LEGGETTE, BRASHEARS & GRAHAM, INC.

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MEMORANDUM

TO:	**Kristina Handt, City of Scandia**
FROM:	**Dave Hume, LBG**
CC:	**Sherri Buss, TKDA** **Roscoe Sopiwnik, LBG** **Jed Chesnut - WCD**
DATE:	**January 16, 2015**
RE:	**Groundwater Monitoring Update (May through December 2014)** **Zavoral Mining and Reclamation Project** **Scandia, MN**

The purpose of this correspondence is to provide the City of Scandia (City) with a summary of the groundwater monitoring results from the Zavoral Mining and Reclamation Project (Site). This memorandum includes the results from May through December 2014, and is referred to herein as the reporting period. The monitoring results from January through April 2014 were provided in Leggette, Brashears & Graham, Inc.'s (LBG's) June 2014 Groundwater Monitoring Update memorandum, dated June 20, 2014. Groundwater monitoring well installation, monitoring procedures, and 2013 results were provided in LBG's *2013 Groundwater Monitoring Summary* letter report dated January 15, 2014.

GROUNDWATER MONITORING ACTIVITIES

The following groundwater monitoring activities were conducted:

- LBG conducted Site visits on June 20th , October 16, 2014, and January 15, 2015 (to obtain 2014 data through December 2014);
- Manually measured water levels and downloaded water level data from the data loggers in the four observation wells (MW-1, PZ-1, PZ-2, and Trails End Well), and downloaded water quality parameter data from the logger in MW-1;
- Obtained the surface water monitoring data from the Washington County Conservation District (WCD) and provided WCD with groundwater data; and,
- Updated the water quality data plots and well hydrographs.

GROUNDWATER MONITORING RESULTS

Groundwater Level Measurements

Groundwater levels across the Site increased from approximately 1 to 1.5 feet from April through July then remained through the end of 2014 in PZ-1 and Trails End. Levels in MW-1 and PZ-2 showed a decline of approximately 0.5 feet from October through the end of 2014. These trends follow the same general patterns observed in 2013 and are typical of seasonal variations caused by variable perception and subsequent recharge.

Groundwater Flow Direction

The groundwater surface contour map is shown on Figure 1 for measurements collected on October 16, 2014. The hydraulic gradient and flow direction is consistent with the 2013 results and those measured in early 2014.

Mining Depth and Groundwater Levels

According to Tiller staff, active mining excavation and reclamation activities occurred during the reporting period during the months of September, October, November, and December 2014. Reclamation activities also occurred during the May through August timeframe. The maximum mining depth during the 2014 season ranged between 850 and 855 feet amsl, which is between 10 and 15 feet above the permitted depth of 840 feet amsl. This maintains the required 25 feet minimum separation distance from the water table as required by the condition outlined in the Conditional Use Permit (CUP).

Zavoral Site Well

The Zavoral Site Well was pumped in October and November 2014 for dust control activities. A total of 8,500 gallons were pumped with 4,000 gallons withdrawn on October 30th, 1,500 gallons on November 3rd, and 3,000 gallons on November 4th. According to Tiller staff, this was the only water groundwater withdrawn during the reporting period. Groundwater levels in the uppermost aquifer below the site were not affected by pumping.

Groundwater Quality - Petroleum Parameters (MW-1)

Groundwater samples were not collected during the reporting period. The results from a sample collected from MW-1 in January 2014 are provided in LBG's June 2014 Groundwater Monitoring Update memorandum. Petroleum compounds (benzene, toluene, ethylbenzene, and xylene) and diesel range organics (DRO) were not detected at or above the method detection limit. The sampling plan and protocol is consistent with Tiller's *Groundwater Quality Protection Plan* GWQPP.

Groundwater Quality – Indicator Parameters (MW-1)

The water quality indicators recorded by the logger in MW-1 are presented in Attachment 1. The values are generally in the range of those recorded in 2013 during the pre-Tiller mining period. The plots show decreases in conductivity, salinity, and total dissolved solids (TDS) beginning in mid-June 2014. In

addition to the expected seasonal variation, the signatures are likely more pronounced due to the significant amounts of precipitation during the early summer months of 2014. Although the signatures were slightly less pronounced in 2013, they followed similar timing and trends.

SUMMARY AND RECOMMENDATIONS

Based on the groundwater monitoring data from this most recent and prior reporting periods, mining and reclamation operations have not impacted groundwater below the Site.

Based on LBG's review and evaluation of the monitoring procedures and data from 2013 through 2014, all CUP conditions related to groundwater monitoring have been met by Tiller. At this time, LBG recommends the conditions of the CUP remain in place and the *Groundwater Quality Protection Plan* GWQPP continue to be followed.

FIGURE

Source: LIDAR DEM from Minnesota Geospatial Information Office. Well Locations Located by LBG. Surface Water Monitoring Locations from MNWCD.

