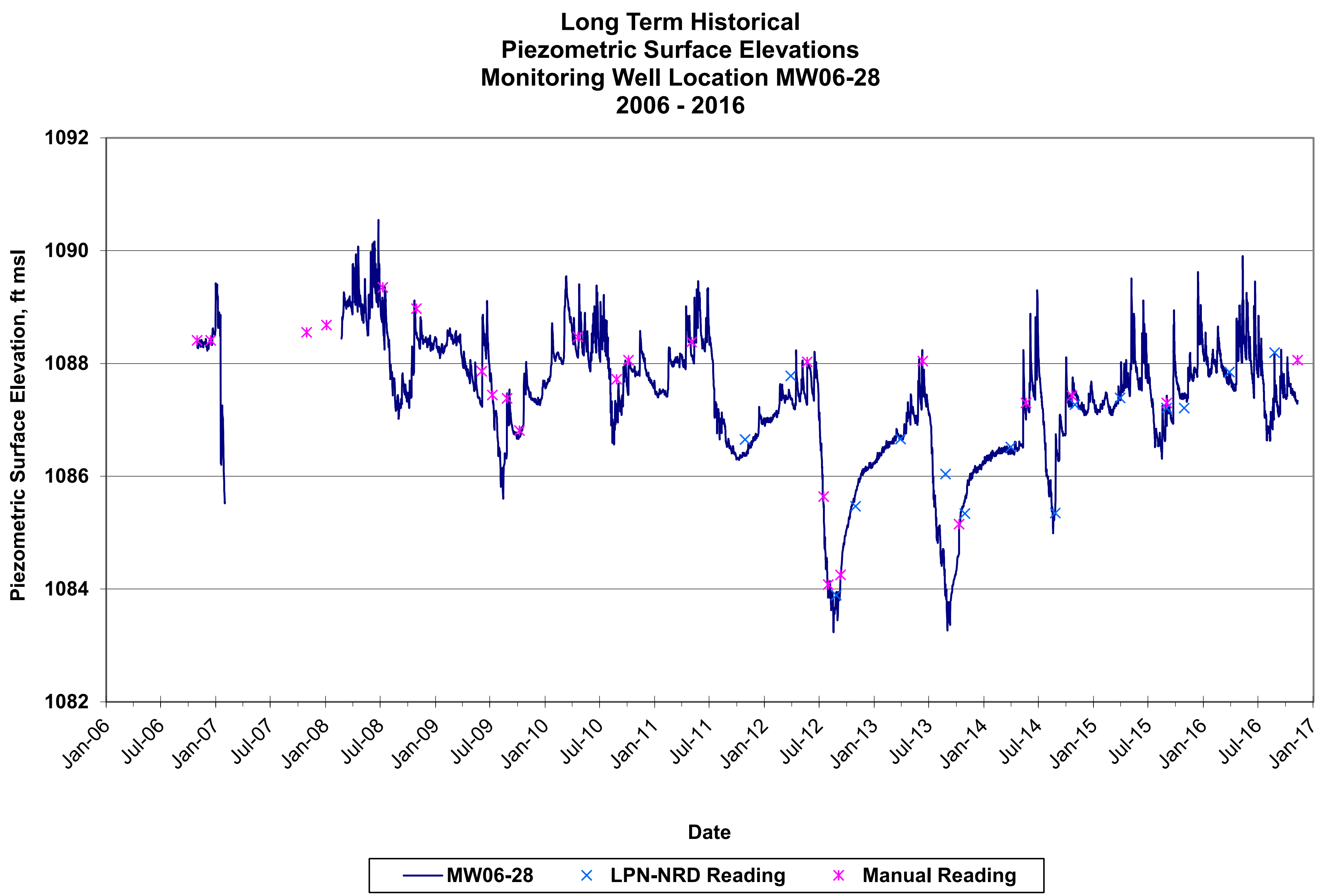
Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW05-22
2005 - 2016
Piezometric Surface Elevation, ft msl
1090
1088
1086
1084
1082
1080
1078
1076
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Date
MW05-22
Manual Data



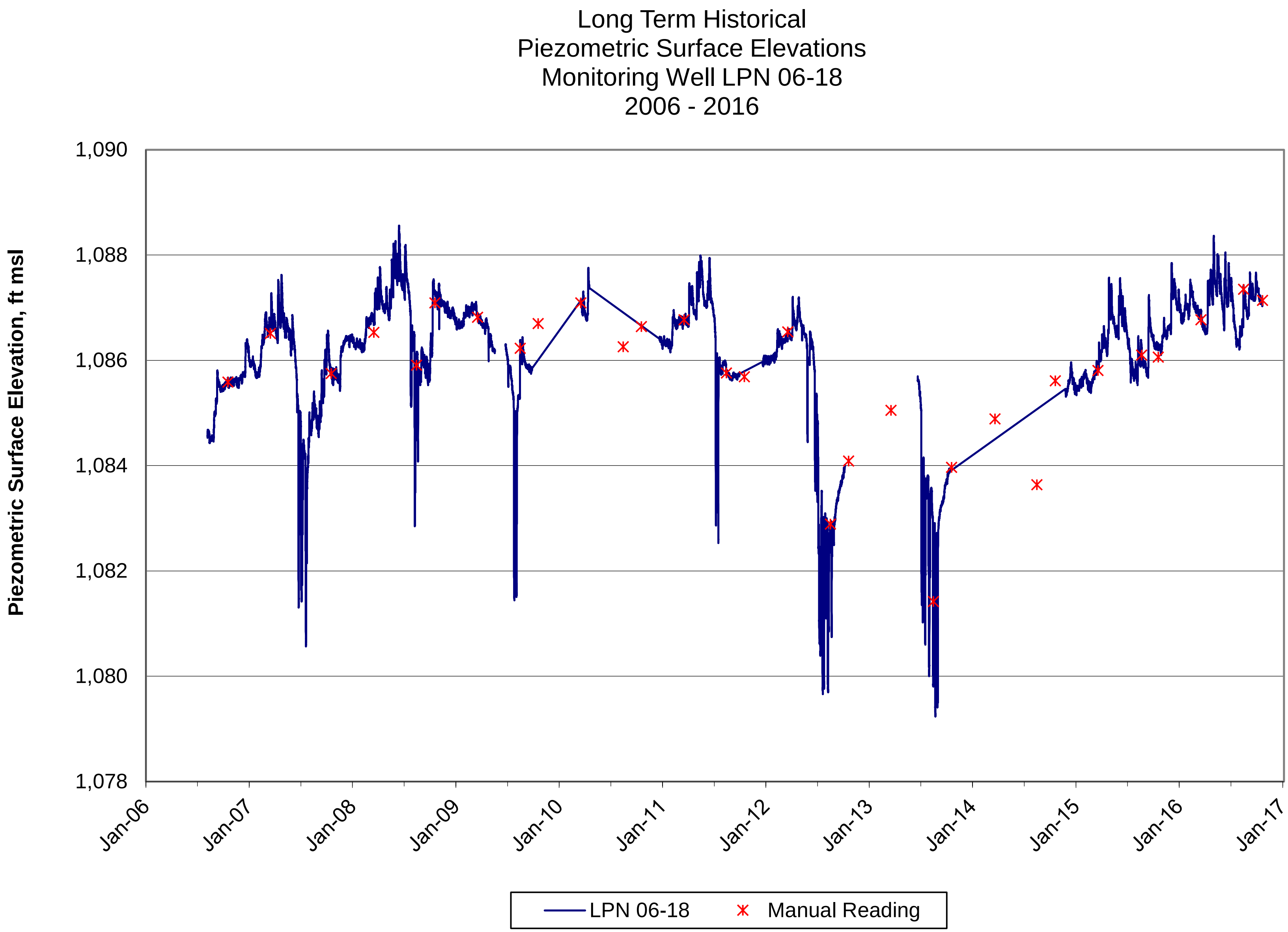
Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW05-23
2005 - 2016
Piezometric Surface Elevation, ft msl
1092
1090
1088
1086
1084
1082
1080
1078
1076
1074
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Date
MW05-23
Manual Reading

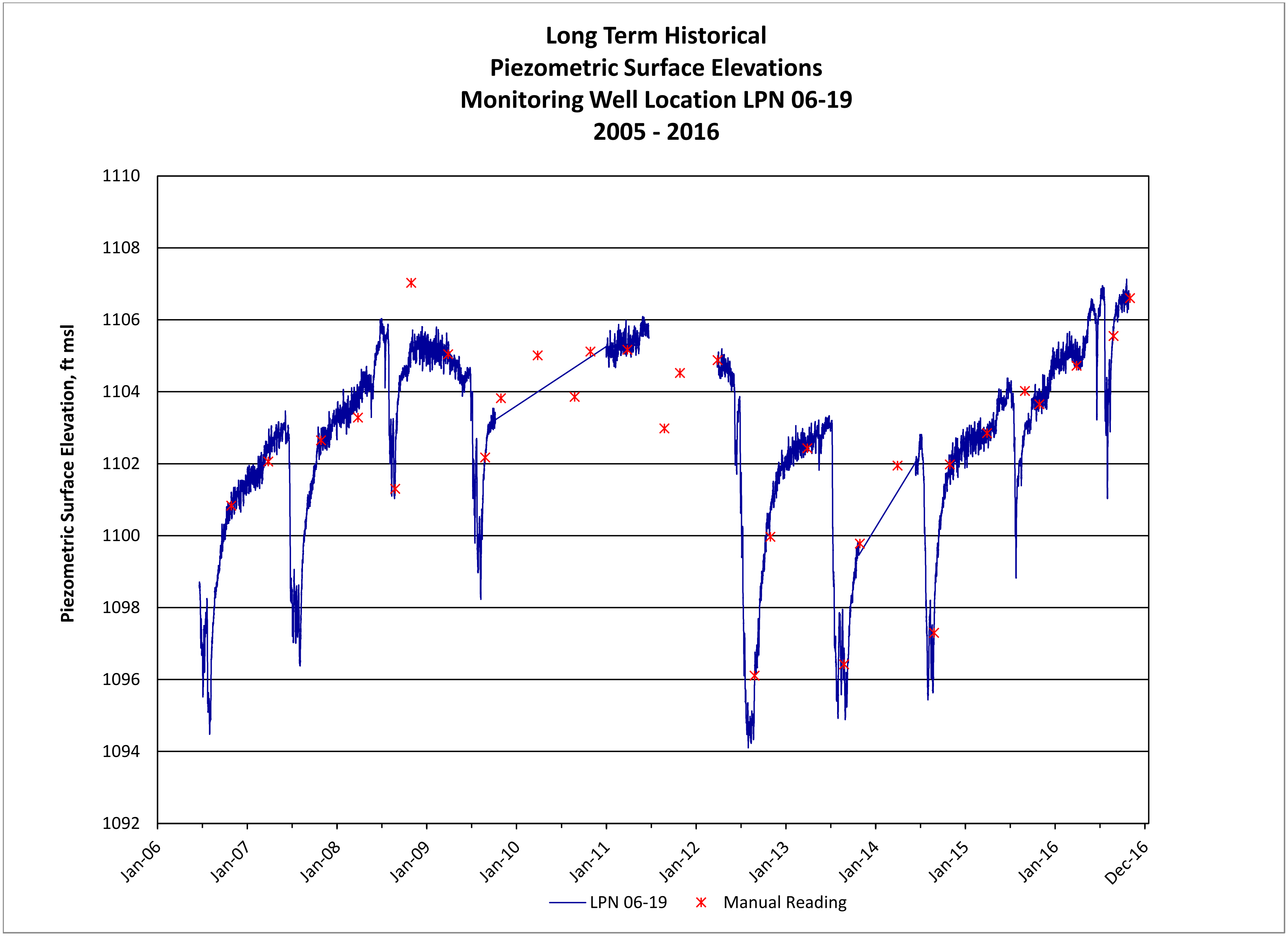


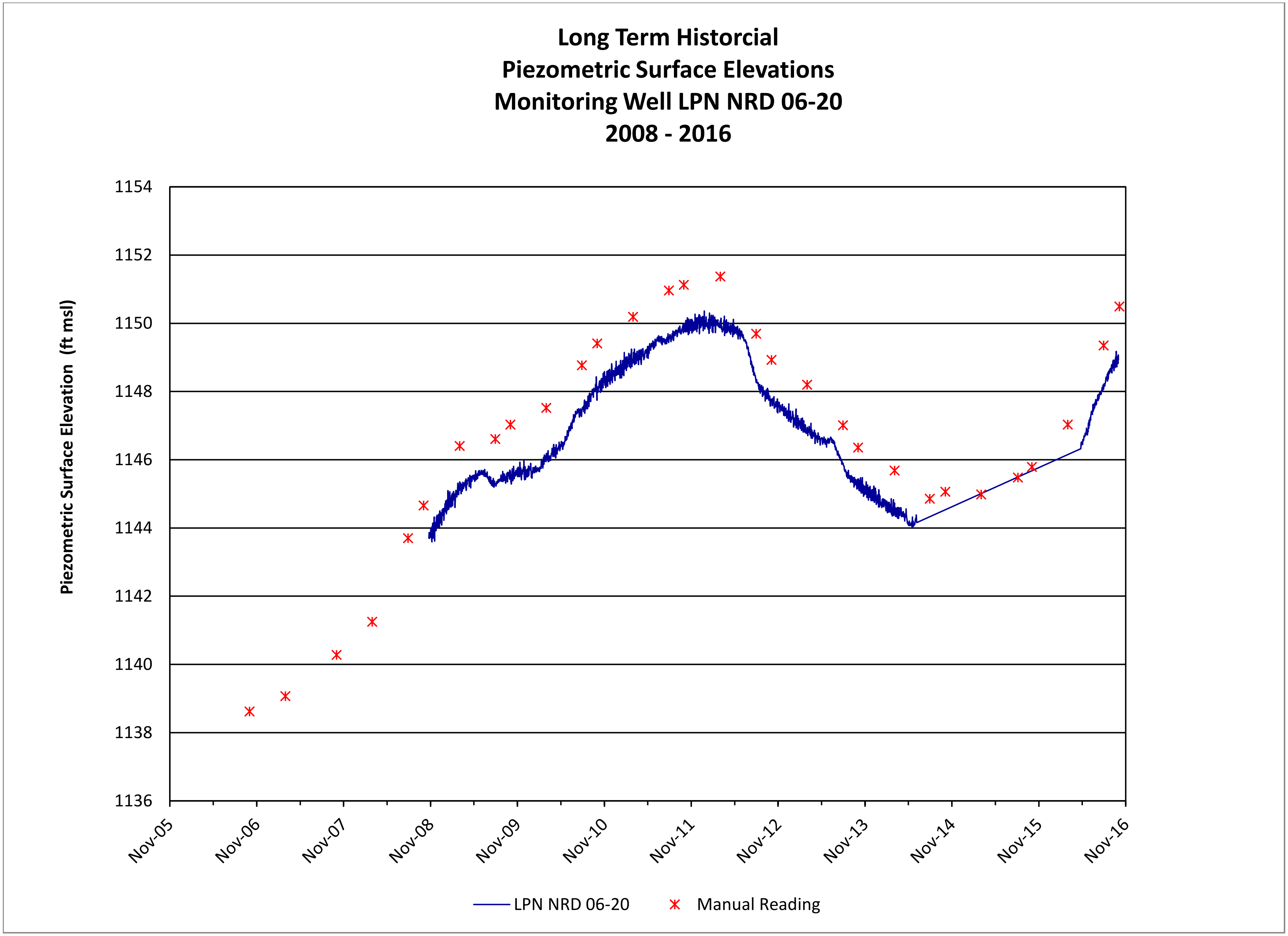
Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW06-27
2008 - 2016
Piezometric Surface Elevation, ft msl
1092
1090
1088
1086
1084
1082
1080
1078
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Date
MW06-27
Manual Reading



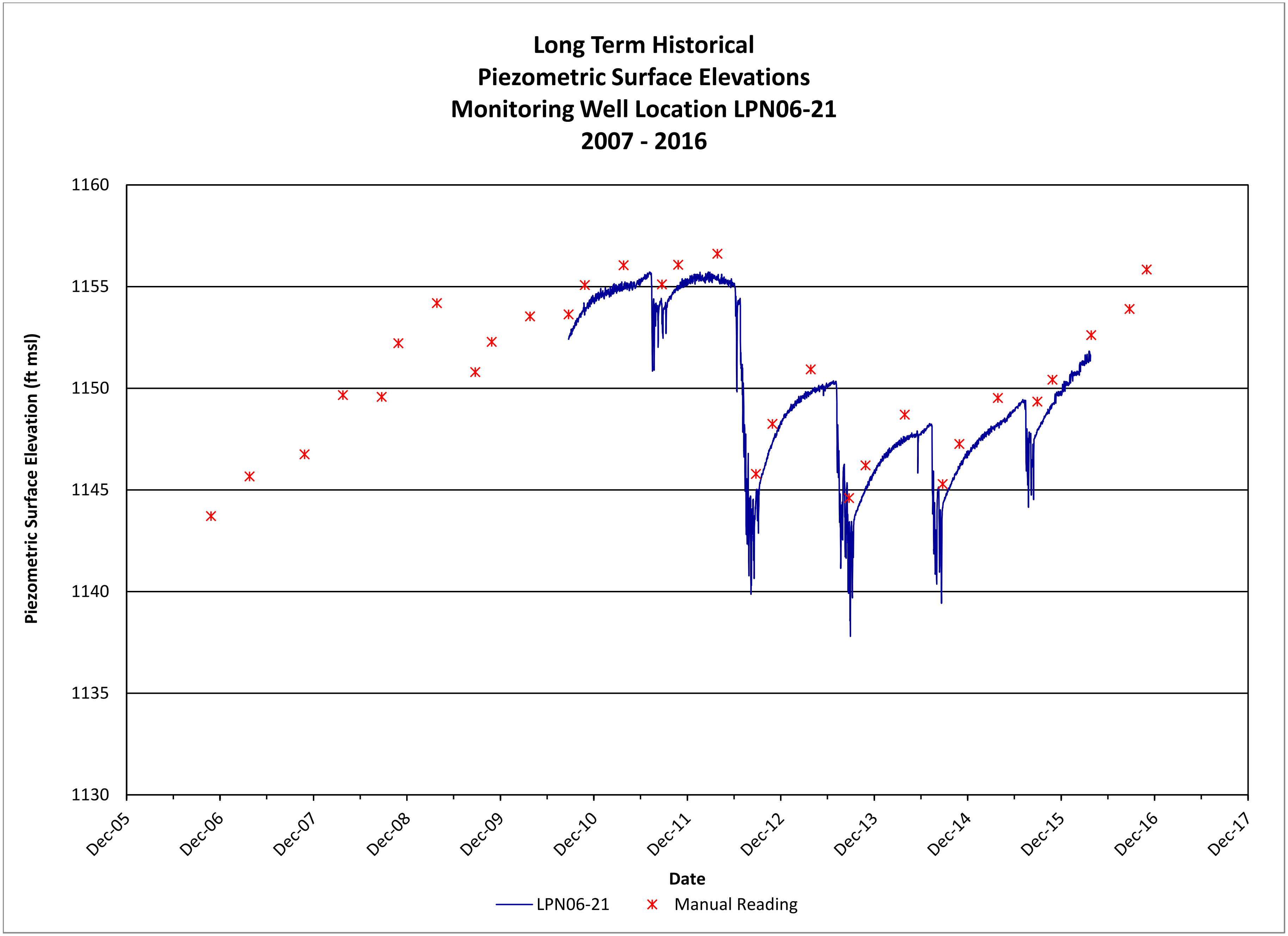
Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW06-28
2006 - 2016
Piezometric Surface Elevation, ft msl
1092
1090
1088
1086
1084
1082
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
Date
MW06-28
LPN-NRD Reading
Manual Reading

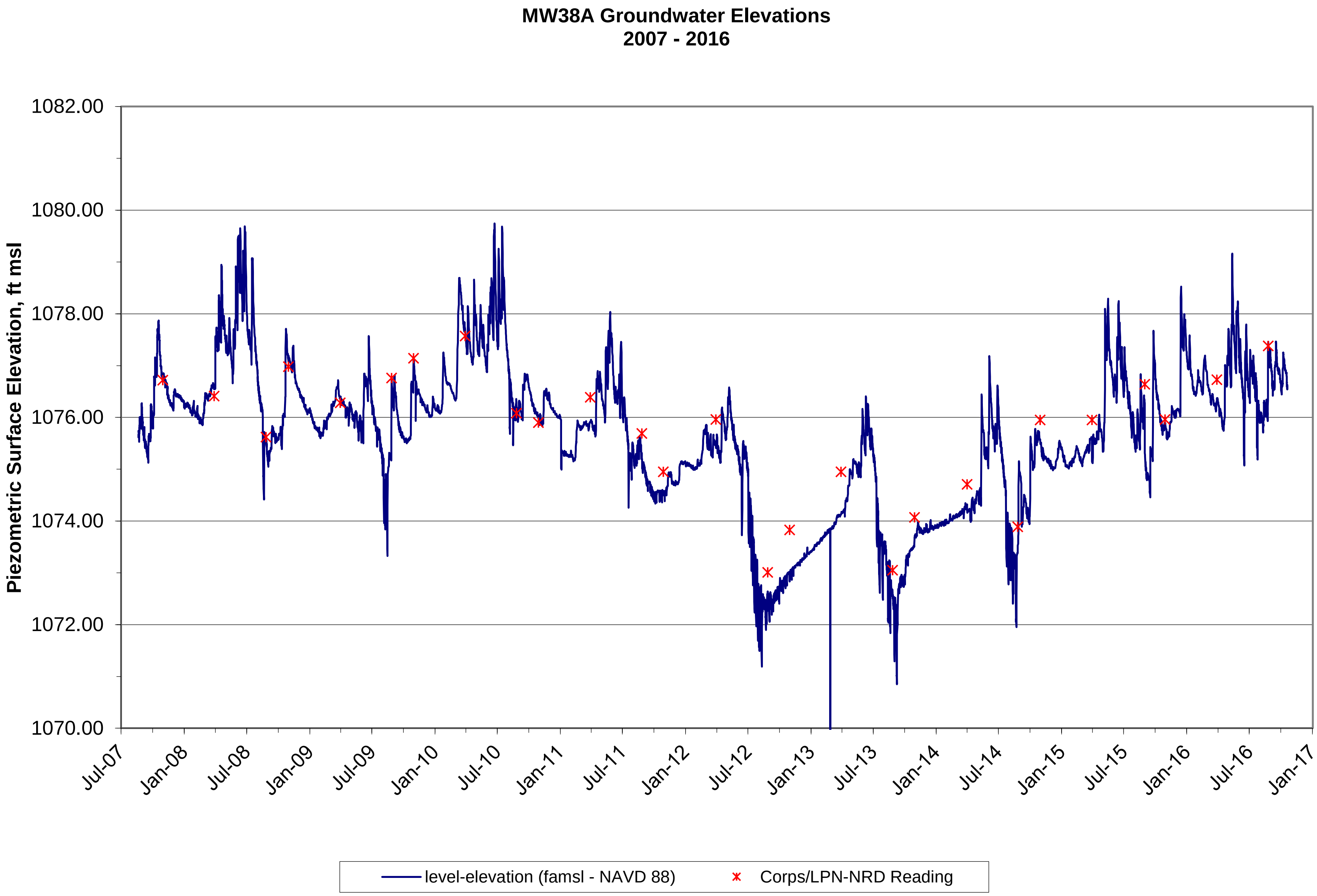

Long Term Historical
Piezometric Surface Elevations
Monitoring Well LPN 06-18
2006 - 2016
Piezometric Surface Elevation, ft msl
1,090
1,088
1,086
1,084
1,082
1,080
1,078
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
LPN 06-18
Manual Reading

