Baltimore Inner Harbor HMS Groundwater Gradient Monitoring Quarterly Report No. 107 Second Quarter 2016

Prepared for

Honeywell International Inc.

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SITE: R30905
SUBJECT: 4.16.1

Contents

Acronyms and Abbreviations

EPA	U.S. Environmental Protection Agency
HMS	Head Maintenance System
INSQL	Industrial System Query Language
MDE	Maryland Department of the Environment
MMS	Master Supervisory System
MMC	Multimedia Cap
Performance Standard	Groundwater Gradient Performance Standard
RAM	random access memory
RIC	remote intelligence controller
Site	Honeywell Baltimore Inner Harbor Site

SECTION 1

HMS Groundwater Gradient Monitoring Report

1.1 Purpose

This document represents the partial fulfillment of the Consent Decree entered into by Honeywell (formerly AlliedSignal, Inc.), the U.S. Environmental Protection Agency (EPA), and the Maryland Department of the Environment (MDE), dated September 29, 1989. Specifically, this document satisfies Section V.3 of the Consent Decree, Exhibit 4 (RCRA Correction Action Plan Task XV.A.9). This section requires that a progress report be submitted every calendar quarter during the life of the Consent Decree. This report provides the data required to satisfy the requirements specified by the *Groundwater Gradient Monitoring Plan* (June 1995).

This report documents activity performed at the Honeywell Baltimore Inner Harbor Site (Site) during the second quarter of 2016.

1.2 Objective

The objective of this report is to document the performance of the vertical hydraulic barrier and head maintenance system (HMS) at the Site. The HMS installed as part of the final remedial construction at the Site includes vaults, pumps, controls, valves, conduits, and tanks. This report documents compliance with the Groundwater Gradient Performance Standard (performance standard), which requires Honeywell to maintain an inward groundwater gradient at the Site. The HMS performance is monitored, controlled, and recorded by the Master Supervisory System (MSS) installed at the Site as part of the corrective measures.

1.3 Groundwater Gradient Performance Standard

The performance standard is set forth in Section V, Paragraphs 13.b and c, of the Consent Decree, Second Amendment:

> b. The following Groundwater Gradient Performance Standard shall be established: for each pair of piezometers, for every 30 day period, the average hydraulic head measured at the piezometer inside the barrier shall be lower than the average hydraulic head measured at the piezometer outside the barrier, and the absolute value of the average hydraulic head differential shall be greater than a value which represents the sum of 0.01 feet plus two times the maximum potential error of measurement of the hydraulic head in any one piezometer. Said value shall represent the arithmetic average of hourly readings for the aforementioned period.

and

> c. Defendant shall monitor the performance of the deep vertical hydraulic barrier at the points and times and in the manner specified in the approved Groundwater Gradient Monitoring Plan.

The performance standard was also described by the *Corrective Measures Implementation Program Plan*, May 1990, Section 2.3.2, Subpart 1, Horizontal Groundwater Gradient Performance Standard:

> Piezometer pairs, one on the inside and one on the outside of the hydraulic barrier, located as described in the Consent Decree, will be monitored at the required frequency to demonstrate that an inward hydraulic gradient exists. Each piezometer will be measured hourly and averaged arithmetically over a 30-day period, to determine that the 30 day running average of the inside

> piezometer's hydraulic head is at least 0.01 foot less than the corresponding outside piezometer's hydraulic head for each piezometer pair location. Additionally, for each performance standard piezometer pair, for any hourly head measurement, if the inward gradient decreases to where the inside piezometric head is 0.01 foot, or less, than the outside piezometric head, groundwater extraction will commence in the vicinity of the inside piezometer. Groundwater extraction will continue until the piezometric head at the outside piezometer becomes greater than 0.01foot relative to the corresponding inside piezometer.

The performance standard was further developed, based on design review, in the *HMS Corrective Measures Prefinal Design Plans, Volume II, Design Report*, 1994. The design report incorporated into the performance standard the calculation of the HMS's inherent measurement error for the water levels, as detailed in the report's Section 3.4 and Appendix 2.2. The performance standard calculation for each piezometer pair was established as the minimum head difference, plus twice the measurement error at one piezometer, or

Performance Standard = [0.01 foot + (2 × HMS water level measurement error)].

The 1994 design report calculated the HMS piezometer measurement error based on the then-current design and instrumentation selection. This calculation was revised because the water level instrumentation was updated and installed into the HMS piezometers. The current performance standard for the installed ultrasonic water level devices is [0.01 foot + (2 × 0.031 measurement error)] = 0.072 foot. The revised error calculation memorandum is presented in Appendix E of the *Baltimore Works Operation and Maintenance Plan*, dated May 2001.

1.4 Gradient Data—Second Quarter of 2016

During the second quarter of 2016, the HMS groundwater gradient met the performance standard according to the data recorded by the MSS. Data were not recorded during brief periods when the water level monitoring system was disabled due to power outages or modifications to the monitoring system during site construction as defined in the Area 1/Phase 1 Detailed Development Plan. The groundwater gradient data are presented in Appendix A. The data are presented via charts and plots that include the following:

- One 30-day running hourly average gradient chart (represents a compilation of all 16 piezometer pair gradients) documents that the groundwater gradient measured across the Site were above the calculated performance standard of 0.072 foot.
- Sixteen quarterly well level charts, one for each piezometer pair, indicate when a piezometer pair's hourly gradient falls below the MSS control set point (the programmed gradient set point that initiates pumping activity) and when the extraction wells begin to pump. The charts illustrate the approximate pumping periods and rates. The MSS control set point is established above the calculated performance standard (a preset operating margin). The MSS control set point for each piezometer pair is set to 0.10 foot, slightly above the calculated performance criterion of 0.072 foot, as discussed in Section 1.4.
- Three monthly summary plots of the groundwater gradient for the Site indicate the average of the hourly gradients for the specified month, for each piezometer pair.

This report is provided on a CD-ROM, and all supporting data for the first quarter of 2016 are presented as follows:

- The data were transferred to Microsoft Excel workbooks from the Industrial System Query Language (INSQL) database, which resides on the MSS.
- Each workbook, except the pump rate comparison, contains separate worksheets for the source data, formatted data, and the data chart, and includes the individual piezometer readings.

- The summary 30-day running hourly average gradient chart is complex and may not open with less than 128 megabytes of random access memory (RAM).

An explanation of qualified data for each period is presented below.

1.5 Qualified Data

Select data used to generate the graphical representation of the 30-day running hourly average gradient may be interpolated (all other charts use the MSS data as recorded). Interpolation of the data may occur whenever a short-term problem occurs, such as a temporary loss of communications with ultrasonic sensors or a short-term power failure.

1.5.1 System Performance

In instances when an interruption in data collection occurred, the MSS data logging system was evaluated and repaired so data collection could resume. During these events, if the hourly gradient reached the MSS control set point, pumping started automatically unless system power was lost. The 30-day running hourly average gradient remained in compliance with the performance standard during the second quarter. During the second quarter greater than anticipated volumes of water continued to be extracted from the shallow aquifer.

1.5.2 System Events

During this quarter, the system was monitored consistently to maintain system performance and reduce periodic data non-acquisition. Table 1-1 presents descriptions of system events during this quarter.

Table 1-1. System Events

Date	Description
4/1/2016	Replaced defective ball valve in Vault 3.
4/4/2016	Replaced level sensor at OP-7 due to erratic readings.
4/4/2016	Monthly piezometer inspections were performed.
4/13/2016	Monthly vault inspections were performed.
4/22/2016	BAW-2 computer was shut down during electrical maintenance.
4/23/2016	A no-flow alarm was reported for Well 3S. Alarm was reset and returned to operation.
4/23/2016	A leak detection alarm was reported for Vault 12. Vault was inspected and no abnormal conditions were observed.
4/25/2016	The bladder pump in Well 3S was replaced after a no-flow alarm was reported on BAW-1.
4/25/2016	Damage was observed at the entry riser for Vault 3. Cracked concrete was repaired by site construction personnel.
4/27/2016	A no-flow alarm was reported for Pump 1S. A pump inspection was performed and the pump bladder was replaced.
4/28/2016	Replaced all three air relief valves in Vault 2.
5/4/2016	Replaced level sensor in OP-3 due to erratic readings.
5/12/2016	Alarm call-out line for BAW-2 was transferred over to new office phone system.
5/13/2016	Relocated BAW-1 from construction trailer to new offices. System was brought back online and tested with no errors reported.

Table 1-1. System Events

Date	Description
5/13/2016	Alarm call-out line for BAW-1 was transferred over to new office phone system.
5/16/2016	Monthly piezometer inspections were performed.
5/18/2016	Site rain gauge was cleaned due to clogging.
5/18/2016	The double containment line for the loading bay sump and transfer line were pressure tested.
5/19/2016	Site weather station was relocated from construction trailer to the Wills Street fence line.
5/23/2016	Vault VJ-3 was entered after a leak detection alarm was reported, which was determined to be from surface water infiltration following a precipitation event.
5/24/2016	Monthly vault inspections were performed.
6/6/2016	Vault door security hardware was installed for Vaults 1, 2, and 12.
6/14/2016	Monthly piezometer inspections were performed.
6/21–6/22/2016	Monthly vault inspections were performed.
6/21/2016	Leak detection alarm occurred for Vault 1 during heavy a precipitation event.
6/27/2016	Well 3S solenoid manually reset after no-flow alarm reported.
6/28/2016	Damage to Vault 1 at the area of old light pole entrance was repaired.
6/28/2016	The bladder in Well 2S was replaced to improve pump performance.
6/29/2016	The solenoid for Well 3S was replaced.

1.6 Belowgrade Vault Inspection

The equipment in the 12 belowgrade vaults, located generally equidistant from each other along the perimeter of the Site, is inspected every month. Inspections are completed by staff from the site operations and maintenance (O&M) provider, Maryland Environmental Service.

The inspections identified the following items:

- April 2016
  - A crack was noted in the corner of Vault 1, where the demolished exterior light pole conduit enters the vault.
  - Vault 1 pressure indicating transmitter was inoperable. A separate vault entry was made to troubleshoot unit and clear error fault on transmitter.
  - A small air leak was observed at the solenoid in Vault 3. The leak was corrected by tightening.
  - A damaged sump lead was replaced in Vault 5.
  - Vault VJ3 floor was very wet from recent perception events. Sealing of the vault is scheduled to be performed in the second half of 2016.
  - Vault 6 light switch was replaced.
  - The GFCI receptacles at Vaults 6 and 9 were tripped and reset.

  - The leak detection alarm for Vault 10 was in alarm and would not reset. A separate vault entry took place to replace the leak detector lead and clear alarm.
  - Sump 12 leads were cleaned to remove calcification.
- May 2016
  - Vault 1 pressure indicating transmitter was inoperable. A separate vault entry will be scheduled to replace unit.
  - Sump 1 leads were cleaned due to buildup of calcification.
  - An unusual noise was noted at the shallow well flow meter at Vault. The noise was not observed on subsequent vault entries.
  - A damaged sump lead was replaced in Vault 5.
  - The leak detection alarm for Vault 12 was in alarm and would not initially reset. No leaks were observed and the alarm was cleared during a subsequent vault entry.
  - Sump 12 leads were cleaned to remove calcification.
- June 2016
  - Sump 1 leads were cleaned to remove calcification.
  - Unsealed electrical connection holes were noted at the top of the RIC control panel, in Vault 1. A separate vault entry will be performed to make repairs.
  - Dark silty sand was noted on the floor of Vault 1.
  - An unusual noise was noted at the shallow well flowmeter in Vault 2. The shallow well check valve was later replaced on 6/28/16.
  - The light pole receptacle for Vault 3 was observed to have damage and is scheduled for replacement.
  - Sump 3 leads were cleaned to remove calcification.
  - Sump 4 leads were cleaned to remove calcification.
  - The leak detection alarm was reset in VJ3.
  - Water was observed around the perimeter of VJ3
  - A damaged sump lead was replaced in Vault 6.
  - Unsealed electrical connection holes were noted at the top of the RIC control panel, in Vault 7.
  - An error was reported on the ultrasonic level controller in Vault 8.
  - The leak detection alarm for Vault 10 was in alarm and would not reset.
  - The floor of Vault 12 was observed to be very wet. The cause of moisture was determined to be infiltration from precipitation events. The condition was reported to the site developer on 6/30/16 to determine corrective actions.

1.7 HMS Pumping

The HMS has pumped groundwater at a stable rate since the completion of the multimedia cap in the second quarter of 1999, with a steady state condition reached in 2005. With the start of the installation of pile and opening of the synthetic layers during site redevelopment starting in June 2014, the pumping

rates have increased. Groundwater pumping volumes by the HMS pumps for April, May, and June 2016 were approximately 58,526 gallons, 31,377 gallons, and 28,461 gallons, respectively. An additional estimated 12,085 gallons of water was extracted by the sump pumps

The rate of groundwater pumping generally increases during the winter months, when tides are lower, and decreases generally in the summer months, when tides are higher. Extracted groundwater totals increased starting on October 23, 2015, when increased pumping of the shallow wells was performed to maintain the inward gradient along the east side of the property. On March 17, 2016, all enhanced pumping of the extraction wells was discontinued when higher tide elevations were present. Groundwater pumping volumes from 1999 through the second quarter of 2016 were compared and are presented in two charts in Appendix B. These charts include the total pump volume per month and quarterly pump volume per extraction well.

During Site development, construction perforations of the synthetic layers of the cap were required to drive pile. While the synthetic layers were removed, rainfall did account for a significant volume of water generated by the HMS. All synthetic layer penetrations for the Exelon Tower construction were closed on May 27, 2015. In February 2016, excavation began in preparation for the sheet pile wall extension associated with the Point Street Apartments construction. In March 2016, the geomembrane was opened, sheet pile driving began and was completed on March 28, 2016. Precautions were taken to ensure minimal impact to HMS components during all below-cap work. On April 11, 2016, all synthetic layer penetrations associated with the Point Street Apartments construction were closed. Water continues to be extracted by the shallow groundwater system and the sump system. Water volumes generated by the sump system are being recorded.

Section 5.2.1 of the *Final Area 1, Phase 1 Detailed Development Plan, Baltimore Works Site, Baltimore, Maryland* (December 3, 2013) stated that potentially 700,000 gallons of water will be displaced during development pile driving. Pile driving has increased the volume of extracted groundwater during the period covered by this report. However, the HMS system performed as intended, maintaining the 30-day running average groundwater gradient below the performance standard throughout the second quarter.

SECTION 2

Piezometer Verification and Site Surveying

Section V.13 of the Consent Decree defines the requirements for monitoring the performance of the deep hydraulic barrier as follows: "…defendant shall monitor the performance of the deep vertical hydraulic barrier at the points and times and in the manner specified in the approved Groundwater Gradient Monitoring Plan." Section 4 of the *Groundwater Gradient Monitoring Plan* defines the procedures for validating water level readings taken by the HMS as "…obtaining manual measurements, resurveying of the piezometers and calibration and precision testing of the instrumentation." Section 4.7 of the *Groundwater Gradient Monitoring Plan* states that "…verification activities will be reported in the quarterly progress reports." These activities are described in this section.

2.1 Manual Verification of Sensor Readings

The *Groundwater Gradient Monitoring Plan* defines the procedures to obtain manual measurements in the following manner: "Each piezometer will be opened and an electronic water level instrument will be inserted to record the current level." Section 4.2 of the *Groundwater Gradient Monitoring Plan* states that "replicate analyses will occur on 20 percent of manual water level measurements collected to assess precision." The data quality goal for precision is ±5 percent, or less than 0.01 foot. Section 4.2 defines accuracy as "the difference between experimental results and true values." The method for determining accuracy is later defined as follows: "…accuracy will be based upon these readings." This statement is interpreted to mean that accuracy will be assessed by reviewing the readings taken during manual verification. The data quality goal for accuracy is ±10 percent, or less than 0.02 foot.

