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Prepared by
Ramboll Environ
Emeryville, California

Date
September 9, 2016

TECHNICAL MEMORANDUM SEEP WELL FIELD FLOW QUANTIFICATION

NEVADA ENVIRONMENTAL RESPONSE TRUST SITE HENDERSON, NEVADA

RAMBOLL ENVIRON

Technical Memorandum
Seep Well Field Flow Quantification

Nevada Environmental Response Trust Site
(Former Tronox LLC Site)
Henderson, Nevada

Nevada Environmental Response Trust (NERT) Representative Certification
I certify that this document and all attachments submitted to the Division were prepared at the request of, or under the direction or supervision of NERT. Based on my own involvement and/or my inquiry of the person or persons who manage the system(s) or those directly responsible for gathering the information or preparing the document, or the immediate supervisor of such person(s), the information submitted and provided herein is, to the best of my knowledge and belief, true, accurate, and complete in all material respects.

Office of the Nevada Environmental Response Trust

Le Petomane XXVII, Inc., not individually, but solely in its representative capacity as the Nevada Environmental Response Trust Trustee

Signature: Jay A Steinberg, not individually, but solely as President, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

Name: Jay A. Steinberg, not individually, but solely in his representative capacity as President of the Nevada Environmental Response Trust Trustee

Title: Solely as President and not individually

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Date: 9-9-16

Technical Memorandum
Seep Well Field Flow Quantification

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Henderson, Nevada

Responsible Certified Environmental Manager (CEM) for this project

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state and local statutes, regulations and ordinances.

___________________________________ 09/09/2016

John M. Pekala, PG Date
Senior Manager

Certified Environmental Manager
Ramboll Environ US Corporation
CEM Certificate Number: 2347
CEM Expiration Date: September 20, 2016

The following individuals provided input to this document:

John M. Pekala, PG
Allan J. DeLorme, PE
Christopher J. Ritchie, PE
Christopher M. Stubbs, PhD, PE
Ross Russell, PG
Jonathan Hunt, PhD
Emily Gilson, MSE
Tommy Winger

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Date	**September 9, 2016**
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Description	**Technical Memorandum, Seep Well Field Flow Quantification**

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Ramboll Environ
2200 Powell Street
Suite 700
Emeryville, CA 94608
USA
T +1 510 655 7400
F +1 510 655 9517
www.ramboll-environ.com

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1. INTRODUCTION AND OBJECTIVES

The Seep Well Field (SWF) is one of three extraction well fields comprising the Groundwater Extraction and Treatment System (GWETS) operated by the Nevada Environmental Response Trust (the Trust or NERT) for the NERT Site in Henderson, Nevada. The SWF is located approximately 12,000 feet downgradient from the Trust's property boundary. Water extracted by the SWF is currently pumped to a fluidized bed reactor biological treatment plant on the Trust's property where perchlorate is removed from the water before it is discharged into the Las Vegas Wash.[1] Two surface water bodies are located near the SWF: the City of Henderson (COH) Bird Viewing Ponds, which are approximately 3,000 feet hydraulically upgradient of the SWF, and the Las Vegas Wash, which is approximately 1,300 feet hydraulically downgradient of the SWF. In comments on the 2014 Semi-Annual Remedial Performance Report (ENVIRON 2015a) and the 2014-2015 Annual Remedial Performance Report (Ramboll Environ 2015), the Nevada Division of Environmental Protection (NDEP) requested that the Trust quantify the relative contributions of the three sources of water to the SWF: Las Vegas Wash, COH Bird Viewing Ponds, and groundwater from other sources (NDEP 2015a, 2015b).

This technical memorandum responds to NDEP's request and presents the current understanding of the origins of water extracted at the SWF. This document focuses solely on sources of water at the SWF and does not address sources of chemicals of potential concern (COPCs). Nor does it address trends in chemical concentrations or mass removal at the SWF. Specifically, this technical memorandum presents the results of the recent data collection and evaluation efforts that were undertaken to refine the current understanding of interactions between groundwater flow and surface water flows near the SWF. These efforts include: 1) supplemental field sampling at numerous locations in the Las Vegas Wash, the COH Bird Viewing Ponds, and the SWF to address data gaps; 2) deployment of ten conductance, temperature, and depth (CTD) loggers in the vicinity of the SWF to measure temporal water level trends and the relative extent of surface water influences on local groundwater; and 3) evaluation of recently collected field and analytical data using chemical fingerprinting and geochemical modeling to quantify the contributions of various sources to the inflow to the SWF. The data collected for this flow quantification will supplement the ongoing NERT Site Remedial Investigation (RI). The results of this flow quantification analysis provide insight into potential opportunities to optimize mass removal of perchlorate by the GWETS, consistent with the goals of the Continuous Optimization Program (COP). The results of this flow quantification analysis also provide justification for the use of the groundwater model to estimate the contribution of COH Bird Viewing Pond water to SWF extraction as a metric in remedial performance reports.

[1] Plans to construct an ion exchange (IX) treatment system near the SWF are being developed so the water extracted by the SWF can be fully or partially treated locally.

2. BACKGROUND

The SWF consists of 10 extraction wells, 8 of which are currently in use. In 2015, the average monthly extraction rate at the SWF ranged from 457.7 gallons per minute (gpm) to 595.8 gpm. The wells in the SWF are screened across the full saturated thickness of the Quaternary Alluvium (Qal) and across the deepest portion of an alluvial channel (ENVIRON 2015a). Because the SWF is located near two surface water bodies (the Las Vegas Wash and the COH Bird Viewing Ponds, see Figure 1a), pumping at the SWF has the potential to induce water originating at these two surface water bodies to flow into the SWF extraction wells. Since the surface water from both the Las Vegas Wash and the COH Bird Viewing Ponds is primarily treated municipal wastewater effluent, minimization of these inflows would allow a greater percentage of the capacity of the SWF to be used for plume capture (ENVIRON 2015a).

Previously, preliminary efforts were made to evaluate and quantify the influence of surface water sources on SWF extraction to enhance the operational efficiency of the GWETS. Interactions between surface water sources and the SWF were first evaluated based on the performance metrics developed as part of the 2013 GWETS Optimization Project Work Plan (ENVIRON 2013). Subsequent evaluations in the 2013 Semi-Annual Remedial Performance Report, the 2013-2014 Annual Remedial Performance Report, and the 2014 Semi-Annual Remedial Performance Report aimed to better characterize these interactions by evaluating analytical data and groundwater elevation trends (ENVIRON 2014a, 2014c, 2015a).

Recent remedial performance reports evaluated the potential for Las Vegas Wash water to be extracted by the SWF by comparing groundwater elevations in shallow monitoring wells near the SWF with the Las Vegas Wash stream stage measured at the Pabco Road weir, located 1,000 feet downstream of the SWF. In this analysis, adjusted stream stages were calculated to compensate for the distances between the monitoring wells and the location of the stream stage measurements. The results of this analysis were inconclusive because the local hydrology and geology were not understood well enough to be incorporated into the stream stage adjustments. The most recent potentiometric surface (Ramboll Environ 2015) indicates that groundwater generally flows to the northeast in the vicinity of the SWF and does not show any flow paths by which Las Vegas Wash water could enter the SWF.

Based on the analysis presented in previous remedial performance reports, the SWF appears to draw a significant quantity of water from the COH Bird Viewing Ponds, which are located hydraulically upgradient. The ponds are used to infiltrate treated wastewater effluent from the adjacent COH wastewater treatment plant. A region of groundwater containing low concentrations of total dissolved solids (TDS) (<2,500 milligrams per liter [mg/L]) originating at the COH Bird Viewing Ponds extends to the SWF, as shown on the TDS plume map presented in the 2014-2015 Annual Remedial Performance Report (Ramboll Environ 2015) and reproduced on Figure 1b. In May 2015, effluent wastewater discharged to the COH Bird Viewing Ponds contained 1,170 mg/L of TDS (COH 2015), which is distinct from the higher TDS concentrations found in groundwater typically ranging from 2,500 to 5,000 mg/L (Ramboll Environ 2015). Thus, TDS values less than 2,500 mg/L in groundwater provide an indicator of the presence of surface water originating from the COH Bird Viewing Ponds. The low TDS region in groundwater extending from the COH Bird Viewing Ponds to the SWF along the direction of groundwater flow indicated by the 2015 potentiometric surface map (reproduced on Figure 1c) has been cited as strong evidence that the SWF is extracting a significant amount of COH Bird Viewing Pond water (Ramboll Environ 2015).

The use of TDS alone as a tracer cannot differentiate COH Bird Viewing Pond water from Las Vegas Wash water. Piper diagrams from a limited dataset were presented as part of the 2013-2014 and 2014-2015 Annual Remedial Performance Reports (ENVIRON 2014c, Ramboll Environ 2015), but more data were needed to respond to NDEP's request to fully quantify the presence of multiple water sources at the SWF. Consequently, the analyses that follow present recent analytical and water level data that clarify the contributions of these two surface water sources to extraction at the SWF.

3. DATA COLLECTION

Additional data were collected from February 8, 2016 to February 19, 2016 to address previously-identified data gaps. Groundwater samples were collected from the SWF extraction wells and nearby monitoring wells. In addition, surface water samples were collected from the COH Bird Viewing Ponds and the south bank of the Las Vegas Wash. All samples were analyzed for the metals and geochemical parameters listed in Table 1. Sample collection and handling procedures used during this sampling were conducted in general accordance with the NERT Site RI Field Sampling Plan (FSP) (ENVIRON 2014b). Sample collection procedures not included in the RI FSP that were part of this data collection (i.e. surface water and extraction well sample collection) are described in Sections 3.1-3.3.

The evaluation presented in Sections 4 and 5 utilizes analytical data collected during several 2015 sampling efforts in addition to the data collected during the February 2016 SWF flow quantification sampling effort. This supplemental data includes sampling results for seven Athens Road Well Field (AWF)-area shallow monitoring wells (PC-151, PC-152, PC-153, PC-154, PC-158, PC-159, PC-160) and six SWF-area monitoring wells (PC-155A, PC-155B, PC-156A, PC-156B, PC-157A, PC-157B) from the RI Phase 1 data gap field investigation for the NERT Site RI (Ramboll Environ 2016b). The majority of the RI Phase 1 data were collected in the first two quarters of 2015, with follow-up samples collected in February 2016 specifically for the analysis of five analytes not measured in 2015 (chlorate, perchlorate, TDS, boron, and total chromium). In addition, nine surface water samples from the COH Bird Viewing Ponds collected in April 2015 (Ramboll Environ 2015) were also included in this evaluation. These supplemental data sets are further described in their associated reports. Each data set was collected at a different time for a specific purpose, resulting in slightly different analytical suites. These differences did not affect the SWF flow quantification evaluation. A complete list of samples and analytical results used in this evaluation is presented in Table 1, and sample locations are displayed on Figure 1a. The electronic data deliverable (EDD) and the Data Validation Summary Report (DVSR) associated with the data collected in February 2016 and presented herein will be submitted with the 2015-2016 Annual Remedial Performance Report in October 2016.

3.1 Groundwater Sampling – SWF Extraction Wells and Monitoring Wells

Groundwater samples were collected from the nine SWF extraction wells (PC-115R, PC-116R, PC-117, PC-118, PC-119, PC-120, PC-121, PC-133, PC-99R2/R3; see Figure 1a). Because PC-99R2 and PC-99R3 are connected and operate as one combined well, a single sample was collected at this location. Samples were collected using existing sampling ports located on the discharge line and without any alteration to extraction flow rates. Prior to sample collection, the sampling port was opened to purge groundwater already present in the discharge line. Water quality readings were taken before and after sampling, and ferrous iron and sulfide levels were measured in the field. Purge water was discharged directly into the sump at Lift Station 1.

Groundwater samples were also collected from five SWF-area monitoring wells (PC-62, PC-86, PC-90, PC-91, and PC-97) and two AWF-area deep monitoring wells (PC-134D and PC-137D; see Figure 1a) with assistance from Ramboll Environ's subcontractor Blaine

Tech using low-flow sampling methods as described in the Low-Flow Groundwater Sampling Field Guidance Document (FGD) in Appendix A of the RI FSP (ENVIRON 2014b). Ferrous iron and sulfide concentrations were measured in the field using CHEMetrics water test kits. Purge water was collected in truck-mounted storage tanks and discharged into the GW-11 holding pond at the end of each day.

3.2 Surface Water Sampling – COH Bird Viewing Ponds and Las Vegas Wash

Surface water samples were collected from 10 locations across the nine COH Bird Viewing Ponds (samples BP-01 through BP-09) and from 10 locations along the south bank of the Las Vegas Wash (samples LVW-01 through LVW-10, see Figure 1a). Samples were collected using dedicated disposable bailers attached to a 12-foot telescoping pole, allowing for samples to be collected approximately 8 to 10 feet from the shoreline. Water quality readings were taken before and after sampling and ferrous iron and sulfide levels were measured in the field using CHEMetrics water test kits.

3.3 Sample Treatment and Analysis

All samples were labeled and placed in a cooler with ice immediately after sample collection. The samples were handled following chain-of-custody procedures and delivered to TestAmerica, located in Irvine, California via FedEX. Nitrate samples were analyzed by Silver State Analytical Laboratories, located in Las Vegas, Nevada. Both laboratories are certified by the State of Nevada.

Samples were analyzed for a list of chemicals specific to the SWF flow quantification effort (see Table 1). Metals were analyzed using methods EPA 200.7, EPA 200.8, and SW7470, and geochemical parameters were analyzed using methods EPA 300, EPA 300.1, EPA 314, EPA 365.3, SM2320, SM2540C, and SM5310B.

A cation-anion balance (CAB) calculation was performed to evaluate data quality per NDEP guidance (NDEP 2009). Most of the samples had CAB percent difference values below the highest acceptable percent difference (5%), though several samples had CAB percent difference values between 5% and 10%. The high percent difference values in all cases were caused by an excess of cations, likely because the samples were not analyzed for fluoride, which could rebalance the CAB. The samples with percent difference values between 5% and 10% were retained in this data evaluation, because a CAB of less than 10% is more than sufficient for this type of analysis. In any case, the inclusion or absence of these samples would not meaningfully affect the conclusions of this evaluation.

Two samples from the Las Vegas Wash were excluded from the evaluation of water sources extracted by the SWF because they were not representative of the general Las Vegas Wash geochemistry. Specifically, LVW-04 was collected from a stagnant area of the Las Vegas Wash with very high TDS, and LVW-07 was collected near a vegetative root zone with very high dissolved organic carbon.

4. HYDRAULIC ANALYSIS

To gain a better understanding of temporal patterns and changes in groundwater near the SWF, CTD loggers were deployed in 10 monitoring wells in early November 2015. The instrumentation at each well consists of a data logger (In-Situ Aqua TROLL 200) and a cellular network telemetry system (In-Situ Tube 300R). Each data logger measures temperature, conductivity, absolute water pressure, and water level and each tube measures absolute barometric pressure so that a barometric pressure correction can be automatically applied to the water level measurements. Measurements are taken at 15-minute intervals and data is telemetrically transmitted to a Ramboll Environ File Transfer Protocol (FTP) site every 12 hours. In instances when CTD loggers fail to transmit data telemetrically due to instrument malfunction or poor reception, data is downloaded manually by field staff.