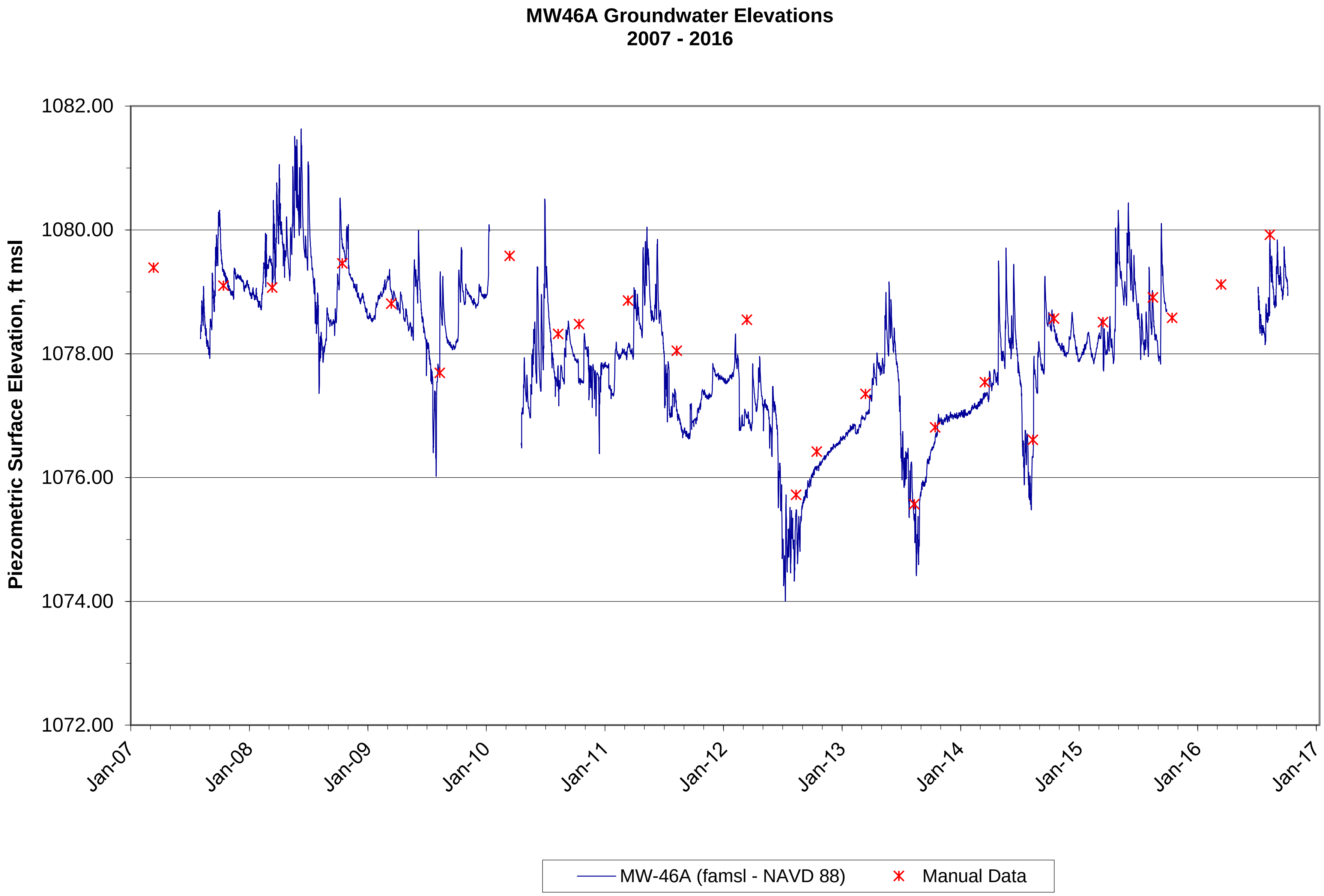

Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location LPN 06-19
2005 - 2016
Piezometric Surface Elevation, ft msl
1110
1108
1106
1104
1102
1100
1098
1096
1094
1092
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Dec-16
LPN 06-19
Manual Reading



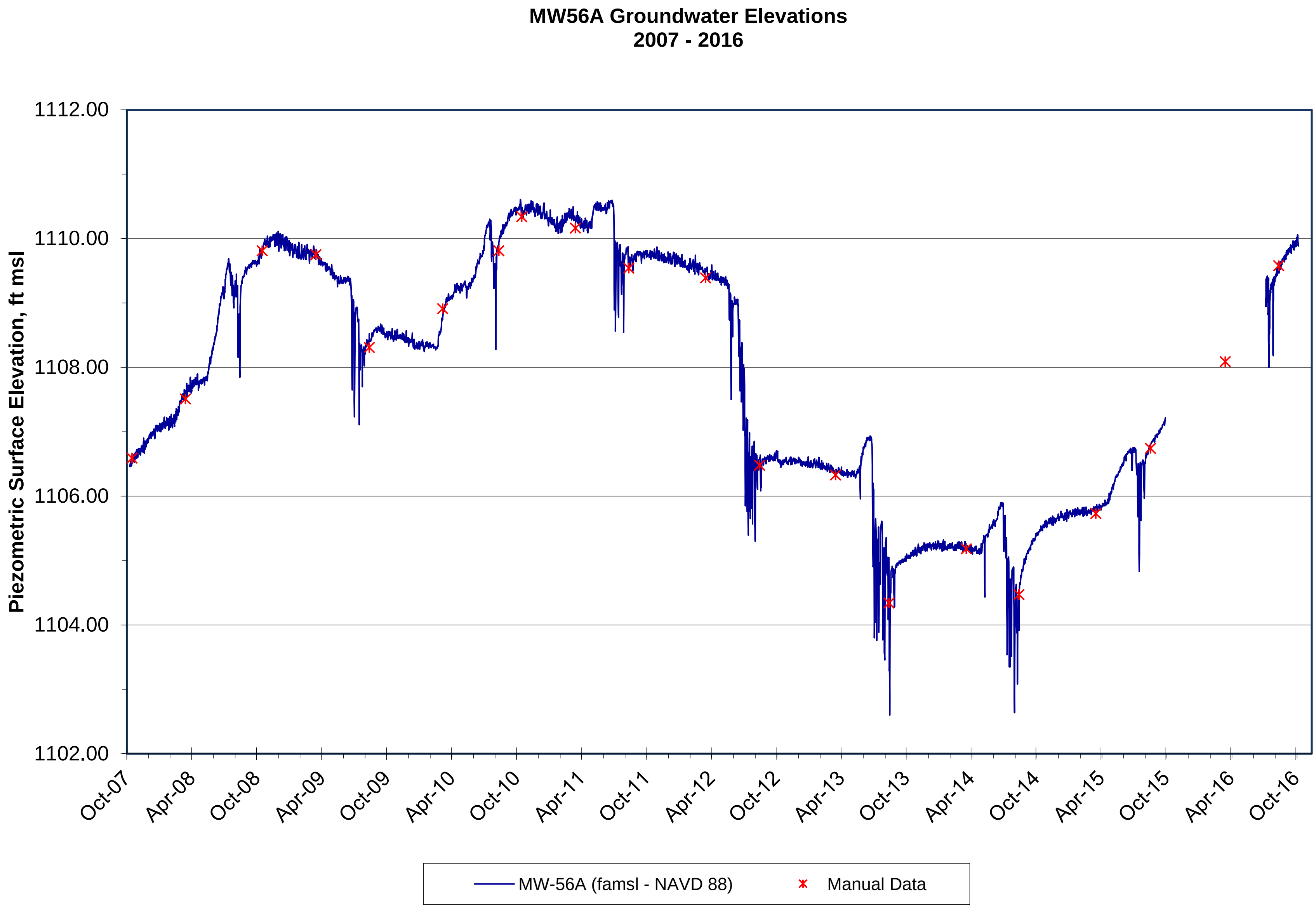
Long Term Historcial
Piezometric Surface Elevations
Monitoring Well LPN NRD 06-20
2008 - 2016
Piezometric Surface Elevation (ft msl)
1154
1152
1150
1148
1146
1144
1142
1140
1138
1136
Nov-05
Nov-06
Nov-07
Nov-08
Nov-09
Nov-10
Nov-11
Nov-12
Nov-13
Nov-14
Nov-15
Nov-16
LPN NRD 06-20
Manual Reading


Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location LPN06-21
2007 - 2016
Piezometric Surface Elevation (ft msl)
1160
1155
1150
1145
1140
1135
1130
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Date
LPN06-21
Manual Reading

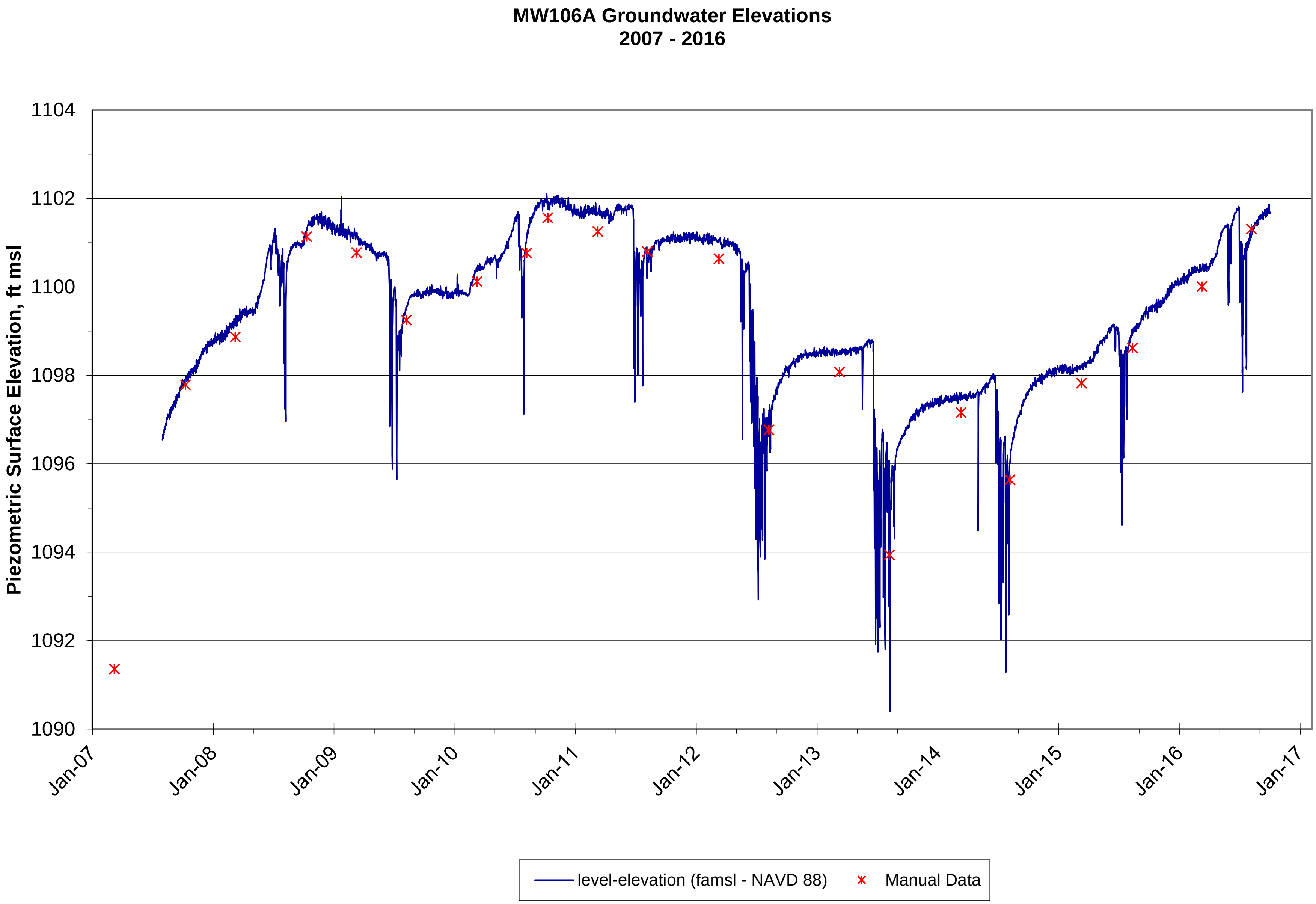

MW38A Groundwater Elevations
2007 - 2016
Piezometric Surface Elevation, ft msl
1082.00
1080.00
1078.00
1076.00
1074.00
1072.00
1070.00
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10
Jan-11
Jul-11
Jan-12
Jul-12
Jan-13
Jul-13
Jan-14
Jul-14
Jan-15
Jul-15
Jan-16
Jul-16
Jan-17
level-elevation (famsl - NAVD 88)
Corps/LPN-NRD Reading

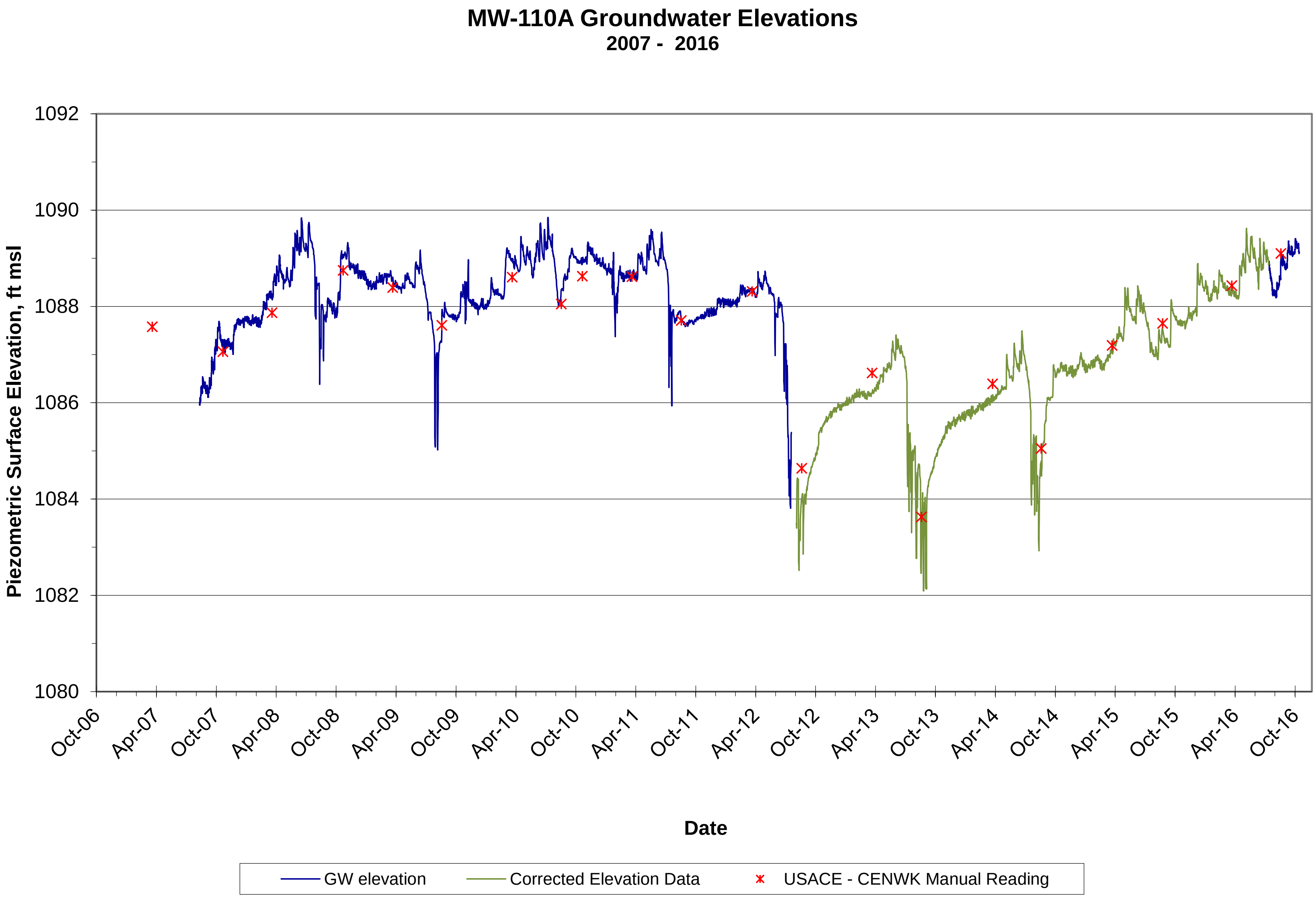


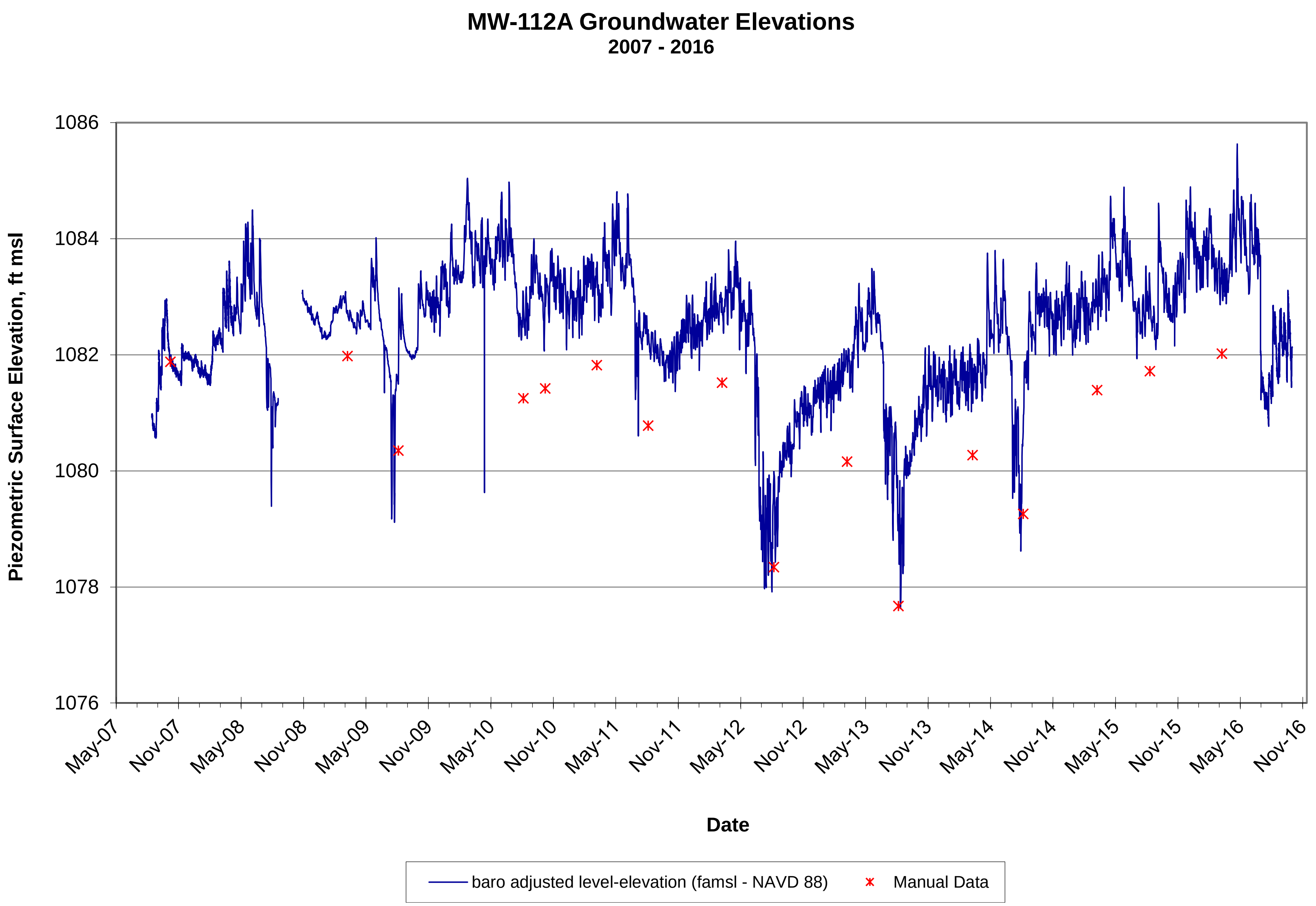
MW46A Groundwater Elevations
2007 - 2016
Piezometric Surface Elevation, ft msl
1082.00
1080.00
1078.00
1076.00
1074.00
1072.00
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
MW-46A (famsl - NAVD 88)
Manual Data



MW56A Groundwater Elevations
2007 - 2016
Piezometric Surface Elevation, ft msl
1112.00
1110.00
1108.00
1106.00
1104.00
1102.00
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
MW-56A (famsl - NAVD 88)
Manual Data

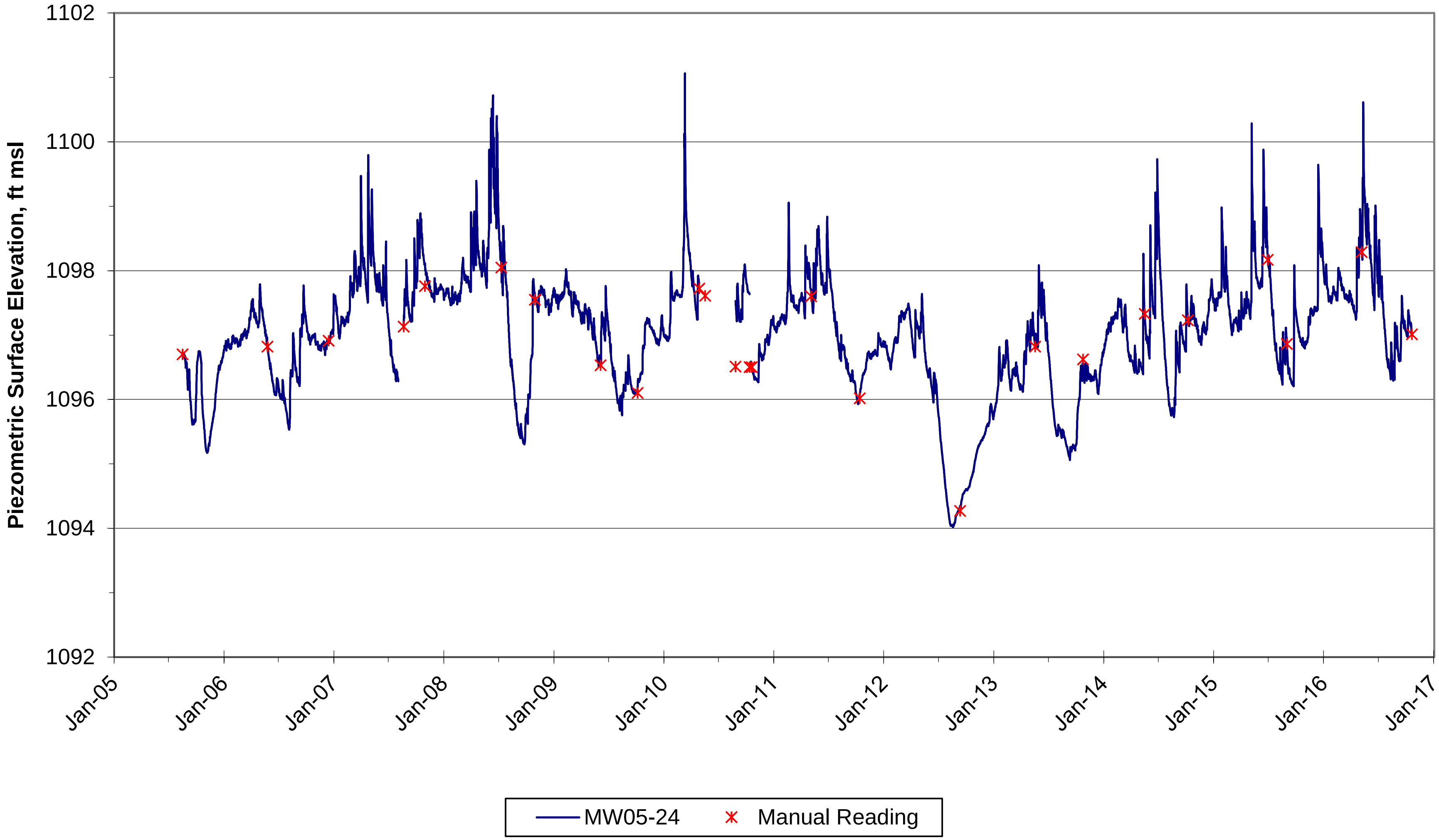

MW106A Groundwater Elevations
2007 - 2016
Piezometric Surface Elevation, ft msl
1104
1102
1100
1098
1096
1094
1092
1090
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
level-elevation (famsl - NAVD 88)
Manual Data