Manual verification readings began with the installation of the final ultrasonic water level sensor in July 1999. Manual verification readings were taken every 2 weeks until December 2001 to establish a statistically relevant database of manual readings. In December 2001, the frequency of readings was reduced to once per month. Historically, only the data from the first monthly verification readings taken each quarter were included in the quarterly report. In compliance with comments in the U.S. Army Corps of Engineers report to EPA titled, *Honeywell Baltimore Works Surface Water Split Sampling and Horizontal Gradient Manual Verification Audit Report* (August 26, 2005), all manual verification readings taken during the time period covered by this report are included herein.

On April 4, 2016, groundwater elevation readings from 19 of the piezometers indicated that there was a difference greater than 0.02 foot between the value reported by the automated measurement devices and the manual measurements. The differences between 10 of the manual measurements from the piezometers and the automatic readings reported by the HMS were greater than 0.05 foot, and 5 of the differences were greater than 0.10 foot. The differences between the gradients recorded by the MSS computer from March 8, 2016, to April 4, 2016, and the gradients measured manually on April 4, 2016, were also reviewed. During this time period, a gradient greater than 0.072 was maintained even when the difference between the automated readings taken by the MSS and the manual readings taken during the manual verification readings were taken into account. These data are presented in Appendix C.

On May 5, 2016, readings from 21 of the piezometers indicated a difference greater than 0.02 foot between the measurement devices and the manual measurements. The differences between 10 of the manual measurements from the piezometers and the automatic readings reported by the HMS were greater than 0.05 foot, and 7 of the differences were greater than 0.10 foot. The differences between the gradients recorded by the MSS computer from April 4, 2016, to May 5, 2016, and the gradients measured manually on May 5, 2016, were reviewed. During the specified time period, a gradient greater than 0.072 was maintained even when the differences between the automated readings taken

by the MSS and the manual readings taken during the manual verification readings were taken into account. These data are presented in Appendix C.

On June 14, 2016, readings from 16 piezometers indicated a difference greater than 0.02 foot between the measurement devices and the manual measurements. The differences between five of the manual measurements from the piezometers and the automatic readings reported by the HMS were greater than 0.05 foot, and two of the differences were greater than 0.10 foot. The differences between the gradients recorded by the MSS computer from May 5, 2016, to June 14, 2016, and the gradients measured manually on June 16, 2016, were reviewed. During the specified time period, a gradient greater than 0.072 was maintained even when the differences between the automated readings taken by the MSS and the manual readings taken during the manual verification readings were taken into account. These data are presented in Appendix C.

The precision of the manual readings taken during the fourth quarter was 100 percent, as defined by the *Groundwater Gradient Monitoring Plan*. The manual verification readings taken during this quarter are included in Appendix C.

2.1.1 Actions Taken to Correct Variance in Reported Values

The following actions were taken to address the variance between the manual water level elevations taken in the field and the readings reported by the HMS:

- All data reported to the MSS were reviewed daily, except for data collected on Saturday and Sunday, which were reviewed on the following Monday.
- The ultrasonic water level meters were reset using correction values obtained from manual verification readings taken in April, May, and June 2016. Additional manual verification readings were taken as needed due to development construction and noted errors.
- On April 4, 2016, the ultrasonic level sensor for Outer Piezometer 7 was replaced after having erratic readings.
- On May 4, 2016, the level controller for Outer Piezometer 3 was replaced after having erratic readings.
- Head maintenance equipment and locations were inspected on days when there was construction activity near that location.

2.2 Verification Surveying

Section 4.7 of the *Groundwater Gradient Monitoring Plan* specifies that annual surveying of the groundwater level reference elevation point will occur until three consecutive measurements show no change. Thereafter, the frequency of verification surveying is once every other year for three events, or 6 years. If no change is noted, then verification surveying will occur once every 5 years until there is a change in elevation readings.

Section 5.4 of the *Honeywell Baltimore Works Operation and Maintenance Plan* states that annual measurement of six settlement monitoring points will occur until three consecutive measurements show no change. Section 4.2 of the *Groundwater Gradient Monitoring Plan* defines the precision and accuracy goals of the readings taken during verification surveying as 0.01 and 0.02 foot, respectively.

The accuracy of the surveying method for the 2015 annual survey was reported as plus or minus 0.02 foot, thereby meeting the accuracy requirement. In response to comments on the *Baltimore Inner Harbor HMS Groundwater Gradient Monitoring Quarterly Progress Report First Quarter, 2005*, Honeywell clarified that errors in precision and accuracy can be additive. If the current reading is within 0.03 foot of the reading from the prior year, no change in elevation reading is noted for that location.

The 2015 annual survey was conducted from December 19 to December 28 2015.The 2016 annual survey has not been performed yet.

The *Baltimore Inner Harbor HMS Groundwater Gradient Monitoring Quarterly Report No. 92–Third Quarter 2011* included a review of the historical verification surveying data and established the precedent that current survey results be compared to historical maximum and minimum reported values. All of the readings obtained during the 2013 annual verification survey were between the maximum and minimum historical values reported for each location, with exceptions provided in Table 2-1 of the *Baltimore Inner Harbor HMS Groundwater Gradient Monitoring Quarterly Report No. 99–Second Quarter 2014*.

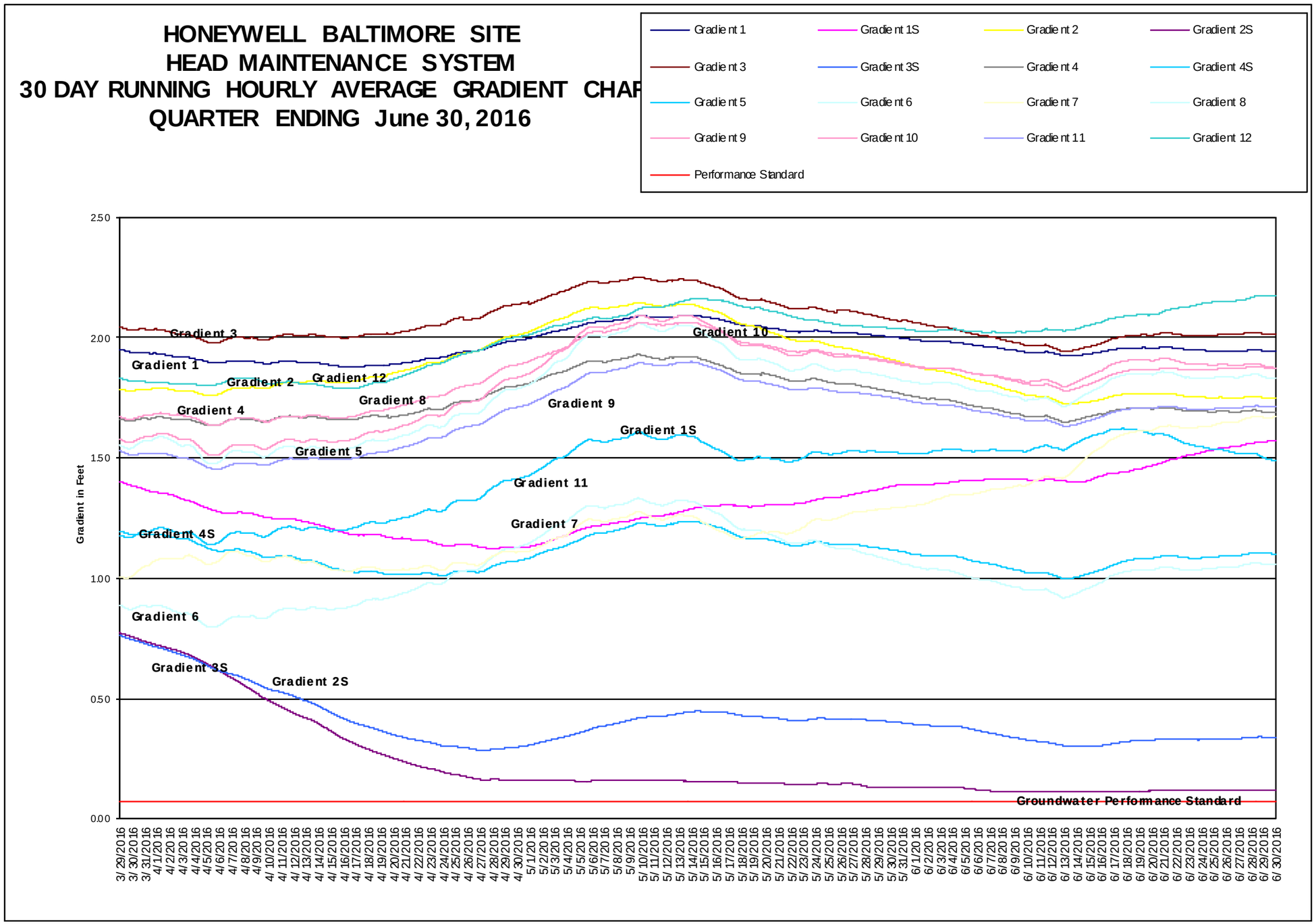
Groundwater level reference elevation verification surveying was performed concurrent with the settlement monitoring survey. Groundwater level reference elevations will continue to be verified concurrently with the settlement monitoring surveying.

The next survey event is anticipated to be completed in the second half of 2016.

Appendix A
HMS Gradient Charts

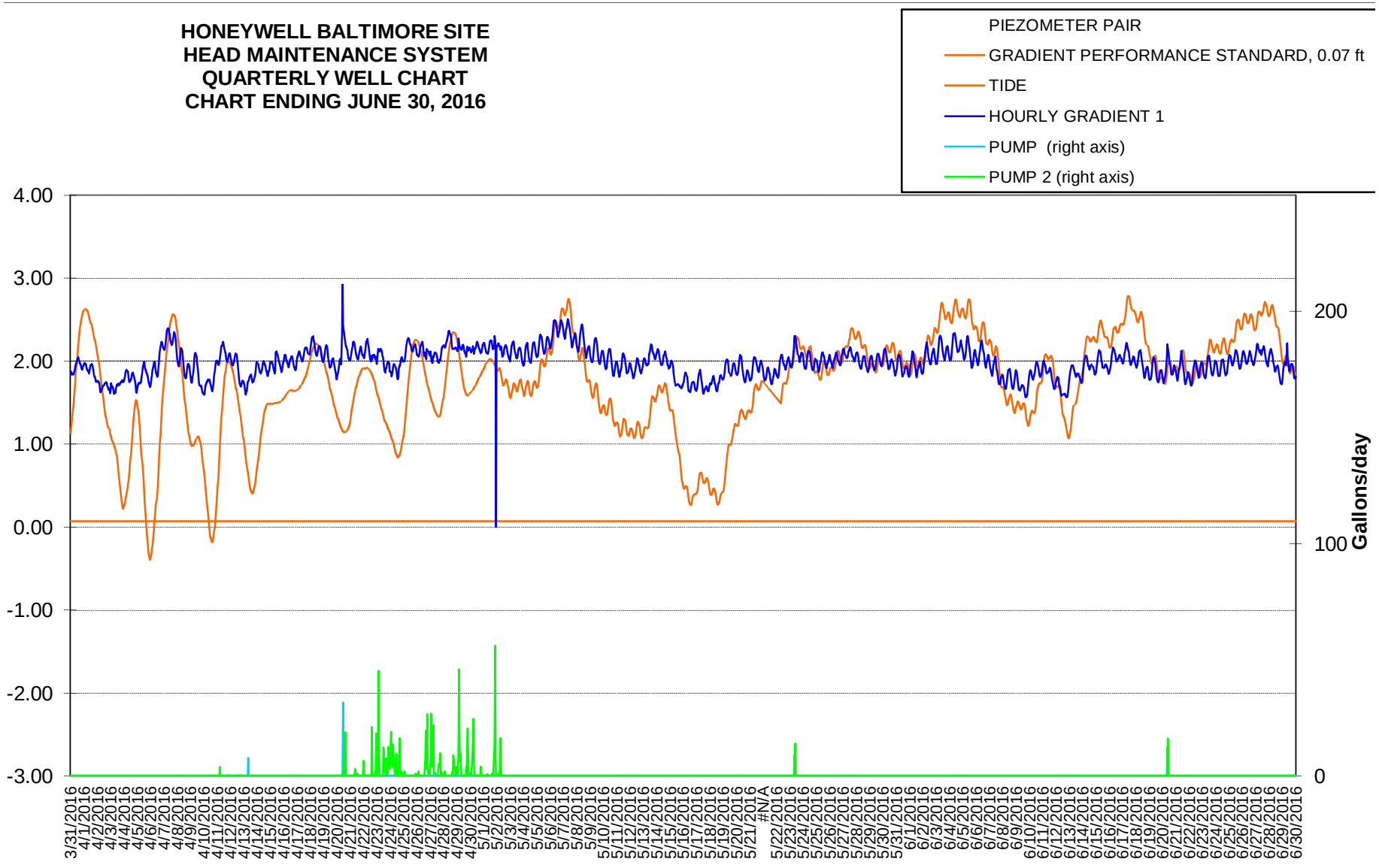
- 30-Day Running Hourly Average Gradient Chart (All Wells)
- Quarterly Well Level and Pumping Charts: Wells 1, 1S, 2, 2S, 3, 3S, 4, 4s, and 5 through 12
- Monthly Averages of Hourly HMS Gradients

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
30 DAY RUNNING HOURLY AVERAGE GRADIENT CHAR
QUARTER ENDING June 30, 2016