G:\GIS\Tiller_Zavoral_Mine\maps\g3zavoral01l.mxd, 11/7/2014, 2:40:38 PM, NAD 1983 UTM Zone 15N

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CITY OF SCANDIA
SCANDIA, MINNESOTA

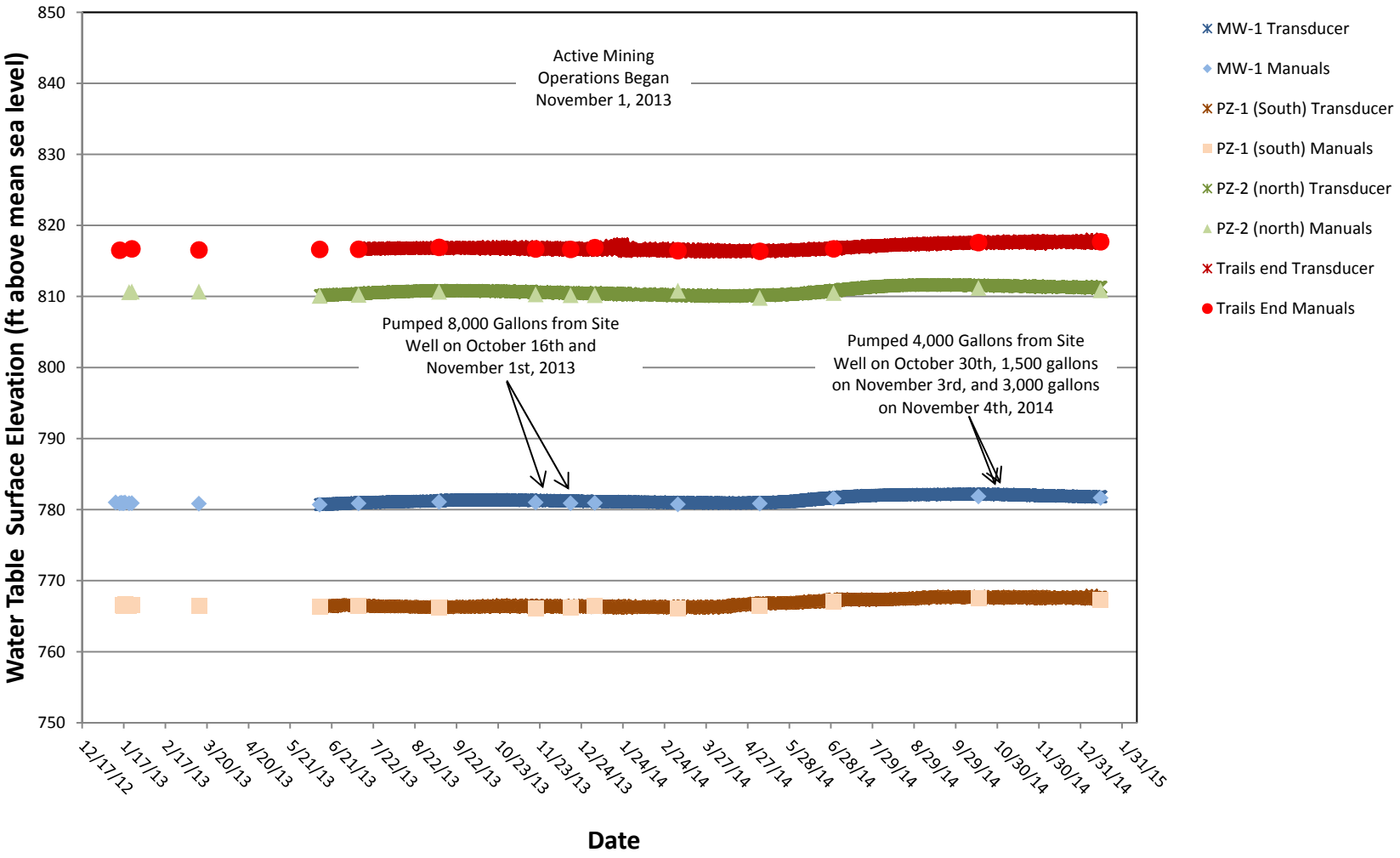
GROUNDWATER ELEVATIONS
OCTOBER 16, 2014

FILE: g3zavoral01l.MXD | DATE: 11/7/2014 | FIGURE: 1