The wells equipped with CTD loggers include PC-62, PC-68, PC-108, PC-155A, PC-155B, PC-156A, PC-156B, PC-157A, PC-157B, and WMW6.15S (see Figure 1a). Monitoring wells PC-62, PC-68, and PC-108 are located between the COH Bird Viewing Ponds and the SWF. Monitoring wells PC-155A, PC-155B, PC-156A, PC-156B, PC-157A, and PC-157B were installed in April 2015 during the RI Phase 1 field investigation and are located north of the SWF, approximately halfway between the SWF and the Las Vegas Wash. Monitoring well WMW6.15S is located adjacent to the Las Vegas Wash near the Pabco Road Weir.

Temperature and specific conductance data from the CTD loggers are generally consistent within each well, but the variation between wells did not exhibit trends or patterns that could distinguish potential SWF source waters. Water level measurements from the CTD loggers were used to understand the influences of local surface water sources at the SWF, as described below.

4.1 Groundwater Elevation Contours

The groundwater elevations recorded by the CTD loggers are shown on Figure 2. In addition, Figure 2 includes the water level of the Las Vegas Wash at the Pabco Road gage. Rain events are also plotted along the x-axis of this figure to show possible effects on groundwater elevations. The groundwater elevations recorded by the CTD loggers were generally consistent with manual measurements shown on the groundwater contour maps presented in the 2014-2015 Annual Remedial Performance Report (Ramboll Environ 2015). The direction of groundwater flow between the SWF and the Las Vegas Wash is generally to the northeast. As shown on the 2015 potentiometric surface map (reproduced on Figure 1c), groundwater flows from the area of the COH Bird Viewing Ponds toward the SWF. Available groundwater elevation data does not suggest any groundwater flow from the Las Vegas Wash toward the SWF.

4.2 Temporal Water Level Trends near the SWF and Las Vegas Wash

The CTD logger data, which are collected at 15-minute intervals, were used to examine daily water level cycles as well as longer term patterns. The United States Geological Survey (USGS) stream gage at Pabco Road also records the stream stage in the Las Vegas Wash every 15 minutes. Figures 3a and 3b show the detrended water level fluctuation in the Las Vegas Wash at the Pabco Road gage and at the CTD logger locations. The water level in the Las Vegas Wash shows a consistent daily fluctuation of approximately 0.3 feet. CTD logger data from monitoring wells show a similar pattern of daily fluctuations in water level, but with a smaller amplitude that decreases with distance from the Las Vegas Wash.

Hydraulic connectivity with the Las Vegas Wash depends on distance from the Las Vegas Wash, but also depends on well depth. Wells PC-155A, PC-155B, PC-156B, and PC-157B exhibit daily fluctuations of approximately 0.15 feet, while wells PC-156A and PC-157A exhibit smaller, but still noticeable, daily fluctuations (see Figure 3a). Wells PC-156A and PC-157A are the shallowest of these 6 RI Phase 1 wells with screened intervals at 10-20 feet and 9-24 feet, respectively. PC-155A has a screened interval of 10-30 feet, and PC-157B, PC-156B, and PC-155B have screened intervals of 30-40 feet, 25-45 feet, and 38-48 feet, respectively, indicating that the Las Vegas Wash has less local hydraulic connectivity with groundwater at depths shallower than 25 feet compared with groundwater at depths of approximately 25-50 feet. The three wells south of the SWF (PC-62, PC-68, and PC-108) that are located farther from Las Vegas Wash have screened intervals of 7.6-37.6 feet, 9.9-54.9 feet, and 9.7-44.7 feet, respectively. Compared to wells with similar screen depths near the Las Vegas Wash, these three wells exhibit smaller daily fluctuations of less than 0.05 feet (see Figure 3b). These observations indicate that the effect of the water level fluctuation of the Las Vegas Wash dissipates in the area between PC-156B and PC-62/PC-68.

Similarly, the wells closest to the Las Vegas Wash with the largest daily water level fluctuations (PC-155A, PC-155B, PC-156B, and PC-157B) mirror the sudden response of the Las Vegas Wash to precipitation events (see Figure 2). Sudden responses to precipitation are not seen in the wells south of the SWF (PC-62, PC-68, and PC-108). Although wells PC-62 and PC-68 are located south of the SWF, they are situated a similar distance from the Las Vegas Wash as the SWF wells. The SWF wells also have similar screen depths to wells PC-62 and PC-68, suggesting that the SWF wells would also demonstrate minimal responses to changes in water levels in the Las Vegas Wash. An observed change in water levels in a given well does not necessarily mean that water is physically moving from the Las Vegas Wash to that well. Mixing requires the physical movement of water. If water were flowing from the Las Vegas Wash to the SWF, a significant response to changes in the stage of the Las Vegas Wash would be observed in wells south of the SWF. These observations therefore indicate that there does not appear to be a significant volume of Las Vegas Wash water being extracted at the SWF.

4.3 Temporal Water Level Trends at the SWF and COH Bird Viewing Ponds

A comparison of historical groundwater elevation measurements to recharge rates at the COH Bird Viewing Ponds indicates that the hydraulic influence of the Bird Viewing Ponds on groundwater near the SWF is stronger and spatially larger than that of the Las Vegas Wash. The recharge at the COH Bird Viewing Ponds follows a roughly annual cycle (see Figure 4a), with lower recharge in the winter and higher recharge in the summer. Similarly, water levels also follow annual cycles at all monitoring wells in the groundwater monitoring program that are at or north of the AWF for which monthly water level data is available. Annual cycles like those for recharge at the COH Bird Viewing Ponds are not observed in monitoring wells in the groundwater monitoring program that are at or south of Sunset Road for which monthly water level data are available.

For the majority of the 2012-2015 period, the well with the smallest lag time relative to COH Bird Viewing Pond cycles was PC-103 which is located at the edge of the Bird Viewing Ponds (see Figure 4a). Cycles in wells in the COH Water Reclamation Facility (WRF) Well Line (PC-103, PC-98R, MW-K5, and PC-53) adjacent to the Bird Viewing Ponds lag the cycles in discharge to the Bird Viewing Ponds by approximately 2 months (see Figure 4a), while cycles in wells further south to the AWF and further north to the Las Vegas Wash (see Figure 4b) lag the cycles at the Bird Viewing Ponds by approximately 4 months. The annual water level fluctuations are generally larger (2-3 feet) in the COH WRF Well Line (see Figure 4a). At wells near the AWF or wells between the Bird Viewing Ponds and the Las Vegas Wash, annual water level fluctuations are generally smaller (1-2 feet). These patterns are consistent with the conclusion that the Bird Viewing Ponds exert a hydraulic influence over groundwater in the broad area from the AWF to the Las Vegas Wash, including in the vicinity of the SWF. Though this influence seems to diminish with distance, it remains prominent in the monitoring wells that surround the SWF extraction wells (see Figure 4b).

5. GEOCHEMICAL ANALYSIS

To identify potential chemical distinctions and therefore better understand the relative contributions of surface water and groundwater sources to SWF flow, data collected during the April 2015 sampling of the COH Bird Viewing Ponds and the February 2016 sampling of the COH Bird Viewing Ponds and Las Vegas Wash were compared to geochemical samples from the SWF and groundwater wells in the shallow and middle water-bearing zones near the AWF. Samples from the SWF were broken down into four distinct categories based on location (see Figure 1a). The four categories are the northern SWF (PC-155A, PC-155B, PC-156A, PC-156B, PC-157A, and PC-157B), the central SWF (PC-90, PC-99R2/R3, PC-115R, PC-116R, and PC-117), the eastern SWF (PC-91, PC-97, and PC-133), and the western SWF (PC-62, PC-86, PC-118, PC-119, PC-120, and PC-121). Samples near the AWF were broken down into two categories based on depth (see Figure 1a). The two categories are shallow groundwater (PC-151, PC-152, PC-153, PC-154, PC-158, PC-159, and PC-160), from wells that are screened in the shallow water-bearing zone, and deep groundwater (PC-134D and PC-137D), from wells that are screened in the middle water-bearing zone.

5.1 Source Fingerprinting

Figure 5 shows a complete Piper diagram of the major cation-anion data, while Figure 6 shows a modified version of the upper portion of the Piper diagram that more clearly displays the distinct water types. The Piper diagrams are useful for fingerprinting distinct water types but can only define semi-quantitative mixing relationships, as the units used in the diagram are meant to quantify individual species' contributions to the overall charge balance, not mass balance. The relative composition of major ions indicates that the Las Vegas Wash is chemically distinct from the shallow groundwater within the perchlorate plume. The waters near the SWF and the waters of the Bird Viewing Ponds are very loosely clustered and chemically overlapping each other. There is no relationship between the physical distance to the Las Vegas Wash and similarity to the Las Vegas Wash in chemical composition. It is therefore likely that the SWF is not extracting water from the Las Vegas Wash, and that the main source of surface water being extracted by the SWF is the COH Bird Viewing Ponds. The deep groundwater has a distinct chemical signature that is much harder and less alkaline than the shallow groundwater, indicating that it is unlikely that a significant quantity of deep groundwater is being extracted by the SWF.

Since neither the Las Vegas Wash nor deep groundwater are contributing significantly to the mixing at the SWF, the SWF water must primarily be a product of mixing between shallow groundwater and the Bird Viewing Pond water. Figure 7 shows a Durov diagram of the data. A Durov diagram is similar to a Piper diagram, but includes pH and TDS information. In the Piper diagram, the Bird Viewing Pond data is distributed loosely enough that it partially overlaps with the shallow groundwater data. However, the Durov diagram shows that these two waters are quite distinct on the TDS and pH axes. This seeming discrepancy can be resolved when the geochemical effects of infiltration on the Bird Viewing Pond surface water are taken into account. As the high pH, low TDS surface water from the Bird Viewing Ponds infiltrates into the subsurface, it likely equilibrates to neutral pH and partially dissolves the caliche present in the alluvium, increasing the amount of carbonate (or bicarbonate) in the water. Figure 8 shows the concentration of alkalinity (as calcite or $CaCO_3$) vs. the concentration of calcium in each of the water samples. The line on Figure 8 shows the increase in both calcium and alkalinity as caliche (containing $CaCO_3$) is dissolved into the Bird Viewing Pond water. The slope of this line is actually an upper bound for carbonate dissolution, as carbonates other than calcite may also be dissolved, which would increase alkalinity without increasing calcium. Carbonate dissolution in infiltrating Bird Viewing Pond water could shift the water's composition towards a higher contribution of carbonate and bicarbonate relative to sulfate and chloride. In Figure 6, this would be represented by a shift of the Bird Viewing Pond data points towards the bottom of the figure, creating a progression of water samples in which the SWF water would be between the Bird Viewing Pond water and the shallow groundwater. This progression would be similar to the progression seen on the TDS axis of the Durov diagram. This suggests that the water at the SWF is indeed a combination of primarily two distinct sources: the Bird Viewing Pond surface water and shallow groundwater.

5.2 Tracer Analysis

After review of the available geochemical data, it was determined that TDS is the best tracer to use to quantify the contribution of Bird Viewing Pond water to the extracted water at the SWF. This determination is consistent with the 2013 GWETS Optimization Project Report (ENVIRON 2015b), though the present analysis considered a larger suite of possible tracers. Major geochemical parameters (e.g. sodium, chloride) are essentially proxies for TDS. Some minor anions and cations could be subject to geochemical reaction in the subsurface (e.g. precipitation of barium as barium sulfate, reduction of nitrate), reducing their usefulness as mass-conservative tracers. Other minor anions and cations exhibit high spatial variability in shallow groundwater (e.g. perchlorate and chromium), which makes it difficult to estimate the representative shallow groundwater concentrations to use in the mixing calculation. Certain trace metals (cobalt, nickel) are detected in the SWF, but are not detected in the shallow groundwater at the AWF, nor in any surface water. Cobalt and nickel were both detected in wells HMW-13, HMW-15, and PC-108 (near the Bird Viewing Ponds) as part of the RI in January 2015 (Ramboll Environ 2016b). These detections could indicate that the SWF is extracting some shallow groundwater that does not originate in the NERT perchlorate plume. Previously, the potential presence of two surface waters (COH Bird Viewing Ponds and Las Vegas Wash) with low TDS concentrations complicated the use of TDS as a tracer. Since it has now been concluded that the Las Vegas Wash does not contribute significantly to SWF extraction, low TDS concentrations in the area of the SWF indicate the presence of COH Bird Viewing Pond water. TDS is therefore an ideal tracer to quantify the contribution of the two major sources of water (shallow groundwater and COH Bird Viewing Pond water) to the extracted water at the SWF.

5.3 Flow Quantification

Water extracted at the SWF is primarily a mixture of Bird Viewing Pond water and shallow groundwater. With only two water sources at the SWF, the simple mixing calculation that was performed in the 2013 GWETS Optimization Project Report (ENVIRON 2015b) to quantify surface water flows at the SWF remains appropriate to quantify Bird Viewing Pond flows at the SWF. The average TDS concentrations from February 2016 in shallow groundwater near the AWF and in the Bird Viewing Ponds are 4,960 mg/L and 1,260 mg/L, respectively. The approximate percentage of Bird Viewing Pond water in a nearby well can be calculated by the equation:

$$100 * \frac{(4{,}960 - TDS(well))}{(4{,}960 - 1{,}260)},$$

where $TDS(well)$ is the concentration of TDS in mg/L in a well.

The percentages of Bird Viewing Pond water in each well near the SWF are presented in Table 2. Given the likelihood of local variability in shallow groundwater TDS levels, these percentages should only be viewed as accurate to within 10%. The wells in the western portion of the SWF are pumping the most water from the Bird Viewing Ponds. PC-118 and PC-119 are pumping approximately 69% and 88% Bird Viewing Pond water, respectively. In the eastern portion of the SWF, PC-133 is pumping approximately 77% Bird Viewing Pond water. In the central portion of the SWF, the wells are pumping significantly less Bird Viewing Pond water, approximately 18-50%. This is most likely due to paleochannels bringing shallow groundwater from the AWF area directly to the central portion of the SWF in the deepest portion of the alluvium. Bird Viewing Pond water may extend to the eastern portion of the SWF by traveling east and mixing in the shallower portion of the alluvium. It is also possible that another unknown source of low TDS water to the east of the extent of the NERT groundwater monitoring program may have an influence on the eastern portion of the SWF. Based on the individual extraction rates and proportions of Bird Viewing Pond water at the SWF extraction wells in April 2016, the SWF is pumping approximately 235 gpm of Bird Viewing Pond water and 295 gpm of shallow groundwater, for an overall extraction rate of 44% Bird Viewing Pond water. This is in close agreement with the Phase 4 model results presented as Attachment A to the 2015 Semi-Annual Performance Report (Ramboll Environ 2016a) that indicated that 39% of water extracted at the SWF originated at the Bird Viewing Ponds. These results may be refined as additional data are collected and interpreted for relevant RI efforts including the investigations of the Downgradient Study Area and the BMI Common Areas/Eastside Area.