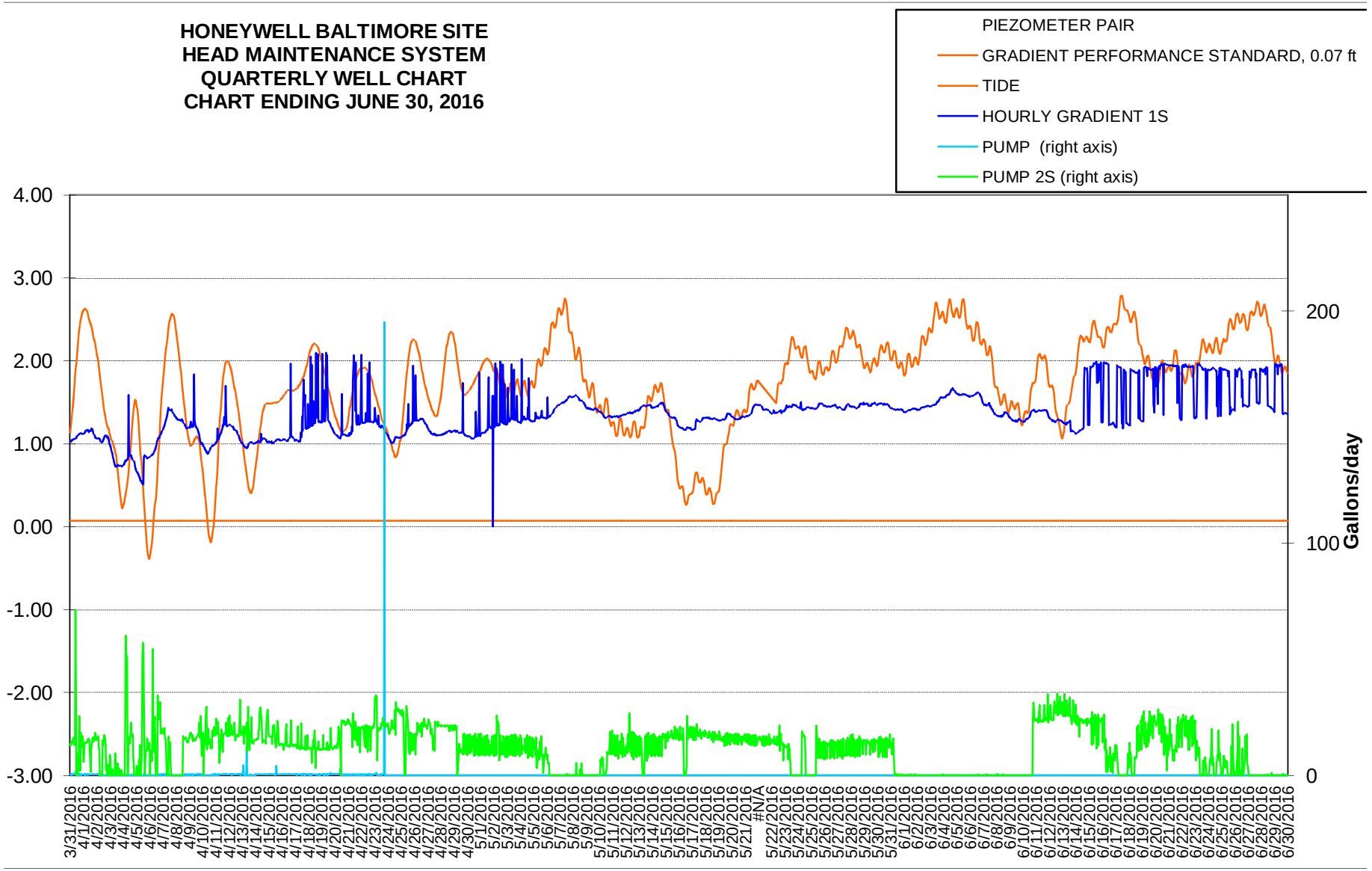


7/1/2016

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016



7/1/2016


HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016
PIEZOMETER PAIR
GRADIENT PERFORMANCE STANDARD, 0.07 ft
TIDE
HOURLY GRADIENT 1S
PUMP (right axis)
PUMP 2S (right axis)
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
200
100
0
Gallons/day
3/31/2016
4/1/2016
4/2/2016
4/3/2016
4/4/2016
4/5/2016
4/6/2016
4/7/2016
4/8/2016
4/9/2016
4/10/2016
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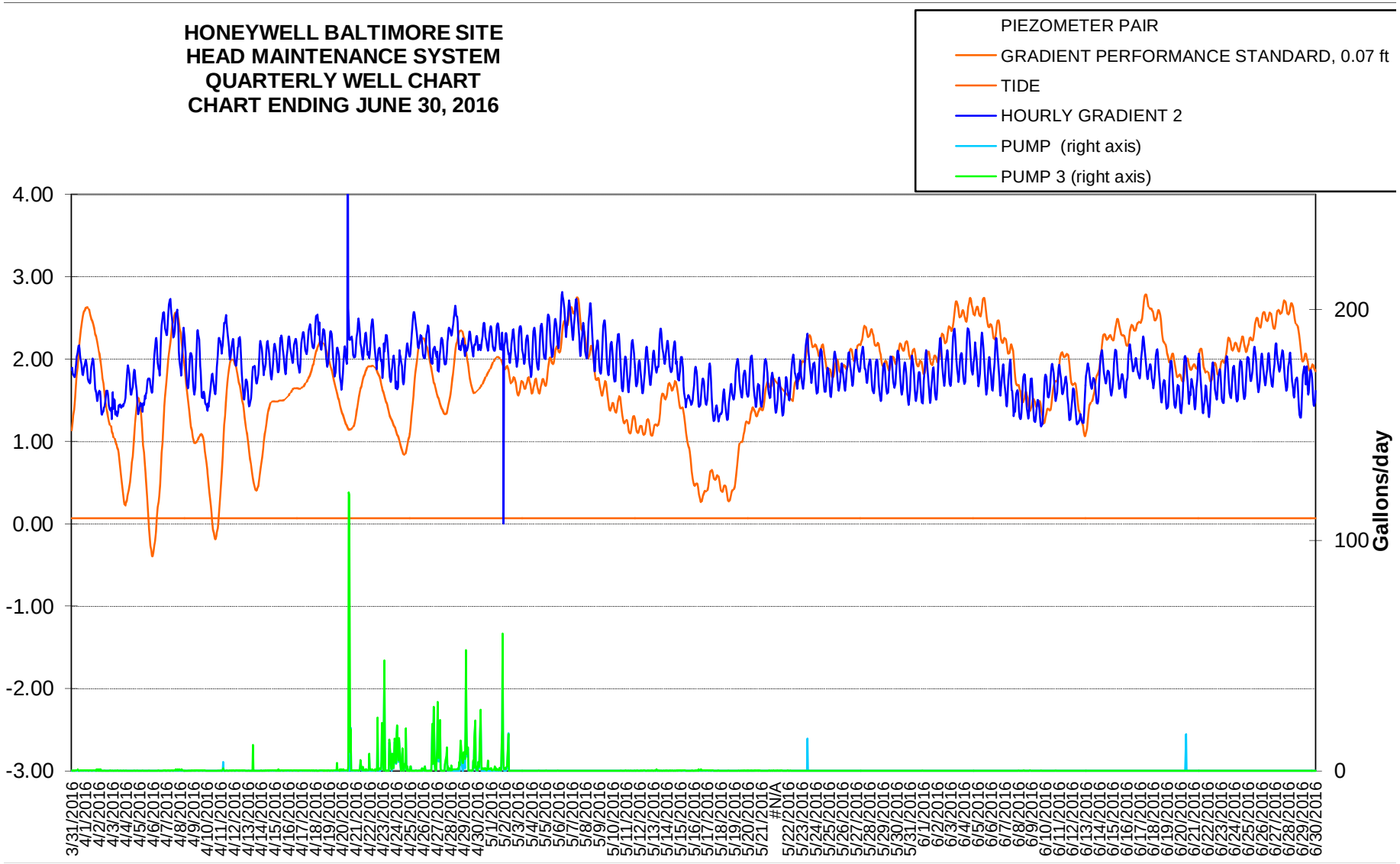
7/1/2016


HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016
PIEZOMETER PAIR
GRADIENT PERFORMANCE STANDARD, 0.07 ft
TIDE
HOURLY GRADIENT 2
PUMP (right axis)
PUMP 3 (right axis)
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
200
100
0
Gallons/day
3/31/2016
4/1/2016
4/2/2016
4/3/2016
4/4/2016
4/5/2016
4/6/2016
4/7/2016
4/8/2016
4/9/2016
4/10/2016
4/11/2016
4/12/2016
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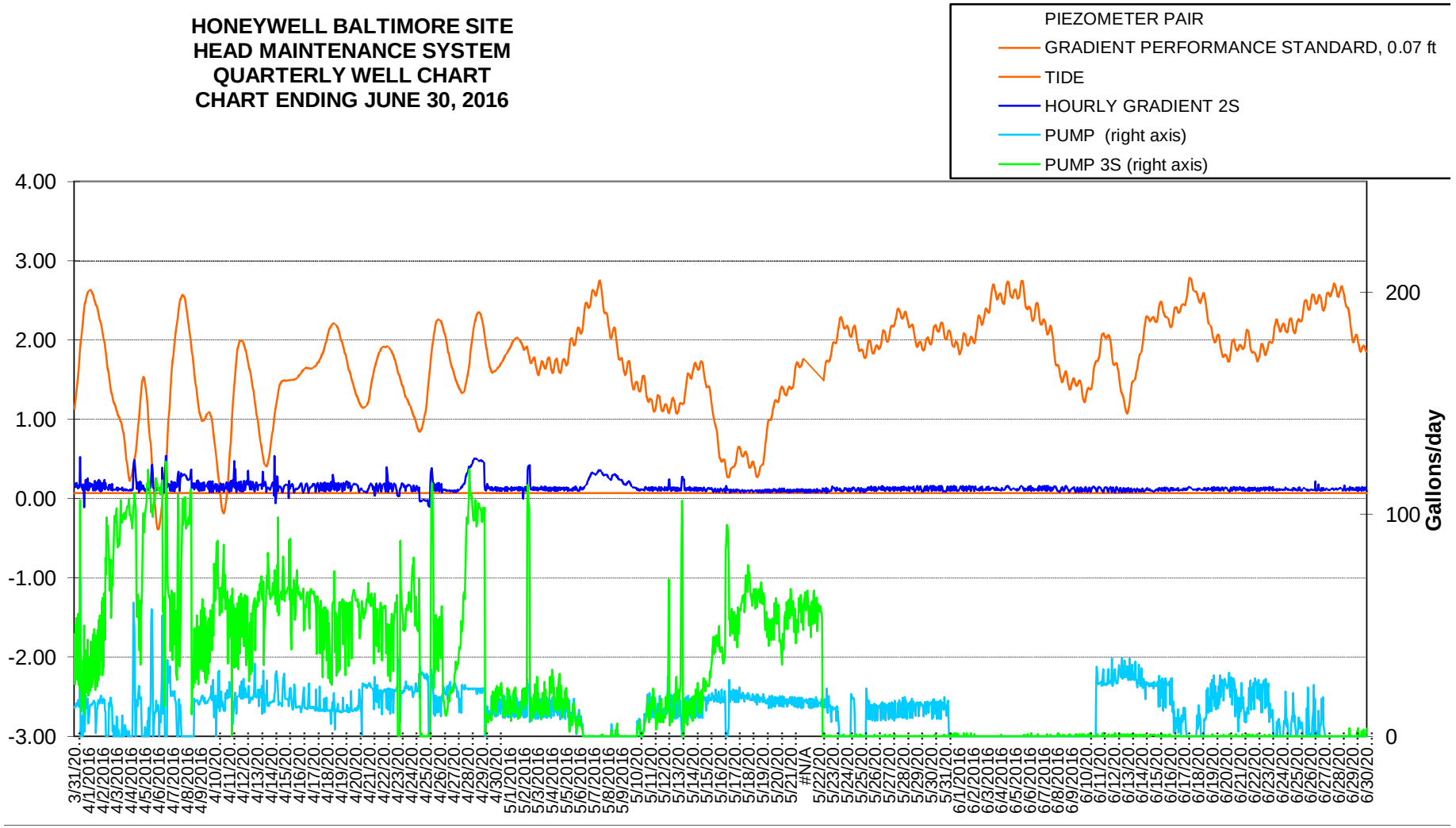
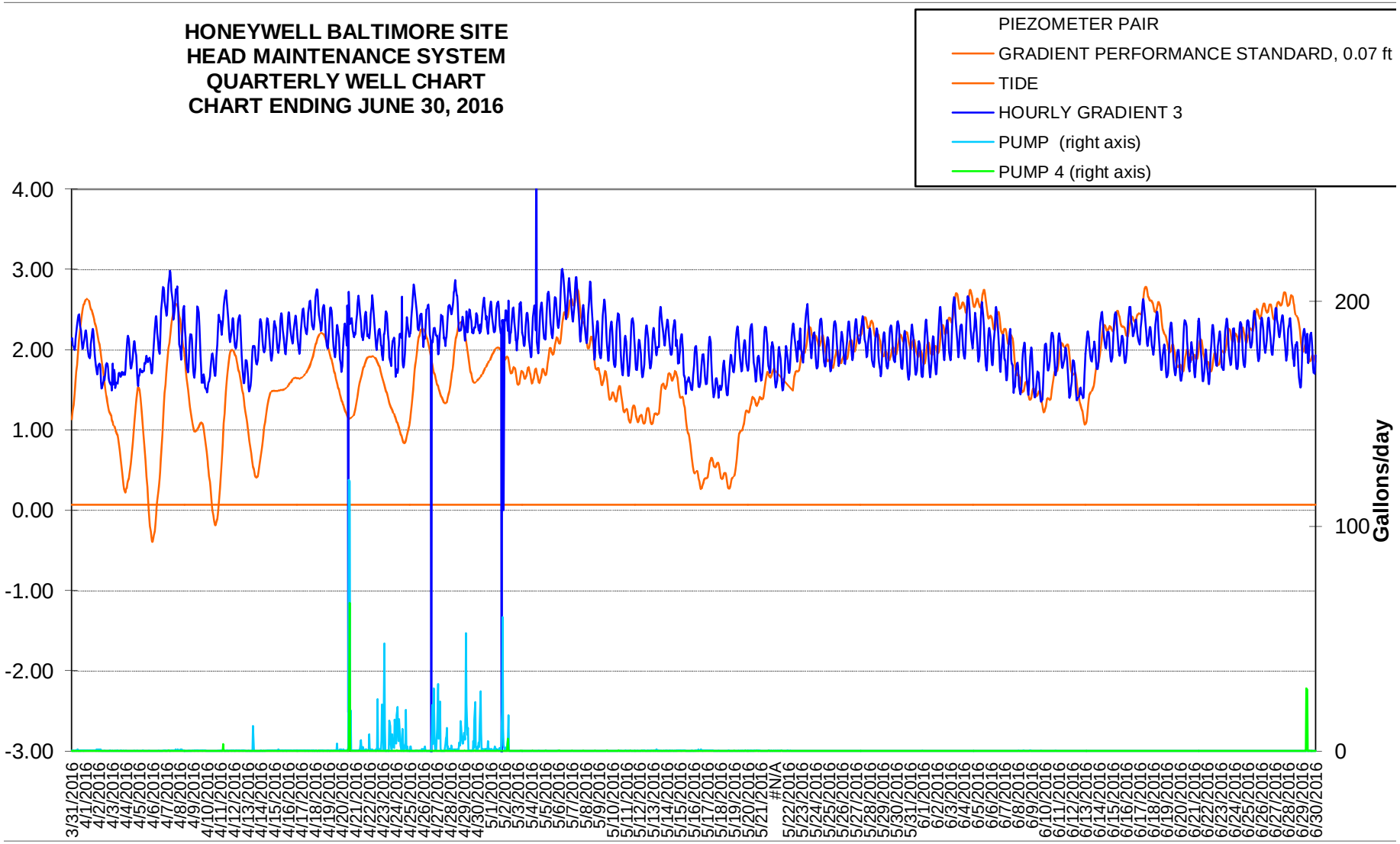
7/1/2016

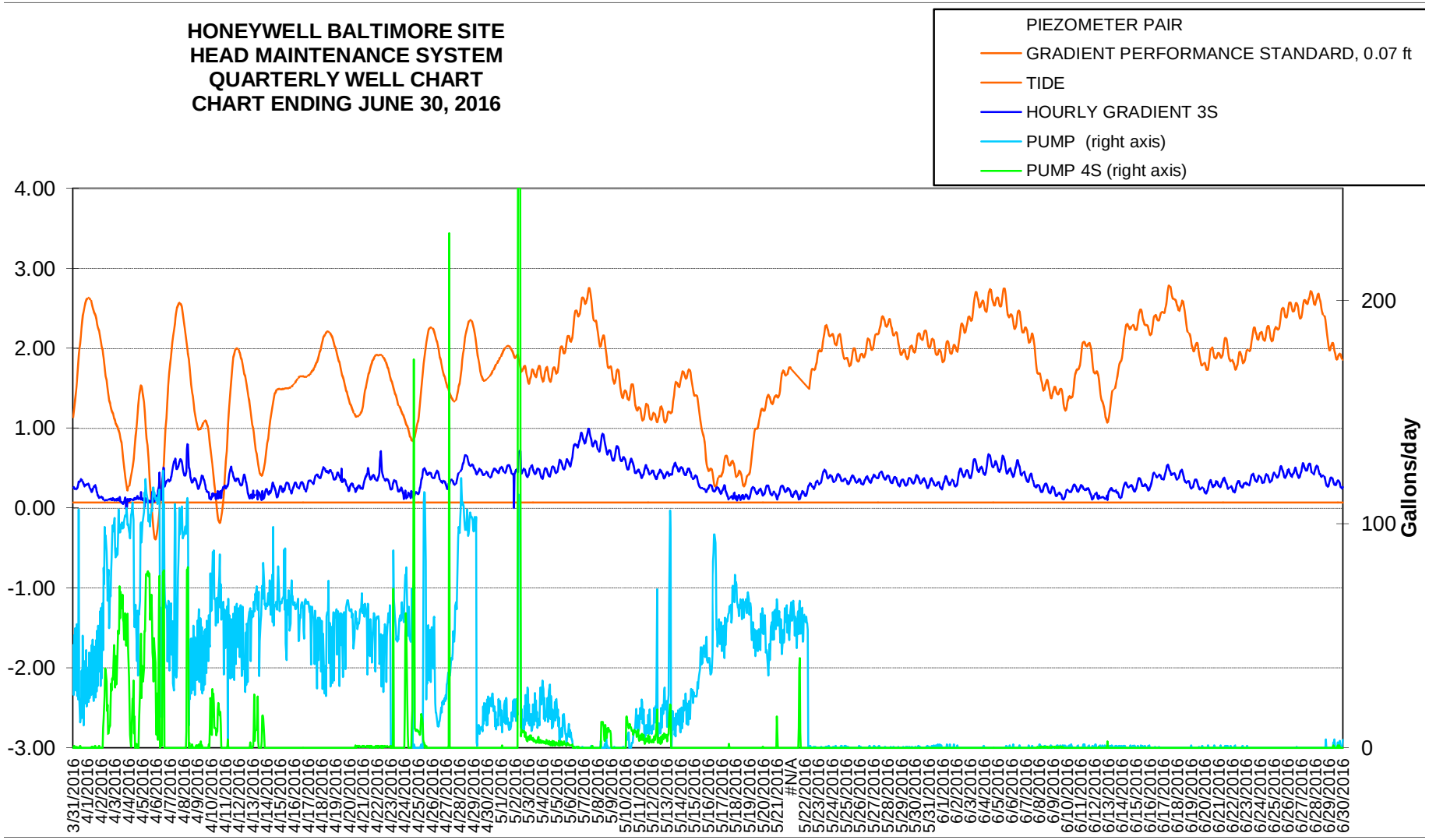
HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016