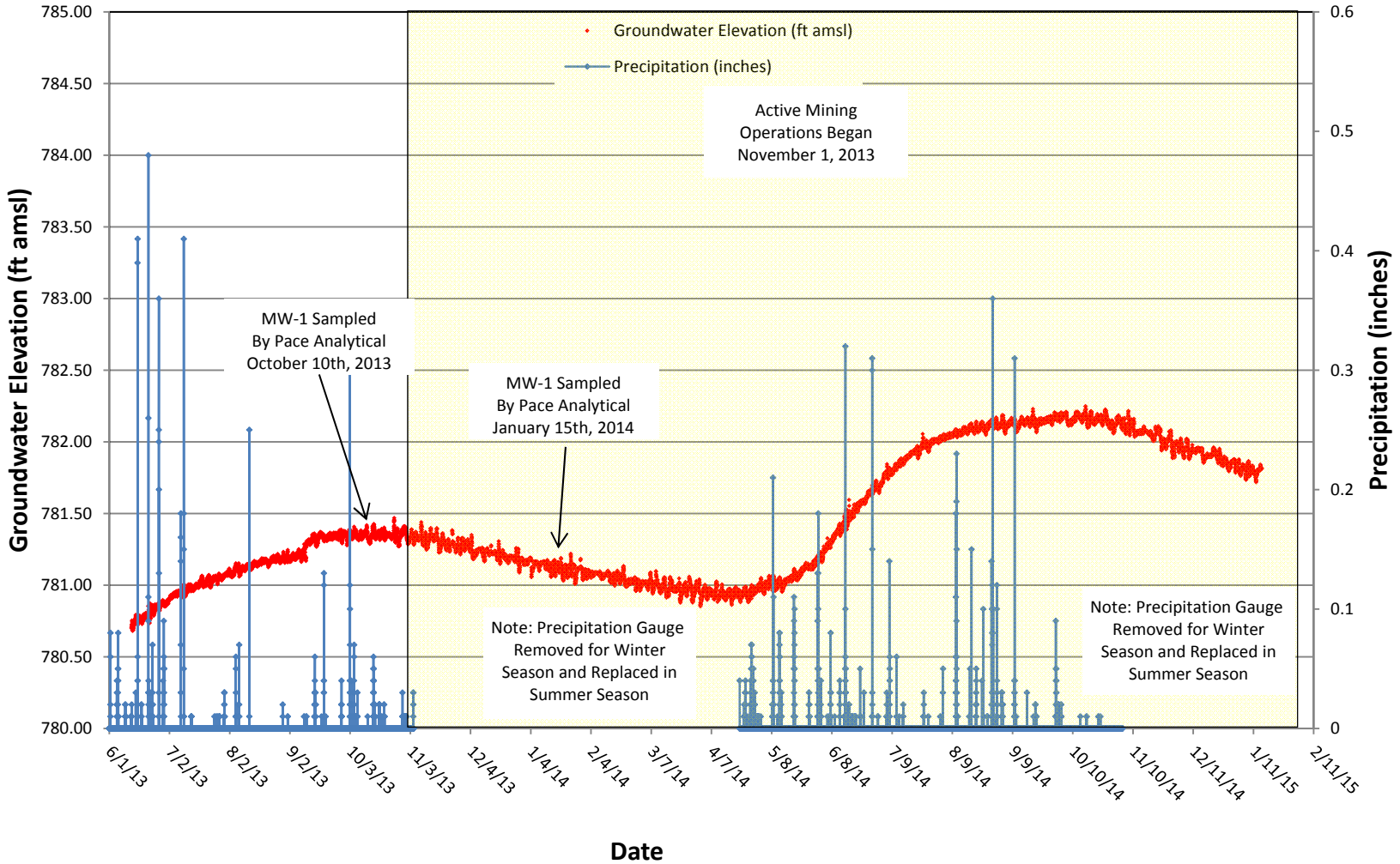
ATTACHMENT 1

WELL HYDROGRAPHS AND
WATER QUALITY INDICATOR PARAMETER DATA PLOTS

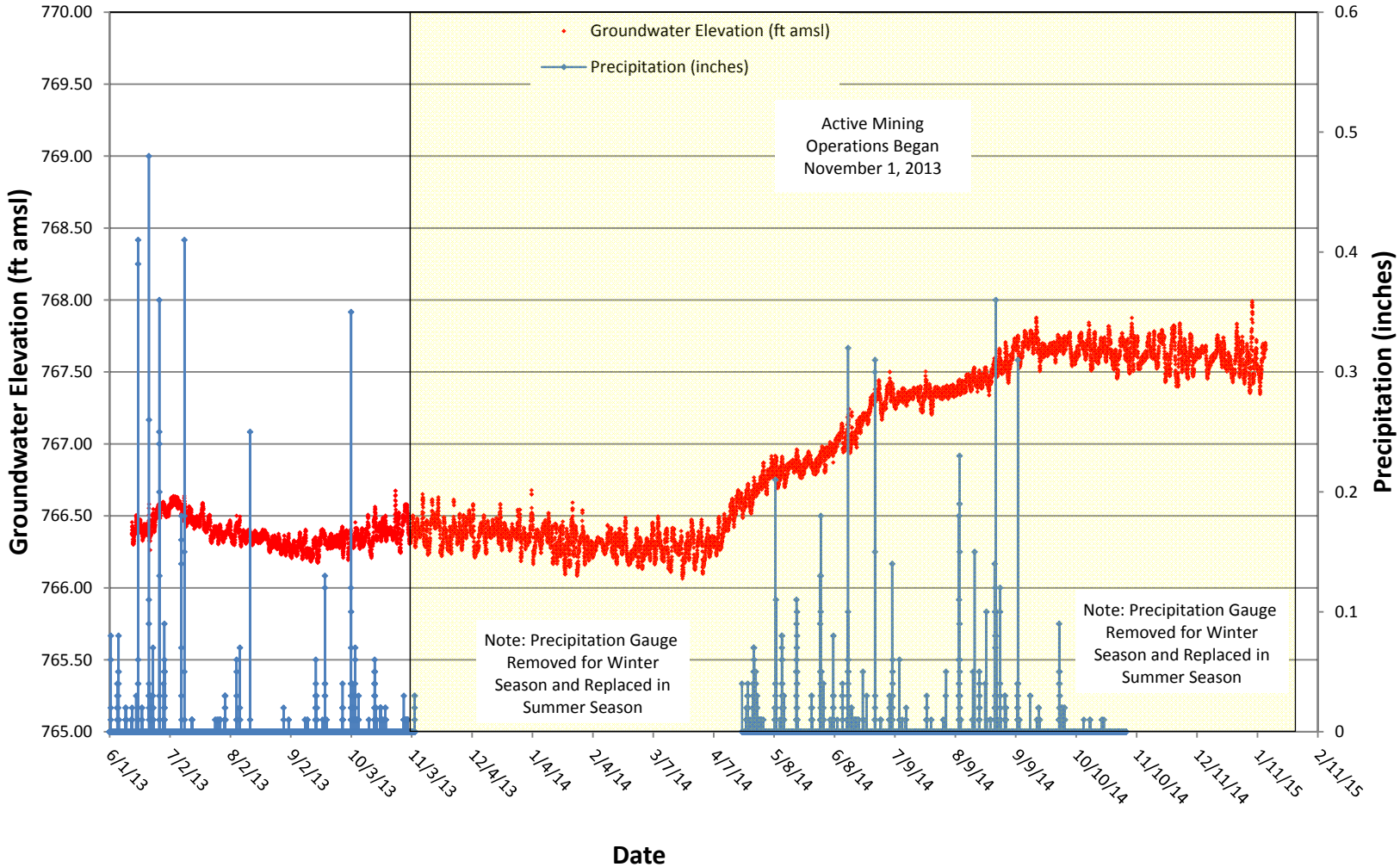
MW-1 Monitoring Well and PZ-1, PZ-2, and Trails End Observation Wells
Groundwater Elevation (ft amsl) vs Time
Zavoral Aggregate Mining and Reclamation Project
Scandia, Minnesota