6. CONCLUSIONS AND RECOMMENDATIONS

Qualitative and geochemical analyses of recent groundwater elevation and analytical data indicate that the major sources of water extracted at the SWF are shallow groundwater and water originating at the COH Bird Viewing Ponds. While the ratio of extracted Bird Viewing Pond water to groundwater varies across the extraction well field, approximately 44% of the water extracted by all operating SWF wells originates at the Bird Viewing Ponds. The least efficient well is PC-119, which is extracting 89% Bird Viewing Pond water. The Las Vegas Wash does not appear to contribute significantly to SWF extraction.

Future relocations of several CTD loggers could improve the understanding of local groundwater flow near the SWF. CTD loggers should be placed in wells PC-96 and PC-97 which are located between the SWF and the RI Phase 1 wells PC-155A, PC-155B, PC-156A, PC-156B, PC-157A, and PC-157B. CTD logger information from these two wells would facilitate a more accurate understanding of the extent of the influence of the Las Vegas Wash on nearby groundwater. Current data indicates that the local influence of the Las Vegas Wash begins to diminish near wells PC-156A and PC-156B, so additional data from PC-96 and PC-97 will help determine how quickly the influence of the Las Vegas Wash decreases with distance from the Las Vegas Wash. CTD loggers should also be placed in wells PC-86 or PC-87, PC-88 or PC-90, and PC-91 or PC-92. These monitoring wells are interspersed with the extraction wells of the SWF and a review of daily water level fluctuations and responses to precipitation in these wells would indicate the extent of the influence of the Las Vegas Wash closer to the SWF.

While the SWF is capturing a significant portion of water originating from the COH Bird Viewing Ponds, extraction rate adjustments to the well field are not planned at this time as this would reduce the capture zone potentially allowing additional perchlorate mass to discharge to the Las Vegas Wash. NERT will ultimately use data collected as part of the Phase 2 RI, the Downgradient Study Area investigation, and the investigation of the Eastside Area (Phase 3 RI) to prepare the comprehensive RI Report and ultimately the Feasibility Study Report. NERT will continue to evaluate the sources of water captured by the SWF as part of the remedy selection process such that the final remedy implemented will be designed to minimize the capture of water originating from the COH Bird Viewing Ponds.

7. REFERENCES

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TABLE 1: SWF FLOW QUANTIFICATION SAMPLE RESULTS
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Analytical Method	Unit	Las Vegas Wash							
				LVW-01/2016	LVW-02/2016	LVW-03/2016	LVW-05/2016	LVW-06/2016	LVW-08/2016	LVW-09/2016	LVW-10/2016
				02/19/2016	02/19/2016	02/19/2016	02/19/2016	02/19/2016	02/18/2016	02/18/2016	02/18/2016
General Chemistry	Alkalinity (as $CaCO_3$)	SM 2320	mg/L	**130**	**130**	**130**	**130**	**140**	**130**	**130**	**130**
	Bicarbonate as HCO_3	SM 2320	mg/L	**160**	**160**	**160**	**160**	**170**	**160**	**160**	**160**
	Carbon	EPA 5310B	mg/L	**6.2**	**6.2**	**6.1**	**6.1**	**6**	**6.1**	**6.2**	**6.2**
	Carbonate (CO_3)	SM 2320	mg/L	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
	Chlorate	EPA 300.1	mg/L	**0.11**	**0.1**	**0.12**	**0.11**	**0.11**	**0.15**	**0.18**	**0.2**
	Chloride	EPA 300.0	mg/L	**240**	**240**	**250**	**270**	**250**	**220**	**230**	**220**
	Hydroxide	SM 2320	mg/L	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
	Nitrate	EPA 300.0	mg/L	**14.3 J**	**14.2 J**	**13.3 J**	**12.9 J**	**13 J**	**12 J**	**12.1 J**	**12 J**
	Perchlorate	EPA 314.0	mg/L	**0.019**	**0.025**	**0.019**	**0.068**	**0.02**	**0.0078**	**0.0086**	**0.0086**
	Phosphorus (total)	EPA 365.3	mg/L	**0.078**	**0.078**	**0.078**	**0.08**	**0.08**	**0.09**	**0.09**	**0.095**
	Sulfate	EPA 300.0	mg/L	**530**	**540**	**620**	**600**	**560**	**450**	**470**	**450**
	Dissolved Solids (total)	SM 2540C	mg/L	**1,600**	**1,600**	**1,700**	**1,600**	**1,500**	**1,300**	**1,400**	**1,300**
	pH	Field	S.U.	7.53	7.625	7.82	7.995	8.14	8.3	8.29	8.33
Metals	Aluminum	EPA 200.7	mg/L	**0.075**	**0.077**	**0.052 J**	**0.062**	**0.085**	**0.16**	**0.16**	**0.17**
	Antimony	EPA 200.8	mg/L	**0.0005 J**	<0.0005	**0.0005 J**	**0.0005 J**	**0.00054 J**	**0.00058 J**	**0.00058 J**	**0.00063 J**
	Arsenic	EPA 200.8	mg/L	**0.006**	**0.0061**	**0.0076**	**0.0074**	**0.0058**	**0.0038**	**0.0038**	**0.0037**
	Barium	EPA 200.7	mg/L	**0.054**	**0.058**	**0.056**	**0.054**	**0.055**	**0.054**	**0.056**	**0.055**
	Boron	EPA 200.7	mg/L	**0.51**	**0.54**	**0.6**	**0.58**	**0.52**	**0.47**	**0.48**	**0.47**
	Cadmium	EPA 200.7	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Calcium	EPA 200.7	mg/L	**140**	**140**	**150**	**140**	**130**	**130**	**130**	**130**
	Chromium (total)	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Cobalt	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Copper	EPA 200.7	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0069 J**	**0.0073 J**	**0.0069 J**
	Iron	EPA 200.7	mg/L	**0.046**	**0.051**	**0.04**	**0.033 J**	**0.044**	**0.039 J**	**0.038 J**	**0.049**
	Lead	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	**0.0029 J**	<0.0025	**0.0028 J**	<0.0025	**0.0029 J**
	Magnesium	EPA 200.7	mg/L	**61**	**65**	**73**	**69**	**64**	**59**	**61**	**59**
	Manganese	EPA 200.7	mg/L	**0.017 J**	**0.019 J**	**0.02**	**0.04**	**0.02**	**0.013 J**	**0.014 J**	**0.013 J**
	Mercury	EPA 7470	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Nickel	EPA 200.7	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Potassium	EPA 200.7	mg/L	**22**	**22**	**23**	**22**	**21**	**22**	**23**	**22**
	Sodium	EPA 200.7	mg/L	**230**	**230**	**230**	**230**	**210**	**220**	**230**	**220**
	Vanadium	EPA 200.7	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Zinc	EPA 200.7	mg/L	**0.028**	**0.029**	**0.024**	**0.027**	**0.027**	**0.034**	**0.033**	**0.032**

Notes:
mg/L = milligrams per liter
S.U. = pH Standard Unit
-- = not analyzed
bold value: detection

TABLE 1: SWF FLOW QUANTIFICATION SAMPLE RESULTS
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Analytical Method	Unit	Deep Groundwater near AWF		Shallow Groundwater near AWF					
				PC-134D	PC-137D	PC-151		PC-152		PC-153	
				02/11/2016	02/11/2016	01/26/2015	02/11/2016	01/26/2015	02/11/2016	01/26/2015	02/11/2016
General Chemistry	Alkalinity (as $CaCO_3$)	SM 2320	mg/L	**41**	**41**	**230**	--	**220**	--	**190**	--
	Bicarbonate as HCO_3	SM 2320	mg/L	**50**	**50**	**280**	--	**260**	--	**240**	--
	Carbon	EPA 5310B	mg/L	<0.65	**0.68 J**	**2.1**	--	**1.8**	--	**1.6**	--
	Carbonate (CO_3)	SM 2320	mg/L	<2.4	<2.4	<2.4	--	<2.4	--	<2.4	--
	Chlorate	EPA 300.1	mg/L	<0.02	<0.02	--	**8.7**	--	**2.2**	--	<0.1
	Chloride	EPA 300.0	mg/L	**250**	**220**	**1,200 J**	--	**1,300**	--	**1,900 J**	--
	Hydroxide	SM 2320	mg/L	<1.4	<1.4	<1.4	--	<1.4	--	<1.4	--
	Nitrate	EPA 300.0	mg/L	<0.0009	<0.0009	**7.7**	--	**5.6**	--	**1.2 J**	--
	Perchlorate	EPA 314.0	mg/L	<0.00095	<0.00095	--	**58**	--	**44**	--	**5**
	Phosphorus (total)	EPA 365.3	mg/L	**0.032 J**	**0.078**	--	--	--	--	--	--
	Sulfate	EPA 300.0	mg/L	**2,000**	**2,200**	**1,400**	--	**1,400**	--	**1,500**	--
	Dissolved Solids (total)	SM 2540C	mg/L	**3,800**	**4,000**	--	**3,800**	--	**4,300**	--	**5,700**
	pH	Field	S.U.	7.48	7.39	6.89	--	6.99	--	6.97	--
Metals	Aluminum	EPA 200.7	mg/L	<0.05	<0.05	0.025 UJ	--	**0.05**	--	**0.038 J**	--
	Antimony	EPA 200.8	mg/L	<0.0005	**0.00055 J**	<0.0005	--	**0.00069 J**	--	<0.0005	--
	Arsenic	EPA 200.8	mg/L	**0.062**	**0.026**	**0.056**	--	**0.054**	--	**0.037**	--
	Barium	EPA 200.7	mg/L	<0.01	**0.015**	**0.021**	--	**0.02**	--	**0.024**	--
	Boron	EPA 200.7	mg/L	**1.4**	**2.3**	--	**1.7**	--	**1.8**	--	**2.5**
	Cadmium	EPA 200.7	mg/L	<0.004	<0.002	<0.004	--	<0.01	--	<0.01	--
	Calcium	EPA 200.7	mg/L	**520**	**530**	**280**	--	**220**	--	**230**	--
	Chromium (total)	EPA 200.7	mg/L	<0.005	<0.0025	--	<0.0025	--	<0.0025	--	<0.0025
	Cobalt	EPA 200.7	mg/L	<0.005	<0.0025	<0.0025	--	<0.0025	--	<0.0025	--
	Copper	EPA 200.7	mg/L	<0.01	<0.005	<0.005	--	<0.005	--	<0.005	--
	Iron	EPA 200.7	mg/L	**0.069 J**	**0.11**	<0.01	--	**0.017 J**	--	**0.043**	--
	Lead	EPA 200.7	mg/L	**0.005 J**	<0.0025	<0.0025	--	<0.0025	--	<0.0025	--
	Magnesium	EPA 200.7	mg/L	**120**	**180**	**150**	--	**130**	--	**120**	--
	Manganese	EPA 200.7	mg/L	**0.053**	**0.16**	**0.39**	--	**0.46**	--	**1**	--
	Mercury	EPA 7470	mg/L	<0.0001	<0.0001	--	--	0.0001 UJ	--	--	--
	Nickel	EPA 200.7	mg/L	<0.01	<0.005	<0.005	--	<0.005	--	<0.005	--
	Potassium	EPA 200.7	mg/L	**28**	**56**	**29**	--	**32**	--	**36**	--
	Sodium	EPA 200.7	mg/L	**320**	**350**	**940**	--	**1,000**	--	**1,600**	--
	Vanadium	EPA 200.7	mg/L	<0.01	<0.005	**0.099**	--	**0.11**	--	**0.055**	--
	Zinc	EPA 200.7	mg/L	<0.02	<0.01	<0.01	--	<0.01	--	<0.01	--

Notes:
mg/L = milligrams per liter
S.U. = pH Standard Unit
-- = not analyzed
bold value: detection

TABLE 1: SWF FLOW QUANTIFICATION SAMPLE RESULTS
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Analytical Method	Unit	Shallow Groundwater near AWF							
				PC-154		PC-158		PC-159		PC-160	
				01/23/2015	02/10/2016	01/23/2015	02/10/2016	01/23/2015	02/10/2016	01/26/2015	02/10/2016
General Chemistry	Alkalinity (as $CaCO_3$)	SM 2320	mg/L	**200**	--	**250**	--	**230**	--	**220**	--
	Bicarbonate as HCO_3	SM 2320	mg/L	**250**	--	**310**	--	**280**	--	**270**	--
	Carbon	EPA 5310B	mg/L	**3.1**	--	**2.8**	--	**2**	--	**2.1**	--
	Carbonate (CO_3)	SM 2320	mg/L	<2.4	--	<2.4	--	<2.4	--	<2.4	--
	Chlorate	EPA 300.1	mg/L	--	**7.8**	--	**8.6**	--	**5.9**	--	**3.6**
	Chloride	EPA 300.0	mg/L	**1,100**	--	**1,300**	--	**1,400**	--	**1,500 J**	--
	Hydroxide	SM 2320	mg/L	<1.4	--	<1.4	--	<1.4	--	<1.4	--
	Nitrate	EPA 300.0	mg/L	**12**	--	**10**	--	**7.7**	--	**4.3**	--
	Perchlorate	EPA 314.0	mg/L	--	**51**	--	**52**	--	**43**	--	**39**
	Phosphorus (total)	EPA 365.3	mg/L	--	--	--	--	--	--	--	--
	Sulfate	EPA 300.0	mg/L	**2,000**	--	**1,700**	--	**1,500**	--	**1,500**	--
	Dissolved Solids (total)	SM 2540C	mg/L	--	**5,300**	--	**5,400**	--	**5,100**	--	**5,100**
	pH	Field	S.U.	7.04	--	7.05	--	7.1	--	7.08	--
Metals	Aluminum	EPA 200.7	mg/L	**0.053 J**	--	**0.066 J**	--	**0.078 J**	--	**0.069**	--
	Antimony	EPA 200.8	mg/L	<0.0005	--	<0.0005	--	<0.0005	--	<0.0005	--
	Arsenic	EPA 200.8	mg/L	**0.087**	--	**0.11**	--	**0.12**	--	**0.11**	--
	Barium	EPA 200.7	mg/L	**0.023**	--	**0.023**	--	**0.023**	--	**0.022**	--
	Boron	EPA 200.7	mg/L	--	**2.1**	--	**2**	--	**2.1**	--	**2.1**
	Cadmium	EPA 200.7	mg/L	<0.002	--	<0.002	--	<0.002	--	<0.01	--
	Calcium	EPA 200.7	mg/L	**440**	--	**300**	--	**240**	--	**200**	--
	Chromium (total)	EPA 200.7	mg/L	--	<0.0025	--	<0.0025	--	<0.0025	--	<0.0025
	Cobalt	EPA 200.7	mg/L	<0.0025	--	<0.0025	--	<0.0025	--	<0.0025	--
	Copper	EPA 200.7	mg/L	<0.005	--	**0.012**	--	<0.005	--	<0.005	--
	Iron	EPA 200.7	mg/L	<0.01	--	**0.038 J**	--	<0.01	--	**0.01 J**	--
	Lead	EPA 200.7	mg/L	0.0025 UJ	--	0.0025 UJ	--	0.0025 UJ	--	<0.0025	--
	Magnesium	EPA 200.7	mg/L	**220**	--	**160**	--	**120**	--	**110**	--
	Manganese	EPA 200.7	mg/L	**0.064**	--	<0.01	--	**0.14**	--	**0.41**	--
	Mercury	EPA 7470	mg/L	--	--	--	--	--	--	--	--
	Nickel	EPA 200.7	mg/L	<0.005	--	**0.012**	--	<0.005	--	<0.005	--
	Potassium	EPA 200.7	mg/L	**38**	--	**33**	--	**33**	--	**30**	--
	Sodium	EPA 200.7	mg/L	**1,100**	--	**1,200**	--	**1,400**	--	**1,300**	--
	Vanadium	EPA 200.7	mg/L	**0.08**	--	**0.16**	--	**0.2**	--	**0.16**	--
	Zinc	EPA 200.7	mg/L	**0.01 J**	--	**0.011 J**	--	**0.01 J**	--	<0.01	--