7/1/2016


HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016
PIEZOMETER PAIR
GRADIENT PERFORMANCE STANDARD, 0.07 ft
TIDE
HOURLY GRADIENT 3
PUMP (right axis)
PUMP 4 (right axis)
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
200
100
0
Gallons/day
3/31/2016
4/1/2016
4/2/2016
4/3/2016
4/4/2016
4/5/2016
4/6/2016
4/7/2016
4/8/2016
4/9/2016
4/10/2016
4/11/2016
4/12/2016
4/13/2016
4/14/2016
4/15/2016
4/16/2016
4/17/2016
4/18/2016
4/19/2016
4/20/2016
4/21/2016
4/22/2016
4/23/2016
4/24/2016
4/25/2016
4/26/2016
4/27/2016
4/28/2016
4/29/2016
4/30/2016
5/1/2016
5/2/2016
5/3/2016
5/4/2016
5/5/2016
5/6/2016
5/7/2016
5/8/2016
5/9/2016
5/10/2016
5/11/2016
5/12/2016
5/13/2016
5/14/2016
5/15/2016
5/16/2016
5/17/2016
5/18/2016
5/19/2016
5/20/2016
5/21/2016
#N/A
5/22/2016
5/23/2016
5/24/2016
5/25/2016
5/26/2016
5/27/2016
5/28/2016
5/29/2016
5/30/2016
5/31/2016
6/1/2016
6/2/2016
6/3/2016
6/4/2016
6/5/2016
6/6/2016
6/7/2016
6/8/2016
6/9/2016
6/10/2016
6/11/2016
6/12/2016
6/13/2016
6/14/2016
6/15/2016
6/16/2016
6/17/2016
6/18/2016
6/19/2016
6/20/2016
6/21/2016
6/22/2016
6/23/2016
6/24/2016
6/25/2016
6/26/2016
6/27/2016
6/28/2016
6/29/2016
6/30/2016

7/1/2016


HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016
PIEZOMETER PAIR
GRADIENT PERFORMANCE STANDARD, 0.07 ft
TIDE
HOURLY GRADIENT 3S
PUMP (right axis)
PUMP 4S (right axis)
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
200
100
0
Gallons/day
3/31/2016
4/1/2016
4/2/2016
4/3/2016
4/4/2016
4/5/2016
4/6/2016
4/7/2016
4/8/2016
4/9/2016
4/10/2016
4/11/2016
4/12/2016
4/13/2016
4/14/2016
4/15/2016
4/16/2016
4/17/2016
4/18/2016
4/19/2016
4/20/2016
4/21/2016
4/22/2016
4/23/2016
4/24/2016
4/25/2016
4/26/2016
4/27/2016
4/28/2016
4/29/2016
4/30/2016
5/1/2016
5/2/2016
5/3/2016
5/4/2016
5/5/2016
5/6/2016
5/7/2016
5/8/2016
5/9/2016
5/10/2016
5/11/2016
5/12/2016
5/13/2016
5/14/2016
5/15/2016
5/16/2016
5/17/2016
5/18/2016
5/19/2016
5/20/2016
5/21/2016
#N/A
5/22/2016
5/23/2016
5/24/2016
5/25/2016
5/26/2016
5/27/2016
5/28/2016
5/29/2016
5/30/2016
5/31/2016
6/1/2016
6/2/2016
6/3/2016
6/4/2016
6/5/2016
6/6/2016
6/7/2016
6/8/2016
6/9/2016
6/10/2016
6/11/2016
6/12/2016
6/13/2016
6/14/2016
6/15/2016
6/16/2016
6/17/2016
6/18/2016
6/19/2016
6/20/2016
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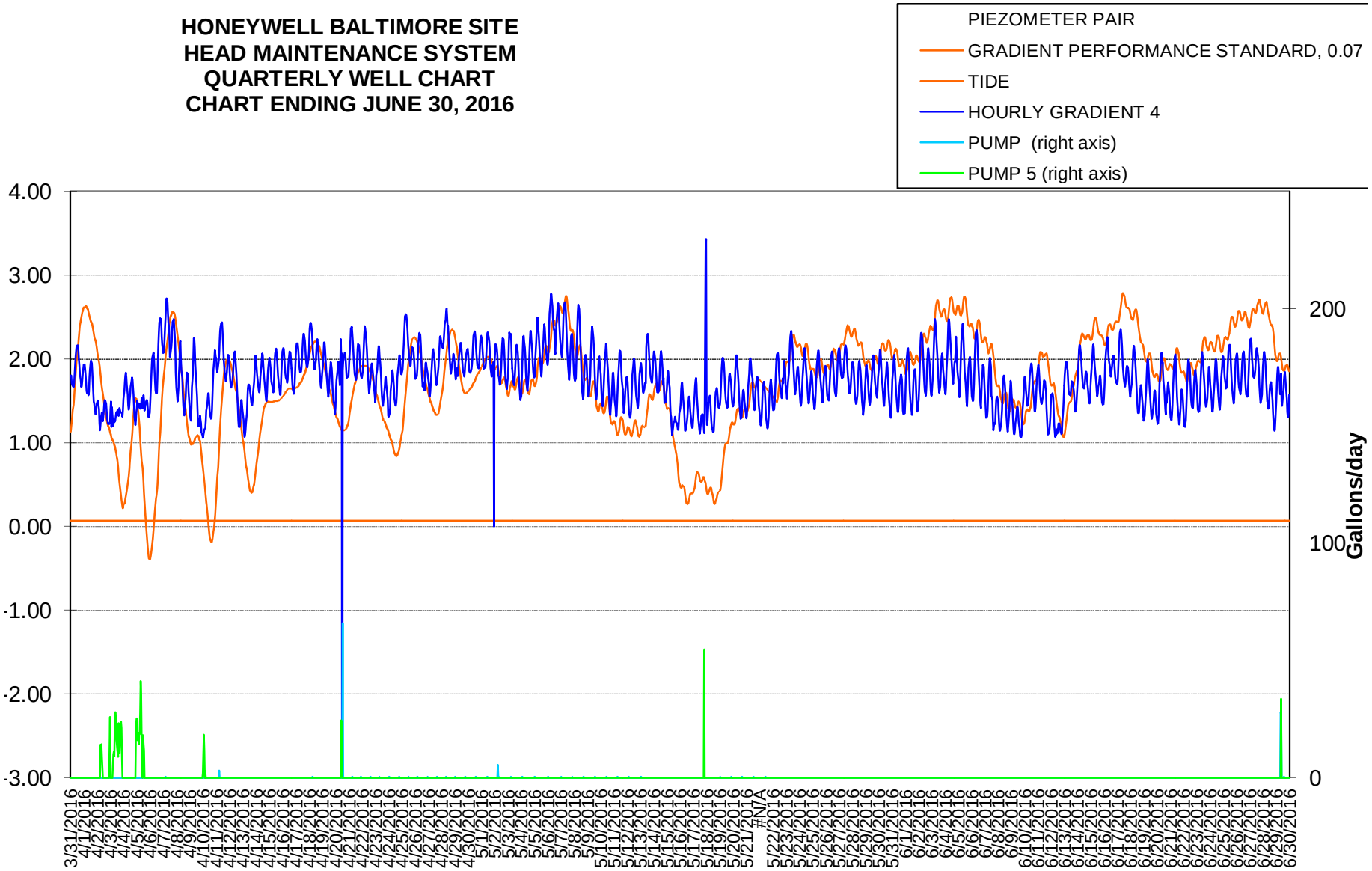
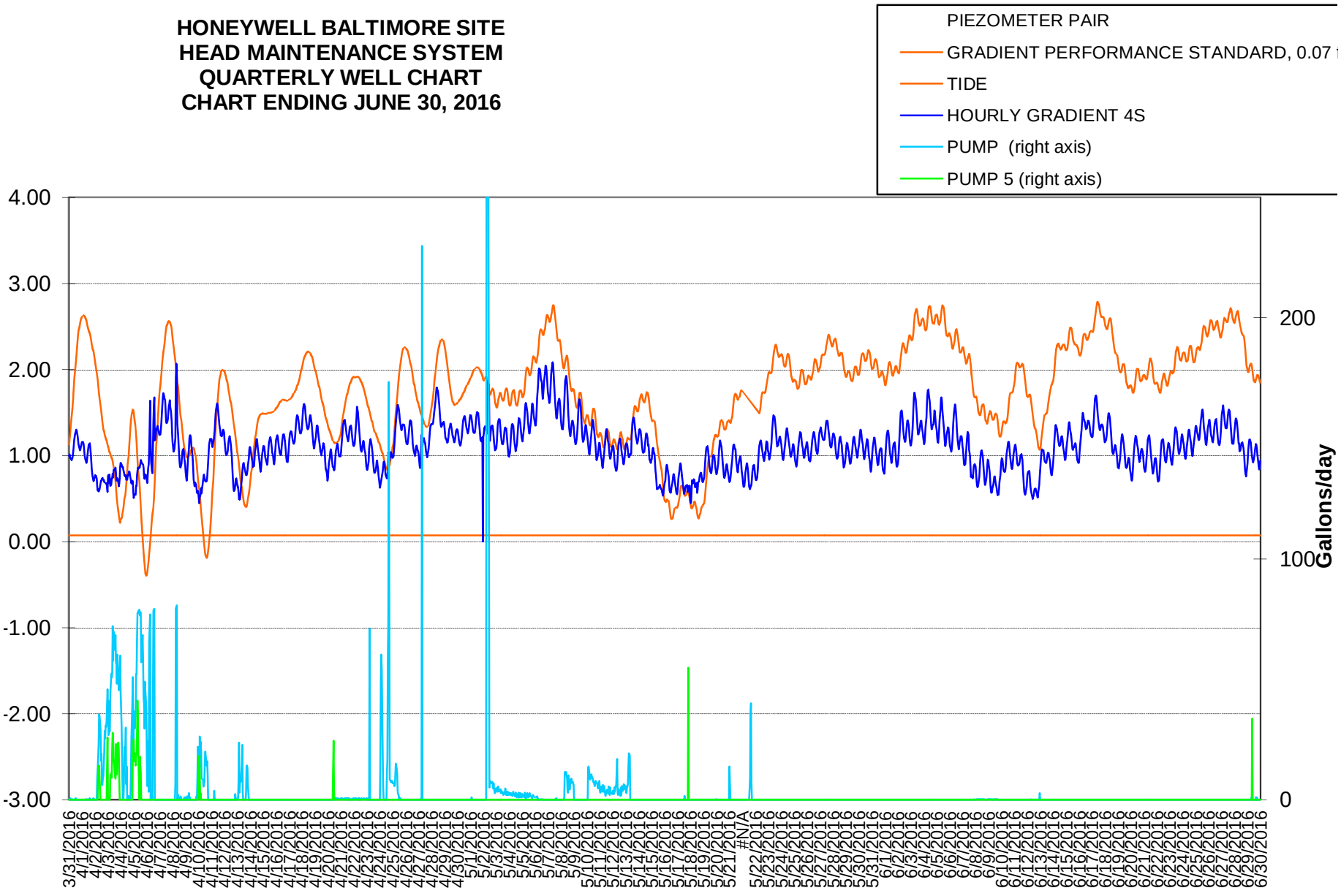
6/26/2016
6/27/2016
6/28/2016
6/29/2016
6/30/2016