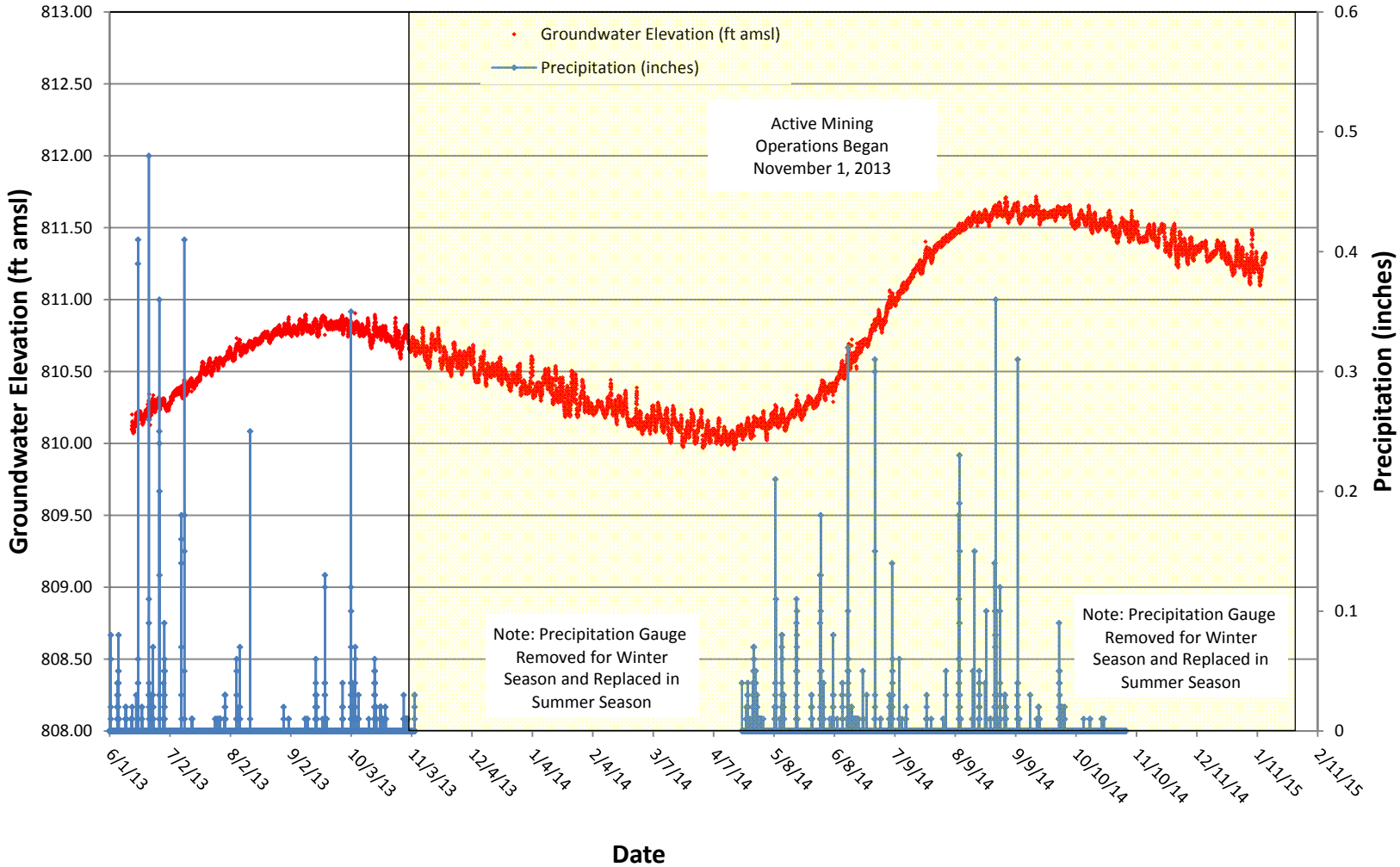
MW-1
Groundwater Elevation (ft amsl) and Precipitation (inches) vs Time
Zavoral Mining and Reclamation Project
Scandia, MN