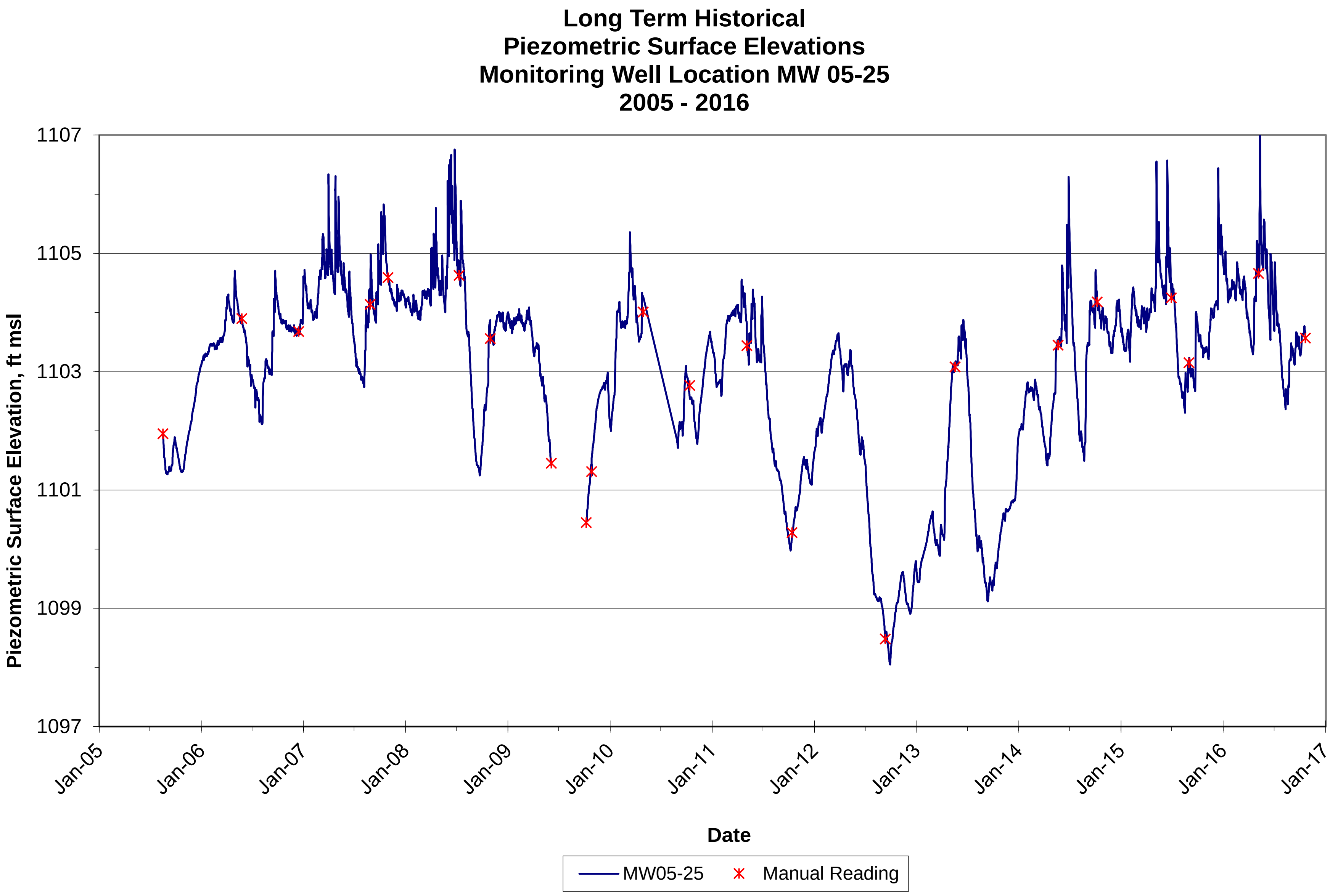

MW-110A Groundwater Elevations
2007 - 2016
Piezometric Surface Elevation, ft msl
1092
1090
1088
1086
1084
1082
1080
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Oct-15
Apr-16
Oct-16
Date
GW elevation
Corrected Elevation Data
USACE - CENWK Manual Reading

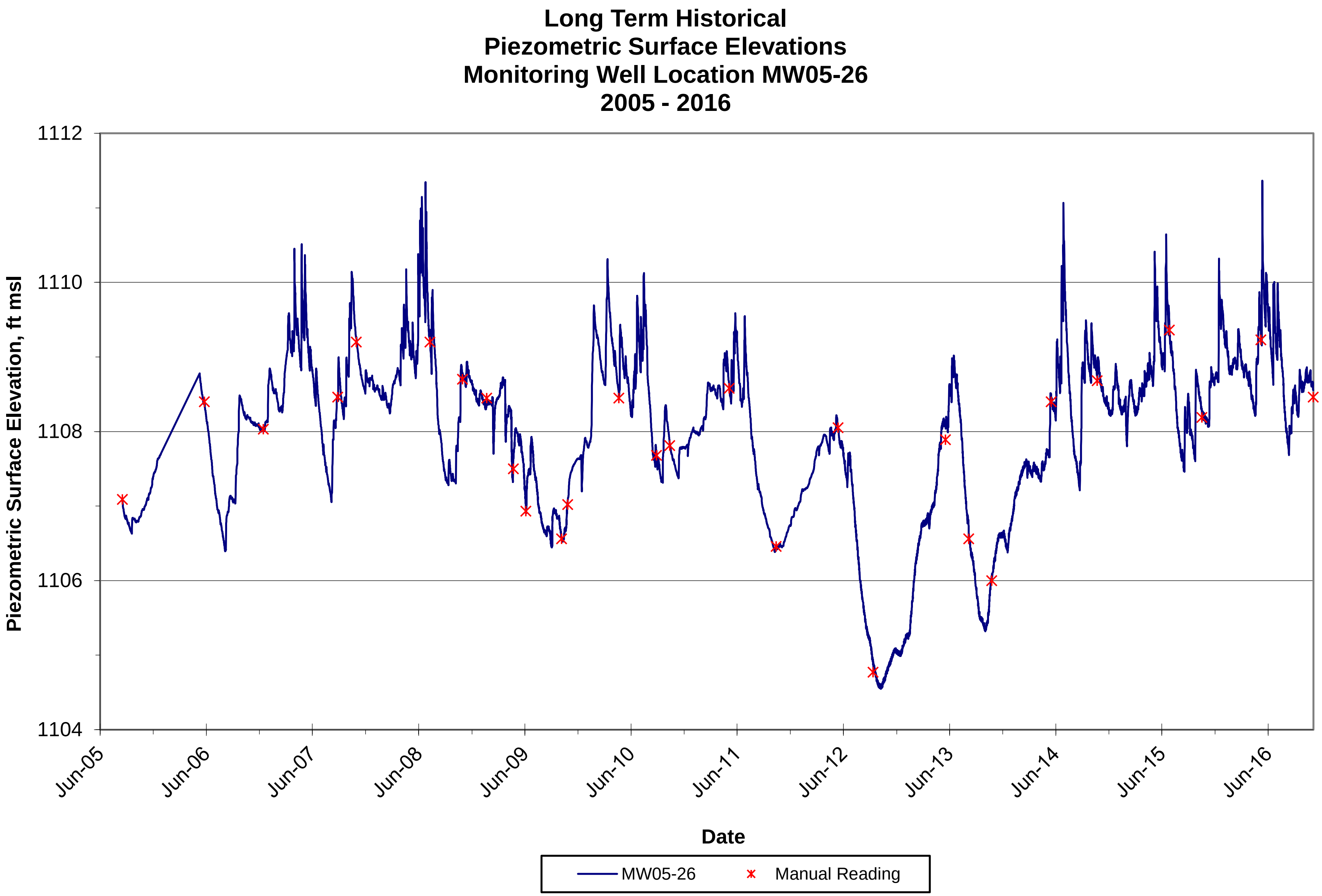

MW-112A Groundwater Elevations
2007 - 2016
Piezometric Surface Elevation, ft msl
1086
1084
1082
1080
1078
1076
May-07
Nov-07
May-08
Nov-08
May-09
Nov-09
May-10
Nov-10
May-11
Nov-11
May-12
Nov-12
May-13
Nov-13
May-14
Nov-14
May-15
Nov-15
May-16
Nov-16
Date
baro adjusted level-elevation (famsl - NAVD 88)
Manual Data

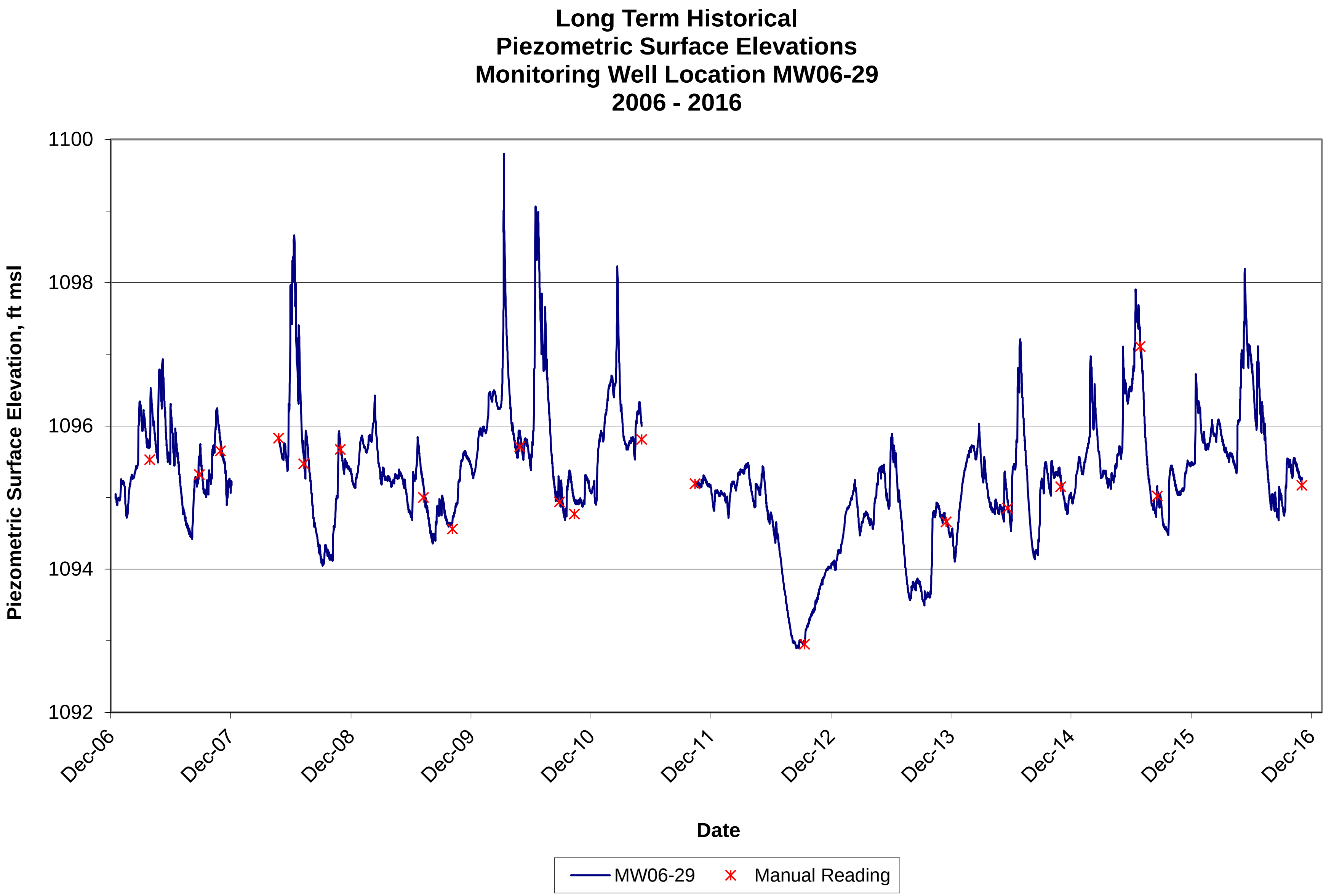
**Douglas County Wells**

**Long Term Historical**
**Piezometric Surface Elevations**
**Monitoring Well Location MW05-24**
**2005 - 2016**



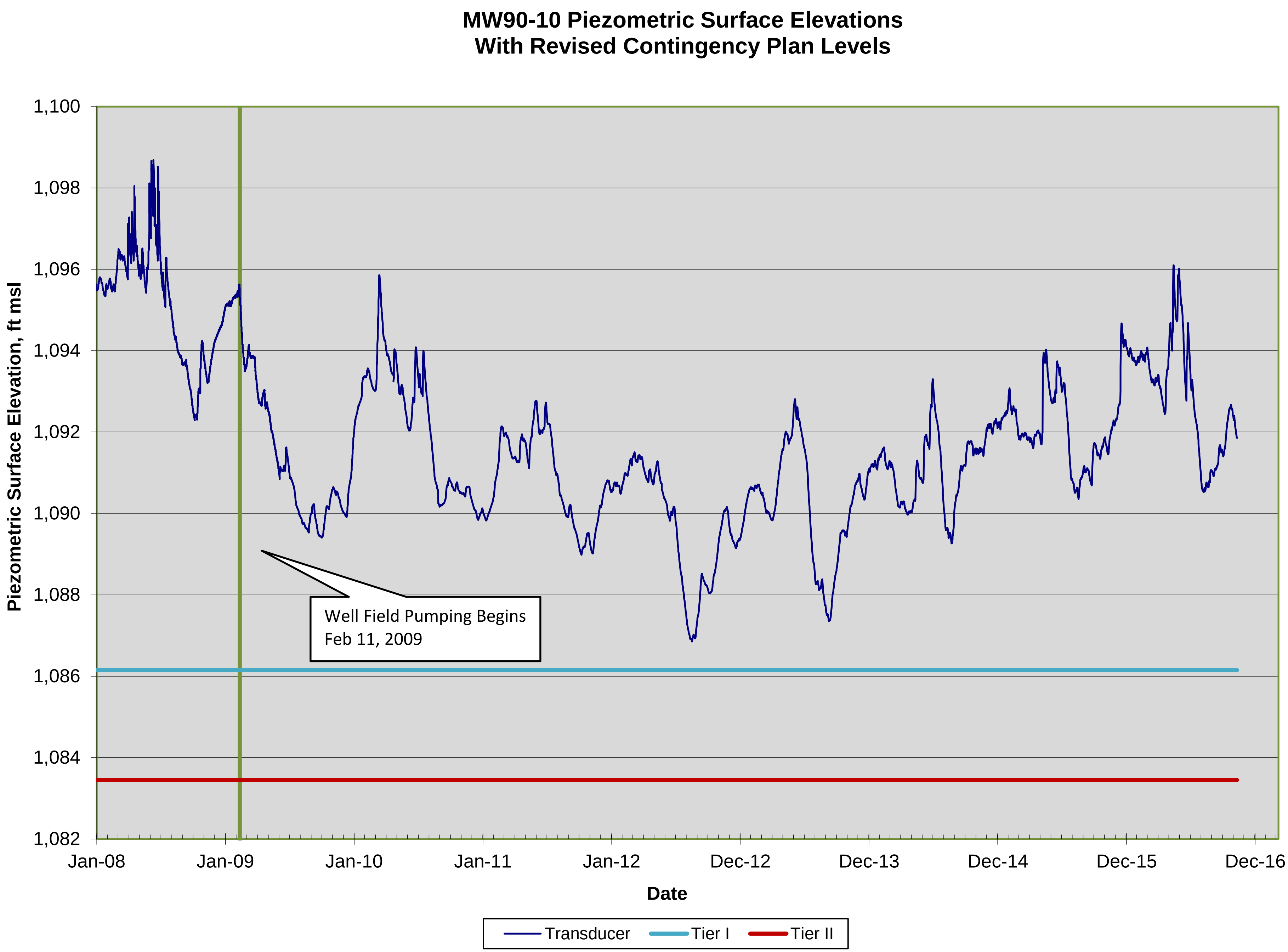

Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW 05-25
2005 - 2016
1107
1105
1103
1101
1099
1097
Piezometric Surface Elevation, ft msl
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Date
MW05-25
Manual Reading

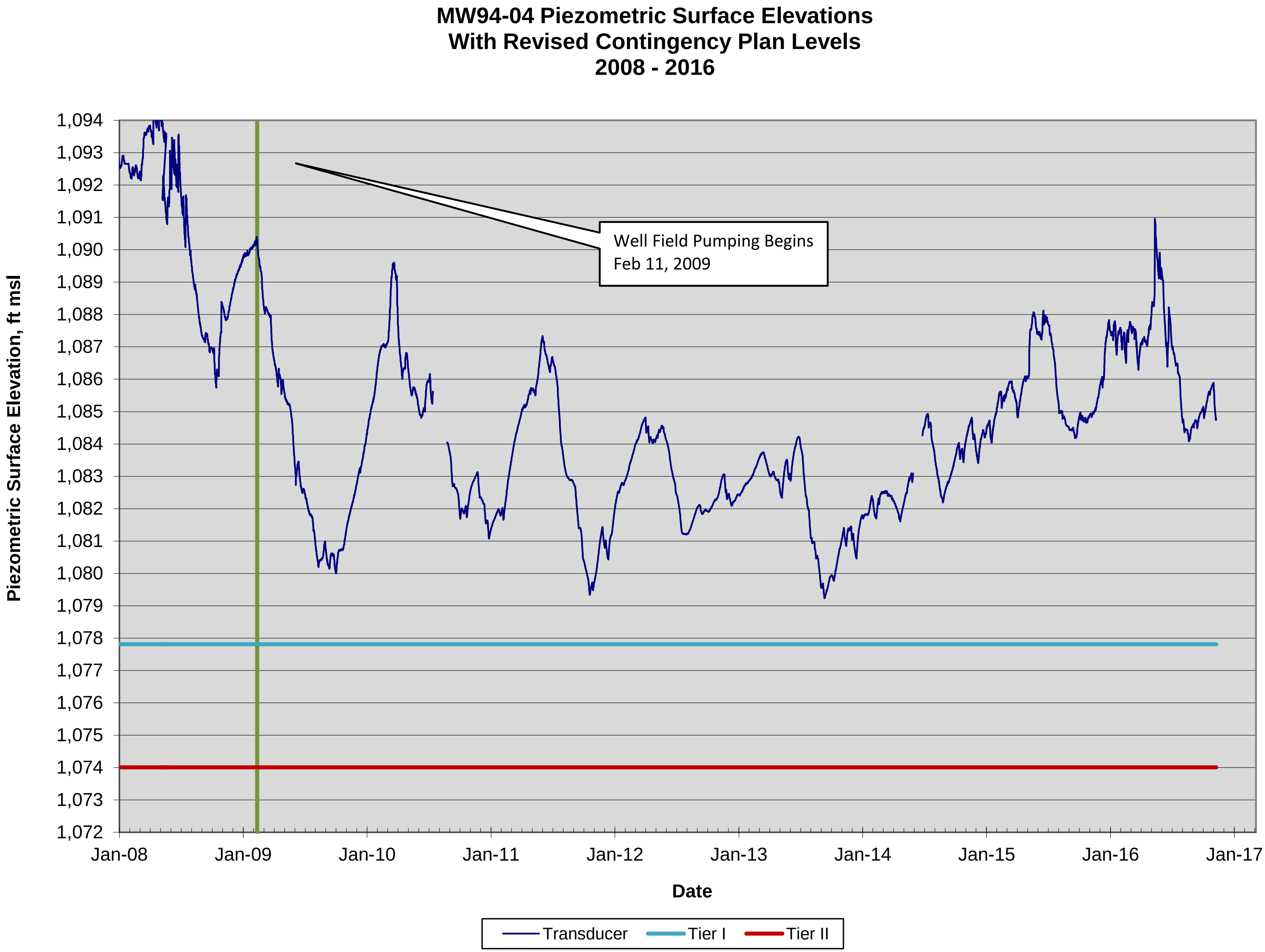

Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW05-26
2005 - 2016
1112
1110
1108
1106
1104
Piezometric Surface Elevation, ft msl
Jun-05
Jun-06
Jun-07
Jun-08
Jun-09
Jun-10
Jun-11
Jun-12
Jun-13
Jun-14
Jun-15
Jun-16
Date
MW05-26
Manual Reading



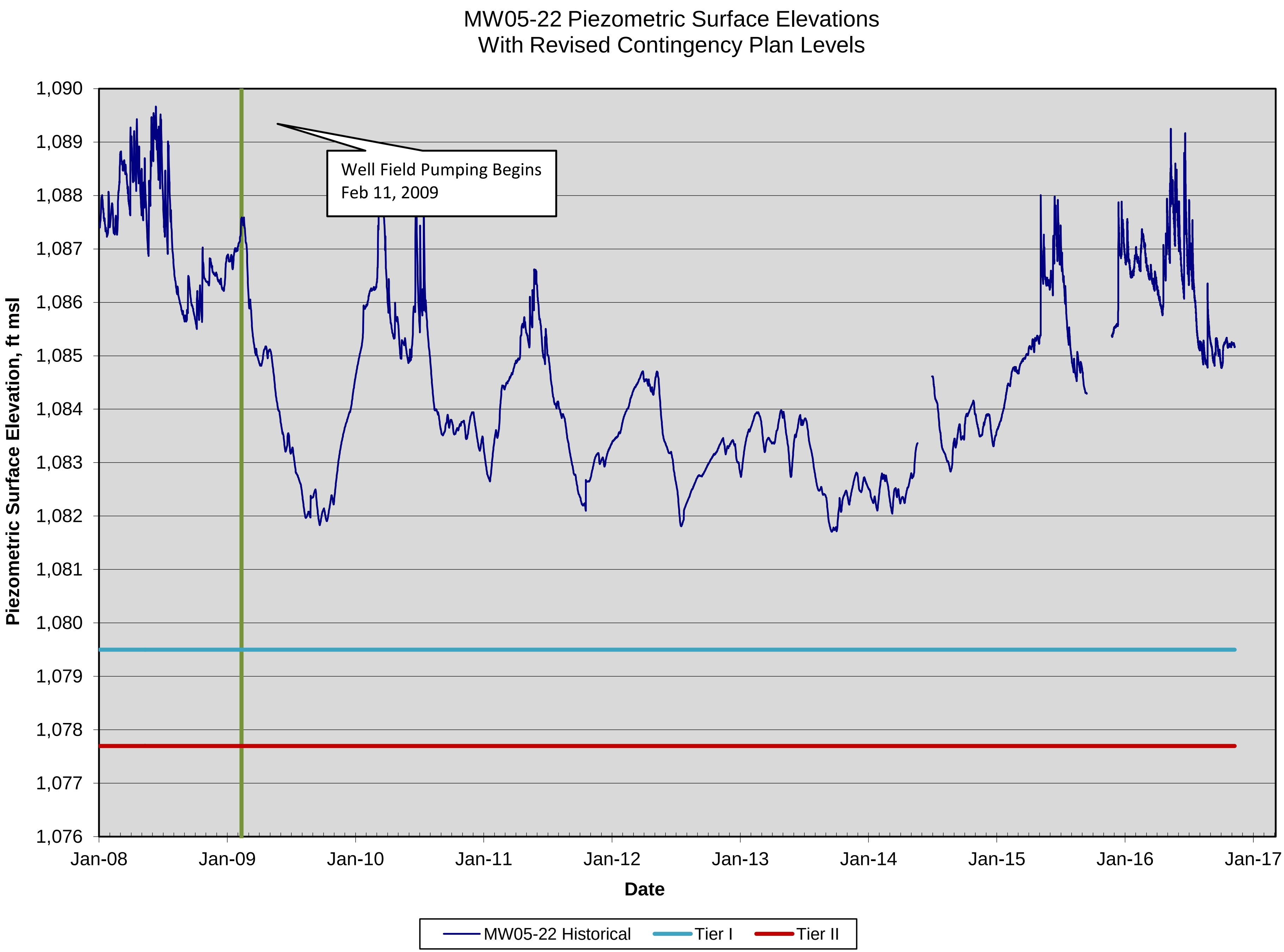
Long Term Historical
Piezometric Surface Elevations
Monitoring Well Location MW06-29
2006 - 2016
Piezometric Surface Elevation, ft msl
1100
1098
1096
1094
1092
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Date
MW06-29
Manual Reading