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016



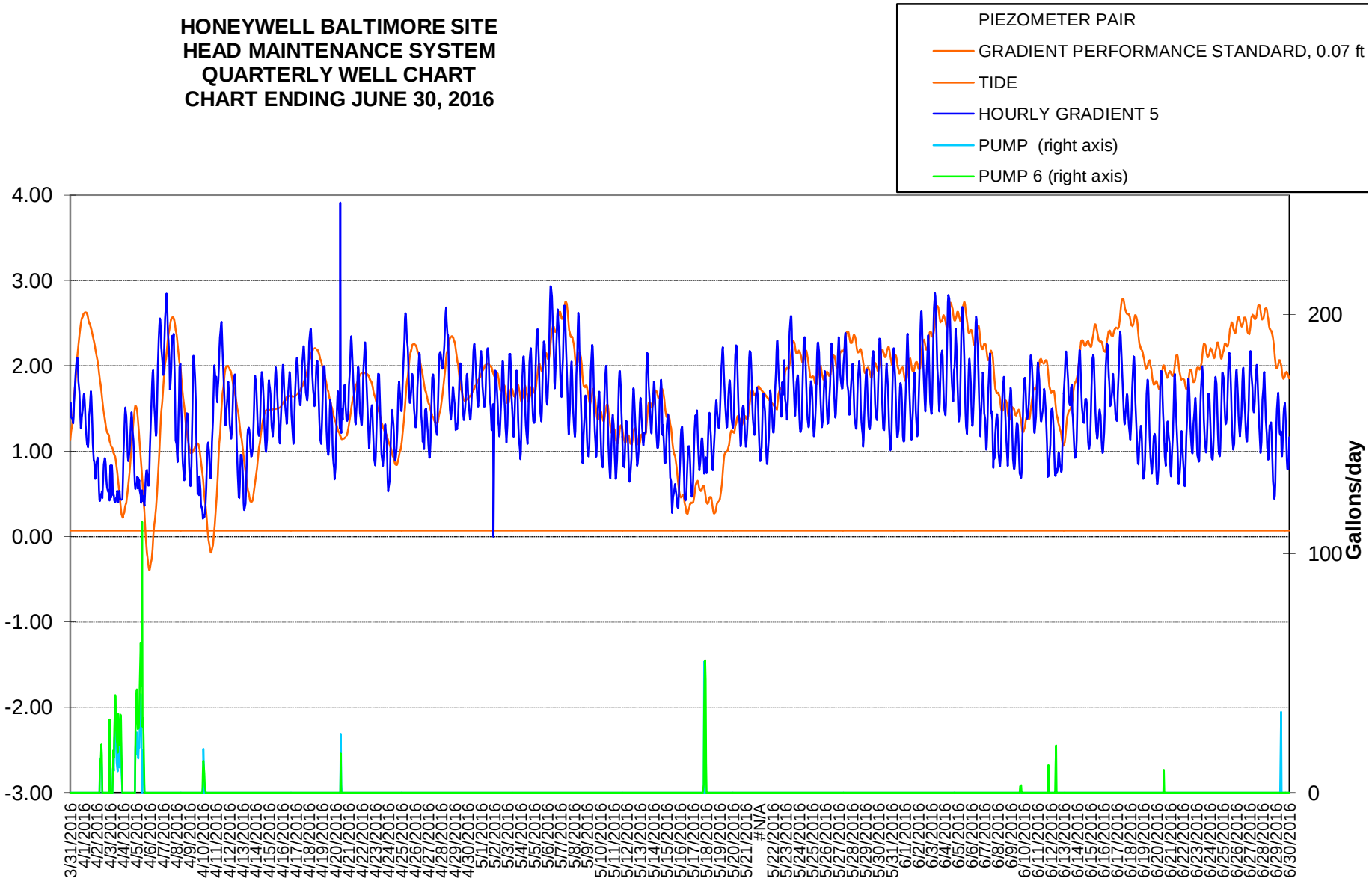
7/1/2016

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016



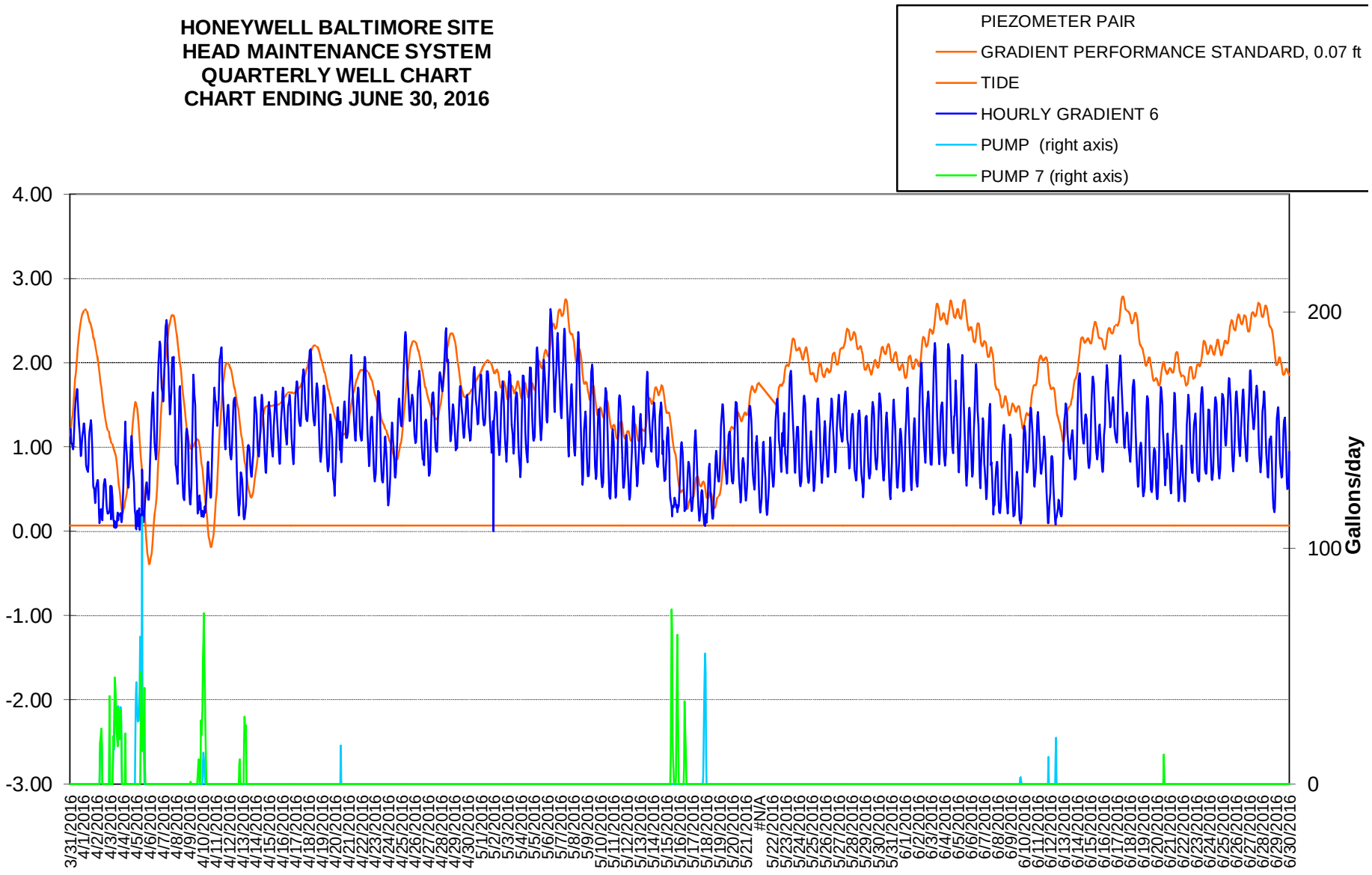
7/1/2016

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016



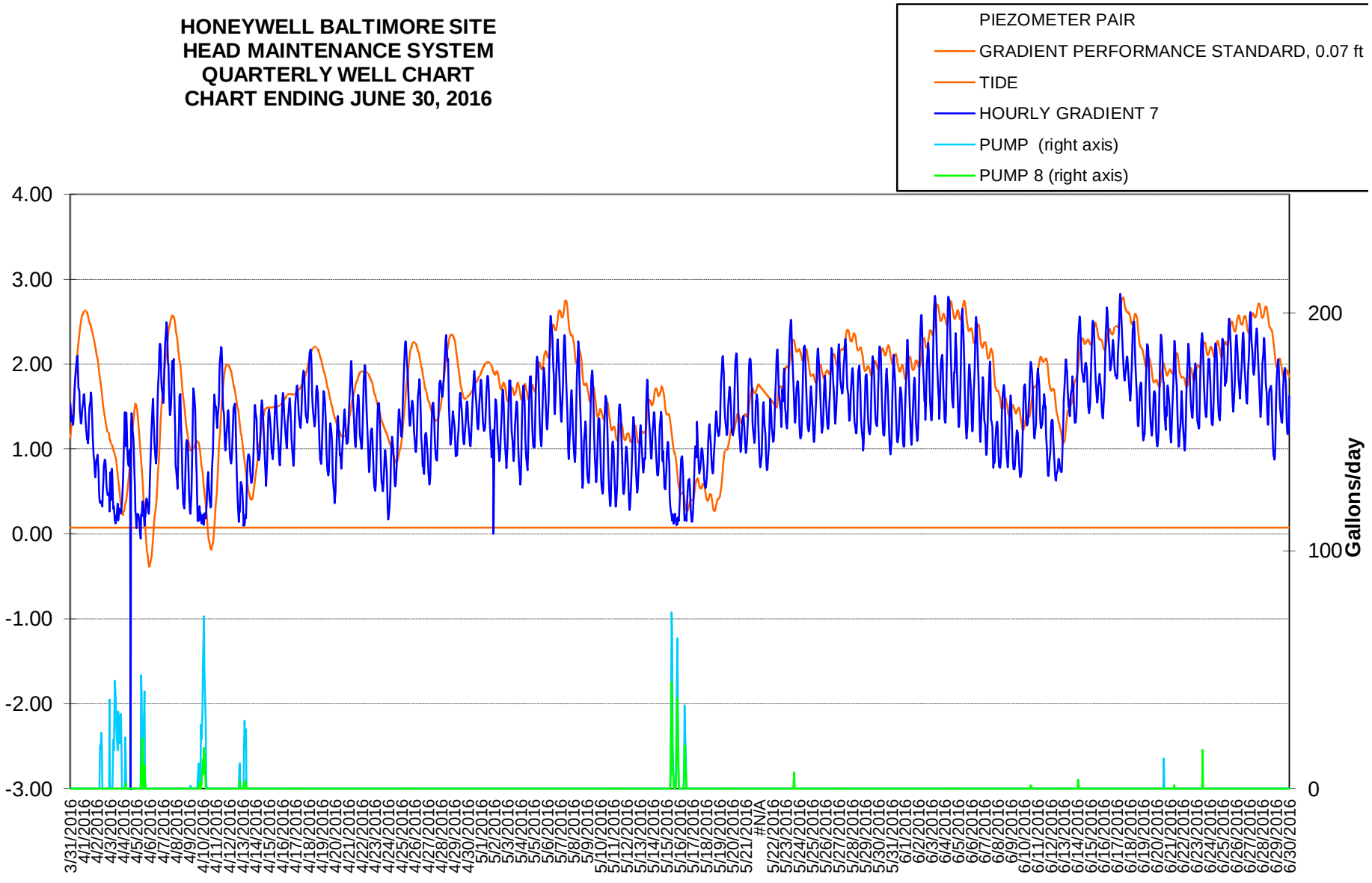
7/1/2016

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016



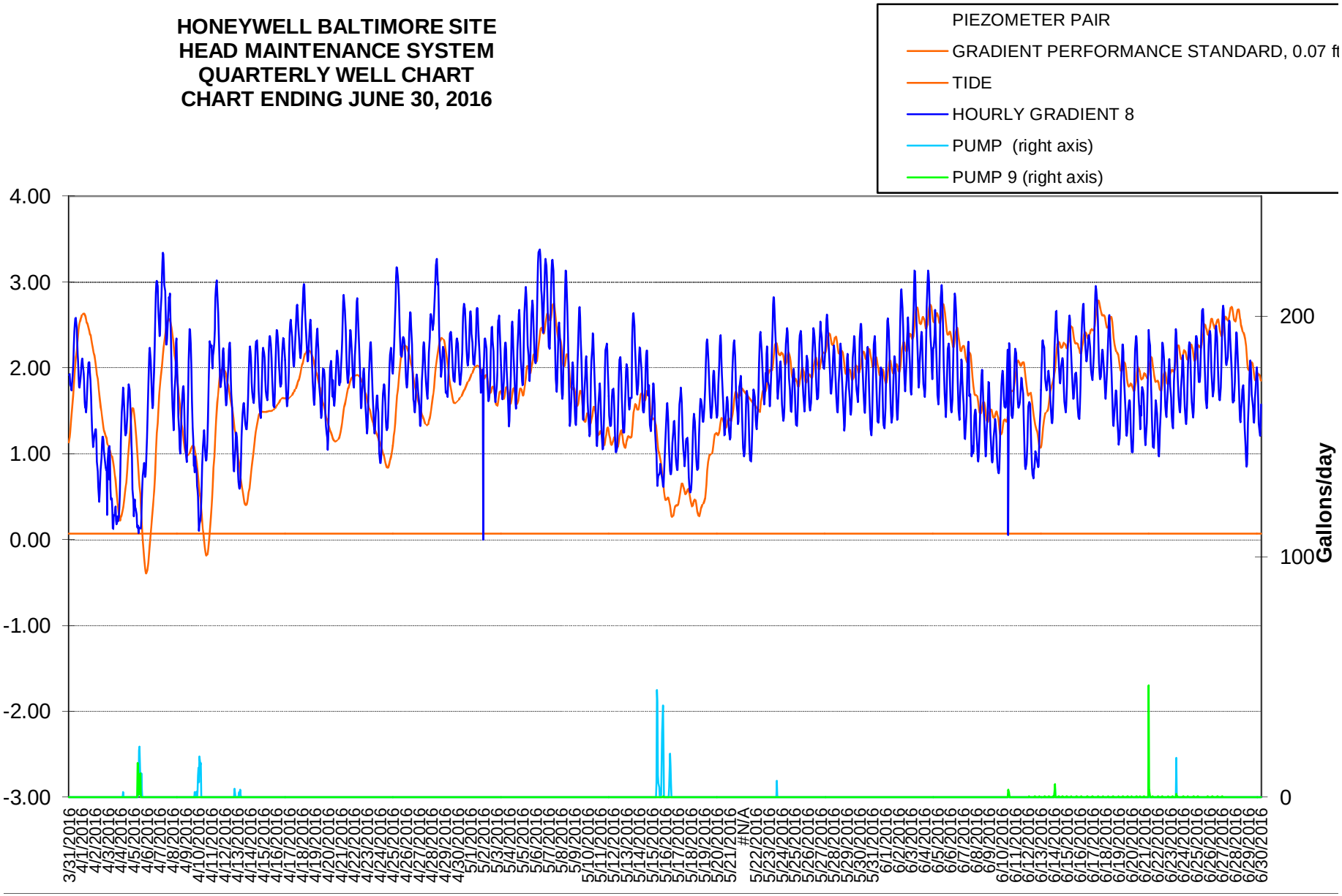
7/1/2016

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016

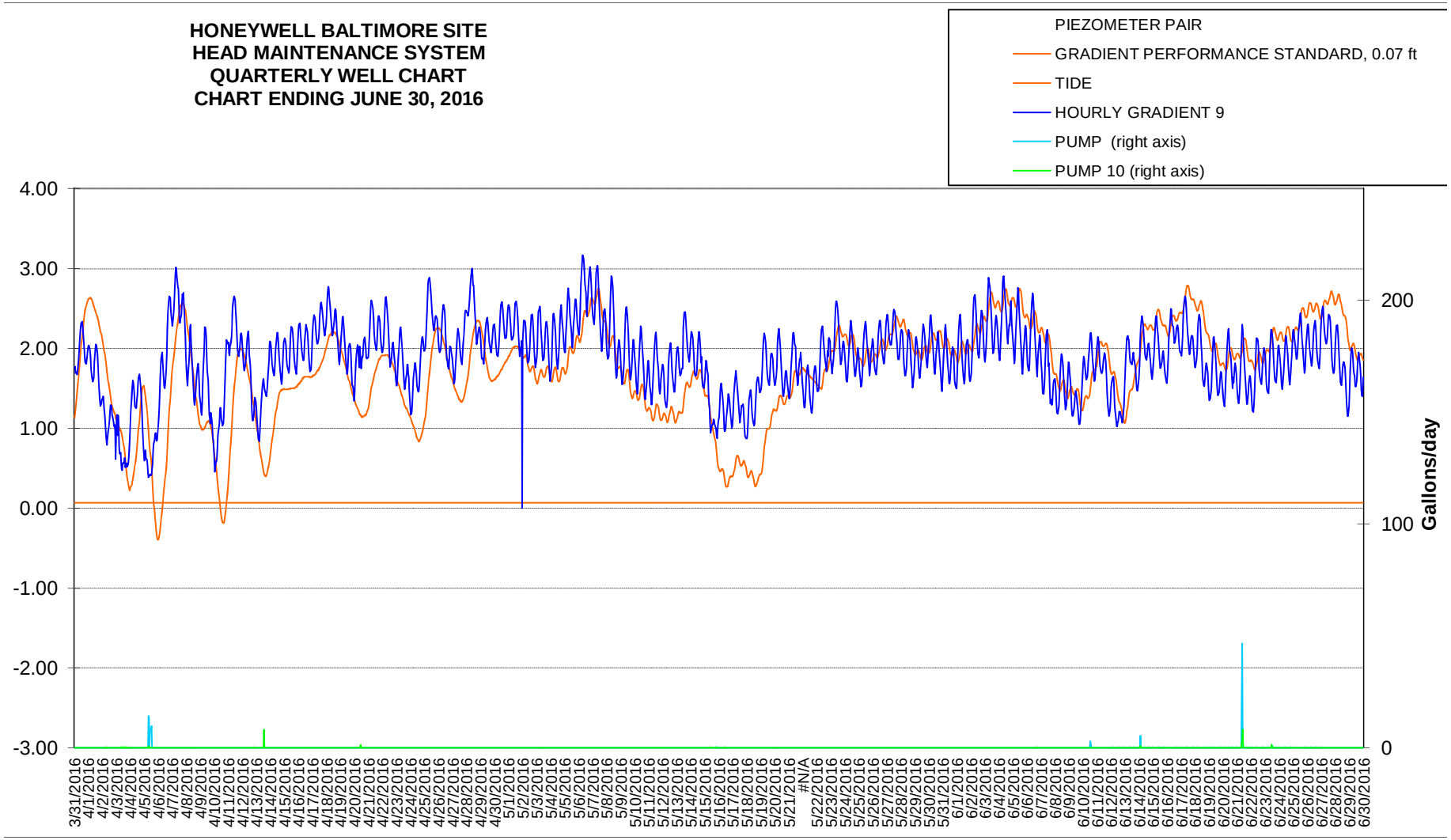


7/1/2016

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016

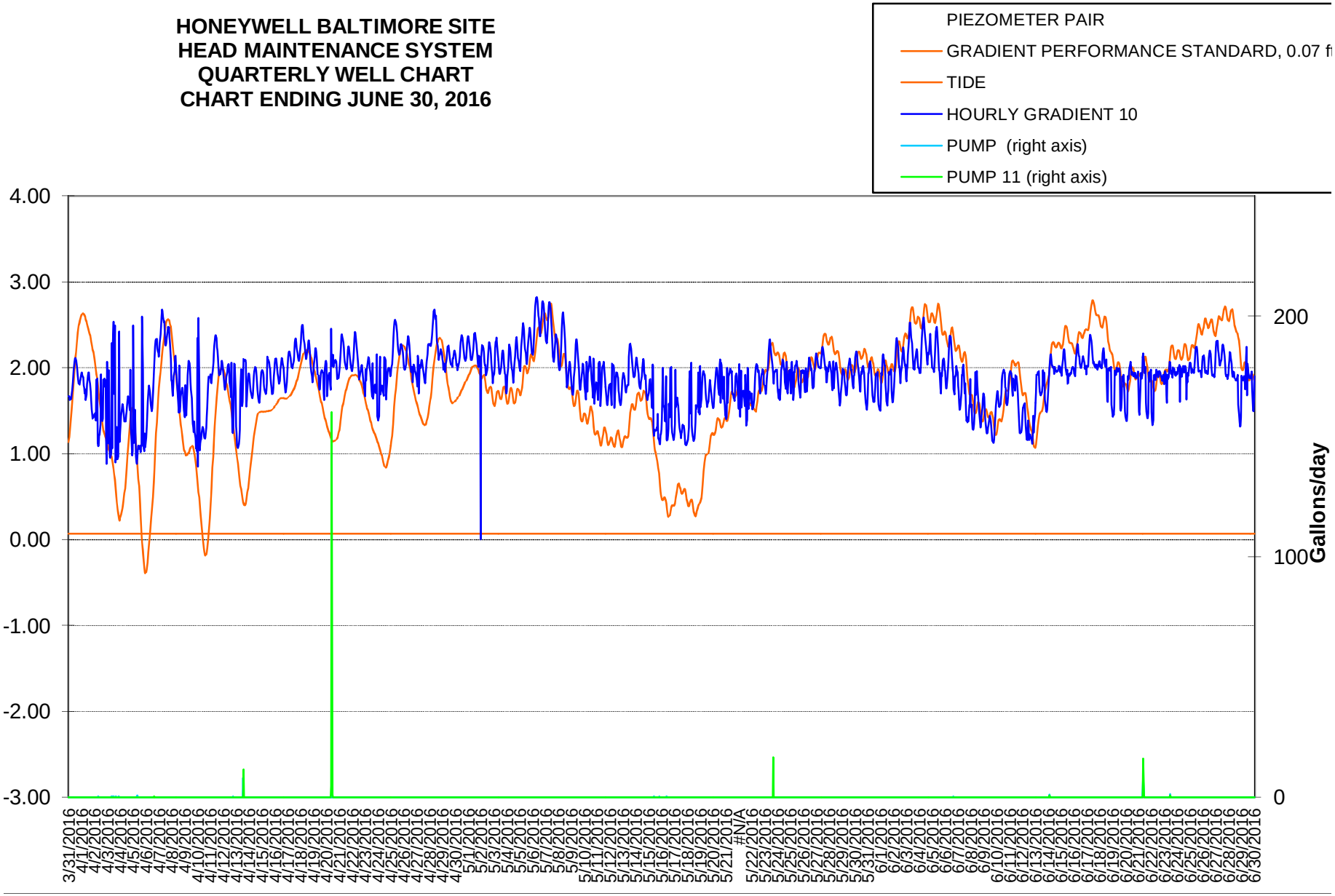


7/1/2016


HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016
PIEZOMETER PAIR
GRADIENT PERFORMANCE STANDARD, 0.07 ft
TIDE
HOURLY GRADIENT 9
PUMP (right axis)
PUMP 10 (right axis)
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
200
100
0
Gallons/day
3/31/2016
4/1/2016
4/2/2016
4/3/2016
4/4/2016
4/5/2016
4/6/2016
4/7/2016
4/8/2016
4/9/2016
4/10/2016
4/11/2016
4/12/2016