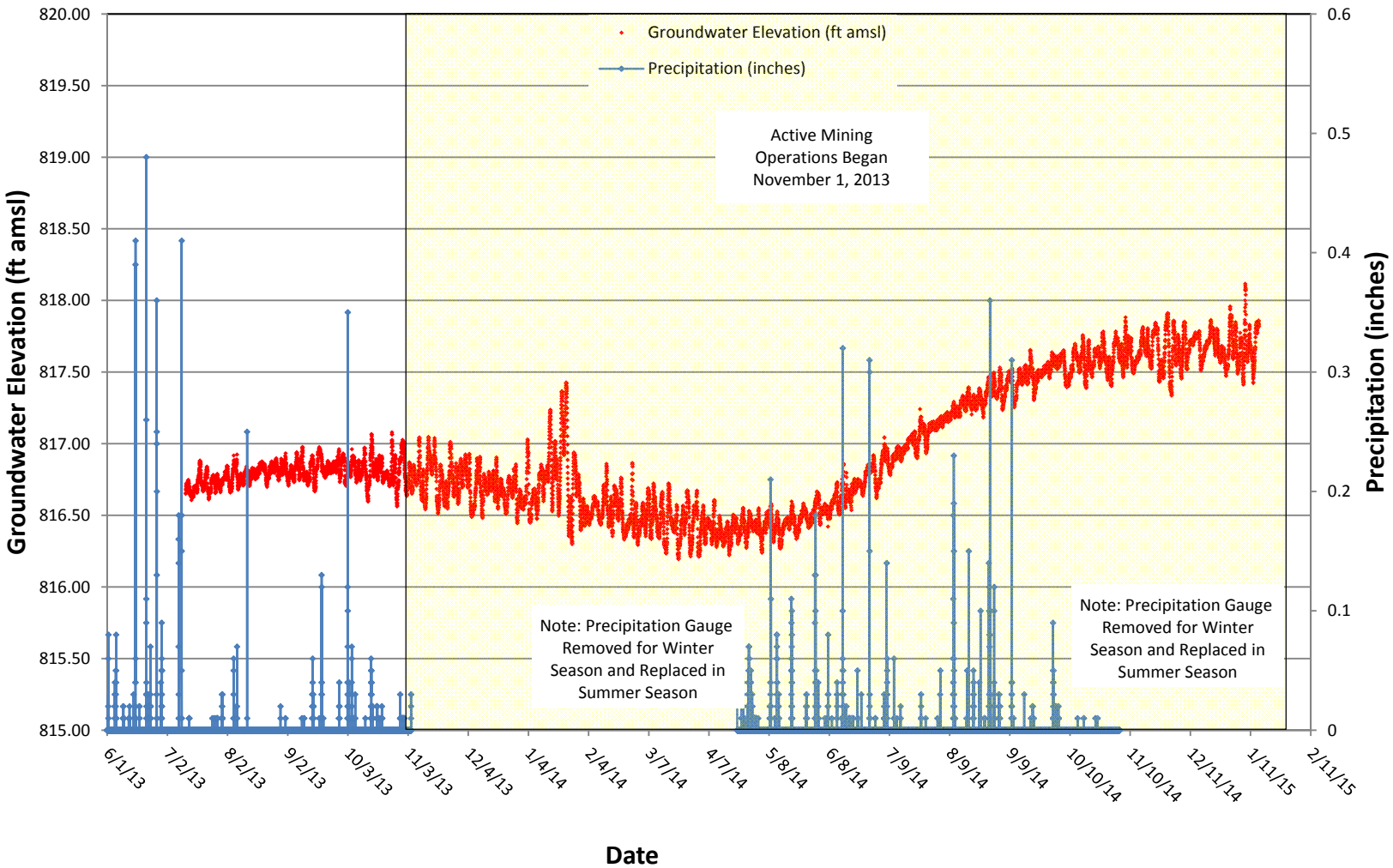
PZ-1
Groundwater Elevation (ft amsl) and Precipitation (inches) vs Time
Zavoral Mining and Reclamation Project
Scandia, MN