# APPENDIX 3-3 - CONTINGENCY PLAN WELL HYDROGRAPHS

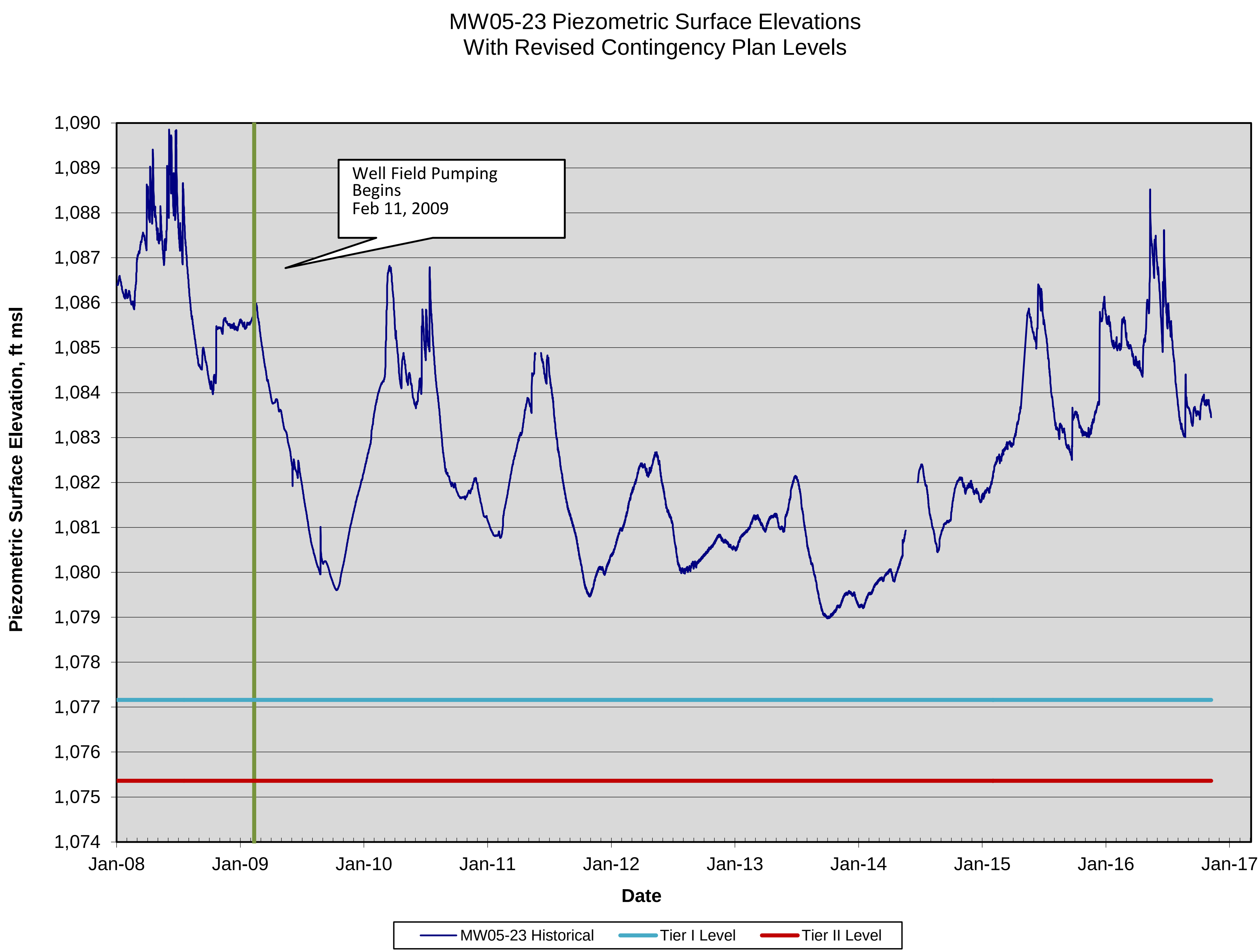

MW90-10 Piezometric Surface Elevations
With Revised Contingency Plan Levels
Piezometric Surface Elevation, ft msl
1,100
1,098
1,096
1,094
1,092
1,090
1,088
1,086
1,084
1,082
Well Field Pumping Begins
Feb 11, 2009
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Date
Transducer
Tier I
Tier II



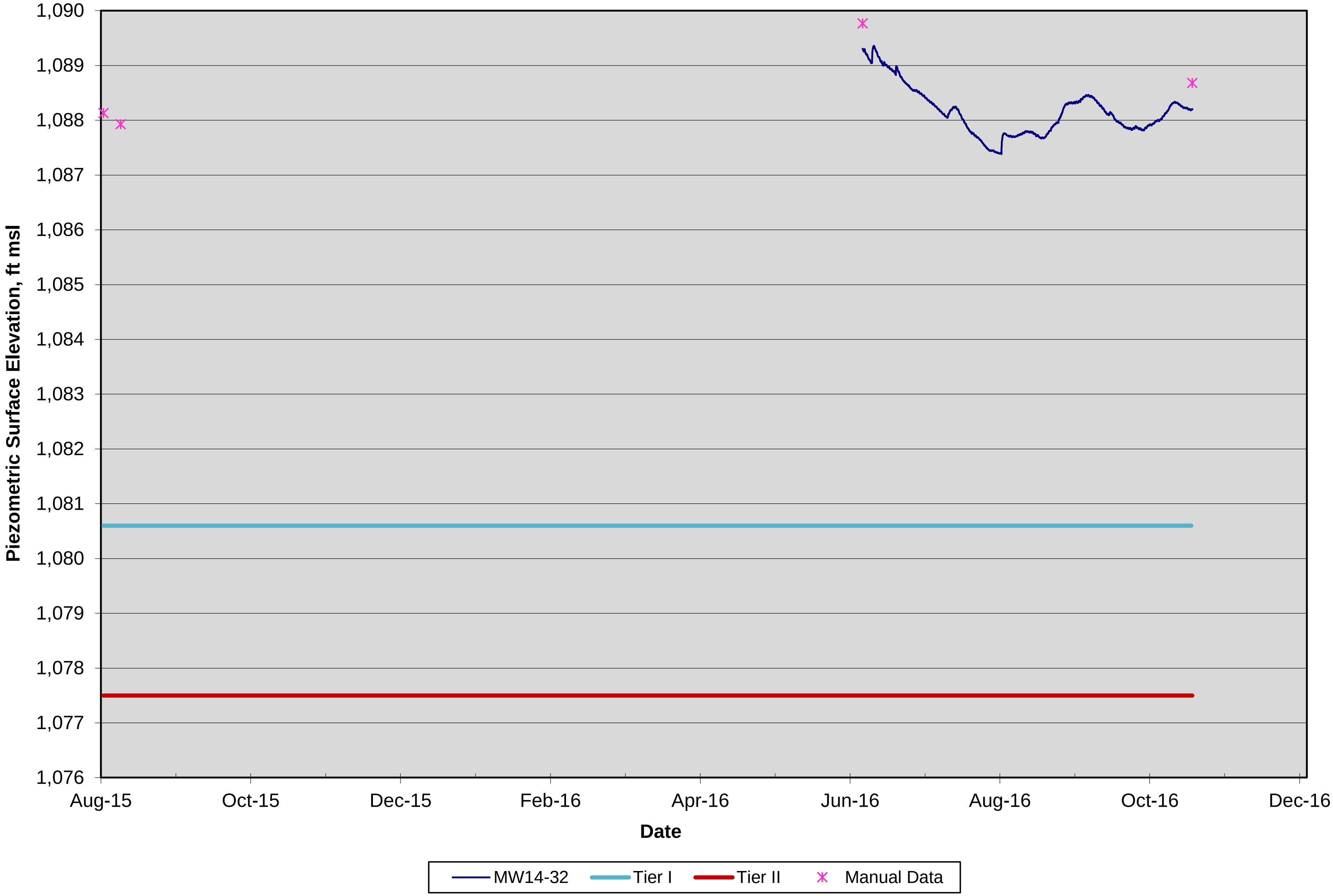
MW94-04 Piezometric Surface Elevations
With Revised Contingency Plan Levels
2008 - 2016
Piezometric Surface Elevation, ft msl
1,094
1,093
1,092
1,091
1,090
1,089
1,088
1,087
1,086
1,085
1,084
1,083
1,082
1,081
1,080
1,079
1,078
1,077
1,076
1,075
1,074
1,073
1,072
Well Field Pumping Begins
Feb 11, 2009
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Date
Transducer
Tier I
Tier II

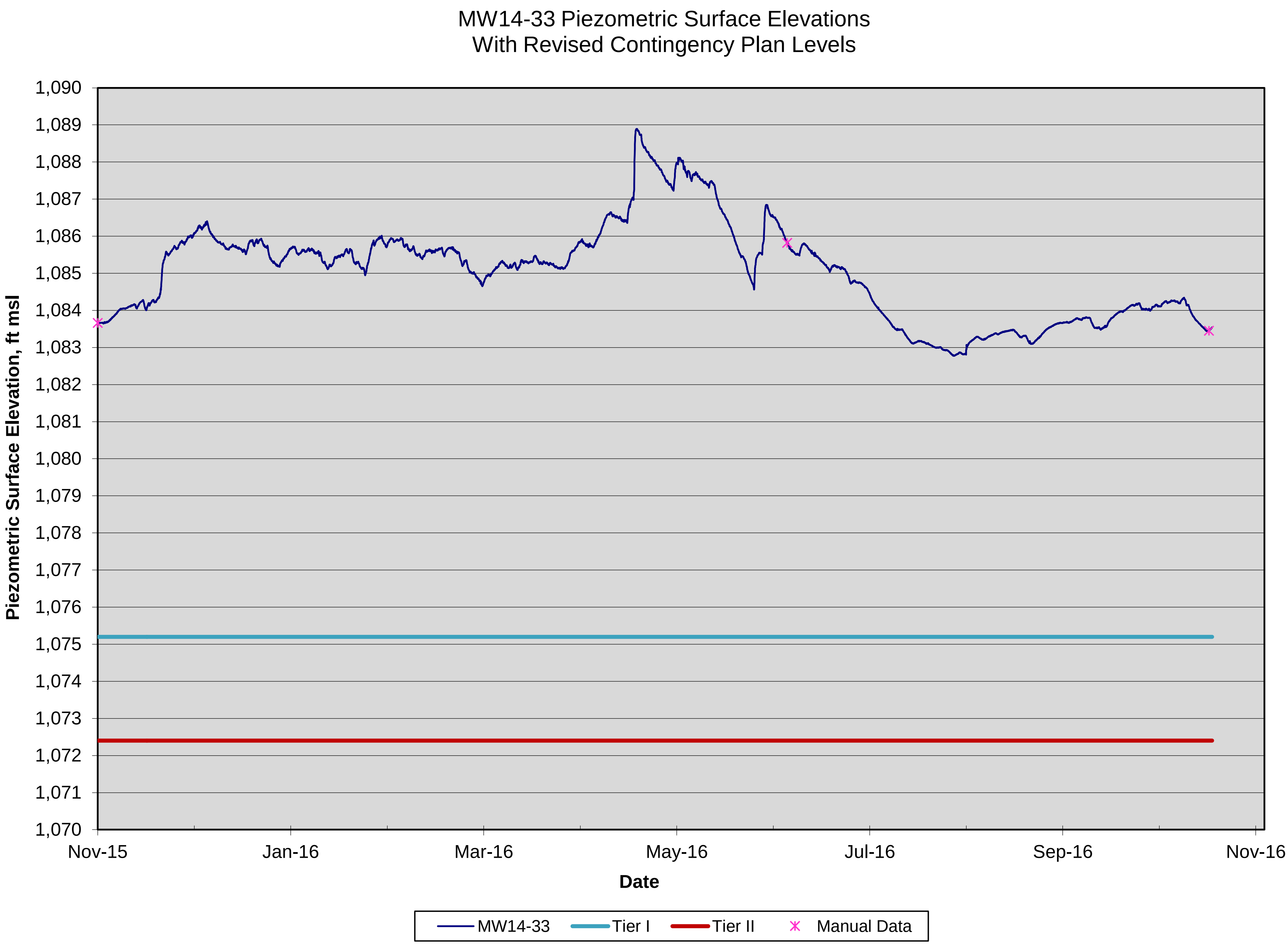


MW05-22 Piezometric Surface Elevations
With Revised Contingency Plan Levels
Well Field Pumping Begins
Feb 11, 2009
Piezometric Surface Elevation, ft msl
1,090
1,089
1,088
1,087
1,086
1,085
1,084
1,083
1,082
1,081
1,080
1,079
1,078
1,077
1,076
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Date
MW05-22 Historical
Tier I
Tier II

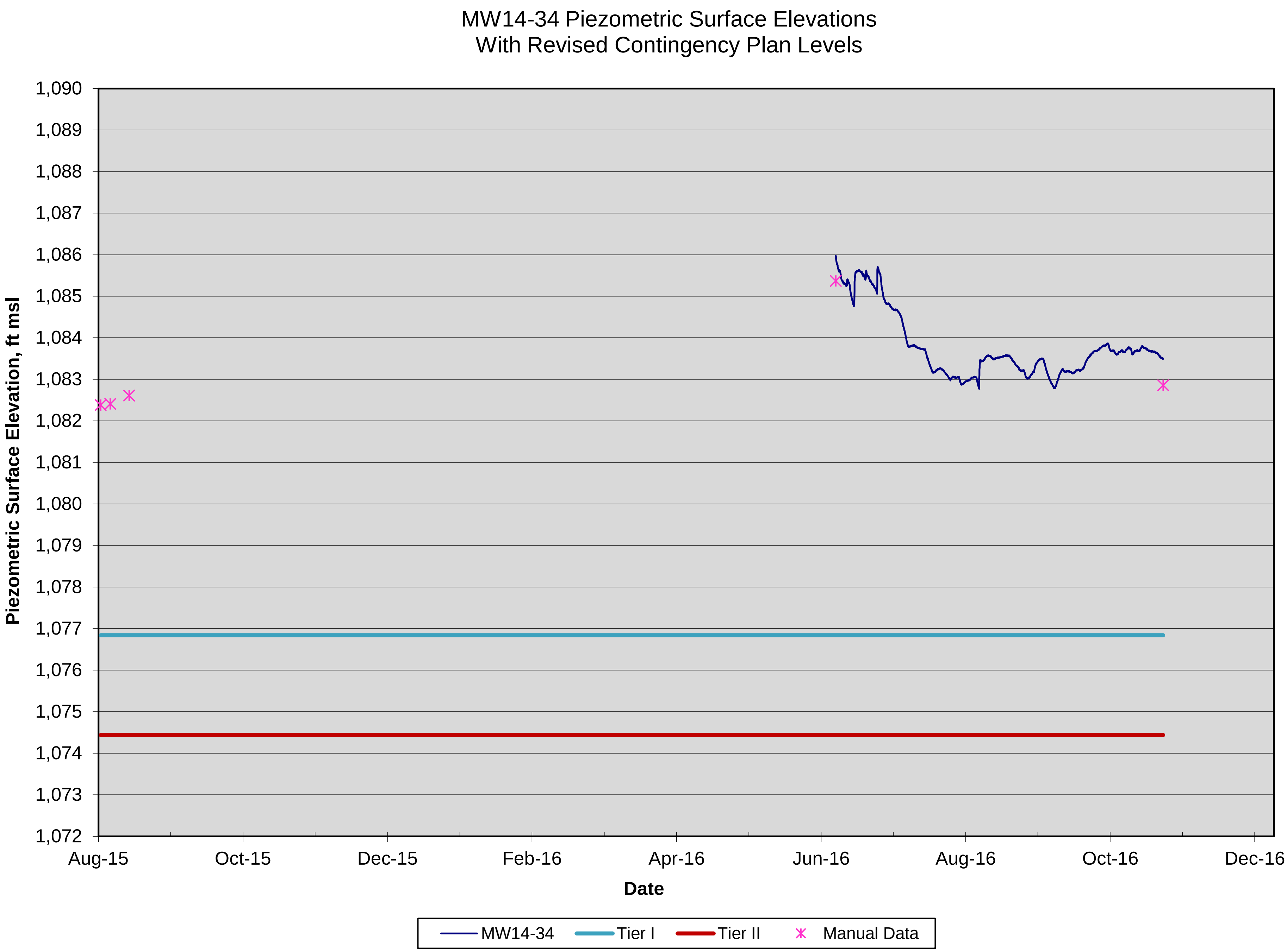

MW05-23 Piezometric Surface Elevations
With Revised Contingency Plan Levels
Well Field Pumping Begins Feb 11, 2009
Piezometric Surface Elevation, ft msl
1,090
1,089
1,088
1,087
1,086
1,085
1,084
1,083
1,082
1,081
1,080
1,079
1,078
1,077
1,076
1,075
1,074
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Date
MW05-23 Historical
Tier I Level
Tier II Level

MW14-32 Piezometric Surface Elevations
With Revised Contingency Plan Levels

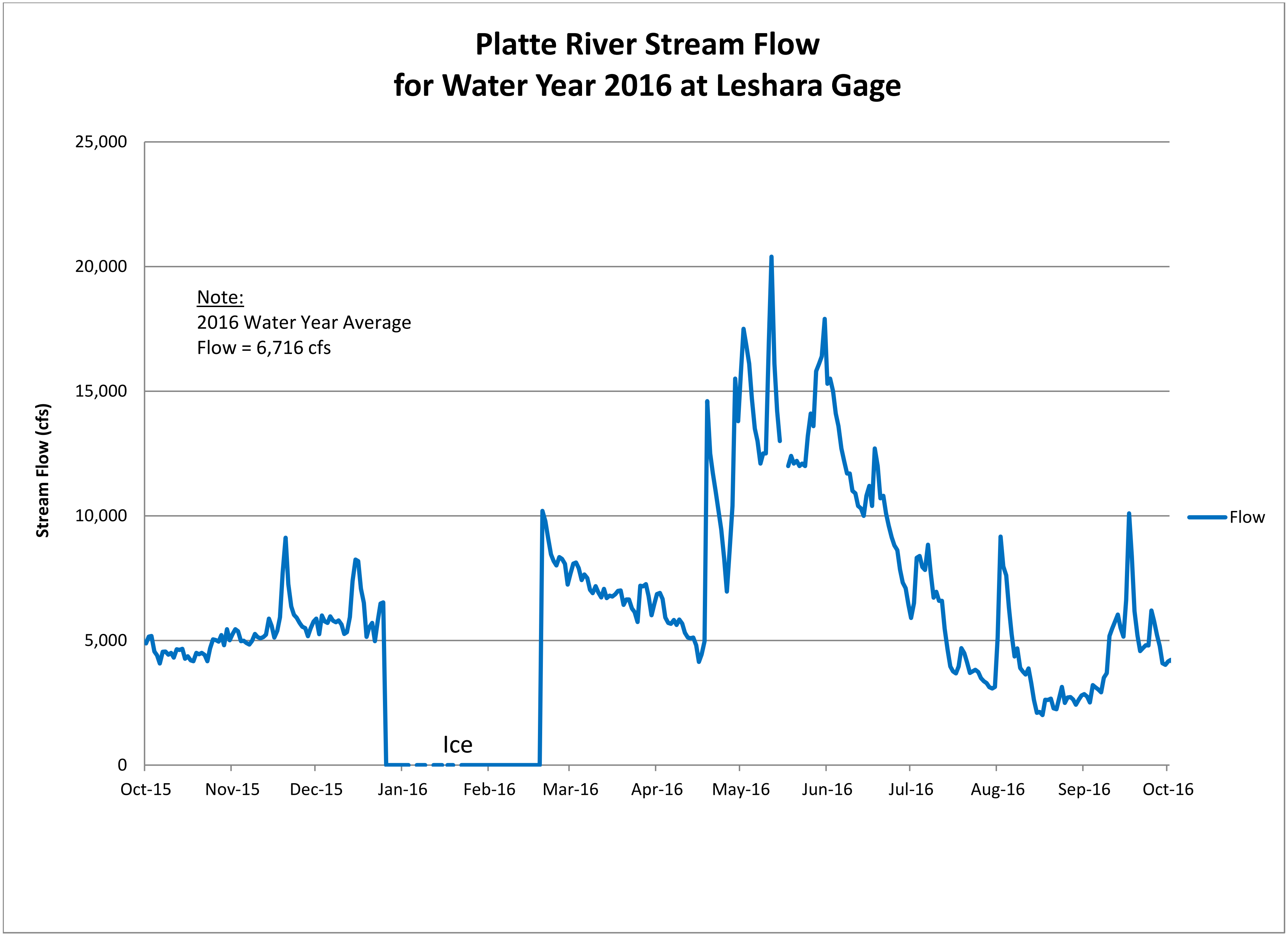


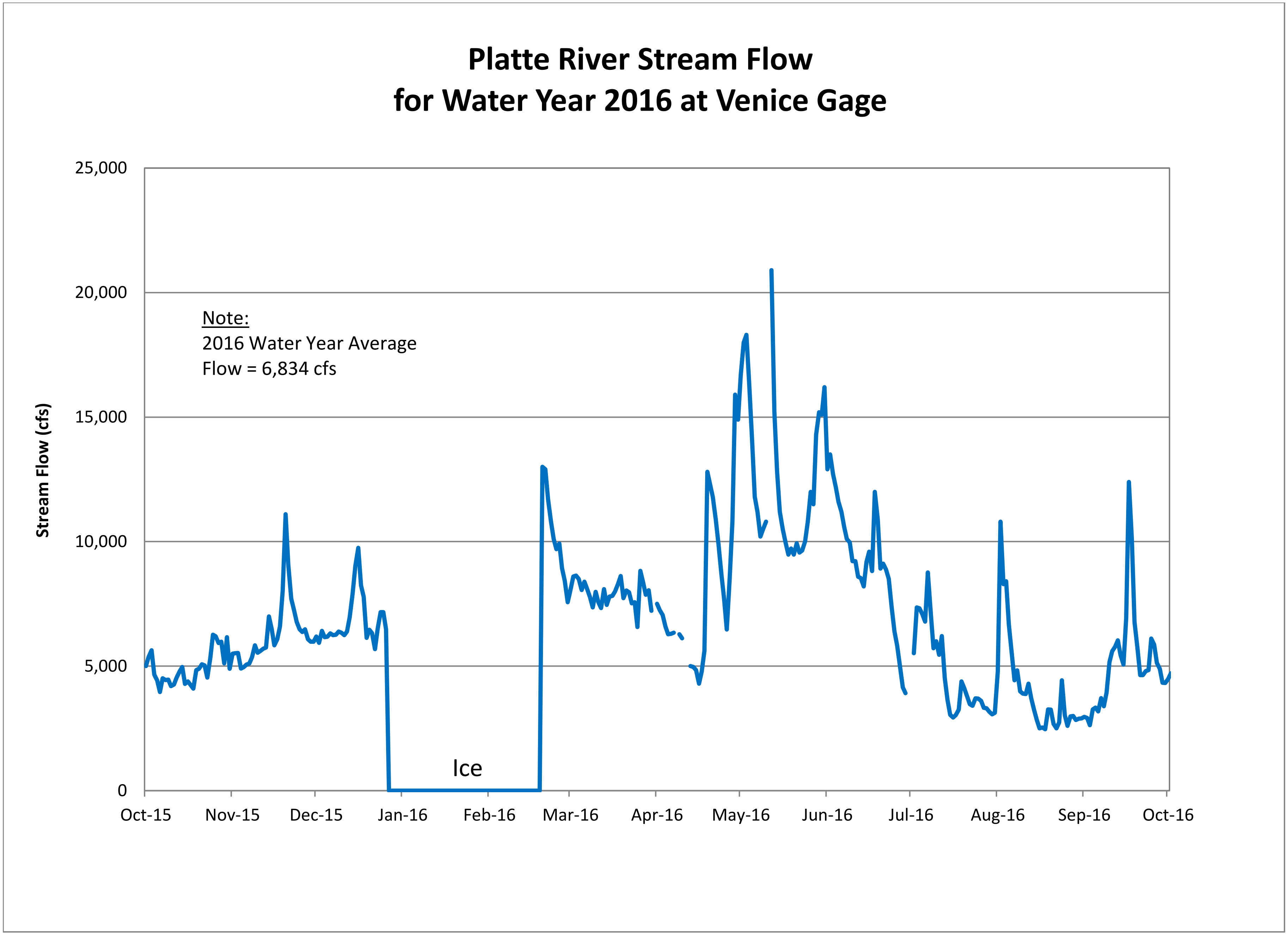


MW14-33 Piezometric Surface Elevations
With Revised Contingency Plan Levels
Piezometric Surface Elevation, ft msl
1,090
1,089
1,088
1,087
1,086
1,085
1,084
1,083
1,082
1,081
1,080
1,079
1,078
1,077
1,076
1,075
1,074
1,073
1,072
1,071
1,070
Nov-15
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Nov-16
Date
MW14-33
Tier I
Tier II
Manual Data