4/13/2016
4/14/2016
4/15/2016
4/16/2016
4/17/2016
4/18/2016
4/19/2016
4/20/2016
4/21/2016
4/22/2016
4/23/2016
4/24/2016
4/25/2016
4/26/2016
4/27/2016
4/28/2016
4/29/2016
4/30/2016
5/1/2016
5/2/2016
5/3/2016
5/4/2016
5/5/2016
5/6/2016
5/7/2016
5/8/2016
5/9/2016
5/10/2016
5/11/2016
5/12/2016
5/13/2016
5/14/2016
5/15/2016
5/16/2016
5/17/2016
5/18/2016
5/19/2016
5/20/2016
5/21/2016
#N/A
5/22/2016
5/23/2016
5/24/2016
5/25/2016
5/26/2016
5/27/2016
5/28/2016
5/29/2016
5/30/2016
5/31/2016
6/1/2016
6/2/2016
6/3/2016
6/4/2016
6/5/2016
6/6/2016
6/7/2016
6/8/2016
6/9/2016
6/10/2016
6/11/2016
6/12/2016
6/13/2016
6/14/2016
6/15/2016
6/16/2016
6/17/2016
6/18/2016
6/19/2016
6/20/2016
6/21/2016
6/22/2016
6/23/2016
6/24/2016
6/25/2016
6/26/2016
6/27/2016
6/28/2016
6/29/2016
6/30/2016

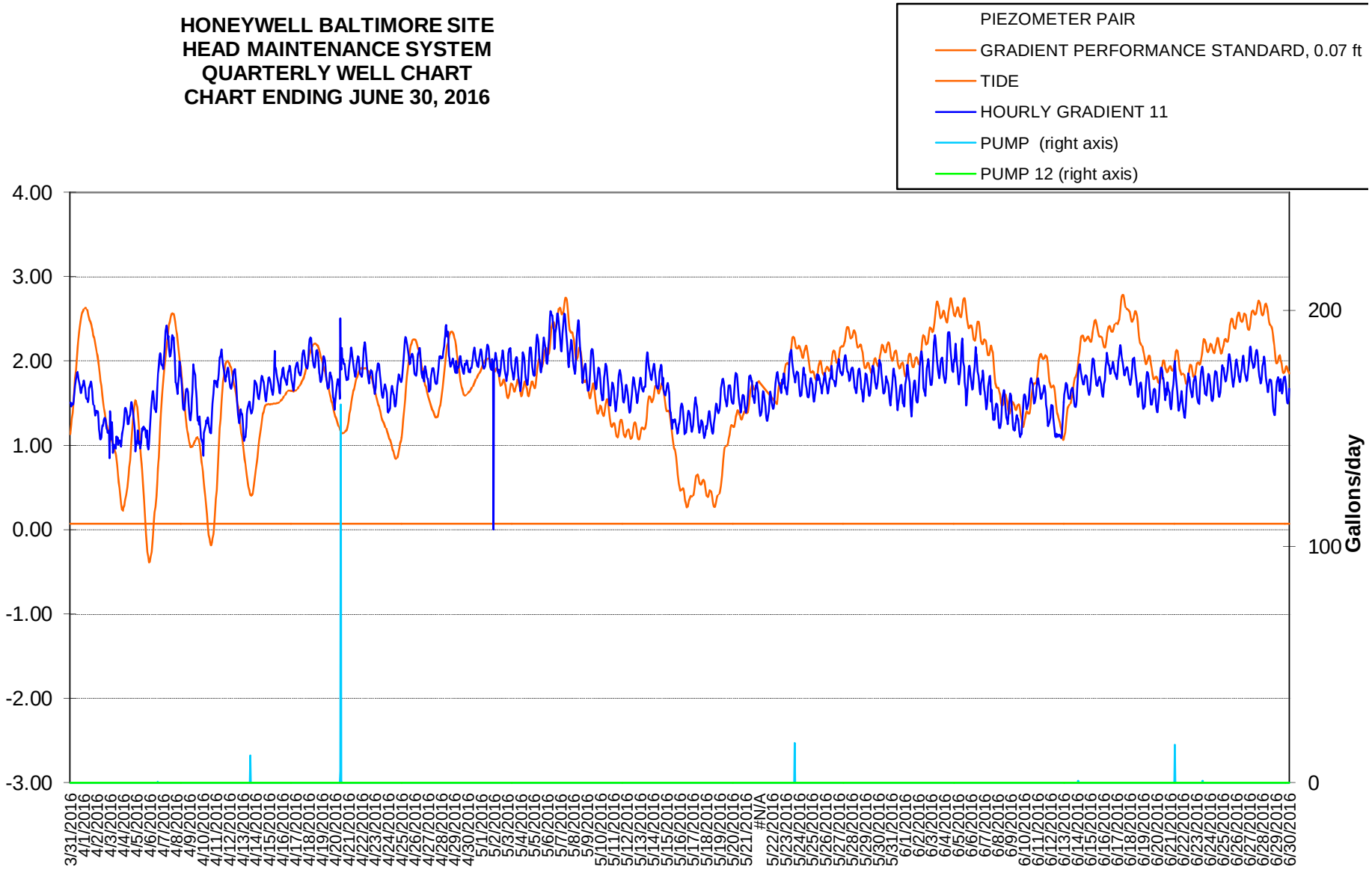
7/1/2016

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016



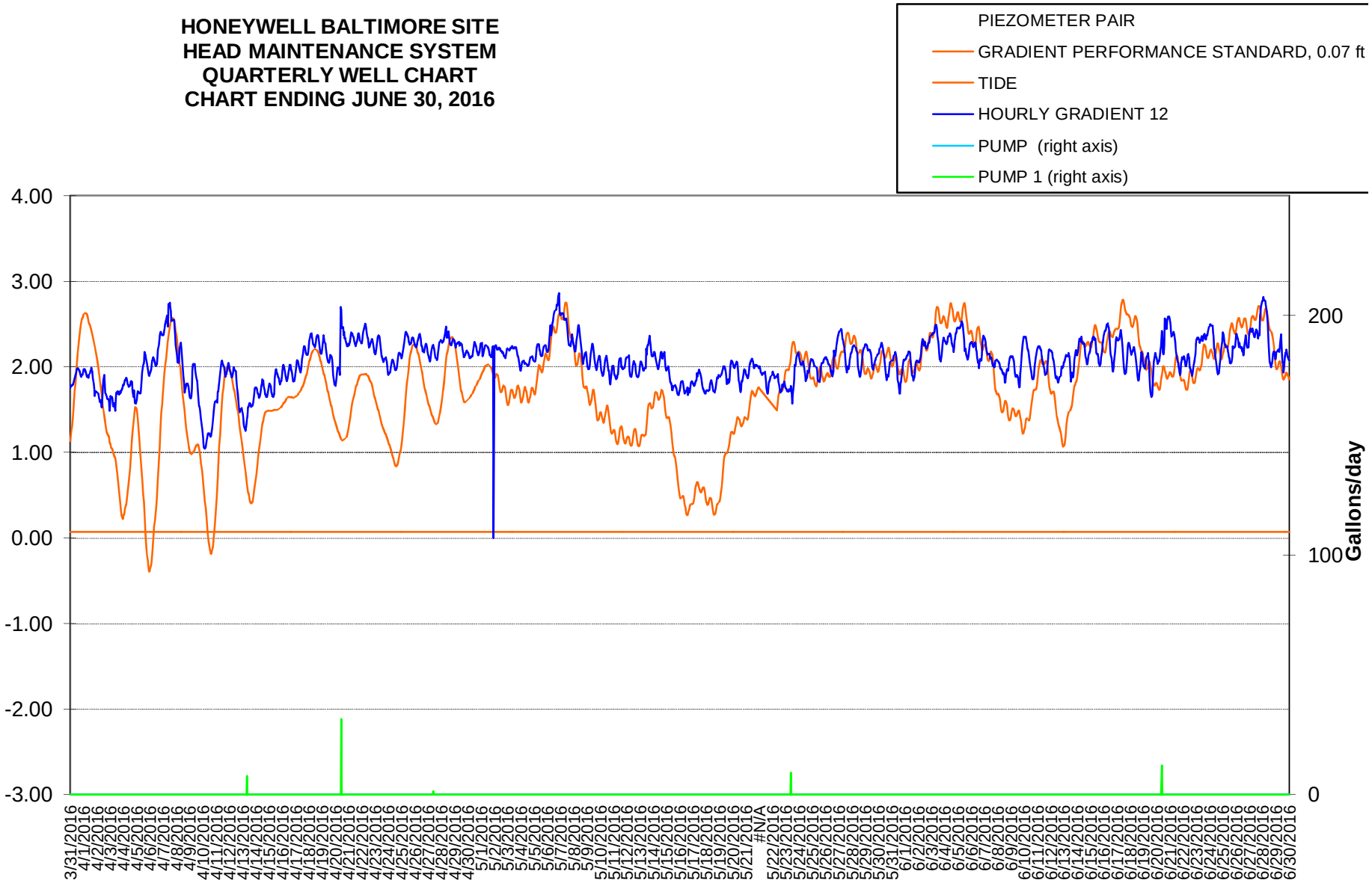
7/1/2016

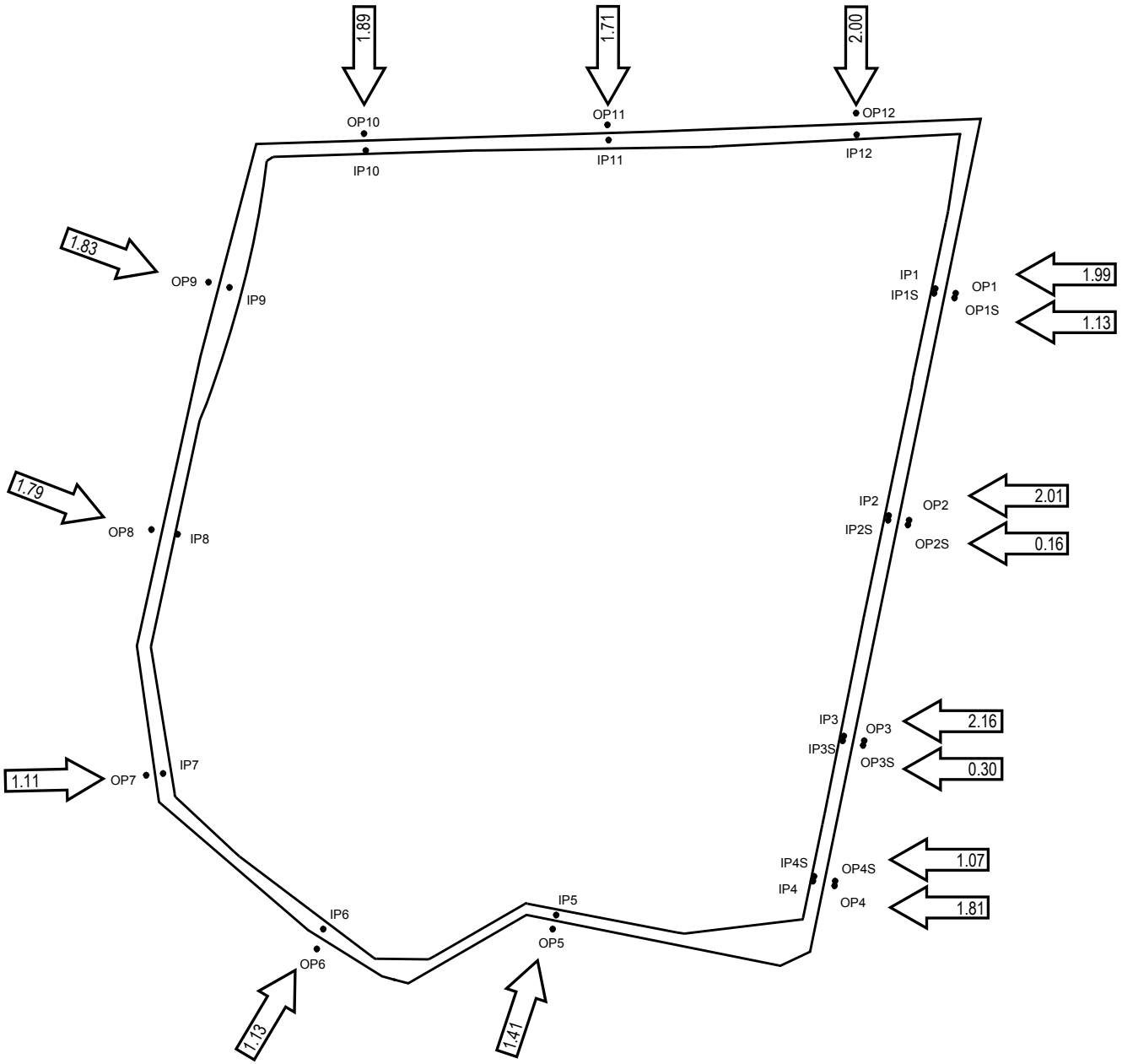
HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016