Notes:
mg/L = milligrams per liter
S.U. = pH Standard Unit
-- = not analyzed
bold value: detection

TABLE 1: SWF FLOW QUANTIFICATION SAMPLE RESULTS
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Analytical Method	Unit	Bird Viewing Ponds 2015								
				BP-01/2015	BP-02/2015	BP-03/2015	BP-04/2015	BP-05/2015	BP-06/2015	BP-07/2015	BP-08/2015	BP-09/2015
				04/16/2015	04/16/2015	04/16/2015	04/16/2015	04/16/2015	04/16/2015	04/16/2015	04/16/2015	04/16/2015
General Chemistry	Alkalinity (as $CaCO_3$)	SM 2320	mg/L	**100**	**140**	**180**	**130**	**130**	**170**	**110**	**180**	**150**
	Bicarbonate as HCO_3	SM 2320	mg/L	**130**	**170**	**220**	**160**	**120**	**200**	**100**	**220**	**190**
	Carbon	EPA 5310B	mg/L	**6.8**	**7.3**	**7.8**	**8.7**	**7.3**	**8.6**	**8.9**	**11**	**7.8**
	Carbonate (CO_3)	SM 2320	mg/L	<2.4	<2.4	<2.4	<2.4	**17**	<2.4	**19**	<2.4	<2.4
	Chlorate	EPA 300.1	mg/L	**0.094**	**0.049**	<0.01	**0.014**	**0.072**	<0.01	**0.011**	<0.01	**0.018**
	Chloride	EPA 300.0	mg/L	**270**	**300**	**320**	**360**	**280**	**340**	**320**	**450**	**330**
	Hydroxide	SM 2320	mg/L	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
	Nitrate	EPA 300.0	mg/L	**20**	**13**	**3.4**	**4.1**	**16**	**2**	**4.1**	**0.84**	**5.6**
	Perchlorate	EPA 314.0	mg/L	<0.0095	<0.0095	<0.0095	<0.0095	<0.0095	<0.0095	<0.0095	<0.0095	<0.00095
	Phosphorus (total)	EPA 365.3	mg/L	--	--	--	--	--	--	--	--	--
	Sulfate	EPA 300.0	mg/L	**340**	**350**	**380**	**420**	**330**	**400**	**370**	**530**	**380**
	Dissolved Solids (total)	SM 2540C	mg/L	**1,200**	**1,300**	**1,400**	**1,400**	**1,200**	**1,400**	**1,300**	**1,800**	**1,300**
	pH	Field	S.U.	--	--	--	--	--	--	--	--	--
Metals	Aluminum	EPA 200.7	mg/L	<0.025	**0.035**	**0.054**	**0.041**	**0.037**	**0.04**	**0.045**	**0.1**	<0.025
	Antimony	EPA 200.8	mg/L	**0.00088**	**0.0011**	**0.00084**	**0.00093**	**0.00074**	**0.0007**	**0.0012**	**0.0011**	**0.00065**
	Arsenic	EPA 200.8	mg/L	**0.003**	**0.0037**	**0.0043**	**0.0036**	**0.003**	**0.0029**	**0.0038**	**0.0035**	**0.0027**
	Barium	EPA 200.7	mg/L	**0.094**	**0.11**	**0.11**	**0.12**	**0.1**	**0.11**	**0.098**	**0.13**	**0.1**
	Boron	EPA 200.7	mg/L	--	--	--	--	--	--	--	--	--
	Cadmium	EPA 200.7	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Calcium	EPA 200.7	mg/L	**100**	**120**	**120**	**110**	**120**	**110**	**94**	**130**	**110**
	Chromium (total)	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Cobalt	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Copper	EPA 200.7	mg/L	**0.0053**	**0.0087**	<0.005	**0.0075**	**0.0096**	<0.005	<0.005	<0.005	<0.005
	Iron	EPA 200.7	mg/L	**0.052**	**0.035**	**0.052**	**0.043**	**0.035**	**0.078**	**0.041**	**0.21**	**0.058**
	Lead	EPA 200.7	mg/L	<0.0025	**0.0033**	<0.0025	**0.0042**	**0.0025**	<0.0025	<0.0025	**0.0031**	**0.0029**
	Magnesium	EPA 200.7	mg/L	**35**	**41**	**45**	**50**	**39**	**47**	**43**	**62**	**43**
	Manganese	EPA 200.7	mg/L	**0.015**	**0.01**	**0.018**	<0.01	<0.01	**0.025**	<0.01	**0.031**	**0.016**
	Mercury	EPA 7470	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Nickel	EPA 200.7	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0052**	<0.005
	Potassium	EPA 200.7	mg/L	**20**	**23**	**26**	**28**	**23**	**28**	**25**	**39**	**25**
	Sodium	EPA 200.7	mg/L	**230**	**260**	**280**	**320**	**260**	**300**	**280**	**410**	**280**
	Vanadium	EPA 200.7	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.0052**	**0.007**	<0.005
	Zinc	EPA 200.7	mg/L	**0.046**	**0.056**	**0.028**	**0.028**	**0.049**	**0.016**	**0.025**	**0.012**	**0.026**

Notes:

mg/L = milligrams per liter

S.U. = pH Standard Unit

-- = not analyzed

bold value: detection

TABLE 1: SWF FLOW QUANTIFICATION SAMPLE RESULTS
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Analytical Method	Unit	Bird Viewing Ponds 2016				
				BP-01/2016	BP-02/2016	BP-03/2016	BP-04/2016	BP-05/2016
				02/17/2016	02/17/2016	02/17/2016	02/17/2016	02/18/2016
General Chemistry	Alkalinity (as $CaCO_3$)	SM 2320	mg/L	**110**	**93**	**72**	**72**	**81**
	Bicarbonate as HCO_3	SM 2320	mg/L	**130**	**76**	**73**	**78**	**75**
	Carbon	EPA 5310B	mg/L	**7.9**	**7.8**	**7.9**	**8.5**	**9.8**
	Carbonate (CO_3)	SM 2320	mg/L	**6.2**	**19**	**7.1**	**5.1**	**12**
	Chlorate	EPA 300.1	mg/L	**0.046**	**0.033**	**0.02**	**0.01 J**	**0.034**
	Chloride	EPA 300.0	mg/L	**240**	**250**	**260**	**270**	**250**
	Hydroxide	SM 2320	mg/L	<1.4	<1.4	<1.4	<1.4	<1.4
	Nitrate	EPA 300.0	mg/L	**11.6**	**7**	**3.9**	**1.6**	**5.99**
	Perchlorate	EPA 314.0	mg/L	**0.0046**	**0.0011**	<0.0005	<0.0005	**0.0012 J**
	Phosphorus (total)	EPA 365.3	mg/L	**0.34**	**0.21**	**0.065**	**0.1**	**0.26 J**
	Sulfate	EPA 300.0	mg/L	**290**	**310**	**320**	**330**	**320**
	Dissolved Solids (total)	SM 2540C	mg/L	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**
	pH	Field	S.U.	8.755	9.41	9.415	9.37	9.31
Metals	Aluminum	EPA 200.7	mg/L	<0.025	**0.026 J**	<0.025	<0.025	**0.026 J**
	Antimony	EPA 200.8	mg/L	**0.00076 J**	**0.00084 J**	**0.00094 J**	**0.00093 J**	**0.00088 J**
	Arsenic	EPA 200.8	mg/L	**0.0026**	**0.0027**	**0.0026**	**0.0031**	**0.0033**
	Barium	EPA 200.7	mg/L	**0.073**	**0.06**	**0.028**	**0.043**	**0.057**
	Boron	EPA 200.7	mg/L	**0.35**	**0.36**	**0.37**	**0.39**	**0.37**
	Cadmium	EPA 200.7	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
	Calcium	EPA 200.7	mg/L	**87**	**75**	**65**	**57**	**72**
	Chromium (total)	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Cobalt	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Copper	EPA 200.7	mg/L	**0.009 J**	**0.0069 J**	<0.005	**0.0071 J**	**0.008 J**
	Iron	EPA 200.7	mg/L	**0.02 J**	<0.01	<0.01	<0.01	<0.01
	Lead	EPA 200.7	mg/L	**0.0028 J**	<0.0025	<0.0025	**0.0028 J**	**0.0034 J**
	Magnesium	EPA 200.7	mg/L	**32**	**33**	**35**	**35**	**34**
	Manganese	EPA 200.7	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
	Mercury	EPA 7470	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Nickel	EPA 200.7	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
	Potassium	EPA 200.7	mg/L	**18 J**	**19 J**	**19 J**	**19 J**	**19**
	Sodium	EPA 200.7	mg/L	**210**	**220**	**230**	**230**	**230**
	Vanadium	EPA 200.7	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
	Zinc	EPA 200.7	mg/L	**0.045**	**0.028**	**0.019 J**	**0.019 J**	**0.022**

Notes:
mg/L = milligrams per liter
S.U. = pH Standard Unit
-- = not analyzed
bold value: detection

TABLE 1: SWF FLOW QUANTIFICATION SAMPLE RESULTS
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Analytical Method	Unit	Bird Viewing Ponds 2016				
				BP-06/2016	BP-07/2016	BP-08/2016	BP-08A/2016	BP-09/2016
				02/18/2016	02/18/2016	02/18/2016	02/18/2016	02/18/2016
General Chemistry	Alkalinity (as $CaCO_3$)	SM 2320	mg/L	**56**	**71**	**69**	**67 J**	**110**
	Bicarbonate as HCO_3	SM 2320	mg/L	**51**	**74**	**74**	**82**	**130**
	Carbon	EPA 5310B	mg/L	**9.5**	**9.4**	**12**	**12**	**9.3**
	Carbonate (CO_3)	SM 2320	mg/L	**8.8**	**6**	**5.1**	<2.4	**4**
	Chlorate	EPA 300.1	mg/L	<0.01	<0.01	<0.01	<0.01	**0.015 J**
	Chloride	EPA 300.0	mg/L	**320**	**250**	**420**	**420**	**260**
	Hydroxide	SM 2320	mg/L	<1.4	<1.4	<1.4	<1.4	<1.4
	Nitrate	EPA 300.0	mg/L	<0.0009	**1.6 J**	**0.19**	**0.13**	**3.19**
	Perchlorate	EPA 314.0	mg/L	<0.00095	<0.00095	<0.00095	<0.00095	<0.00095
	Phosphorus (total)	EPA 365.3	mg/L	**0.2**	**0.12**	**0.15**	**0.17**	**0.15 J**
	Sulfate	EPA 300.0	mg/L	**420**	**340**	**560**	**550**	**340**
	Dissolved Solids (total)	SM 2540C	mg/L	**1,300**	**1,100**	**1,800**	**1,800**	**1,100**
	pH	Field	S.U.	9.4	9.56	9.27	9.28	8.415
Metals	Aluminum	EPA 200.7	mg/L	**0.075**	**0.034 J**	**0.04 J**	**0.025 J**	**0.13**
	Antimony	EPA 200.8	mg/L	**0.00097 J**	**0.0013 J**	**0.00088 J**	**0.001 J**	**0.0011 J**
	Arsenic	EPA 200.8	mg/L	**0.0021**	**0.0026**	**0.0022**	**0.0025**	**0.0028**
	Barium	EPA 200.7	mg/L	**0.032**	**0.032**	**0.067**	**0.074**	**0.065**
	Boron	EPA 200.7	mg/L	**0.44**	**0.41**	**0.57**	**0.64**	**0.4**
	Cadmium	EPA 200.7	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
	Calcium	EPA 200.7	mg/L	**60**	**60**	**80**	**88**	**97**
	Chromium (total)	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Cobalt	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Copper	EPA 200.7	mg/L	**0.0064 J**	<0.005	<0.005	<0.005	**0.0087 J**
	Iron	EPA 200.7	mg/L	**0.013 J**	<0.01	**0.044**	**0.042 J**	**0.015 J**
	Lead	EPA 200.7	mg/L	<0.0025	<0.0025	<0.0025	**0.0053 J**	<0.0025
	Magnesium	EPA 200.7	mg/L	**42**	**38**	**55**	**61**	**38**
	Manganese	EPA 200.7	mg/L	<0.01	<0.01	**0.014 J**	**0.017 J**	<0.01
	Mercury	EPA 7470	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Nickel	EPA 200.7	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
	Potassium	EPA 200.7	mg/L	**25**	**20**	**33**	**36**	**27**
	Sodium	EPA 200.7	mg/L	**270**	**240**	**350**	**390**	**280**
	Vanadium	EPA 200.7	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
	Zinc	EPA 200.7	mg/L	**0.012 J**	**0.016 J**	<0.01	<0.01	**0.022**

Notes:
mg/L = milligrams per liter
S.U. = pH Standard Unit
-- = not analyzed
bold value: detection