PZ-2
Groundwater Elevation (ft amsl) and Precipitation (inches) vs Time
Zavoral Mining and Reclamation Project
Scandia, MN



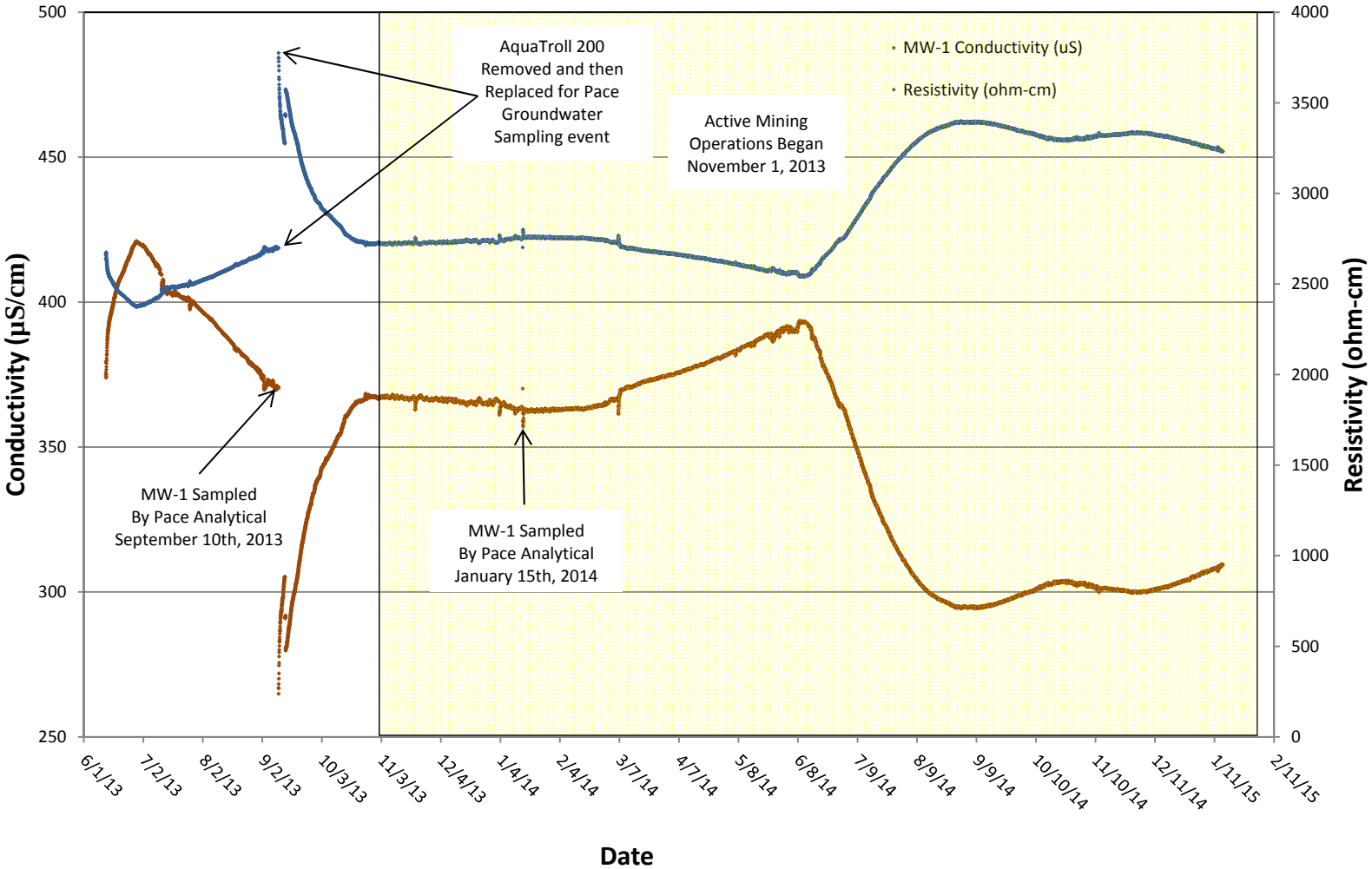
Trails End
Groundwater Elevation (ft amsl) and Precipitation (inches) vs Time
Zavoral Mining and Reclamation Project
Scandia, MN