7/1/2016

HONEYWELL BALTIMORE SITE
HEAD MAINTENANCE SYSTEM
QUARTERLY WELL CHART
CHART ENDING JUNE 30, 2016





LEGEND

Inward Gradient (Toward Site)

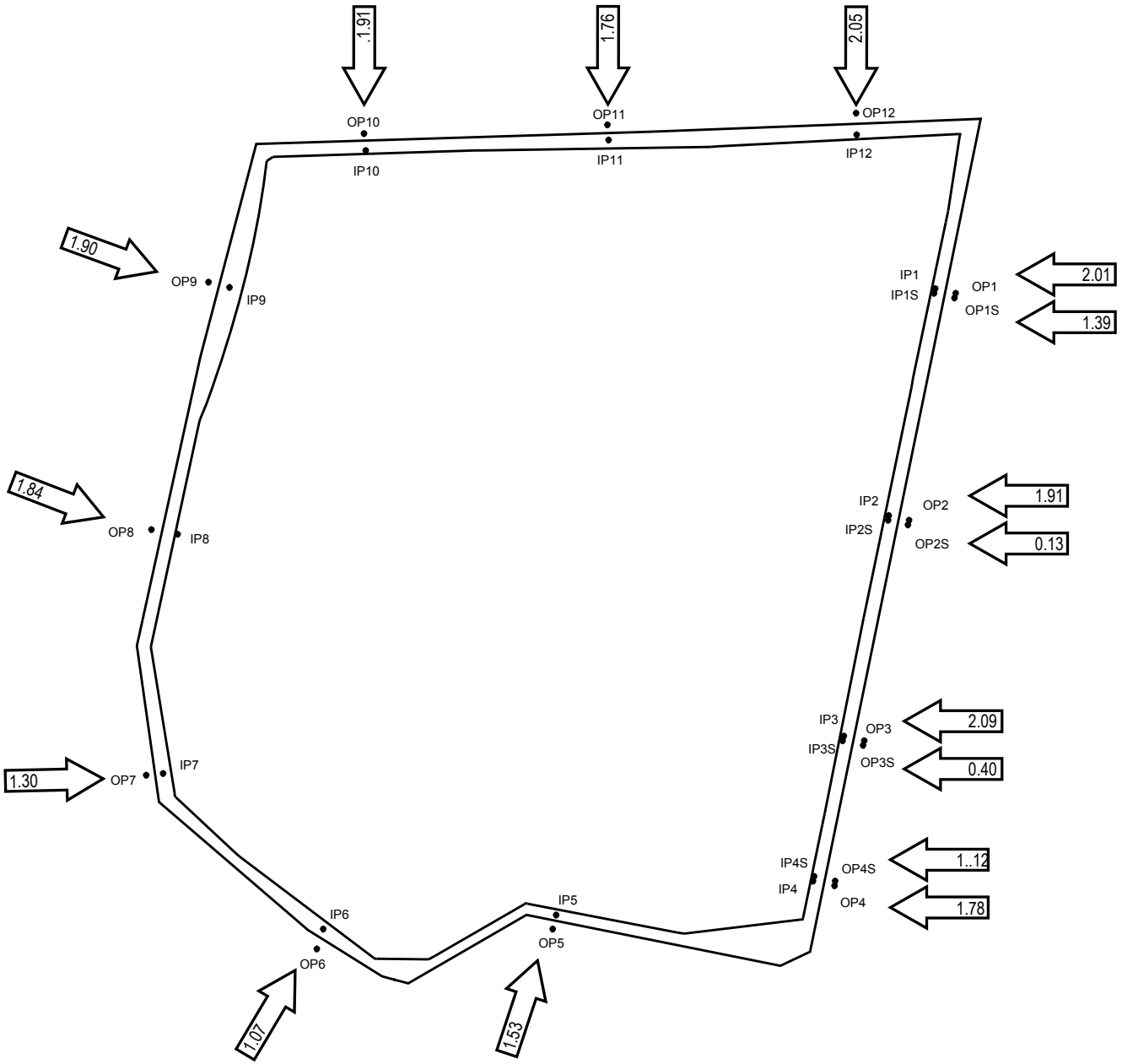
Outward Gradient (Away from Site)

IP - Inboard Piezometer
OP - Outboard Piezometer
IP_S - Inboard Piezometer - Shallow
OP_S - Outboard Piezometer - Shallow

N
W
E
S

125 62.5 0 125
Feet

APPENDIX A
Average of Hourly HMS Gradients
for Month of April 2016
Honeywell Baltimore Site



LEGEND

Inward Gradient (Toward Site)

Outward Gradient (Away from Site)

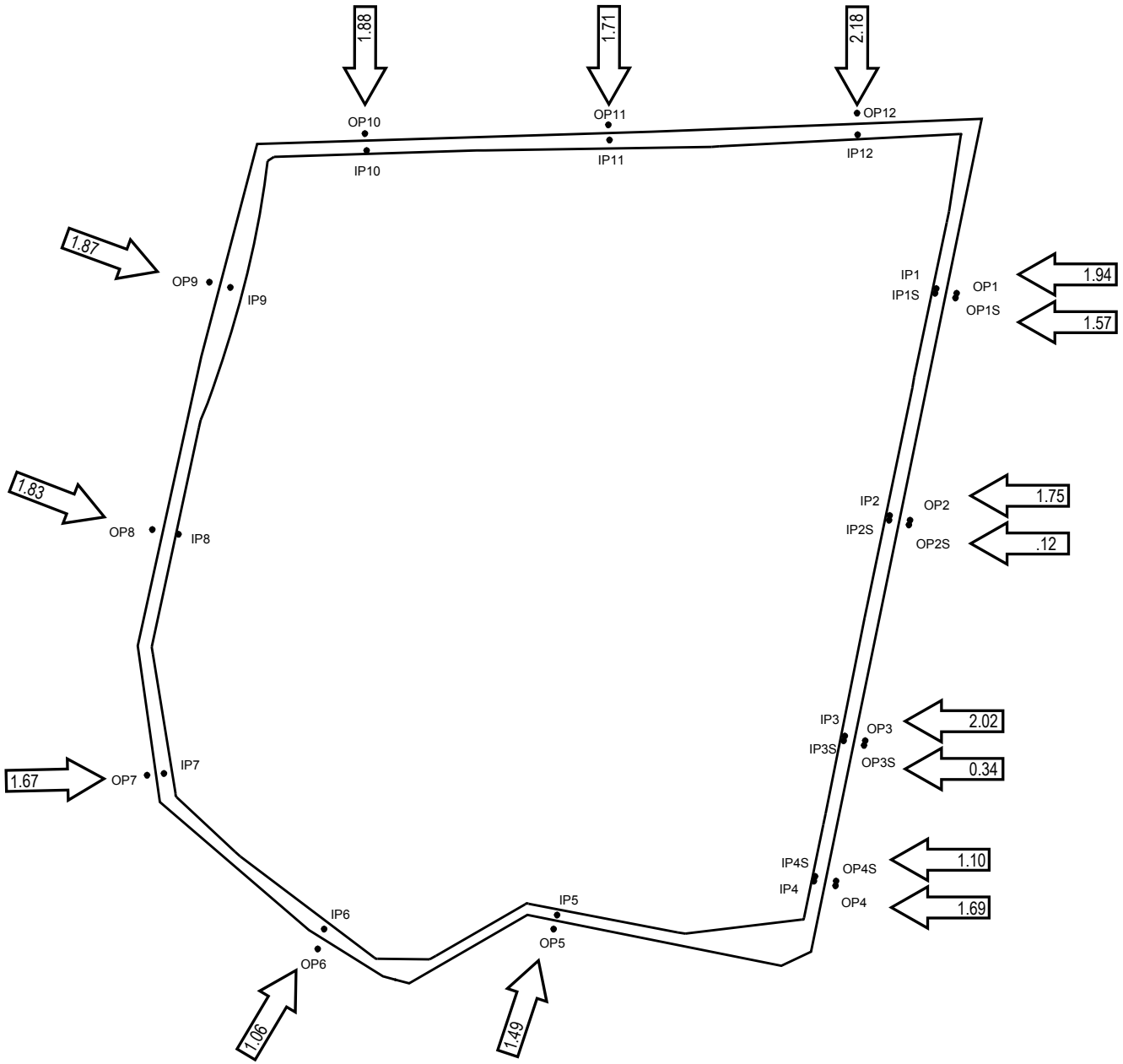
IP - Inboard Piezometer
OP - Outboard Piezometer
IP_S - Inboard Piezometer - Shallow
OP_S - Outboard Piezometer - Shallow

N
W
E
S

125 62.5 0 125
Feet

APPENDIX A
Average of Hourly HMS Gradients for Month of May 2016 *Honeywell Baltimore Site*

CH2MHILL



LEGEND

Inward Gradient (Toward Site)

Outward Gradient (Away from Site)

IP - Inboard Piezometer
OP - Outboard Piezometer
IP_S - Inboard Piezometer - Shallow
OP_S - Outboard Piezometer - Shallow

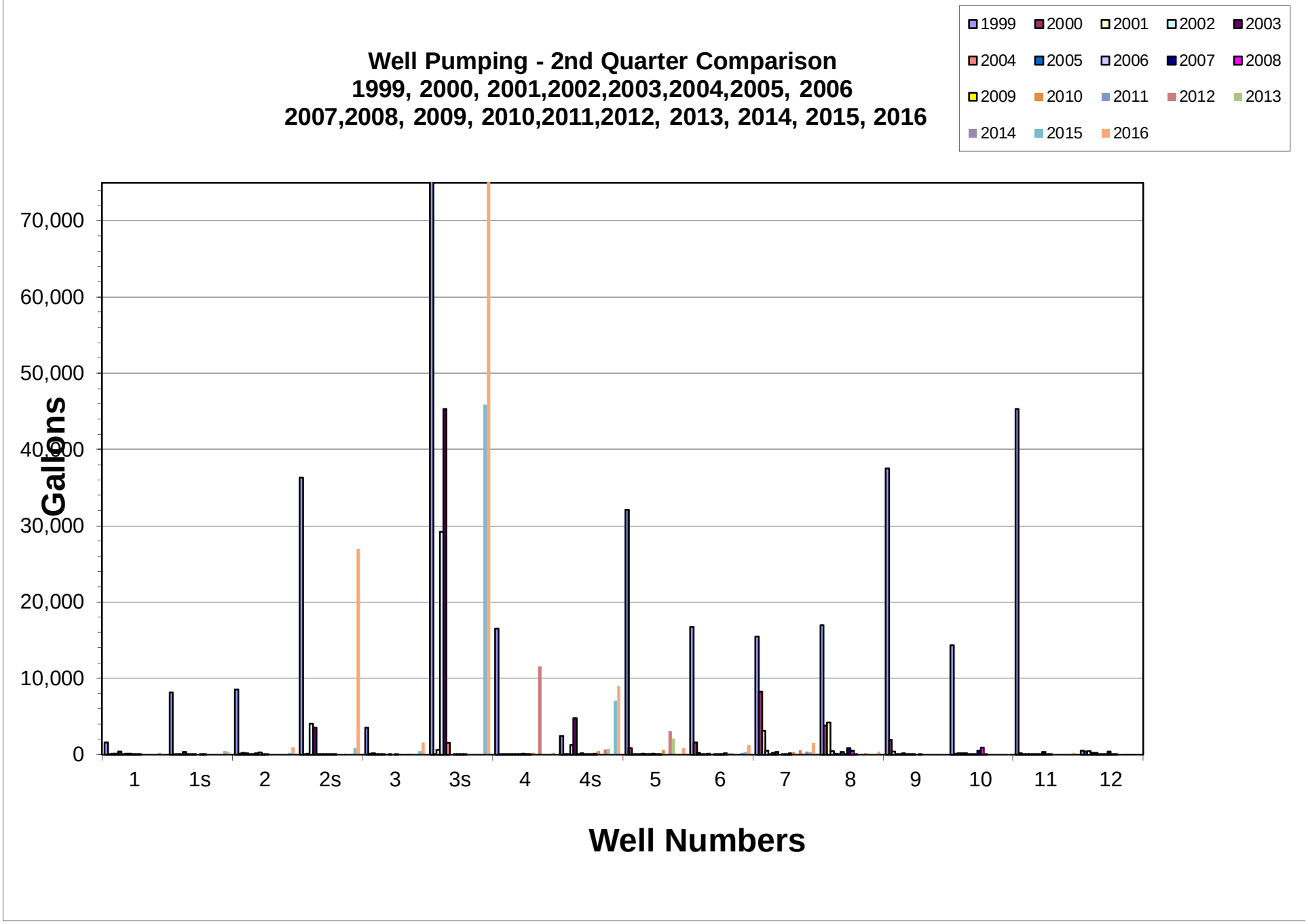
N
W
E
S

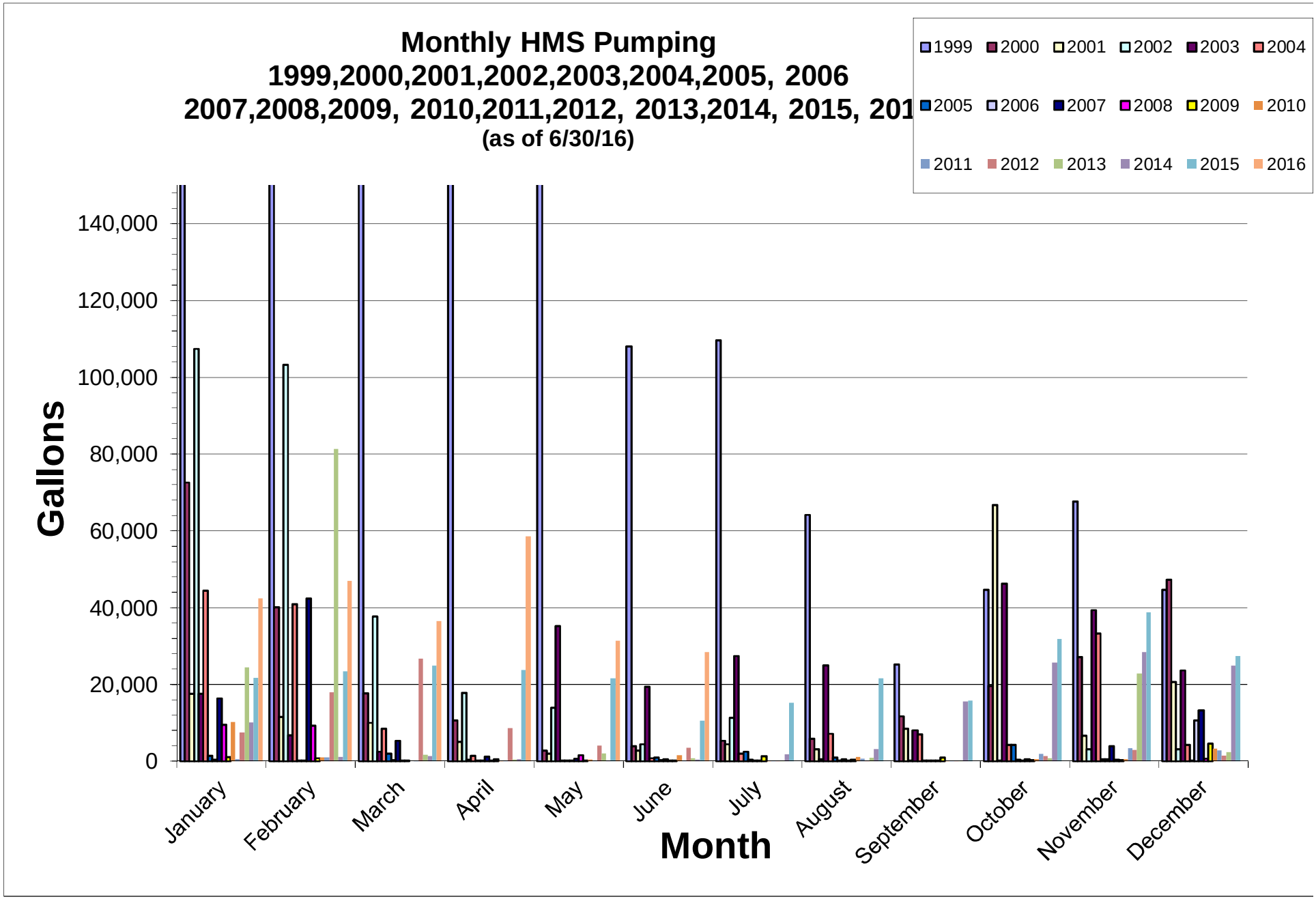
125 62.5 0 125
Feet

APPENDIX A
Average of Hourly HMS Gradients
for Month of June 2016
Honeywell Baltimore Site