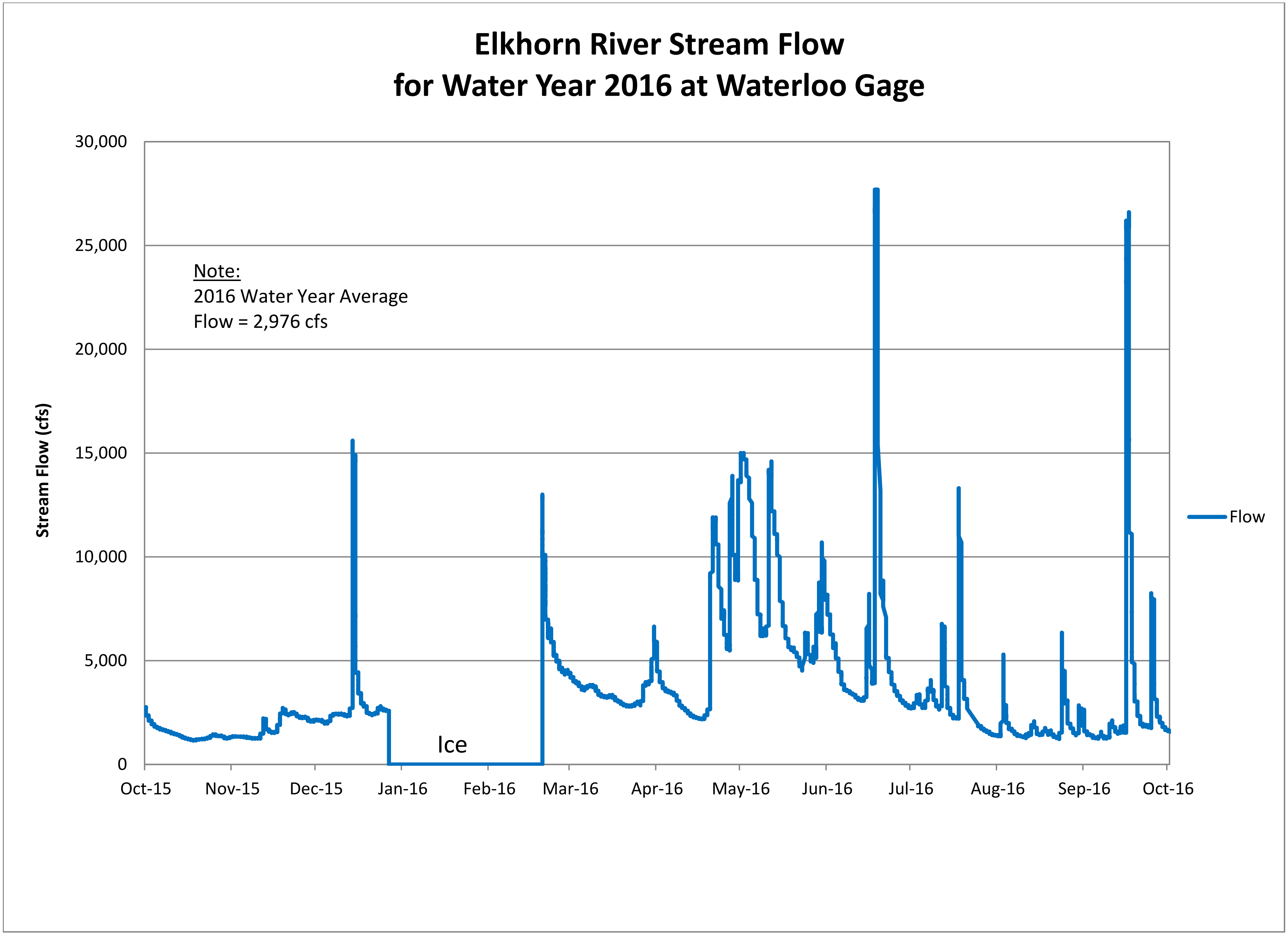

MW14-34 Piezometric Surface Elevations
With Revised Contingency Plan Levels
Piezometric Surface Elevation, ft msl
1,090
1,089
1,088
1,087
1,086
1,085
1,084
1,083
1,082
1,081
1,080
1,079
1,078
1,077
1,076
1,075
1,074
1,073
1,072
Aug-15
Oct-15
Dec-15
Feb-16
Apr-16
Jun-16
Aug-16
Oct-16
Dec-16
Date
MW14-34
Tier I
Tier II
Manual Data

# APPENDIX 3-4 - PLATTE AND ELKHORN RIVER STREAMFLOW DATA


Platte River Stream Flow
for Water Year 2016 at Leshara Gage
Note:
2016 Water Year Average
Flow = 6,716 cfs
Stream Flow (cfs)
25,000
20,000
15,000
10,000
5,000
0
Ice
Oct-15
Nov-15
Dec-15
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Flow



Platte River Stream Flow
for Water Year 2016 at Venice Gage
Note:
2016 Water Year Average
Flow = 6,834 cfs
Ice
Stream Flow (cfs)
25,000
20,000
15,000
10,000
5,000
0
Oct-15
Nov-15
Dec-15
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16


Elkhorn River Stream Flow
for Water Year 2016 at Waterloo Gage
Note:
2016 Water Year Average
Flow = 2,976 cfs
Stream Flow (cfs)
30,000
25,000
20,000
15,000
10,000
5,000
0
Ice
Oct-15
Nov-15
Dec-15
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Flow

# APPENDIX 4-1 - FNOP PLUME BASELINE

## When Does the U.S. Corps of Engineers Sample Water Supply Wells?

As part of the U.S. Corps of Engineers commitment to public safety, water supply wells that are within one mile from the delineated groundwater contamination plumes are sampled on a regular basis. Water supply wells located less than one mile from the delineated groundwater contamination plumes are in the "One-Mile Buffer Zone" and are sampled once a year. Water supply wells located less than one-half mile away from the delineated groundwater contamination plumes are in the "Half-Mile Buffer Zone" and are sampled twice a year. If at any point the water supply well is confirmed to contain TCE and/or RDX above their respective action levels, then a whole house granular activated carbon unit will be installed to treat the water and maintained by the U.S. Corps of Engineers at no cost to the landowner. Water supply wells that have a whole house granular activated carbon unit installed are sampled at the inlet and outlet of the treatment unit during each sampling event to monitor the effectiveness of treatment. The results of all water supply well testing are sent directly to each landowner.

**Granular Activated Carbon Unit**

**Extraction Well Screen Before and After Cleaning with Sonar Jet™**

**Sonar Jet™ Cleaning Device Being Lowered into an Extraction Well**

## Extraction Well Cleaning

As part of the operation and maintenance program at the former Nebraska Ordnance Plant, extraction wells are evaluated annually to determine whether they require cleaning. In October 2015, two extraction wells (EW-12 and EW-17) were cleaned using an alternative cleaning method called Sonar Jet™ instead of the traditional cleaning methods that include scrubbing, bailing, surging, purging, jetting, and chemical addition. This new method uses a detonation cord lowered into the well that emits shockwaves to break up debris on the well screen and within the surrounding aquifer. The debris within the well was air lifted out using compressed air. Downhole video inspections and pumping tests were performed after the cleaning which confirmed the effectiveness of this new method. Sonar Jet™ proved to be a faster and less expensive cleaning method than traditional cleaning methods that use brushes, water jets, and chemicals. This cleaning method will be used again in the future when extraction wells need to be cleaned.



# NEWSLetter

Former Nebraska Ordnance Plant ■ Mead, Nebraska

## Open House Meeting

The U.S. Army Corps of Engineers will host the annual Site Tour and Open House on Wednesday, May 18, 2016. Please come join us at the Main Groundwater Treatment Plant at the junction of County Road 6 and County Road F, in Ashland, Nebraska. The open house will be from 4:30-5:30 p.m. and a Site Tour from 5:30 p.m. until approximately 7:30 p.m. Representatives from the U.S. Environmental Protection Agency and Nebraska Department of Environmental Quality are expected to attend as well.

Please plan on attending our Open House and Site Tour for handouts, light refreshments and poster presentations at 5:00 p.m. on the Assessment of the Groundwater Containment System on the Omadi Formation, the Water Supply Well Sampling Program, and Cleaning Extraction Wells with Sonar Jet™. Project personnel will be available to provide and interpret water sampling results and other site data from 4:30-5:30 p.m. Neighbors and local residents are welcome to join us for a guided bus tour starting at 5:30 p.m. that will introduce you to many parts of the groundwater clean-up project.

The tour will begin at the Main Groundwater Treatment Plant and we will then take the bus to the following locations: Load Line 4 and Advanced Oxidation Process Groundwater Treatment Plants, EW-5 pump house, the former Atlas Missile Area, and focused extraction well FEW-15. The tour will end at approximately 7:30 p.m. at the Main Groundwater Treatment Plant. See site tour map on the following page.

## Open House Meeting (continued)

For further information regarding the meeting, contact the U.S. Army Corps of Engineers Project Manager at (816) 389-3563.

## Operations and Maintenance Summary

Operation of the Ultraviolet treatment systems and the Load Line 1, Advanced Oxidation Process, and Load Line 4 Groundwater Treatment Plants have resulted in removal of the following amounts of contaminants of concern from groundwater as of March 31, 2016, since their respective startup.

TCE (trichloroethene) removed:
- Load Line 1 Groundwater Treatment Plant – 1,286 pounds
- Advanced Oxidation Process Treatment Plant – 32,235 pounds
- Load Line 4 Groundwater Treatment Plant – 4,853 pounds

RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) removed:
- Ultraviolet Treatment Systems – 86 pounds

Gallons of water treated since startup:
- Load Line 1 Groundwater Treatment Plant – 1,901,361,000 gallons
- Advanced Oxidation Process Treatment Plant – 1,916,431,000 gallons
- Load Line 4 Groundwater Treatment Plant – 1,525,943,000 gallons
- Ultraviolet Treatment Systems – 1,587,200,000 gallons

**May 2016**

For more information or any questions concerning the former Nebraska Ordnance Plant project, please contact:

**Edwin Louis**
Project Manager
U.S. Army Corps of Engineers
Kansas City District
601 East 12th Street
Kansas City, Missouri 64106
Phone: (816) 389-3563

or go to the project website at:

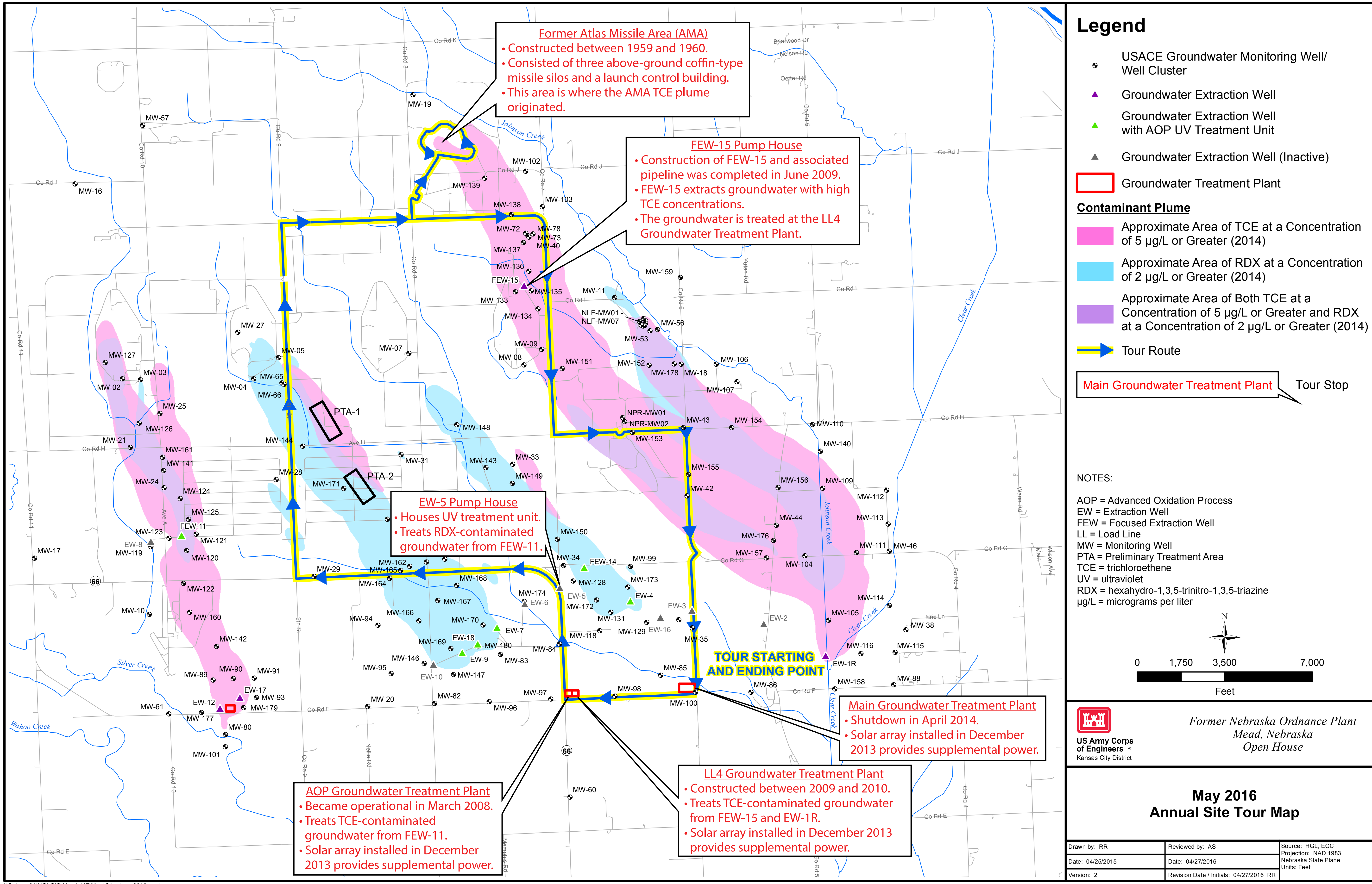
http://www.nwk.usace.army.mil/Missions/Environmental/EnvironmentalProjects/NOP.aspx

Information repository documents are available for review at:

**Mead Public Library**
316 South Vine Street
Mead, Nebraska 68041
Phone: (402) 624-6605

**Hours**
Tuesday: 10 a.m. - 1 p.m. and 2-6 p.m.
Wednesday: 4-8 p.m.
Thursday: 10-11 a.m. and 2-6 p.m.
Saturday: 10 a.m. - 2 p.m.

US Army Corps of Engineers ®


Former Atlas Missile Area (AMA)
• Constructed between 1959 and 1960.
• Consisted of three above-ground coffin-type missile silos and a launch control building.
• This area is where the AMA TCE plume originated.
FEW-15 Pump House
• Construction of FEW-15 and associated pipeline was completed in June 2009.
• FEW-15 extracts groundwater with high TCE concentrations.
• The groundwater is treated at the LL4 Groundwater Treatment Plant.
EW-5 Pump House
• Houses UV treatment unit.
• Treats RDX-contaminated groundwater from FEW-11.
TOUR STARTING AND ENDING POINT
Main Groundwater Treatment Plant
• Shutdown in April 2014.
• Solar array installed in December 2013 provides supplemental power.
LL4 Groundwater Treatment Plant
• Constructed between 2009 and 2010.
• Treats TCE-contaminated groundwater from FEW-15 and EW-1R.
• Solar array installed in December 2013 provides supplemental power.
AOP Groundwater Treatment Plant
• Became operational in March 2008.
• Treats TCE-contaminated groundwater from FEW-11.
• Solar array installed in December 2013 provides supplemental power.
PTA-1
PTA-2
Johnson Creek
Clear Creek
Silver Creek
Wahoo Creek
Legend
USACE Groundwater Monitoring Well/ Well Cluster
Groundwater Extraction Well
Groundwater Extraction Well with AOP UV Treatment Unit
Groundwater Extraction Well (Inactive)
Groundwater Treatment Plant
Contaminant Plume
Approximate Area of TCE at a Concentration of 5 µg/L or Greater (2014)
Approximate Area of RDX at a Concentration of 2 µg/L or Greater (2014)
Approximate Area of Both TCE at a Concentration of 5 µg/L or Greater and RDX at a Concentration of 2 µg/L or Greater (2014)
Tour Route
Main Groundwater Treatment Plant
Tour Stop
NOTES:
AOP = Advanced Oxidation Process
EW = Extraction Well
FEW = Focused Extraction Well
LL = Load Line
MW = Monitoring Well
PTA = Preliminary Treatment Area
TCE = trichloroethene
UV = ultraviolet
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
µg/L = micrograms per liter
N
0 1,750 3,500 7,000
Feet
US Army Corps of Engineers
Kansas City District
Former Nebraska Ordnance Plant
Mead, Nebraska
Open House
May 2016
Annual Site Tour Map
Drawn by: RR
Reviewed by: AS
Date: 04/25/2015
Date: 04/27/2016
Version: 2
Revision Date / Initials: 04/27/2016 RR
Source: HGL, ECC
Projection: NAD 1983
Nebraska State Plane
Units: Feet
\\Gst-srv-01\HGLGIS\Mead_NE\Misc\Site_tour_2016.mxd

# APPENDIX 4-2 - CHEMICAL SAMPLING DATA

# Quality Control Summary Report
# May 2016 Monitoring Well Sampling Event

## Metropolitan Utilities District of Omaha
## Platte West Well Field

## Saunders County, Nebraska

**Prepared for**
**Metropolitan Utilities District of Omaha**

**Prepared by**
**Olsson Associates**

**Olsson Project Number: 011-1087**

**June 2016**

## Table of Contents

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***List of Appendices***



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## 1.0 INTRODUCTION

The Metropolitan Utilities District of Omaha (MUD) provides potable water for a metropolitan area of over three-quarters of a million people. To meet projected water demands from continued population growth in the greater Omaha area in the coming decades, MUD completed construction of the Platte West Well Field (PWWF) in 2008. The PWWF consists of 42 wells constructed along and adjacent to the Platte River approximately seven miles east of the town of Mead in Saunders County, Nebraska. The well field began operations in July of 2008 and currently has the capacity to provide 100 million gallons per day (mgd). Because the PWWF transmits water across the Platte River from wells on the west bank eastward via a pipeline, the well field is subject to U.S. Army Corp of Engineers (USACE) Omaha District (CENWO) Section 404 Permit regulations. This permit requires MUD to monitor any influence the well field activity may have on remediation efforts at the former Nebraska Ordnance Plant (NOP) south of Mead, which is under the jurisdiction of the USACE Kansas City District (CENWK). Two overlapping plumes of contaminants (trichloroethylene and RDX) from former munitions and missile plants are found in the subsurface south/southeast of Mead and follow the ambient groundwater gradient from the northwest to the southeast. USACE monitoring of the aquifer conditions consists of tracking both physical parameters (water table elevations and gradient) and changes in contaminant concentrations in the groundwater in both the plume area and the PWWF. Data obtained from these activities will be used by MUD and the USACE to determine if any impacts have occurred by assessing changes in any concentrations of any contaminants present in monitoring wells. Water levels will also be used to verify the groundwater model of the well field area.

Olsson Associates was contracted by MUD to monitor the aquifer conditions in accordance with the USACE requirements. This Quality Control Summary Report (QCSR) provides the results of data validation for the May 2016 sampling event at the PWWF completed on May 18, 2016.

## 2.0 FIELD SAMPLING ACTIVITIES

The Field Sampling Plan (Olsson, 2015a) calls for samples to be collected from six monitoring wells and analyzed for volatile organic compounds (VOCs) and explosive compounds as listed in Table 2-1. In accordance with the Field Sampling Plan, the following QC samples were collected:

1. One field duplicate
2. One matrix spike/matrix spike duplicate
3. One trip blank

Field notes are included in Appendix B. The samples collected on May 18, 2016 were shipped to the laboratory in coolers packed in ice.

The following subsections present results of the data quality evaluation. The evaluation was performed in accordance with the Quality Assurance Project Plan (QAPP) developed specifically for this monitoring program (Olsson, 2015b). Qualifiers were assigned by the laboratory in accordance to their quality control program.

Table 2-2 provides an explanation of the abbreviations, laboratory qualifiers and notes associated with the tables in this QCSR report. Table 2-3 provides information on sample collection, laboratory numbering and analyses requested as listed below:

- Quality control sample information including duplicate sample location
- A cross reference between field sample and laboratory sample IDs
- Sample delivery group numbers
- Dates of sample collection and sample receipt at the laboratory
- List of analyses requested

## 3.0 ANALYTICAL RESULTS

The samples were analyzed by TestAmerica, Inc. in Burlington, Vermont for VOCs and explosive compounds. A summary of the analytical results is presented in Table 3-1 for VOCs and Table 3-2 for explosive compounds. As listed in Table 3-3 and 3-4, there were no unqualified VOC or explosive compounds detected above the reporting limits, except for 4-Nitrotoluene. 4-Nitrotoluene was detected in samples AMW06-031-052016 and AMW06-030-052016 at concentrations exceeding its reporting limit.

### 3.1 Summary of Receipt in the Laboratory

The samples were received on May 19, 2016 as noted on the Chain-of-Custody (COC) and Sample Login Acknowledgements included in Appendix A. The samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt ranged from 3.7 to 5.9 degrees Celsius which is within the acceptable range of 0 to 6 degrees Celsius.

### 3.2 Holding Times

Samples were extracted and analyzed within the method specific holding times as required in the QAPP (Olsson, 2015b) and noted below, with the exception of a re-analysis for one sample:

- 14-days to extraction for VOCs
- 7-days to extraction and 40-days to analysis for Explosives

### 3.3 Tuning and Calibration

Assessment of tune and calibration data was validated by reviewing the case narrative and analytical report. There were no tuning and calibration outliers detailed by the laboratory in the Final Analytical Report (TestAmerica, 2016) for compounds detected above reporting limits in these samples.

### 3.4 Laboratory Method Blanks

Method blanks were prepared and analyzed per the requirements of the QAPP (Olsson, 2015b). Method blanks are sample containers filled by the laboratory with analyte-free water that is carried through the entire preparation and analysis sequence for the purpose of identifying potential contamination. Method blanks were analyzed with each sample batch for all analyses. There were no compounds detected in the method blanks above reporting limits.

### 3.5 Trip Blanks

Trip blanks are required when samples are collected for analysis of VOCs. Trip blanks are prepared in the laboratory with analyte-free water and are shipped to the site with the regular sample containers. The blanks are kept unopened in the field during site sampling activities and are shipped for analysis with the project samples. Trip blanks are designed to evaluate VOC contamination encountered during sampling, transportation, and storage.

One trip blank sample was placed in the sample cooler containing samples to be analyzed for VOCs collected on May 18$^{th}$. There were no compounds detected in the trip blank.

### 3.6 Rinsate Blanks

Rinsate blank samples serve as a quality control check on the cleanliness of the sampling device and the equipment decontamination process. Rinsate blanks are prepared in the field using analyte-free or organic-free water. The samples are used to evaluate if contaminants have been introduced through contact with the sampling equipment. Rinsate blanks are only required when non-dedicated sampling equipment is used to collect groundwater samples, as specified in the QAPP (Olsson, 2015b). For the MUD Platte West Monitoring program, rinsate samples were not required because dedicated sampling equipment, specifically, Hydrasleeves, were used to collect the groundwater samples.

### 3.7 Surrogates

Surrogates are compounds that are added (spiked) into samples prior to sample extraction or analysis, depending on the method. The compounds are not normally found in the environment and therefore can be analyzed for their percent recovery as part of the quality control process. The percent recovery (%REC) of each surrogate is used to assess the success of the sample preparation process for each sample.

For the 8260B VOC analyses (GC/MS), four surrogate analytes were introduced:

- 1,2-Dichloroethane-d4 (80-120%)
- Toluene-d8 (80-120%)
- Bromofluorobenzene (80-125%)
- 1,2-Dichlorobenzene-d4 (75-120%)

All four surrogates were recovered within their acceptable range as noted above.

### 3.8 Laboratory Control Sample

The laboratory control sample (LCS) consists of a matrix similar to the field sample. The LCS is spiked with known concentrations of analytes. As with the surrogates, the LCS %REC is a measure of the method accuracy. If %REC results are outside the laboratory criteria, then the data is flagged with a laboratory qualifier "*" meaning the %REC exceeds the control limits. There were no LCS control limit exceedances for any compounds detected above reporting limits in these samples.

