DATA REPORT: GROUNDWATER SOURCE CONTROL EXTRACTION SYSTEM TEST – PHASE 1 STEP 4

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Prepared for

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LIST OF ACRONYMS AND ABBREVIATIONS

CDR	*Revised Groundwater Source Control Construction Design Report*
DEQ	Oregon Department of Environmental Quality
DNAPL	dense non-aqueous phase liquid
gpm	gallons per minute
HC&C	hydraulic control and containment
POTW	publicly owned treatment works
Siltronic	Siltronic Corporation
Site	Gasco site
the Test Plan	Final Groundwater Source Control Extraction System Test Plan
WBZ	water-bearing zone

1 INTRODUCTION AND DATA COLLECTION OBJECTIVES

The groundwater hydraulic control and containment (HC&C) system has been constructed on the NW Natural and Siltronic Corporation (Siltronic)-owned portions of the Gasco site (Site). This source control work is being completed consistent with the requirements of the following: 1) the Joint Order (Oregon Department of Environmental Quality [DEQ] Order No. ECVC-NWR-00-27 to NW Natural and Siltronic, dated October 4, 2000); and 2) the Voluntary Agreement (DEQ No. WMCVM-NWR-94-13, dated August 8, 1994, as amended July 19, 2006).

Four Phase 1 tests of the groundwater source control extraction system have been completed as described in the *Final Groundwater Source Control Extraction System Test Plan* (Test Plan; Anchor QEA 2013a). The results of the first three Phase 1 tests were submitted to the DEQ in a December 2013 report (Anchor QEA 2013b). That report described the data from those tests and recommended the parameters for conducting the next (Phase 1 Step 4) system test. This Data Report describes the data and findings from the Phase 1 Step 4 system test.

DEQ provided comments on the December 2013 data report in a January 29, 2014, email. DEQ and U.S. Environmental Protection Agency comments were attached to the email. Among the comments, DEQ requested revisions to the way that data are presented in the data plots, and those revisions have been incorporated into this Step 4 Data Report.

As with the previous report, this Data Report is not intended to be an analysis of whether the HC&C system achieved hydraulic capture of groundwater. That capture analysis will be done in subsequent reports after the project groundwater flow model has been calibrated and validated. This Data Report primarily provides an assessment of system operational parameters that can be evaluated from the groundwater elevation data obtained during the field tests. This report also presents the dense non-aqueous phase liquid (DNAPL) monitoring data, evaluates the potential need for contingency measures, and sets the stage for the next field test.

Following the formal Phase 1 Step 4 testing, preliminary review of the data showed that we had general improvement in performance throughout the well network, but not enough improvement in the Upper Alluvium of Segment 2. Therefore, we conducted some additional informal testing during preparation of this report. The findings of that informal testing are described in Section 6.2. Based on the results of the Step 4 Test and the informal tests conducted after the Step 4 tests, an additional Step 5 Test is recommended, as described in Section 7.

The figures presented in this report are designed to allow a visual evaluation of the seven data collection objectives described in Section 2.2 of the Test Plan and listed below.

1. Confirm the design objectives of the Upper Alluvium water-bearing zone (WBZ) extraction wells in shoreline Segment 1 are maintained during each set-point test. Based on the information in the *Revised Groundwater Source Control Construction Design Report* (CDR), the hydraulic gradient design objectives include inducing horizontal gradients from the river toward the extraction wells, reducing the horizontal hydraulic gradients in the vicinity of each well by reducing the well spacing, and establishing upward vertical gradients from the Lower Alluvium to the Upper Alluvium. Note that this data collection objective description was modified from the description provided by the Oregon Department of Environmental Quality (DEQ) in the October 1 comments, based on agreements with NW Natural made during the October 7 conference call.
2. Confirm that the water level elevations in the control wells are continuously lower than the river by approximately the set-point value.
3. Confirm that groundwater elevations in performance monitoring installations exhibiting "high" hydraulic efficiency are continuously more than 0.05 foot lower than the river stage.
4. Confirm that groundwater elevations in performance monitoring installations exhibiting "low" hydraulic efficiency are continuously more than 0.05 foot lower than the river stage or consistently more than 0.05 foot lower than the river stage based on analysis of water levels using the Serfes method.
5. Confirm that the groundwater elevations in performance monitoring installations constructed below the deep aquitard clearly show the groundwater gradient is from these installations toward extraction wells.
6. Confirm that groundwater elevations in performance monitoring installations located near the margins of the HC&C system (e.g., northern and southern ends, nearshore and offshore piezometers) are continuously more than 0.05 foot lower than the river stage or are consistently more than 0.05 foot lower than the river stage based on analysis of water levels using the Serfes method.
7. Measure and monitor DNAPL removal rates throughout the entire initial HC&C system testing phase to assess the relationship between control well set-points and DNAPL accumulation rates.

2 SUMMARY OF SYSTEM OPERATIONS AND DATA ORGANIZATION

Operation of the extraction and treatment system began on September 23, 2013. This operational period consisted of running the extraction wells at a fixed flow rate approximately eight hours per day, Monday through Friday each week. The system was operated at an average total flow rate of approximately 130 gallons per minute (gpm) to allow the treatment system to be fine-tuned. During this period, the system was not operated on level control; that is, each extraction well was set to pump at a fixed rate. The Lower Alluvium extraction wells were set to yield approximately 10 gpm, and the Upper Alluvium extraction wells were set to yield approximately 3 gpm. During this period, the treated water was discharged to the publicly owned treatment works (POTW) under the existing wastewater discharge permit. This operational period continued each week until the system was shut down prior to the Phase 1 Pre-Test. A summary of Phase 1 testing is provided below.

- Phase 1 Step 1: Took place on November 6 and consisted of 24 hours of pumping just the Upper Alluvium extraction wells at a set-point of -0.1 foot.
- Phase 1 Step 2: Took place on November 7 through November 14 and consisted of pumping all site extraction wells operating at a set-point of -0.1 foot.
- Phase 1 Step 3: Took place on November 18 through November 25 and consisted of pumping all site extraction wells operating at a set-point of -0.15 foot.
- Phase 1 Step 4: Took place on February 25 through March 4 and consisted of pumping all site extraction wells operating at a set-point of -0.30 foot.

The results of the Phase 1 Steps 1, 2, and 3 testing were submitted to DEQ in a December 2013 report (Anchor QEA 2013b). This report presents the results of the Phase 1 Step 4 test following the same format of the previous report.

Section 3 of this report presents the water elevation data using surface contours and data plots that enable evaluation of DEQ Data Objectives 1 through 6, as described in Section 2.2 of the Test Plan. Section 4 presents the DNAPL monitoring data. Section 5 addresses the possible need for contingency measures, and Section 6 makes recommendations for conducting the next Phase 1 field test.

Figures 1.1 through 1.5 provide location maps of the wells and piezometers used in this data report, including separate maps indicating which wells are associated with the individual

hydrogeologic units. Also, the following figures include detailed well location maps and geologic cross-sections showing well construction details:

- Figure 2.1 Monitoring Well and Cross Section Location Map
- Figures 2.2a, b, c, d Map of Groundwater Extraction and Treatment System
- Figures 2.3a, b, c Geologic Cross Section A-A'
- Figure 2.4 Geologic Cross Section B-B'
- Figure 2.5 Geologic Cross Section C-C'
- Figure 2.6 Geologic Cross Section D-D'
- Figure 2.7 Geologic Cross Section E-E'
- Figures 2.8a, b Geologic Cross Section F-F'

Table 1 provides the construction details of all of the wells and piezometers used in this evaluation. Table 2 contains the details of the Source Control Monitoring Plan, including the estimated relative hydraulic efficiency of the wells. Both of these tables were in the Test Plan and have not been revised based on the results of the Phase 1 testing.

3 ASSESS OPERATIONAL PARAMETERS

3.1 Potentiometric Surface Contour Maps

Potentiometric surface maps have been prepared for Step 4 (-0.3 foot set-point test) of the Phase 1 testing. These contour maps were proposed in Sections 5.1.1.1 and 5.1.1.1.1 of the Test Plan. Figures were prepared using a 3-day rolling average, based on the method presented by Serfes (1991) for the Upper Alluvium and Lower Alluvium. Potentiometric surface maps of average groundwater elevations were prepared for the Upper Alluvium and Lower Alluvium for two time periods during the Step 4 test: February 26 through February 28 (Figures 3.1a and 3.1b) and March 1 through March 3 (Figures 3.2a and 3.2b).

As requested in the January 29 agency comments, potentiometric surface maps were added for the Fill and Deep Lower Alluvium WBZs. We did not add contours to the maps for the Deep Lower Alluvium WBZs (Figures 3.1d and 3.2d) because of insufficient data point locations to support meaningful contours. Per agency request, we also added contour maps of the elevation differences between the river and Fill WBZ, river and Upper Alluvium WBZ, river and Lower Alluvium WBZ, and Deep Lower Alluvium WBZ (Figures 3.3a through 3.3d, and 3.4a through 3.4d). Consistent with the previous comment on data point locations, we did not add contours for the Deep Lower Alluvium WBZ maps (Figures 3.3d and 3.4d).

Similar to the previous tests, groundwater elevation contours in Segments 1 and 2 for the Lower Alluvium consistently show gradient reversal from the river toward the HC&C system, and groundwater elevation contours for the Upper Alluvium also generally show gradient reversal from the river toward the HC&C system in Segment 1. However, the maps also show that gradient reversal was not achieved throughout the Upper Alluvium in Segment 2.

3.2 Water Elevation Difference: River and Wells

Water elevation differences were evaluated for each monitoring well, observation well, and piezometer equipped with a pressure transducer, as shown on Figures 4.1 through 4.79. For reader convenience, a list of the hydrographs with well numbers is provided at the beginning of Figure 4. Each figure contains the data for an individual well, displayed on three time-series charts of water elevations or water elevation differences plotted from February 20, 2014 (5 days before the start of the Step 4 test) through March 7, 2014 (3 days after the completion of the Step 4 test). The top chart shows the hydrograph for the river and the associated monitoring well, presented both at the frequency of measurements (15-minute intervals) and as a 3-day

rolling average (Serfes method). The middle chart shows the non-averaged water level difference (ΔH) between the river and the well (i.e., elevation at well minus the river stage). The bottom chart shows the difference of the 3-day Serfes method average between the river and the well. Dashed lines at the +/-0.05-foot elevation differences are shown on the charts for easy comparison to the data collection objectives outlined in Section 2.2 of the Test Plan. If the difference in water levels is below -0.05 foot, then it is indicative of flow towards upland. The figures are organized first by hydrogeologic unit, then by their position downstream to upstream (left to right, as shown on Figures 1.1 through 1.5). Figures 4.1 through 4.16 show the data from the Fill wells. Figures 4.17 through 4.47 show the data from the Upper Alluvium wells, organized from downstream to upstream. Figures 4.48 through 4.70 show the data from the Lower Alluvium wells, organized from downstream to upstream. Figures 4.71 through 4.79 show the data from the Deep Alluvium wells, organized from downstream to upstream.

As with the -0.1 or -0.15 foot set-point tests, during the -0.3 foot test, groundwater elevations in the fill were not very responsive to pumping. Pumping with a higher set-point over a longer period may show more response in the Fill WBZ. With some exceptions, the groundwater elevations in the Upper Alluvium show clear responses to pumping, with water elevations lower than the river by 0.05 foot or more in a majority of the wells. At MW-16-45 (Figure 4.26), there is little apparent response to pumping, but this is likely due to the presence of DNAPL in the well screen, which has clogged the filter pack sand. The groundwater elevations in the Lower Alluvium show the most consistent response to pumping, with the water elevations lower than the river by more than 0.05 foot in most of the wells. Although the wells in the Deep Lower Alluvium show clear responses to pumping, the water elevations are not below the river elevation in all cases. Further assessment of groundwater flow in the Deep Alluvium is provided in Section 3.3.3.

3.3 Water Elevation Difference Charts to Assess Vertical Groundwater Flow Paths

For Phase 1 Step 4, three sets of water elevation difference charts were developed to assess vertical groundwater flow paths:

1. Water level elevation differences between paired wells screened in adjacent hydrogeological units: Fill and Upper Alluvium (Figures 5.1 to 5.3), Upper Alluvium and Lower Alluvium (Figures 5.4 to 5.13), and Lower Alluvium and Deep Lower Alluvium WBZs (Figures 5.14 to 5.21).

2. Contour maps of water level elevation differences (Figure 6) between the Upper Alluvium and Lower Alluvium WBZs were developed to show areal distributions over the Site.
3. Groundwater flow paths from the Deep Lower Alluvium WBZ (Figure 7) were assessed through a comparison of water elevation difference of Deep Lower Alluvium with Lower Alluvium and the river. For a subset of wells where a corresponding pairing between a Lower Alluvium and Upper Alluvium well was possible, paired water elevation difference charts were developed to track groundwater flows paths from the Lower Alluvium to the Upper Alluvium.

These analyses were performed to address concerns raised by DEQ that the operation of the HC&C system would lead to DNAPL exacerbation, and to assist in the determination of groundwater flow paths. Data collection objectives 1, 5, and 6 in Section 2.2, and the analyses outlined in Section 5.1.1.1.2 of the Test Plan are addressed here.

In response to agency January 29 comments, the convention for identifying negative and positive elevation differences were changed for Figures 5, 6, and 7. For all three figures, a negative elevation difference between paired wells indicates a downward flow gradient and a positive elevation difference between paired wells indicates an upward flow gradient.

3.3.1 *Water Elevation Difference between Well Pairs in Adjacent Hydrogeological Units*

Water level elevation differences between select well pairs in the Fill and Upper Alluvium, Upper Alluvium and Lower Alluvium, and Lower Alluvium and Deep Lower Alluvium WBZs were calculated using the Serfes 3-day rolling averages and plotted as a time series (Figures 5.1 to 5.21). The top panel of these figures shows the Serfes 3-day rolling averages for the well in each WBZ. The bottom panel of each figure shows the water level elevation difference between the well pair as a Serfes 3-day rolling average. Dashed lines at the +/-0.05-foot elevation differences are shown in the bottom panel for easy comparison to the data collection objectives outlined in Section 2.2 of the Test Plan. Negative water level elevation differences in the bottom panel indicate downward gradients. These analyses address data quality objectives 1, 5, and 6.

Fill and Upper Alluvium WBZ water level elevation differences were calculated for three well pairs (Figures 5.1 to 5.3). All three Fill and Upper Alluvium WBZ well pairs showed downward gradients from the Fill to the Upper Alluvium WBZ.

Upper Alluvium and Lower Alluvium WBZ water level elevation differences were calculated for ten well pairs (Figures 5.4 to 5.13). With the exception of MW-1-55 and MW-1-82 (Figure 5.4), all Upper Alluvium and Lower Alluvium WBZ well pairs in Segment 2 (Figures 5.4 to 5.8) showed downward gradients. Considering that there are no extraction wells in the Upper Alluvium in Segment 2, except PW8-39, these results are consistent with expectations. Since there is no DNAPL in Segment 2, there is no need to maintain an upward gradient between the Lower Alluvium and Upper Alluvium. Upper Alluvium and Lower Alluvium WBZ well pairs in Segment 1 typically showed upward gradients in the DNAPL areas (Figures 5.9 to 5.13). At the upstream end of Segment 1, there were two well pairs, MW-36U/WS-21-112 and WS-8-59/WS-12-125, that had downward gradients (Figures 5.12 and 5.13). These findings for Upper Alluvium and Lower Alluvium are also illustrated on the contour maps described in Section 3.3.2. This is consistent with the Phase 1 Step 2 and Step 3 tests.

Lower Alluvium and Deep Lower Alluvium WBZ water level elevation differences were calculated at eight well pairs (Figures 5.14 to 5.21). All well pairs except one had upward elevation gradients. At the upstream end of Segment 1 there was one well pair (WS-12-125/WS-12-161) with a downward elevation gradient (Figure 5.21).

3.3.2 *Water Elevation Difference from Potentiometric Surface Contours of Upper Alluvium and Lower Alluvium*

Contour maps of the Serfes 3-day rolling average water level elevation differences between the Lower Alluvium and Upper Alluvium WBZs across the Site were generated for two date ranges over the course of the Phase 1 Step 4 test. Positive water level elevation contours (dashed lines) indicate upward flow from the Lower Alluvium to Upper Alluvium WBZ. Two contour maps were created for the Phase 1 Step 4 test. The time periods for the two Phase 1 Step 4 test water level elevation contour maps are February 26 through 28, 2014 (Figure 6.1), and March 1 through 3, 2014 (Figure 6.2). Upward gradients from the Lower Alluvium to Upper Alluvium WBZ existed across the majority of Segment 1 during the Phase 1 Step 4 test. Downward gradients from the Upper Alluvium to Lower Alluvium were present in Segment 2 and in a portion of Segment 1 on Siltronic property. These maps are consistent with the data plots described in Section 3.3.1.

3.3.3 *Assessment of Vertical Groundwater Flow Paths in the Alluvium*

Water level elevation differences between well pairs in the Lower Alluvium and Deep Lower Alluvium WBZs, the Upper Alluvium and Lower Alluvium WBZs, and the river were calculated using the Serfes 3-day rolling averages and plotted as a time series (Figures 7.1 to 7.8b). The top panel of these figures shows the Serfes 3-day rolling averages for the well in each WBZ and the river. The bottom panel of each figure shows the water level elevation difference between the well pair as a Serfes 3-day rolling average, and the water level elevation difference between either the Lower Alluvium or Deep Lower Alluvium WBZ well and the river. Dashed lines at the +/-0.05-foot elevation differences are shown in the bottom panel for easy comparison to the data collection objectives outlined in Section 2.2 of the Test Plan. Water level elevation differences between the Lower Alluvium and Deep Lower Alluvium, and the Upper Alluvium and Lower Alluvium WBZs were calculated for 13 well pairs. Positive water level elevation differences indicate upward flow between WBZs. All well pairs, except three located on the upstream end of Segment 1, had water level elevation differences indicating upward flow. For example, Figures 7.2a and 7.2b show the following:

1. The water elevation difference between Deep Lower Alluvium and Lower Alluvium is greater than water elevation difference between Deeper Lower Alluvium and the river (Figure 7.2a);
2. The water elevation difference between Lower Alluvium and Upper Alluvium is greater than Lower Alluvium and the river, thereby indicating that the direction of flow from Deep Lower Alluvium is generally upward towards Lower Alluvium and Upper Alluvium pumping wells rather than towards the river.

Three well pairs (WS-12-125/WS-12-161, WS-8-59/WS-12-125, and MW-36U/WS-21-112) at the upstream end of Segment 1 had water level elevation differences indicating downward flow (Figures 7.7a, 7.7b, and 7.8b).

4 ASSESS EFFECTS OF PUMPING ON DNAPL

4.1 DNAPL Entering Wells

As shown on Table 2, there are 70 wells and piezometers in the DNAPL monitoring program in Segments 1 and 2. In addition to the wells listed on Table 2, five additional wells (MW-PW2L, MW-PW10L, DW-6U, DW-11U, and DW-14U) are also currently being monitoring for DNAPL. The DW wells were installed for DNAPL removal purposes. The primary purpose of monitoring DNAPL during this program is to determine how the operation of the extraction wells affects the rate of DNAPL accumulation in the wells. Of the 75 wells being monitored, measurable DNAPL has only been detected in 16 wells. Of those 16 wells, DNAPL is being removed from eight of the wells (MW-16-45, MW-18-30, MW-26U, MW-34L, MW-38U, MW-PW2L, PW-1-80, and PW-2L) via dedicated DNAPL removal pumps. The wells are checked frequently to see where the DNAPL depth is relative to the top of the well sump. DNAPL is removed at the frequency necessary to keep the DNAPL below the top of the sump. DNAPL is not being removed from the other eight wells, including the DW wells, because, to date, the thickness of DNAPL has not been close to exceeding the containment capacity of the well sump. Figure 8 shows DNAPL accumulation rates as time series plots prior to and during the Phase 1 tests. DNAPL accumulation rates are not plotted for the DW wells, because only a trace of DNAPL has been detected in these wells to date.

Analysis of Figure 8 shows that, with the possible exception of extraction well PW-2L, pumping of the HC&C system has not increased the rates of DNAPL entry into the wells during any of the Phase 1 tests. Extraction well PW-2L is screened in a layer of DNAPL. Moreover, with the exception of PW-2L, the rates of the volume of DNAPL removed from the previously mentioned eight wells decreased during the testing periods.

DNAPL accumulation rates are typically less than 0.2 gallons per day.

5 ASSESS NEED FOR CONTINGENCY MEASURES

Section 2.4 of the Test Plan addresses the need for contingency measures. The six types of contingency measures being considered are as follows:

1. Adjusting pumping parameters
2. Adjusting the depth of the pump intake in an extraction well
3. Changing monitoring wells that are being used as control wells
4. Adjusting the performance monitoring sampling and analytical program
5. Installing DNAPL extraction wells
6. Adding groundwater extraction wells

As described in Section 1, we implemented Contingency Measure 5 with the installation of DNAPL recovery wells DW-6U, DW-11U, and DW-14U.

Additional Phase 1 testing is needed to adequately assess all of the potential measures listed above. A Phase 1 Step 5 test is proposed that will adjust pumping parameters (set-point) and change the monitoring wells that are being used as control wells. The proposed Phase 1 Step 5 test is outlined in Section 6.

6 FINDINGS AND INTERIM TEST RESULTS

6.1 Summary of Findings

Results from the Phase 1 Step 4 test indicate that the set-point of -0.3 foot produced water elevation differences (monitoring well minus the river) of -0.05 foot or greater over large portions of Segment 1 in the Upper Alluvium WBZ and over most of Lower Alluvium WBZ in Segments 1 and 2. Redevelopment of PW-1U and PW-1L was successful increasing the specific capacities of these wells. Improved yield in those two wells resulted in stronger gradient reversals in the Upper Alluvium and Lower Alluvium in the Siltronic portion of Segment 1.

In general, pumping wells in the Lower Alluvium, which has a much higher hydraulic conductivity than the Upper Alluvium, showed good results with larger (i.e., more negative) water elevation differences relative to the river in most of the Lower Alluvium monitoring wells. Upper Alluvium wells in Segment 1, east of the dock (PW-14U through PW-2U) showed good results with water elevation differences greater than -0.05 foot relative to the river (i.e., groundwater flows towards the wells).

While there was an improvement over the previous Phase 1 tests, a few Upper Alluvium monitoring wells in Segment 2 (MW-21U, MW-22U, MW-23U), did not show good results, with largely non-negative water elevation differences relative to the river for both set-points of the Phase 1 tests.

An evaluation of the vertical groundwater flow paths using water elevation data from the Lower Alluvium and Upper Alluvium monitoring wells indicates that groundwater flow is generally upward in Segment 1 (east of the dock on the Gasco property), and downward in portions of Segment 2 (in the vicinity of the dock) and Segment 1 (in the Siltronic property east of PW-2U/PW-2L).

Water elevation differences calculated between adjacent hydrogeological units indicate a generally downward flow between Fill and Upper Alluvium. The analyses showed a general upward flow from Deep Lower Alluvium to Lower Alluvium, and from Lower Alluvium to Upper Alluvium (except in the portions of Segment 2, as noted above).

6.2 Interim Testing

Following completion of the formal Step 4 tests, preliminary review of the data showed that the gradient reversals in the Upper Alluvium of Segment 2 were not sufficient. Therefore, we did some additional testing during the preparation of this report. This additional informal testing was done using the following temporary changes to the system:

1. The Upper Alluvium extraction wells were placed on flow control at 5 gpm rather than elevation control.
2. The Lower Alluvium extraction wells were operated with the control well set points at -0.15 foot.
3. The control wells for the Segment 2 Lower Alluvium extraction wells were moved to selected Upper Alluvium monitoring wells.

The system was operated with the above changes from April 2 through 4 to determine if this operational configuration would improve performance in Segment 2. The results of this informal test are shown on the hydrographs of the Upper Alluvium monitoring wells in Segment 2 (Appendix A). The hydrographs in Appendix A show that much better gradient reversal was achieved in the Upper Alluvium of Segment 2. The groundwater elevations in the depicted Upper Alluvium monitoring wells stayed below the river elevation throughout the April 2 through 4 testing period. Based on the results of this informal test, a Phase 1 Step 5 test is recommended as described in Section 7.

7 RECOMMENDATIONS

As described in Section 6.1, the Step 4 test results showed improved performance throughout the well network. However, the gradient reversals did not improve enough in the Upper Alluvium of Segment 2. Therefore, the following recommendations are provided for a Phase 1 Step 5 test:

- Lower Alluvium control wells will have a set-point of -0.15 foot. In addition to the success of the informal interim test described in Section 6.2, a -0.15 foot set-point was effective in the Phase 1 Step 3 test for the Lower Alluvium.
- Upper Alluvium extraction wells will be operated on flow control rather than level control, pumping at a rate of 5 gpm, with the exception of PW-1U, which will be pumped at 10 gpm. Pumping the Upper Alluvium wells at a constant rate will help maintain upward vertical gradients, and the increased rate at PW-1U should improve response at WS-8-59.
- In Segment 2, the control wells for Lower Alluvium extraction wells PW-7-93, PW-8-68, PW-9-92, and PW-10L will be changed to Upper Alluvium monitoring wells. PW-7-93 and PW-8-68 will both be controlled by MW-21U; PW-9-92 will be controlled by MW-23U; and PW-10L will be controlled by MW-22U. By using MW-21U to control both PW-7-93 and PW-8-68, both pumping wells will operate at the same time to get the gradient reversal at MW-21U.

Other procedures outlined in the Test Plan will be followed in Step 5 without modifications. The Step 5 results will be evaluated to assess the effectiveness of the recommended changes. If the Step 5 results indicate sufficient improvement in performance, the next data report will include a full analysis of the seven data objectives listed in Section 1.

8 REFERENCES

Anchor QEA, LLC, 2013a. *Final Groundwater Source Control Extraction System Test Plan*. Prepared for NW Natural. November 2013.

Anchor QEA, LLC, 2013b. *Data Report: Groundwater Source Control Extraction System Test, NW Natural Gasco Site*. Prepared for Oregon Department of Environmental Quality. December 23, 2013.

Serfes, M.E., 1991. Determining the mean hydraulic gradient of groundwater affected by tidal fluctuations. *Groundwater 29*, No. 4: 549-555.

TABLES

Table 1
Well Contruction Details

Well Number	Water-Bearing Zone	Date Installed	Date Decomm-issioned	Installation Method	Monument Type	Screen Type	Slot Size (inches)	Sand Pack (Colorado)	Well Diam. (inches)	Ground Surface (feet COP)	Top of Casing (feet COP)	Top of Casing (feet bgs)	Pump Inlet (feet bgs)	Pump Inlet (feet COP)	Top Screen (feet bgs)	Top Screen (feet COP)	Base Screen (feet bgs)	Base Screen (feet COP)	Well Depth (feet bgs)	Well Depth (feet COP)
Existing Monitoring Wells																				
MW-1-22	Surficial Fill	10/24/95	-	Hollow-Stem Auger	Above-grade	Slotted PVC	0.020	10-20	2	32.0	34.75	(2.7)	NA	NA	11.0	21.0	21.0	11.0	22.0	10.0
MW-1-55	Alluvial	7/10/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	33.1	35.64	(2.5)	NA	NA	45.0	-11.9	55.0	-21.9	57.0	-23.9
MW-1-82	Alluvial	7/9/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	33.5	35.95	(2.5)	NA	NA	72.0	-38.5	82.0	-48.5	84.0	-50.5
MW-2-32	Surficial Fill	11/6/95	-	Hollow-Stem Auger	Flush	Slotted PVC	0.020	10-20	2	34.8	34.41	0.4	NA	NA	21.5	13.3	31.5	3.3	32.5	2.3
MW-2-61	Alluvial	10/8/98	-	Hollow-Stem Auger	Flush	Slotted PVC	0.020	10-20	2	34.7	34.33	0.4	NA	NA	50.0	-15.3	60.0	-25.3	61.5	-26.8
MW-2-104	Alluvial	6/25/07	-	Sonic	Flush	Continuous wrap stainless steel	0.020	10-20	2	34.9	34.80	0.1	NA	NA	94.0	-59.1	104.0	-69.1	106.0	-71.1
MW-3-26	Surficial Fill	11/2/95	-	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.2	34.04	(2.8)	NA	NA	15.0	16.2	25.0	6.2	26.0	5.2
MW-3-56	Alluvial	11/1/95	-	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.2	34.02	(2.8)	NA	NA	45.0	-13.8	55.0	-23.8	56.0	-24.8
MW-4-35	Surficial Fill/Alluvial	10/31/95	-	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.7	34.44	(2.7)	NA	NA	24.0	7.7	34.0	-2.3	35.0	-3.3
MW-4-57	Alluvial	10/30/95	-	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.7	34.48	(2.8)	NA	NA	46.0	-14.3	56.0	-24.3	57.0	-25.3
MW-4-101	Alluvial	10/16/98	-	Dual Wall Reverse Air	Above-grade	Slotted PVC (pre-pack)	0.010	20-40	2	31.8	34.26	(2.5)	NA	NA	89.5	-57.7	99.5	-67.7	101.0	-69.2
MW-5-32	Surficial Fill/Alluvial	10/27/95	-	Hollow-Stem Auger	Above-grade	Slotted PVC	0.020	10-20	2	25.1	27.72	(2.6)	NA	NA	21.0	4.1	31.0	-5.9	32.0	-6.9
MW-5-100	Alluvial	10/23/98	-	Dual Wall Reverse Air	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	25.4	27.27	(1.9)	NA	NA	88.0	-62.6	98.0	-72.6	100.0	-74.6
MW-5-175	Alluvial	10/22/98	-	Dual Wall Reverse Air	Above-grade	Slotted PVC (pre-pack)	0.010	20-40	2	25.2	27.12	(1.9)	NA	NA	163.0	-137.8	173.0	-147.8	175.0	-149.8
MW-16-45	Alluvial	7/20/04	-	Sonic	Above-grade	Slotted stainless steel	0.010	10-20	2	30.8	33.10	(2.3)	NA	NA	30.0	0.8	45.0	-14.2	47.5	-16.7
MW-16-65	Alluvial	7/19/04	-	Sonic	Above-grade	Slotted stainless steel	0.010	10-20	2	30.6	33.13	(2.5)	NA	NA	55.0	-24.4	65.0	-34.4	67.5	-36.9
MW-18-30	Surficial Fill	2/27/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.7	34.18	(2.5)	NA	NA	19.0	12.7	29.0	2.7	30.0	1.7
MW-18-125	Alluvial	4/22/10	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.9	34.57	(2.6)	NA	NA	115.0	-83.1	125.0	-93.1	126.0	-94.1
MW-18-180	Alluvial	2/26/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.7	33.81	(2.1)	NA	NA	170.0	-138.3	180.0	-148.3	181.0	-149.3
MW-19-22	Surficial Fill	3/6/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	27.4	29.72	(2.3)	NA	NA	12.0	15.4	22.0	5.4	23.0	4.4
MW-19-125	Alluvial	3/12/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	27.2	29.33	(2.1)	NA	NA	115.0	-87.8	125.0	-97.8	126.0	-98.8
MW-19-180	Alluvial	3/2/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	27.3	29.73	(2.4)	NA	NA	170.0	-142.7	180.0	-152.7	181.0	-153.7
MW-20-120	Alluvial	3/8/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	25.6	27.69	(2.1)	NA	NA	110.0	-84.4	120.0	-94.4	121.0	-95.4
MW-21-12	Surficial Fill	7/6/07	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	20.3	23.16	(2.8)	NA	NA	7.0	13.3	12.0	8.3	14.0	6.3
MW-21U	Alluvial	9/24/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	20.5	22.38	(1.9)	NA	NA	25.0	-4.5	35.0	-14.5	38.0	-17.5
MW-21-75	Alluvial	7/5/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	20.4	23.03	(2.6)	NA	NA	65.0	-44.6	75.0	-54.6	77.0	-56.6
MW-21-115	Alluvial	7/2/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	20.5	23.35	(2.8)	NA	NA	105.0	-84.5	115.0	-94.5	117.0	-96.5
MW-21-165	Alluvial	6/28/07	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	20.5	23.06	(2.6)	NA	NA	156.0	-135.5	166.0	-145.5	168.0	-147.5
MW-22U	Alluvial	9/20/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	33.5	36.37	(2.9)	NA	NA	45.0	-11.5	55.0	-21.5	58.0	-24.5
MW-22-80	Alluvial	1/28/10	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	33.6	35.89	(2.3)	NA	NA	69.9	-36.3	79.9	-46.3	80.9	-47.3
MW-23-27	Surficial Fill	2/16/10	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	32.8	34.63	(1.9)	NA	NA	17.7	15.1	27.7	5.1	28.0	4.8
MW-23U	Alluvial	9/24/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.9	35.51	(2.6)	NA	NA	40.0	-7.1	50.0	-17.1	53.0	-20.1
MW-23-75	Alluvial	2/16/10	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	32.9	34.78	(1.9)	NA	NA	64.7	-31.8	74.7	-41.8	75.7	-42.8
MW-23-123	Alluvial	2/5/10	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	32.9	34.96	(2.1)	NA	NA	113.3	-80.4	123.3	-90.4	124.3	-91.4

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MW-24-70	Alluvial	2/3/10	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	31.4	33.74	(2.3)	NA	NA	60.1	-28.7	70.1	-38.7	71.1	-39.7
MW-24-130	Alluvial	2/2/10	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	31.3	33.66	(2.3)	NA	NA	120.1	-88.8	130.1	-98.8	131.1	-99.8
MW-25L	Alluvial	9/19/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.3	34.12	(2.8)	NA	NA	54.0	-22.7	64.0	-32.7	67.0	-35.7
MW-26U	Alluvial	9/25/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.4	33.93	(2.5)	NA	NA	38.5	-7.1	48.5	-17.1	51.7	-20.3
MW-27U	Alluvial	11/20/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.9	34.18	(2.3)	NA	NA	66.1	-34.2	76.1	-44.2	79.1	-47.2
MW-27L	Alluvial	11/16/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.9	34.16	(2.3)	NA	NA	106.0	-74.1	116.0	-84.1	119.0	-87.1
MW-28U	Alluvial	10/5/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.0	34.73	(2.7)	NA	NA	75.0	-43.0	85.0	-53.0	88.0	-56.0
MW-28L	Alluvial	10/4/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.4	34.87	(2.5)	NA	NA	109.8	-77.4	119.8	-87.4	122.8	-90.4
MW-29U	Alluvial	11/27/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.0	34.84	(2.8)	NA	NA	46.0	-14.0	56.0	-24.0	59.0	-27.0
MW-30U	Alluvial	11/14/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	27.4	30.46	(3.1)	NA	NA	40.1	-12.7	50.1	-22.7	53.1	-25.7
MW-31U	Alluvial	9/28/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	25.8	28.37	(2.6)	NA	NA	84.9	-59.1	94.9	-69.1	97.9	-72.1
MW-31L	Alluvial	9/27/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	26.0	28.53	(2.5)	NA	NA	105.0	-79.0	115.0	-89.0	118.0	-92.0
MW-32U	Alluvial	11/6/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	25.8	28.48	(2.7)	NA	NA	39.9	-14.1	49.9	-24.1	52.9	-27.1
MW-33U	Alluvial	11/5/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	24.8	27.66	(2.9)	NA	NA	38.0	-13.2	48.0	-23.2	51.0	-26.2
MW-34U	Alluvial	11/12/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	24.2	26.81	(2.6)	NA	NA	63.3	-39.1	73.3	-49.1	76.3	-52.1
MW-34L	Alluvial	11/8/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	24.1	26.91	(2.8)	NA	NA	99.0	-74.9	109.0	-84.9	112.0	-87.9
MW-35U	Alluvial	9/28/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	33.9	36.45	(2.6)	NA	NA	54.0	-20.1	64.0	-30.1	67.0	-33.1
MW-36U	Alluvial	9/27/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	35.1	37.93	(2.8)	NA	NA	44.0	-8.9	54.0	-18.9	57.0	-21.9
MW-37U	Alluvial	11/21/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	32.3	34.90	(2.6)	NA	NA	40.1	-7.8	50.1	-17.8	53.1	-20.8
MW-38U	Alluvial	11/28/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	2	31.8	34.74	(2.9)	NA	NA	50.1	-18.3	60.1	-28.3	63.1	-31.3
PW-1-80	Alluvial	8/9/05	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	10-20	6	32.0	34.07	(2.1)	NA	NA	39.5	-7.5	79.5	-47.5	82.0	-50.0
PW-3-85	Alluvial	6/20/07	-	Cable Tool	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	25.2	26.72	(1.5)	NA	NA	75.0	-49.8	85.0	-59.8	95.0	-69.8
WS-11-125	Alluvial	3/10/03	-	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	33.3	33.06	0.2	NA	NA	109.0	-75.7	124.0	-90.7	125.0	-91.7
WS-11-161	Alluvial	3/10/03	-	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	33.3	33.06	0.2	NA	NA	145.0	-111.7	160.0	-126.7	161.0	-127.7
WS-12-125	Alluvial	9/21/03	-	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	34.5	34.01	0.5	NA	NA	109.0	-74.5	124.0	-89.5	125.0	-90.5
WS-12-161	Alluvial	9/21/03	-	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	34.5	34.02	0.5	NA	NA	145.0	-110.5	160.0	-125.5	161.0	-126.5
WS-14-125	Alluvial	7/9/04	-	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	33.8	33.30	0.5	NA	NA	109.0	-75.2	124.0	-90.2	125.0	-91.2
WS-14-161	Alluvial	7/9/04	-	Sonic	Flush	Continuous wrap stainless steel	0.010	10-20	2	33.8	33.37	0.4	NA	NA	145.0	-111.2	160.0	-126.2	161.0	-127.2
WS-21-112	Alluvial	6/13/06	-	Sonic	Flush	Slotted PVC	0.010	10-20	2	35.4	34.69	0.7	NA	NA	101.0	-65.6	111.0	-75.6	112.0	-76.6
WS-26-86	Alluvial	10/29/08	-	Sonic	Flush	NA	0.010	10-20	2	34.9	34.43	0.5	NA	NA	75.0	-40.1	85.0	-50.1	86.0	-51.1
Existing Observation Well																				
OW-1F	Surficial Fill	3/23/12	-	Sonic	Above-grade	Slotted PVC	0.010	10-20	2	35.3	37.60	(2.3)	NA	NA	30.0	5.3	35.0	0.3	35.3	0.0
OW-2F	Surficial Fill	3/22/12	-	Sonic	Above-grade	Slotted PVC	0.010	10-20	2	34.5	36.86	(2.4)	NA	NA	25.6	8.9	30.6	3.9	30.9	3.6
OW-5F	Surficial Fill	11/29/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	32.2	34.70	(2.5)	NA	NA	28.5	3.7	33.5	-1.3	33.8	-1.6
OW-7-17	Surficial Fill	2/23/10	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	24.2	26.42	(2.2)	NA	NA	12.5	11.7	17.5	6.7	17.7	6.5
OW-8-15	Surficial Fill	2/12/10	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	24.6	26.31	(1.8)	NA	NA	10.1	14.5	15.1	9.5	15.3	9.3
OW-8-28	Alluvial	8/13/10	-	Hollow-Stem Auger	Above-grade	Slotted PVC	0.020	10-20	2	23.8	26.27	(2.5)	NA	NA	23.1	0.7	28.1	-4.3	28.7	-4.9

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OW-9-25	Surficial Fill	3/8/10	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	33.1	35.29	(2.2)	NA	NA	20.0	13.1	25.0	8.1	25.3	7.8
OW-10F	Surficial Fill	9/20/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	30.8	33.75	(3.0)	NA	NA	20.7	10.1	25.7	5.1	26.0	4.8
Existing Extraction Well																				
PW-1U	Alluvial	1/9/13	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	35.0	37.50	(2.5)	52.0	-17.0	55.1	-20.1	70.1	-35.1	75.1	-40.1
PW-1L	Alluvial	1/8/13	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	34.9	37.32	(2.4)	109.6	-74.7	114.8	-79.9	134.8	-99.9	139.6	-104.7
PW-2U	Alluvial	4/25/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	34.5	36.70	(2.2)	55.8	-21.3	57.8	-23.3	72.8	-38.3	5.0	29.5
PW-2L	Alluvial	2/6/13	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	34.5	37.14	(2.6)	114.4	-79.9	120.1	-85.6	140.1	-105.6	145.1	-110.6
PW-2L-A[1]	Alluvial	12/12/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	34.2	36.70	(2.5)	NA	NA	119.8	-85.6	139.8	-105.6	144.8	-110.6
PW-3U	Alluvial	4/11/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	25.6	27.52	(1.9)	41.7	-16.1	42.8	-17.2	57.8	-32.2	62.8	-37.2
PW-3-118	Alluvial	6/13/07	-	Cable Tool	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	25.5	27.01	(1.5)	104.5	-79.0	108.0	-82.5	118.0	-92.5	128.0	-102.5
PW-4U	Alluvial	1/16/13	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	28.3	31.01	(2.7)	43.8	-15.5	47.2	-18.9	62.2	-33.9	67.2	-38.9
PW-4L	Alluvial	1/10/13	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	28.2	30.27	(2.1)	97.4	-69.2	105.4	-77.2	125.4	-97.2	130.4	-102.2
PW-5U	Alluvial	4/20/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	32.5	34.82	(2.3)	47.7	-15.2	49.9	-17.4	64.9	-32.4	69.9	-37.4
PW-5L	Alluvial	1/23/13	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	32.3	34.19	(1.9)	100.6	-68.3	105.7	-73.4	125.7	-93.4	130.7	-98.4
PW-6U	Alluvial	4/17/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	31.5	33.93	(2.4)	48.6	-17.1	49.4	-17.9	64.4	-32.9	69.4	-37.9
PW-6L	Alluvial	11/6/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	31.0	33.32	(2.3)	97.7	-66.7	103.7	-72.7	123.7	-92.7	128.7	-97.7
PW-7-93	Alluvial	2/22/10	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	24.2	26.81	(2.6)	67.4	-43.2	73.5	-49.3	93.5	-69.3	95.5	-71.3
PW-8-39	Alluvial	8/13/10	-	Hollow-Stem Auger	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	23.2	25.75	(2.5)	21.5	1.7	24.2	-1.0	39.2	-16.0	42.2	-19.0
PW-8-68	Alluvial	2/11/10	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	24.6	27.18	(2.5)	43.0	-18.4	48.0	-23.4	68.0	-43.4	70.0	-45.4
PW-9-92	Alluvial	3/1/10	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	8	33.0	35.84	(2.8)	67.7	-34.7	72.6	-39.6	92.6	-59.6	94.6	-61.6
PW-10L	Alluvial	11/12/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	10-20	6	31.5	33.40	(1.9)	58.1	-26.6	59.8	-28.3	79.8	-48.3	84.8	-53.3
PW-10-LA[1]	Alluvial	10/12/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.035	16-30	6	31.4	33.20	(1.8)	NA	NA	60.2	-28.8	80.2	-48.8	85.2	-53.8
PW-11U	Alluvial	1/26/13	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	24.0	26.78	(2.7)	NA	NA	49.8	-25.8	64.8	-40.8	69.8	-45.8
PW-12U	Alluvial	12/21/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	26.2	28.58	(2.4)	NA	NA	47.8	-21.6	62.8	-36.6	67.8	-41.6
PW-13U	Alluvial	12/28/12	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	32.2	34.60	(2.4)	NA	NA	57.6	-25.4	72.6	-40.4	77.6	-45.4
PW-14U	Alluvial	1/14/13	-	Sonic	Above-grade	Continuous wrap stainless steel	0.020	16-30	6	31.9	34.68	(2.7)	NA	NA	57.8	-25.9	67.8	-35.9	72.8	-40.9
Existing Piezometers																				
PZ1-5	Alluvial	3/17/05	-	Manual	Above-grade	Solinst push point	NA	NA	1	10.0	35.98	(26.0)	NA	NA	4.5	5.5	5.4	4.6	5.6	4.3
PZ1-20	Alluvial	3/17/05	-	Manual	Above-grade	Solinst push point	NA	NA	1	10.2	36.34	(26.2)	NA	NA	19.3	-9.2	20.2	-10.1	20.5	-10.3
PZ1-50	Alluvial	11/23/09	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.2	37.58	(27.4)	NA	NA	45.1	-34.9	50.1	-39.9	50.4	-40.2
PZ2-5	Alluvial	3/18/05	-	Manual	Above-grade	Solinst push point	NA	NA	1	2.9	37.83	(34.9)	NA	NA	5.5	-2.6	6.4	-3.5	6.7	-3.8
PZ2-20	Alluvial	3/17/05	-	Manual	Above-grade	Solinst push point	NA	NA	1	3.4	37.81	(34.4)	NA	NA	20.6	-17.2	21.5	-18.1	21.7	-18.4
PZ2-43	Alluvial	12/3/09	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	3.8	37.87	(34.1)	NA	NA	38.3	-34.5	43.3	-39.5	43.6	-39.8
PZ2-77	Alluvial	12/2/09	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	3.1	38.55	(35.5)	NA	NA	71.9	-68.9	76.9	-73.9	77.2	-74.2
PZ4-12	Alluvial	12/4/09	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	-8.6	34.59	(43.2)	NA	NA	6.7	-15.3	11.7	-20.3	12.0	-20.6
PZ4-41	Alluvial	11/24/09	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	-8.3	34.48	(42.8)	NA	NA	36.1	-44.4	41.1	-49.4	41.4	-49.7
PZ5-5	Alluvial	11/20/09	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.7	16.46	(5.7)	NA	NA	3.8	6.9	4.8	5.9	5.0	5.7

Table 1
Well Contruction Details

Well Number	Water-Bearing Zone	Date Installed	Date Decomm-issioned	Installation Method	Monument Type	Screen Type	Slot Size (inches)	Sand Pack (Colorado)	Well Diam. (inches)	Ground Surface (feet COP)	Top of Casing (feet COP)	Top of Casing (feet bgs)	Pump Inlet (feet bgs)	Pump Inlet (feet COP)	Top Screen (feet bgs)	Top Screen (feet COP)	Base Screen (feet bgs)	Base Screen (feet COP)	Well Depth (feet bgs)	Well Depth (feet COP)
PZ5-20	Alluvial	11/20/09	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.8	16.20	(5.4)	NA	NA	15.0	-4.2	20.0	-9.2	20.3	-9.5
PZ5-55	Alluvial	11/20/09	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.9	16.25	(5.4)	NA	NA	50.0	-39.1	55.0	-44.1	55.3	-44.4
PZ5-85	Alluvial	11/19/09	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.9	16.38	(5.5)	NA	NA	79.9	-69.0	84.9	-74.0	85.2	-74.3
PZ6-5	Alluvial	10/17/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	7.8	14.72	(6.9)	NA	NA	3.9	3.9	4.9	2.9	5.0	2.8
PZ6-50	Alluvial	10/17/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	8.1	14.88	(6.8)	NA	NA	45.2	-37.1	50.2	-42.1	50.5	-42.4
PZ6-115	Alluvial	10/18/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	7.4	13.79	(6.3)	NA	NA	110.1	-102.7	115.1	-107.7	115.4	-108.0
PZ6-150	Alluvial	10/26/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	7.7	14.15	(6.4)	NA	NA	145.4	-137.7	150.4	-142.7	150.7	-143.0
PZ7-5	Alluvial	10/22/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.6	16.36	(5.8)	NA	NA	4.1	6.5	5.2	5.4	5.3	5.3
PZ7-50	Alluvial	10/19/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.7	16.40	(5.7)	NA	NA	43.2	-32.5	48.2	-37.5	48.5	-37.8
PZ7-100	Alluvial	10/23/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	9.9	16.13	(6.2)	NA	NA	94.3	-84.4	99.3	-89.4	99.6	-89.7
PZ7-150	Alluvial	10/31/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	10.0	15.50	(5.5)	NA	NA	145.3	-135.3	150.3	-140.3	150.6	-140.6
PZ8-5	Alluvial	10/9/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	6.8	12.21	(5.4)	NA	NA	4.5	2.3	5.4	1.4	5.5	1.3
PZ8-50	Alluvial	10/9/12	-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	6.9	12.45	(5.5)	NA	NA	44.7	-37.8	49.7	-42.8	50.0	-43.1
Stilling Well Up	Willamette River	5/23/13	-	Manual	NA	NA	NA	NA	2	-8.6	34.41	(43.0)	NA	NA	NA	NA	NA	NA	NA	NA
Stilling Well Down	Willamette River	5/23/13	-	Manual	NA	NA	NA	NA	2	-8.6	34.39	(43.0)	NA	NA	NA	NA	NA	NA	NA	NA
Proposed Piezometers																				
PZ9-5	Alluvial		-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	9.0	15.00	(6.0)	NA	NA	4.0	5.0	5.0	4.0	5.5	3.5
PZ9-50	Alluvial		-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	9.0	15.00	(6.0)	NA	NA	45.0	-36.0	50.0	-41.0	50.5	-41.5
PZ9-75	Alluvial		-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	9.0	15.00	(6.0)	NA	NA	69.0	-60.0	74.0	-65.0	74.5	-65.5
PZ9-110	Alluvial		-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	9.0	15.00	(6.0)	NA	NA	105.0	-96.0	110.0	-101.0	110.5	-101.5
PZ9-150	Alluvial		-	Sonic	Above-grade	Slotted PVC	0.020	10-20	2	9.0	15.00	(6.0)	NA	NA	145.0	-136.0	150.0	-141.0	150.5	-141.5
Decommissioned Wells																				
PZ-PW2	Alluvial	3/21/12	9/25/12	Sonic	Above-grade	Slotted PVC	0.010	10-20	2	34.4	37.11	(2.8)	NA	NA	63.8	-29.4	68.8	-34.4	69.1	-34.7
PZ-PW3	Alluvial	3/19/12	9/24/12	Sonic	Above-grade	Slotted PVC	0.010	10-20	2	25.3	27.41	(2.1)	NA	NA	50.3	-25.0	55.3	-30.0	55.6	-30.3
MW-17-79	Alluvial	7/26/05	9/28/12	Sonic	Above-grade	Continuous wrap stainless steel	0.010	10-20	2	32.6	34.83	(2.3)	NA	NA	38.5	-5.9	78.5	-45.9	80.5	-47.9
MW-16-125	Alluvial	7/15/04	4/26/10	Sonic	Above-grade	Slotted stainless steel	0.010	10-20	2	30.5	33.18	(2.7)	NA	NA	115.0	-84.5	125.0	-94.5	127.5	-97.0

Notes:
1 = to be abandoned
bgs = below ground surface
btc = below top of casing
COP = City of Portland Datum
NA = not applicable
nd = no data
ns = not surveyed
PVC = polyvinyl chloride

Table 2
Source Control Monitoring Plan

Well ID	Water-Bearing Zone	Estimated Relative Efficiency	Data Collection Objectives	Monitoring Water Level Transducer[6]	Controlling Water Level Transducer	Extraction Wells associated with each Control Well	Transducer Connected to Logic and Logging System	Sampling Program[1]	Source Control Sampling Program		
								Semi-Annual	Tiered[2]	Semi-Annual[1]	DNAPL Monitoring[5]
Shoreline Monitoring Wells											
MW-1-22	Surficial Fill	M	A, F					X		X	
MW-1-55	Upper Alluvium	L	B, F	X[9]				X		X	
MW-1-82	Lower Alluvium	H	C, F	X[9]				X		X	
MW-2-32	Surficial Fill	M	A, F					X		X	
MW-2-61	Upper Alluvium	L	B, F					X		X	
MW-2-104	Lower Alluvium	H	C, F					X		X	
MW-3-26	Surficial Fill	M	A, F					X		X	X
MW-3-56	Upper Alluvium	L	B, F					X		X	X
MW-4-35	Fill/Upper Alluvium	M	A, F					X		X	X
MW-4-57	Upper Alluvium	L	B	X				X		X	X
MW-4-101	Lower Alluvium	H	C, F					X		X	X
MW-5-32	Fill/Upper Alluvium	L	B, F	X				X		X	X
MW-5-100	Upper Alluvium	H	B, F					X		X	X
MW-5-175	Deep Alluvium	H	C, F	X				X		X	X
MW-16-45	Upper Alluvium	L	B	X[9]				NS		NS	X
MW-16-65	Upper Alluvium	L	B, F	X[9]				X		X	X
MW-18-30	Surficial Fill	M	A	X				NS		NS	X
MW-18-125	Lower Alluvium	H	C, F	X[9]				X		X	X
MW-18-180	Deep Alluvium	H	D, F	X[9]				X		X	X
MW-19-22	Surficial Fill	M	A, F	X				X		X	X
MW-19-125	Lower Alluvium	H	C, F	X[9]				X		X	X
MW-19-180	Deep Alluvium	H	D, F	X[9]				X		X	X
MW-20-120	Lower Alluvium	H	C, F					X		X	X
MW-21-12	Surficial Fill	M	A, F					X		X	
MW-21U	Upper Alluvium	L	B, F	X				NS		X[3]	
MW-21-75	Lower Alluvium	H	C		X[9]	PW-8-68	X	X		NS[4]	
MW-21-115	Lower Alluvium	H	C, F	X[9]				X		X	
MW-21-165	Deep Alluvium	H	D, F	X[9]				X		X	
MW-22U	Upper Alluvium	L	B, F	X				NS		X[3]	
MW-22-80	Lower Alluvium	H	C		X	PW-10L	X	NS		NS[4]	
MW-23-27	Surficial Fill	M	A, F					NS		X[3]	
MW-23U	Upper Alluvium	L	B, F	X				NS		X[3]	
MW-23-75	Lower Alluvium	L	C		X	PW-9-92	X	NS		NS[4]	
MW-23-123	Lower Alluvium	H	C, F					NS		X[3]	
MW-24-70	Upper Alluvium	L	B					NS		X[3]	X
MW-24-130	Lower Alluvium	H	C		X	PW-7-93	X	NS		NS[4]	X
MW-25L	Lower Alluvium	H	C		X		X	NS		X[3]	

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Well ID	Water-Bearing Zone	Estimated Relative Efficiency	Data Collection Objectives	Monitoring Water Level Transducer[6]	Controlling Water Level Transducer	Extraction Wells associated with each Control Well	Transducer Connected to Logic and Logging System	Sampling Program[1]	Source Control Sampling Program		
								Semi-Annual	Tiered[2]	Semi-Annual[1]	DNAPL Monitoring[5]
MW-26U	Upper Alluvium	L	B		X	PW-6U	X	NS		NS[4]	X
MW-27L	Lower Alluvium	H	C		X	PW-6L	X	NS		NS[4]	X
MW-27U	Upper Alluvium	L	B, F	X				NS		X[3]	X
MW-28L	Lower Alluvium	H	C		X	PW-5-L	X	NS		NS[4]	X
MW-28U	Upper Alluvium	L	B, F	X				NS		X[3]	X
MW-29U	Upper Alluvium	L	B		X	PW-13U	X	NS		NS[4]	X
MW-30U	Upper Alluvium	L	B		X[9]	PW-4U	X	NS		NS[4]	X
MW-31L	Lower Alluvium	H	C		X	PW-4L	X	NS		NS[4]	X
MW-31U	Upper Alluvium	L	B, F	X				NS		X[3]	X
MW-32U	Upper Alluvium	L	B		X	PW-12U	X	NS		NS[4]	X
MW-33U	Upper Alluvium	L	B		X	PW-3U	X	NS		NS[4]	X
MW-34L	Lower Alluvium	H	C		X	PW-3-118	X	NS		NS[4]	X
MW-34U	Upper Alluvium	L	B, F	X				NS		X[3]	X
MW-35U	Upper Alluvium	L	B		X	PW-11U	X	NS		NS[4]	X
MW-36U	Upper Alluvium	L	B		X	PW-2U	X	NS		NS[4]	X
MW-37U	Upper Alluvium	L	B		X	PW-14U	X	NS		NS[4]	X
MW-38U	Upper Alluvium	L	B		X	PW-5U	X	NS		NS[4]	X
PW-1-80	Upper Alluvium	L	B					NS		NS	X
PW-3-85	Upper Alluvium	L	B, F	X				NS		X	X
Shoreline Monitoring Well Total				**23**	**18**		**18**	**25**	**0**	**36**	**38**
Monitored Siltronic Wells											
WS-8-33	Surficial Fill	M	A	X				X		NS	
WS-8-59	Upper Alluvium	L	B	X[9]				X		NS	
WS-11-161	Deep Alluvium	H	D, F	X				X		X	X
WS-12-125	Lower Alluvium	H	D, F		X[9]	PW-1L	X	X		NS[4]	
WS-12-161	Deep Alluvium	H	D	X[9]				X		NS	
WS-14-161	Deep Alluvium	H	D, F	X				X		X	X
WS-21-112	Lower Alluvium	H	C		X	PW-2L	X	X		NS[4]	X
WS-26-86	Upper Alluvium	L	B, F		X	PW-1U	X	X		NS[4]	
Monitored Siltronic Well Total				**5**	**3**		**3**	**8**	**0**	**2**	**3**

Table 2
Source Control Monitoring Plan

Well ID	Water-Bearing Zone	Estimated Relative Efficiency	Data Collection Objectives	Monitoring Water Level Transducer[6]	Controlling Water Level Transducer	Extraction Wells associated with each Control Well	Transducer Connected to Logic and Logging System	Sampling Program[1]	Source Control Sampling Program		
								Semi-Annual	Tiered[2]	Semi-Annual[1]	DNAPL Monitoring[5]
Observation Wells											
OW-1F	Surficial Fill	M	A, F	X				NS		X[3]	
OW-2F	Surficial Fill	M	A, F	X				NS		X[3]	X
OW-5F	Surficial Fill	M	A, F	X				NS		X[3]	X
OW-7-17	Surficial Fill	M	A, F	X				NS		X[3]	
OW-8-15	Surficial Fill	M	A, F	X				NS		X[3]	
OW-8-28	Upper Alluvium	M	B, F					NS		X[3]	
OW-9-25	Surficial Fill	M	A, F	X				NS		X[3]	
OW-10F	Surficial Fill	M	A, F	X				NS		X[3]	
Observation Well Total				**7**	**0**		**0**	**0**	**0**	**8**	**2**
Extraction Wells											
PW-1L	Lower Alluvium	H	C, F	X[7]			X	NS	X		
PW-1U	Upper Alluvium	L	B, F	X			X	NS	X		
PW-2L	Lower Alluvium	H	C, F	X[7]			X	NS	X		X
PW-2U	Upper Alluvium	L	B, F	X			X	NS	X		X
PW-3-118	Lower Alluvium	H	C, F	X[7]			X	NS	X		X
PW-3U	Upper Alluvium	L	B, F	X			X	NS	X		X
PW-4L	Lower Alluvium	H	C, F	X[7]			X	NS	X		X
PW-4U	Upper Alluvium	L	B, F	X			X	NS	X		X
PW-5L	Lower Alluvium	H	C, F	X[7]			X	NS	X		X
PW-5U	Upper Alluvium	L	B, F	X			X	NS	X		X
PW-6L	Lower Alluvium	H	C, F	X[7]			X	NS	X		X
PW-6U	Upper Alluvium	L	B, F	X			X	NS	X		X
PW-7-93	Lower Alluvium	H	C, F	X[7]			X	NS	X		
PW-8-39	Upper Alluvium	H	B, F	X			X	NS	X		
PW-8-68	Lower Alluvium	H	C, F	X			X	NS	X		
PW-9-92	Lower Alluvium	H	C, F	X[7]			X	NS	X		
PW-10L	Lower Alluvium	H	C, F	X[7]			X	NS	X		
PW-11U	Upper Alluvium	L	B, F	X			X	NS	X		X
PW-12U	Upper Alluvium	L	B, F	X			X	NS	X		X
PW-13U	Upper Alluvium	L	B, F	X			X	NS	X		X
PW-14U	Upper Alluvium	L	B, F	X			X	NS	X		X
Extraction Well Total				**21**	**0**		**21**	**0**	**21**	**0**	**14**

Table 2
Source Control Monitoring Plan

Well ID	Water-Bearing Zone	Estimated Relative Efficiency	Data Collection Objectives	Monitoring Water Level Transducer[6]	Controlling Water Level Transducer	Extraction Wells associated with each Control Well	Transducer Connected to Logic and Logging System	Sampling Program[1]	Source Control Sampling Program		
								Semi-Annual	Tiered[2]	Semi-Annual[1]	DNAPL Monitoring[5]
Piezometers											
PZ1-5	Surficial Fill	M	A,E	X			X	NS		NS	
PZ1-20	Upper Alluvium	L	B,E	X[9]			X	NS		NS	
PZ1-50	Lower Alluvium	H	C,E	X			X	NS		NS	
PZ2-5	Surficial Fill	M	A,E	X[8]			X	NS		NS	
PZ2-20	Upper Alluvium	L	B,E	X[8,9]			X	NS		NS	
PZ2-43	Lower Alluvium	H	C,E	X[8]			X	NS		NS	
PZ2-77	Lower Alluvium	H	C,E	X[8]			X	NS		NS	
PZ4-12	Upper Alluvium	L	A,E	X[9]			X	NS		NS	
PZ4-41	Lower Alluvium	H	B,E	X[9]			X	NS		NS	
PZ5-5	Surficial Fill	M	A,E,F	X				NS		X[3]	
PZ5-20	Upper Alluvium	L	B,E,F	X				NS		X[3]	
PZ5-55	Upper Alluvium	H	C,E,F	X				NS		X[3]	
PZ5-85	Lower Alluvium	H	C,E,F	X				NS		X[3]	
PZ6-5	Surficial Fill	M	A,E,F	X[9]				NS		X[3]	X
PZ6-50	Upper Alluvium	L	B,E,F	X				NS		X[3]	X
PZ6-115	Lower Alluvium	H	C,E,F	X				NS		X[3]	X
PZ6-150	Deep Alluvium	H	D,E,F	X[9]				NS		X[3]	X
PZ7-5	Surficial Fill	M	A,E,F	X[8,9]				NS		X[3]	X
PZ7-50	Upper Alluvium	L	B,E,F	X[8]				NS		X[3]	X
PZ7-100	Lower Alluvium	H	C,E,F	X[8]				NS		X[3]	X
PZ7-150	Deep Alluvium	H	D,E,F	X[9]				NS		X[3]	X
PZ8-5	Surficial Fill	M	A,E,F	X[8,9]				NS		X[3]	
PZ8-50	Upper Alluvium	H	B,E,F	X[8]				NS		X[3]	
Piezometer Total				**23**	**0**		**9**	**0**	**0**	**14**	**8**
Proposed Piezometers											
PZ9-5	Surficial Fill	M	A,E,F	X[8]				NS		X[3]	X
PZ9-50	Upper Alluvium	L	B,E,F	X[8]				NS		X[3]	X
PZ9-75	Deep Alluvium	L	C,E,F	X[8]				NS		X[3]	X
PZ9-110	Deep Alluvium	H	C,E,F	X				NS		X[3]	X
PZ9-150	Deep Alluvium	H	D,E,F	X				NS		X[3]	X
Proposed Piezometer Total				**5**	**0**		**0**	**0**	**0**	**5**	**5**
Total (all wells and piezometers)				**84**	**21**		**51**	**33**	**21**	**65**	**70**

Table 2
Source Control Monitoring Plan

Notes:

NS = not sampled

A = Used to monitor groundwater elevation and evaluate extent of groundwater capture in the surficial fill.

B = Used to monitor groundwater elevation and evaluate extent of groundwater capture in the Upper Alluvium.

C = Used to monitor groundwater elevation and evaluate extent of groundwater capture in the Lower Alluvium.

D = Used to monitor groundwater elevation and evaluate extent of groundwater capture in the Lower Alluvium below the aquitard.

E = Shoreline and/or offshore piezometer to monitor groundwater elevation and extent of groundwater capture in nearshore river sediments.

F = Will be used to monitor changes in groundwater quality parameters and chemistry over time during HC&C system operation.

L = Estimated to have low hydraulic efficiency (typically screened in Upper Alluvium). Designation may change based on the results of Phase 1 testing.

H = Estimated to have high hydraulic efficiency (typically screened in Lower Alluvium). Designation may change based on the results of Phase 1 testing.

M = estimated to have minimal hydraulic efficiency (typically screened in fill). Designation may change based on the results of Phase 1 testing.

1 = During the first year of testing, the two semi-annual sampling events will occur within 6 months of the start of Phase 1 testing. Wells with measurable DNAPL will not be sampled.

2 = Tiered Monitoring Program entails monthly sampling for 1 year beginning with Phase 2 testing.

3 = Newly constructed wells, with the exception of control wells, will be sampled for four consecutive quarters, including the semi-annual sampling events.

4 = Control wells cannot be sampled without disruption to the pumping of the associated pumping well it controls. Newly installed wells will be initially sampled following well installation and development.

5 = Wells will be gaged for DNAPL daily at startup of Phase 1 pumping for 1 week, weekly for the next 3 weeks, every other week for the remainder of the first quarter, monthly until the completion of 1 year, and then following the monitoring program discussed above. At the completion of the first Phase 1 test, a plan will be developed for the remainder of Phase 1 testing, and this plan may be modified. Control wells will not be gaged while the system is operating in level control.

6 = Unless otherwise indicated, a 30 PSI LevelTroll 500 series transducer will be installed.

7 = 100 PSI LevelTroll 500 series transducer will be installed.

8 = AquaTroll series transducer will be installed that will additionally monitor temperature and specific conductance.

9 = Transducer set up with a 1 minute logging interval at the request of DEQ

DNAPL = dense nonaqueous phase liquid

HC&C = hydraulic control and containment

FIGURES

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Pumping Wells

- Upper Alluvium
- Lower Alluvium

Monitoring Wells

- Fill
- Upper Alluvium
- Lower Alluvium
- Deep Lower Alluvium

NOTES:
Not all of the wells are labeled on this drawing due to space limitations, but they are all labeled on figures 1.2 through 1.5

Feet
0 100 200

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Figure 1.1
Locations of Monitoring Wells
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

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Pumping Wells

- Upper Alluvium
- Lower Alluvium

Monitoring Wells

- Fill

Feet
0 100 200

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Figure 1.2
Locations of Monitoring Wells
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\GIS\EECA_BaseMap.mxd bgong 3/26/2014 3:43:50 PM

Pumping Wells

- Upper Alluvium
- Lower Alluvium

Monitoring Wells

- Upper Alluvium

Feet

0 100 200

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Figure 1.3
Locations of Monitoring Wells
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

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Pumping Wells

- Upper Alluvium
- Lower Alluvium

Monitoring Wells

- Lower Alluvium

Feet

0 100 200

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Figure 1.4
Locations of Monitoring Wells
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

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Pumping Wells

- Upper Alluvium
- Lower Alluvium

Monitoring Wells

- Deep Lower Alluvium

Feet

0 100 200

ANCHOR QEA

Figure 1.5
Locations of Monitoring Wells
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

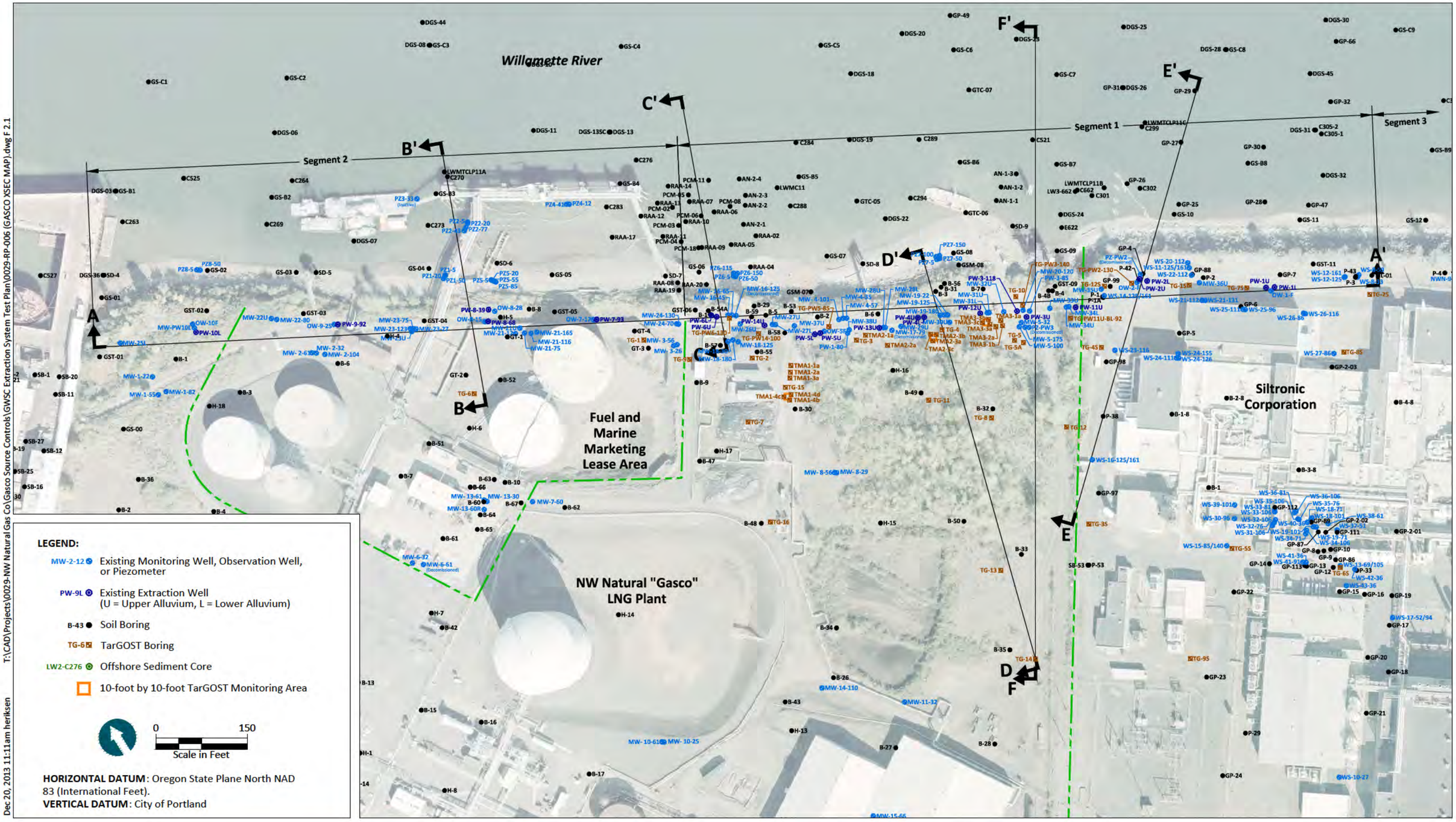

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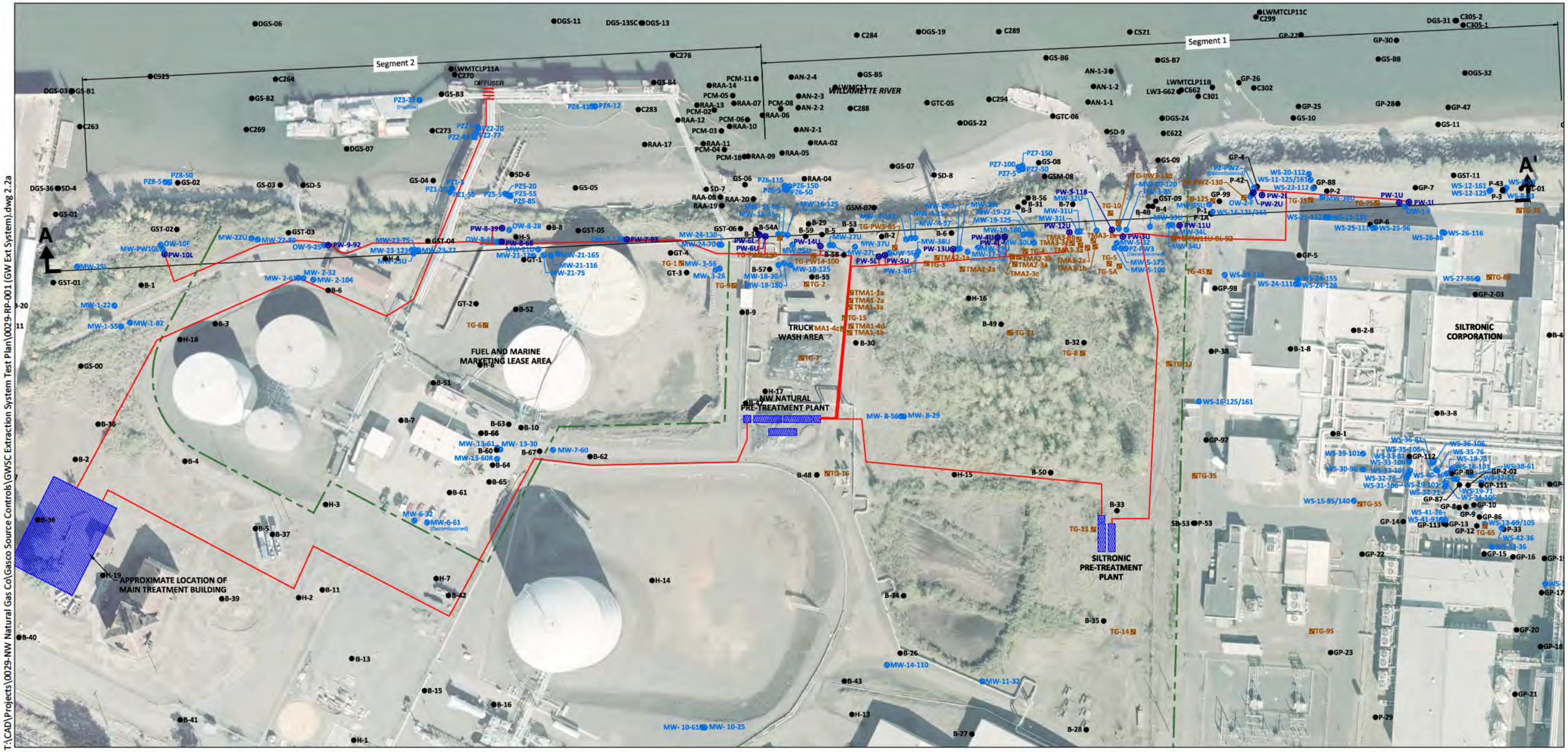
Figure 2.1
Monitoring Well and Cross Section Location Map
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



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Dec 20, 2013 11:15am heriksen

LEGEND:

- MW-2-32 — Existing Monitoring Well, Observation Well, or Piezometer
- PW-8-39 — Existing Extraction Well (U = Upper Alluvium, L = Lower Alluvium)
- TG-6 — TarGOST Boring
- GTC-05 — Sediment Sample or Soil Boring
- Source Control Main Pipeline Route

0 140
Scale in Feet

HORIZONTAL DATUM: Oregon State Plane North NAD 83 (International Feet).

VERTICAL DATUM: City of Portland

NOTE: Drawing prepared from CAD file provided by Advanced Remediation Technologies Co, dated January 5, 2012.