Appendix B
HMS Pumping Charts

- Monthly Pumping: 1999–2016 (year to date)
- Well Pumping: First Quarter Comparisons: 1999–2016


Well Pumping - 2nd Quarter Comparison
1999, 2000, 2001,2002,2003,2004,2005, 2006
2007,2008, 2009, 2010,2011,2012, 2013, 2014, 2015, 2016
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Gallons
1
1s
2
2s
3
3s
4
4s
5
6
7
8
9
10
11
12
Well Numbers


Monthly HMS Pumping
1999,2000,2001,2002,2003,2004,2005, 2006
2007,2008,2009, 2010,2011,2012, 2013,2014, 2015, 201
(as of 6/30/16)
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Gallons
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
January
February
March
April
May
June
July
August
September
October
November
December
Month

Appendix C
Manual Verification Reports

- April
- May
- June
- Manual Verification Gradient Review

		4/5/2016				
		ELEVATION, WELL CAP, FEET	FIELD READING, FEET, (RADIO)	FIELD CALCULATED ELEVATION FEET	COMPUTER DISPLAY, FEET (WONDERW)	DELTA: FIELD MINUS COMPUTER, FEET
IP	1	* 20.01	20.22	-0.21	-0.21	0.00
OP	1	* 20.78	19.27	1.51	1.53	-0.02
IP	1 S	* 20.24	19.97	0.27	0.61	-0.34
OP	1 S	* 21.05	19.91	1.14	1.17	-0.03
IP	2	* 12.82	13.49	-0.67	-0.51	-0.16
OP	2	* 12.90	12.20	0.70	0.74	-0.04
IP	2 S	* 12.88	13.15	-0.27	-0.34	0.07
OP	2 S	* 12.94	13.20	-0.26	-0.23	-0.03
IP	3	* 15.01	16.27	-1.26	-1.30	0.04
OP	3	* 15.04	14.55	0.49	0.43	0.06
IP	3 S	15.54	15.84	-0.30	-0.29	-0.01
OP	3 S	* 14.86	15.05	-0.19	-0.21	0.02
IP	4	* 11.72	12.82	-1.10	-1.10	0.00
OP	4	11.53	11.02	0.51	0.50	0.01
IP	4 S	* 11.78	12.83	-1.05	-1.02	-0.03
OP	4 S	* 11.11	11.30	-0.19	-0.17	-0.02
	TIDE	7.58	8.91	-1.33	-0.60	-0.73
IP	5	* 9.02	10.38	-1.36	-1.37	0.01
OP	5	7.85	8.65	-0.80	-0.81	0.01
IP	6	* 8.83	10.75	-1.92	-1.79	-0.13
OP	6	* 7.02	8.03	-1.01	-0.97	-0.04
IP	7	8.79	9.89	-1.10	-1.40	0.30
OP	7	8.20	9.20	-1.00	-0.94	-0.06
IP	8	* 10.39	11.22	-0.83	-0.86	0.03
OP	8	* 6.68	7.40	-0.72	-0.73	0.01
IP	9	* 9.61	10.83	-1.22	-1.21	-0.01
OP	9	* 7.93	8.70	-0.77	-0.77	0.00
IP	10	* 8.50	9.55	-1.05	-1.01	-0.04
OP	10	* 6.54	6.55	-0.01	0.06	-0.07
IP	11	* 18.56	19.26	-0.70	-0.71	0.01
OP	11	* 19.34	18.80	0.54	0.53	0.01
IP	12	* 11.46	12.10	-0.64	-0.61	-0.03
OP	12	* 11.26	9.78	1.48	1.41	0.07
DUPLICATE READINGS(TAKE FIVE DUPLICATE READINGS LIST WELL IDENTIFIER AND READING)						
OP	12		9.78		0	
OP	6		8.03		0	
OP	10		6.55		0	
IP	6		10.75		0	
IP	3S		15.84		0	
Cvr'd Slip		11.86				
Gas Vent		18.98				

Note: Elevations based on STANTEC survey 2015

'*' Denotes readings are taken from the PVC casing rather than the steel outer casing

			5/16/2016			
	ELEVATION, WELL CAP, FEET	FIELD READING, FEET , (RADIO)	FIELD CALCULATED ELEVATION FEET	COMPUTER DISPLAY, FEET (WONDERW)	DELTA: FIELD MINUS COMPUTER, FEET
IP 1	* 20.01	19.60	0.41	0.41	0.00
OP 1	* 20.78	18.63	2.15	2.14	0.01
IP 1 S	* 20.24	20.05	0.19	0.25	-0.06
OP 1 S	* 21.05	19.60	1.45	1.42	0.03
IP 2	* 12.82	12.53	0.29	0.12	0.17
OP 2	* 12.90	11.35	1.55	1.54	0.01
IP 2 S	* 12.88	13.15	-0.27	-0.30	0.03
OP 2 S	* 12.94	13.06	-0.12	-0.13	0.01
IP 3	* 15.01	15.01	0.00	-0.07	0.07
OP 3	* 15.04	13.53	1.51	1.55	-0.04
IP 3 S	15.54	15.49	0.05	0.01	0.04
OP 3 S	* 14.86	14.65	0.21	0.22	-0.01
IP 4	* 11.72	11.25	0.47	0.46	0.01
OP 4	11.53	9.93	1.60	1.61	-0.01
IP 4 S	* 11.78	11.80	-0.02	-0.03	0.01
OP 4 S	* 11.11	10.55	0.56	0.53	0.03
TIDE	7.58	5.42	2.16	1.57	0.59
IP 5	* 9.02	8.67	0.35	0.38	-0.03
OP 5	7.85	6.70	1.15	0.83	0.32
IP 6	* 8.83	8.55	0.28	0.23	0.05
OP 6	* 7.02	6.42	0.60	0.61	-0.01
IP 7	8.79	8.60	0.19	0.49	-0.30
OP 7	8.20	7.26	0.94	0.62	0.32
IP 8	* 10.39	10.03	0.36	0.37	-0.01
OP 8	* 6.68	5.45	1.23	1.16	0.07
IP 9	* 9.61	9.85	-0.24	-0.24	0.00
OP 9	* 7.93	7.05	0.88	0.80	0.08
IP 10	* 8.50	8.38	0.12	0.08	0.04
OP 10	* 6.54	5.10	1.44	1.39	0.05
IP 11	* 18.56	18.11	0.45	0.50	-0.05
OP 11	* 19.34	17.60	1.74	1.78	-0.04
IP 12	* 11.46	11.00	0.46	0.43	0.03
OP 12	* 11.26	8.96	2.30	2.22	0.08
DUPLICATE READINGS(TAKE FIVE DUPLICATE READINGS LIST WELL IDENTIFIER AND READING)					
OP 12		11.00		20.440882	
OP 1 S		19.60		0	
OP 8		5.45		0	
OP 3 S		14.65		0	
IP 10		8.38		0	
Cvr'd Slip	11.86	11.61	0.25		
Gas Vent	18.98	8.67	10.31		

Note: Elevations based on STANTEC survey 2015

'*' Denotes readings are taken from the PVC casing rather than the steel outer casing

** Tide,Gas Vent, and Covered Slip reading taken on 5/20/16

				6/14/2016			
			ELEVATION, WELL CAP, FEET	FIELD READING, FEET , (RADIO)	FIELD CALCULATED ELEVATION FEET	COMPUTER DISPLAY, FEET (WONDERW)	DELTA: FIELD MINUS COMPUTER, FEET
IP	1	*	20.01	19.47	0.54	0.54	0.00
OP	1	*	20.78	18.35	2.43	2.44	-0.01
IP	1 S	*	20.24	19.94	0.30	0.17	0.13
OP	1 S	*	21.05	19.65	1.40	1.40	0.00
IP	2	*	12.82	12.43	0.39	0.39	0.00
OP	2	*	12.90	10.84	2.06	2.08	-0.02
IP	2 S	*	12.88	13.13	-0.25	-0.23	-0.02
OP	2 S	*	12.94	13.06	-0.12	-0.13	0.01
IP	3	*	15.01	14.91	0.10	0.19	-0.09
OP	3	*	15.04	12.98	2.06	2.07	-0.01
IP	3 S		15.54	15.48	0.06	0.05	0.01
OP	3 S	*	14.86	14.60	0.26	0.28	-0.02
IP	4	*	11.72	11.12	0.60	0.58	0.02
OP	4		11.53	9.38	2.15	2.13	0.02
IP	4 S	*	11.78	11.74	0.04	0.04	0.00
OP	4 S	*	11.11	10.15	0.96	0.95	0.01
	TIDE		7.58	5.58	2.00	1.96	0.04
IP	5	*	9.02	8.54	0.48	0.46	0.02
OP	5		7.85	6.15	1.70	1.99	-0.29
IP	6	*	8.83	8.45	0.38	0.43	-0.05
OP	6	*	7.02	5.70	1.32	1.28	0.04
IP	7		8.79	8.45	0.34	0.31	0.03
OP	7		8.20	6.71	1.49	1.30	0.19
IP	8	*	10.39	9.93	0.46	0.43	0.03
OP	8	*	6.68	4.50	2.18	2.20	-0.02
IP	9	*	9.61	9.75	-0.14	-0.18	0.04
OP	9	*	7.93	6.31	1.62	1.66	-0.04
IP	10	*	8.50	8.31	0.19	0.15	0.04
OP	10	*	6.54	4.63	1.91	1.89	0.02
IP	11	*	18.56	18.05	0.51	0.48	0.03
OP	11	*	19.34	17.15	2.19	2.14	0.05
IP	12	*	11.46	10.87	0.59	0.51	0.08
OP	12	*	11.26	8.90	2.36	2.32	0.04
DUPLICATE READINGS(TAKE FIVE DUPLICATE READINGS LIST WELL IDENTIFIER AND READING)							
OP	8		4.50			200	
OP	7		8.20			200	
IP	3 S		15.54			200	
OP	10		4.63			200	
OP	9		6.31			200	
	Cvr'd Slip		11.86				
	Gas Vent		18.98				

Note: Elevations based on STANTEC survey 2015

'*' Denotes readings are taken from the PVC casing rather than the steel outer casing

Appendix C

Manual Verification Gradient Review

Second Quarter 2016

April	Gradient 1	Gradient 1S	Gradient 2	Gradient 2S	Gradient 3	Gradient 3S	Gradient 4	Gradient 4S	Gradient 5	Gradient 6	Gradient 7	Gradient 8	Gradient 9	Gradient 10	Gradient 11	Gradient 12
Average	1.99	1.13	2.01	0.16	2.16	0.30	1.81	1.07	1.41	1.13	1.11	1.79	1.83	1.89	1.71	2.00
Max	2.92	2.10	5.78	0.53	2.98	0.80	2.72	2.07	3.91	2.51	2.49	3.34	3.01	2.68	2.51	2.75
Min	1.60	0.51	1.27	-0.11	1.47	-0.01	1.06	0.45	0.21	0.02	0.07	0.07	0.38	0.85	0.85	1.04
Delta Manual Verification	-0.02	0.31	0.12	-0.10	0.02	0.00	0.01	0.01	0.00	0.09	-0.36	-0.02	0.01	-0.03	0.00	0.10
Value plus 0.072	0.09	0.38	0.19	0.17	0.09	0.07	0.08	0.08	0.07	0.16	0.43	0.09	0.08	0.10	0.07	0.17
Gradient Greater Than Variance	1.50	0.13	1.08	-0.28	1.37	-0.08	0.97	0.36	0.14	-0.14	-0.36	-0.02	0.30	0.75	0.77	0.87
May																
Average	2.01	1.39	1.91	0.13	2.09	0.40	1.78	1.12	1.53	1.07	1.30	1.84	1.90	1.91	1.76	2.05
Max	2.51	2.02	2.81	0.42	5.70	0.99	3.43	2.08	2.93	2.63	2.57	3.38	3.16	2.82	2.59	2.86
Min	1.61	1.10	1.24	0.07	1.40	0.09	1.09	0.45	0.28	0.06	0.10	0.55	0.87	1.10	1.09	1.57
Delta Manual Verification	0.01	0.09	-0.16	-0.02	-0.11	-0.05	-0.02	0.02	0.35	-0.06	0.62	0.08	0.08	0.01	0.01	0.05
Value plus 0.072	0.08	0.16	0.23	0.09	0.18	0.12	0.09	0.09	0.42	0.13	0.69	0.15	0.15	0.08	0.08	0.12
Gradient Greater Than Variance	1.52	0.93	1.01	-0.03	1.22	-0.03	1.00	0.35	-0.14	-0.07	-0.59	0.40	0.72	1.02	1.01	1.45
June																
Average	1.94	1.57	1.75	0.12	2.02	0.34	1.69	1.10	1.49	1.06	1.67	1.83	1.87	1.88	1.71	2.18
Max	2.34	1.99	2.37	0.21	2.66	0.67	2.47	1.77	2.85	2.23	2.83	3.13	2.90	2.58	2.34	2.81
Min	1.56	1.12	1.18	0.07	1.35	0.10	1.06	0.50	0.44	0.08	0.63	0.05	1.02	1.11	1.09	1.65
Delta Manual Verification	-0.01	-0.13	-0.02	0.03	0.08	-0.03	0.00	0.01	-0.31	0.09	0.16	-0.05	-0.08	-0.02	0.02	-0.04
Value plus 0.072	0.08	0.20	0.09	0.10	0.15	0.10	0.07	0.08	0.38	0.16	0.23	0.12	0.15	0.09	0.09	0.11
Gradient Greater Than Variance	1.48	0.92	1.09	-0.03	1.20	0.00	0.99	0.42	0.06	-0.09	0.39	-0.07	0.87	1.02	0.99	1.54