### 3.9 Matrix Spike/Matrix Spike Duplicate

Matrix Spike/Matrix Spike Duplicate (MS/MSD) analyses measure method accuracy and precision for a project-specific matrix. A field sample is split into three portions (original, MS, and MSD) and known amounts of analytes are spiked into the MS and MSD portions of the sample. The analytical results of these two portions are compared to each other for reproducibility using the RPD. The results are also compared against the unspiked portion of the sample for %REC of the spiked analytes. There are no MS/MSD analysis that exceeded their control limits for compounds detected above reporting limits in these samples.

### 3.10 Field Duplicate Results

Field duplicate results provide information on the reproducibility of field sample results and account for error introduced from handling, shipping, storage, preparation, and analysis of field samples. One field duplicate pair was collected during the May 2016 groundwater sampling event. The field duplicate pair is AMW06-018-052016 and AMW06-218-052016. The pair was analyzed for VOCs and explosives.

Along with QC evaluations presented in other sections of this QCSR, the results of the field duplicate pair are compared to one another. Results within a factor of two of each other are considered to be in agreement. Results between a factor of two to three of each other are considered a minor discrepancy and results greater than a factor of three are considered a major discrepancy. Tables 3-5 and 3-6 present the results of the field duplicate pair for VOCs and explosive compounds (respectively). The results are within a factor of two of each other and are considered in agreement.

### 3.11 Dilutions and Re-analyses

As noted on the data tables presented in this QCSR, the VOC and explosive samples did not require dilution (dilution factor = 1). The data reported in the tables are usable as reported.

### 3.12 Other QC Parameters

A column comparison between the detected explosive results was made using explosive identification summary forms. The RPDs were calculated by the laboratory on the appropriate Form X, Identification Summary. All detected explosives reported were confirmed by a second column. The lower value was reported. The percent difference between the two columns did not exceed 40% for compounds detected above their reporting limit with the exception of 4-Nitrotoluene in sample AMW06-030-052016. This data point was qualified with a "p" qualifier because the RPD between the primary and confirmation column differed by more than 40%.

### 3.13 Laboratory Qualifiers For May 2016 Data

Analytes detected below the quantitation limit or reporting limit but above the lowest level of detection were quantified and results were assigned an estimate (J) qualifier by the laboratory. The qualifiers are identified in Tables 3-1 through 3-7. Data with these qualifiers were are considered usable and do not count against the completeness assessment.

# 4.0 OVERALL ASSESSMENT

The following sections present the field completeness, analytical completeness and project completeness for the May 2016 monitoring well sampling event.

## 4.1 Field Completeness

Field completeness for sample collection is assessed by comparing the number of samples collected to the number of samples originally planned for collection. Table 4-1 presents the field completeness values for the May 2016 monitoring event. Field completeness for explosives was 100%. Field completeness for the VOCs was 100%. The overall field completeness was 100% which exceeds the goal of 95%.

## 4.2 Analytical Completeness

There are two components to the analytical completeness evaluation. Analytical completeness is evaluated by quantifying the overall acceptable data and the overall quality data. The following paragraphs provide the evaluation of each component and Table 4-2 presents acceptable and quality data completeness.

Acceptable data is a measure of contract laboratory compliance. Acceptable data includes data that has not been rejected or qualified (except for J qualified data). Qualified data is considered acceptable if appropriate corrective actions were taken by the laboratory. The acceptable data completeness percentage for VOCs was 99% and for explosives was 99%. The overall acceptable data completeness is 99% which is above the overall acceptable data completeness goal of 85%.

Quality data is a measure of the percentage of usable data. Quality data includes all data except rejected data points, and does not include analyses for which replacement data points are available. There was no rejected data and therefore quality data completeness percentages for VOCs and explosives were 100% which exceeds the quality data completeness goals of 85% for each analytical method.

By averaging the completeness of the two components, the overall analytical completeness evaluation is calculated. Overall quality data completeness is 100% for the May 2016 sampling event, which exceeds the overall quality data completeness goal of 85%.

## 4.3 Project Completeness

Project completeness combines sampling and analytical completeness percentages to assess the success in achieving the expectations of the project as a whole. Project completeness is determined by comparing the percentage of usable samples/measurements to the percentage of planned or observed samples/measurements. For the field completeness portion, this involves comparison of the number of samples properly collected to the number of samples planned for collection. For the analytical data completeness portion, this involves comparison of the number of usable data points to the number of observed data points. The field completeness and analytical completeness (quality data) completeness percentages are used to calculate the project completeness percentage. Table 4-3 presents project completeness calculations. For the May 2016 monitoring event, project completeness is 100%, which exceeds the project completeness goal of 90%.

## 5.0 CONCLUSIONS

**Data are valid for use, as qualified.** Overall field completeness is 100%, acceptable data completeness is 100%, quality data completeness is 99%, and project completeness is 100%. No data have been rejected. Data are qualified using the laboratory qualifiers as listed in Table 2-2 and as associated with the data provided in Tables 3-1 through 3-7.

## 6.0 REFERENCES

Olsson Associates, 2015a. Final Field Sampling Plan for the Metropolitan Utilities District of Omaha, Platte West Well Field, Monitoring Well Sampling Program, Mead, Nebraska, prepared for the Metropolitan Utilities District of Omaha, February.

Olsson Associates, 2015b. Quality Assurance Project Plan for the Metropolitan Utilities District of Omaha, Platte West Well Field, Monitoring Well Sampling Program, Mead, Nebraska, prepared for the Metropolitan Utilities District of Omaha, February.

TestAmerica, 2016. Analytical Report, Job Number 200-33594-1. M.U.D. Platte West Well Field prepared for Olsson Associates by TestAmerica, James W. Madison, Project Manager. June 8, 2016.

Respectfully Submitted,
**Olsson Associates**

Prepared by,

Jason Byler, PE
Environmental Engineer

Reviewed by,

Bill Imig, CHMM
Environmental Scientist

# TABLES

**Table 2-1**
**Monitoring Well Samples and Analytical Requirements**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Well Identification | Latitude | Longitude | Analyses |
|---|---|---|---|
| MW06-18A | -96.382036 | 41.160754 | Volatile Organic and Explosive Compounds |
| MW06-18B | -96.382036 | 41.160754 | Volatile Organic and Explosive Compounds |
| MW06-30A | -96.405926 | 41.190157 | Volatile Organic and Explosive Compounds |
| MW06-30B | -96.405926 | 41.190157 | Volatile Organic and Explosive Compounds |
| MW06-31A | -96.391220 | 41.175544 | Volatile Organic and Explosive Compounds |
| MW06-31B | -96.391220 | 41.175544 | Volatile Organic and Explosive Compounds |

# Table 2-2
## Abbreviations, Data Qualifiers and Notes
## May 2016 Monitoring Well Sampling Event
## Metropolitan Utilities District, Saunders County, NE

**Notes:**

All analyses were completed by TestAmerica in Burlington, Vermont

**Abbreviations:**

| | |
|---|---|
| Dup | Duplicate sample |
| GC/MS | Gas Chromatograph/Mass Spectrometer |
| HPLC/IC | High Performance Liquid Chromatography/Ionic Chromatography |
| ID | Identification |
| Invest. | Investigative sample |
| Lab | Laboratory |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| NA | Not Analyzed |
| QC | Quality Control |
| RPD | Relative Percent Difference |
| VOAs | Volatile Organic Analyses |
| VOCs | Volatile Organic Compounds |

**Data Qualifiers (Q):**

*GC/MS VOA*

| | |
|---|---|
| * | LCS or LCSD is outside acceptance limits. |
| J | Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value. |
| U | Indicates the analyte was analyzed for but not detected. The laboratory reporting limit (RL) is listed for U coded data. |
| B | Compound was found in the blank and sample. |
| F1 | MS and/or MSD Recovery is outside acceptance limits. |

*HPLC/IC*

| | |
|---|---|
| J | Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value. |
| p | The %RPD between the primary and confirmation column/detector is >40%. The lower value has been reported. |
| U | Indicates the analyte was analyzed for but not detected. The laboratory reporting limit (RL) is listed for U coded data. |
| F1 | MS and/or MSD Recovery is outside acceptance limits. |

**Table 2-3**
**Sample Collection Summary**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Well Number | Investigative Sample ID | Quality Control Sample ID | MS/MSD Sample ID | Trip Blank Sample ID | Date Sampled | Date Received by Lab | COC Record Number | Lab ID | Sample Delivery Group | VOCs | Explosives |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MW06-18A | AMW06-018-052016 | -- | -- | -- | 5/18/2016 | 5/19/2016 | None | 200-33594-1 | 33594 | Yes | Yes |
| MW06-18A | -- | AMW06-218-052016 | -- | -- | 5/18/2016 | 5/19/2016 | None | 200-33594-2 | 33594 | Yes | Yes |
| MW06-18B | BMW06-018-052016 | -- | -- | -- | 5/18/2016 | 5/19/2016 | None | 200-33594-3 | 33594 | Yes | Yes |
| MW06-18B | -- | -- | BMW06-018-052016 | -- | 5/18/2016 | 5/19/2016 | None | 200-33594-3MS | 33594 | Yes | Yes |
| MW06-18B | -- | -- | BMW06-018-052016 | -- | 5/18/2016 | 5/19/2016 | None | 200-33594-3MSD | 33594 | Yes | Yes |
| MW06-30A | AMW06-030-052016 | -- | -- | -- | 5/18/2016 | 5/19/2016 | None | 200-33594-6 | 33594 | Yes | Yes |
| MW06-30B | BMW06-030-052016 | -- | -- | -- | 5/18/2016 | 5/19/2016 | None | 200-33594-7 | 33594 | Yes | Yes |
| MW06-31A | AMW06-031-052016 | -- | -- | -- | 5/18/2016 | 5/19/2016 | None | 200-33594-4 | 33594 | Yes | Yes |
| MW06-31B | BMW06-031-052016 | -- | -- | -- | 5/18/2016 | 5/19/2016 | None | 200-33594-5 | 33594 | Yes | Yes |
| Trip Blank | -- | -- | -- | 200-052016 | -- | 5/19/2016 | None | 200-33594-10 | 33594 | Yes | No |

**Notes:**

**See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-1 Results - Volatile Organic Compounds**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| ***Sample ID*** | AMW06-018-052016 | | BMW06-018-052016 | | AMW06-031-052016 | | BMW06-031-052016 | | AMW06-030-052016 | | BMW06-030-052016 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Lab Sample Number*** | 200-33594-1 | | 200-33594-3 | | 200-33594-4 | | 200-33594-5 | | 200-33594-6 | | 200-33594-7 | |
| ***Sampling Date*** | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | |
| ***Matrix*** | Water | | Water | | Water | | Water | | Water | | Water | |
| ***Dilution Factor*** | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| ***Units*** | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | |
| **Analyte** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** |
| Dichlorodifluoromethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Chloromethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Vinyl chloride | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Bromomethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Chloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Trichlorofluoromethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1-Dichloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Freon TF | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Acetone | 5.0 | U | 2.6 | J | 3.2 | J | 3.6 | J | 5.0 | U | 2.4 | J |
| Carbon disulfide | 1.0 | U | 1.0 | U F1 | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Methylene Chloride | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| trans-1,2-Dichloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Methyl t-butyl ether | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1-Dichloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| cis-1,2-Dichloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 2-Butanone | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U |
| Bromochloromethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Chloroform | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1,1-Trichloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1-Dichloropropene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Carbon tetrachloride | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Benzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dichloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Trichloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dichloropropane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Dibromomethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Bromodichloromethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| cis-1,3-Dichloropropene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 4-Methyl-2-pentanone | 5.0 | U | 5.0 | U | 0.86 | J | 5.0 | U | 5.0 | U | 5.0 | U |
| Toluene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| trans-1,3-Dichloropropene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1,2-Trichloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Tetrachloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,3-Dichloropropane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 2-Hexanone | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U |
| Dibromochloromethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dibromoethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |

**Table 3-1 Results - Volatile Organic Compounds**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| *Sample ID* | AMW06-018-052016 | | BMW06-018-052016 | | AMW06-031-052016 | | BMW06-031-052016 | | AMW06-030-052016 | | BMW06-030-052016 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lab Sample Number* | 200-33594-1 | | 200-33594-3 | | 200-33594-4 | | 200-33594-5 | | 200-33594-6 | | 200-33594-7 | |
| *Sampling Date* | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | |
| *Matrix* | Water | | Water | | Water | | Water | | Water | | Water | |
| *Dilution Factor* | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| *Units* | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | |
| **Analyte** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** |
| Chlorobenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1,1,2-Tetrachloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Ethylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| m&p-Xylene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Xylenes, Total | 2.0 | U | 2.0 | U | 2.0 | U | 2.0 | U | 2.0 | U | 2.0 | U |
| o-Xylene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Styrene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Bromoform | 1.0 | U | 1.0 | U F1 | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Isopropylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Bromobenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1,2,2-Tetrachloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| n-Propylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 2-Chlorotoluene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,3,5-Trimethylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 4-Chlorotoluene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| tert-Butylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2,4-Trimethylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| sec-Butylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,3-Dichlorobenzene | 1.0 | U | 1.0 | U | 0.20 | J | 1.0 | U | 1.0 | U | 1.0 | U |
| 4-Isopropyltoluene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,4-Dichlorobenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dichlorobenzene | 1.0 | U | 1.0 | U | 0.23 | J | 1.0 | U | 1.0 | U | 1.0 | U |
| n-Butylbenzene | 1.0 | U | 1.0 | U | 0.32 | J | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dibromo-3-Chloropropane | 1.0 | U * | 1.0 | U * F1 | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U * |
| 1,2,4-Trichlorobenzene | 1.0 | U | 1.0 | U F1 | 0.66 | J | 1.0 | U | 1.0 | U | 1.0 | U |
| Hexachlorobutadiene | 1.0 | U | 1.0 | U F1 | 1.3 | B | 1.0 | U | 1.0 | U | 1.0 | U |
| Naphthalene | 1.0 | U | 1.0 | U | 1.4 | B | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2,3-Trichlorobenzene | 1.0 | U * | 1.0 | U * F1 | 1.1 | * | 1.0 | U * | 1.0 | U * | 1.0 | U * |
| 1,2-Dichloroethene, Total | 2.0 | U | 2.0 | U | 2.0 | U | 2.0 | U | 2.0 | U | 2.0 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

## Table 3-2 Results - Explosive Compounds
## May 2016 Monitoring Well Sampling Event
## Metropolitan Utilities District, Saunders County, NE

| *Sample ID* | AMW06-018-052016 | | BMW06-018-052016 | | AMW06-031-052016 | | BMW06-031-052016 | | AMW06-030-052016 | | BMW06-030-052016 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lab Sample Number* | 200-33594-1 | | 200-33594-3 | | 200-33594-4 | | 200-33594-5 | | 200-33594-6 | | 200-33594-7 | |
| *Sampling Date* | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | |
| *Matrix* | Water | | Water | | Water | | Water | | Water | | Water | |
| *Dilution Factor* | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| *Units* | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | |
| **Analyte** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** |
| HMX | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| RDX | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.035 | J |
| 1,3,5-Trinitrobenzene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 1,3-Dinitrobenzene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| Nitrobenzene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| Tetryl | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2,4,6-Trinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 4-Amino-2,6-dinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2-Amino-4,6-dinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2,6-Dinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2,4-Dinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2-Nitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 4-Nitrotoluene | 0.094 | J p | 0.20 | U | 0.55 | | 0.20 | U | 0.95 | p | 0.13 | J p |
| 3-Nitrotoluene | 0.20 | U | 0.20 | U | 0.12 | J p | 0.20 | U | 0.054 | J p | 0.20 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-2b MS/MSD Results for Qualified Compounds**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Analyte | Sample Concentration | Spike Added | Matrix Spike Concentration | Matrix Spike Duplicate Concentration | Matrix Spike Recovery | Matrix Spike Duplicate Recovery | QC Limits |
|---|---|---|---|---|---|---|---|
| **VOCs** | | | | | | | |
| NA | - | - | - | - | - | - | - |
| **Explosive Compounds** | | | | | | | |
| NA | - | - | - | - | - | - | - |

*There were no qualified MS/MSD Results

**Table 3-3 Detections - Volatile Organic Compounds**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| *Sample ID* | AMW06-018-052016 | | BMW06-018-052016 | | AMW06-031-052016 | | BMW06-031-052016 | | AMW06-030-052016 | | BMW06-030-052016 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lab Sample Number* | 200-33594-1 | | 200-33594-3 | | 200-33594-4 | | 200-33594-5 | | 200-33594-6 | | 200-33594-7 | |
| *Sampling Date* | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | |
| *Matrix* | Water | | Water | | Water | | Water | | Water | | Water | |
| *Dilution Factor* | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| *Units* | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | |
| **Analyte** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** |

There were no unqualified VOC compounds detected above the reporting limit.

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-4 Detections - Explosive Compounds**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Sample ID | AMW06-018-052016 | | BMW06-018-052016 | | AMW06-031-052016 | | BMW06-031-052016 | | AMW06-030-052016 | | BMW06-030-052016 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lab Sample Number | 200-33594-1 | | 200-33594-3 | | 200-33594-4 | | 200-33594-5 | | 200-33594-6 | | 200-33594-7 | |
| Sampling Date | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | |
| Matrix | Water | | Water | | Water | | Water | | Water | | Water | |
| Dilution Factor | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| Units | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | |
| Analyte | Result | Q | Result | Q | Result | Q | Result | Q | Result | Q | Result | Q |
| 4-Nitrotoluene | 0.094 | J p | 0.20 | U | 0.55 | | 0.20 | U | 0.95 | p | 0.13 | J p |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-5 Field Duplicate Results - Volatile Organic Compounds**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| ***Sample ID*** | **AMW06-018-052016** | | **AMW06-218-052016** | |
|---|---|---|---|---|
| ***Lab Sample Number*** | **200-33594-1** | | **200-33594-2** | |
| ***Sampling Date*** | **05/18/16** | | **05/18/16** | |
| ***Matrix*** | **Water** | | **Water** | |
| ***Dilution Factor*** | **1** | | **1** | |
| ***Units*** | **ug/L** | | **ug/L** | |
| **Analyte** | | | | |
| Dichlorodifluoromethane | 1.0 | U | 1.0 | U |
| Chloromethane | 1.0 | U | 1.0 | U |
| Vinyl chloride | 1.0 | U | 1.0 | U |
| Bromomethane | 1.0 | U | 1.0 | U |
| Chloroethane | 1.0 | U | 1.0 | U |
| Trichlorofluoromethane | 1.0 | U | 1.0 | U |
| 1,1-Dichloroethene | 1.0 | U | 1.0 | U |
| Freon TF | 1.0 | U | 1.0 | U |
| Acetone | 5.0 | U | 2.0 | J |
| Carbon disulfide | 1.0 | U | 1.0 | U |
| Methylene Chloride | 1.0 | U | 1.0 | U |
| trans-1,2-Dichloroethene | 1.0 | U | 1.0 | U |
| Methyl t-butyl ether | 1.0 | U | 1.0 | U |
| 1,1-Dichloroethane | 1.0 | U | 1.0 | U |
| cis-1,2-Dichloroethene | 1.0 | U | 1.0 | U |
| 2-Butanone | 5.0 | U | 5.0 | U |
| Bromochloromethane | 1.0 | U | 1.0 | U |
| Chloroform | 1.0 | U | 1.0 | U |
| 1,1,1-Trichloroethane | 1.0 | U | 1.0 | U |
| 1,1-Dichloropropene | 1.0 | U | 1.0 | U |
| Carbon tetrachloride | 1.0 | U | 1.0 | U |
| Benzene | 1.0 | U | 1.0 | U |
| 1,2-Dichloroethane | 1.0 | U | 1.0 | U |
| Trichloroethene | 1.0 | U | 1.0 | U |
| 1,2-Dichloropropane | 1.0 | U | 1.0 | U |
| Dibromomethane | 1.0 | U | 1.0 | U |
| Bromodichloromethane | 1.0 | U | 1.0 | U |
| cis-1,3-Dichloropropene | 1.0 | U | 1.0 | U |
| 4-Methyl-2-pentanone | 5.0 | U | 5.0 | U |
| Toluene | 1.0 | U | 1.0 | U |
| trans-1,3-Dichloropropene | 1.0 | U | 1.0 | U |
| 1,1,2-Trichloroethane | 1.0 | U | 1.0 | U |
| Tetrachloroethene | 1.0 | U | 1.0 | U |
| 1,3-Dichloropropane | 1.0 | U | 1.0 | U |
| 2-Hexanone | 5.0 | U | 5.0 | U |
| Dibromochloromethane | 1.0 | U | 1.0 | U |

## Table 3-5 Field Duplicate Results - Volatile Organic Compounds
## May 2016 Monitoring Well Sampling Event
## Metropolitan Utilities District, Saunders County, NE

| ***Sample ID*** | **AMW06-018-052016** | | **AMW06-218-052016** | |
|---|---|---|---|---|
| ***Lab Sample Number*** | **200-33594-1** | | **200-33594-2** | |
| ***Sampling Date*** | **05/18/16** | | **05/18/16** | |
| ***Matrix*** | **Water** | | **Water** | |
| ***Dilution Factor*** | **1** | | **1** | |
| ***Units*** | **ug/L** | | **ug/L** | |
| **Analyte** | | | | |
| 1,2-Dibromoethane | 1.0 | U | 1.0 | U |
| Chlorobenzene | 1.0 | U | 1.0 | U |
| 1,1,1,2-Tetrachloroethane | 1.0 | U | 1.0 | U |
| Ethylbenzene | 1.0 | U | 1.0 | U |
| m&p-Xylene | 1.0 | U | 1.0 | U |
| Xylenes, Total | 2.0 | U | 2.0 | U |
| o-Xylene | 1.0 | U | 1.0 | U |
| Styrene | 1.0 | U | 1.0 | U |
| Bromoform | 1.0 | U | 1.0 | U |
| Isopropylbenzene | 1.0 | U | 1.0 | U |
| Bromobenzene | 1.0 | U | 1.0 | U |
| 1,1,2,2-Tetrachloroethane | 1.0 | U | 1.0 | U |
| n-Propylbenzene | 1.0 | U | 1.0 | U |
| 2-Chlorotoluene | 1.0 | U | 1.0 | U |
| 1,3,5-Trimethylbenzene | 1.0 | U | 1.0 | U |
| 4-Chlorotoluene | 1.0 | U | 1.0 | U |
| tert-Butylbenzene | 1.0 | U | 1.0 | U |
| 1,2,4-Trimethylbenzene | 1.0 | U | 1.0 | U |
| sec-Butylbenzene | 1.0 | U | 1.0 | U |
| 1,3-Dichlorobenzene | 1.0 | U | 1.0 | U |
| 4-Isopropyltoluene | 1.0 | U | 1.0 | U |
| 1,4-Dichlorobenzene | 1.0 | U | 1.0 | U |
| 1,2-Dichlorobenzene | 1.0 | U | 1.0 | U |
| n-Butylbenzene | 1.0 | U | 1.0 | U |
| 1,2-Dibromo-3-Chloropropane | 1.0 | U * | 1.0 | U * |
| 1,2,4-Trichlorobenzene | 1.0 | U | 1.0 | U |
| Hexachlorobutadiene | 1.0 | U | 1.0 | U |
| Naphthalene | 1.0 | U | 1.0 | U |
| 1,2,3-Trichlorobenzene | 1.0 | U * | 1.0 | U * |
| 1,2-Dichloroethene, Total | 2.0 | U | 2.0 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-6 Field Duplicate Results - Explosive Compounds**
**May 2016 Monitroing Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| | | | | |
|---|---|---|---|---|
| ***Sample ID*** | **AMW06-018-052016** | | **AMW06-218-052016** | |
| ***Lab Sample Number*** | **200-33594-1** | | **200-33594-2** | |
| ***Sampling Date*** | **05/18/16** | | **05/18/16** | |
| ***Matrix*** | **Water** | | **Water** | |
| ***Dilution Factor*** | **1** | | **1** | |
| ***Units*** | **ug/L** | | **ug/L** | |
| **Analyte** | | | | |
| HMX | 0.20 | U | 0.20 | U |
| RDX | 0.20 | U | 0.20 | U |
| 1,3,5-Trinitrobenzene | 0.20 | U | 0.20 | U |
| 1,3-Dinitrobenzene | 0.20 | U | 0.20 | U |
| Nitrobenzene | 0.20 | U | 0.20 | U |
| Tetryl | 0.20 | U | 0.20 | U |
| 2,4,6-Trinitrotoluene | 0.20 | U | 0.20 | U |
| 4-Amino-2,6-dinitrotoluene | 0.20 | U | 0.20 | U |
| 2-Amino-4,6-dinitrotoluene | 0.20 | U | 0.20 | U |
| 2,6-Dinitrotoluene | 0.20 | U | 0.20 | U |
| 2,4-Dinitrotoluene | 0.20 | U | 0.20 | U |
| 2-Nitrotoluene | 0.20 | U | 0.20 | U |
| 4-Nitrotoluene | 0.094 | J p | 0.20 | U |
| 3-Nitrotoluene | 0.20 | U | 0.20 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-7**
**Trip Blank Results - Volatile Organic Compounds**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| ***Sample ID*** | **TB** | |
|---|---|---|
| ***Lab Sample Number*** | **200-33594-8** | |
| ***Sampling Date*** | **05/18/16** | |
| ***Matrix*** | **Water** | |
| ***Dilution Factor*** | **1** | |
| ***Units*** | **ug/L** | |
| **Analyte** | | |
| Dichlorodifluoromethane | 1.0 | U |
| Chloromethane | 1.0 | U |
| Vinyl chloride | 1.0 | U |
| Bromomethane | 1.0 | U |
| Chloroethane | 1.0 | U |
| Trichlorofluoromethane | 1.0 | U |
| 1,1-Dichloroethene | 1.0 | U |
| Freon TF | 1.0 | U |
| Acetone | 5.0 | U |
| Carbon disulfide | 1.0 | U |
| Methylene Chloride | 1.0 | U |
| trans-1,2-Dichloroethene | 1.0 | U |
| Methyl t-butyl ether | 1.0 | U |
| 1,1-Dichloroethane | 1.0 | U |
| cis-1,2-Dichloroethene | 1.0 | U |
| 2-Butanone | 5.0 | U |
| Bromochloromethane | 1.0 | U |
| Chloroform | 1.0 | U |
| 1,1,1-Trichloroethane | 1.0 | U |
| 1,1-Dichloropropene | 1.0 | U |
| Carbon tetrachloride | 1.0 | U |
| Benzene | 1.0 | U |
| 1,2-Dichloroethane | 1.0 | U |
| Trichloroethene | 1.0 | U |
| 1,2-Dichloropropane | 1.0 | U |
| Dibromomethane | 1.0 | U |
| Bromodichloromethane | 1.0 | U |
| cis-1,3-Dichloropropene | 1.0 | U |
| 4-Methyl-2-pentanone | 5.0 | U |
| Toluene | 1.0 | U |
| trans-1,3-Dichloropropene | 1.0 | U |
| 1,1,2-Trichloroethane | 1.0 | U |
| Tetrachloroethene | 1.0 | U |