TABLE 1: SWF FLOW QUANTIFICATION SAMPLE RESULTS
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Analytical Method	Unit	Northern SWF							
				PC-155A		PC-155B		PC-156A		PC-156B	
				05/06/2015	02/09/2016	05/06/2015	02/09/2016	05/06/2015	02/10/2016	05/06/2015	02/10/2016
General Chemistry	Alkalinity (as $CaCO_3$)	SM 2320	mg/L	**180**	--	**180**	--	**290**	--	**270**	--
	Bicarbonate as HCO_3	SM 2320	mg/L	**220**	--	**220**	--	**350**	--	**330**	--
	Carbon	EPA 5310B	mg/L	**1.8**	--	**1.8**	--	**2.7**	--	**2.6**	--
	Carbonate (CO_3)	SM 2320	mg/L	<2.4	--	<2.4	--	<2.4	--	<2.4	--
	Chlorate	EPA 300.1	mg/L	--	**0.31**	--	**0.29**	--	<0.01	--	**0.041**
	Chloride	EPA 300.0	mg/L	**660**	--	**660**	--	**610**	--	**650**	--
	Hydroxide	SM 2320	mg/L	<1.4	--	<1.4	--	<1.4	--	<1.4	--
	Nitrate	EPA 300.0	mg/L	**3.6 J**	--	**4.1 J**	--	**0.2 J**	--	**0.5 J**	--
	Perchlorate	EPA 314.0	mg/L	--	**3**	--	**2.9**	--	**0.12**	--	**0.98**
	Phosphorus (total)	EPA 365.3	mg/L	--	--	--	--	--	--	--	--
	Sulfate	EPA 300.0	mg/L	**1,500**	--	**1,400**	--	**890**	--	**980**	--
	Dissolved Solids (total)	SM 2540C	mg/L	--	**3,300**	--	**3,200**	--	**2,000**	--	**2,300**
	pH	Field	S.U.	7.04	--	7.02	--	7.02	--	7.1	--
Metals	Aluminum	EPA 200.7	mg/L	<0.025	--	**0.052**	--	<0.025	--	<0.025	--
	Antimony	EPA 200.8	mg/L	<0.0005	--	<0.0005	--	<0.0005	--	<0.0005	--
	Arsenic	EPA 200.8	mg/L	**0.07**	--	**0.071**	--	**0.1**	--	**0.11**	--
	Barium	EPA 200.7	mg/L	**0.015**	--	**0.013**	--	**0.026**	--	**0.019**	--
	Boron	EPA 200.7	mg/L	--	**1.8**	--	**1.7**	--	**0.79**	--	**1.1**
	Cadmium	EPA 200.7	mg/L	<0.002	--	<0.002	--	<0.002	--	<0.002	--
	Calcium	EPA 200.7	mg/L	**370**	--	**340**	--	**200**	--	**150**	--
	Chromium (total)	EPA 200.7	mg/L	--	<0.0025	--	<0.0025	--	<0.0025	--	<0.0025
	Cobalt	EPA 200.7	mg/L	**0.0051 J**	--	**0.0036 J**	--	**0.0033 J**	--	**0.0045 J**	--
	Copper	EPA 200.7	mg/L	<0.005	--	<0.005	--	<0.005	--	<0.005	--
	Iron	EPA 200.7	mg/L	**0.016 J**	--	<0.01	--	<0.01	--	**0.018 J**	--
	Lead	EPA 200.7	mg/L	**0.0038 J**	--	**0.0034 J**	--	<0.0025	--	<0.0025	--
	Magnesium	EPA 200.7	mg/L	**150**	--	**140**	--	**72**	--	**61**	--
	Manganese	EPA 200.7	mg/L	**1.5**	--	**1.3**	--	**0.6**	--	**0.7**	--
	Mercury	EPA 7470	mg/L	<0.0001	--	<0.0001	--	<0.0001	--	<0.0001	--
	Nickel	EPA 200.7	mg/L	**0.017**	--	**0.013**	--	**0.02**	--	**0.021**	--
	Potassium	EPA 200.7	mg/L	**28**	--	**29**	--	**24**	--	**29**	--
	Sodium	EPA 200.7	mg/L	**580**	--	**550**	--	**500**	--	**660**	--
	Vanadium	EPA 200.7	mg/L	**0.029**	--	**0.03**	--	**0.081**	--	**0.037**	--
	Zinc	EPA 200.7	mg/L	**0.011 J**	--	<0.01	--	<0.01	--	**0.01 J**	--

Notes:
mg/L = milligrams per liter
S.U. = pH Standard Unit
-- = not analyzed
bold value: detection

TABLE 1: SWF FLOW QUANTIFICATION SAMPLE RESULTS
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Analytical Method	Unit	Northern SWF				Central SWF				
				PC-157A		PC-157B		PC-115R	PC-116R	PC-117	PC-90	PC-99R2/R3
				05/06/2015	02/09/2016	05/06/2015	02/09/2016	02/12/2016	02/12/2016	02/12/2016	02/08/2016	02/12/2016
General Chemistry	Alkalinity (as $CaCO_3$)	SM 2320	mg/L	**290**	--	**180**	--	**260**	**230**	**230**	**240**	**220**
	Bicarbonate as HCO_3	SM 2320	mg/L	**350**	--	**220**	--	**310**	**280**	**280**	**290**	**270**
	Carbon	EPA 5310B	mg/L	**2.6**	--	**1.9**	--	**2.3**	**2.3**	**2.7**	**2.4**	**2.2**
	Carbonate (CO_3)	SM 2320	mg/L	<2.4	--	<2.4	--	<2.4	<2.4	<2.4	<2.4	<2.4
	Chlorate	EPA 300.1	mg/L	--	<0.01	--	**0.32**	**96**	**30**	**15**	**13**	**20**
	Chloride	EPA 300.0	mg/L	**580**	--	**600**	--	**920**	**1,000**	**780**	**1,000**	**1,100**
	Hydroxide	SM 2320	mg/L	<1.4	--	<1.4	--	<1.4	<1.4	<1.4	<1.4	<1.4
	Nitrate	EPA 300.0	mg/L	<0.56	--	**3.4 J**	--	**4.95**	**6.35**	**3.21**	**4.5**	**7.61**
	Perchlorate	EPA 314.0	mg/L	--	**0.12**	--	**3**	**15**	**18**	**8.6**	**12**	**20**
	Phosphorus (total)	EPA 365.3	mg/L	--	--	--	--	**0.078**	**0.059**	**0.059**	**0.035 J**	**0.053**
	Sulfate	EPA 300.0	mg/L	**910**	--	**1,300**	--	**1,100**	**1,300**	**890**	**1,200**	**1,400**
	Dissolved Solids (total)	SM 2540C	mg/L	--	**2,000**	--	**3,200**	**3,500**	**4,200**	**3,100**	**3,900**	**4,300**
	pH	Field	S.U.	7.04	--	7.03	--	7.17	7.185	7.165	7.16	7.265
Metals	Aluminum	EPA 200.7	mg/L	<0.025	--	<0.025	--	<0.025	<0.025	<0.025	**0.03 J**	<0.025
	Antimony	EPA 200.8	mg/L	<0.0005	--	<0.0005	--	<0.0005	<0.0005	<0.0005	**0.0018 J**	<0.0005
	Arsenic	EPA 200.8	mg/L	**0.12**	--	**0.077**	--	**0.11**	**0.11**	**0.1**	**0.12**	**0.11**
	Barium	EPA 200.7	mg/L	**0.041**	--	**0.014**	--	**0.023**	**0.02**	**0.017**	**0.024**	**0.019**
	Boron	EPA 200.7	mg/L	--	**0.82**	--	**1.7**	**1.4**	**1.7**	**1.3**	**1.5**	**1.9**
	Cadmium	EPA 200.7	mg/L	<0.002	--	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
	Calcium	EPA 200.7	mg/L	**220**	--	**350**	--	**220**	**250**	**200**	**310**	**250**
	Chromium (total)	EPA 200.7	mg/L	--	<0.0025	--	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Cobalt	EPA 200.7	mg/L	<0.0025	--	**0.0052 J**	--	**0.0052 J**	**0.004 J**	**0.0057 J**	**0.0032 J**	**0.003 J**
	Copper	EPA 200.7	mg/L	<0.005	--	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005
	Iron	EPA 200.7	mg/L	**0.066**	--	**0.048**	--	**0.013 J**	<0.01	**0.011 J**	<0.01	<0.01
	Lead	EPA 200.7	mg/L	<0.0025	--	<0.0025	--	0.0025 UJ	0.0025 UJ	0.0025 UJ	<0.0025	0.0025 UJ
	Magnesium	EPA 200.7	mg/L	**90**	--	**140**	--	**82**	**91**	**73**	**110**	**97**
	Manganese	EPA 200.7	mg/L	**0.16**	--	**1.5**	--	**0.83**	**0.61**	**0.61**	**0.17**	**0.73**
	Mercury	EPA 7470	mg/L	<0.0001	--	**0.00021**	--	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Nickel	EPA 200.7	mg/L	**0.019**	--	**0.019**	--	**0.012**	**0.011**	**0.015**	**0.013**	**0.0088 J**
	Potassium	EPA 200.7	mg/L	**27**	--	**31**	--	**20**	**20**	**18**	**24**	**20**
	Sodium	EPA 200.7	mg/L	**560**	--	**610**	--	**790**	**910**	**660**	**780**	**940**
	Vanadium	EPA 200.7	mg/L	**0.073**	--	**0.032**	--	**0.076**	**0.061**	**0.048**	**0.075**	**0.063**
	Zinc	EPA 200.7	mg/L	<0.01	--	<0.01	--	<0.01	<0.01	<0.01	<0.01	<0.01

Notes:
mg/L = milligrams per liter
S.U. = pH Standard Unit
-- = not analyzed
bold value: detection

TABLE 1: SWF FLOW QUANTIFICATION SAMPLE RESULTS
Nevada Environmental Response Trust Site
Henderson, Nevada

Chemical Group	Analyte	Analytical Method	Unit	Eastern SWF			Western SWF					
				PC-133	PC-91	PC-97	PC-118	PC-119	PC-120	PC-121	PC-62	PC-86
				02/12/2016	02/11/2016	02/08/2016	02/12/2016	02/12/2016	02/12/2016	02/12/2016	02/08/2016	02/08/2016
General Chemistry	Alkalinity (as $CaCO_3$)	SM 2320	mg/L	**240**	**230**	**220**	**260**	**250**	**240**	**240**	**300**	**240**
	Bicarbonate as HCO_3	SM 2320	mg/L	**290**	**280**	**270**	**310**	**300**	**290**	**290**	**370**	**290**
	Carbon	EPA 5310B	mg/L	**3**	**2.6**	**3.2**	**2.8**	**3.1**	**3**	**3.8**	**3.1**	**3.2**
	Carbonate (CO_3)	SM 2320	mg/L	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4
	Chlorate	EPA 300.1	mg/L	**16**	**2.1**	<0.01	**1.2**	<0.01	<0.01	<0.01	<0.05	<0.01
	Chloride	EPA 300.0	mg/L	**470**	**570**	**390**	**600**	**390**	**360**	**370**	**420**	**380**
	Hydroxide	SM 2320	mg/L	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
	Nitrate	EPA 300.0	mg/L	--	**0.95**	**0.15**	**0.86**	<0.0009	<0.0009	<0.0009	**0.23**	<0.056
	Perchlorate	EPA 314.0	mg/L	**1.6**	**2.6**	**0.31**	**4.1**	**0.3**	**0.011**	**0.007**	**0.5**	<0.00095
	Phosphorus (total)	EPA 365.3	mg/L	<0.025	<0.025	**0.1**	**0.066**	**0.1**	**0.087**	**0.083**	**0.18**	**0.094**
	Sulfate	EPA 300.0	mg/L	**620**	**750**	**580**	**670**	**460**	**440**	**440**	**480**	**470**
	Dissolved Solids (total)	SM 2540C	mg/L	**2,100**	**2,700**	**1,900**	**2,400**	**1,700**	**1,700**	**1,700**	**1,900**	**1,700**
	pH	Field	S.U.	7.155	7.03	7.09	7.26	7.265	7.27	7.255	6.99	7.18
Metals	Aluminum	EPA 200.7	mg/L	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	**0.037 J**	<0.025
	Antimony	EPA 200.8	mg/L	<0.0005	<0.0005	**0.00059 J**	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	**0.0045**
	Arsenic	EPA 200.8	mg/L	**0.091**	**0.073**	**0.1**	**0.12**	**0.1**	**0.097**	**0.094**	**0.1**	**0.096**
	Barium	EPA 200.7	mg/L	**0.015**	**0.013**	**0.02**	**0.02**	**0.015**	**0.0084 J**	**0.018**	**0.036**	**0.021**
	Boron	EPA 200.7	mg/L	**0.9**	**1.4**	**0.8**	**0.93**	**0.67**	**0.64**	**0.63**	**0.78**	**0.66**
	Cadmium	EPA 200.7	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
	Calcium	EPA 200.7	mg/L	**160**	**150**	**160**	**130**	**120**	**130**	**120**	**120**	**130**
	Chromium (total)	EPA 200.7	mg/L	<0.0025	0.0025 UJ	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
	Cobalt	EPA 200.7	mg/L	**0.0052 J**	**0.0055 J**	**0.0067 J**	**0.0054 J**	**0.0067 J**	**0.0061 J**	**0.0074 J**	**0.0077 J**	**0.0072 J**
	Copper	EPA 200.7	mg/L	<0.005	<0.005	**0.0053 J**	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Iron	EPA 200.7	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	0.01 UJ	**0.024 J**	<0.01	<0.01
	Lead	EPA 200.7	mg/L	0.0025 UJ	**0.0034 J**	<0.0025	0.0025 UJ	0.0025 UJ	0.0025 UJ	0.0025 UJ	<0.0025	<0.0025
	Magnesium	EPA 200.7	mg/L	**59**	**97**	**58**	**54**	**40**	**43**	**42**	**50**	**44**
	Manganese	EPA 200.7	mg/L	**0.44**	**0.049**	**0.71**	**0.6**	**0.51**	<0.01	**0.5**	**0.7**	**0.57**
	Mercury	EPA 7470	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Nickel	EPA 200.7	mg/L	**0.018**	**0.018**	**0.023**	**0.015**	**0.018**	**0.017**	**0.019**	**0.018**	**0.018**
	Potassium	EPA 200.7	mg/L	**16**	**27**	**20**	**19**	**17**	**15**	**16**	**19**	**19**
	Sodium	EPA 200.7	mg/L	**380**	**610**	**390**	**540**	**360**	**320**	**320**	**420**	**370**
	Vanadium	EPA 200.7	mg/L	**0.046**	**0.05**	**0.051**	**0.068**	**0.045**	**0.037**	**0.043**	**0.09**	**0.045**
	Zinc	EPA 200.7	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	**0.013 J**	<0.01	<0.01	<0.01

Notes:
mg/L = milligrams per liter
S.U. = pH Standard Unit
-- = not analyzed
bold value: detection

TABLE 2: PERCENTAGE OF BVP WATER IN SWF WELLS
Nevada Environmental Response Trust Site
Henderson, Nevada

Location		February 2016 TDS (mg/L)	% BVP[1]	April 2016 Flow (gpm)
Shallow Groundwater near AWF		4,960	0%	--
Bird Viewing Ponds		1,260	100%	--
Northern SWF	PC-155A	3,300	45%	--
	PC-155B	3,200	48%	--
	PC-156A	2,000	80%	--
	PC-156B	2,300	72%	--
	PC-157A	2,000	80%	--
	PC-157B	3,200	48%	--
Central SWF	PC-115R	3,500	39%	116.7
	PC-116R	4,200	21%	116.7
	PC-117	3,100	50%	116.7
	PC-90	3,900	29%	--
	PC-99R2/R3	4,300	18%	58.4
Eastern SWF	PC-133	2,100	77%	9.1
	PC-91	2,700	61%	--
	PC-97	1,900	83%	--
Western SWF	PC-118	2,400	69%	58.4
	PC-119	1,700	88%	58.4
	PC-120	1,700	88%	0.0
	PC-121	1,700	88%	0.0
	PC-62	1,900	83%	--
	PC-86	1,700	88%	--

Notes:

mg/L = milligrams per liter

gpm = gallons per minute

-- = not a pumping well

1. Values are +/- 10% due to uncertainty in average shallow groundwater TDS

LEGEND

Sampling Locations

- Las Vegas Wash
- Deep Groundwater near AWF
- Shallow Groundwater near AWF
- Bird Viewing Ponds 2016
- Bird Viewing Ponds 2015
- Northern Seep Well Field
- Central Seep Well Field
- Eastern Seep Well Field
- Western Seep Well Field
- Transducer Location
- Pabco Road Gage