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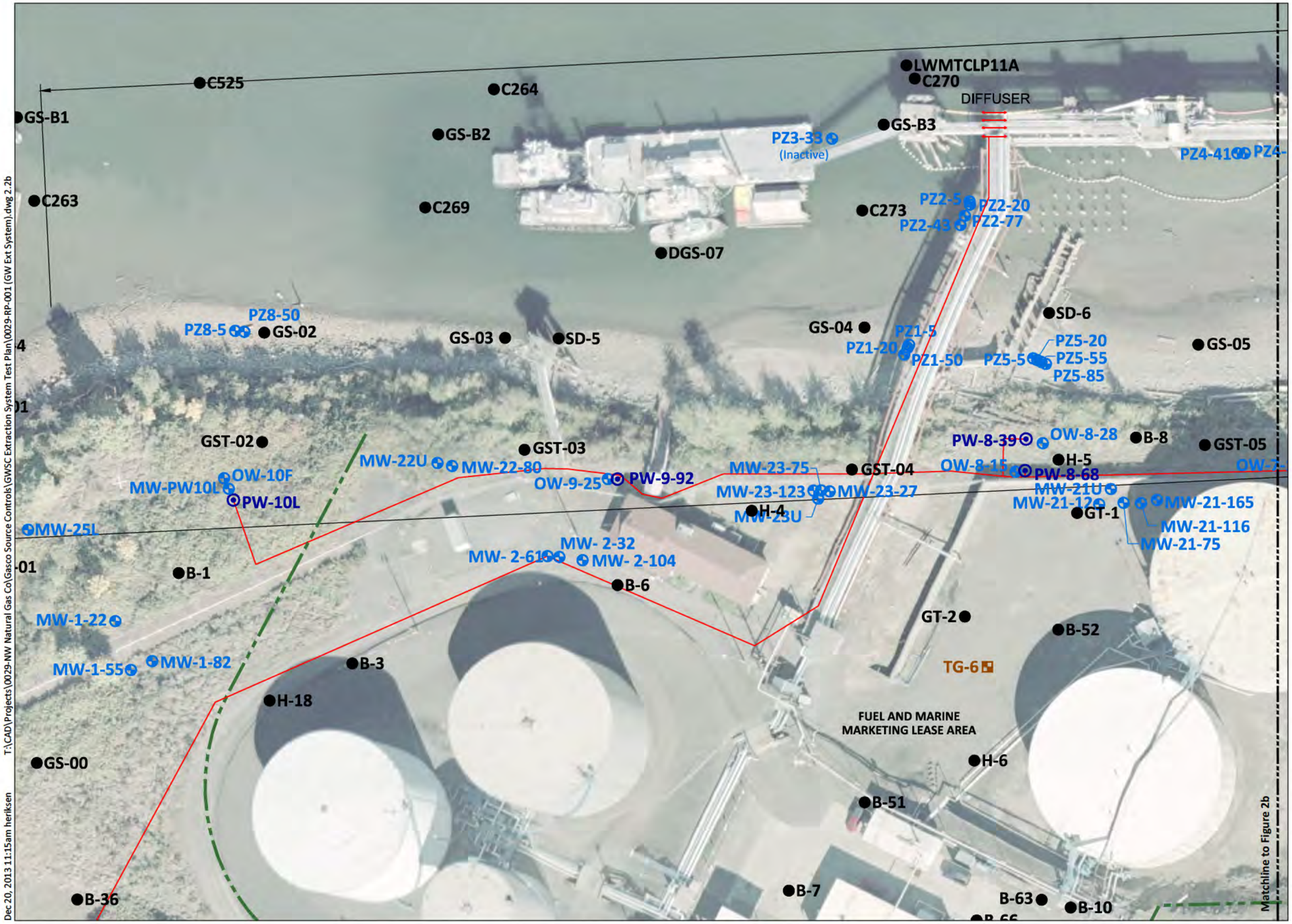
Figure 2.2a
Map of Groundwater Extraction and Treatment System
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- MW-2-32 — Existing Monitoring Well, Observation Well, or Piezometer
- PW-8-39 — Existing Extraction Well (U = Upper Alluvium, L = Lower Alluvium)
- TG-6 — TarGOST Boring
- GTC-05 — Sediment Sample or Soil Boring
- Source Control Main Pipeline Route

0 60
Scale in Feet

HORIZONTAL DATUM: Oregon State Plane North NAD 83 (International Feet).

VERTICAL DATUM: City of Portland

NOTE: Drawing prepared from CAD file provided by Advanced Remediation Technologies Co, dated January 5, 2012.

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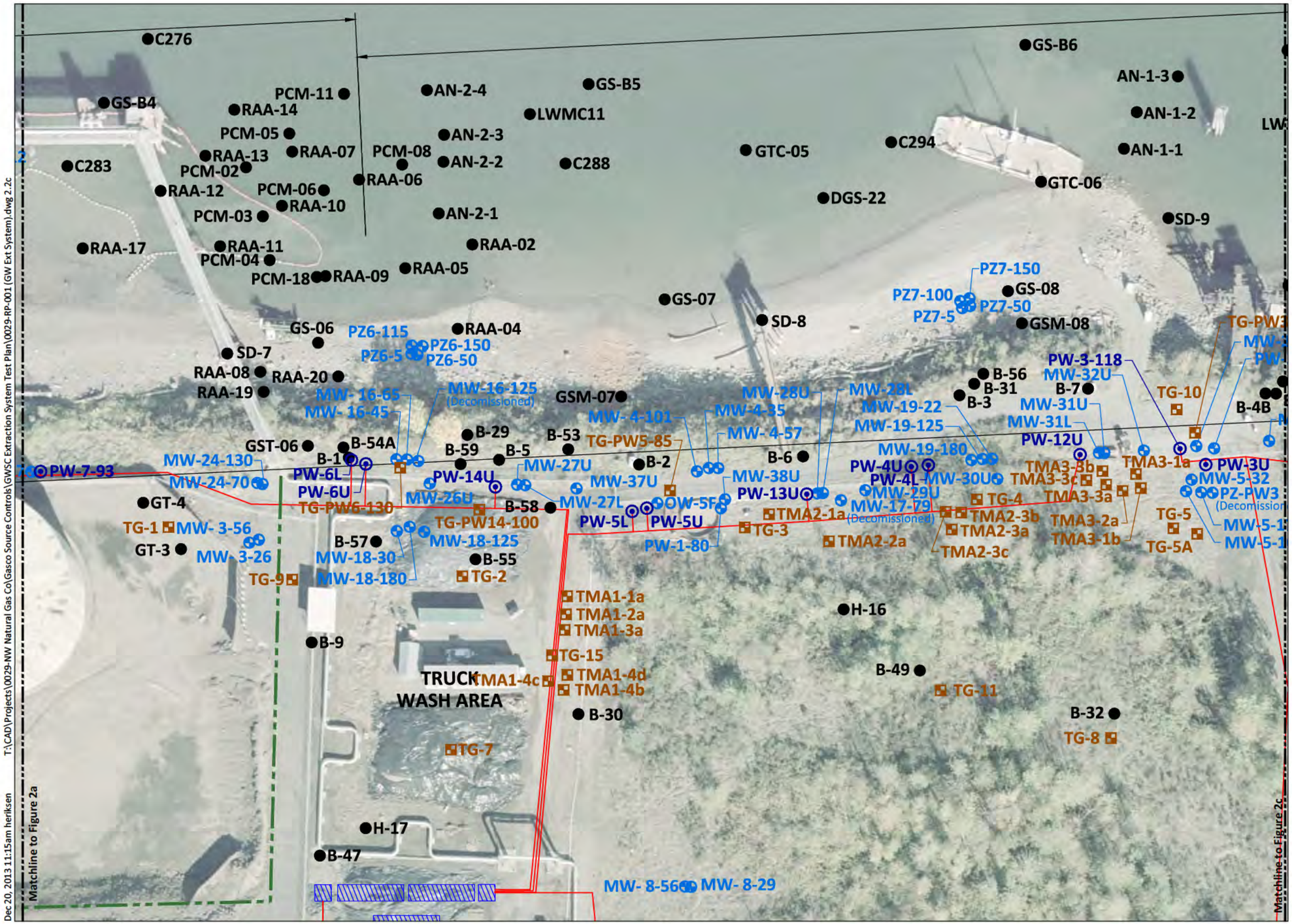
ANCHOR QEA

Figure 2.2b
Map of Groundwater Extraction and Treatment System
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- MW-2-32 — Existing Monitoring Well, Observation Well, or Piezometer
- PW-8-39 — Existing Extraction Well (U = Upper Alluvium, L = Lower Alluvium)
- TG-6 — TarGOST Boring
- GTC-05 — Sediment Sample or Soil Boring
- Source Control Main Pipeline Route

0 60
Scale in Feet

HORIZONTAL DATUM: Oregon State Plane North NAD 83 (International Feet).

VERTICAL DATUM: City of Portland

NOTE: Drawing prepared from CAD file provided by Advanced Remediation Technologies Co, dated January 5, 2012.

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Figure 2.2c
Map of Groundwater Extraction and Treatment System
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

LEGEND:

- MW-2-32 — Existing Monitoring Well, Observation Well, or Piezometer
- PW-8-39 — Existing Extraction Well (U = Upper Alluvium, L = Lower Alluvium)
- TG-6 — TarGOST Boring
- GTC-05 — Sediment Sample or Soil Boring
- Source Control Main Pipeline Route

0 60
Scale in Feet

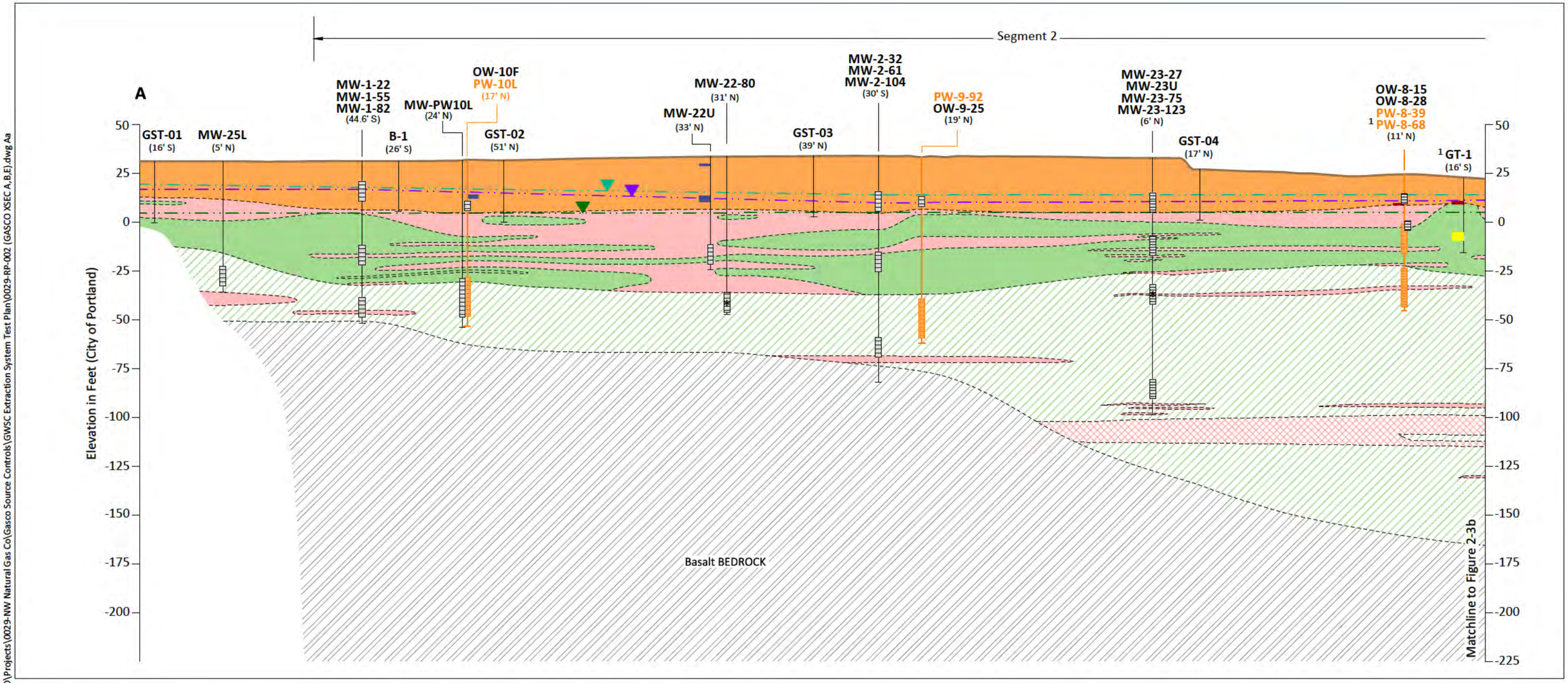
HORIZONTAL DATUM: Oregon State Plane North NAD 83 (International Feet).

VERTICAL DATUM: City of Portland

NOTE: Drawing prepared from CAD file provided by Advanced Remediation Technologies Co, dated January 5, 2012.

ANCHOR QEA

Figure 2.2d
Map of Groundwater Extraction and Treatment System
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** - Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** - Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- **Lower Alluvium WBZ** - Primarily medium grained SAND with generally less than 5% fines.
- **Aquitard** - Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Basalt BEDROCK
- Potentiometric Surface of Surficial Fill (measured June 3, 2009)
- Potentiometric Surface of Surficial Fill (measured August 5, 2009)
- Potentiometric Surface of Alluvium (measured August 5, 2009)
- Existing Ground Surface

MW-21-16 — Boring ID
(57' E) — Offset Distance in Feet

Existing Extraction Well
Existing Well or Piezometer

- Tar Interval
- Oil or Mixed Oil and Tar Interval
- Sheen Interval
- Well Screen
- * — Control Well

0 50
Scale in Feet

NOTE: Geologic contacts are inferred between borings.
[1] Based on visual observations and analytical testing conducted by Hahn and Associates (Remedial Investigation Report, Hahn and Associates, April 2007), the oil and sheen detected in the fill unit does not appear to be MGP-related, but appears to be associated with petroleum products stored in the FAMM storage tanks.

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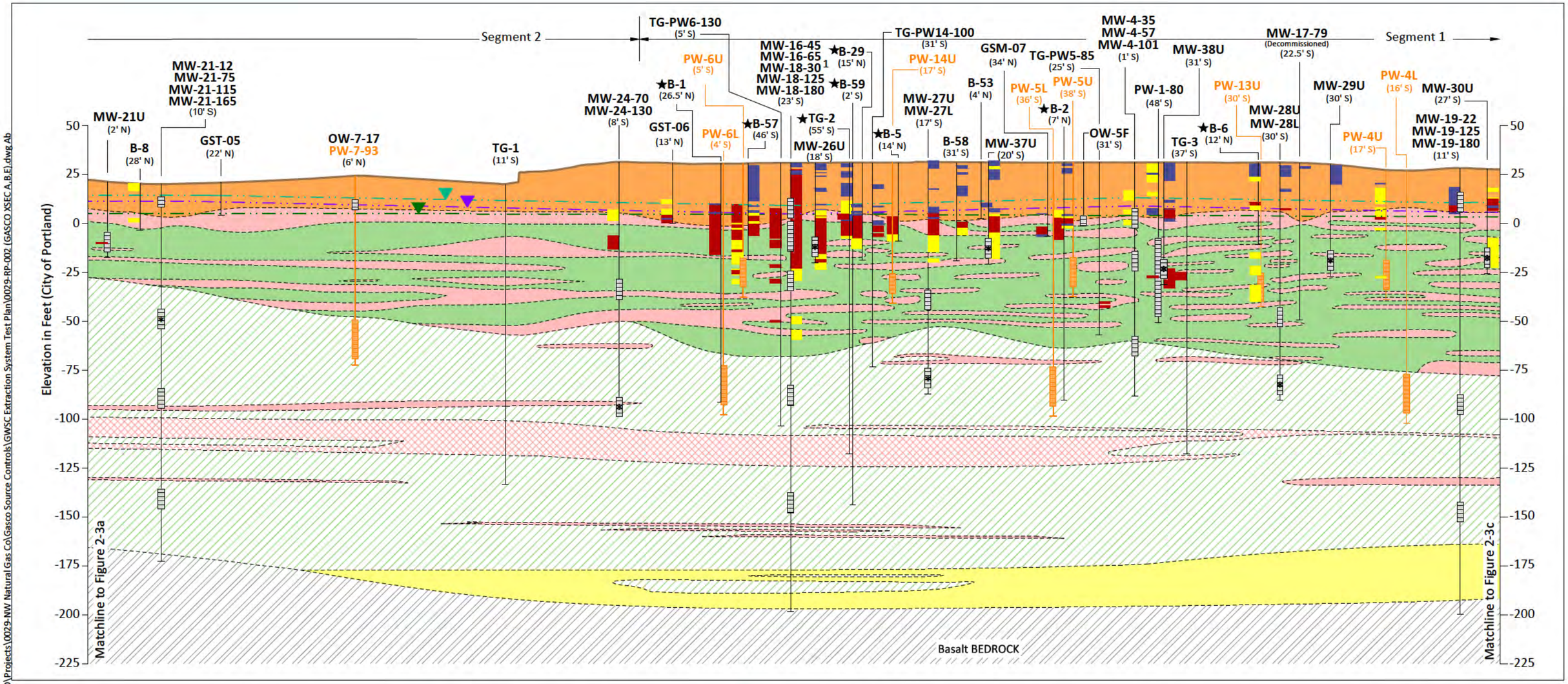
Figure 2.3a
Geologic Cross Section A-A'
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** - Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** - Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- **Lower Alluvium WBZ** - Primarily medium grained SAND with generally less than 5% fines.
- **Aquitard** - Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Basalt BEDROCK
- Potentiometric Surface of Surficial Fill (measured June 3, 2009)
- Potentiometric Surface of Surficial Fill (measured August 5, 2009)
- Potentiometric Surface of Alluvium (measured August 5, 2009)
- Existing Ground Surface

MW-21-16 — Boring ID
(57' E) — Offset Distance in Feet

Existing Extraction Well
Existing Well or Piezometer
— Tar Interval
— Oil or Mixed Oil and Tar Interval
— Sheen Interval
— Well Screen

* — Control Well

0 50
Scale in Feet

NOTE: Geologic contacts are inferred between borings.

★ Not used for geologic interpretation.

1 Data from MW-18-125 used for geologic interpretation from ground surface to -94 feet elevation. Data from MW-18-180 used for geologic interpretation from -94 to -198 feet elevation.

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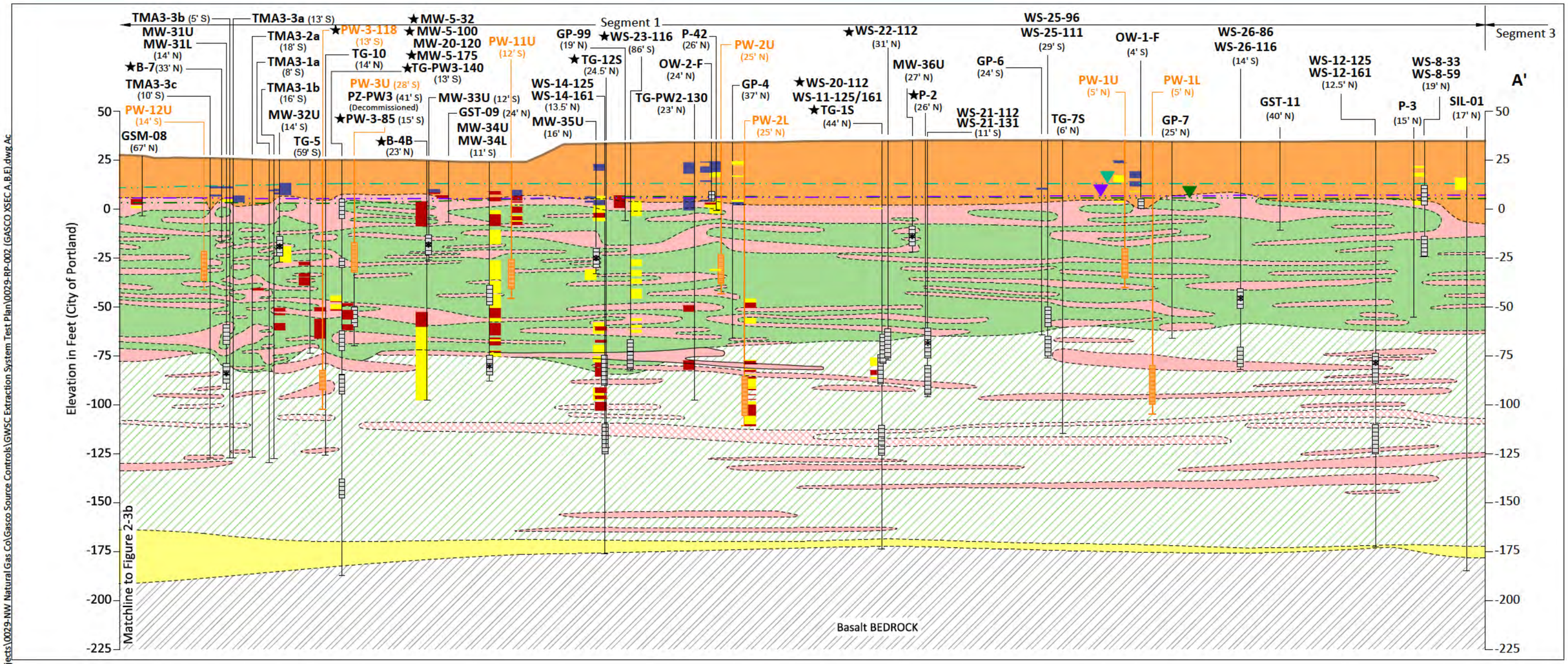
ANCHOR QEA

Figure 2.3b
Geologic Cross Section A-A'
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** - Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** - Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- **Lower Alluvium WBZ** - Primarily medium grained SAND with generally less than 5% fines.
- **Aquitard** - Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Basalt BEDROCK
- Potentiometric Surface of Surficial Fill (measured June 3, 2009)
- Potentiometric Surface of Surficial Fill (measured August 5, 2009)
- Potentiometric Surface of Alluvium (measured August 5, 2009)
- Existing Ground Surface

MW-21-16 — Boring ID
(57' E) — Offset Distance in Feet

Existing Extraction Well
Existing Well or Piezometer

- Tar Interval
- Oil or Mixed Oil and Tar Interval
- Sheen Interval
- Well Screen
- * — Control Well

0 50
Scale in Feet

NOTE: Geologic contacts are inferred between borings.

★ Not used for geologic interpretation.

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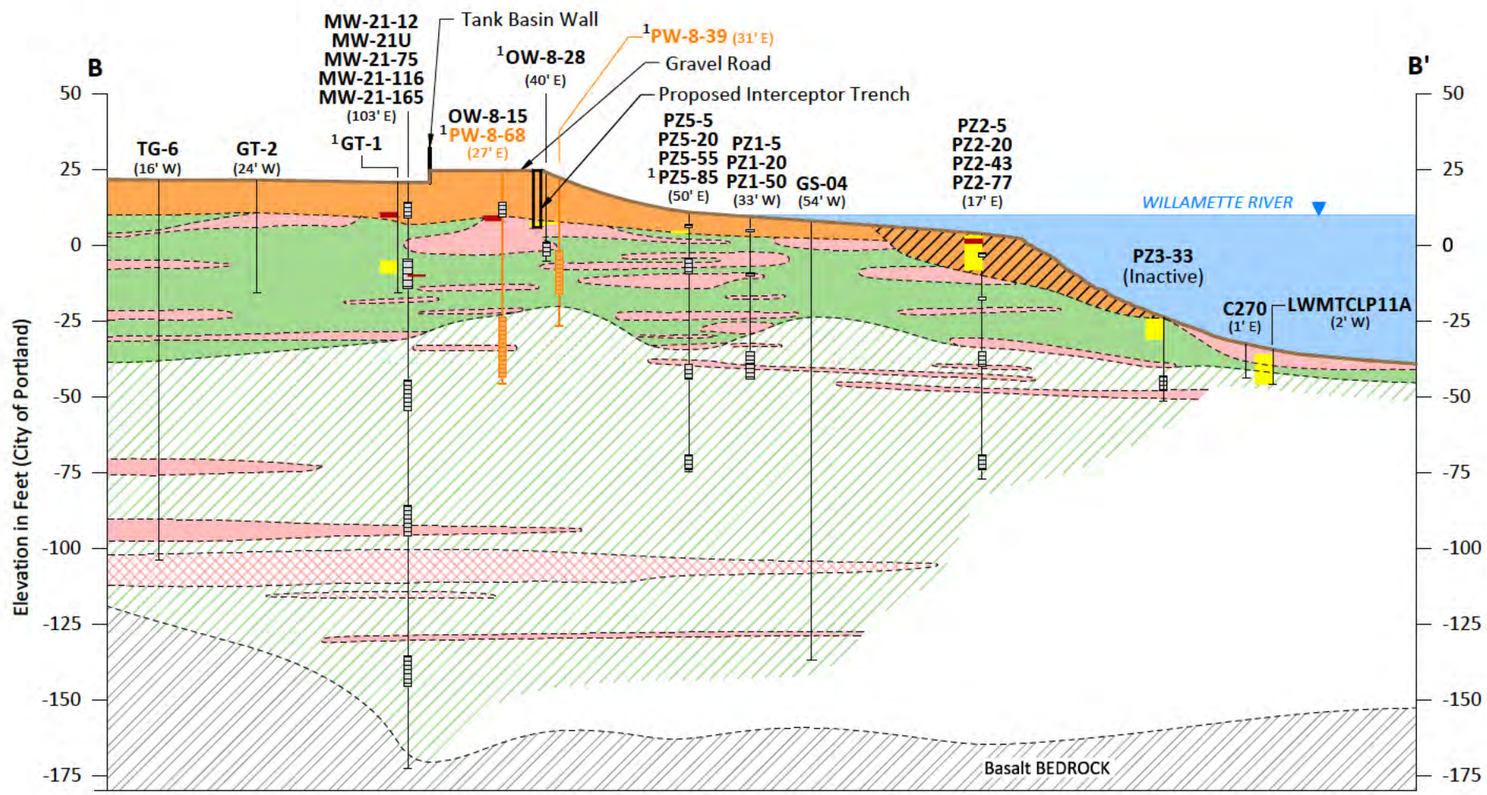
Figure 2-3c
Geologic Cross Section A-A'
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** - Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** - Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- **Lower Alluvium WBZ** - Primarily medium grained SAND with generally less than 5% fines.
- **Aquitard** - Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Basalt BEDROCK
- SAND and SILT mixed with wood chips and anthropogenic material (wood, metal, cardboard)
- Existing Ground Surface
- Approximate Willamette River Elevation

TG-6 — Boring ID
(16' W) — Offset Distance in Feet

Existing Extraction Well
Existing Well or Piezometer

- Tar Interval
- Oil or Mixed Oil and Tar Interval
- Sheen Interval
- Well Screen

0 50
Scale in Feet

NOTE: Geologic contacts are inferred between borings.
[1] Based on visual observations and analytical testing conducted by Hahn and Associates (Remedial Investigation Report, Hahn and Associates, April 2007), the oil and sheen detected in the fill unit does not appear to be MGP-related, but appears to be associated with petroleum products stored in the FAMM storage tanks.

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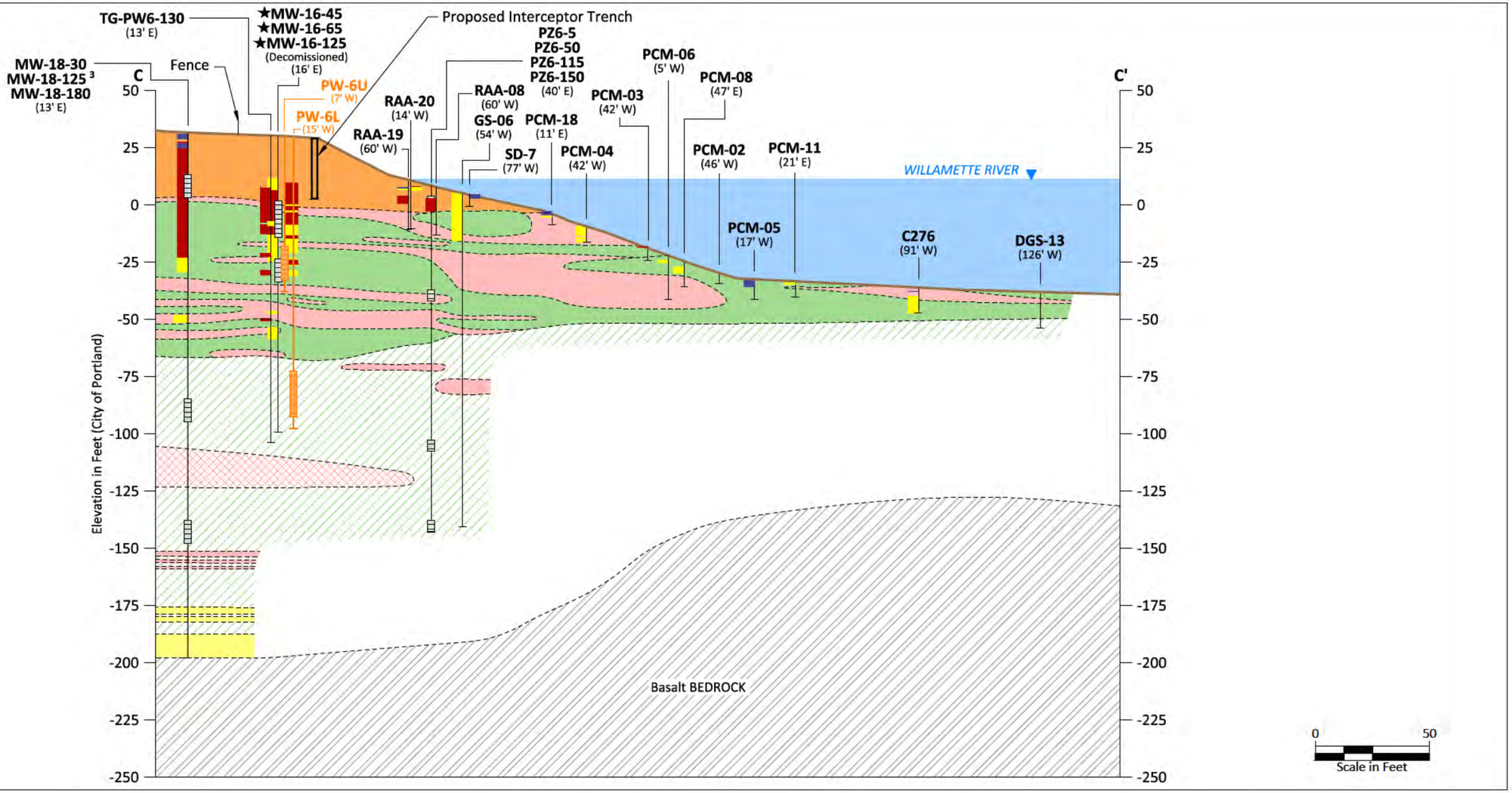
Figure 2.4
Geologic Cross Section B-B'
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** - Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** - Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- **Lower Alluvium WBZ** - Primarily medium grained SAND with generally less than 5% fines.
- **Aquitard** - Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Basalt BEDROCK
- Existing Ground Surface
- Approximate Willamette River Elevation

GS-06 — Boring ID
(54' W) — Offset Distance in Feet

Soil Boring or Sediment Core
Existing Extraction Well
Existing Well or Piezometer

- Tar Interval
- Oil or Mixed Oil and Tar Interval
- Sheen Interval
- Well Screen

NOTES:

1. Geologic contacts are inferred between borings.
2. Tar interval in SD-7 is approximately 3 feet higher in elevation than shown on cross section.
3. MW-18-125 used for geologic interpretation from ground surface to -94 feet elevation. MW-18-180 used for geologic interpretation from -94 to -198 feet elevation.

★ Not used for geologic interpretation.

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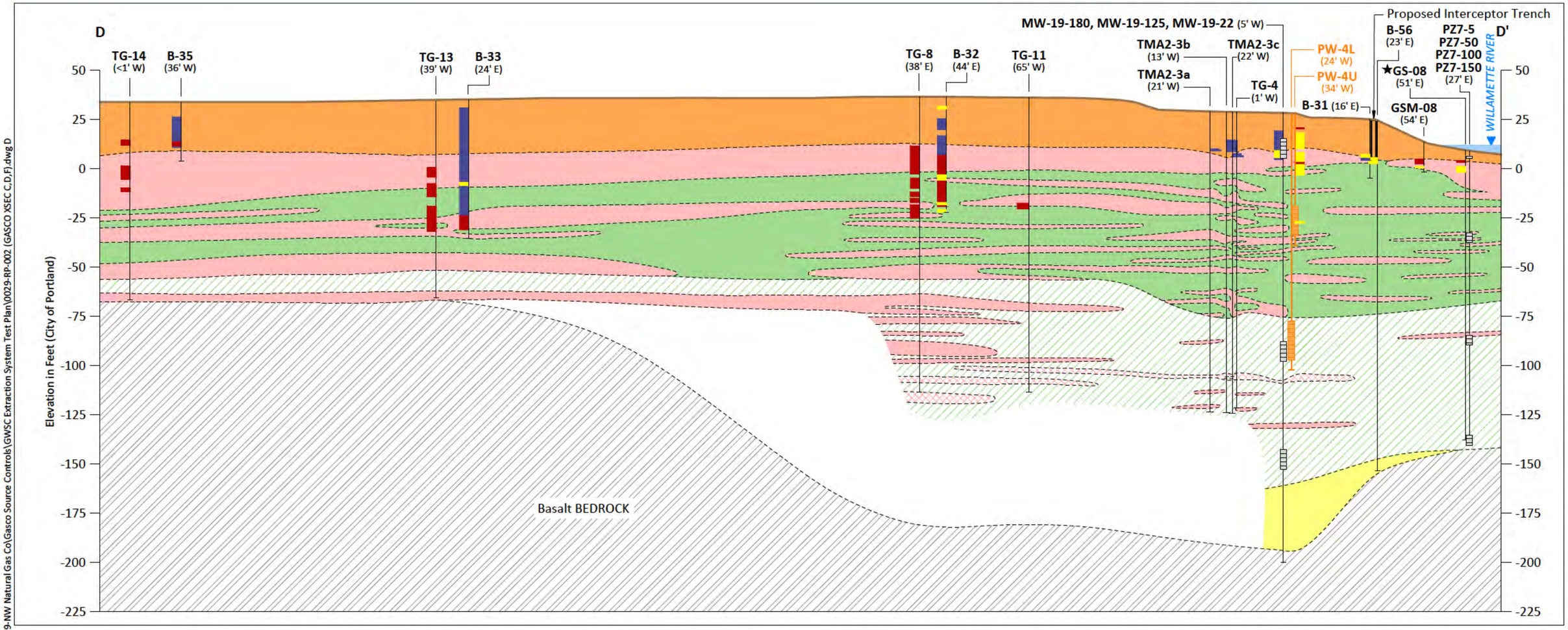
Figure 2.5
Geologic Cross Section C-C'
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** - Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** - Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- **Lower Alluvium WBZ** - Primarily medium grained SAND with generally less than 5% fines.
- **Aquitard** - Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Basalt BEDROCK

Existing Ground Surface

TG-8 — Boring ID
(38' E) — Offset Distance in Feet

Soil Boring or Sediment Core
Existing Extraction Well
Existing Well or Piezometer

- Tar Interval
- Oil or Mixed Oil and Tar Interval
- Sheen Interval
- Well Screen

0 50
Scale in Feet

NOTE: Geologic contacts are inferred between borings.

★ Not used for geologic interpretation.

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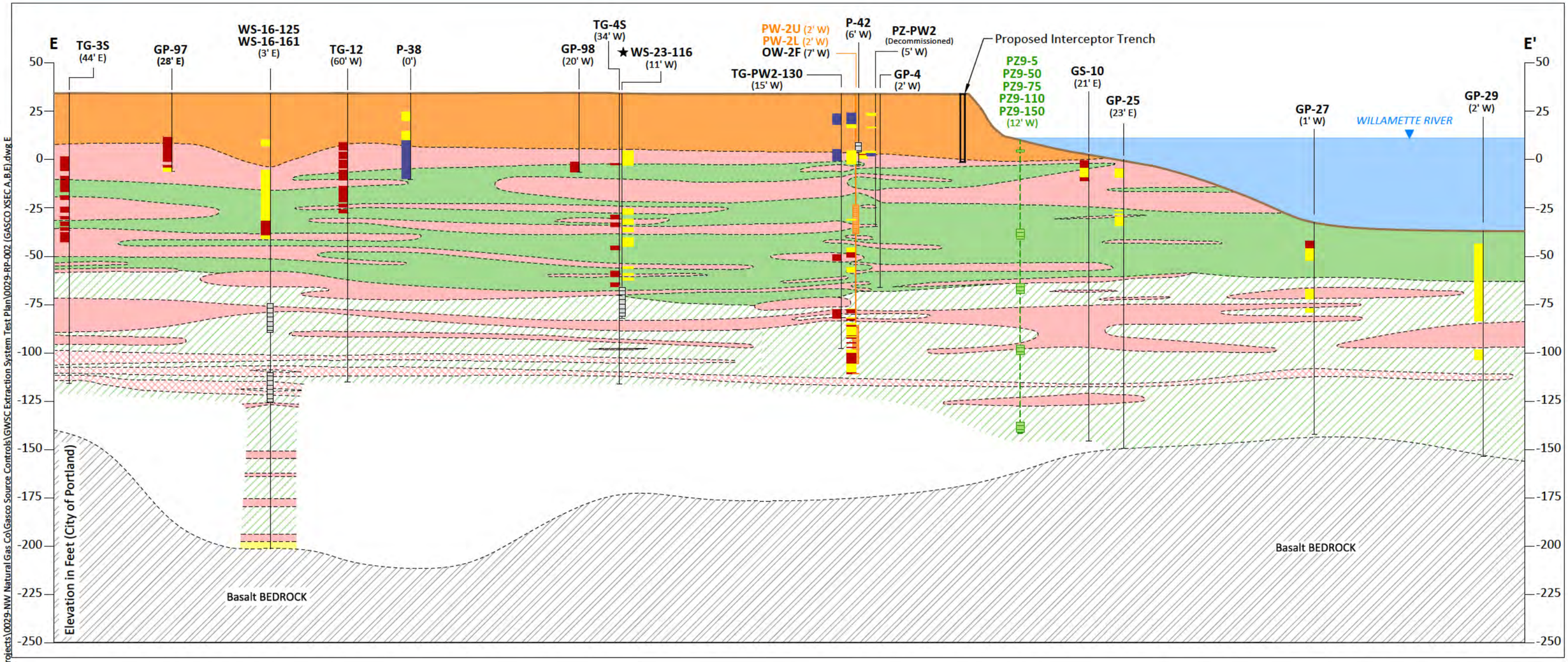
Figure 2.6
Geologic Cross Section D-D'
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

Fill WBZ - Fill composed of gravel, silt, sand, metal, brick, and concrete debris

Upper Alluvium WBZ - Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers

Lower Alluvium WBZ - Primarily medium grained SAND with generally less than 5% fines.

Aquitard - Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers

Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers

Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt

Basalt BEDROCK

Existing Ground Surface

Approximate Willamette River Elevation

TG-6 (16' W)
— Boring ID
— Offset Distance in Feet
Soil Boring or Sediment Core
Proposed Well or Piezometer
Existing Well or Piezometer
— Oil or Mixed Oil and Tar Interval
— Sheen Interval
— Well Screen

0 50
Scale in Feet

NOTE: Geologic contacts are inferred between borings.

★ Not used for geologic interpretation.

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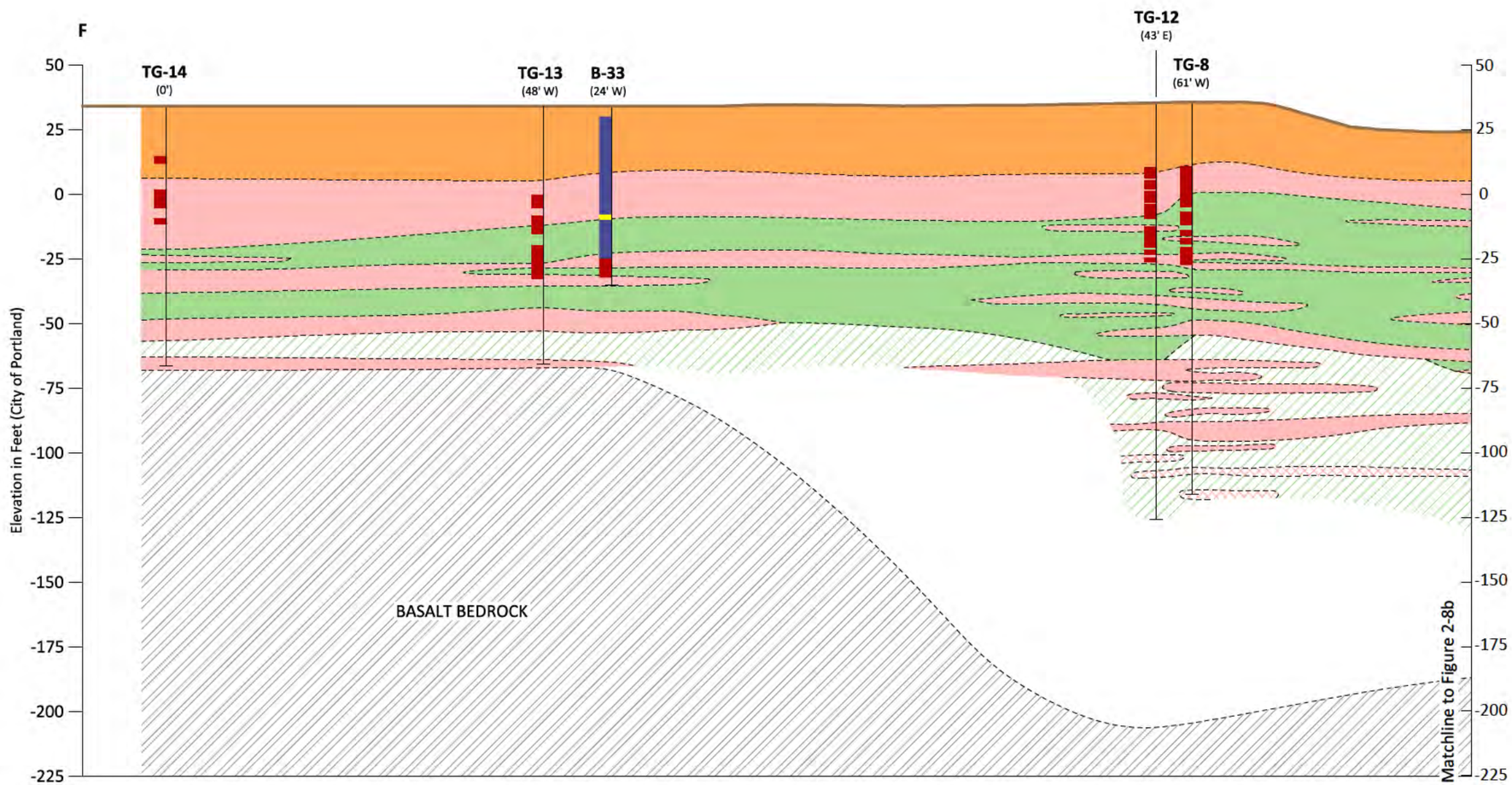
Figure 2.7
Geologic Cross Section E-E'
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** - Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** - Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- **Lower Alluvium WBZ** - Primarily medium grained SAND with generally less than 5% fines.
- **Aquitard** - Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Basalt BEDROCK
- Existing Ground Surface
- Approximate Willamette River Elevation

GS-06 — Boring ID
(54' W) — Offset Distance in Feet

Soil Boring or Sediment Core
Existing Extraction Well
Existing Well or Piezometer

- Tar Interval
- Oil or Mixed Oil and Tar Interval
- Sheen Interval
- Well Screen

0 50
Scale in Feet

NOTES:

1. Geologic contacts are inferred between borings.
2. PW-3-85 was initially intended as an extraction well, but it has been replaced by PW-3U.

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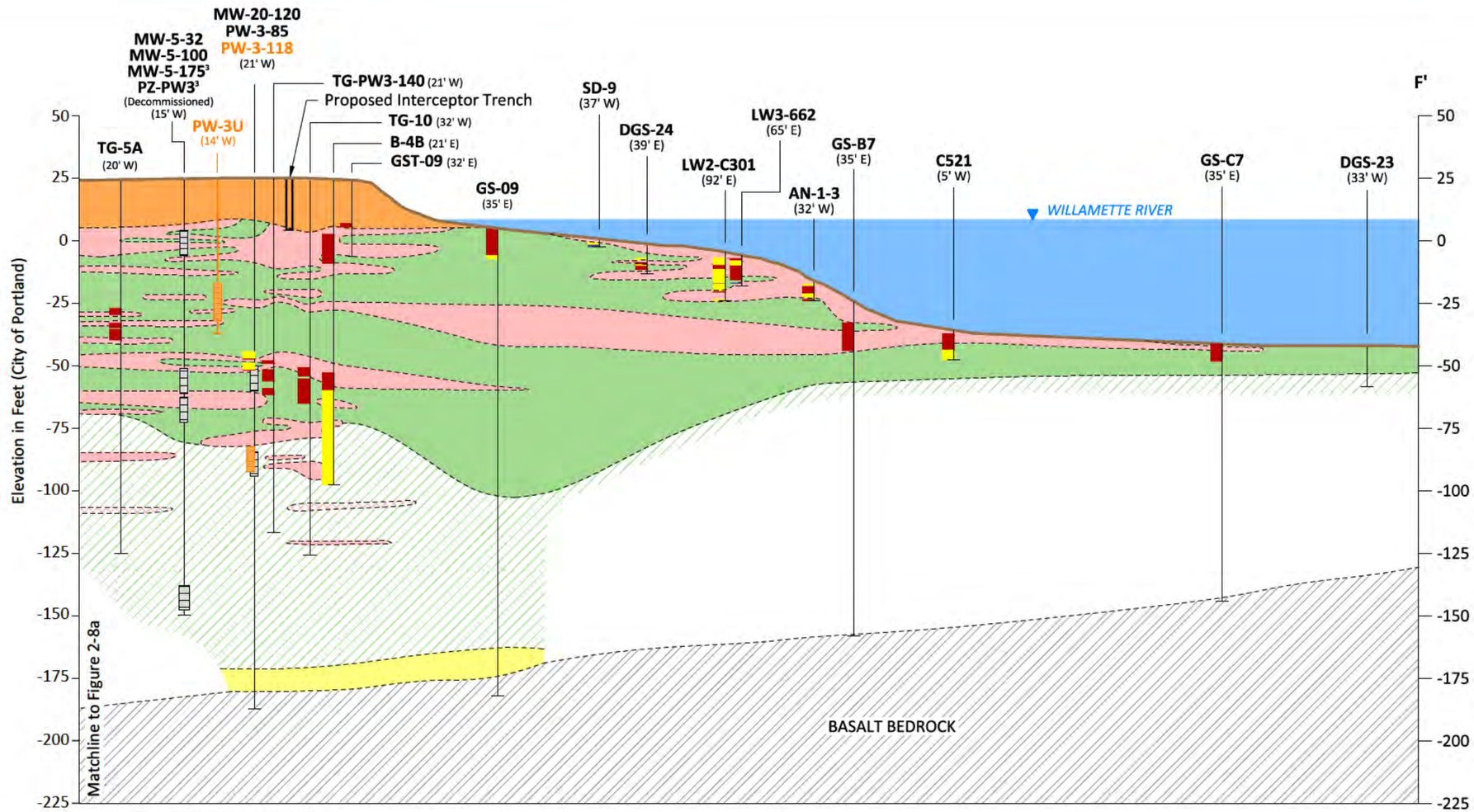
Figure 2.8a
Geologic Cross Section F-F'
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site



LEGEND:

- **Fill WBZ** - Fill composed of gravel, silt, sand, metal, brick, and concrete debris
- **Upper Alluvium WBZ** - Primarily fine to medium grained SAND and SILTY-SAND interbedded with thin silt and sandy-silt layers
- **Lower Alluvium WBZ** - Primarily medium grained SAND with generally less than 5% fines.
- **Aquitard** - Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Primarily SILT and SANDY-SILT interbedded with thin sand and silty-sand layers
- Alluvial GRAVEL, sandy gravel, gravelly sand, and gravelly silt
- Basalt BEDROCK
- Existing Ground Surface
- Approximate Willamette River Elevation

GS-06 — Boring ID
(54' W) — Offset Distance in Feet

Soil Boring or Sediment Core
Existing Extraction Well
Existing Well or Piezometer

- Tar Interval
- Oil or Mixed Oil and Tar Interval
- Sheen Interval
- Well Screen

0 50
Scale in Feet

NOTES:

1. Geologic contacts are inferred between borings.
2. PW-3-85 was initially intended as an extraction well, but it has been replaced by PW-3U.
3. Data from PZ-PW3 used for geologic interpretation from ground surface to -30 feet elevation, and from MW-5-175 from -30 feet to -150 feet elevation.

T:\CAD\Projects\0029-NW Natural Gas Co\Gasco Source Controls\GWSC Extraction System Test Plan\0029-RP-002 (GASCO XSEC C,D,F).dwg Fb
Dec 20, 2013 11:37am heriksen

ANCHOR QEA

Figure 2.8b
Geologic Cross Section F-F'
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

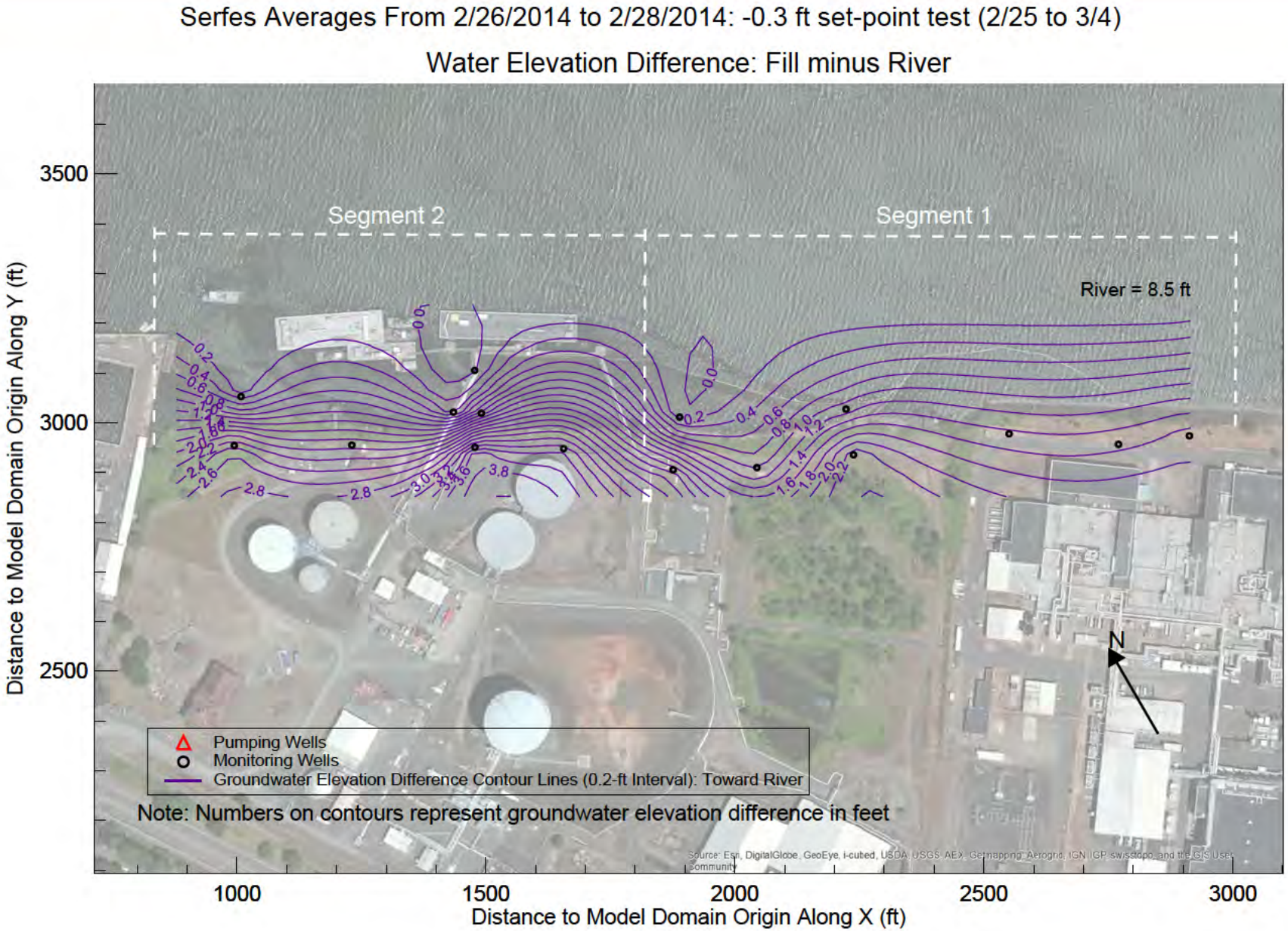


Figure 3.3a

Contours of Water Elevation Difference Between Fill and River Using Serfes 3-Day Rolling Averages From 2/26/2014 to 2/28/2014
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Contours generated through geostastical interpolation (Kriging) in Interactive Data Language

BG - C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__contour_horizontal.pro Wed Apr 09 10:34:29 2014

ANCHOR QEA

Serfes Averages From 2/26/2014 to 2/28/2014: -0.3 ft set-point test (2/25 to 3/4)

Water Elevation Difference: Upper Alluvium minus River

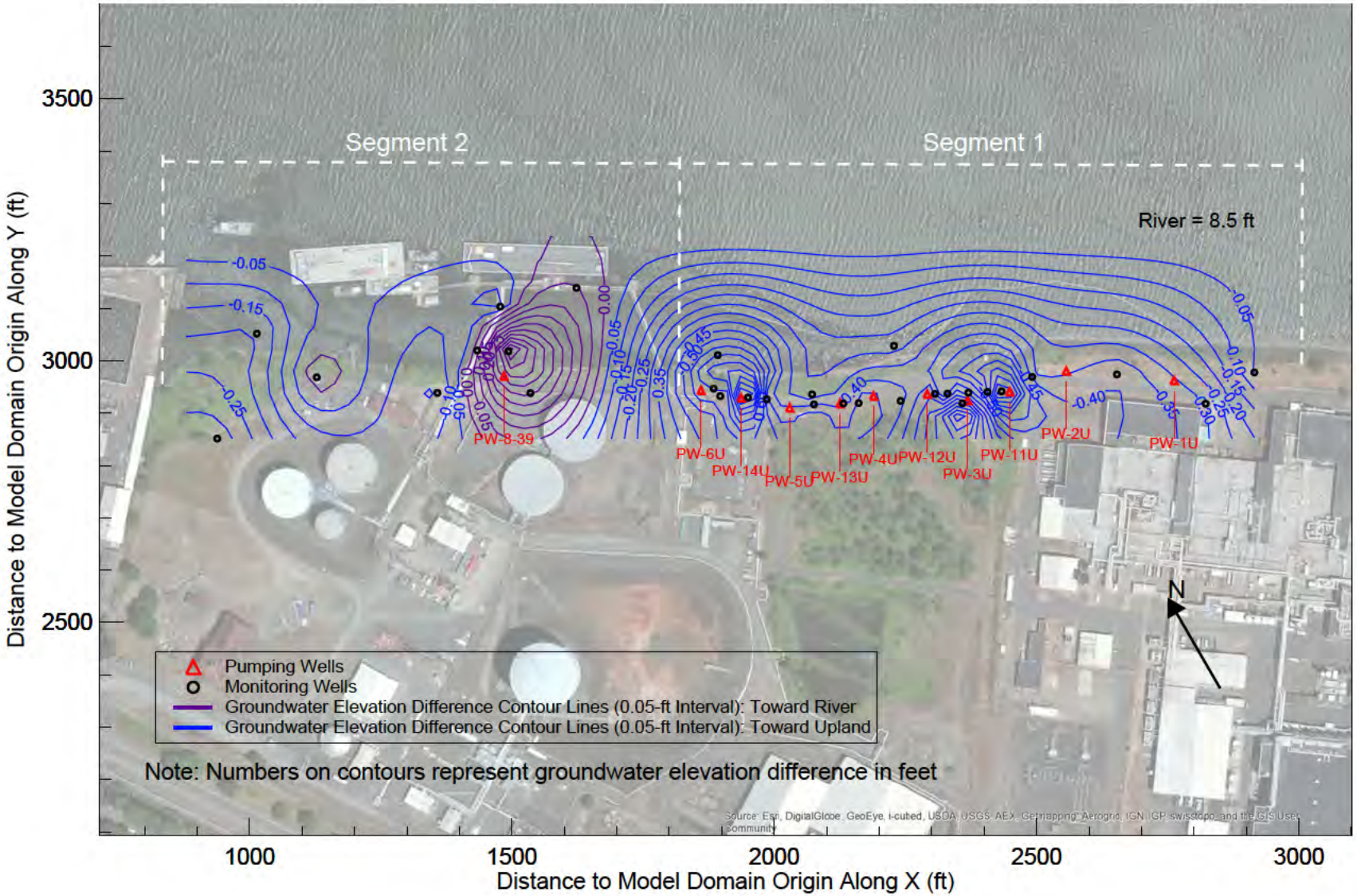


Figure 3.3b

Contours of Water Elevation Difference Between Upper Alluvium and River Using Serfes 3-Day Rolling Averages From 2/26/2014 to 2/28/2014

Groundwater Source Control Extraction System Test Data Report

NW Natural Gasco Site

Contours generated through geostastical interpolation (Kriging) in Interactive Data Language. MW-16-45 excluded: screen saturated with LNAPL

BG - C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__contour_horizontal.pro Wed Apr 09 10:34:31 2014

Serfes Averages From 2/26/2014 to 2/28/2014: -0.3 ft set-point test (2/25 to 3/4)

Water Elevation Difference: Lower Alluvium minus River

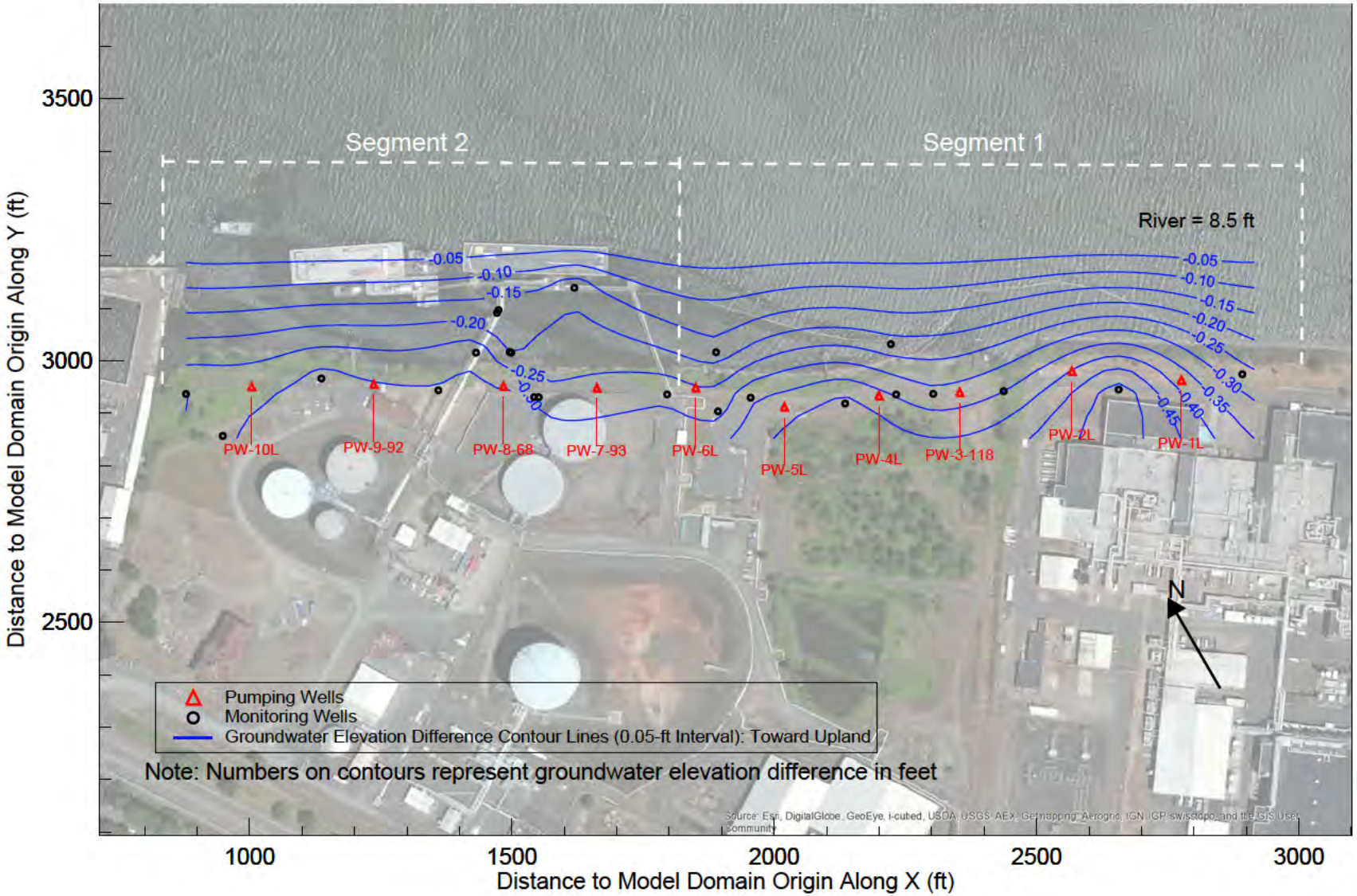


Figure 3.3c

Contours of Water Elevation Difference Between Lower Alluvium and River Using Serfes 3-Day Rolling Averages From 2/26/2014 to 2/28/2014

Groundwater Source Control Extraction System Test Data Report

NW Natural Gasco Site

Contours generated through geostastical interpolation (Kriging) in Interactive Data Language

BG - C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__contour_horizontal.pro Wed Apr 09 10:34:33 2014

ANCHOR QEA

Serfes Averages From 2/26/2014 to 2/28/2014: -0.3 ft set-point test (2/25 to 3/4)

Water Elevation Difference: Deep Lower Alluvium minus River

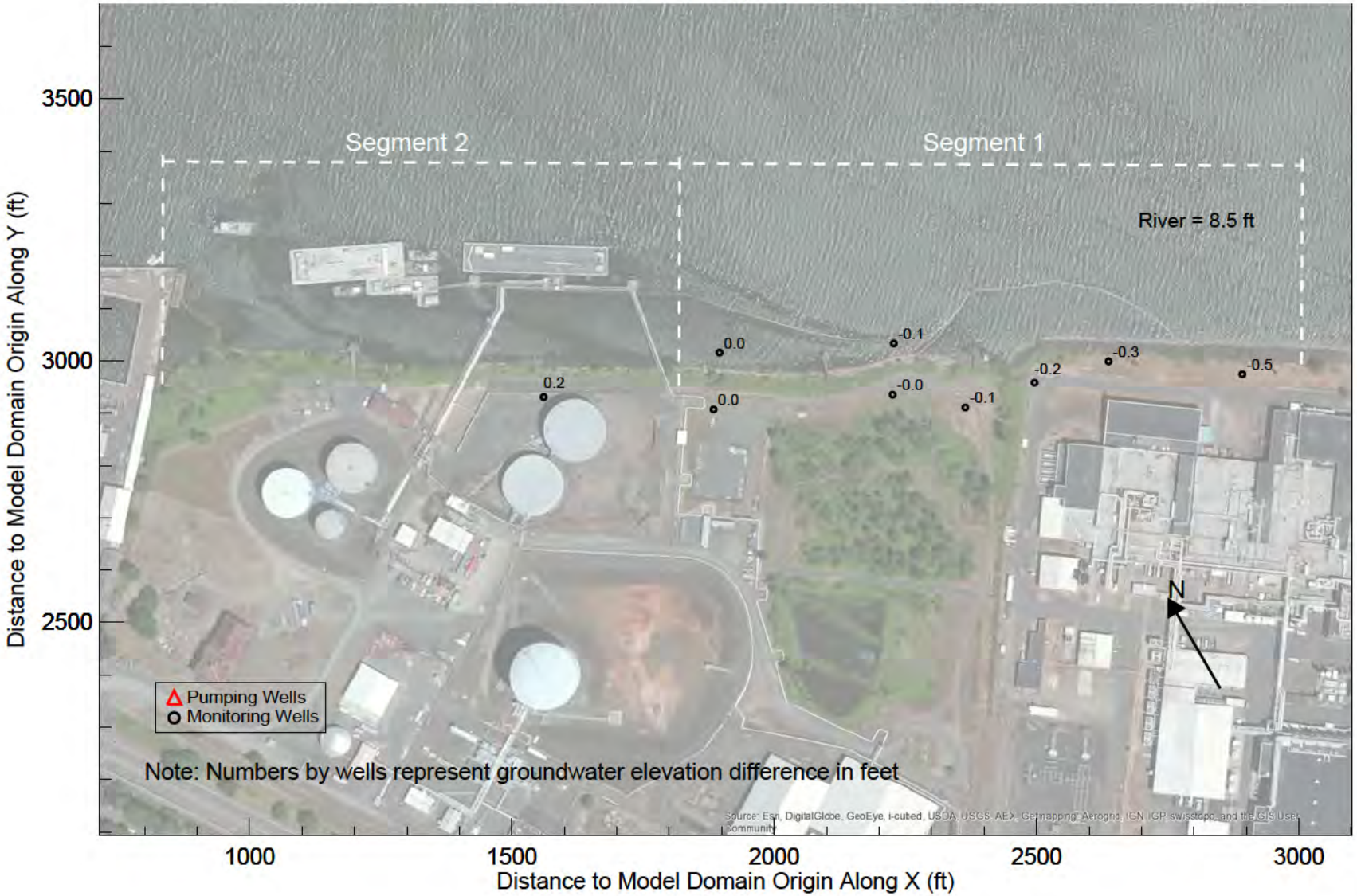


Figure 3.3d

Water Elevation Difference Between Deep Lower Alluvium and River Using Serfes 3-Day Rolling Averages From 2/26/2014 to 2/28/2014

Groundwater Source Control Extraction System Test Data Report

NW Natural Gasco Site

Contours were not added because of insufficient data points

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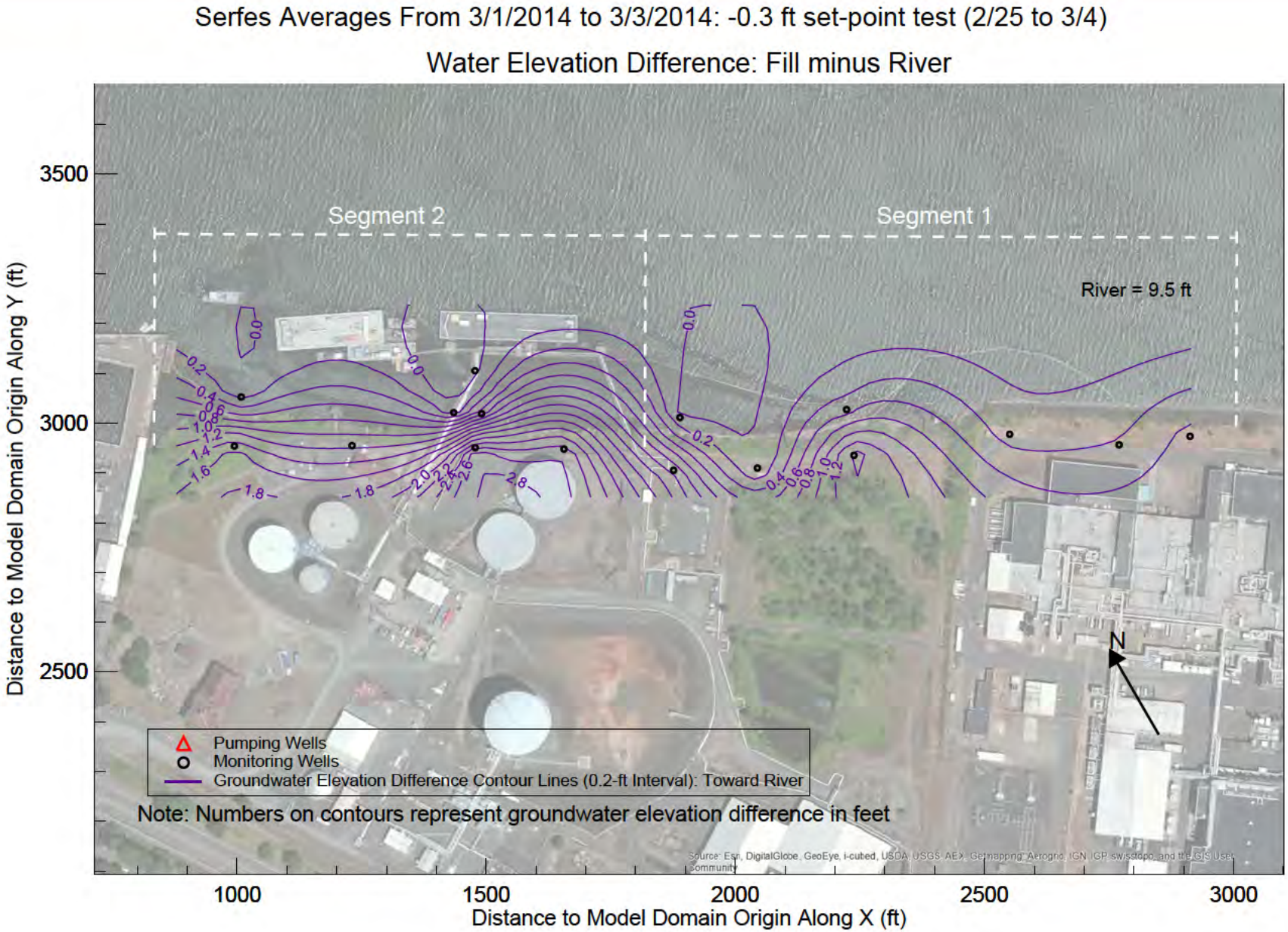

Figure 3.4a

Contours of Water Elevation Difference Between Fill and River Using Serfes 3-Day Rolling Averages From 3/1/2014 to 3/3/2014
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Contours generated through geostastical interpolation (Kriging) in Interactive Data Language

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ANCHOR QEA

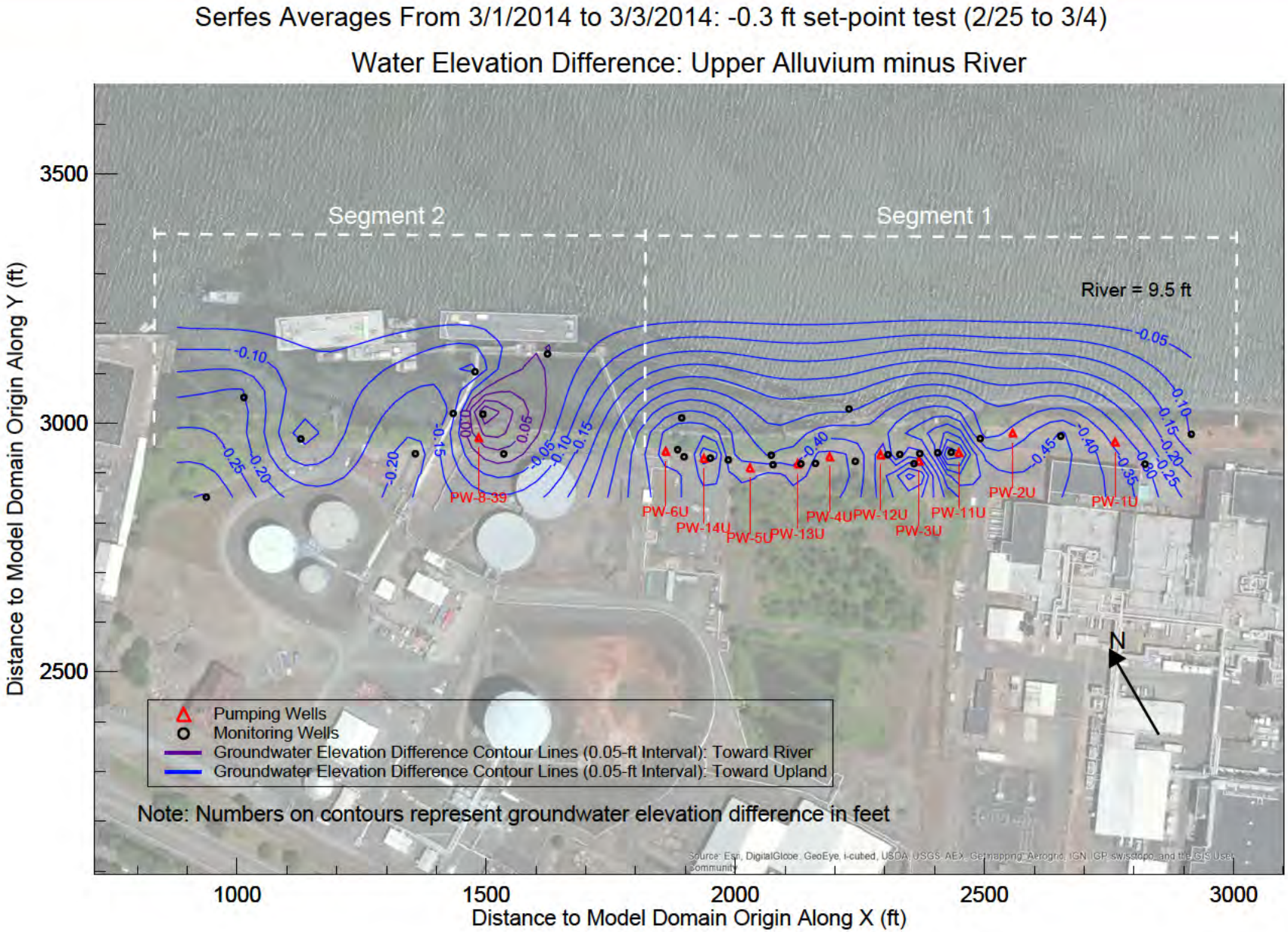

Figure 3.4b

Contours of Water Elevation Difference Between Upper Alluvium and River Using Serfes 3-Day Rolling Averages From 3/1/2014 to 3/3/2014
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Contours generated through geostastical interpolation (Kriging) in Interactive Data Language. MW-16-45 excluded: screen saturated with LNAPL

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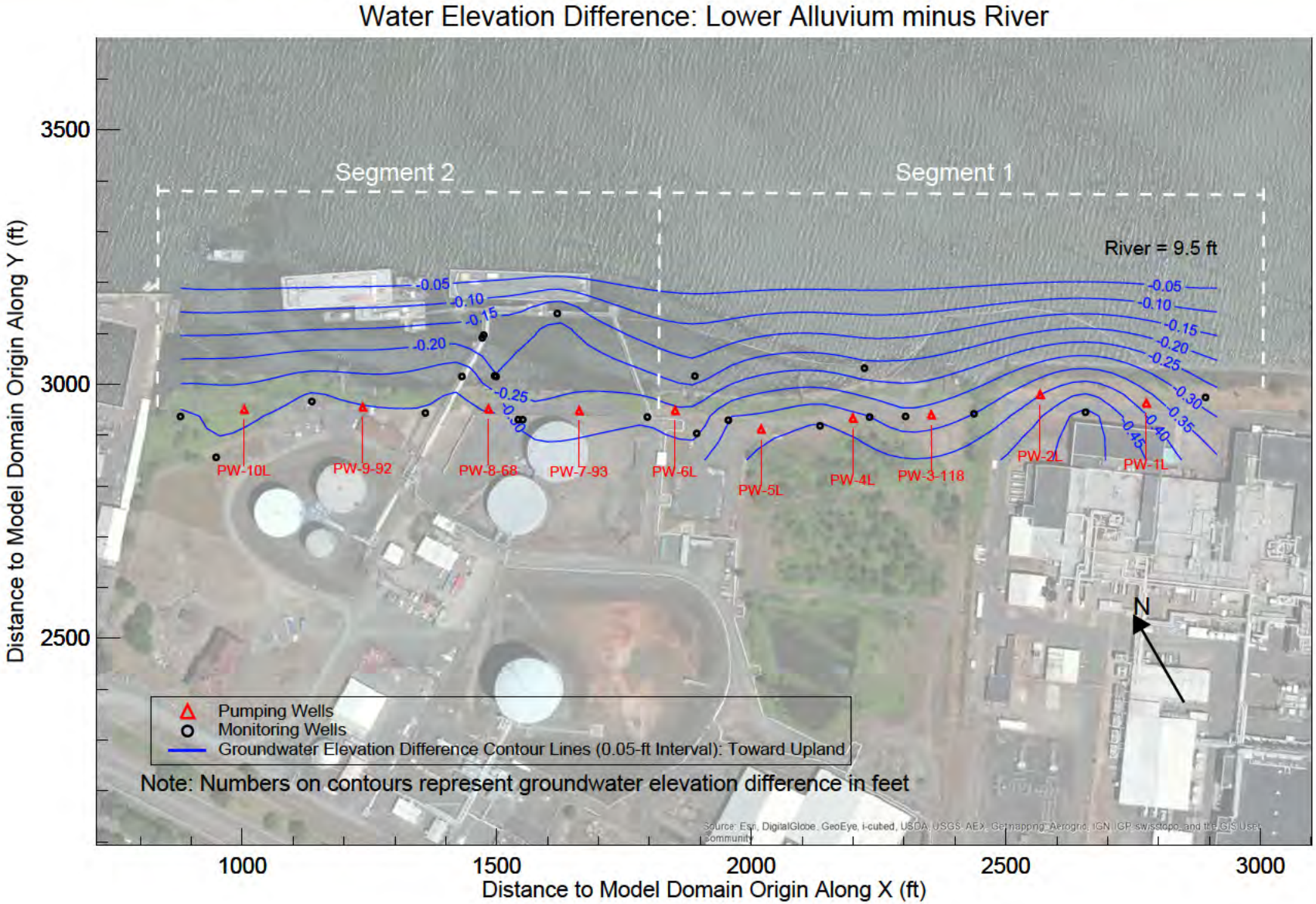