**Table 3-7**
**Trip Blank Results - Volatile Organic Compounds**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| *Sample ID* | TB | |
|---|---|---|
| *Lab Sample Number* | 200-33594-8 | |
| *Sampling Date* | 05/18/16 | |
| *Matrix* | Water | |
| *Dilution Factor* | 1 | |
| *Units* | ug/L | |
| **Analyte** | | |
| 1,3-Dichloropropane | 1.0 | U |
| 2-Hexanone | 5.0 | U |
| Dibromochloromethane | 1.0 | U |
| 1,2-Dibromoethane | 1.0 | U |
| Chlorobenzene | 1.0 | U |
| 1,1,1,2-Tetrachloroethane | 1.0 | U |
| Ethylbenzene | 1.0 | U |
| m&p-Xylene | 1.0 | U |
| Xylenes, Total | 2.0 | U |
| o-Xylene | 1.0 | U |
| Styrene | 1.0 | U |
| Bromoform | 1.0 | U |
| Isopropylbenzene | 1.0 | U |
| Bromobenzene | 1.0 | U |
| 1,1,2,2-Tetrachloroethane | 1.0 | U |
| n-Propylbenzene | 1.0 | U |
| 2-Chlorotoluene | 1.0 | U |
| 1,3,5-Trimethylbenzene | 1.0 | U |
| 4-Chlorotoluene | 1.0 | U |
| tert-Butylbenzene | 1.0 | U |
| 1,2,4-Trimethylbenzene | 1.0 | U |
| sec-Butylbenzene | 1.0 | U |
| 1,3-Dichlorobenzene | 1.0 | U |
| 4-Isopropyltoluene | 1.0 | U |
| 1,4-Dichlorobenzene | 1.0 | U |
| 1,2-Dichlorobenzene | 1.0 | U |
| n-Butylbenzene | 1.0 | U |
| 1,2-Dibromo-3-Chloropropane | 1.0 | U * |
| 1,2,4-Trichlorobenzene | 1.0 | U |
| Hexachlorobutadiene | 1.0 | U |
| Naphthalene | 1.0 | U |
| 1,2,3-Trichlorobenzene | 1.0 | U * |
| 1,2-Dichloroethene, Total | 2.0 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table- 4-1**
**Field Completeness**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| | Volatile Organic Compounds (8260B) | | Percent Complete | Explosive Compounds (8330B) | | Percent Complete |
|---|---|---|---|---|---|---|
| | *Actual* | *Proposed* | | *Actual* | *Proposed* | |
| **No. of Sampling Locations** | 6 | 6 | 100% | 6 | 6 | 100% |
| **Number of Field Duplicates** | 1 | 1 | 100% | 1 | 1 | 100% |
| **Number of Matrix Spike Samples** | 1 | 1 | 100% | 1 | 1 | 100% |
| **Number of Matrix Spike Duplicate Samples** | 1 | 1 | 100% | 1 | 1 | 100% |
| **Number of Field Blanks** | 0 | 0 | NA[2] | 0 | 0 | NA[2] |
| **Number of Equipment Blanks** | 0 | 0 | NA[2] | 0 | 0 | NA[2] |
| **Number of VOC Trip Blanks** | 1 | 1 | 100% | 0 | 0 | NA[2] |
| **Number of Lab Performance Testing Samples[1]** | 0 | 0 | NA[2] | 0 | 0 | NA[2] |
| **Total Number of Samples per event** | 10 | 10 | 100% | 9 | 9 | 100% |

| **Overall Field Completeness** | 100% | **Overall Field Completeness Goal** | 95% |
|---|---|---|---|

[1] The number of Batch or Project-specific proficiency testing (PT) samples are scheduled for this sampling event.

[2] Percent Complete calculation not required since no samples were proposed for this event.

**Table- 4-2**
**Analytical Completeness**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| | Volatile Organic Compound Analyses | Explosive Compound Analyses |
|---|---|---|
| **Number of Analyses** | 396 | 84 |
| **Number of qualified data points (excluding J qualifications)** | 2 | 1 |
| **Percent Complete** | 99% | 99% |

| | |
|---|---|
| **Overall Acceptable Data Analytical Completeness** | 99% |

| | |
|---|---|
| **Overall Acceptable Data Analytical Completeness Goal** | 85% |

| | Volatile Organic Compound Analyses | Explosive Compound Analyses |
|---|---|---|
| **Number of Analyses** | 396 | 84 |
| **Number of Rejected Data points** | 0 | 0 |
| **Percent Complete** | 100% | 100% |

| | |
|---|---|
| **Overall Quality Data Analytical Completeness** | 100% |

| | |
|---|---|
| **Overall Quality Data Analytical Completeness Goal** | 85% |

**Table- 4-3**
**Project Completeness**
**May 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Overall Field Completeness | Overall Analytical Completeness[1] | Overall Project Completeness[2] |
|---|---|---|
| 100% | 99% | 100% |

| | |
|---|---|
| **Overall Project Completeness Goal** | 90% |

**Notes:**
1 = Analytical completeness is the percentage of usable data i.e. quality data completeness.
2 = Project completeness combines sampling and analytical protocols to assess the expectations of the project as a whole. Project completeness is determined by comparing the percentage of samples / measurements that are determined to be usable to the total number of samples / measurements planned.

# Quality Control Summary Report
# October 2016 Monitoring Well Sampling Event

# Metropolitan Utilities District of Omaha
# Platte West Well Field

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## Saunders County, Nebraska

**Prepared for**
**Metropolitan Utilities District of Omaha**

**Prepared by**
**Olsson Associates**

**Olsson Project Number: 011-1087**

**December 2016**

OLSSON® ASSOCIATES

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## 1.0 INTRODUCTION

The Metropolitan Utilities District of Omaha (MUD) provides potable water for a metropolitan area of over three-quarters of a million people. To meet projected water demands from continued population growth in the greater Omaha area in the coming decades, MUD completed construction of the Platte West Well Field (PWWF) in 2008. The PWWF consists of 42 wells constructed along and adjacent to the Platte River approximately seven miles east of the town of Mead in Saunders County, Nebraska. The well field began operations in July of 2008 and currently has the capacity to provide 100 million gallons per day (mgd). Because the PWWF transmits water across the Platte River from wells on the west bank eastward via a pipeline, the well field is subject to U.S. Army Corp of Engineers (USACE) Omaha District (CENWO) Section 404 Permit regulations. This permit requires MUD to monitor any influence the well field activity may have on remediation efforts at the former Nebraska Ordnance Plant (NOP) south of Mead, which is under the jurisdiction of the USACE Kansas City District (CENWK). Two overlapping plumes of contaminants (trichloroethylene and RDX) from former munitions and missile plants are found in the subsurface south/southeast of Mead and follow the ambient groundwater gradient from the northwest to the southeast. USACE monitoring of the aquifer conditions consists of tracking both physical parameters (water table elevations and gradient) and changes in contaminant concentrations in the groundwater in both the plume area and the PWWF. Data obtained from these activities will be used by MUD and the USACE to determine if any impacts have occurred by assessing changes in any concentrations of any contaminants present in monitoring wells. Water levels will also be used to verify the groundwater model of the well field area.

Olsson Associates was contracted by MUD to monitor the aquifer conditions in accordance with the USACE requirements. This Quality Control Summary Report (QCSR) provides the results of data validation for the October 2016 sampling event at the PWWF completed on October 20, 2016.

## 2.0 FIELD SAMPLING ACTIVITIES

The Field Sampling Plan (Olsson, 2015a) calls for samples to be collected from six monitoring wells and analyzed for volatile organic compounds (VOCs) and explosive compounds as listed in Table 2-1. In accordance with the Field Sampling Plan, the following QC samples were collected:

1. One field duplicate
2. One matrix spike/matrix spike duplicate
3. One trip blank

Field notes are included in Appendix A. The samples collected on October 20, 2016 were shipped to the laboratory in coolers packed in ice.

The following subsections present results of the data quality evaluation. The evaluation was performed in accordance with the Quality Assurance Project Plan (QAPP) developed specifically for this monitoring program (Olsson, 2015b). Qualifiers were assigned by the laboratory in accordance to their quality control program.

Table 2-2 provides an explanation of the abbreviations, laboratory qualifiers and notes associated with the tables in this QCSR report. Table 2-3 provides information on sample collection, laboratory numbering and analyses requested as listed below:

- Quality control sample information including duplicate sample location
- A cross reference between field sample and laboratory sample IDs
- Sample delivery group numbers
- Dates of sample collection and sample receipt at the laboratory
- List of analyses requested

## 3.0 ANALYTICAL RESULTS

The samples were analyzed by TestAmerica, Inc. in Burlington, Vermont for VOCs and explosive compounds. A summary of the analytical results is presented in Table 3-1 for VOCs and Table 3-2 for explosive compounds. As listed in Table 3-3 and 3-4, there were no unqualified VOC or explosive compounds detected above the reporting limits.

### 3.1 Summary of Receipt in the Laboratory

The samples were received on October 22, 2016 as noted on the Chain-of-Custody (COC) and Sample Login Acknowledgements included in Appendix B. The samples arrived in good condition, properly preserved and on ice. The temperature of the coolers was 4.6 degrees Celsius which is within the acceptable range of 0 to 6 degrees Celsius.

### 3.2 Holding Times

Samples were extracted and analyzed within the method specific holding times as required in the QAPP (Olsson, 2015b) as noted below:

- 14-days to extraction for VOCs
- 7-days to extraction and 40-days to analysis for Explosives

### 3.3 Tuning and Calibration

Assessment of tune and calibration data was validated by reviewing the case narrative and analytical report. There were no tuning and calibration outliers detailed by the laboratory in the Final Analytical Report (TestAmerica, 2016) for compounds detected above reporting limits in these samples.

### 3.4 Laboratory Method Blanks

Method blanks were prepared and analyzed per the requirements of the QAPP (Olsson, 2015b). Method blanks are sample containers filled by the laboratory with analyte-free water that is carried through the entire preparation and analysis sequence for the purpose of identifying potential contamination. Method blanks were analyzed with each sample batch for all analyses. There were no compounds detected in the method blanks above reporting limits, however Toluene was reported in sample AMW06-031-102016 above the reporting limit and was detected in the method blank.

### 3.5 Trip Blanks

Trip blanks are required when samples are collected for analysis of VOCs. Trip blanks are prepared in the laboratory with analyte-free water and are shipped to the site with the regular sample containers. The blanks are kept unopened in the field during site sampling activities and are shipped for analysis with the project samples. Trip blanks are designed to evaluate VOC contamination encountered during sampling, transportation, and storage.

One trip blank sample was placed in the sample cooler containing samples to be analyzed for VOCs collected on October 20$^{th}$. There were no compounds detected in the trip blank above reporting limits.

### 3.6 Rinsate Blanks

Rinsate blank samples serve as a quality control check on the cleanliness of the sampling device and the equipment decontamination process. Rinsate blanks are prepared in the field using analyte-free or organic-free water. The samples are used to evaluate if contaminants have been introduced through contact with the sampling equipment. Rinsate blanks are only required when non-dedicated sampling equipment is used to collect groundwater samples, as specified in the QAPP (Olsson, 2015b). For the MUD Platte West Monitoring program, rinsate samples were not required because dedicated sampling equipment, specifically, Hydrasleeves, were used to collect the groundwater samples.

### 3.7 Surrogates

Surrogates are compounds that are added (spiked) into samples prior to sample extraction or analysis, depending on the method. The compounds are not normally found in the environment and therefore can be analyzed for their percent recovery as part of the quality control process. The percent recovery (%REC) of each surrogate is used to assess the success of the sample preparation process for each sample.

For the 8260B VOC analyses (GC/MS), four surrogate analytes were introduced:

- Dibromofluoromethane (50-150%)
- 1,2-Dichloroethane-d4 (80-120%)
- Toluene-d8 (80-120%)
- Bromofluorobenzene (80-125%)

Samples AMW06-018-102016, AMW06-218-102016, BMW06-018-102016 and AMW06-031-102016 yielded marginally elevated recovery of surrogate 1,2-Dichloroethene-d4. Recovery of the other three surrogates was acceptable in these samples. All four surrogates were recovered within their acceptable range as noted above for remaining samples.

The target compounds associated with surrogate 1,2-Dichloroethene-d4 were not detected above reporting limits. Therefore, the laboratory analyst made the determination that the data was not impacted as the target compounds would have been detected had they been present (as opposed to low recovery, where we may not have detected them if the system was running on the low side). Several of the early eluting compounds associated with surrogate 1,2-Dichloroethene-d4 are qualified with an * flag due to high recovery in the laboratory control sample (LCS).

### 3.8 Laboratory Control Sample

The LCS consists of a matrix similar to the field sample. The LCS is spiked with known concentrations of analytes. As with the surrogates, the LCS %REC is a measure of the method accuracy. If %REC results are outside the laboratory criteria, then the data is flagged with a laboratory qualifier “*” meaning the %REC exceeds the control limits. There were no LCS control limit exceedances for any compounds detected above reporting limits in these samples.

### 3.9 Matrix Spike/Matrix Spike Duplicate

Matrix Spike/Matrix Spike Duplicate (MS/MSD) analyses measure method accuracy and precision for a project-specific matrix. A field sample is split into three portions (original, MS, and MSD) and known amounts of analytes are spiked into the MS and MSD portions of the sample. The analytical results of these two portions are compared to each other for reproducibility using the RPD. The results are also compared against the unspiked portion of the sample for %REC of the spiked analytes. There are no MS/MSD analysis that exceeded their control limits for compounds detected above reporting limits in these samples.

### 3.10 Field Duplicate Results

Field duplicate results provide information on the reproducibility of field sample results and account for error introduced from handling, shipping, storage, preparation, and analysis of field samples. One field duplicate pair was collected during the October 2016 groundwater sampling event. The field duplicate pair is AMW06-018-102016 and AMW06-218-102016. The pair was analyzed for VOCs and explosives.

Along with QC evaluations presented in other sections of this QCSR, the results of the field duplicate pair are compared to one another. Results within a factor of two of each other are considered to be in agreement. Results between a factor of two to three of each other are considered a minor discrepancy and results greater than a factor of three are considered a major discrepancy. Tables 3-5 and 3-6 present the results of the field duplicate pair for VOCs and explosive compounds (respectively). The results are within a factor of two of each other and are considered in agreement.

### 3.11 Dilutions and Re-analyses

As noted on the data tables presented in this QCSR, the VOC and explosive samples did not require dilution (dilution factor = 1). The data reported in the tables are usable as reported.

### 3.12 Other QC Parameters

A column comparison between the detected explosive results was made using explosive identification summary forms. The RPDs were calculated by the laboratory on the appropriate Form X, Identification Summary. All detected explosives reported were confirmed by a second column. The lower value was reported. The percent difference between the two columns did not exceed 40% for compounds detected above their reporting limit.

### 3.13 Laboratory Qualifiers for October 2016 Data

Analytes detected below the quantitation limit or reporting limit but above the lowest level of detection were quantified and results were assigned an estimate (J) qualifier by the laboratory. The qualifiers are identified in Tables 3-1 through 3-7. Data with these qualifiers were are considered usable and do not count against the completeness assessment.

## 4.0 OVERALL ASSESSMENT

The following sections present the field completeness, analytical completeness and project completeness for the October 2016 monitoring well sampling event.

### 4.1 Field Completeness

Field completeness for sample collection is assessed by comparing the number of samples collected to the number of samples originally planned for collection. Table 4-1 presents the field completeness values for the October 2016 monitoring event. Field completeness for explosives was 100%. Field completeness for the VOCs was 100%. The overall field completeness was 100% which exceeds the goal of 95%.

### 4.2 Analytical Completeness

There are two components to the analytical completeness evaluation. Analytical completeness is evaluated by quantifying the overall acceptable data and the overall quality data. The following paragraphs provide the evaluation of each component and Table 4-2 presents acceptable and quality data completeness.

Acceptable data is a measure of contract laboratory compliance. Acceptable data includes data that has not been rejected or qualified (except for J qualified data). Qualified data is considered acceptable if appropriate corrective actions were taken by the laboratory. The acceptable data completeness percentage for VOCs was 99.7% and for explosives was 100%. The overall acceptable data completeness is 99.9% which is above the overall acceptable data completeness goal of 85%.

Quality data is a measure of the percentage of usable data. Quality data includes all data except rejected data points, and does not include analyses for which replacement data points are available. There was no rejected data and therefore quality data completeness percentages for VOCs and explosives were 100% which exceeds the quality data completeness goals of 85% for each analytical method.

By averaging the completeness of the two components, the overall analytical completeness evaluation is calculated. Overall quality data completeness is 100% for the October 2016 sampling event, which exceeds the overall quality data completeness goal of 85%.

### 4.3 Project Completeness

Project completeness combines sampling and analytical completeness percentages to assess the success in achieving the expectations of the project as a whole. Project completeness is determined by comparing the percentage of usable samples/measurements to the percentage of planned or observed samples/measurements. For the field completeness portion, this involves comparison of the number of samples properly collected to the number of samples planned for collection. For the analytical data completeness portion, this involves comparison of the number of usable data points to the number of observed data points. The field completeness and analytical completeness (quality data) completeness percentages are used to calculate the project completeness percentage. Table 4-3 presents project completeness calculations. For the October 2016 monitoring event, project completeness is 99.9%, which exceeds the project completeness goal of 90%.

## 5.0 CONCLUSIONS

**Data are valid for use, as qualified.** Overall field completeness is 100%, acceptable data completeness is 99.9%, quality data completeness is 100%, and project completeness is 99.9%. No data have been rejected. Data are qualified using the laboratory qualifiers as listed in Table 2-2 and as associated with the data provided in Tables 3-1 through 3-7.

## 6.0 REFERENCES

Olsson Associates, 2015a. Final Field Sampling Plan for the Metropolitan Utilities District of Omaha, Platte West Well Field, Monitoring Well Sampling Program, Mead, Nebraska, prepared for the Metropolitan Utilities District of Omaha, February.

Olsson Associates, 2015b. Quality Assurance Project Plan for the Metropolitan Utilities District of Omaha, Platte West Well Field, Monitoring Well Sampling Program, Mead, Nebraska, prepared for the Metropolitan Utilities District of Omaha, February.

TestAmerica, 2016. Analytical Report, Job Number 200-35849-1. M.U.D. Platte West Well Field prepared for Olsson Associates by TestAmerica, James W. Madison, Project Manager. November 17, 2016.