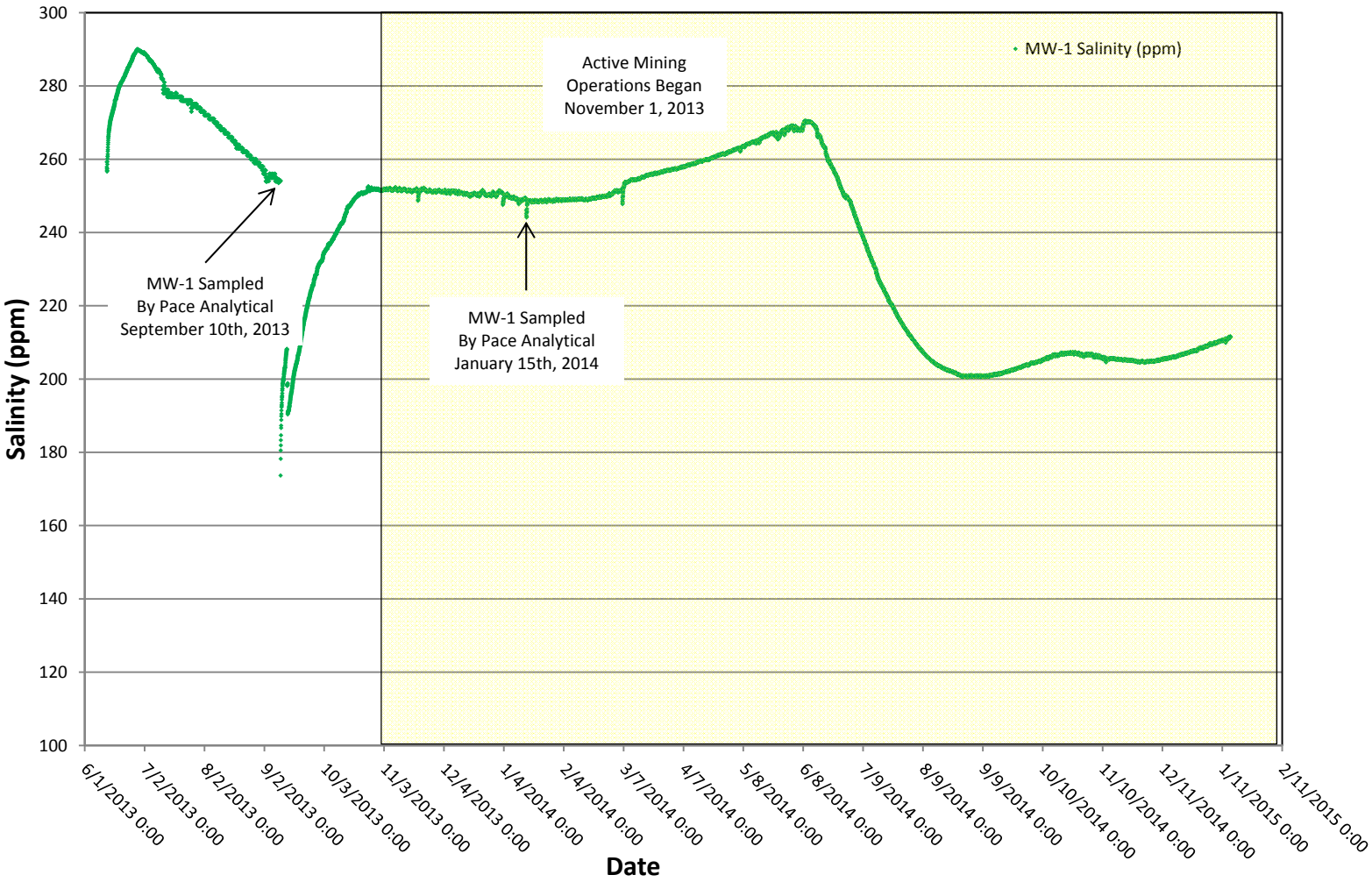
S:\Tech\Scandia Aggregate\Zavoral\Monitoring Reports\2014\May-December 2014 memo\
MW-1, PZ-1, 2, 3 Groundwater Quality Parameters

LEGGETTE, BRASHEARS & GRAHAM, INC.