Figure 3.4c

Contours of Water Elevation Difference Between Lower Alluvium and River Using Serfes 3-Day Rolling Averages From 3/1/2014 to 3/3/2014
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Contours generated through geostastical interpolation (Kriging) in Interactive Data Language

BG - C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__contour_horizontal.pro Wed Apr 09 10:34:39 2014

ANCHOR QEA

Serfes Averages From 3/1/2014 to 3/3/2014: -0.3 ft set-point test (2/25 to 3/4)

Water Elevation Difference: Deep Lower Alluvium minus River

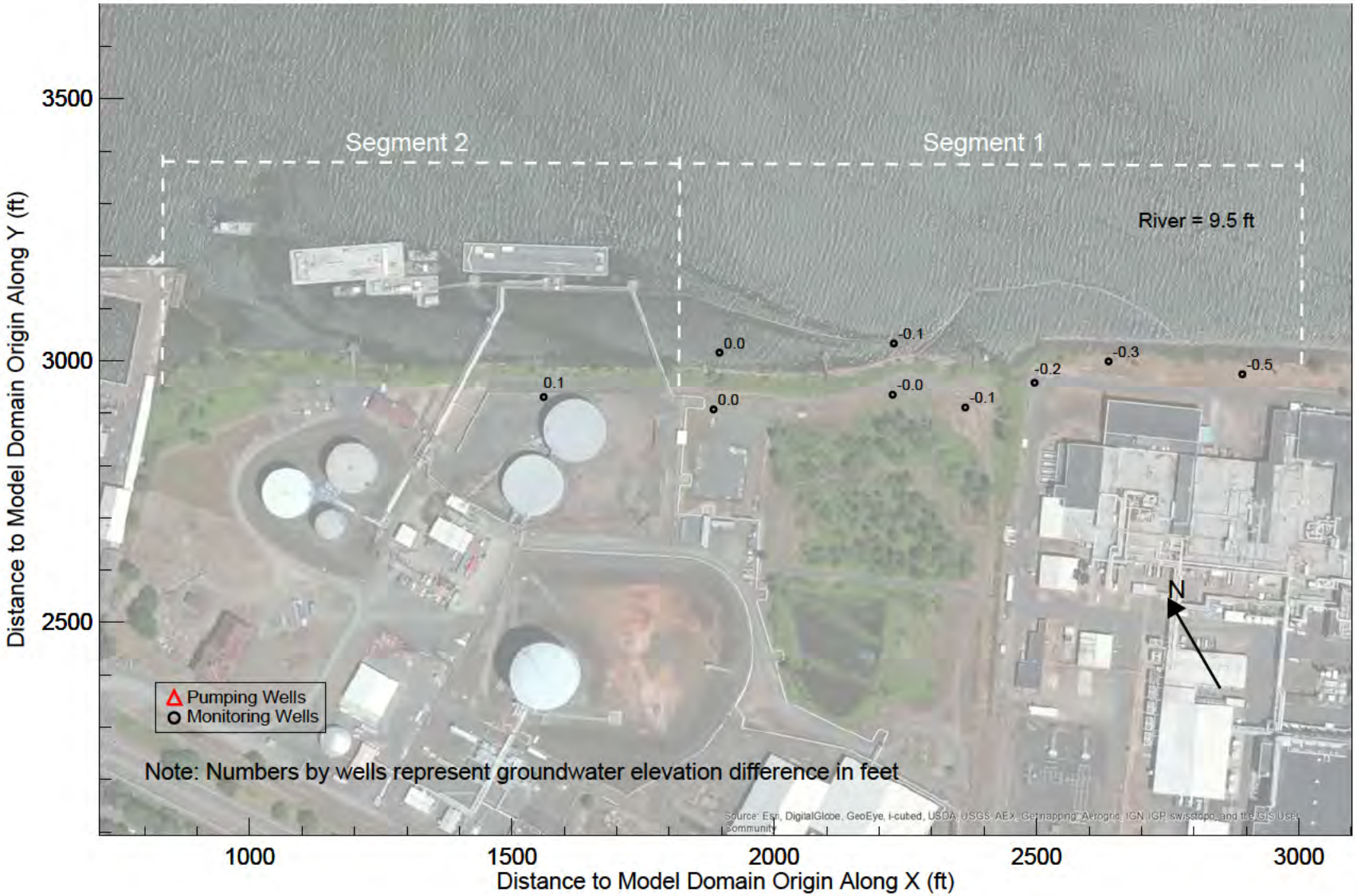

Figure 3.4d

Water Elevation Difference Between Deep Lower Alluvium and River Using Serfes 3-Day Rolling Averages From 3/1/2014 to 3/3/2014

Groundwater Source Control Extraction System Test Data Report

NW Natural Gasco Site

Contours were not added because of insufficient data points

BG - C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__contour_horizontal.pro Wed Apr 09 10:34:40 2014

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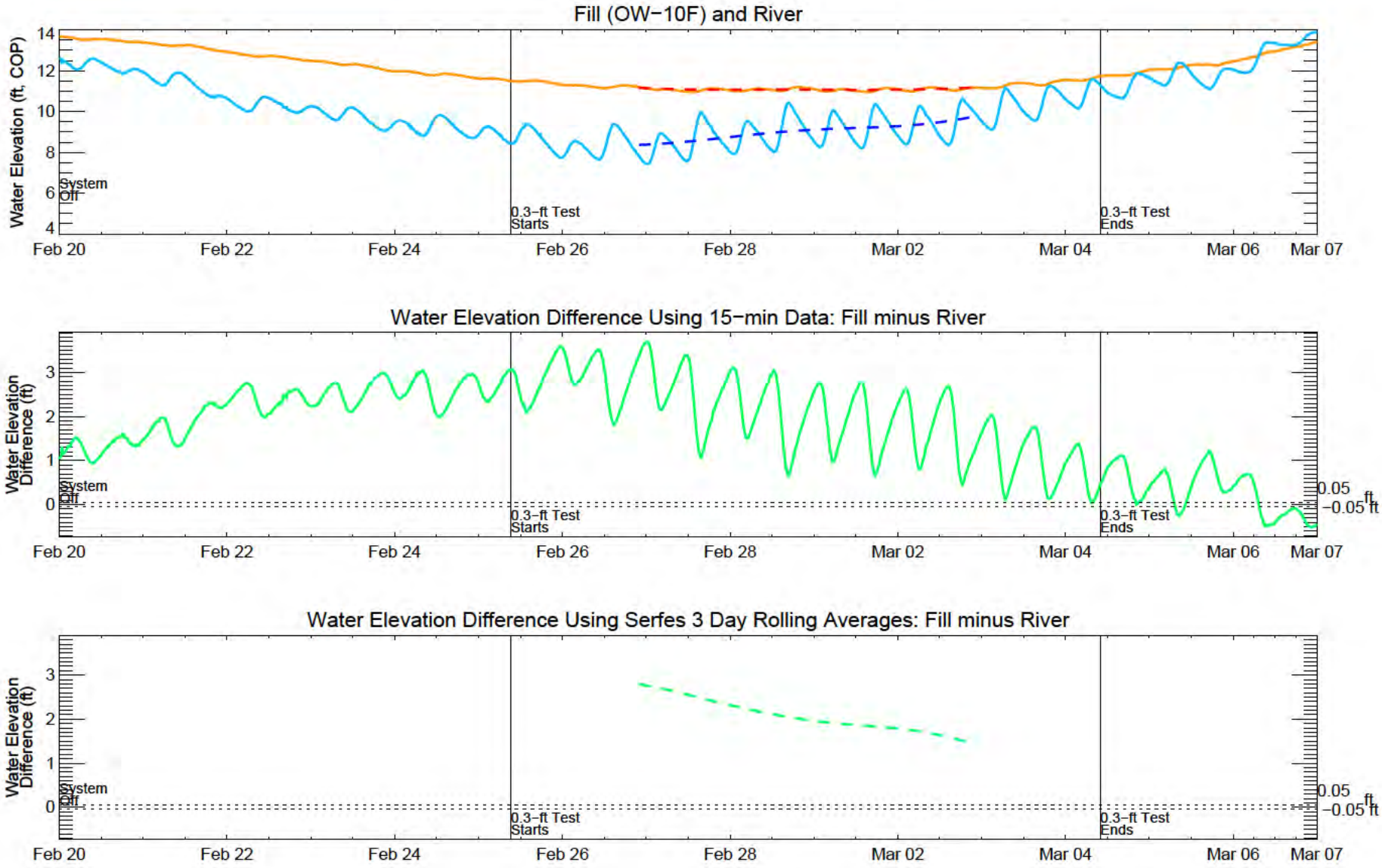
Figure 4 Series

Fill		Upper Alluvium (continued)		Lower Allluvium (continued)	
4.1	OW-10F	4.28	PZ6-50	4.55	PZ5-55
4.2	PZ8-5	4.29	MW-26U	4.56	PZ5-85
4.3	OW-9-25	4.30	MW-27U	4.57	MW-21-75
4.4	PZ1-5	4.31	MW-37U	4.58	MW-21-115
4.5	PZ2-5	4.32	MW-4-57	4.59	PZ4-41
4.6	OW-8-15	4.33	MW-38U	4.60	MW-24-130
4.7	PZ5-5	4.34	MW-28U	4.61	PZ6-115
4.8	OW-7-17	4.35	MW-29U	4.62	MW-18-125
4.9	MW-18-30	4.36	PZ7-50	4.63	MW-27L
4.10	PZ6-5	4.37	MW-30U	4.64	MW-28L
4.11	OW-5F	4.38	MW-31U	4.65	PZ7-100
4.12	PZ7-5	4.39	MW-32U	4.66	MW-19-125
4.13	MW-19-22	4.40	MW-5-32	4.67	MW-31L
4.14	OW-2F	4.41	PW-3-85	4.68	MW-34L
4.15	OW-1F	4.42	MW-33U	4.69	WS-21-112
4.16	WS-8-23	4.43	MW-34U	4.70	WS-12-125
Upper Alluvium		4.44	MW-35U	**Deep Alluvium**	
4.17	MW-1-55	4.45	MW-36U	4.71	MW-21-165
4.18	PZ8-50	4.46	WS-26-86	4.72	MW-18-180
4.19	MW-22U	4.47	WS-8-59	4.73	PZ6-150
4.20	MW-23U	**Lower Alluvium**		4.74	MW-19-180
4.21	PZ1-20	4.48	MW-25L	4.75	PZ7-150
4.22	PZ2-20	4.49	MW-1-82	4.76	MW-5-175
4.23	PZ5-20	4.50	MW-22-80	4.77	WS-14-161
4.24	MW-21U	4.51	MW-23-75	4.78	WS-11-161
4.25	PZ4-12	4.52	PZ1-50	4.79	WS-12-161
4.26	MW-16-45	4.53	PZ2-43		
4.27	MW-16-65	4.54	PZ2-77		



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Fill: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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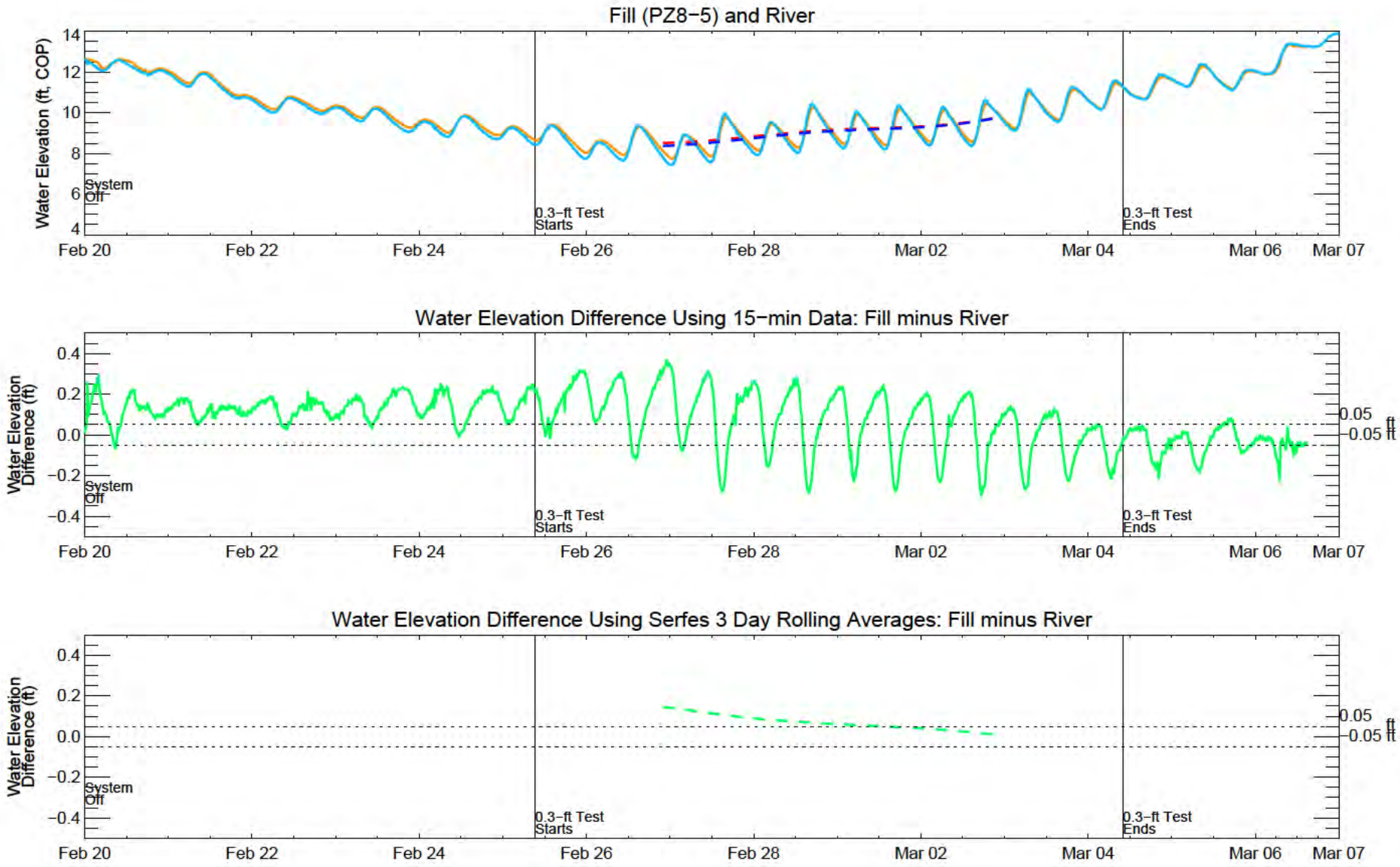
Figure 4.1
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:38 2014



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River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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Figure 4.2
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:38 2014

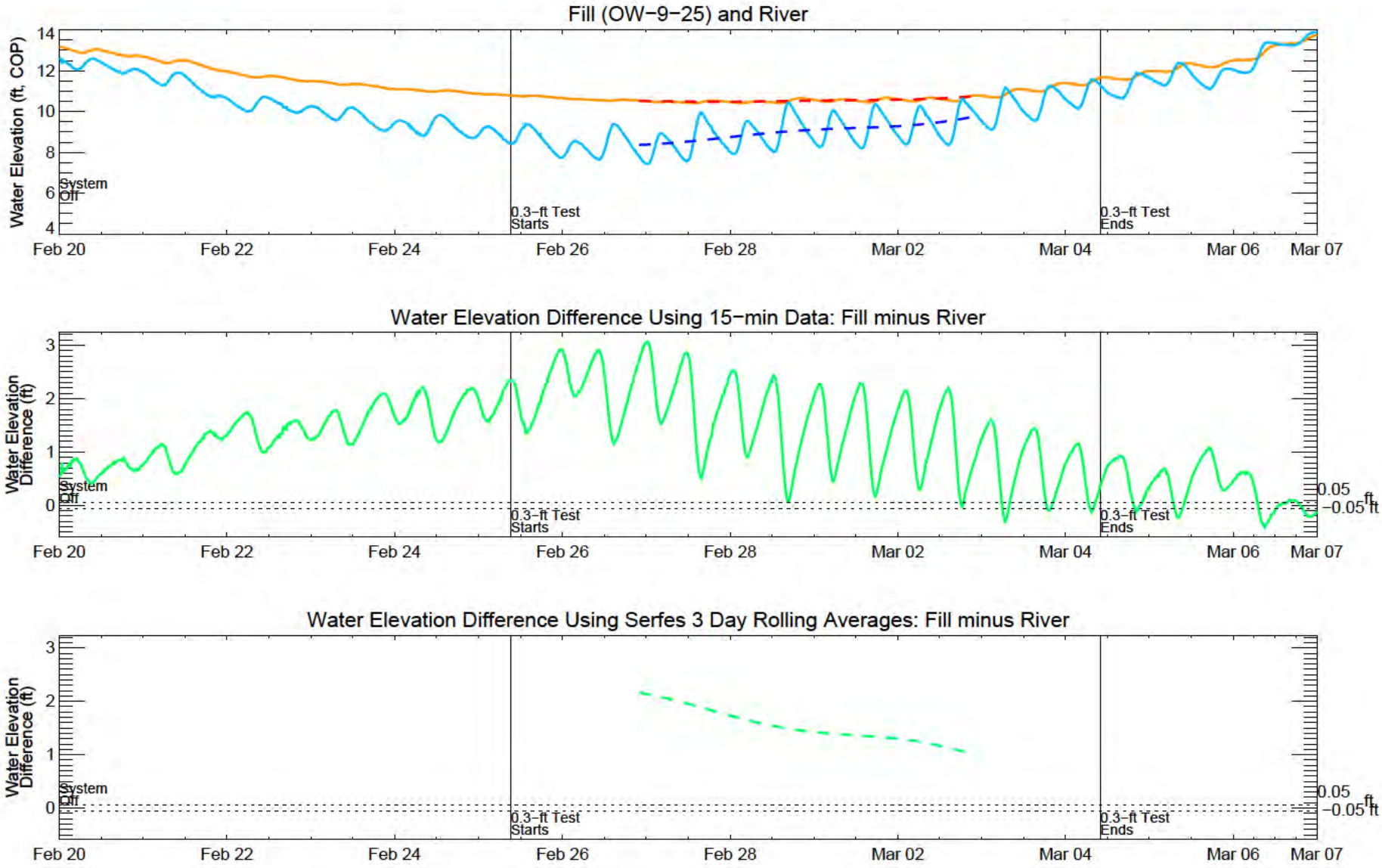

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Figure 4.3

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

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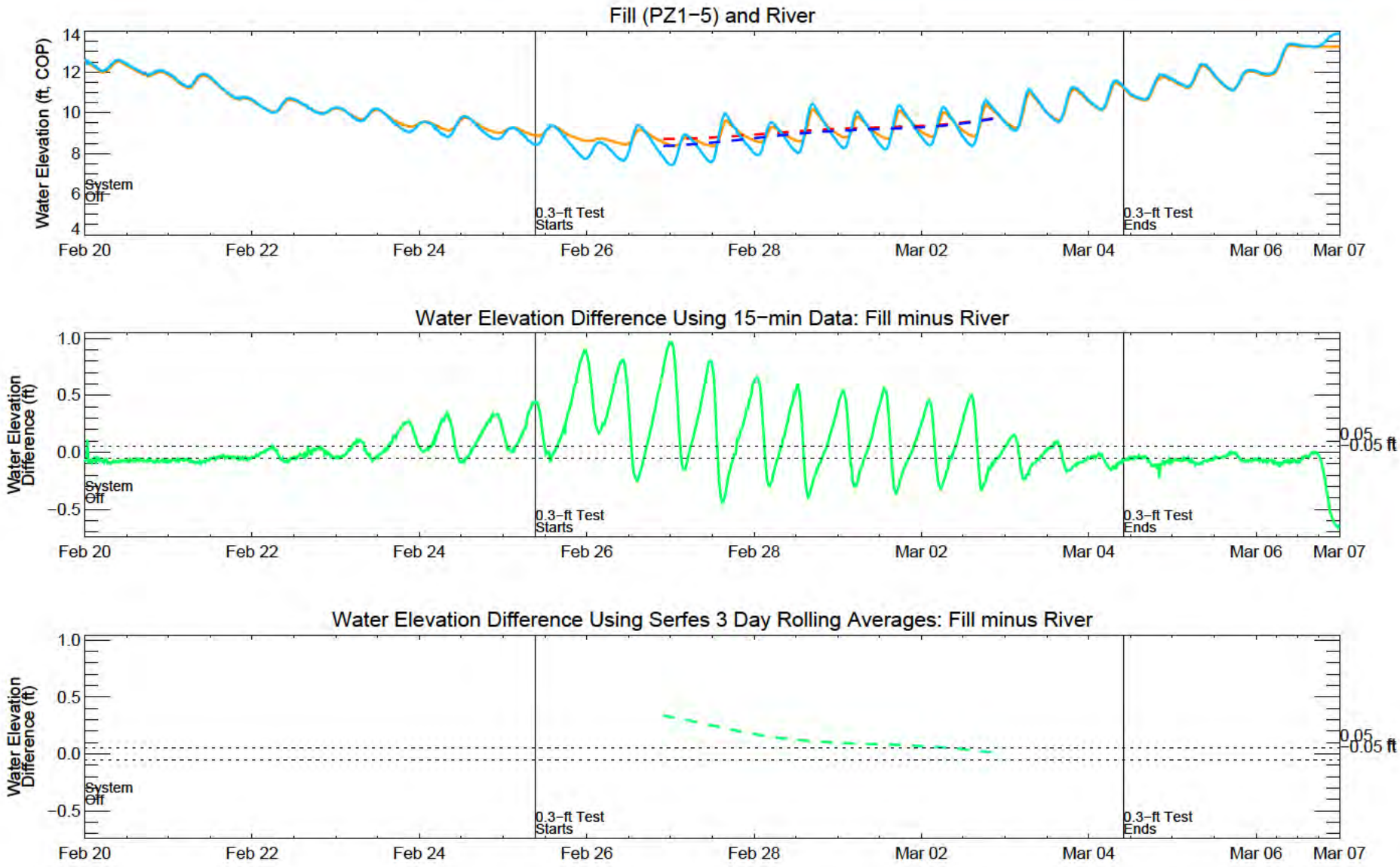

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Fill: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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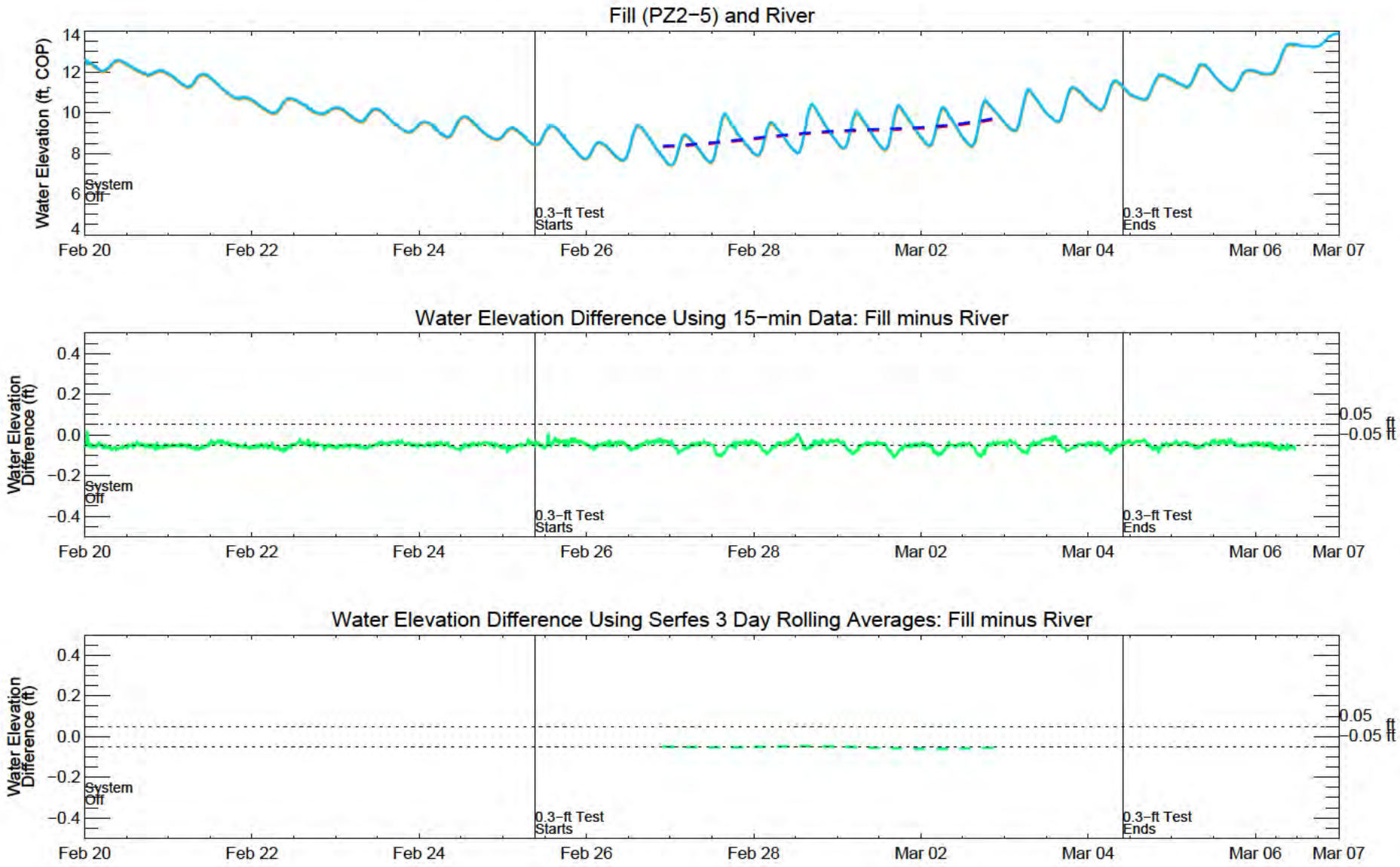
Figure 4.4
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:39 2014



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Fill: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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Figure 4.5
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

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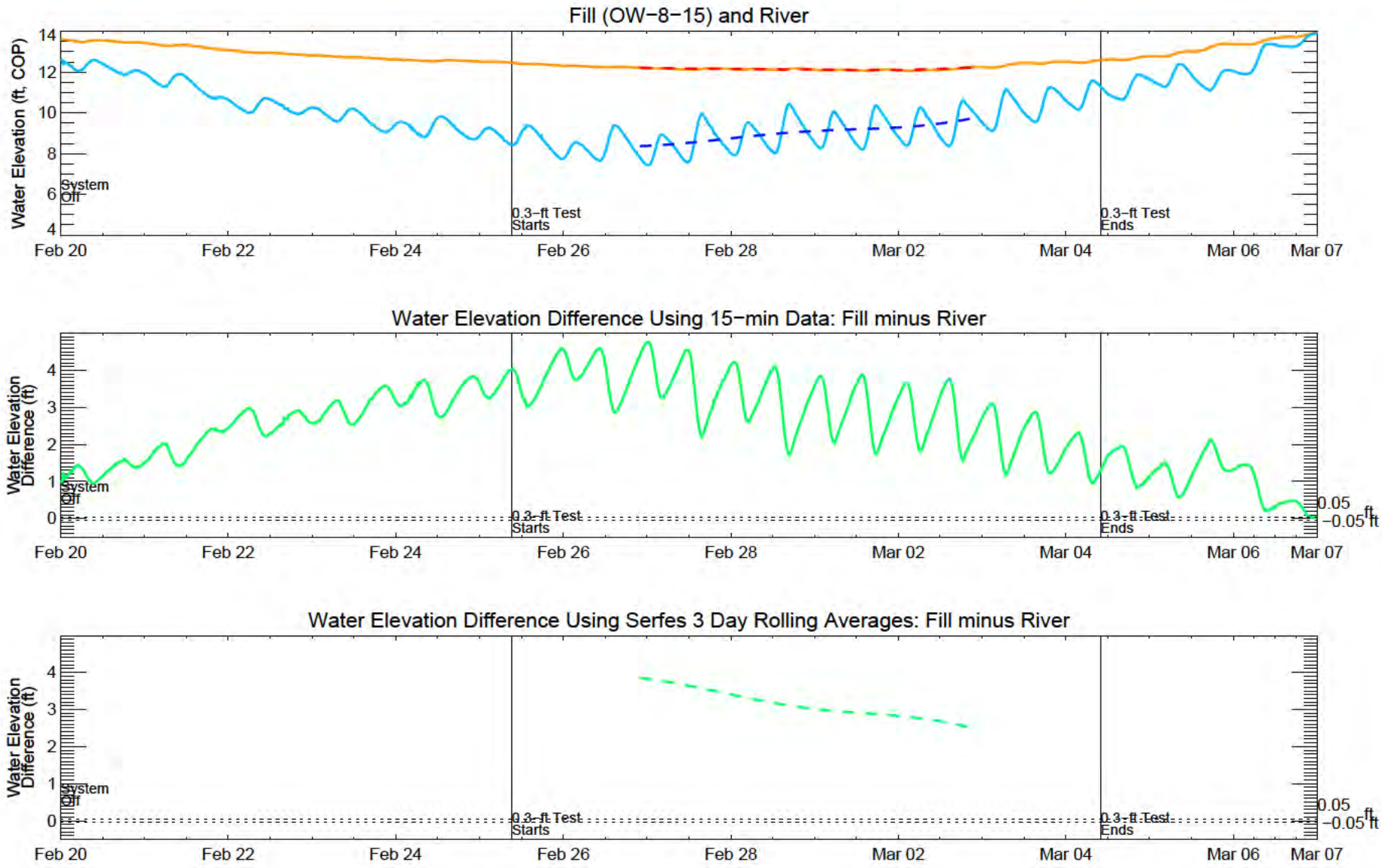

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Figure 4.6

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

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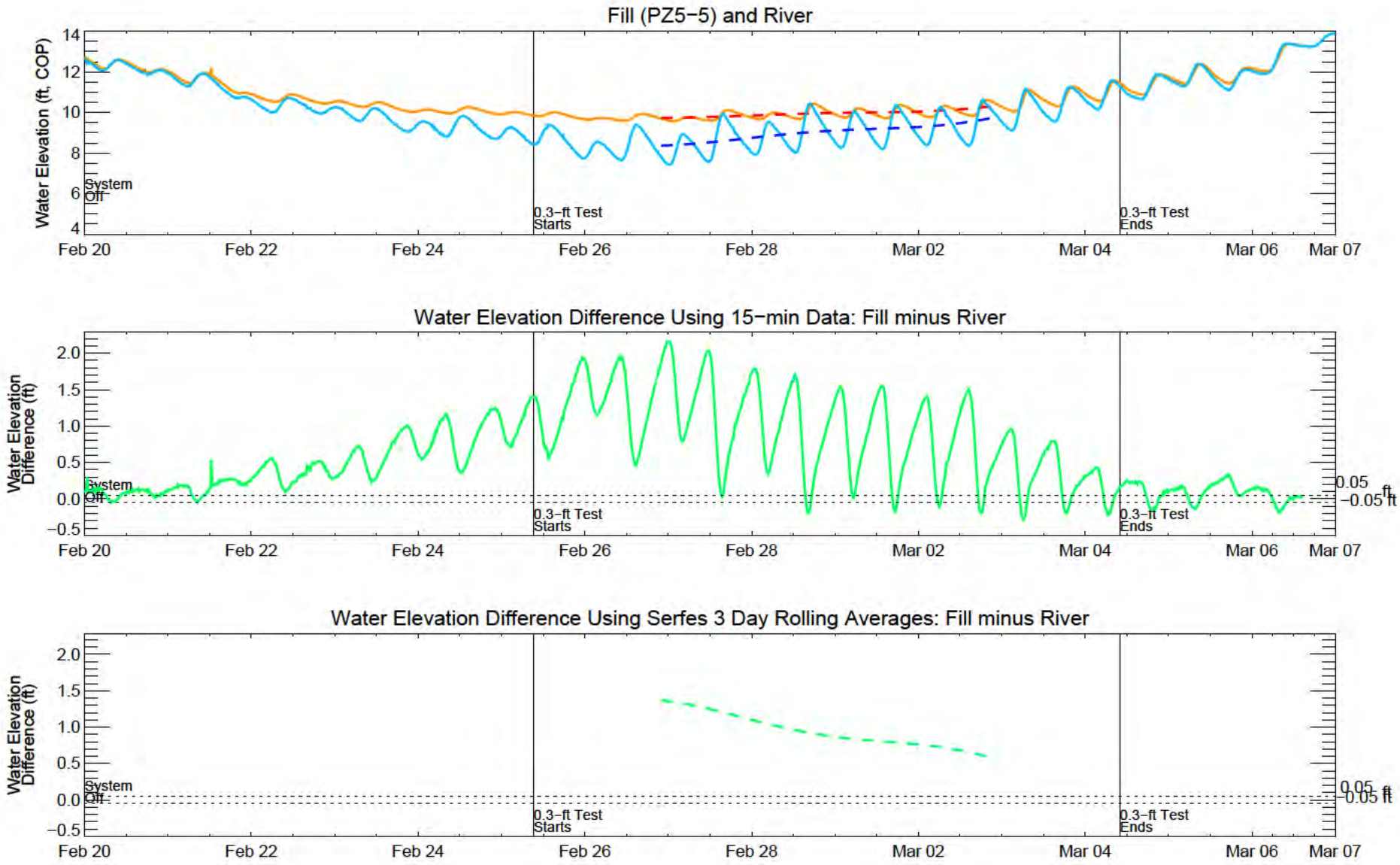

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Figure 4.7

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

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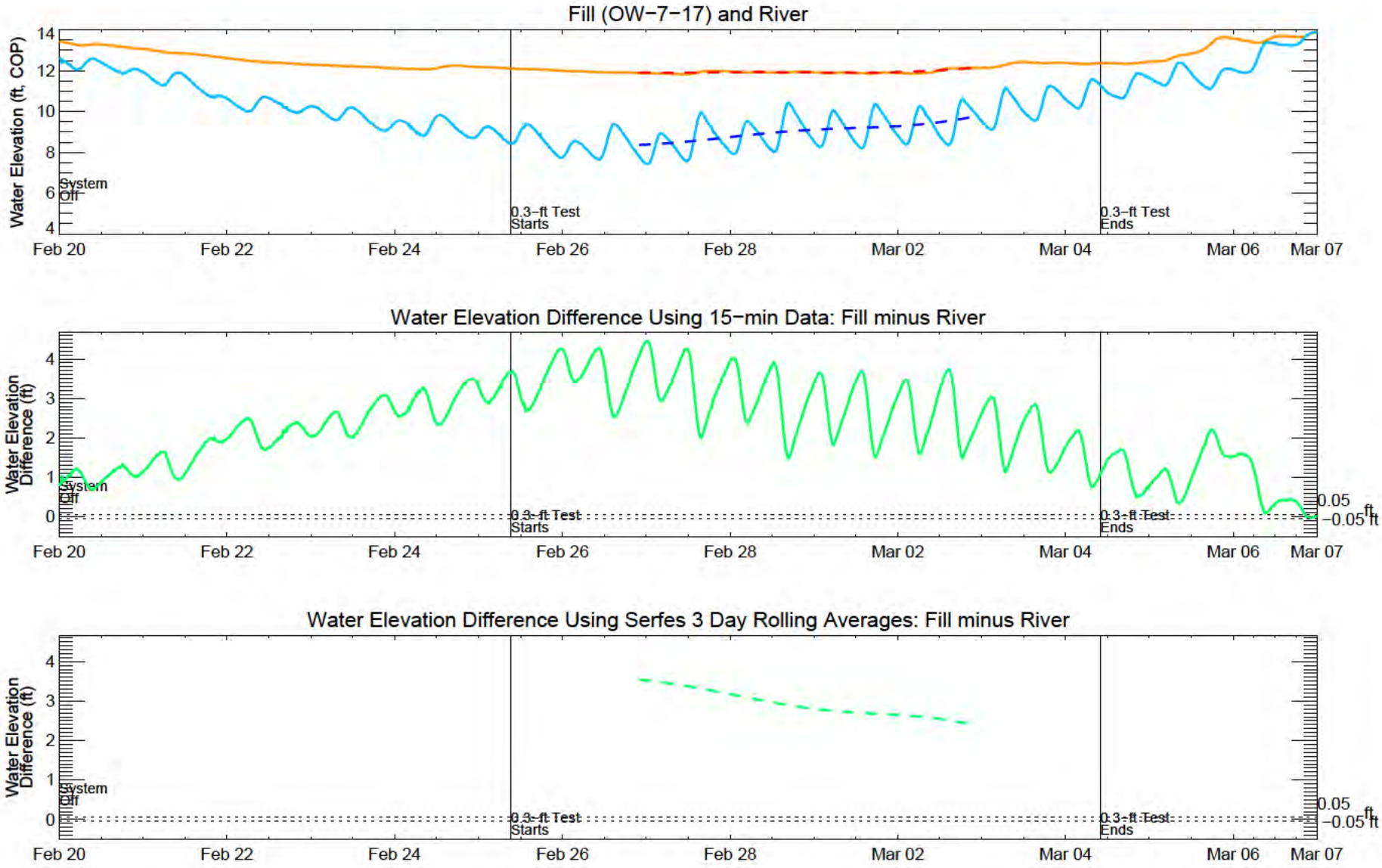

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Figure 4.8

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

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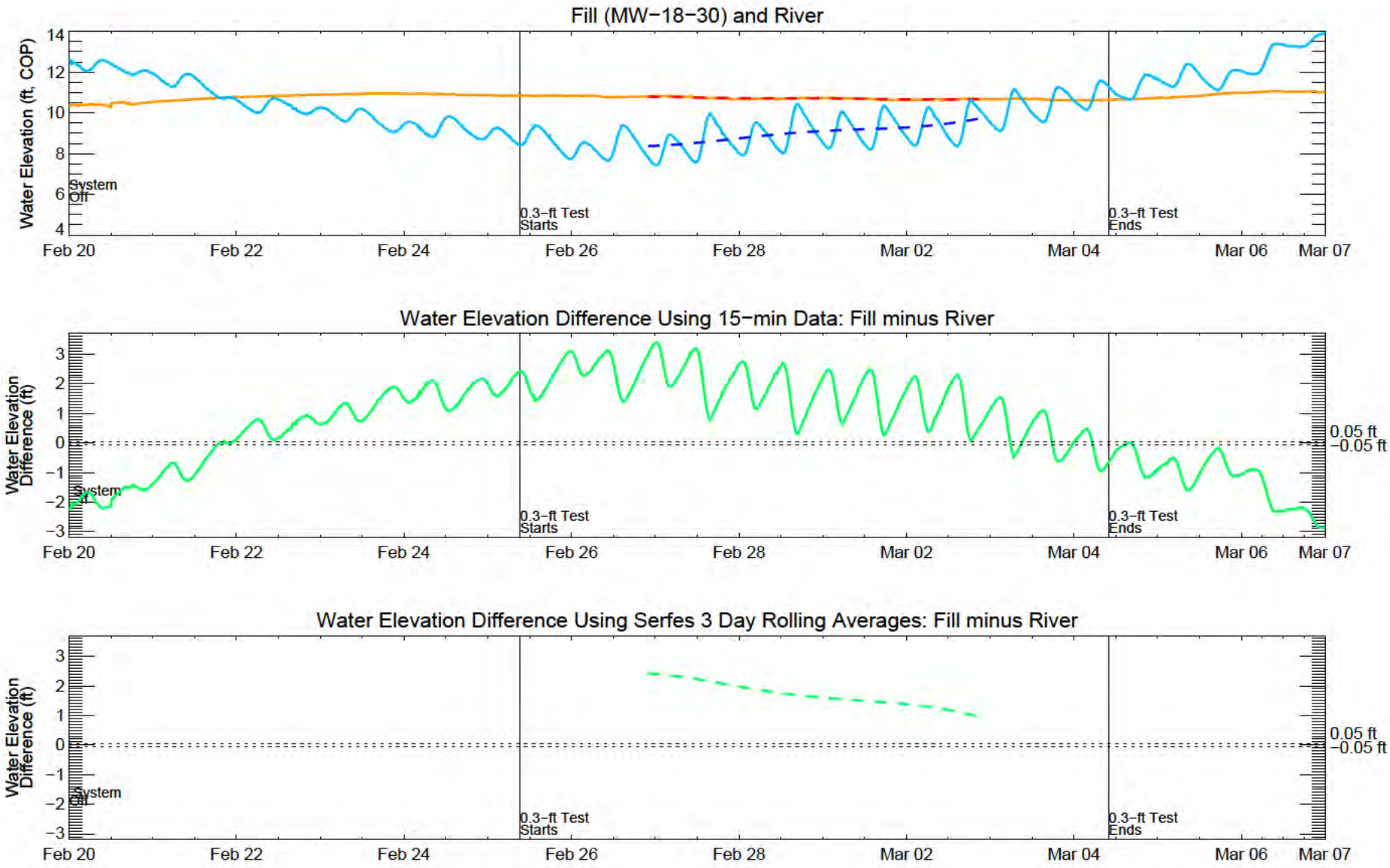

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River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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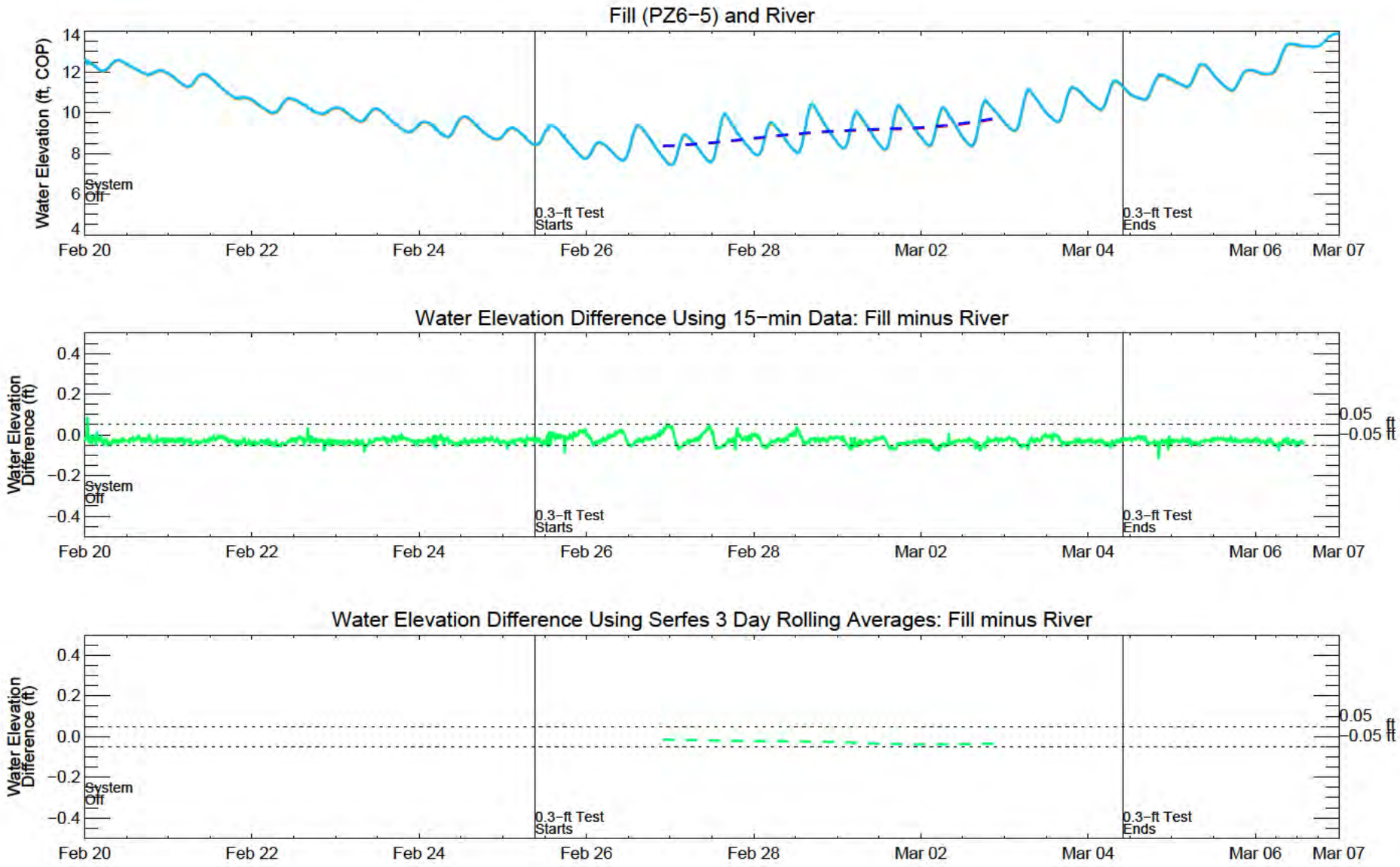
Figure 4.9
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:40 2014



Fill: 15-min Data
Fill: Serfes Averages
River: 15-min Data
River: Serfes Averages
Water Elevation Difference: 15-min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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Figure 4.10
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

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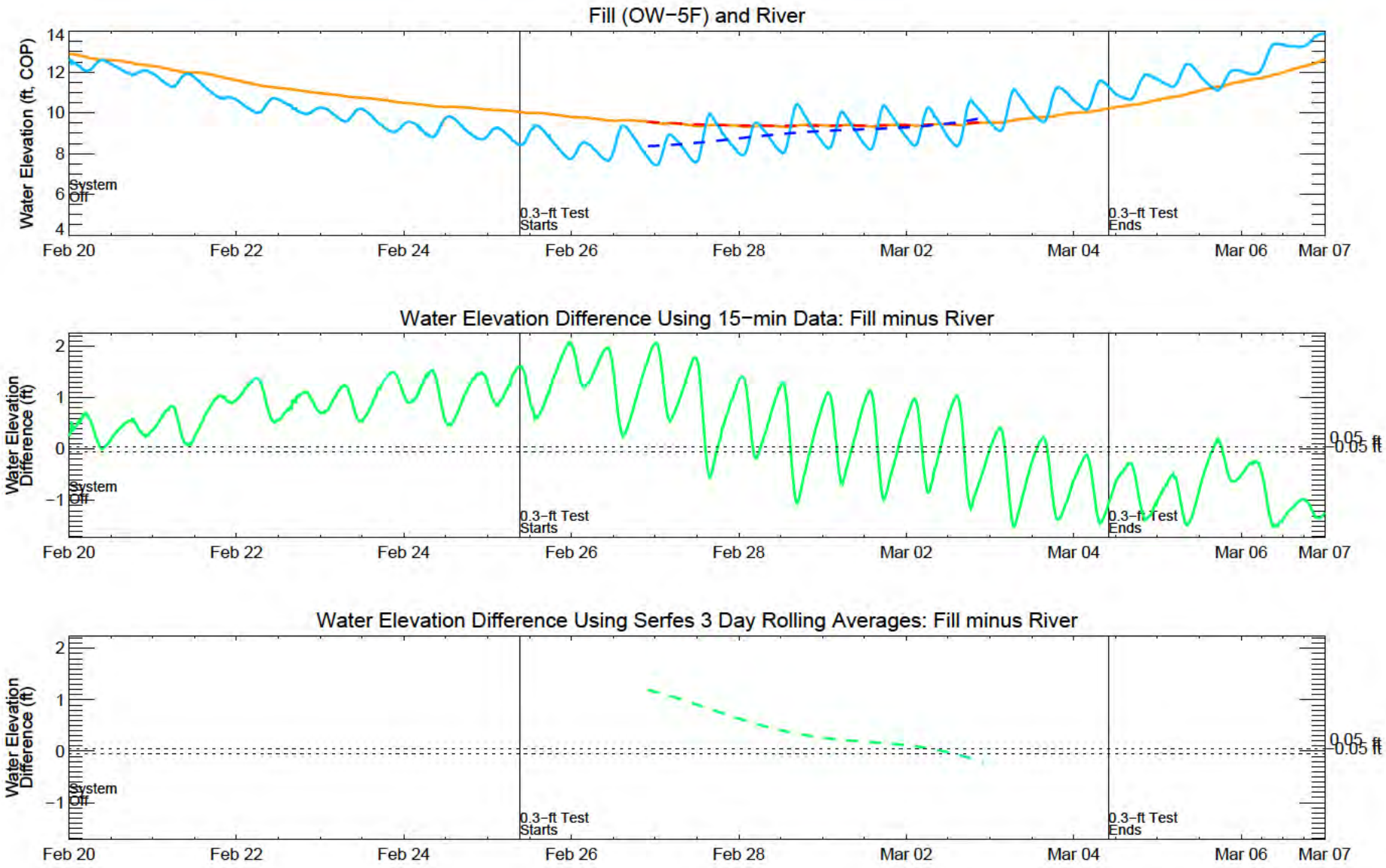

Fill: 15−min Data
Fill: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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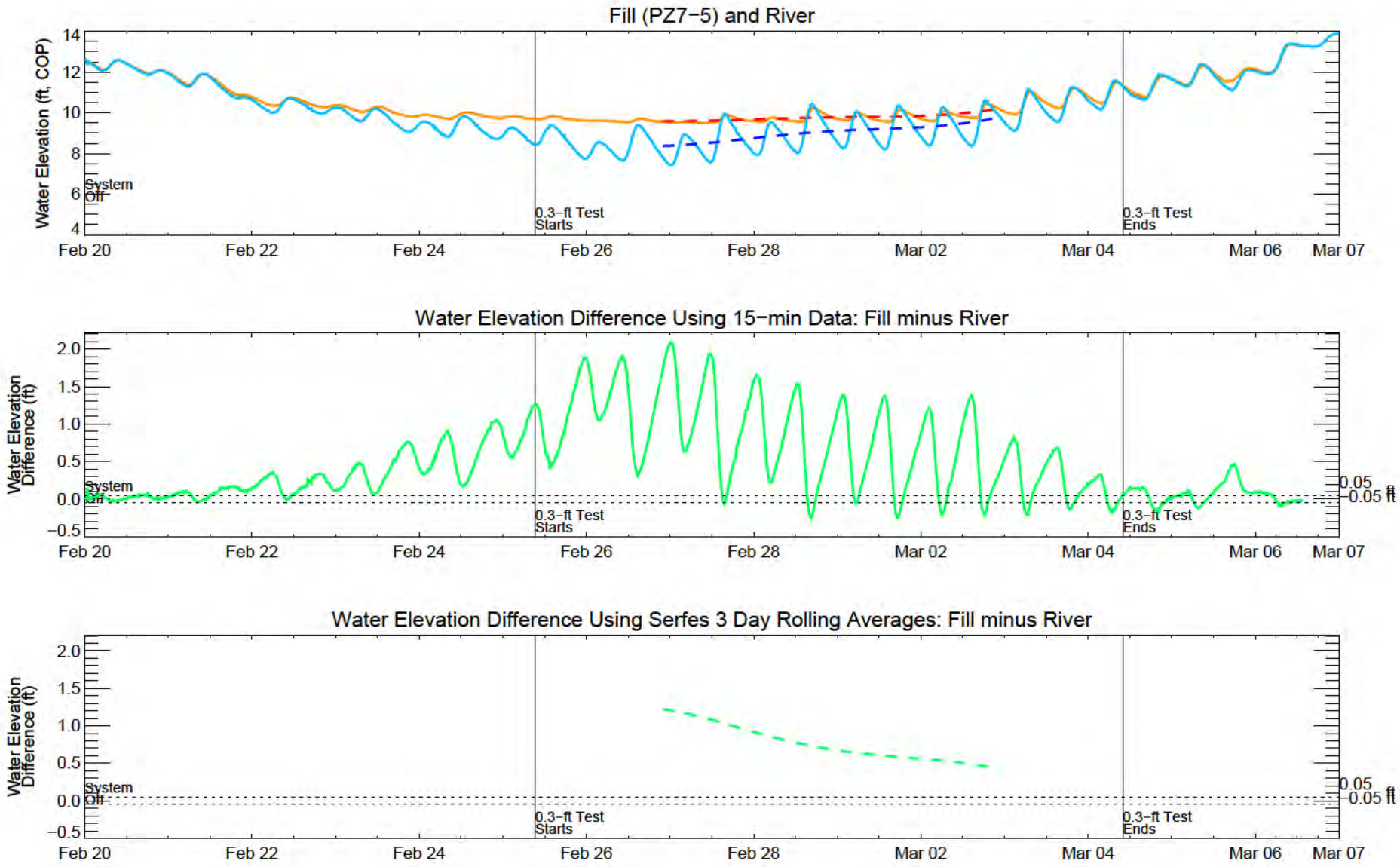
Figure 4.11
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:40 2014



Fill: 15−min Data
Fill: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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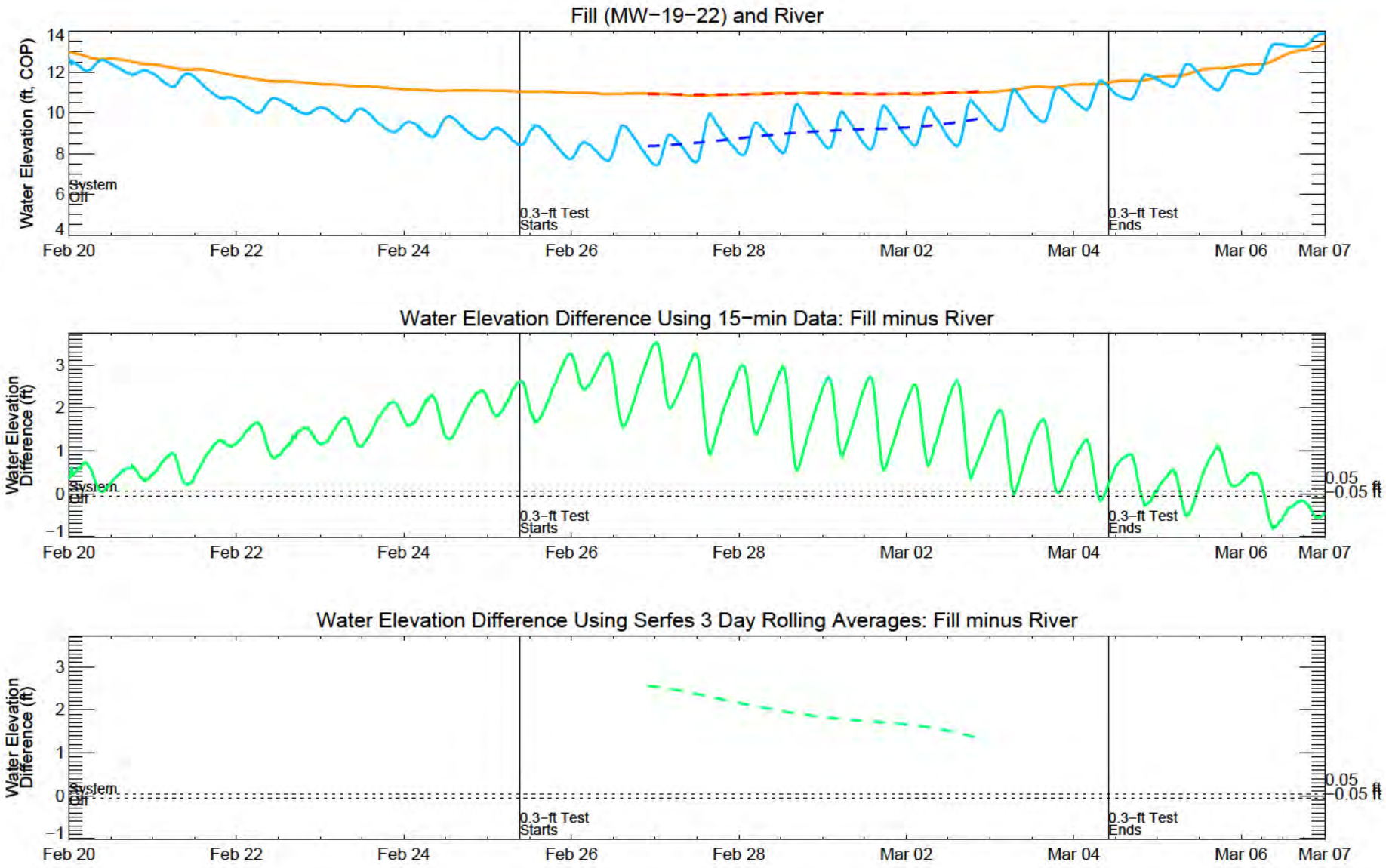
Figure 4.12
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:40 2014



Fill: 15−min Data
Fill: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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Figure 4.13
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:40 2014

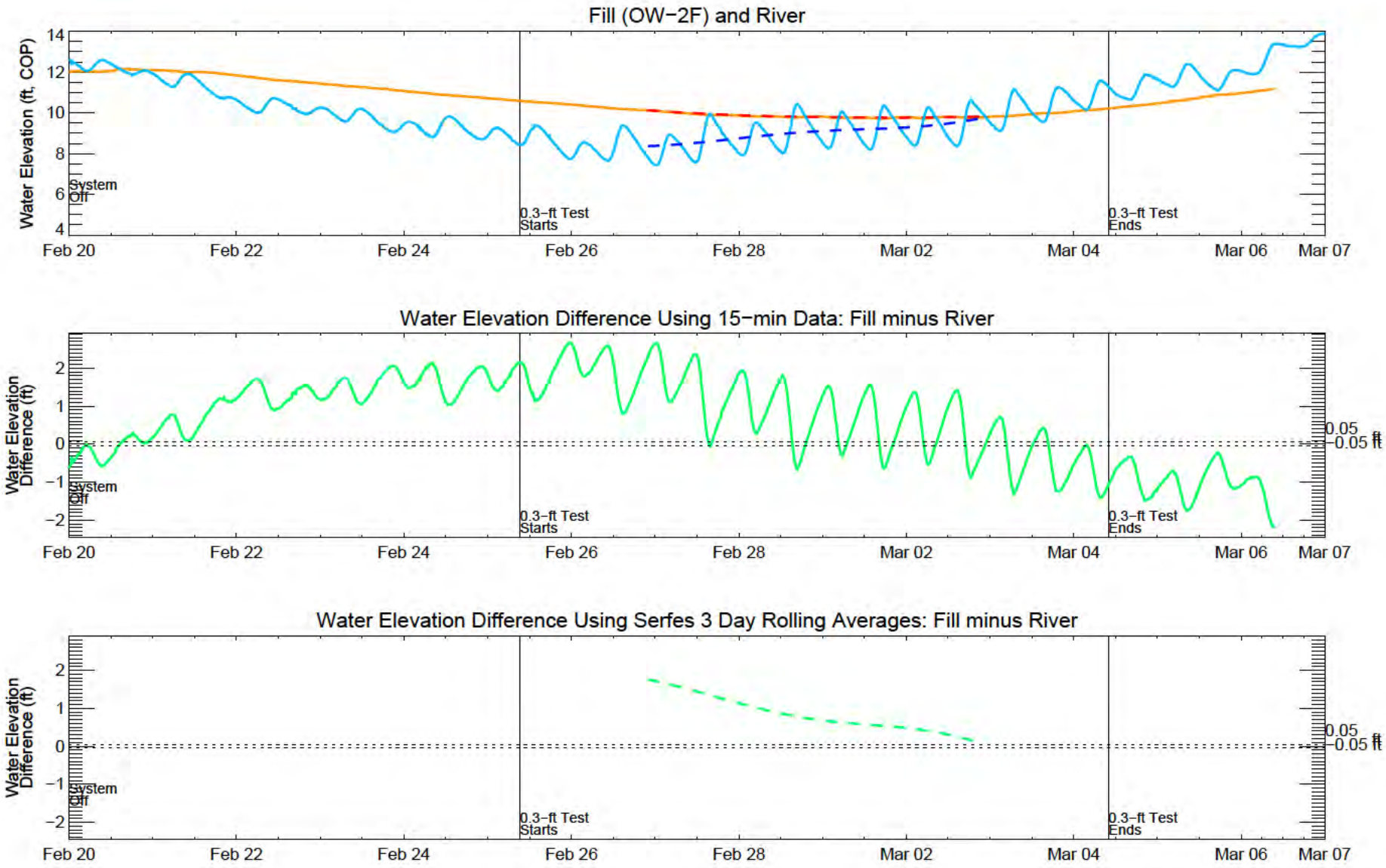

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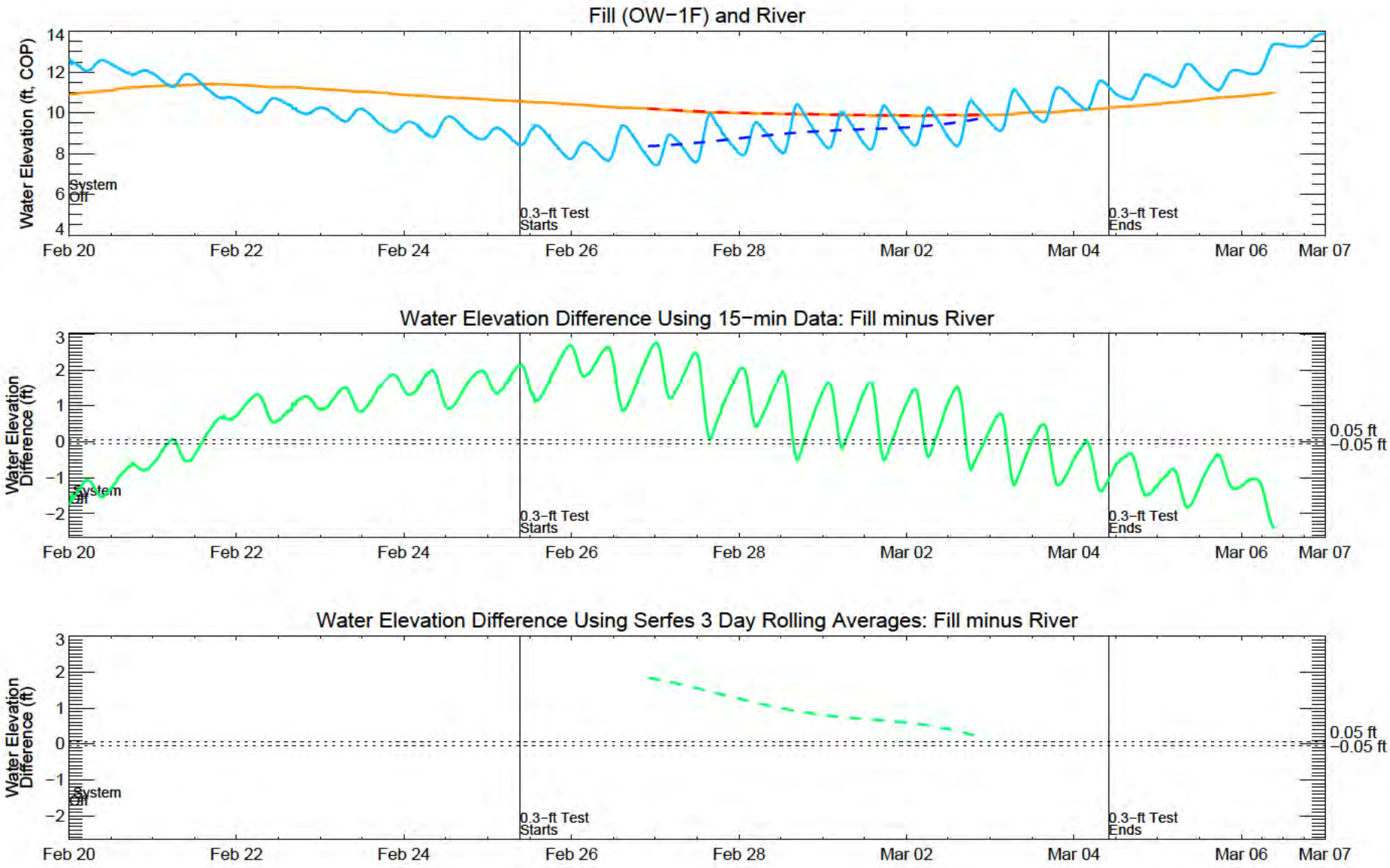
Figure 4.14

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:41 2014



Fill: 15−min Data
Fill: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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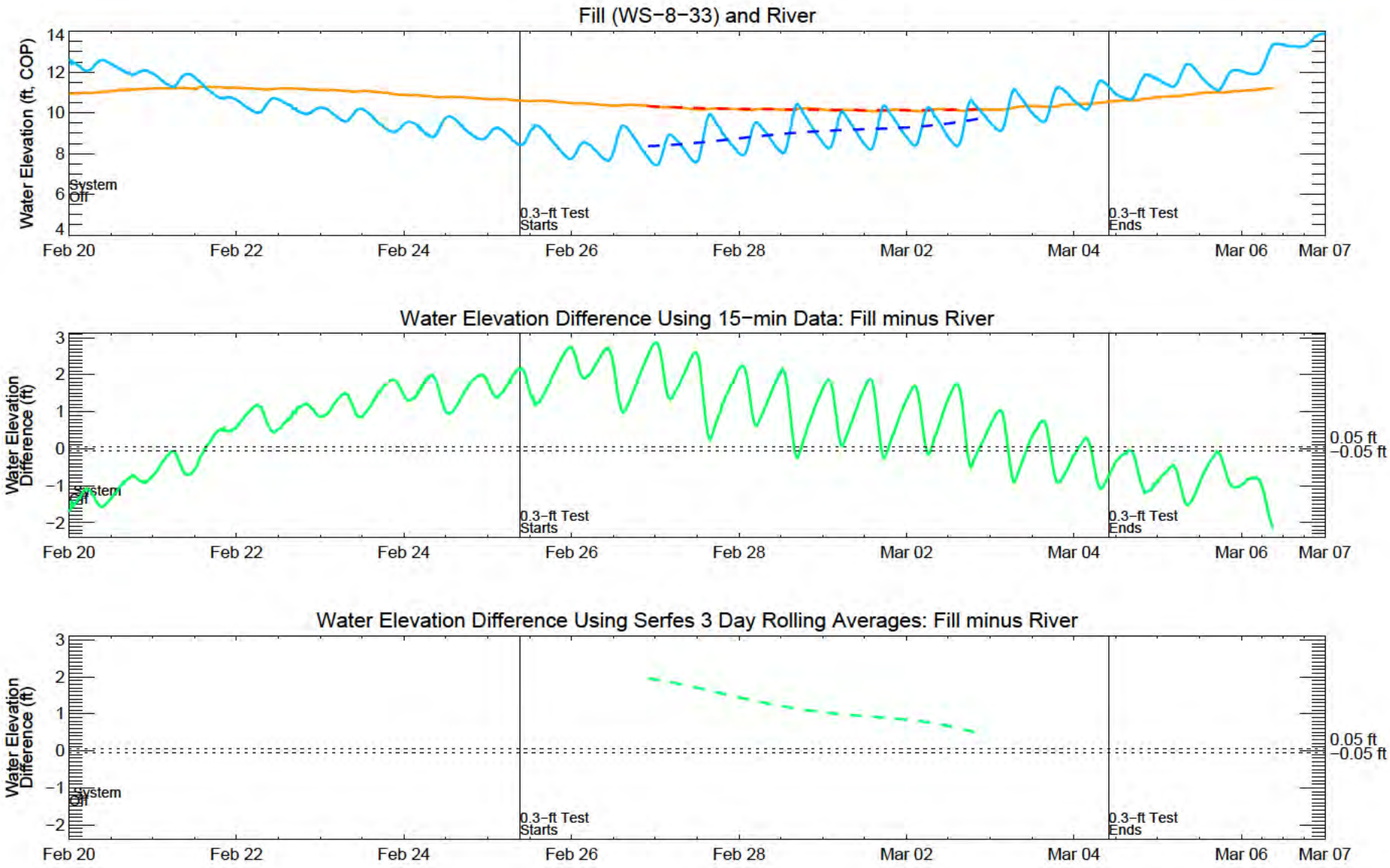
Figure 4.15
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:41 2014



- Fill: 15-min Data
- Fill: Serfes Averages
- River: 15-min Data
- River: Serfes Averages
- Water Elevation Difference: 15-min Data
- Water Elevation Difference: Serfes Averages
- 0.05 ft Total Potential Uncertainty

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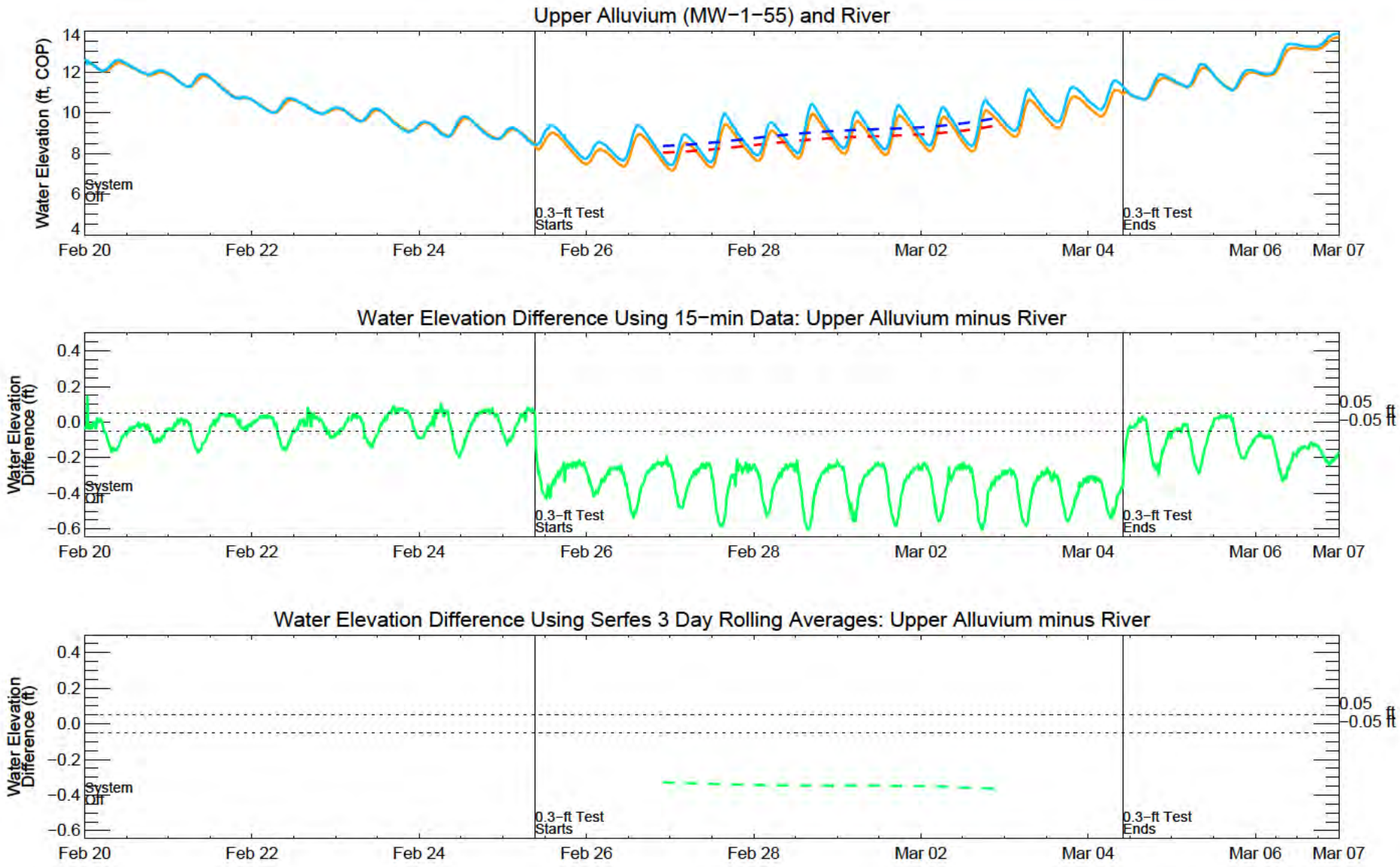
Figure 4.16

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:41 2014

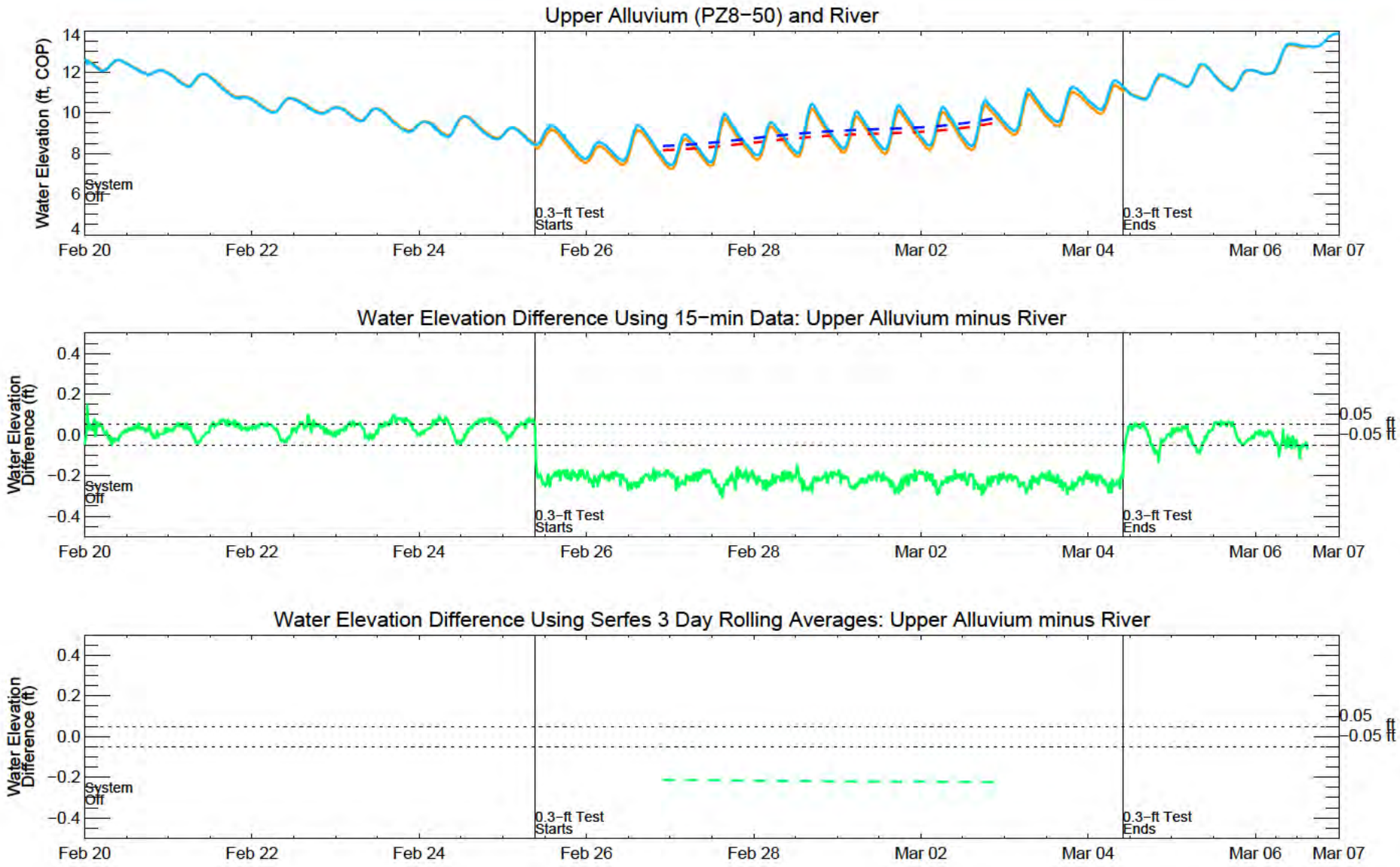


Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.17
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:41 2014