PC-121 Extraction Well

N
W E
S

0 375 750 1,500 Feet

RAMBOLL ENVIRON

SWF Flow Quantification Sample and CTD Logger Locations

Nevada Environmental Response Trust Site

Henderson, Nevada

Date: 9/2/2016	Contract Number: 21-38800C		Figure
Drafter: ERG	Approved:	Revised:	1a

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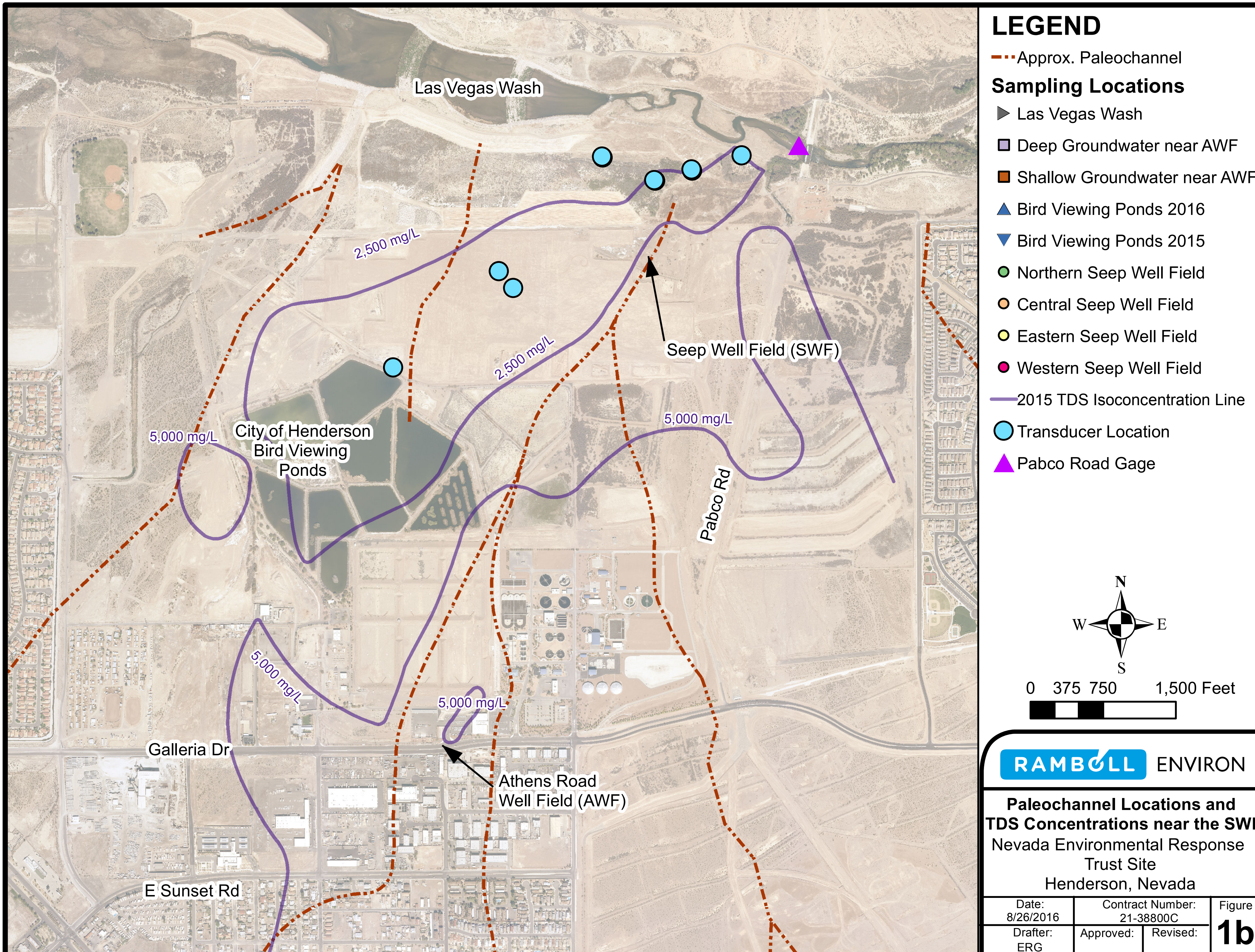

RAMBOLL ENVIRON

Paleochannel Locations and TDS Concentrations near the SWF

Nevada Environmental Response Trust Site
Henderson, Nevada

Date: 8/26/2016	Contract Number: 21-38800C		Figure 1b
Drafter: ERG	Approved:	Revised:	

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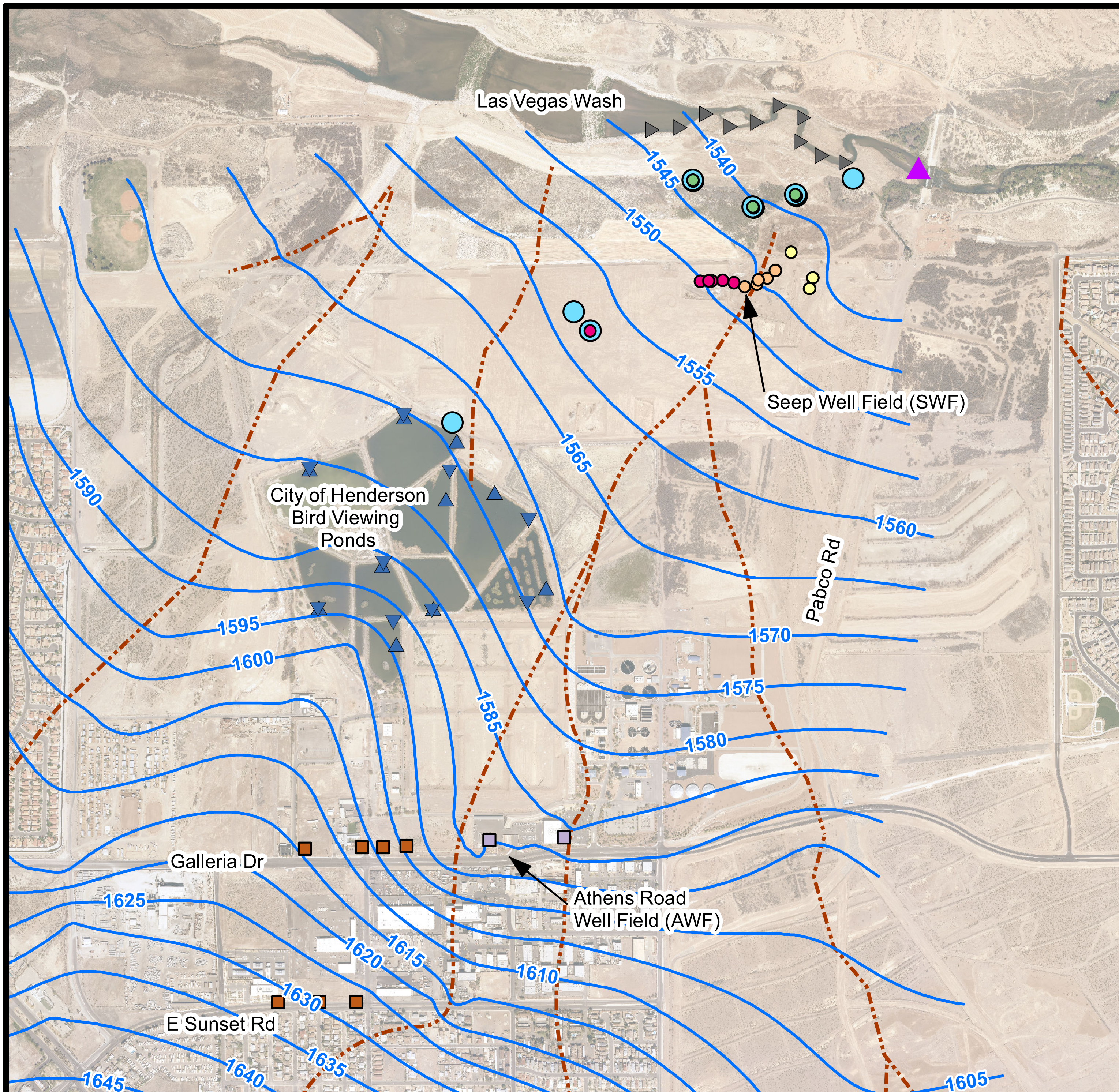

LEGEND

Potentiometric Surface Contour (feet), 2015

Approx. Paleochannel

Sampling Locations

- Las Vegas Wash
- Deep Groundwater near AWF
- Shallow Groundwater near AWF
- Bird Viewing Ponds 2016
- Bird Viewing Ponds 2015
- Northern Seep Well Field
- Central Seep Well Field
- Eastern Seep Well Field
- Western Seep Well Field
- Transducer Location
- Pabco Road Gage

N
W E
S

0 375 750 1,500 Feet

RAMBOLL ENVIRON

Potentiometric Surface Contours near the SWF

Nevada Environmental Response Trust Site
Henderson, Nevada

Date: 8/23/2016	Contract Number: 21-38800C		Figure 1c
Drafter: ERG	Approved:	Revised:	

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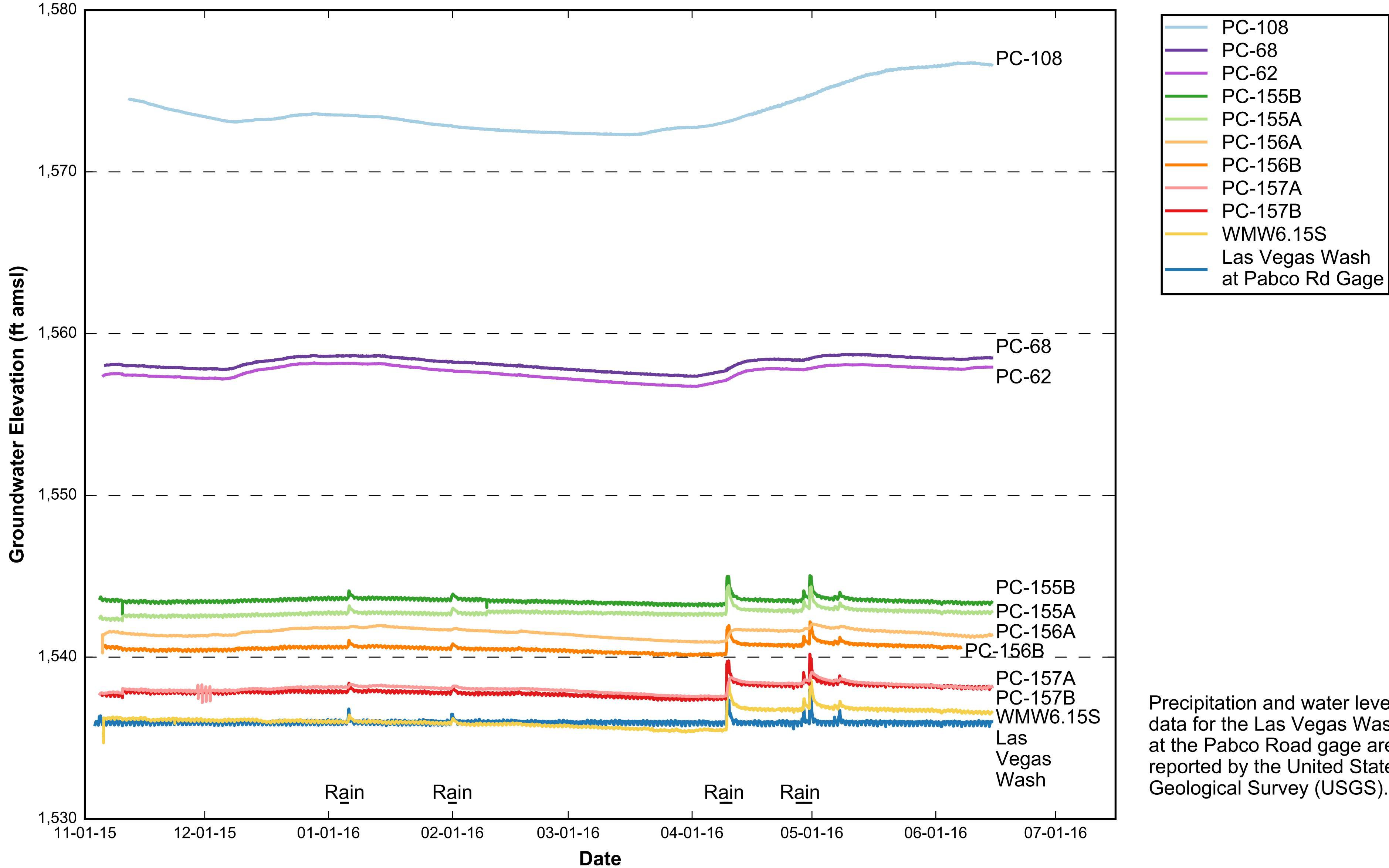

Precipitation and water level data for the Las Vegas Wash at the Pabco Road gage are reported by the United States Geological Survey (USGS).