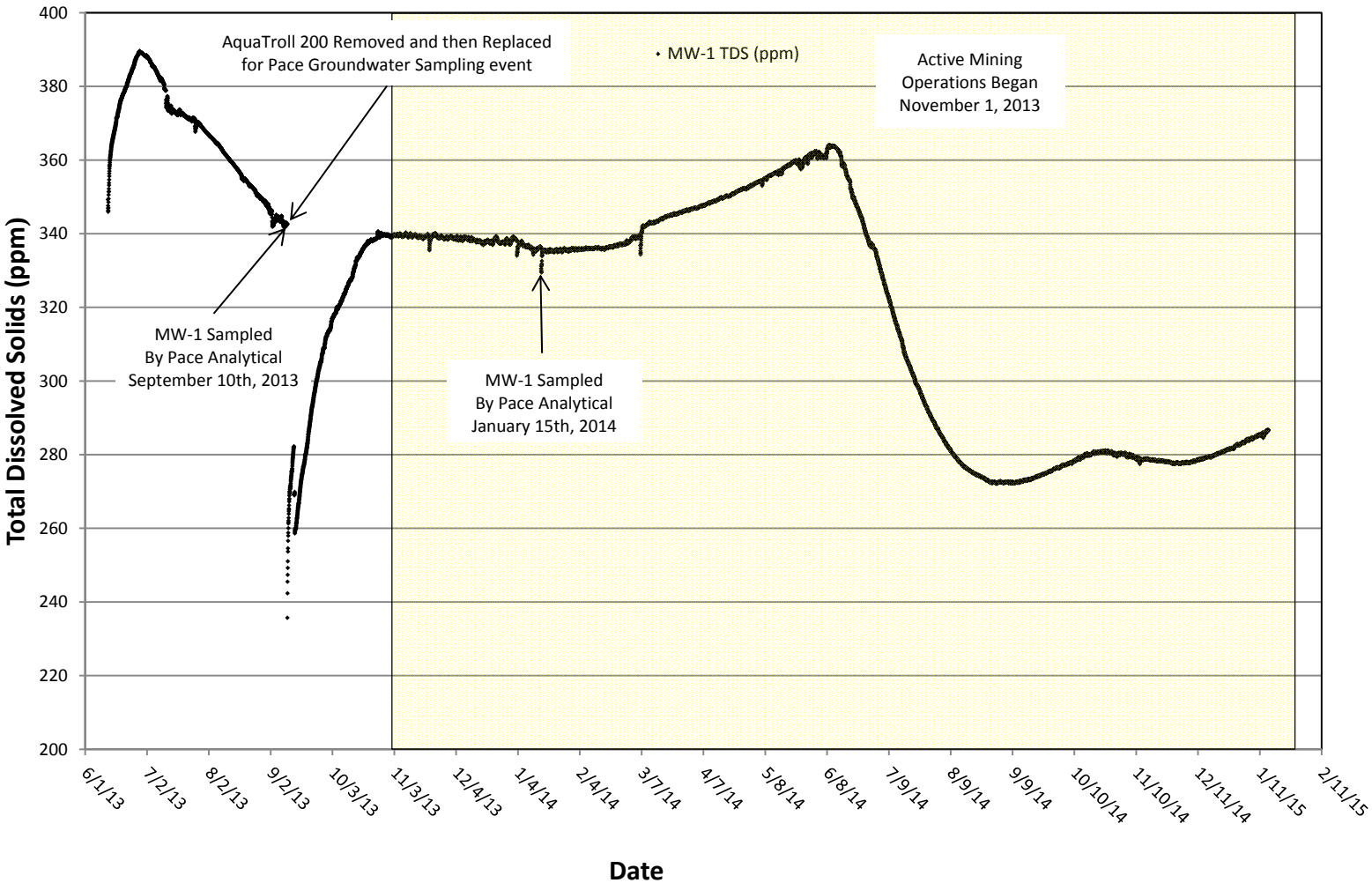
MW-1
Conductivity (µS/cm) and Resistivity (ohm-cm) vs Time
Zavoral Mining and Reclamation Project
Scandia, MN



MW-1
Salinity (ppm) vs Time
Zavoral Mining and Reclamation Project
Scandia, MN



MW-1
Total Dissolved Solids (ppm) vs Time
Zavoral Mining and Reclamation Project
Scandia, MN



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