ANCHOR QEA

Figure 4.18

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:41 2014

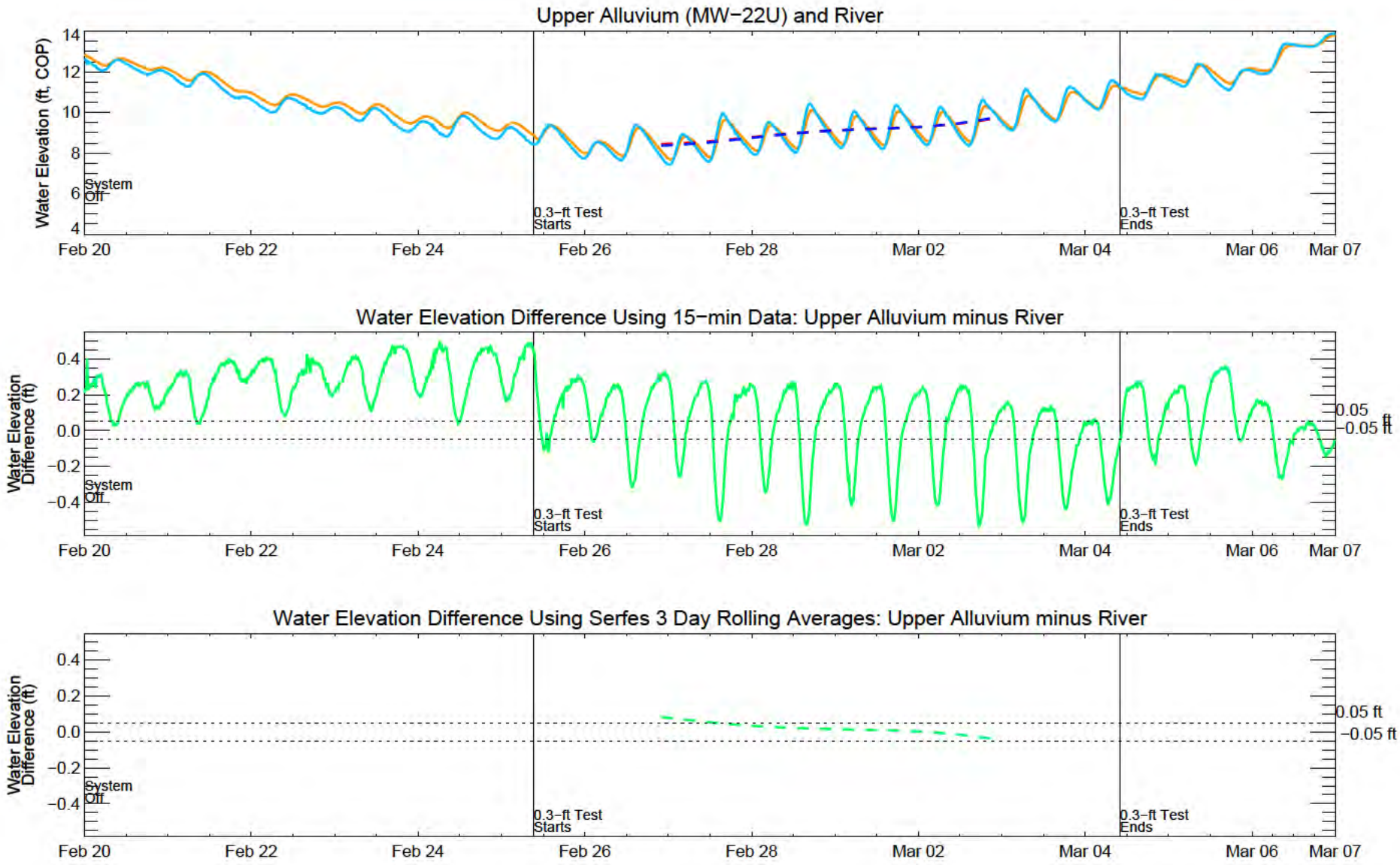


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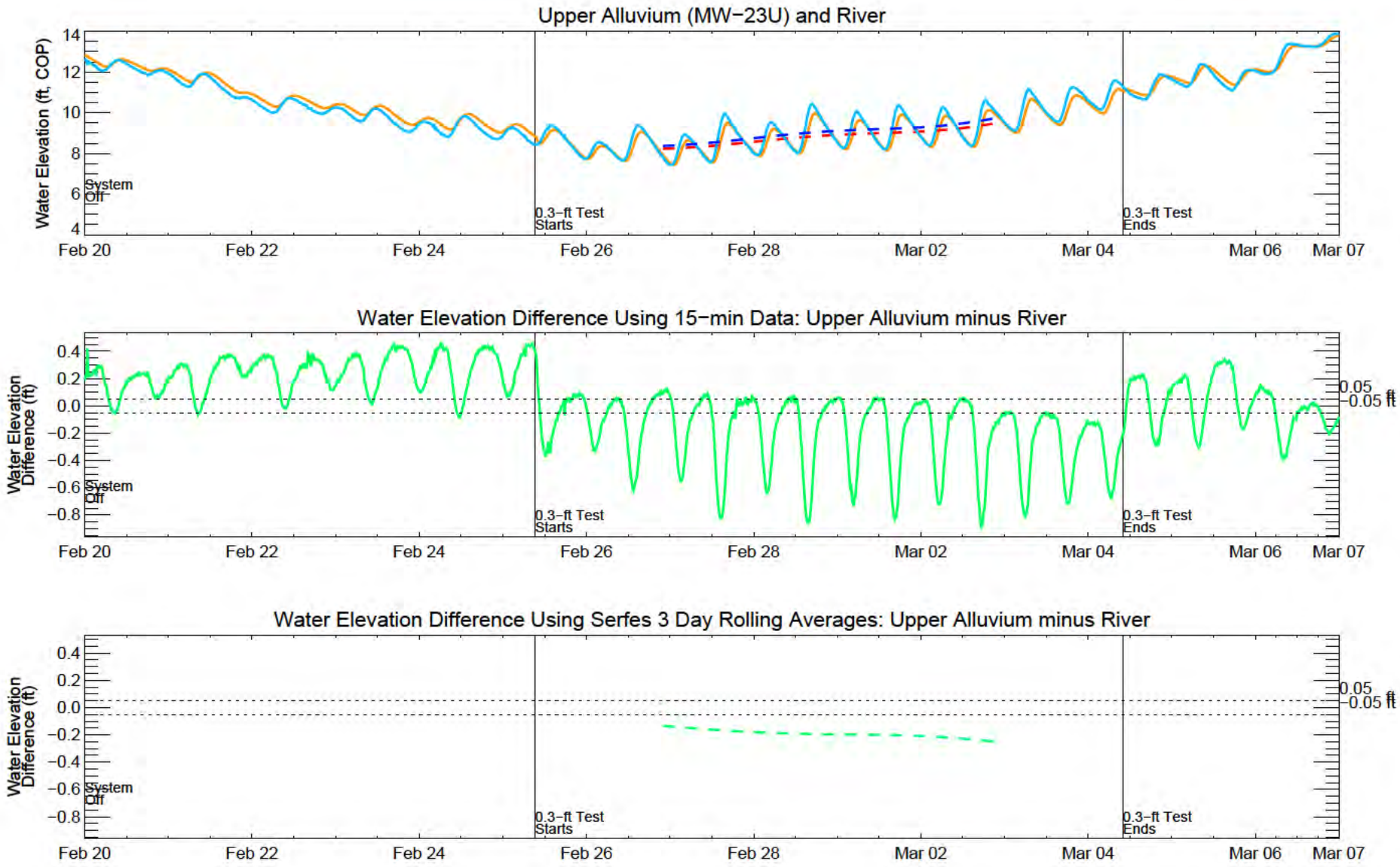
Figure 4.19

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:41 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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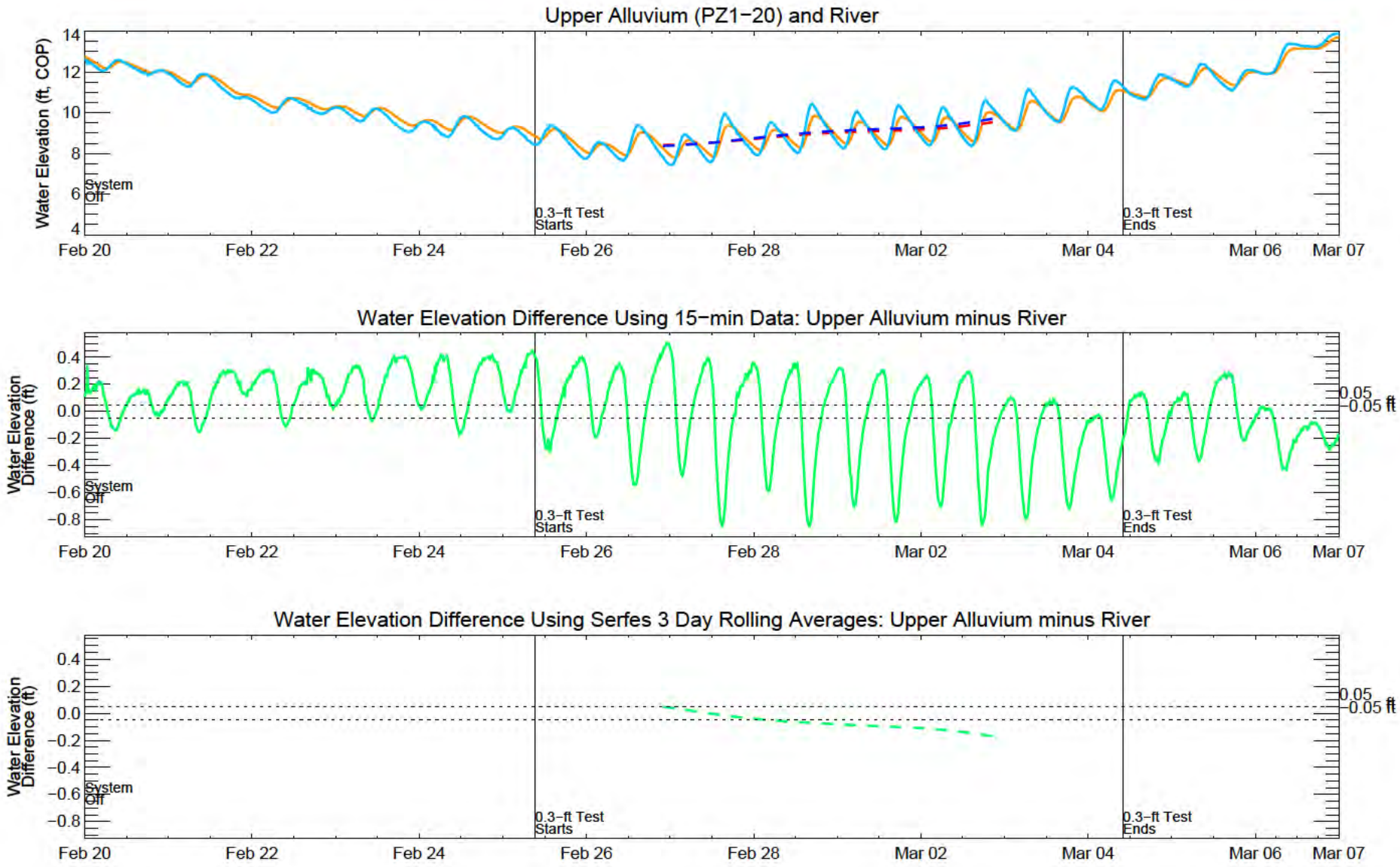
Figure 4.20
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:42 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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Figure 4.21
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:42 2014

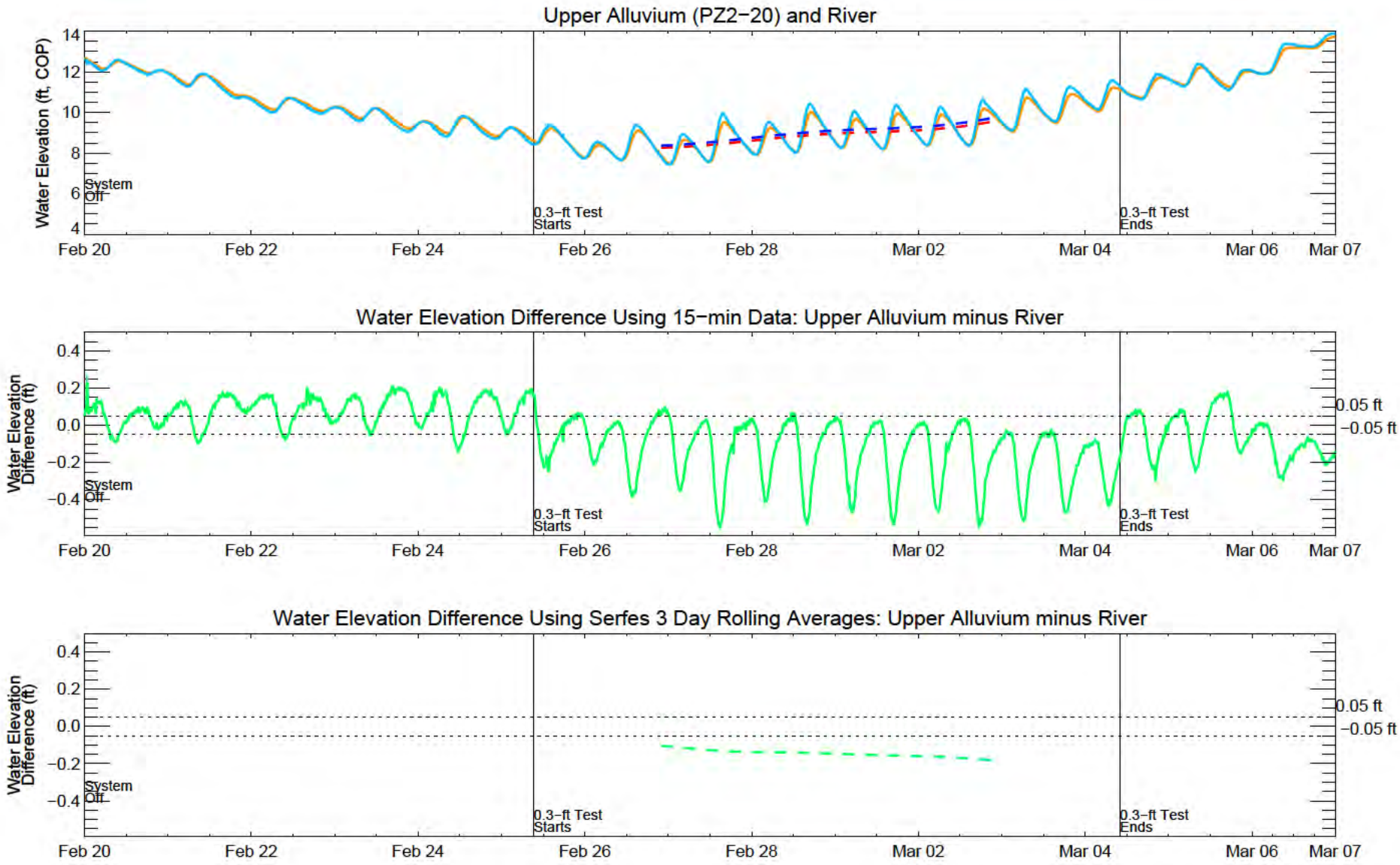

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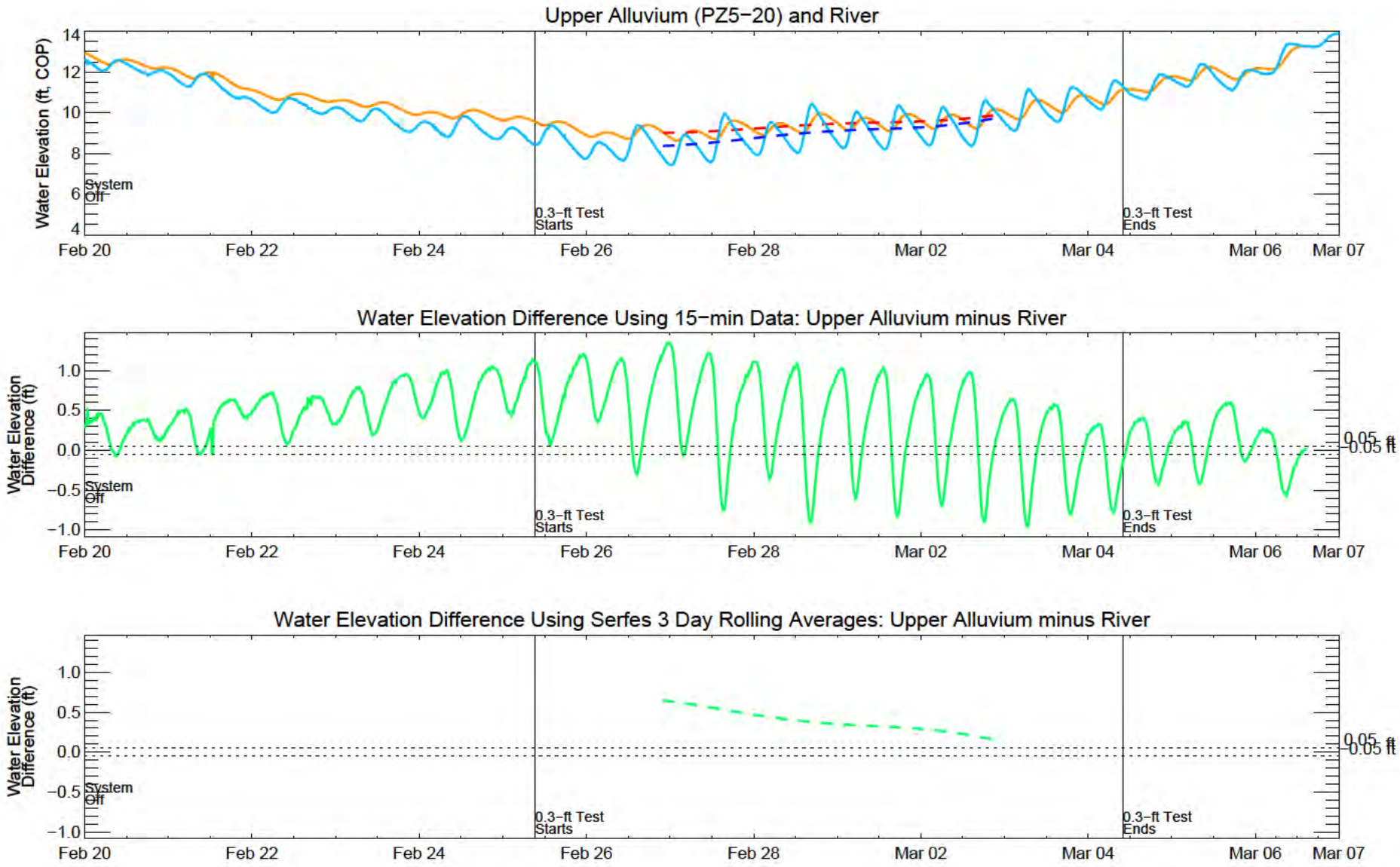
Figure 4.22

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:42 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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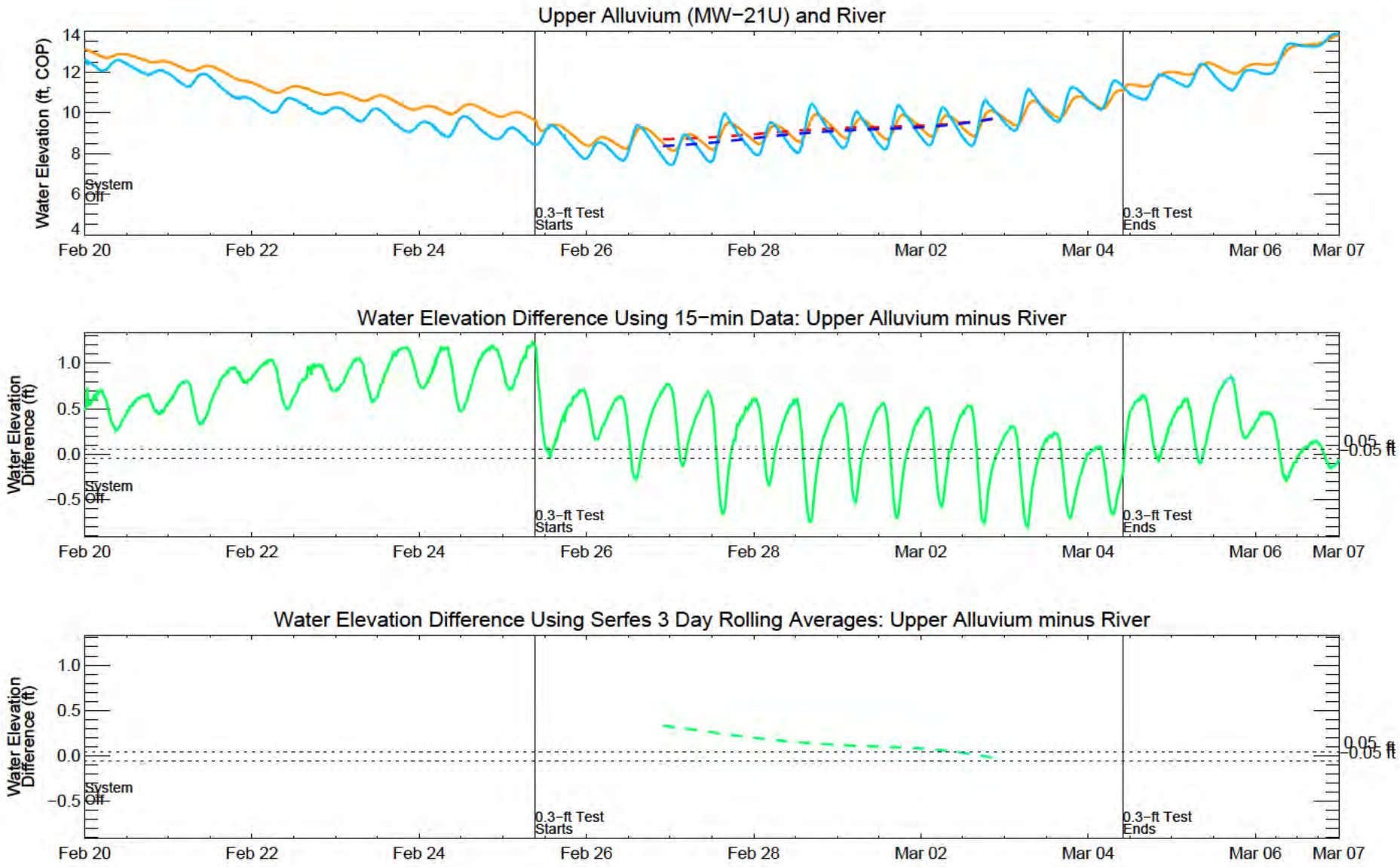
Figure 4.23
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:42 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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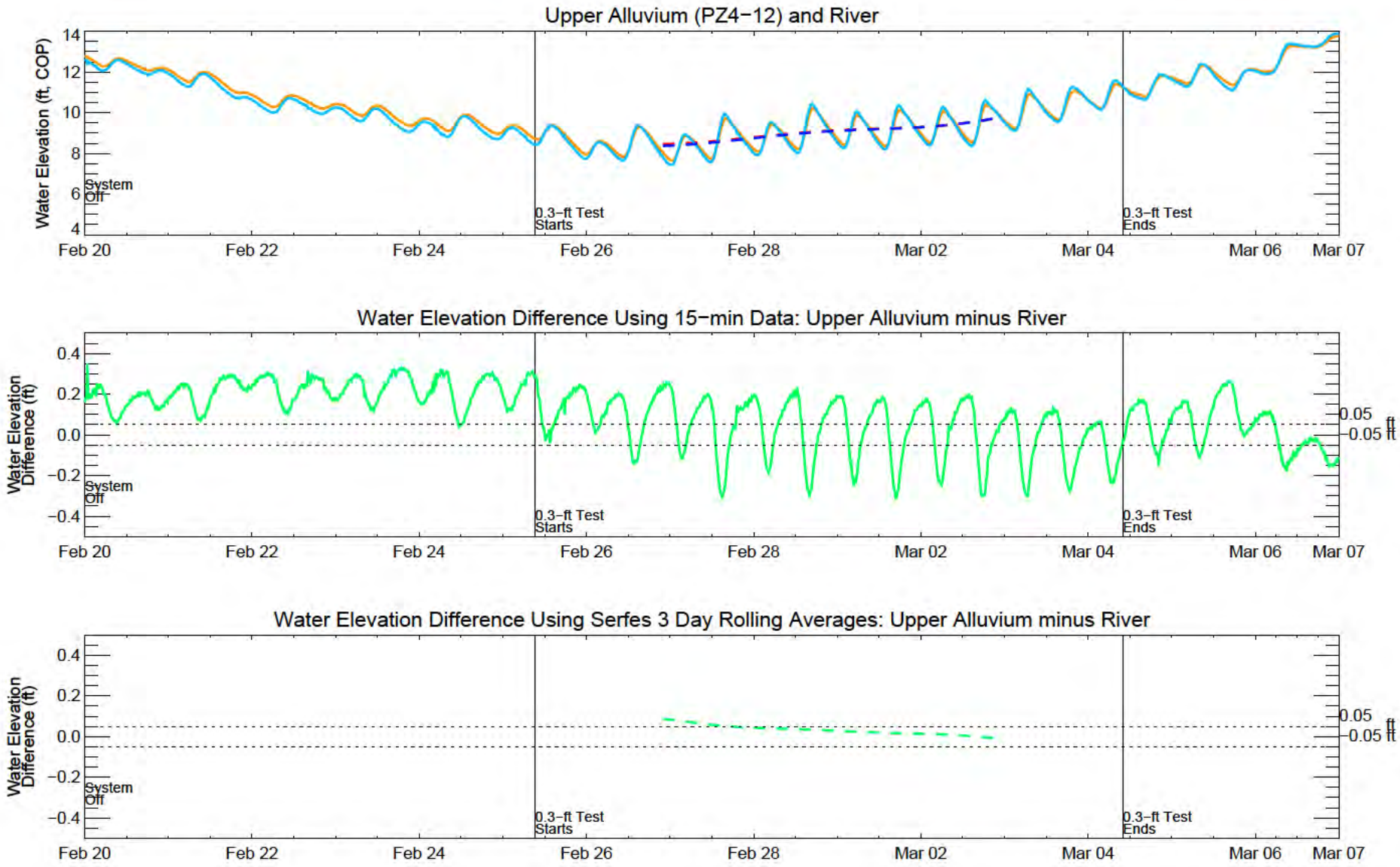
Figure 4.24
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:42 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.25
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:42 2014

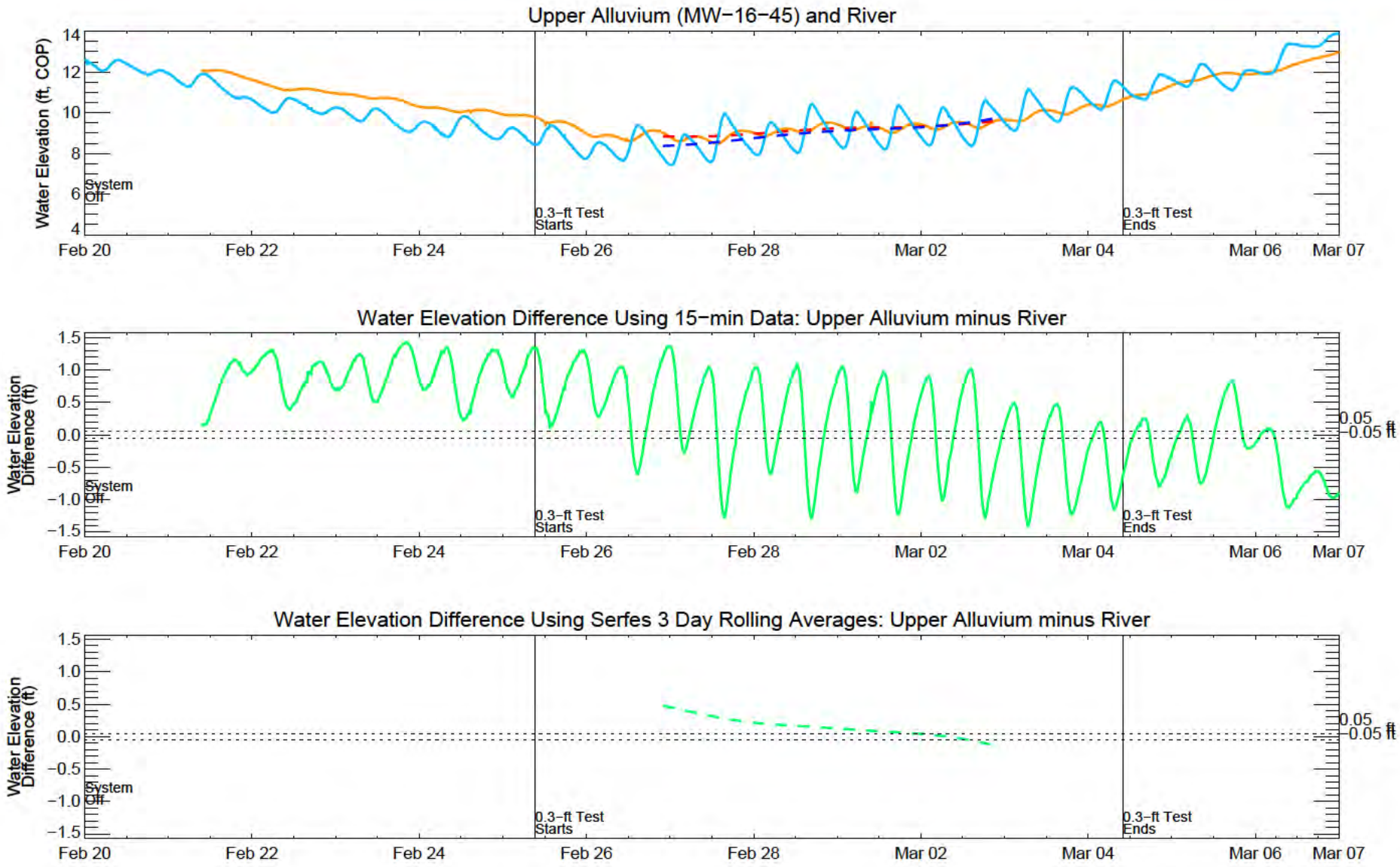


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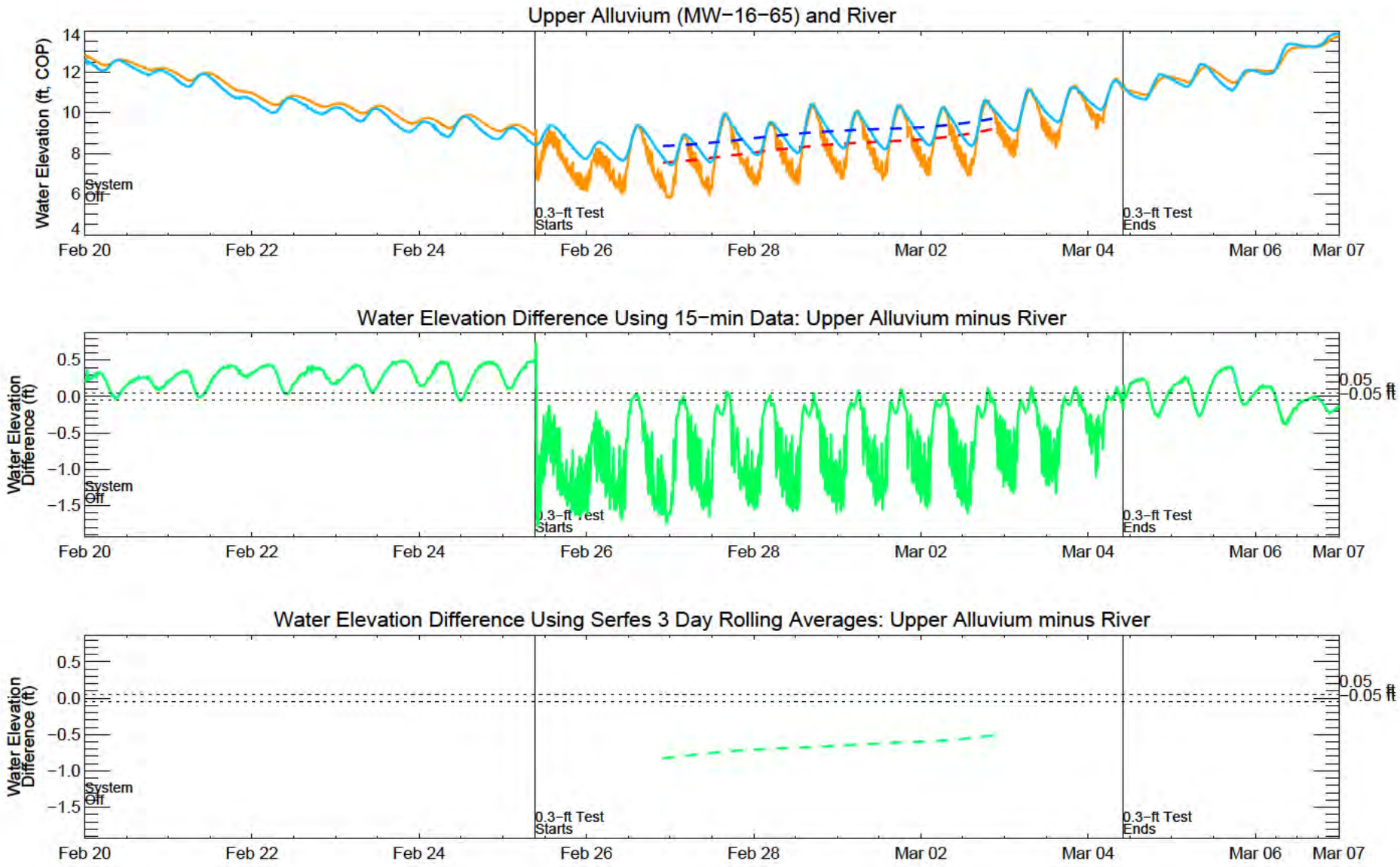
Figure 4.26

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:43 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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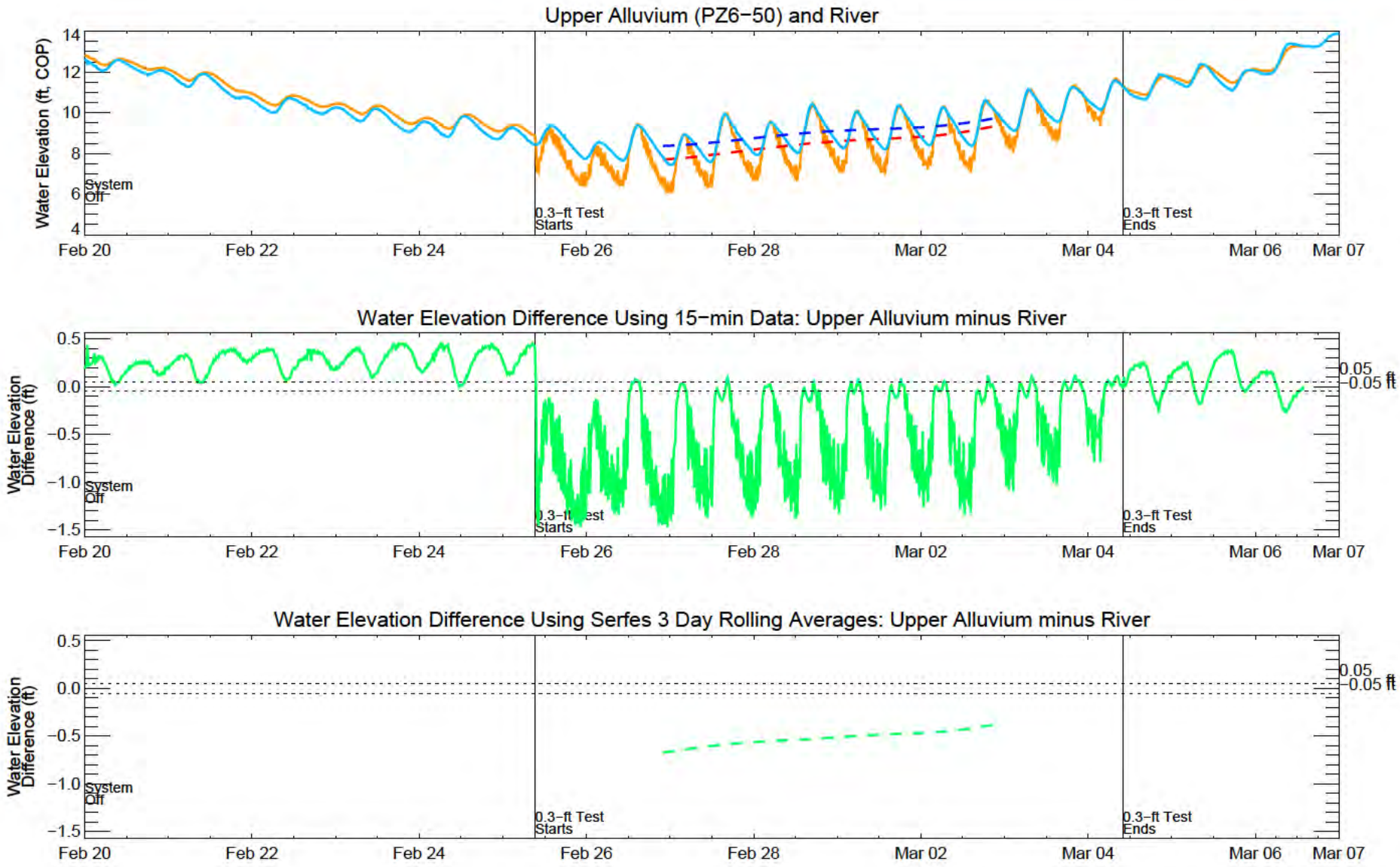
Figure 4.27
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:43 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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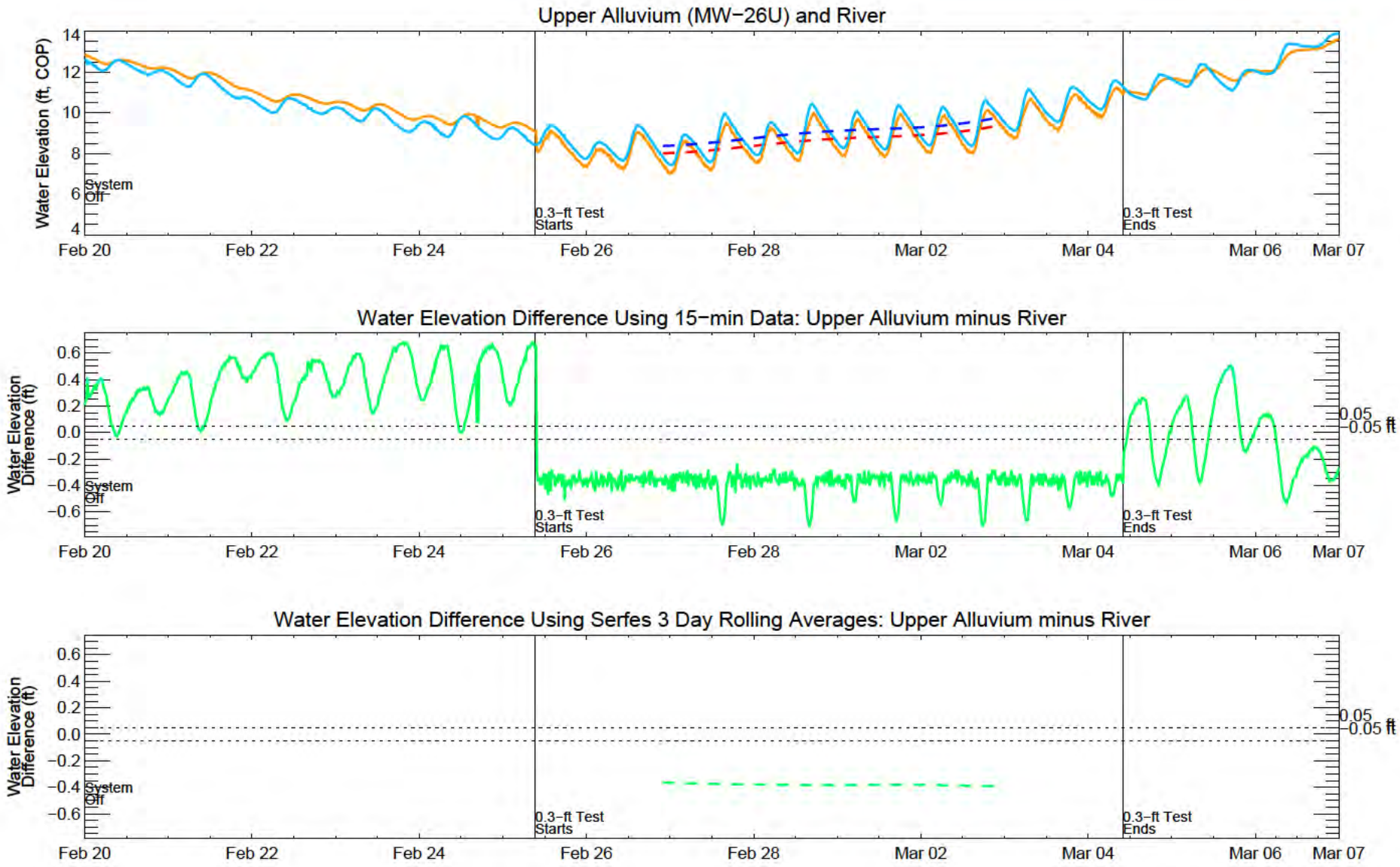
Figure 4.28
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:43 2014



- Upper Alluvium: 15−min Data
- Upper Alluvium: Serfes Averages
- River: 15−min Data
- River: Serfes Averages
- Water Elevation Difference: 15−min Data
- Water Elevation Difference: Serfes Averages
- 0.05 ft Total Potential Uncertainty

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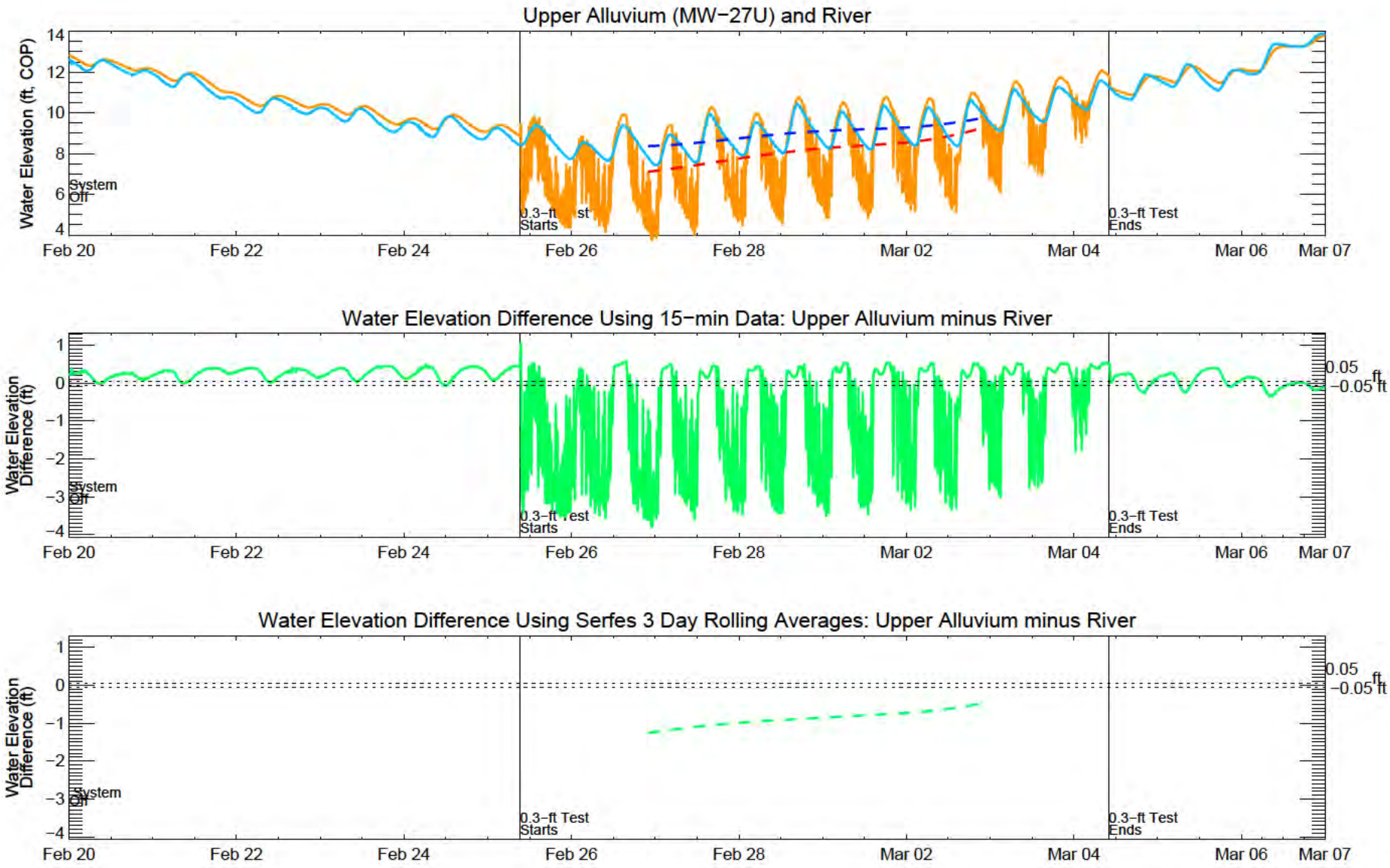
Figure 4.29

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:43 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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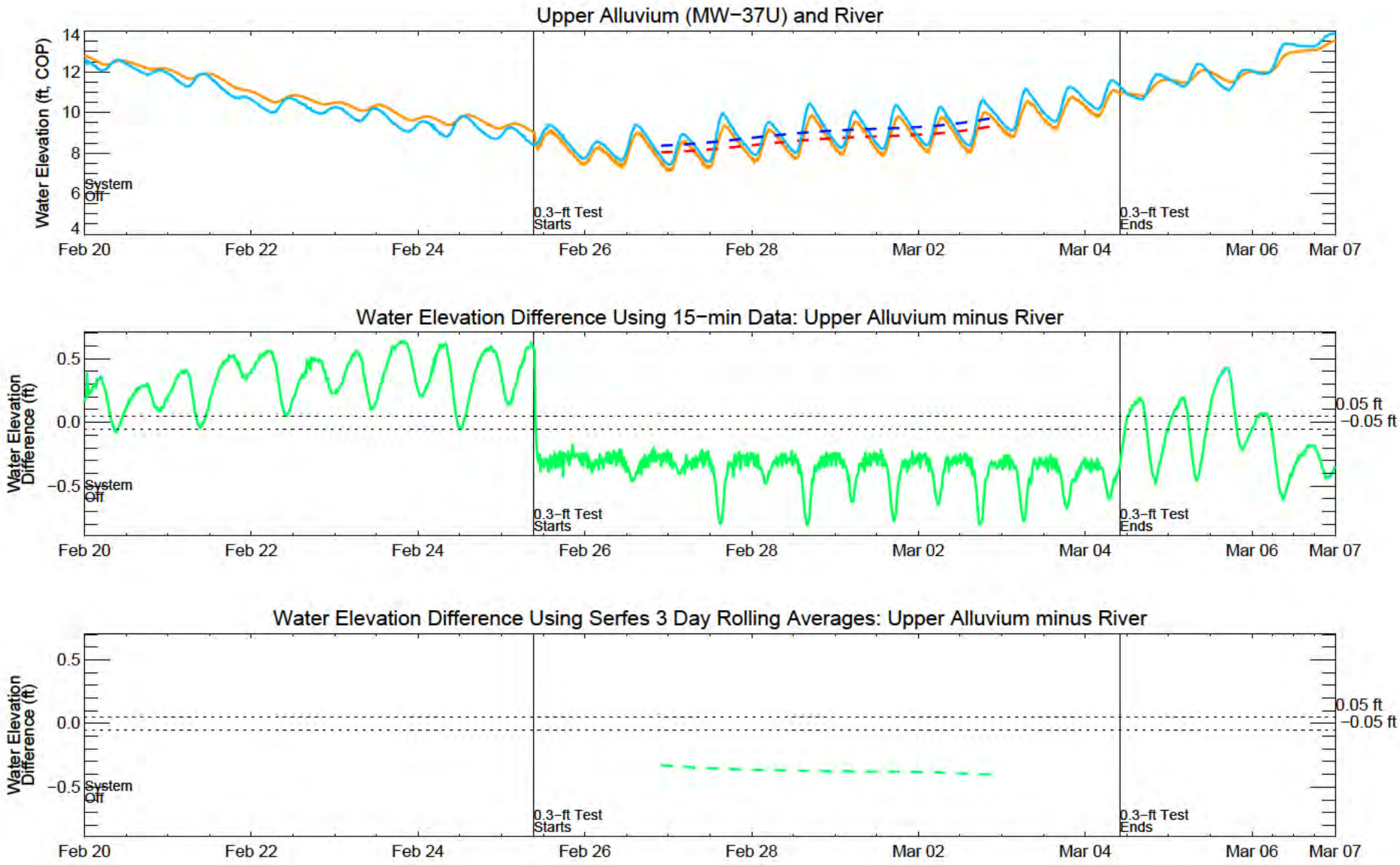
Figure 4.30

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:43 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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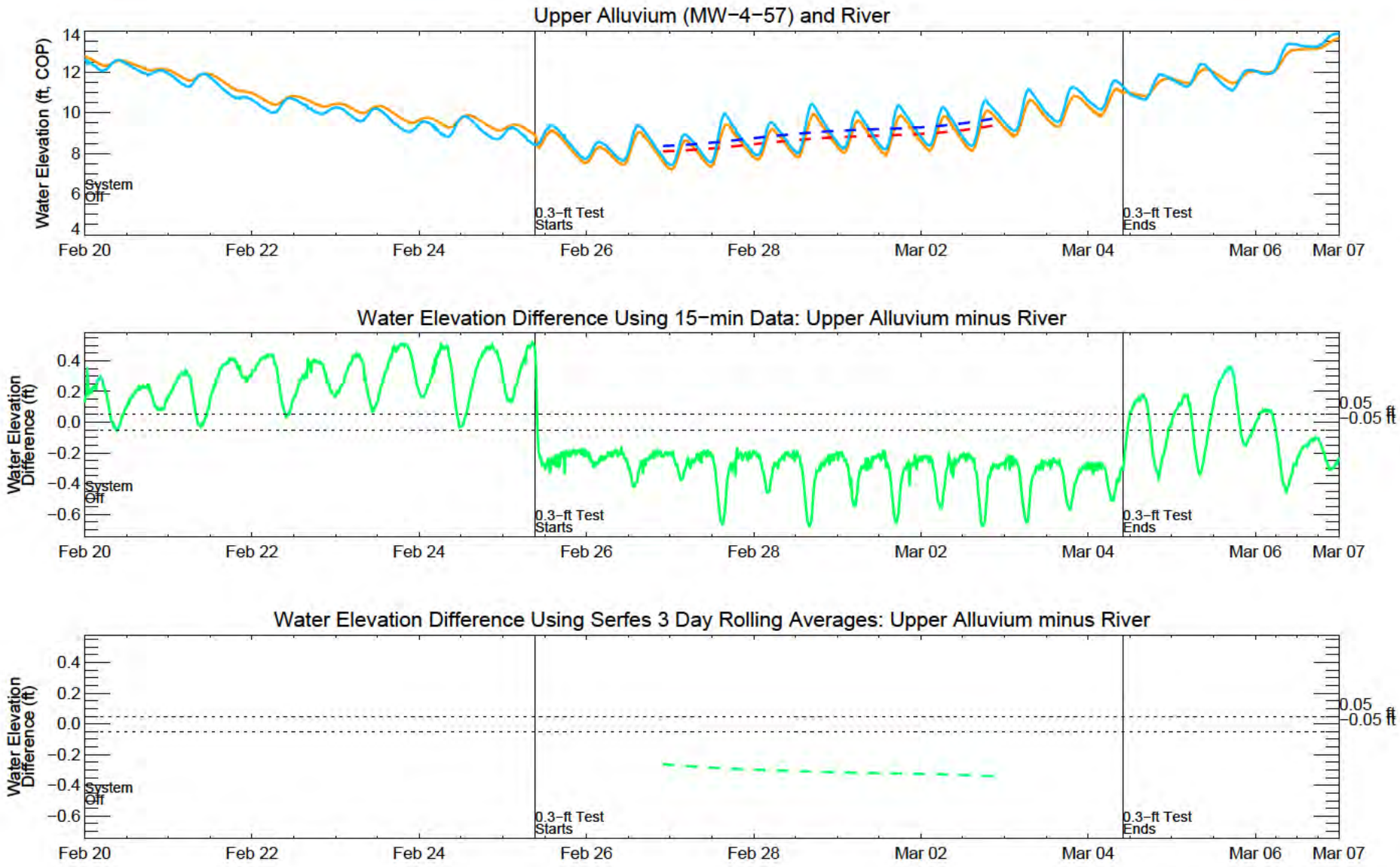
Figure 4.31
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:44 2014

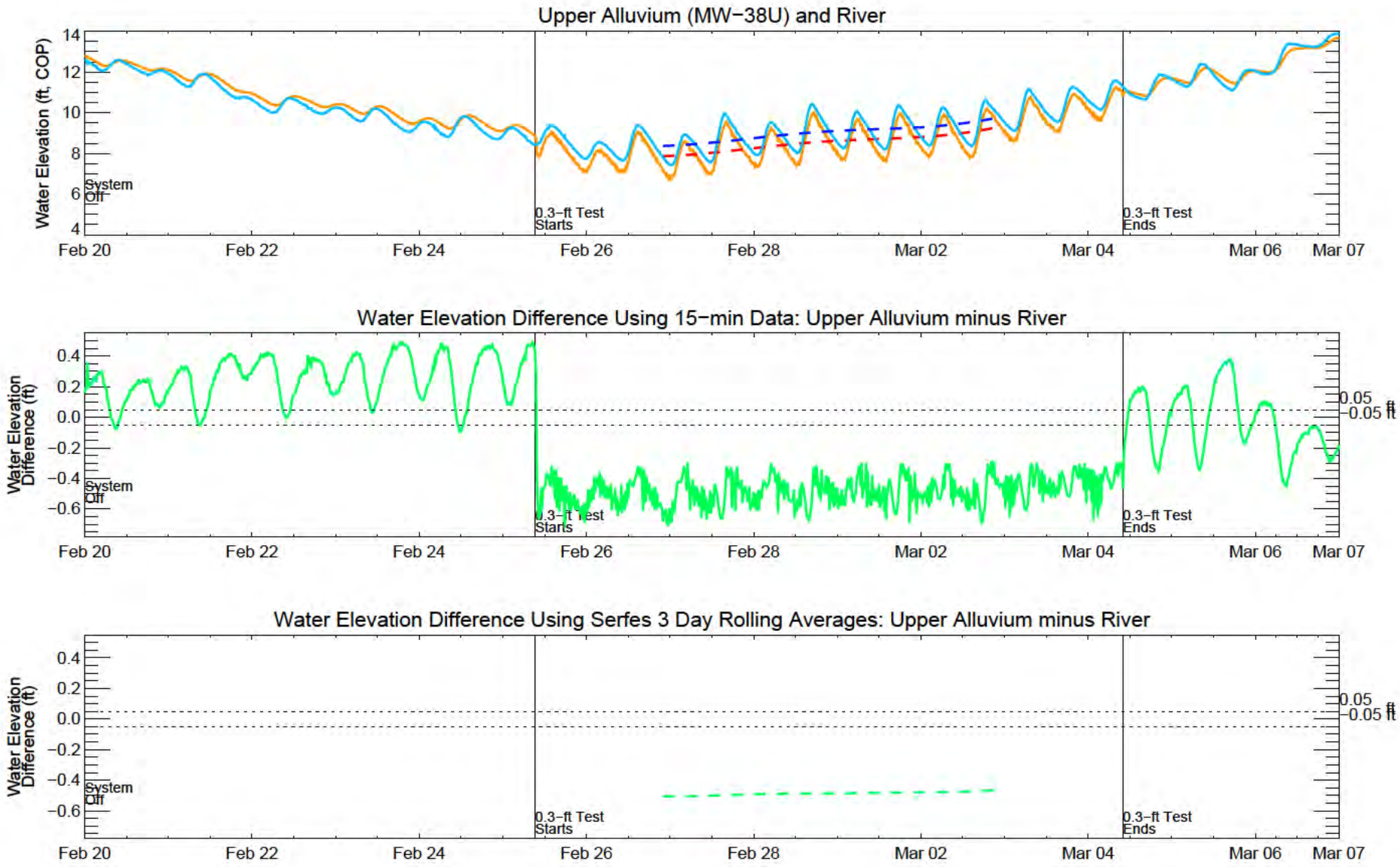


Upper Alluvium: 15-min Data
Upper Alluvium: Serfes Averages
River: 15-min Data
River: Serfes Averages
Water Elevation Difference: 15-min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.32
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:44 2014

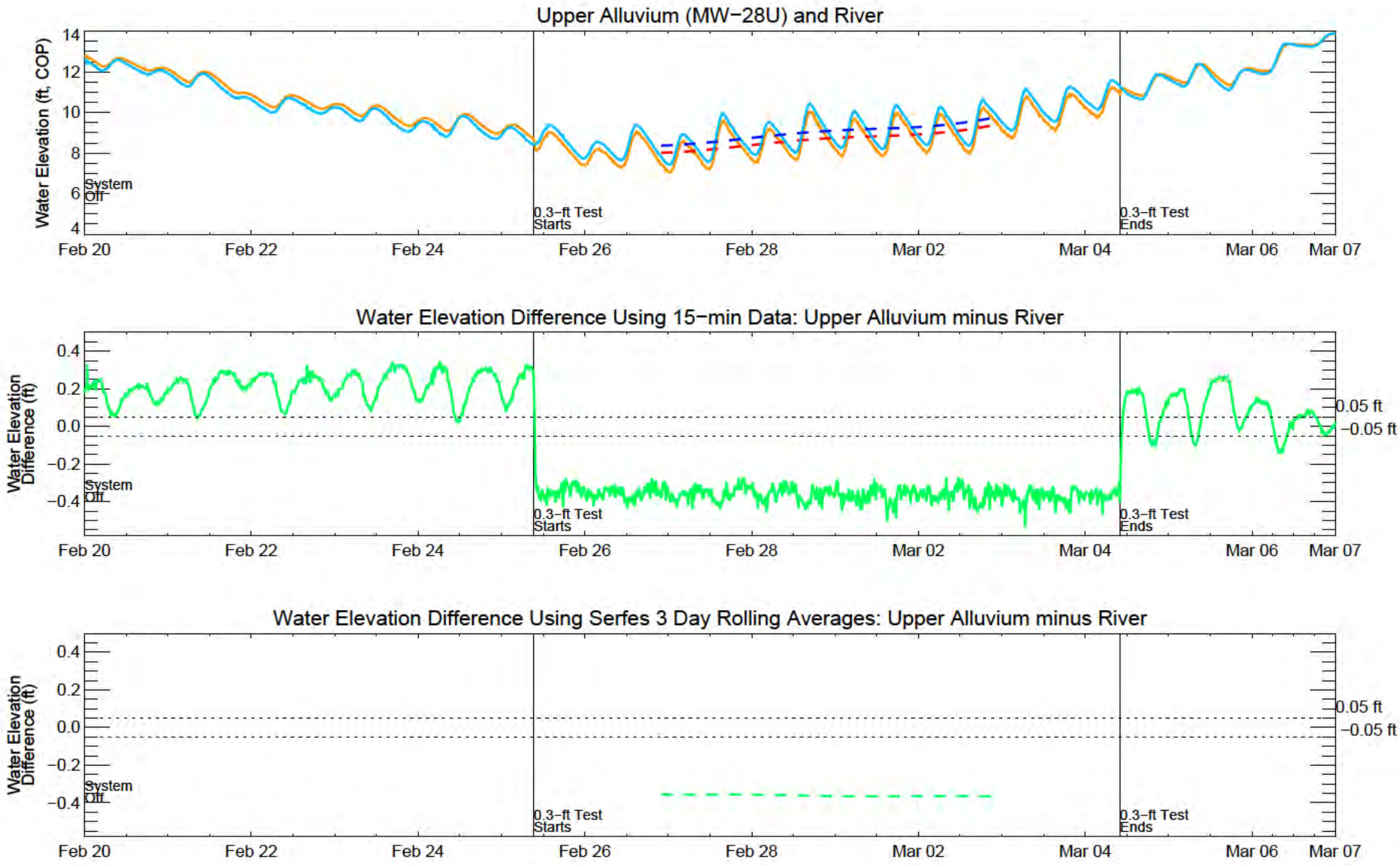


Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.33
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:44 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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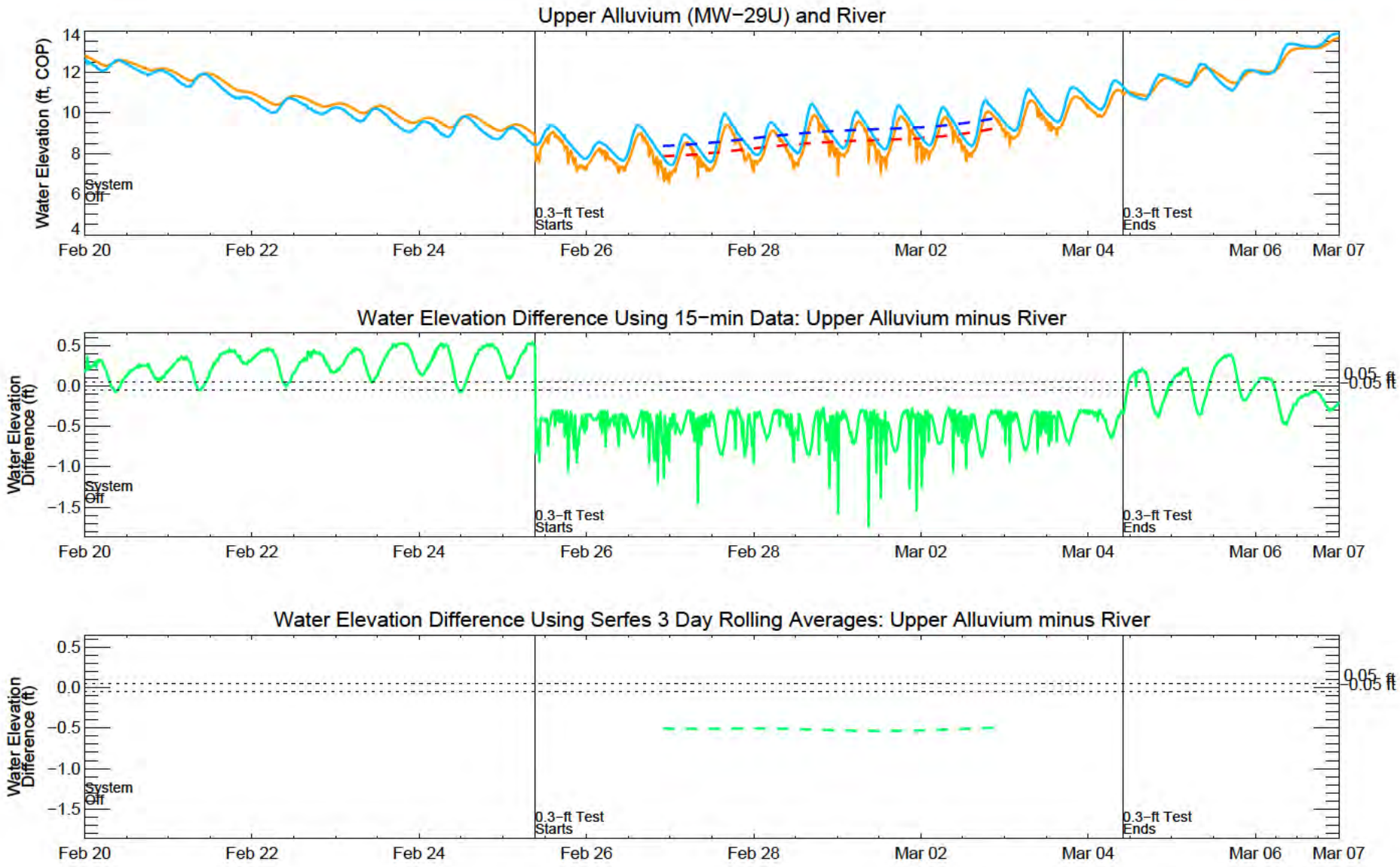
Figure 4.34
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:44 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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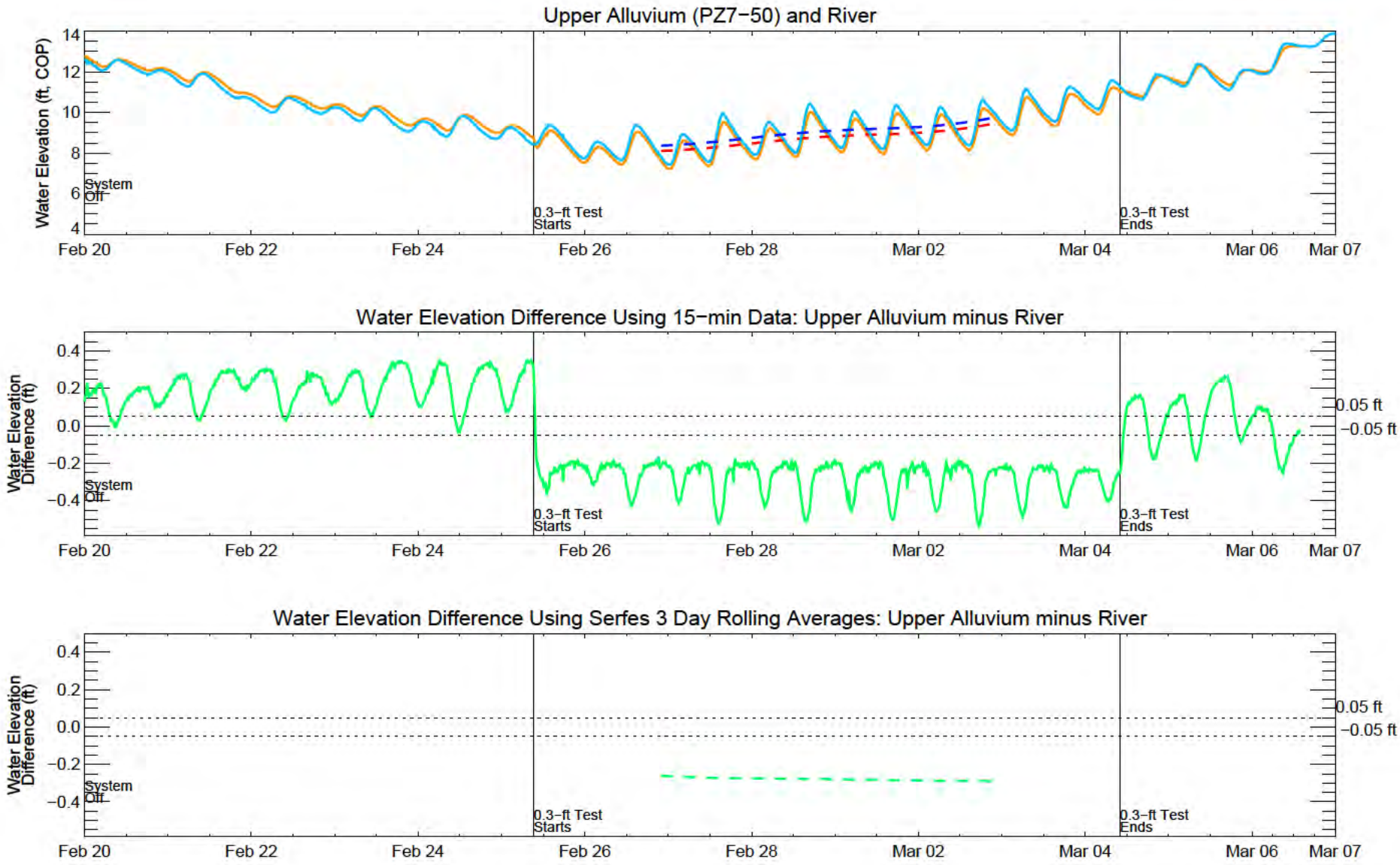
Figure 4.35

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:44 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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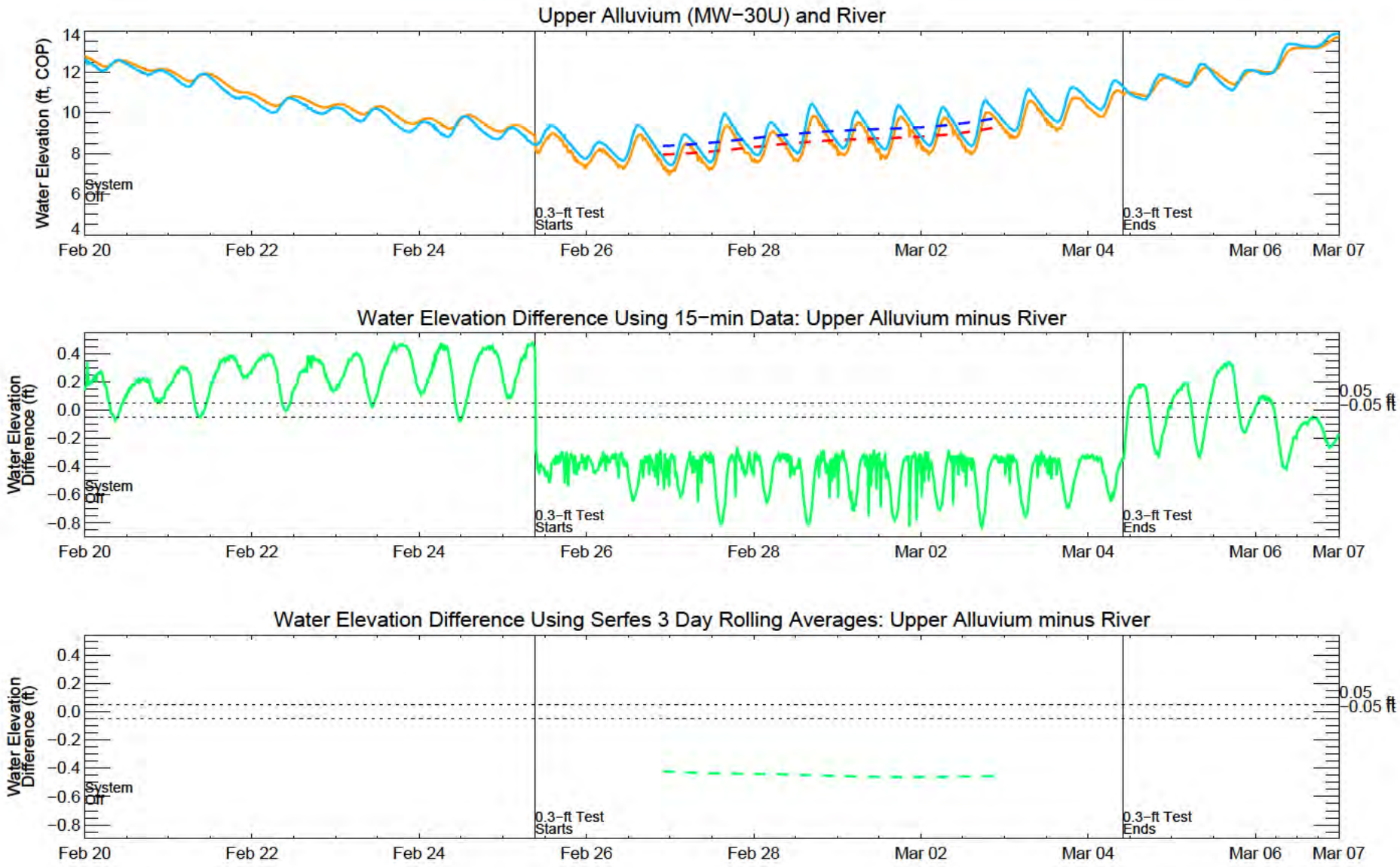
Figure 4.36
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:44 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