RAMBOLL ENVIRON

Groundwater Elevation Measured by CTD Loggers near the SWF
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure

2

Drafter: ERG | Date: 08/25/2016 | Contract Number: 21-38800C | Approved: | Revised:

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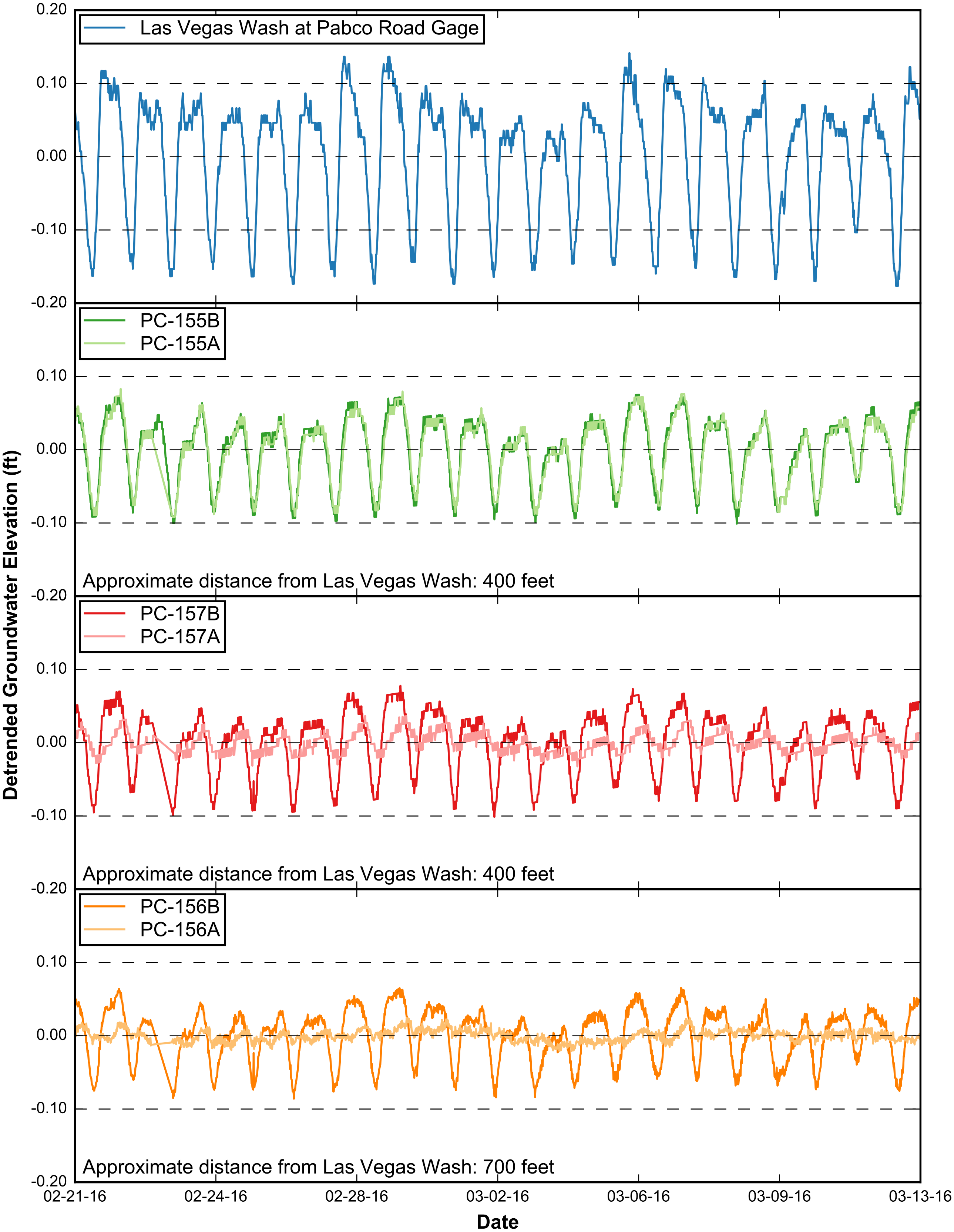


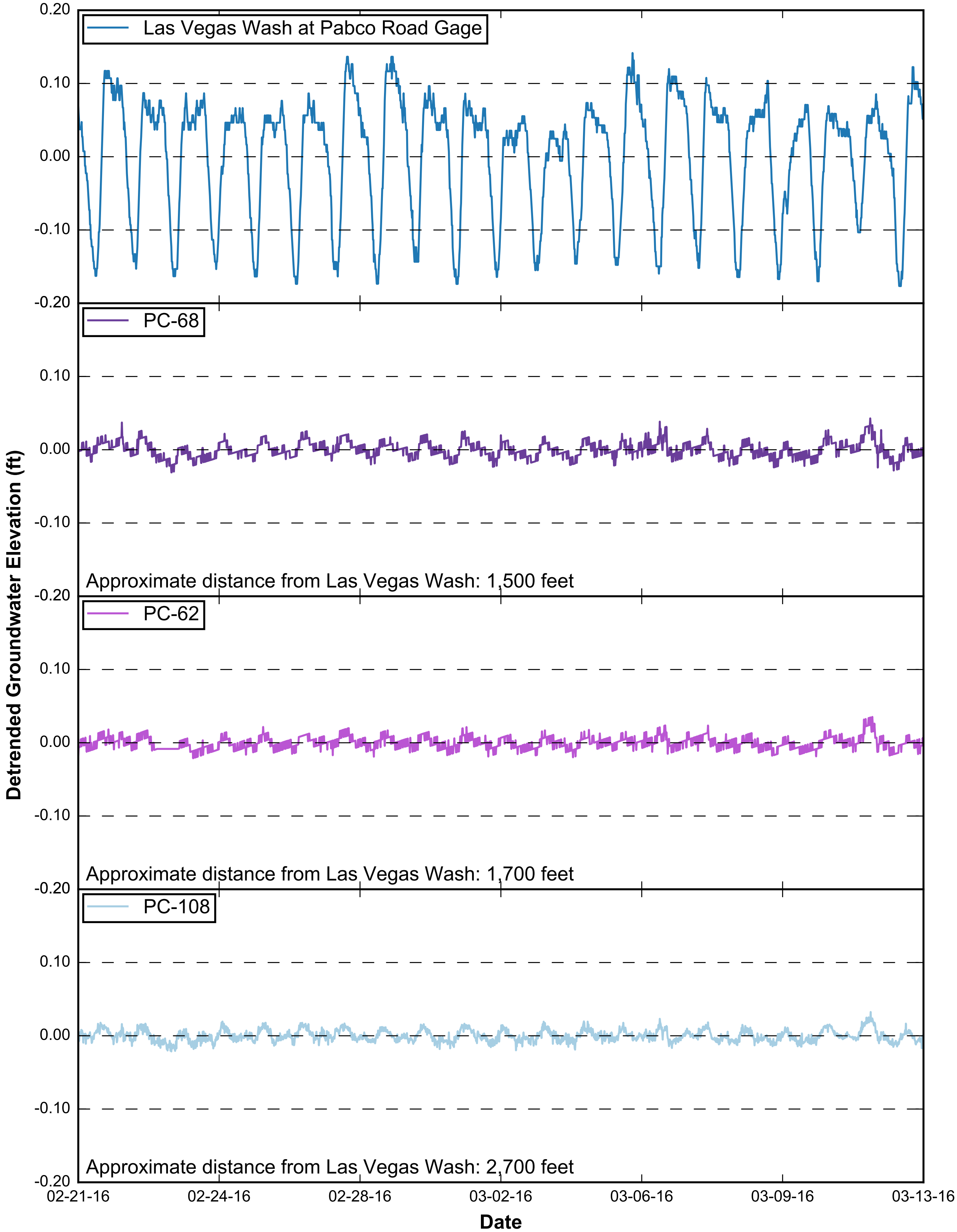
RAMBOLL ENVIRON

Detrended Groundwater Elevations North of SWF
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
3a

Drafter: ERG | Date: 09/02/2016 | Contract Number: 21-38800C | Approved: | Revised:

Path: ramboll\projects\NERT\GWETS\normalizedGWEplots.py



RAMBOLL ENVIRON

Detrended Groundwater Elevations Southwest of SWF
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
3b

Drafter: ERG | Date: 09/02/2016 | Contract Number: 21-38800C | Approved: | Revised:

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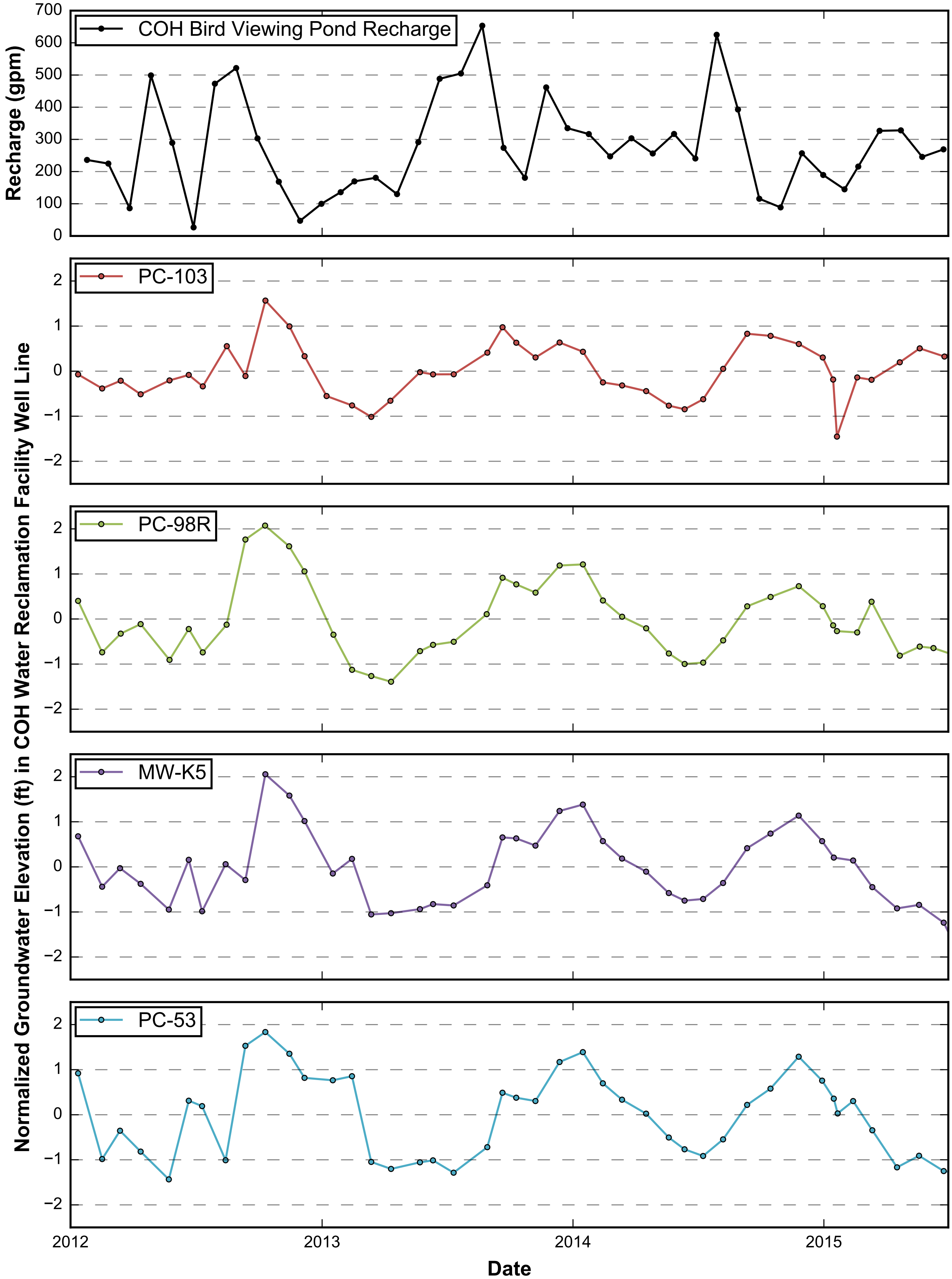

Bird Viewing Ponds Recharge and Nearby Groundwater Elevations
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
4a

Drafter: ERG | Date: 06/13/2016 | Contract Number: 21-38800C | Approved: | Revised:

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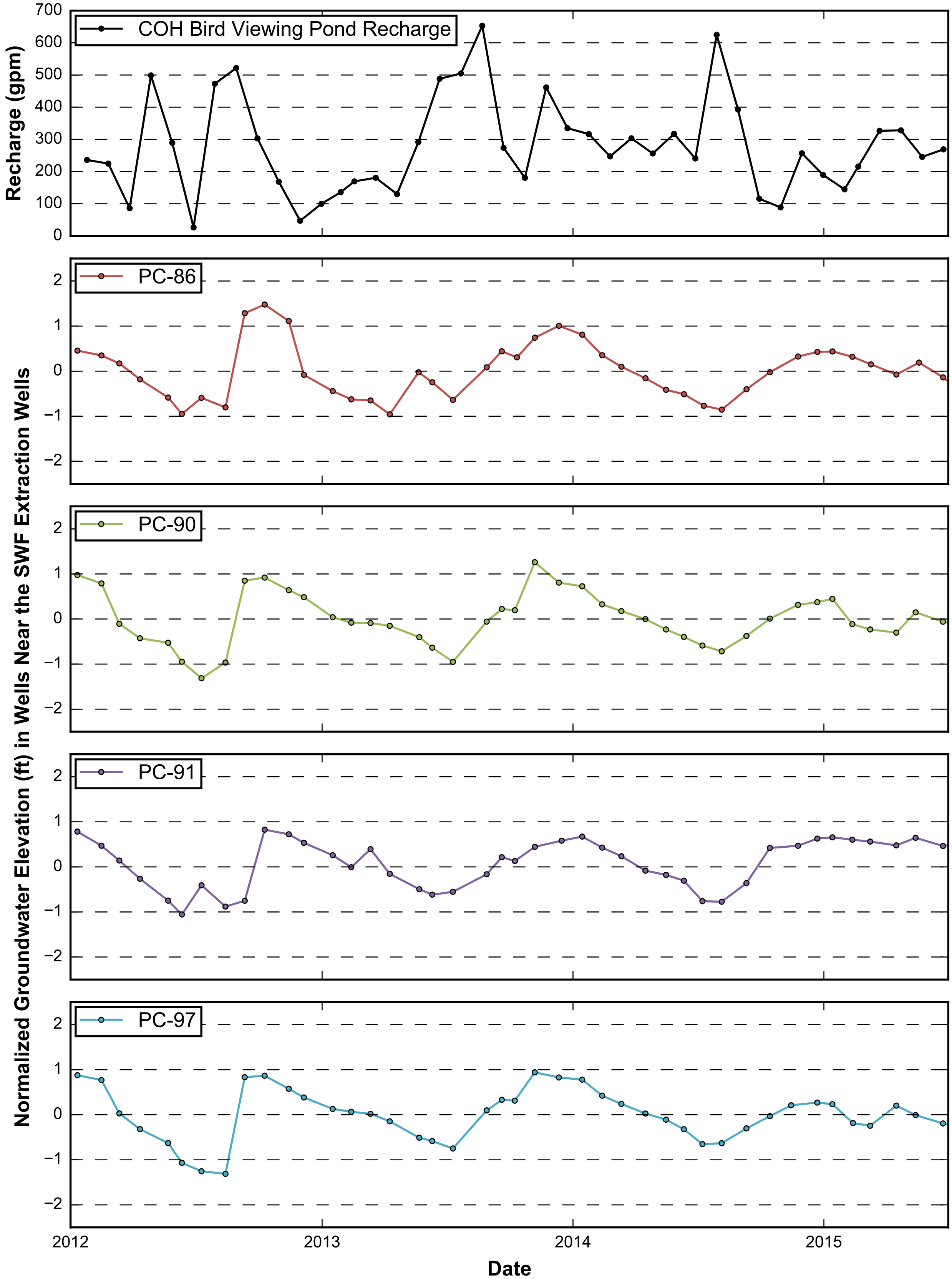
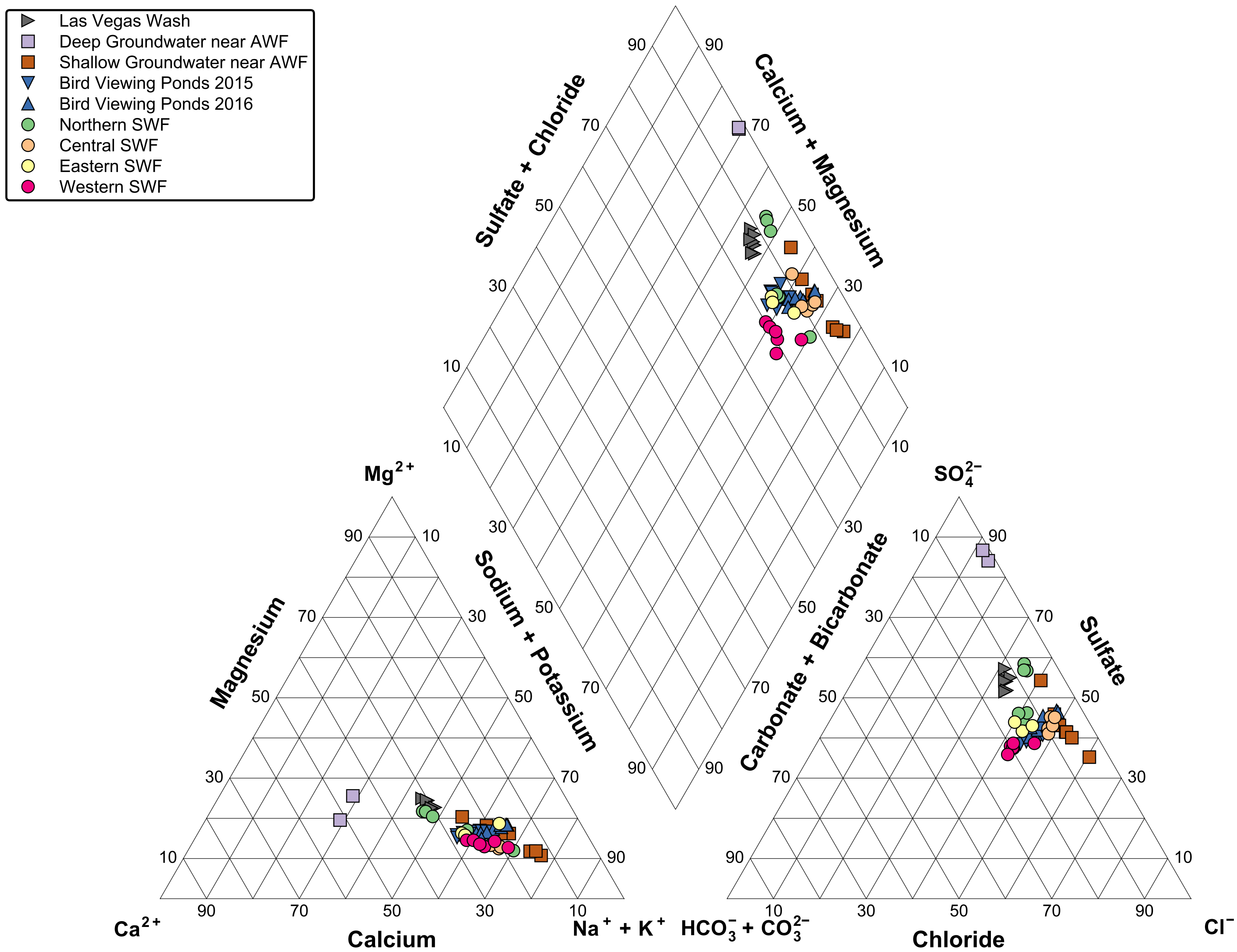