Respectfully Submitted,
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# TABLES

**Table 2-1**
**Monitoring Well Samples and Analytical Requirements**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Well Identification | Latitude | Longitude | Analyses |
|---|---|---|---|
| MW06-18A | -96.382036 | 41.160754 | Volatile Organic and Explosive Compounds |
| MW06-18B | -96.382036 | 41.160754 | Volatile Organic and Explosive Compounds |
| MW06-30A | -96.405926 | 41.190157 | Volatile Organic and Explosive Compounds |
| MW06-30B | -96.405926 | 41.190157 | Volatile Organic and Explosive Compounds |
| MW06-31A | -96.391220 | 41.175544 | Volatile Organic and Explosive Compounds |
| MW06-31B | -96.391220 | 41.175544 | Volatile Organic and Explosive Compounds |

**Table 2-2**
**Abbreviations, Data Qualifiers and Notes**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

**Notes:**

All analyses were completed by TestAmerica in Burlington, Vermont

**Abbreviations:**

| | |
|---|---|
| Dup | Duplicate sample |
| GC/MS | Gas Chromatograph/Mass Spectrometer |
| HPLC/IC | High Performance Liquid Chromatography/Ionic Chromatography |
| ID | Identification |
| Invest. | Investigative sample |
| Lab | Laboratory |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| NA | Not Analyzed |
| QC | Quality Control |
| RPD | Relative Percent Difference |
| VOAs | Volatile Organic Analyses |
| VOCs | Volatile Organic Compounds |

**Data Qualifiers (Q):**

*GC/MS VOA*

| | |
|---|---|
| * | LCS or LCSD is outside acceptance limits. |
| J | Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value. |
| U | Indicates the analyte was analyzed for but not detected. The laboratory reporting limit (RL) is listed for U coded data. |
| B | Compound was found in the blank and sample. |
| F1 | MS and/or MSD Recovery is outside acceptance limits. |

*HPLC/IC*

| | |
|---|---|
| J | Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value. |
| p | The %RPD between the primary and confirmation column/detector is >40%. The lower value has been reported. |
| U | Indicates the analyte was analyzed for but not detected. The laboratory reporting limit (RL) is listed for U coded data. |
| F1 | MS and/or MSD Recovery is outside acceptance limits. |

**Table 2-3**
**Sample Collection Summary**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Well Number | Investigative Sample ID | Quality Control Sample ID | MS/MSD Sample ID | Trip Blank Sample ID | Date Sampled | Date Received by Lab | COC Record Number | Lab ID | Sample Delivery Group | VOCs | Explosives |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MW06-18A | AMW06-018-102016 | -- | -- | -- | 10/20/2016 | 10/22/2016 | 200-35849 | 200-35849-1 | 35849 | Yes | Yes |
| MW06-18A | -- | AMW06-218-102016 | -- | -- | 10/20/2016 | 10/22/2016 | 200-35849 | 200-35849-2 | 35849 | Yes | Yes |
| MW06-18B | BMW06-018-102016 | -- | -- | -- | 10/20/2016 | 10/22/2016 | 200-35849 | 200-35849-3 | 35849 | Yes | Yes |
| MW06-18B | -- | -- | BMW06-018-102016MS | -- | 10/20/2016 | 10/22/2016 | 200-35849 | 200-35849-3MS | 35849 | Yes | Yes |
| MW06-18B | -- | -- | BMW06-018-102016MSD | -- | 10/20/2016 | 10/22/2016 | 200-35849 | 200-35849-3MSD | 35849 | Yes | Yes |
| MW06-30A | AMW06-030-102016 | -- | -- | -- | 10/20/2016 | 10/22/2016 | 200-35849 | 200-35849-6 | 35849 | Yes | Yes |
| MW06-30B | BMW06-030-102016 | -- | -- | -- | 10/20/2016 | 10/22/2016 | 200-35849 | 200-35849-7 | 35849 | Yes | Yes |
| MW06-31A | AMW06-031-102016 | -- | -- | -- | 10/20/2016 | 10/22/2016 | 200-35849 | 200-35849-4 | 35849 | Yes | Yes |
| MW06-31B | BMW06-031-102016 | -- | -- | -- | 10/20/2016 | 10/22/2016 | 200-35849 | 200-35849-5 | 35849 | Yes | Yes |
| Trip Blank | -- | -- | -- | TRB-200-102016 | -- | 10/22/2016 | 200-35849 | 200-35849-8 | 35849 | Yes | No |

**Notes:**

**See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-1 Results - Volatile Organic Compounds**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| *Sample ID* | AMW06-018-102016 | | BMW06-018-102016 | | AMW06-031-102016 | | BMW06-031-102016 | | AMW06-030-102016 | | BMW06-030-102016 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lab Sample Number* | 200-35849-1 | | 200-35849-3 | | 200-35849-4 | | 200-35849-5 | | 200-35849-6 | | 200-35849-7 | |
| *Sampling Date* | 10/20/16 | | 10/20/16 | | 10/20/16 | | 10/20/16 | | 10/20/16 | | 10/20/16 | |
| *Matrix* | Water | | Water | | Water | | Water | | Water | | Water | |
| *Dilution Factor* | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| *Units* | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | |
| **Analyte** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** |
| Dichlorodifluoromethane | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U | 1.0 | U |
| Chloromethane | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U | 1.0 | U |
| Vinyl chloride | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U | 1.0 | U |
| Bromomethane | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U * |
| Chloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Trichlorofluoromethane | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U * | 1.0 | U | 1.0 | U |
| 1,1-Dichloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Freon TF | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Acetone | 5.0 | U | 1.3 | J B | 1.8 | J B | 5.0 | U | 1.1 | J | 1.5 | J |
| Carbon disulfide | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Methylene Chloride | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| trans-1,2-Dichloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Methyl t-butyl ether | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1-Dichloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| cis-1,2-Dichloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 2-Butanone | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U |
| Bromochloromethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Chloroform | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1,1-Trichloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1-Dichloropropene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Carbon tetrachloride | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Benzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dichloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Trichloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dichloropropane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Dibromomethane | 1.0 | U | 1.0 | U | 0.12 | J | 1.0 | U | 1.0 | U | 1.0 | U |
| Bromodichloromethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| cis-1,3-Dichloropropene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 4-Methyl-2-pentanone | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U |
| Toluene | 0.30 | J B | 0.45 | J B | 1.3 | B | 0.33 | J B | 0.57 | J B | 0.57 | J B |
| trans-1,3-Dichloropropene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1,2-Trichloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Tetrachloroethene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,3-Dichloropropane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 2-Hexanone | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U | 5.0 | U |
| Dibromochloromethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dibromoethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |

**Table 3-1 Results - Volatile Organic Compounds**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| ***Sample ID*** | **AMW06-018-102016** | | **BMW06-018-102016** | | **AMW06-031-102016** | | **BMW06-031-102016** | | **AMW06-030-102016** | | **BMW06-030-102016** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Lab Sample Number*** | **200-35849-1** | | **200-35849-3** | | **200-35849-4** | | **200-35849-5** | | **200-35849-6** | | **200-35849-7** | |
| ***Sampling Date*** | **10/20/16** | | **10/20/16** | | **10/20/16** | | **10/20/16** | | **10/20/16** | | **10/20/16** | |
| ***Matrix*** | **Water** | | **Water** | | **Water** | | **Water** | | **Water** | | **Water** | |
| ***Dilution Factor*** | **1** | | **1** | | **1** | | **1** | | **1** | | **1** | |
| ***Units*** | **ug/L** | | **ug/L** | | **ug/L** | | **ug/L** | | **ug/L** | | **ug/L** | |
| **Analyte** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** |
| Chlorobenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1,1,2-Tetrachloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Ethylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| m&p-Xylene | 1.0 | U | 1.0 | U | 0.42 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| Xylenes, Total | 2.0 | U | 2.0 | U | 0.42 | J B | 2.0 | U | 2.0 | U | 2.0 | U |
| o-Xylene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Styrene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Bromoform | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Isopropylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| Bromobenzene | 1.0 | U | 1.0 | U | 0.32 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,1,2,2-Tetrachloroethane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| n-Propylbenzene | 1.0 | U | 1.0 | U | 0.43 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| 2-Chlorotoluene | 1.0 | U | 1.0 | U | 0.35 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,3,5-Trimethylbenzene | 1.0 | U | 1.0 | U | 0.43 | J | 1.0 | U | 1.0 | U | 1.0 | U |
| 4-Chlorotoluene | 1.0 | U | 1.0 | U | 0.39 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| tert-Butylbenzene | 1.0 | U | 1.0 | U | 0.47 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2,4-Trimethylbenzene | 1.0 | U | 1.0 | U | 0.46 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| sec-Butylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,3-Dichlorobenzene | 1.0 | U | 1.0 | U | 0.17 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| 4-Isopropyltoluene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,4-Dichlorobenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dichlorobenzene | 1.0 | U | 1.0 | U | 0.17 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| n-Butylbenzene | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2-Dibromo-3-Chloropropane | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U | 1.0 | U |
| 1,2,4-Trichlorobenzene | 1.0 | U | 1.0 | U | 0.67 | J B | 0.39 | J B | 1.0 | U | 0.37 | J B |
| Hexachlorobutadiene | 1.0 | U | 1.0 | U | 0.79 | J B | 1.0 | U | 1.0 | U | 1.0 | U |
| Naphthalene | 1.0 | U | 1.0 | U | 0.89 | J B | 0.57 | J B | 1.0 | U | 0.57 | J B |
| 1,2,3-Trichlorobenzene | 1.0 | U | 1.0 | U | 0.75 | J B | 0.37 | J B | 1.0 | U | 0.37 | J B |
| 1,2-Dichloroethene, Total | 2.0 | U | 2.0 | U | 2.0 | U | 2.0 | U | 2.0 | U | 2.0 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-2 Results - Explosive Compounds**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Sample ID | AMW06-018-102016 | | BMW06-018-102016 | | AMW06-031-102016 | | BMW06-031-102016 | | AMW06-030-102016 | | BMW06-030-102016 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lab Sample Number | 200-35849-1 | | 200-35849-3 | | 200-35849-4 | | 200-35849-5 | | 200-35849-6 | | 200-35849-7 | |
| Sampling Date | 10/20/16 | | 10/20/16 | | 10/20/16 | | 10/20/16 | | 10/20/16 | | 10/20/16 | |
| Matrix | Water | | Water | | Water | | Water | | Water | | Water | |
| Dilution Factor | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| Units | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | |
| **Analyte** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** |
| HMX | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| RDX | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 1,3,5-Trinitrobenzene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 1,3-Dinitrobenzene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| Nitrobenzene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| Tetryl | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2,4,6-Trinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 4-Amino-2,6-dinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2-Amino-4,6-dinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2,6-Dinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2,4-Dinitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 2-Nitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 4-Nitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |
| 3-Nitrotoluene | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U | 0.20 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-2b MS/MSD Results for Qualified Compounds**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Analyte | Sample Concentration | Spike Added | Matrix Spike Concentration | Matrix Spike Duplicate Concentration | Matrix Spike Recovery | Matrix Spike Duplicate Recovery | QC Limits |
|---|---|---|---|---|---|---|---|
| **VOCs** | | | | | | | |
| NA | - | - | - | - | - | - | - |
| **Explosive Compounds** | | | | | | | |
| NA | - | - | - | - | - | - | - |

*There were no qualified MS/MSD Results

**Table 3-3 Detections - Volatile Organic Compounds**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| *Sample ID* | AMW06-018-052016 | | BMW06-018-052016 | | AMW06-031-052016 | | BMW06-031-052016 | | AMW06-030-052016 | | BMW06-030-052016 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lab Sample Number* | 200-33594-1 | | 200-33594-3 | | 200-33594-4 | | 200-33594-5 | | 200-33594-6 | | 200-33594-7 | |
| *Sampling Date* | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | |
| *Matrix* | Water | | Water | | Water | | Water | | Water | | Water | |
| *Dilution Factor* | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| *Units* | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | |
| **Analyte** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** |

There were no unqualified VOC compounds detected above the reporting limit.

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-4 Detections - Explosive Compounds**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| *Sample ID* | AMW06-018-052016 | | BMW06-018-052016 | | AMW06-031-052016 | | BMW06-031-052016 | | AMW06-030-052016 | | BMW06-030-052016 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lab Sample Number* | 200-33594-1 | | 200-33594-3 | | 200-33594-4 | | 200-33594-5 | | 200-33594-6 | | 200-33594-7 | |
| *Sampling Date* | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | | 05/18/16 | |
| *Matrix* | Water | | Water | | Water | | Water | | Water | | Water | |
| *Dilution Factor* | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
| *Units* | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | | ug/L | |
| **Analyte** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** | **Result** | **Q** |

There were no unqualified explosive compounds detected above the reporting limit.

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-5 Field Duplicate Results - Volatile Organic Compounds**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| ***Sample ID*** | **AMW06-018-102016** | | **AMW06-218-102016** | |
|---|---|---|---|---|
| ***Lab Sample Number*** | **200-35849-1** | | **200-35849-2** | |
| ***Sampling Date*** | **10/20/16** | | **10/20/16** | |
| ***Matrix*** | **Water** | | **Water** | |
| ***Dilution Factor*** | **1** | | **1** | |
| ***Units*** | **ug/L** | | **ug/L** | |
| **Analyte** | | | | |
| Dichlorodifluoromethane | 1.0 | U * | 1.0 | U * |
| Chloromethane | 1.0 | U * | 1.0 | U * |
| Vinyl chloride | 1.0 | U * | 1.0 | U * |
| Bromomethane | 1.0 | U * | 1.0 | U * |
| Chloroethane | 1.0 | U | 1.0 | U |
| Trichlorofluoromethane | 1.0 | U * | 1.0 | U * |
| 1,1-Dichloroethene | 1.0 | U | 1.0 | U |
| Freon TF | 1.0 | U | 1.0 | U |
| Acetone | 5.0 | U | 5.0 | U |
| Carbon disulfide | 1.0 | U | 1.0 | U |
| Methylene Chloride | 1.0 | U | 1.0 | U |
| trans-1,2-Dichloroethene | 1.0 | U | 1.0 | U |
| Methyl t-butyl ether | 1.0 | U | 1.0 | U |
| 1,1-Dichloroethane | 1.0 | U | 1.0 | U |
| cis-1,2-Dichloroethene | 1.0 | U | 1.0 | U |
| 2-Butanone | 5.0 | U | 5.0 | U |
| Bromochloromethane | 1.0 | U | 1.0 | U |
| Chloroform | 1.0 | U | 1.0 | U |
| 1,1,1-Trichloroethane | 1.0 | U | 1.0 | U |
| 1,1-Dichloropropene | 1.0 | U | 1.0 | U |
| Carbon tetrachloride | 1.0 | U | 1.0 | U |
| Benzene | 1.0 | U | 1.0 | U |
| 1,2-Dichloroethane | 1.0 | U | 1.0 | U |
| Trichloroethene | 1.0 | U | 1.0 | U |
| 1,2-Dichloropropane | 1.0 | U | 1.0 | U |
| Dibromomethane | 1.0 | U | 1.0 | U |
| Bromodichloromethane | 1.0 | U | 1.0 | U |
| cis-1,3-Dichloropropene | 1.0 | U | 1.0 | U |
| 4-Methyl-2-pentanone | 5.0 | U | 5.0 | U |
| Toluene | 0.30 | J B | 0.31 | J B |
| trans-1,3-Dichloropropene | 1.0 | U | 1.0 | U |
| 1,1,2-Trichloroethane | 1.0 | U | 1.0 | U |
| Tetrachloroethene | 1.0 | U | 1.0 | U |
| 1,3-Dichloropropane | 1.0 | U | 1.0 | U |
| 2-Hexanone | 5.0 | U | 5.0 | U |
| Dibromochloromethane | 1.0 | U | 1.0 | U |

**Table 3-5 Field Duplicate Results - Volatile Organic Compounds**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| ***Sample ID*** | **AMW06-018-102016** | | **AMW06-218-102016** | |
|---|---|---|---|---|
| ***Lab Sample Number*** | **200-35849-1** | | **200-35849-2** | |
| ***Sampling Date*** | **10/20/16** | | **10/20/16** | |
| ***Matrix*** | **Water** | | **Water** | |
| ***Dilution Factor*** | **1** | | **1** | |
| ***Units*** | **ug/L** | | **ug/L** | |
| **Analyte** | | | | |
| 1,2-Dibromoethane | 1.0 | U | 1.0 | U |
| Chlorobenzene | 1.0 | U | 1.0 | U |
| 1,1,1,2-Tetrachloroethane | 1.0 | U | 1.0 | U |
| Ethylbenzene | 1.0 | U | 1.0 | U |
| m&p-Xylene | 1.0 | U | 1.0 | U |
| Xylenes, Total | 2.0 | U | 2.0 | U |
| o-Xylene | 1.0 | U | 1.0 | U |
| Styrene | 1.0 | U | 1.0 | U |
| Bromoform | 1.0 | U | 1.0 | U |
| Isopropylbenzene | 1.0 | U | 1.0 | U |
| Bromobenzene | 1.0 | U | 1.0 | U |
| 1,1,2,2-Tetrachloroethane | 1.0 | U | 1.0 | U |
| n-Propylbenzene | 1.0 | U | 1.0 | U |
| 2-Chlorotoluene | 1.0 | U | 1.0 | U |
| 1,3,5-Trimethylbenzene | 1.0 | U | 1.0 | U |
| 4-Chlorotoluene | 1.0 | U | 1.0 | U |
| tert-Butylbenzene | 1.0 | U | 1.0 | U |
| 1,2,4-Trimethylbenzene | 1.0 | U | 1.0 | U |
| sec-Butylbenzene | 1.0 | U | 1.0 | U |
| 1,3-Dichlorobenzene | 1.0 | U | 1.0 | U |
| 4-Isopropyltoluene | 1.0 | U | 1.0 | U |
| 1,4-Dichlorobenzene | 1.0 | U | 1.0 | U |
| 1,2-Dichlorobenzene | 1.0 | U | 1.0 | U |
| n-Butylbenzene | 1.0 | U | 1.0 | U |
| 1,2-Dibromo-3-Chloropropane | 1.0 | U | 1.0 | U |
| 1,2,4-Trichlorobenzene | 1.0 | U | 1.0 | U |
| Hexachlorobutadiene | 1.0 | U | 1.0 | U |
| Naphthalene | 1.0 | U | 1.0 | U |
| 1,2,3-Trichlorobenzene | 1.0 | U | 1.0 | U |
| 1,2-Dichloroethene, Total | 2.0 | U | 2.0 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table 3-6 Field Duplicate Results - Explosive Compounds**
**October 2016 Monitroing Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| *Sample ID* | AMW06-018-102016 | | AMW06-218-102016 | |
|---|---|---|---|---|
| *Lab Sample Number* | 200-35849-1 | | 200-35849-2 | |
| *Sampling Date* | 10/20/16 | | 10/20/16 | |
| *Matrix* | Water | | Water | |
| *Dilution Factor* | 1 | | 1 | |
| *Units* | ug/L | | ug/L | |
| **Analyte** | | | | |
| HMX | 0.20 | U | 0.20 | U |
| RDX | 0.20 | U | 0.20 | U |
| 1,3,5-Trinitrobenzene | 0.20 | U | 0.20 | U |
| 1,3-Dinitrobenzene | 0.20 | U | 0.20 | U |
| Nitrobenzene | 0.20 | U | 0.20 | U |
| Tetryl | 0.20 | U | 0.20 | U |
| 2,4,6-Trinitrotoluene | 0.20 | U | 0.20 | U |
| 4-Amino-2,6-dinitrotoluene | 0.20 | U | 0.20 | U |
| 2-Amino-4,6-dinitrotoluene | 0.20 | U | 0.20 | U |
| 2,6-Dinitrotoluene | 0.20 | U | 0.20 | U |
| 2,4-Dinitrotoluene | 0.20 | U | 0.20 | U |
| 2-Nitrotoluene | 0.20 | U | 0.20 | U |
| 4-Nitrotoluene | 0.20 | U | 0.20 | U |
| 3-Nitrotoluene | 0.20 | U | 0.20 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

# Table 3-7
# Trip Blank Results - Volatile Organic Compounds
# October 2016 Monitoring Well Sampling Event
# Metropolitan Utilities District, Saunders County, NE

| | | |
|---|---|---|
| ***Sample ID*** | **TRB-200-102016** | |
| ***Lab Sample Number*** | **200-35849-8** | |
| ***Sampling Date*** | **10/20/16** | |
| ***Matrix*** | **Water** | |
| ***Dilution Factor*** | **1** | |
| ***Units*** | **ug/L** | |
| **Analyte** | | |
| Dichlorodifluoromethane | 1.0 | U |
| Chloromethane | 1.0 | U |
| Vinyl chloride | 1.0 | U |
| Bromomethane | 1.0 | U * |
| Chloroethane | 1.0 | U |
| Trichlorofluoromethane | 1.0 | U |
| 1,1-Dichloroethene | 1.0 | U |
| Freon TF | 1.0 | U |
| Acetone | 5.0 | U |
| Carbon disulfide | 1.0 | U |
| Methylene Chloride | 1.0 | U |
| trans-1,2-Dichloroethene | 1.0 | U |
| Methyl t-butyl ether | 1.0 | U |
| 1,1-Dichloroethane | 1.0 | U |
| cis-1,2-Dichloroethene | 1.0 | U |
| 2-Butanone | 5.0 | U |
| Bromochloromethane | 1.0 | U |
| Chloroform | 1.0 | U |
| 1,1,1-Trichloroethane | 1.0 | U |
| 1,1-Dichloropropene | 1.0 | U |
| Carbon tetrachloride | 1.0 | U |
| Benzene | 1.0 | U |
| 1,2-Dichloroethane | 1.0 | U |
| Trichloroethene | 1.0 | U |
| 1,2-Dichloropropane | 1.0 | U |
| Dibromomethane | 1.0 | U |
| Bromodichloromethane | 1.0 | U |
| cis-1,3-Dichloropropene | 1.0 | U |
| 4-Methyl-2-pentanone | 5.0 | U |
| Toluene | 0.97 | J B |
| trans-1,3-Dichloropropene | 1.0 | U |
| 1,1,2-Trichloroethane | 1.0 | U |
| Tetrachloroethene | 1.0 | U |

## Table 3-7
## Trip Blank Results - Volatile Organic Compounds
## October 2016 Monitoring Well Sampling Event
## Metropolitan Utilities District, Saunders County, NE

| ***Sample ID*** | **TRB-200-102016** | |
|---|---|---|
| ***Lab Sample Number*** | **200-35849-8** | |
| ***Sampling Date*** | **10/20/16** | |
| ***Matrix*** | **Water** | |
| ***Dilution Factor*** | **1** | |
| ***Units*** | **ug/L** | |
| **Analyte** | | |
| 1,3-Dichloropropane | 1.0 | U |
| 2-Hexanone | 5.0 | U |
| Dibromochloromethane | 1.0 | U |
| 1,2-Dibromoethane | 1.0 | U |
| Chlorobenzene | 1.0 | U |
| 1,1,1,2-Tetrachloroethane | 1.0 | U |
| Ethylbenzene | 1.0 | U |
| m&p-Xylene | 1.0 | U |
| Xylenes, Total | 2.0 | U |
| o-Xylene | 1.0 | U |
| Styrene | 1.0 | U |
| Bromoform | 1.0 | U |
| Isopropylbenzene | 1.0 | U |
| Bromobenzene | 1.0 | U |
| 1,1,2,2-Tetrachloroethane | 1.0 | U |
| n-Propylbenzene | 1.0 | U |
| 2-Chlorotoluene | 1.0 | U |
| 1,3,5-Trimethylbenzene | 1.0 | U |
| 4-Chlorotoluene | 1.0 | U |
| tert-Butylbenzene | 1.0 | U |
| 1,2,4-Trimethylbenzene | 1.0 | U |
| sec-Butylbenzene | 1.0 | U |
| 1,3-Dichlorobenzene | 1.0 | U |
| 4-Isopropyltoluene | 1.0 | U |
| 1,4-Dichlorobenzene | 1.0 | U |
| 1,2-Dichlorobenzene | 1.0 | U |
| n-Butylbenzene | 1.0 | U |
| 1,2-Dibromo-3-Chloropropane | 1.0 | U |
| 1,2,4-Trichlorobenzene | 1.0 | U |
| Hexachlorobutadiene | 1.0 | U |
| Naphthalene | 0.54 | J B |
| 1,2,3-Trichlorobenzene | 1.0 | U |
| 1,2-Dichloroethene, Total | 2.0 | U |

**Note: See Table 2-2 for laboratory qualifiers, notes, and abbreviations.**

**Table- 4-1**
**Field Completeness**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| | Volatile Organic Compounds (8260B) | | Percent Complete | Explosive Compounds (8330B) | | Percent Complete |
|---|---|---|---|---|---|---|
| | *Actual* | *Proposed* | | *Actual* | *Proposed* | |
| **No. of Sampling Locations** | 6 | 6 | 100% | 6 | 6 | 100% |
| **Number of Field Duplicates** | 1 | 1 | 100% | 1 | 1 | 100% |
| **Number of Matrix Spike Samples** | 1 | 1 | 100% | 1 | 1 | 100% |
| **Number of Matrix Spike Duplicate Samples** | 1 | 1 | 100% | 1 | 1 | 100% |
| **Number of Field Blanks** | 0 | 0 | NA[2] | 0 | 0 | NA[2] |
| **Number of Equipment Blanks** | 0 | 0 | NA[2] | 0 | 0 | NA[2] |
| **Number of VOC Trip Blanks** | 1 | 1 | 100% | 0 | 0 | NA[2] |
| **Number of Lab Performance Testing Samples[1]** | 0 | 0 | NA[2] | 0 | 0 | NA[2] |
| **Total Number of Samples per event** | 10 | 10 | 100% | 9 | 9 | 100% |

| | | | |
|---|---|---|---|
| **Overall Field Completeness** | 100.0% | **Overall Field Completeness Goal** | 95% |

[1] The number of Batch or Project-specific proficiency testing (PT) samples are scheduled for this sampling event.

[2] Percent Complete calculation not required since no samples were proposed for this event.

**Table- 4-2**
**Analytical Completeness**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| | Volatile Organic Compound Analyses | Explosive Compound Analyses |
|---|---|---|
| Number of Analyses | 396 | 84 |
| Number of qualified data points (excluding J qualifications) | 1 | 0 |
| Percent Complete | 99.7% | 100.0% |

| | |
|---|---|
| Overall Acceptable Data Analytical Completeness | 99.9% |

| | |
|---|---|
| Overall Acceptable Data Analytical Completeness Goal | 85% |

| | Volatile Organic Compound Analyses | Explosive Compound Analyses |
|---|---|---|
| Number of Analyses | 396 | 84 |
| Number of Rejected Data points | 0 | 0 |
| Percent Complete | 100.0% | 100.0% |

| | |
|---|---|
| Overall Quality Data Analytical Completeness | 100.0% |

| | |
|---|---|
| Overall Quality Data Analytical Completeness Goal | 85% |

**Table- 4-3**
**Project Completeness**
**October 2016 Monitoring Well Sampling Event**
**Metropolitan Utilities District, Saunders County, NE**

| Overall Field Completeness | Overall Analytical Completeness[1] | Overall Project Completeness[2] |
|---|---|---|
| 100.0% | 99.9% | 99.9% |

| Overall Project Completeness Goal | 90% |
|---|---|

**Notes:**
1 = Analytical completeness is the percentage of usable data i.e. quality data completeness.
2 = Project completeness combines sampling and analytical protocols to assess the expectations of the project as a whole. Project completeness is determined by comparing the percentage of samples / measurements that are determined to be usable to the total number of samples / measurements planned.

CREATE AMAZING.

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