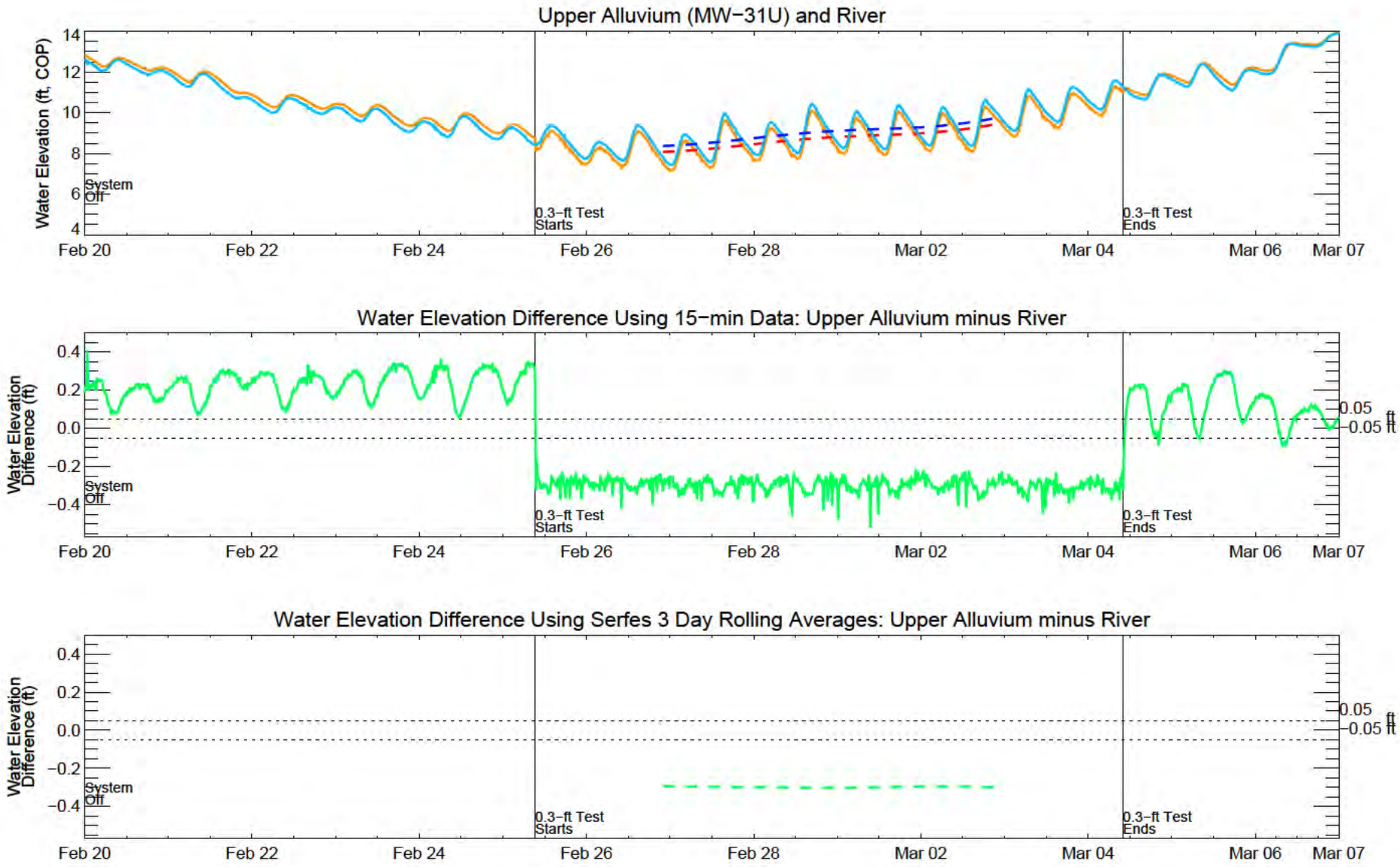
ANCHOR QEA

Figure 4.37

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:45 2014

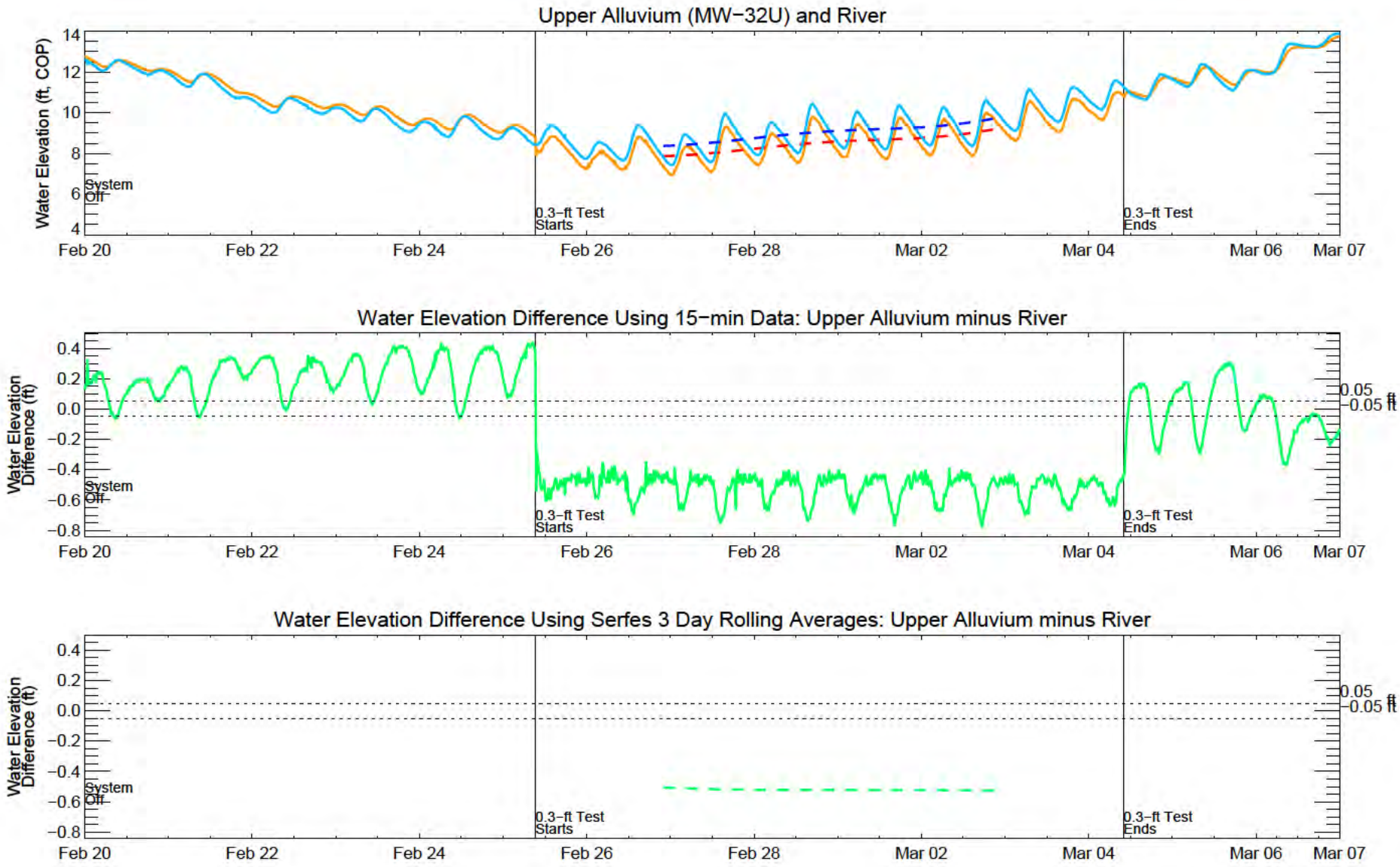


Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.38
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:45 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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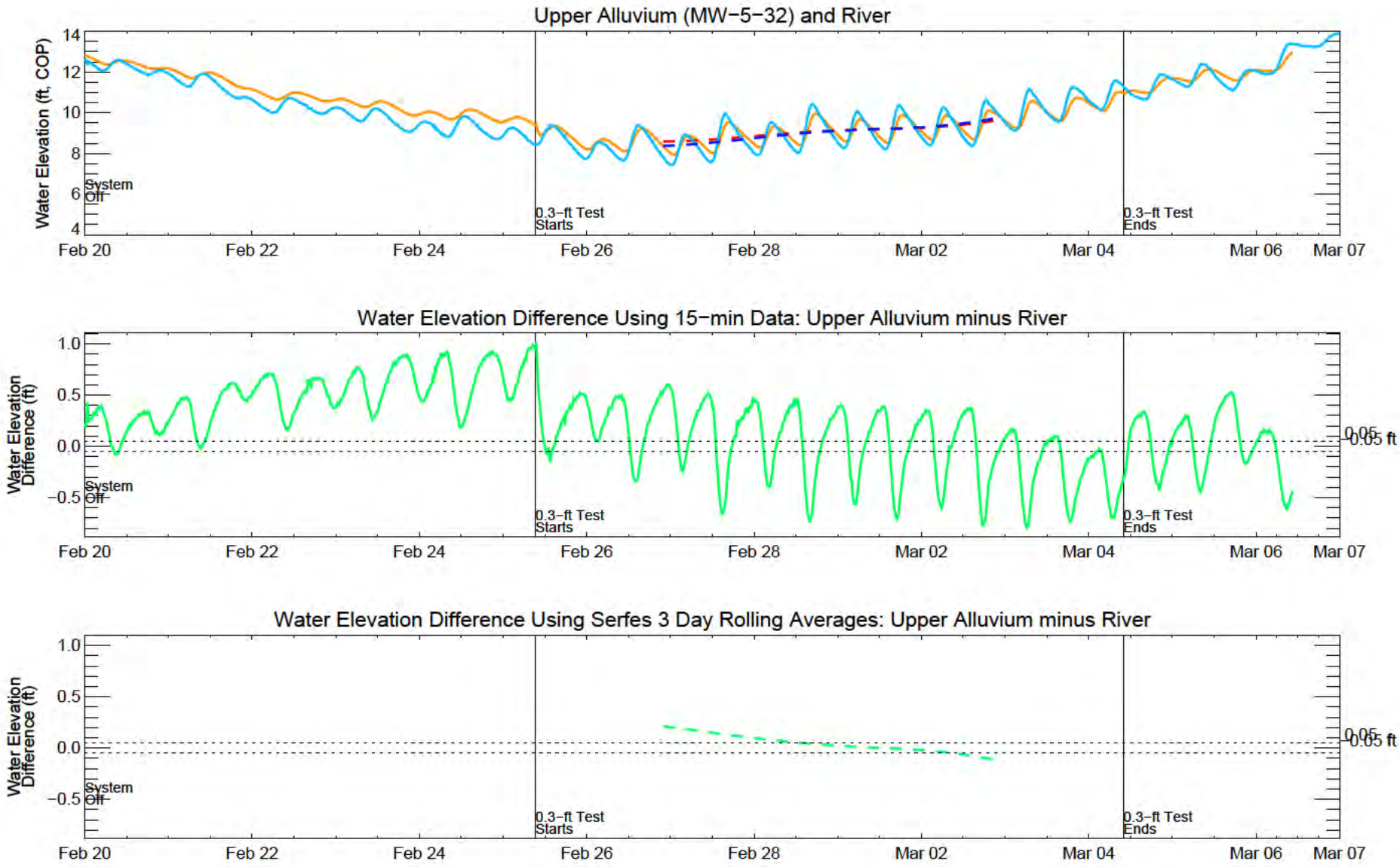
Figure 4.39
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:45 2014

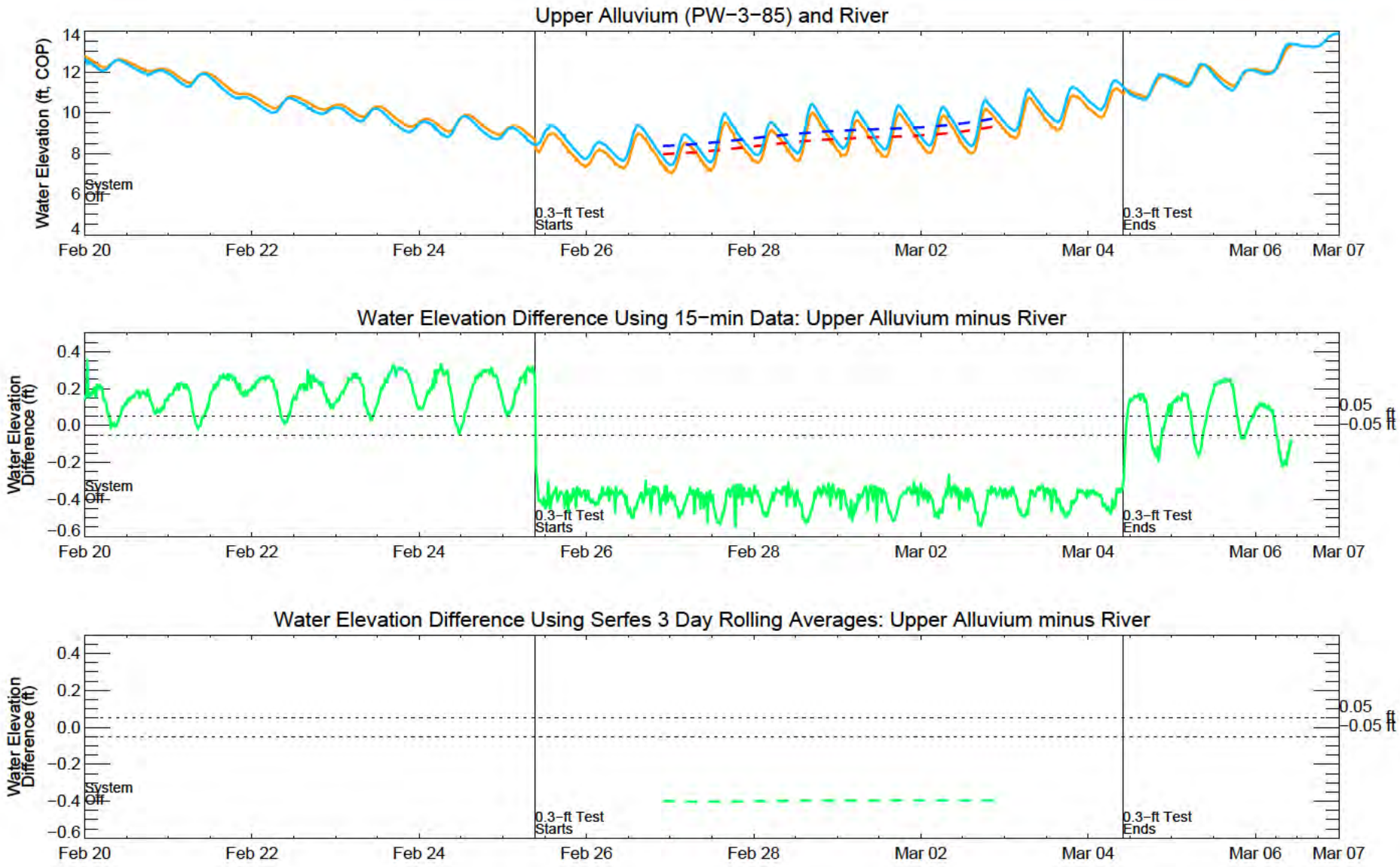


Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.40
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:45 2014



Upper Alluvium: 15-min Data
Upper Alluvium: Serfes Averages
River: 15-min Data
River: Serfes Averages
Water Elevation Difference: 15-min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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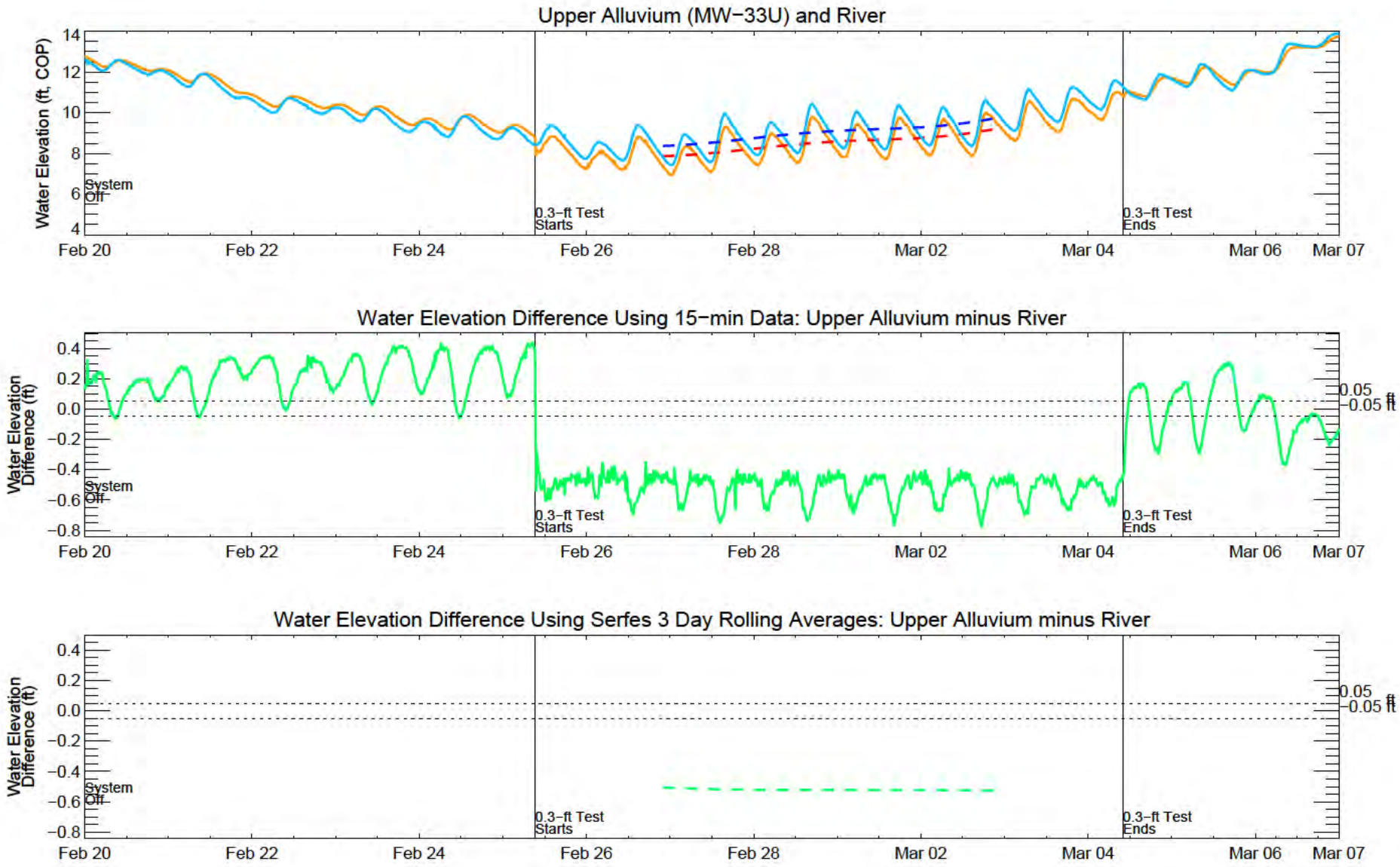
Figure 4.41
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG - C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:45 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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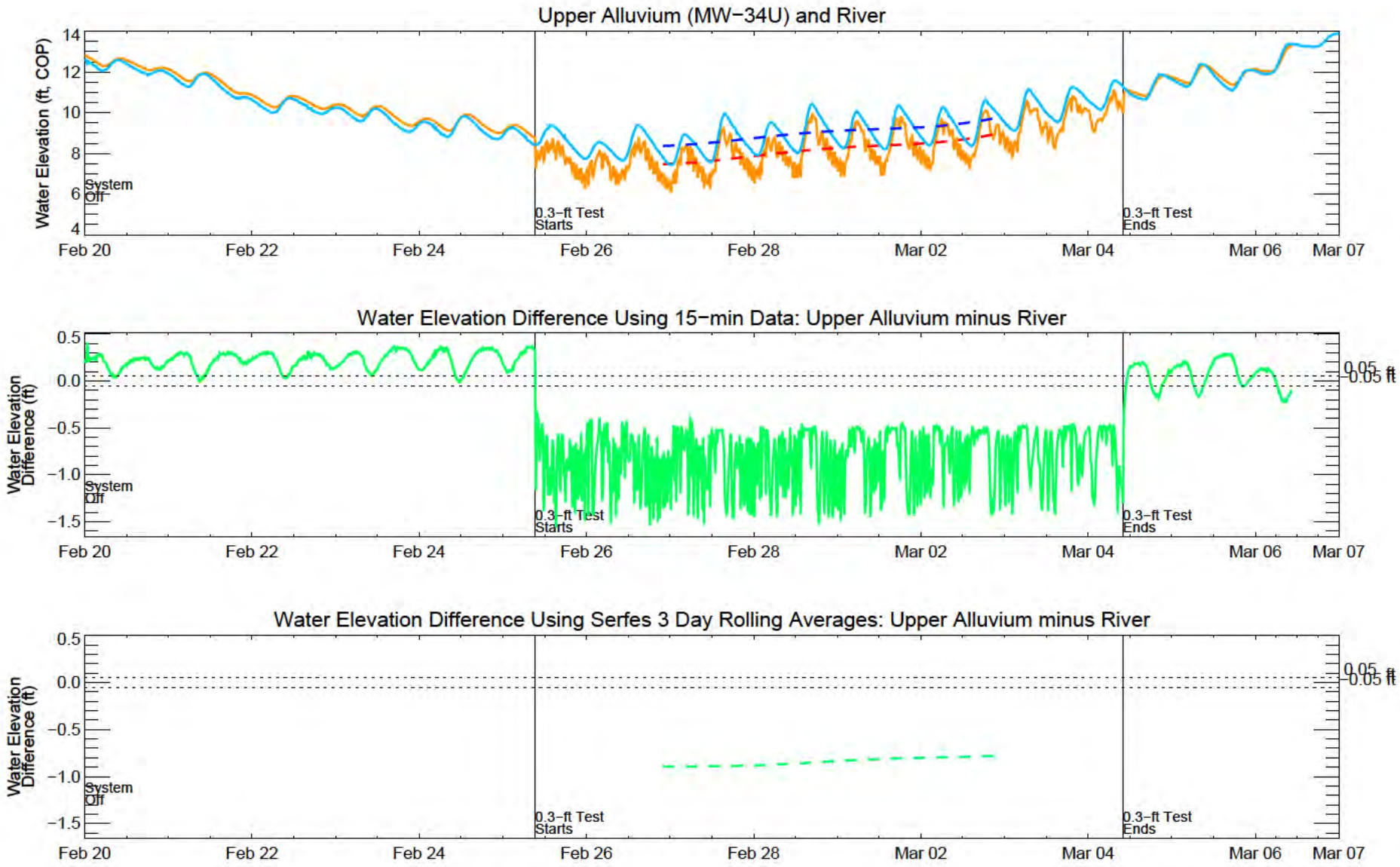
Figure 4.42

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:45 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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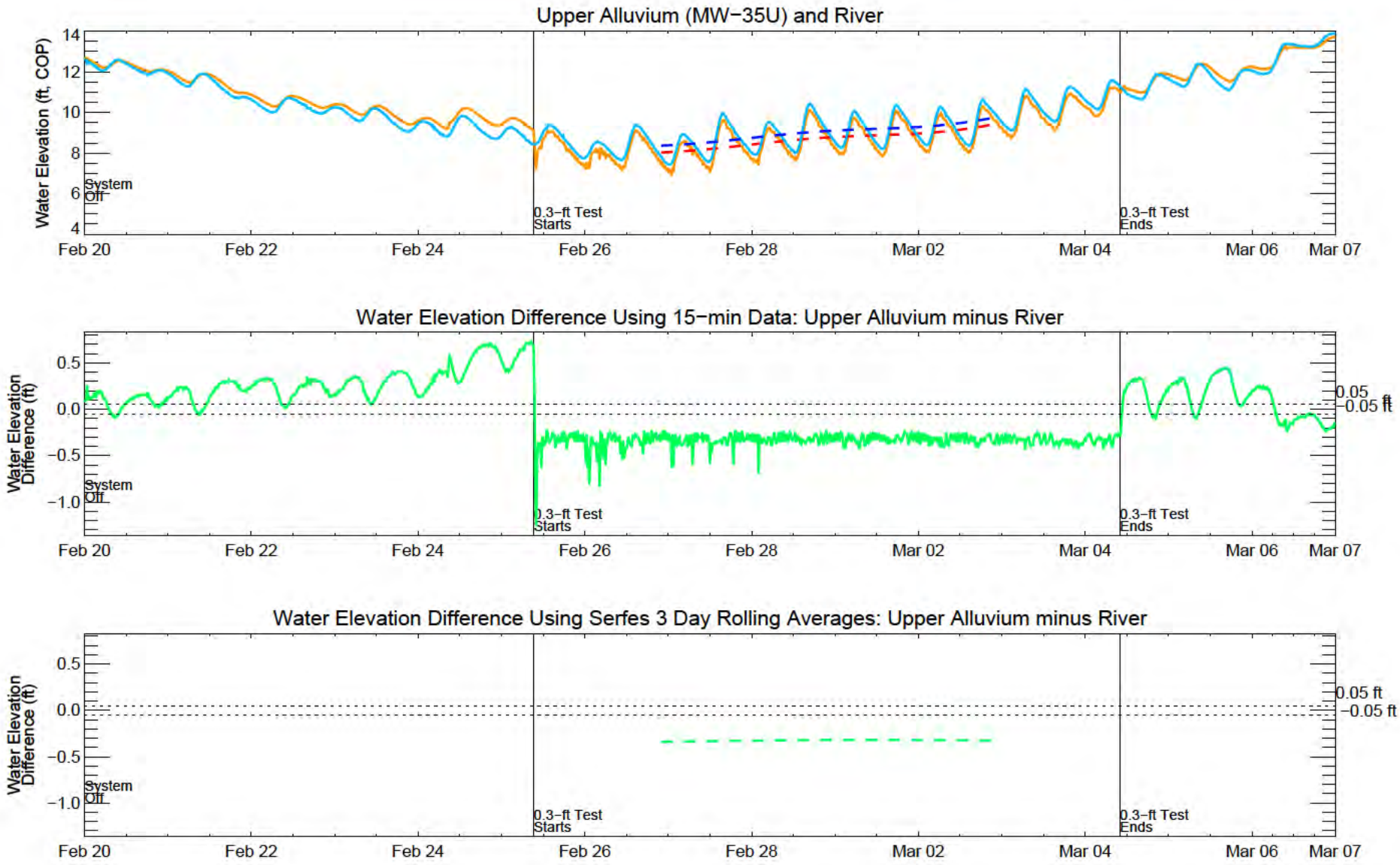
Figure 4.43
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:46 2014



Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

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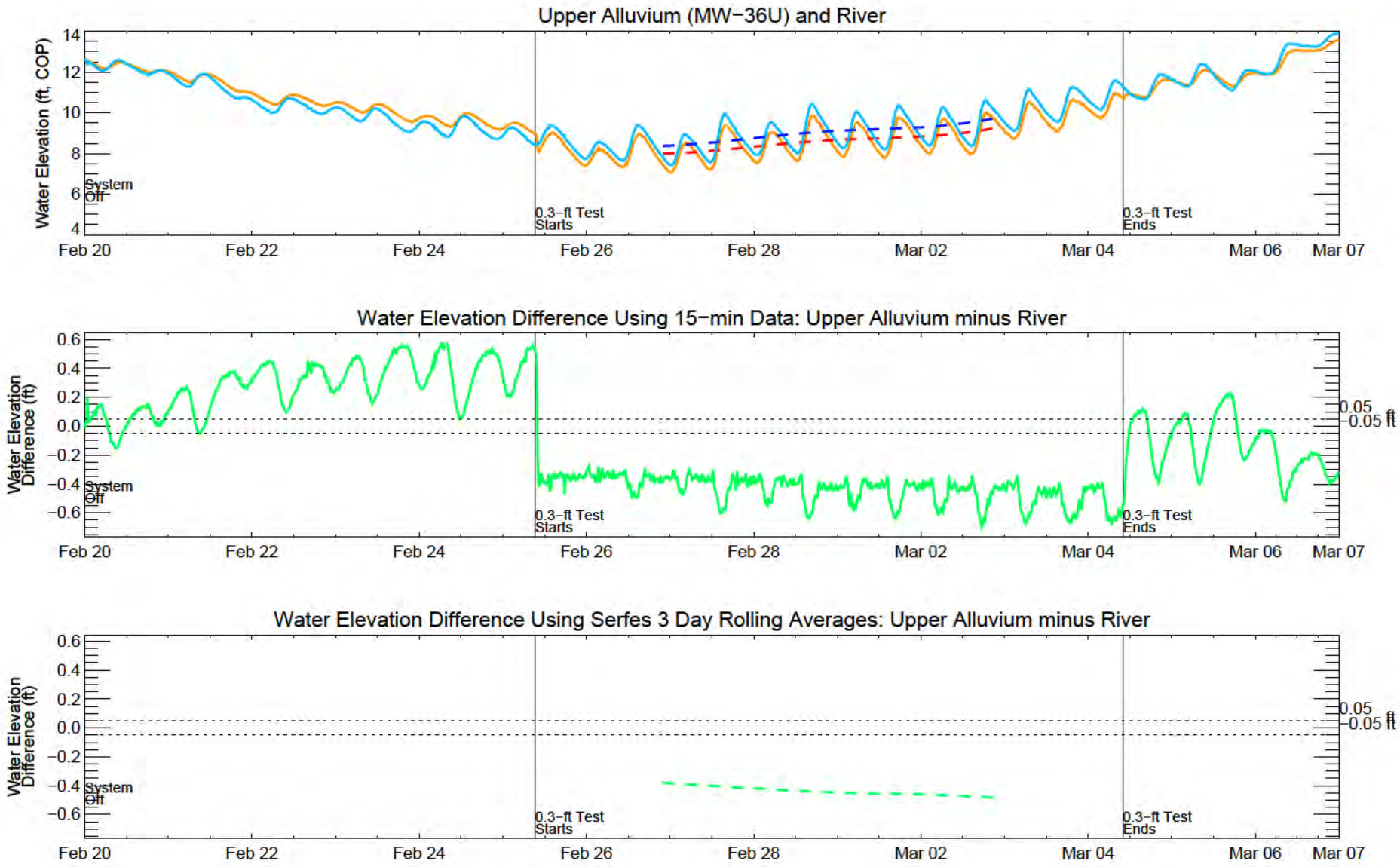
Figure 4.44
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:46 2014

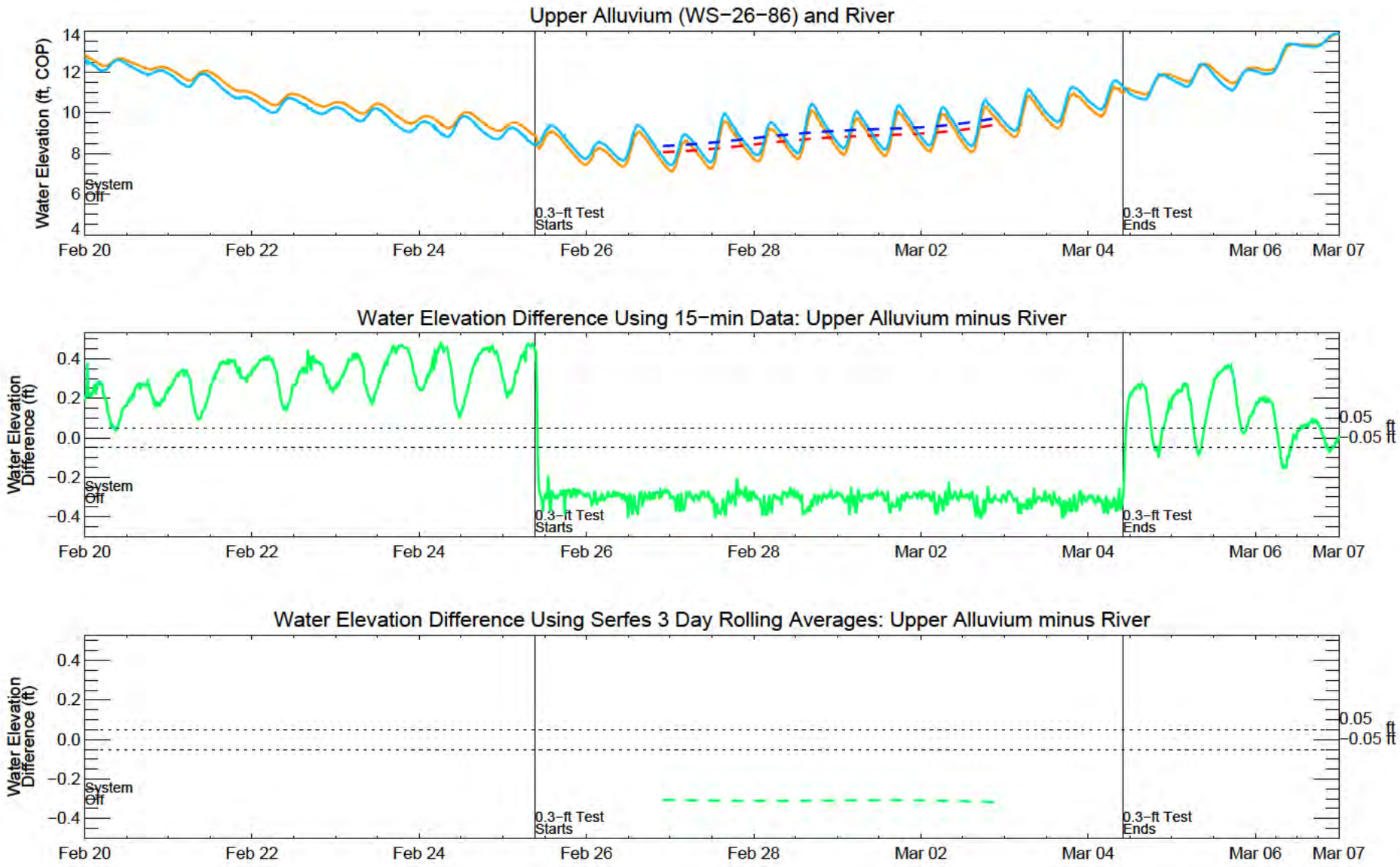


Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.45
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:46 2014

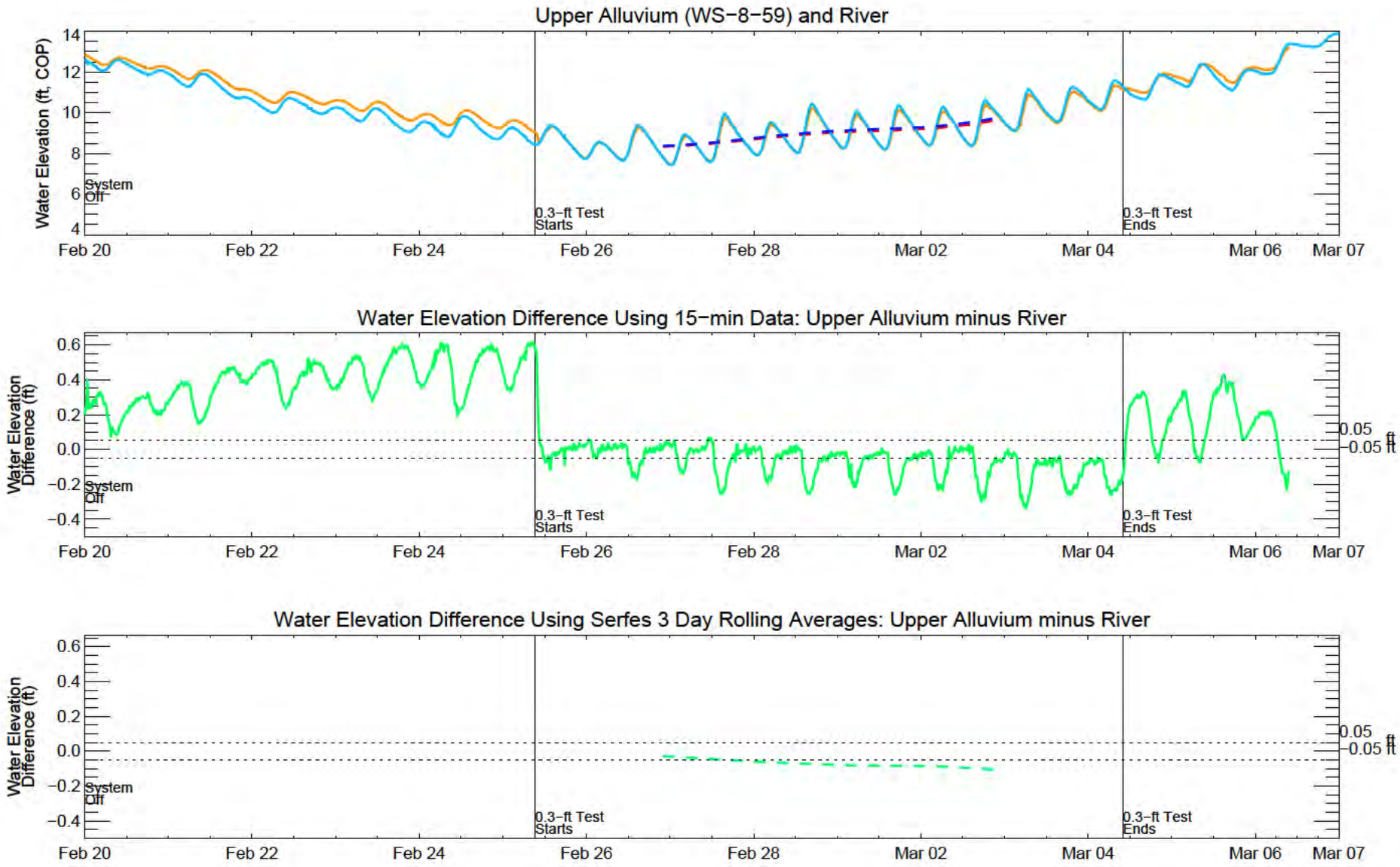


Upper Alluvium: 15−min Data
Upper Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.46
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:46 2014

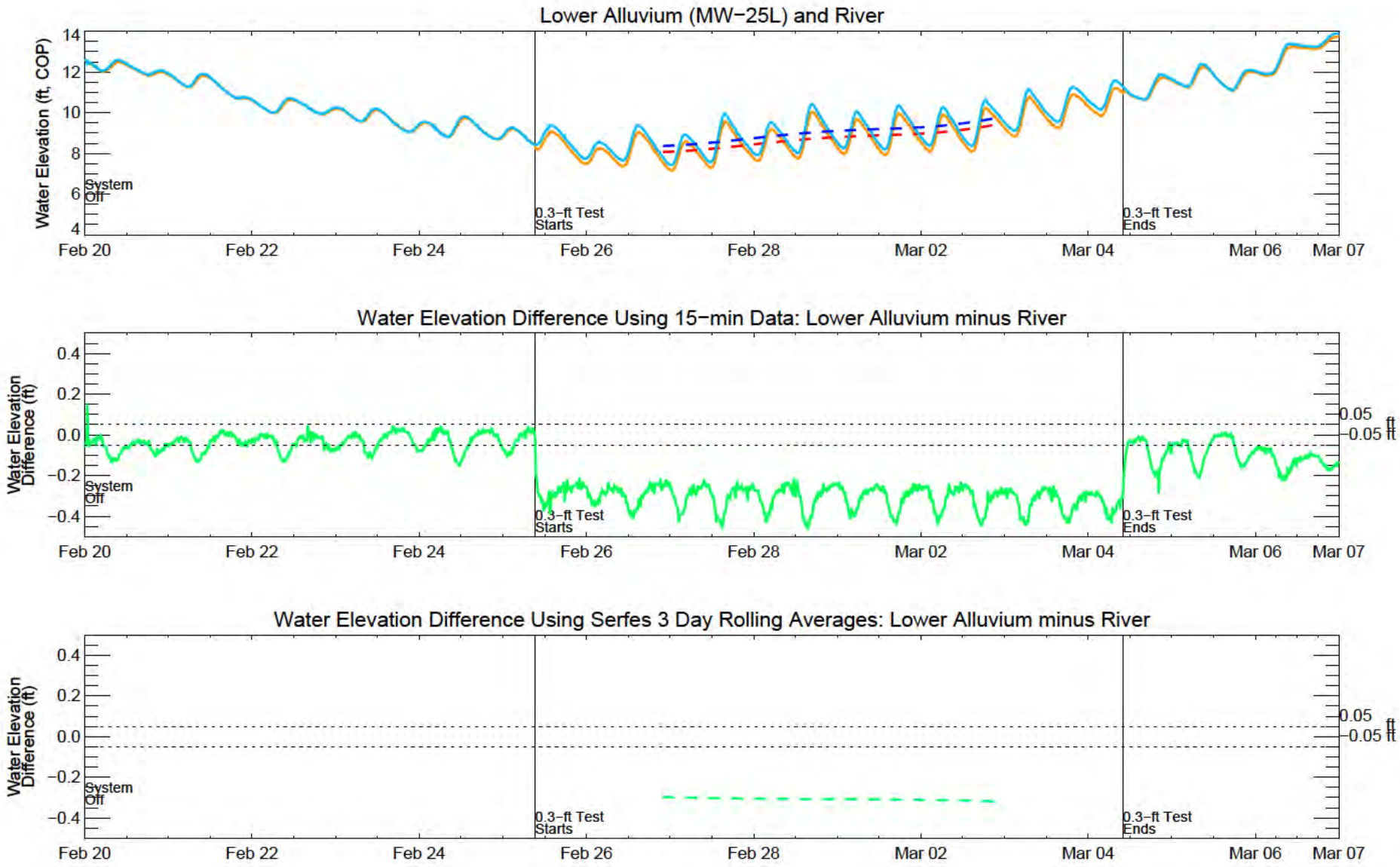


Upper Alluvium: 15-min Data
Upper Alluvium: Serfes Averages
River: 15-min Data
River: Serfes Averages
Water Elevation Difference: 15-min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.47
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG - C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:46 2014

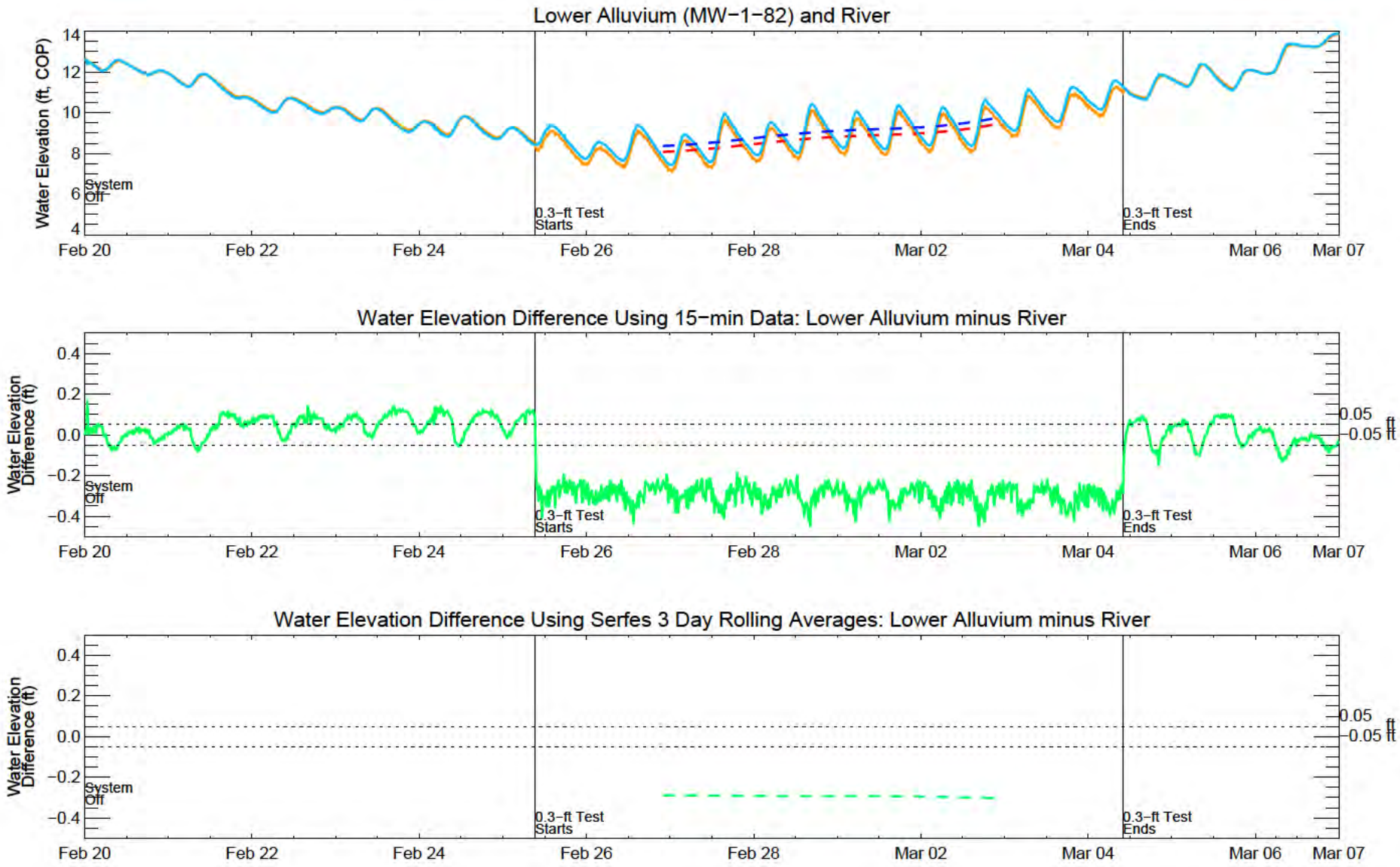


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.48
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:47 2014

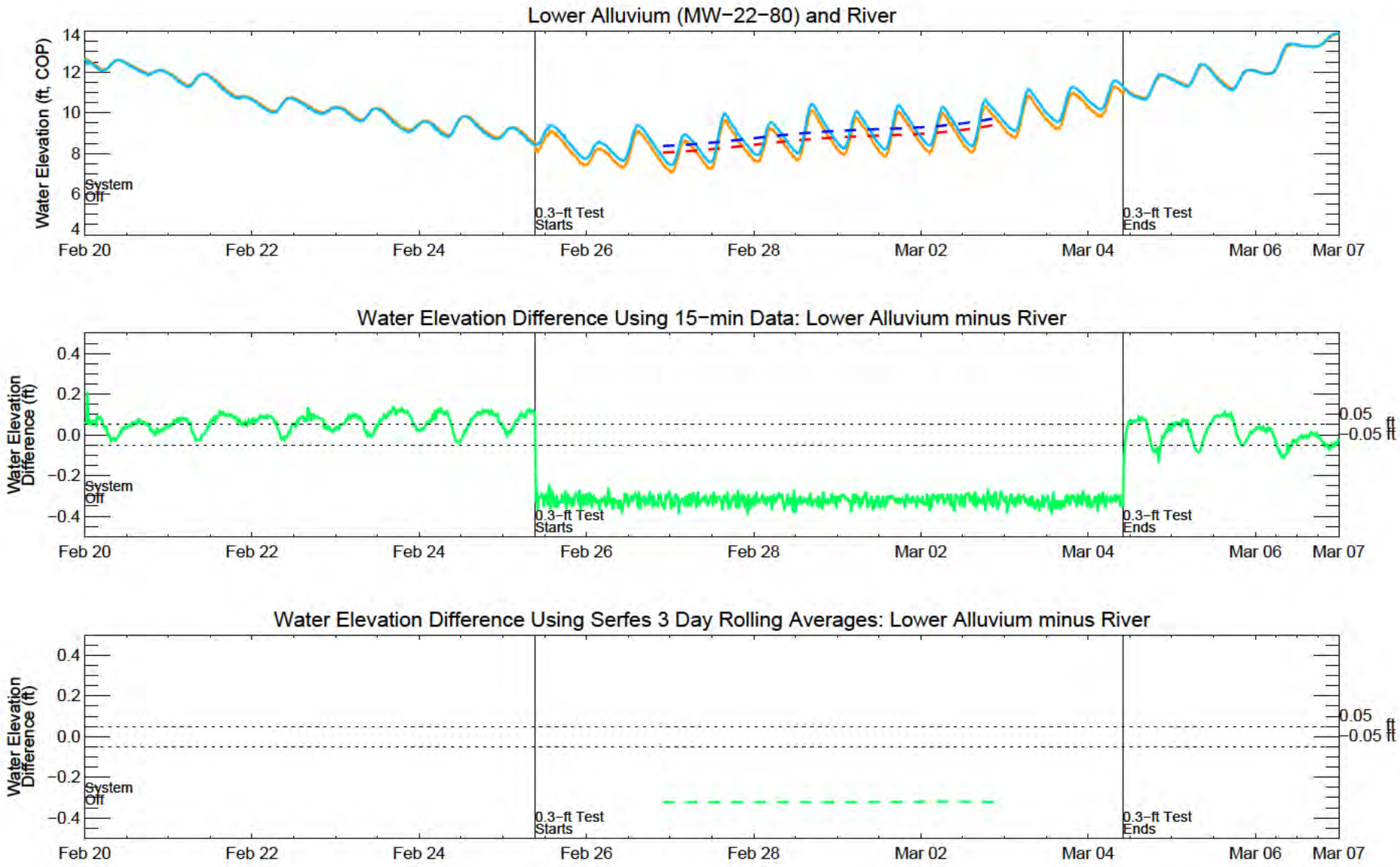


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.49
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:47 2014

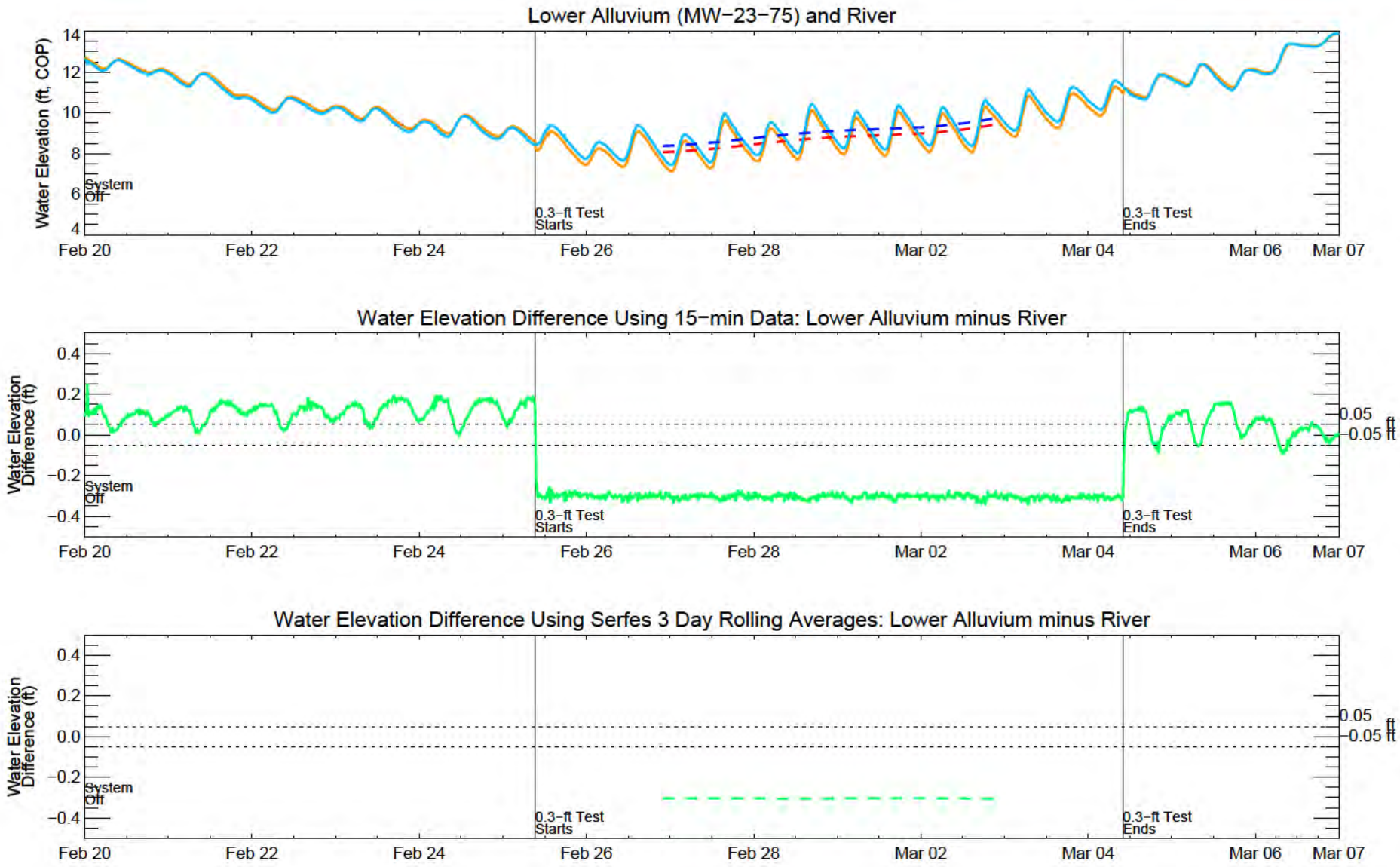


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.50
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:47 2014

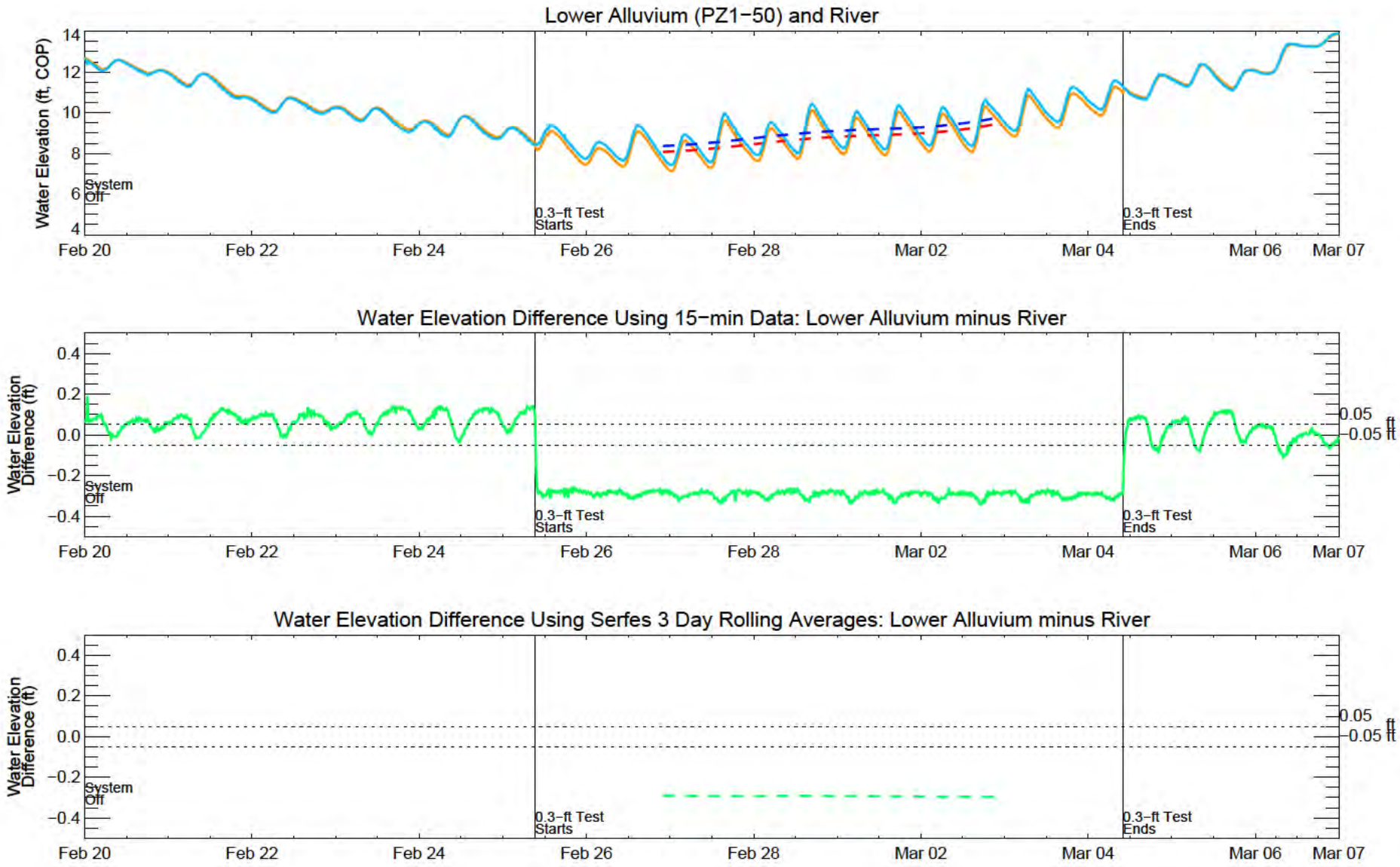


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.51
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:47 2014

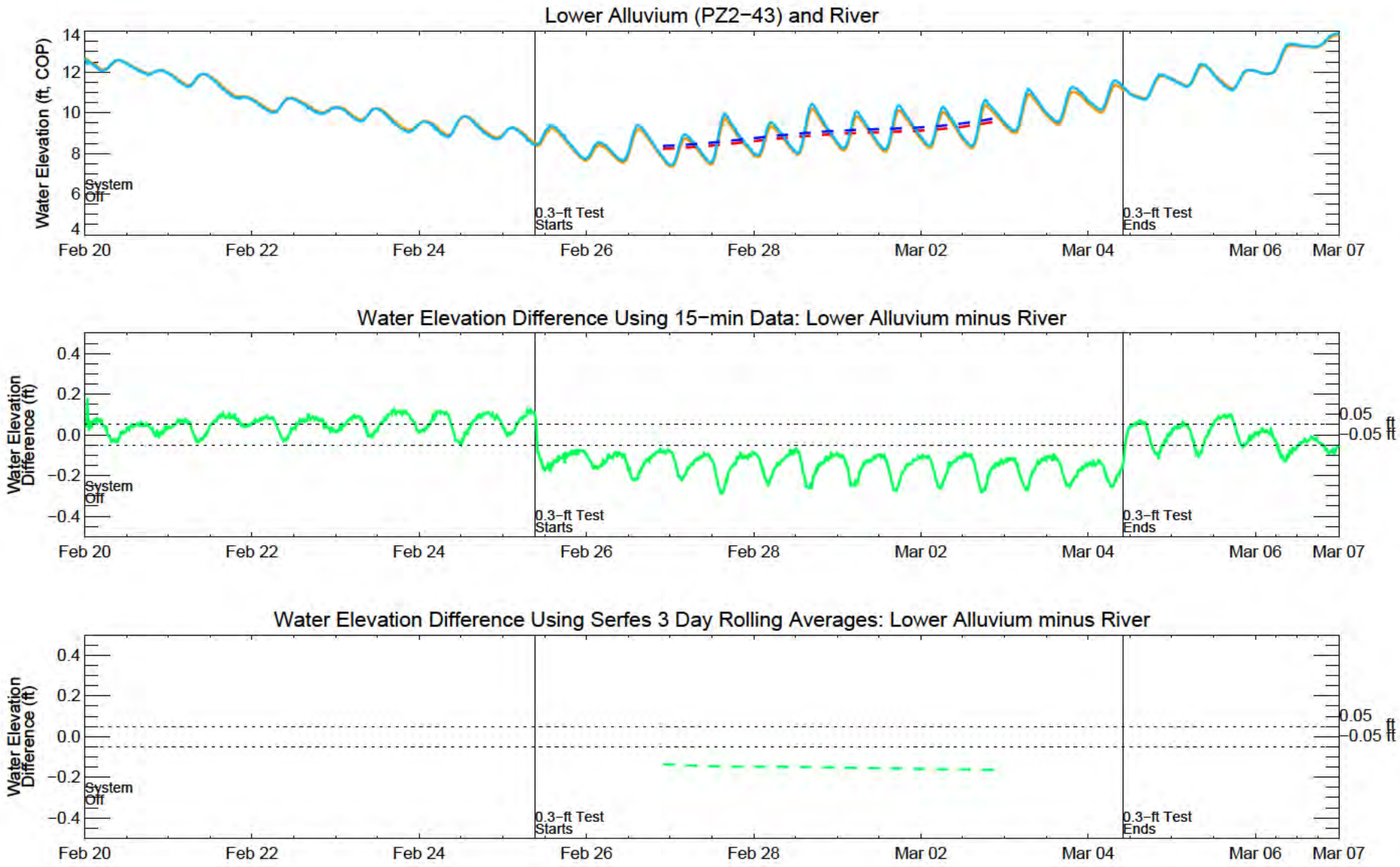


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.52
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:47 2014

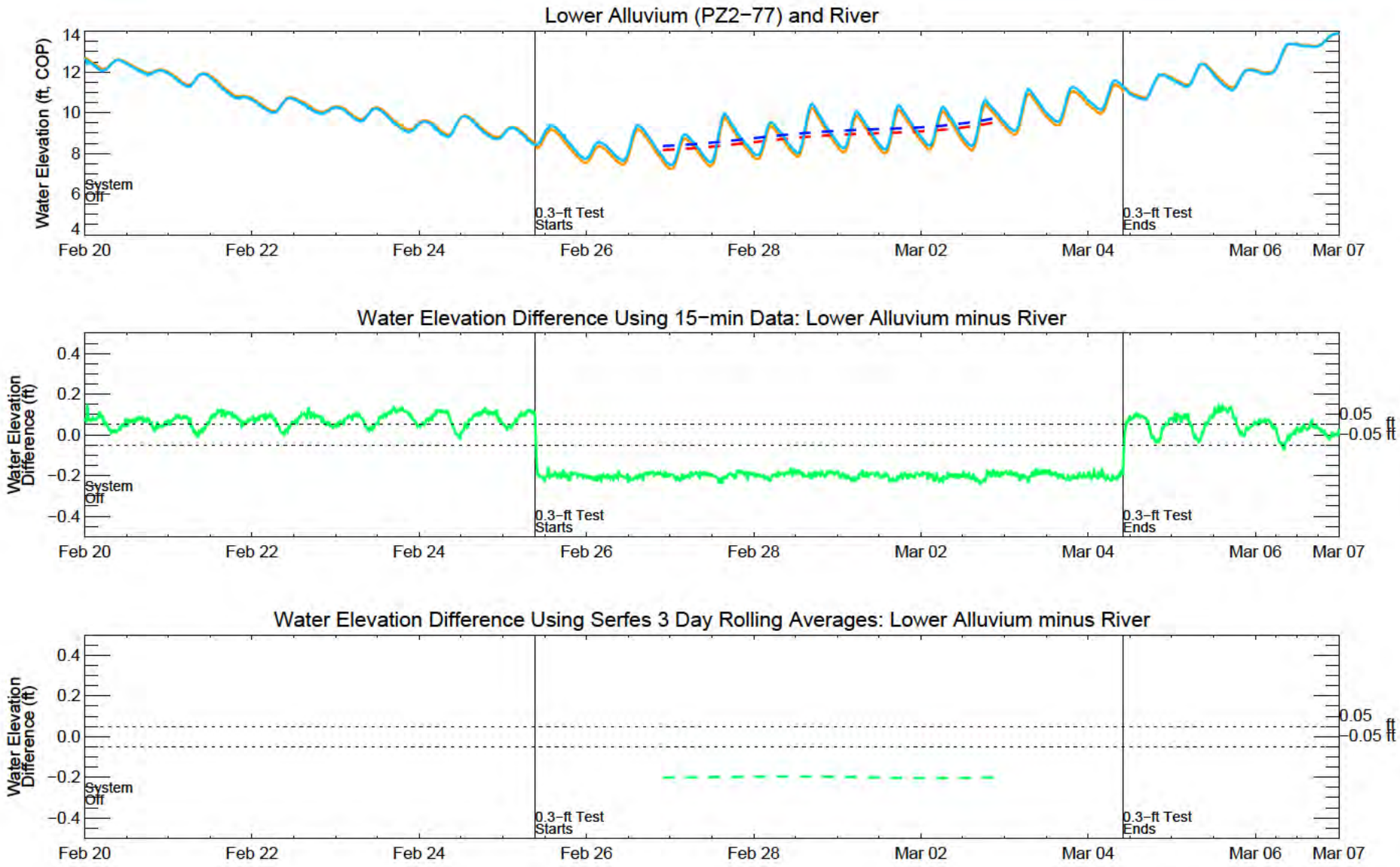


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.53
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:47 2014



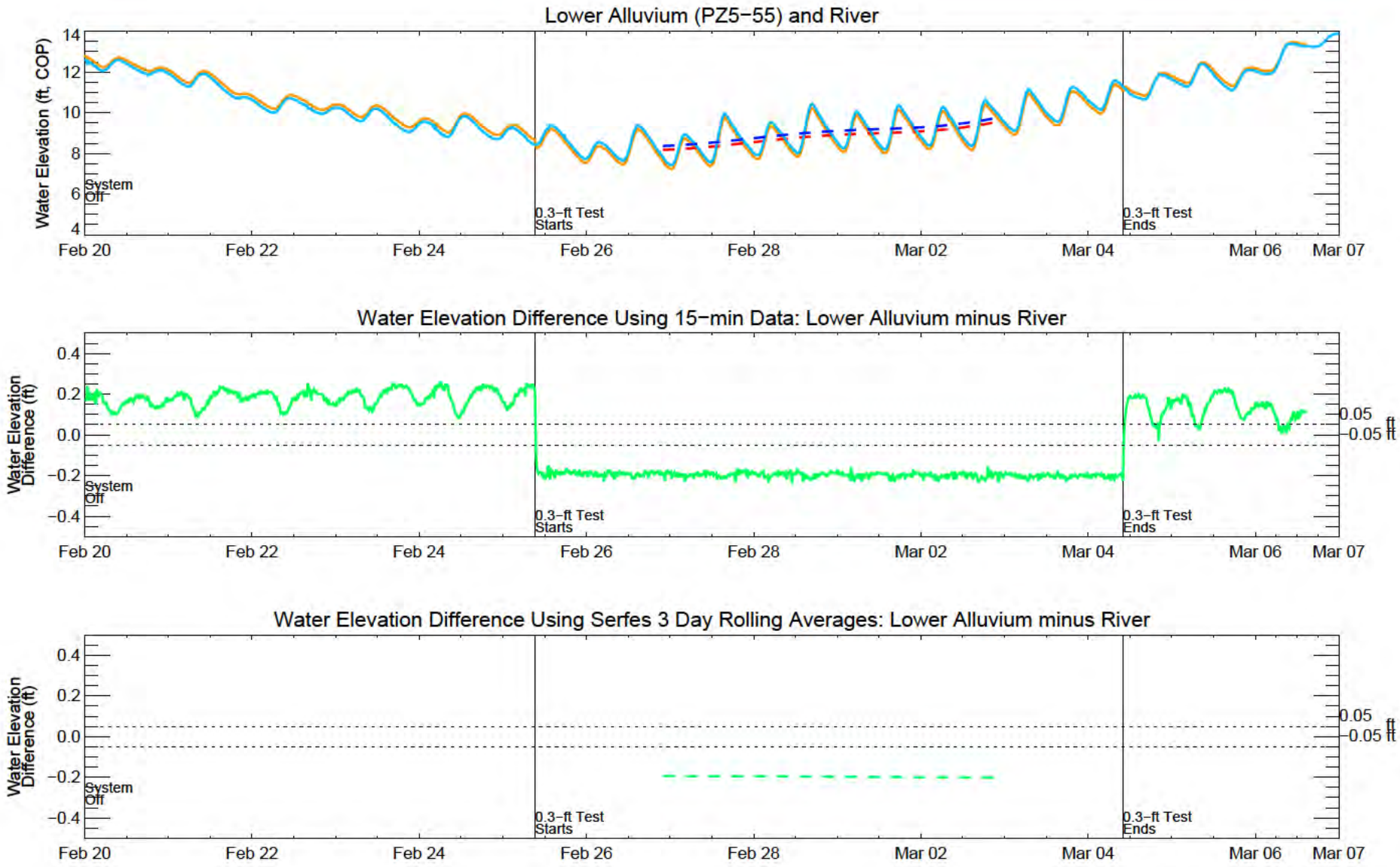
ANCHOR QEA

Figure 4.54

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:48 2014



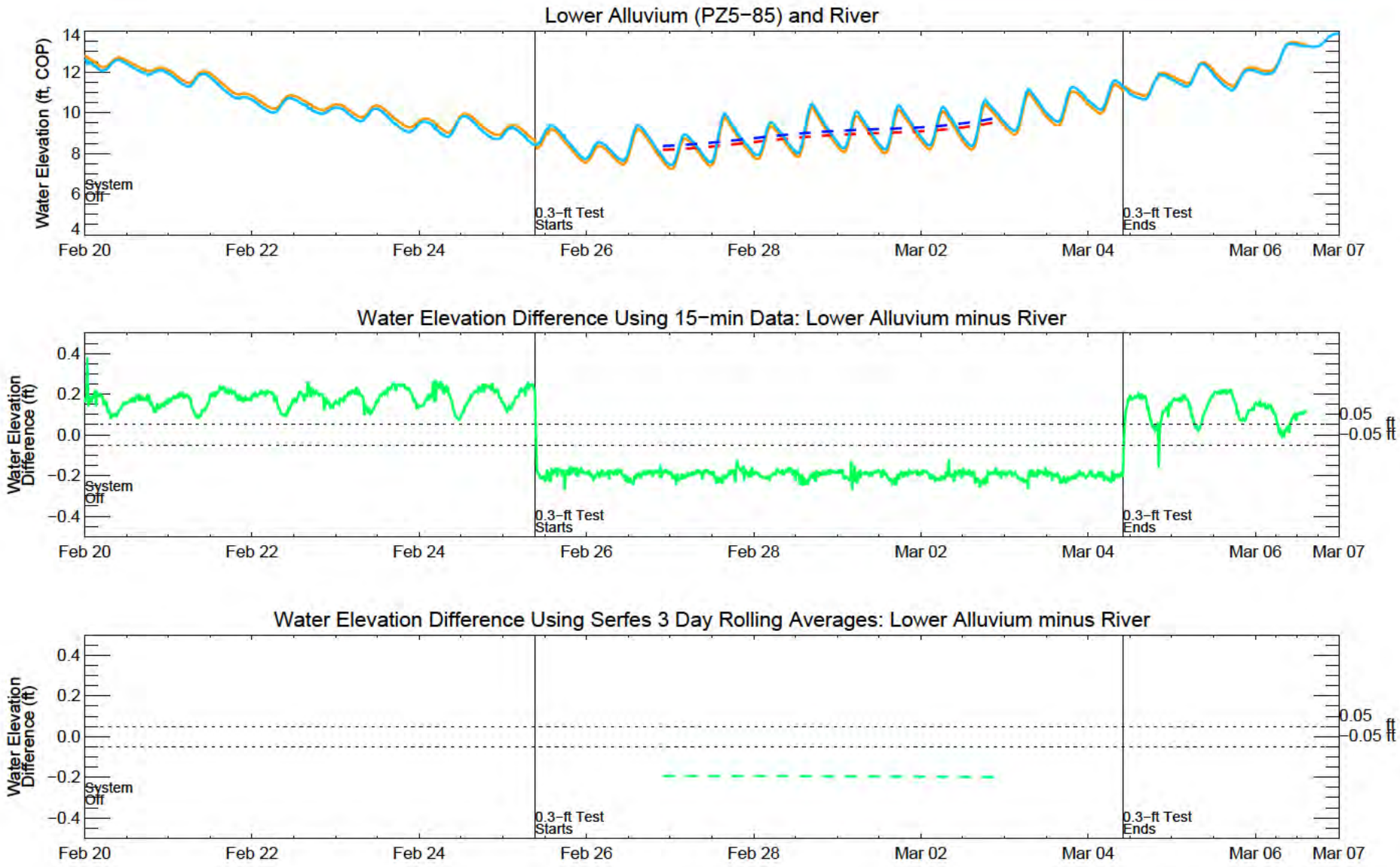
ANCHOR QEA

Figure 4.55

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:48 2014



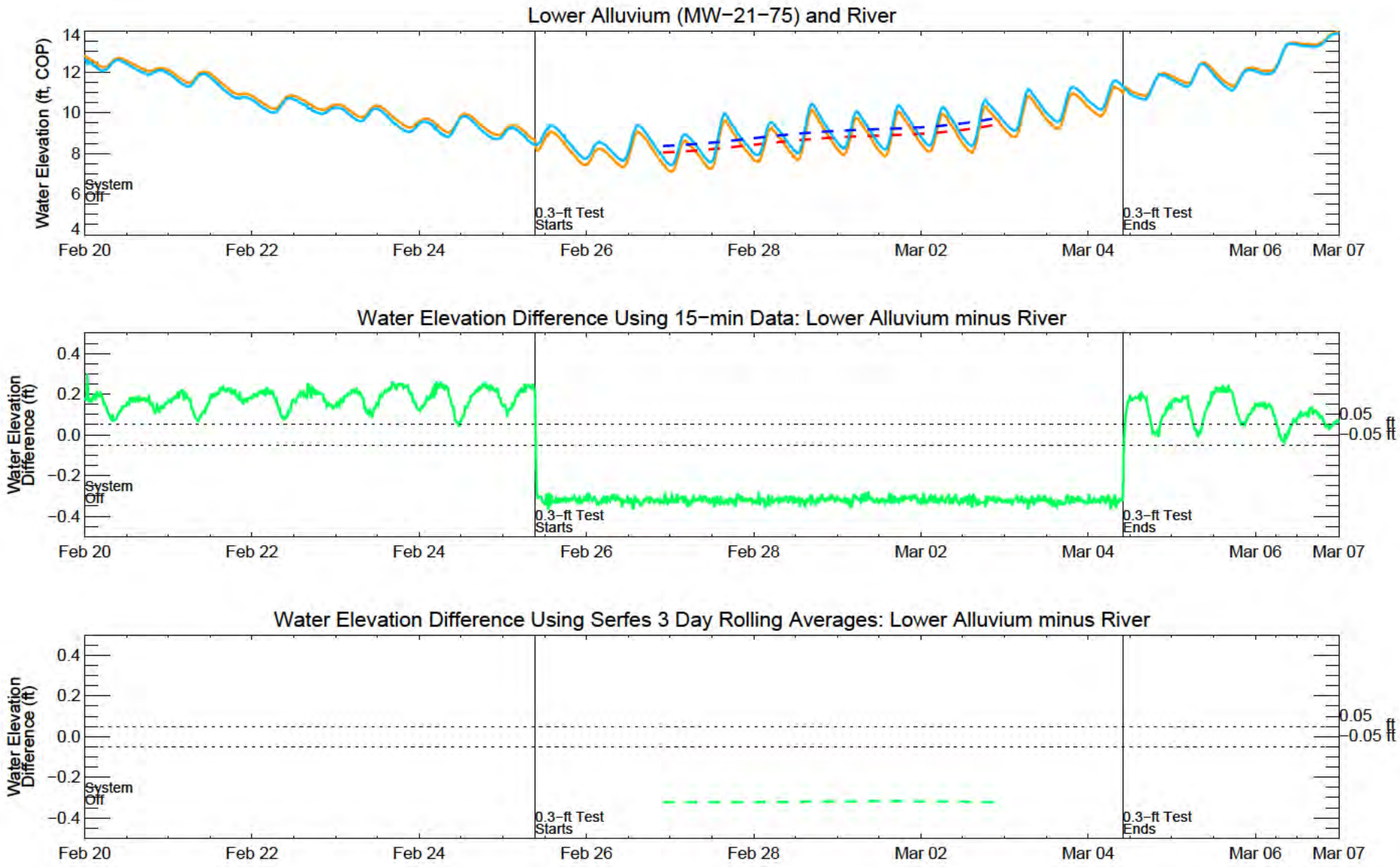
ANCHOR QEA

Figure 4.56

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:48 2014

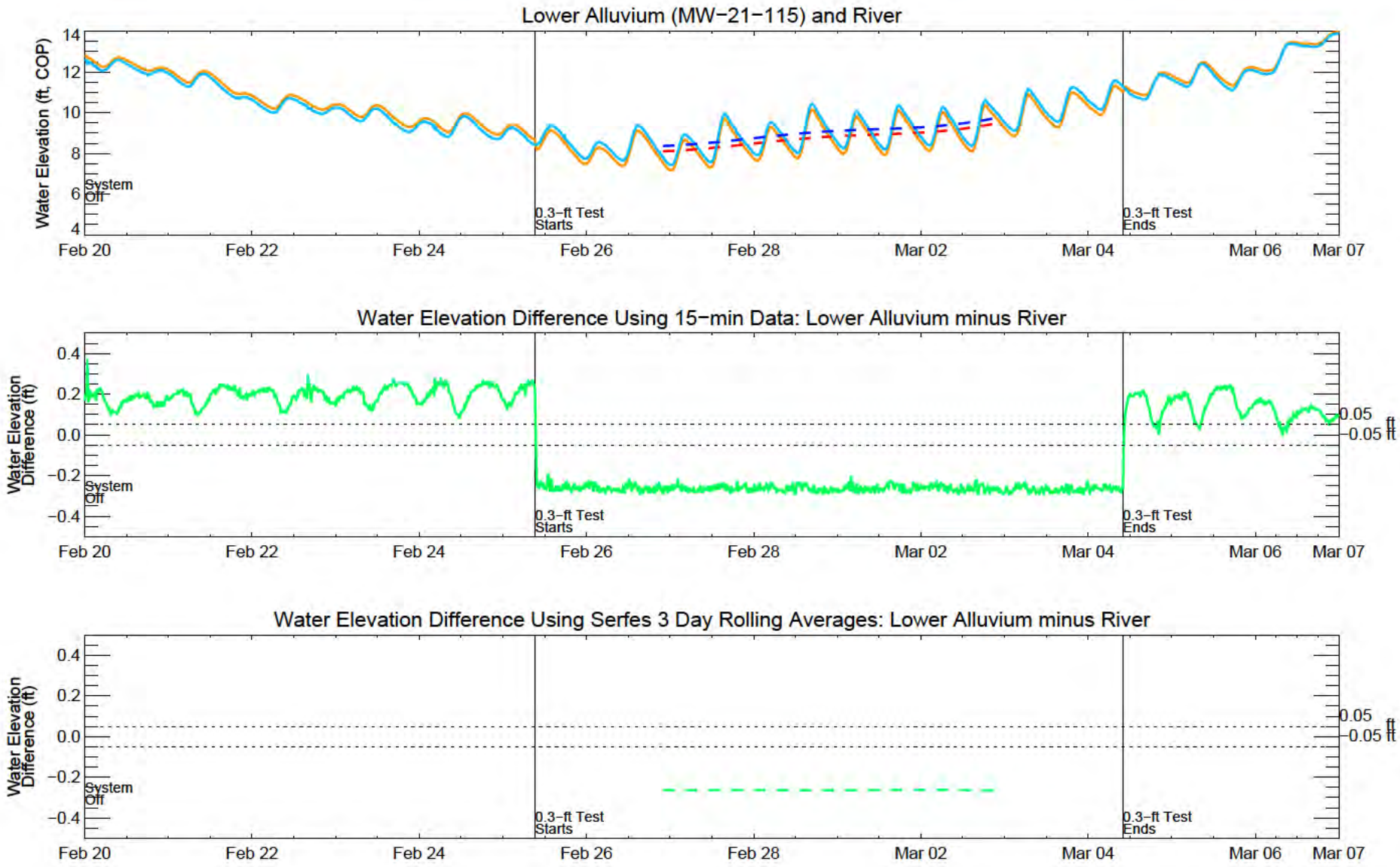


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.57
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:48 2014

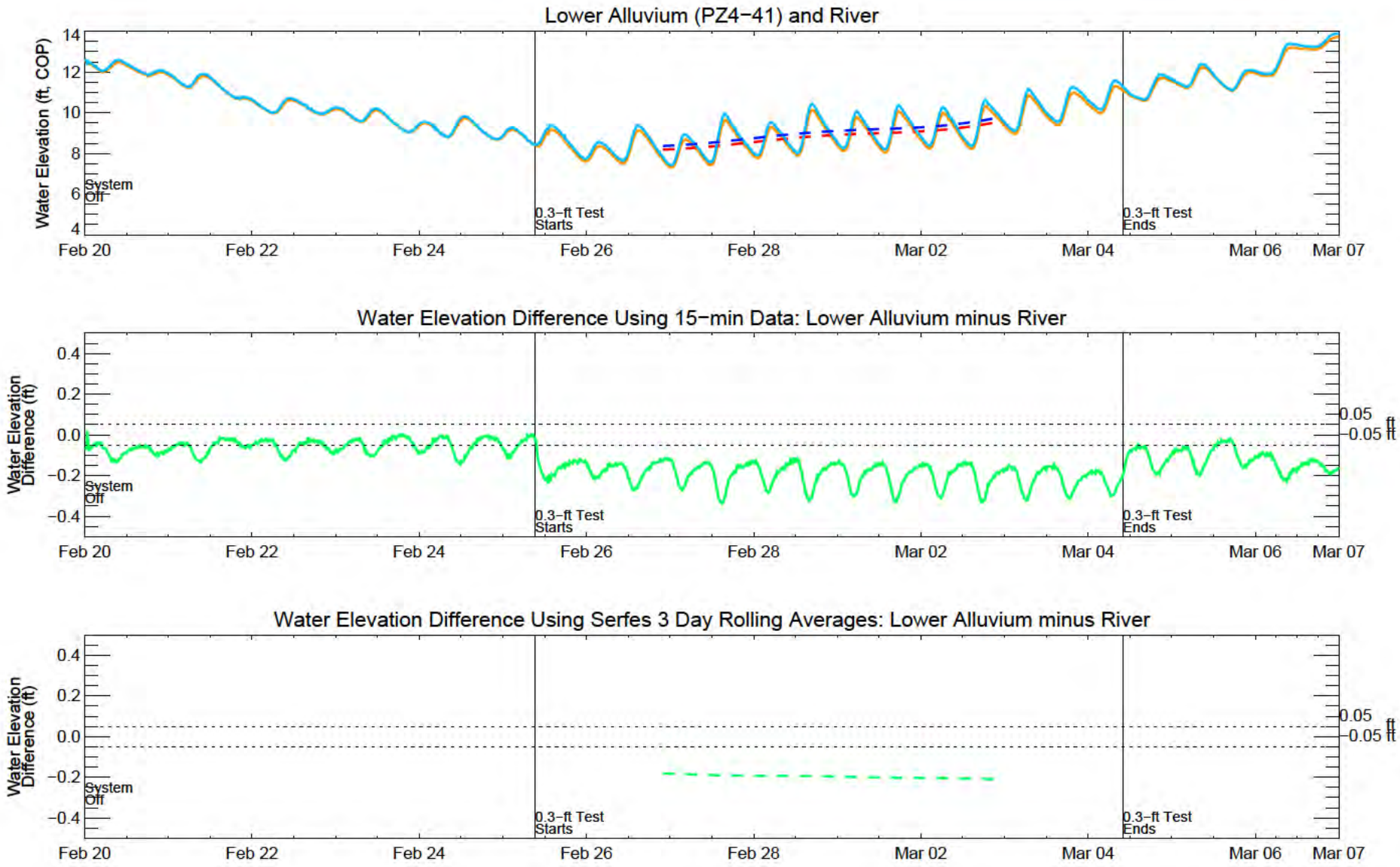


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.58
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:48 2014

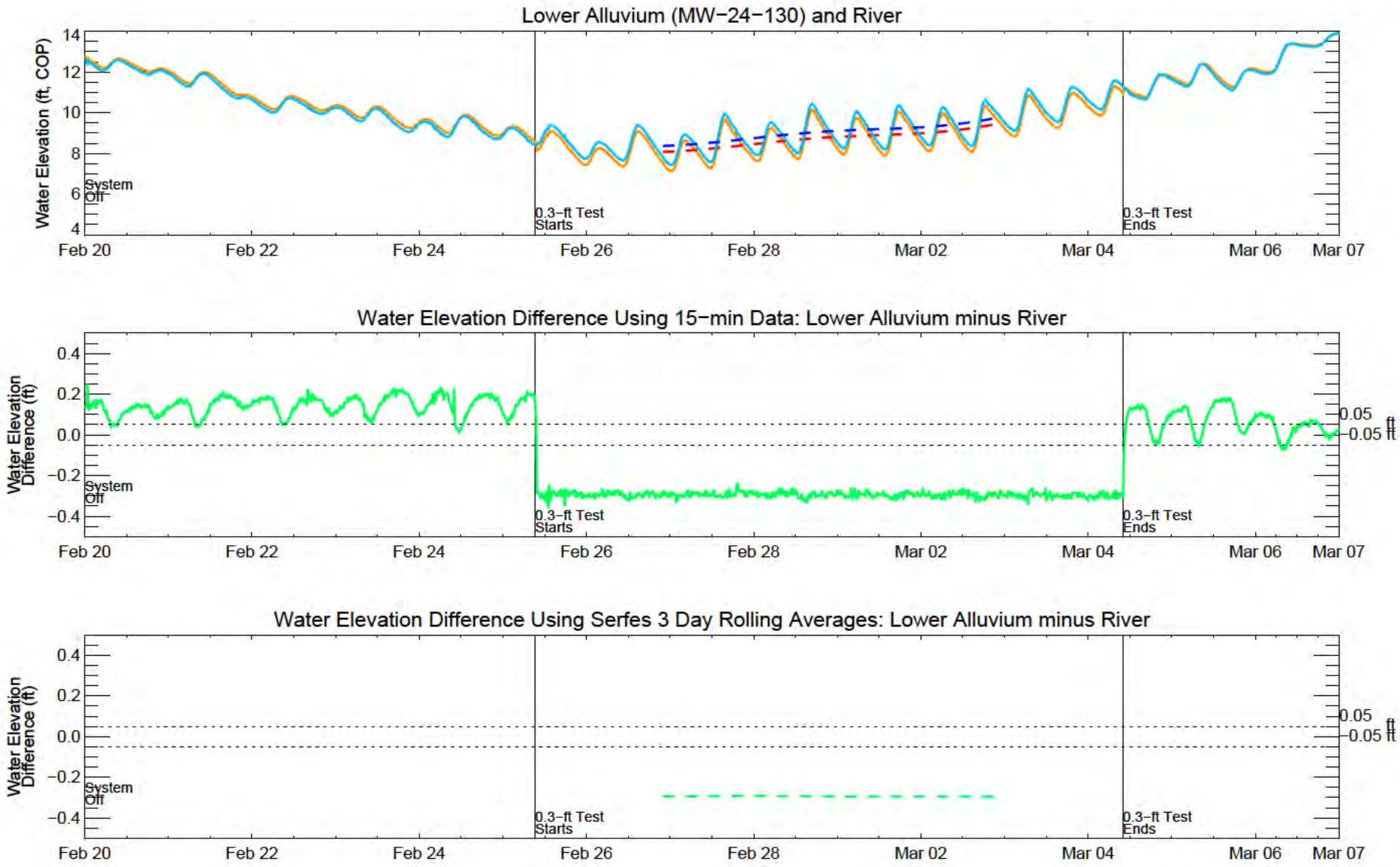


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.59
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:48 2014

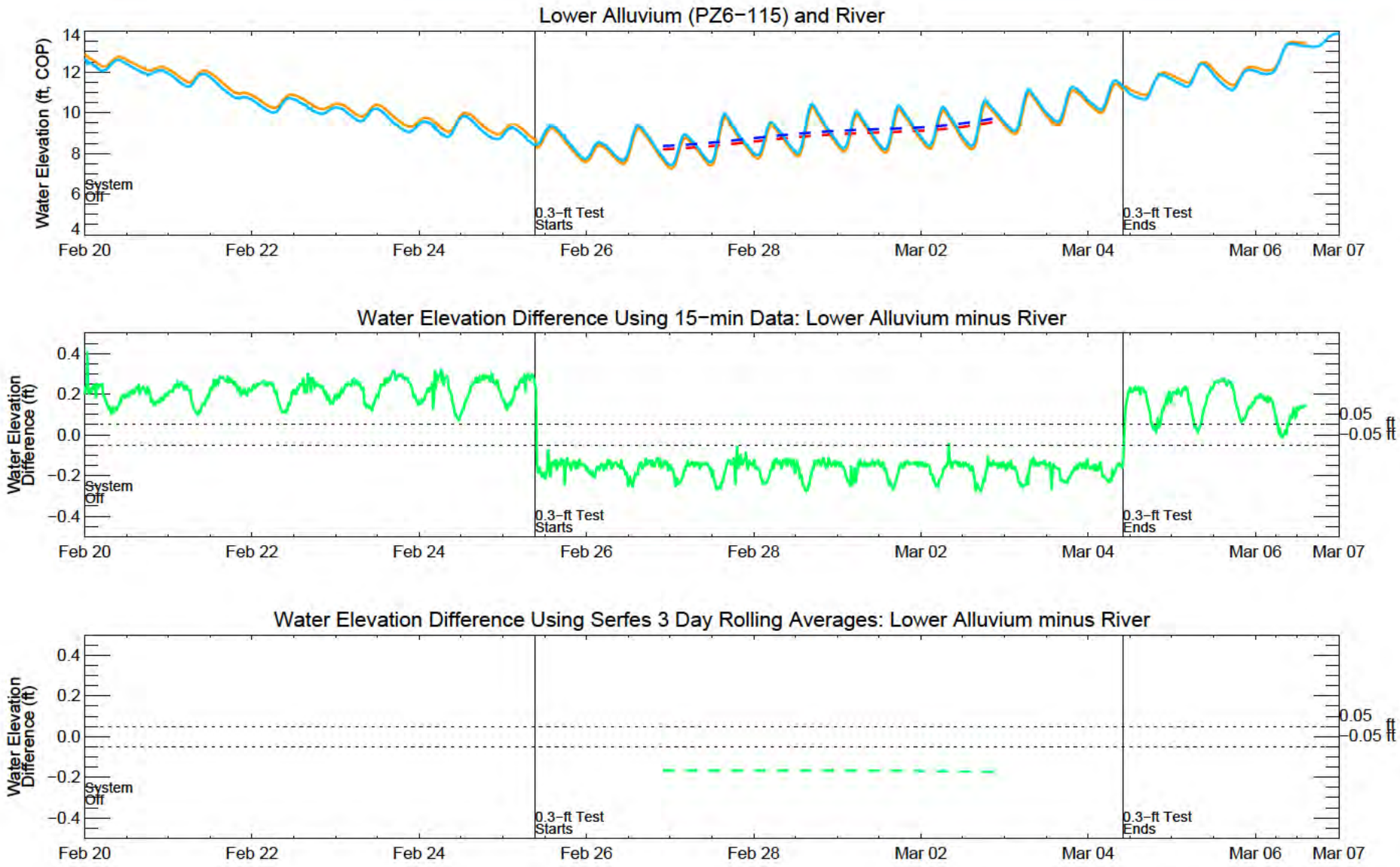


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.60
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:49 2014

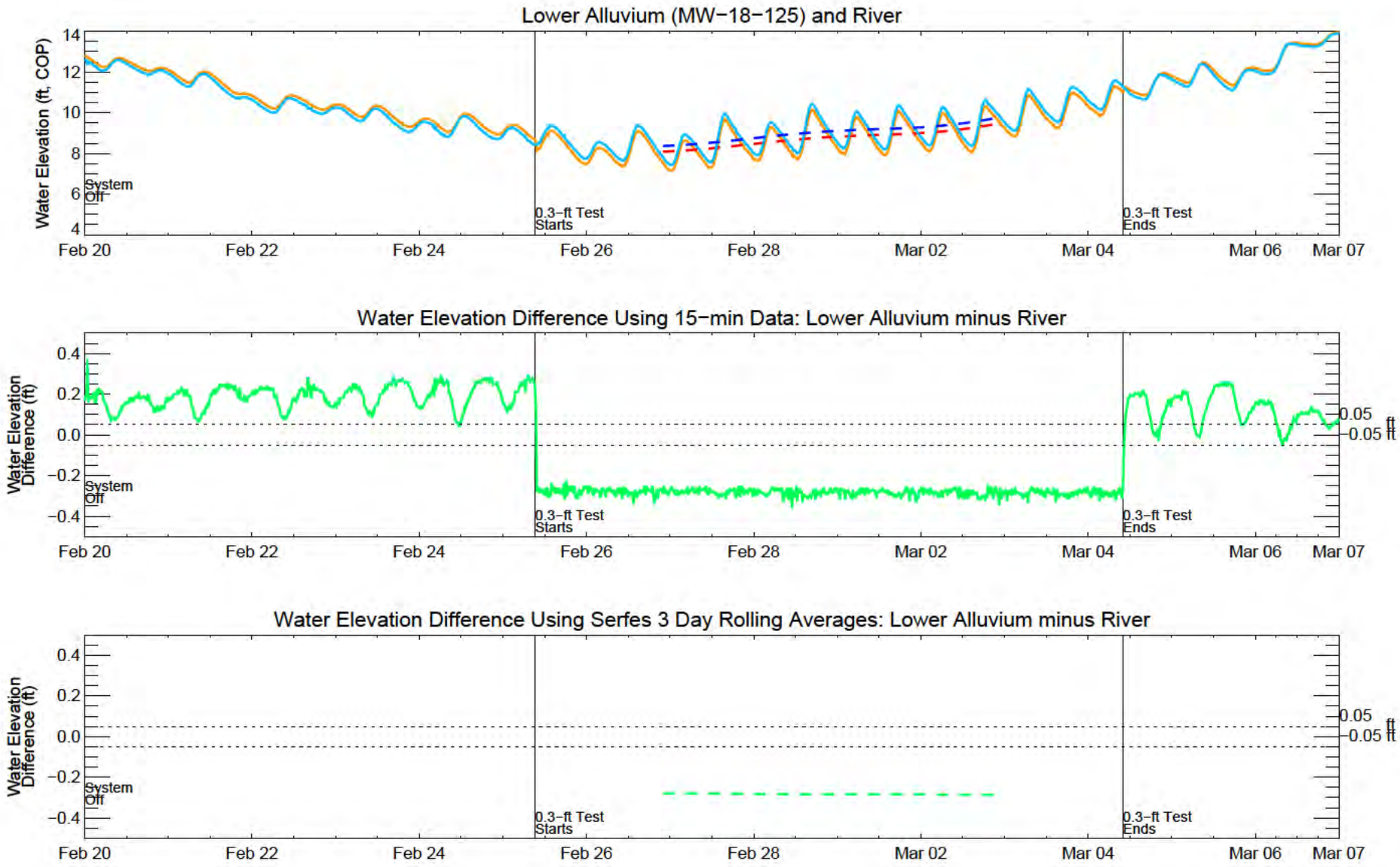


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.61
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:49 2014

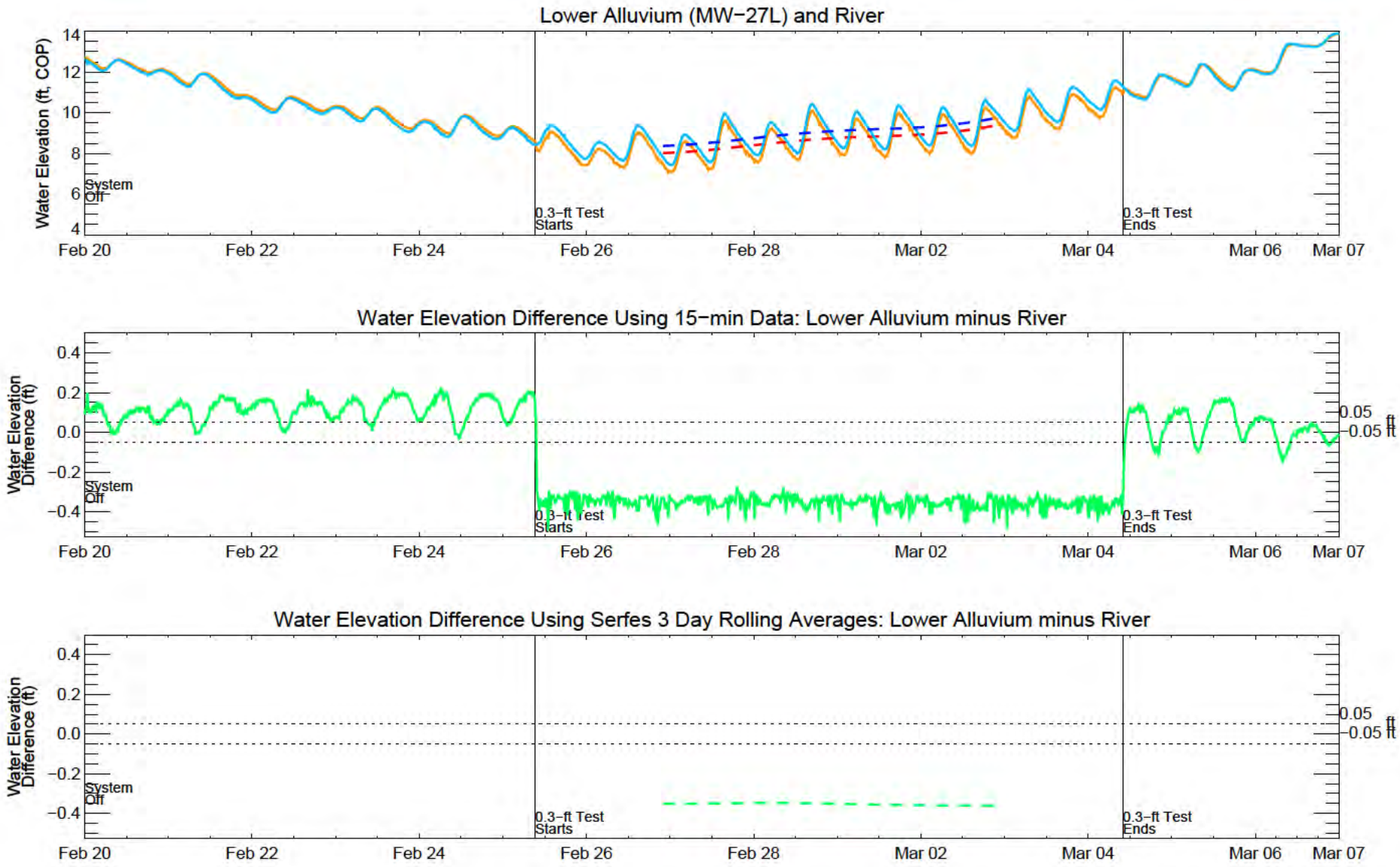


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.62
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:49 2014

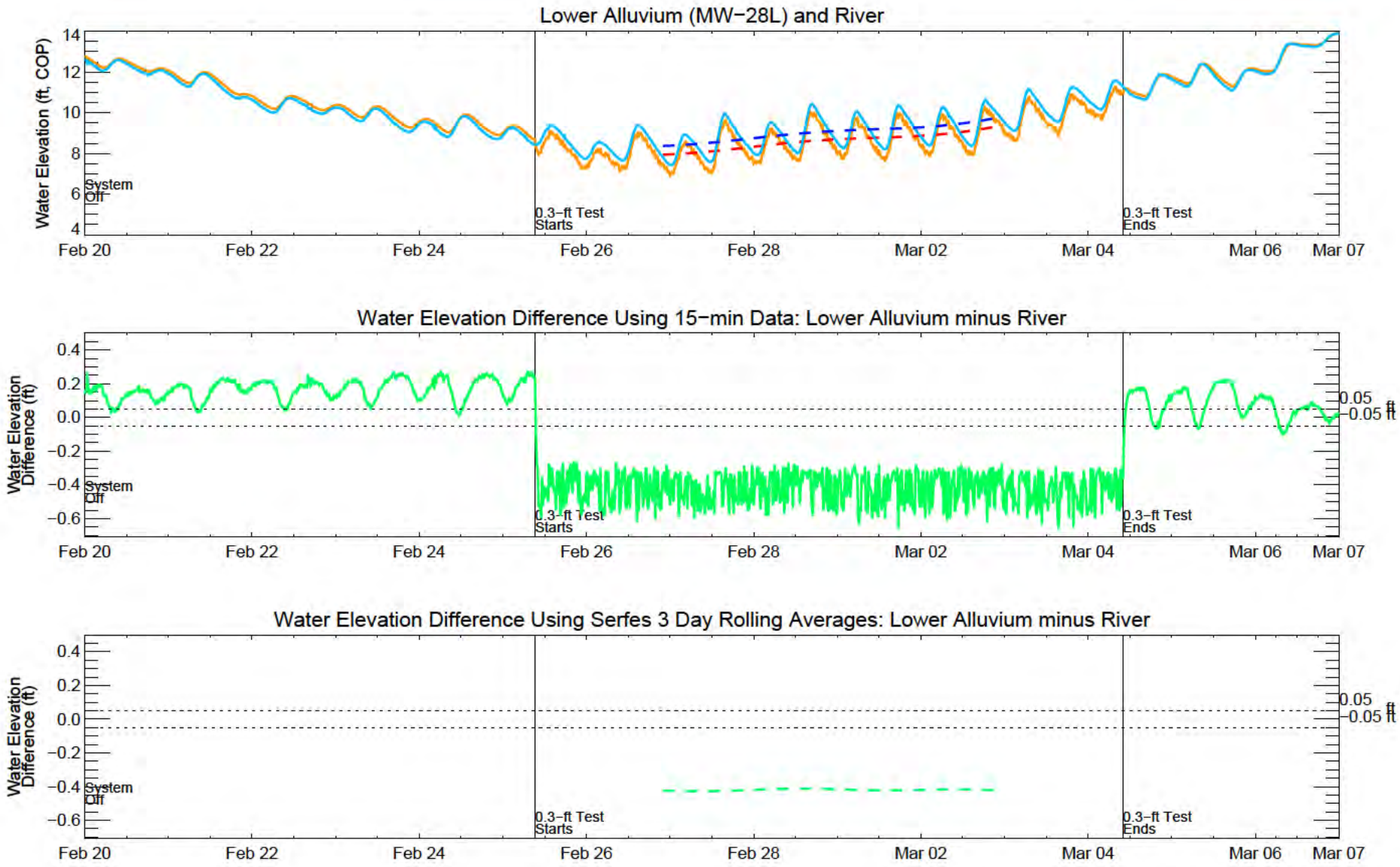


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.63
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:49 2014



- Lower Alluvium: 15−min Data
- Lower Alluvium: Serfes Averages
- River: 15−min Data
- River: Serfes Averages
- Water Elevation Difference: 15−min Data
- Water Elevation Difference: Serfes Averages
- 0.05 ft Total Potential Uncertainty

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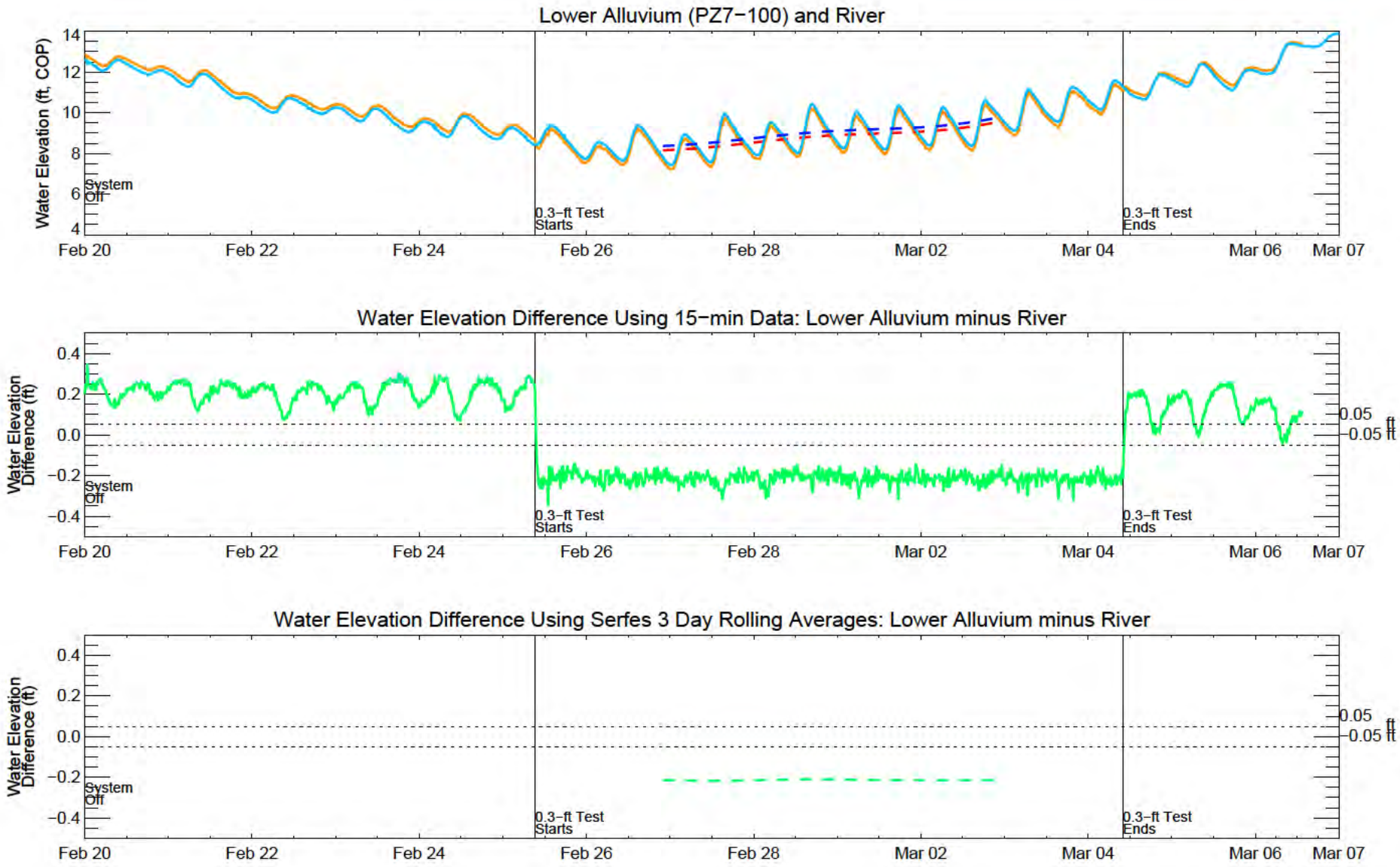
Figure 4.64

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:49 2014

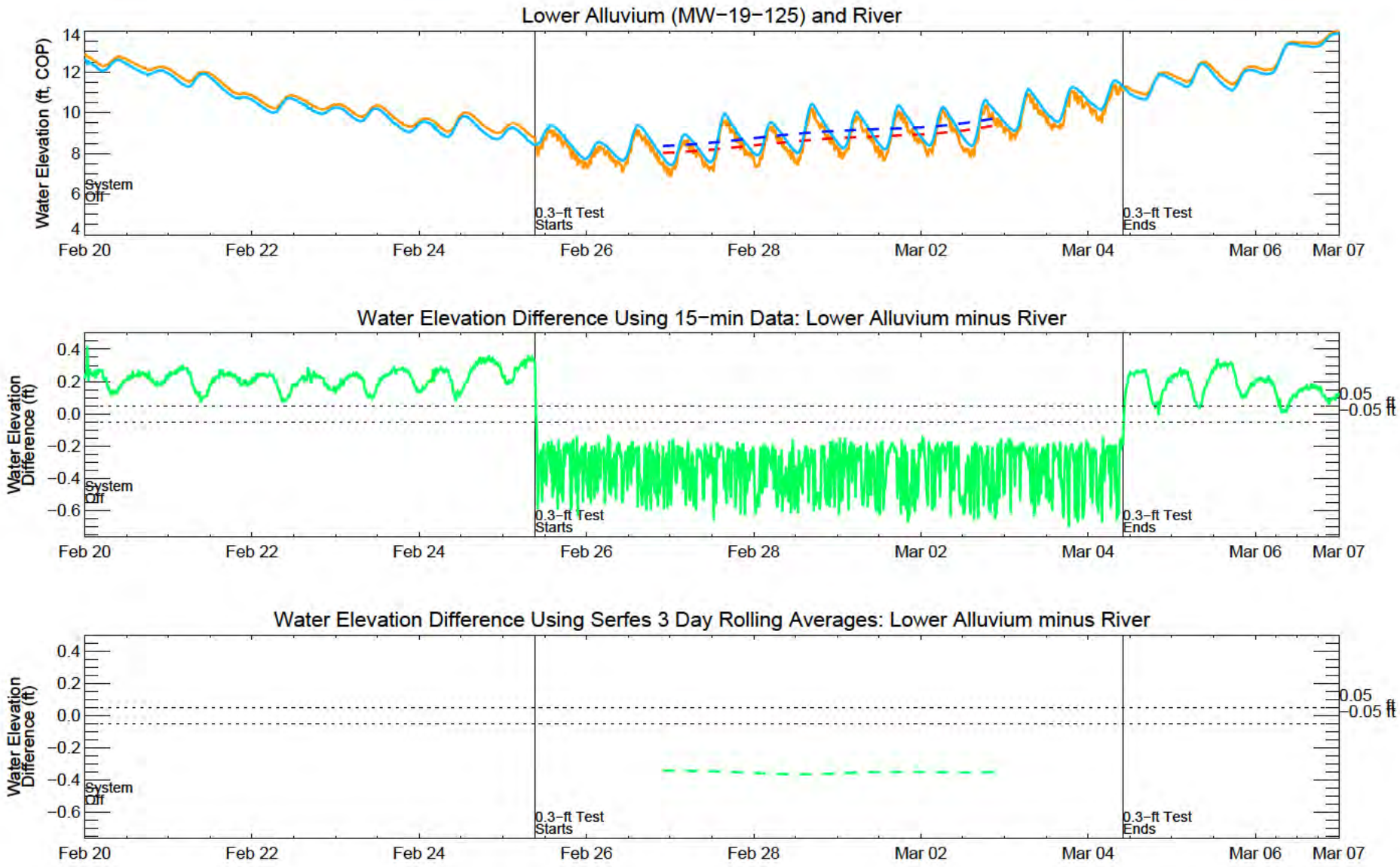


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.65
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:49 2014

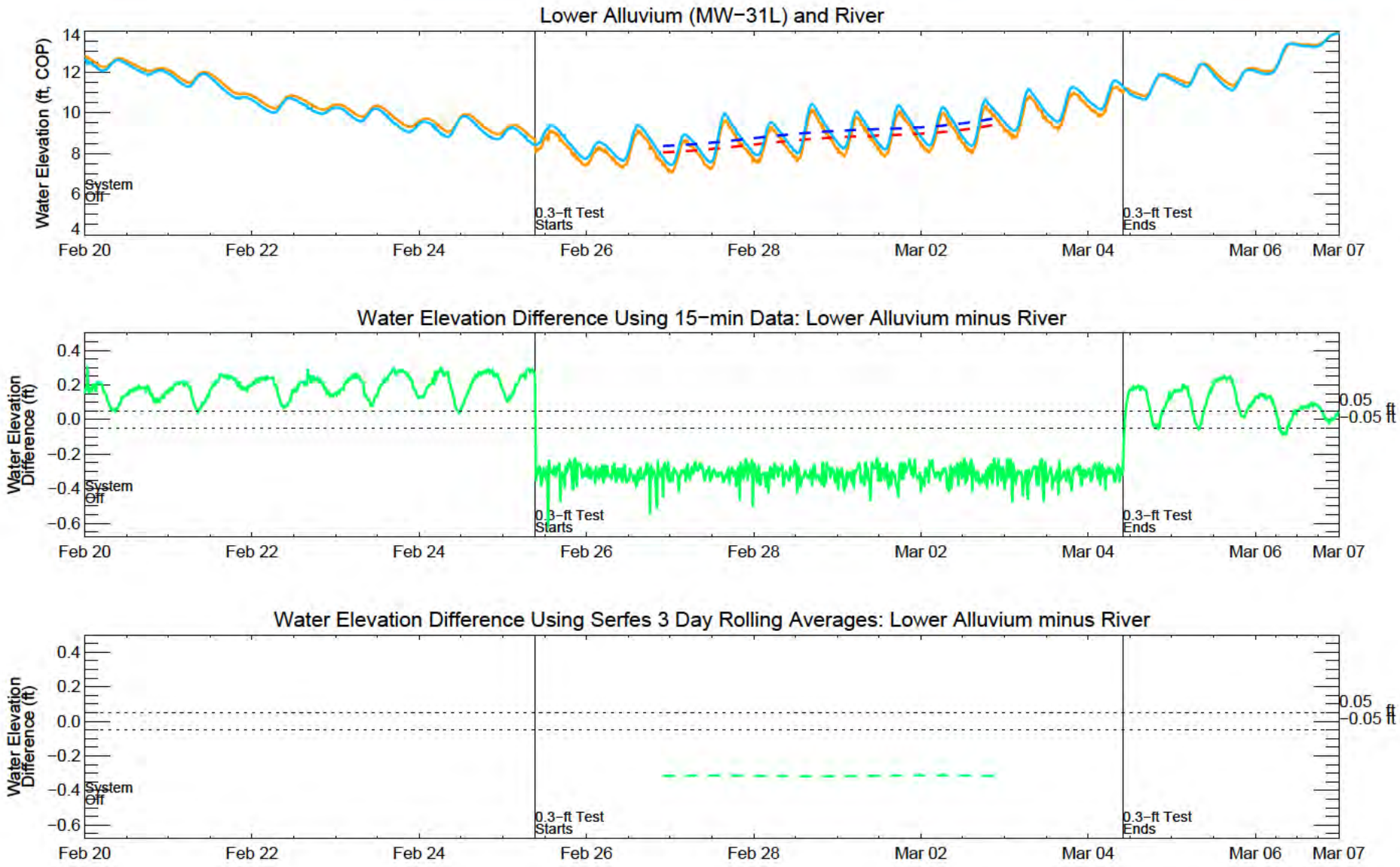


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.66
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:50 2014

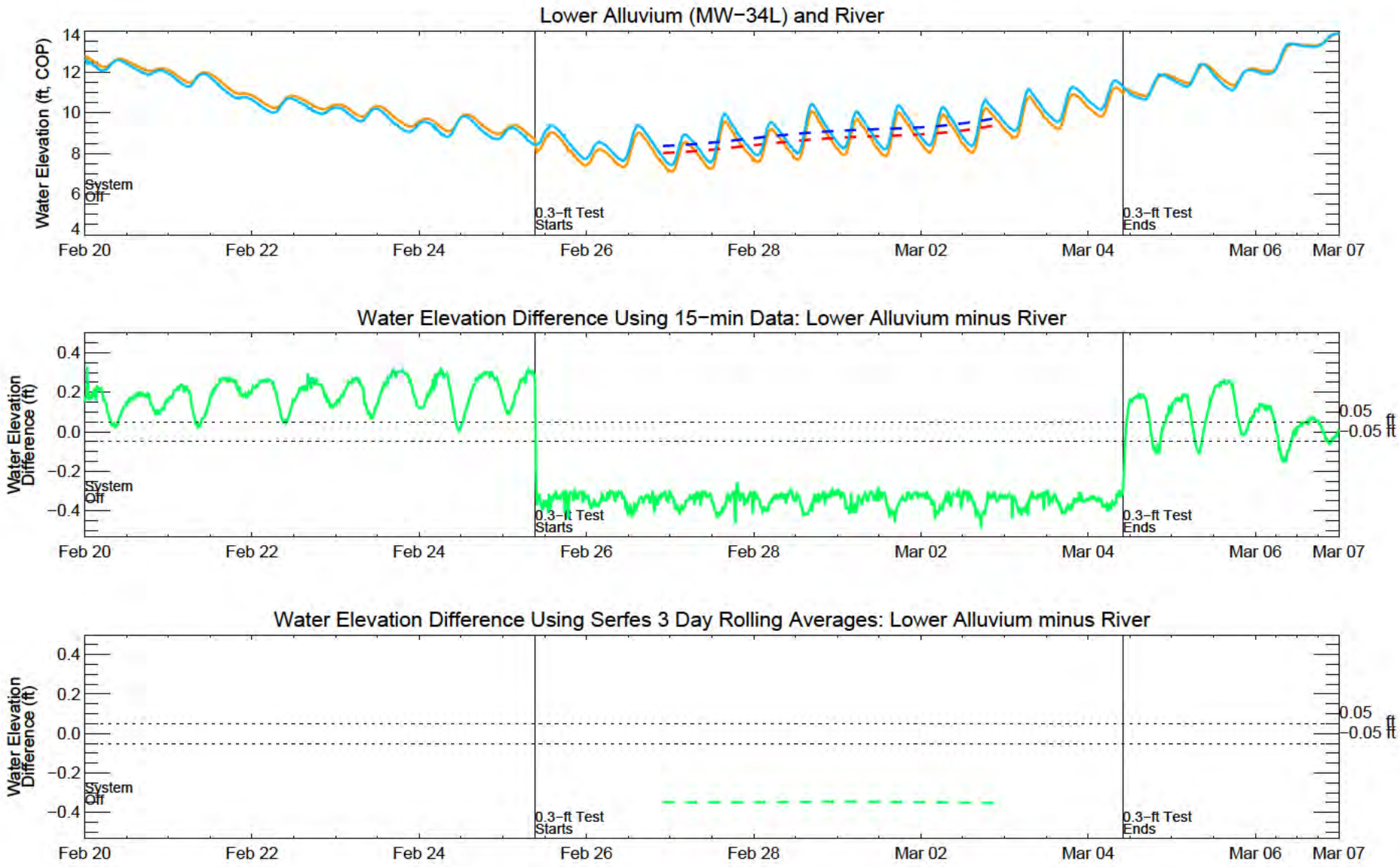


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.67
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:50 2014

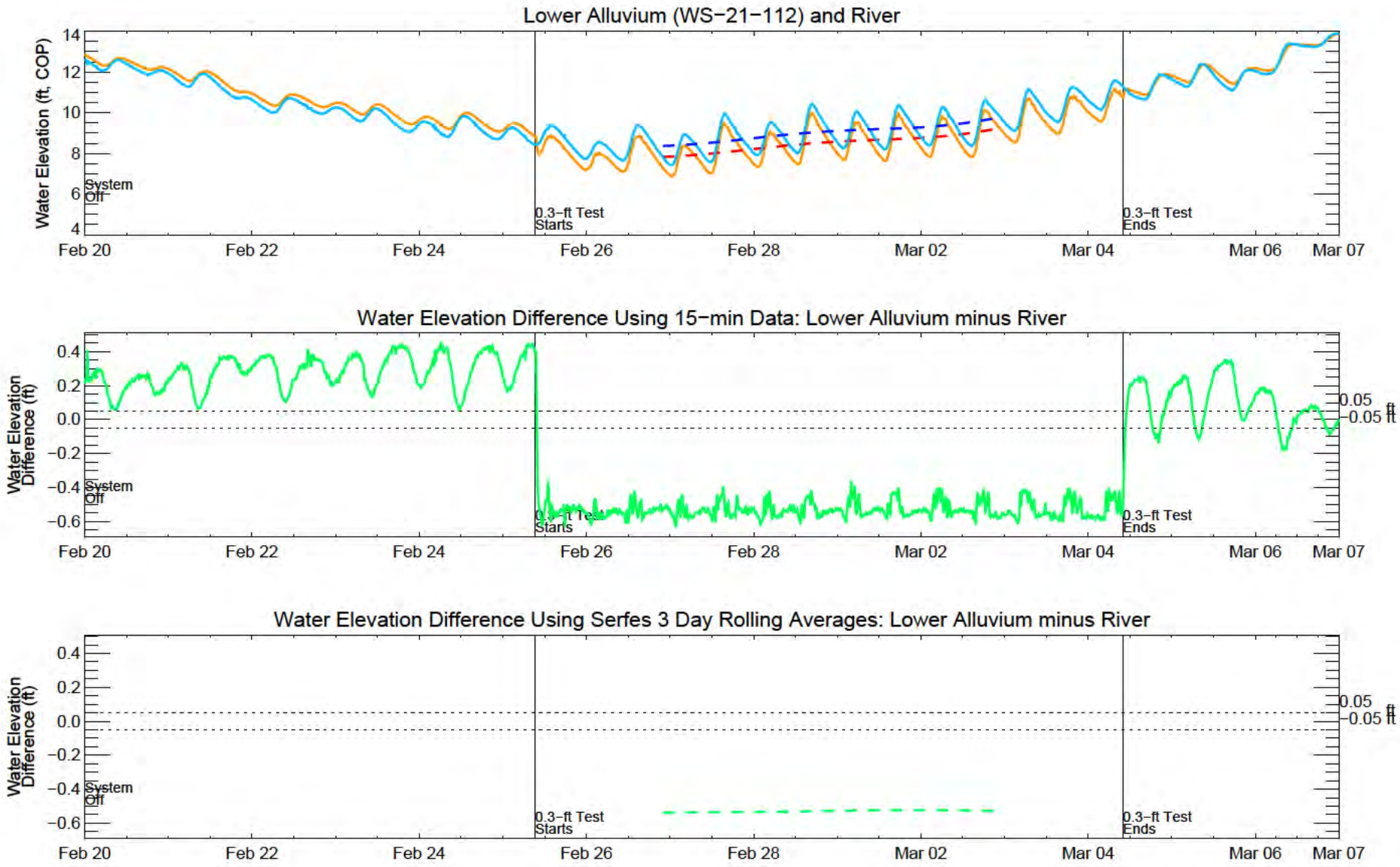


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.68
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:50 2014



- Lower Alluvium: 15−min Data
- Lower Alluvium: Serfes Averages
- River: 15−min Data
- River: Serfes Averages
- Water Elevation Difference: 15−min Data
- Water Elevation Difference: Serfes Averages
- 0.05 ft Total Potential Uncertainty

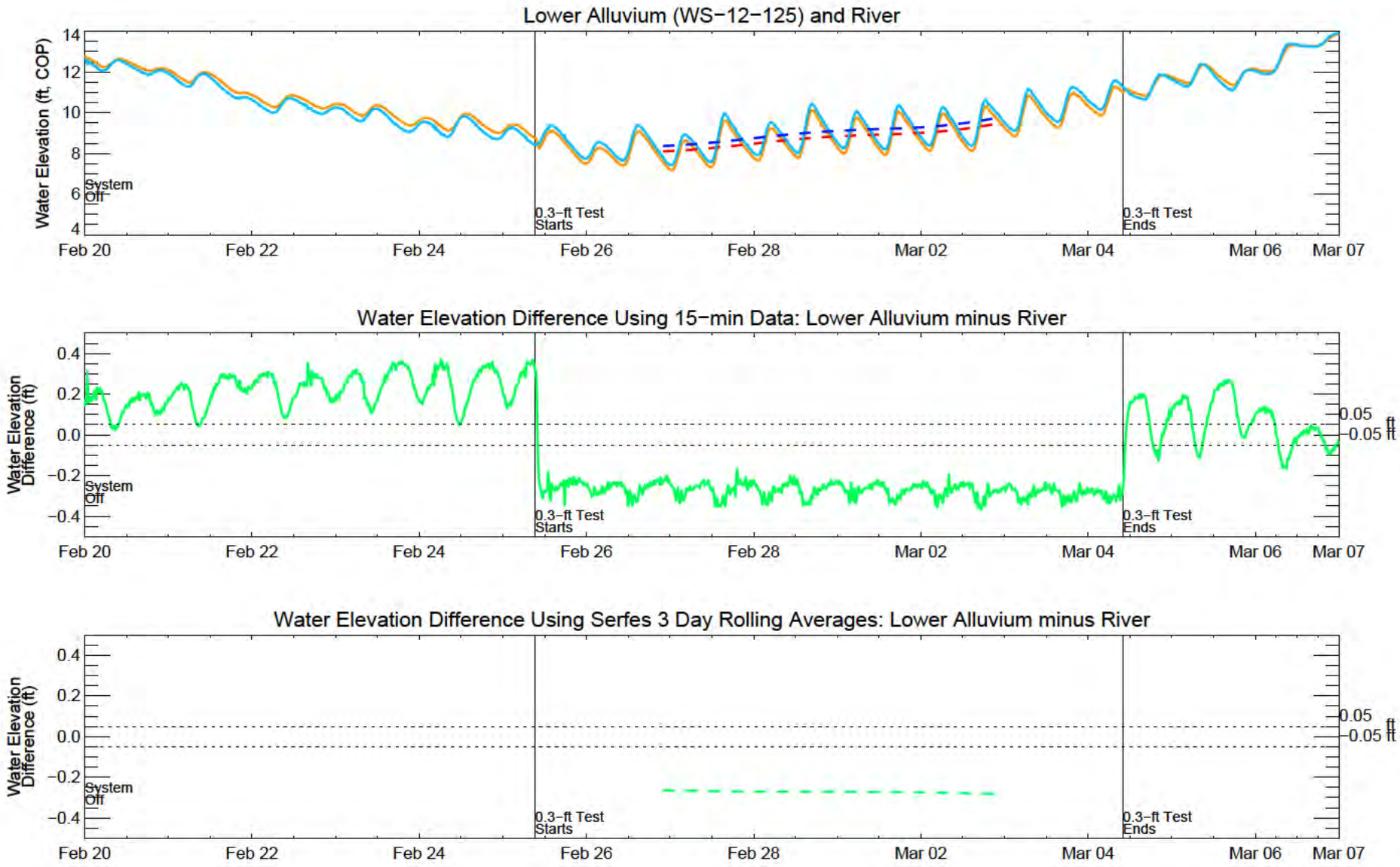
ANCHOR QEA

Figure 4.69

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:50 2014

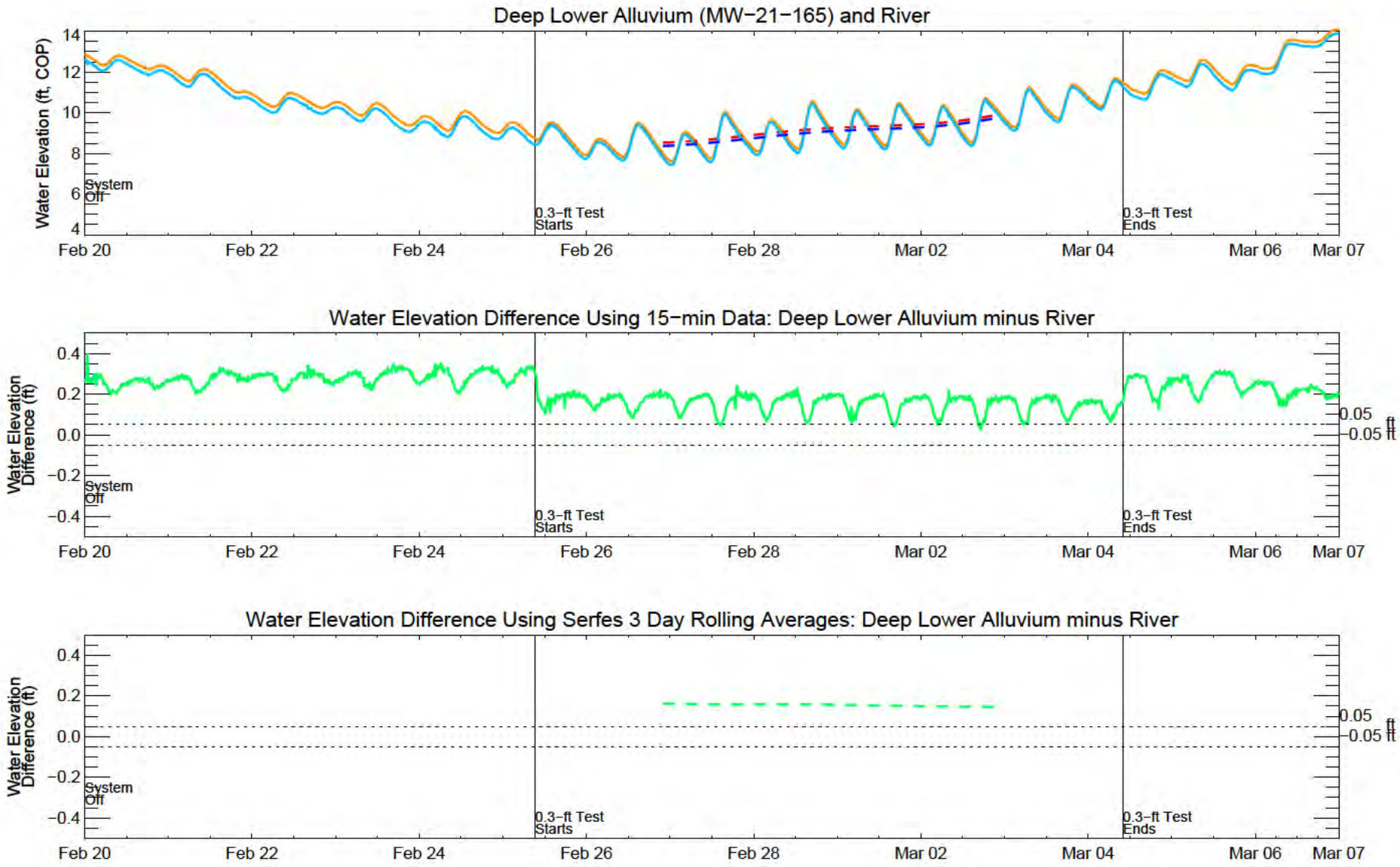


Lower Alluvium: 15−min Data
Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.70
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:50 2014

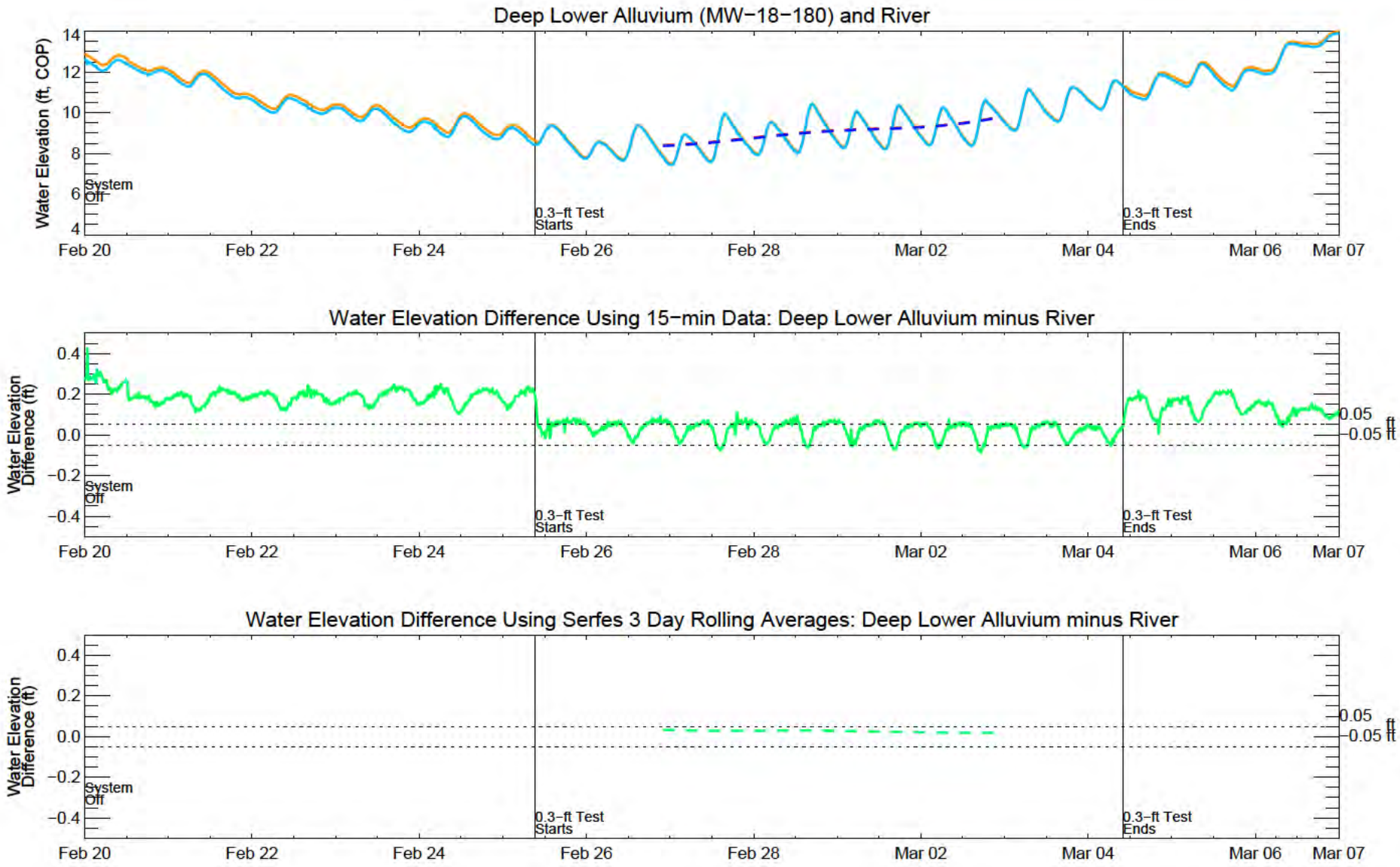


Deep Lower Alluvium: 15−min Data
Deep Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.71
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:51 2014

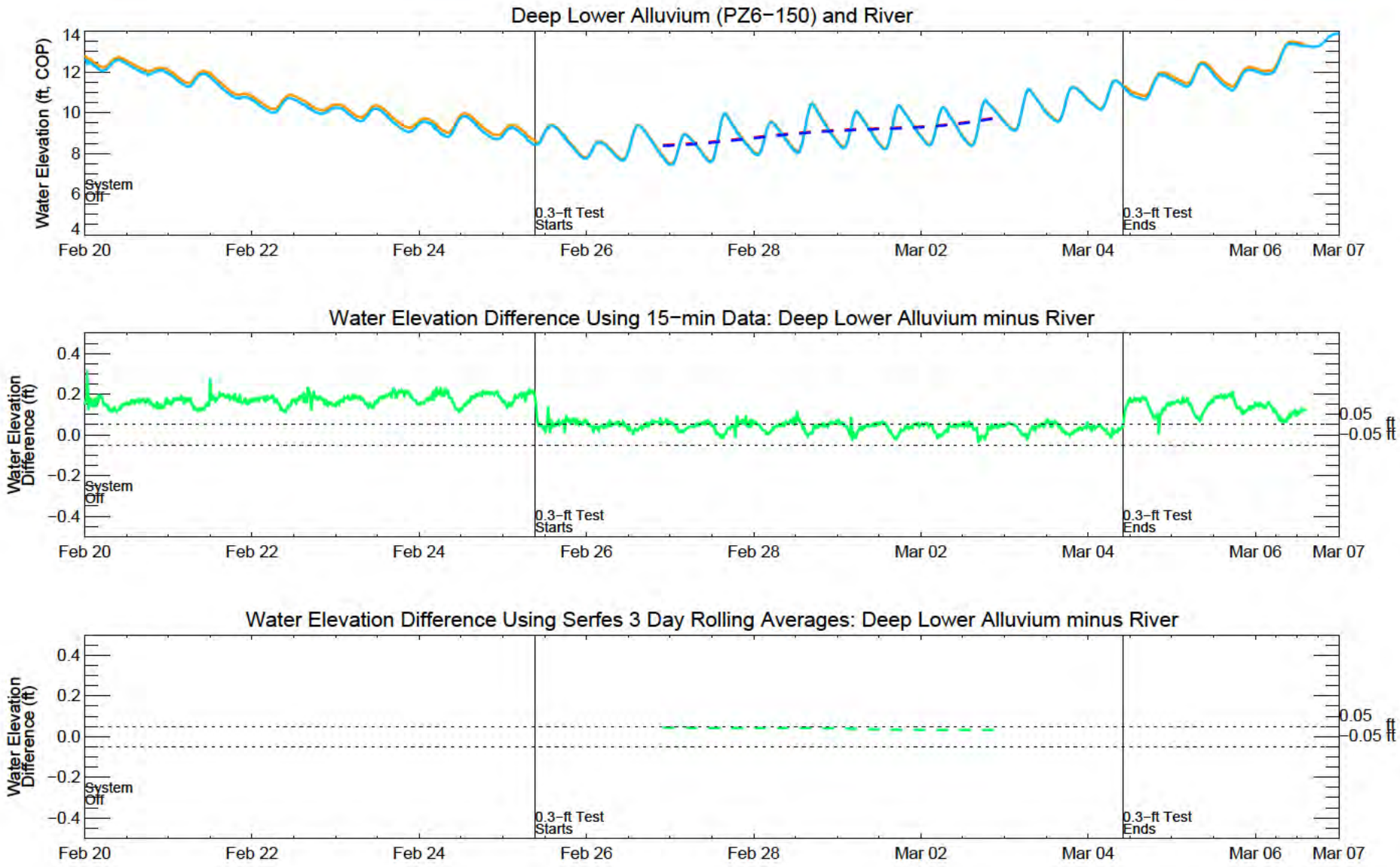


Deep Lower Alluvium: 15−min Data
Deep Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.72
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:51 2014

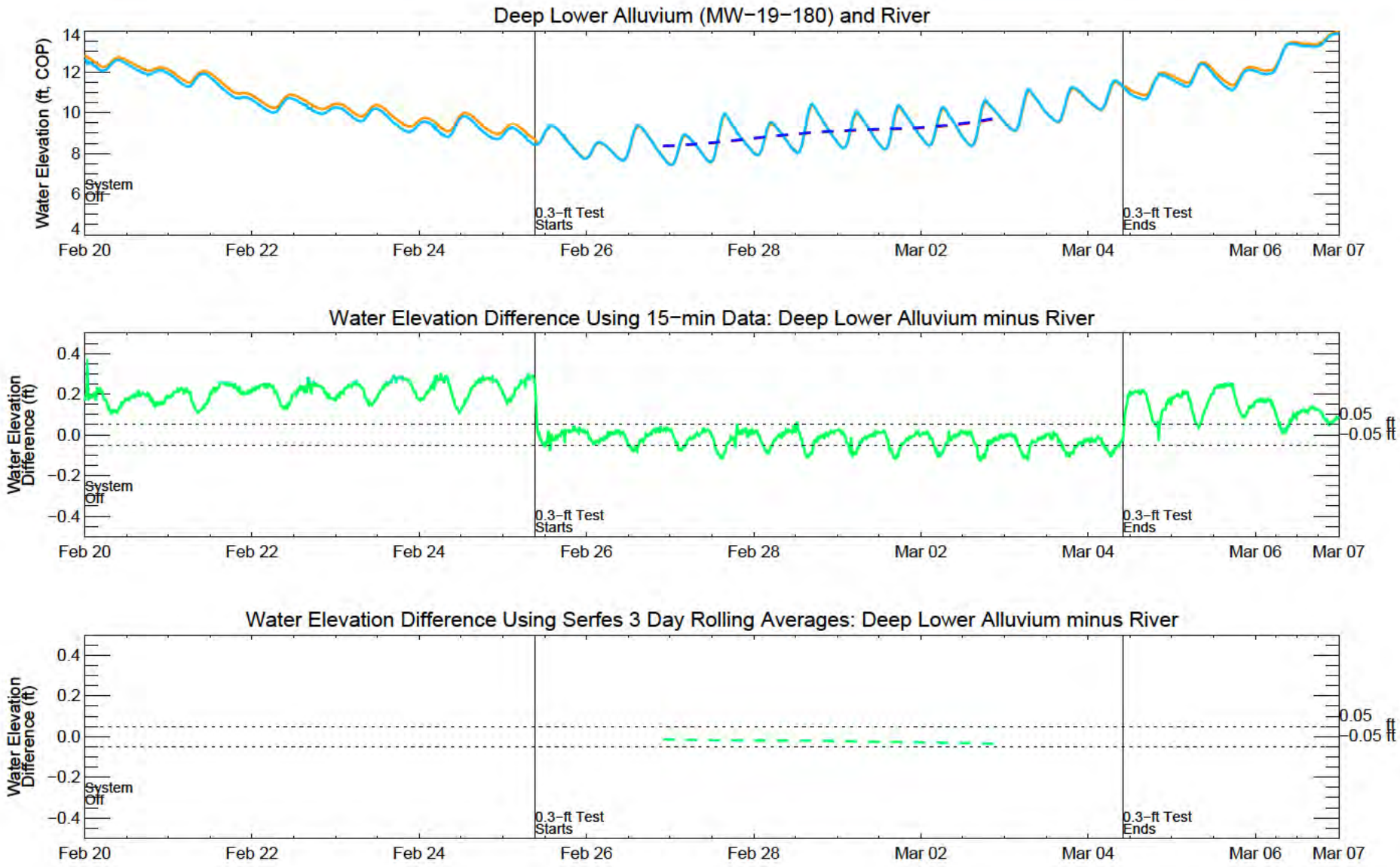


Deep Lower Alluvium: 15−min Data
Deep Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.73
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:51 2014

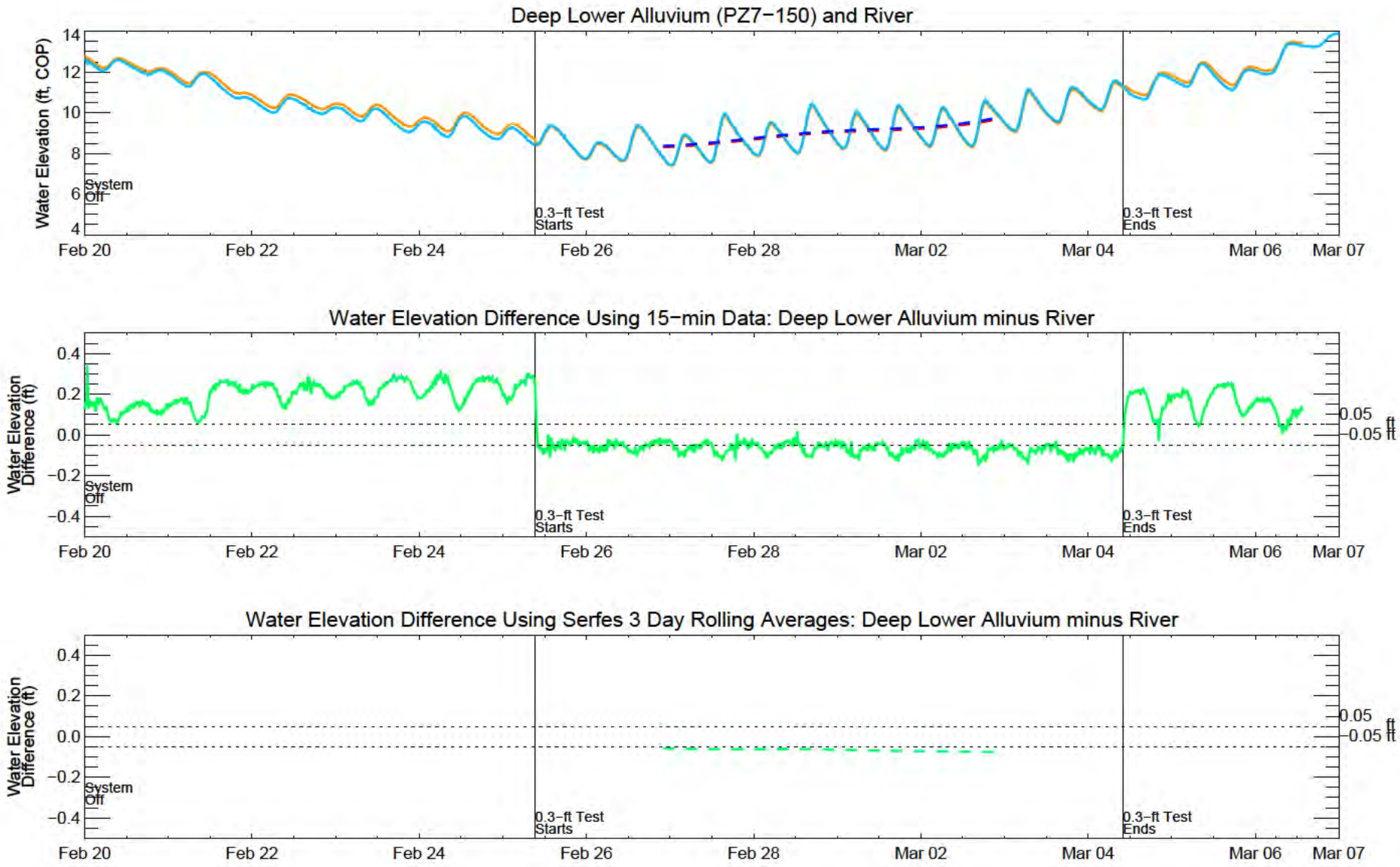


Deep Lower Alluvium: 15−min Data
Deep Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.74
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:51 2014

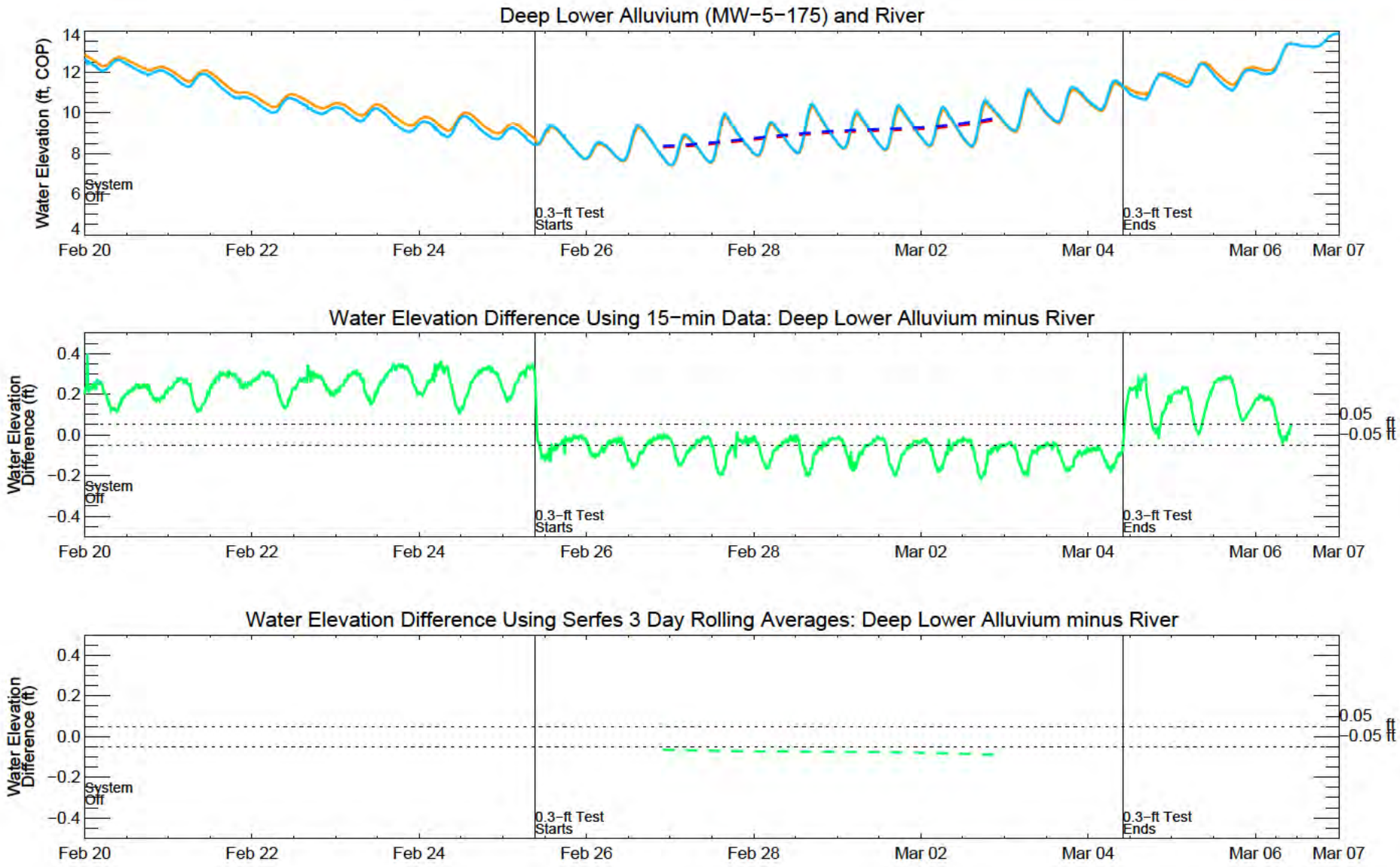


Deep Lower Alluvium: 15−min Data
Deep Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.75
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:51 2014

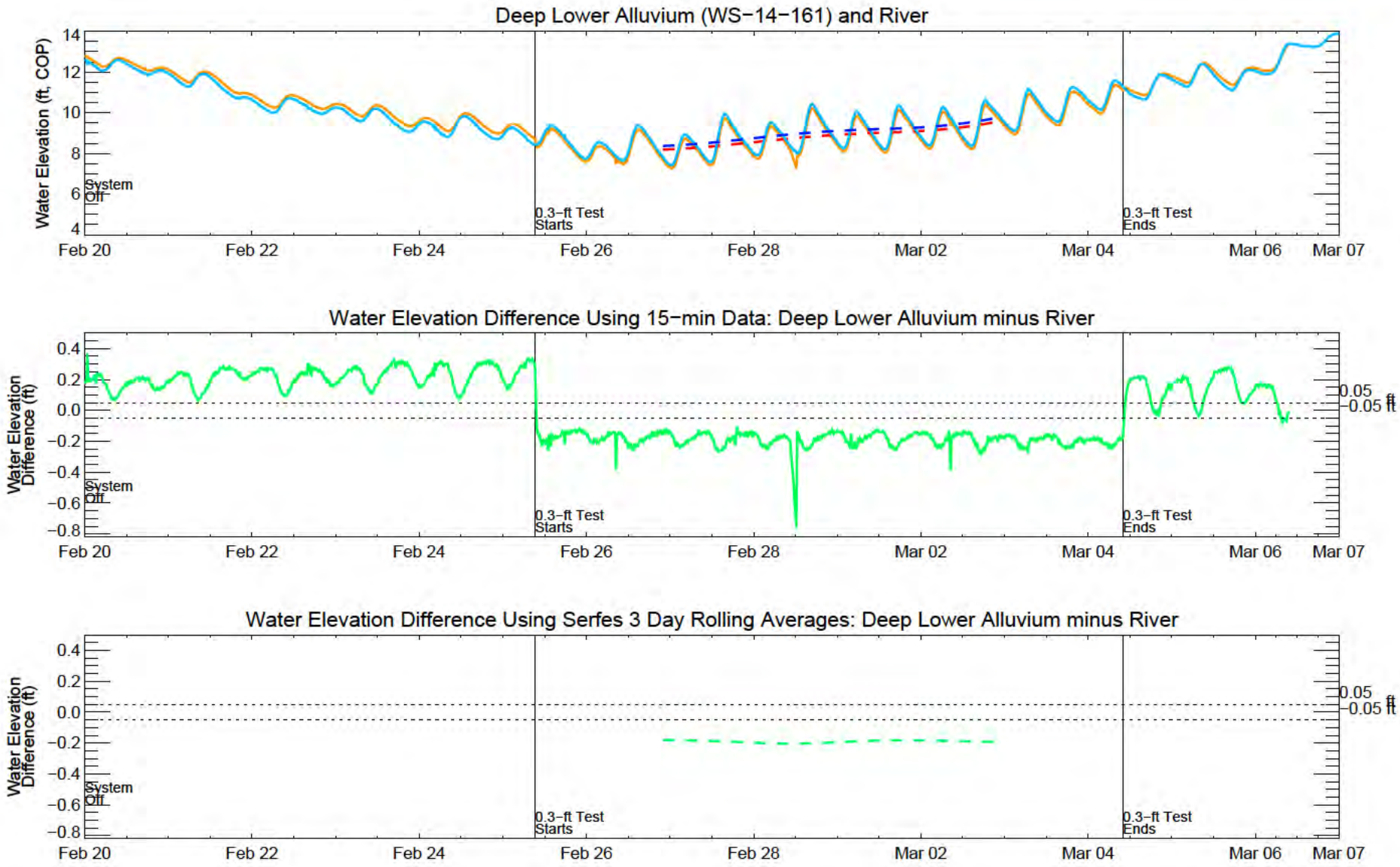


Deep Lower Alluvium: 15-min Data
Deep Lower Alluvium: Serfes Averages
River: 15-min Data
River: Serfes Averages
Water Elevation Difference: 15-min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.76
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:51 2014

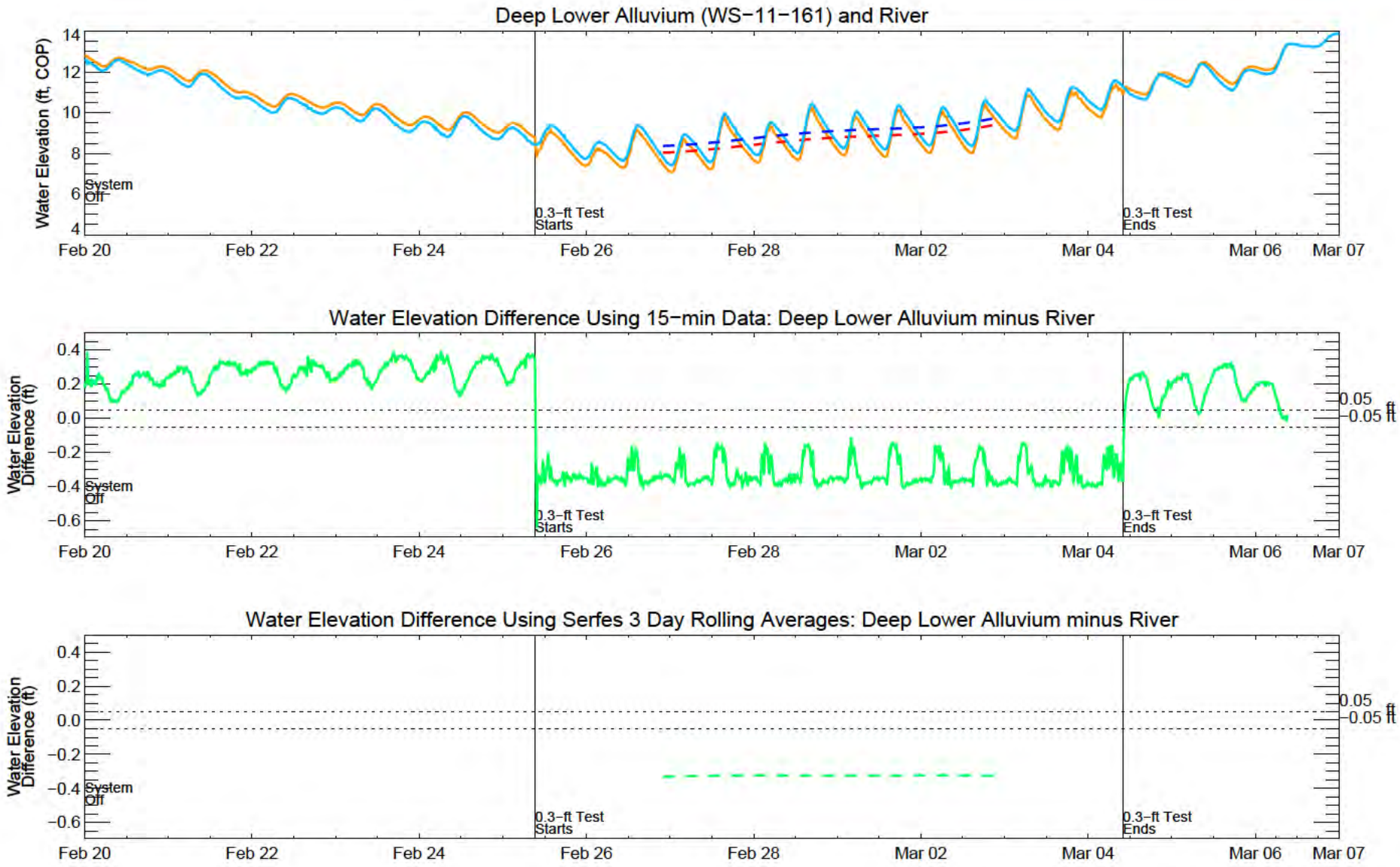


Deep Lower Alluvium: 15−min Data
Deep Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.77
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:52 2014

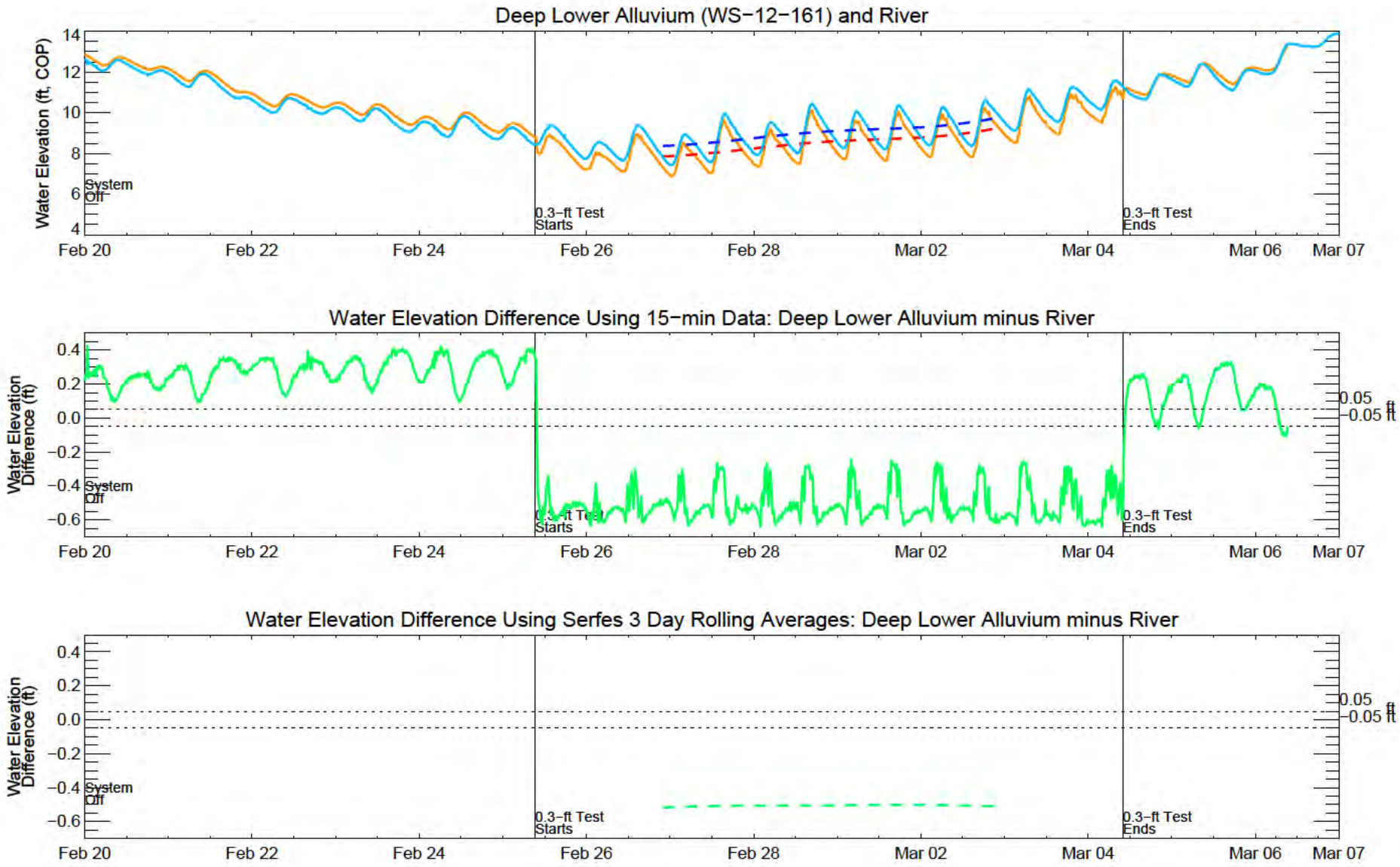


Deep Lower Alluvium: 15-min Data
Deep Lower Alluvium: Serfes Averages
River: 15-min Data
River: Serfes Averages
Water Elevation Difference: 15-min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.78
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG – C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:52 2014

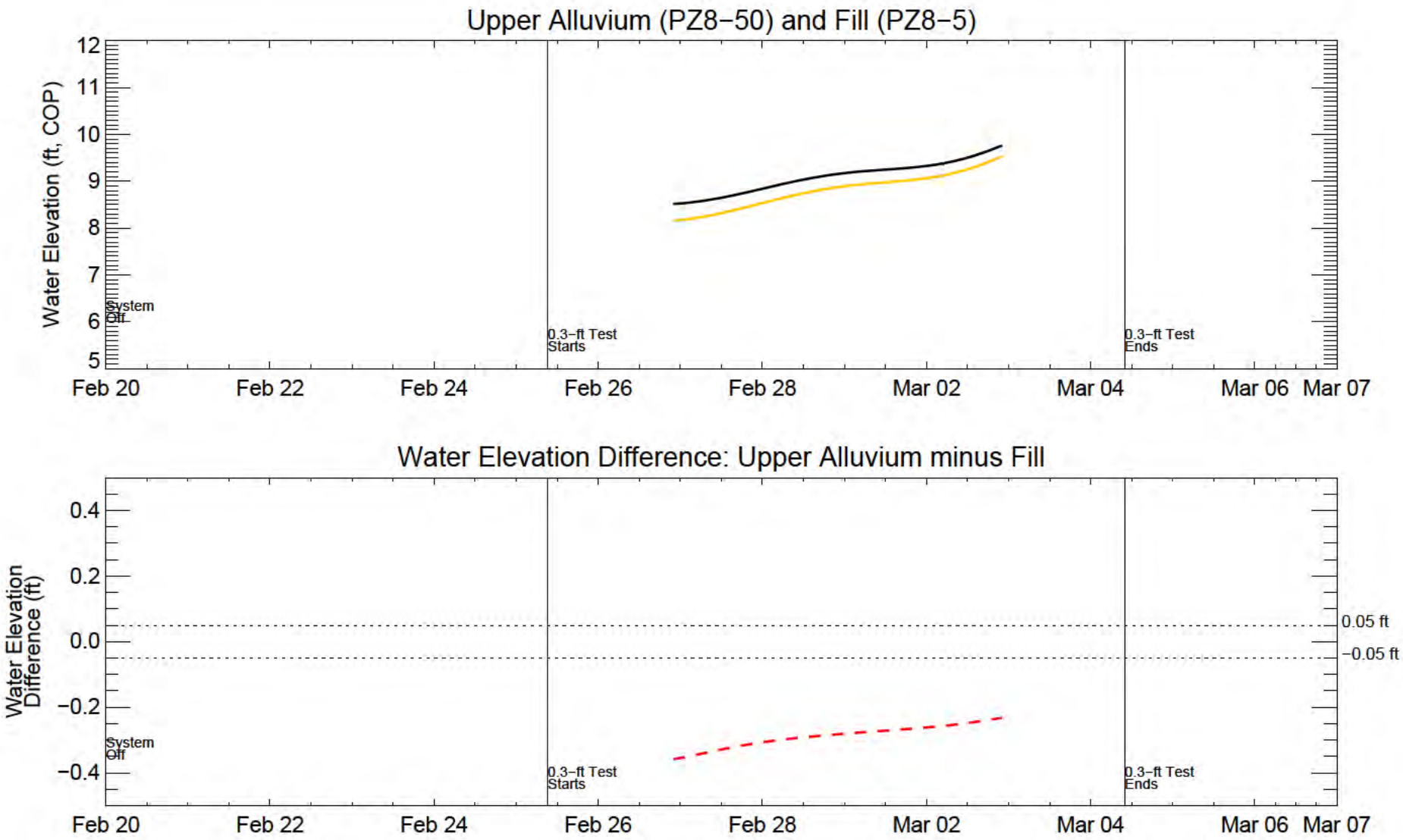


Deep Lower Alluvium: 15−min Data
Deep Lower Alluvium: Serfes Averages
River: 15−min Data
River: Serfes Averages
Water Elevation Difference: 15−min Data
Water Elevation Difference: Serfes Averages
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 4.79
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site
COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:11:52 2014



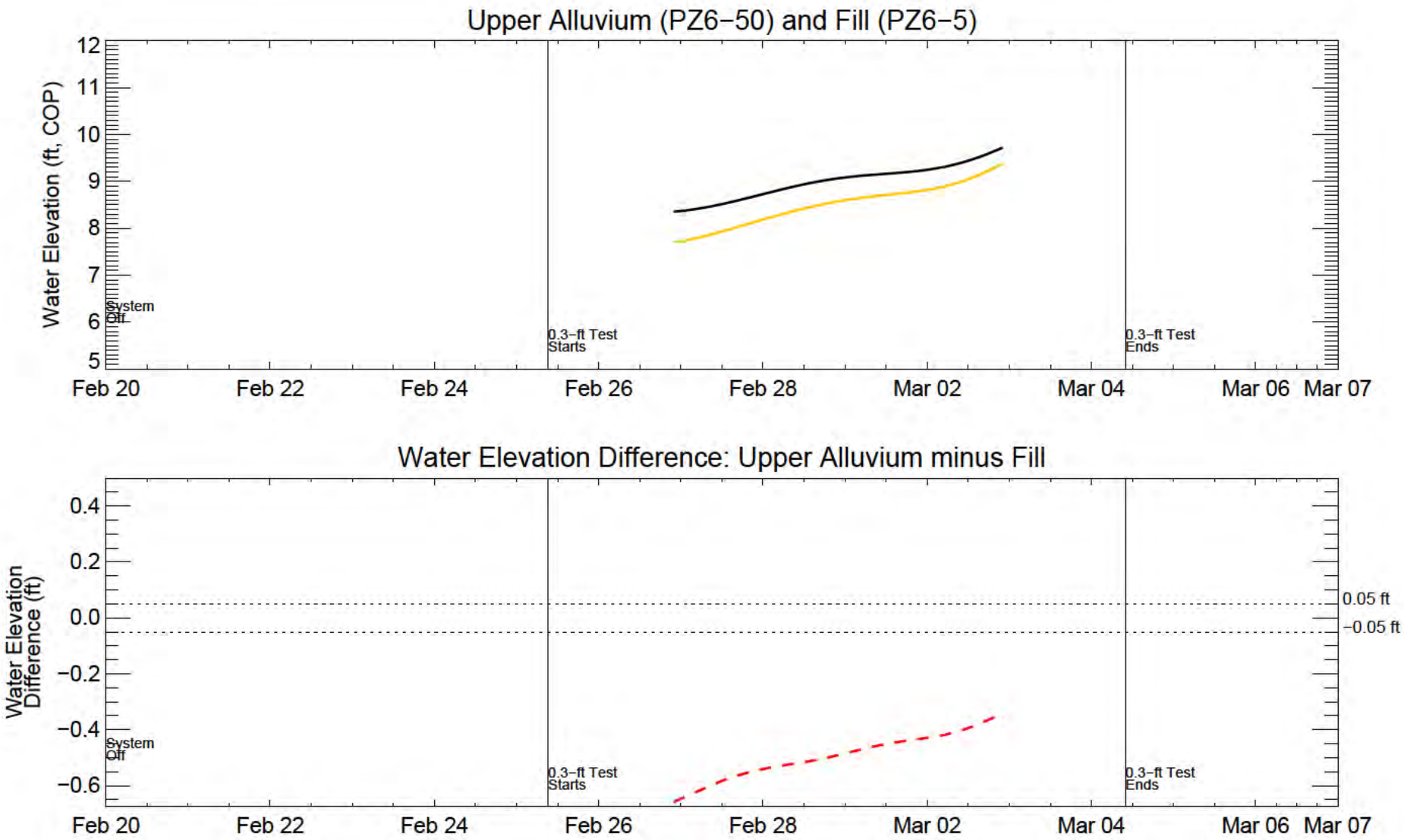
Upper Alluvium
Fill
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.1
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:23 2014



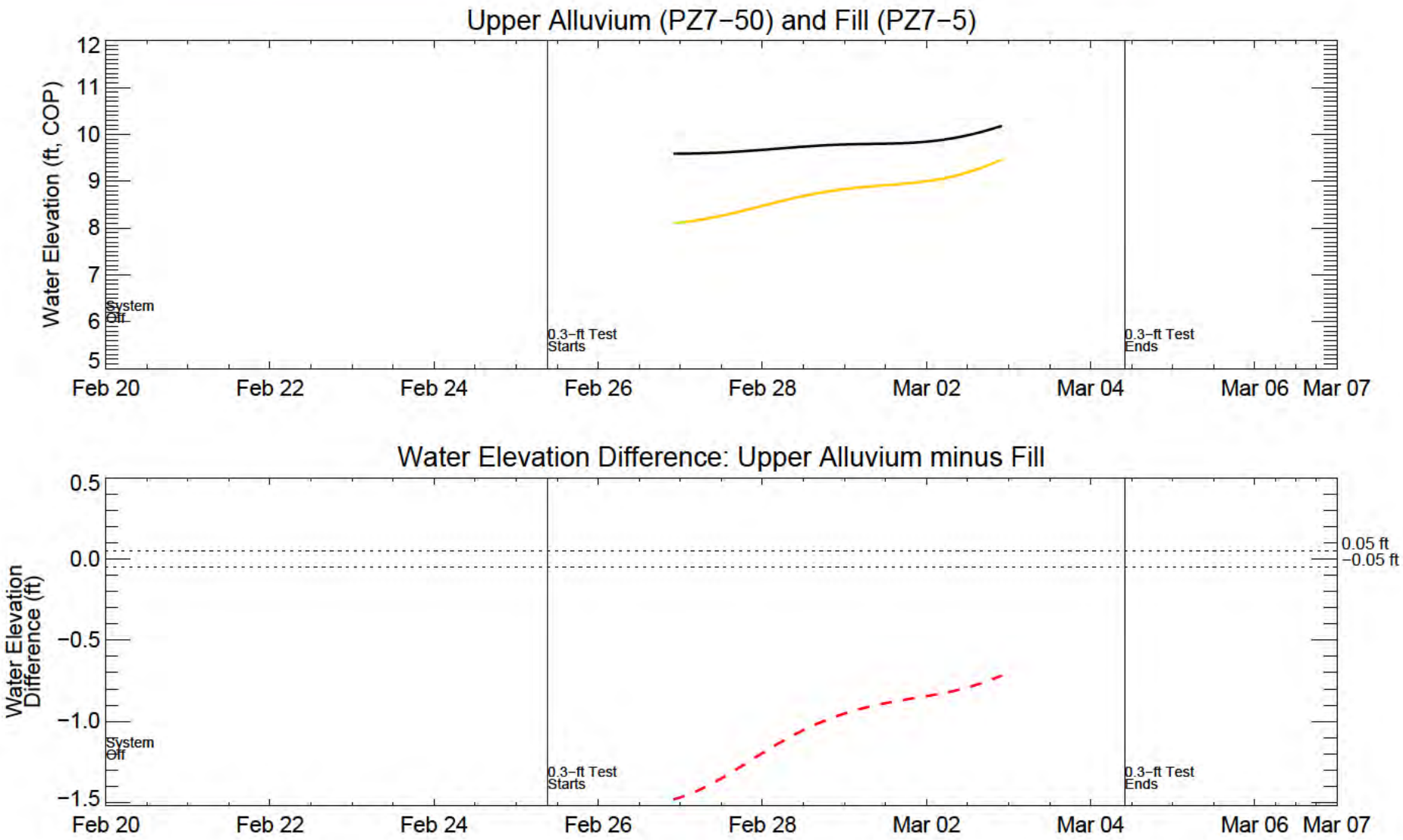
Upper Alluvium
Fill
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.2
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:23 2014



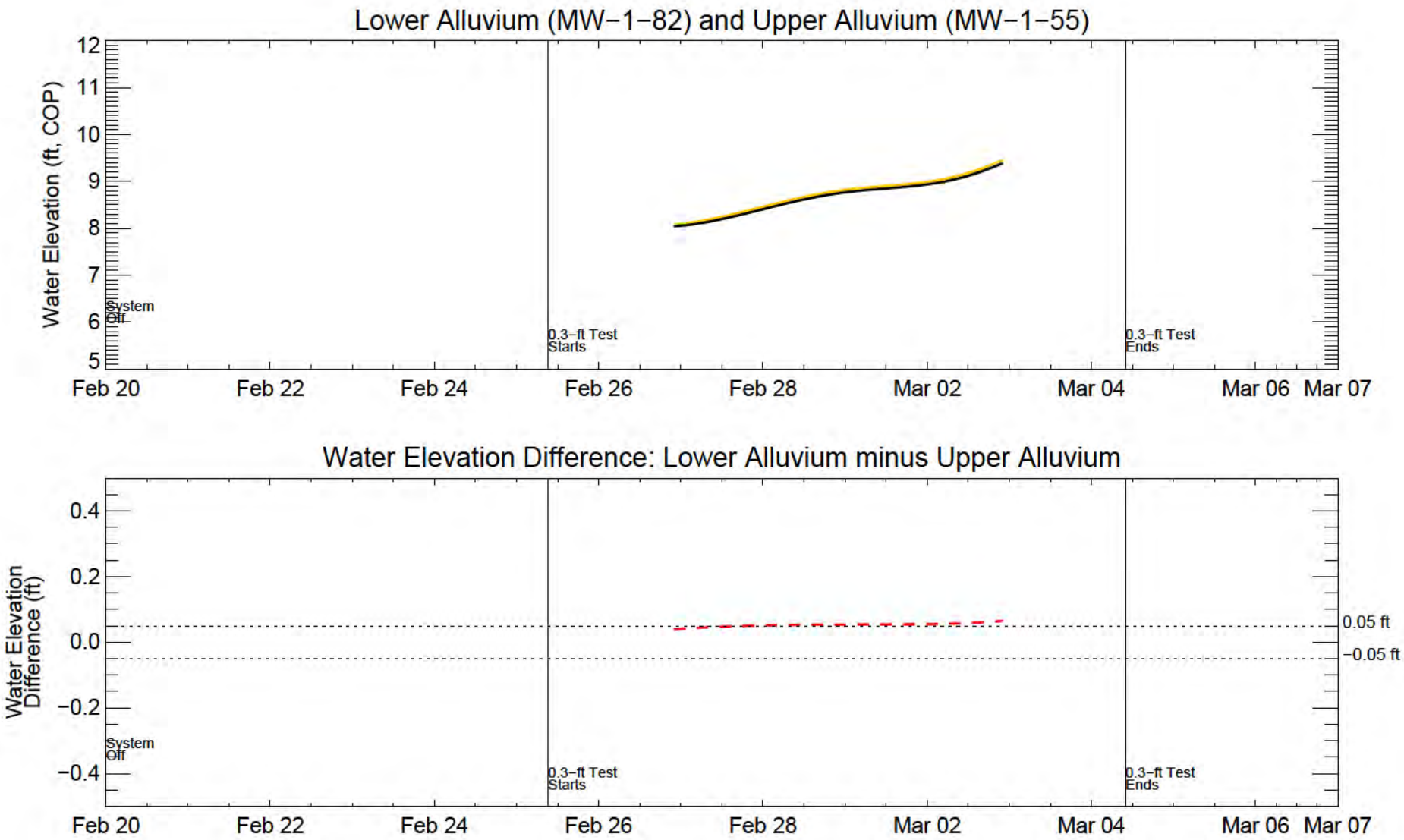
Upper Alluvium
Fill
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.3
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:23 2014



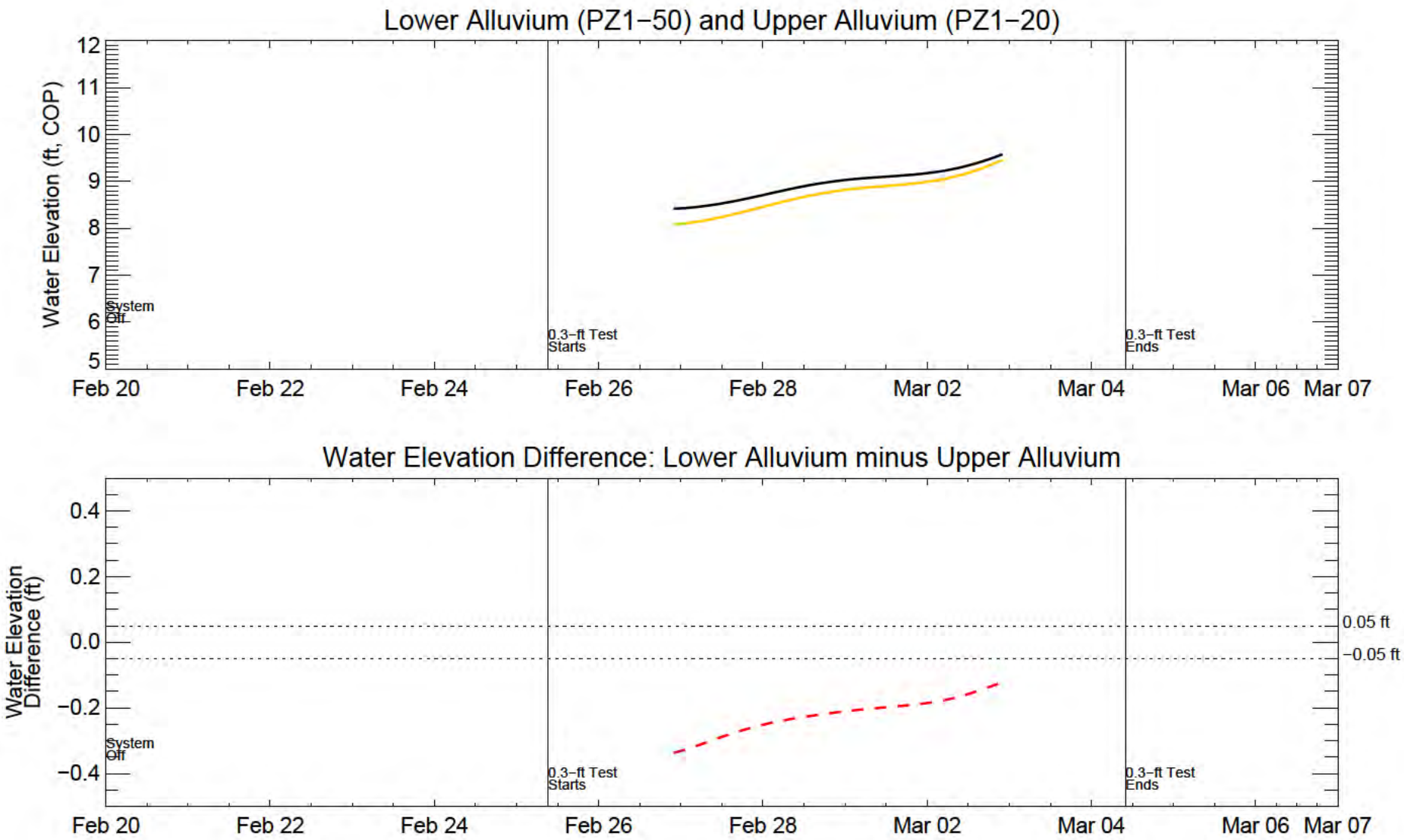
Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.4
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:23 2014



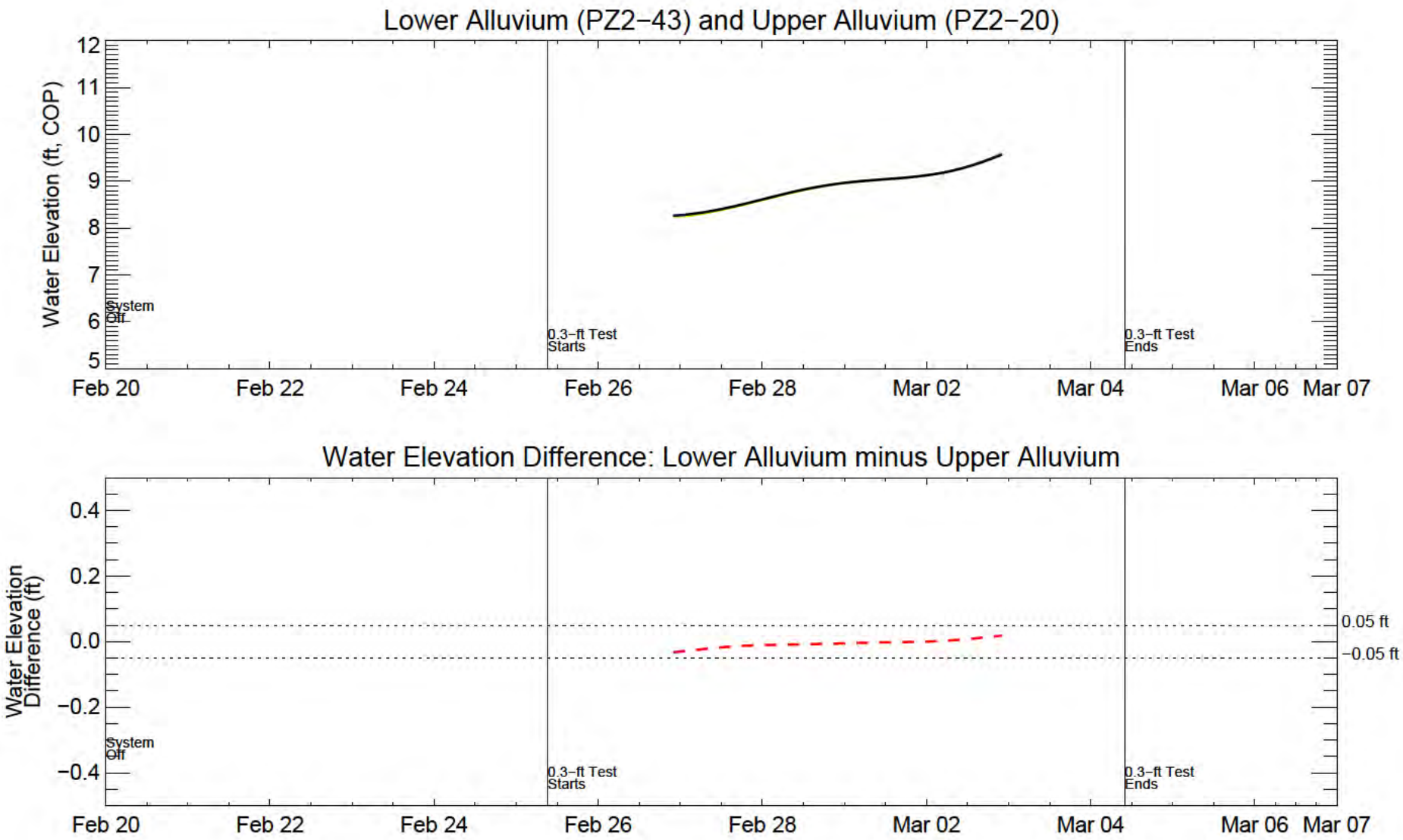
Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.5
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:23 2014



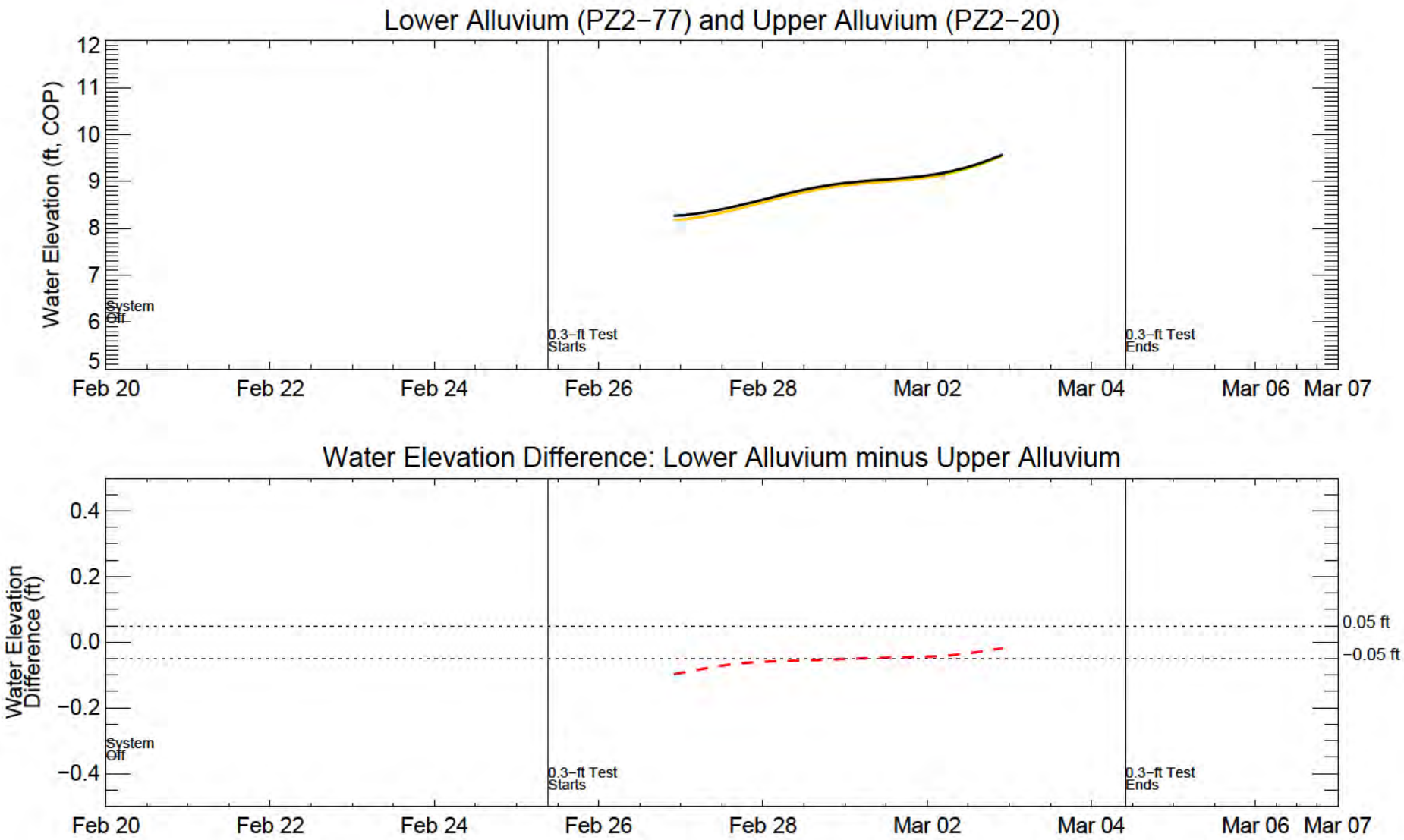
Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.6
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:23 2014



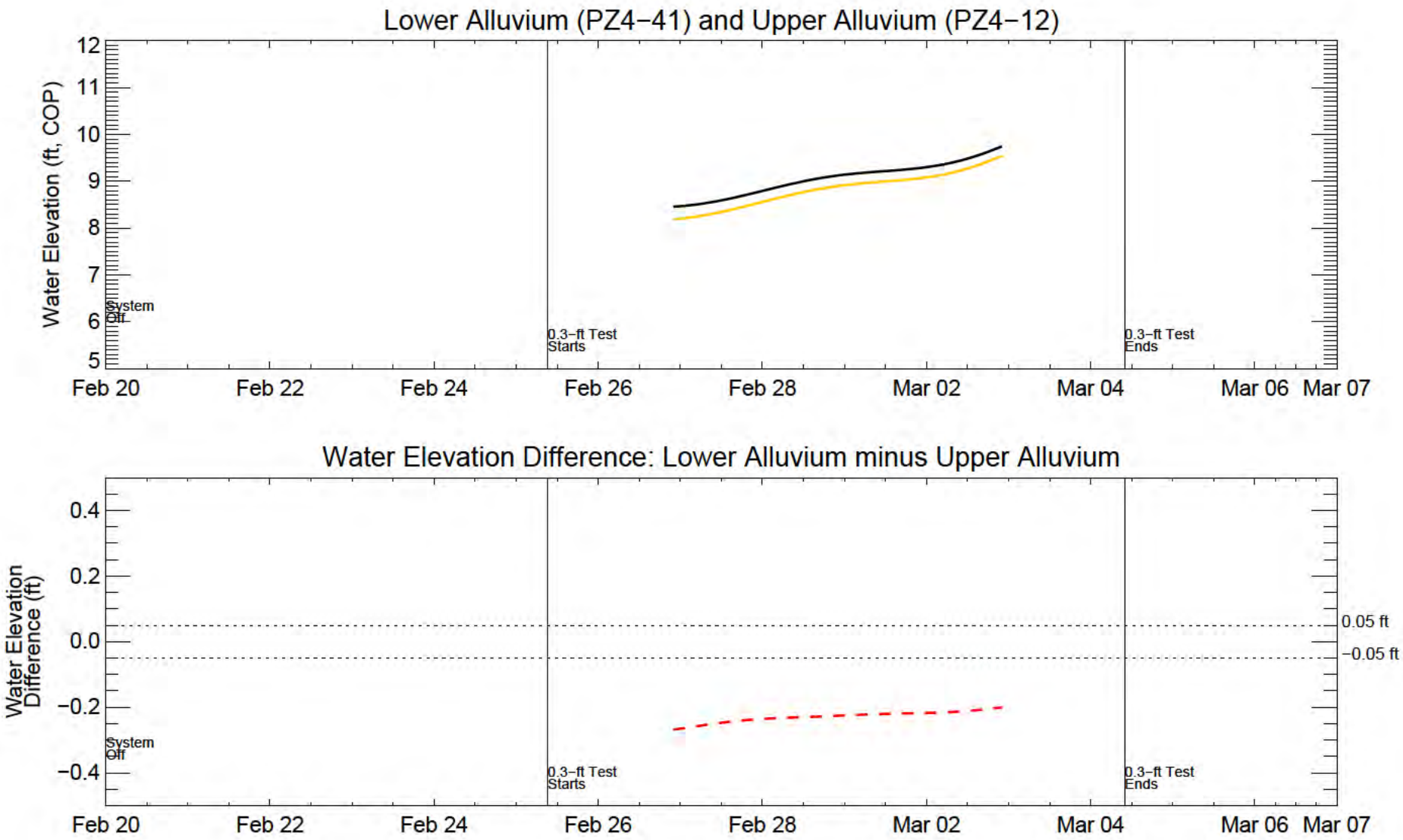
Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.7
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:24 2014



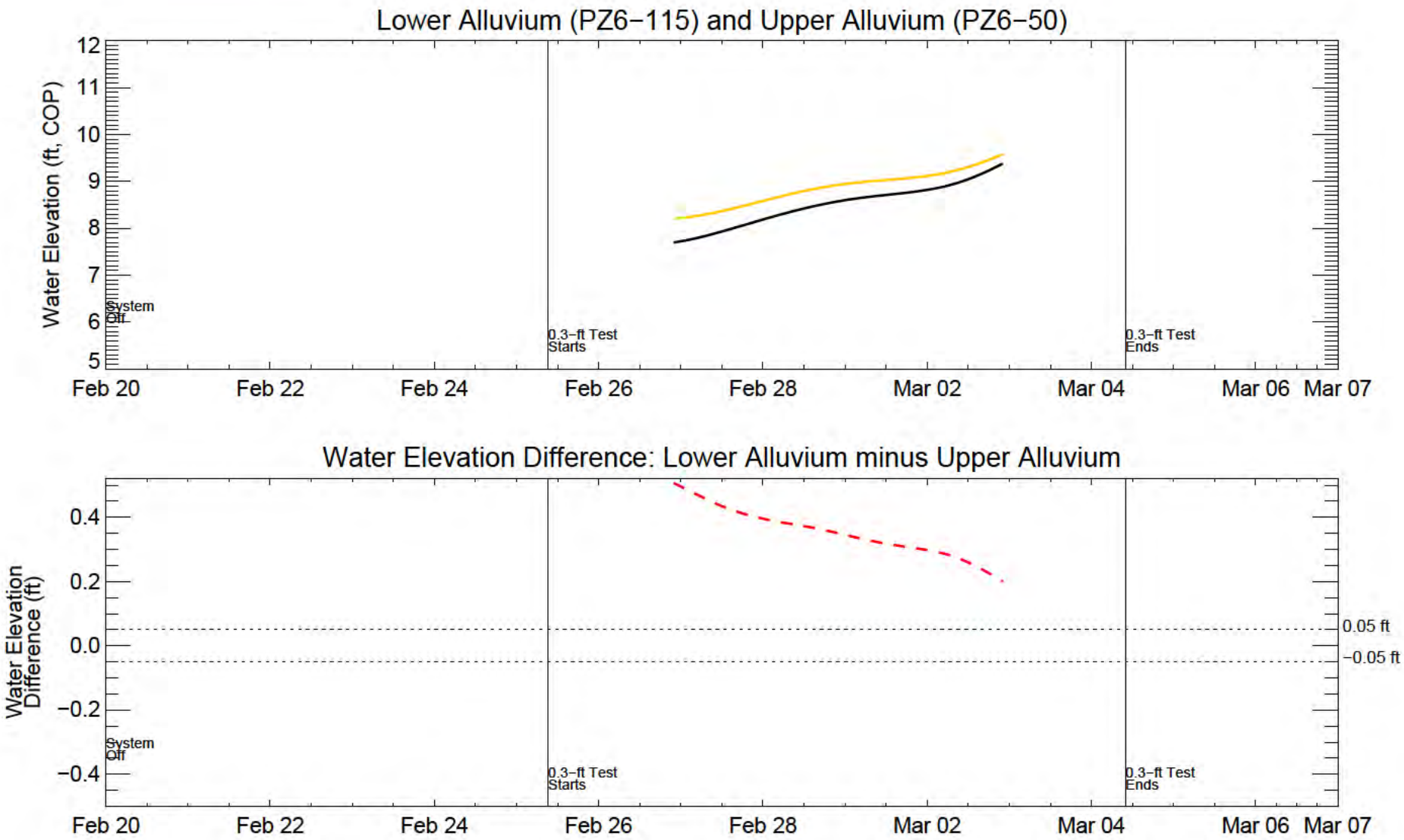
Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.8
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:24 2014



Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.9
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

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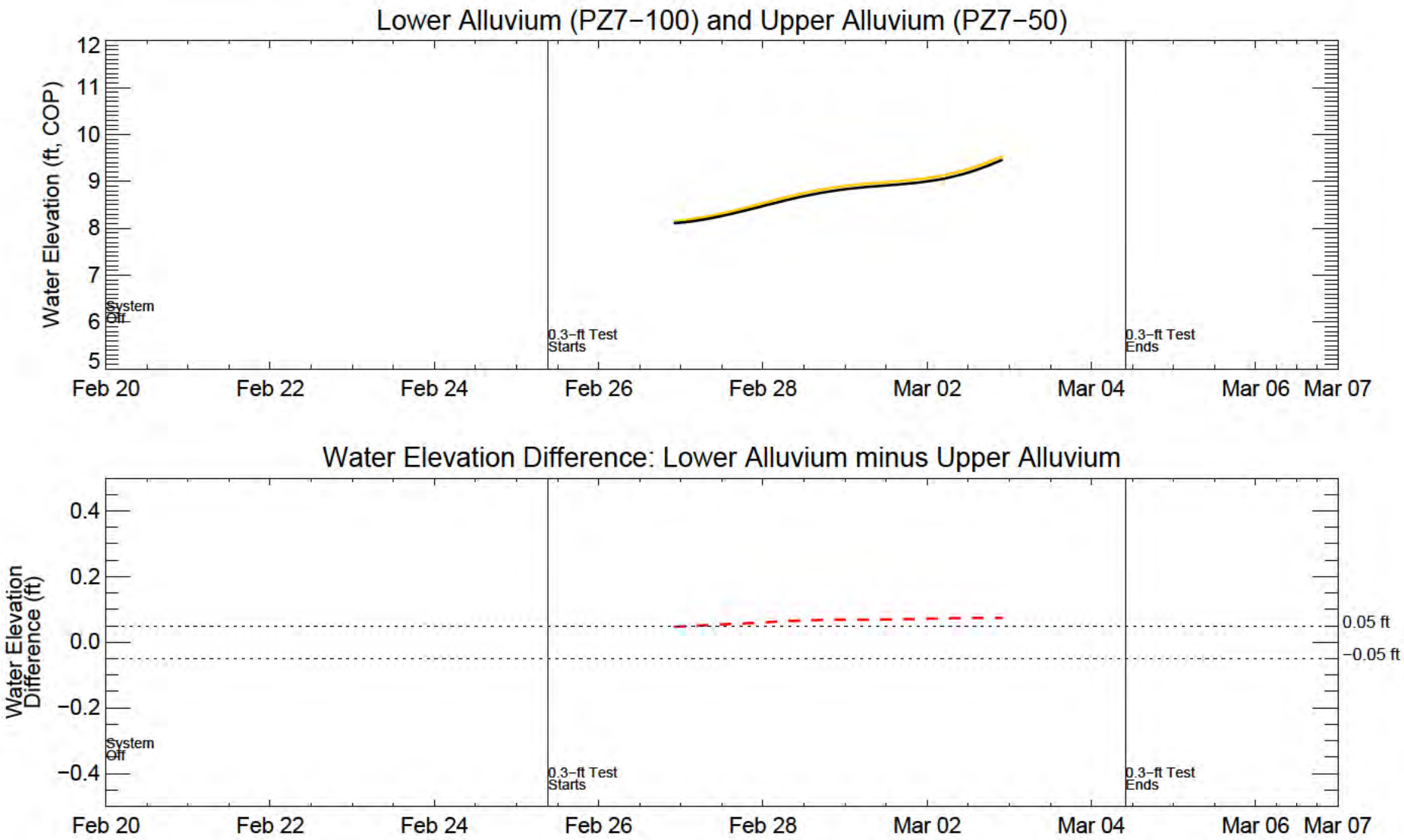

Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.10
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

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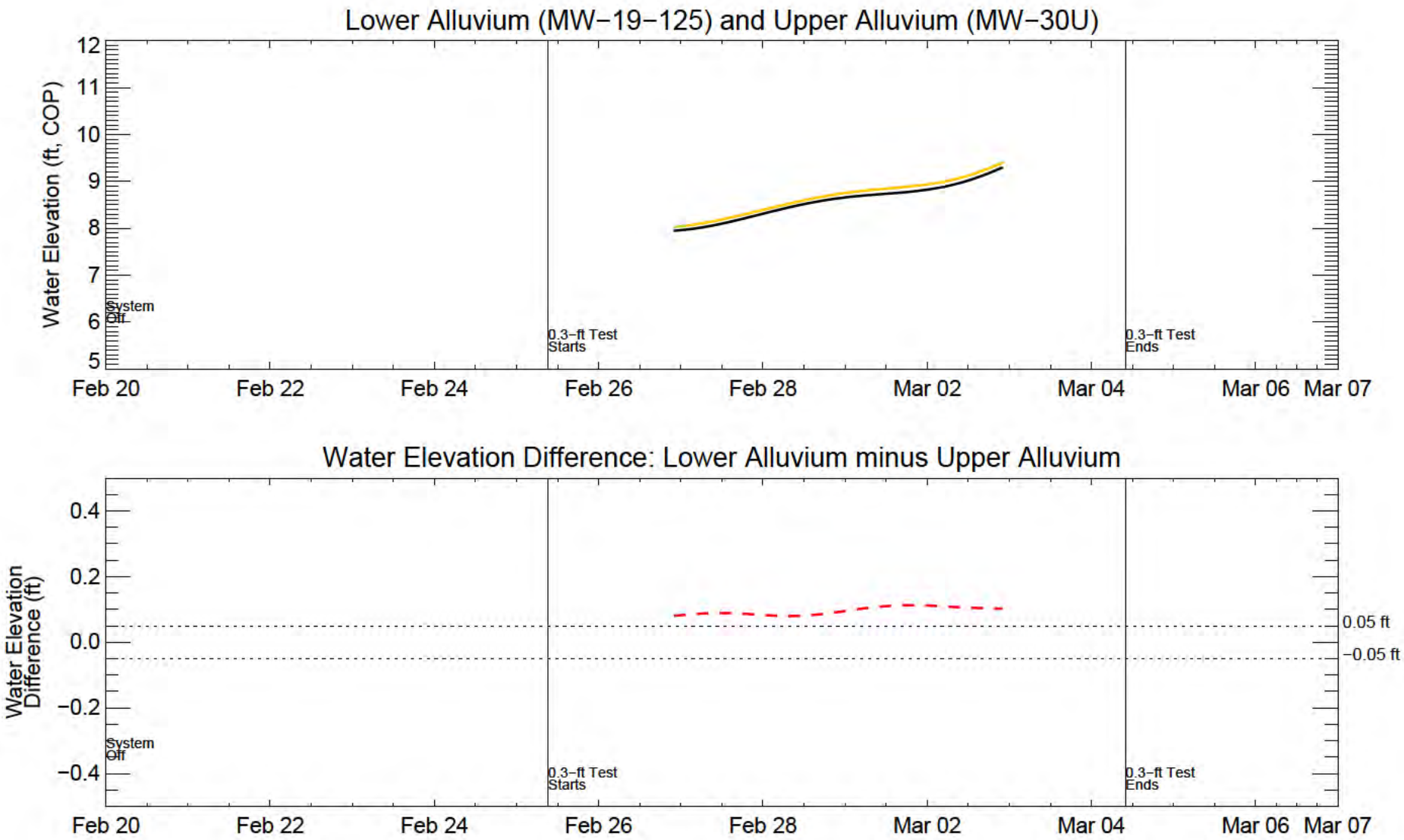


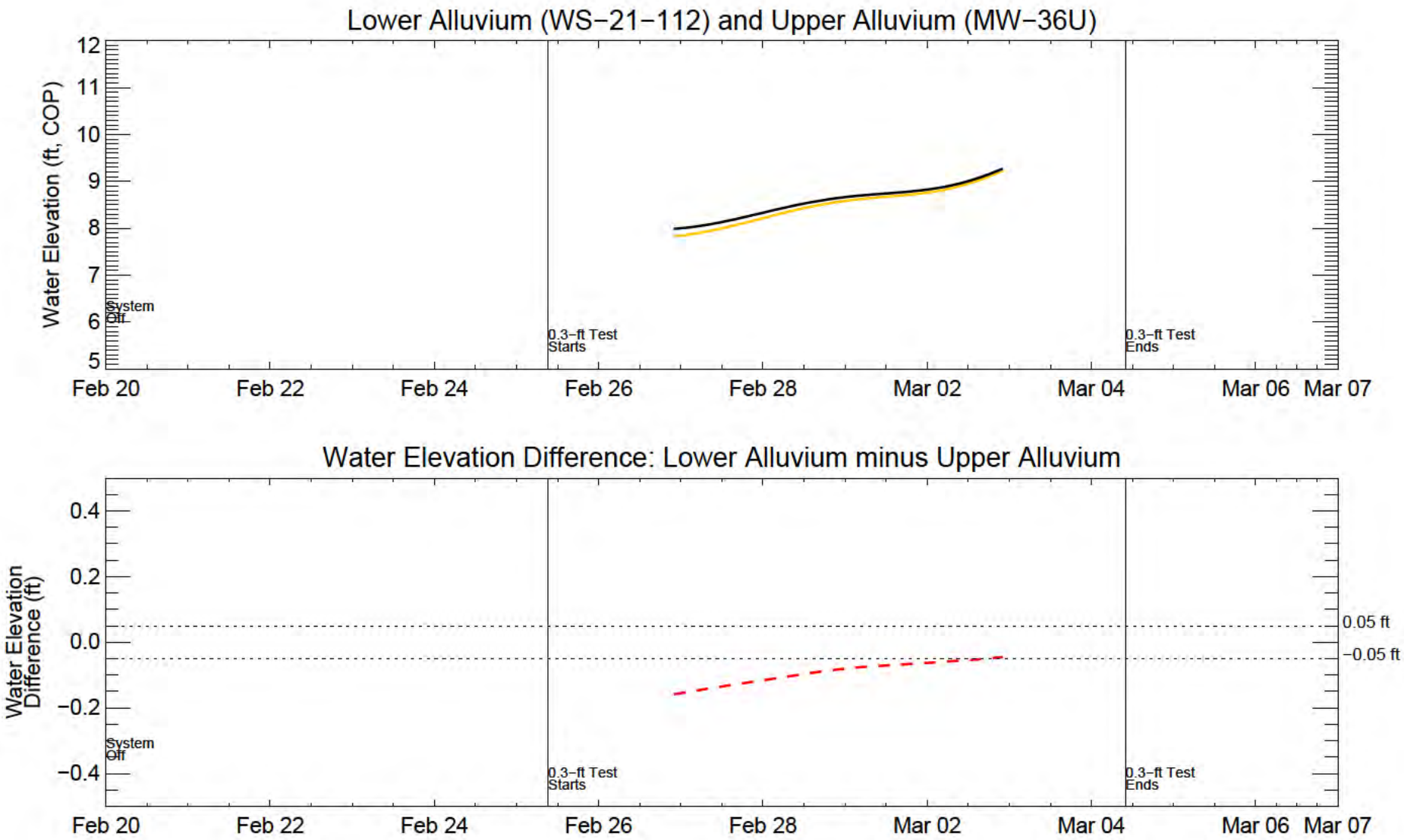
Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.11
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:24 2014



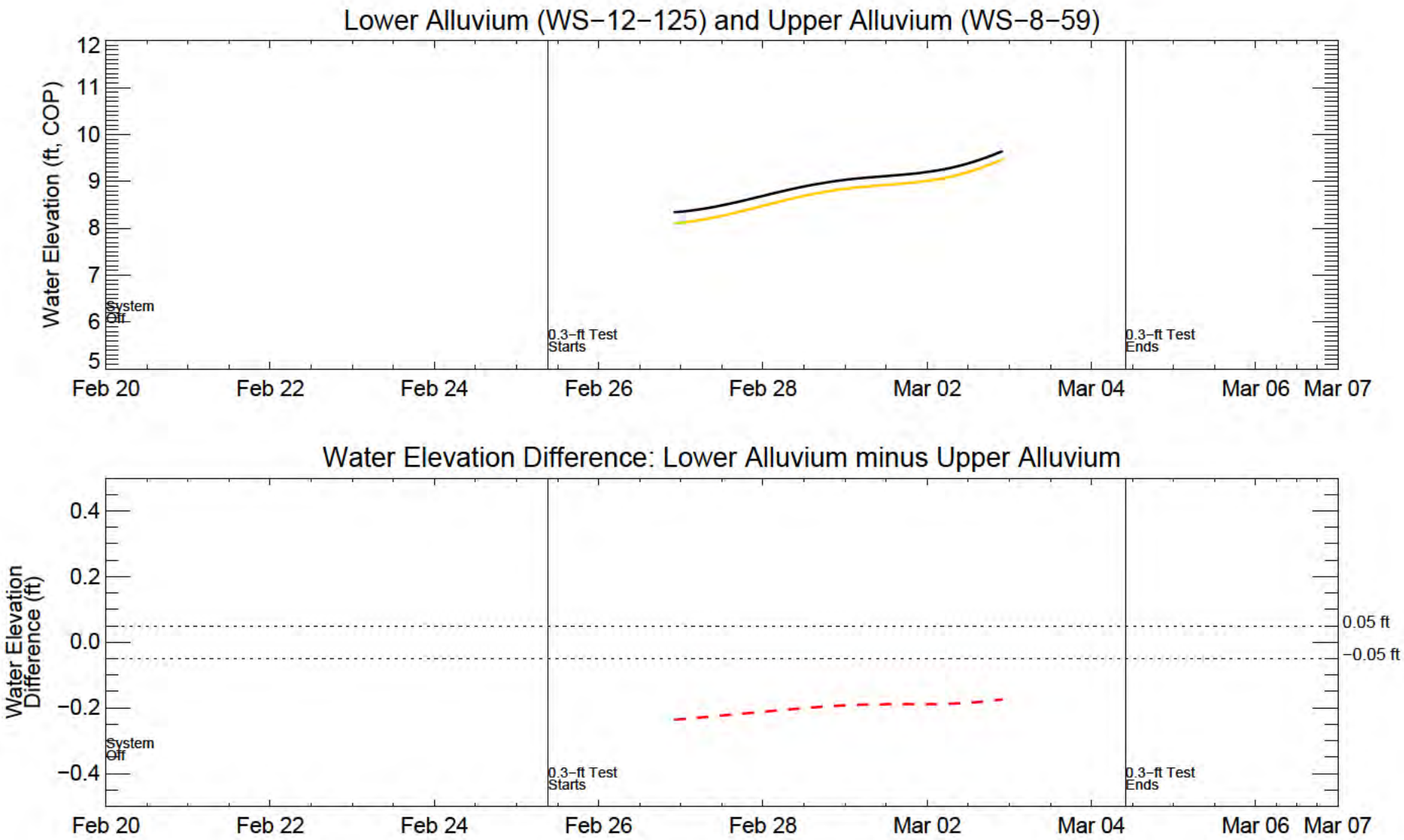
Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.12
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:24 2014



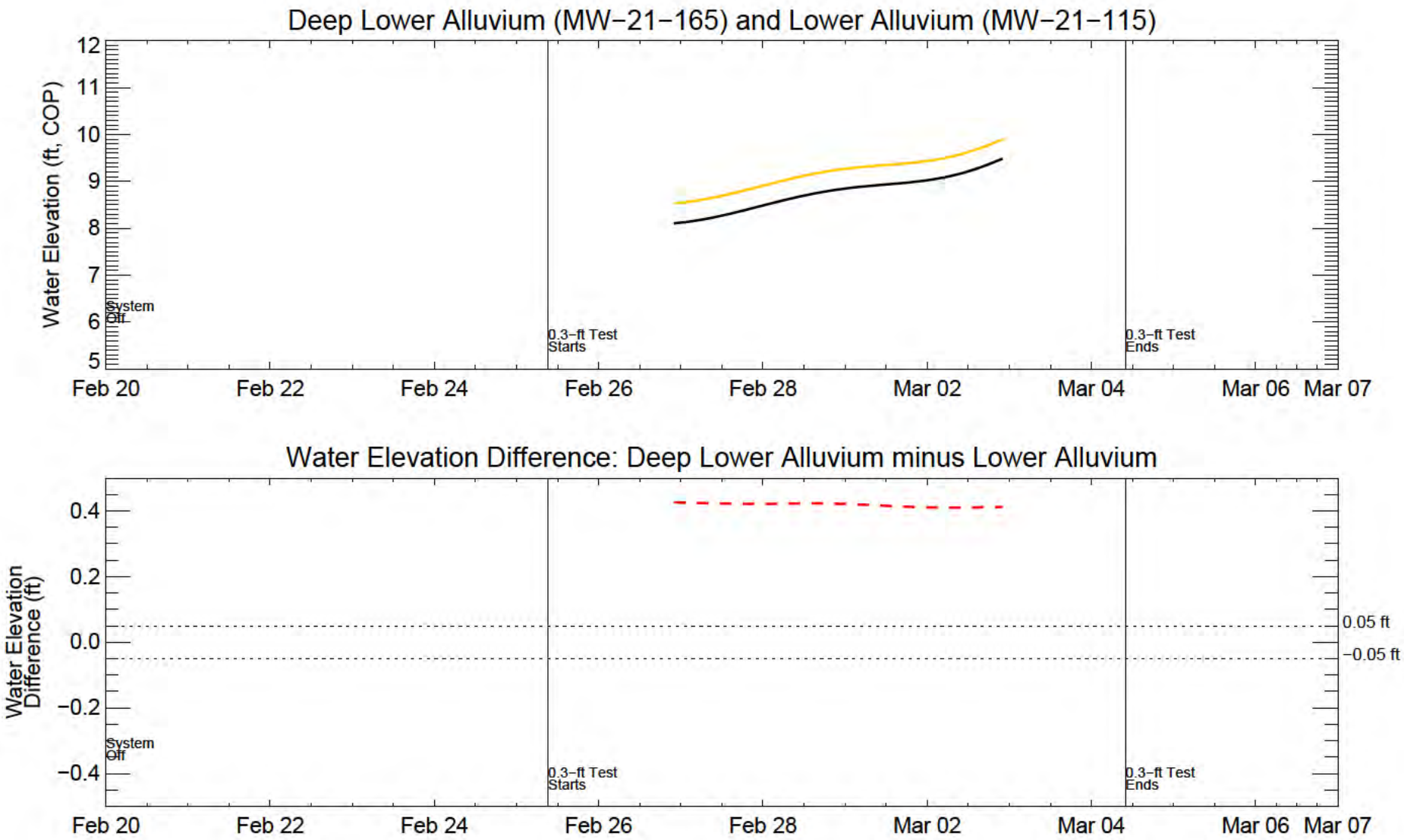
Lower Alluvium
Upper Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.13
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:25 2014



Deep Lower Alluvium
Lower Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.14
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

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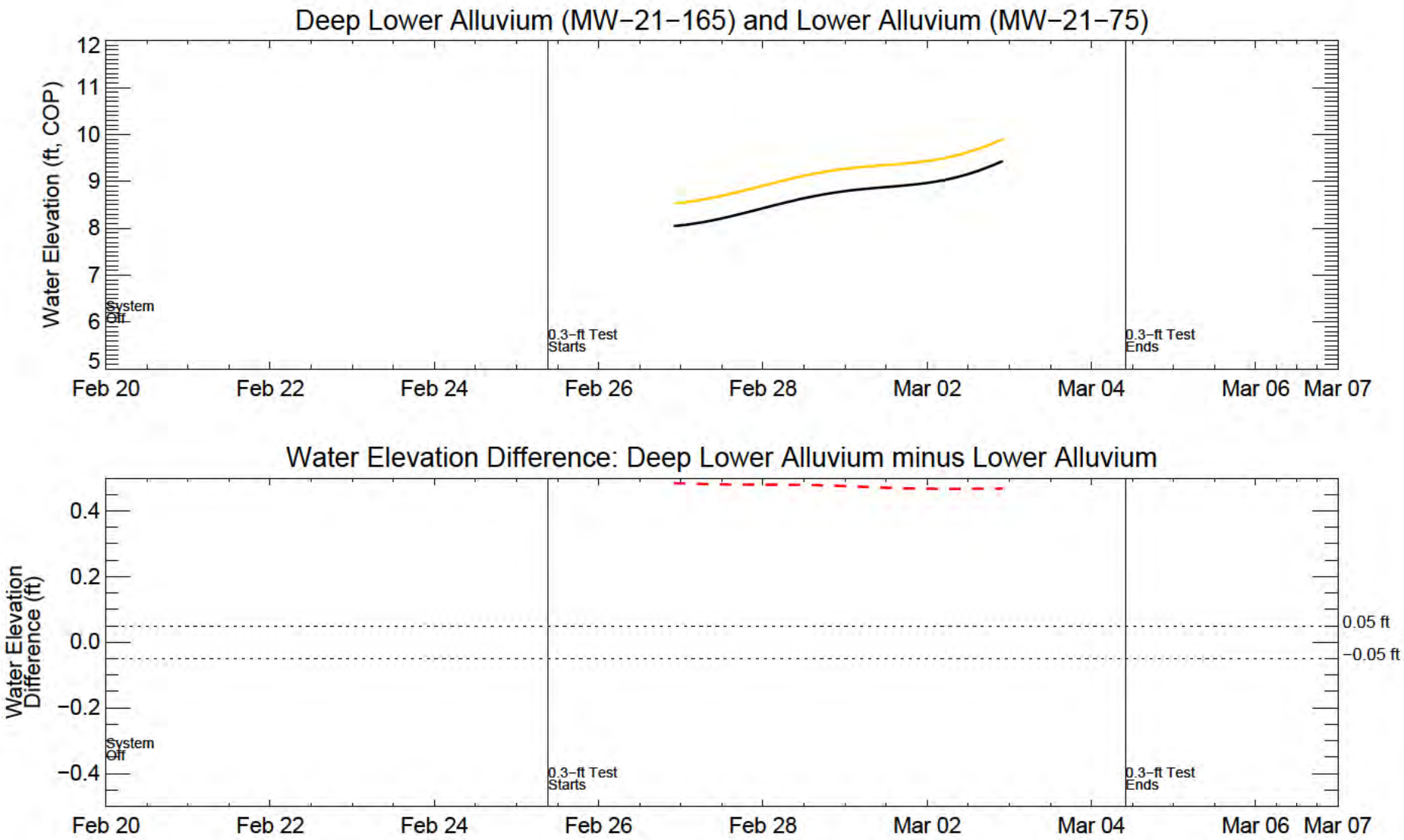


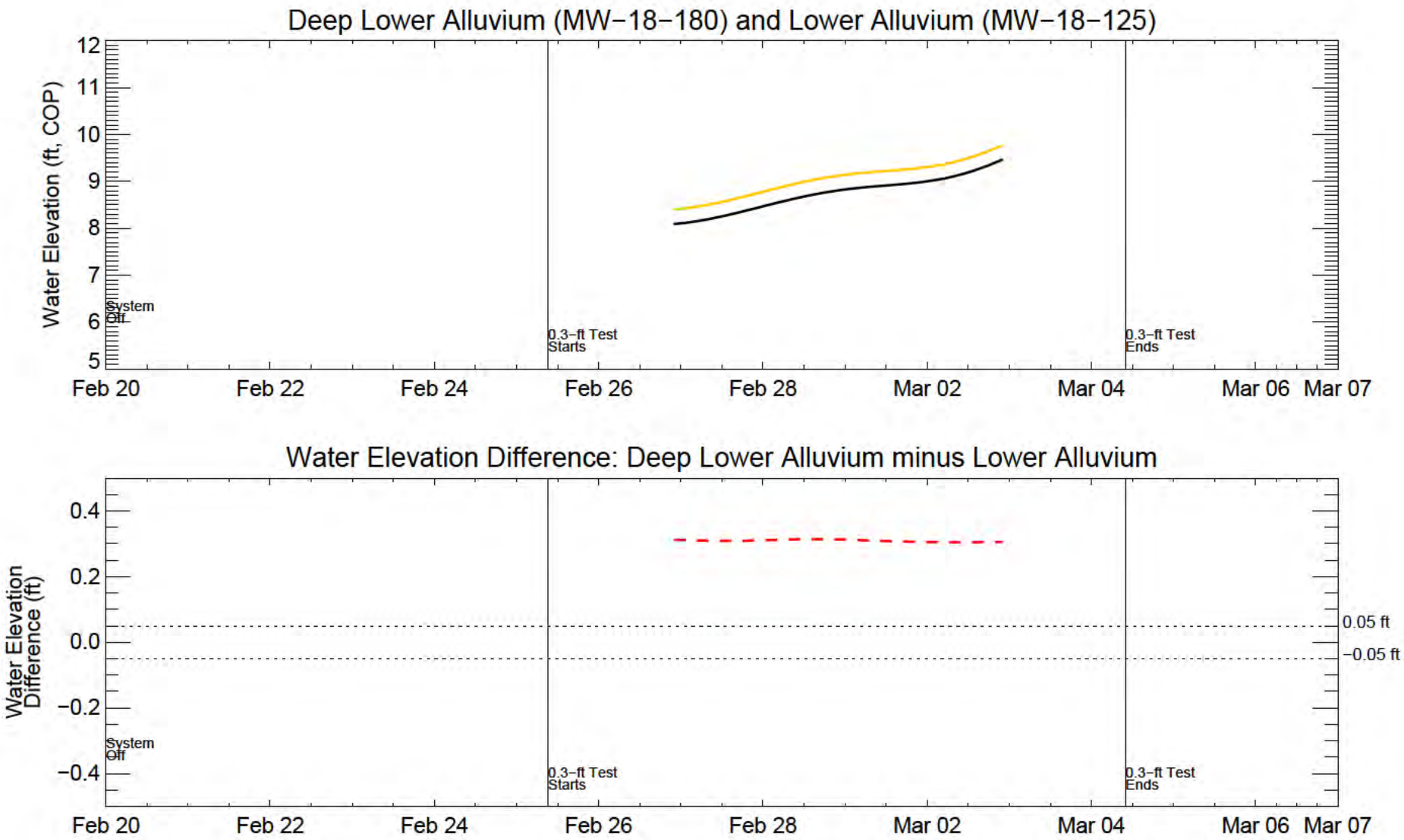
Deep Lower Alluvium
Lower Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.15
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:25 2014



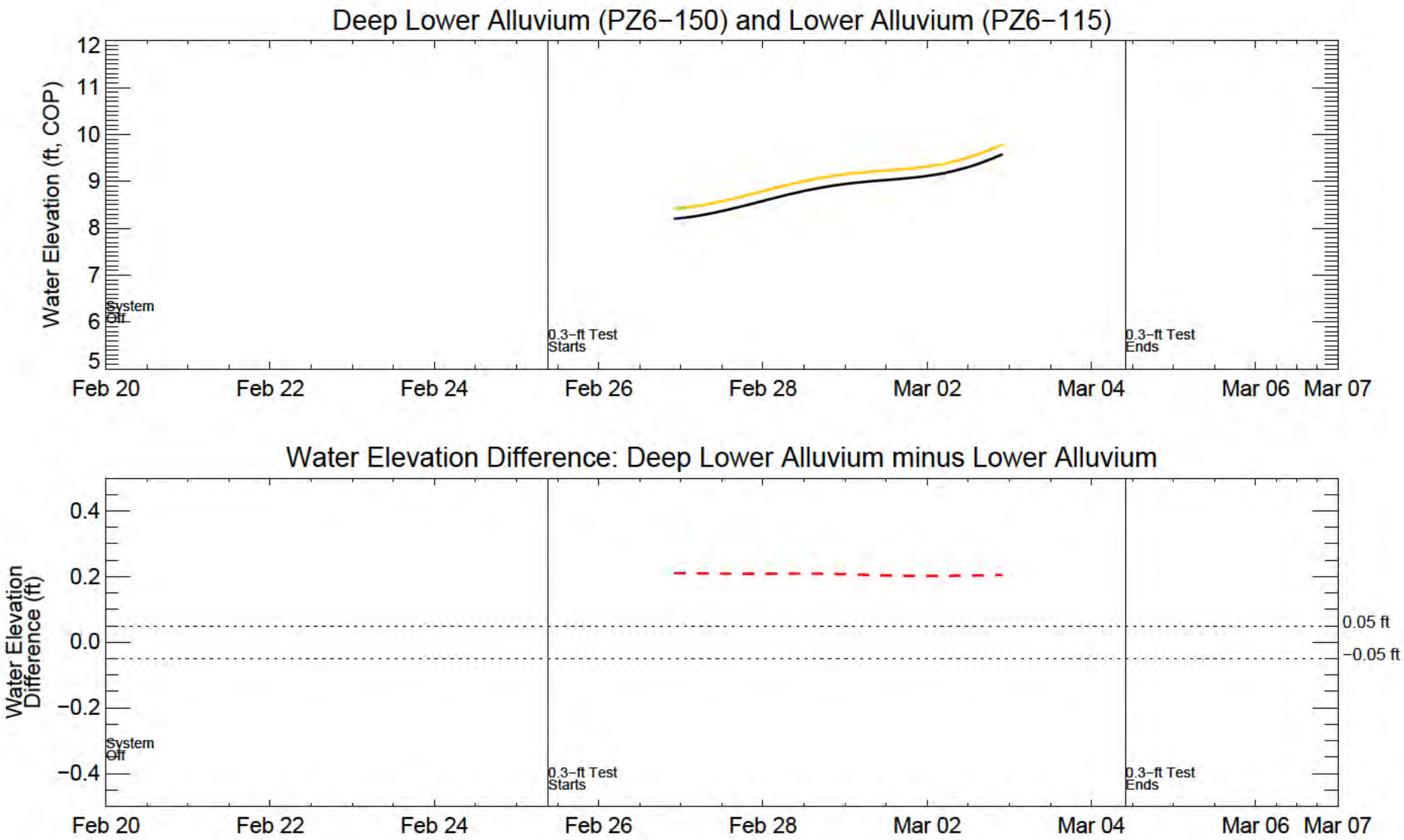
Deep Lower Alluvium
Lower Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.16
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:25 2014



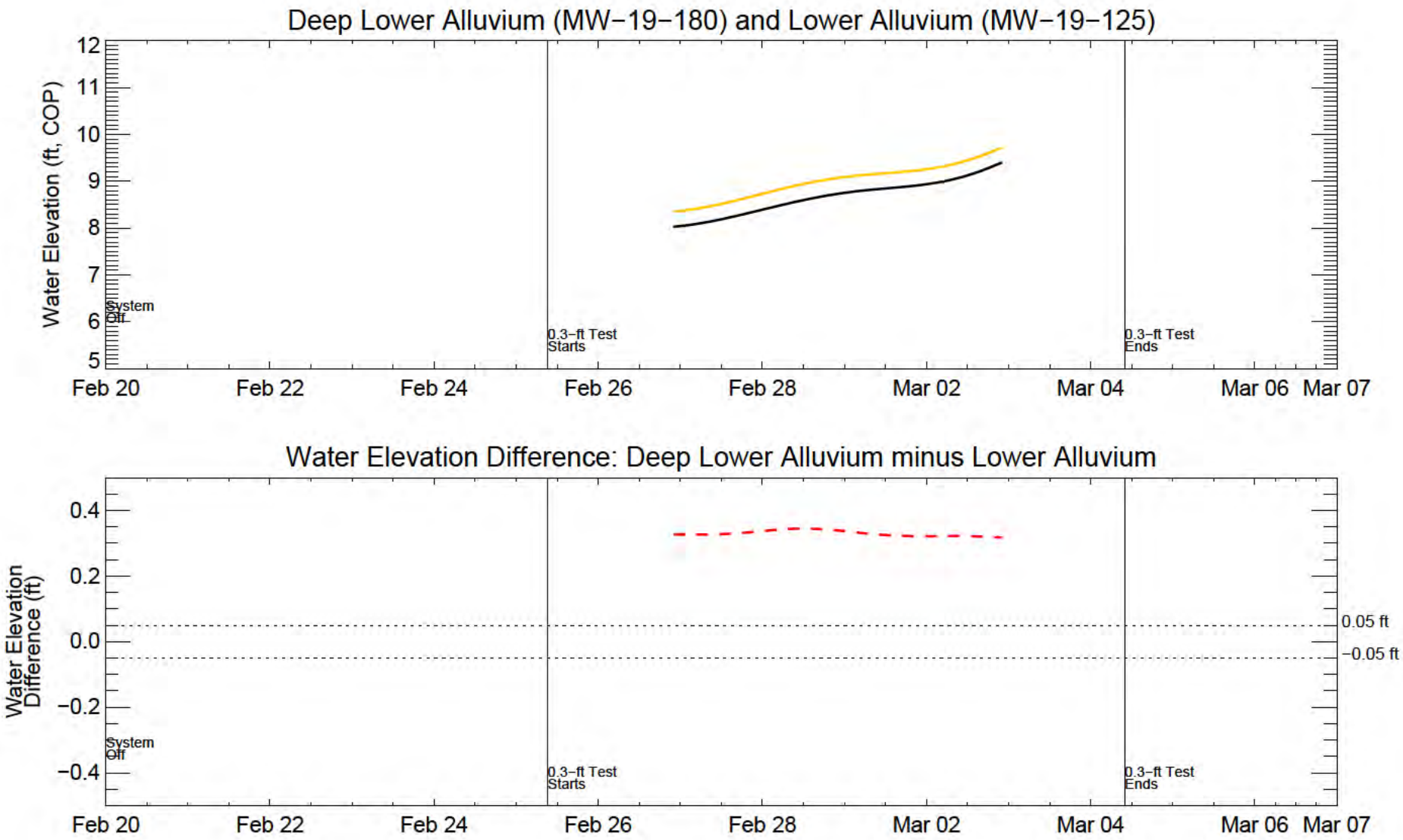
Deep Lower Alluvium
Lower Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.17
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:25 2014



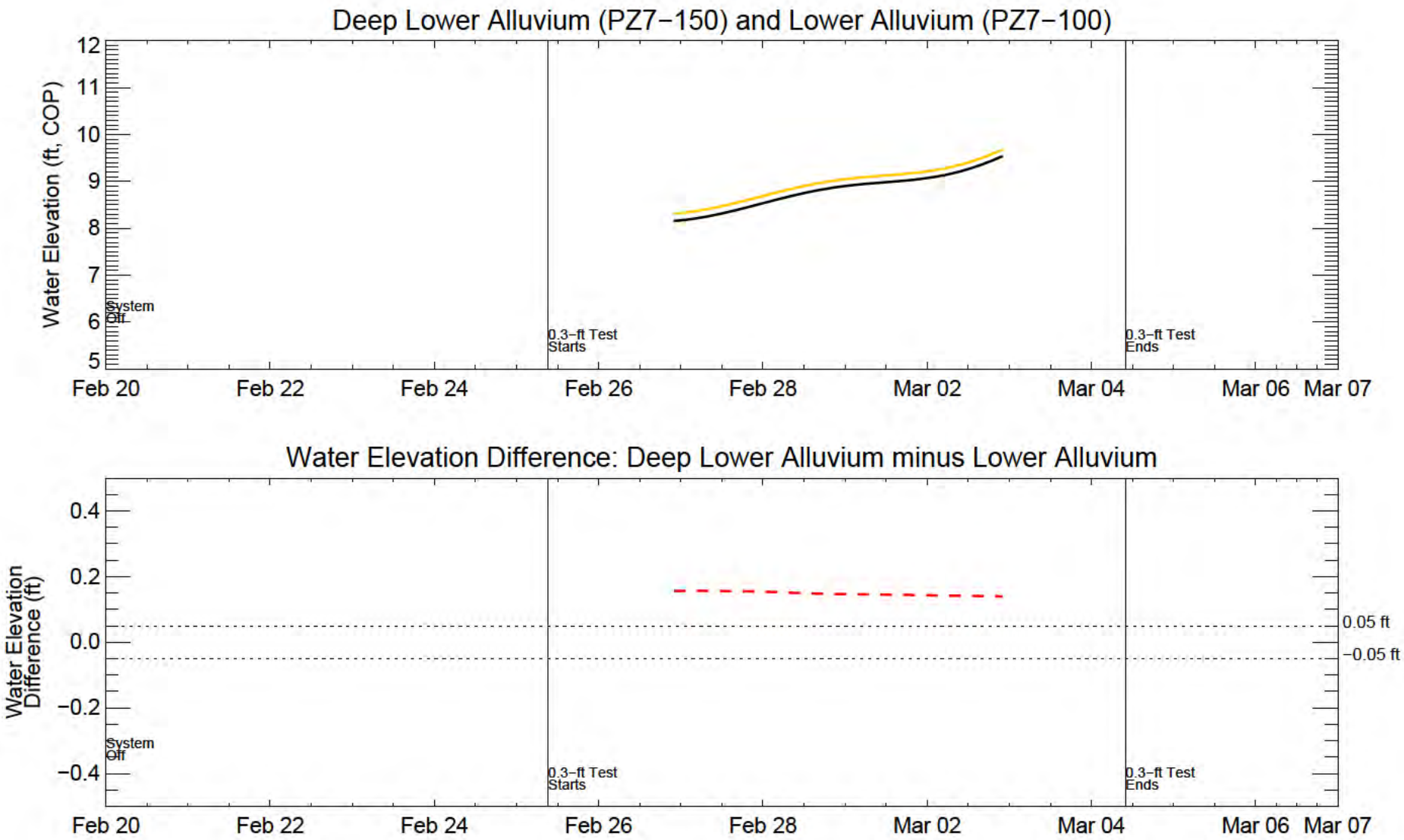
Deep Lower Alluvium
Lower Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.18
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:26 2014



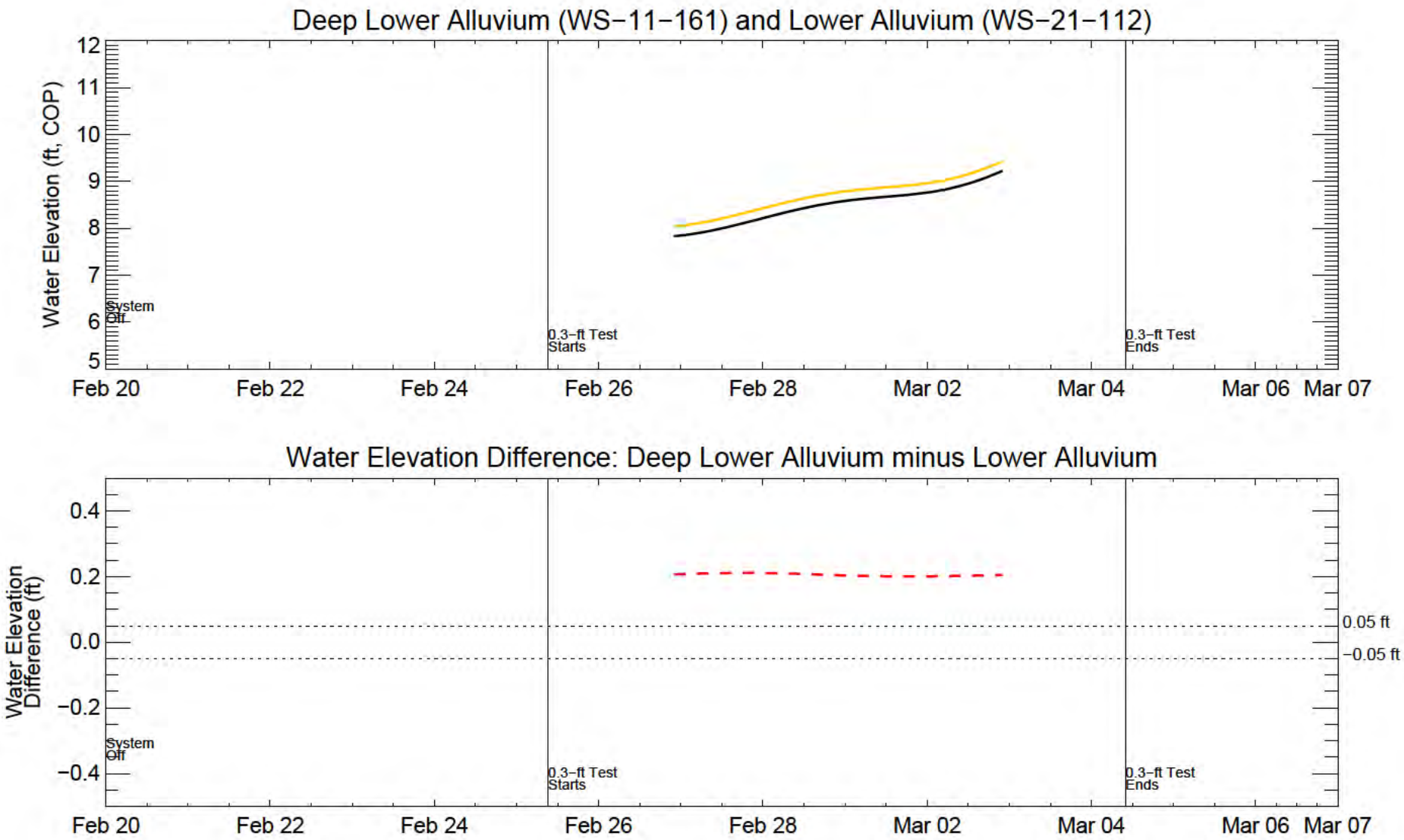
Deep Lower Alluvium
Lower Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.19
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:26 2014



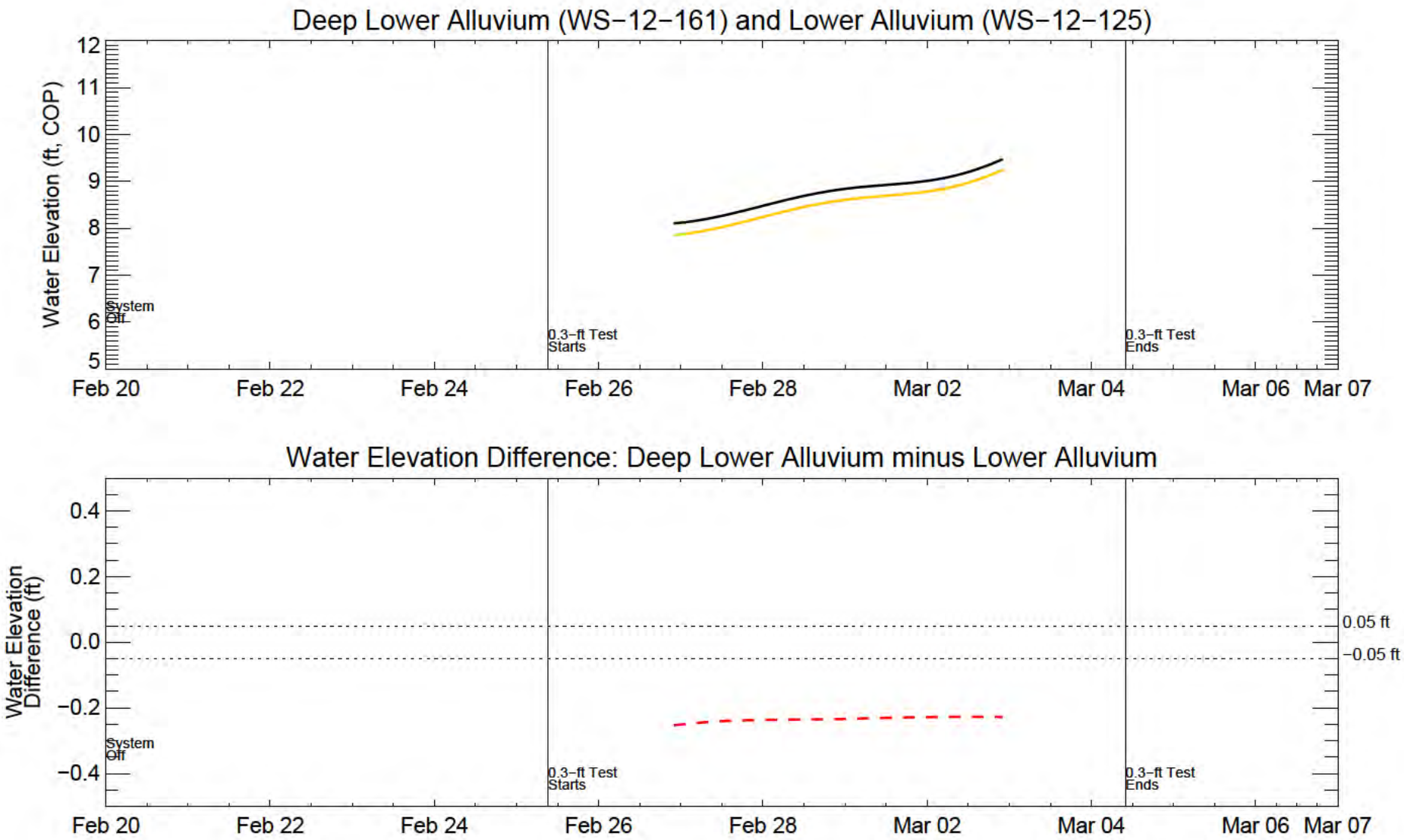
Deep Lower Alluvium
Lower Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.20
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

BG − C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Mon Apr 07 14:00:26 2014



Deep Lower Alluvium
Lower Alluvium
Water Elevation Difference
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 5.21
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3−day rolling averages (Serfes Method). COP = City of Portland Datum

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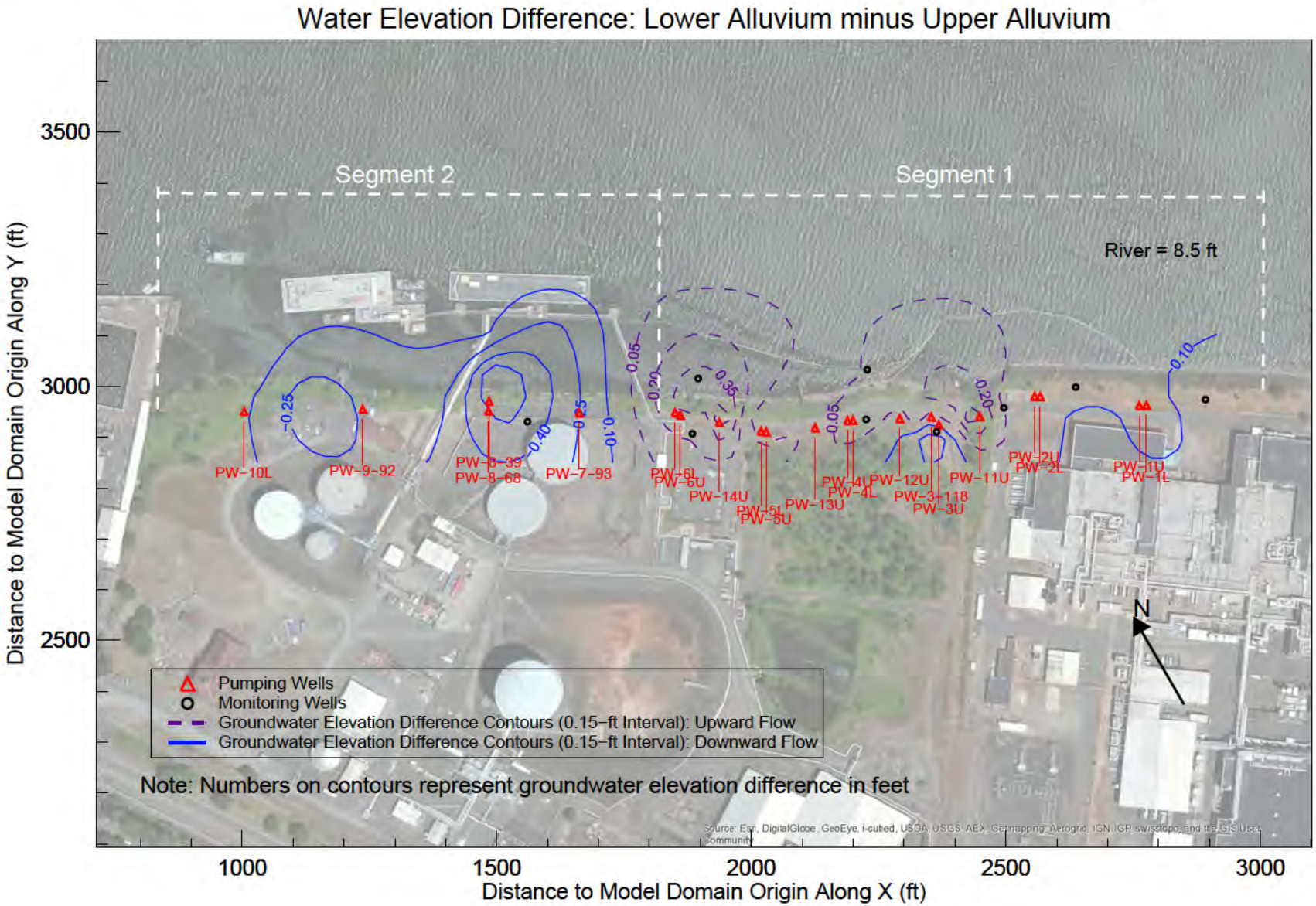

Figure 6.1

Contours of Water Elevation Difference Between Upper and Lower Alluvium Using Serfes 3−Day Rolling Averages From 2/26/2014 to 2/28/2014
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Contours generated through geostastical interpolation (Kriging) in Interactive Data Language. MW−16−45 excluded: screen saturated with LNAPL

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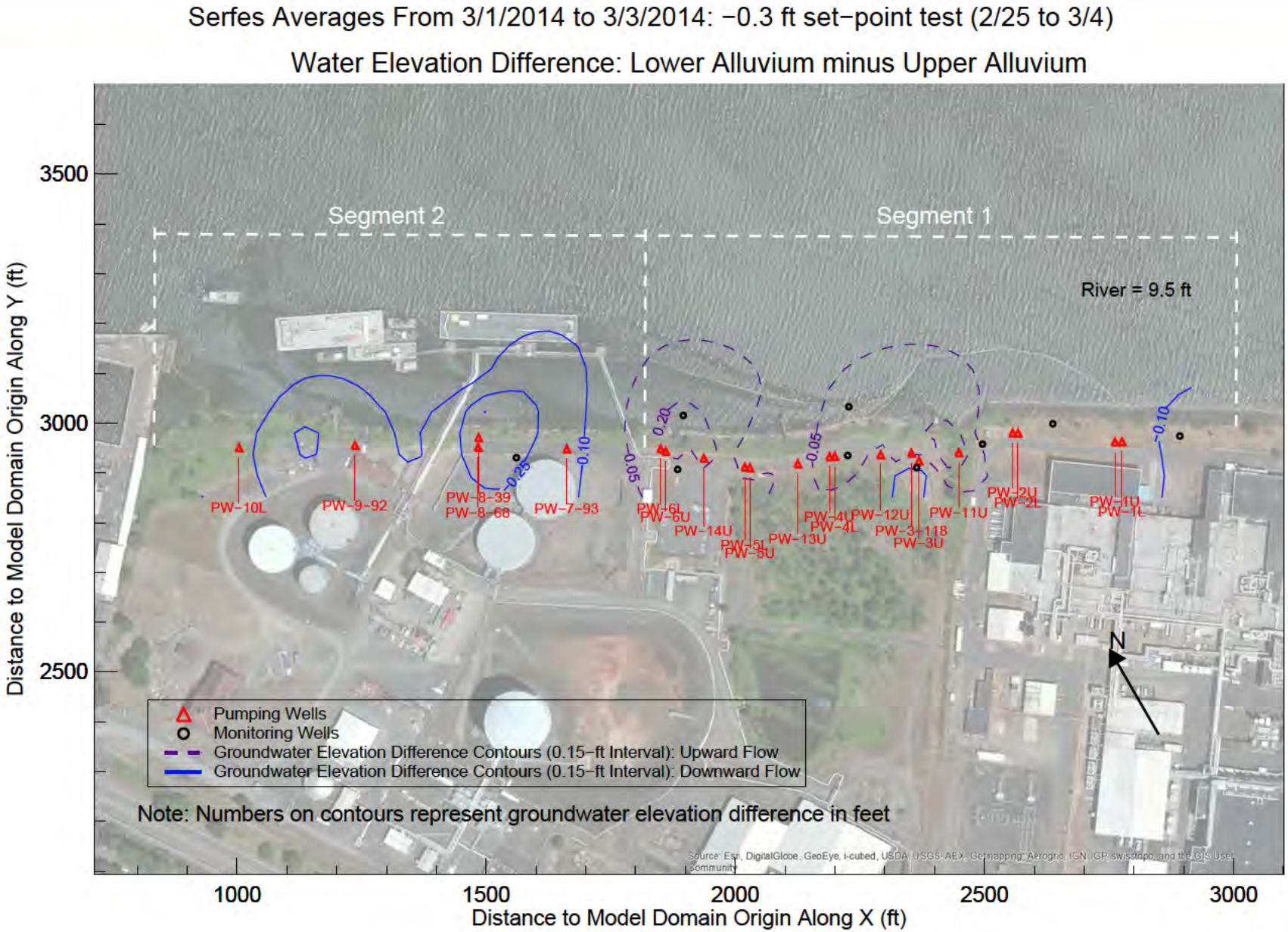

Figure 6.2

Contours of Water Elevation Difference Between Upper and Lower Alluvium Using Serfes 3−Day Rolling Averages From 3/1/2014 to 3/3/2014

Groundwater Source Control Extraction System Test Data Report

NW Natural Gasco Site

Contours generated through geostastical interpolation (Kriging) in Interactive Data Language. MW−16−45 excluded: screen saturated with LNAPL

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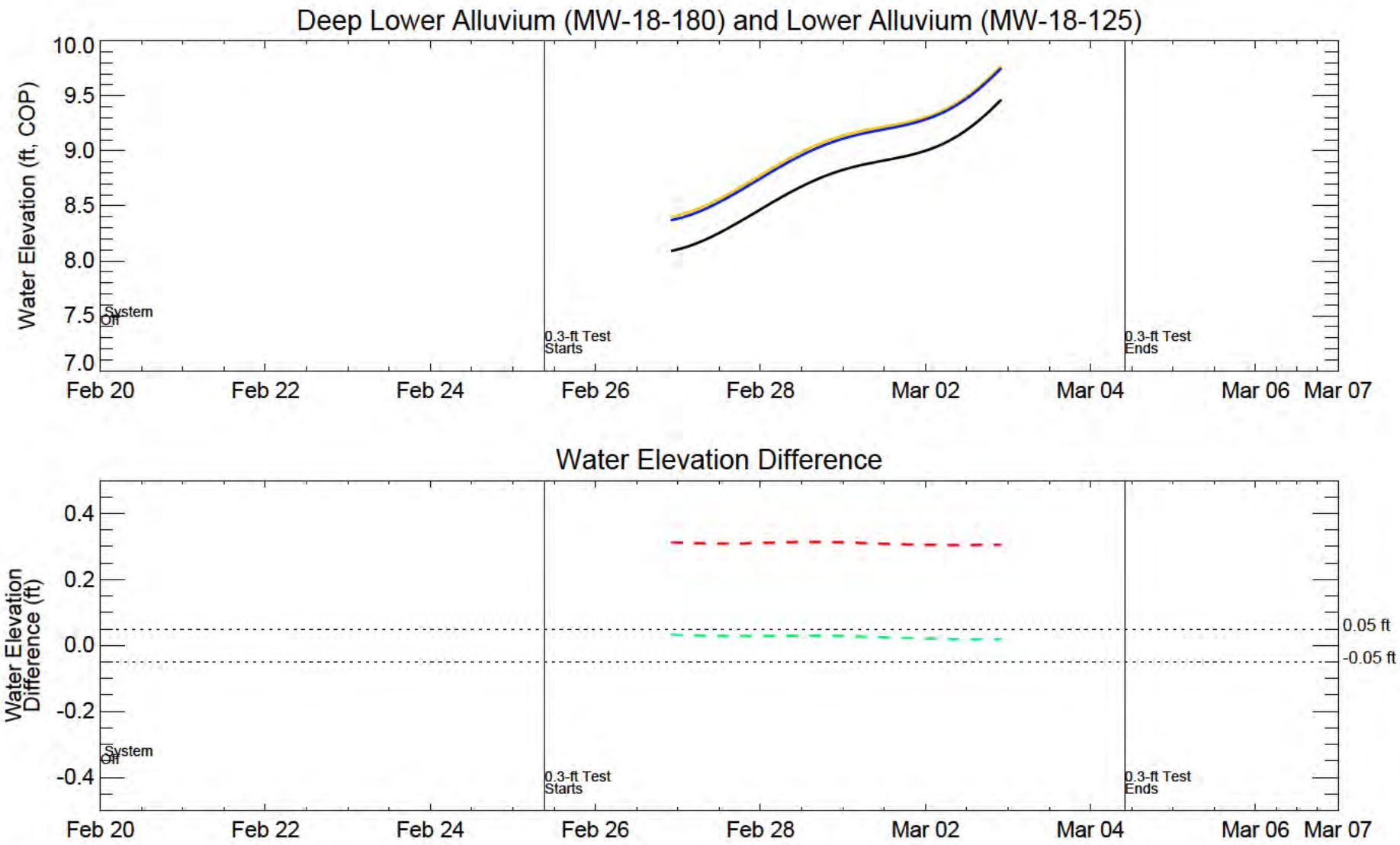


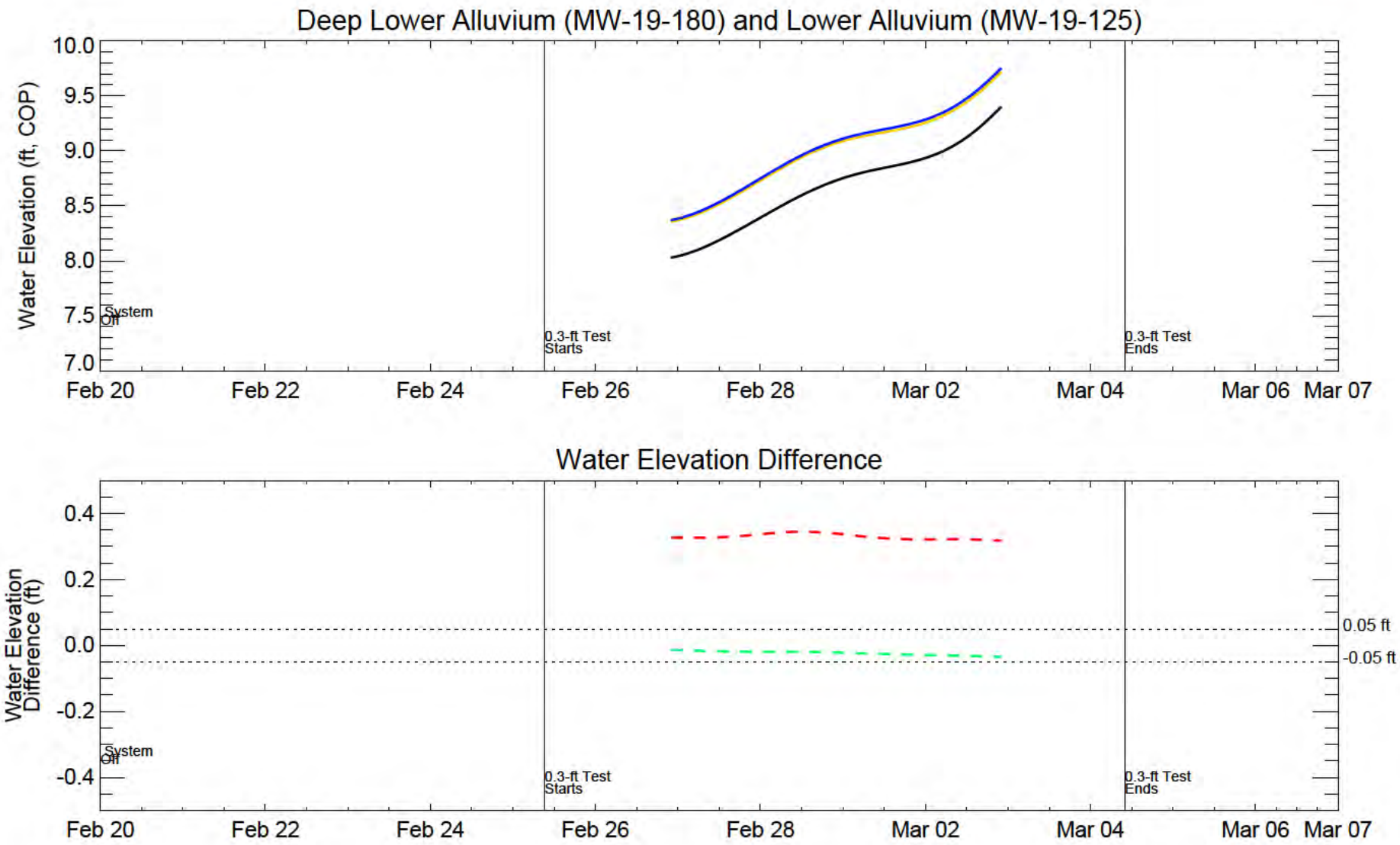
Deep Lower Alluvium
Lower Alluvium
River
Water Elevation Difference = Deep Lower Alluvium - Lower Alluvium
Water Elevation Difference = Deep Lower Alluvium - River
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 7.1
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

BG - C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Wed Apr 09 09:45:22 2014



Deep Lower Alluvium
Lower Alluvium
River
Water Elevation Difference = Deep Lower Alluvium - Lower Alluvium
Water Elevation Difference = Deep Lower Alluvium - River
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 7.2a
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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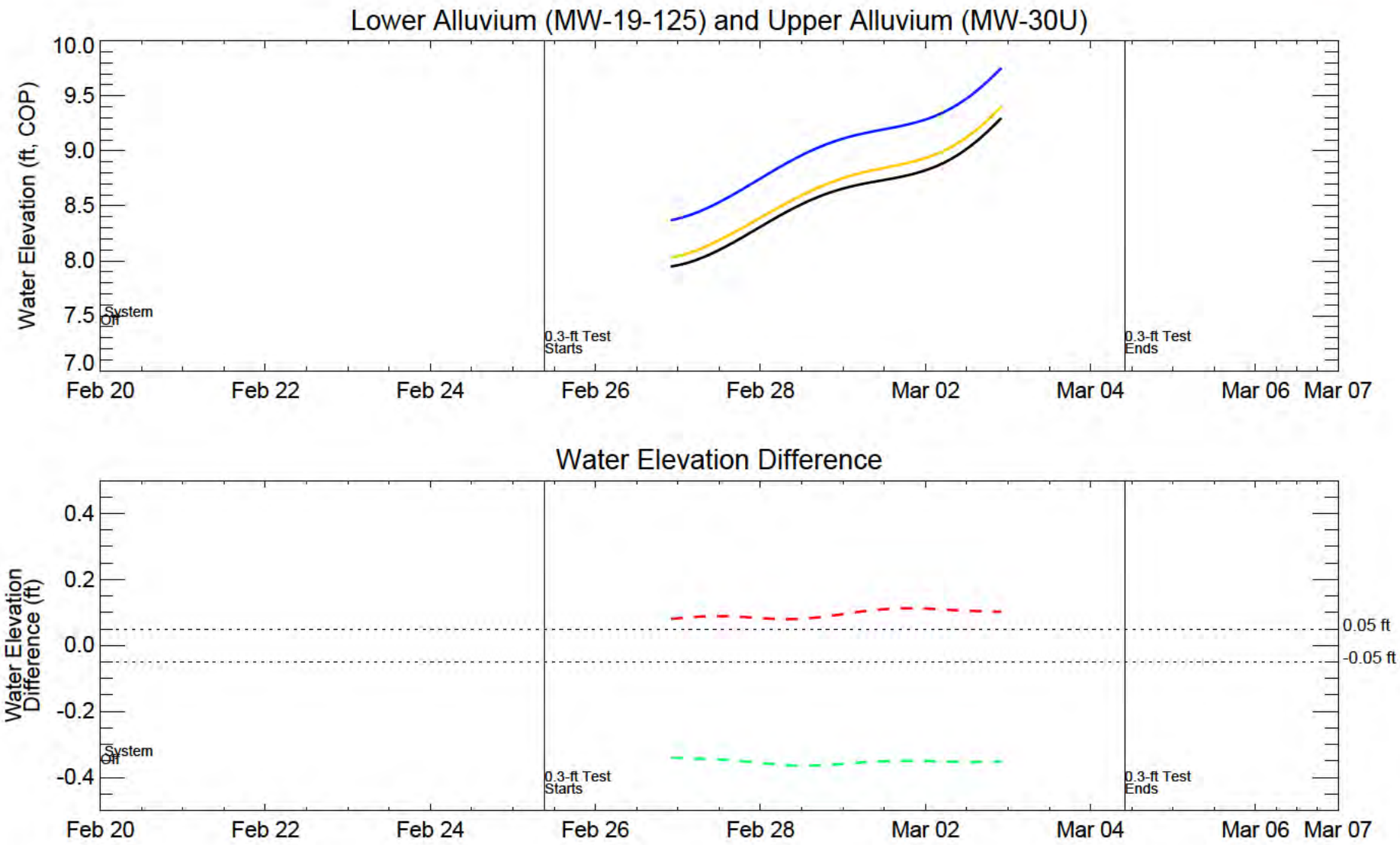

Lower Alluvium
Upper Alluvium
River
Water Elevation Difference = Lower Alluvium - Upper Alluvium
Water Elevation Difference = Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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Figure 7.2b

Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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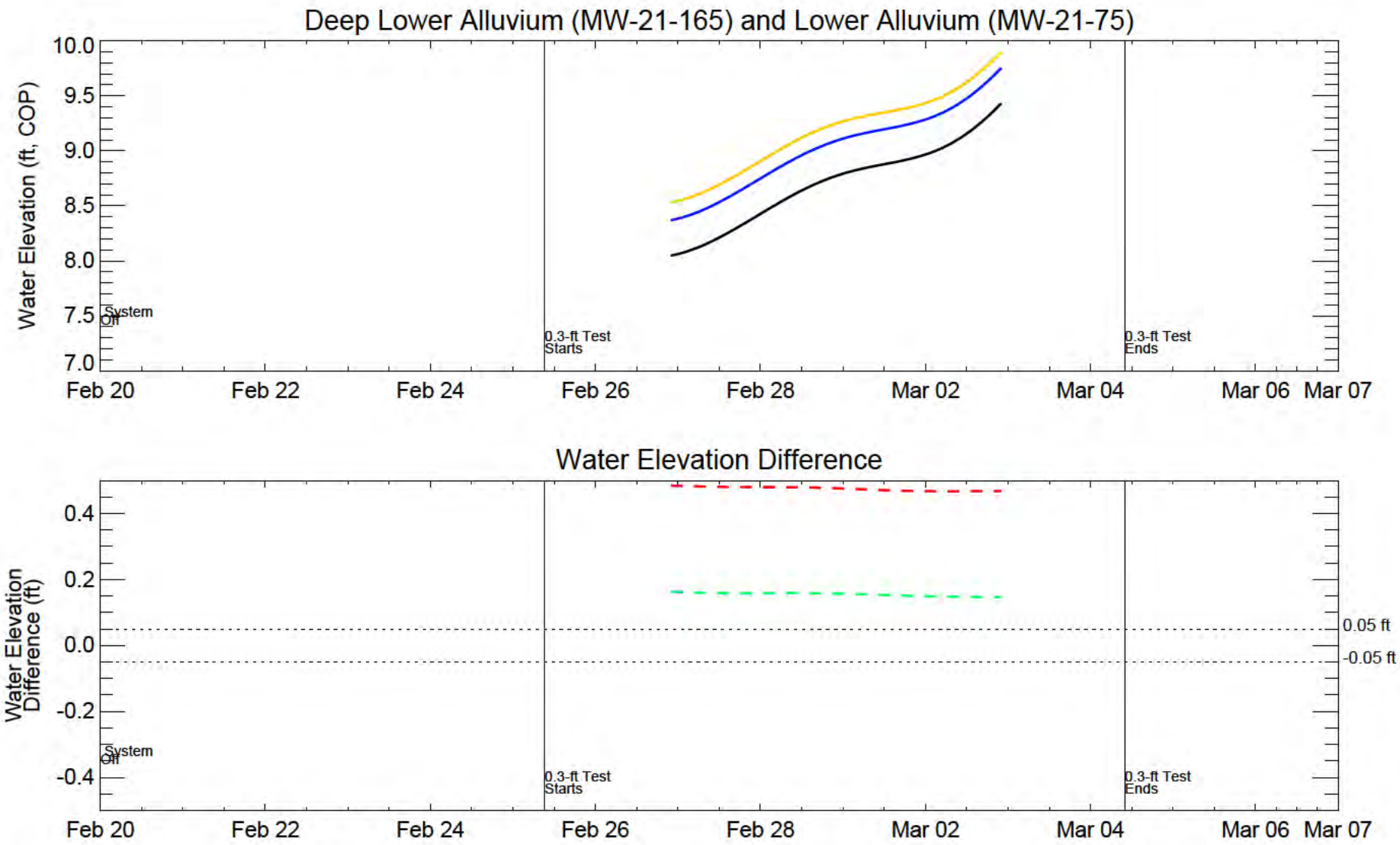

Deep Lower Alluvium
Lower Alluvium
River
Water Elevation Difference = Deep Lower Alluvium - Lower Alluvium
Water Elevation Difference = Deep Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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Figure 7.3
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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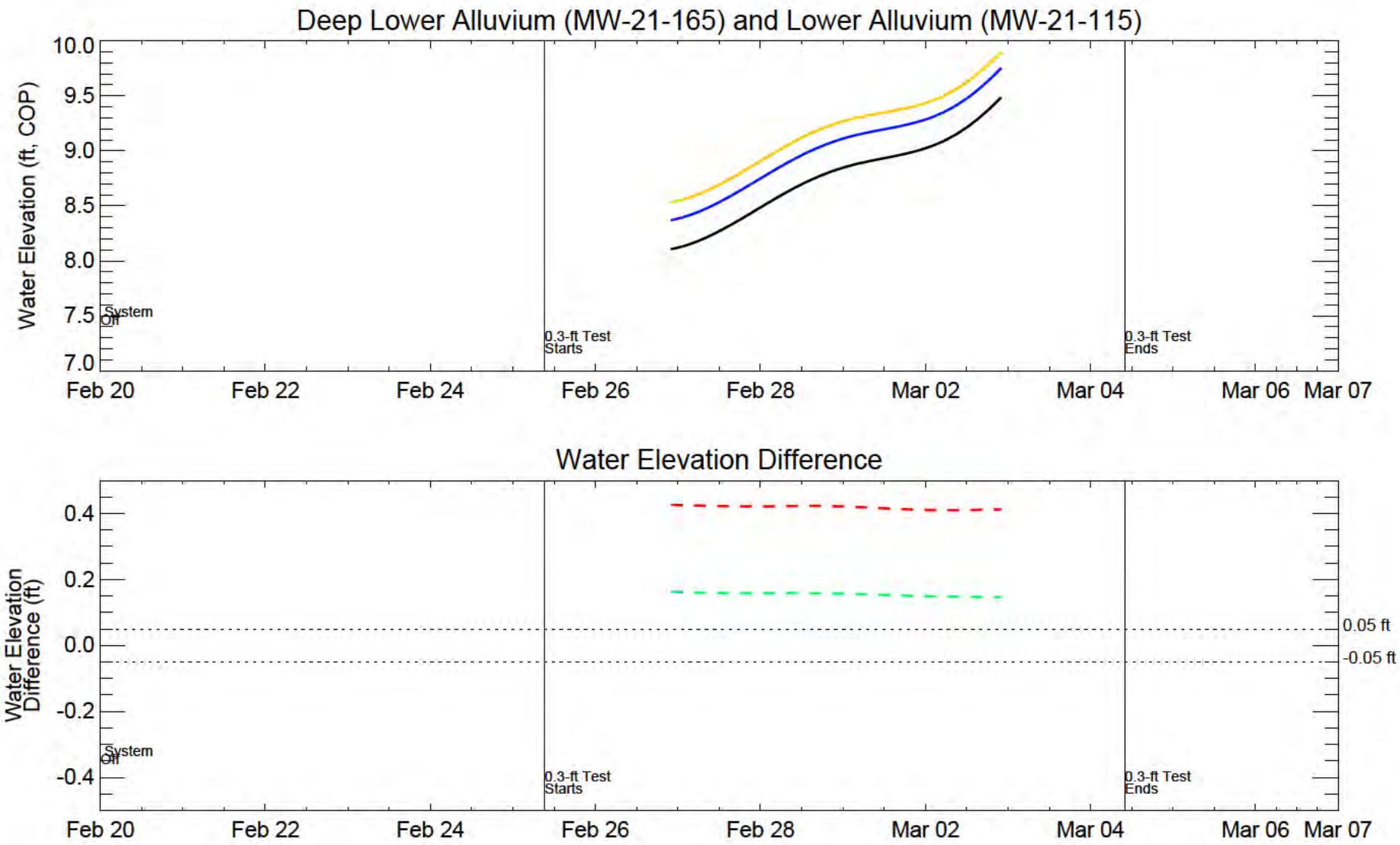

Deep Lower Alluvium
Lower Alluvium
River
Water Elevation Difference = Deep Lower Alluvium - Lower Alluvium
Water Elevation Difference = Deep Lower Alluvium - River
0.05 ft Total Potential Uncertainty

ANCHOR QEA

Figure 7.4
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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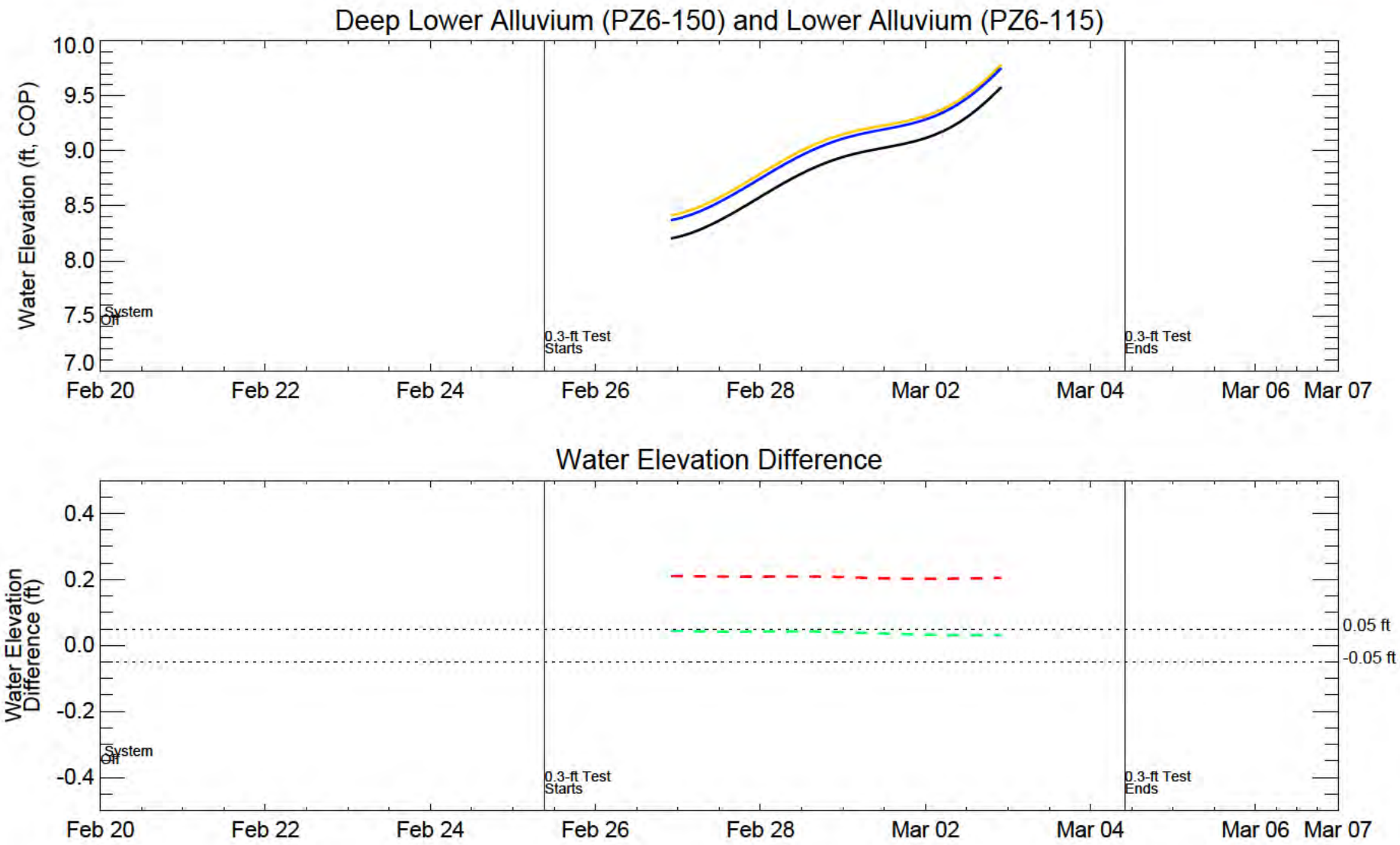

Deep Lower Alluvium
Lower Alluvium
River
Water Elevation Difference = Deep Lower Alluvium - Lower Alluvium
Water Elevation Difference = Deep Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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Figure 7.5a
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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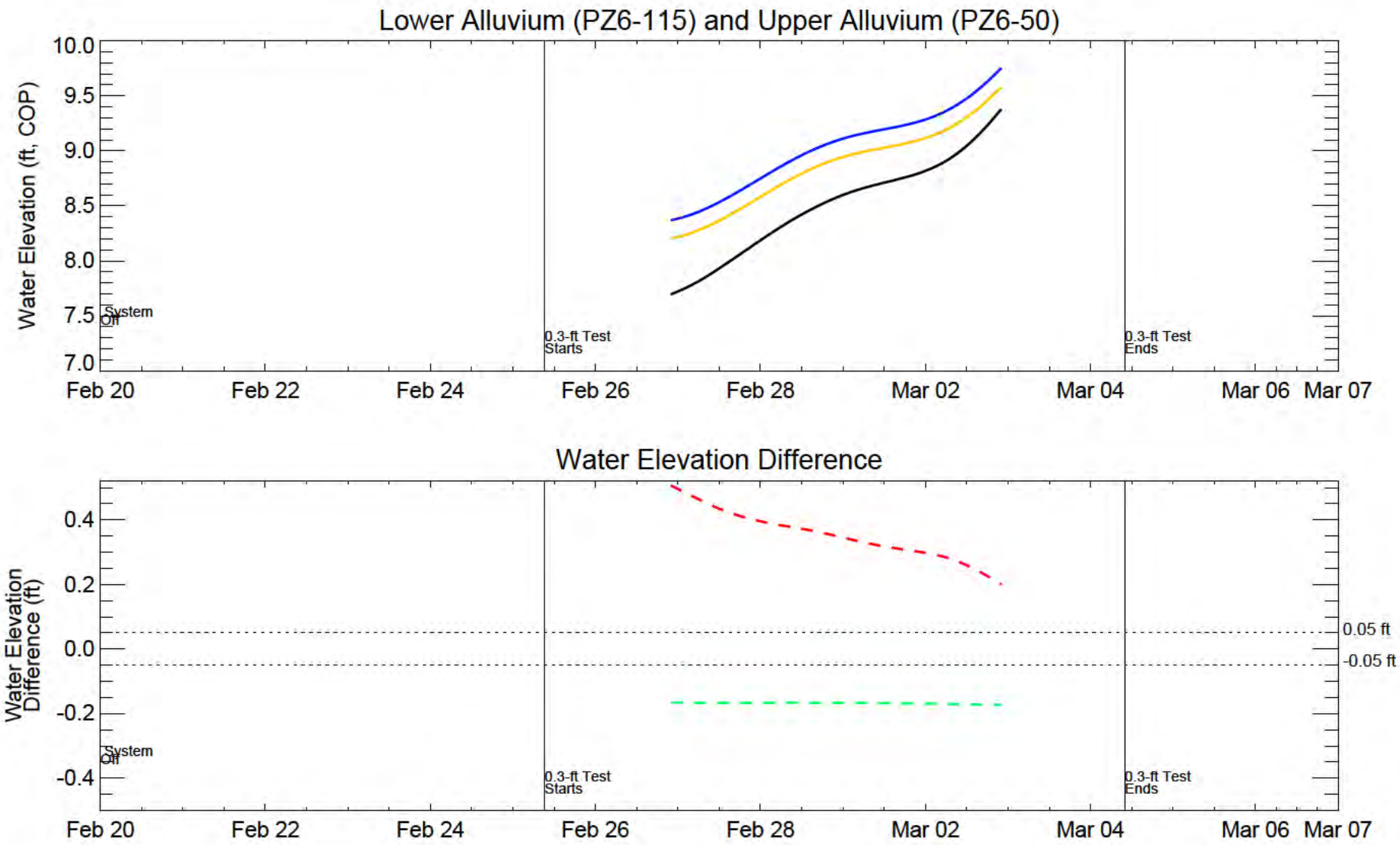

Lower Alluvium
Upper Alluvium
River
Water Elevation Difference = Lower Alluvium - Upper Alluvium
Water Elevation Difference = Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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Figure 7.5b
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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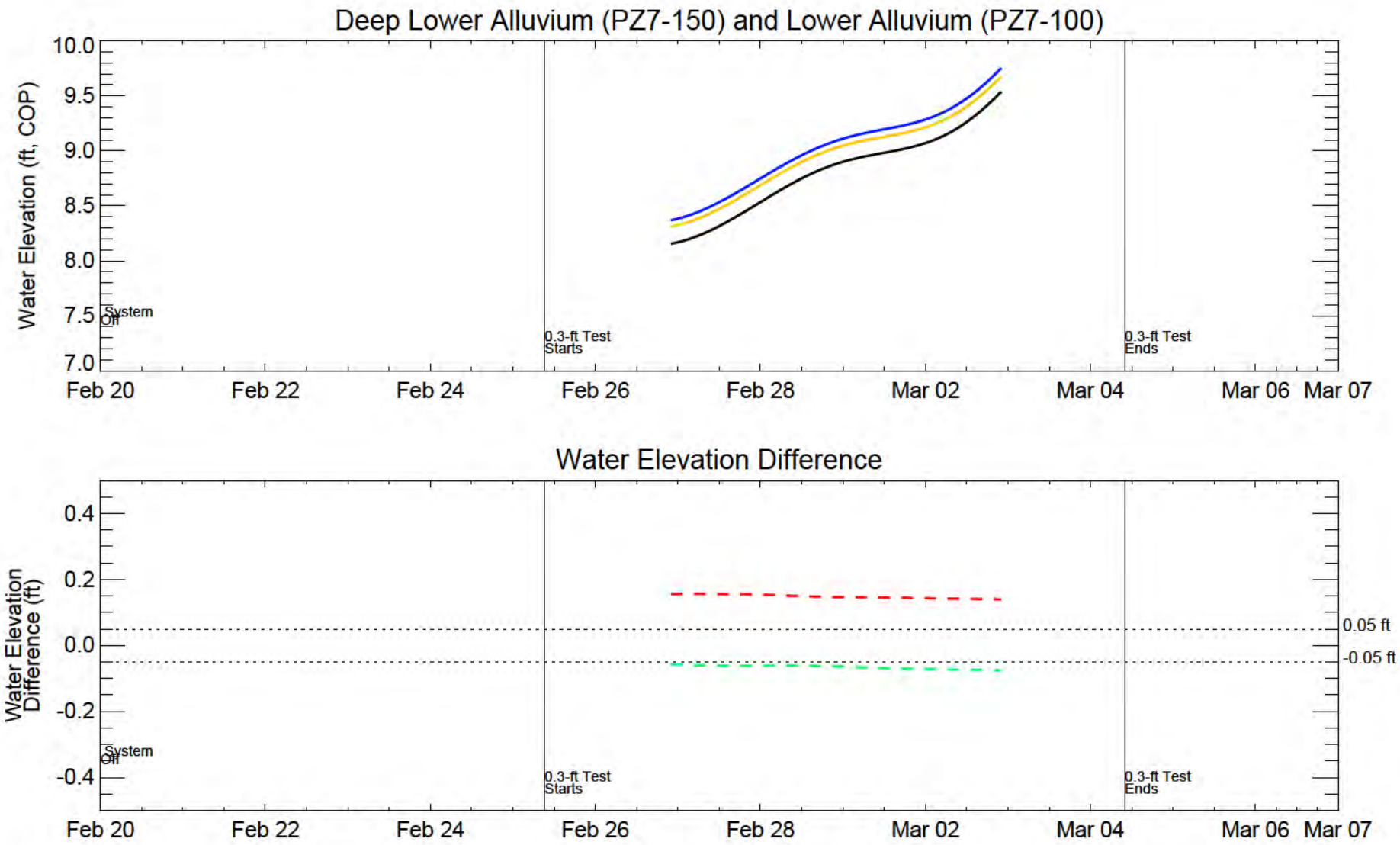

Deep Lower Alluvium
Lower Alluvium
River
Water Elevation Difference = Deep Lower Alluvium - Lower Alluvium
Water Elevation Difference = Deep Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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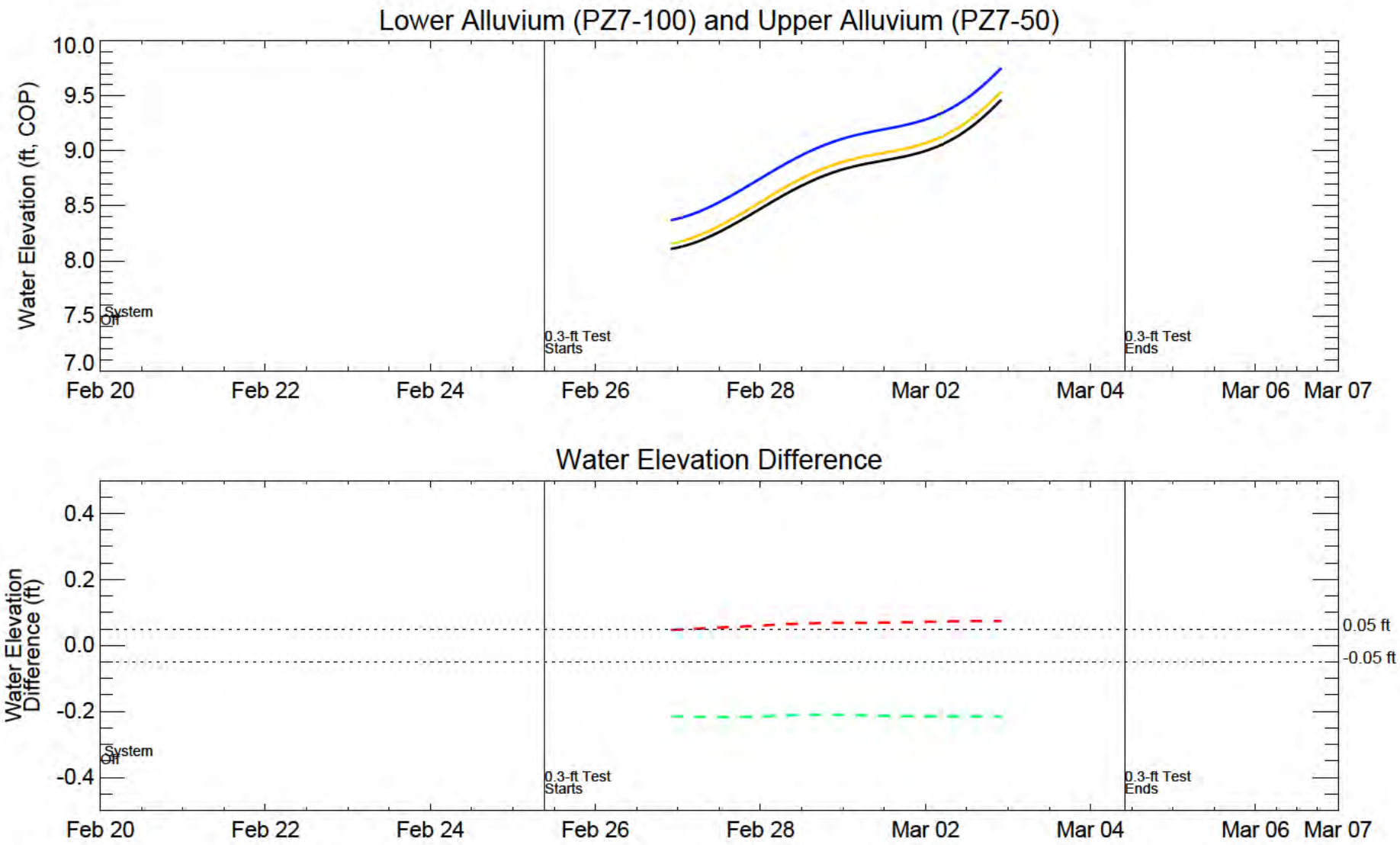
Figure 7.6a
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

BG - C:\D_Drive\WORK\Gasco\Source_Control_Evaluation\IDL\Gasco_SC_data_plot__hydrograph_gradient__v2.pro Wed Apr 09 09:45:24 2014



Lower Alluvium
Upper Alluvium
River
Water Elevation Difference = Lower Alluvium - Upper Alluvium
Water Elevation Difference = Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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Figure 7.6b
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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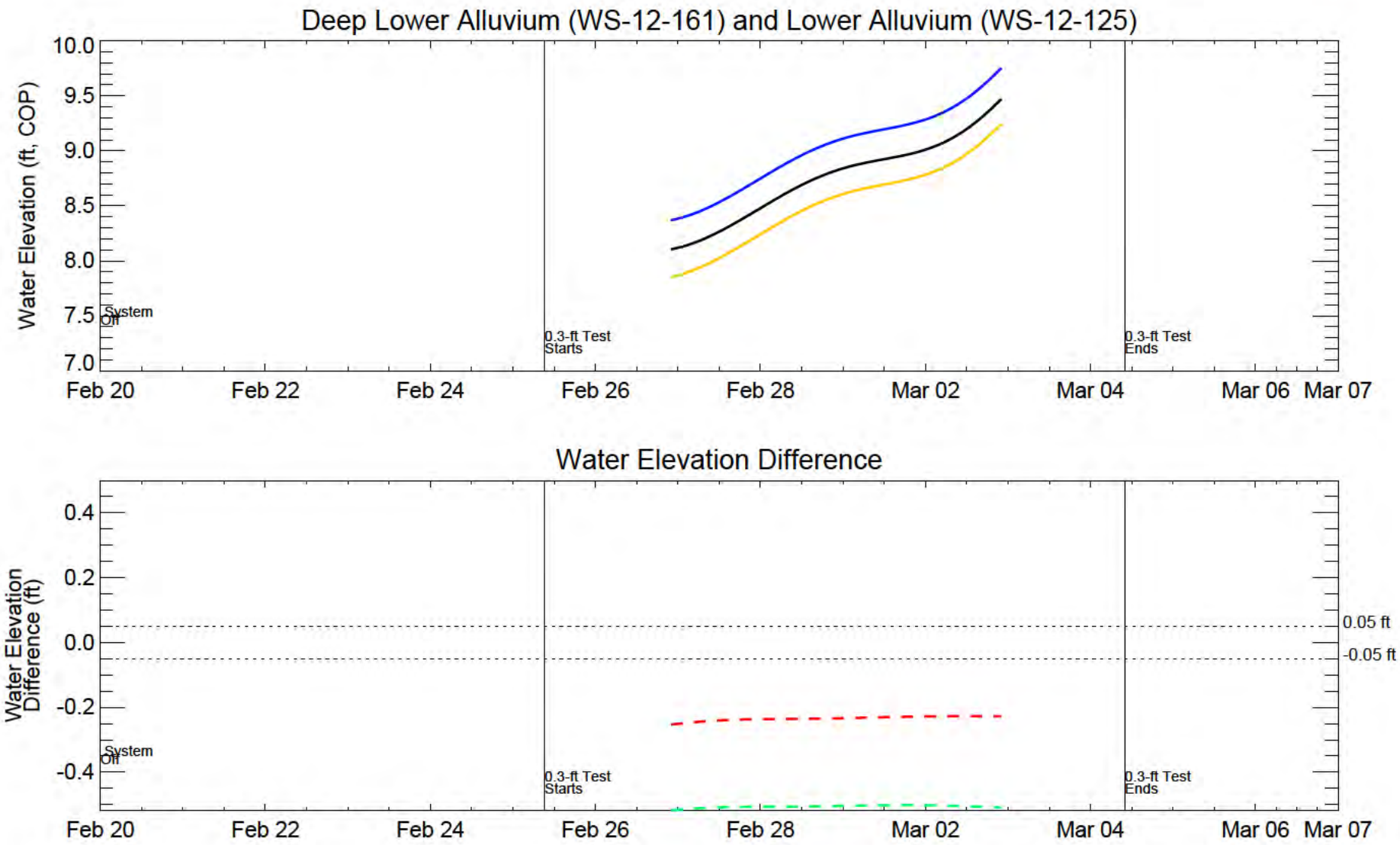

Deep Lower Alluvium
Lower Alluvium
River
Water Elevation Difference = Deep Lower Alluvium - Lower Alluvium
Water Elevation Difference = Deep Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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Figure 7.7a
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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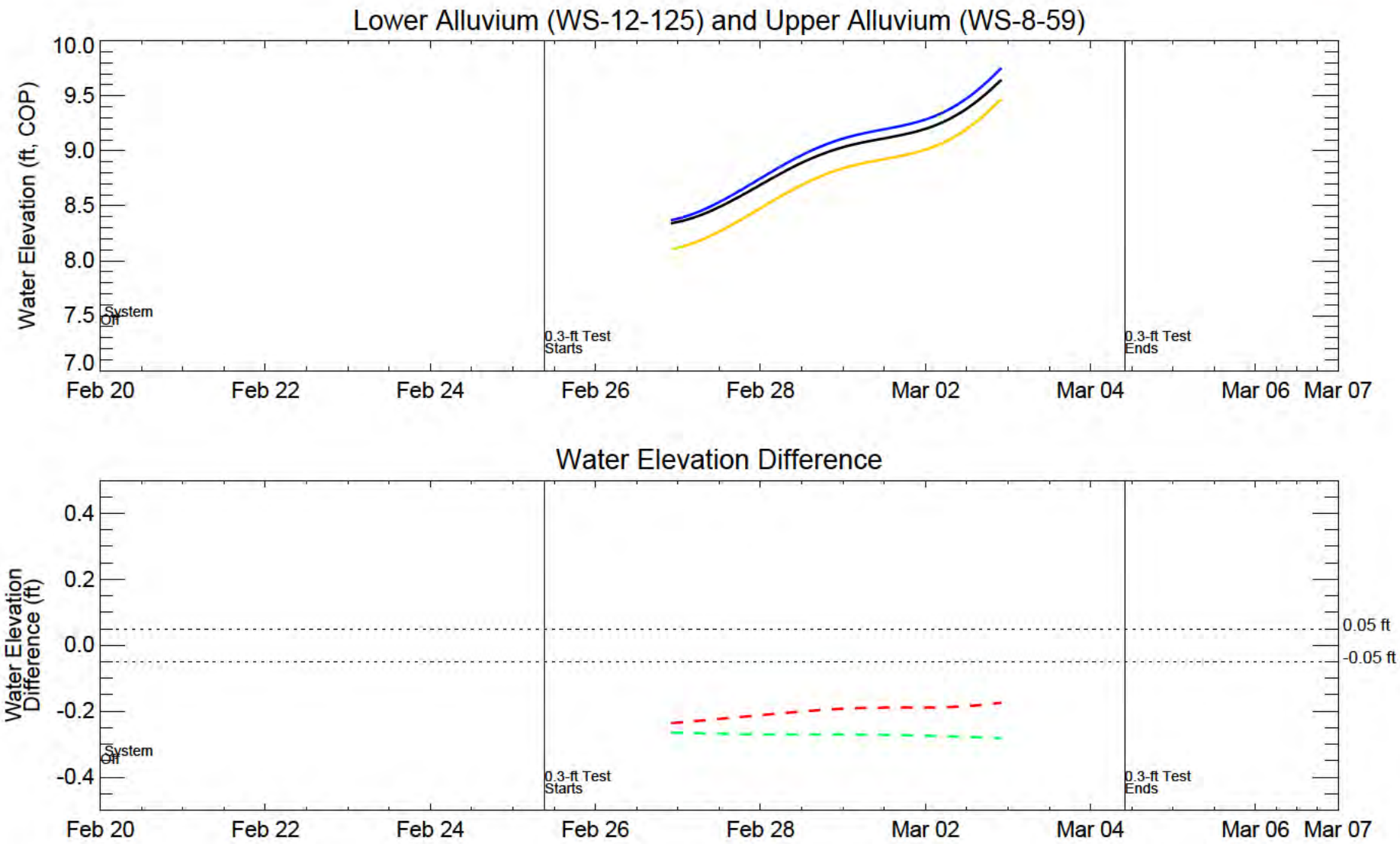

Lower Alluvium
Upper Alluvium
River
Water Elevation Difference = Lower Alluvium - Upper Alluvium
Water Elevation Difference = Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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Figure 7.7b
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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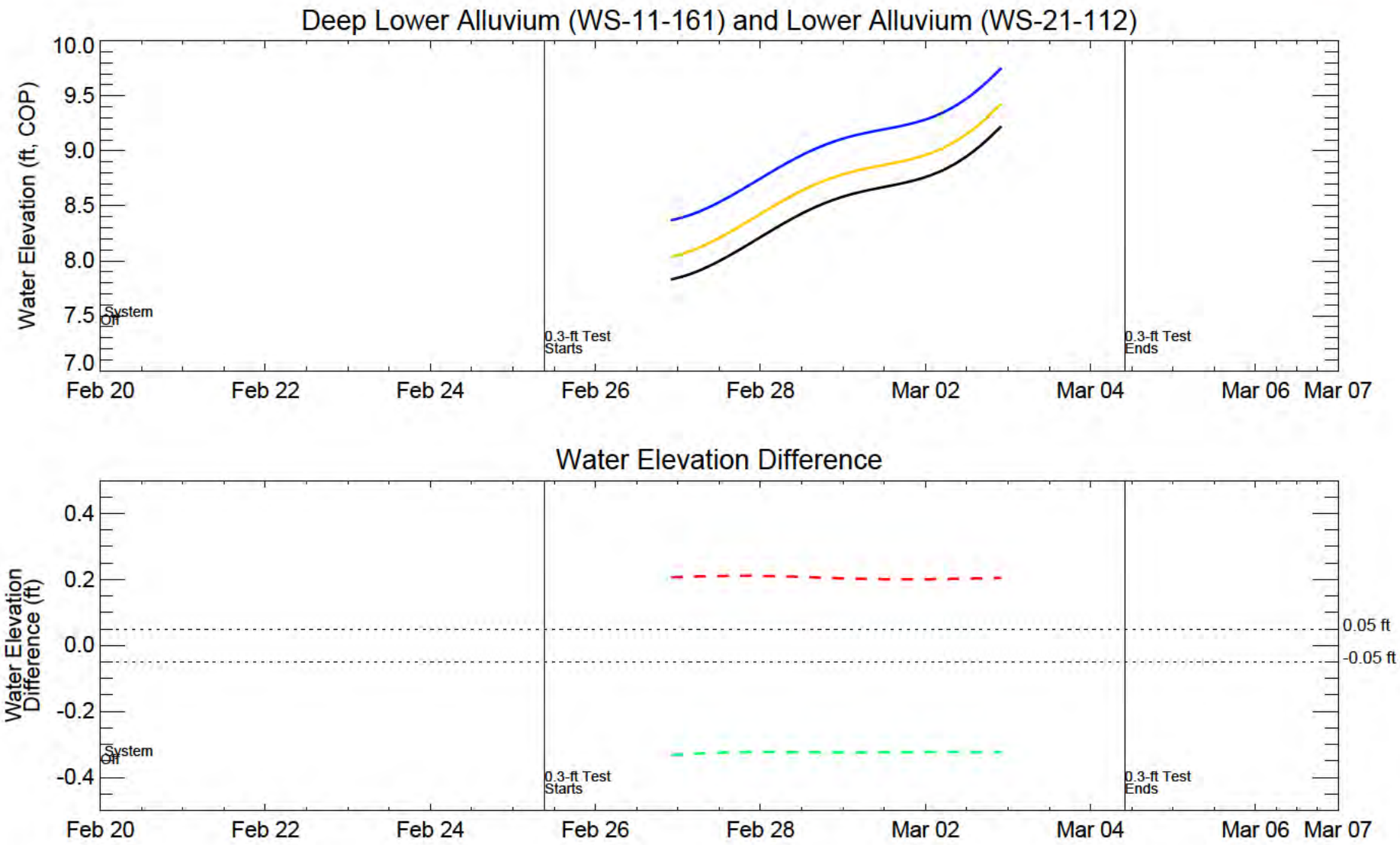

Deep Lower Alluvium
Lower Alluvium
River
Water Elevation Difference = Deep Lower Alluvium - Lower Alluvium
Water Elevation Difference = Deep Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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Figure 7.8a
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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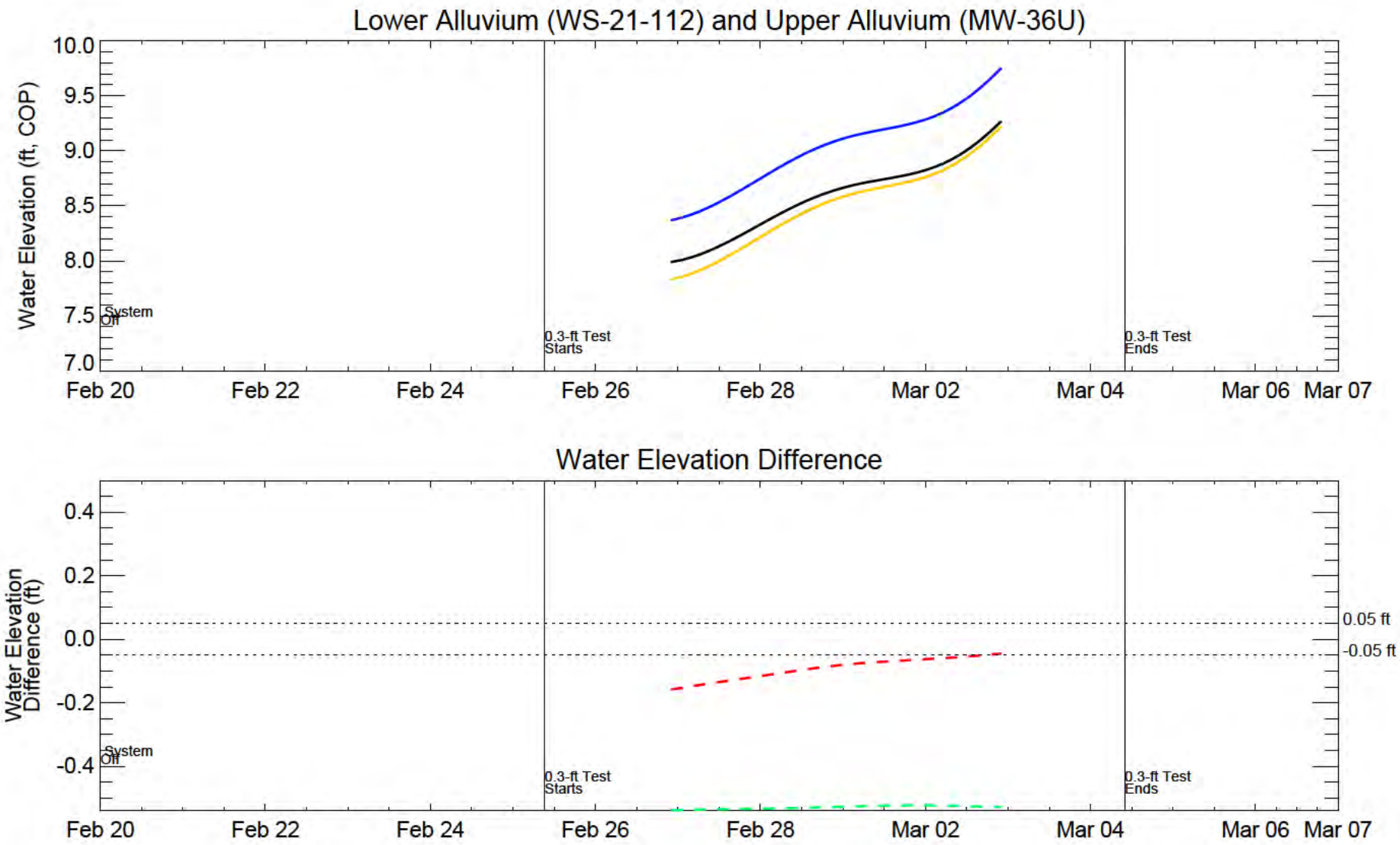

Lower Alluvium
Upper Alluvium
River
Water Elevation Difference = Lower Alluvium - Upper Alluvium
Water Elevation Difference = Lower Alluvium - River
0.05 ft Total Potential Uncertainty

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Figure 7.8b
Groundwater Elevation Differences
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site

Values shown are 3-day rolling averages (Serfes Method). COP = City of Portland Datum

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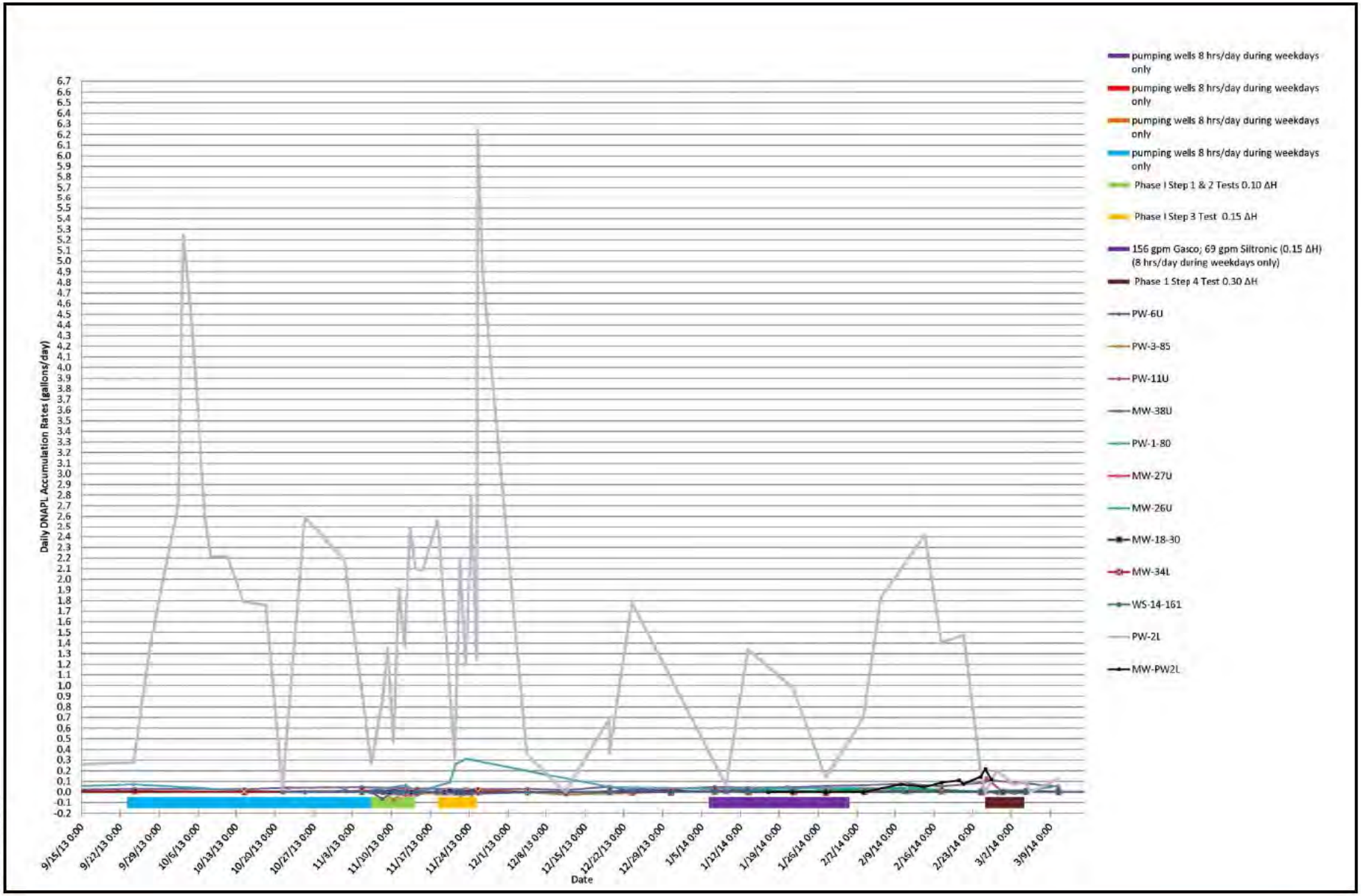

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Figure 8
DNAPL Accumulation Rates
GroundwaterSource Control Extraction System Test Data Report
NW Natural Gasco Site

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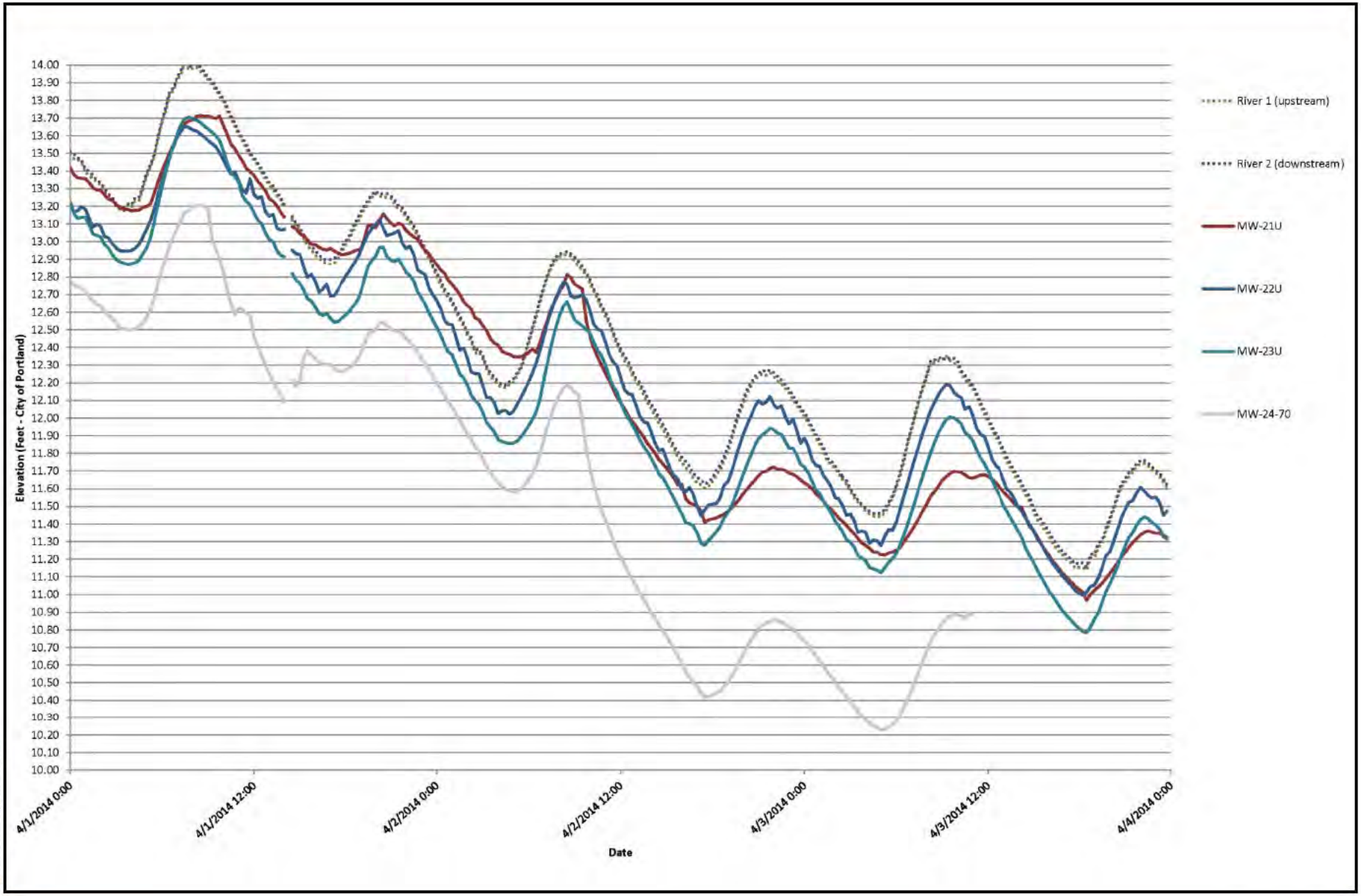
EA

APPENDIX A
WELL HYDROGRAPHS



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Appendix A
Post Testing Segment 2 Upper Alluvium Monitoring Well Hydrographs
Groundwater Source Control Extraction System Test Data Report
NW Natural Gasco Site