RAMBOLL ENVIRON

Bird Viewing Ponds Recharge and Groundwater Elevations near SWF
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
4b

Drafter: ERG | Date: 06/09/2016 | Contract Number: 21-38800C | Approved: | Revised:



RAMBOLL ENVIRON

Seep Well Field Flow Quantification Piper Diagram
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
5

Drafter: JH	Date: 09/02/16	Contract Number: 21-38800C	Approved:	Revised:

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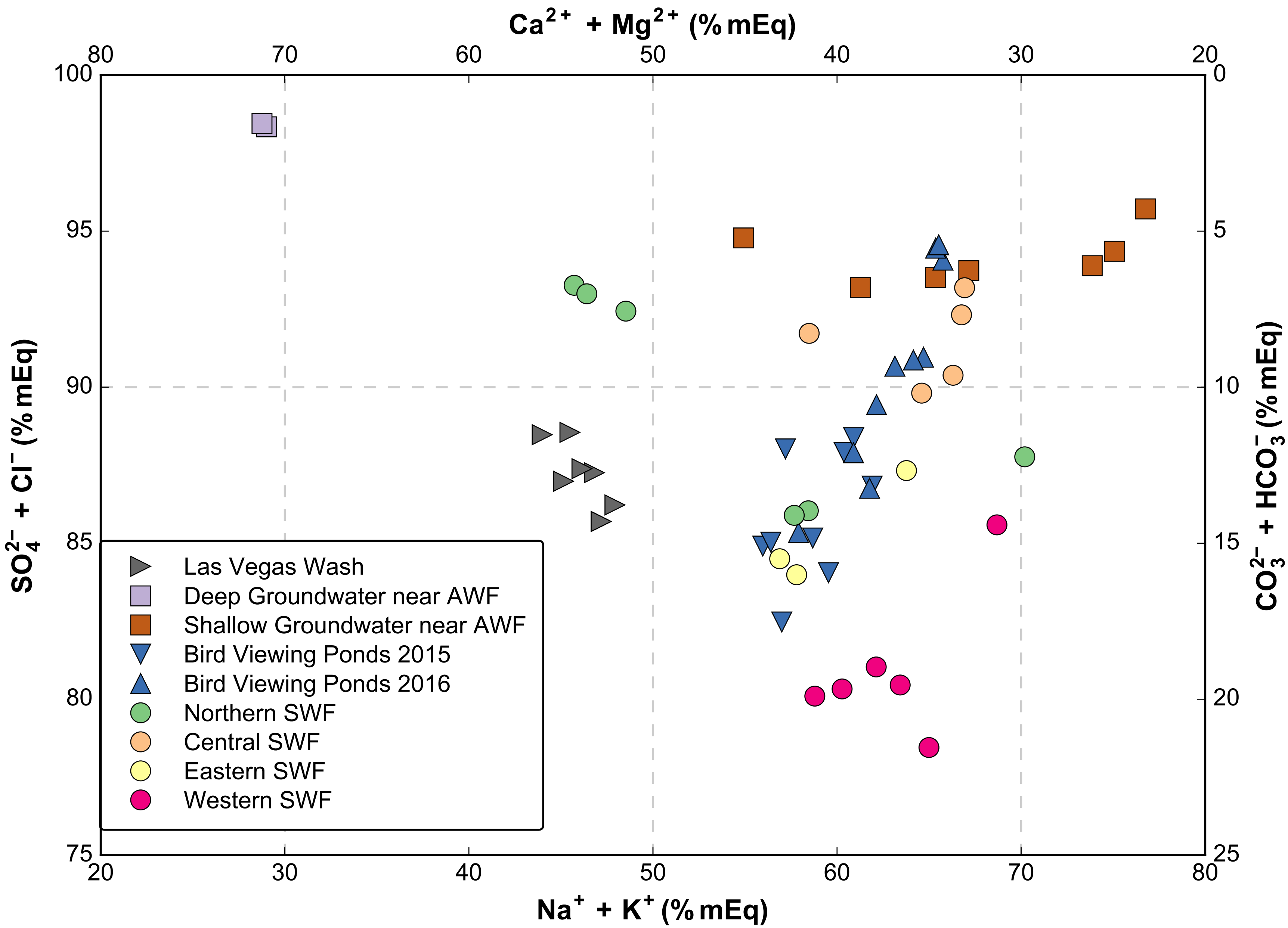

RAMBOLL ENVIRON

Seep Well Field Flow Quantification Modified Piper Diagram
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure
6

Drafter: JH	Date: 09/02/16	Contract Number: 21-38800C	Approved:	Revised:

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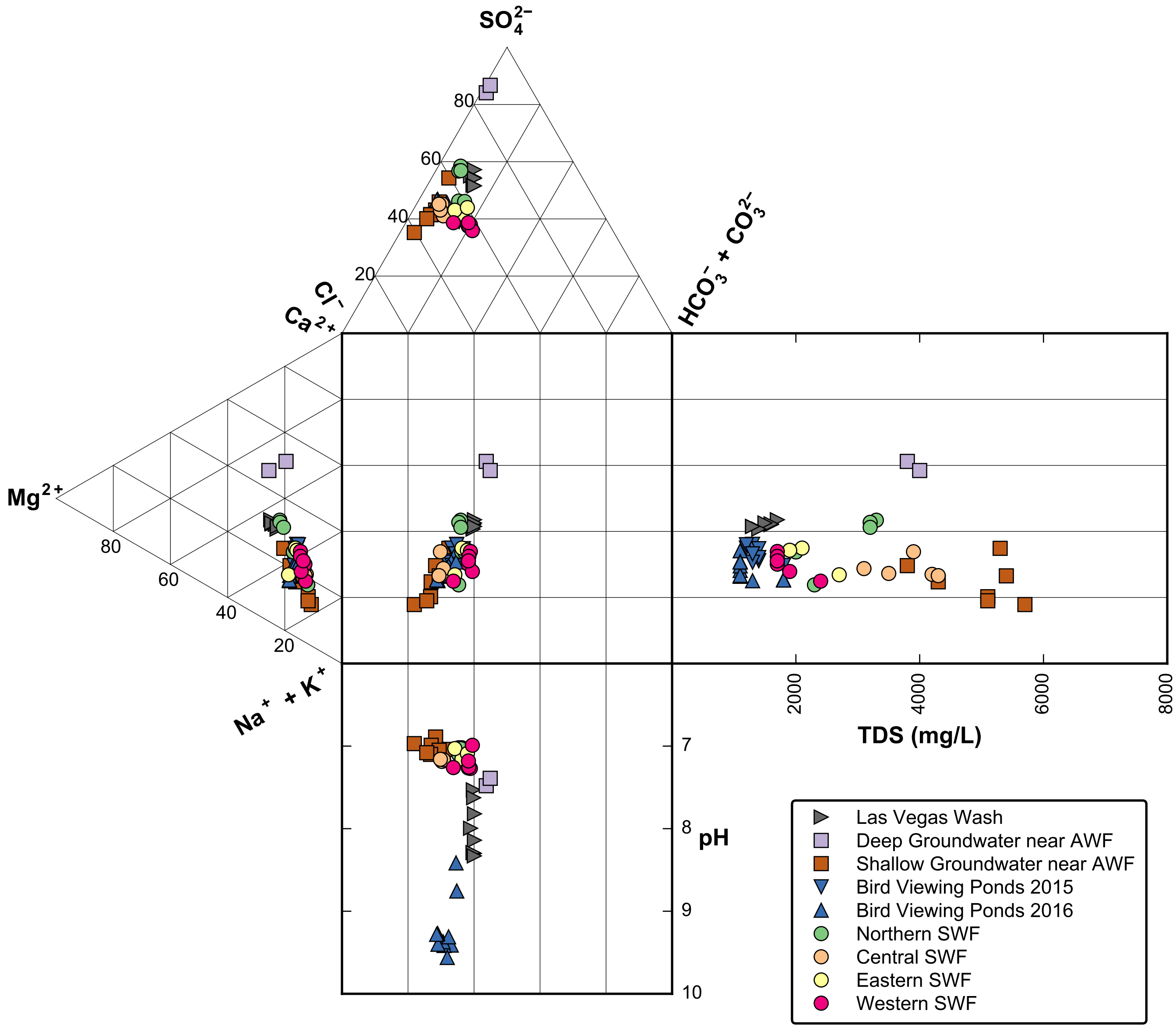

RAMBOLL ENVIRON

Seep Well Field Flow Quantification Durov Diagram
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure **7**

Drafter: JH	Date: 09/02/16	Contract Number: 21-38800C	Approved:	Revised:

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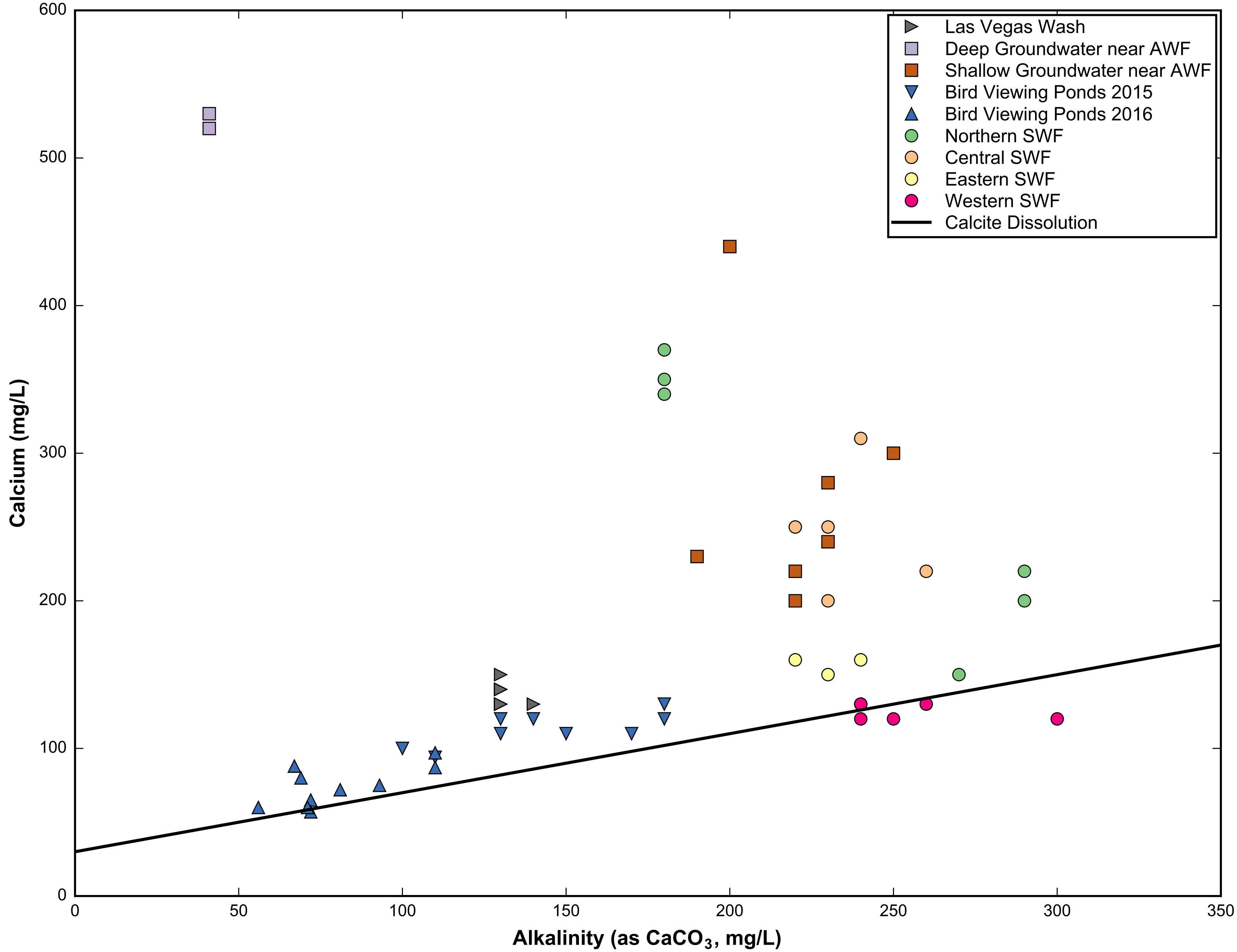

RAMBOLL ENVIRON

Seep Well Field Flow Quantification Alkalinity vs. Calcium
Nevada Environmental Response Trust Site
Henderson, Nevada

Figure **8**

Drafter: JH | Date: 09/02/16 | Contract Number: 21-38800C | Approved: | Revised: