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Surface Water Investigation Technical Memorandum

NERT Remedial Investigation – Downgradient Study Area
Nevada Environmental Response Trust Site
Henderson, Nevada

Final Draft

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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.

_____ _____

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Contents

1.0 Introduction 1-1

2.0 Field Procedures 2-1

2.1 Sampling Event during USGS Seepage Study, December 2016 2-1
2.1.1 Sampling Procedures 2-2
2.1.2 Deviations from SWIP 2-2

2.2 Staff Gage Installation 2-3
2.2.1 Installation Procedures 2-3
2.2.2 Deviations from SWIP 2-4

2.3 Transect Sampling 2-4
2.3.1 Sampling Procedures 2-4
2.3.2 Deviations from SWIP 2-5

2.4 Discrete Sampling 2-5
2.4.1 Sampling Procedures 2-5
2.4.2 Deviations from SWIP 2-6

3.0 Analytical Program 3-1

4.0 Data Validation 4-1

5.0 Summary of Surface Water Data: Sampling Event during USGS Seepage Study .. 5-1

5.1 Field Water Quality Parameters 5-1

5.2 Laboratory Analyses Results 5-1
5.2.1 Perchlorate 5-1
5.2.2 Chlorate 5-2
5.2.3 Total Dissolved Solids 5-3
5.2.4 Chloride and Bromide 5-3
5.2.5 Quality Control Samples 5-3

6.0 Summary of Staff Gage Installation and Cross Sections 6-1

6.1 Gage Readings 6-1

6.2 Cross Sections 6-1

7.0 Summary of Surface Water Data: Transect Sampling 7-1

7.1 Field Water Quality Parameters 7-1

7.2 Laboratory Analyses Results 7-1
7.2.1 Perchlorate 7-1

7.2.2 Chlorate 7-3
7.2.3 Total Dissolved Solids 7-4
7.2.4 Chloride and Bromide 7-5
7.3 Quality Control Samples 7-8

8.0 Summary of Surface Water Data: Discrete Sampling 8-1
8.1 Field Water Quality Parameters 8-1
8.2 Laboratory Analyses Results 8-1
8.2.1 Perchlorate 8-1
8.2.2 Chlorate 8-3
8.2.3 Total Dissolved Solids 8-4
8.2.4 Chloride and Bromide 8-4
8.2.5 Quality Control Samples 8-5

9.0 Perchlorate Mass Flux Estimates 9-1
9.1 Screening of Samples 9-1
9.2 Provisional Flow Estimates for Flux Calculations 9-1
9.3 Flux Estimates: Transect Samples 9-2
9.4 Flux Estimates: Discrete Samples 9-4
9.5 Influence of Wastewater Discharge and Flow 9-7

10.0 Revised Conceptual Site Model for Las Vegas Wash 10-1
10.1 Anthropogenic Sources of Discharge to the LVW 10-1
10.2 Known Sources of Perchlorate 10-2
10.3 Perchlorate Patterns and Suspected Discharges ..... **Error! Bookmark not defined.**

11.0 Conclusions 11-1

12.0 Recommendations 12-1

13.0 References 13-1

List of Appendices

Appendix A – Daily Field Reports
A1 – Sampling Event during USGS Seepage Study
A2 – Staff Gage Installation
A3 – Transect Sampling

A4 – Discrete Sampling

Appendix B – Daily Health and Safety Sheets

B1 – Sampling Event during USGS Seepage Study

B2 – Staff Gage Installation

B3 – Transect Sampling

B4 – Discrete Sampling

Appendix C –Calibration Logs

C1 – Sampling Event during USGS Seepage Study

C2 – Staff Gage Installation

C3 – Transect Sampling

C4 – Discrete Sampling

Appendix D – Sample Times and Flows

D1 – Sampling Event during USGS Seepage Study

D2 – Transect Sampling

D3 – Discrete Sampling

Appendix E – Laboratory Reports

E1 – Sampling Event during USGS Seepage Study

E2 – Transect Sampling

E3 – Discrete Sampling

Appendix F – Data Validation Summary Report

Appendix G – Staff Gage Data and Cross Sections of Transects

List of Figures

Figure 1 Downgradient Study Area Location Map

Figure 2 Locations of Surface Water and Seep Samples: May, 2016

Figure 3 Locations of Surface Water Samples: Sampling Event during USGS Seepage Study

Figure 4 Locations of USGS Gages, AECOM Gages and Barometers

Figure 5 Transects and Sample Locations

Figure 6 Locations of Surface Water Samples: Discrete Sampling

Figure 7 Perchlorate Concentrations in Surface Water Samples: Sampling Event during USGS Seepage Study

Figure 8 Concentrations of Perchlorate by River Mile: Sampling Event during USGS Seepage Study

Figure 9 Concentrations of Perchlorate by River Mile: Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016

Figure 10 Chlorate concentrations in Surface Water Samples: Sampling Event during USGS Seepage Study

Figure 11 Concentrations of Chlorate by River Mile: Sampling Event during USGS Seepage Study

Figure 12 Concentrations of Chlorate by River Mile: Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016

Figure 13 Total Dissolved Solids concentrations in Surface Water Samples: Sampling Event during USGS Seepage Study

Figure 14 Concentrations of Total Dissolved Solids by River Mile: Sampling Event during USGS Seepage Study

Figure 15 Concentrations of Total Dissolved Solids by River Mile: Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016

Figure 16 Chloride concentrations in Surface Water Samples: Sampling Event during USGS Seepage Study

Figure 17 Concentrations of Chloride by River Mile: Sampling Event during USGS Seepage Study

Figure 18 Concentrations of Chloride by River Mile: Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016

Figure 19 Bromide concentrations in Surface Water Samples: Sampling Event during USGS Seepage Study

Figure 20 Concentrations of Bromide by River Mile: Sampling Event during USGS Seepage Study

Figure 21 Concentrations of Bromide by River Mile: Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016

Figure 22 Chloride/Bromide Ratio in Surface Water Samples: Sampling Event during USGS Seepage Study

Figure 23 Ratio of Chloride/Bromide by River Mile: Sampling Event during USGS Seepage Study

Figure 24 Ratio of Chloride/Bromide by River Mile: Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016

Figure 25 Transect Sampling Perchlorate Concentrations

Figure 26 Transect Sampling Chlorate Concentrations

Figure 27 Transect Sampling Total Dissolved Solids

Figure 28 Transect Sampling Chloride Concentrations
Figure 29 Transect Sampling Bromide Concentrations
Figure 30 Transect Sampling Ratio of Chloride/Bromide
Figure 31 Perchlorate in Surface Water Samples by River Mile: Discrete Sampling Low Flow
Figure 32 Perchlorate in Surface Water Samples by River Mile: Discrete Sampling High Flow
Figure 33 Perchlorate in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
Figure 34 Chlorate in Surface Water Samples by River Mile: Discrete Sampling Low Flow
Figure 35 Chlorate in Surface Water Samples by River Mile: Discrete Sampling High Flow
Figure 36 Chlorate in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
Figure 37 Total Dissolved Solids in Surface Water Samples by River Mile: Discrete Sampling Low Flow
Figure 38 Total Dissolved Solids in Surface Water Samples by River Mile: Discrete Sampling High Flow
Figure 39 Total Dissolved Solids in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
Figure 40 Chloride in Surface Water Samples by River Mile: Discrete Sampling Low Flow
Figure 41 Chloride in Surface Water Samples by River Mile: Discrete Sampling High Flow
Figure 42 Chloride in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
Figure 43 Bromide in Surface Water Samples by River Mile: Discrete Sampling Low Flow
Figure 44 Bromide in Surface Water Samples by River Mile: Discrete Sampling High Flow
Figure 45 Bromide in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
Figure 46 Chloride/Bromide Ratio in Surface Water Samples: Discrete Sampling Low Flow
Figure 47 Chloride/Bromide Ratio in Surface Water Samples by River Mile: Discrete Sampling High Flow
Figure 48 Chloride/Bromide Ratio in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
Figure 49 Perchlorate Flux Estimates (lb/day): Transect Samples
Figure 50 Perchlorate Flux Estimates (lb/day): Discrete Low-Flow Samples
Figure 51 Perchlorate Flux Estimates (lb/day): Discrete High-Flow Samples
Figure 52 Perchlorate Flux Estimates (lb/day): Discrete Mid-Flow Samples
Figure 53 Revised CSM
Figure 54 Perchlorate Flux Estimates (lb/day): All SWIP Samples

List of Tables

Table 1 Cross Reference of Historical Sample Locations, Sample IDs, Features, and River Miles
Table 2 Field Collected Water Quality Data: Sampling Event during USGS Seepage Study
Table 3 GPS Coordinates: Sampling Event during USGS Seepage Study
Table 4 Samples Collected: Sampling Event during USGS Seepage Study
Table 5 Surface Water Staff Gage and Transect Locations

Table 6 Depth of Water Along Transects
Table 7 Field Collected Water Quality Data: Transect Sampling
Table 8 GPS Coordinates: Barometers, Staff Gages and Transect Samples
Table 9 Samples Collected: Transect Sampling
Table 10 Field Collected Water Quality Data: Discrete Sampling
Table 11 GPS Coordinates: Discrete Sampling
Table 12 Samples Collected: Discrete Sampling
Table 13 Analytical Program for Surface Water Samples
Table 14 Analytical Results: Sampling Event during USGS Seepage Study
Table 15 Analytical Results: Transect Sampling
Table 16 Analytical Results: Discrete Sampling
Table 17 Flux Estimates: Transect Sampling
Table 18 Flux Estimates: Discrete Sampling

List of Abbreviations

cfs	cubic feet per second
CSM	Conceptual Site Model
DL	detection limit
DOI	Department of the Interior
DTS	Distributed temperature sensing
DVSR	Data Validation Summary Report
EB	equipment blank
EPA	United States Environmental Protection Agency
FB	field blank
FD	field duplicate
GLW	Designation for new sampling locations within the LVW
GLWC	Designation for new sampling locations from tributaries and side streams
KM	seep sample stations sampled by Kerr McGee
lb/day	pounds per day
LVW	Las Vegas Wash
LW	Designation for pre-existing sampling locations in the LVW
LWC	Designation for pre-existing sampling locations from tributaries and side streams
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
NDEP	Nevada Division of Environmental Protection
NERT	Nevada Environmental Response Trust
NTU	Nephelometric Turbidity Units
PST	Pacific Standard Time
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation

RM	River Mile
RPD	Relative Percent Difference
SNWA	Southern Nevada Water Authority
SWIP	Surface Water Investigation Plan
t/ss	tributary/side stream
µg/L	micrograms per liter
µS/cm	micro-Siemens per centimeter
USGS	United States Geological Survey

Definition of Key Terms

Groundwater discharge: approximate location where groundwater is entering the surface, either on land or under water. The groundwater may or may not contain perchlorate.

Groundwater flux: measurement of the amount of groundwater discharging per unit of time (for example gallons per minute or cubic feet per second).

Perchlorate discharge: approximate location where groundwater containing perchlorate is discharging to the surface, either on land or under water.

Perchlorate flux: estimate of the amount of perchlorate present in a stream per unit of time (e.g. pounds per day).

Potential discharge: a location where discharge may be occurring, but where there is still uncertainty.

Seep: an area of slow discharge of groundwater on land or into a body of water.

Spring: a discrete place where groundwater actively discharges on land or into a body of water. Springs often create small rivulets on the ground surface, and may be visible underwater as sand boils or areas of reduced cloudiness.

Sump: a manmade collection structure used to manage surface runoff.

Time: all time presented as HHMM Pacific Standard or Daylight Saving Time (e.g., 0823 or 1741 for 8:23 a.m. and 5:41 p.m.)

1.0 Introduction

This technical memorandum (memo) describes the surface water investigation conducted for the Nevada Environmental Response Trust (NERT) Remedial Investigation (RI) - Downgradient Study Area in Henderson, Nevada (**Figure 1**).The surface water investigation consisted of water level gaging and surface water sampling along various reaches of the Las Vegas Wash (LVW) within the Downgradient Study Area. The main purpose of the surface water investigation described in this memo is to identify reaches along the LVW where perchlorate-impacted groundwater discharges to the LVW, which would subsequently reach Lake Mead and the Colorado River, a source of potable water for portions of Arizona, California and Nevada. Determination of the seasonal patterns of perchlorate concentrations is not the intent of the sampling events described in this memo. Although the concentrations in the LVW may vary significantly with time, both diurnally (from wastewater reclamation discharge) and seasonally (due to sporadic rain events, evapotranspiration, etc.), the sampling design described in this memo is intended to provide indication as to which reaches in the LVW are currently receiving significant perchlorate from groundwater or seep discharges. This in turn will assist in focusing additional investigations of perchlorate pathways in groundwater within the Downgradient Study Area. This memo has been prepared as in interim deliverable in advance of the forthcoming NERT RI Report. Except as noted in this memo, the work was conducted per the procedures and methods described in the Surface Water Investigation Plan (SWIP; AECOM 2016a) approved by the Nevada Division of Environmental Protection (NDEP) in December, 2016.

While quarterly sampling has been conducted at a limited number of surface water locations in the past few years, a coordinated effort to quantify perchlorate concentrations relative to flow and location in the LVW has not been undertaken. As part of the planning phase for the surface water investigation in the Downgradient Study Area, sampling of these historical surface water sample locations was conducted in May 2016 to assess surface water conditions in the LVW. The surface water and seep sampling locations sampled in May 2016 were reported in a Surface Water Technical Memorandum (AECOM 2016b) and are shown on **Figure 2**. In addition, the United States Geological Survey (USGS) is currently working under a contract with NDEP to conduct a long-term study of flows and seeps in the LVW, which will provide more insights on the potential inputs of perchlorate in the LVW in the future. This long-term study includes installation of flow gages on the LVW, periodic surveys of seeps along the shoreline, and flow-controlled stream gaging. These data will be incorporated in NERT's RI Report.

The objective of the Downgradient Study Area Investigation is to identify downgradient and cross-gradient subsurface pathways through which perchlorate-impacted groundwater is entering the LVW (**Figure 1**). The surface water sampling program is being conducted to aid in meeting that objective. This surface water investigation consisted of several tiers of sampling to characterize surface water concentrations of key constituents under a variety of flow conditions.

The reaches where perchlorate is entering the LVW can be grossly defined, but additional data are required to direct a subsurface investigation that will identify more specific loci of perchlorate discharge. The gaps include:

- Is there residual perchlorate discharge not being captured by the seep well field that is entering the LVW?
- If so, what are the approximate locations and fluxes of those inputs and the contribution of each location to the perchlorate flux discharging to Lake Mead?
- Of the almost 20 seeps sampled by Kerr McGee in 2000 that were investigated by AECOM in May 2016, only three were located. Where might the other seeps, if still active, be discharging?
- Are seeps, including those known and potentially unknown, contributing perchlorate to the LVW?

- To what extent do the daily fluctuations in the flow in the LVW, due to waste water discharges, impact the concentrations of perchlorate?
- What is the variability in perchlorate concentrations across each cross-section? Are potential points of groundwater discharge located near the south bank, mid-channel, or near the north bank of the LVW?
- Are there other, unknown, sources of perchlorate to the LVW?

The gaging, sampling and analytical results of the samples collected during this investigation are summarized in this technical memorandum. The data collected during this field effort have been used to estimate perchlorate flux in the LVW and update the Conceptual Site Model (CSM), previously presented in the SWIP. As an interim deliverable, this document presents the sampling and analytical results of the samples collected per the SWIP. All surface water data will be further evaluated by NERT during the preparation of the RI report.

2.0 Field Procedures

Surface water sampling for this investigation was conducted consistent with the SWIP in two field mobilizations: sampling was conducted during the USGS seepage study in December 2016 and the gage installation, transect and discrete sampling was performed in February 2017. Daily field reports are provided in **Appendix A**. Daily Health and Safety sheets are provided in **Appendix B. Appendix C** contains the calibration logs for the field equipment used for recording water quality readings.

AECOM's field teams for each of the efforts consisted of two environmental scientists per team who performed the field work in the Downgradient Study Area. The December 2016 sampling consisted of two teams (four staff total) collecting surface water samples over a one-day period in coordination with USGS, who was conducting a seepage study on behalf of NDEP. In February 2017, one team (two staff total) was deployed for a week to install nine staff gages. During the second week, two teams (four staff total) collected 48 surface water samples from locations along the 11 transects ("transect sampling") that were established during the first week, including the eight transects at newly installed staff gages and three transects at established USGS gages. The third week of sampling in February 2017 consisted of five teams plus one coordinator (11 staff total) who collected 180 discrete surface water samples from locations in the LVW and the tributary/ side streams (t/ss), including Wastewater Channel, locations over four days ("discrete sampling"). Details of the field efforts are provided in the following subsections.

The location names for the sampling event coordinated with USGS flow controlled stream gaging in December 2016 and the discrete sampling in February 2017 are generally consistent with historic sampling conducted on the LVW and tributaries. Some of the "LWC" t/ss[1] samples were located in t/ss under current post-weir construction conditions. Others were in the LVW proper, although usually along a bank indicating the coordinates could have historically been in the side stream. New locations (those not previously sampled by Southern Nevada Water Authority [SNWA] or others) are prefaced with "G". The digits following "LW", "GLW", or "T" (for transects) indicate the estimated river mile (RM), which is measured from the high pool elevation of Lake Mead (i.e., the elevation of the water [1,221 feet above mean sea level] when the water reaches the top of the spillway crest of Hoover Dam) (Shanahan and Zhou 2013). Samples collected near each other are designated with "_1", "_2", etc. to distinguish them from main stations. As part of this investigation, a base map of detailed (i.e., to 0.05 mile) RM with locations of samples collected in 2016 and 2017 was created. The identification and estimated RM for every location sampled was evaluated on this base map of RMs. Since many of the locations are historic, the identification of the locations (e.g., LW7.2, etc.) was not changed. However it was noted that several of the sample and location identifications did not match the RM; for example LW7.2 is closer to RM 6.95 than 7.2. Plotting the data by RM was complicated by this. Therefore, a cross-reference table (**Table 1**) of sample point, weirs, and other features has been developed to assist in the presentation of the data.

2.1 Sampling Event during USGS Seepage Study, December 2016

The USGS plans to conduct two seepage studies in the LVW involving measurements of temperature and specific conductance at approximately 12 sites in the Downgradient Study Area. One seepage study has been completed (December 2016), and one was planned for the summer of 2017. The overall goal of the USGS study is to identify reaches where groundwater is discharging to the LVW (or vice versa) and the design of the studies is to conduct them, to the degree practical, while wastewater is maintained at a low discharge and constant flow. In

[1] "LWC" is the designation for pre-existing sampling locations from tributaries and side streams (t/ss).

December 2016, the treatment plants did not hold flows steady, but provided detailed flow data from their facilities for the date.

The first USGS seepage study event took place on December 8, 2016. Since one goal of the SWIP is to limit the influence of flow/discharge on perchlorate concentrations measured throughout the Downgradient Study Area, AECOM mobilized a four-person field team to the Site in order to conduct a one-day surface water sampling effort simultaneous with the first USGS seepage study event field effort.

On December 7, 2016, the field team arrived at the Downgradient Study Area. The team performed a site reconnaissance determining vehicle access and parking locations; possible canoe launch, and safe wading entrances into the LVW. Once on site the field team was made aware that Clark County Water Reclamation District no longer intended to control wastewater discharges at a constant rate the following day. However, the USGS decided to perform their seepage study the following day regardless of the wastewater discharges and AECOM planned to concurrently conduct the grab surface water sampling fieldwork as well.

2.1.1 Sampling Procedures

During the first AECOM field mobilization on December 8, 2016, 19 surface water locations were sampled between the hours of 0823 and 1545 Pacific Standard Time (PST). Two teams conducted the field work both on foot and by canoe, as conditions required. Water quality parameters using a YSI multi-parameter sonde, which measures temperature, specific conductivity, turbidity, dissolved oxygen, and pH (**Table 2**), were recorded prior to sample collection at each location. Coordinates were collected in Arc Pad using a handheld Trimble each time a sample location was accessed (**Table 3**). At sample locations with less than 3 feet of water or where practical, surface water samples were collected by direct immersion of unpreserved dedicated sample bottles. Bottles were filled at mid-depth in order to capture the mixed system. For sample locations with 3 feet of water or deeper, a peristaltic pump with dedicated tubing was used to collect samples at one third and two thirds of the total water depth. A total of 20 samples, not including quality control, were collected during the program (**Table 4**). Locations of the samples are presented in **Figure 3**. Quality control samples (including field duplicates) were collected in compliance with the SWIP (AECOM, 2016a), which incorporates by reference the requirements of the Quality Assurance Project Plan (QAPP) (AECOM, 2016c). After collection, samples were stored on ice, and transported that day to the local Test America facility for shipment to their Irvine, California, laboratory for analyses of perchlorate, chlorate, chloride, bromide and total dissolved solids.

2.1.2 Deviations from SWIP

Due to circumstances beyond control and conditions encountered in the field, the following deviations from the SWIP were noted for the USGS coordination sampling:

- The intention of the first mobilization was to collect surface water samples on a day absent of or with minimal discharge of wastewater to the LWV. This mobilization, which was performed in coordination with the USGS seepage study, was intended to characterize perchlorate concentrations within reaches of the LVW without the influence of discharges from the four treatment plants that discharge to the LVW including the Clark County Water Reclamation District, City of Las Vegas, City of North Las Vegas, and City of Henderson facilities. Despite previous arrangements between USGS and the wastewater treatment facilities, on the day before the scheduled sampling, USGS was informed that the facilities could not hold flows the following day. However, AECOM and USGS conducted their fieldwork as scheduled. Since the wastewater flow rates and fluctuations are the predominant contributors of water flow through the LVW and contain insignificant concentrations of perchlorate, they heavily influence the perchlorate concentrations in the LVW. Timing of the samples collected was therefore plotted with flows from the nearest USGS gage for reference (**Appendix D**).
- The objective of sample GLW3.78 was to sample a location upstream of the seep KM67 that may have evidence of groundwater input. The southern bank along the Three Kids Weir was examined visually

and using the conductivity meter for possible groundwater seeps. The weir and southern bank are heavily rip-rapped and access to surface water was extremely limited. Due to the presence of rip-rap, only the temperature and dissolved oxygen probes could be submerged to sufficient depths for recording the water quality. The temperature and dissolved oxygen readings of the surface water accessed along the southern bank did not indicate evidence of groundwater influx (i.e., areas of groundwater influx tend to have higher temperature and low dissolved oxygen). Therefore, the location for sample GLW3.78 was selected midway up the weir on a rip-rap slope.

2.2 Staff Gage Installation

Daily water flow in the LVW varies due to discharge of treated water from several wastewater facilities located upstream of the Downgradient Study Area. The wastewater in these daily discharges is assumed to be virtually free of perchlorate and, therefore, will dilute perchlorate concentrations, particularly during periods of higher flow. While existing USGS water level gages are used to calculate flow in various section of the LVW, there is a substantial distance and time lag between them. Additional gages were necessary to further define areas where perchlorate discharge may be entering the LVW and to fill some gaps in the knowledge of flows in the LVW (i.e., fill spatial gaps between USGS stations). The USGS gages are located at:

- USGS Gage 09419698 Below Duck Creek Confluence (RM6.84)
- USGS Gage 09419700 Pabco Road (RM6.08)
- USGS Gage 09419747 Above Bostick Weir (RM5.16)
- USGS Gage 01419749 Above Homestead Weir (RM4.59)
- USGS Gage 09419753 Above Three Kids Wash (RM3.3)

At eight pre-selected locations, a staff gage was installed. At these eight locations plus three locations at USGS gages, a cross-sectional diagram of water depth and bottom contour was developed by recording water depth at intervals across each transect (**Appendix G**). These locations and the rationale for their selection are summarized in **Table 5**. Appendix G also presents example gage heights at the USGS gages and installed staff gages, as an example, from February 1 and 2, 2017. These data indicate flows lag approximately by 1.25 hours between the gages at Duck Creek and Pabco Road, 1 hour from Pabco Road to the gage at Homestead Weir, and 0.75 hour from the gage at Homestead Weir to the gage at Three Kids.

2.2.1 Installation Procedures

Staff gage and transducer assemblies were similar in design to those used by USGS, but modified as appropriate given the temporary nature of the installations. The assemblies were installed at eight locations shown on **Figure 4**. Specific installation points were identified to be reachable from the shore-side access road but generally away from areas frequented by foot traffic.

Except as noted below, each assembly consists of a recording pressure transducer mounted inside an L-shaped length of PVC pipe. The transducer head is mounted inside a perforated PVC protective casing. The transducer cable runs back to shore through the PVC pipe into a short standpipe. The standpipe has a secure, lockable cap to allow access to the data retrieval port.

The staff gage assembly was anchored to the southern bank of the LVW (except as noted below) using fence posts. The standpipe is located at the water's edge or near-shore, depending on the condition of the LVW bottom. The transducer head extends into the channel approximately 10 feet north and is secured with fence posts. Where conditions permit, the horizontal pipes were laid in a shallow trench to both protect and secure the pipe, and to minimize their profile in the LVW.

The staff gages, marked in 0.01-foot increments, were secured to the posts at the channel-end of the pipe assemblies. The gages are located near enough to shore to allow accurate readings from the stream banks and deep enough to cover the range of streamflow variation.

On-shore pressure transducers (barometers) were places at three locations along the study area to provide reference atmospheric pressure data. These transducers are presented in **Figure 4** and are located near:

- Pabco Weir (B6.0), west of the main parking area;
- Lower Narrows Weir (B4.65), at the end of the access road; and
- Three Kids Weir (B3.8), adjacent to the parking area.

2.2.2 Deviations from SWIP

Due to conditions encountered in the field, the following modifications, which deviated from the SWIP, were made to staff gage installation:

- S3.75 (Immediately downstream of Three Kids Weir): Rocky conditions on the shore banks and stream bed precluded anchoring the gage assembly on shore and extending it into the wash. Instead, the pressure transducer was located approximately one third of the way across the wash from the south bank, mounted inside a PVC pipe driven into the sediment. The pipe has a locked cap to allow for access to the data port. The staff gage was secured directly to this pipe. This location is accessible by foot directly downstream from the Three Kids Weir.
- S6.35 (Downstream of Proposed Sunrise Mountain Weir): Extensive vegetation up to and along the shore of the wash precluded anchoring the gage assembly on the southern bank. The assembly was anchored to the opposite bank and extended into the LVW from the north. On-shore access to this gage is made by crossing the LVW at the Pabco Road Weir and following the LVW upstream approximately one-third mile to the west.

2.3 Transect Sampling

The main objectives of the Transect Sampling were to: 1) assess the variability in perchlorate concentrations across each cross-section and thereby determine any potential points of groundwater discharge within the southern bank, northern bank or within the channel of the LVW; and (2) provide an average perchlorate concentration within each transect.

2.3.1 Sampling Procedures

A total of 11 transects were staked and sampled between January 30, and February 3, 2017 within the Downgradient Study Area (**Figure 5**). Two teams conducted the field work both on foot and by canoe, as conditions required. Two to three transects were sampled each day during the reach specific predicted low-flow period. Flow periods were forecasted using available USGS data and transducer/staff gage data collected during the staff gage installation program. Each targeted transect was field established. From the south bank, a target was identified and staked on the north bank, perpendicular to the LVW. The teams placed stakes along the transect, and proceeded across the channel on foot or by canoe to each staked location. Approximately every 5 to 10 feet along each transect, depending on the channel width, a depth to streambed from water surface was measured and recorded. Transects or cross sections are provided in **Table 6** and shown on **Figure 5**.

Surface water grab samples were subsequently collected near the north and south banks, as well as within the channel within the alignment of each transect. Water quality parameters (temperature, specific conductivity, turbidity, dissolved oxygen, and pH) were measured using a YSI multi-parameter sonde (**Table 7**) prior to sample collection at each location. A minimum of three locations along each transect were sampled and a total of 45

locations were sampled during the transect sampling (**Figure 5**). Coordinates of each sample location were collected in Arc Pad using a hand-held Trimble (**Table 8**). At sample locations with less than 3 feet of water, surface water samples were collected by direct immersion of unpreserved dedicated sample bottles. Bottles were filled from near bottom depth in order to capture any potential seep inputs. For sample locations with 3 feet of water or deeper, a peristaltic pump with dedicated tubing was used to collect samples at one third the total water depth in addition to near bottom. A total of 48 samples, not including quality control, were collected during the program (**Table 9**). Quality control samples (including field duplicates) were collected in compliance with the Quality Assurance Project Plan (QAPP) (AECOM 2016c). After collection, samples were stored on ice, and transported that day to the local Test America facility for shipment to their Irvine, California, laboratory for analyses of perchlorate, chlorate, chloride, bromide and total dissolved solids.

2.3.2 Deviations from SWIP

Due to conditions encountered in the field, the following deviations from the SWIP were noted in transect sampling:

- T3.6 (Mid-way between Three Kids Weir and Rainbow Gardens Weir): The SWIP indicates a transect “T3.6”. Pre-made chain-of-custody records and labels listed this transect as T3.5. The samples will remain indicated as T3.5, which is a minor modification from the SWIP. This does not affect the data quality objective of the placement of this transect, which was to evaluate water quality downgradient of Three Kids Weir, but before Rainbow Gardens Weir.
- At sample location 3.5A along transect T3.5, the YSI conductivity reading would not stabilize and therefore a range of observed conductivities was recorded.
- The depth profile across T3.5 was moved approximately 5 feet downstream of Transect sample 3.5D because strong current and wind conditions, combined with water depth, prohibited the field team from safely and accurately maintaining a position closer to the station.
- The specific conductivity across T6.8 was low near the north and south banks (2,304 and 2,614 µS/cm, respectively) but was 3,539 µS/cm (or approximately 50% higher) in the middle of LVW. Due to notable changes in specific conductivity across T6.8, it was decided in the field to collect samples at five locations to help capture any potential inputs of perchlorate that may be indicated by the higher specific conductivity.

2.4 Discrete Sampling

The objectives of the discrete sampling program were to 1) obtain a current snapshot assessment of perchlorate concentrations in the LVW; 2) assess whether the loci of groundwater discharge can be delineated and used to determine loci perchlorate discharge; and 3) determine to what extent daily fluctuations in the flow in the LVW, due to waste water discharges, impact the concentrations of perchlorate.

2.4.1 Sampling Procedures

During the discrete sampling, 19 surface water locations were sampled daily for four consecutive days during daily minimum flow and daily high-end flow within the Downgradient Study Area (**Figure 6**). A sub-set of five locations were also sampled during an estimated mid-flow period. Flow charts with sample times are provided in **Appendix D**. Sampling was conducted from February 6 through February 9, 2017. Five teams conducted the field work both on foot and by canoe, as conditions required. Each team was tasked with accessing and sampling three to five sample locations, depending on accessibility and proximity. Due to the geographical spread of sample locations and intensity of sampling, an additional field person served as the on-shore point person and was responsible for coordinating between teams, collecting and putting samples on ice, preparing samples for laboratory delivery, and ensuring daily field records were complete and correct.

Daily flows were monitored in real time from the office and communicated to the field teams to ensure flow requirements described in the SWIP were met. The flow requirements were:

- Daily low flow was the lower 10th percentile of flow at each location, based on measurements from the nearest USGS gage.
- Daily high-flow target was above the 50th percentile of flow. Since high flows last for eight to ten hours, this percentile encompasses the highest daily flows.
- Daily mid flows were defined as the mid-point on the hydrograph, between the low point and the peak high flow.

Water quality parameters (temperature, specific conductivity, turbidity, dissolved oxygen, and pH) were measured using a YSI multi-parameter sonde (**Table 10**) prior to sample collection at each location. Except as noted in the deviations, below, coordinates were collected in Arc Pad using a hand-held Trimble each time a sample location was accessed (**Table 11**). At sample locations with less than 3 feet of water, surface water samples were collected by direct immersion of unpreserved dedicated sample bottles. Bottles were filled at mid-depth in order to capture the mixed system. For sample locations with 3 feet of water or deeper, a peristaltic pump with dedicated tubing was used to collect samples at one third and two thirds of the total water depth. A total of 180 samples, not including quality control, were collected during the program (**Table 12**). Quality control samples (including field duplicates) were collected in compliance with the QAPP (AECOM 2016c). After collection, samples were stored on ice, and transported that day to the local Test America facility for shipment to their Irvine, California, laboratory for analyses of perchlorate, chlorate, chloride, bromide and total dissolved solids.

2.4.2 Deviations from SWIP

The following deviation from the SWIP was noted during discrete sampling:

- The AECOM field team was notified that three of the five ordered GPS units would not arrive until the afternoon of the first sampling day of the discrete sampling program. To keep the program on schedule, the field team leader decided to pre-locate and stake several of the sampling locations with the two available GPS units. On February 5, one day before the start ("Day 1") of the discrete sampling, the AECOM field team accessed 11 sample locations using the available GPS units for the three teams that did not have GPS units on Day 1. Reliable marking devices such as stakes, flagging and rebar (depending on location conditions) were used to pre-mark the sample stations and all materials were removed from the LVW upon the completion of the discrete sampling program. On Day 1 the three teams without GPS units, navigated to the sampling locations and collected their samples at the pre-marked locations. Details on collection of coordinates are provided in **Table 11**. The missing GPS units were received by the field teams in the evening of Day 1. For the remainder of the discrete sampling program ("Day 2" through "Day 4") each time a sample was collected the coordinates were collected in Arc Pad on the GPS device, with the following exceptions:
  - One team continued to navigate to the pre-staked locations for stations LW6.05, LW6.7 and LW7.2 and, because samples were collected at the stake every time, there was no need to collect coordinates on the GPS.
  - Coordinates were not collected at stations GLW4.4, GLW4.8 and LW.41 on Day 4. However, station markers were still in place and, as with previous days, the samples were collected consistently at these markers.

3.0 Analytical Program

The analytical program was focused on Downgradient Study Area groundwater constituents that may affect water quality in the LVW (**Table 13**), with refinements made based on the results of the May 2016 Surface Water Sampling Program. Surface water samples were analyzed for the following constituents:

- Perchlorate (United States Environmental Protection Agency [EPA] Method 314.0);
- Chlorate (EPA Method 300.1);
- Chloride (EPA Method 300.0);
- Bromide (EPA Method 300.0); and
- Total Dissolved Solids (Standard Method 2540C).

Total dissolved and hexavalent chromium have been analyzed previously, including in the May 2016 surface water sampling program. Based on a review of the data conducted in the SWIP (AECOM, 2016a), AECOM determined that analyzing for dissolved and hexavalent chromium was not necessary to achieve the objectives of the surface water sampling program (i.e., locate areas of contaminated groundwater input). Perchlorate and chlorate concentrations in the seep samples collected in May 2016 were elevated by one to two orders of magnitude compared to adjacent samples in the LVW. Therefore, both perchlorate and chlorate can be used as tracers for this seep water. The SWIP, therefore, did not include additional analyses of dissolved chromium and hexavalent chromium.

As directed by NDEP, field-filtering of water samples for perchlorate analysis was not required. Copies of the analytical results and chain-of-custody records are provided in **Appendix E**.

4.0 Data Validation

Consistent with the recently revised NDEP requirements, all samples were validated according to Stage 2A data validation procedures. The overall project requirements and completeness levels were met. As presented in the Data Validation Summary Report (DVSR; **Appendix F**), there were:

- 22 surface water samples coordinated with the USGS seepage study (including two field duplicates), one field blank and one equipment blank;
- 55 transect surface water samples (including seven field duplicates), six equipment blanks and three field blanks; and
- 199 discrete surface water samples (including 17 field duplicates), nine equipment blanks and nine field blanks;

Each primary sample, duplicate, equipment blank, and field blank was analyzed for five constituents (perchlorate, chlorate, total dissolved solids, chloride, and bromide) for a total of 1,525 results. A total of 150 results, or 9.8 percent of the total, were qualified by either the laboratory or during data validation. No results were rejected. Based upon the Stage 2A data validation all other results are considered valid and usable for all purposes.

The frequency of qualified results for each component of the surface water investigation was as follows:

- Of the 120 results from the samples coordinated with the USGS seepage study, 17 results (14.2 percent) were qualified.
- Of the 320 results from the transect surface water samples, 36 results (11.3 percent) were qualified.
- Of the 1,085 results from the discrete surface water samples, 97 results (8.9 percent) were qualified.

Qualified results consisted of three categories: results below the practical quantification limit but above the MDL (95 qualified results), results whose corresponding matrix spike percent recoveries exceeded criteria provided in the QAPP (49 results) and results whose field duplicate RPD exceeded criteria provided in the QAPP (6 results). Results in all three categories were qualified with a J-flag indicating that the quantity provided is an estimate.

Due to a lapse in laboratory certification for perchlorate in non-potable water, all perchlorate analyses related to this investigation were collected in deviation from the QAPP. This deviation has been investigated and it was concluded that there was no negative impact on data quality. Corrective actions from both AECOM and the laboratory are being implemented. Details of the deviation, investigation, and corrective action are provided in **Appendix F**.

5.0 Summary of Surface Water Data: Sampling Event during USGS Seepage Study

Surface water samples were collected from 14 locations in the LVW channel (LW3.4, LW3.75, GLW3.78, LW3.85, LW4.1, GLW4.4, GLW4.85, GLW4.9, LW4.95, LW5.3, LW5.9, LW6.05, LW6.7, and LW7.2), one location outside the channel (t/ss location LWC3.7) and 4 locations in Wastewater Channel (LWC6.1_1, LWC6.1_2, GLWC6.1_3, and GLWC6.1_4) (**Figure 3**). **Table 14** presents the analytical results of surface water sampling conducted in coordination with USGS efforts.

5.1 Field Water Quality Parameters

At each location, a YSI multi-parameter sonde was used to measure pH, specific conductivity, dissolved oxygen, turbidity and temperature in the field (**Table 2**). Temperature ranged from 15.87 to 25.29 degrees Celsius. The water temperature was generally coolest in the samples collected in the morning. Samples in the LVW collected later in the day tended to be warmer. Specific conductivity ranged from 1,012 to 4,342 micro-Siemens per centimeter (µS/cm). The highest conductivity of 4,342 µS/cm was measured at LWC3.7 (near the KM67 seep), which is almost two times higher than the next highest reading (2,404 µS/cm at GLW4.85). The pH measurements were generally near neutral to slightly alkaline, ranging from 7.18 (LWC3.7) to 8.48 (LW6.05). Dissolved oxygen in the surface water ranged from 0.65 to 12.19 milligrams per liter (mg/L), and most locations were near or exceeded 100 percent saturation (saturation is the dissolved oxygen concentration corrected for water temperature and daily atmospheric pressure [entered during daily calibration of YSI multi-parameter sondes]). Dissolved oxygen was lowest in LWC3.7, near the KM67 seep (0.65 mg/L; 7.8 percent saturation); all other stations had dissolved oxygen at or greater than 80 percent saturation. The turbidity meter was not functional for all locations. Turbidity that was measured ranged from 3.1 to 8.9 Nephelometric Turbidity Units (NTUs). The high specific conductivity and low dissolved oxygen at LWC3.7 indicates it was likely sampled very close to seep KM67.

5.2 Laboratory Analyses Results

As discussed in Section 3, surface water samples were analyzed for perchlorate, chlorate, chloride, bromide, and Total Dissolved Solids. Concentrations for each analyte are included in **Table 14** and presented on a map of the Downgradient Study Area, plotted on a semi-logarithmic scale by RM and in comparison to May 2016 data, respectively. Figures of the sampling results during the December 2016 USGS Seepage Study are presented for perchlorate (**Figure 7** through **Figure 9**), chlorate (**Figure 10** through **Figure 12**), total dissolved solids (**Figure 13** through **Figure 15**), chloride (**Figure 16** through **Figure 18**), bromide (**Figure 19** through **Figure 21**), and chloride/bromide ratios (**Figure 22** through **Figure 24**). The analytical results are discussed below.

5.2.1 Perchlorate

Perchlorate concentrations generally increase with distance downstream (i.e., declining RM) (**Figure 7** and **Figure 8**). Following is a summary of the perchlorate analytical results from samples collected from upstream to downstream locations in the LVW during the December 2016 USGS Seepage Study:

<u>Upper Reach (LW7.2 to Proposed Location of Sunrise Mountain Weir)</u>

Two samples were collected from the Upper Reach of the Study Area (LW7.2 to the proposed location of Sunrise Mountain Weir). Perchlorate was not detected in either sample (detection limit [DL] of 0.95 µg/L).

Pabco Road Reach (Proposed Location of Sunrise Mountain Weir to LW5.9)

In the Pabco Road Reach, concentrations of perchlorate in the t/ss of the Wastewater Channel were low (1.5 J µg/L [GLWC6.1_4] and 1.7 J µg/L [GLWC6.1_3]) and non-detect [< 0.95 µg/L]). Perchlorate in the LVW increased, but remained below 10 µg/L in the two samples from this reach.

Main Reach (LW5.9 to Homestead Weir)

Perchlorate was detected in all samples in this reach (> 0.95 µg/L). The concentrations of perchlorate in the Main Reach of the LVW increased slightly from the Pabco Road Reach, and a markedly higher concentration (270 µg/L at the new location GLW4.85) downstream of Calico Ridge Weir at RM 4.65. Immediately upstream of Homestead Weir (at RM 4.1), the concentration of perchlorate was 23 µg/L, which was slightly higher than the perchlorate concentration measured upstream of Calico Ridge Weir at RM 4.7 (14 µg/L). This indicates that the high perchlorate concentration noted at GLW4.85 may be attributable to a nearby seep that disperses into the overall flow through the LVW. No seep has been documented in the immediate vicinity of Calico Ridge Weir near GLW4.85. However, seep KM-91, sampled by Kerr McGee in 2000 (AECOM, 2016b) is located approximately 500 feet downstream. When sampled in 2000, KM-91 had a perchlorate concentration of 2,100 µg/L.

Three Kids Reach (Homestead Weir to Rainbow Gardens Weir)

Perchlorate was detected in all samples in this reach (> 0.95 µg/L). The concentrations in the samples from the Three Kids Reach are higher, on average, than in the reaches upstream, ranging in concentration from 20 to 47 µg/L. In addition, LWC3.7 had a high concentration (1,600 µg/L), which likely reflects a seep near the Three Kids Weir.

Downstream Reach (Rainbow Gardens Weir to LW3.1)

Perchlorate was detected in all samples in this reach (> 0.95 µg/L). The Downstream of Rainbow Gardens Weir, the estimated concentration of perchlorate, which was below the reporting limit, was 33 J µg/L, similar to the reach immediately upstream.

Comparison to May 2016 Grab Samples

The samples collected in May 2016 were targeted at a low flow; the samples collected simultaneously with the USGS Seepage Study in December 2016 were all collected in one day, regardless of flow. While these two data sets are not fully comparable due to differences in flows and locations (different samples were collected in May and December with some overlap), they reflect similar patterns (**Figure 9**). Concentrations of perchlorate trend higher with distance downstream. The unaccounted increase in the Main Reach appears to be from a previously unsampled source at GLW4.85 (RM 4.65 immediately downstream of Calico Ridge Weir). Previous concentrations of perchlorate at LWC3.7 were not elevated (61 µg/L in May 2016), but the sample collected in December 2016 may reflect influence from the seep KM67, which was sampled in May but not in December 2016.

5.2.2 Chlorate

Chlorate was detected (> 10 µg/L) in all samples and ranged from 20 µg/L (LWC6.1_2 in the Wastewater Channel) to 4,300 µg/L (LWC3.7). The concentrations of chlorate are similar to perchlorate concentrations in the reach from Historic Lateral Weir to Three Kids Weir, including a high concentration (980 µg/L) at GLW4.85 downstream of Calico Ridge Weir (**Figure 10** and **Figure 11**). However, chlorate increased in the t/ss location LWC3.7, which had a perchlorate concentration (4,300 µg/L) that was higher than surrounding locations. In addition, while perchlorate was non-detect in the Upper Reach, chlorate was detected at concentrations similar to those downstream. This is consistent with previous observations and may indicate that reclaimed water (i.e., non-

NERT outfalls and discharges to the LVW located upstream of the Downgradient Study Area) may be a significant source of chlorate (but not perchlorate) to the LVW.

Compared to May 2016 results, chlorate concentration show greater variability in December, with higher concentrations noted near Calico Ridge Weir and Three Kids Weir (**Figure 12**). The location at Calico Ridge represents a new location not sampled in May 2016. The location at Three Kids Weir (LWC3.7) shows higher concentrations of chlorate in December 2016 (4,300 µg/L) than in May 2016 (260 µg/L). LWC3.7 was likely sampled closer to the seep (KM67) in December 2016 since the concentration is similar to the chlorate concentration of 4,400 µg/L in KM67 when it was sampled in May 2016. KM67 was not sampled in December.

5.2.3 Total Dissolved Solids

Total dissolved solids were detected (> 5.0 mg/L) in all samples (**Figure 13** and **Figure 14**). Total dissolved solids concentrations ranged from 620 to 3,300 mg/L, with the lowest concentration in the Wastewater Channel (LWC6.1_2) and the highest concentration at LWC3.7 near Three Kids Weir, where high concentrations of perchlorate and chlorate were noted. Other surface water samples ranged from 1,000 to 1,600 mg/L.

In May 2016, the sample collected at LWC6.3_1 had a total dissolved solids concentration of 5,000 mg/L; this location was not resampled in December 2016. Compared to May 2016 results, total dissolved solids concentrations were similar in December to locations sampled in May 2016, with lower concentrations noted in the other Wastewater Channel t/ss samples (**Figure 15**). The location at Three Kids Weir (LWC3.7) shows higher concentrations of total dissolved solids than in May, and was likely sampled closer to the seep (KM67) which was not sampled in December.

5.2.4 Chloride and Bromide

Chloride (**Figure 16** and **Figure 17**) was detected (> 0.25 mg/L) in all surface water locations. Chloride concentrations followed the pattern of total dissolved solids, and were generally similar, ranging from 200 to 250 mg/L in most samples. Noted exceptions are a low concentration (84 mg/L) at LWC6.1_2, located in the Wastewater Channel, 350 mg/L at GLWC6.1_4 in the Wastewater Channel downstream of the confluence of the outfalls, and 490 mg/L at LWC3.7. Compared to sampling conducted in May 2016 (**Figure 18**), chloride concentrations were consistent, with high and low concentrations in the Wastewater Channel samples. Similar to the other constituents measured in the surface water samples, the high concentration of chloride at LWC3.7 noted in December was not noted in May.

Bromide (**Figure 19** and **Figure 20**) was detected (>0.25 mg/L) in all surface water samples, although several samples were “J” flagged during validation. Concentrations were highest at LWC3.7 (2.4 J mg/L) and lowest at LWC6.1_2 (0.31 J mg/L). Similar to sampling conducted in May 2016 (**Figure 21**), bromide concentrations varied in December 2016, with high (1.2 mg/L at LWC6.1_1) and low (0.31 J mg/L at LWC6.1_2) concentrations in the Wastewater Channel samples. During the May 2016 event, bromide concentrations in the Wastewater Channel samples also varied, but were generally higher, ranging from undetected (< 0.5 mg/L at LWC6.1_2) to 3.5 mg/L (LWC6.1_1). Similar to the other constituents measured in the surface water samples, the high concentration of bromide at LWC3.7 reported in December (2.4 J mg/L) was not encountered in May (0.93 mg/L).

The ratios of chloride to bromide (**Figure 22** and **Figure 23**) vary considerably between sample locations with no clear discernable patterns. Higher ratios were noted upstream of Three Kids Weir and Calico Ridge Weir. Compared to sampling conducted in May 2016 (**Figure 24**), chloride to bromide ratios reported for December were highly varied.

5.2.5 Quality Control Samples

Quality control samples collected with the water samples coordinated with the USGS seepage study included two field duplicates (FD), a field blank (FB), and an equipment blank (EB). As required, the laboratory ran quality

control procedures including matrix spike and matrix spike duplicate (MS/MSD) analysis. A detailed discussion of quality control and data validation is included in the DVSR (**Appendix F**).

FD samples were collected for two primary samples (LW3.85-20161208-0.3 and LWC3.7-20160208-0.6) (DVSR Table 5). Acceptable relative percent difference (RPD) between the primary and duplicate sample was specified as 30 percent in the QAPP (AECOM 2016c). Acceptable field and analytical precision was demonstrated for all field duplicate pairs for samples coordinated with the USGS seepage study.

An EB sample and a FB sample were collected and analyzed with this group of samples. Target analytes were not detected in the either the EB or the FB; therefore, no data from samples coordinated with the USGS seepage study were qualified based on the EB or FB.

MS/MSD samples were run as required by the laboratory. One perchlorate MS/MSD recovery exceeded control criteria. Perchlorate results for 9 primary samples (GLWC6.1_3-20161208-0.5, GLWC6.1_4-20161208-0.5, LW3.4-20161208-0.5, LW3.85-20161208-0.3, LW3.85-20161208-0.3-FD, LW4.1-20161208-0.2, LW5.3-20161208-1.0, LW5.3-20161208-2.5, LW6.05-20161208-0.5) were qualified on the basis of this exceedance. While the results from these samples would be expected to be biased high, the bias is not expected to impact the discussion provided in this section. Details of these qualifications are provided in the DVSR (**Appendix F**).

6.0 Summary of Staff Gage Installation and Cross Sections

Staff gages were installed at eight locations along the LVW (**Figure 4** and **Table 5**). These staff gages were used to fill gaps in flow record from the five USGS stations present in the Downgradient Study Area.

6.1 Gage Readings

The recording pressure transducers (Solinst Leveloggers) installed at the staff gage locations were programmed to record water pressure every 5 minutes (288 times per day). The Levelogger is not a vented unit, so pressure data collected on the datalogger required compensation for changes in barometric pressure. Three recording barometers (Solinst Barologgers) were installed at various locations throughout the study area and programmed to collect barometric pressure readings on a 5-minute frequency. Corrected water pressure readings were then correlated to readings on the attached staff gage through comparison to the manual readings of the staff gage throughout the study period.

The pressure transducers were downloaded several times during the sampling period to help evaluate the timing of transect sampling relative to the nearby flow regime in the LVW, and to help predict that timing during the discrete sampling week. An example of the staff gage readings from S3.8, the staff gage located at transect T3.8 is presented in **Appendix G**. These readings are representative of staff gage readings from January/February 2017. Readings at the eight stations installed by AECOM (collected on a 5-minute frequency) are plotted as calibrated to the readings on the staff gage. Chart blank includes both the automated data collected by the datalogger (after barometric compensation and correlation to staff gage readings) and the manual readings of the staff gage during the study period.

At the end of the study period, all units (Solinst Leveloggers and Solinst Barologgers) were reprogrammed to record pressure on an hourly frequency. The units are still in the field recording data and will be retrieved during a future sampling event.

The temporary stream gages installed in January 2017 have not been calibrated for direct reading of flow and record only the height of the staff gage; however, these gages were used to estimate flows based on the flow data from the nearest USGS gages. The cross-sections of the transects were taken at large intervals that do not lend themselves for the generation of calibrated flow curves. The cross sections provided depth information across the LVW that was used in the transect sample design and can be used in the future to select additional sampling locations and depths.

Readings at the USGS stations (collected on a 15-minute frequency) were adjusted to plot on a similar scale as the AECOM stations. The adjusted USGS data correctly show the timing and magnitude of stream stage change at the respective stations. Most stations show the observed downstream delay in daily low and daily peak streamflow. The gage at Bostick Weir reflects a somewhat different timing. The stream channel in that area was strongly impacted by the storms prior to the sampling period, and conditions may have still been adjusting during the time period represented on the chart.

6.2 Cross Sections

Water depths along the transects were measured at regular intervals (**Table 6**). These data were plotted with sample location and are presented in **Appendix G**.

7.0 Summary of Surface Water Data: Transect Sampling

Surface water samples were collected from 45 locations along 11 transects (**Figure 5**). Three locations were sampled for two depths. **Table 15** presents the analytical results of surface water sampling from transects.

7.1 Field Water Quality Parameters

At each location, a meter was used to measure pH, specific conductivity, dissolved oxygen, turbidity and temperature in the field (**Table 7**). Temperature ranged from 16.50 to 20.09 degrees Celsius. The water temperature was generally coolest in the samples collected in the morning. Samples in the LVW collected later in the day tended to be warmer. Specific conductivity ranged from 2,031 to 7,162 µS/cm. The highest conductivity was measured at T5.3 along the south bank. The pH measurements were generally near neutral to slightly alkaline, ranging from 7.49 (T4.75_D) to 8.30 (T3.5_F). Dissolved oxygen in the surface water ranged from 6.26 to 14.28 mg/L, and most locations were near or exceeded 100 percent saturation. Dissolved oxygen was lowest in samples along T4.75. The turbidity meter was not functional for all locations. Turbidity that was measured ranged from 0.1 to 135.5 NTUs. High turbidity was noted along the south bank of T4.2 and T4.6.

7.2 Laboratory Analyses Results

Surface water samples were collected generally from near-bottom depth. Samples were collected near the south bank, near the north bank and at locations along the transects determined during the field event to represent the flow and channelization of the LVW. **Appendix G** shows the sampling locations along the transects with cross sections of streambed depth. Figures are presented for perchlorate (**Figure 25**), chlorate (**Figure 26**), total dissolved solids (**Figure 27**), chloride (**Figure 28**), bromide (**Figure 29**), and chloride/bromide ratios (**Figure 30**). The results of the laboratory analysis of surface water samples from transect samples are presented in **Table 15** and discussed below. The discussion focuses on the pattern within each transect, with some consideration given to between transect discussion.

7.2.1 Perchlorate

Figure 25 presents the perchlorate data along the transects. Following is a summary of the perchlorate analytical results from samples collected from upstream to downstream transects in the LVW during the February 2017 transect sampling event:

<u>Transect T6.8 (Upstream of Duck Creek Confluence):</u> Perchlorate was not detected (<0.95 µg/L) in four of five samples across this transect. The mid-channel sample was detected at a low concentration (1.6 J µg/L).

<u>Transect T6.35 (Downstream of Proposed Sunrise Mountain Weir):</u> Perchlorate was detected (>0.95 µg/L) in all samples. Concentrations on the north and south bank were identical (18 µg/L) and the concentration in the mid-channel was similar (17 µg/L) in shallow and deep samples. This increase in concentration from Transect T6.8 was consistent with findings from the May 2016, December 2016 and February 2017 grab sampling where increases were noted downstream of Proposed Sunrise Mountain Weir, close to Pabco Road Weir. No sampling had been conducted by AECOM near the Proposed Sunrise Mountain Weir prior to this transect sampling. This demonstrates that the increase in perchlorate is closer to the Proposed Sunrise Mountain Weir than Pabco Road Weir.

<u>Transect T6.0 (Upstream of Pabco Road Weir):</u> Perchlorate was detected (>0.95 µg/L) in all samples. Concentrations from the south bank to the middle of the channel were identical (16 µg/L) and the concentration near the north bank was similar (15 µg/L). This increase in concentration from Transect T6.8 was consistent with

findings from grab sampling conducted by AECOM in 2016 and 2017. During grab sampling events, no marked increase in perchlorate was noted between this Transect and upstream T6.35, so the results of the transect sampling were consistent with other events.

Transect T5.3 (Downstream of Proposed Historic Lateral Weir Expansion): Perchlorate was detected (>0.95 µg/L) in all samples. Concentrations from mid-channel and the north bank were similar (17 and 18 µg/L, respectively) to each other and upstream transects T6.0 and T6.35. The shallow and deep samples from near the south bank were almost two times the concentration (32 and 33 µg/L, respectively) which accounts for the slight increase that has been noted during AECOM grab sampling events from sample LW5.3 near the proposed location of the Historic Lateral Weir Expansion.

Transect T4.75 (Downstream of Calico Ridge Weir): Perchlorate was detected (>0.95 µg/L) in all samples. Concentrations from mid-channel were similar (22 J and 23 J µg/L) to each other and reflect the mixed concentrations from T5.3. Near both the north bank (420 J µg/L) and south bank (820 J µg/L), concentrations were markedly higher. These samples may reflect a slow (i.e., low flow) perchlorate “seep” or may be from incomplete mixing at an upstream location. This data gap should be addressed.

Transect T4.65 (Upstream of Lower Narrows Weir): Perchlorate was detected (>0.95 µg/L) in all samples. Concentrations from northerly mid-channel and north bank samples were similar (31 and 30 µg/L) to each other and reflect mixed concentrations from the mid-channel and north bank locations of T4.75. They indicate that the north bank perchlorate concentration at T4.75 is not contributing a large flux of perchlorate to the LVW. The concentrations from the south bank sample (57 J µg/L) and first mid-channel sample from the south bank (51 µg/L) were markedly higher than the other locations at T4.65. These samples likely reflect the mixing of the higher perchlorate detected along the south bank at T4.75 into the channel of the LVW.

Transect T4.6 (Downstream of Lower Narrows Weir): Perchlorate was detected (>0.95 µg/L) in all samples. Concentrations of perchlorate in T4.6, located downstream of Lower Narrows Weir, are similar to those in T4.65 which is on the immediate upstream side of Lower Narrows Weir. Concentrations from northerly, mid-channel and north bank samples were similar (30 J and 32 J µg/L) to each other and to T4.65. The concentrations from the south bank sample (64 J µg/L) and first mid-channel sample from the south bank (57 J µg/L) were markedly higher than the other locations at T4.6 and slightly higher than the concentrations immediately upstream in the same locations from T4.65.

Transect T4.2 (Upstream of Homestead Weir): Perchlorate was detected (>0.95 µg/L) in all samples. Concentrations of perchlorate in T4.2, located immediately upstream of Homestead Weir, are similar to those in T4.65 and T4.6 in that concentrations from northerly mid channel and north bank samples were similar (27 and 25 µg/L) to each other and lower than in the other samples along the transect. The concentrations at T4.2 were lower than those immediately upstream, but the difference is insignificant. The concentrations from the south bank sample (66 µg/L) and first mid-channel sample from the south bank (40 µg/L) were markedly higher than the other locations at T4.2. The mid-channel location is lower than upstream, indicating there may be cross sectional mixing near the Homestead Weir.

Transect T3.8 (Upstream of Three Kids Weir): Perchlorate was detected (>0.95 µg/L) in all samples. The perchlorate concentration from northerly mid channel sample (32 J µg/L) was lower than other samples along T3.8. At the north bank, the concentration was 46 J µg/L, indicating there may be a perchlorate influx just upstream of Three Kids Weir. The concentrations from the south bank sample (57 J µg/L) and first mid-channel sample from the south bank (45 J µg/L) were similar to the concentrations immediately upstream at T4.2.

Transect T3.75 (Downstream of Three Kids Weir): Perchlorate was detected (>0.95 µg/L) in all samples. Transect T3.75 is located immediately downstream of Three Kids Weir. The perchlorate concentration from northerly mid channel sample (31 µg/L) was lower than other samples along T3.75, similar to the transect T3.8 upstream of Three Kids Weir. At the north bank, the concentration was 85 µg/L, much higher than the locations upstream on

the north bank (i.e., T3.8 [46 J µg/L], T4.2 [25 µg/L], etc.). There may be a perchlorate influx just downstream of Three Kids Weir. The concentrations from the south bank sample (63 J µg/L) and first mid-channel sample from the south bank (51 J µg/L) were similar to the concentrations immediately upstream at T3.8, but slightly higher.

Transect T3.5 (Mid-way between Three Kids Weir and Rainbow Gardens Weir): Perchlorate was detected (>0.95 µg/L) in all samples. Transect T3.5 is located approximately midway between Three Kids Weir and Rainbow Gardens Weir. The perchlorate concentrations increased from the north bank (38 µg/L) toward the south (47 µg/L to 66 µg/L to 98 µg/L to a maximum of 140 µg/L) in the sample collected just towards mid-channel from the south bank. The south bank sample contained 73 µg/L of perchlorate. This pattern indicates that there may be an input of perchlorate to the south of the mid-channel line.

7.2.2 Chlorate

Figure 26 presents the chlorate data along the transects. Following is a summary of the chlorate analytical results from samples collected from upstream to downstream transects in the LVW during the February 2017 transect sampling event:

Transect T6.8 (Upstream of Duck Creek Confluence): Chlorate was detected (>0.25 µg/L) in all five samples across this transect. Concentrations ranged from 48 to 73 µg/L, with the highest chlorate detected mid-channel, consistent with the perchlorate pattern along this transect mid-channel

Transect T6.35 (Downstream of Proposed Sunrise Mountain Weir): Chlorate was detected (>0.25 µg/L) in all samples. Concentrations in all samples were similar, ranging from 53 to 57 µg/L. This increase in concentration from Transect T6.8 is consistent with findings from grab sampling and consistent with the perchlorate data from the transect sampling.

Transect T6.0 (Upstream of Pabco Road Weir): Chlorate was detected (>0.25 µg/L) in all samples. Concentrations from the south bank to the north were similar (49 to 50 µg/L). Unlike perchlorate, concentrations of chlorate decrease slightly from Transect T6.8.

Transect T5.3 (Downstream of Proposed Historic Lateral Weir Expansion): Chlorate was detected (>0.25 µg/L) in all samples. Concentrations from mid-channel and the north bank were similar (54 and 51 µg/L, respectively) to each other and upstream transects T6.0 and T6.35. The shallow and deep samples from near the south bank were almost three times the concentration (140 and 130 µg/L, respectively). This is consistent with the pattern of perchlorate in transect samples.

Transect T4.75 (Downstream of Calico Ridge Weir): Chlorate was detected (>0.25 µg/L) in all samples. Concentrations from mid-channel were similar (83 and 94 µg/L) to each other and reflect the mixed concentrations from T5.3. Near both the north bank (35 J µg/L) and south bank (3,100 µg/L), concentrations were markedly different. The increase on the south bank is similar to but greater in magnitude than the perchlorate increase noted at this transect. On the north bank, perchlorate increased, but chlorate was lower.

Transect T4.65 (Upstream of Lower Narrows Weir): Chlorate was detected (>0.25 µg/L) in all samples. Concentrations increased from north to south (78 µg/L, 100 µg/L, 210 µg/L and 250 µg/L) and were higher than T4.75, but the southern samples may reflect mixing from the high chlorate in the south bank sample at T4.75.

Transect T4.6 (Downstream of Lower Narrows Weir): Chlorate was detected (>0.25 µg/L) in all samples. Similar to T4.65 upstream of Lower Narrows Weir, concentrations of chlorate in T4.6, located immediately downstream of Lower Narrows Weir, increased from north to south (83 µg/L, 100 µg/L, 210 µg/L and 260 µg/L).

Transect T4.2 (Upstream of Homestead Weir): Chlorate was detected (>0.25 µg/L) in all samples. The pattern of chlorate in T4.2, upstream of Homestead Weir, followed that of T4.6 and T7.65. Concentrations increased from

north to south (78 µg/L, 88 µg/L, 170 µg/L and 260 µg/L), and were slightly lower than the immediate upstream transects.

Transect T3.8 (Upstream of Three Kids Weir): Chlorate was detected (>0.25 µg/L) in all samples. The chlorate concentration mimics that of perchlorate from this transect, with the northerly mid-channel sample (110 µg/L) lower than other samples along T3.8. At the north bank, the concentration was 130 µg/L. The concentrations from the south bank sample (270 µg/L) and first mid-channel sample from the south bank (210 µg/L) were similar to the concentrations immediately upstream at T4.2 and those in T4.6 and T4.65, further upstream.

Transect T3.75 (Downstream of Three Kids Weir): Chlorate was detected (>0.25 µg/L) in all samples. Transect T3.75 is located immediately downstream of Three Kids Weir. The perchlorate concentration from the northerly mid-channel sample (110 µg/L) was lower than other samples along T3.75, similar to the transect T3.8 upstream of Three Kids Weir. At the north bank, the concentration was 260 µg/L, which is much higher than upstream locations on the north bank. This pattern is consistent with perchlorate concentrations. The concentrations from the south bank sample (270 µg/L) and first mid-channel sample from the south bank (210 µg/L) were identical to the concentrations immediately upstream at T3.8.

Transect T3.5 (Mid-way between Three Kids Weir and Rainbow Gardens Weir): Chlorate was detected (>0.25 µg/L) in all samples. Transect T3.5 is located approximately midway between Three Kids Weir and Rainbow Gardens Weir. The chlorate concentrations increase from the north bank (140 µg/L) toward the south (190 µg/L to 270 µg/L to 420 µg/L to a maximum of 430 µg/L) in the sample collected just towards mid-channel from the south bank. This is the same pattern observed in the perchlorate data. The south bank sample contained 310 µg/L of perchlorate. This pattern indicates that there may be an input of chlorate mid-channel close to the south bank.

7.2.3 Total Dissolved Solids

Figure 27 presents the total dissolved solids data along the transects. Following is a summary of the total dissolved solids analytical results from samples collected from upstream to downstream transects in the LVW during the February 2017 transect sampling event:

Transect T6.8 (Upstream of Duck Creek Confluence): Total dissolved solids were detected (>5 mg/L) in all five samples across this transect. Concentrations ranged from 1,200 to 1,900 mg/L, with the highest concentration detected mid-channel, consistent with the perchlorate and chlorate.

Transect T6.35 (Downstream of Proposed Sunrise Mountain Weir): Total dissolved solids were detected (>5 mg/L) in all samples. Concentrations in all samples were similar, ranging from 1,500 to 1,600 mg/L. This reflects a well-mixed channel.

Transect T6.0 (Upstream of Pabco Road Weir): Total dissolved solids were detected (>5 mg/L) in all samples. Concentrations from the south bank to the north were identical (1,500 mg/L). This reflects a well-mixed channel.

Transect T5.3 (Downstream of Proposed Historic Lateral Weir Expansion): Total dissolved solids were detected (>5 mg/L) in all samples. Concentrations from the south bank to the north were identical (1,500 mg/L). This reflects a well-mixed channel.

Transect T4.75 (Downstream of Calico Ridge Weir): Total dissolved solids were detected (>5 mg/L) in all samples. Concentrations from mid-channel were identical (1,600 mg/L) to each other and upstream at T5.3 and T6.0. Near both the north bank (2,100 mg/L) and south bank (2,200 mg/L), concentrations were markedly higher. The increase is similar to the perchlorate increase noted on the north bank and the chlorate and perchlorate increase noted at the south bank at this transect.

Transect T4.65 (Upstream of Lower Narrows Weir): Total dissolved solids were detected (>5 mg/L) in all samples. Concentrations from the south bank to the north were identical (1,500 mg/L). The observed higher concentrations at upstream T4.75 were not apparent. This reflects a well-mixed channel.

Transect T4.6 (Downstream of Lower Narrows Weir): Total dissolved solids were detected (>5 mg/L) in all samples. Concentrations from the south bank to the north were similar (1,500 to 1,600 mg/L). This reflects a well-mixed channel.

Transect T4.2 (Upstream of Homestead Weir): Total dissolved solids were detected (>5 mg/L) in all samples. Concentrations from the south bank to the north were identical (1,400 mg/L). Concentrations were slightly lower than the immediate upstream transects, similar to perchlorate and chlorate levels in this area. This reflects a well-mixed channel.

Transect T3.8 (Upstream of Three Kids Weir): Total dissolved solids were detected (>5 mg/L) in all samples. Concentrations from the south bank to the north were similar (1,400 to 1,500 mg/L). This reflects a well-mixed channel.

Transect T3.75 (Downstream of Three Kids Weir): Total dissolved solids were detected (>5 mg/L) in all samples. Concentrations from the south bank to the north were similar (1,400 to 1,500 mg/L) and identical to the T3.8, located immediately upstream. This reflects a well-mixed channel.

Transect T3.5 (Mid-way between Three Kids Weir and Rainbow Gardens Weir): Total dissolved solids were detected (>5 mg/L) all samples. Transect T3.5 is located approximately midway between Three Kids Weir and Rainbow Gardens Weir. The total dissolved solids concentrations were generally consistent from the north bank toward the south, ranging from 1,500 to 1,600 mg/L. The south bank sample contained 2,700 mg/L total dissolved solids.

7.2.4 Chloride and Bromide

7.2.4.1 *Chloride*

Figure 28 presents the chloride data along the transects. Following is a summary of the chloride analytical results from samples collected from upstream to downstream transects in the LVW during the February 2017 transect sampling event:

Transect T6.8 (Upstream of Duck Creek Confluence): Chloride was detected (>0.25 mg/L) in all five samples across this transect. Concentrations ranged from 230 to 290 mg/L, with the highest chloride detected mid-channel, consistent with the pattern observed for other constituents.

Transect T6.35 (Downstream of Proposed Sunrise Mountain Weir): Chloride was detected (>0.25 mg/L) in all samples. Concentrations in all samples were similar, ranging from 260 to 270 mg/L.

Transect T6.0 (Upstream of Pabco Road Weir): Chloride was detected (>0.25 mg/L) in all samples. Concentrations from the south bank to the north were similar (280 to 290 mg/L). Chloride was slightly higher in T6.0 than upstream at T6.35.

Transect T5.3 (Downstream of Proposed Historic Lateral Weir Expansion): Chloride was detected (>0.25 mg/L) in all samples. Concentrations from the south bank to the north were similar (290 to 300 mg/L), and were slightly higher in T5.3 than upstream at T6.0.

Transect T4.75 (Downstream of Calico Ridge Weir): Chloride was detected (>0.25 mg/L) in all samples. Concentrations from mid-channel were similar (260 and 270 mg/L) to each other. Near both the north bank (350

mg/L) and south bank (360 mg/L), concentrations were markedly higher. A similar pattern was noted for perchlorate and total dissolved solids.

Transect T4.65 (Upstream of Lower Narrows Weir): Chloride was detected (>0.25 mg/L) in all samples. Concentrations were similar from north (260 mg/L) to the south bank (280 mg/L). Similar to total dissolved solids, the observed higher concentrations at upstream T4.75 were not apparent.

Transect T4.6 (Downstream of Lower Narrows Weir): Chloride was detected (>0.25 mg/L) in all samples. Concentrations in all samples were 280 mg/L.

Transect T4.2 (Upstream of Homestead Weir): Chloride was detected (>0.25 mg/L) in all samples. Concentrations were similar in all samples (260 to 270 mg/L).

Transect T3.8 (Upstream of Three Kids Weir): Chloride was detected (>0.25 mg/L) in all samples. Concentrations were similar in all samples (250 to 260 mg/L) and slightly lower than upstream at T4.2.

Transect T3.75 (Downstream of Three Kids Weir): Chloride was detected (>0.25 mg/L) in all samples. Concentrations in all samples were 280 mg/L.

Transect T3.5 (Mid-way between Three Kids Weir and Rainbow Gardens Weir): Chloride was detected (>0.25 µg/L) in all samples. Transect T3.5 is located approximately midway between Three Kids Weir and Rainbow Gardens Weir. The chlorate concentrations increase from the north bank (260 mg/L) toward the south, increasing to 280 mg/L in the sample collected just towards mid-channel from the south bank. This is the same pattern observed in the perchlorate data. The south bank sample contained 420 mg/L of chloride. This pattern indicates that there may be an input of chloride mid-channel close to the south bank.

7.2.4.2 *Bromide*

Figure 29 presents the bromide data along the transects. Following is a summary of the bromide analytical results from samples collected from upstream to downstream transects in the LVW during the February 2017 transect sampling event:

Transect T6.8 (Upstream of Duck Creek Confluence): Bromide was detected (>0.25 – 0.50 mg/L) in all five samples across this transect. Concentrations ranged from 0.64 to 1.8 mg/L, with the highest bromide detected mid-channel, consistent with the pattern observed for other constituents. The concentrations of bromide at Transect T6.8 were generally higher than other LVW transect samples. Downstream at Transect T4.65 and Transect T4.6, bromide concentrations are of similar magnitude (see below). Overall, bromide is variable and a trend is not discernible.

Transect T6.35 (Downstream of Proposed Sunrise Mountain Weir): Bromide was detected (>0.25 – 0.50 mg/L) in most samples. Bromide was not detected (< 0.25 mg/L) near the north bank. Concentrations in other samples were similar, ranging from 0.31 J to 0.57 mg/L, with a higher concentration noted mid-channel.

Transect T6.0 (Upstream of Pabco Road Weir): Bromide was not detected (<0.50 mg/L) in all samples.

Transect T5.3 (Downstream of Proposed Historic Lateral Weir Expansion): Bromide was detected (>0.25 – 0.50 mg/L) in one sample on the south bank (0.30 J mg/L). Bromide was not detected (< 0.50 mg/L) in the other samples.

Transect T4.75 (Downstream of Calico Ridge Weir): Bromide was detected (>0.25 – 0.50 mg/L) in most samples. Bromide was not detected (< 0.50 mg/L) near the north bank. Concentrations in other samples were similar, ranging from 0.57 to 0.69 J mg/L, with a higher concentration noted near the south bank.

Transect T4.65 (Upstream of Lower Narrows Weir): Bromide was detected (>0.25 – 0.50 mg/L) in all samples. The concentration in the sample collected towards mid-channel from the north bank (0.74 J mg/L) was lower than the north bank (1.7 mg/L) and the two southern samples (1.8 and 1.4 mg/L).

Transect T4.6 (Downstream of Lower Narrows Weir): Bromide was detected (>0.25 – 0.50 mg/L) in most samples. Bromide was not detected (< 0.25 mg/L) towards mid-channel from the north bank. Concentrations in other samples were similar, ranging from 1.6 to 1.7 mg/L.

Transect T4.2 (Upstream of Homestead Weir): Bromide was detected (>0.25 – 0.50 mg/L) in all samples. Concentrations were similar, ranging from 0.58 to 0.67 J mg/L.

Transect T3.8 (Upstream of Three Kids Weir): Bromide was detected (>0.25 – 0.50 mg/L) in most samples. Bromide was not detected (< 0.50 mg/L) near the north bank. Concentrations in other samples were similar, ranging from 0.53 J to 0.60 J mg/L.

Transect T3.75 (Downstream of Three Kids Weir): Bromide was detected (>0.25 – 0.50 mg/L) in the samples near the south bank and mid-channel. Bromide was not detected (< 0.50 mg/L) in the sample collected near the north bank. Bromide was detected at similar concentration in the mid-channel and south bank samples (0.33 J – 0.34 J mg/L).

Transect T3.5 (Mid-way between Three Kids Weir and Rainbow Gardens Weir): Bromide was detected (>0.25 – 0.50 mg/L) in the samples near the north and south banks. Bromide was not detected (< 0.50 mg/L) in three samples collected mid-channel. Bromide was detected (0.64 J mg/L) in the sample collected towards mid-channel of the south bank. At the north bank, the concentrations (0.70 to 0.84 J mg/L) were slightly lower than the south bank (1.1 mg/L).

7.2.4.3 *Ratio of Chloride to Bromide*

Figure 30 presents the chloride/bromide ratio along the transects. Following is a summary of the chloride-to-bromide ratios based on samples collected from upstream to downstream transects in the LVW during the February 2017 transect sampling event:

Transect T6.8 (Upstream of Duck Creek Confluence): The chloride/bromide ratio was higher near the north bank (312 and 359) than mid-channel and south, where the ratio ranged from 161 to 192.

Transect T6.35 (Downstream of Proposed Sunrise Mountain Weir): The ratio at the north bank (1,080) was higher than other locations. Mid-channel was 474 to 844 and the ratio at the south bank was 839.

Transect T6.0 (Upstream of Pabco Road Weir): At transect T6.0, the chloride/bromide ratio was similar across the transect (560 to 580).

Transect T5.3 (Downstream of Proposed Historic Lateral Weir Expansion): At transect T5.3, the chloride/bromide ratio was similar to transect T6.0 (580) with the exception of the south bank (ratio of 1,000).

Transect T4.75 (Downstream of Calico Ridge Weir): The chloride/bromide ratio was higher on the north bank (700) and south bank (522) than mid-channel (441 to 474).

Transect T4.65 (Upstream of Lower Narrows Weir): The chloride/bromide ratio was highest just towards mid-channel of the north bank (351). The other samples ranged from 144 to 200.

Transect T4.6 (Downstream of Lower Narrows Weir): Similar to T4.65, the chloride/bromide ratio was highest just towards mid-channel of the north bank (1120). The other samples ranged from 165 to 175.

Transect T4.2 (Upstream of Homestead Weir): The chloride/bromide ratio along T4.2 was relatively even, ranging from 388 to 466.

Transect T3.8 (Upstream of Three Kids Weir): The chloride/bromide ratio along T3.8 was relatively even, ranging from 433 to 500.

Transect T3.75 (Downstream of Three Kids Weir): At transect T3.75, located immediately downstream of Three Kids Weir, the chloride/bromide ratio is lower on the north bank (560) than the other three locations which ranged from 824 to 848.

Transect T3.5 (Mid-way between Three Kids Weir and Rainbow Gardens Weir): The chloride/bromide ratio downstream at T3.5 was higher in mid-channel locations than north (310 to 357) or south bank (382). The mid-channel ratios ranged from 438 to 540, lower than those upstream at T3.75.

7.3 Quality Control Samples

Quality control samples collected with the Transect samples included seven FD, three FB, and six EB. As required, the laboratory ran quality control procedures including MS/MSD analysis. A detailed discussion of quality control and data validation is included in the DVSR (**Appendix F**).

FD samples were collected for seven primary samples (DVSR Table 5). Acceptable RPD between the primary and duplicate sample was specified as 30 percent in the QAPP (AECOM 2016c). Acceptable field and analytical precision was demonstrated for all FD pairs except for the bromide analysis of sample T3.8C-20170130-0.4 and its duplicate.

EB samples (six) and FB samples (three) were collected and analyzed. Target analytes were either not detected in EBs and FBs or did not require data qualification. Sample concentrations were compared to concentrations detected in the EB and FB as required by the QAPP (AECOM 2016c). No sample data were qualified based on the EB or FB results because no analytes were detected in those samples.

MS/MSD samples were run as required by the laboratory. Four of the perchlorate MS/MSD recoveries exceeded control criteria. Perchlorate results for 18 samples were qualified on this basis. These qualified results would be expected to be biased high and include several samples with relatively high concentrations of perchlorate (T4.75A-20170201-1.3 [820 µg/L], T4.75A-20170201-1.3-FD [830 µg/L], and T4.75D-2017-201-1.5 [420 µg/L]. Despite the high bias, the conclusion that these locations likely represent a nearby seep is still considered valid. Details of these qualifications are provided in Section 2.1.2 of the DVSR (**Appendix F**).

8.0 Summary of Surface Water Data: Discrete Sampling

Surface water samples were collected from 14 locations in the LVW channel (LW3.4, LW3.75, GLW3.78, LW3.85, LW4.1, GLW4.4, GLW4.85, GLW4.9, LW4.95, LW5.3, LW5.9, LW6.05, LW6.7, and LW7.2), one location outside the channel (t/ss location LWC3.7) and four locations in Wastewater Channel (LWC6.1_1, LWC6.1_2, GLWC6.1_3, and GLWC6.1_4) (**Figure 6**). Samples were collected from each location at least twice a day during the sample period, targeting both the typical low-flow and high-flow periods. In addition, several locations were sampled a third time each day targeting moderate flow conditions. For purposes of this program, the daily low flow ("daily minimum flow") was defined as the lower 10th percentile of daily flows. For high flows, the 90th percentile of daily flow had been proposed as the sampling target but was relaxed to the 50th percentile to allow the field teams to work in safe conditions during daylight hours (the 90th percentile of daily flow occurs from approximately 0000 to 0400). Mid flows are those flows occurring approximately half way between the daily minimum and daily maximum flow on the hydrograph. **Table 16** presents the analytical results of discrete surface water sampling.

8.1 Field Water Quality Parameters

At each location, a meter was used to measure pH, specific conductivity, dissolved oxygen, turbidity and temperature in the field (**Table 10**). During low flows, temperature ranged from 14.77 to 22.89 degrees Celsius. The water temperature was generally coolest in the samples collected in the morning. Temperature ranges increased at high flows (16.30 to 23.64 degrees Celsius).

The highest conductivity of 4,342 µS/cm was measured at LWC3.7 (near the KM67 seep). The pH measurements were generally near neutral to slightly alkaline, ranging from 7.32 (GLWC6.1_3) to 8.41 (LW3.4) at low flows and 7.30 (GLWC6.1_3) to 8.46 (LW3.85) at high flows.

Dissolved oxygen in the surface water ranged from 5.2 to 11.63 mg/L at low flow and 2.1 to 10.30 mg/L at high flow, and most locations were near or exceeded 100 percent saturation (saturation was corrected for temperature and atmospheric pressure). Dissolved oxygen was lowest in LWC3.7, near the KM67 seep, during low and high flows.

The turbidity meter was not functional for all locations. Turbidity that was measured ranged from 0.0 to 14.2 NTUs at low flow and 0.0 to 13.5 NTU at high flow. The water quality data at LWC3.7 (low dissolved oxygen, low turbidity) indicates it was likely sampled very close to seep KM67.

8.2 Laboratory Analyses Results

In February 2017, the concentrations of target contaminants in the LVW and t/ss confirmed other recent findings (May 2016) of an overall reduction at most locations sampled than in previous sampling events. The results of the 2017 sampling are presented in **Figure 31** through **Figure 48**, and discussed below.

8.2.1 Perchlorate

Perchlorate data from the discrete sampling are provided in **Table 16** and presented in **Figure 31** (low-flow sampling results), **Figure 32** (high-flow sampling results) and **Figure 33** (mid-flow sampling results). The results are discussed by reach, below.

<u>Upper Reach (LW7.2 to Proposed Location of Sunrise Mountain Weir)</u>

Concentrations of perchlorate in surface water were not detected in the upper portions of the LVW (<0.95 µg/L at LW7.2 and at LW6.7] during any of the low-flow, high-flow, or mid-flow samples over four days of sampling.

Pabco Road Reach (Proposed Location of Sunrise Mountain Weir to LW5.9)

By the time water in the LVW reaches the Pabco Road Weir, perchlorate concentrations under low-flow conditions increase to 18 to 19 µg/L at LW6.05, and 15 to 21 µg/L at LW5.9. As would be expected, concentrations are highly flow dependent, with concentrations under high-flow conditions of 6.0 to 8.9 µg/L at LW6.05, and 6.7 to 10 µg/L at LW5.9. During periods of moderate flow (mid-flow), concentrations ranged from 8.0 J to 17 µg/L at LW6.05.

It is not known how much the increase in this reach is attributable to the addition of perchlorate that may be transported via groundwater discharge from the Kerr-McGee sump area and how much may be attributable to other, more diffused groundwater inputs from uncharted paleochannels, underground sources, or other discharges such as uncaptured groundwater from the American Pacific Corporation (AMPAC; Endeavor) perchlorate plume. Please refer to Endeavor (2017) for additional information on groundwater impacts and perchlorate mass entering the LVW from this plume. During the February 2017 sampling period, samples collected in the Wastewater Channel that enters the LVW near the Pabco Road Weir indicated that channel contributed relatively minor amounts of perchlorate. Of the 33 samples collected in that channel, only four contained perchlorate above method detection limits: one of nine samples from LWC6.1_1 at 1.3 J µg/L; two of eight samples from GLWC6.1_3 at 1.1J µg/L and 1.5J µg/L; and one of eight samples from GLWC6.1_4 at 1.3J µg/L. All of the eight samples at LWC6.1_2 were <0.95 µg/L.

Main Reach (LW5.9 to Homestead Weir)

In the region of the Proposed Historic Lateral Weir Expansion, sampling results from LW5.3 indicate similar results to upstream samples near Pabco Road. Water depths at LW5.3 were greater than 3 feet, so samples were collected from a both a shallow depth (1.0 to 1.2 feet below water surface) and a deeper interval (2.0 to 2.4 feet below surface). Results for samples collected from different depths under the same flow conditions did not vary significantly. During low-flow conditions, the shallow sample ranged from 17 to 22 µg/L with a median of 18 µg/L, and the deep samples ranged from 16 to 30 µg/L with a median of 19 µg/L. During high-flow conditions, the shallow sample ranged from 8.9 to 11 µg/L with a median of 10 µg/L, and the deep samples ranged from 8.8 to 12 µg/L with a median of 9.3 µg/L.

Near the eastern edge of the Henderson Landfill Site (LW4.95), perchlorate results indicated an increase in perchlorate concentration, with 19 to 24 µg/L during low flows, 12 to 22 µg/L during moderate flows, and 10 to 13 µg/L during high flows. LW4.95 is located downstream of the Bostick Weir. Between the Bostick and Calico Ridge Weirs, the LVW channel is split into two subchannels by a large island, with LW4.95 located in the northern channel. Because most of the perchlorate increase is located along the southern shore, the sampling location may be isolated to a degree from the mixing in of any upstream inputs. GLW4.9 is located a short distance downstream in the southern channel, and sample results were higher. Perchlorate concentrations at GLW4.9 were 22 to 28 J µg/L during low flows, and 14 to 21 µg/L during high flows.

Below the Calico Ridge Weir (GLW4.85), samples collected near the south bank contained variable and high concentrations of perchlorate. The velocity of water is very low in that area so any waters disturbance near the time of sampling (either from entering the water to sample, or spooking of resident fish) may have a significant impact upon results. Perchlorate concentrations at GLW4.85 were 290 to 1,100 µg/L during low flows, and 180 to 750 µg/L during high flows.

Concentrations of perchlorate in surface water were higher at the Homestead Weir. At station GLW4.4, immediately upstream of the Weir, perchlorate results were 25 to 28 µg/L during low flows, 25 to 33 µg/L during moderate flows, and 15 to 23 µg/L during high flows Much of that increase may be attributable to the high

concentrations found near the Calico Ridge Weir (GLW4.85), which indicate groundwater may be contributing a significant amount of perchlorate in that area.

Three Kids Reach (Homestead Weir to Rainbow Gardens Weir)

Sampling results indicate significantly higher perchlorate concentrations below the Homestead Weir; however, the location of LW4.1 was near the southern quarter of the channel. Downstream results indicate that surface water sampled at LW4.1 was either not sufficiently mixed from upstream groundwater seepage, or was near a location of seepage. Perchlorate results from LW4.1 were 40 to 53 µg/L during low flows, and 35 to 38 µg/L for three of the four high-flow samples. The fourth high-flow sample from LW4.1 (LW4.1-20170208-16:33-0.4) returned a result of <0.95 µg/L. Other analytes for that sample (bromide, chlorate, chloride, and total dissolved solids) were within the range of other high-flow samples, so the perchlorate result is considered to be anomalous.

Sample results for stations located mid-channel near the Three Kids Weir indicate concentrations similar to those found above the Homestead Weir (at GLW4.4). Above the Three Kids Weir, perchlorate concentrations in samples from LW3.85 were 28 to 36 µg/L during low flows, and 24 to 32 µg/L during high flows. Below the weir, perchlorate concentrations in samples from LW3.75 were 26 to 35 J µg/L during low flows, and 23 to 31 µg/L during high flows. Two other stations were sampled near the southern shore at the Three Kids Weir. At station GLW3.78, water sampled from below the surface of the boulder structure of the weir indicated perchlorate concentrations of 40 to 54 µg/L during low flows, and 40 to 48 µg/L during high flows. During the sampling period, the fluctuation in flows in the LVW did not proportionally impact the perchlorate concentrations. Near the toe of the weir, samples collected at LWC3.7 had concentrations of 550 to 670 µg/L during low flows, and 770 to 1,100 µg/L during high flows. LWC3.7 is located in a very low velocity section of the channel a short distance upstream of spring KM-67. That spring was sampled in May 2016 and found to have a perchlorate concentration of 1,500 µg/L. Groundwater discharging from the spring is significantly clearer. Under the often cloudy conditions of surface water in the LVW, that clearer water could be seen backing up into the vicinity of LWC3.7, particularly during higher flow periods.

Downstream Reach (Rainbow Gardens Weir to LW3.1)

Samples collected at the Rainbow Gardens Weir indicate a rise in perchlorate concentrations of surface water within the LVW. The results from LW3.4 ranged from 42 to 53 µg/L during low flows, 42 to 57 µg/L during moderate flows, and 32 to 39 µg/L during high flows. Most of that increase is attributed to the discharge of groundwater at KM-67. Some additional contaminated groundwater may be entering the LVW from the south in the vicinity of KM-67; however, the nearby topography and geology suggests a groundwater divide a short distance downstream. In this portion of the LVW, the valley floor crosses the volcanic rocks of the Horse Spring Formation (Rainbow Garden and Frenchman Mountain). Those rocks represent a topographic high to the north. A short cliff consisting of lithified alluvial deposits is located approximately 100 feet downstream of KM-67, representing a topographic high extending to the south. With the water table typically reflecting topography, these features suggest the presence of groundwater divides in the vicinity of the Three Kids Weir. Faulting is also present in this area. The groundwater flow in this area is complex and not well characterized. There may be groundwater upwelling and/or a groundwater divide in the vicinity of the Three Kids Weir.

8.2.2 Chlorate

Chlorate data from the discrete sampling are provided in **Table 16** and presented in **Figure 34** (low-flow sampling results), **Figure 35** (high-flow sampling results) and **Figure 36** (mid-flow sampling results). The results are discussed, below.

Chlorate was detected above the detection limit (> 20 µg/L) in all samples from the LVW channel and t/ss. Chlorate concentrations fluctuated with streamflow magnitude in a fashion similar to observations for perchlorate. Several of the results represented outliers including an anomalously low value during high flow sampling at

LWC3.7 on Day 3(80 µg/L compared to other results of 2,500 (Day 1), 2,600 (Day 2) and 3,100 (Day 4) µg/L for other high-flow samples at this location), and an anomalously high value at LW4.95 (2,000 µg/L on Day 3 compared to other results of 57 to 78 µg/L for high-flow samples).

Within those stations thought to represent conditions in the main channel of the LVW, chlorate concentrations increased in the downstream direction. Between LW7.2 and LW5.3, chlorate results are relatively stable at 50 to 120 µg/L during low-flow conditions and 43 to 69 µg/L during high-flow conditions. Samples collected between the Bostick and Calico Ridge Weirs demonstrate an increase in chlorate concentration. In the northern channel of the LVW (LW4.95), chlorate results were 79 to 86 µg/L during low flow, 70 to 91 µg/L during moderate flow, and 57 to 78 µg/L during high flows, with an anomalous peak of 2,000 µg/L measured in a sample on Day 3 high-flow. Downstream results in the southern channel (GLW4.9) indicate chlorate is about 10 µg/L higher, with 87 to 100 µg/L during low flow, and 71 to 91 µg/L during high flow.

Above the Homestead Weir, chlorate results indicate another increase in concentration. Results from GLW4.4 were 99 to 120 µg/L during low flows, 93 to 140 µg/L during moderate flows, and 79 to 110 µg/L during high flows. Similar concentrations were observed at the two mid-channel sampling stations near the Three Kids Weir (LW3.85 and LW3.75). Those concentrations ranged from 100 to 140 µg/L during low flows, and 100 to 130 µg/L during low flows.

By the time the LVW reached the Rainbow Gardens Weir (LW3.4), concentrations of chlorate had risen to 170 to 190 µg/L during low flows, 160 to 200 µg/L during moderate flows, and 130 to 160 µg/L during high flows.

The highest chlorate concentrations were found in samples collected near regions of suspected groundwater discharge. Below the Calico Ridge Weir (GLW4.85), chlorate concentrations were 1,200 to 4,300 µg/L during low flow, and 900 to 3,000 µg/L during high flow. Two other stations in the LVW whose results were impacted by the nearby discharge of groundwater (LW4.1 and GLW3.78) had chlorate concentrations that were elevated relative to concentrations at other nearby stations (160 to 230 µg/L).

Samples collected in the wastewater channel entering the LVW near the Pabco Road Weir had moderately low concentrations of chlorate (81 to 110 µg/L at LW6.1_1, 47 to 91 µg/L at LW6.1_2, 76 to 110 µg/L at GLWC6.1_3, and 71 to 100 µg/L at GLWC6.1_4).

8.2.3 Total Dissolved Solids

Total dissolved solids data from the discrete sampling are provided in **Table 16** and presented in **Figure 37** (low flow sampling results), **Figure 38** (high-flow sampling results) and **Figure 39** (mid-flow sampling results). The results are discussed below.

Total dissolved solids were detected above the detection limit (> 5 mg/L) in all samples from the LVW channel and t/ss. Total dissolved solids concentrations in the samples other than the Wastewater Channel ranged from 1,200 to 2,200 mg/L during low flow, 1,300 to 1,600 mg/L at mid flow and 1,100 to 2,500 mg/L at high flow, indicating little difference in total dissolved solids. The highest concentrations were detected at LWC3.7 and GLW4.85, both in samples that contained high concentrations of perchlorate. In the Wastewater Channel, concentrations ranged from 610 to 1,400 mg/L at low flow and 590 to 1,400 mg/L at high flow. The lowest total dissolved solids concentrations were collected at LWC6.1_2.

8.2.4 Chloride and Bromide

Chloride and bromide data from the discrete sampling are provided in **Table 16**. Chloride concentrations are presented in **Figure 40** (low-flow sampling results), **Figure 41** (high-flow sampling results) and **Figure 42** (mid-flow sampling results). Bromide concentrations are presented in **Figure 43** (low-flow sampling results), **Figure 44** (high-flow sampling results) and **Figure 45** (mid-flow sampling results). The results of the ratio of chloride to

bromide concentrations are presented in **Figure 46** (low-flow sampling results), **Figure 47** (high-flow sampling results) and **Figure 48** (mid-flow sampling results). The results are discussed below.

Chloride was detected above the detection limit (> 0.25 mg/L) in all surface water locations. Chloride concentrations followed the pattern of total dissolved solids, and were generally similar, ranging from 200 to 460 mg/L in most samples. Noted exceptions were low concentrations (96 to 140 mg/L) at LWC6.1_2, located in the Wastewater Channel. Chloride did not vary substantially with depth or flow.

Bromide was detected above the detection limit (> 0.25 to 1.25 mg/L) in most surface water samples, and several samples were “J” flagged during validation. Including locations where either the sample or field duplicate was non-detect, 55 samples were non-detects, split relatively evenly among low flow (28 of 80) and high flow (24 of 80). Three locations out of 20 collected during mid flow were non-detect. Overall, concentrations were higher during low flow than high flow indicating influx into the LVW. During low flow, concentrations ranged up to 2.3 mg/L compared to 1.6 mg/L during high flow. The highest concentrations at low flow were noted at LW5.3 and GLW4.9, near proposed Historic Lateral Weir Expansion and Calico Ridge Weir. The highest concentration during high flow was at LWC3.7. During mid flow, concentrations were generally higher upstream at LW6.7 and LW7.2, but LWC3.7, LW5.3 and GLW4.9 were not sampled for comparison to low and high flow.

The ratios of chloride to bromide were varied. Higher ratios were noted during high flow samples compared to low or mid flow samples. This reflects the higher bromide concentrations during low flows, which may be indicative of a higher flow contribution from groundwater.

8.2.5 Quality Control Samples

Quality control samples collected for discrete samples included FD, FB, and EB. As required, the laboratory ran quality control procedures including MS/MSD analysis. A detailed discussion of quality control and data validation is included in the DVSR (**Appendix F**).

FD samples were collected for 17 primary samples (DVSR Table 5). Acceptable RPD between the primary and duplicate sample was specified as 30 percent in the QAPP (AECOM 2016c). Acceptable field and analytical precision was demonstrated for all FD pairs with the exception of bromide analysis in the following pairs:

1. LW3.85-20170207-15:50-0.6 and its FD which had a RPD of 33 percent,
2. GLWC6.1_4-20170208-10:35-1.3 and its FD which had an RPD of 59.15 percent, and
3. GLW4.9-20170208-16:35-1.4 and its FD which had an RPD of 33 percent.

Bromide results in these three pairs of samples were qualified as estimates with a “J” flag.

EB samples (nine) and FB samples (eight) were collected and analyzed. Target analytes were either not detected in EBs and FBs or did not require data qualification. Sample concentrations were compared to concentrations detected in the EB and FB as required by the QAPP (AECOM 2016c). No sample data were qualified based on the EB or FB results because no analytes were detected in those samples.

MS/MSD samples were run as required by the laboratory. Some of the bromide (one) and perchlorate (nine) MS/MSD recoveries exceeded control criteria. No bromide samples required qualification, but perchlorate results for 25 samples were qualified on this basis. Details of these qualifications are provided in Section 2.1.2 of the DVSR (**Appendix F**).

9.0 Perchlorate Mass Flux Estimates

The perchlorate results were converted from concentrations (in µg/L) to estimates of perchlorate mass flux (in pound per day [lb/day]) using estimates of streamflow in the LVW at the time of sampling.

9.1 Screening of Samples

The transect and discrete sampling data both had a wide range of perchlorate concentrations and did not show a consistent curve of increase with distance downstream. The transect sampling was designed to identify loci across the LVW that may be contributing to perchlorate inputs. During the discrete sampling, samples collected near suspected or previously unknown perchlorate inputs show up as “anomalous” high concentrations that would cause a mass flux estimate to be biased high. The sample data were evaluated and sub-sets of transect and discrete data were selected to minimize bias in the perchlorate mass flux estimates. The treatment of the sample data is described in Sections 9.3 and 9.4.

9.2 Provisional Flow Estimates for Flux Calculations

AECOM estimated streamflow at the transects and the discrete locations using the five permanent USGS gaging stations and several AECOM temporary stream gaging stations along the study reach of the LVW. All those stations demonstrate the daily pattern of highs and lows related to the release of wastewater from upstream wastewater treatment plants. The timing of those highs and lows vary from station to station, arriving later in the day with distance downstream. Between the stations at the Duck Creek Confluence and Rainbow Gardens Weirs (essentially representing the study reach), the daily highs and lows are separated by approximately three hours. Stream stage and estimated streamflow are reported by the USGS on a 15-minute frequency. Those data are available from the USGS on their “WaterWatch” webpage (USGS 2017). The temporary stream gages installed by AECOM (see Section 6.0) could not be used to estimate flow as they have not been calibrated for direct reading of flow and record only the height of the staff gage; however, these gages were used to estimate flows based on the flow data from the USGS gages.

Stream channels are highly dynamic environments, and the relationship between stream stage and streamflow (rating equation) often changes. Through periodic direct measurements of streamflow at the stations, the USGS evaluates that relationship and makes changes to the rating equation (and streamflow estimates) as needed. Until data are officially approved by the USGS, reported streamflow data are considered provisional in nature and may be subject to later revision. Several large storms reached the Las Vegas area during the weeks prior to transect sampling. While the stormwater runoff from such events is quickly passed through the LVW, the peak flows caused alterations to portions of the stream channel and significantly changed the rating equation at several of the USGS stations (USGS 2017), including the stations at Bostick and Three Kids. There have been several adjustments to data reported for the LVW during the period of transect sampling; however, some of the data will likely require further modification prior to USGS approval. The provisional data used in this analysis were downloaded on May 3, 2017.

In comparison to historic streamflow patterns in the LVW, data reported at the time of downloading for the LVW above Three Kids Wash (USGS station 09419753) were lower than anticipated by AECOM throughout the sampling period. During portions of the sampling period, data reported for the stations above the Bostick and Homestead Weirs (USGS stations 09419747 and 09419749, respectively) were also different from what was expected, with some of the data reported for the Bostick Weir lower than expected and flow at the Homestead Weir higher than expected based on AECOM review of historic data. AECOM contacted USGS who confirmed the data are provisional and, because of high flows in January, some erosion occurred and the flow calibration curves for the gages would need to be reviewed. With these three stations representing flow conditions for the

lower half of the study area, AECOM also utilized flow data from the downstream station below Lake Las Vegas (USGS station 09419800) to help characterize flow at the time of sampling. With nearly 70 percent of the length of the channel between the Three Kids station (immediately upstream of the Rainbow Gardens Weir) and the Lake Las Vegas station being conveyed through a pipeline at relatively high velocities, the timing and magnitude of daily peaks and lows are very similar at the two stations. A review of high and low flow peaks at the two gages indicates a 15 to 30 minute delay from Three Kids to Lake Las Vegas.

Streamflows at sampling locations above Pabco Road were estimated using data from the station below Duck Creek confluence (USGS station 09419698). Depending upon the location of stations below Pabco Road, where the LVW picks up a significant flow from a series of treatment outfalls, streamflows were mostly estimated using a combination of data from the Pabco Road and Lake Las Vegas stations (USGS stations 09419700 and 09419800, respectively). Given the uncertainty associated with some of the available data, USGS were consulted and agreed that the approach was appropriate for preliminary estimates of perchlorate flux (USGS 2017b). Some of the streamflow data reported for the Bostick and Homestead stations were used for streamflow estimates when that data reflected the observed flow regime elsewhere in the LVW.

To help derive flow estimates at transects located some distance from the USGS streamflow stations, stage data collected at AECOM's eight temporary stations were used to determine when the samples were collected relative to the daily streamflow cycle. For instance, if a sample was collected at a transect when stream stage there indicated the height of water was 5 percent above the daily low, the similarly timed low stage at the closest USGS gaging station was adjusted upward by 5 percent and flow at the transect was estimated based upon that stage.

The USGS characterizes the accuracy of approved daily average streamflow data as excellent (95% of daily data within 5% of actual streamflow), good (95% of daily flows within 10% of actual flow), fair (95% of daily data within 15% of actual flow), and poor, or having a less than "fair" accuracy (USGS 2009). For the two long-term stations at Pabco Road and below the Three Kids Weirs, annual data summaries characterize the data quality as fair, i.e., 95% of daily data falls within 15% of actual flow. Most of the data used in this study were provisional, i.e., data of "unverified accuracy and subject to revision" (USGS 2016). The high frequency provisional data used to evaluate flow conditions throughout the study area should be considered to be accurate to no less than 15% of true streamflow (30 to 60 cubic feet per second [cfs] over the typical daily range of flows of 200 to 400 cfs). Uncertainty also comes from the stage/flow estimates for ungaged (i.e., no flows calibrated for the gage) transect locations. Additionally there may be real differences in streamflow between stations (groundwater inflow and outflow, evaporation, etc.); however, those differences are likely to be small relative to the 30 to 60 cfs uncertainty associated with the use of preliminary USGS data and the correlation of that flow to AECOM's temporary stations.

9.3 Flux Estimates: Transect Samples

Where sampling results along the individual transect indicated the potential for the inflow of contaminated groundwater, a "representative" concentration was selected in an attempt to characterize the average level of perchlorate concentration entering the transect (**Table 17**). It was assumed that any inputs observed along the transect, which generally are observed as higher concentrations near the banks, would be the representative concentration at downstream transects. In the case of the transect below the Calico Ridge Weir (T4.75) for example, the perchlorate results for the sample collected near the south bank was almost 40 times higher than samples collected near the middle of the channel. Without knowing the perchlorate concentration and flow rate of that groundwater inflow, higher concentrations from one or more samples along the transect could not be integrated into a representative concentration without introducing significant error to the subsequent flux calculations. Instead, an average concentration from samples collected near the middle of the transect was chosen (as the median).

The perchlorate flux estimates at the transect sections are shown in **Table 17** and **Figure 49**. Several transects (i.e., T6 and T4.2) indicated a downstream drop in perchlorate flux. Those apparent losses are thought to be related to data issues (primarily the estimation of flows) and the complex way in which water in an open stream

channel mixes. The differences in perchlorate flux between those two stations and their neighboring stations can be explained by the potential 10 percent error in accuracy for preliminary streamflow data.

Near the Duck Creek Confluence Weir (Transect T6.8), samples were mostly below the 0.95 µg/L detection limit. One sample near the middle (T6.8C) had an estimated concentration of 1.6 µg/L. Assuming the average concentration at T6.8 was 0.95 µg/L, the resulting mass flux would have been < 1.0 lb/day. By the time it reached Transect T6.35, the perchlorate concentration in the LVW had increased to 18 µg/L, corresponding to 18 lb/day of perchlorate flux. That station is near a formerly sampled seep (KM71) that contained 3,400 µg/L of perchlorate during a 2000 sampling event conducted by Kerr McGee. Attempts to find KM71 have been unsuccessful since the original sampling of the seep.

Near Pabco Road, the apparent perchlorate flux dropped to 15 lb/day. A significant volume (approximately 40 cfs) of surface flow comes in immediately downstream of that transect (T6) from the Wastewater Channel. This is approximately 15 percent of the total flow in the LVW. Samples for perchlorate collected from the Wastewater Channel are generally below the detection limit, so if there is mixing of that water at T6 it would result in a lower concentration and resulting flux estimate (flow at T6 is estimated from the Duck Creek station near T6.8). This apparent drop is thought to be related to the increase in flow and not reflective of an actual loss of perchlorate in the system.

Near the proposed Historic Lateral Weir Expansion (Transect T5.3), the estimated perchlorate flux representative of the main channel was 17 lb/day, which is similar to the 18 lb/day estimated at T6.35. The potential influence from contaminated groundwater can be seen near the south bank where sample T5.3A contained 32 µg/L (vs. 18 µg/L in the main channel). By the time it passed through the Calico Ridge Weir (Transect T4.75), the perchlorate flux near the center of the LVW had risen to 25 lb/day with a significant increase observed coming in from the south and north banks (T4.75A at 820 J µg/L and T4.75D at 420 J µg/L, respectively).

Transects above and below the Lower Narrows Weir (T4.65 and T4.6, respectively) both had estimated perchlorate flux of 35 lb/day. Samples collected near the south bank continue to show some additional perchlorate entering the system (results of 40 to 66 µg/L from T4.65 to T3.8); however, the estimated flux changed only a little by the time the flow reaches the Three Kids Weir. Above the Three Kids Weir, Transect T3.8 had an estimated flux of 37 lb/day. Below the weir, the flux was a similar 35 lb/day at T3.75. While the concentration of perchlorate near the banks between the Lower Narrows and Three Kids Weirs may be almost twice as high as in the main channel, the rate of groundwater inflow must be low enough to not appreciably alter the total perchlorate flux in the LVW.

The data for Transect 4.2 near the Homestead Weir indicates an apparent 5 lb/day drop in perchlorate flux. Similar to the apparent loss near Pabco Road, the reduction near the Homestead Weir is thought to be related to the data, not a true loss of perchlorate to the system. Estimates of flux using the discrete data collected near that location (sample GLW4.4; **Table 18**) indicated perchlorate flux of 30 to 45 lb/day.

Near the Three Kids Weir, the influence of groundwater can be seen again near the north bank (samples T3.8D at 46 µg/L and T3.75D at 85 µg/L). The flux estimate is 37 lb/day. Immediately downstream of T3.75, a large spring enters the LVW. During a May 2016 sampling event, that spring (KM67) was found to contain 1,500 µg/L of perchlorate.

Flow from the spring KM67 enters the LVW below the Three Kids Weir in a somewhat braided area of the stream. Most of the discharge from KM67 is likely to enter several smaller channels along the south bank, while the majority of flow passes to the north. The final transect crosses this braided area, with concentrations of up to 140 µg/L in stations to the south (T3.5A to T3.5D) and lower concentrations to the north (37 to 47 µg/L at T3.5E and T3.5F). A concentration of 43 µg/L was selected as being representative of the main flow through the transect, for an estimated flux of 43 lb/day. The actual perchlorate flux in the LVW at Transect T3.5 would likely be higher

after the mixing of all the subchannels. Estimates of flux using discrete data downstream of T3.5 indicated flux may be as high as 57 to 75 lb/day (sample LW3.4; **Table 18**).

9.4 Flux Estimates: Discrete Samples

Flux calculations were made to demonstrate both how the total estimated perchlorate flux along the LVW changes, and how changes in the flow regime over the daily cycle may impact that flux. Most stations were sampled twice a day over the four-day period during a time of low and high streamflow. Several of the stations were also sample a third time each day with the goal of capturing mid-cycle flows (LW6.05, LW4.95, LW4.4, and LW3.4). In contrast, samples collected from the transects were collected once during periods of low streamflow.

Samples were collected at the discrete sampling locations on four consecutive days. That resulted in a range of concentrations and calculated perchlorate flux; however, perchlorate flux calculated at each station under the same flow regime (low, mid, and high) were generally in good agreement with each other. Some of the variation in flux and concentration at the sampling points may be attributed to the streamflow estimation process critical in the calculation of flux from perchlorate concentration, and some may be attributed to variations in perchlorate influx into the LVW and how that influx mixes with the surface water in the LVW. The perchlorate flux estimates provided in this report use the median values from each location and flow regime from the discrete sampling.

Several stations were not included in the estimation and discussion of perchlorate flux. Four stations were excluded from the estimation and discussion of perchlorate flux as they represented flow from the Wastewater Channel that enters the LVW at the Pabco Road Weir (LWC6.1_1, LWC6.1_2, GLWC6.1_3, and GLWC6.1_4). Of the 33 total samples collected from those four locations, 29 samples were below the method detection limit of 0.95 µg/L, and four were estimated to contain up to 1.5 µg/L of perchlorate. That water enters the LVW upstream of the Pabco Road Weir. In contrast, samples of water in the LVW at discrete sampling locations near Pabco Road averaged 13 µg/L, approximately an order of magnitude higher than the concentrations in the Wastewater Channel.

In addition to the locations in the Wastewater Channel, four other discrete stations were not included as their sample results clearly indicate they were outliers impacted by the nearby discharge of contaminated groundwater (LWC3.7, GLW3.78, LW4.1, and GLW4.85). Those elevated results are not representative of average concentrations passing through LVW. Attributing those concentrations to the entire flow passing through the vicinity of the sampling location would greatly overestimate the total flux of perchlorate in that region of the LVW. Those perchlorate contributions detected at these four stations would show up at downstream stations as the groundwater influx mixes with surface water in the LVW:

- LWC3.7 – This location is near the south bank immediately upstream of a spring that discharges below the toe of the Three Kids Weir. A sample collected from spring KM67 in May 2016 was found to contain 1,500 µg/L of perchlorate (AECOM, 2016). During the discrete sampling event, water velocity in the LVW in the vicinity of LWC3.7 and KM67 is very low, and discharge from the spring was visibly observed to back up into the region of the sampling location (groundwater discharge from KM67 is significantly clearer than surface water in the LVW). The median concentration of perchlorate from samples collected at LWC3.7 (730 µg/L) was 24 times higher than samples collected in the main channel of the LVW near the Three Kids Weir (30 µg/L at LW3.85 and LW3.75). The perchlorate contribution from KM67 (and any other nearby contributions from the aquifer feeding it) becomes mixed with the waters of the LVW as it travels to the lowest discrete sampling point at the Rainbow Gardens Weir (LW3.4). Samples from LW3.4 were collected mid-stream within the weir outlet and may be representative of the total, well-mixed load of the LVW at that point. As discussed later in this section, the flux of perchlorate increases from approximately 36 lb/day near the Homestead and Three Kids Weirs to between 60 and 70 lb/day at the Rainbow Gardens Weir. This flux is slightly higher than that provided by EPA for the Northshore Road measurements (52-67 lb/day) (NDEP Northshore sampling results, 1998-current pending provided via email October 2, 2017) but is in general good agreement considering the

uncertainties in the provisional flow data provided by USGS, the one-time sampling and estimation, the flow estimates based on the water levels measured at the staff gages and the variability in concentrations along and across the LVW. Assuming that the 24 to 34 lb/day gain of perchlorate flux originates from KM67, the spring would need to be flowing at a rate of 3.0 to 4.2 cfs (1,300 to 1,900 gallons per minute) to provide this mass flux gain at a concentration of 1,500 µg/L.

- GLW3.78 – Some of the higher concentration observed at LWC3.7 may be attributed to additional groundwater discharge through springs and seepage along the southern bank of the Three Kids Weir. Station GLW3.78 was selected to evaluate for that potential, with samples targeted to represent a mix of surface water flowing through the rock structure of the weir and potential groundwater inflow from the south. Samples collected at GLW3.78 had a median concentration of 47 µg/L, 56 percent higher than the 30 µg/L median for samples collected nearby in the main channel. The results for GLW3.78 are somewhat lower than results for samples collected near the southern shore during the Transect sampling discussed in Section 9.3. From the Lower Narrows Weir down to the Three Kids Weir, those near shore samples ranged from 57 to 64 µg/L. It is not known if the elevated results at GLW3.78 are attributable to groundwater discharge along the bank of the Three Kids Weir or if it is the result of incomplete mixing of upstream groundwater discharge with the surface water of the main channel. Due to the potential for influence or incomplete mixing, GLW3.78 was not included in the flux calculations.
- LW4.1 – Samples collected during the discrete sampling below the Homestead Weir (LW4.1) averaged 43 µg/L, 70 percent higher than samples collect upstream near the weir (25 µg/L at GLW4.4). Given the higher concentration of perchlorate observed near the south shore sampling locations along this reach of stream during the transect sampling week, some increase in concentration and total perchlorate flux would be anticipated in the area. However, by the time the LVW enters the Three Kids Weir, samples collected near the middle of the channel (LW3.85 and LW3.75) averaged 30 µg/L, or 26 percent lower than the average at LW4.1. That downstream decrease in concentration would represent an average loss in perchlorate flux of 20 lb/day. With samples at LW4.1 being collected approximately one-quarter of the stream width away from the south bank, the anomalously high levels observed there are attributed to an incomplete mixture of groundwater along that bank.
- LW4.85 – Other than results related to the spring near the Three Kids Weir (KM67 near LWC3.7), the highest levels of perchlorate along that southern bank were encountered at GLW4.85. Samples from that station, which was located immediately downstream of the Calico Ridge Weir, had a median perchlorate concentration of 310 µg/L, with one sample as high as 1,100 µg/L. That average concentration (310 µg/L) is 13 times higher than concentrations found near the middle of that channel cross section during the transect sampling (23 µg/L). During the transect sampling, elevated perchlorate concentrations were found at both the south and north banks (820 and 420 µg/L, respectively). Together, those observations clearly indicate an influx of groundwater near the Calico Ridge Weir.

The results from several of the discrete sampling locations (LW5.9 and LW3.75) indicated a small drop in perchlorate flux from the upstream location (LW6.05 and LW3.85, respectively). Rather than representing an actual reduction of perchlorate flux, that observed drop is likely related to data uncertainties (primarily the estimation of flows) and the complex way in which water in an open stream channel mixes. Similar to some of the results from the transect sampling, the differences in flux could largely be explained by the potential 10 percent error in accuracy for preliminary streamflow data (Section 9.2). It should also be noted here that at one station (LW5.3), water depth was over 3 feet, so samples were collected from both a deep location near the streambed and from a shallower location. Results from samples collected at different depths were not significantly different, so shallow and deep concentrations were combined for calculating median perchlorate flux values.

The perchlorate flux estimates at all other discrete sampling locations are shown in **Table 18**. The table includes perchlorate results (median concentration, median flow, and median perchlorate flux) for low-flow, mid-flow (where applicable), and high-flow sampling regimes. The flux estimates are presented by RM for low-flow estimates (**Figure 50**), high-flow estimates (**Figure 51**) and mid-flow estimates (**Figure 52**).

The maximum potential perchlorate flux at upstream stations where perchlorate results were below detection limits (LW7.2 and LW6.7) were calculated by assuming the perchlorate concentration was near the method detection limit of 0.95 µg/L. That assumption resulted in a maximum potential flux of 0.9 lb/day under low-flow conditions (<1 lb/day in **Table 18**) and 1.7 lb/day under high-flow conditions (<2 lb/day). The maximum potential flux rates at these stations were calculated to represent a potential starting point for changes in perchlorate flux across downstream reaches of the LVW. The actual flux of perchlorate near the Duck Creek Confluence Weir and Upper Narrows Weir is likely to be substantially lower than that maximum potential.

Perchlorate flux estimates at different flow regimes generally remained in good agreement from Pabco Road down to station GLW4.9 (upstream of the Calico Ridge Weir). At the next station downstream of Pabco Road (LW5.9), the perchlorate flux was essentially the same under low- and high-flow conditions (16 and 15 lb/day, respectively). Perchlorate flux estimates at the next two stations are complicated by flow dynamics below the Bostic Weir. Between the Bostick and Calico Ridge Weirs, the LVW is split into two channels by a large island. Station LW4.95 is located in the northern channel near the Bostic Weir. Station GLW 4.9 is located in the southern channel near the downstream Calico Ridge Weir. Between those stations, sampling results indicate there is a gain in perchlorate along the southern bank. Under low- and mid-flow regimes, the perchlorate flux at LW4.95 remained steady at 25 to 26 lb/day, respectively, but dropped to 22 lb/day under the high-flow regime. That decrease under the high-flow regime may be related to variations in streamflow routing between the two channels under different flow regimes. The average perchlorate flux estimate at GLW4.9 under both the low-flow and high-flow regimes was 29 lb/day. Where that northern and southern channel merge back together (above the Calico Ridge Weir), the actual perchlorate flux of the LVW would reflect a combination of the flux in the northern channel (approximately 25 lb/day at LW4.95) and in the southern channel (approximately 29 lb/day at GLW4.9). The flux of perchlorate immediately above the Calico Ridge Weir is estimated from this at 25 to 29 lb/day.

Beginning near GLW4.4 (upstream of the Homestead Weir), estimated perchlorate fluxes become consistently higher under high-flow conditions. While the estimated flux at GLW4.4 under the low-flow regime (median value of 30 lb/day) was similar to the estimated flux under the high-flow regime (33 lb/day), higher flux was estimated under the mid-flow regime (45 lb/day). Near the Three Kids Weir, the estimated perchlorate flux under the low-flow regime (37 and 31 lb/day, respectively, at stations LW3.85 and LW3.75) was approximately 20 lb/day lower than under the high-flow regime (56 to 50 lb/day, respectively). It should be noted that the indicated perchlorate flux decrease from the upstream station (LW3.85) to the downstream station (LW3.75) is thought to reflect differences in the mixing of surface water through the weir. The actual range of results at the two stations under the two different regimes is very similar; however, lower values in the respective ranges were more common at the downstream station.

At the Rainbow Gardens Weir, the most downstream station in the discrete sampling investigation, the difference between estimated perchlorate fluxes under the low-flow regime (median value of 57 lb/day at LW3.4) was approximate 15 lb/day lower than under the high-flow regime (71 lb/day). The magnitude of that difference is lower than at the Three Kids Weir (20 lb/day). That may be due to the significant influx of perchlorate from the spring near the toe of that weir (KM-67), which may serve to moderate background fluctuations in upstream perchlorate concentration. That impact may also be reflected in the agreement between estimated perchlorate fluxes under the mid-flow regime (median value of 75 lb/day) and high-flow regime (71 lb/day).

The perchlorate concentration at any given time and location throughout the NERT RI Downgradient Study Area is dependent upon the perchlorate concentration in surface water entering the location from upstream, additional perchlorate entering the LVW from groundwater discharge near the location, the timing of observation within the daily cycle of streamflow peaks and lows, and the delay between that cycle and the arrival of diluted wastewater driving daily peak flows. All of those variables may change significantly from one sample location to another, leading to variations in perchlorate flux estimates throughout the flow regime. At stations above the Calico Ridge Weir, the perchlorate flux under different flow regimes appears to be similar on average, although significant differences may still arise between individual measurements. Near the Lower Narrows Weir, perchlorate

estimates under different flow regimes become more significant, with higher estimates of flux under mid-to-high-flow regimes.

9.5 Influence of Wastewater Discharge and Flow

One of the goals of the SWIP was to observe how concentrations of perchlorate fluctuate with respect to the daily cycle of wastewater discharge. During periods of low flow, streamflow in the LVW was generally on the order of 200 cfs. The rate of wastewater discharge from upstream treatment plants increases in the late morning, and streamflow in the LVW increases to approximately 350 cfs. Similar to the perchlorate concentrations observed in the Wastewater Channel entering the LVW near Pabco Road (LWC6.1_1, LWC6.1_2, GLWC6.1_3, and GLWC6.1_4), wastewater from those sources is assumed to contain low concentrations of perchlorate (<0.95 µg/l). That assumption is confirmed to a degree for the period of this study by the results for the two upstream stations. When the streamflow increased by approximately 75 percent between low-flow and high-flow conditions, the concentration of perchlorate remained under the method detection limit.

That dilution is complicated by the travel time of water particles in the LVW, which lags significantly behind the propagation of the streamflow peak from upstream wastewater release. The arrival of daily low and daily high streamflow at the USGS station above the Three Kids Wash (near the Rainbow Gardens Weir) generally occurs 3 hours after the arrival at the upstream station at the Duck Creek Confluence Weir. In contrast, the peak concentration of particles in a recent dye tracing study (Department of the Interior [DOI] 2016) lagged by approximately 6 hours over a similar reach of the LVW (between the Upper Narrows Weir and Fire Station Weir). As that water moves downstream, it mixes in with streamflow that is gaining perchlorate from a series of springs and groundwater seepage locations along the way.

Along portions of the study area, the timing of additional perchlorate and additional wastewater discharge may be balanced to a degree, with increased flow being compensated by the dilution of perchlorate concentration. The result of dilution can be seen near Pabco Road, where perchlorate flux at station LW6.05 did not change under low- and mid-flow regimes. The average streamflow during sampling collection increased by 30 percent; however, the average flux remained 18 lb/day (**Table 18**) due to a lower concentration resulting from the wastewater discharges. At high-flow conditions, the flux dropped to 12 lb/day (**Table 18**). That drop may be due to the arrival of increasingly diluted water, and may also be related to mixing of water with low perchlorate concentrations from the Wastewater Channel that enters the LVW at Pabco Road.

10.0 Revised Conceptual Site Model for Las Vegas Wash

A CSM of the LVW and potential inputs of perchlorate was developed for the SWIP (AECOM 2016a). This section updates the CSM based on the data collected to implement the SWIP in December 2016 and January and February 2017. A diagram of the updated CSM is provided in **Figure 53**. NERT will incorporate this information with all other data collected during the RI and present a comprehensive CSM in the RI Report.

10.1 Anthropogenic Sources of Discharge to the LVW

Discharges from the four major wastewater treatment plants in the valley represent the vast majority of anthropogenic flow in the LVW (Clark County Water Reclamation District, City of Las Vegas Water Pollution and Control Facility, City of Henderson Water Reclamation Facilities, and City of North Las Vegas Water Reclamation Facility). Outfalls from groundwater treatment plants (NERT, American Pacific Corporation, and TIMET) join the channel conveying treated wastewater from the City of Henderson, entering LVW above Pabco Weir (indicated as combined treated wastewater inflow on **Figure 53**). The remaining flow in the LVW comes from other sources such as Duck Creek and the C-1 channel, as well as non-point sources including urban and stormwater runoff and shallow groundwater discharge. It is expected that some reaches of the LVW are below the groundwater table and, therefore, receive groundwater discharge. Other reaches of the LVW are above the groundwater, which cause infiltration (loss) of the surface water. This condition is dynamic and changes depending on a wide variety of variables including, but not limited to, increases in flow rates from the wastewater treatment plants due to increased land development, diurnal fluctuations in wastewater flows, seasonal fluctuations of the groundwater table and occasional episodes of precipitation in the LVW drainage area.

The treatment plants contribute a relatively steady daily supply of water to the LVW throughout the year. The outfalls discharge continuously but at a predictably cyclic rate. That cycling causes a diurnal flow pattern similar to a tidal pattern, with daily high and daily low flows. Unless disrupted by rain storm events, daily high flows are on the order of 100 percent higher than the daily low. However, the constant daily discharge represents the vast majority of flow in LVW, and the natural, seasonal variability in streamflow has largely been eliminated. On average, streamflow tends to be somewhat higher from October through March (290 to 340 cfs) and lower from April through September (260 to 310 cfs) (USGS 2017).

Along with the general increase in background flow in LVW through the years, there has also been an increase in the magnitude of stormwater runoff draining into the LVW. Fifty years ago, the annual peak flow at Pabco Road was on the order of 300 cfs (median value of 280 cfs from 1957 to 1967), or similar to the current average annual flow (298 cfs). More recently, annual peak flows are on the order of 4,500 cfs (median value of 4,350 cfs from 2005 to 2015) (USGS 2016).

In an effort to protect the channel from the erosive forces of higher flows, a series of erosion control structures (weirs) have been constructed to slow the water velocities in the LVW. Where erosional forces have been allowed to run their course, the stream channel within the Downgradient Study Area is generally 40 feet or less in width. Near some of the weirs, the width increases to 300 feet or more.

The channel materials consist of loose, unconsolidated sediments that have been shifted and sorted by the energy of the flowing water. Most of the underlying material is alluvium that consists of both fine-grained materials (silts and clays) and courser materials (sands and gravels). As the water carries those deposits downstream, sand and gravel are deposited in areas with higher velocity, providing a more solid streambed. Where streamflow slows down in natural pools and behind some of the weir structures, silts and clays are deposited, creating a soft bottom. The Horse Springs Formation is present in the southern streambank east of Calico Ridge Weir, and the

Thumb Formation is present on the northern and southern streambanks between the Lower Narrows and Three Kids Weirs.

10.2 Known Sources of Perchlorate

During the May 2016 sampling program (AECOM 2016), an attempt was made to locate the seeps that were sampled by Kerr McGee in 2000. Seeps that were successfully located, accessible, and flowing were subsequently sampled. It is surmised that weir construction, onshore riparian zone restoration, flooding and vegetative growth during intervening years, and the ongoing regional drought conditions may have affected the occurrence and, if present, the flow from the previously identified seeps. Because the installation of the weirs likely changed the seep locations, attempts were made to relocate the seeps and, if possible, sample them. Of the 18 historic seep locations, only three (KM-45, KM-67 and KM-71) could be located in the field. All other historic seeps may have been buried by weir and bank construction, submerged by the expanded stream channel and associated sediments, temporarily dried up under the ongoing drought conditions, or obscured by dense vegetation. Two seeps (KM-67 and KM-71) were sampled. The concentrations of perchlorate in the seeps were lower in 2016 than in 2000. At KM-71, the concentration in 2016 (1.4 J µg/L) was substantially lower than in 2000 (3,400 µg/L). In 2000, KM-71 was located downgradient of the proposed location of the Sunrise Mountain Weir. The seep was located in 2016 immediately upstream of this location in a backwater channel. While unknown from existing information, the seep that was sampled in May 2016 could be a different seep than that sampled in 2000. At KM-67, located near the Three Kids Weir, the concentration (1,500 µg/L) in 2016 was slightly lower than in 2000 (2,100 µg/L). Construction of Three Kids Weir was completed in July 2015. A riprap weir referred to as “Demonstration Weir” was constructed near this location in 1999. The Demonstration Weir was relocated and rebuilt in 2007 and was eventually dismantled in 2013 and replaced by the Three Kids Weir (Las Vegas Wash Coordination Committee 2016). Although a weir was in place in this location during both the 2000 and 2016 sampling events, it is not clear to what extent, if any, each weir affected the stream flow and sample results during the 2000 and 2016 sampling events.

In the SWIP (AECOM, 2016a), sampling locations and methodology were designed to further refine the understanding of where perchlorate enters the LVW, and what impact the varying flow regime has on perchlorate concentrations in surface water samples. Known and suspected regions of perchlorate discharge were selected to help pinpoint loci of discharge and where, along transects, that discharge may be occurring. During the January/February 2017 sampling event, samples were collected from sampling points across 11 transects. Perchlorate concentrations from the transect sampling are provided in **Figure 25**. During December 2016 and February 2017, samples were collected from 14 discrete sampling locations on the LVW, one backchannel location, and four locations along the Wastewater Channel entering the LVW near Pabco Road. The LVW locations ranged from the upstream portion of the Downgradient Study Area (LW7.2) downstream to LW3.4, located downstream of the Downgradient Study Area. The perchlorate concentrations from these grab and discrete samples are provided in **Figure 7 and Figure 8** (December 2016 sampling)**,** and **Figure 31** through **Figure 33** (February 2017 sampling; low flow, high flow and mid flow, respectively).

The results of the seep sampling conducted by Kerr McGee in 2000 and by AECOM in May 2016, December 2016 and January/February 2017 indicate that there is perchlorate discharge to the LVW. The data indicate perchlorate is entering the LVW in the areas near the proposed Sunrise Mountain Weir, the Bostick Weir, the Calico Ridge Weir, and the Three Kids Weir. Sampling results also indicate the potential for small gains of perchlorate along the southern bank of the LVW from the region near the proposed Historic Lateral Weir Expansion down to the Three Kids Weir, where perchlorate was generally found to be approximately twice as high as samples collected from mid-channel locations. Along much of that bank, the slow, relatively minor seepage of groundwater may not be significant enough to appreciably increase the detected concentrations in the main flow of the LVW. Larger, observable gains observed in sample results are more likely to be attributed to more focused discharge of groundwater with higher concentrations of perchlorate, such as the 1,500 µg/L results for the spring at KM67, near the toe of the Three Kids Weir.

By characterizing the flow regime during sample collection, estimates of actual perchlorate flux were calculated to represent flow-weighted sampling results (**Section 9**). **Figure 53** is the revised conceptual site model that shows the range (minimum and maximum) fluxes of perchlorate calculated from the discrete sampling (**Table 18**). The following discussion of perchlorate flux is based on the data presented in the conceptual site model (**Figure 53**).

The daily fluctuations in flows in the LVW have a significant impact upon perchlorate concentrations in samples. At stations upstream of the Calico Ridge Weir, the dilution of perchlorate concentration (in µg/L) at higher flows shows a tendency to balance with the flow rate such that the perchlorate flux (in lb/day) is generally in good agreement across the range of observed flow conditions. Downstream of the Lower Narrows Weir, differences in perchlorate flux become more pronounced, with higher flux under mid-to-high-flow conditions. Those differences complicate the general estimates of perchlorate fluxes at those downstream stations.

Above the Upper Narrows Weir, perchlorate levels were nearly all below the method detection limit of 0.95 µg/L (one of the five samples collected along transect T6.8 was found to have an estimated concentration of 1.6 µg/L). The first increase in perchlorate concentrations moving downstream appears near the proposed Sunrise Mountain Weir, where samples collected at transect T6.35 indicate a perchlorate flux of 12 to18 lb/day (**Figure 53**). Estimated perchlorate flux remained near that level downstream to the proposed Historic Lateral Weir Expansion (perchlorate flux of 17 to 21 lb/day). The results from samples collected between the Bostick Weir and Calico Ridge Weir indicate the LVW may gain approximately 5 lb/day between the proposed Historic Lateral Weir Expansion and the Bostick Weir, for a perchlorate flux of 22 to 26 lb/day. An additional 8 to 19 lb/day may be gained by the time the LVW passes through the Lower Narrows Weir, for a perchlorate flux of 30 to 45 lb/day. Most of that additional flux is suspected to come from groundwater discharge near the toe of the Calico Ridge Weir. Samples collected near the south bank of that weir contained up to 1,100 µg/L of perchlorate, 50 times higher than samples collected near the middle of the channel. Samples collected near the north bank were also elevated (almost 20 times higher). By the Three Kids Weir, the LVW may gain more perchlorate; however, perchlorate flux estimates from the lower portions of the study area were increasingly impacted by the varying flow regime. Some gain would be expected along this section of the channel given the somewhat higher concentrations observed along the south bank. At the Three Kids Weir, estimated perchlorate fluxes were generally on the order of 37 to 56 lb/day, for a potential gain of 7 to 11 lb/day. Below the Three Kids Weir, discharge from spring KM-67 enters on the south bank and begins to mix in with the waters of the LVW (**Figure 53**). That mixing occurs over a long distance due in part to the splitting of the channel by several small islands. At the lowest transect (T3.5), higher concentrations attributable to that spring remained in the southern half of the cross section. The sub channels all merge below that transect and are thought to be well mixed by the time the LVW passed through the lowest discrete sampling location (LW3.4 below at the Rainbow Gardens Weir). The estimated perchlorate flux at the Rainbow Gardens Weir was generally 57 to 75 lb/day, for a gain of approximately 19 to 20 lb/day. Most of that gain is attributed to KM-67 (1,500 µg/L); however, perchlorate concentrations near the northern bank (60 µg/L) were also elevated relative to mid-channel samples (30 µg/L). There is uncertainty associated with these flux data, including a potential overestimation of gain, as these results are based on limited data. Confirmation of these data during additional sampling is recommended (Section 12).

11.0 Conclusions

The SWIP was designed, in part, to address the following study questions developed based on the CSM.

Study Question1. *Is there residual perchlorate discharge not being captured by the seep well field that is entering the LVW?*

Concentrations of perchlorate appear to increase based on transect sampling (**Figure 49**) in the area of the seep well field, downgradient of the proposed Sunrise Mountain Weir. This area had not previously been sampled. The concentrations at T6.35 near proposed Sunrise Mountain Weir are higher (17 to 18 µg/L) than at T6.8 (upstream of Duck Creek Confluence Weir [<0.95 to 1.6 J µg/L; **Figure 25]**), indicating there is some input to the system between these transects on the order of approximately 18 lb/day. Given this, the potential for uncaptured or residual perchlorate to be discharging to the LVW from the AMPAC/Endeavor plume and/or the NERT plume cannot be ruled out. Additional information on groundwater impacts and perchlorate mass entering LVW is provided in the Semi-Annual Monitoring and Performance Report, July 1 to December 31, 2016, Perchlorate Bioremediation System (Endeavor 2017).

Study Question 2. *If so, what are the approximate locations and fluxes of those inputs and the contribution of each location to the perchlorate flux discharging to Lake Mead?*

As described in Section 9.0, perchlorate flux increases at certain key points along the LVW. Between proposed Sunrise Mountain Weir (RM 6.35) and proposed Historic Lateral Weir (RM 5.25), the flux is relatively constant at 16 to 19 lb/day. Near Calico Ridge Weir (RM 4.68), there is an increase of approximately 45 percent above the upstream flux to 24 to 29 lb/day. Perchlorate flux increases again at Lower Narrows Weir (RM 4.4) to 35 lb/day. Some increase downstream near Three Kids Weir (RM 3.63) to 37 to 47 lb/day is noted. At RM 3.27 downstream of Rainbow Gardens Weir, perchlorate flux increases notably again to 68 lb/day. Based on this, inputs appear to be near proposed Sunrise Mountain Weir, Bostick Weir, Calico Ridge Weir, Three Kids Weir and Rainbow Gardens Weir (**Figure 54**).

Study Question 3. *Of the almost 20 seeps sampled by Kerr McGee in 2000 that were investigated in May 2016, only three were located. Where might the other seeps, if still active, be discharging?*

Other seeps may be actively discharging. USGS is currently investigating the presence of additional seeps. As discussed under Study Question 2, inputs appear to be near proposed Sunrise Mountain Weir, Bostick Weir, Calico Ridge Weir, Three Kids Weir and Rainbow Gardens Weir (**Figure 54**).

Study Question 4. *Are these seeps contributing perchlorate to the LVW?*

Based on the data collected during this investigation, both documented and undocumented sources of perchlorate-impacted groundwater discharging to LVW are present. Documented sources including seep KM71 may be contributing to the perchlorate increases near proposed Sunrise Mountain Weir and KM67 is discharging near Three Kids Weir. Additional unaccounted seeps likely are present near Calico Ridge Weir.

Study Question 5. *To what extent do the daily fluctuations in the flow in the LVW, due to waste water discharges, impact the concentrations of perchlorate?*

Daily fluctuation of flow in the LVW impact perchlorate concentrations, but the measured flows are not directly accountable for increases or decreases (i.e., increases to 1.5 times low flow does not cause a directly

proportionate decrease in perchlorate concentrations). The dilution of perchlorate by increased flows from wastewater discharge is complicated by the travel time of water particles in the LVW, which lags significantly behind the propagation of the streamflow peak from upstream wastewater release. As that water moves downstream, it mixes in with streamflow that is gaining perchlorate from a series of springs and groundwater seepage locations along way. There is a lag in mixing, based on the difference in the time it takes for flows to increase across the Downgradient Study Area (approximately 3 hours) and the mixing time based on the Bureau of Land Management (2016) dye tracer study (6 hours).

Study Question 6. *What is the variability in perchlorate concentrations across each cross-section? Are potential points of groundwater discharge located near the south bank, mid-channel, or near the north bank of the LVW?*

As described in Section 7, perchlorate concentrations are relatively even across transects in the upstream reaches of the Downgradient Study Area. High variability is noted across transect T4.75 downstream of Calico Ridge Weir, with concentrations 20 to 40 times higher in the north and south banks, respectively, than the mid-channel samples. The concentrations on the south bank remain two to three times higher than other samples in the transects downstream near Lower Narrows Weir (T4.65 and T4.6) and above Homestead Weir (T4.2). At T3.75, downstream of Three Kids Weir, the concentrations on the banks are elevated compared to mid-channel, with the north bank showing the highest concentration. The furthest downstream transect (T3.5) located halfway between Three Kids Weir and Rainbow Gardens Weir also has highly varied concentrations of perchlorate across the transect, with the highest concentrations just towards mid-channel from the south bank. Overall, these data indicate the potential for inputs on the north bank near Calico Ridge Weir and Three Kids Weir, and potential inputs from the south bank from Calico Ridge Weir and downstream to the end of the transects.

Study Question 7. *Are there other, unknown, sources of perchlorate to the LVW?*

There may be sources of perchlorate to the LVW other than the NERT and AMPAC plumes near Calico Ridge Weir and downstream of Three Kids Weir that have not been documented. No surface features have been identified that may be contributing perchlorate, so it is assumed these sources would be groundwater discharging to the LVW.

12.0 Recommendations

Based on the SWIP sampling effort, several locations of potential perchlorate input have been identified. At several locations along the LVW in the study area, perchlorate concentrations increase, as noted in the following bullets:

- An increase in perchlorate is noted near Calico Ridge Weir. This increase is approximately 45 percent or 5 to 10 lb/day.
- An increase of approximately 6 lb/day is noted at Lower Narrows Weir.
- Up to 10 lb/day of perchlorate is added to the LVW near Three Kids Weir.
- Downstream of Rainbow Gardens Weir, the flux of perchlorate almost doubles to an estimated 68 lb/day (from 37 to 47 lb/day at Three Kids Weir).

While these flux measurements are estimates based on a one-time sampling event, they do indicate reaches where perchlorate may be entering the LVW. To help focus the investigation, additional sampling should be considered to confirm the observations described in this technical memorandum. The additional sampling should include two phases: additional surface water perchlorate sampling to fill data gaps in the perchlorate flux in the LVW and identifying areas of groundwater inflow (which may or may not contain perchlorate).

Between discrete/grab sampling and transect sampling, identification of loci of perchlorate inputs appears to be better determined using transects and near bottom sampling. Resampling the existing transects and adding transects and locations along existing transects could help reduce the uncertainty in the loci of perchlorate discharge:

- Transect data currently being collected monthly by NERT can be reviewed to reduce the uncertainty.
- Transects should be added near the Upper Narrows Weir and above the proposed Sunrise Mountain Weir to determine where from Duck Creek to Pabco Road the increases in perchlorate are obvious.
- Further downstream, an additional transect above Calico Ridge Weir and additional samples along the transect below Calico Ridge Weir would support identifying loci of the high concentrations noted on the north and south bank samples below Calico Ridge Weir.
- A transect below Homestead Weir would help identify the location of the perchlorate inputs in this area.
- No transect was located near Rainbow Gardens Weir, where the discrete data indicted a large flux of perchlorate. A transect upstream of this weir could help identify the loci.

In addition to surface water sampling for perchlorate, groundwater inputs can be identified (independent of perchlorate concentration) using temperature sensors. Tools such as distributed temperature sensing (DTS) can be used to monitor groundwater flux using temperature differences between the groundwater and surface water. These tools can be deployed for several days over a reach of approximately 0.25 miles in the areas of suspected perchlorate inputs. The current understanding of the perchlorate patterns in the LVW indicate that groundwater may be contributing to the perchlorate load near Pabco Road (likely due to uncaptured perchlorate from AMPAC and NERT plumes), and downstream near Calico Ridge Weir and Three Kids Weir (potential sources unknown). By monitoring temperature in the LVW surface water near these two unknown perchlorate sources using DTS, the loci of groundwater inputs can be identified. Paired with the perchlorate sampling data, the locations of potential sources of groundwater containing perchlorate can be refined.

13.0 References

AECOM, 2016a. Surface Water Investigation Plan. NERT Remedial Investigation – Downgradient Study Area. Nevada Environmental Response Trust Site, Henderson, Nevada. Final. December 27, 2016.

AECOM, 2016b. Surface Water and Seep Sampling Technical Memorandum. NERT Remedial Investigation – Downgradient Study Area. Nevada Environmental Response Trust Site, Henderson, Nevada. Final. November, 2016.

AECOM. 2016c. Quality Assurance Project Plan. NERT Remedial Investigation – Downgradient Study Area. Nevada Environmental Response Trust Site, Henderson, Nevada. Final. March, 2016.

Department of the Interior (DOI), 2016. Las Vegas Wash Time-of-Travel Study. Research and Development Office, Bureau of Reclamation, Final Report ST-2016-2262-1. May 2016.

Endeavor, 2017. BISC Semi-Annual Monitoring and Performance Report. July 1 to December 31, 2016. Perchlorate Bioremediation System, Endeavor LLC. Henderson, Nevada.

ENSR International. 2005. Conceptual Site Model, Kerr-McGee Facility, Henderson, Nevada. February.

ENVIRON International Corporation. 2012. Revised Interim Soil Removal Action Completion Report, Nevada Environmental Response Trust Site, Henderson, Nevada, August 2010 – November 2011. January. Revised September 28. NDEP approved December 17, 2012.

Las Vegas Wash Coordination Committee (LVWCC). 2016. https://www.lvwash.org/html/being_done_stabilization_demonstrationweir.html

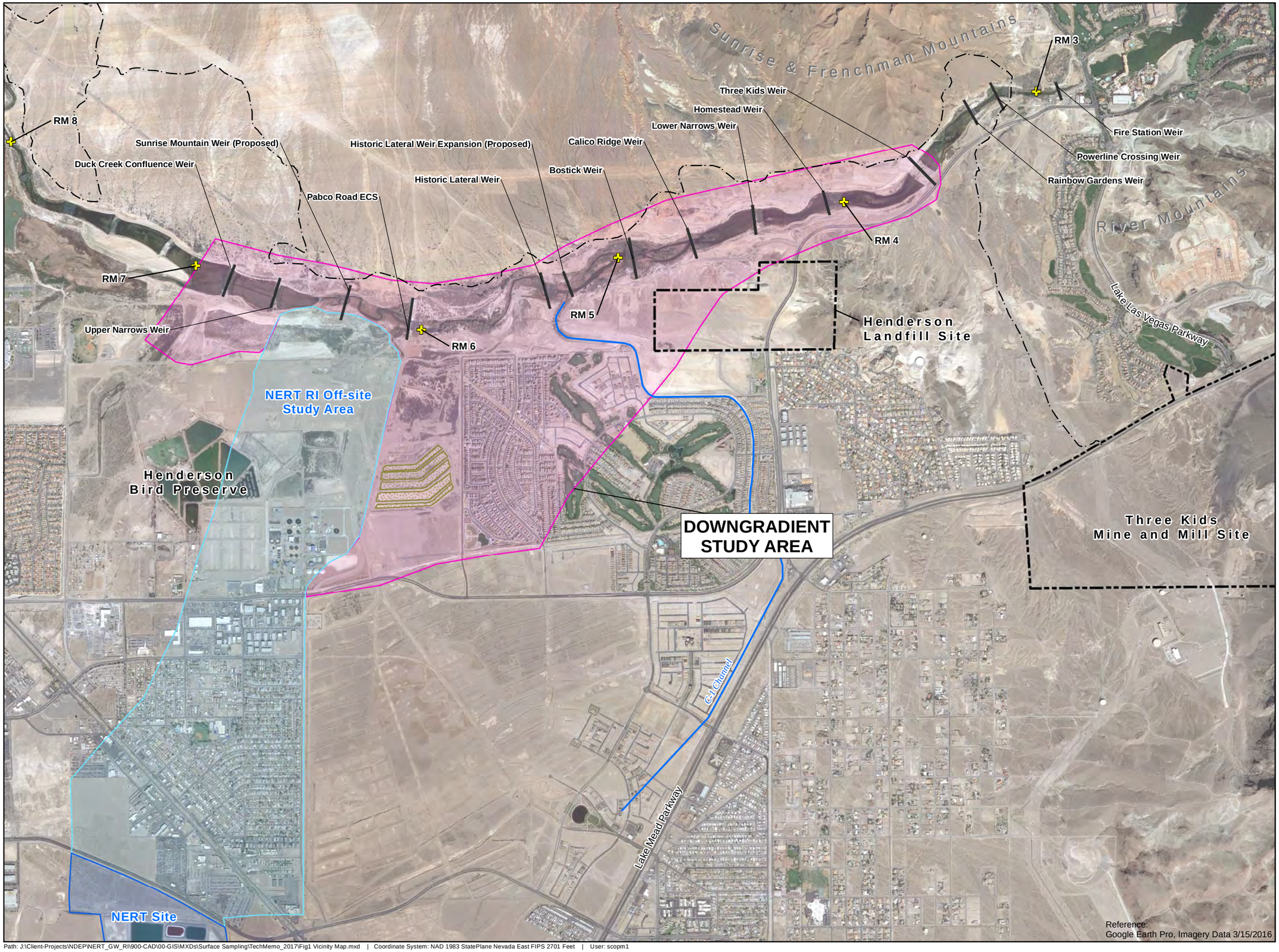
Shanahan, S.A. and X. Zhou, Ph.D. 2013. “Appendix M: Lake Mead and Las Vegas Wash Water Quality Sampling Nomenclature” to “Las Vegas Wash Surface Water Quality Monitoring and Assessment Plan” Southern Nevada Water Authority. Prepared for Las Vegas Wash Coordination Committee, Research and Environmental Monitoring Study Team. September.

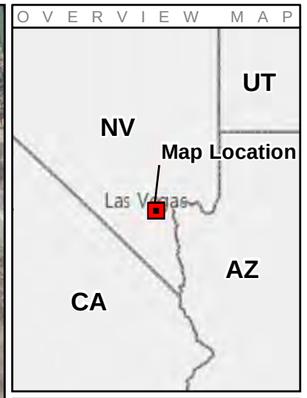
United States Geological Survey (USGS), 2009. “Accuracy of U.S. Geological Survey Streamflow Data”, available at https://nevada.usgs.gov/water/coop_meeting/coop_accuracysldshw_122409.pdf.

USGS, 2016. Water-resources data for the United States. https://wdr.water.usgs.gov/allsearch.php Updated December 12, 2016.

USGS. 2017. Flow data obtained from http://maps.waterdata.usgs.gov/mapper/index.html

Figures





Legend

- Wetlands Trail
- Channels
- Northern Rapid Infiltration Basins
- River Mile (RM)
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area
- NERT Site

NORTH

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

DOWNGRADIENT STUDY AREA LOCATION MAP

Date: 5/11/2017 Project: 60477365

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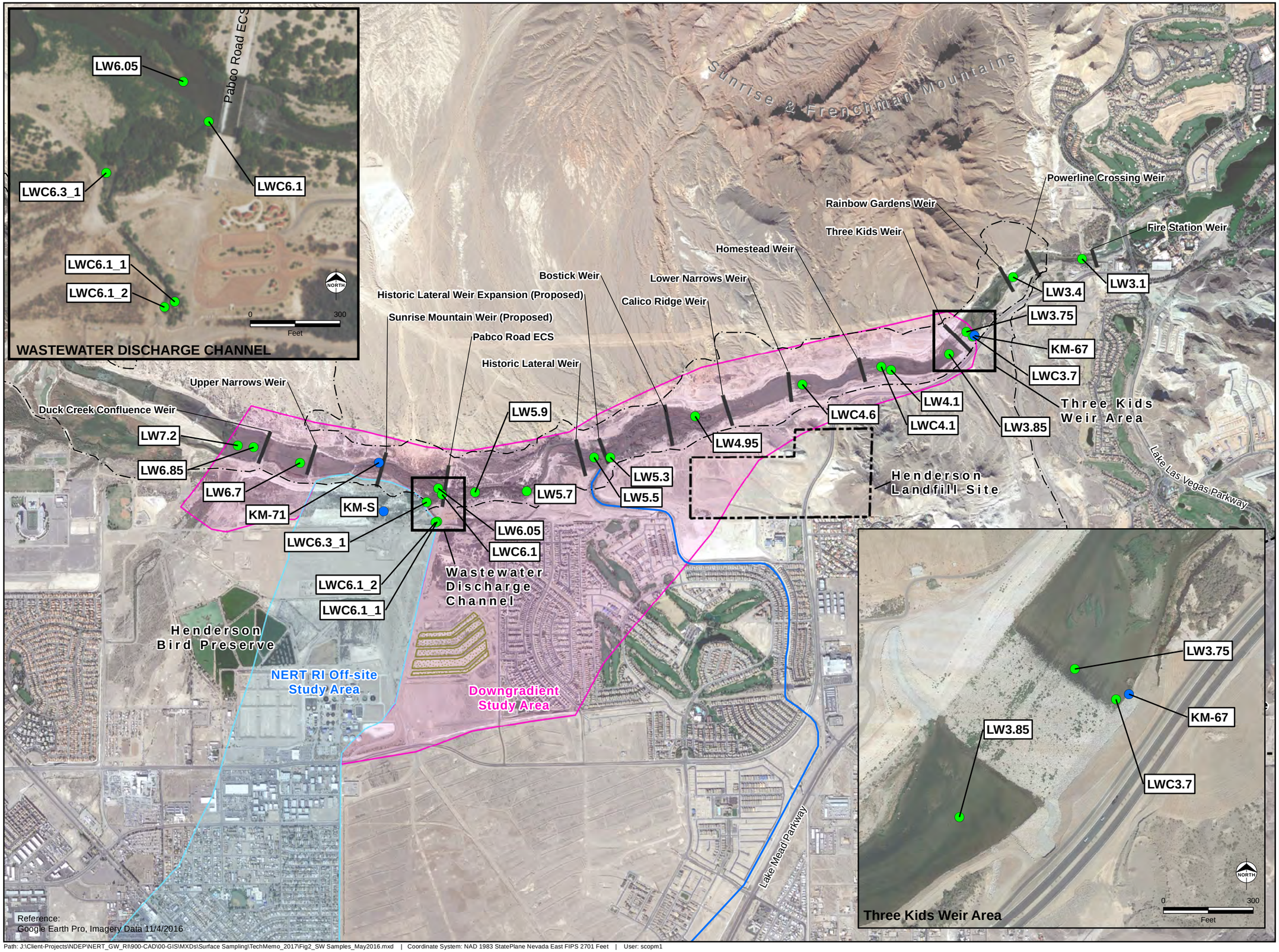
Figure 1



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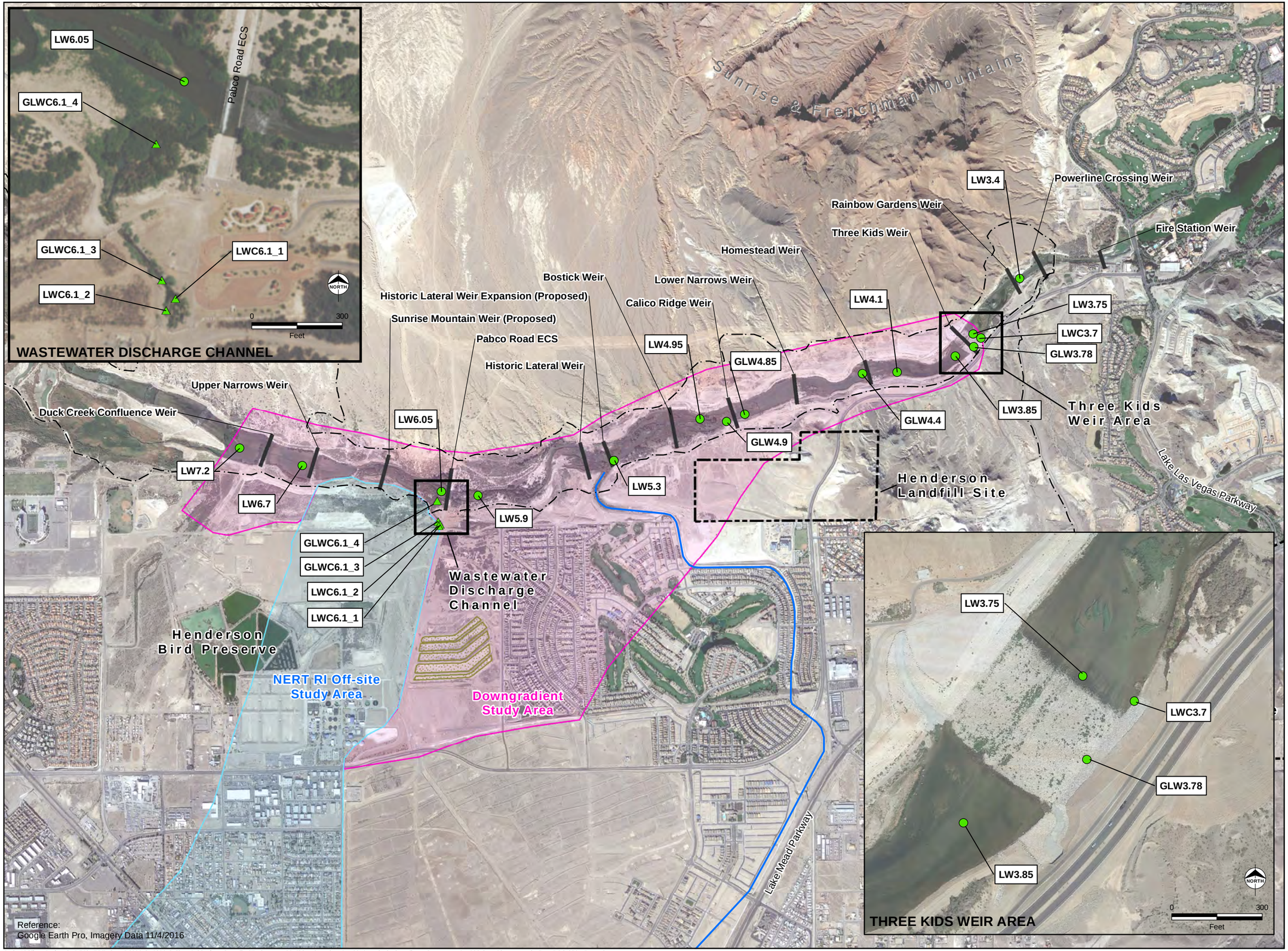
NERT RI
Downgradient Study Area

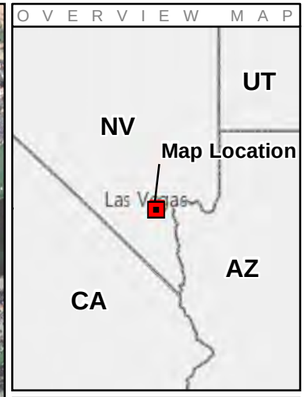
LOCATIONS OF SURFACE WATER AND SEEP SAMPLES MAY 2016

Date: 10/24/2016 Project: 60477365

AECOM

Figure 2





Legend

- Surface Water Sample Location - Las Vegas Wash
- Surface Water Sample Location - Tributaries
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

GLW	Designation for new sampling locations within the LVW
GLWC	Designation for new sampling locations from tributaries and side streams
LW	Designation for pre-existing sampling locations in the LVW
LWC	Designation for pre-existing sampling locations from tributaries and side streams

NORTH

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

LOCATIONS OF SURFACE WATER SAMPLES: SAMPLING EVENT DURING USGS SEEPAGE STUDY

Date: 6/14/2017 Project: 60477365

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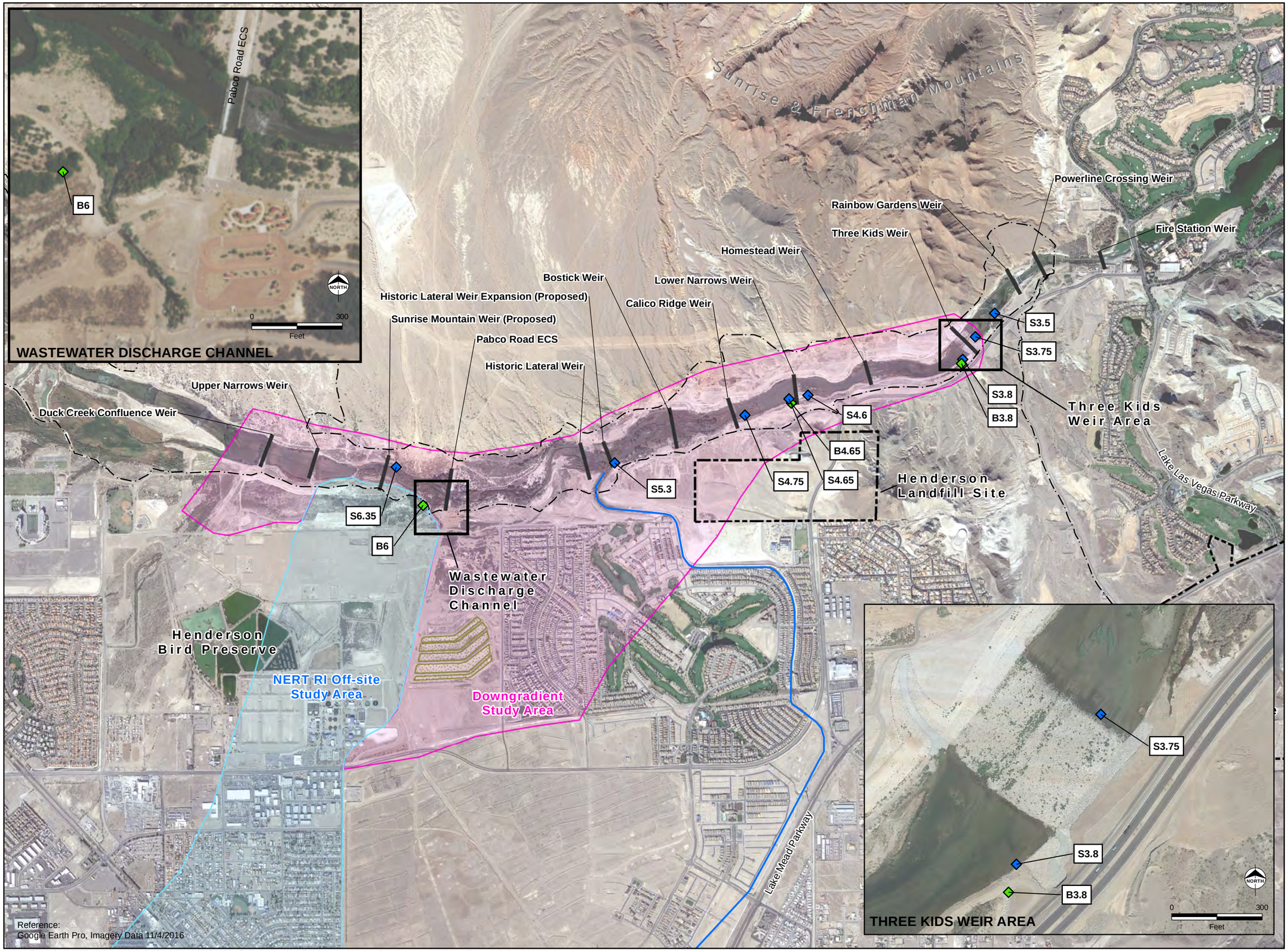
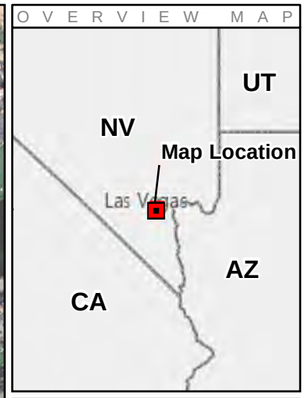
Figure 3





Legend

- Barometer Location
- Staff Gage Location
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

NORTH

0 2,000

Feet

Scale 1:24,000

1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

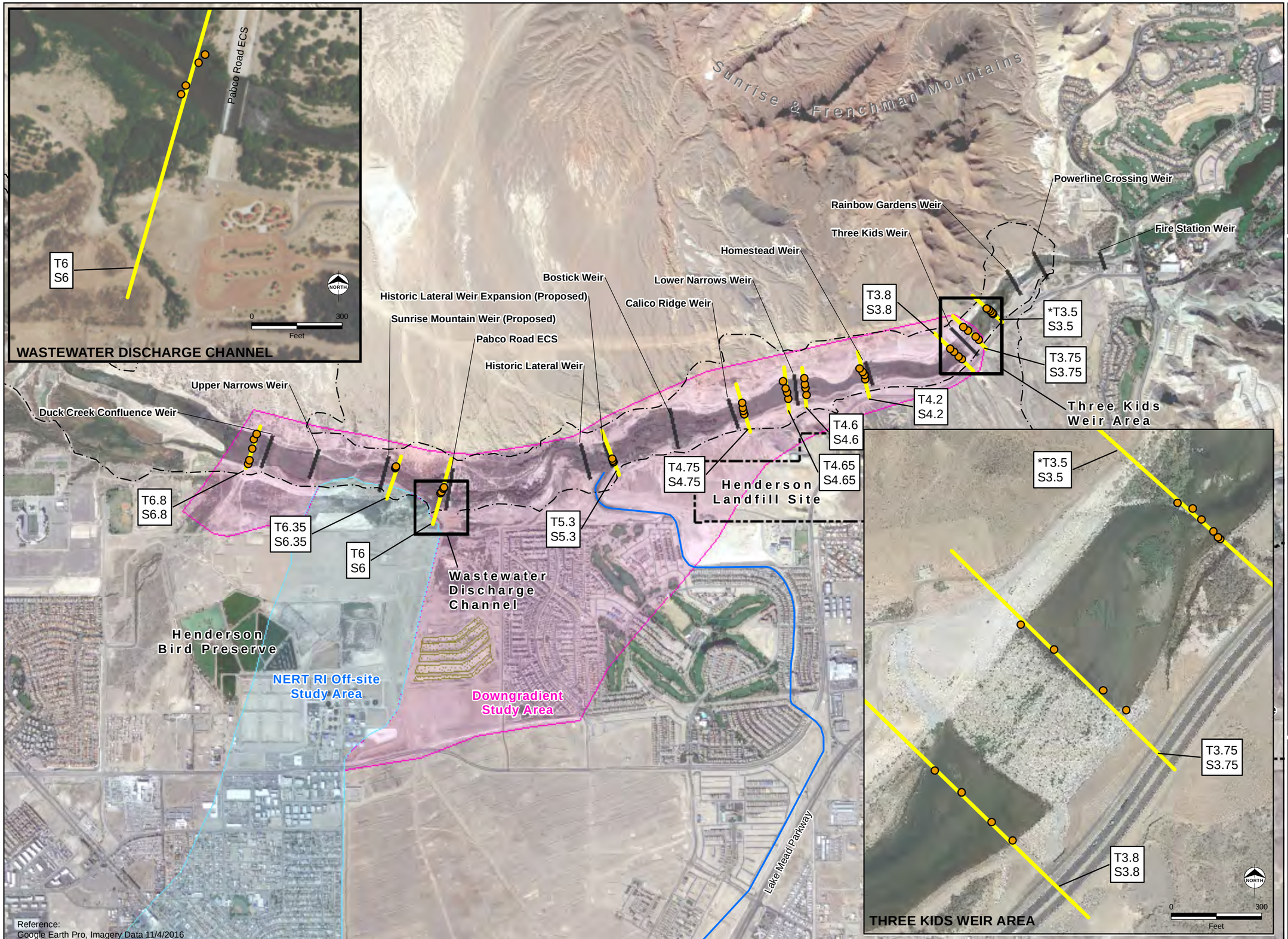
LOCATIONS OF USGS GAGES, AECOM GAGES AND BAROMETERS

Date: 5/17/2017 Project: 60477365

AECOM

Figure 4

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\TechMemo_2017\Fig4_Gages.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1



Legend

- Transect Sample Location
- Transects_2017
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Note

* This transect was originally labeled T3.6 but the identification was changed to T3.5 during the field program.

NORTH

0 2,000

Feet

Scale 1:24,000

1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

TRANSECTS AND SAMPLE LOCATIONS

Date: 5/17/2017 Project: 60477365

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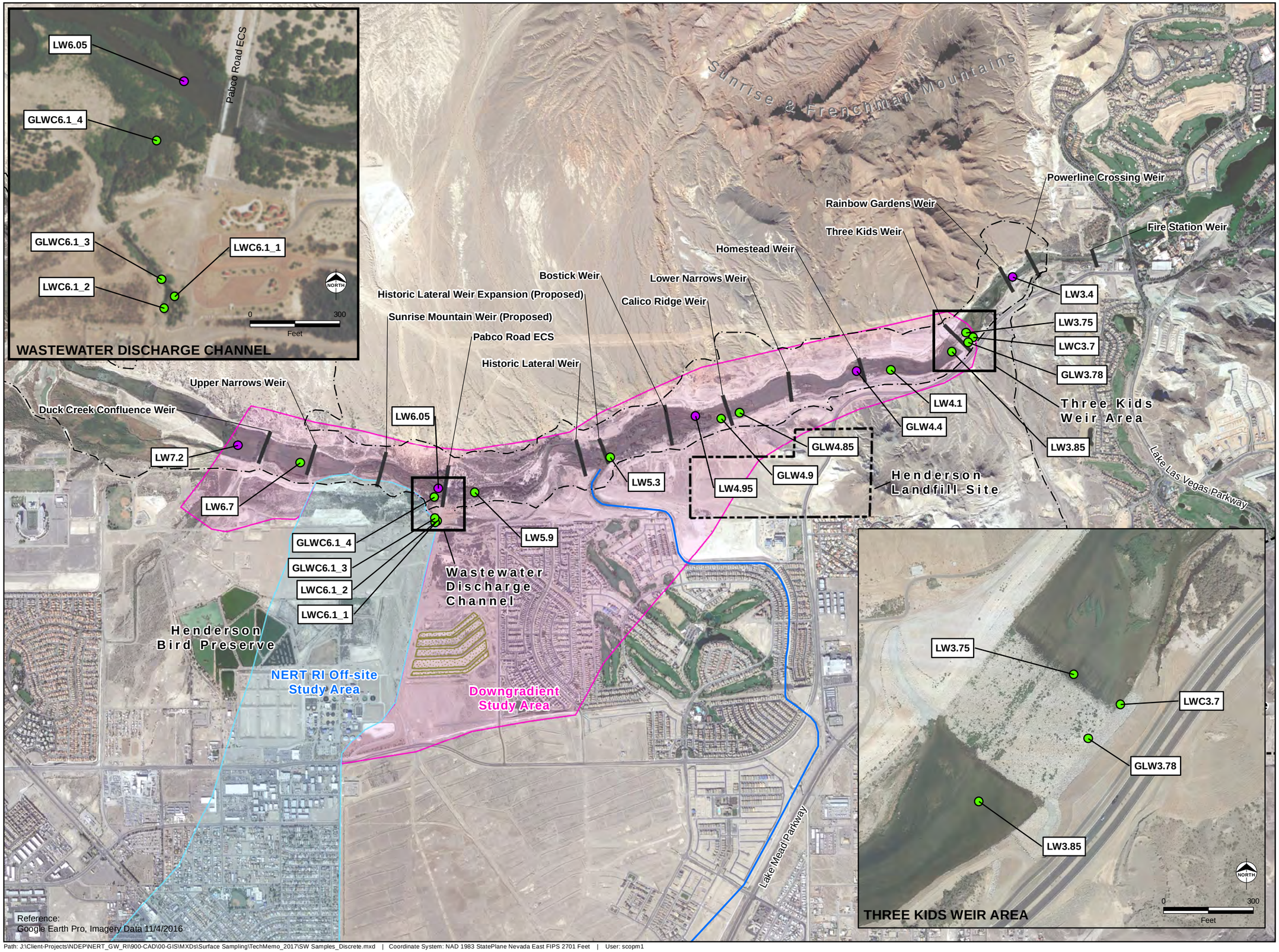
Figure 5



Legend

- Surface Water Sample Location - Sampled during low and high flow conditions
- Surface Water Sample Location - Sampled during low, mid and high flow
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

GLW Designation for new sampling locations within the LVW
GLWC Designation for new sampling locations from tributaries and side streams
LW Designation for pre-existing sampling locations in the LVW
LWC Designation for pre-existing sampling locations from tributaries and side streams

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

LOCATIONS OF SURFACE WATER SAMPLES DISCRETE SAMPLING

Date: 5/9/2017 Project: 60477365

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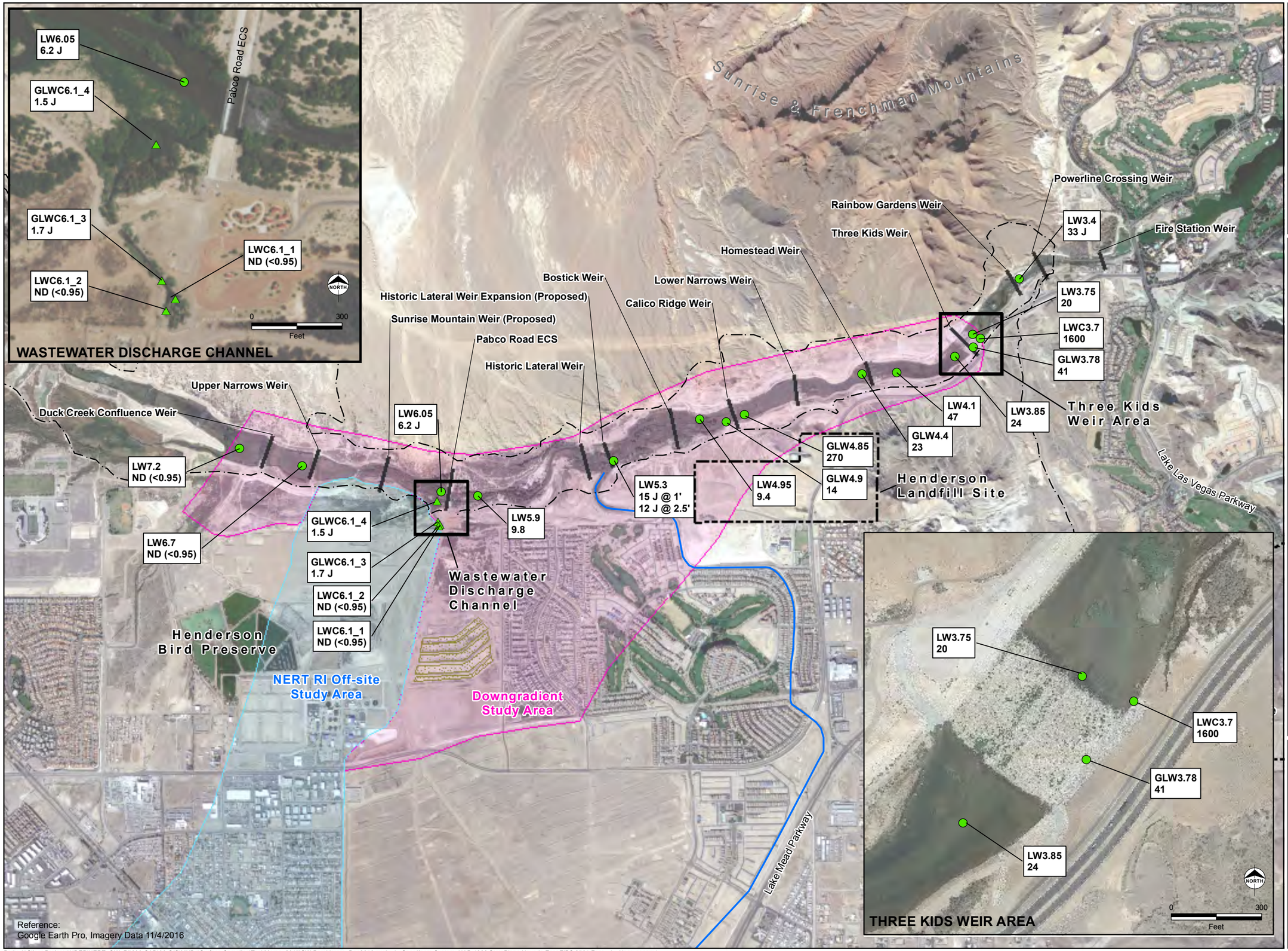
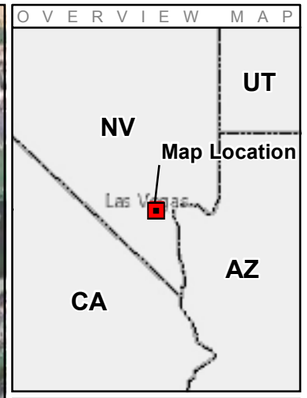
Figure 6





Legend

- Surface Water Sample Location - Las Vegas Wash
- Surface Water Sample Location - Tributaries
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Perchlorate Concentration in µg/L

ND - Not Detected above method detection limit
J - Estimated concentration between method detection limit and method reporting limit
µg/L - Micrograms per liter

Note:
At LW5.3, samples were collected at two depths (indicated in feet below the water surface).

GLW Designation for new sampling locations within the LVW
GLWC Designation for new sampling locations from tributaries and side streams
LW Designation for pre-existing sampling locations in the LVW
LWC Designation for pre-existing sampling locations from tributaries and side streams

0 2,000
Feet
NORTH
Scale 1:24,000
1 inch = 2,000 feet

NERT RI
Downgradient Study Area

PERCHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLING EVENT DURING USGS SEEPAGE STUDY

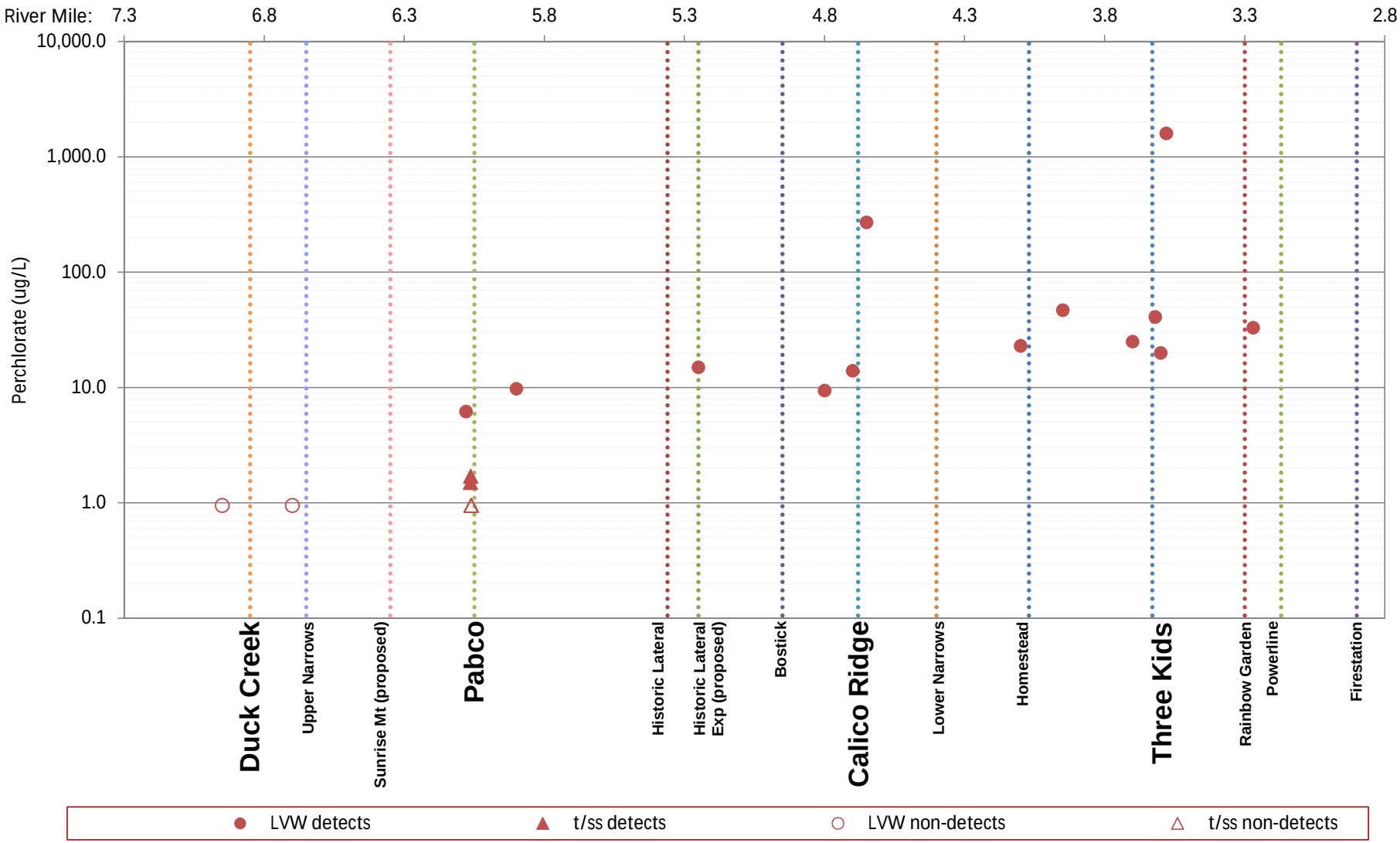
Date: 6/14/2017 Project: 60477365

AECOM

Figure 7

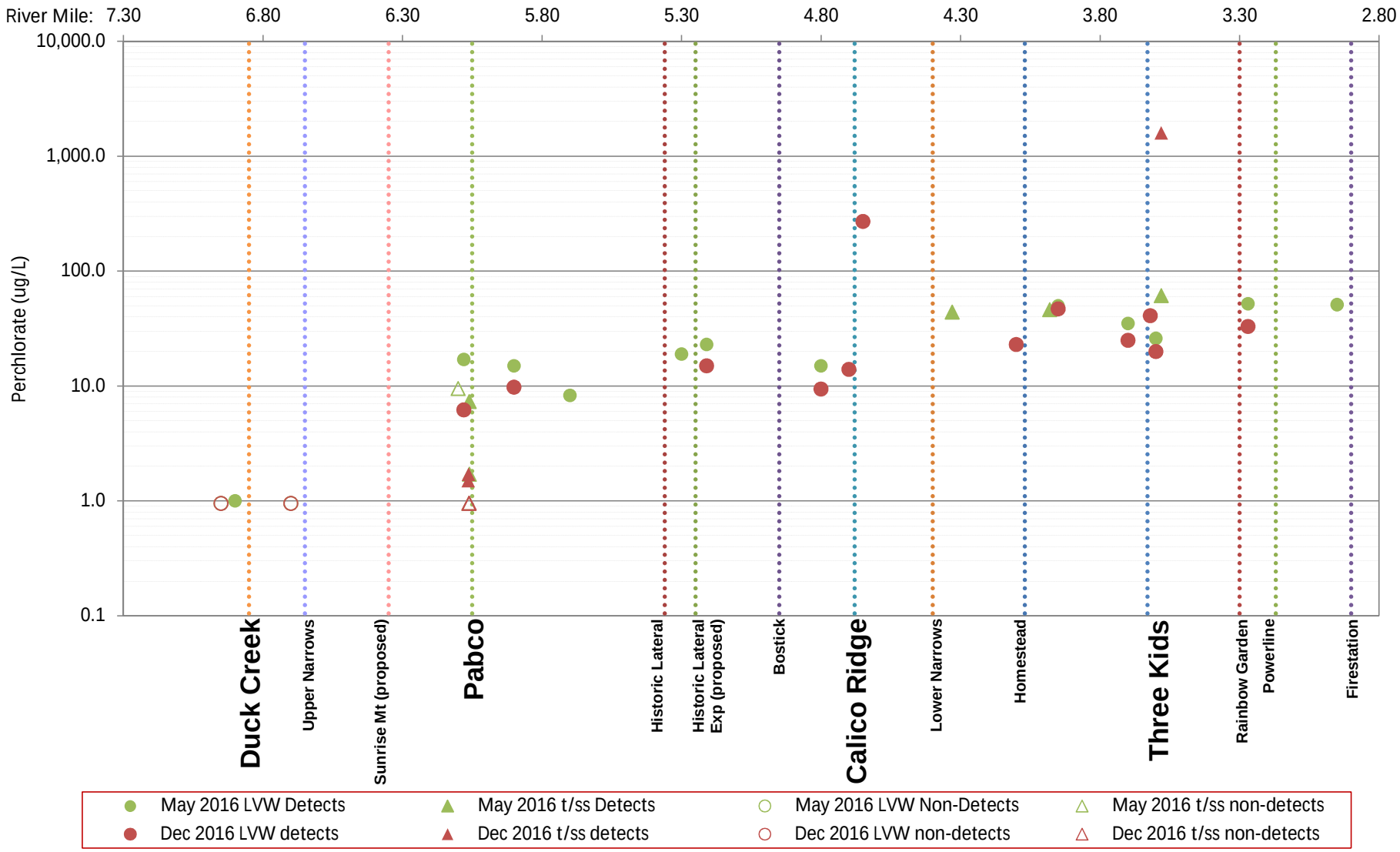
Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\TechMemo_2017\SW Perchlorate_Dec2016.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: scopm1

Figure 8. Concentrations of Perchlorate by River Mile: Sampling Event during USGS Seepage Study
December 8, 2016

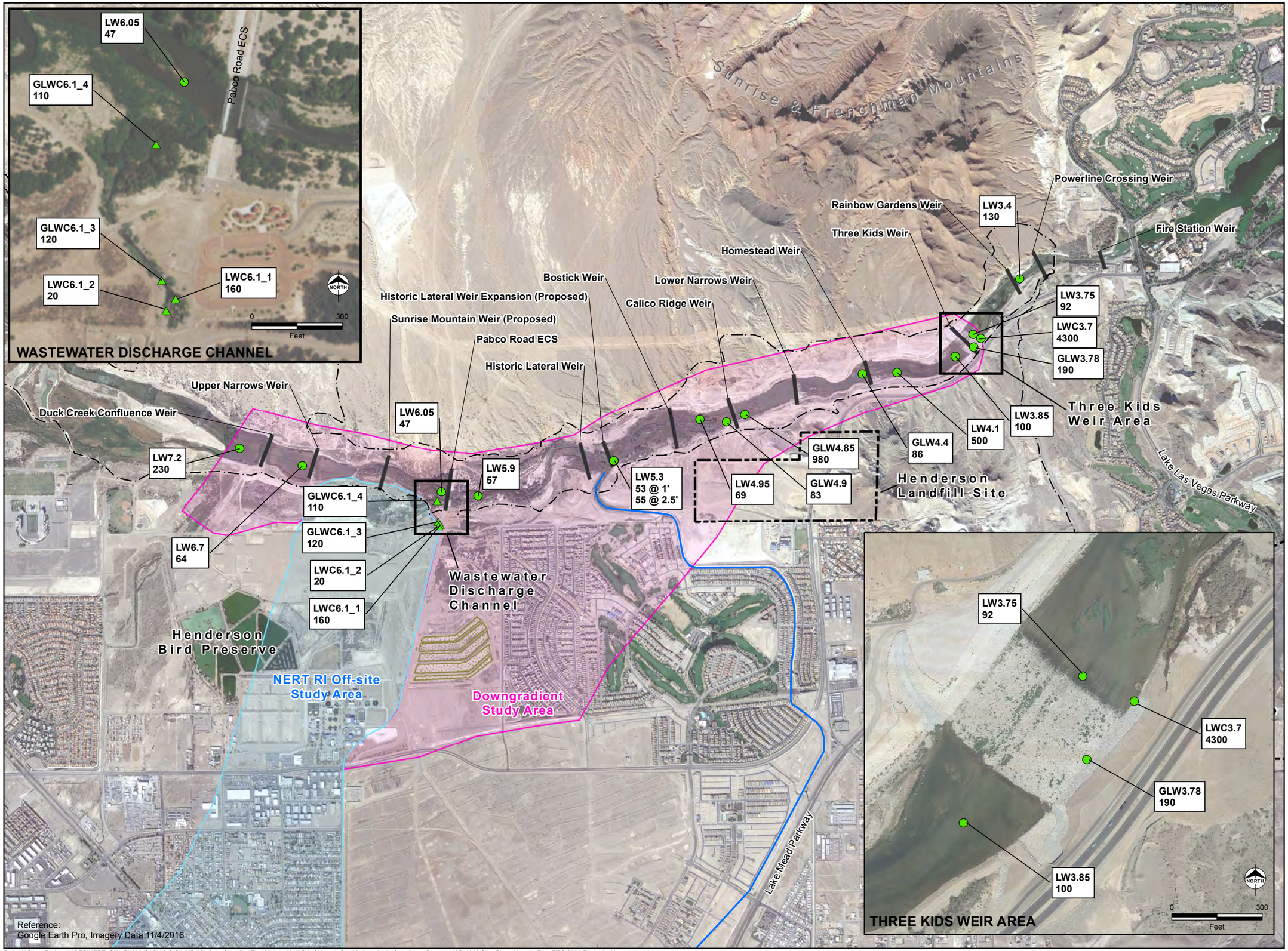


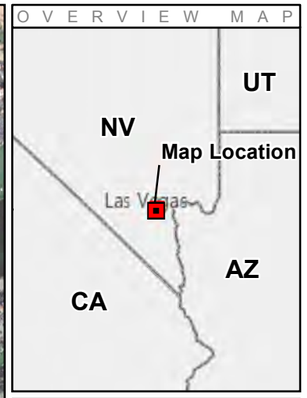
Notes: (1)Non-detects shown at detection limit. (2)Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, GLWC6.1_3, GLWC6.1_4]

Figure 9. Concentrations of Perchlorate by River Mile:
Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016



Notes: (1)Non-detects shown at detection limit. (2)Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, LWC4.1, LWC4.6, LWC 6.1, LWC6.3_1, GLWC6.1_3, GLWC6.1_4]





Legend

- Surface Water Sample Location - Las Vegas Wash
- Surface Water Sample Location - Tributaries
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Chlorate Concentration in µg/L

µg/L - Micrograms per liter

Note:
At LW5.3, samples were collected at two depths (indicated in feet below the water surface).

GLW	Designation for new sampling locations within the LVW
GLWC	Designation for new sampling locations from tributaries and side streams
LW	Designation for pre-existing sampling locations in the LVW
LWC	Designation for pre-existing sampling locations from tributaries and side streams

0 2,000
Feet
Scale 1:24,000
1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

CHLORATE CONCENTRATIONS IN SURFACE WATER SAMPLING EVENT DURING USGS SEEPAGE STUDY

Date: 6/14/2017 Project: 60477365

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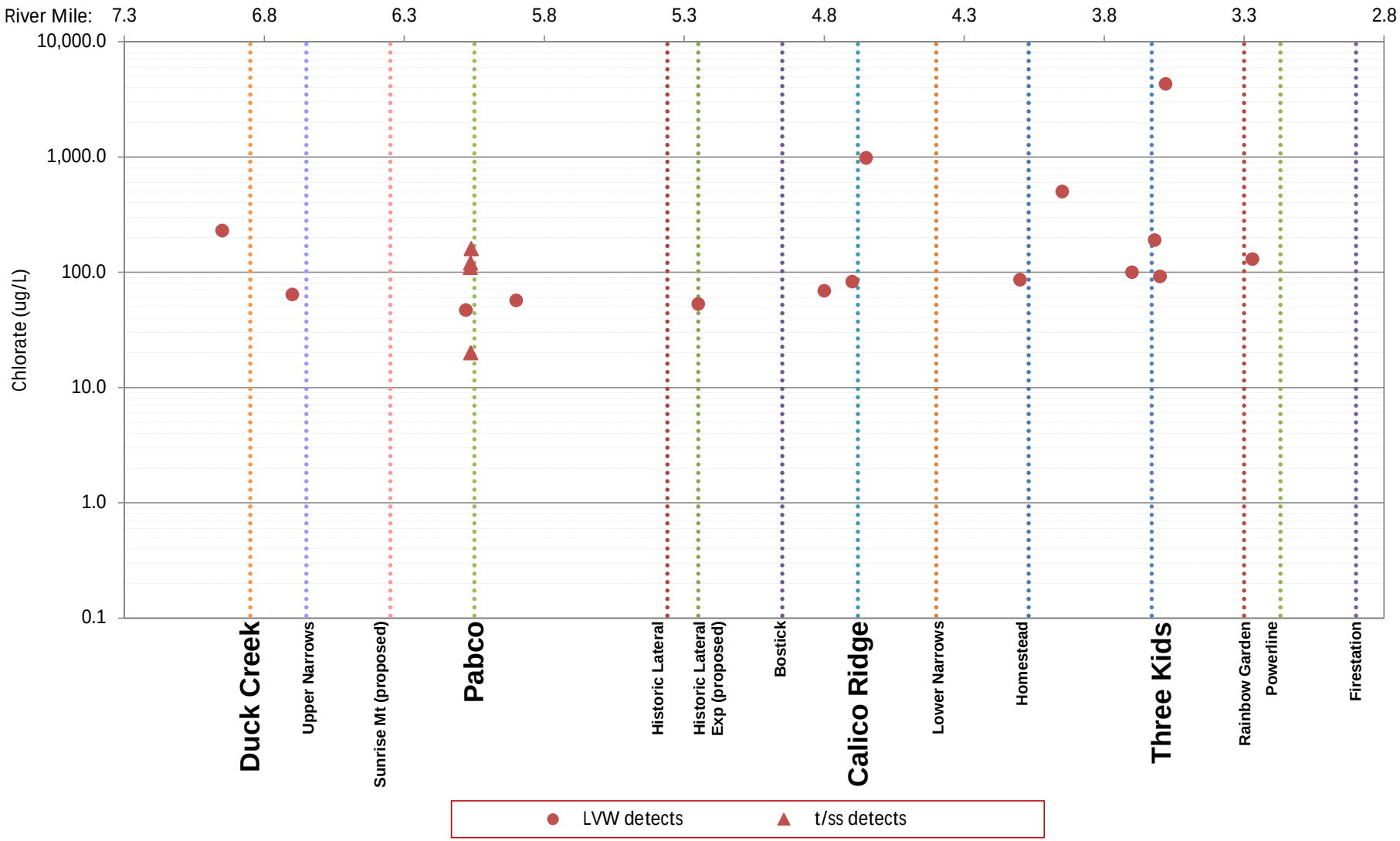
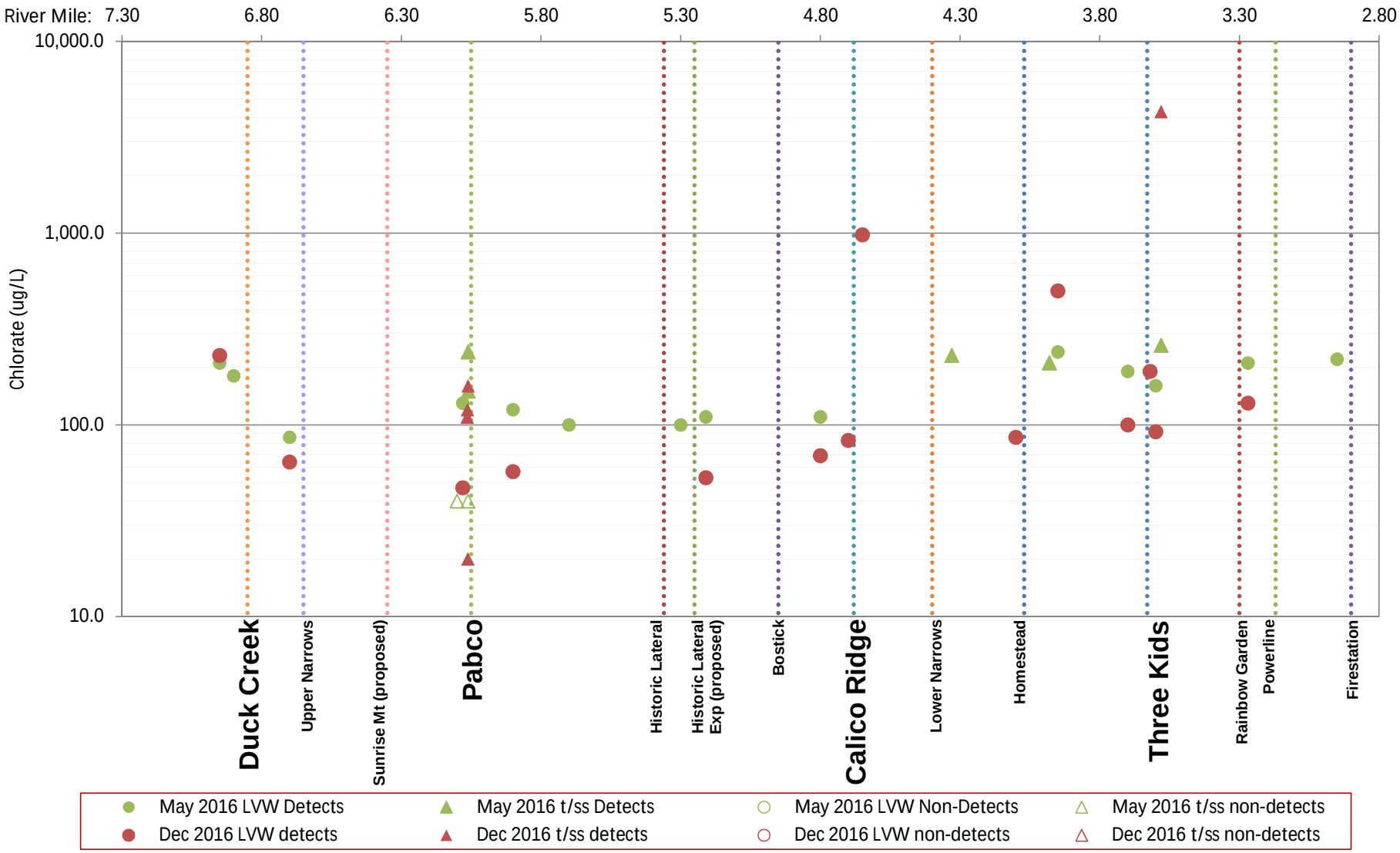
Figure 10

Figure 11. Concentrations of Chlorate by River Mile: Sampling Event during USGS Seepage Study
December 8, 2016

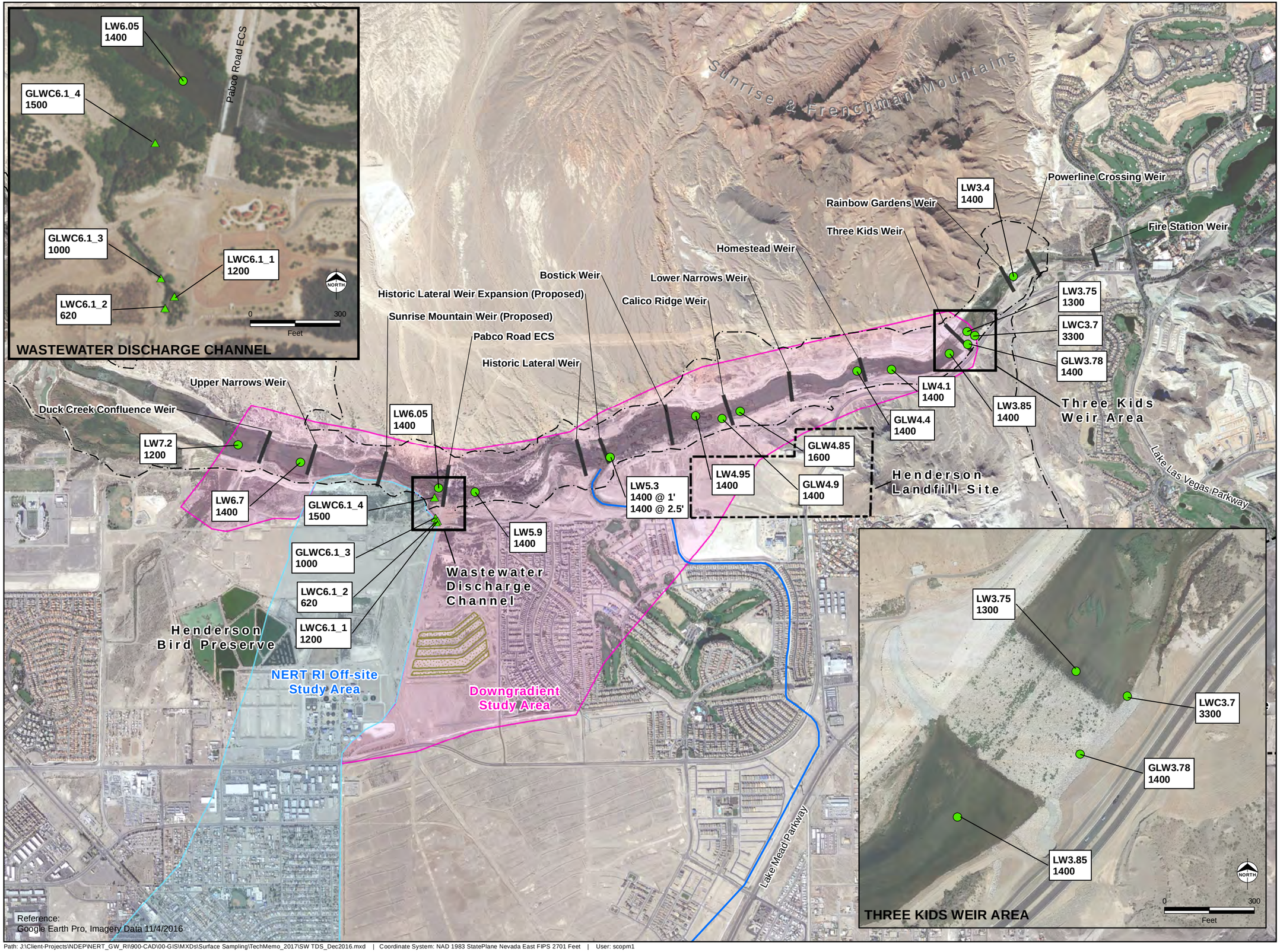


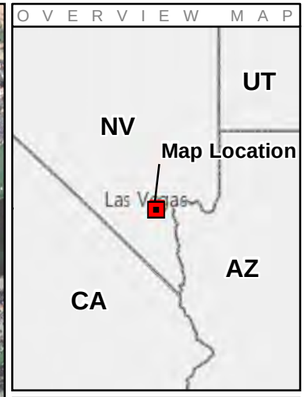
Notes: (1) Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, GLWC6.1_3, GLWC6.1_4]

Figure 12. Concentrations of Chlorate by River Mile:
Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016



Notes: (1)Non-detects shown at detection limit. (2)Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, LWC4.1, LWC4.6, LWC 6.1, LWC6.3_1, GLWC6.1_3, GLWC6.1_4]





Legend

- Surface Water Sample Location - Las Vegas Wash
- Surface Water Sample Location - Tributaries
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter

Note:
At LW5.3, samples were collected at two depths (indicated in feet below the water surface).

GLW	Designation for new sampling locations within the LVW
GLWC	Designation for new sampling locations from tributaries and side streams
LW	Designation for pre-existing sampling locations in the LVW
LWC	Designation for pre-existing sampling locations from tributaries and side streams

0 2,000
Feet
Scale 1:24,000
1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

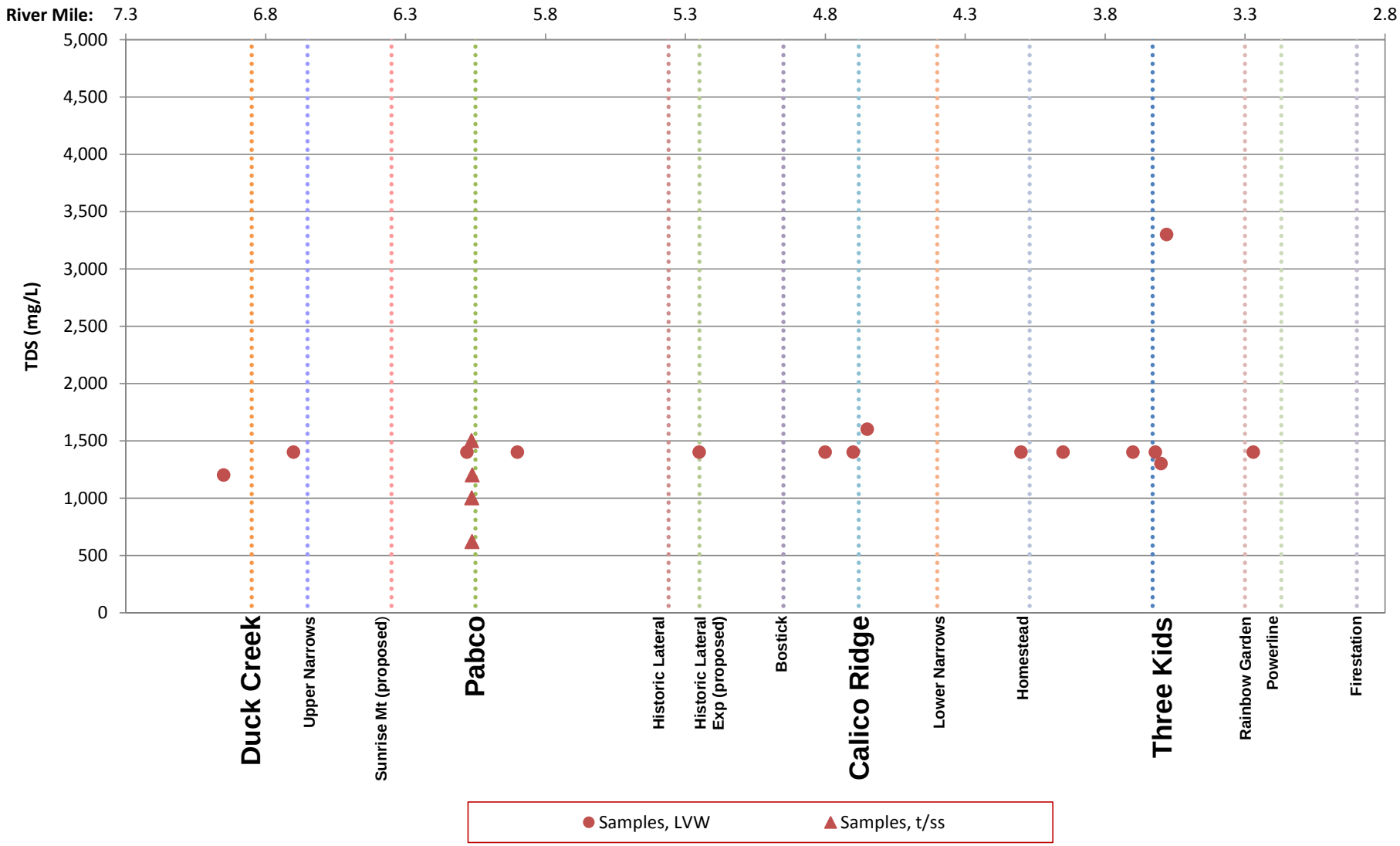
TOTAL DISSOLVED SOLIDS IN SURFACE WATER SAMPLING EVENT DURING USGS SEEPAGE STUDY

Date: 6/14/2017 Project: 60477365

AECOM

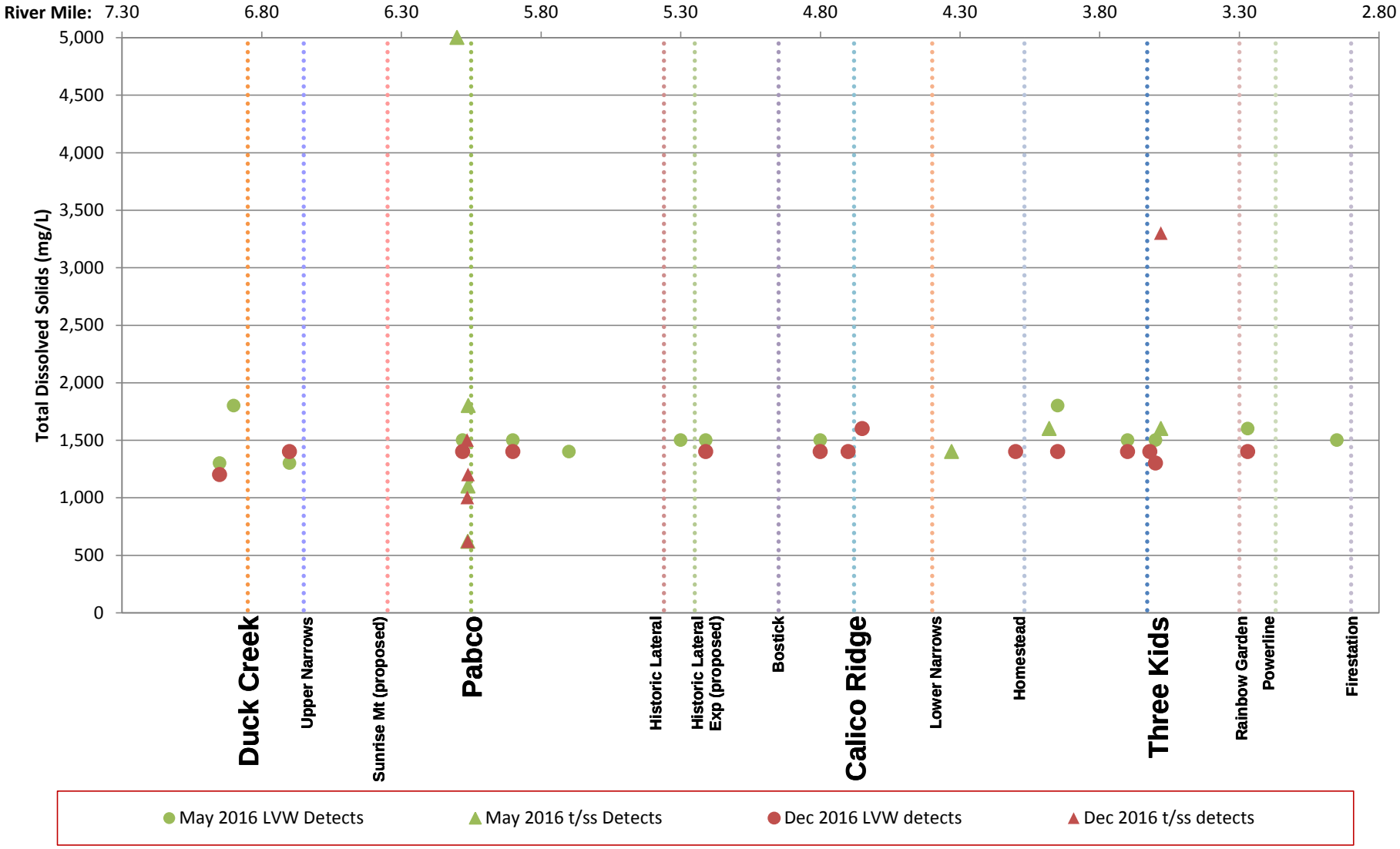
Figure 13

Figure 14. Concentrations of Total Dissolved Solids by River Mile: Sampling Event during USGS Seepage Study December 8, 2016

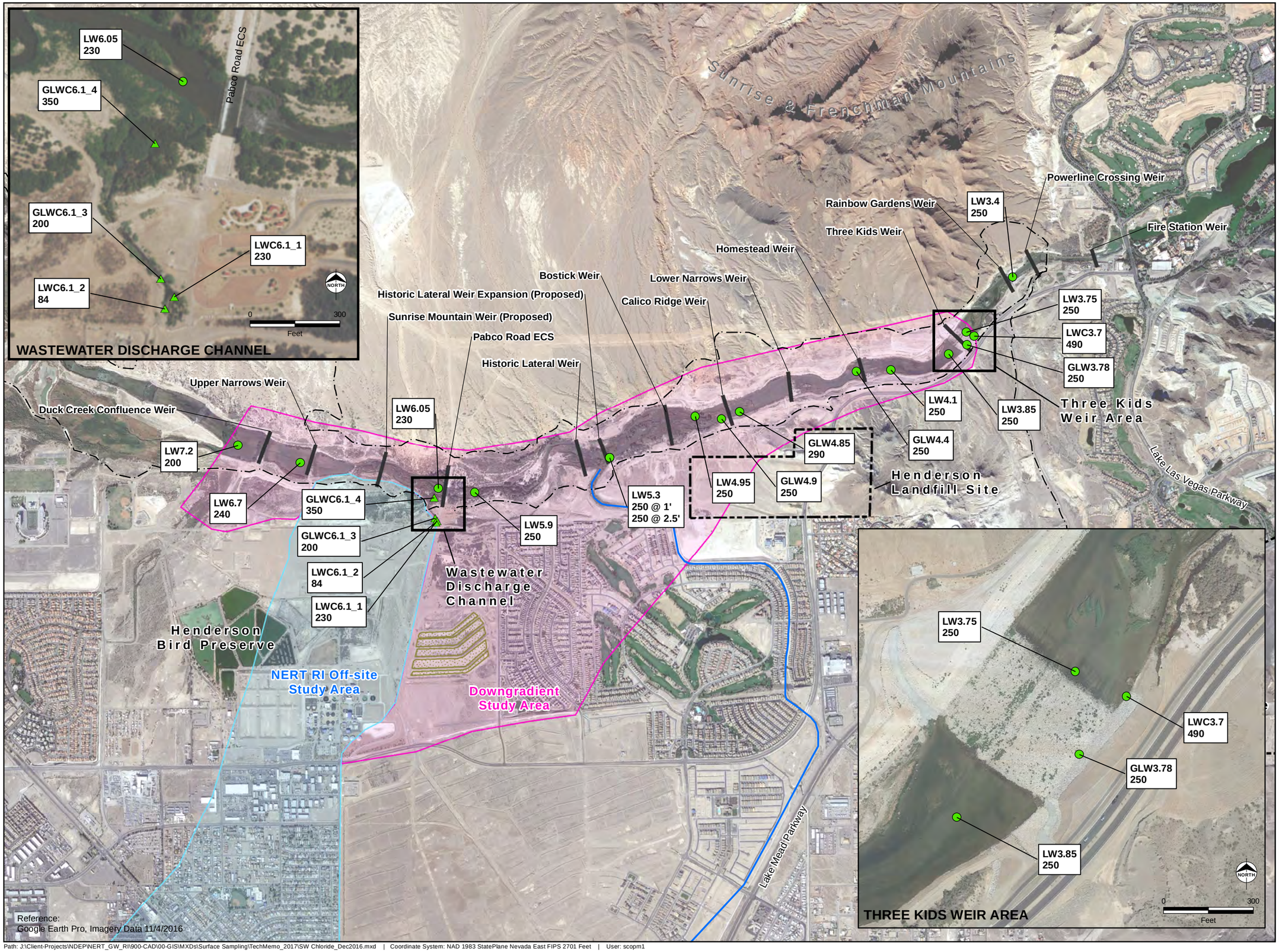


Notes: (1) Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, GLWC6.1_3, GLWC6.1_4]

Figure 15. Concentrations of Total Dissolved Solids by River Mile: Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016



Notes: (1) Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, LWC4.1, LWC4.6, LWC 6.1, LWC6.3_1, GLWC6.1_3 , GLWC6.1_4]



Legend

- Surface Water Sample Location - Las Vegas Wash
- Surface Water Sample Location - Tributaries
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Chloride Concentration in mg/L

mg/L - Milligrams per liter

Note:
At LW5.3, samples were collected at two depths (indicated in feet below the water surface).

GLW	Designation for new sampling locations within the LVW
GLWC	Designation for new sampling locations from tributaries and side streams
LW	Designation for pre-existing sampling locations in the LVW
LWC	Designation for pre-existing sampling locations from tributaries and side streams

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

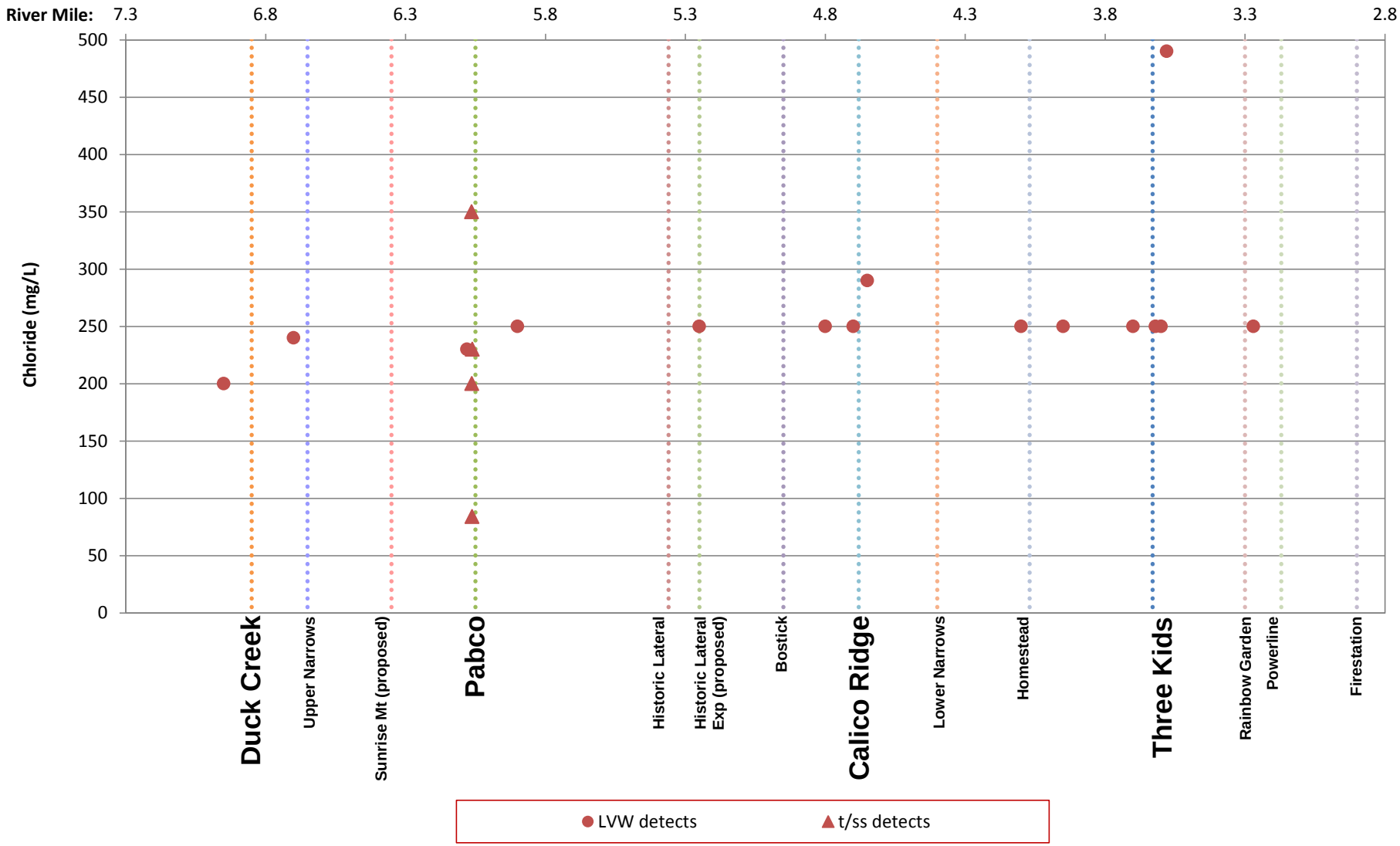
CHLORIDE CONCENTRATIONS IN SURFACE WATER SAMPLING EVENT DURING USGS SEEPAGE STUDY

Date: 6/14/2017 Project: 60477365

AECOM

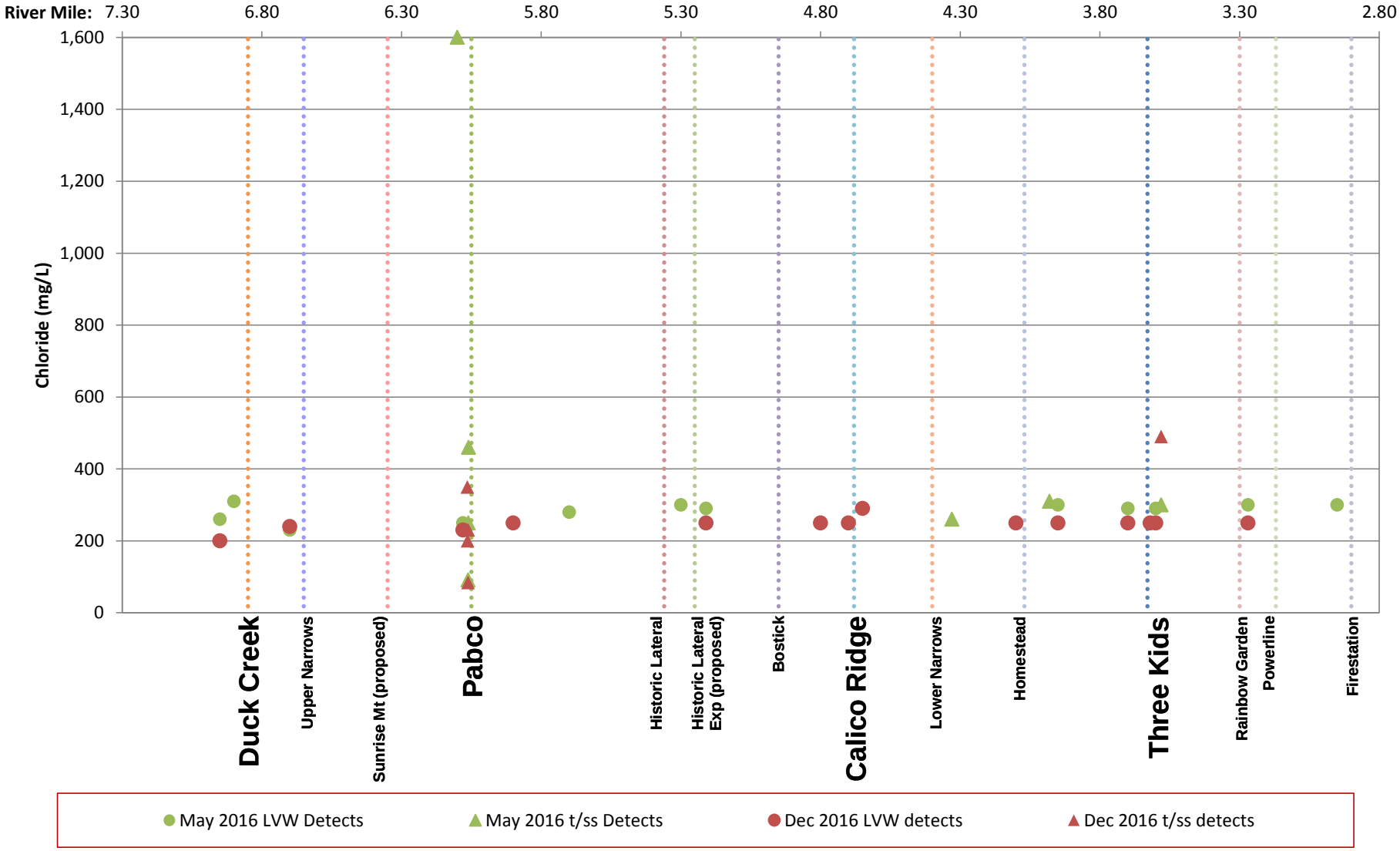
Figure 16

Figure 17. Concentrations of Chloride by River Mile: Sampling Event during USGS Seepage Study
December 8, 2016

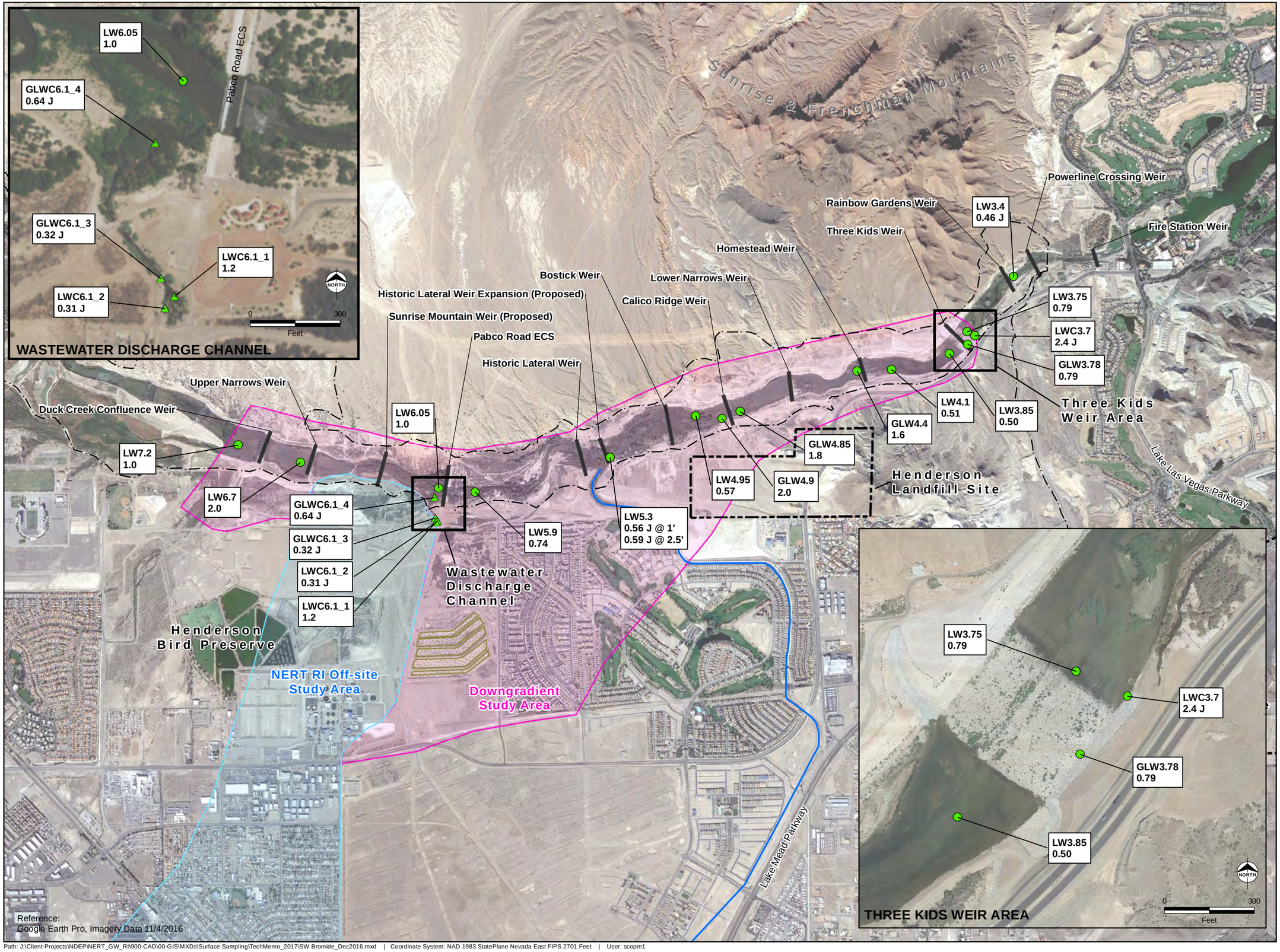


Notes: (1) Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, GLWC6.1_3, GLWC6.1_4]

Figure 18. Concentrations of Chloride by River Mile:
Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016



Notes: (1) Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, LWC4.1, LWC4.6, LWC 6.1, LWC6.3_1, GLWC6.1_3, GLWC6.1_4]



Legend

- Surface Water Sample Location - Las Vegas Wash
- Surface Water Sample Location - Tributaries
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Bromide Concentration in mg/L

J - Estimated concentration between method detection limit and method reporting limit

mg/L - Milligrams per liter

Note:
At LW5.3, samples were collected at two depths (indicated in feet below the water surface).

GLW Designation for new sampling locations within the LVW

GLWC Designation for new sampling locations from tributaries and side streams

LW Designation for pre-existing sampling locations in the LVW

LWC Designation for pre-existing sampling locations from tributaries and side streams

0 2,000
Feet
Scale 1:24,000
1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

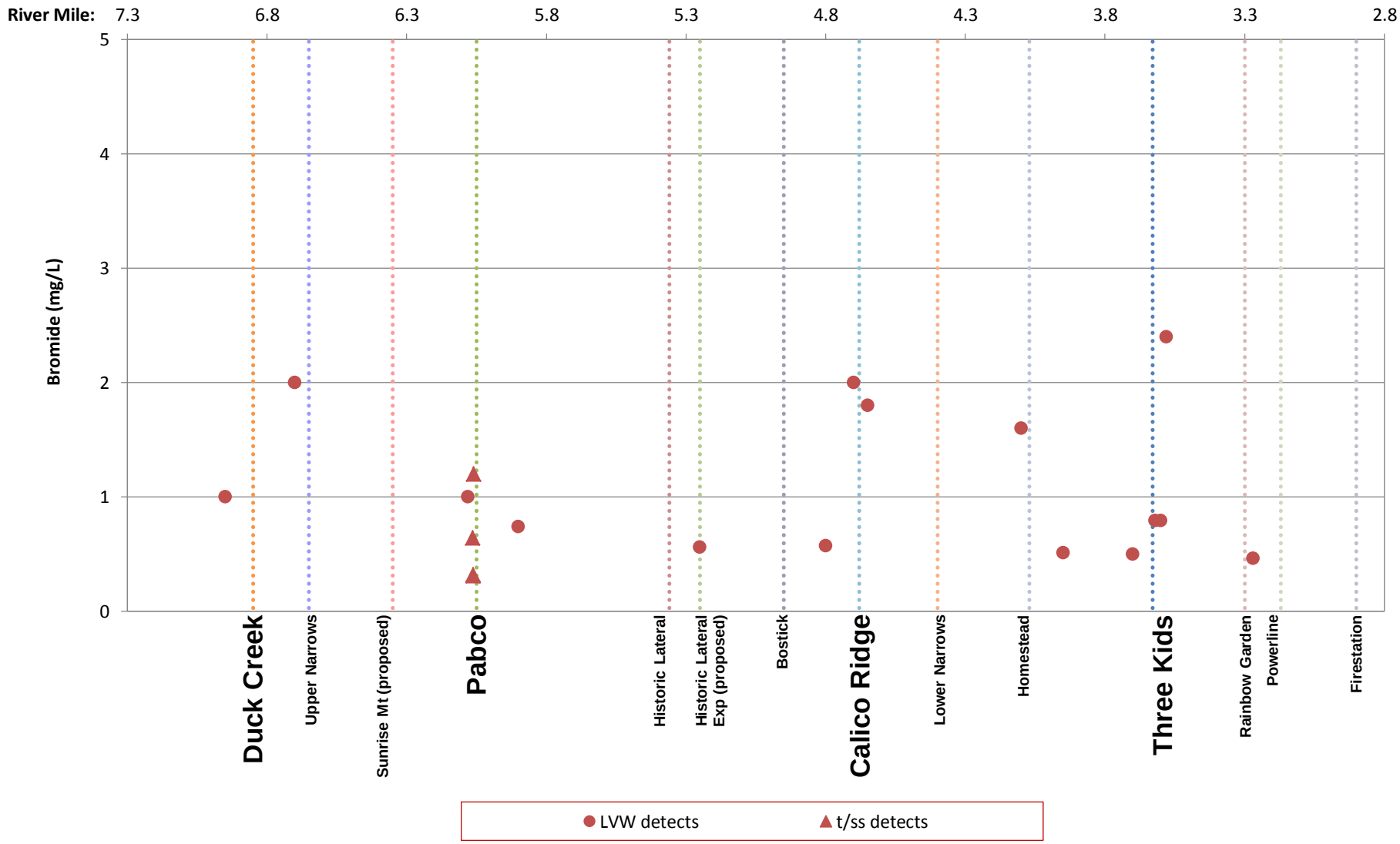
BROMIDE CONCENTRATIONS IN SURFACE WATER SAMPLING EVENT DURING USGS SEEPAGE STUDY

Date: 6/14/2017 Project: 60477365

AECOM

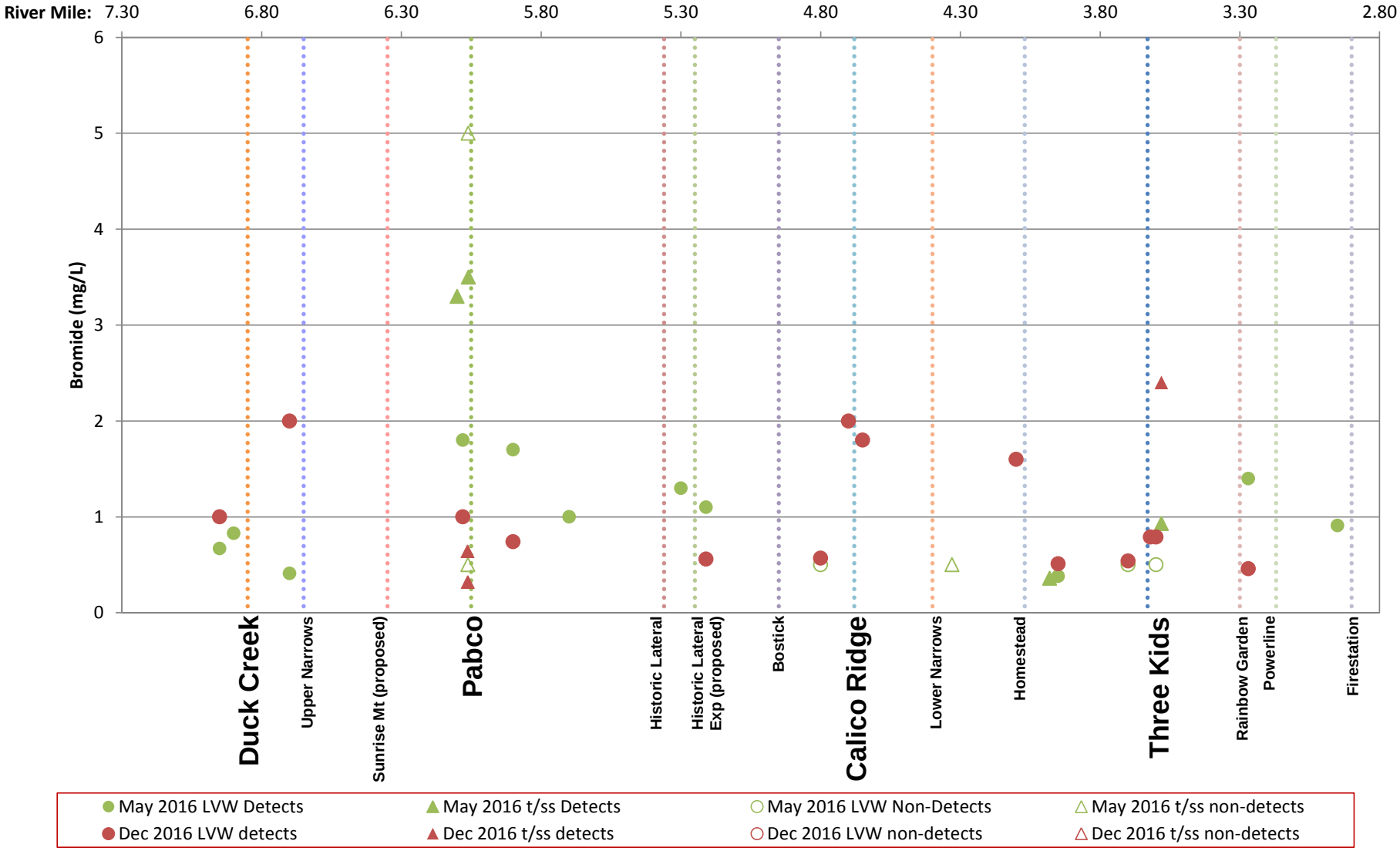
Figure 19

Figure 20. Concentrations of Bromide by River Mile: Sampling Event during USGS Seepage Study
December 8, 2016

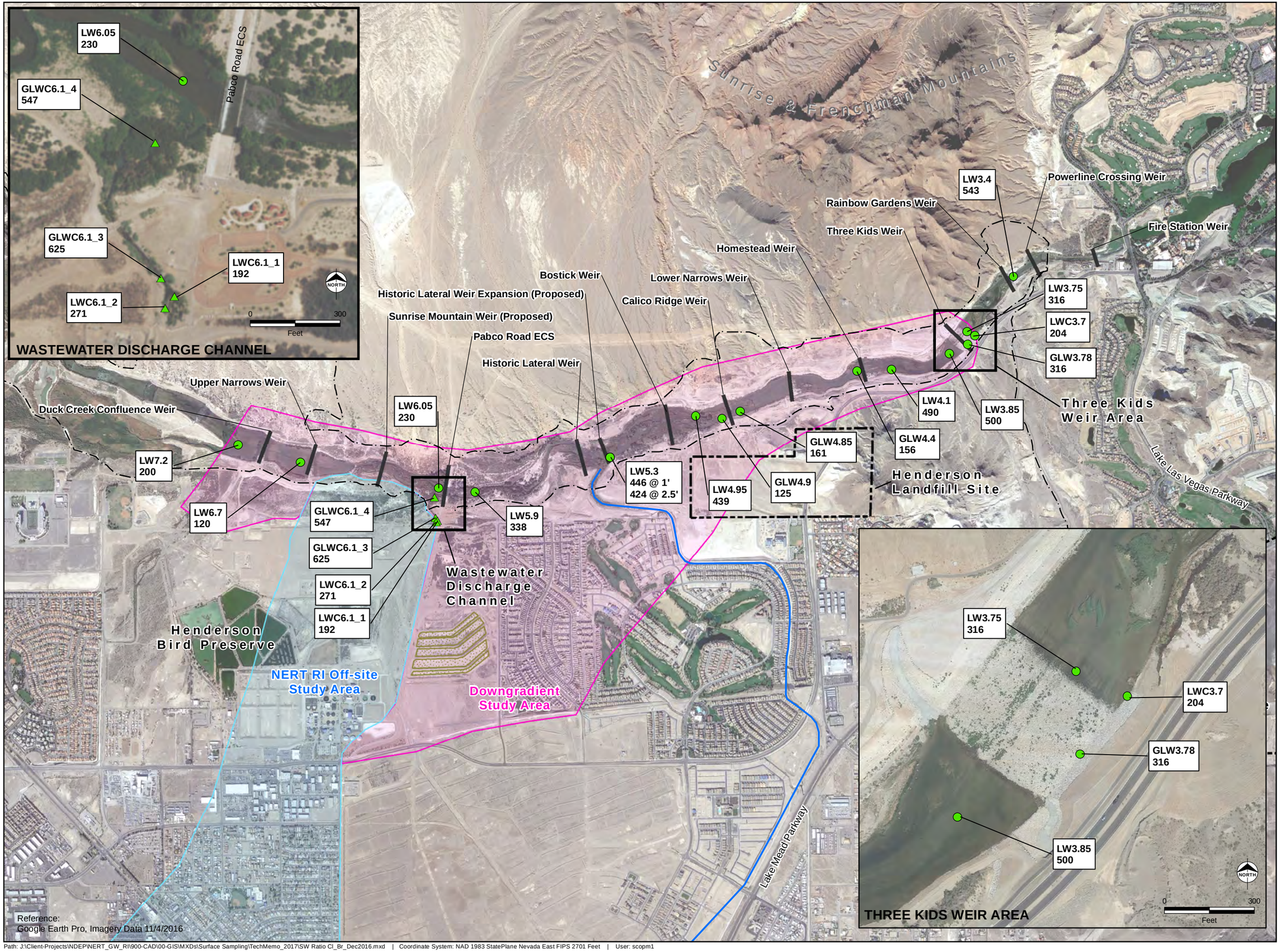


Notes: (1) Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, GLWC6.1_3, GLWC6.1_4]

Figure 21. Concentrations of Bromide by River Mile:
Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016



Notes: (1)Non-detects shown at detection limit. (2)Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, LWC4.1, LWC4.6, LWC 6.1, LWC6.3_1, GLWC6.1_3, GLWC6.1_4]



Legend

- Surface Water Sample Location - Las Vegas Wash
- Surface Water Sample Location - Tributaries
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Chloride/Bromide Concentrations Ratios

Note:
At LW5.3, samples were collected at two depths (indicated in feet below the water surface).

GLW	Designation for new sampling locations within the LVW
GLWC	Designation for new sampling locations from tributaries and side streams
LW	Designation for pre-existing sampling locations in the LVW
LWC	Designation for pre-existing sampling locations from tributaries and side streams

0 2,000
Feet
Scale 1:24,000
1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

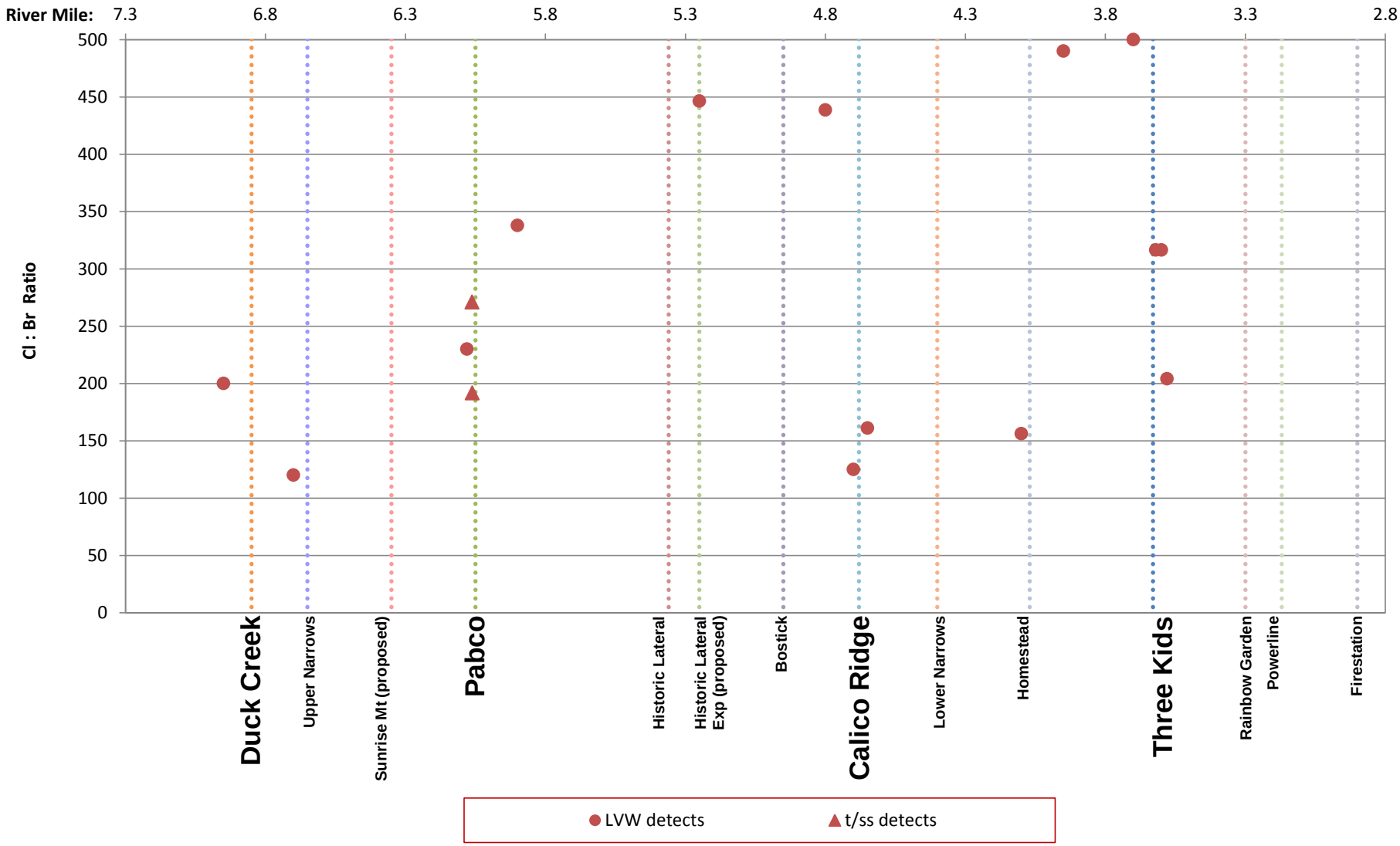
CHLORIDE/BROMIDE RATIOS IN SURFACE WATER SAMPLING EVENT DURING USGS SEEPAGE STUDY

Date: 6/14/2017 Project: 60477365

AECOM

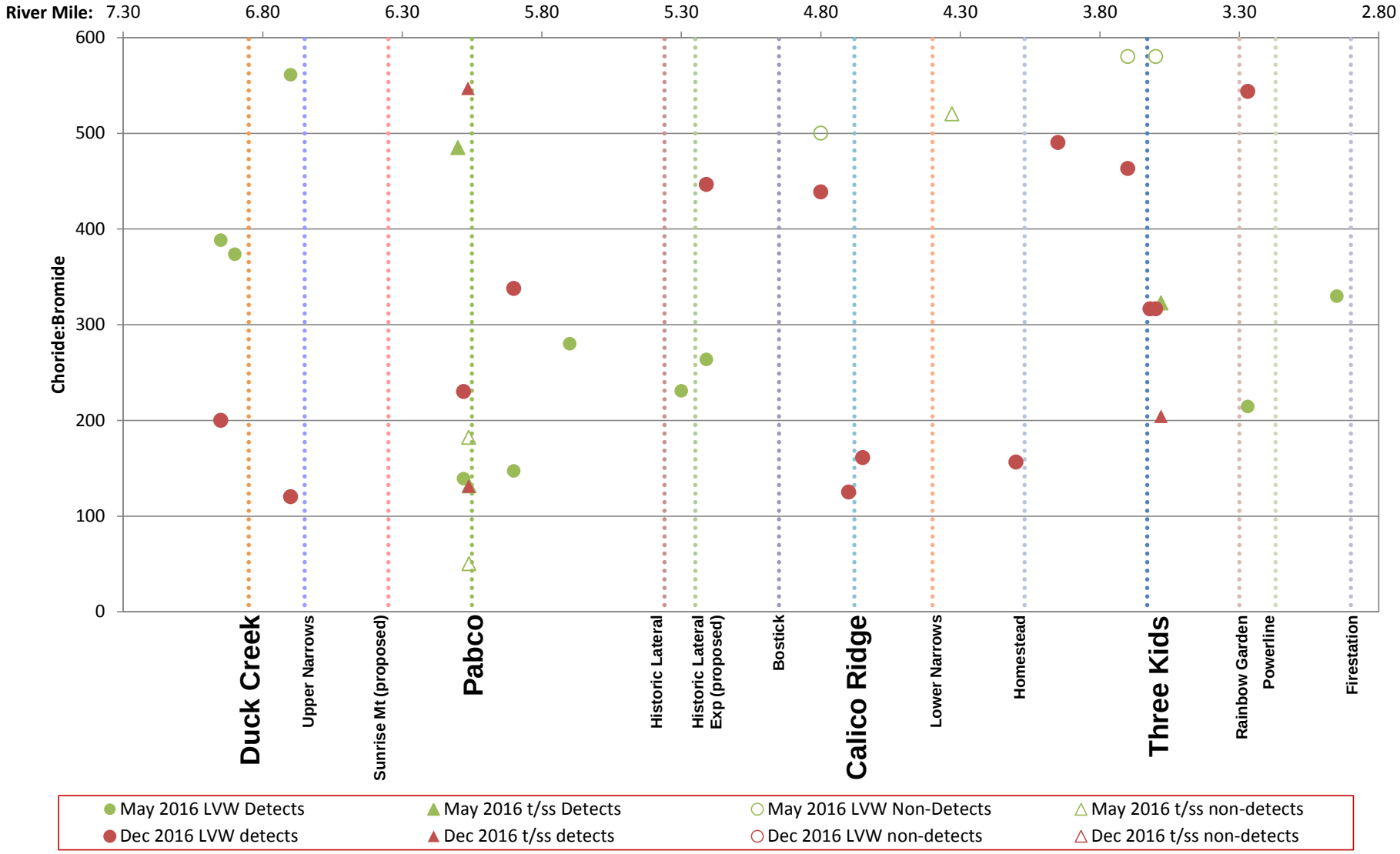
Figure 22

Figure 23. Ratio of Chloride/Bromide by River Mile: Sampling Event during USGS Seepage Study
December 8, 2016

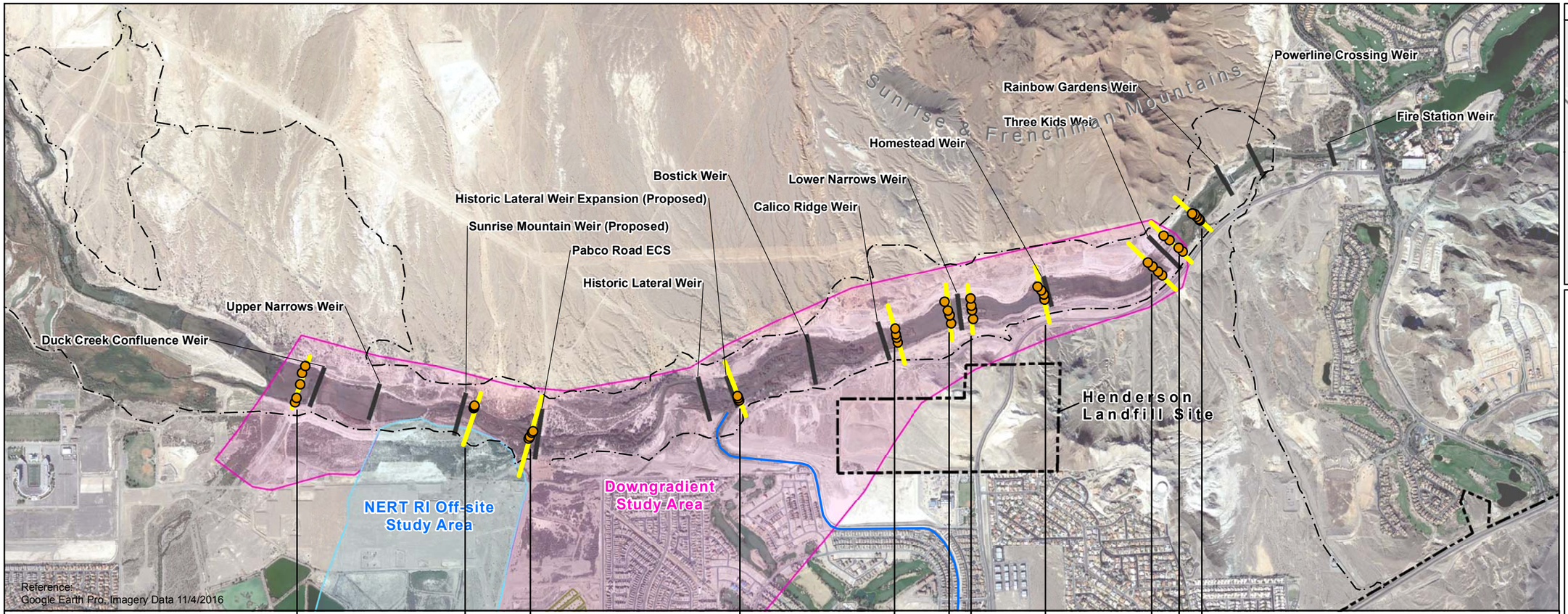


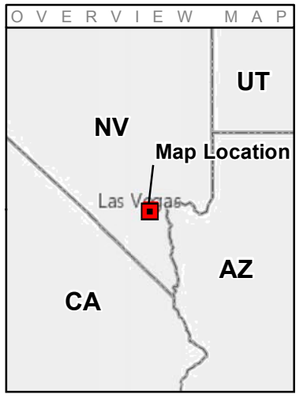
Notes: (1) Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, GLWC6.1_3, GLWC6.1_4]

Figure 24. Ratio of Chloride/Bromide by River Mile:
Sampling Event during USGS Seepage Study December 8, 2016 and Grab Sampling May 2016



Notes: (1)Ratios with non-detects shown at detection limit. (2)Field duplicates not shown. LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel [LWC3.7, LWC6.1_1, LWC6.1_2, LWC4.1, LWC4.6, LWC 6.1, LWC6.3_1, GLWC6.1_3, GLWC6.1_4]





Legend

- Transect Sample Location
- Transects
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Perchlorate Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter

Transect ID	T6.8 S6.8	T6.35 S6.35	T6.0 S6.0	T5.3 S5.3	T4.75 S4.75	T4.65 S4.65	T4.6 S4.6	T4.2 S4.2	T3.8 S3.8	T3.75 S3.75	T3.5 S3.5
North Bank	<0.95	18	15	17	420 J	30	32 J	25	46 J	85	38
	<0.95	17	16	18	22 J	31	30 J	27	32 J	31	37
	1.6 J	17	16	32	23 J	51	57 J	40	45 J	51 J	47
	<0.95	18	16	33	820 J	57 J	64 J	66	57 J	63 J	66
South Bank	<0.95										98
											140
											73

Color Scale Perchlorate Concentration (µg/L)

>90
80
70
60
50
40
30
20
10
0

NORTH

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

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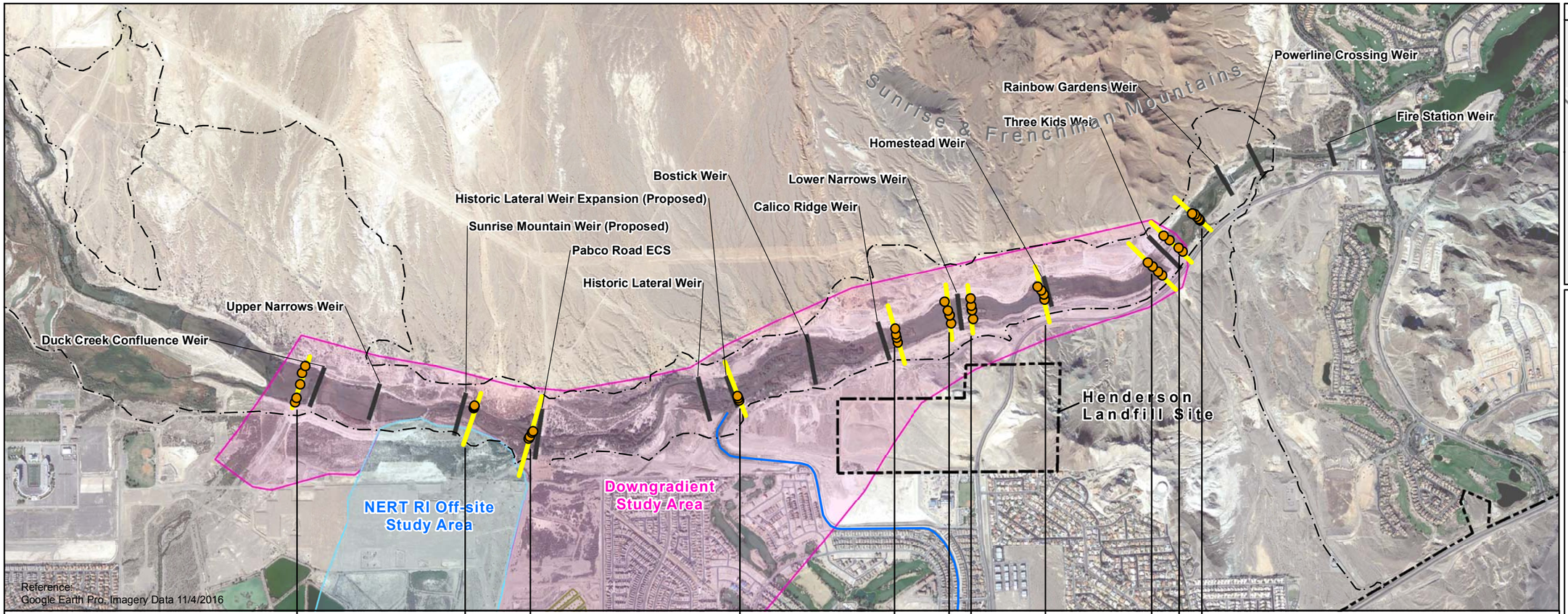
NERT RI
Downgradient Study Area

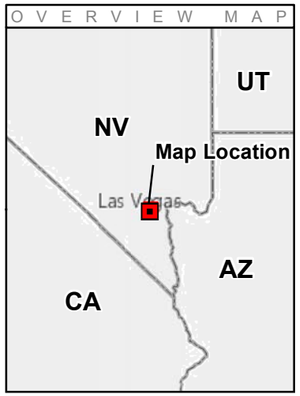
TRANSECTS SAMPLING PERCHLORATE CONCENTRATIONS (February 2017)

Date: 6/14/2017 Project: 60477365

AECOM

Figure 25





Legend

- Transect Sample Location
- Transects
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Chlorate Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter

Transect ID	T6.8 S6.8	T6.35 S6.35	T6.0 S6.0	T5.3 S5.3	T4.75 S4.75	T4.65 S4.65	T4.6 S4.6	T4.2 S4.2	T3.8 S3.8	T3.75 S3.75	T3.5 S3.5
North Bank	48	57	50	51	35 J	78	83	78	130	260	140
	52	53	50	54	83	100	100	88	110	110	130
	73	56	49	140	94	210	210	170	210	210	190
	59	55	49	130	3100	250	260	260	270	270	270
South Bank	51										420
											430
											310

Color Scale Chlorate Concentration (µg/L)

- >400
- 350
- 300
- 250
- 200
- 150
- 100
- <50

NORTH

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

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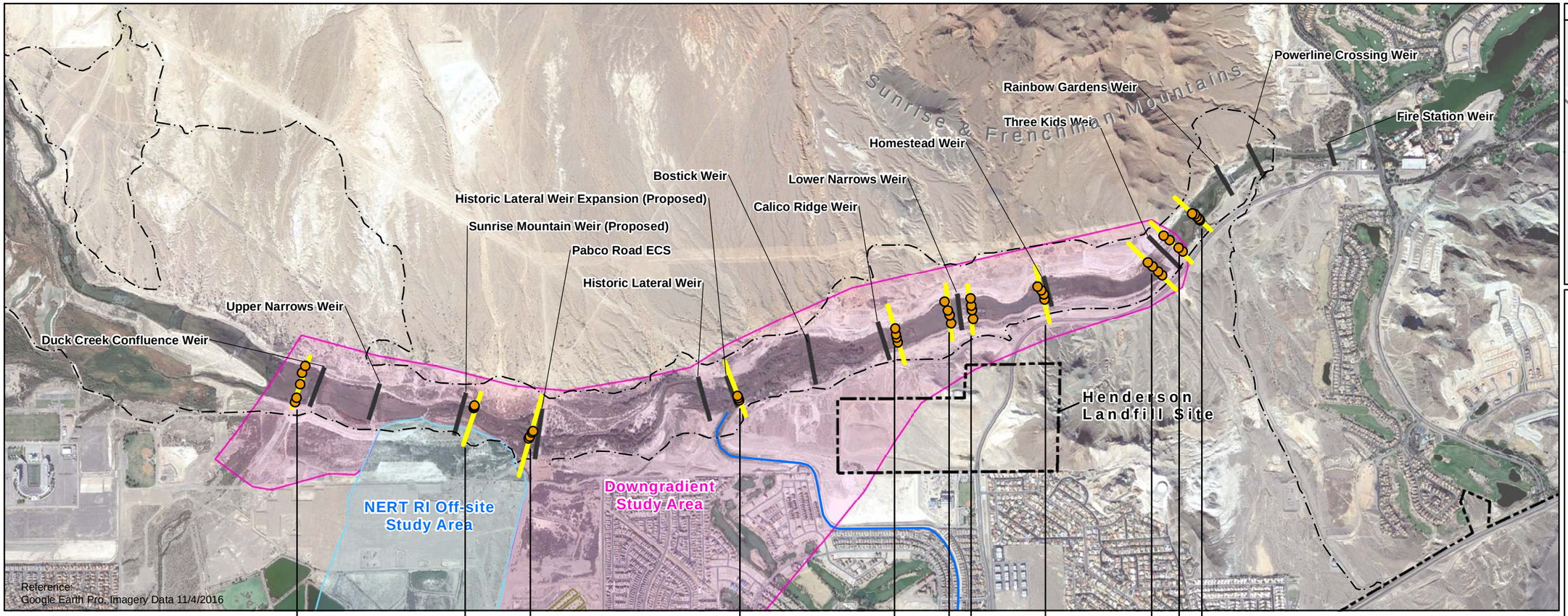
NERT RI
Downgradient Study Area

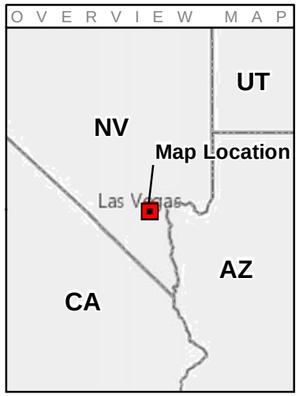
TRANSECTS SAMPLING CHLORATE CONCENTRATIONS (February 2017)

Date: 6/14/2017 Project: 60477365

AECOM

Figure 26



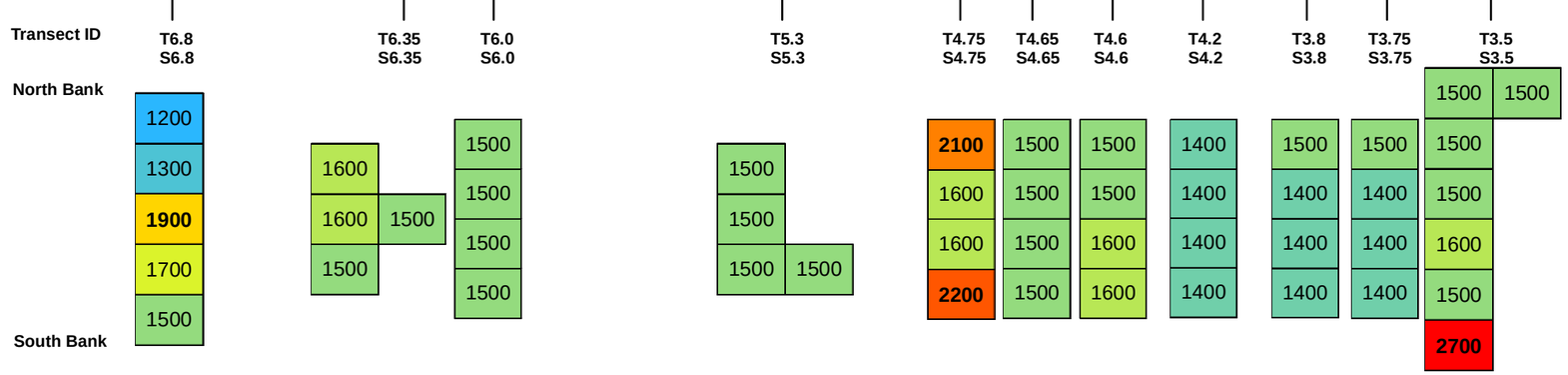


Legend

- Transect Sample Location
- Transects
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Total Dissolved Solids Concentration in mg/L

mg/L - Milligrams per liter



Color Scale Total Dissolved Solid Concentration (mg/L)

- >2,400
- 2200
- 2000
- 1800
- 1600
- 1400
- <1200

NORTH

0 2,000 Feet

Scale 1:24,000

1 inch = 2,000 feet

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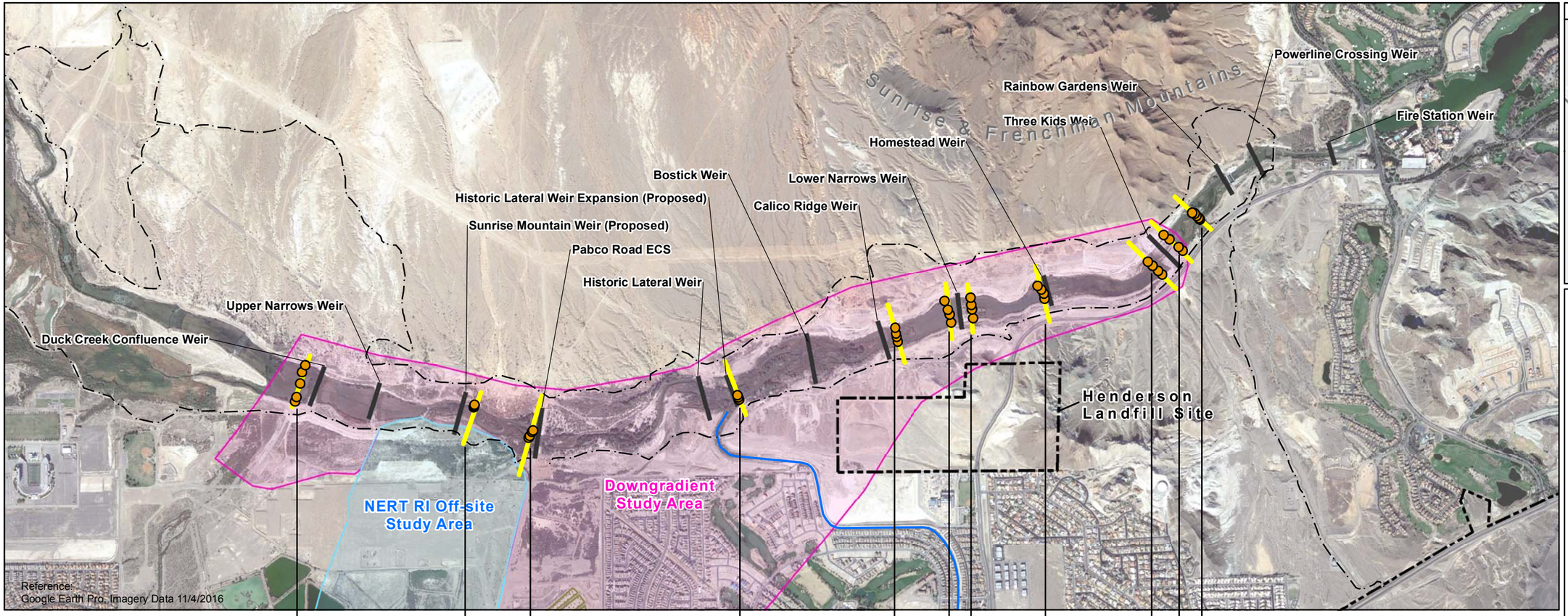
NERT RI
Downgradient Study Area

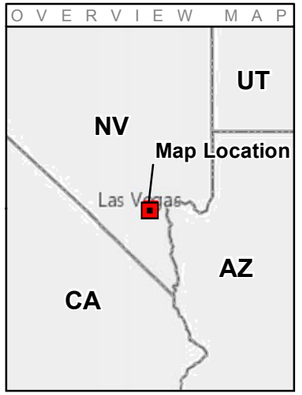
TRANSECTS SAMPLING TOTAL DISSOLVED SOLIDS CONCENTRATIONS (February 2017)

Date: 6/14/2017 Project: 60477365

AECOM

Figure 27



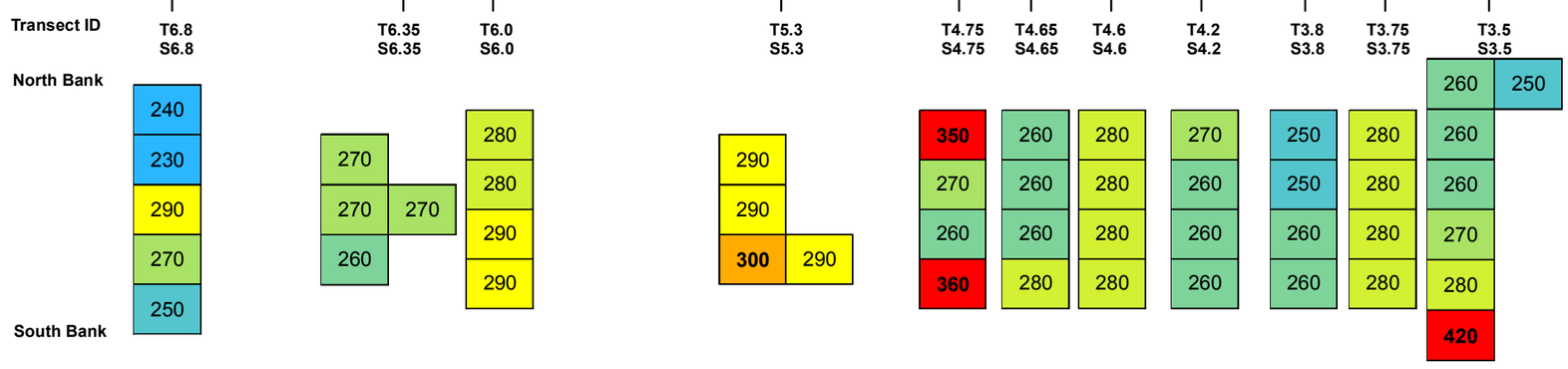


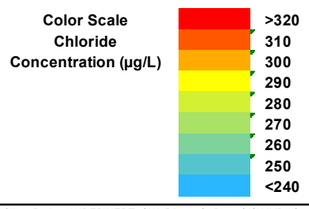
Legend

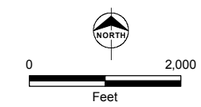
- Transect Sample Location
- Transects
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Chloride Concentration in µg/L

µg/L - Micrograms per liter







Scale 1:24,000
1 inch = 2,000 feet

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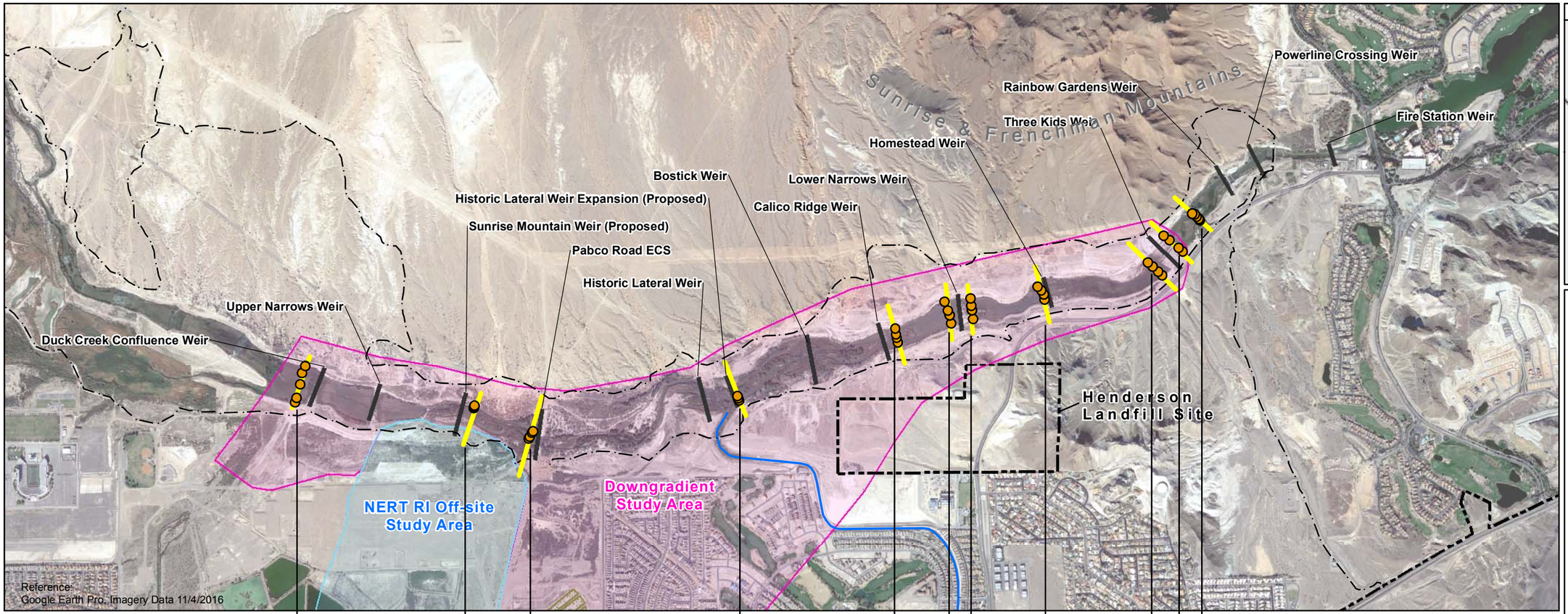
NERT RI
Downgradient Study Area

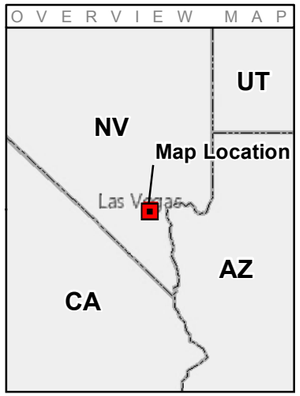
TRANSECTS SAMPLING CHLORIDE CONCENTRATIONS (February 2017)

Date: 6/14/2017 Project: 60477365

AECOM

Figure 28





Legend

- Transect Sample Location
- Transects
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Bromide Concentration in µg/L

J - Associated concentration is estimate
µg/L - Micrograms per liter

Transect ID	T6.8 S6.8	T6.35 S6.35	T6.0 S6.0	T5.3 S5.3	T4.75 S4.75	T4.65 S4.65	T4.6 S4.6	T4.2 S4.2	T3.8 S3.8	T3.75 S3.75	T3.5 S3.5	
North Bank											0.84 J	0.70
	0.77	<0.25	<0.50	<0.50	<0.50	1.7	1.6	0.58	<0.50	<0.50	<0.50	
	0.64	0.57	<0.50	<0.50	0.57	0.74 J	<0.25	0.58	0.53 J	0.34 J	<0.50	
	1.8	0.32 J	<0.50	<0.50	0.59	1.8	1.6	0.67 J	0.59 J	0.33 J	<0.50	
	1.6	0.31 J	<0.50	0.30 J	0.69 J	1.4	1.7	0.60	0.60 J	0.34 J	0.64 J	
South Bank	1.3			<0.50							1.1	

Color Scale Bromide Concentration (µg/L)

- >2.0
- 80
- 70
- 60
- 50
- 40
- 30
- 20
- 10
- 0

NORTH

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

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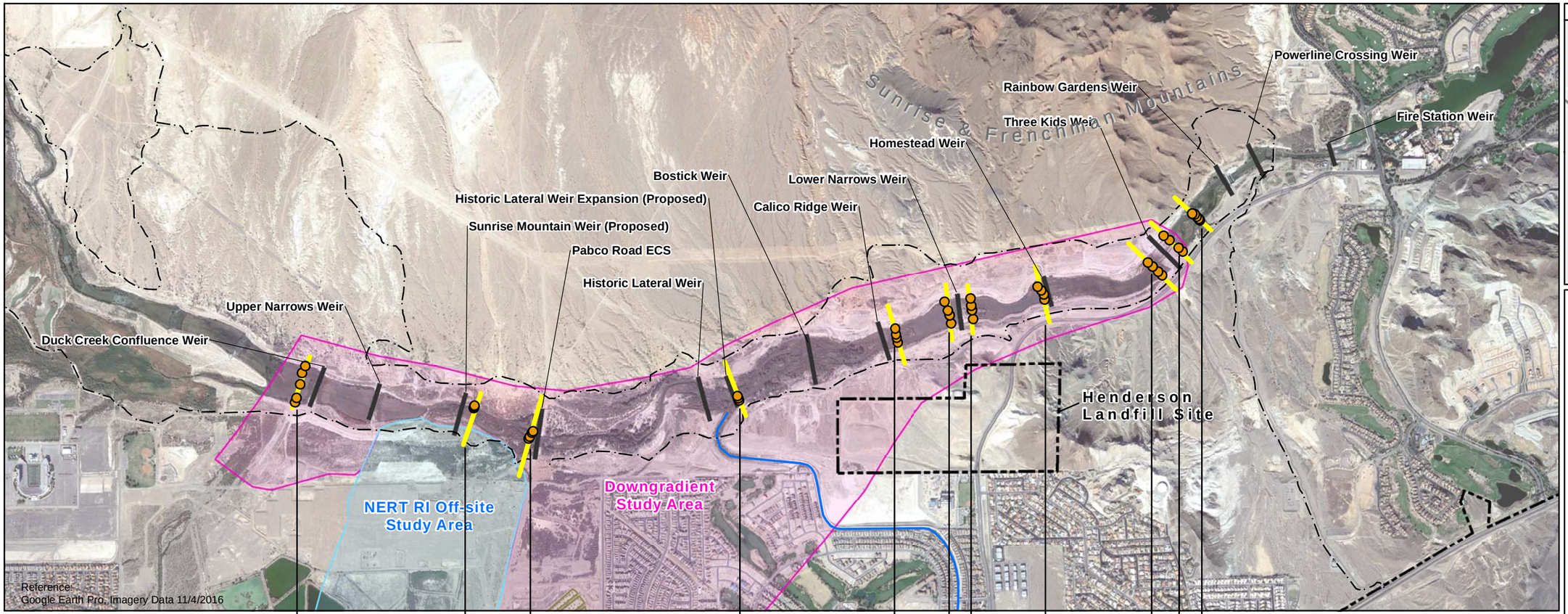
NERT RI
Downgradient Study Area

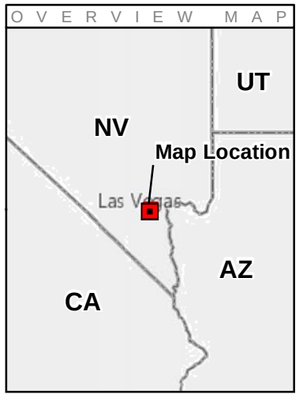
TRANSECTS SAMPLING BROMIDE CONCENTRATIONS (February 2017)

Date: 6/14/2017 Project: 60477365

AECOM

Figure 29





Legend

- Transect Sample Location
- Transects
- Weir
- Northern Rapid Infiltration Basins
- Wetlands Trail
- Channels
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area

Chloride/Bromide Concentrations Ratios

Transect ID	T6.8 S6.8	T6.35 S6.35	T6.0 S6.0	T5.3 S5.3	T4.75 S4.75	T4.65 S4.65	T4.6 S4.6	T4.2 S4.2	T3.8 S3.8	T3.75 S3.75	T3.5 S3.5
North Bank	312	1080	560	580	700	153	175	466	500	560	310
	359	474	560	580	474	351	1120	448	472	824	357
	161	844	580	580	441	144	175	388	441	848	520
	169	839	580	1000	522	200	165	433	433	824	520
	192			580							540
South Bank											438
											382

Color Scale Chloride/Bromide Ratio

- >1,000
- 900
- 800
- 700
- 600
- 500
- 400
- 300
- <200

NORTH

0 2,000
Feet

Scale 1:24,000
1 inch = 2,000 feet

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NERT RI
Downgradient Study Area

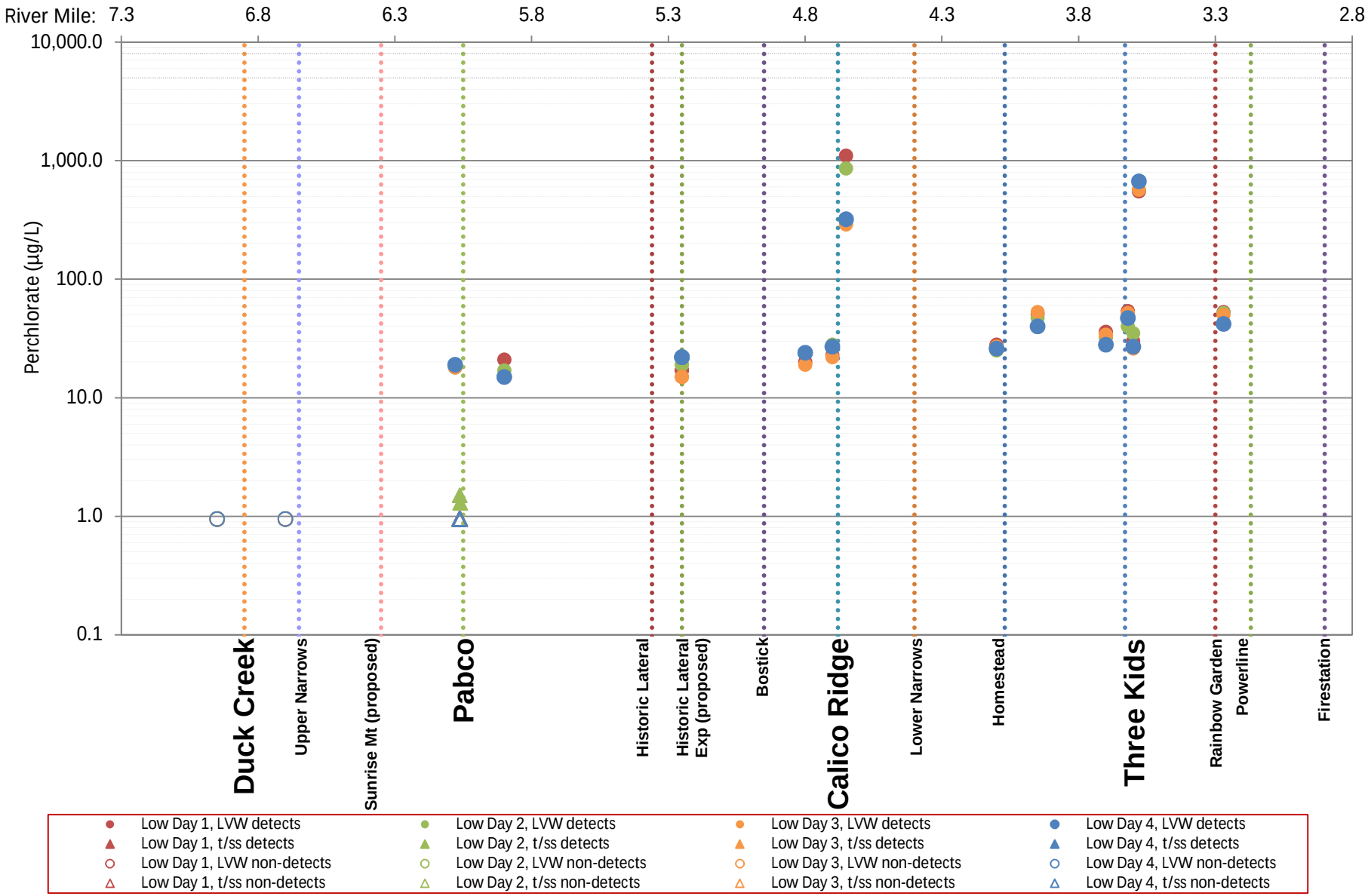
TRANSECTS SAMPLING CHLORIDE/BROMIDE RATIOS (February 2017)

Date: 6/14/2017 Project: 60477365

AECOM

Figure 30

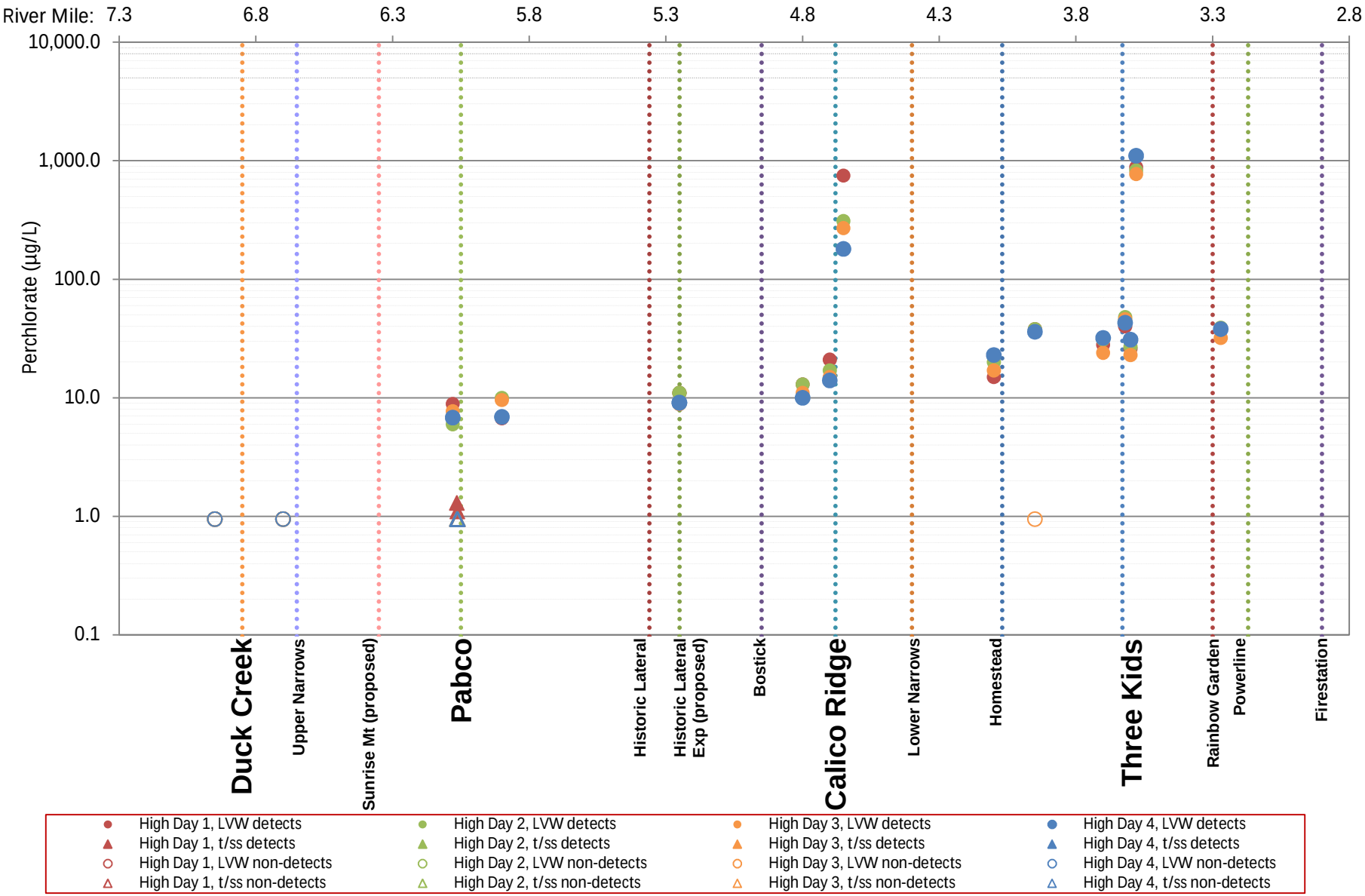
Figure 31. Perchlorate in Surface Water Samples by River Mile: Discrete Sampling Low Flow
February 6 - 9, 2017



Notes: (1)Non-detects shown at detection limit.
(2) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

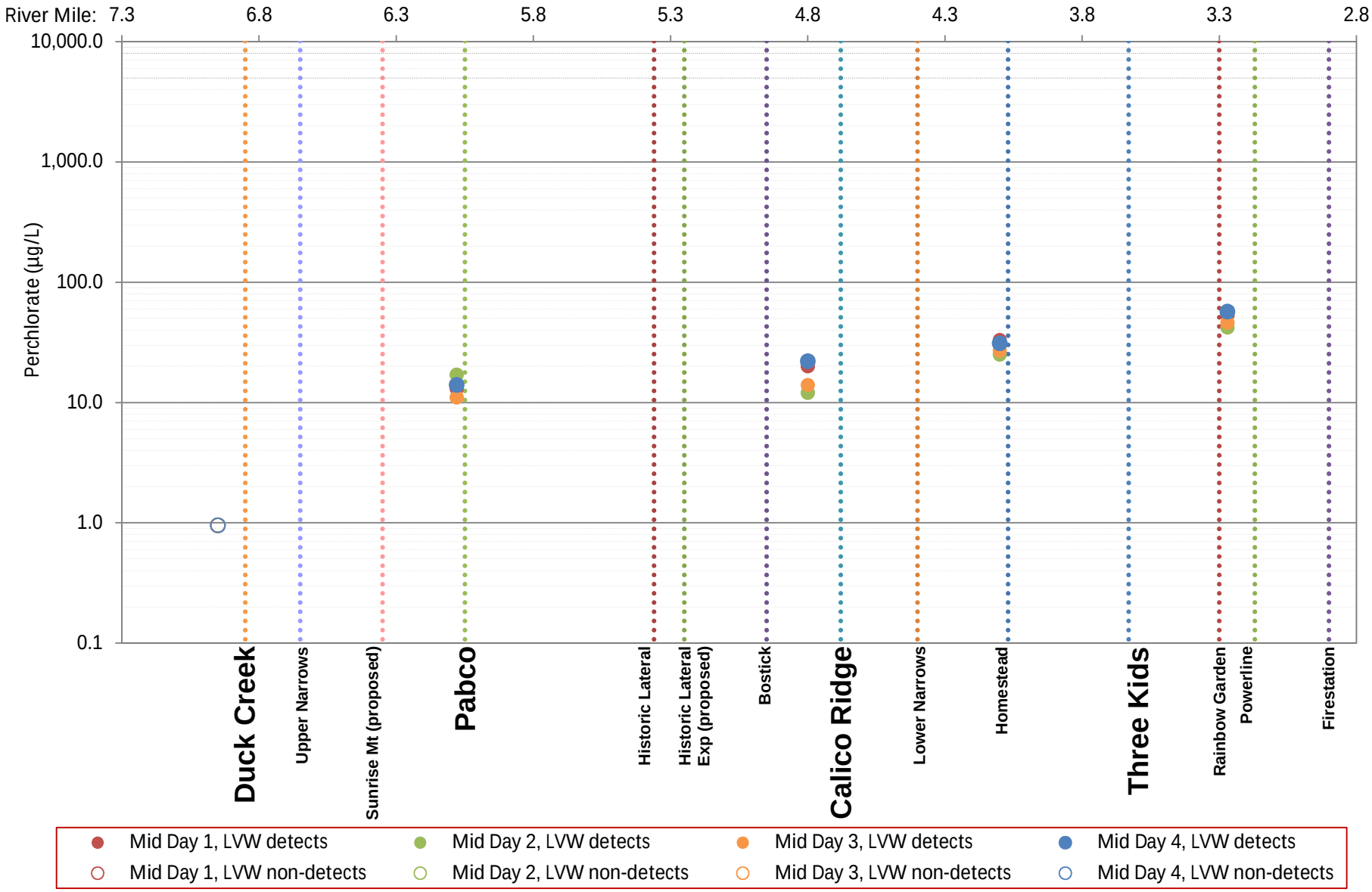
Figure 32. Perchlorate in Surface Water Samples by River Mile: Discrete Sampling High Flow
February 6 - 9, 2017



Notes: (1)Non-detects shown at detection limit.
(2) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

Figure 33. Perchlorate in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
February 6 - 9, 2017

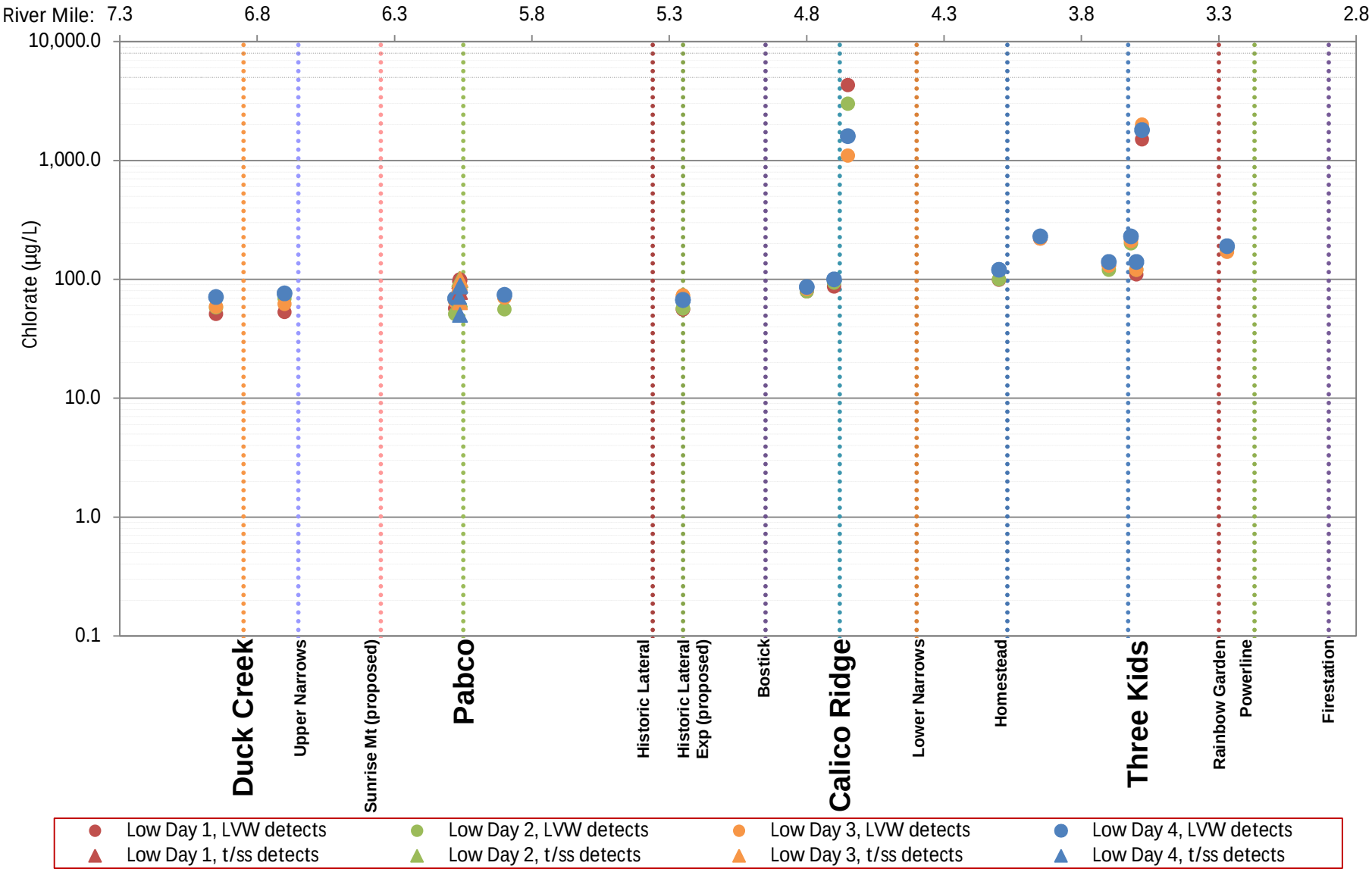


Mid Day 1, LVW detects
Mid Day 2, LVW detects
Mid Day 3, LVW detects
Mid Day 4, LVW detects
Mid Day 1, LVW non-detects
Mid Day 2, LVW non-detects
Mid Day 3, LVW non-detects
Mid Day 4, LVW non-detects

Notes: (1)Non-detects shown at detection limit.
(2) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

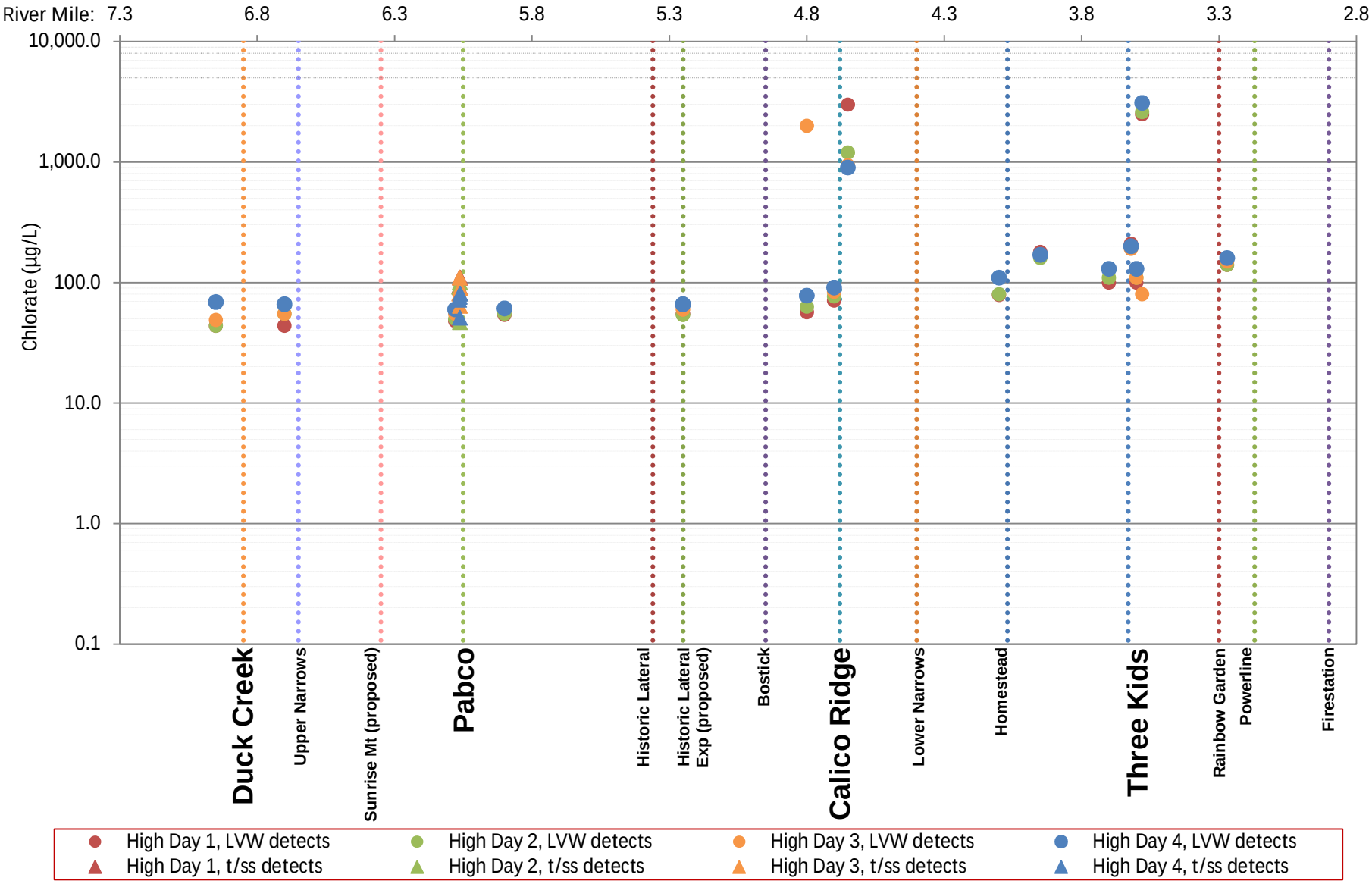
Figure 34. Chlorate in Surface Water Samples by River Mile: Discrete Sampling Low Flow
February 6 - 9, 2017



Notes: (1) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

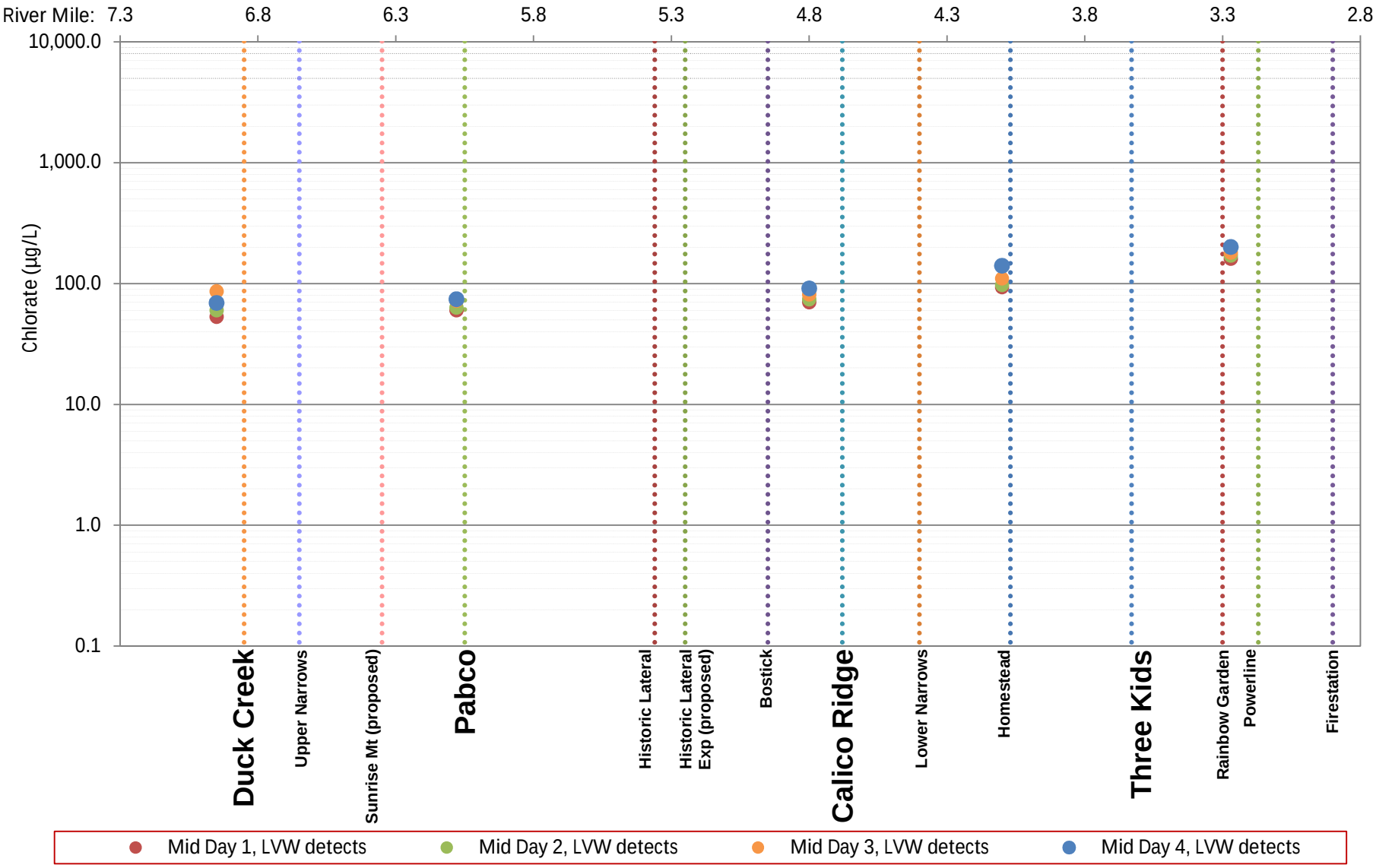
Figure 35. Chlorate in Surface Water Samples by River Mile: Discrete Sampling High Flow
February 6 - 9, 2017



Notes: (1) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

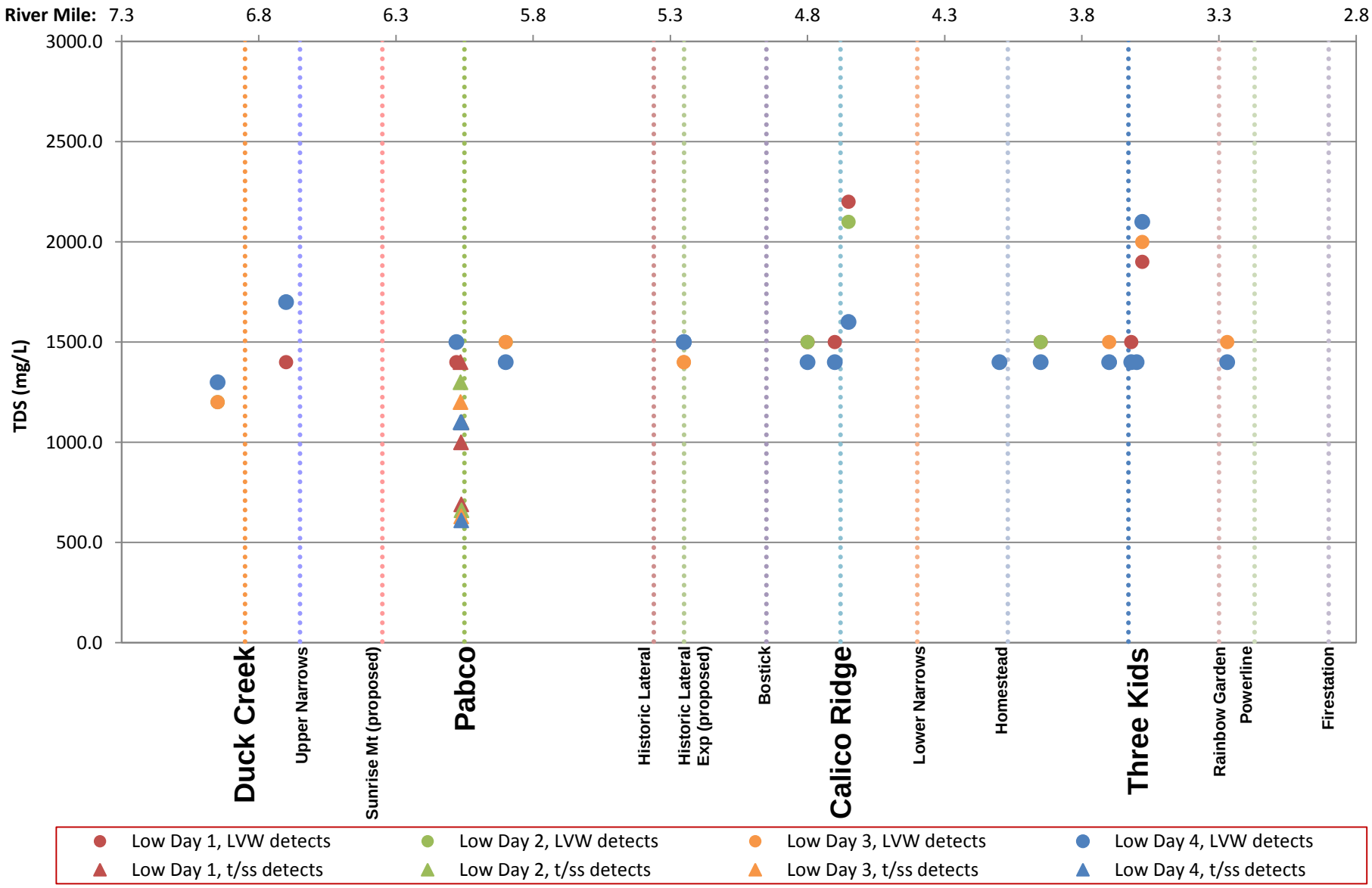
Figure 36. Chlorate in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
February 6 - 9, 2017



Notes: (1)Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

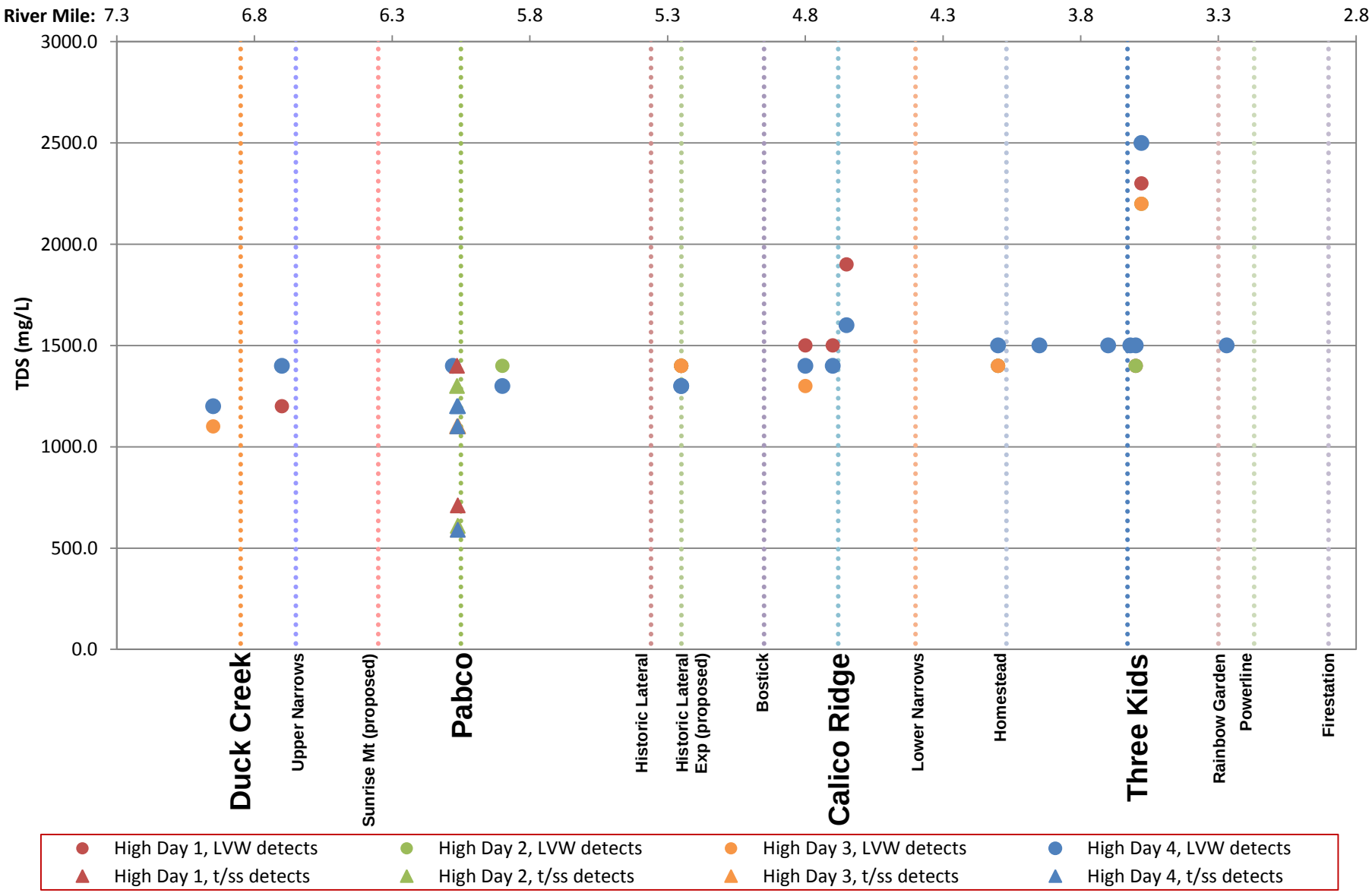
Figure 37. Total Dissolved Solids in Surface Water Samples by River Mile: Discrete Sampling Low Flow
February 6 - 9, 2017



Notes: (1) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

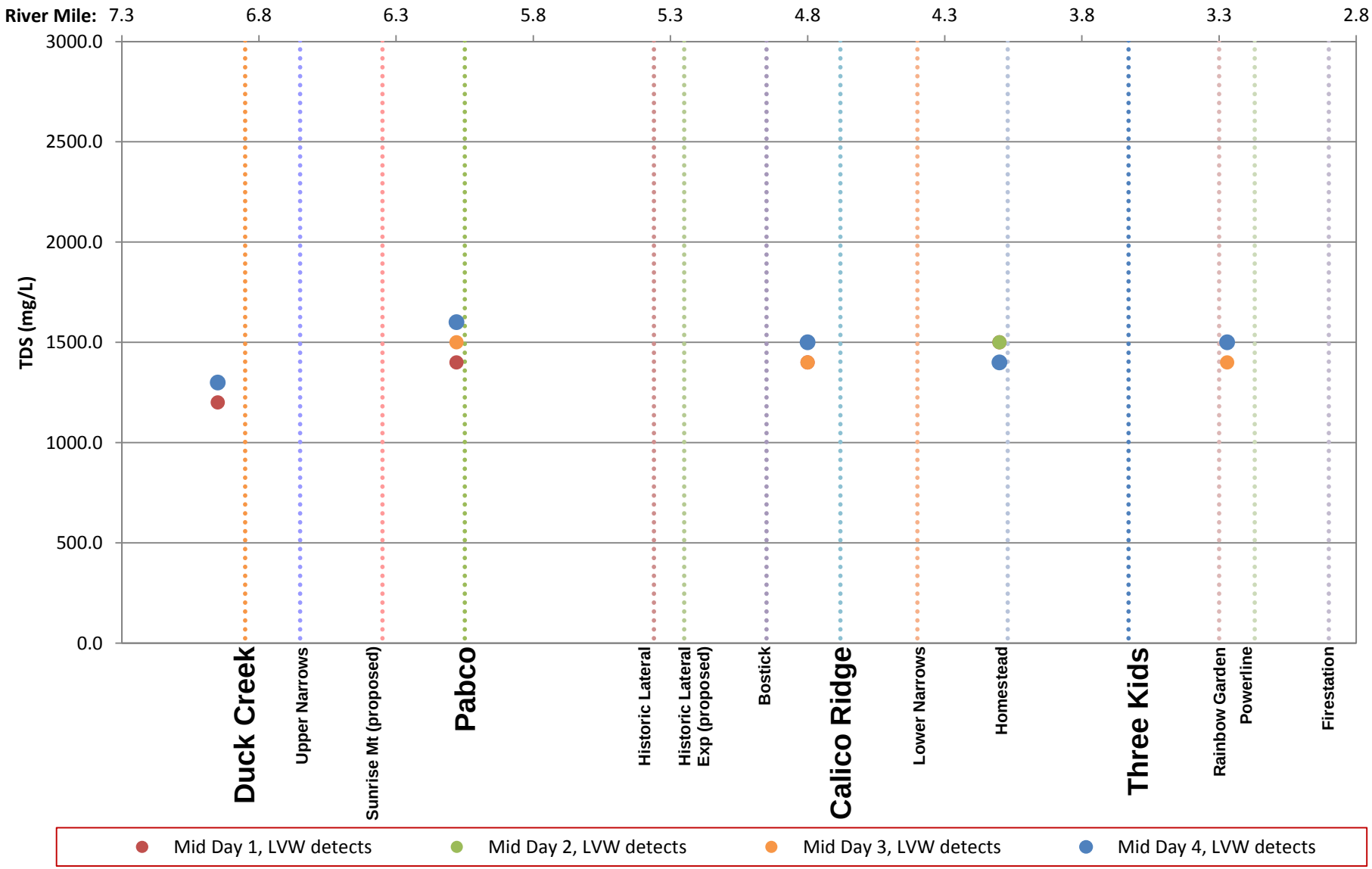
Figure 38. Total Dissolved Solids in Surface Water Samples by River Mile: Discrete Sampling High Flow
February 6 - 9, 2017



Notes: (1) Field duplicates not shown.
.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

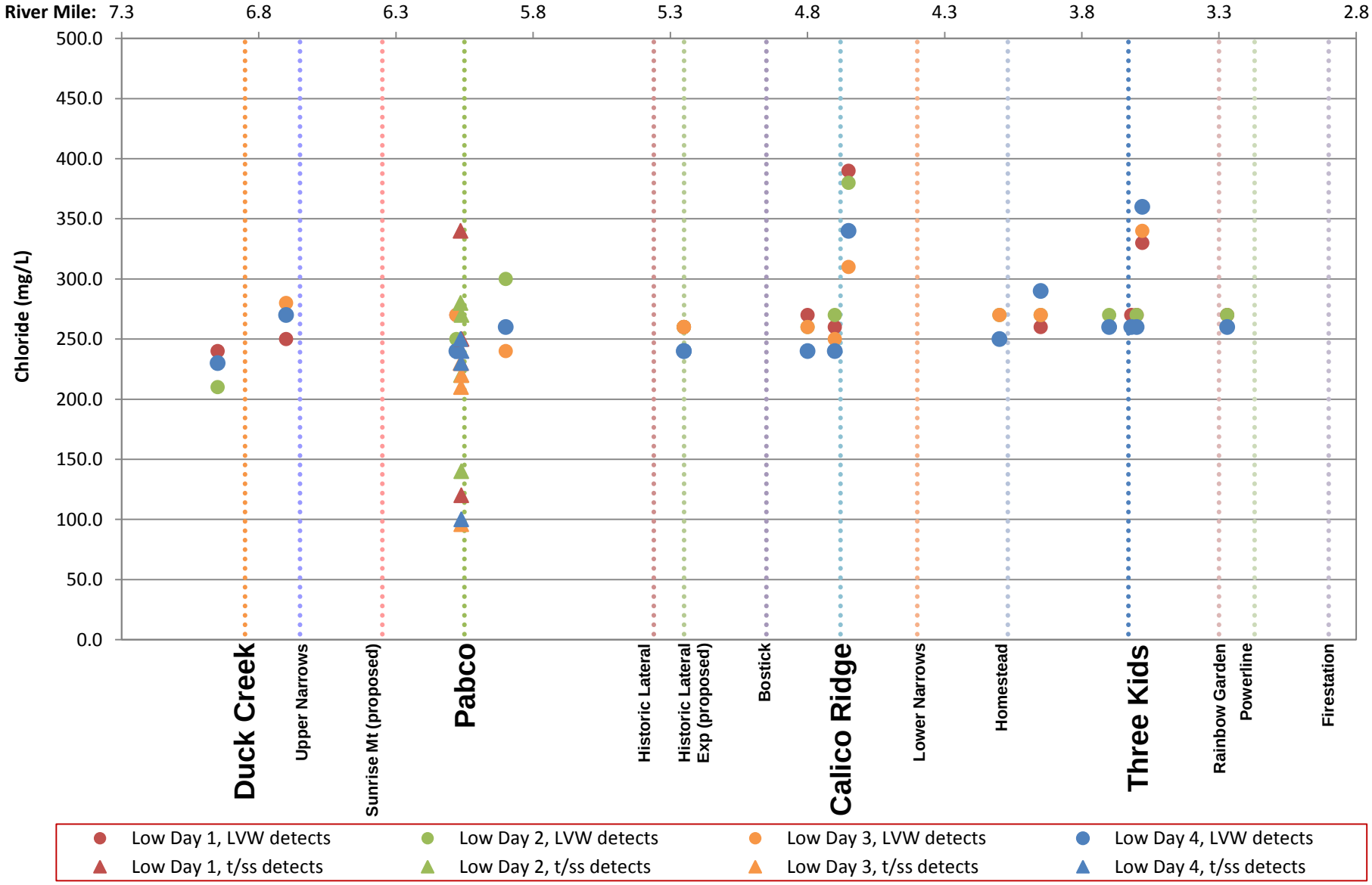
Figure 39. Total Dissolved Solids in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
February 6 - 9, 2017



Notes: (1) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

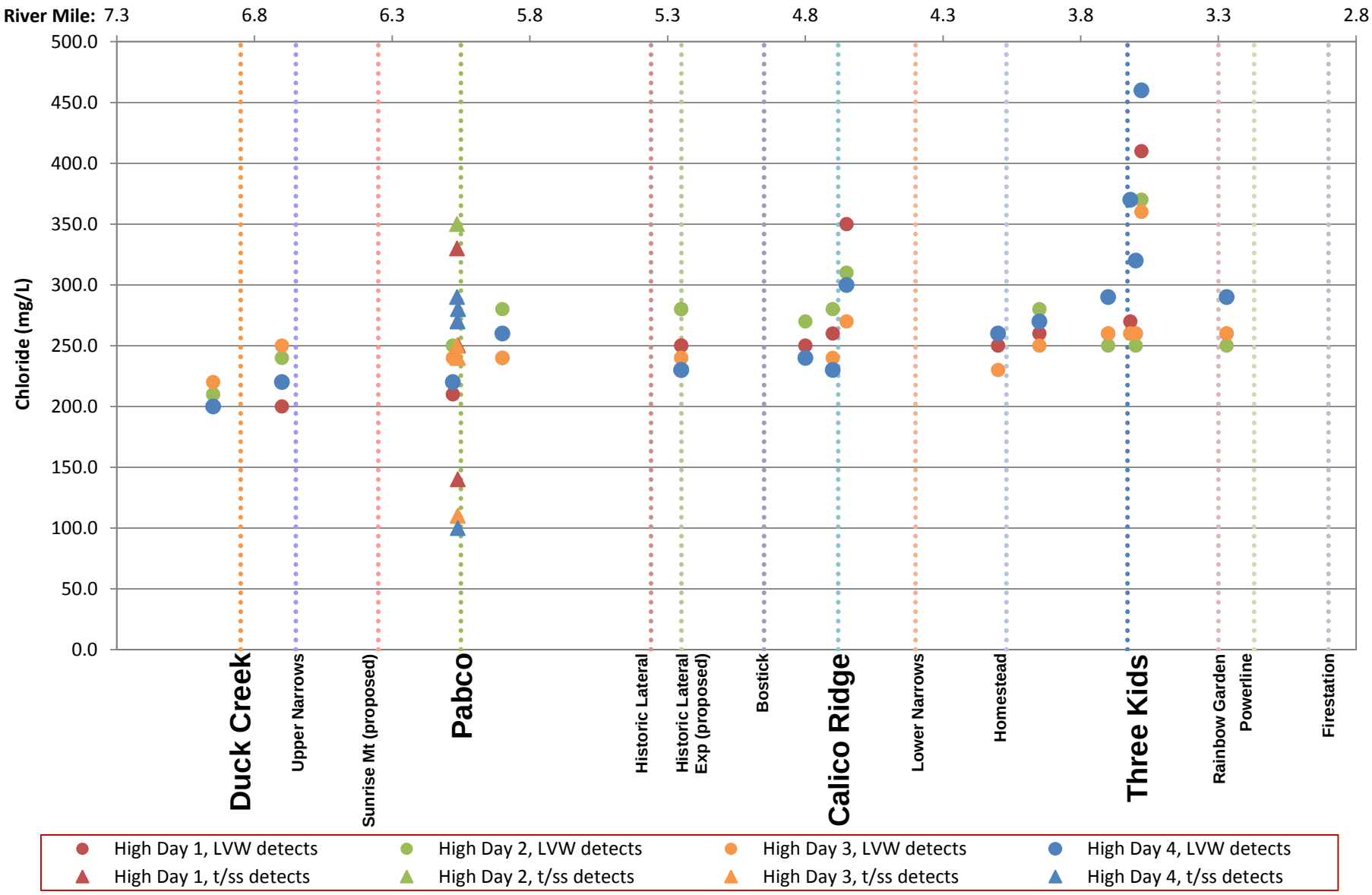
Figure 40. Chloride in Surface Water Samples by River Mile: Discrete Sampling Low Flow
February 6 - 9, 2017



Notes: (1) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

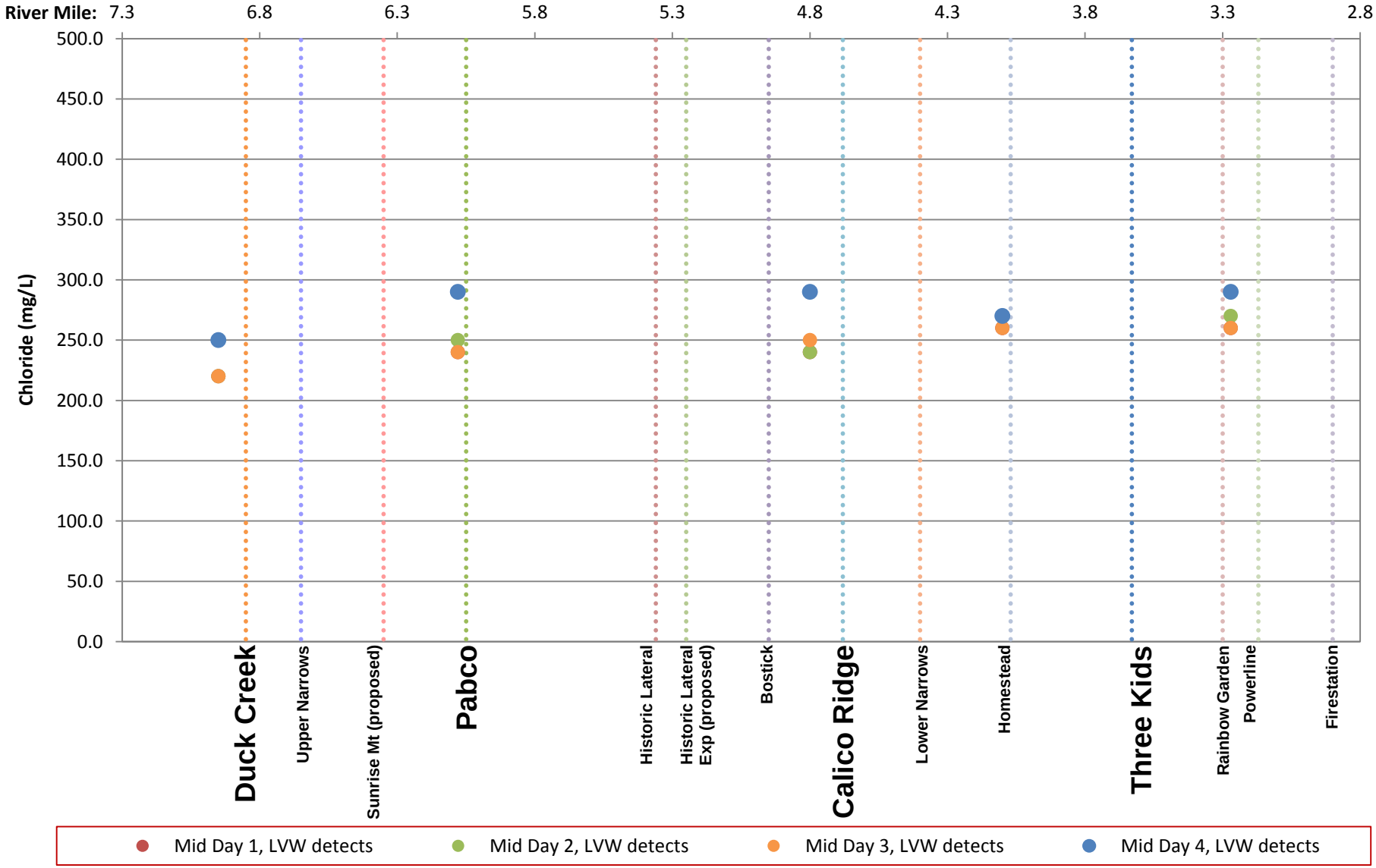
Figure 41. Chloride in Surface Water Samples by River Mile: Discrete Sampling High Flow
February 6 - 9, 2017



Notes: (1) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

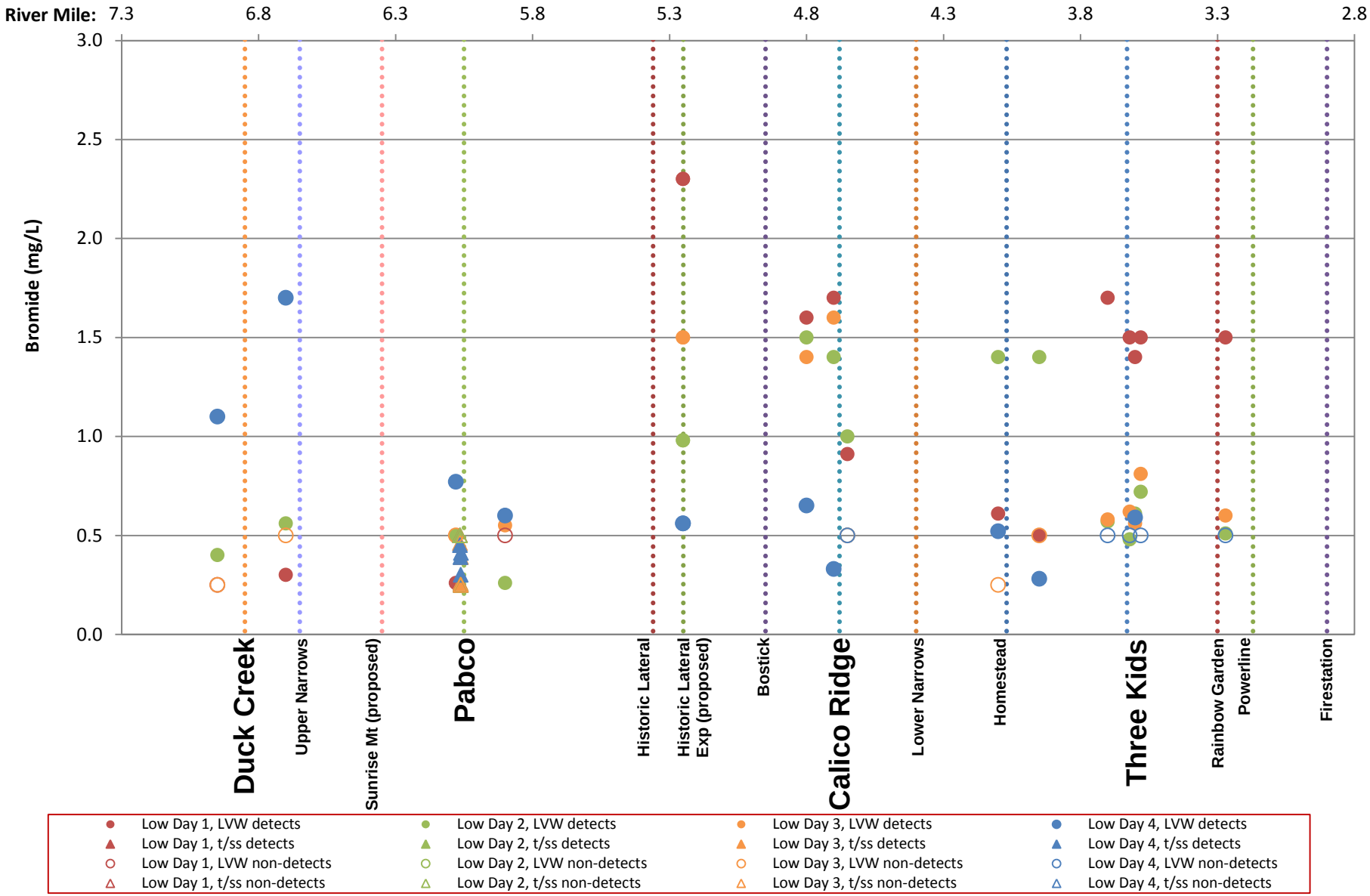
Figure 42. Chloride in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
February 6 - 9, 2017



Notes: (1) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

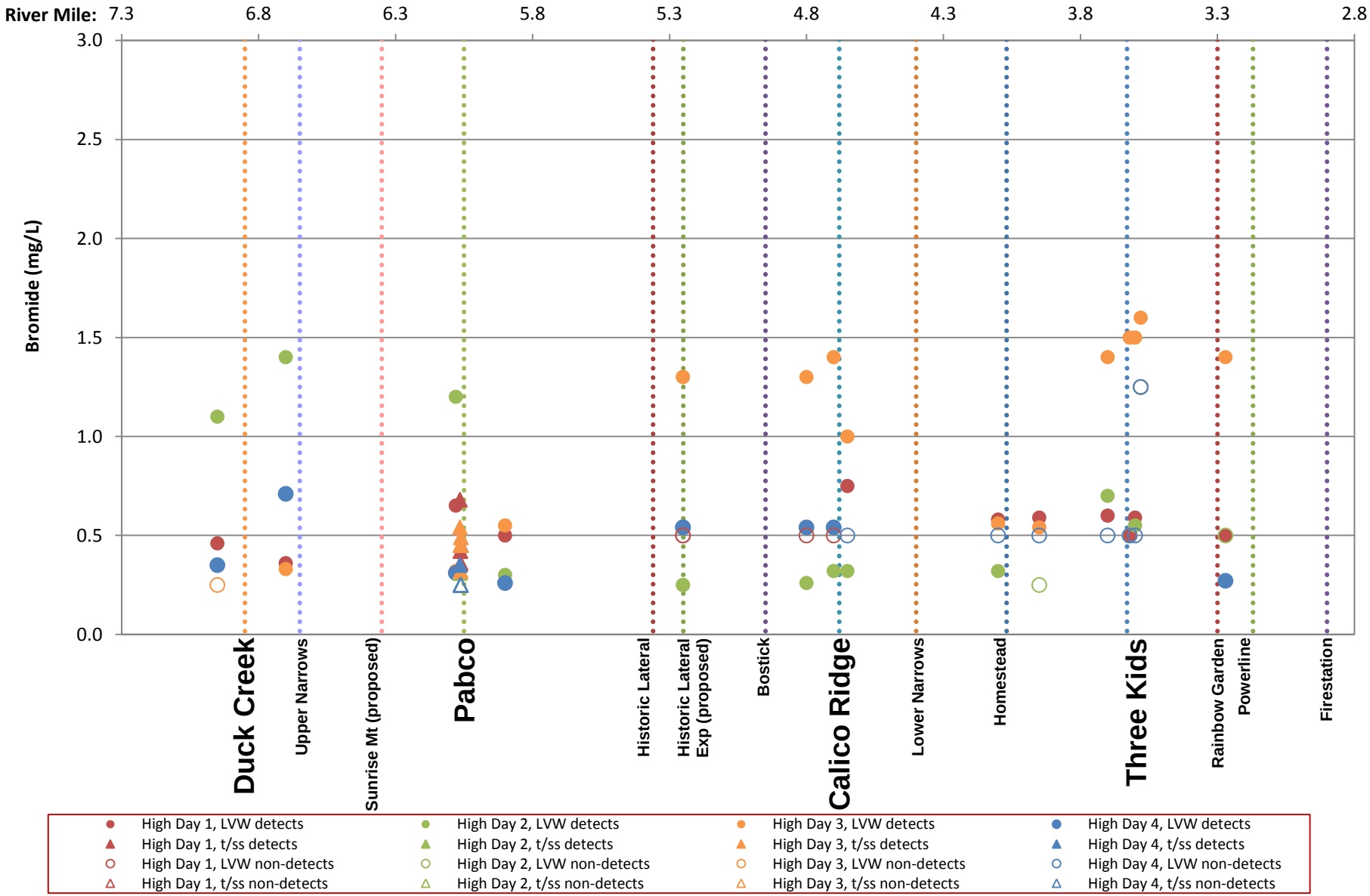
Figure 43. Bromide in Surface Water Samples by River Mile: Discrete Sampling Low Flow
February 6 - 9, 2017



Notes: (1)Non-detects shown at detection limit.
(2) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

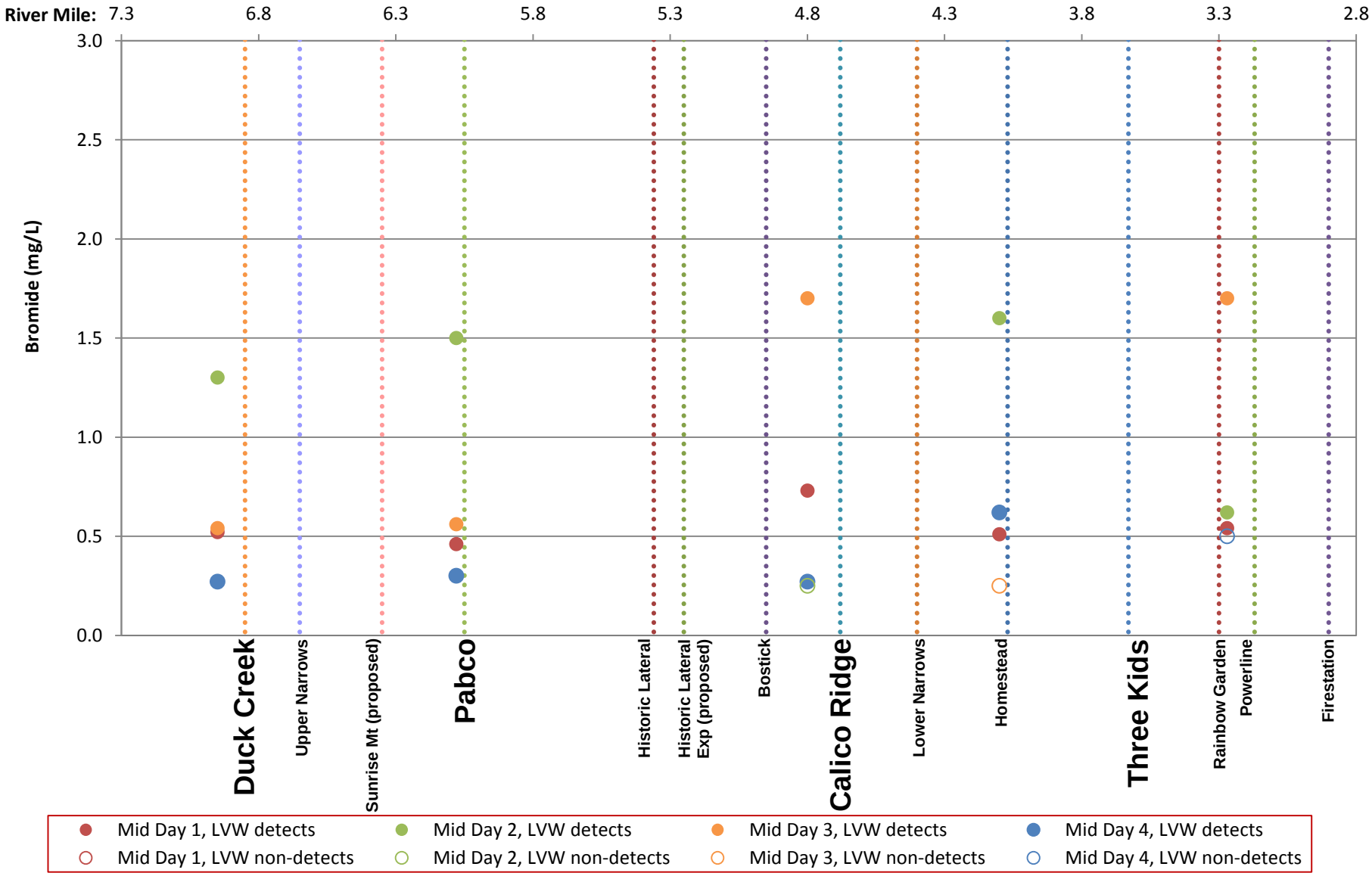
Figure 44. Bromide in Surface Water Samples by River Mile: Discrete Sampling High Flow
February 6 - 9, 2017



Notes: (1)Non-detects shown at detection limit.
(2) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

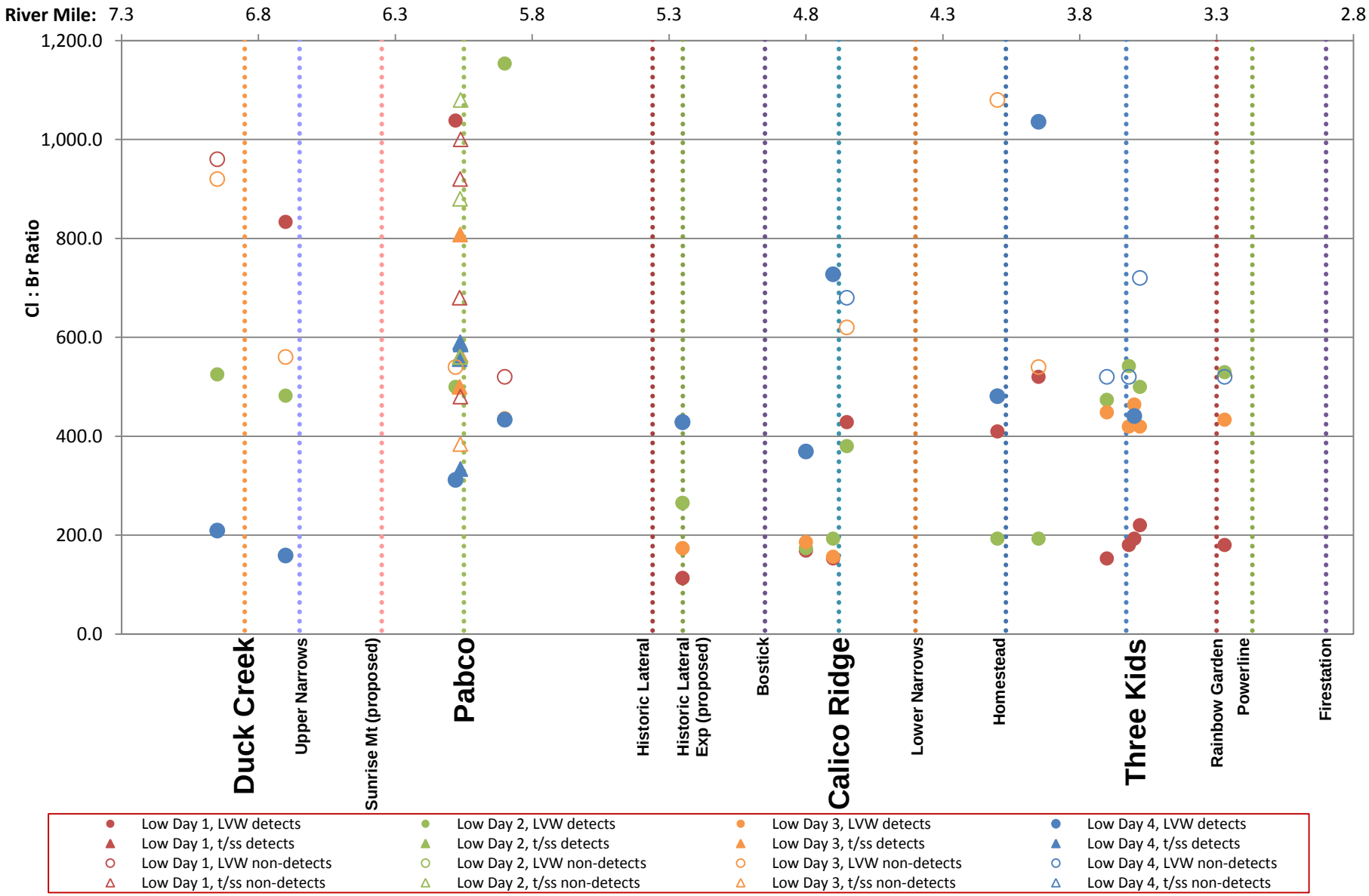
Figure 45. Bromide in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
February 6 - 9, 2017



Notes: (1)Non-detects shown at detection limit.
(2) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

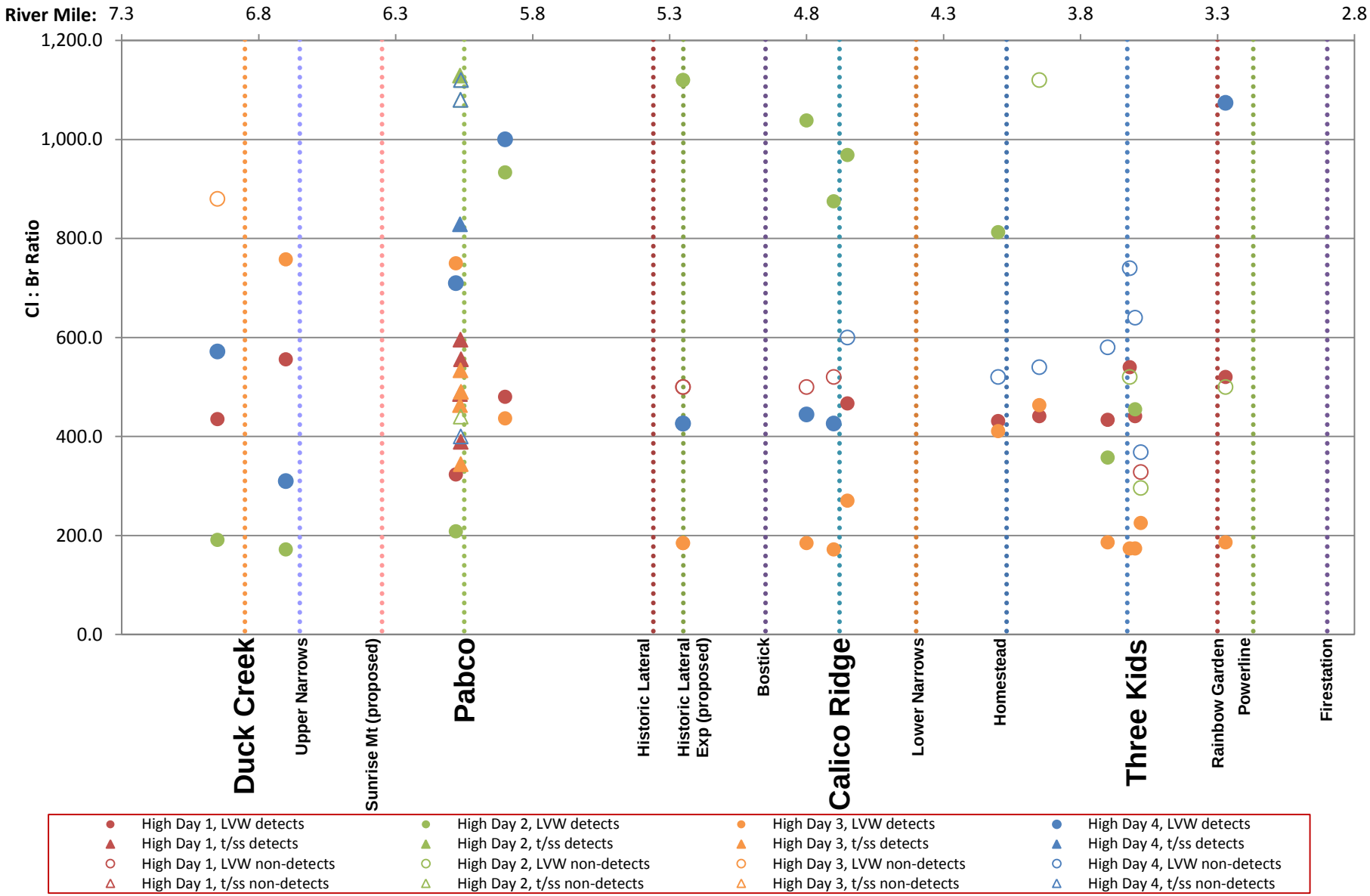
Figure 46. Chloride/Bromide Ratio in Surface Water Samples by River Mile: Discrete Sampling Low Flow
February 6 - 9, 2017



Notes: (1) Ratios with non-detects calculated using detection limit.
(2) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

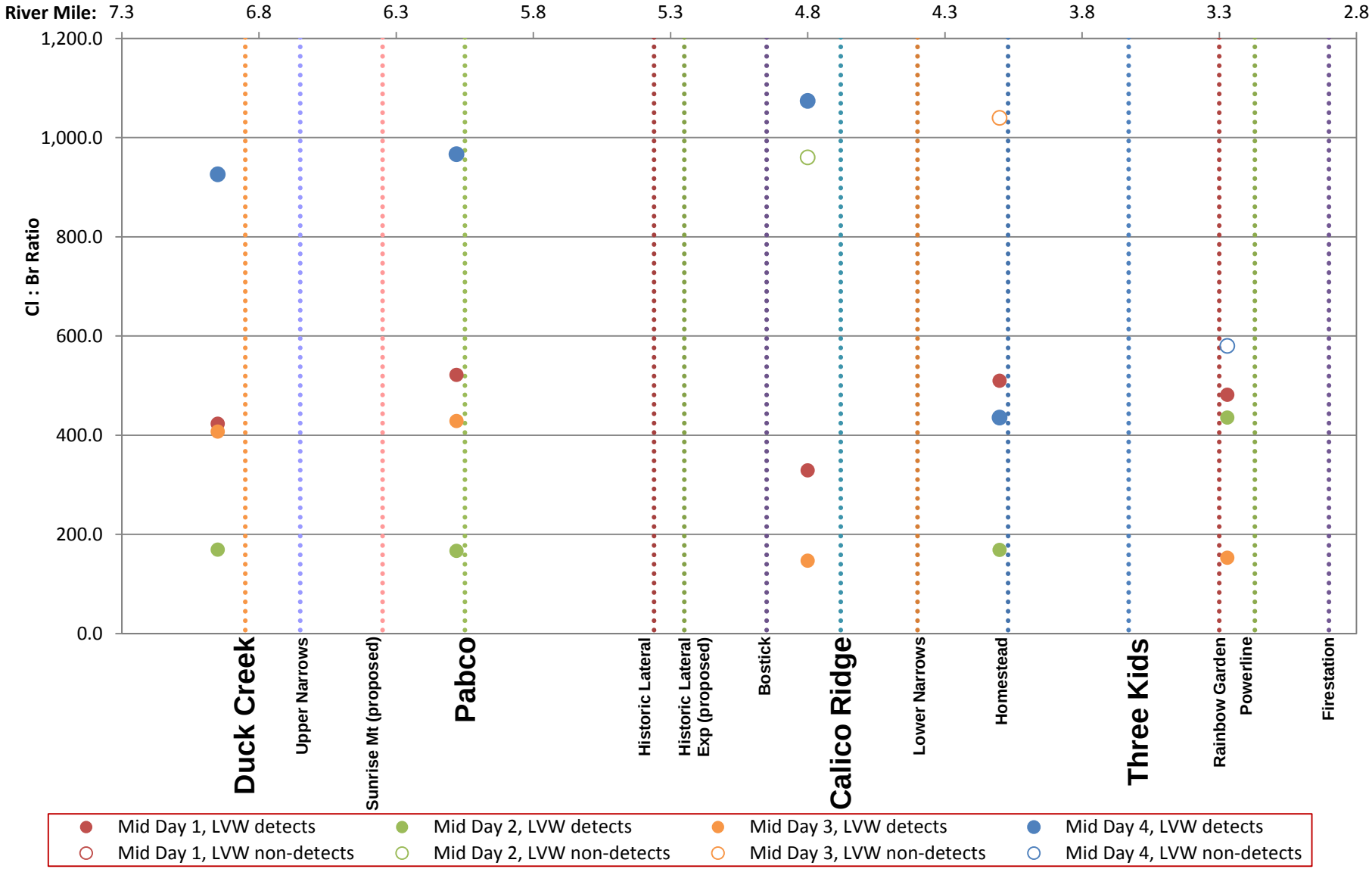
Figure 47. Chloride/Bromide Ratio in Surface Water Samples by River Mile: Discrete Sampling High Flow
February 6 - 9, 2017



Notes: (1) Ratios with non-detects calculated using detection limit.
(2) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

Figure 48. Chloride/Bromide Ratio in Surface Water Samples by River Mile: Discrete Sampling Mid Flow
February 6 - 9, 2017



Notes: (1) Ratios with non-detects calculated using detection limit.
(2) Field duplicates not shown.

LVW = Las Vegas Wash
t/ss = tributary/sidestream including Wastewater Channel

Figure 49. Perchlorate Flux Estimates (lb/day): Transect Samples

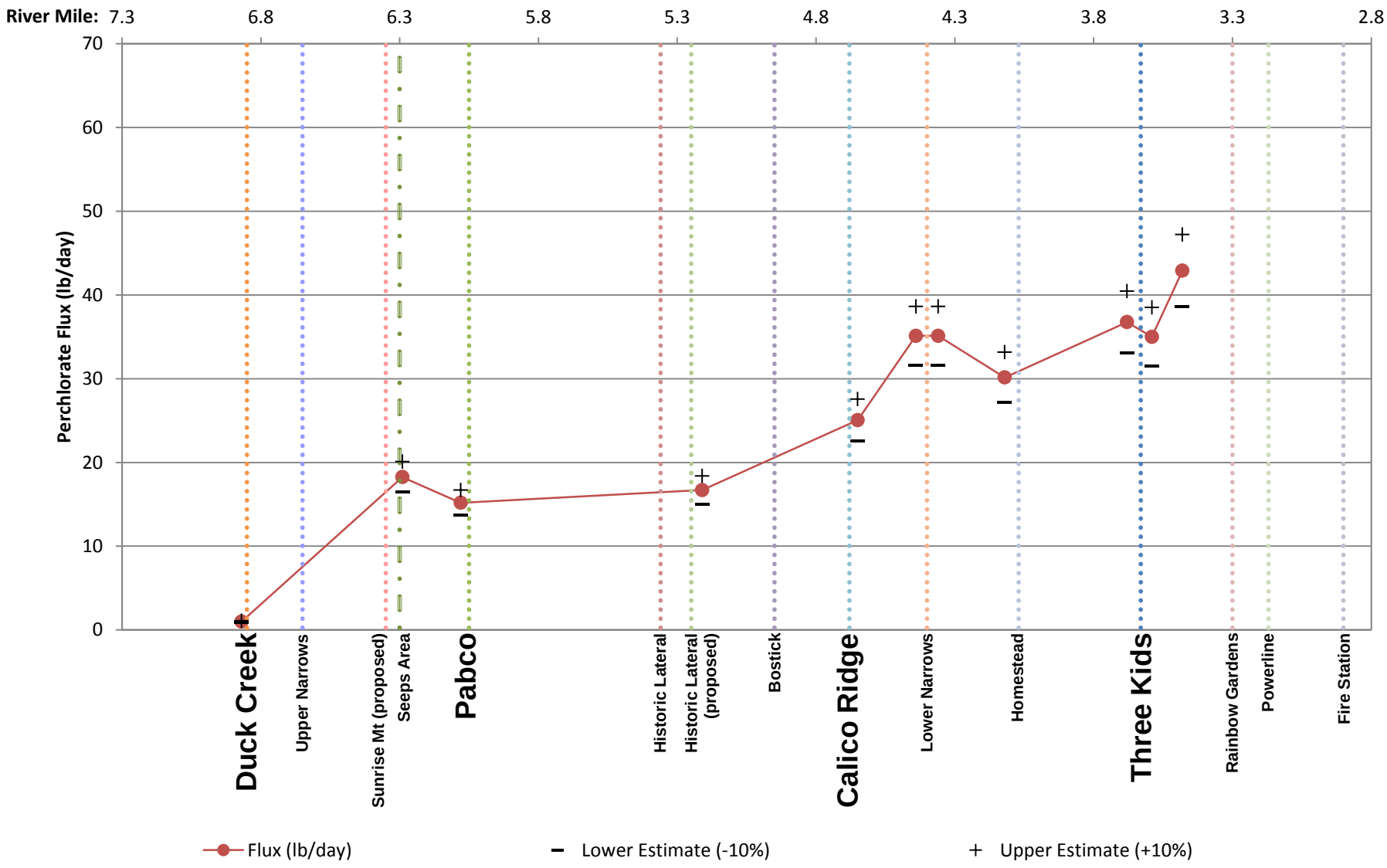


Figure 50. Perchlorate Flux Estimates (lb/day): Discrete Low Flow Samples

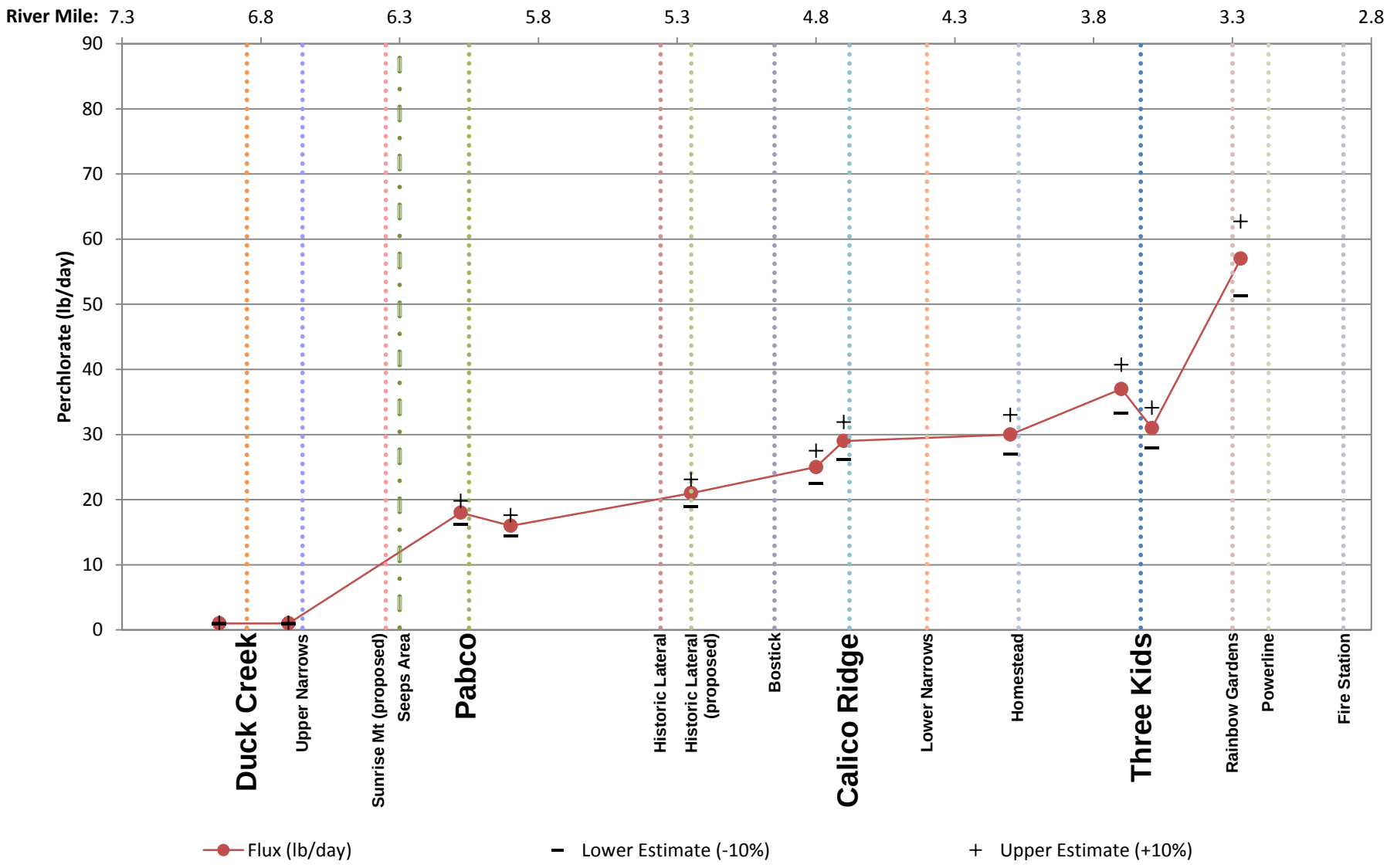


Figure 51. Perchlorate Flux Estimates (lb/day): Discrete High Flow Samples

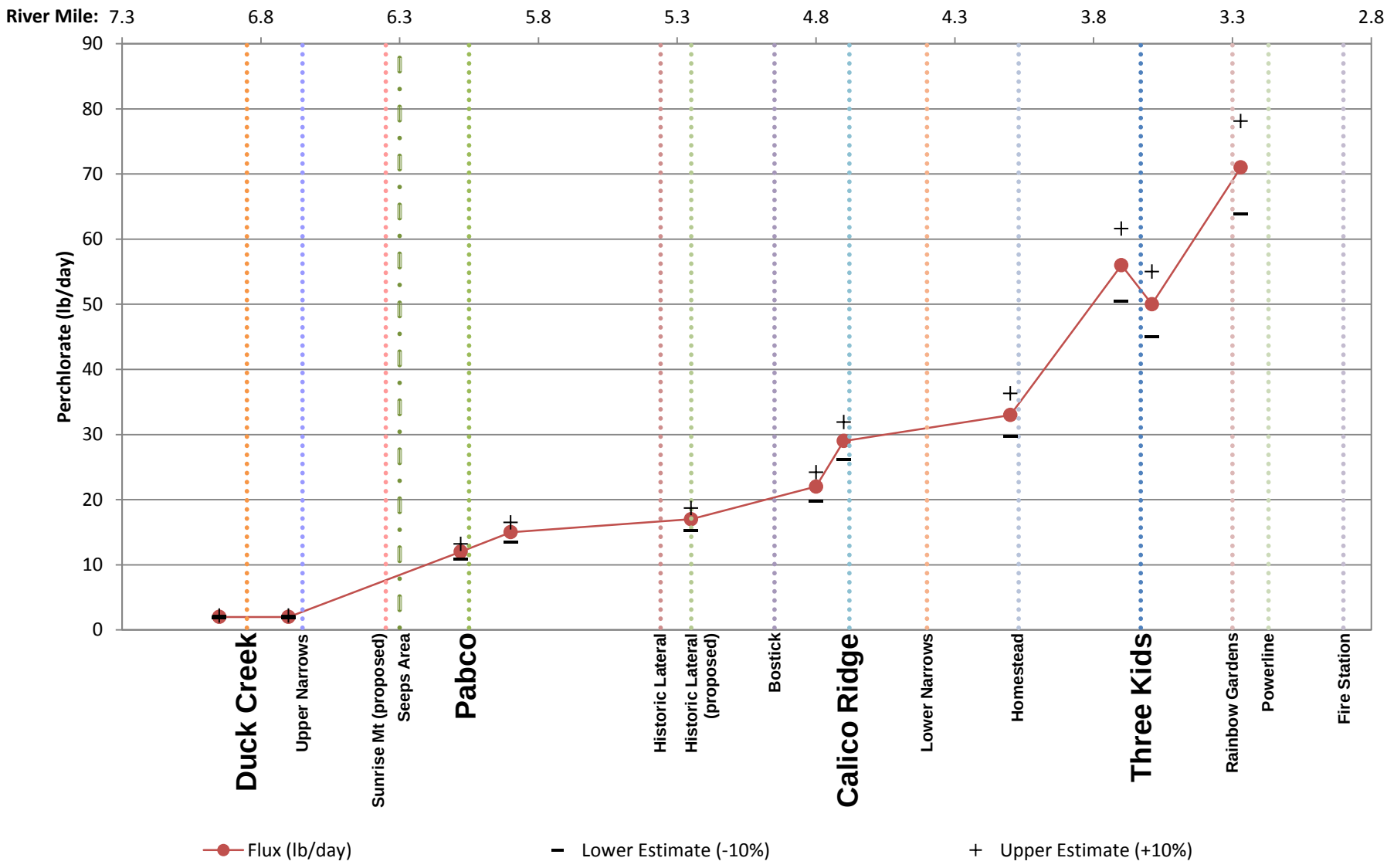
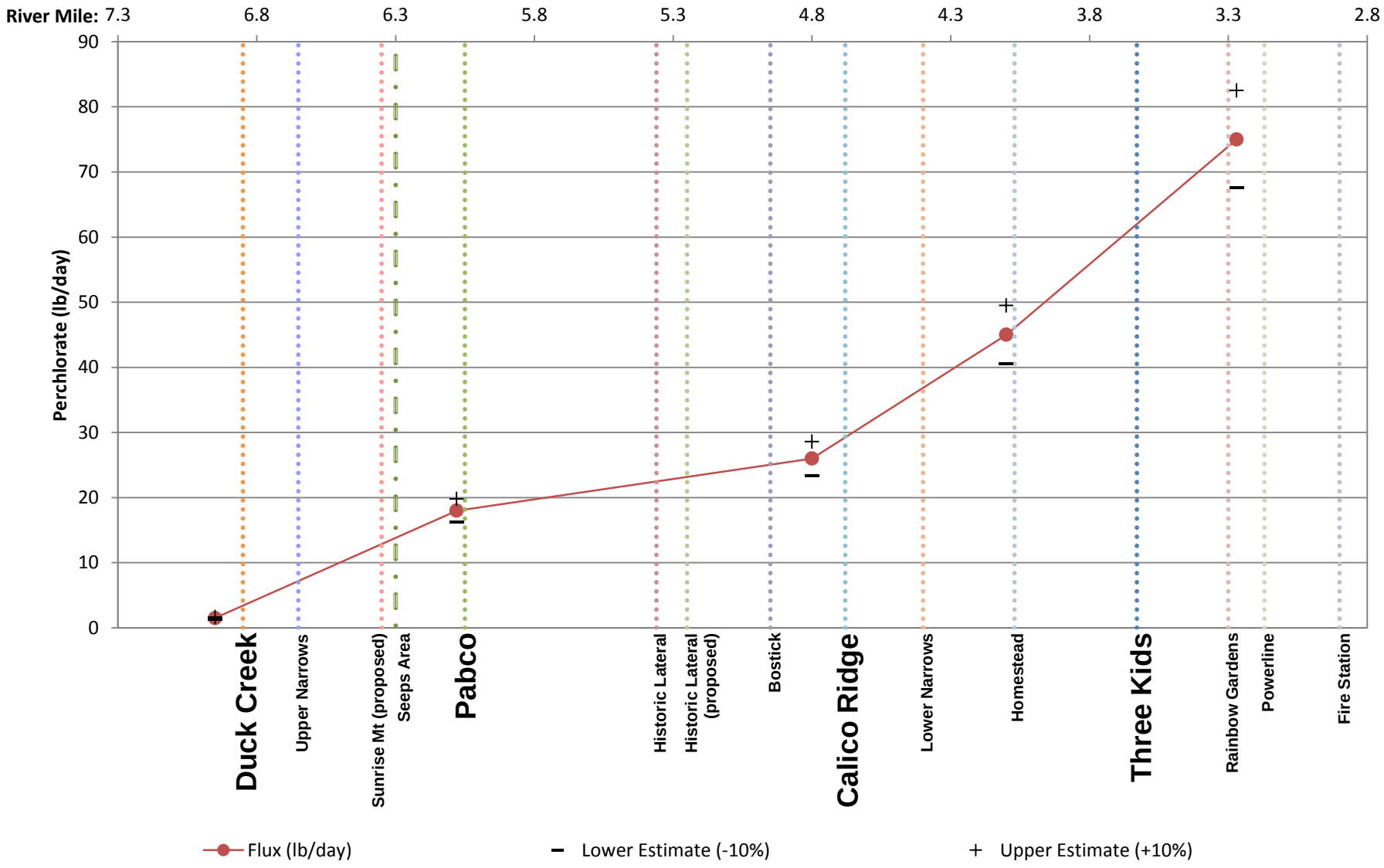
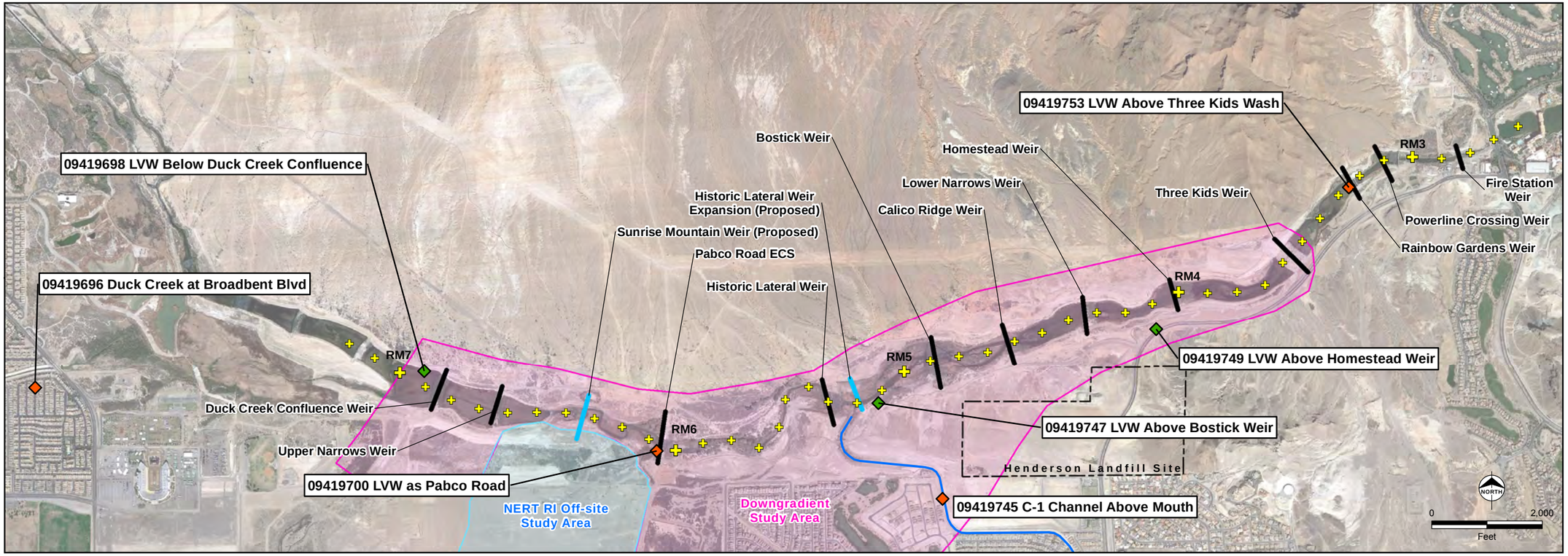
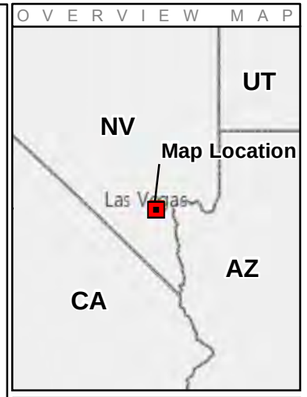


Figure 52. Perchlorate Flux Estimates (lb/day): Discrete Mid Flow Samples







Legend

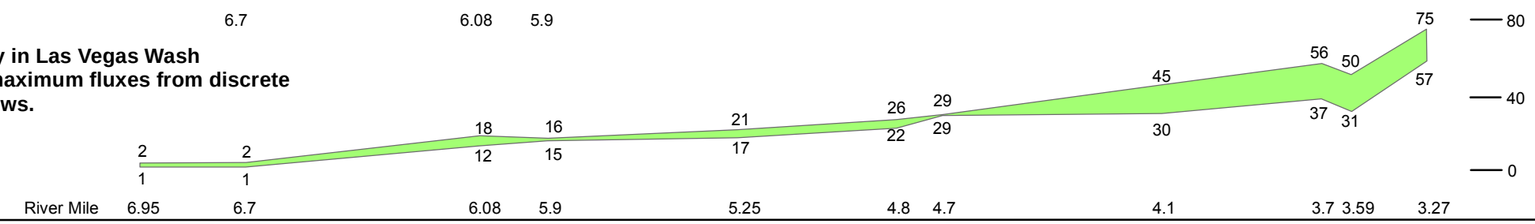
- Approximate Location of Temporary USGS Stream Gage (Installed September 2016)
- Approximate Location of Permanent USGS Stream Gage
- River Mile (RM)
- Channels
- Weir
- Weir (Proposed)
- NERT RI Downgradient Study Area
- NERT RI Off-site Study Area
- Non Point Source / Influence

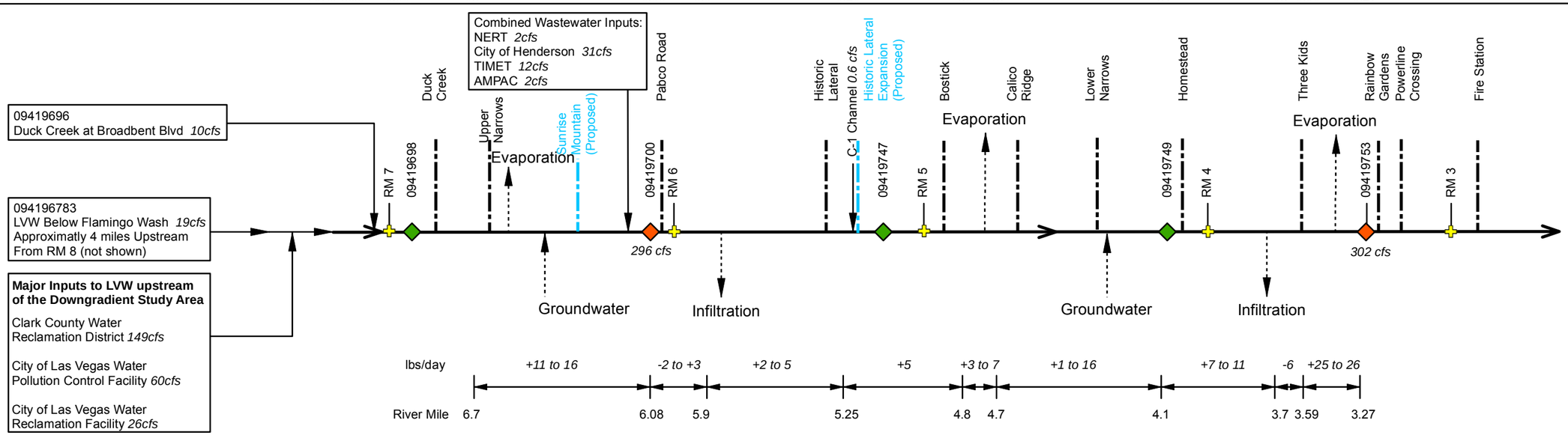
LVW = Las Vegas Wash

cfs = Cubic Feet per Second

µg/L = Micrograms per Liter

February 2017 Perchlorate Flux in lbs/day in Las Vegas Wash
Fluxes presented are the minimum and maximum fluxes from discrete sampling, including low, mid and high flows.





NERT RI
Downgradient Study Area

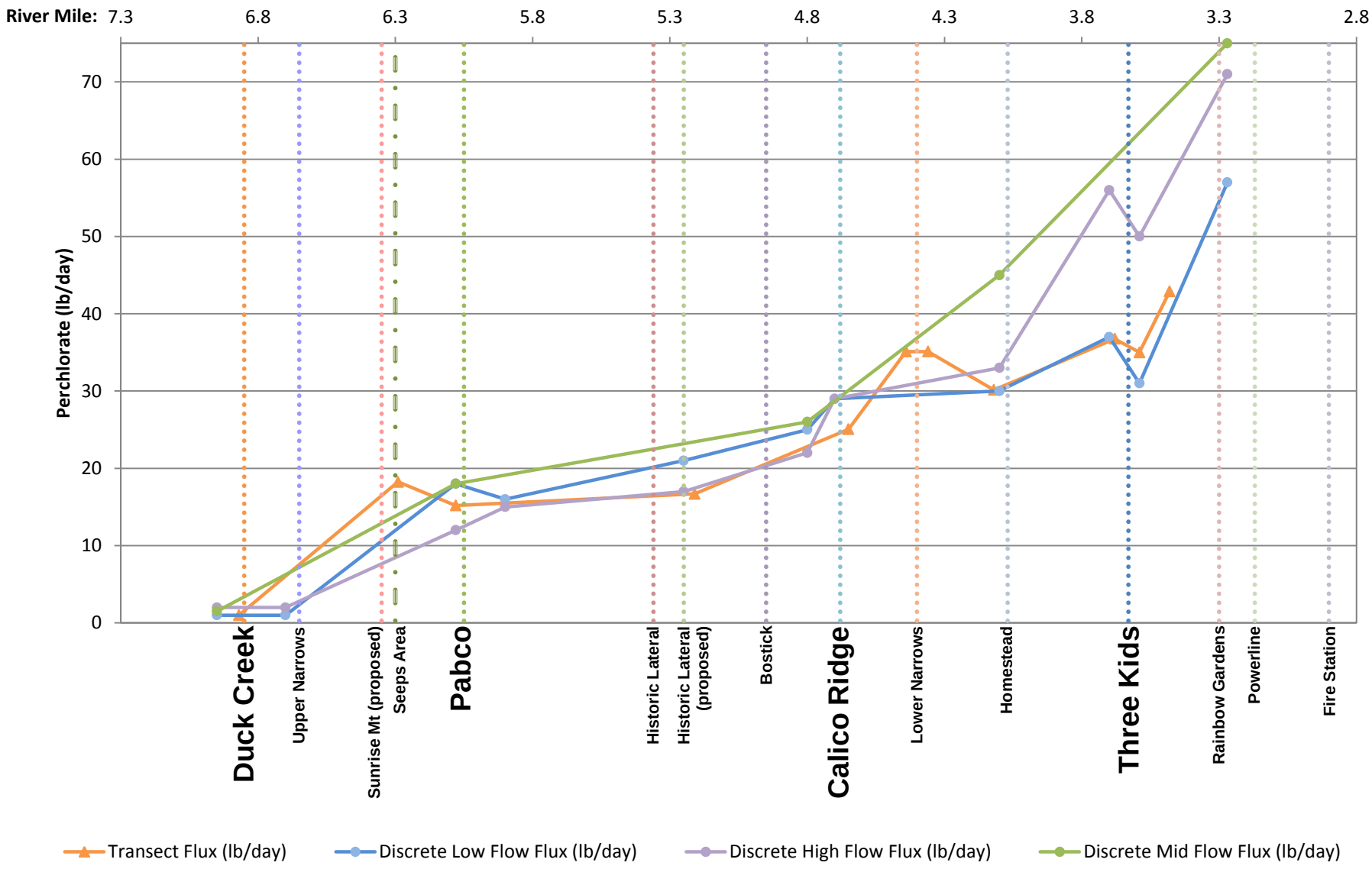
Conceptual Site Model Las Vegas Wash

Date: 6/14/2017 Project: 60477365

AECOM

Figure 53

Figure 54. Perchlorate Flux Estimates (lb/day): Transect and Discrete Samples



Tables

Table 1 Cross Reference of Historical Sample Locations, Sample IDs, Features, and River Miles
NERT Remedial Investigation, Downgradient Study Area
Henderson, Nevada

Location ID / Feature	Former River Mile	Revised River Mile
LW7.2	7.20	6.95
LW6.85	6.85	6.90
T6.8	6.80	6.87
Duck Creek Weir	6.80	6.85
LW6.7	6.70	6.70
Upper Narrows Weir	6.60	6.65
KM-71 [seep]	6.40	6.36
Sunrise Mountain Weir (Proposed)	6.36	6.35
Seep Area	6.30	6.30
T6.35	6.35	6.29
LW6.05	6.05	6.08
T6.0	6.00	6.08
GLWC6.1_4 [t/ss]	6.14	6.06
GLWC6.1_3 [t/ss]	6.13	6.06
LWC6.1_2 [t/ss]	6.12	6.06
LWC6.1_1 [t/ss]	6.11	6.06
LWC6.1 [t/ss]	6.00	6.06
Pabco Road Weir	5.95	6.05
LW5.9	5.90	5.90
LW5.7	5.70	5.70
Historic Lateral Weir	5.55	5.36
LW5.5	5.50	5.30
LW5.3	5.30	5.25
Historic Lateral Weir Expansion (Proposed)	5.31	5.25
T5.3	5.30	5.21
Bostick Weir	5.10	4.95
LW4.95	4.95	4.80
GLW4.9	4.90	4.70
Calico Ridge Weir	4.80	4.68
GLW4.85	4.85	4.65
T4.75	4.75	4.65
T4.65	4.65	4.44
Lower Narrows Weir	4.50	4.40
T4.6	4.60	4.36
LWC4.6 [t/ss]	4.60	4.33
T4.2	4.20	4.12
GLW4.4	4.40	4.10
Homestead Weir	4.00	4.07
LWC4.1 [t/ss]	4.15	3.98
LW4.1	4.10	3.95
LW3.85	3.85	3.70
T3.8	3.80	3.68
Three Kids Weir	3.80	3.63
GLW3.78	3.78	3.62
LW3.75	3.75	3.60
T3.75	3.75	3.59
LWC3.7 [t/ss]	3.70	3.58
KM-67 [seep]	3.72	3.57
T3.5	3.50	3.48
Rainbow Gardens Weir	3.45	3.30
LW3.4	3.40	3.27
Powerline Crossing Weir	3.30	3.17
LW3.1	3.10	2.95
Fire Station Weir	3.05	2.90

Notes:
"Former River Mile" refers to location used in development of figures and tables through the SWIP.
"Revised River Mile" reflects a more accurate representation of location along the LVW.
t/ss - tributary/side stream; added for clarity and not part of actual Location ID
ID: identification

Table 2 Field Collected Water Quality Data: Sampling Event during USGS Seepage Study
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Date and Time of Measurement	Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
								mg/L	% saturation
LW7.2	12/8/2016 15:40	2.00	NR	21.78	1740	8.23	Error [1]	9.56	109.5
LW6.7	12/8/2016 15:00	1.00	NR	20.43	2163	8.31	NR	10.67	119.3
LW6.05	12/8/2016 13:45	1.00	NR	20.21	2041	8.48	Error [1]	11.10	123.3
GLWC6.1_3 [t/ss]	12/8/2016 12:15	1.50	0.80	23.40	1602	7.63	NR	8.44	99.7
GLWC6.1_4 [t/ss]	12/8/2016 13:25	1.00	NR	23.25	2343	7.34	NR	7.40	87.2
LWC6.1_1 [t/ss]	12/8/2016 11:45	NR	NR	22.62	1779	7.84	Error [1]	8.51	99.4
LWC6.1_2 [t/ss]	12/8/2016 12:05	1.00	NR	25.29	1012	8.46	Error [1]	8.33	101.7
LW5.9	12/8/2016 10:00	1.00	NR	18.36	2115	8.24	Error [1]	10.31	110.2
LW5.3	12/8/2016 9:25	3.50	1.75 [3]	17.79	2131	8.16	Error [1]	9.96	105.6
LW4.95	12/8/2016 13:58	1.40	0.70	18.90	2193	8.36	3.8	9.24	100.2
GLW4.9	12/8/2016 14:18	2.20	1.10	18.69	2204	8.31	4.9	8.87	95.8
GLW4.85	12/8/2016 14:45	1.60	0.80	18.92	2404	8.07	3.1	7.36	80.0
GLW4.4	12/8/2016 12:06	2.20	1.10	17.48	2186	8.20	4.0	9.83	103.5
LW4.1	12/8/2016 11:28	0.40	0.20	17.09	2175	8.15	5.6	9.56	98.9
LW3.85	12/8/2016 10:36	0.60	0.30	17.15	2128	8.46	4.2	12.19	127.4
GLW3.78	12/8/2016 10:05	0.25	0.10	16.04	NR [2]	8.22	5.1	10.05	101.7
LW3.75	12/8/2016 9:07	0.50	0.30	16.19	2112	8.29	6.2	10.57	108.0
LWC3.7 [t/ss]	12/8/2016 9:24	1.20	0.60	23.12	4342	7.18	NR	0.65	7.8
LW3.4	12/8/2016 8:17	1.00	0.50	15.87	2151	8.14	8.9	9.63	89.0

Notes:

1) Field notes indicate turbidity sensor was not working properly; reading "Error".

2) Sample location was too shallow to submerge the specific conductivity sensor in the water.

3) Due to total depth, two samples were collected for laboratory analysis (from 1.5 feet and 2.5 feet) at LW5.3; however, only one set of water quality parameters were recorded (measured from 1.75 feet).

NR - Not Recorded
Spec. Cond. - Specific Conductivity
LW - Prefix indicates historical locations that were sampled in May 2016
GLW - Prefix indicates new grab locations
ft - feet
ID - identification
t/ss - tributary/side stream; added for clarity and not part of actual Location ID

˚C - degrees Celsius
µS/cm - micro-Siemens per centimeter
NTU - Nephelometric Turbitiy Unit
mg/L - milligrams per Liter
% - Percent

% saturation for dissolved oxygen is based on sample temperature and daily atmospheric barometric pressure (input during calibration)

Table 3 GPS Coordinates: Sampling Event during USGS Seepage Study
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Surface Water Location Sample ID	Date and Time of Sample Collection		GPS Coordinates	
			Northing	Easting
LW7.2	12/8/2016	15:45	26735154.1764	828169.516523
LW6.7	12/8/2016	15:10	26734766.8596	829555.863160
LW6.05	12/8/2016	13:50	26734195.7184	832631.194936
GLWC6.1_3 [t/ss]	12/8/2016	12:20	26733537.9448	832556.136687
GLWC6.1_4 [t/ss]	12/8/2016	13:25	26733989.3753	832537.314546
LWC6.1_1 [t/ss]	12/8/2016	11:48	26733476.4360	832600.633974
LWC6.1_2 [t/ss]	12/8/2016	12:10	26733438.3482	832570.092368
LW5.9	12/8/2016	10:25	26734111.4991	833447.419025
LW5.3	12/8/2016	9:29	26734883.9414[1]	836445.363817[1]
LW5.3	12/8/2016	9:34	26734883.9414[1]	836445.363817[1]
LW4.95	12/8/2016	14:02	26735800.8645	838354.591954
GLW4.9	12/8/2016	14:20	26735744.7130	838936.950697
GLW4.85	12/8/2016	14:50	26735901.5496	839338.536180
GLW4.4	12/8/2016	12:10	26736802.1895	841941.137930
LW4.1	12/8/2016	11:32	26736833.1567	842708.315530
LW3.85	12/8/2016	10:40	26737186.6278	843989.553781
GLW3.78	12/8/2016	10:12	26737396.7569	844398.532622
LW3.75	12/8/2016	9:12	26737672.9440	844386.046426
LWC3.7 [t/ss]	12/8/2016	9:30	26737590.0758	844557.400742
LW3.4	12/8/2016	8:23	26738900.7254	845419.303874

Notes:

ID - Identification

t/ss - tributary/side stream; added for clarity and not part of actual Location ID

GPS - global positioning system

(1) Coordinates are the same for shallow and deep samples.

Table 4 Samples Collected: Sampling Event during USGS Seepage Study
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID	Date	Time	QC Type
LW7.2-20161208-1.0	12/8/2016	15:45	
LW6.7-20161208-0.5	12/8/2016	15:10	
LW6.05-20161208-0.5	12/8/2016	13:50	MS/MSD
GLWC6.1_3-20161208-0.5	12/8/2016	12:20	
GLWC6.1_4-20161208-0.5	12/8/2016	13:25	
LWC6.1_1-20161208-0.5	12/8/2016	11:48	
LWC6.1_2-20161208-0.5	12/8/2016	12:10	
LW5.9-20161208-0.5	12/8/2016	10:25	
LW5.3-20161208-1.0	12/8/2016	9:34	
LW5.3-20161208-1.0-EB	12/8/2016	14:20	EB
LW5.3-20161208-2.5	12/8/2016	9:29	
LW4.95-20161208-0.7	12/8/2016	14:02	
GLW4.9-20161208-1.1	12/8/2016	14:20	
GLW4.85-20161208-0.8	12/8/2016	14:50	
GLW4.4-20161208-1.1	12/8/2016	12:10	
LW4.1-20161208-0.2	12/8/2016	11:32	
LW3.85-20161208-0.3	12/8/2016	10:40	
LW3.85-20161208-0.3-FD	12/8/2016	10:40	FD
GLW3.78-20161208-0.1	12/8/2016	10:12	
LW3.75-20161208-0.3	12/8/2016	9:12	
LWC3.7-20161208-0.6	12/8/2016	9:30	
LWC3.7-20161208-0.6-FD	12/8/2016	9:30	FD
LW3.4-20161208-0.5	12/8/2016	8:23	
LW3.4-20161208-0.5-FB	12/8/2016	14:25	FB

Notes:
ID - Identification
FD - field duplicate
FB - field blank
EB - equipment blank
MS - matrix spike
MSD - matrix spike duplicate
QC - quality control
Sample ID comprised of "Location"-"YYYYMMDD"-"Depth"-"QC type if applicable"
YYMMDD - YearMonthDay (example 20161208 is December 8, 2016)

Table 5 Surface Water Investigation Staff Gage and Transect Locations
NERT Remedial Investigation, Downgradient Study Area
Henderson, Nevada

Transect ID	Gage ID	Location	Rationale for Location
T3.5[1]	AECOM Gage S3.5	Mid-way between Three Kids Weir and Rainbow Gardens Weir	Evaluate water quality downstream of groundwater inputs near Three Kids Weir
T3.75	AECOM Gage S3.75	Immediately downstream of Three Kids Weir	Check for potential groundwater inputs along Three Kids Weir upstream of KM67 (2,100 µg/L perchlorate)
T3.8	AECOM Gage S3.8	Immediately upstream of Three Kids Weir	Evaluate water quality entering Three Kids Weir
T4.2	USGS Gage 01419749 [Above Homestead Weir]	Upstream of Homestead Weir	Downgradient of western edge of Henderson Landfill Site near new USGS staff gage/seepage study
T4.6	AECOM Gage S4.6	Downstream of Lower Narrows Weir	Downgradient of middle portions of Henderson Landfill Site in region of observed perchlorate gain
T4.65	AECOM Gage S4.65	Upstream of Lower Narrows Weirs	Downgradient of middle portions of Henderson Landfill Site in region of observed perchlorate gain
T4.75	AECOM Gage S4.75	Downstream of Calico Ridge Weir	Downgradient of western edge of Henderson Landfill Site in region of potential perchlorate gain
T5.3	AECOM Gage S5.3	Downstream of Proposed Historic Lateral Weir Expansion	Mid-point between Pabco Road and Calico Ridge Weir
T6	USGS Gage 09419700 [Pabco Road]	Upstream of Pabco Road Weir	Downstream of Groundwater inputs from NERT Off-Site Study Area and Henderson WWTP
T6.35	AECOM Gage S6.35	Downstream of Proposed Sunrise Mountain Weir	Downgradient of NERT Off-Site Study area near mapped location of KM71 seep (3,400 µg/L perchlorate)
T6.8	USGS Gage 09419698 [Below Duck Creek Confluence]	Upstream of Duck Creek Confluence	Downgradient of NERT Off-Site Study area near mapped location of KM71 seep (3,400 µg/L perchlorate)

Notes:
1) This transect was originally T3.6 but the identification was changed to T3.5 during the field program.
ID - identification
USGS - United States Geological Survey
µg/L - micrograms per liter
WWTP - wastewater treamtne plant
NERT - Nevada Environmental Response Trust

Table 6 Transect Depth Measurements
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Measurement Number	Distance from South Bank (feet)	Depth to Bottom (feet)	Notes
Transect: T6.8		**Measurements Collected: 2/3/2017 10:04 to 10:42**	
1	0	0.00	"A" sample collection point
2	5	1.50	
3	10	1.75	
4	20	1.58	
5	30	1.58	
6	40	1.58	
7	50	1.58	
8	60	1.83	
9	70	1.92	
10	80	1.67	
11	90	1.42	"B" sample collection point
12	100	1.33	
13	110	1.42	
14	125	1.08	
15	140	1.08	
16	155	1.33	
17	170	1.33	
18	185	1.17	
19	200	1.00	
20	215	1.17	
21	230	1.08	
22	245	1.42	
23	260	1.33	
24	275	1.00	
25	290	0.83	
26	305	0.67	
27	320	0.58	"C" sample collection point
28	335	0.58	
29	350	0.50	
30	365	0.42	
31	380	0.38	
32	395	0.42	
33	410	0.42	
34	425	0.58	
35	440	0.58	
36	455	0.67	
37	470	0.83	
38	485	0.92	
39	500	0.92	
40	515	1.08	"D" sample collection point
41	530	1.25	
42	545	1.00	
43	560	0.79	
44	575	1.00	
45	590	1.17	
46	605	1.13	
47	620	1.00	
48	635	0.92	
49	640	1.00	
50	645	1.00	
51	650	1.00	
52	655	0.96	
53	660	0.83	"E" sample collection point
54	665	0.00	
Transect: T6.35		**Measurements Collected: 2/3/2017 9:19 to 9:32**	
1	0	2.22	"A" sample collection point
1.4	12	2.63	
1.5	8	2.95	
2	15	2.87	
2.5	15	3.31	
2.6	21	3.58	
3	26	4.05	"B" sample collection point
4	34	5.6	
4.5	40	3	
5	47	1.62	"C" sample collection point

Table 6 Transect Depth Measurements
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Measurement Number	Distance from South Bank (feet)	Depth to Bottom (feet)	Notes
Transect: T6		**Measurements Collected: 2/2/2017 11:08 to 11:25**	
1	0	0.94	"A" sample collection point
2	12	2.14	
3	25	2.36	
4	37	1.77	"B" sample collection point
5	50	1.46	
6	61	0.77	
7	66	0	Island
8	89	0	Island
9	102	0.46	
10	112	1.15	
11	124	1.79	"C" sample collection point
12	137	2.45	
13	147	1.64	
14	159	2.23	
15	172	0.37	"D" sample collection point
Transect: T5.3		**Measurements Collected: 2/2/2017 9:00 to 10:15**	
1	0	0.95	North Bank
2	6	4.34	"A" sample collection point
3	14	5.67	
4	30	4.1	
5	36	3	
6	42	2.77	"B" sample collection point
7	54	1.94	
8	62	1.67	
9	72	1.85	
10	85	1.74	"C" South Bank
Transect: T4.75		**Measurements Collected: 2/1/2017 10:42 to 11:35**	
1	0	0.00	
2	10	1.50	
3	20	2.08	
4	30	1.58	
5	40	0.67	
6	50	2.25	
7	60	4.25	
8	70	5.42	
9	80	5.75	
10	90	5.67	
11	100	3.75	
12	105	0.00	island start
13	117	0.00	island end
14	127	0.25	
15	137	3.25	
16	147	2.50	
17	157	2.33	
18	167	2.67	
19	177	>6.5	
20	187	>6.5	
21	197	5.92	
22	207	3.92	
23	217	3.08	
24	227	2.58	
25	237	2.67	
26	247	1.25	
27	257	1.92	
28	267	2.17	
29	277	1.92	
30	287	1.83	
31	288	0.00	

Table 6 Transect Depth Measurements
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Measurement Number	Distance from South Bank (feet)	Depth to Bottom (feet)	Notes
Transect: T4.65		**Measurements Collected: 1/31/2017 11:33 to 12:04**	
1	0	0.00	
2	10	2.00	
3	20	2.00	
4	30	2.13	
5	40	2.08	
6	50	2.25	
7	60	2.00	
8	70	2.17	
9	80	1.92	
10	90	2.08	
11	100	1.83	
12	110	1.92	
13	120	1.92	
14	130	1.92	
15	140	1.83	
16	150	1.83	"B" sample collection point
17	160	2.00	
18	170	1.83	
19	180	1.92	
20	190	2.00	
21	200	1.83	
22	210	1.83	
23	220	1.75	
24	230	1.50	"C" sample collection point
25	240	1.42	
26	250	1.25	
27	260	1.17	
28	270	1.08	
29	280	1.42	
30	290	1.50	
31	300	1.67	
32	310	1.83	
33	320	1.83	
34	330	1.92	
35	340	1.83	
36	350	2.00	
37	360	1.92	
38	370	1.75	
39	380	1.25	
40	390	0.92	
41	400	0.67	
42	410	0.00	Shoreline

Table 6 Transect Depth Measurements
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Measurement Number	Distance from South Bank (feet)	Depth to Bottom (feet)	Notes
Transect: T4.6		**Measurements Collected: 1/31/2017 11:50 to 13:00**	
0	377	1.13	"D" sample collection point
1	370	1.13	
2	358	1.02	
3	347	0.83	
4	336	0.87	
5	327	0.6	
6	315	0.81	
7	307	1.12	
8	300	1.4	
9	290	1.77	
10	279	1.43	
11	271	1.49	
12	262	1.91	
13	252	2.18	
14	243	1.92	
15	231	1.22	"C" sample collection point
16	224	1.7	
17	214	1.72	
18	201	1.35	
19	193	0.62	
20	182	0.74	
21	172	0.78	
22	157	1.17	
23	146	1.26	"B" sample collection point
24	136	0.95	
25	127	0.59	
26	116	0.46	
27	104	0.95	
28	97	2.04	
29	85	2.2	
30	74	1.25	
31	64	0.58	
32	54	1.43	
33	42	0.87	
34	34	1.01	
35	19	0.73	
36	0	1.06	"A" sample collection point
Transect: T4.2		**Measurements Collected: 2/1/2017 10:00 to 11:00**	
1	0	0.79	"A" sample collection point
2	9	1.59	
3	21	2.1	
4	33	2	
5	42	2.43	
6	59	2.55	
7	68	2.19	
8	84	2.06	
9	96	2.14	"B" sample collection point
10	105	1.54	
11	114	2.04	
12	124	1.54	
13	135	1.93	
14	146	2.2	
15	157	1.81	
16	168	1.73	
17	178	1.42	
18	187	1.09	"C" sample collection point
19	197	0.76	
20	207	0.71	
21	218	0.74	
22	229	0.7	
23	240	0.98	
24	251	1.34	
25	260	1.74	
26	270	1.68	"D" sample collection point

Table 6 Transect Depth Measurements
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Measurement Number	Distance from South Bank (feet)	Depth to Bottom (feet)	Notes
Transect: T3.8		**Measurements Collected: 1/30/2017 12:15 to 13:00**	
1	0	0.62	"A" sample collection point
2	10	1.38	
3	24	0.96	
4	36	0.85	
5	48	0.83	
6	59	0.9	
7	69	0.98	
8	79	0.8	
9	93	1.05	"B" sample collection point
10	102	0.92	
11	112	1.15	
12	124	1.33	
13	135	0.5	
14	144	0.89	
15	156	1.1	
16	168	0.78	
17	176	0.69	
18	189	0.58	
19	199	0.68	
20	209	0.87	
21	220	0.63	
22	231	0.51	
22.5	234	0.5	"C" sample collection point
23	243	0.82	
24	255	0.97	
25	265	0.87	
26	275	0.8	
27	287	0.89	
28	296	0.95	
29	306	0.88	
30	316	0.79	
31	328	0.8	
32	338	0.86	
33	349	0.66	"D" sample collection point
34	359	0.61	
35	370	0.6	

Table 6 Transect Depth Measurements
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Measurement Number	Distance from South Bank (feet)	Depth to Bottom (feet)	Notes
Transect: T3.75		**Measurements Collected: 1/30/2017 12:34 to 13:34**	
0	2	0	South Bank
1	6	1	"A" sample collection point
2	10	0.25	
3	15	0.1	
4	20	0.2	
5	25	0	Rock
6	30	0.1	
7	35	0.4	
8	40	0.4	
9	45	0.7	
10	50	0.625	
11	55	0.92	
12	60	0.92	
13	65	0.92	
14	70	0.75	
15	75	0.96	
16	80	1.04	
17	85	0.88	
18	90	0.83	
19	95	0.83	
20	100	0.63	
21	105	0.88	
22	108	4.48	"B" sample collection point
23	110	0.79	
24	115	0.42	
25	120	0.71	
26	125	0.88	
27	130	0.67	
28	135	0.50	
29	137	1.08	
30	140	1.33	
31	145	1.25	
32	150	1.58	
33	155	0.83	
34	160	1.04	
35	165	1.08	
36	170	1.33	
37	175	0.58	
38	180	1.00	
39	185	1.17	
40	190	1.08	
41	192	2.33	
42	194	0.50	
43	198	1.83	
44	200	1.83	
45	205	1.50	
46	210	1.67	
47	215	1.42	
48	220	1.08	
49	225	0.58	
50	230	0.42	
51	235	0.25	
52	240	0.33	
53	245	0.67	
54	250	0.58	
55	255	0.00	Island start
56	257.5	0.00	Island end
57	260	0.75	
58	270	0.67	
59	280	0.96	
60	290	0.67	
61	300	1.13	
62	310	1.08	"C" sample collection point
63	320	1.00	
64	330	1.08	
65	340	1.42	
66	350	0.58	
67	360	0.83	
68	370	1.25	
69	380	1.67	
70	390	0.92	
71	400	0.92	
72	410	1.00	
73	420	0.83	
74	430	0.58	
75	435	0.00	"D" sample collection point

Table 6 Transect Depth Measurements
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Measurement Number	Distance from South Bank (feet)	Depth to Bottom (feet)	Notes
Transect: T3.5		**Measurements Collected: 2/2/2017 12:58 to 13:41**	
1	0	0.00	"A" sample collection point
2	1.5	0.25	
3	2	0.00	
4	2.5	0.00	
5	3	0.17	
6	8	0.33	
7	13	0.58	"B" sample collection point
8	15	0.75	
9	16	0.50	
10	17	0.00	start island
11	24	0.00	end island
12	26	0.50	
13	30	1.08	
14	35	0.75	"C" sample collection point
15	40	0.33	
16	45	0.42	
17	50	0.25	
18	53	0.00	island start
19	63	0.00	island end
20	68	0.33	
21	70	0.92	
22	80	1.08	
23	85	1.50	
24	90	2.42	"D" sample collection point
25	100	3.25	
26	110	4.58	
27	120	3.17	
28	130	1.42	
29	140	1.58	"E" sample collection point
30	150	4.42	
31	160	6.33	
32	170	>6.5	
33	180	>6.6	
34	190	4.75	"F" sample collection point
35	198	0.00	

Notes:
Sample collection points are noted as "A" for near the southern bank and progress B, C, etc. moving north.

Table 7 Field Collected Water Quality Data: Transect Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
									mg/L	% saturation
T6.8_A	2/3/2017	9:09	1.10	1.00	17.40	2614	7.64	8.8	7.32	77.1
T6.8_B	2/3/2017	9:19	1.40	1.30	18.52	3048	7.83	2.7	9.36	100.7
T6.8_C	2/3/2017	9:27	0.50	0.40	17.80	3539	7.93	0.1	10.16	107.7
T6.8_D	2/3/2017	9:38	1.00	0.90	20.09	2366	8.03	1.1	9.63	106.7
T6.8_E	2/3/2017	9:47	0.80	0.70	18.21	2304	7.86	4.4	7.36	78.9
T6.35_A	2/3/2017	9:32	2.20	1.50	17.95	2385	7.85	2.3	8.74	92.8
T6.35_B[5]	2/3/2017	9:44	4.05	3.00	18.05	2407	7.93	2.4	9.07	96.7
T6.35_B[5]	2/3/2017	9:55	4.05	1.00	18.05	2410	7.93	3.0	9.04	96.2
T6.35_C	2/3/2017	9:19	1.62	1.00	17.92	2380	7.50	9.7	9.67	102.6
T6_A	2/2/2017	8:57	1.00	0.90	17.80	2723	7.83	2.9	8.55	90.8
T6_B	2/2/2017	9:03	1.80	1.70	17.87	2719	7.83	2.9	8.79	93.3
T6_C	2/2/2017	9:09	1.80	1.70	17.90	2721	7.82	3.4	8.75	93.0
T6_D	2/2/2017	9:14	0.50	0.40	17.27	2685	7.80	14.1	8.90	93.2
T5.3_A[5]	2/2/2017	9:22	4.34	1.40	17.85	2357	7.51	4.4	8.95	95.9
T5.3_A[5]	2/2/2017	9:32	4.34	2.80	17.86	2356	7.61	4.3	8.93	94.7
T5.3_B	2/2/2017	10:13	2.77	2.00	18.10	2367	7.91	6.4	9.34	99.5
T5.3_C	2/2/2017	9:59	1.74	1.20	18.10	2340	7.86	8.4	9.34	99.4
T4.75_A	2/1/2017	10:00	1.40	1.30	19.56	3416	7.60	40.9 [1]	6.80	69.2
T4.75_B	2/1/2017	10:10	1.00	0.90	18.08	2660	8.01	3.5	9.69	103.3
T4.75_C	2/1/2017	10:21	2.30	2.20	18.08	2672	8.04	3.7	9.79	104.5
T4.75_D	2/1/2017	10:30	1.65	1.50	19.63	3031	7.49	12.8	6.26	69.4
T4.65_A	1/31/2017	10:38	0.80	0.70	17.53	2558	7.68	7.4	9.61	96.7
T4.65_B	1/31/2017	10:50	2.00	1.90	18.21	2581	7.98	4.2	10.00	106.9
T4.65_C	1/31/2017	10:55	1.40	1.30	18.16	2560	8.01	4.6	10.15	108.5
T4.65_D	1/31/2017	11:06	0.70	0.60	17.25	2525	7.92	8.5	9.70	101.9
T4.6_A	1/31/2017	10:40	NR	0.30	16.92	2348	7.66	135.5	8.77	91.4
T4.6_B	1/31/2017	10:47	0.95	0.60	17.50	2358	7.83	5.1	9.35	98.9
T4.6_C	1/31/2017	10:56	1.27	0.80	17.50	2329	7.93	8.3	9.48	99.9
T4.6_D	1/31/2017	11:13	1.13	0.80	17.49	2337	7.96	6.8	9.29	97.5
T4.2_A	2/1/2017	9:55	0.79	0.40	16.50	2308	8.24	126.3	8.94	138.5
T4.2_B	2/1/2017	10:19	NR	1.00	17.38	2316	8.08	7.5	9.98	104.9
T4.2_C	2/1/2017	10:35	NR	0.80	17.46	2311	8.00	52.0	10.50	105.8

Table 7 Field Collected Water Quality Data: Transect Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
									mg/L	% saturation
T4.2_D	2/1/2017	10:47	NR	1.00	17.53	2307	7.98	10.8	9.98	105.2
T3.8_A	1/30/2016	11:30	0.50	0.40	17.84	2061	8.01	4.1	10.66	113.0
T3.8_B	1/30/2016	11:37	0.50	0.40	18.44	2060	8.19	4.4	11.50	123.1
T3.8_C	1/30/2016	11:46	0.50	0.40	18.44	2054	8.15	6.0	10.99	117.9
T3.8_D	1/30/2016	11:55	0.50	0.40	18.58	2031	8.13	9.5	10.90	117.1
T3.75_A	1/30/2016	11:40	1.00	0.90	17.07	2063	7.95	6.2	9.71	101.3
T3.75_B	1/30/2016	11:53	0.80	NR	17.62	2053	8.12	7.5	10.47	110.3
T3.75_C	1/30/2016	12:10	0.80	0.70	17.56	2196	7.98	24.0	9.52	100.3
T3.75_D	1/30/2016	12:09	0.60	0.50	17.56	2035	8.11	10.8	10.50	110.8
T3.5_A[3]	2/2/2017	11:06	0.20	0.20	16.60	7162	7.55	41 [2]	9.52	99.3
T3.5_A[3]	2/2/2017	12:44	0.20	0.20	NR	6752-5478 [4]	7.68	11.5	14.28	156.3
T3.5_B	2/2/2017	11:13	0.60	0.50	19.03	2794	8.08	3.3	9.80	106.6
T3.5_C	2/2/2017	11:22	0.70	0.60	19.09	2787	8.05	4.0	9.78	106.6
T3.5_D	2/2/2017	12:00	1.50	1.40	19.30	2727	8.21	4.7	10.40	113.6
T3.5_E	2/2/2017	12:03	1.60	1.50	19.30	2685	8.26	5.9	10.45	114.2
T3.5_F[5]	2/2/2017	12:13	4.80	4.00	19.22	2673	8.24	6.2	10.25	111.8
T3.5_F[5]	2/2/2017	12:34	4.80	1.50	19.40	2681	8.30	6.3	10.36	113.6

Notes:

1) Field notes indicate high turbidity due to stirred silt by canoe and fish.

2) High turbidity reading due to disturbed silty streambed.

3) Due to disturbed streambed during initial water quality readings, sample location T3.5 was revisited and water quality readings were collected a second time.

4) A range of readings were provided because the specific conductivity reading did not stabilize within 10 minutes.

5) Due to total depths greater than or equal to 3.0 feet, two samples were collected at sample locations T5.3_A, T6.35B and T3.5_F.

NR - Not Recorded
Spec. Cond. - Specific Conductivity
Transect sample location A is located near the southern Bank and continue B, C, D,.. to the northern bank.
ft - feet
ID - identification

˚C - degrees Celsius
µS/cm - micro-Siemens per centimeter
NTU - Nephelometric Turbitiy Unit
mg/L - milligrams per Liter
% - Percent

% saturation for dissolved oxygen is based on sample temperature and daily atmospheric barometric pressure (input during calibration)

Table 8 GPS Coordinates: Barometers, Staff Gages and Transect Samples
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Idntification	Date and Time of Sample Collection		GPS Coordinates	
			Northing	Easting
Barometers				
B6 [Pabco Road]	1/26/2017	NR	26733899.2259	832227.942134
B4.65 [Lower Narrows]	1/26/2017	NR	26736165.1918	840367.414372
B3.8 [Three Kids]	1/29/2017	NR	26737037.8180	844126.017419
Staff Gages				
S6.35	1/26/2017	NR	26734748.9312	831632.177249
S5.3	1/27/2017	NR	26734845.4172	836460.371661
S4.75	1/27/2017	NR	26735892.7891	839339.429879
S4.65	1/26/2017	NR	26736254.1460	840312.179246
S4.6	1/29/2017	NR	26736334.7978	840729.157415
S3.8	1/24/2017	NR	26737131.2306	844152.302143
S3.75	1/25/2017	NR	26737628.2817	844432.358013
S3.5	1/29/2017	NR	26738151.8899	844861.616669
Transect Samples				
6.8_A	02/03/17	9:13	26734811.1046	828367.800248
6.8_B	02/02/17	9:25	26734889.3525	828394.004592
6.8_C	02/02/17	9:32	26735139.9297	828459.376836
6.8_D	02/02/17	9:41	26735346.2889	828495.414166
6.8_E	02/02/17	9:50	26735470.0613	828552.953421
6.35_A	02/03/17	09:32	26734706.9779	831617.787186
6.35_B	02/03/17	9:55	26734731.2961[1]	831625.536514[1]
6.35_B	02/03/17	9:44	26734731.2961[1]	831625.536514[1]
6.35_C	02/03/17	9:19	26734752.2048	831632.855725
6_A	02/03/17	9:00	26734155.8543	832621.087345
6_B	02/03/17	9:05	26734184.6239	832636.455096
6_C	02/03/17	9:13	26734261.1051	832679.418921
6_D	02/03/17	9:18	26734287.1516	832699.987449
5.3_A	02/02/17	9:32	26734848.4841[1]	836445.655811[1]
5.3_A	02/02/17	9:37	26734848.4841[1]	836445.655811[1]
5.3_B	02/02/17	10:13	26734884.4362	836430.697508
5.3_C	02/02/17	9:59	26734922.5578	836416.284807
4.75_A	02/01/17	10:04	26735899.6749	839337.203834
4.75_B	02/01/17	10:13	26735984.4090	839320.559182
4.75_C	02/01/17	10:23	26736047.9857	839307.906320
4.75_D	02/01/17	10:35	26736154.7591	839291.202613
4.65_A	01/31/17	10:40	26736249.0850	840315.123794
4.65_B	01/31/17	10:50	26736391.3000	840285.154694
4.65_C	01/31/17	10:58	26736476.2673	840250.798135
4.65_D	01/31/17	11:06	26736637.3405	840195.513141
4.6_A	01/31/17	10:40	26736327.6751	840715.072469
4.6_B	01/31/17	10:47	26736483.5626	840694.370411
4.6_C	01/31/17	10:56	26736568.0991	840677.425891
4.6_D	01/31/17	11:13	26736700.1930	840664.234644
4.2_A	02/01/17	09:55	26736677.4641	842013.435030
4.2_B	02/01/17	10:19	26736772.8156	842001.178165
4.2_C	02/01/17	10:35	26736844.5868	841951.608710
4.2_D	02/01/17	10:47	26736915.5325	841884.369671
3.8_A	01/30/17	11:30	26737122.1541	844150.764417
3.8_B	01/30/17	11:37	26737182.7390	844080.294085
3.8_C	01/30/17	11:46	26737281.9566	843981.791985
3.8_D	01/30/17	11:55	26737353.5211	843892.955221
3.75_A	01/30/17	11:48	26737555.3518	844527.832232

Table 8 GPS Coordinates: Barometers, Staff Gages and Transect Samples
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Idntification	Date and Time of Sample Collection		GPS Coordinates	
			Northing	Easting
3.75_B	01/30/17	11:53	26737620.3129	844450.440983
3.75_C	01/30/17	12:00	26737756.1968	844287.791045
3.75_D	01/30/17	12:09	26737837.9326	844177.711541
3.5_A	02/02/17	11:08	26738121.7460	844839.008447
3.5_B	02/02/17	11:13	26738127.5849	844831.662333
3.5_C	02/02/17	11:22	26738148.1540	844817.137428
3.5_D	02/02/17	12:00	26738187.2888	844776.408178
3.5_E	02/02/17	12:07	26738224.3245	844747.628380
3.5_F	02/02/17	12:34	26738242.0948[1]	844698.140400[1]
3.5_F	02/02/17	12:25	26738242.0948[1]	844698.140400[1]

Notes:
NR - Not Recorded
GPS - global positioning system
(1) Coordinates are the same for shallow and deep samples.

Table 9 Samples Collected: Transect Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID	Location on Transect	Depth	QC Type	Date Sampled	Time Sampled
Transect 6.8					
T6.8A-20170203-1.0	Near south bank	Near bottom		2/3/2017	9:13
T6.8B-20170203-1.3	Second from south bank	Near bottom		2/3/2017	9:25
T6.8C-20170203-0.4	Third from south bank	Near bottom		2/3/2017	9:32
T6.8D-20170203-0.9	Fourth from south bank	Near bottom		2/3/2017	9:41
T6.8E-20170203-0.7	Fifth from south bank	Near bottom		2/3/2017	9:50
Transect 6.35					
T6.35A-20170203-1.5	Near south bank	Near bottom		2/3/2017	9:32
T6.35B-20170203-1.0	Second from south bank	Near bottom		2/3/2017	9:55
T6.35C-20170203-3.0	Third from south bank	Near bottom		2/3/2017	9:44
T6.35B-20170203-1.0	Second from south bank	1/3 depth		2/3/2017	9:19
Transect 6					
T6A-20170202-0.9	Near south bank	Near bottom		2/2/2017	9:00
T6A-20170202-FB	Near south bank	Near bottom	FB	2/2/2017	15:35
T6B-20170202-1.7	Second from south bank	Near bottom		2/2/2017	9:05
T6C-20170202-1.7	Third from south bank	Near bottom		2/2/2017	9:13
T6D-20170202-0.4	Fourth from south bank	Near bottom		2/2/2017	9:18
Transect 5.3					
T5.3A-20170202-2.8	Near south bank	Near bottom		2/2/2017	9:37
T5.3B-20170202-2.0	Second from south bank	Near bottom		2/2/2017	0:13
T5.3B-20170202-2.0-FD	Second from south bank	Near bottom	FD	2/2/2017	10:13
T5.3C-20170202-1.2	Third from south bank	Near bottom		2/2/2017	9:59
T5.3A-20170202-1.4	Near south bank	1/3 depth		2/2/2017	9:37
T5.3A-20170202-1.4-EB	Near south bank	1/3 depth	EB	2/2/2017	15:30
Transect 4.75					
T4.75A-20170101-1.3	Near south bank	Near bottom		2/1/2017	10:04
T4.75A-20170201-1.3-FD	Near south bank	Near bottom	FD	2/1/2017	10:04
T4.75B-20170201-0.9	Second from south bank	Near bottom		2/1/2017	10:13
T4.75C-20170201-2.2	Third from south bank	Near bottom		2/1/2017	10:23
T4.75D-20170201-1.5	Fourth from south bank	Near bottom		2/1/2017	10:35
T4.75B-20170201-EB	Second from south bank	Near bottom	EB	2/1/2017	10:00
Transect 4.65					
T4.65A-20170131-0.7	Near south bank	Near bottom		1/31/2017	10:40
T4.65A-20170131-0.7-MS	Near south bank	Near bottom	MS	1/31/2017	10:40
T4.65A-20170131-0.7-MSD	Near south bank	Near bottom	MSD	1/31/2017	10:40
T4.65B-20170131-0.9	Second from south bank	Near bottom		1/31/2017	10:50
T4.65B-20170131-0.9-FD	Second from south bank	Near bottom	FD	1/31/2017	10:50
T4.65C-20170131-1.3	Third from south bank	Near bottom		1/31/2017	10:58
T4.65D-20170131-0.6	Fourth from south bank	Near bottom		1/31/2017	11:06
Transect 4.6					
T4.6A-20170131-EB	Near south bank	Near bottom	EB	1/31/2017	10:00
T4.6A-20170131-0.3	Near south bank	Near bottom		1/31/2017	10:40
T4.6B-20170131-0.6	Second from south bank	Near bottom		1/31/2017	10:47
T4.6B-20170131-0.6-FD	Second from south bank	Near bottom	FD	1/31/2017	10:47
T4.6C-20170131-0.8	Third from south bank	Near bottom		1/31/2017	10:56
T4.6D-20170131-0.8	Fourth from south bank	Near bottom		1/31/2017	11:13
Transect 4.2					
T4.2A-20170201-0.4	Near south bank	Near bottom		2/1/2017	9:55
T4.2A-20170201-0.4-EB	Near south bank	Near bottom	EB	2/1/2017	10:00
T4.2A-20170201-0.4-MS	Near south bank	Near bottom	MS	2/1/2017	9:55
T4.2A-20170201-0.4-MSD	Near south bank	Near bottom	MSD	2/1/2017	9:55
T4.2B-20170201-1.0	Second from south bank	Near bottom		2/1/2017	10:19
T4.2B-20170201-1.0-FD	Second from south bank	Near bottom	FD	2/1/2017	10:19
T4.2C-20170201-0.8	Third from south bank	Near bottom		2/1/2017	10:35
T4.2D-20170201-1.0	Fourth from south bank	Near bottom		2/1/2017	10:47

Table 9 Samples Collected: Transect Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID	Location on Transect	Depth	QC Type	Date Sampled	Time Sampled
Transect 3.8					
T3.8A-20170130-0.4	Near south bank	Near bottom		1/30/2017	11:30
T3.8A-20170130-FB	Near south bank	Near bottom	FB	1/30/2017	11:05
T3.8B-2017130-0.4	Second from south bank	Near bottom		1/30/2017	11:37
T3.8B-2017130-0.4-MS	Second from south bank	Near bottom	MS	1/30/2017	11:37
T3.8B-2017130-0.4-MSD	Second from south bank	Near bottom	MSD	1/30/2017	11:37
T3.8C-20170130-0.4	Third from south bank	Near bottom		1/30/2017	11:46
T3.8C-20170130-0.4-FD	Third from south bank	Near bottom	FD	1/30/2017	11:46
T3.8D-20170130-0.4	Fourth from south bank	Near bottom		1/30/2017	11:55
Transect 3.75					
T3.75A-20170130-0.9	Near south bank	Near bottom		1/30/2017	11:48
T3.75A-20170130-EB	Near south bank	Near bottom	EB	1/30/2017	11:05
T3.75B-20170130-0.7	Second from south bank	Near bottom		1/30/2017	11:53
T3.75C-20170130-0.6	Third from south bank	Near bottom		1/30/2017	12:00
T3.75D-20170130-0.4	Fourth from south bank	Near bottom		1/30/2017	12:09
Transect 3.5					
T3.5A-20170202-0.2	Near south bank	Near bottom		2/2/2017	11:08
T3.5A-20170202-FB	Near south bank	Near bottom	FB	2/2/2017	15:40
T3.5B-20170202-0.5	Second from south bank	Near bottom		2/2/2017	11:13
T3.5B-20170202-0.5-FD	Second from south bank	Near bottom	FD	2/2/2017	11:13
T3.5C-20170202-0.6	Third from south bank	Near bottom		2/2/2017	11:22
T3.5C-20170202-0.6-EB	Third from south bank	Near bottom	EB	2/2/2017	15:45
T3.5D-20170202-1.4	Fourth from south bank	Near bottom		2/2/2017	12:00
T3.5E-20170202-1.5	Fifth from south bank	Near bottom		2/2/2017	12:07
T3.5F-20170202-4.0	Sixth from south bank	Near bottom		2/2/2017	12:25
T3.5F-20170202-1.5	Sixth from south bank	1/3 depth		2/2/2017	12:34

Notes:
ID - Identification
FD - field duplicate
FB - field blank
EB - equipment blank
MS - matrix spike
MSD - matrix spike duplicate
QC - quality control
Sample ID comprised of "Location"-"YYYYMMDD"-"Depth"-"QC type if applicable"
YYMMDD - YearMonthDay (example 20170202 is February 2, 2017)

Table 10 Field Collected Water Quality Data: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Targeted Flow	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
										mg/L	% saturation
Day 1											
LW7.2	Low	2/6/2017	9:45	1.52	0.80	18.14	1881	7.99	4.8	9.27	100.7
LW6.7	Low	2/6/2017	10:15	0.75	0.40	18.36	2061	8.04	5.4	9.58	102.7
LW6.05	Low	2/6/2017	11:20	1.22	0.60	17.95	2151	8.09	2.8	9.96	105.5
LWC6.1_1 [t/ss]	Low	2/6/2017	9:30	1.17	0.58	18.28	1798	7.68	1.2	8.19	87.5
LWC6.1_2 [t/ss]	Low	2/6/2017	9:57	1.75	0.83	21.97	1082	8.10	1.5	7.95	91.2
GLWC6.1_3 [t/ss]	Low	2/6/2017	10:05	2.08	1.04	18.87	1692	7.61	1.3	8.25	89.1
GLWC6.1_4 [t/ss]	Low	2/6/2017	10:30	2.25	1.08	18.85	2214	7.70	7.7	8.80	95.2
LW5.9	Low	2/6/2017	11:06	1.00	0.50	14.77	2225	8.02	7.0	9.92	94.9
LW5.3	Low	2/6/2017	10:00	3.40	1.20	17.80	2156	7.92	3.0	9.27	98.3
LW5.3	Low	2/6/2017	10:30	3.40	2.35	17.82	2154	7.91	3.3	9.21	97.6
LW4.95	Low	2/6/2017	11:00	2.19	1.10	17.80	2158	8.06	3.1	9.44	99.9
GLW4.9	Low	2/6/2017	11:15	2.91	1.45	17.94	2137	7.97	3.7	8.95	95.2
GLW4.85	Low	2/6/2017	10:18	13.00	0.60	19.50	3105	7.50	11.5	5.97	66.0
GLW4.4	Low	2/6/2017	11:01	2.20	1.10	17.80	2277	8.06	2.2	10.30	109.0
LW4.1	Low	2/6/2017	11:17	0.60	0.30	18.00	2306	8.00	12.7	9.95	106.0
LW3.85	Low	2/6/2017	9:50	1.00	0.50	18.31	2602	8.28	0.8	10.55	113.1
GLW3.78	Low	2/6/2017	10:32	0.83	0.42	18.42	2621	8.07	5.6	8.93	96.0
LW3.75	Low	2/6/2017	10:23	1.67	0.83	18.31	2604	8.19	2.8	9.43	101.0
LWC3.7 [t/ss]	Low	2/6/2017	10:12	0.67	0.33	20.12	3467	7.52	3.6	5.97	66.1
LW3.4	Low	2/6/2017	11:06	0.83	0.42	18.39	2638	8.25	3.8	9.33	100.2
LW7.2	Mid	2/6/2017	12:10	1.71	0.80	20.28	1868	8.26	3.1	10.03	111.7
LW6.05	Mid	2/6/2017	12:36	1.33	0.70	18.60	2125	8.27	4.5	9.83	105.8
LW4.95	Mid	2/6/2017	13:20	2.15	1.08	18.26	2113	8.19	4.9	9.39	100.4
GLW4.4	Mid	2/6/2017	14:15	2.40	1.20	18.26	2322	8.25	2.7	10.80	115.0
LW3.4	Mid	2/6/2017	14:43	1.25	0.63	18.74	2733	8.38	7.3	9.26	100.2
LW7.2	High	2/6/2017	14:30	1.80	1.00	20.63	1780	8.18	4.5	9.47	106.1
LW6.7	High	2/6/2017	15:02	1.25	0.60	20.24	1813	8.27	7.7	9.47	105.3
LW6.05	High	2/6/2017	15:26	1.40	0.70	19.52	2000	8.31	10.7	9.46	103.8
GLWC6.1_4 [t/ss]	High	2/6/2017	15:17	1.21	0.58	16.30	2079	8.20	13.5	9.31	95.5
LWC6.1_2 [t/ss]	High	2/6/2017	14:53	1.17	0.58	21.44	1197	8.26	2.3	7.99	90.8
LWC6.1_1 [t/ss]	High	2/6/2017	14:35	1.67	0.83	18.33	1838	7.63	1.0	8.23	88.0

Table 10 Field Collected Water Quality Data: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Targeted Flow	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
										mg/L	% saturation
GLWC6.1_3 [t/ss]	High	2/6/2017	14:58	1.83	0.92	18.51	1803	7.80	1.8	8.32	89.6
LW5.9	High	2/6/2017	15:42	2.63	1.25	18.64	2248	7.61	10.5	7.70	82.9
LW5.3	High	2/6/2017	16:00	3.40	1.20	19.05	1973	8.18	0.2	8.28	89.9
LW5.3	High	2/6/2017	16:10	3.40	2.30	19.05	1973	8.19	5.4	9.06	98.4
LW4.95	High	2/6/2017	15:15	2.20	1.10	18.72	2052	8.22	6.4	9.03	97.4
GLW4.9	High	2/6/2017	15:00	2.95	1.50	18.52	2090	8.20	4.4	9.02	97.0
GLW4.85	High	2/6/2017	15:55	1.30	0.60	19.40	2732	7.97	1.2	8.08	88.8
GLW4.4	High	2/6/2017	16:17	2.60	1.30	18.30	2263	8.27	3.0	9.98	106.0
LW4.1	High	2/6/2017	16:39	0.70	0.30	18.10	2302	8.23	5.6	9.55	101.8
LW3.85	High	2/6/2017	16:00	1.17	0.58	18.47	2657	8.38	3.8	9.68	104.2
GLW3.78	High	2/6/2017	16:37	1.92	0.96	18.45	2707	8.20	5.5	8.67	93.5
LW3.75	High	2/6/2017	16:28	1.33	0.67	18.34	2642	8.36	3.4	9.07	97.7
LWC3.7 [t/ss]	High	2/6/2017	16:16	1.67	0.58	21.41	3757	7.48	0.6	4.07	43.7
LW3.4	High	2/6/2017	17:01	1.42	0.71	18.29	2668	8.27	5.9	8.93	95.7

Table 10 Field Collected Water Quality Data: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Targeted Flow	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
										mg/L	% saturation
Day 2											
LW7.2	Low	2/7/2017	8:55	1.45	0.70	19.57	1816	7.33	Error [1]	8.96	98.5
LW6.7	Low	2/7/2017	9:13	0.73	0.40	18.25	2422	7.87	Error [1]	9.06	96.9
LW6.05	Low	2/7/2017	9:30	1.21	0.60	18.50	2115	8.00	Error [1]	9.18	98.8
LWC6.1_2 [t/ss]	Low	2/7/2017	9:18	1.38	0.69	20.82	1131	8.24	3.5	8.22	92.2
LWC6.1_1 [t/ss]	Low	2/7/2017	8:45	1.75	0.88	18.21	1845	7.70	0.1	8.19	87.5
GLWC6.1_3 [t/ss]	Low	2/7/2017	9:25	1.94	0.96	18.47	1790	7.60	0.0	8.33	89.3
GLWC6.1_4 [t/ss]	Low	2/7/2017	10:30	2.60	1.30	18.67	2157	7.60	4.5	8.00	86.3
LW5.9	Low	2/7/2017	9:50	0.80	0.40	15.42	2293	8.00	4.8	9.43	95.0
LW5.3	Low	2/7/2017	9:45	3.00	1.00	18.31	2275	7.96	2.1	9.02	96.6
LW5.3	Low	2/7/2017	9:50	3.00	2.90	18.32	2274	7.94	2.9	8.96	96.0
LW4.95	Low	2/7/2017	10:45	1.95	1.00	18.67	2276	8.22	2.1	9.76	105.3
GLW4.9	Low	2/7/2017	10:50	2.30	1.20	18.46	2267	8.06	1.8	9.09	97.6
GLW4.85	Low	2/7/2017	9:42	1.40	0.70	19.68	2804	7.88	4.1	5.20	62.0
GLW4.4	Low	2/7/2017	10:06	4.40	2.30	18.50	2341	7.93	1.1	9.00	96.0
LW4.1	Low	2/7/2017	10:32	0.60	0.30	18.59	2372	7.98	0.6	8.90	96.0
LW3.85	Low	2/7/2017	10:07	1.00	0.50	19.35	2446	8.35	0.0	10.92	119.1
GLW3.78	Low	2/7/2017	9:30	1.33	0.67	18.48	2470	8.07	4.2	9.10	98.1
LW3.75	Low	2/7/2017	10:38	1.75	0.88	19.34	2450	8.29	1.0	10.30	112.3
LWC3.7 [t/ss]	Low	2/7/2017	10:26	0.83	0.42	20.81	3494	7.94	2.1	5.34	60.5
LW3.4	Low	2/7/2017	11:09	1.08	0.54	19.43	2486	8.39	0.2	9.40	103.0
LW7.2	Mid	2/7/2017	10:55	1.64	0.80	18.66	1866	8.01	Error [1]	10.37	115.7
LW6.05	Mid	2/7/2017	11:20	1.25	0.60	19.08	2168	8.12	Error [1]	10.41	113.0
LW4.95	Mid	2/7/2017	13:25	2.30	1.20	19.40	2270	8.30	4.0	9.17	100.2
GLW4.4	Mid	2/7/2017	14:11	2.50	1.30	19.35	2446	8.20	0.6	9.40	103.0
LW3.4	Mid	2/7/2017	14:35	1.30	0.60	19.30	2439	8.32	4.4	9.20	101.0
LW7.2	High	2/7/2017	14:02	1.80	0.90	21.75	1761	7.92	2.4	10.05	115.0
LW6.7	High	2/7/2017	14:25	1.28	0.60	21.26	1998	8.24	2.2	10.17	115.3
LW6.05	High	2/7/2017	14:48	1.44	0.70	20.93	2015	8.35	3.4	10.24	115.5
LWC6.1_2 [t/ss]	High	2/7/2017	14:55	1.40	0.70	21.93	1098	8.20	1.1	8.07	92.5
LWC6.1_1 [t/ss]	High	2/7/2017	14:41	1.50	0.80	18.46	1886	7.47	0.0	8.21	88.1
GLWC6.1_3 [t/ss]	High	2/7/2017	14:58	1.75	0.90	18.70	1839	7.50	0.0	8.22	88.5

Table 10 Field Collected Water Quality Data: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Targeted Flow	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
										mg/L	% saturation
GLWC6.1_4 [t/ss]	High	2/7/2017	16:07	2.70	1.30	18.94	2185	7.66	3.4	7.80	84.6
LW5.9	High	2/7/2017	15:27	1.13	0.60	17.62	2196	8.19	9.8	9.36	98.7
LW5.3	High	2/7/2017	15:45	3.51	1.20	20.40	2190	8.25	3.7	8.84	98.6
LW5.3	High	2/7/2017	15:50	3.51	2.40	20.40	2188	8.25	3.8	8.82	98.4
LW4.95	High	2/7/2017	16:30	2.46	1.20	20.24	2201	8.27	4.5	8.71	97.0
GLW4.9	High	2/7/2017	16:45	2.80	1.40	20.16	2198	8.25	3.6	8.66	99.7
GLW4.85	High	2/7/2017	15:42	1.60	0.80	20.13	2649	8.06	2.4	2.10	29.0
GLW4.4	High	2/7/2017	16:06	2.40	1.20	19.78	2364	8.25	1.2	8.80	97.0
LW4.1	High	2/7/2017	16:20	0.90	0.40	19.49	2405	8.22	1.3	8.50	93.0
LW3.85	High	2/7/2017	15:47	1.17	0.58	20.03	2532	8.45	2.3	9.77	108.1
GLW3.78	High	2/7/2017	16:30	2.42	1.21	19.78	2572	8.26	1.3	8.92	98.8
LW3.75	High	2/7/2017	16:17	2.00	1.00	20.02	2520	8.38	2.6	9.10	100.9
LWC3.7 [t/ss]	High	2/7/2017	16:05	1.25	0.63	21.85	3880	7.34	0.1	4.13	47.7
LW3.4	High	2/7/2017	16:58	1.33	0.67	19.88	2539	8.34	2.5	9.02	99.8

Table 10 Field Collected Water Quality Data: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Targeted Flow	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
										mg/L	% saturation
Day 3											
LW7.2	Low	2/8/2017	8:45	1.46	0.70	20.41	1798	7.64	0.5	8.80	98.1
LW6.7	Low	2/8/2017	9:03	0.63	0.30	19.12	2295	7.79	1.7	9.28	101.1
LW6.05	Low	2/8/2017	9:35	1.17	0.50	19.46	2112	7.92	0.5	9.79	107.2
LWC6.1_2 [t/ss]	Low	2/8/2017	9:54	1.20	0.60	20.61	1053	8.13	1.1	8.19	97.9
LWC6.1_1 [t/ss]	Low	2/8/2017	9:45	1.70	0.90	18.62	1857	7.74	0.7	8.58	98.3
GLWC6.1_3 [t/ss]	Low	2/8/2017	10:05	2.30	1.20	18.82	1793	7.32	1.6	8.04	93.1
GLWC6.1_4 [t/ss]	Low	2/8/2017	11:15	2.50	1.30	18.98	1879	7.51	1.9	Error [2]	Error [2]
LW5.9	Low	2/8/2017	10:33	0.80	0.40	16.66	2275	7.75	4.3	9.43	104.9
LW5.3	Low	2/8/2017	10:00	3.05	1.00	19.21	2432	7.91	1.8	9.44	103.0
LW5.3	Low	2/8/2017	10:03	3.05	2.00	19.22	2432	7.92	1.9	9.45	103.1
LW4.95	Low	2/8/2017	10:30	2.28	1.10	19.32	2426	8.09	2.0	9.76	106.6
GLW4.9	Low	2/8/2017	10:50	2.49	1.20	19.05	2409	8.00	4.8-6.0	9.01	98.0
GLW4.85	Low	2/8/2017	9:45	1.30	0.60	19.40	2619	7.69	1.4	7.00	76.0
GLW4.4	Low	2/8/2017	10:07	2.30	1.10	19.29	2354	7.98	1.4	9.22	100.7
LW4.1	Low	2/8/2017	10:22	0.70	0.40	19.21	2383	7.95	1.2	8.87	96.2
LW3.85	Low	2/8/2017	9:23	1.00	0.50	19.93	2210	8.27	2.4	10.59	117.0
GLW3.78	Low	2/8/2017	10:03	1.00	0.50	19.59	2239	8.11	8.3	8.81	96.7
LW3.75	Low	2/8/2017	9:53	1.17	0.80	19.86	2213	8.24	0.4	9.59	105.7
LWC3.7 [t/ss]	Low	2/8/2017	9:42	0.92	0.46	20.97	3144	7.42	1.3	5.35	60.8
LW3.4	Low	2/8/2017	10:27	1.00	0.50	19.93	2247	8.30	0.7	8.75	96.8
LW7.2	Mid	2/8/2017	11:07	1.65	0.80	21.67	1858	8.34	1.6	10.69	122.3
LW6.05	Mid	2/8/2017	12:35	1.51	0.80	21.18	2121	8.30	1.7	11.15	126.5
LW4.95	Mid	2/8/2017	13:05	2.39	1.20	20.35	2472	8.22	3.5	9.58	106.8
GLW4.4	Mid	2/8/2017	13:47	2.40	1.30	20.58	2428	8.17	1.1	9.68	108.0
LW3.4	Mid	2/8/2017	14:15	1.17	0.58	20.99	2798	8.43	3.5	8.81	99.6
LW7.2	High	2/8/2017	14:40	1.80	0.90	23.11	1742	8.28	3.0	9.92	116.4
LW6.7	High	2/8/2017	15:02	1.24	0.60	22.26	2079	8.21	4.8	9.98	115.4
LW6.05	High	2/8/2017	15:36	1.42	0.70	22.46	1988	8.29	1.7	9.78	113.4
LWC6.1_1 [t/ss]	High	2/8/2017	14:39	1.40	0.70	18.94	1611	6.86 [3]	Error [2]	Error [2]	Error [2]
LWC6.1_2 [t/ss]	High	2/8/2017	14:50	1.30	0.70	20.63	1085	7.77	Error [2]	Error [2]	Error [2]
GLWC6.1_3 [t/ss]	High	2/8/2017	15:00	1.95	1.00	19.29	1515	7.30	Error [2]	Error [2]	Error [2]

Table 10 Field Collected Water Quality Data: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Targeted Flow	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
										mg/L	% saturation
GLWC6.1_4 [t/ss]	High	2/8/2017	16:05	1.90	1.00	19.30	1639	7.49	Error [2]	Error [2]	Error [2]
LW5.9	High	2/8/2017	15:37	1.20	0.60	18.86	1834	7.87	Error [2]	Error [2]	Error [2]
LW5.3	High	2/8/2017	15:45	3.64	1.20	21.63	2352	8.21	3.6	9.00	102.9
LW5.3	High	2/8/2017	15:50	3.64	2.40	21.65	2347	8.21	3.7	8.99	102.9
LW4.95	High	2/8/2017	16:20	2.65	1.30	21.45	2355	8.21	3.6	8.81	100.5
GLW4.9	High	2/8/2017	16:35	2.85	1.40	21.28	2371	8.20	2.3	8.70	98.9
GLW4.85	High	2/8/2017	16:00	1.60	0.80	20.96	2540	7.92	2.1	7.40	79.0
GLW4.4	High	2/8/2017	16:21	2.50	1.30	20.91	2414	8.31	1.2	8.80	99.0
LW4.1	High	2/8/2017	16:33	0.85	0.40	20.59	2451	8.28	0.7	8.50	95.3
LW3.85	High	2/8/2017	16:01	1.08	0.54	21.30	2311	8.44	1.8	9.33	106.0
GLW3.78	High	2/8/2017	16:37	2.75	1.38	20.73	2331	8.21	0.5	8.03	90.6
LW3.75	High	2/8/2017	16:28	2.00	1.00	21.19	2311	8.37	0.9	8.42	95.5
LWC3.7 [t/ss]	High	2/8/2017	16:17	1.17	0.54	22.31	3658	7.45	2.9	3.93	46.4
LW3.4	High	2/8/2017	17:00	1.25	0.63	20.90	2329	8.32	3.4	8.42	95.0

Table 10 Field Collected Water Quality Data: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Targeted Flow	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
										mg/L	% saturation
Day 4											
LW7.2	Low	2/9/2017	8:56	1.46	0.70	20.68	1782	7.43	0.5	9.55	107.1
LW6.7	Low	2/9/2017	9:11	0.71	0.30	19.46	2270	7.82	5.5	9.67	106.0
LW6.05	Low	2/9/2017	9:31	1.18	0.50	19.63	2055	7.93	0.4	9.85	108.5
LWC6.1_2 [t/ss]	Low	2/9/2017	9:20	1.10	0.55	22.89	1007	8.21	Error [2]	Error [2]	Error [2]
LWC6.1_1 [t/ss]	Low	2/9/2017	9:15	2.00	1.00	18.87	1821	8.25	Error [2]	Error [2]	Error [2]
GLWC6.1_3 [t/ss]	Low	2/9/2017	9:25	2.38	1.19	19.02	1793	7.62	Error [2]	Error [2]	Error [2]
GLWC6.1_4 [t/ss]	Low	2/9/2017	10:19	2.63	1.31	19.47	1844	7.41	Error [2]	Error [2]	Error [2]
LW5.9	Low	2/9/2017	9:49	0.83	0.42	16.58	2205	7.83	Error [2]	Error [2]	Error [2]
LW5.3	Low	2/9/2017	10:00	3.08	1.00	19.34	2262	7.94	1.7	9.27	101.1
LW5.3	Low	2/9/2017	10:03	3.08	2.00	19.34	2260	7.95	2.5	9.29	101.4
LW4.95	Low	2/9/2017	10:35	2.09	1.00	19.55	2259	8.13	2.1	9.71	106.5
GLW4.9	Low	2/9/2017	10:50	2.35	1.20	19.31	2250	8.01	1.9	9.10	99.3
GLW4.85	Low	2/9/2017	9:58	1.40	0.70	19.40	2727	7.47	14.2	6.40	70.0
GLW4.4	Low	2/9/2017	10:22	2.25	1.10	19.60	2388	8.05	1.2	9.40	103.0
LW4.1	Low	2/9/2017	10:36	0.65	0.30	19.50	2408	8.04	0.6	9.20	100.0
LW3.85	Low	2/9/2017	10:25	1.00	0.50	20.80	2256	8.40	1.9	11.52	129.6
GLW3.78	Low	2/9/2017	11:03	0.58	0.29	21.24	2293	8.35	1.6	9.05	103.4
LW3.75	Low	2/9/2017	10:53	0.92	0.46	20.70	2260	8.36	0.1	10.21	114.6
LWC3.7 [t/ss]	Low	2/9/2017	10:49	0.80	0.40	21.41	3212	7.47	1.1	5.45	62.4
LW3.4	Low	2/9/2017	11:50	1.00	0.50	21.06	2304	8.41	1.5	8.74	98.9
LW7.2	Mid	2/9/2017	10:52	1.61	0.80	22.04	1771	8.34	3.4	11.15	128.2
LW6.05	Mid	2/9/2017	12:00	1.32	0.60	21.44	2117	8.21	0.3	9.93	113.1
LW4.95	Mid	2/9/2017	12:30	2.19	1.10	20.58	2309	8.22	2.7	9.36	105.5
GLW4.4	Mid	2/9/2017	13:10	2.40	1.20	20.60	2449	8.28	0.8	10.00	112.0
LW3.4	Mid	2/9/2017	13:25	1.00	0.50	21.58	2328	8.47	2.8	8.68	99.1
LW7.2	High	2/9/2017	14:41	1.80	0.90	23.64	1665	8.33	6.0	9.89	117.2
LW6.7	High	2/9/2017	15:04	1.22	0.60	22.97	1924	8.30	5.7	10.30	117.5
LW6.05	High	2/9/2017	15:23	1.42	0.70	23.00	1879	8.35	6.0	9.91	116.2
LWC6.1_2 [t/ss]	High	2/9/2017	14:50	1.58	0.79	21.31	1001	8.24	Error [2]	Error [2]	Error [2]
LWC6.1_1 [t/ss]	High	2/9/2017	14:34	2.13	1.06	19.27	1856	7.62	Error [2]	Error [2]	Error [2]
GLWC6.1_3 [t/ss]	High	2/9/2017	14:54	2.27	1.14	19.34	1826	7.68	Error [2]	Error [2]	Error [2]

Table 10 Field Collected Water Quality Data: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location ID	Targeted Flow	Date and Time of Measurement		Total Depth (ft)	Sample Depth (ft)	Temperature (˚C)	Spec. Cond. (µS/cm)	pH	Turbidity (NTU)	Dissolved Oxygen	
										mg/L	% saturation
GLWC6.1_4 [t/ss]	High	2/9/2017	15:50	3.25	1.63	19.45	1897	7.58	Error [2]	Error [2]	Error [2]
LW5.9	High	2/9/2017	15:23	1.48	0.74	19.43	1994	8.15	Error [2]	Error [2]	Error [2]
LW5.3	High	2/9/2017	15:15	3.35	1.10	22.25	2159	8.25	3.7	8.86	102.5
LW5.3	High	2/9/2017	15:18	3.35	2.20	22.25	2157	8.25	4.1	8.87	102.5
LW4.95	High	2/9/2017	15:40	2.45	1.20	22.09	2168	8.28	4.2	8.75	100.9
GLW4.9	High	2/9/2017	15:49	2.89	1.40	21.88	2196	8.25	4.0	8.57	98.4
GLW4.85	High	2/9/2017	15:15	1.60	0.80	21.43	2558	8.11	5.1	7.70	87.0
GLW4.4	High	2/9/2017	15:42	2.50	1.30	21.40	2451	8.38	1.3	8.90	102.0
LW4.1	High	2/9/2017	16:00	0.90	0.40	21.10	2487	8.36	2.3	8.60	98.0
LW3.85	High	2/9/2017	15:39	1.17	0.58	21.69	2394	8.46	1.1	9.57	109.7
GLW3.78	High	2/9/2017	16:30	2.58	1.29	21.21	2397	8.28	2.7	8.51	96.6
LW3.75	High	2/9/2017	16:05	1.67	0.83	21.63	2356	8.42	0.8	8.83	101.0
LWC3.7 [t/ss]	High	2/9/2017	15:54	1.17	0.58	22.03	3270	7.46	0.6	5.31	61.7
LW3.4	High	2/9/2017	16:48	1.25	0.63	21.45	2379	8.36	9.3	8.15	92.9

Notes:

1) Measurement disqualified: Field team noted that turbidity probe is malfunctioning and was therefore not recorded.

2) Dissolved Oxygen and Tubidity probes sensors failed and therefore were not recorded.

3) Field team noted that pH reading seemed low at LWC6.1_1 on 2/8/2016.

Spec. Cond. - Specific Conductivity
LW - Prefix indicates historical locations that were also sampled in May 2016
GLW - Prefix indicates new grab locations
ft - feet
ID - identification

˚C - degrees Celsius
µS/cm - micro-Siemens per centimeter
NTU - Nephelometric Turbitiy Unit
mg/L - milligrams per Liter
% - Percent

t/ss - tributary/side stream; added for clarity and not part of actual Location ID

% saturation for dissolved oxygen is based on sample temperature and daily atmospheric barometric pressure (input during calibration)

Table 11 GPS Coordinates: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample Day	Targeted Flow	Location ID	Date and Time of Sample Collection		GPS Coordinates		Additional Information
					Northing	Easting	
Day 1	Low	LW7.2	2/6/2017	9:45	26735154.1764	828169.516523	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	LW6.7	2/6/2017	10:15	26734766.8596	829555.863160	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	LW6.05	2/6/2017	11:20	26734195.7184	832631.194936	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	LWC6.1_1 [t/ss]	2/6/2017	9:45	36° 05' 09.7118" N	114° 59' 10.2496" W	Converted coordinates: 26733478.5980 UTM Northing, 832602.959035 UTM Easting
Day 1	Low	LWC6.1_2 [t/ss]	2/6/2017	10:00	36° 05' 09.3302" N	114° 59' 10.6786" W	Converted coordinates: 26733439.7965 UTM Northing, 832567.986184 UTM Easting
Day 1	Low	GLWC6.1_3 [t/ss]	2/6/2017	10:07	36° 05' 10.2830" N	114° 59' 10.7778" W	t/ss. Converted coordinates: 26733536.0886 UTM Northing, 832559.253154 UTM Easting
Day 1	Low	GLWC6.1_4 [t/ss]	2/6/2017	10:35	36° 05' 14.8717" N	114° 59' 10.9452" W	t/ss. Converted coordinates: 26733999.9893 UTM Northing, 832542.666511 UTM Easting
Day 1	Low	LW5.9	2/6/2017	11:08	36° 05' 15.8894" N	114° 58' 59.9004" W	Converted coordinates: 26734108.4713 UTM Northing, 833448.50446 UTM Easting
Day 1	Low	LW5.3	2/6/2017	10:00	26734884.8696	836443.594463	Coordinates duplicated (shallow sample)
Day 1	Low	LW5.3	2/6/2017	10:35	26734884.8696	836443.594463	Coordinates duplicated (deep sample)
Day 1	Low	LW4.95	2/6/2017	11:30	26735811.1617	838356.807172	
Day 1	Low	GLW4.9	2/6/2017	11:15	26735748.9325	838930.751235	
Day 1	Low	GLW4.85	2/6/2017	10:22	26735901.5496	839338.536180	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	GLW4.4	2/6/2017	11:04	26736802.1895	841941.137930	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	LW4.1	2/6/2017	11:20	26736833.1567	842708.315530	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	LW3.85	2/6/2017	9:53	26737186.6278	843989.553781	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	GLW3.78	2/6/2017	10:45	26737396.7569	844398.532622	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	LW3.75	02/06/17	10:25	26737672.9440	844386.046426	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	LWC3.7 [t/ss]	02/06/17	10:16	26737590.0758	844557.400742	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Low	LW3.4	02/06/17	11:10	26738900.7254	845419.303874	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Mid	LW7.2	2/6/2017	12:10	26735154.1764	828169.516523	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Mid	LW6.05	2/6/2017	12:36	26734195.7184	832631.194936	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Mid	LW4.95	2/6/2017	13:20	26735811.1617	838356.807172	Coordinates not collected during high flow sampling. (Low flow coordinates duplicated).
Day 1	Mid	GLW4.4	2/6/2017	14:15	26736802.1895	841941.137930	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	Mid	LW3.4	02/06/17	14:46	26738900.7254	845419.303874	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	LW7.2	2/6/2017	14:30	26735154.1764	828169.516523	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	LW6.7	2/6/2017	15:00	26734766.8596	829555.863160	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	LW6.05	2/6/2017	15:26	26734195.7184	832631.194936	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	LWC6.1_1 [t/ss]	2/6/2017	14:43	36° 05' 09.6713" N	114° 59' 10.2112" W	Converted coordinates: 26733474.5222 UTM Northing, 832606.13581 UTM Easting
Day 1	High	LWC6.1_2 [t/ss]	2/6/2017	14:55	36° 05' 09.3230" N	114° 59' 10.6850" W	Converted coordinates: 26733439.0652 UTM Northing, 832567.465379 UTM Easting
Day 1	High	GLWC6.1_3 [t/ss]	2/6/2017	15:00	36° 05' 10.3201" N	114° 59' 10.7984" W	t/ss. Converted coordinates: 26733539.8296 UTM Northing, 832557.539413 UTM Easting
Day 1	High	GLWC6.1_4 [t/ss]	2/6/2017	15:45	36° 05' 14.8717" N	114° 59' 10.9452" W	t/ss. Converted coordinates: 26733999.9893 UTM Northing, 832542.666511 UTM Easting
Day 1	High	LW5.9	2/6/2017	15:18	36° 05' 15.8729" N	114° 58' 59.9037" W	Converted coordinates: 26734106.8012 UTM Northing, 833448.243914 UTM Easting
Day 1	High	LW5.3	2/6/2017	16:00	26734891.4440	836452.228633	Coordinates duplicated (shallow sample)
Day 1	High	LW5.3	2/6/2017	16:10	26734891.4440	836452.228633	Coordinates duplicated (deep sample)
Day 1	High	LW4.95	2/6/2017	15:15	26735811.1617	838356.807172	Coordinates not collected during high flow sampling. (Low flow coordinates duplicated).
Day 1	High	GLW4.9	2/6/2017	15:00	26735748.9325	838930.751235	Coordinates not collected during high flow sampling. (Low flow coordinates duplicated).
Day 1	High	GLW4.85	2/6/2017	15:58	26735901.5496	839338.536180	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	GLW4.4	2/6/2017	16:19	26736802.1895	841941.137930	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	LW4.1	2/6/2017	16:42	26736833.1567	842708.315530	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	LW3.85	2/6/2017	16:03	26737186.6278	843989.553781	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	GLW3.78	2/6/2017	16:40	26737396.7569	844398.532622	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	LW3.75	02/06/17	16:30	26737672.9440	844386.046426	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	LWC3.7 [t/ss]	02/06/17	16:20	26737590.0758	844557.400742	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 1	High	LW3.4	02/06/17	17:01	26738900.7254	845419.303874	Team without GPS (Stations Staked). Coordinates from December 2016.
Day 2	Low	LW7.2	2/7/2017	8:55	26735154.1764	828169.516523	Did not collect coordinates (Stations Staked). Coordinates from December 2016.

Table 11 GPS Coordinates: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample Day	Targeted Flow	Location ID	Date and Time of Sample Collection		GPS Coordinates		Additional Information
					Northing	Easting	
Day 2	Low	LW6.7	2/7/2017	9:13	26734766.8596	829555.863160	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 2	Low	LW6.05	2/7/2017	9:30	26734195.7184	832631.194936	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 2	Low	LWC6.1_1 [t/ss]	2/7/2017	9:03	36° 05' 09.6804" N	114° 59' 10.2501" W	Converted coordinates: 26733475.4227 UTM Northing, 832602.937489 UTM Easting
Day 2	Low	LWC6.1_2 [t/ss]	2/7/2017	9:20	36° 05' 09.2779" N	114° 59' 10.6500" W	Converted coordinates: 26733434.5226 UTM Northing, 832570.365957 UTM Easting
Day 2	Low	GLWC6.1_3 [t/ss]	2/7/2017	9:30	36° 05' 10.3068" N	114° 59' 10.7887" W	t/ss. Converted coordinates: 26733538.4896 UTM Northing, 832558.343782 UTM Easting
Day 2	Low	GLWC6.1_4 [t/ss]	2/7/2017	10:35	36° 05' 14.8862" N	114° 59' 10.9549" W	t/ss. Converted coordinates: 26734001.4506 UTM Northing, 832541.861412 UTM Easting
Day 2	Low	LW5.9	2/7/2017	10:00	36° 05' 15.8602" N	114° 58' 59.9034" W	Converted coordinates: 26734105.5172 UTM Northing, 833448.276457 UTM Easting
Day 2	Low	LW5.3	2/7/2017	9:45	26734888.1166	836458.754538	Coordinates duplicated (shallow sample)
Day 2	Low	LW5.3	2/7/2017	9:50	26734888.1166	836458.754538	Coordinates duplicated (deep sample)
Day 2	Low	LW4.95	2/7/2017	10:45	26735807.7765	838355.131651	
Day 2	Low	GLW4.9	2/7/2017	10:55	26735746.4400	838931.121641	
Day 2	Low	GLW4.85	2/7/2017	9:42	36° 05' 33.05" N	114° 57' 48.074" W	Converted coordinates: 26735880.6328 UTM Northing, 839332.388411 UTM Easting
Day 2	Low	GLW4.4	2/7/2017	10:18	36° 05' 41.922" N	114° 57' 16.016" W	Converted coordinates: 26736794.6167 UTM Northing, 841957.49863 UTM Easting
Day 2	Low	LW4.1	2/7/2017	10:39	36° 05' 42.272" N	114° 57' 06.950" W	Converted coordinates: 26736834.8277 UTM Northing, 842701.267355 UTM Easting
Day 2	Low	LW3.85	2/7/2017	10:12	26737239.7881	844063.690444	Waypoint recorded twice on GPS
Day 2	Low	LW3.85	2/7/2017	10:12	26737238.3288	844063.588410	Waypoint recorded twice on GPS
Day 2	Low	GLW3.78	2/7/2017	9:35	26737449.1036	844428.592273	
Day 2	Low	LW3.75	2/7/2017	10:45	26737663.5481	844381.142565	
Day 2	Low	LWC3.7 [t/ss]	2/7/2017	10:32	26737563.6343	844536.652300	Missing GPS Waypoint Data. Coordinates recorded in Field Notes
Day 2	Low	LW3.4	2/7/2017	11:11	26738904.2979	845421.736284	
Day 2	Mid	LW7.2	2/7/2017	10:55	26735154.1764	828169.516523	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 2	Mid	LW6.05	2/7/2017	11:20	26734195.7184	832631.194936	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 2	Mid	LW4.95	2/7/2017	13:25	26735808.4507	838354.240905	
Day 2	Mid	GLW4.4	2/7/2017	14:11	36° 05' 42.060" N	114° 57' 16.206" W	Converted coordinates: 26736808.4698 UTM Northing, 841941.816113 UTM Easting
Day 2	Mid	LW3.4	2/7/2017	14:35	36° 06' 02.536" N	114° 56' 33.507" W	Converted coordinates: 26738901.7749 UTM Northing, 845432.254704 UTM Easting
Day 2	High	LW7.2	2/7/2017	14:02	26735154.1764	828169.516523	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 2	High	LW6.7	2/7/2017	14:25	26734766.8596	829555.863160	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 2	High	LW6.05	2/7/2017	14:48	26734195.7184	832631.194936	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 2	High	LWC6.1_1 [t/ss]	2/7/2017	14:45	36° 05' 09.6760" N	114° 59' 10.2142" W	Converted coordinates: 26733474.9959 UTM Northing, 832605.886671 UTM Easting
Day 2	High	LWC6.1_2 [t/ss]	2/7/2017	14:58	36° 05' 09.2632" N	114° 59' 10.4620" W	Converted coordinates: 26733433.1309 UTM Northing, 832585.804986 UTM Easting
Day 2	High	GLWC6.1_3 [t/ss]	2/7/2017	15:06	36° 05' 10.2877" N	114° 59' 10.7966" W	t/ss. Converted coordinates: 26733536.5543 UTM Northing, 832557.707253 UTM Easting
Day 2	High	GLWC6.1_4 [t/ss]	2/7/2017	16:10	36° 05' 14.9068" N	114° 59' 11.0212" W	t/ss. Converted coordinates: 26734003.5002 UTM Northing, 832536.407232 UTM Easting
Day 2	High	LW5.9	2/7/2017	15:27	36° 05' 15.9842" N	114° 59' 00.0598" W	Converted coordinates: 26734117.9763 UTM Northing, 833435.363045 UTM Easting
Day 2	High	LW5.3	2/7/2017	15:45	26734888.1251	836462.868375	Coordinates duplicated (shallow sample)
Day 2	High	LW5.3	2/7/2017	15:50	26734888.1251	836462.868375	Coordinates duplicated (deep sample)
Day 2	High	LW4.95	2/7/2017	16:30	26735809.7788	838354.715313	
Day 2	High	GLW4.9	2/7/2017	16:45	26735747.9453	838930.335881	
Day 2	High	GLW4.85	2/7/2017	15:42	26735882.3118	839339.757962	
Day 2	High	GLW4.4	2/7/2017	16:06	26736807.6416	841942.960761	
Day 2	High	LW4.1	2/7/2017	16:20	26736837.0435	842706.112122	
Day 2	High	LW3.85	2/7/2017	15:50	26737240.1667	844062.261969	
Day 2	High	GLW3.78	2/7/2017	16:35	26737449.1000	844425.674956	
Day 2	High	LW3.75	2/7/2017	16:25	26737665.6337	844381.800700	
Day 2	High	LWC3.7 [t/ss]	2/7/2017	16:10	26737564.7743	844533.517260	
Day 2	High	LW3.4	2/7/2017	17:00	26738904.4659	845421.394093	
Day 3	Low	LW7.2	2/8/2017	8:45	26735154.1764	828169.516523	Did not collect coordinates (Stations Staked). Coordinates from December 2016.

Table 11 GPS Coordinates: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample Day	Targeted Flow	Location ID	Date and Time of Sample Collection		GPS Coordinates		Additional Information
					Northing	Easting	
Day 3	Low	LW6.7	2/8/2017	9:03	26734766.8596	829555.863160	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 3	Low	LW6.05	2/8/2017	9:35	26734195.7184	832631.194936	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 3	Low	LWC6.1_1 [t/ss]	2/8/2017	9:45	36° 05' 09.6816" N	114° 59' 10.3146" W	Converted coordinates: 26733475.5115 UTM Northing, 832597.642981 UTM Easting
Day 3	Low	LWC6.1_2 [t/ss]	2/8/2017	10:00	36° 05' 09.2809" N	114° 59' 10.6487" W	Converted coordinates: 26733434.8266 UTM Northing, 832570.470791 UTM Easting
Day 3	Low	GLWC6.1_3 [t/ss]	2/8/2017	10:05	36° 05' 10.3140" N	114° 59' 10.7670" W	t/ss. Converted coordinates: 26733539.2286 UTM Northing, 832560.120312 UTM Easting
Day 3	Low	GLWC6.1_4 [t/ss]	2/8/2017	11:20	36° 05' 14.8944" N	114° 59' 10.9785" W	t/ss. Converted coordinates: 26734002.2679 UTM Northing, 832539.919416 UTM Easting
Day 3	Low	LW5.9	2/8/2017	10:35	36° 05' 15.9718" N	114° 58' 59.9401" W	Converted coordinates: 26734116.783 UTM Northing, 833445.194803 UTM Easting
Day 3	Low	LW5.3	2/8/2017	10:00	26734887.8450	836462.156762	Coordinates duplicated (shallow sample)
Day 3	Low	LW5.3	2/8/2017	10:03	26734887.8450	836462.156762	Coordinates duplicated (deep sample)
Day 3	Low	LW4.95	2/8/2017	10:30	26735810.1853	838356.295691	
Day 3	Low	GLW4.9	2/8/2017	10:50	26735747.2766	838930.895591	
Day 3	Low	GLW4.85	2/8/2017	9:45	26735881.1461	839340.944968	
Day 3	Low	GLW4.4	2/8/2017	10:07	26736803.9428	841944.462727	
Day 3	Low	LW4.1	2/8/2017	10:22	26736832.0458	842707.967105	
Day 3	Low	LW3.85	2/8/2017	9:27	26737238.3288	844063.588500	Missing GPS Waypoint Data. Coordinates recorded in Field Notes
Day 3	Low	GLW3.78	2/8/2017	10:10	26737448.1991	844428.807824	
Day 3	Low	LW3.75	2/8/2017	9:57	26737667.1754	Error	GPS malfunction
Day 3	Low	LWC3.7 [t/ss]	2/8/2017	9:48	26737565.9731	844536.993959	
Day 3	Low	LW3.4	2/8/2017	10:30	26738904.5820	845421.363600	
Day 3	Mid	LW7.2	2/8/2017	11:07	26735154.1764	828169.516523	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 3	Mid	LW6.05	2/8/2017	12:35	26734195.7184	832631.194936	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 3	Mid	LW4.95	2/8/2017	13:05	26735809.4675	838354.471875	
Day 3	Mid	GLW4.4	2/8/2017	13:47	26736803.1138	841944.901046	
Day 3	Mid	LW3.4	2/8/2017	14:18	26738907.3651	845419.535829	
Day 3	High	LW7.2	2/8/2017	14:40	26735154.1764	828169.516523	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 3	High	LW6.7	2/8/2017	15:02	26734766.8596	829555.863160	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 3	High	LW6.05	2/8/2017	15:36	26734195.7184	832631.194936	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 3	High	LWC6.1_1 [t/ss]	2/8/2017	14:43	36° 05' 09.6956" N	114° 59' 10.2516" W	Converted coordinates: 26733476.9589 UTM Northing, 832602.804943 UTM Easting
Day 3	High	LWC6.1_2 [t/ss]	2/8/2017	14:53	36° 05' 09.2634" N	114° 59' 10.6608" W	Converted coordinates: 26733433.051 UTM Northing, 832569.488557 UTM Easting
Day 3	High	GLWC6.1_3 [t/ss]	2/8/2017	15:00	36° 05' 10.3593" N	114° 59' 10.7542" W	t/ss. Converted coordinates: 26733543.8155 UTM Northing, 832561.142742 UTM Easting
Day 3	High	GLWC6.1_4 [t/ss]	2/8/2017	16:07	36° 05' 14.9361" N	114° 59' 10.7070" W	t/ss. Converted coordinates: 26734006.6211 UTM Northing, 832562.176176 UTM Easting
Day 3	High	LW5.9	2/8/2017	15:41	36° 05' 15.9590" N	114° 58' 59.9295" W	Converted coordinates: 26734115.4941 UTM Northing, 833446.07275 UTM Easting
Day 3	High	LW5.3	2/8/2017	15:45	26734889.1159	836461.533404	Coordinates duplicated (shallow sample)
Day 3	High	LW5.3	2/8/2017	15:50	26734889.1159	836461.533404	Coordinates duplicated (deep sample)
Day 3	High	LW4.95	2/8/2017	16:20	26735807.7306	838354.144120	
Day 3	High	GLW4.9	2/8/2017	16:35	26735747.8042	838931.327021	
Day 3	High	GLW4.85	2/8/2017	16:00	26735887.0946	839339.005339	
Day 3	High	GLW4.4	2/8/2017	16:21	26736805.6256	841942.107088	
Day 3	High	LW4.1	2/8/2017	16:33	26736834.8368	842707.586857	
Day 3	High	LW3.85	2/8/2017	16:05	26737240.4931	844061.666498	
Day 3	High	GLW3.78	2/8/2017	16:42	26737448.4917	844427.161173	
Day 3	High	LW3.75	2/8/2017	16:30	26737664.6701	844380.716056	
Day 3	High	LWC3.7 [t/ss]	2/8/2017	16:20	26737565.3143	844533.514635	
Day 3	High	LW3.4	2/8/2017	17:05	26738901.5134	845417.720544	
Day 4	Low	LW7.2	2/9/2017	8:56	26735154.1764	828169.516523	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	Low	LW6.7	2/9/2017	9:11	26734766.8596	829555.863160	Did not collect coordinates (Stations Staked). Coordinates from December 2016.

Table 11 GPS Coordinates: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample Day	Targeted Flow	Location ID	Date and Time of Sample Collection		GPS Coordinates		Additional Information
					Northing	Easting	
Day 4	Low	LW6.05	2/9/2017	9:31	26734195.7184	832631.194936	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	Low	LWC6.1_1 [t/ss]	2/9/2017	9:10	36° 05' 09.6459" N	114° 59' 10.2078" W	Converted coordinates: 26733471.9556 UTM Northing, 832606.430628 UTM Easting
Day 4	Low	LWC6.1_2 [t/ss]	2/9/2017	9:25	36° 05' 09.3077" N	114° 59' 10.6846" W	Converted coordinates: 26733437.5184 UTM Northing, 832567.507704 UTM Easting
Day 4	Low	GLWC6.1_3 [t/ss]	2/9/2017	9:32	36° 05' 10.2657" N	114° 59' 10.7493" W	t/ss. Converted coordinates: 26733534.3536 UTM Northing, 832561.60299 UTM Easting
Day 4	Low	GLWC6.1_4 [t/ss]	2/9/2017	10:33	36° 05' 14.7784" N	114° 59' 10.9370" W	t/ss. Converted coordinates: 26733990.5595 UTM Northing, 832543.397403 UTM Easting
Day 4	Low	LW5.9	2/9/2017	10:01	36° 05' 15.8657" N	114° 58' 59.8537" W	Converted coordinates: 26734106.0985 UTM Northing, 833452.352009 UTM Easting
Day 4	Low	LW5.3	2/9/2017	10:00	26734889.0690	836463.610500	Coordinates duplicated (shallow sample)
Day 4	Low	LW5.3	2/9/2017	10:03	26734889.0690	836463.610500	Coordinates duplicated (deep sample)
Day 4	Low	LW4.95	2/9/2017	10:35	26735806.7716	838356.088342	
Day 4	Low	GLW4.9	2/9/2017	10:50	26735747.4928	838932.849656	
Day 4	Low	GLW4.85	2/9/2017	9:58	26735901.5496	839338.536180	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	Low	GLW4.4	2/9/2017	10:22	26736802.1895	841941.137930	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	Low	LW4.1	2/9/2017	10:38	26736833.1567	842708.315530	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	Low	LW3.85	2/9/2017	10:30	26737240.8553	844063.666822	
Day 4	Low	GLW3.78	2/9/2017	11:28	26737449.2575	844429.193650	
Day 4	Low	LW3.75	2/9/2017	10:58	26737664.0159	844381.547420	
Day 4	Low	LWC3.7 [t/ss]	2/9/2017	10:48	26737565.0282	844536.931295	
Day 4	Low	LW3.4	2/9/2017	12:00	26738904.2733	845419.821918	
Day 4	Mid	LW7.2	2/9/2017	10:52	26735154.1764	828169.516523	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	Mid	LW6.05	2/9/2017	12:00	26734195.7184	832631.194936	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	Mid	LW4.95	2/9/2017	12:30	26735808.4219	838354.430209	
Day 4	Mid	GLW4.4	2/9/2017	13:11	26736802.1895	841941.137930	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	Mid	LW3.4	2/9/2017	13:33	26738904.3412	845419.812700	
Day 4	High	LW7.2	2/9/2017	14:41	26735154.1764	828169.516523	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	High	LW6.7	2/9/2017	15:04	26734766.8596	829555.863160	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	High	LW6.05	2/9/2017	15:23	26734195.7184	832631.194936	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	High	LWC6.1_1 [t/ss]	2/9/2017	14:39	36° 05' 09.7005" N	114° 59' 10.2909" W	Converted coordinates: 26733477.4345 UTM Northing, 832599.576399 UTM Easting
Day 4	High	LWC6.1_2 [t/ss]	2/9/2017	14:52	36° 05' 09.3136" N	114° 59' 10.6776" W	Converted coordinates: 26733438.1185 UTM Northing, 832568.07856 UTM Easting
Day 4	High	GLWC6.1_3 [t/ss]	2/9/2017	14:57	36° 05' 10.2903" N	114° 59' 10.7594" W	t/ss. Converted coordinates: 26733536.836 UTM Northing, 832560.75878 UTM Easting
Day 4	High	GLWC6.1_4 [t/ss]	2/9/2017	15:51	36° 05' 14.8989" N	114° 59' 11.1918" W	t/ss. Converted coordinates: 26734002.6155 UTM Northing, 832522.410593 UTM Easting
Day 4	High	LW5.9	2/9/2017	15:27	36° 05' 15.8877" N	114° 58' 59.9175" W	Converted coordinates: 26734108.2907 UTM Northing, 833447.102088 UTM Easting
Day 4	High	LW5.3	2/9/2017	15:15	26734890.5677	836465.120667	Coordinates duplicated (shallow sample)
Day 4	High	LW5.3	2/9/2017	15:18	26734890.5677	836465.120667	Coordinates duplicated (deep sample)
Day 4	High	LW4.95	2/9/2017	15:40	26735807.5360	838353.319647	
Day 4	High	GLW4.9	2/9/2017	15:53	26735747.9321	838931.861140	
Day 4	High	GLW4.85	2/9/2017	15:18	26735901.5496	839338.536180	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	High	GLW4.4	2/9/2017	15:44	26736802.1895	841941.137930	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	High	LW4.1	2/9/2017	16:02	26736833.1567	842708.315530	Did not collect coordinates (Stations Staked). Coordinates from December 2016.
Day 4	High	LW3.85	2/9/2017	15:45	26737236.7156	844062.678307	
Day 4	High	GLW3.78	2/9/2017	16:30	26737445.4478	844427.814387	
Day 4	High	LW3.75	2/9/2017	16:11	26737662.7206	844379.987383	
Day 4	High	LWC3.7 [t/ss]	2/9/2017	16:00	26737562.6181	844536.418173	
Day 4	High	LW3.4	2/9/2017	16:55	26738902.1695	845423.273700	

Notes:
ID - Identification
t/ss - tributary/side stream; added for clarity and not part of actual Location ID

Table 12 Samples Collected: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID (Append HH:MM-Interval)	Timing	QC Type	Date Sampled	Time
DAY 1				
TEAM 1				
LW3.85-20170206-09:53-0.6	low flow		2/6/2017	9:53
GLW3.78-20170206-10:45-0.42	low flow		2/6/2017	10:45
LW3.75-20170206-10:25-0.83	low flow		2/6/2017	10:25
LWC3.7-20170206-10:16-0.33	low flow		2/6/2017	10:16
LW3.4-20170206-11:10-0.42	low flow		2/6/2017	11:10
LW3.4-20170206-14:46-0.63	mid flow		2/6/2017	14:46
LW3.85-20170206-16:03-0.58	high flow		2/6/2017	16:03
GLW3.78-20170206-16:40-0.96	high flow		2/6/2017	16:40
LW3.75-20170206-16:30-0.67	high flow		2/6/2017	16:30
LWC3.7-20170206-16:20-0.58	high flow		2/6/2017	16:20
LW3.4-20170206-17:01-0.7	high flow		2/6/2017	17:01
LW3.4-20170206-17:01-0.7-FD	high flow	FD	2/6/2017	17:01
LW3.85-20170206-1300-FB		FB	2/6/2017	
LW3.85-201702061300-EB		EB	2/6/2017	
TEAM 2				
GLW4.85-20170206-10:22-0.6	low flow		2/6/2017	10:22
GLW4.4-20170206-11:04-1.1	low flow		2/6/2017	11:04
LW4.1-20170206-11:20-0.3	low flow		2/6/2017	11:20
GLW4.4-20170206-14:15-1.2	mid flow		2/6/2017	14:15
GLW4.85-20170206-15:58-0.6	high flow		2/6/2017	15:58
GLW4.4-20170206-16:19-1.3	high flow		2/6/2017	16:19
LW4.1-20170206-16:42-0.6	high flow		2/6/2017	16:42
GLW4.4-20170206-14:55-FB		FB	2/6/2017	
GLW4.4-20170206-14:58-EB		EB	2/6/2017	
TEAM 3				
LW5.3-20170206-10:00-1.2	low flow shallow		2/6/2017	10:00
LW5.3-20170206-10:35-2.35	low flow deep		2/6/2017	10:35
LW4.95-20170206-11:30-1.1	low flow		2/6/2017	11:30
GLW4.9-20170206-11:15-1.45	low flow		2/6/2017	11:15
LW4.95-20170206-13:20-1.08	mid flow		2/6/2017	13:20
LW5.3-20170206-16:00-1.2	high flow shallow		2/6/2017	16:00
LW5.3-20170206-16:10-2.3	high flow deep		2/6/2017	16:10
LW4.95-20170206-15:15-1.1	high flow		2/6/2017	15:15
GLW4.9-20170206-15:00-1.5	high flow		2/6/2017	15:00
LW5.3-20170206-14:26-FB		FB	2/6/2017	
LW5.3-20170206-14:24-EB		EB w/pump	2/6/2017	
TEAM 4				
LWC6.1_1-20170206-09:45-0.58	low flow		2/6/2017	9:45
LWC6.1_2-20170206-10:00-0.8	low flow		2/6/2017	10:00
GLWC6.1_3-20170206-10:07-1.0	low flow		2/6/2017	10:07
GLWC6.1_4-20170206-10:35-1.1	low flow		2/6/2017	10:35
LW5.9-20170206-11:08-0.5	low flow		2/6/2017	11:08
LWC6.1_1-20170206-14:43-0.8	high flow		2/6/2017	14:43
LWC6.1_2-20170206-15:55-0.6	high flow		2/6/2017	15:55
GLWC6.1_3-20170206-15:00-0.9	high flow		2/6/2017	15:00
GLWC6.1_4-20170206-15:45-1.3	high flow		2/6/2017	15:45
GLWC6.1_4-20170206-15:45-1.3-FD	high flow	FD	2/6/2017	15:45
LW5.9-20170206-15:18-0.6	high flow		2/6/2017	15:18
LW5.9-20170206-14:23-EB		EB	2/6/2017	14:23

Table 12 Samples Collected: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID (Append HH:MM-Interval)	Timing	QC Type	Date Sampled	Time
TEAM 5				
LW7.2-20170206-09:45-0.8	low flow		2/6/2017	9:45
LW6.7-20170206-10:15-0.4	low flow		2/6/2017	10:15
LW6.05-20170206-11:20-0.6	low flow		2/6/2017	11:20
LW7.2-20170206-12:10-0.8	mid flow		2/6/2017	12:10
LW6.05-20170206-12:36-0.7	mid flow		2/6/2017	12:36
LW7.2-20170206-14:30-1.0	high flow		2/6/2017	14:30
LW7.2-20170206-14:30-1.0-FD	high flow	FD	2/6/2017	14:30
LW6.7-20170206-15:00-0.6	high flow		2/6/2017	15:00
LW6.05-20170206-15:26-0.7	high flow		2/6/2017	15:26
LW7.2-20170206-15:50-EB		EB	2/6/2017	15:50
DAY 2				
TEAM 1				
LW3.85-20170207-10:12-0.5	low flow		2/7/2017	10:12
GLW3.78-20170207-09:35-0.7	low flow		2/7/2017	9:35
LW3.75-20170207-10:45-0.9	low flow		2/7/2017	10:45
LWC3.7-20170207-10:32-0.4	low flow		2/7/2017	10:32
LW3.4-20170207-11:11-0.5-MS	low flow	MS	2/7/2017	11:11
LW3.4-20170207-11:11-0.5-MSD	low flow	MSD	2/7/2017	11:11
LW3.4-20170207-11:11-0.5	low flow		2/7/2017	11:11
LW3.4-20170207-14:35-0.6	mid flow		2/7/2017	14:35
LW3.85-20170207-15:50-0.6	high flow		2/7/2017	15:50
LW3.85-20170207-15:50-0.6-FD	high flow	FD	2/7/2017	15:50
GLW3.78-20170207-16:35-1.2	high flow		2/7/2017	16:35
LW3.75-20170207-16:25-1.0	high flow		2/7/2017	16:25
LWC3.7-20170207-16:10-0.6	high flow		2/7/2017	16:10
LW3.4-20170207-17:00-0.7	high flow		2/7/2017	17:00
TEAM 2				
GLW4.85-20170207-09:42-0.7	low flow		2/7/2017	9:42
GLW4.4-20170207-10:18-1.1	low flow		2/7/2017	10:18
LW4.1-20170207-10:39-0.3-MS	low flow	MS	2/7/2017	10:39
LW4.1-20170207-10:39-0.3-MSD	low flow	MSD	2/7/2017	10:39
LW4.1-20170207-10:39-0.3	low flow		2/7/2017	10:39
GLW4.4-20170207-14:11-1.3	mid flow		2/7/2017	14:11
GLW4.4-20170207-14:11-1.3-FD	mid flow	FD	2/7/2017	14:11
GLW4.85-20170207-15:42-0.8	high flow		2/7/2017	15:42
GLW4.85-20170207-15:42-0.8-FD	high flow	FD	2/7/2017	15:42
GLW4.4-20170207-16:06-1.2	high flow		2/7/2017	16:06
LW4.1-20170207-16:20-0.4	high flow		2/7/2017	16:20
TEAM 3				
LW5.3-20170207-09:45-1.0	low flow shallow		2/7/2017	9:45
LW5.3-20170207-09:50-2.0	low flow deep		2/7/2017	9:50
LW4.95-20170207-10:45-1.0	low flow		2/7/2017	10:45
GLW4.9-20170207-10:55-1.2-MS	low flow	MS	2/7/2017	10:55
GLW4.9-20170207-10:55-1.2-MSD	low flow	MSD	2/7/2017	10:55
GLW4.9-20170207-10:55-1.2	low flow		2/7/2017	10:55
LW4.95-20170207-13:25-1.2	mid flow		2/7/2017	13:25
LW5.3-20170207-15:45-1.2	high flow shallow		2/7/2017	15:45
LW5.3-20170207-15:50-2.4	high flow deep		2/7/2017	15:50
LW4.95-20170207-16:30-1.2	high flow		2/7/2017	16:30
LW4.95-20170207-16:30-1.2-FD	high flow	FD	2/7/2017	16:30
GLW4.9-20170207-16:45-1.4	high flow		2/7/2017	16:45

Table 12 Samples Collected: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID (Append HH:MM-Interval)	Timing	QC Type	Date Sampled	Time
TEAM 4				
LWC6.1_1-20170207-09:03-0.9	low flow		2/7/2017	9:09
LWC6.1_2-20170207-09:20-0.7	low flow		2/7/2017	9:20
GLWC6.1_3-20170207-09:30-1.0	low flow		2/7/2017	9:30
GLWC6.1_4-20170207-10:35-1.3	low flow		2/7/2017	10:35
LW5.9-20170207-10:00-0.4-MS	low flow	MS	2/7/2017	10:00
LW5.9-20170207-10:00-0.4-MSD	low flow	MSD	2/7/2017	10:00
LW5.9-20170207-10:00-0.4	low flow		2/7/2017	10:00
LWC6.1_1-20170207-14:45-0.8	high flow		2/7/2017	14:45
LWC6.1_2-20170207-14:58-0.7	high flow		2/7/2017	14:58
GLWC6.1_3-20170207-15:06-0.9	high flow		2/7/2017	15:06
GLWC6.1_3-20170207-15:06-0.9-FD	high flow	FD	2/7/2017	15:06
GLWC6.1_4-20170207-16:10-1.3	high flow		2/7/2017	16:10
LW5.9-20170207-15:27-0.6	high flow		2/7/2017	15:27
TEAM 5				
LW7.2-20170207-08:55-0.7	low flow		2/7/2017	8:55
LW6.7-20170207-09:13-0.4	low flow		2/7/2017	9:13
LW6.05-20170207-09:30-0.6-MS	low flow	MS	2/7/2017	9:30
LW6.05-20170207-09:30-0.6-MSD	low flow	MSD	2/7/2017	9:30
LW6.05-20170207-09:30-0.6	low flow		2/7/2017	9:30
LW7.2-20170207-10:55-0.8	mid flow		2/7/2017	10:55
LW6.05-20170207-11:20-0.6	mid flow		2/7/2017	11:20
LW7.2-20170207-14:02-0.9	high flow		2/7/2017	14:02
LW6.7-20170207-14:25-0.6	high flow		2/7/2017	14:25
LW6.7-20170207-14:25-0.6-FD	high flow	FD	2/7/2017	14:25
LW6.05-20170207-14:48-0.7	high flow		2/7/2017	14:48
DAY 3				
TEAM 1				
LW3.85-20170208-09:27-0.5	low flow		2/8/2017	9:27
LW3.85-20170208-09:27-0.5-FD	low flow	FD	2/8/2017	9:27
GLW3.78-20170208-10:10-0.58	low flow		2/8/2017	10:10
LW3.75-20170208-09:57-0.8	low flow		2/8/2017	9:57
LWC3.7-20170208-09:48-0.5	low flow		2/8/2017	9:48
LW3.4-20170208-10:55-FB	low flow	FB	2/8/2017	10:55
LW3.4-20170208-10:30-0.5	low flow		2/8/2017	10:30
LW3.4-20170208-14:18-0.6	mid flow		2/8/2017	14:18
LW3.85-20170208-16:05-0.5	high flow		2/8/2017	16:05
GLW3.78-20170208-16:42-1.4	high flow		2/8/2017	16:42
LW3.75-20170208-16:30-1.0	high flow		2/8/2017	16:30
LWC3.7-20170208-16:20-0.5	high flow		2/8/2017	16:20
LW3.4-20170208-17:05-0.6	high flow		2/8/2017	17:05
TEAM 2				
GLW4.85-20170208-09:45-0.6	low flow		2/8/2017	9:45
GLW4.4-20170208-11:02-EB	low flow	EB	2/8/2017	11:02
GLW4.4-20170208-10:07-1.1	low flow		2/8/2017	10:07
LW4.1-20170208-11:12-FB	low flow	FB	2/8/2017	11:12
LW4.1-20170208-10:22-0.4	low flow		2/8/2017	10:22
LW4.1-20170208-10:22-0.4-FD	low flow	FD	2/8/2017	10:22
GLW4.4-20170208-13:47-1.2	mid flow		2/8/2017	13:47
GLW4.85-20170208-16:00-0.8	high flow		2/8/2017	16:00
GLW4.4-20170208-16:21-1.3	high flow		2/8/2017	16:21
LW4.1-20170208-16:33-0.4	high flow		2/8/2017	16:33

Table 12 Samples Collected: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID (Append HH:MM-Interval)	Timing	QC Type	Date Sampled	Time
TEAM 3				
LW5.3-20170208-10:00-1.0	low flow shallow		2/8/2017	10:00
LW5.3-20170208-10:03-2.0	low flow deep		2/8/2017	10:03
LW4.95-20170208-11:06-EB	low flow	EB	2/8/2017	11:06
LW4.95-20170208-10:30-1.1	low flow		2/8/2017	10:30
GLW4.9-20170208-11:09-FB	low flow	FB	2/8/2017	11:00
GLW4.9-20170208-10:50-1.2	low flow		2/8/2017	10:50
LW4.95-20170208-13:05-1.2	mid flow		2/8/2017	13:05
LW5.3-20170208-15:45-1.2	high flow shallow		2/8/2017	15:45
LW5.3-20170208-15:50-2.4	high flow deep		2/8/2017	15:50
LW4.95-20170208-16:20-1.3	high flow		2/8/2017	16:20
GLW4.9-20170208-16:35-1.4	high flow		2/8/2017	16:35
GLW4.9-20170208-16:35-1.4-FD	high flow	FD	2/8/2017	16:35
TEAM 4				
LWC6.1_1-20170208-11:40-EB	low flow	EB	2/8/2017	11:40
LWC6.1_1-20170208-09:45-0.9	low flow		2/8/2017	9:45
LWC6.1_2-20170208-10:00-0.6	low flow		2/8/2017	10:00
GLWC6.1_3-20170208-10:05-1.2	low flow		2/8/2017	10:05
GLWC6.1_4-20170208-10:35-1.3	low flow		2/8/2017	10:35
GLWC6.1_4-20170208-10:35-1.3-FD	low flow	FD	2/8/2017	10:35
LW5.9-20170208-11:45-FB	low flow	FB	2/8/2017	11:45
LW5.9-20170208-10:35-0.4	low flow		2/8/2017	10:35
LWC6.1_1-20170208-14:43-0.7	high flow		2/8/2017	14:43
LWC6.1_2-20170208-14:53-0.7	high flow		2/8/2017	14:53
GLWC6.1_3-20170208-15:00-1.0	high flow		2/8/2017	15:00
GLWC6.1_4-20170208-16:07-1.0	high flow		2/8/2017	16:07
LW5.9-20170208-15:41-0.6	high flow		2/8/2017	15:41
TEAM 5				
LW7.2-20170208-08:45-0.7	low flow		2/8/2017	8:45
LW6.7-20170208-10:35-EB	low flow	EB	2/8/2017	10:35
LW6.7-20170208-09:03-0.3	low flow		2/8/2017	9:03
LW6.05-20170208-10:30-FB	low flow	FB	2/8/2017	10:30
LW6.05-20170208-09:35-0.5	low flow		2/8/2017	9:35
LW7.2-20170208-11:07-0.8	mid flow		2/8/2017	11:07
LW6.05-20170208-12:35-0.8	mid flow		2/8/2017	12:35
LW6.05-20170208-12:35-0.8-FD	mid flow	FD	2/8/2017	12:35
LW7.2-20170208-14:40-0.9	high flow		2/8/2017	14:40
LW6.7-20170208-15:02-0.6	high flow		2/8/2017	15:02
LW6.05-20170208-15:36-0.7	high flow		2/8/2017	15:36
DAY 4				
TEAM 1				
LW3.85-20170209-10:30-0.5	low flow		2/9/2017	10:30
GLW3.78-20170209-11:28-0.3	low flow		2/9/2017	11:28
LW3.75-20170209-10:58-0.5	low flow		2/9/2017	10:58
LWC3.7-20170209-10:48-0.4	low flow		2/9/2017	10:48
LW3.4-20170209-12:00-0.5	low flow		2/9/2017	12:00
LW3.4-20170209-13:33-0.5	mid flow		2/9/2017	13:33
LW3.4-20170209-13:33-0.5-FD	mid flow	FD	2/9/2017	13:33
LW3.85-20170209-15:45-0.6	high flow		2/9/2017	15:45
GLW3.78-20170209-16:30-1.4	high flow		2/9/2017	16:30
LW3.75-20170209-16:11-0.8	high flow		2/9/2017	16:11
LWC3.7-20170209-16:00-0.6	high flow		2/9/2017	16:00
LW3.4-20170209-16:55-0.6	high flow		2/9/2017	16:55

Table 12 Samples Collected: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Sample ID (Append HH:MM-Interval)	Timing	QC Type	Date Sampled	Time
TEAM 2				
GLW4.85-20170209-09:58-0.7	low flow		2/9/2017	9:58
GLW4.4-20170209-10:22-1.1	low flow		2/9/2017	10:22
LW4.1-20170209-10:38-0.3	low flow		2/9/2017	10:38
GLW4.4-20170209-13:11-1.2	mid flow		2/9/2017	13:11
GLW4.4-20170209-13:11-1.2-MS	mid flow	MS	2/9/2017	13:11
GLW4.4-20170209-13:11-1.2-MSD	mid flow	MSD	2/9/2017	13:11
GLW4.85-20170209-15:18-0.8	high flow		2/9/2017	15:18
GLW4.4-20170209-15:44-1.3	high flow		2/9/2017	15:44
LW4.1-20170209-16:02-0.4	high flow		2/9/2017	16:02
LW4.1-20170209-16:02-0.4-FD	high flow	FD	2/9/2017	16:02
TEAM 3				
LW5.3-20170209-10:00-1.0	low flow shallow		2/9/2017	10:00
LW5.3-20170209-10:03-2.0	low flow deep		2/9/2017	10:03
LW4.95-20170209-10:35-1.0	low flow		2/9/2017	10:35
LW4.95-20170209-10:35-1.0-FD	low flow	FD	2/9/2017	10:35
GLW4.9-20170209-10:50-1.2	low flow		2/9/2017	10:50
LW4.95-20170209-12:30-1.1	mid flow		2/9/2017	12:30
LW4.95-20170209-12:30-1.1-MS	mid flow	MS	2/9/2017	12:30
LW4.95-20170209-12:30-1.1-MSD	mid flow	MSD	2/9/2017	12:30
LW5.3-20170209-15:15-1.1	high flow shallow		2/9/2017	15:15
LW5.3-20170209-15:18-1.2	high flow deep		2/9/2017	15:18
LW4.95-20170209-15:40-1.2	high flow		2/9/2017	15:40
GLW4.9-20170209-15:53-1.4	high flow		2/9/2017	15:53
TEAM 4				
LWC6.1_1-20170209-09:10-1.0	low flow		2/9/2017	9:10
LWC6.1_2-20170209-09:25-0.6	low flow		2/9/2017	9:25
GLWC6.1_3-20170209-09:32-1.2	low flow		2/9/2017	9:32
GLWC6.1_4-20170209-10:33-1.3	low flow		2/9/2017	10:33
GLWC6.1_4-20170209-10:33-1.3-MS	low flow	MS	2/9/2017	10:33
GLWC6.1_4-20170209-10:33-1.3-MSD	low flow	MSD	2/9/2017	10:33
LW5.9-20170209-10:01-0.4	low flow		2/9/2017	10:01
LWC6.1_1-20170209-14:39-1.1	high flow		2/9/2017	14:39
LWC6.1_1-20170209-14:39-1.1-FD	high flow	FD	2/9/2017	14:39
LWC6.1_2-20170209-14:52-0.8	high flow		2/9/2017	14:52
GLWC6.1_3-20170209-14:57-1.1	high flow		2/9/2017	14:57
GLWC6.1_4-20170209-15:51-1.6	high flow		2/9/2017	15:51
LW5.9-20170209-15:27-0.7	high flow		2/9/2017	15:27
TEAM 5				
LW7.2-20170209-08:56-0.7	low flow		2/9/2017	8:56
LW6.7-20170209-09:11-0.3	low flow		2/9/2017	9:11
LW6.05-20170209-09:31-0.5	low flow		2/9/2017	9:31
LW6.05-20170209-10:40-FB	low flow	FB	2/9/2017	10:40
LW7.2-20170209-10:52-0.8	mid flow		2/9/2017	10:52
LW7.2-20170209-10:52-0.8-MS	mid flow	MS	2/9/2017	10:52
LW7.2-20170209-10:52-0.8-MSD	mid flow	MSD	2/9/2017	10:52
LW6.05-20170209-12:00-0.6	mid flow		2/9/2017	12:00
LW7.2-20170209-14:41-0.9	high flow		2/9/2017	14:41
LW7.2-20170209-14:41-0.9-FD	high flow	FD	2/9/2017	14:41
LW6.7-20170209-15:04-0.6	high flow		2/9/2017	15:04
LW6.05-20170209-15:23-0.7	high flow		2/9/2017	15:23

Notes:
FD - field duplicate
FB - field blank
EB - equipment blank
MS - matrix spike
MSD - matrix spike duplicate
QC - quality control
Sample ID comprised of "Location"-"YYYYMMDD"-"Depth"-"QC type if applicable"
YYMMDD - YearMonthDay (example 20170209 is February 9, 2017)

Table 13 Analytical Program for Surface Water Samples
NERT Remedial Investigation, Downgradient Study Area, Henderson, Nevada

Analytes	Matrix	Analytical Method	Analytical Laboratory
Perchlorate	Water	EPA Method 314.0 (1)	TestAmerica (Irvine, CA)
Chlorate	Water	EPA Method 300.1	TestAmerica (Irvine, CA)
Chloride (2)	Water	EPA Method 300.0	TestAmerica (Irvine, CA)
Bromide (2)	Water	EPA Method 300.0	TestAmerica (Irvine, CA)
Total Dissolved Solids	Water	SM 2540C	TestAmerica (Irvine, CA)

Notes:

EPA = United States Environmental Protection Agency

SM = Standard Method

MDL = Method Detection Limit

All groundwater and surface water samples will be analyzed for the constituents listed above.

1) For this NERT RI Downgradient Study Area, field-filtering of surface water samples for perchlorate analysis is not required (NDEP 2015).

2) Although included in the analytical suite, consideration was given to removal of chloride and bromide from the sampling suite. The chloride and bromide results from the May 2016 grab sampling event did not provide usable information pertaining to potential groundwater discharge to the LVW.

Sources:

NDEP. 2015. Email from James Dotchkin, Chief Bureau of Industrial Site Cleanup, Nevada Division of Environmental Protection, re: Sterile Filtration Not Required for NERT Regional Groundwater RI Perchlorate Samples, November 18.

Table 14 Analytical Results: Sampling Event during USGS Seepage Study
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Bromide (mg/L)	Chlorate (µg/L)	Chloride (mg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
LW7.2	LW7.2-20161208-1.0	12/8/2016	15:45	1.0	230	200	ND (<0.95)	1200
LW6.7	LW6.7-20161208-0.5	12/8/2016	15:10	2.0	64	240	ND (<0.95)	1400
LW6.05	LW6.05-20161208-0.5	12/8/2016	13:50	1.0	47	230	6.2 J	1400
GLWC6.1_3 [t/ss]	GLWC6.1_3-20161208-0.5	12/8/2016	12:20	0.32 J	120	200	1.7 J	1000
GLWC6.1_4 [t/ss]	GLWC6.1_4-20161208-0.5	12/8/2016	13:25	0.64 J	110	350	1.5 J	1500
LWC6.1_2 [t/ss]	LW6.1_2-20161208-0.5	12/8/2016	12:10	0.31 J	20	84	ND (<0.95)	620
LWC6.1_1 [t/ss]	LWC6.1_1-20161208-0.5	12/8/2016	11:48	1.2	160	230	ND (<0.95)	1200
LW5.9	LW5.9-20161208-0.5	12/8/2016	10:25	0.74	57	250	9.8	1400
LW5.3	LW5.3-20161208-1.0	12/8/2016	9:29	0.56 J	53	250	15 J	1400
LW5.3	LW5.3-20161208-2.5	12/8/2016	9:34	0.59 J	55	250	12 J	1400
LW4.95	LW4.95-20161208-0.7	12/8/2016	14:02	0.57	69	250	9.4	1400
GLW4.9	GLW4.9-20161208-1.1	12/8/2016	14:20	2.0	83	250	14	1400
GLW4.85	GLW4.85-20161208-0.8	12/8/2016	14:50	1.8	980	290	270	1600
GLW4.4	GLW4.4-20161208-1.1	12/8/2016	12:10	1.6	86	250	23	1400
LW4.1	LW4.1-20161208-0.2	12/8/2016	11:32	0.51	500	250	47 J	1400
LW3.85	LW3.85-20161208-0.3	12/8/2016	10:40	0.50	100	250	24 J	1400
LW3.85	LW3.85-20161208-0.3-FD	12/8/2016	10:40	0.54 J	96	250	25 J	1400
GLW3.78	GLW3.78-20161208-0.1	12/8/2016	10:12	0.79	190	250	41	1400
LW3.75	LW3.75-20161208-0.3	12/8/2016	9:12	0.79	92	250	20	1300
LWC3.7 [t/ss]	LWC3.7-20161208-0.6	12/8/2016	9:30	2.4 J	4300	490	1600	3300
LWC3.7 [t/ss]	LWC3.7-20161208-0.6-FD	12/8/2016	9:30	2.9	4300	490	1600	3200
LW3.4	LW3.4-20161208-0.5	12/8/2016	8:23	0.46 J	130	250	33 J	1400

ND - Not Detected above associated method detection limit
J - Estimated concentration between method detection limit and method reporting limit
µg/L - Micrograms per liter
mg/L - Milligrams per liter
t/ss - tributary/side stream; added for clarity and not part of actual Location ID
ID - identification

Table 15 Analytical Results: Transect Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Bromide (mg/L)	Chlorate (µg/L)	Chloride (mg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
Transect T6.8								
T6.8_A	T6.8A-20170203-1.0	2/3/2017	9:13	1.3	51	250	ND (<0.95)	1500
T6.8_B	T6.8B-20170203-1.3	2/3/2017	9:25	1.6	59	270	ND (<0.95)	1700
T6.8_C	T6.8C-20170203-0.4	2/3/2017	9:32	1.8	73	290	1.6 J	1900
T6.8_D	T6.8D-20170203-0.9	2/3/2017	9:41	0.64	52	230	ND (<0.95)	1300
T6.8_E	T6.8E-20170203-0.7	2/3/2017	9:50	0.77	48	240	ND (<0.95)	1200
Transect T6.35								
T6.35_A	T6.35A-20170203-1.5	2/3/2017	09:32	0.31 J	55	260	18	1500
T6.35_B	T6.35B-20170203-1.0	2/3/2017	9:55	0.57	53	270	17	1600
T6.35_B	T6.35B-20170203-3.0	2/3/2017	9:44	0.32 J	56	270	18	1500
T6.35_C	T6.35C-20170203-1.0	2/3/2017	9:19	ND (<0.25)	57	270	18	1600
Transect T6								
T6_A	T6A-20170202-0.9	2/2/2017	9:00	ND (<0.50)	49	290	16	1500
T6_B	T6B-20170202-1.7	2/2/2017	9:05	ND (<0.50)	49	290	16	1500
T6_C	T6C-20170202-1.7	2/2/2017	9:13	ND (<0.50)	50	280	16	1500
T6_D	T6D-20170202-0.4	2/2/2017	9:18	ND (<0.50)	50	280	15	1500
Transect T5.3								
T5.3_A	T5.3A-20170202-1.4	2/2/2017	9:32	0.30 J	140	300	32	1500
T5.3_A	T5.3A-20170202-2.8	2/2/2017	9:37	ND (<0.50)	130	290	33	1500
T5.3_B	T5.3B-20170202-2.0	2/2/2017	10:13	ND (<0.50)	54	290	18	1500
T5.3_B	T5.3B-20170202-2.0-FD	2/2/2017	10:13	ND (<0.50)	55	290	18	1500
T5.3_C	T5.3C-2010202-1.2	2/2/2017	9:59	ND (<0.50)	51	290	17	1500
Transect T4.75								
T4.75_A	T4.75A-20170201-1.3	2/1/2017	10:04	0.69 J	3100	360	820 J	2200
T4.75_A	T4.75A-20170201-1.3-FD	2/1/2017	10:04	0.71 J	3100	360	830 J	2200
T4.75_B	T4.75B-20170201-0.9	2/1/2017	10:13	0.59	94	260	23 J	1600
T4.75_C	T4.75C-20170201-2.2	2/1/2017	10:23	0.57	83	270	22 J	1600
T4.75_D	T4.75D-2017-201-1.5	2/1/2017	10:35	ND (<0.50)	35 J	350	420 J	2100
Transect T4.65								
T4.65_A	T4.65A-20170131-0.7	1/31/2017	10:40	1.4	250	280	57 J	1500
T4.65_B	T4.65B-20170131-0.9	1/31/2017	10:50	1.8	210	260	51	1500
T4.65_B	T4.65B-20170131-0.9-FD	1/31/2017	10:50	1.7	210	270	51	1500
T4.65_C	T4.65C-20170131-1.3	1/31/2017	10:58	0.74 J	100	260	31	1500
T4.65_D	T4.65D-20170131-0.6	1/31/2017	11:06	1.7	78	260	30	1500
Transect T4.6								
T4.6_A	T4.6A-20170131-0.3	1/31/2017	10:40	1.7	260	280	64 J	1600
T4.6_B	T4.6B-20170131-0.6	1/31/2017	10:47	1.6	210	280	57 J	1600
T4.6_B	T4.6B-20170131-0.6-FD	1/31/2017	10:47	1.6	220	280	56 J	1600
T4.6_C	T4.6C-20170131-0.8	1/31/2017	10:56	ND (<0.25)	100	280	30 J	1500
T4.6_D	T4.6D-20170131-0.8	1/31/2017	11:13	1.6	83	280	32 J	1500

Table 15 Analytical Results: Transect Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Bromide (mg/L)	Chlorate (µg/L)	Chloride (mg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
Transect T4.2								
T4.2_A	T4.2A-20170201-0.4	2/1/2017	09:55	0.60	260	260	66	1400
T4.2_B	T4.2B-20170201-1.0	2/1/2017	10:19	0.67 J	170	260	40	1400
T4.2_B	T4.2B-20170201-1.0-FD	2/1/2017	10:19	0.60	170	260	40	1400
T4.2_C	T4.2C-20170201-0.8	2/1/2017	10:35	0.58	88	260	27	1400
T4.2_D	T4.2D-20170201-1.0	2/1/2017	10:47	0.58	78	270	25	1400
Transect T3.8								
T3.8_A	T3.8A-20170130-0.4	1/30/2017	11:30	0.60 J	270	260	57 J	1400
T3.8_B	T3.8B-20170130-0.4	1/30/2017	11:37	0.59 J	210	260	45 J	1400
T3.8_C	T3.8C-20170130-0.4	1/30/2017	11:46	0.53 J	110	250	32 J	1400
T3.8_C	T3.8C-20170130-0.4-FD	1/30/2017	11:46	0.90 J	110	250	32 J	1400
T3.8_D	T3.8D-20170130-0.4	1/30/2017	11:55	ND (<0.50)	130	250	46 J	1500
Transect T3.75								
T3.75_A	T3.75A-20170130-0.9	1/30/2017	11:48	0.34 J	270	280	63 J	1400
T3.75_B	T3.75B-20170130-0.7	1/30/2017	11:53	0.33 J	210	280	51 J	1400
T3.75_C	T3.75C-20170130-0.6	1/30/2017	12:00	0.34 J	110	280	31	1400
T3.75_D	T3.75D-20170130-0.4	1/30/2017	12:09	ND (<0.50)	260	280	85	1500
Transect T3.5								
T3.5_A	T3.5A-20170202-0.2	2/2/2017	11:08	1.1	310	420	73	2700
T3.5_B	T3.5B-20170202-0.5	2/2/2017	11:13	0.64 J	430	280	140	1500
T3.5_B	T3.5B-20170202-0.5-FD	2/2/2017	11:13	ND (<0.50)	440	270	140	1500
T3.5_C	T3.5C-20170202-0.6	2/2/2017	11:22	ND (<0.50)	420	270	98	1600
T3.5_D	T3.5D-20170202-1.4	2/2/2017	12:00	ND (<0.50)	270	260	66	1500
T3.5_E	T3.5E-20170202-1.5	2/2/2017	12:07	ND (<0.50)	190	260	47	1500
T3.5_F	T3.5F-20170202-1.5	2/2/2017	12:34	0.84 J	140	260	38	1500
T3.5_F	T3.5F-20170202-4.0	2/2/2017	12:25	0.70	130	250	37	1500

ND - Not Detected above associated method detection limit
J - Estimated concentration between method detection limit and method reporting limit
µg/L - Micrograms per liter
mg/L - Milligrams per liter
ID - identification

Table 16 Analytical Results: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Bromide (mg/L)	Chlorate (µg/L)	Chloride (mg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
Day 1								
Low Flow								
LW7.2	LW7.2-20170206-09:45-0.8	2/6/2017	9:45	ND (<0.25)	51	240	ND (<0.95)	1300
LW6.7	LW6.7-20170206-10:15-0.4	2/6/2017	10:15	0.30 J	53	250	ND (<0.95)	1400
LW6.05	LW6.05-20170206-11:20-0.6	2/6/2017	11:20	0.26 J	57	270	18	1400
GLWC6.1_3 [t/ss]	GLWC6.1_3-20170206-10:07-1.0	2/6/2017	10:07	ND (<0.50)	100	230	ND (<0.95)	1000
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170206-10:35-1.1	2/6/2017	10:35	ND (<0.50)	96	340	ND (<0.95)	1400
LWC6.1_1 [t/ss]	LWC6.1_1-20170206-09:45-0.58	2/6/2017	9:45	ND (<0.50)	98	250	ND (<0.95)	1100
LWC6.1_2 [t/ss]	LWC6.1_2-20170206-10:00-0.8	2/6/2017	10:00	ND (<0.50)	78	120	ND (<0.95)	690
LW5.9	LW5.9-20170206-11:08-0.5	2/6/2017	11:08	ND (<0.50)	71	260	21	1400
LW5.3	LW5.3-20170206-10:00-1.2	2/6/2017	10:00	2.3	56	260	17	1500
LW5.3	LW5.3-20170206-10:35-2.35	2/6/2017	10:35	1.9	56	260	16	1500
LW4.95	LW4.95-20170206-11:30-1.1	2/6/2017	11:30	1.6	79	270	20	1500
GLW4.9	GLW4.9-20170206-11:15-1.45	2/6/2017	11:15	1.7	87	260	23	1500
GLW4.85	GLW4.85-20170206-10:22-0.6	2/6/2017	10:22	0.91 J	4300	390	1100	2200
GLW4.4	GLW4.4-20170206-11:04-1.1	2/6/2017	11:04	0.61	99	250	28	1400
LW4.1	LW4.1-20170206-11:20-0.3	2/6/2017	11:20	0.50	220	260	51	1500
LW3.85	LW3.85-20170206-09:53-0.6	2/6/2017	9:53	1.7	130	260	36	1400
GLW3.78	GLW3.78-20170206-10:45-0.42	2/6/2017	10:45	1.5	220	270	54	1500
LW3.75	LW3.75-20170206-10:25-0.83	2/6/2017	10:25	1.4	110	270	30	1400
LWC3.7 [t/ss]	LWC3.7-20170206-10:16-0.33	2/6/2017	10:16	1.5	1500	330	550	1900
LW3.4	LW3.4-20170206-11:10-0.42	2/6/2017	11:10	1.5	180	270	53	1400
Mid Flow								
LW7.2	LW7.2-20170206-12:10-0.8	2/6/2017	12:10	0.52	53	220	ND (<0.95)	1200
LW6.05	LW6.05-20170206-12:36-0.7	2/6/2017	12:36	0.46 J	60	240	13	1400
LW4.95	LW4.95-20170206-13:20-1.08	2/6/2017	13:20	0.73	70	240	20	1400
GLW4.4	GLW4.4-20170206-14:15-1.2	2/6/2017	14:15	0.51	93	260	33	1500
LW3.4	LW3.4-20170206-14:46-0.63	2/6/2017	14:46	0.54	160	260	53	1500
High Flow								
LW7.2	LW7.2-20170206-14:30-1.0	2/6/2017	14:30	0.44 J	43	200	ND (<0.95)	1200
LW7.2	LW7.2-20170206-14:30-1.0-FD	2/6/2017	14:30	0.46 J	44	200	ND (<0.95)	1200
LW6.7	LW6.7-20170206-15:00-0.6	2/6/2017	15:00	0.36 J	44	200	ND (<0.95)	1200
LW6.05	LW6.05-20170206-15:26-0.7	2/6/2017	15:26	0.65	48	210	8.9	1400
GLWC6.1_3 [t/ss]	GLWC6.1_3-20170206-15:00-0.9	2/6/2017	15:00	0.42 J	110	250	1.1 J	1100
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170206-15:45-1.3	2/6/2017	15:45	0.68 J	93	330	1.3 J	1400 J
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170206-15:45-1.3-FD	2/6/2017	15:45	0.67 J	91	330	1.2 J	1400
LWC6.1_1 [t/ss]	LWC6.1_1-20170206-14:43-0.8	2/6/2017	14:43	0.45 J	110	250	ND (<0.95)	1100
LWC6.1_2 [t/ss]	LWC6.1_2-20170206-14:55-0.6	2/6/2017	14:55	0.36 J	91	140	ND (<0.95)	710
LW5.9	LW5.9-20170206-15:18-0.6	2/6/2017	15:18	0.50	54	240	6.7	1300
LW5.3	LW5.3-20170206-16:00-1.2	2/6/2017	16:00	ND (<0.50)	55	250	11	1400
LW5.3	LW5.3-20170206-16:10-2.3	2/6/2017	16:10	ND (<0.50)	61	250	12	1400
LW4.95	LW4.95-20170206-15:15-1.1	2/6/2017	15:15	ND (<0.50)	57	250	13	1500
GLW4.9	GLW4.9-20170206-15:00-1.5	2/6/2017	15:00	ND (<0.50)	71	260	21	1500
GLW4.85	GLW4.85-20170206-15:58-0.6	2/6/2017	15:58	0.75 J	3000	350	750	1900
GLW4.4	GLW4.4-20170206-16:19-1.3	2/6/2017	16:19	0.58	79	250	15	1400

Table 16 Analytical Results: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Bromide (mg/L)	Chlorate (µg/L)	Chloride (mg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
LW4.1	LW4.1-20170206-16:42-0.3	2/6/2017	16:42	0.59	180	260	38	1500
LW3.85	LW3.85-20170206-16:03-0.58	2/6/2017	16:03	0.60	100	260	28 J	1500
GLW3.78	GLW3.78-20170206-16:40-0.96	2/6/2017	16:40	0.50	210	270	40	1500
LW3.75	LW3.75-20170206-16:30-0.67	2/6/2017	16:30	0.59	100	260	26 J	1400
LWC3.7 [t/ss]	LWC3.7-20170206-16:20-0.58	2/6/2017	16:20	ND (<1.25)	2500	410	880	2300
LW3.4	LW3.4-20170206-17:01-0.7	2/6/2017	17:01	0.50	130	260	38 J	1500
LW3.4	LW3.4-20170206-17:01-0.7-FD	2/6/2017	17:01	0.48 J	140	260	38 J	1500
Day 2								
Low Flow								
LW7.2	LW7.2-20170207-08:55-0.7	2/7/2017	8:55	0.40 J	58	210	ND (<0.95)	1200
LW6.7	LW6.7-20170207-09:13-0.4	2/7/2017	9:13	0.56 J	69	270	ND (<0.95)	1700
LW6.05	LW6.05-20170207-09:30-0.6	2/7/2017	9:30	0.50 J	51	250	18 J	1500
GLWC6.1_3 [t/ss]	GLWC6.1_3-20170207-09:30-1.0	2/7/2017	9:30	ND (<0.25)	100	220	1.5 J	1100
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170207-10:35-1.3	2/7/2017	10:35	ND (<0.50)	100	280	ND (<0.95)	1300
LWC6.1_1 [t/ss]	LWC6.1_1-20170207-09:03-0.9	2/7/2017	9:03	ND (<0.25)	98	270	1.3 J	660
LWC6.1_2 [t/ss]	LWC6.1_2-20170207-09:20-0.7	2/7/2017	9:20	ND (<0.25)	67	140	ND (<0.95)	1100
LW5.9	LW5.9-20170207-10:00-0.4	2/7/2017	10:00	0.26 J	56	300	17 J	1500
LW5.3	LW5.3-20170207-09:45-1.0	2/7/2017	9:45	0.98 J	57	260	19 J	1500
LW5.3	LW5.3-20170207-09:50-2.0	2/7/2017	9:50	1.7	59	260	20 J	1500
LW4.95	LW4.95-20170207-10:45-1.0	2/7/2017	10:45	1.5	79	260	24 J	1500
GLW4.9	GLW4.9-20170207-10:55-1.2	2/7/2017	10:55	1.4	94	270	28 J	1400
GLW4.85	GLW4.85-20170207-09:42-0.7	2/7/2017	9:42	1.0	3000	380	860 J	2100
GLW4.4	GLW4.4-20170207-10:18-1.1	2/7/2017	10:18	1.4	100	270	25 J	1400
LW4.1	LW4.1-20170207-10:39-0.3	2/7/2017	10:39	1.4	230	270	47 J	1500
LW3.85	LW3.85-20170207-10:12-0.5	2/7/2017	10:12	0.57 J	120	270	32 J	1400
GLW3.78	GLW3.78-20170207-09:35-0.7	2/7/2017	9:35	0.48 J	200	260	40	1400
LW3.75	LW3.75-20170207-10:45-0.9	2/7/2017	10:45	0.61 J	120	270	35 J	1400
LWC3.7 [t/ss]	LWC3.7-20170207-10:32-0.4	2/7/2017	10:32	0.72 J	1800	360	670 J	2100
LW3.4	LW3.4-20170207-11:11-0.5	2/7/2017	11:11	0.51 J	180	270	52 J	1400
Mid Flow								
LW7.2	LW7.2-20170207-10:55-0.8	2/7/2017	10:55	1.3	60	220	ND (<0.95)	1300
LW6.05	LW6.05-20170207-11:20-0.6	2/7/2017	11:20	1.5	63	250	17	1600
LW4.95	LW4.95-20170207-13:25-1.2	2/7/2017	13:25	ND (<0.25)	74	240	12	1500
GLW4.4	GLW4.4-20170207-14:11-1.3	2/7/2017	14:11	1.6	97	270	25	1500
GLW4.4	GLW4.4-20170207-14:11-1.3-FD	2/7/2017	14:11	1.2	96	270	25	1500
LW3.4	LW3.4-20170207-14:35-0.6	2/7/2017	14:35	0.62	170	270	42	1500
High Flow								
LW7.2	LW7.2-20170207-14:02-0.9	2/7/2017	14:02	1.1	44	210	ND (<0.95)	1200
LW6.7	LW6.7-20170207-14:25-0.6	2/7/2017	14:25	1.4	55	240	ND (<0.95)	1400
LW6.7	LW6.7-20170207-14:25-0.6-FD	2/7/2017	14:25	1.4	55	240	ND (<0.95)	1400
LW6.05	LW6.05-20170207-14:48-0.7	2/7/2017	14:48	1.2	50	250	6.0	1400
GLWC6.1_3 [t/ss]	GLWC6.1_3-20170207-15:06-0.9	2/7/2017	15:06	ND (<0.25)	100	260	ND (<0.95)	1100
GLWC6.1_3 [t/ss]	GLWC6.1_3-20170207-15:06-0.9-FD	2/7/2017	15:06	ND (<0.25)	100	270	ND (<0.95)	1100
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170207-16:10-1.3	2/7/2017	16:10	0.31 J	92	350	ND (<0.95)	1300
LWC6.1_1 [t/ss]	LWC6.1_1-20170207-14:45-0.8	2/7/2017	14:45	ND (<0.25)	100	280	ND (<0.95)	1100

Table 16 Analytical Results: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Bromide (mg/L)	Chlorate (µg/L)	Chloride (mg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
LWC6.1_2 [t/ss]	LWC6.1_2-20170207-14:58-0.7	2/7/2017	14:58	ND (<0.25)	47	110	ND (<0.95)	610
LW5.9	LW5.9-20170207-15:27-0.6	2/7/2017	15:27	0.30 J	55	280	10	1400
LW5.3	LW5.3-20170207-15:45-1.2	2/7/2017	15:45	0.25 J	54	280	11	1400
LW5.3	LW5.3-20170207-15:50-2.4	2/7/2017	15:50	0.25 J	52	280	9.6	1400
LW4.95	LW4.95-20170207-16:30-1.2	2/7/2017	16:30	0.26 J	63	270	13	1400
LW4.95	LW4.95-20170207-16:30-1.2-FD	2/7/2017	16:30	ND (<0.25)	59	270	12	1400
GLW4.9	GLW4.9-20170207-16:45-1.4	2/7/2017	16:45	0.32 J	77	280	17	1400
GLW4.85	GLW4.85-20170207-15:42-0.8	2/7/2017	15:42	0.29 J	1200	300	290	1600
GLW4.85	GLW4.85-20170207-15:42-0.8-FD	2/7/2017	15:42	0.32 J	1200	310	310	1600
GLW4.4	GLW4.4-20170207-16:06-1.2	2/7/2017	16:06	0.32 J	80	260	20 J	1400
LW4.1	LW4.1-20170207-16:20-0.4	2/7/2017	16:20	ND (<0.25)	160	280	38 J	1500
LW3.85	LW3.85-20170207-15:50-0.6	2/7/2017	15:50	0.70 J	110	250	31	1500
LW3.85	LW3.85-20170207-15:50-0.6-FD	2/7/2017	15:50	0.50 J	110	250	30	1500
GLW3.78	GLW3.78-20170207-16:35-1.2	2/7/2017	16:35	ND (<0.50)	200	260	48	1500
LW3.75	LW3.75-20170207-16:25-1.0	2/7/2017	16:25	0.55 J	110	250	27	1400
LWC3.7 [t/ss]	LWC3.7-20170207-16:10-0.6	2/7/2017	16:10	ND (<1.25)	2600	370	830	2200
LW3.4	LW3.4-20170207-17:00-0.7	2/7/2017	17:00	ND (<0.50)	140	250	39	1500
Day 3								
Low Flow								
LW7.2	LW7.2-20170208-08:45-0.7	2/8/2017	8:45	ND (<0.25)	59	230	ND (<0.95)	1200
LW6.7	LW6.7-20170208-09:03-0.3	2/8/2017	9:03	ND (<0.50)	62	280	ND (<0.95)	1700
LW6.05	LW6.05-20170208-09:35-0.5	2/8/2017	9:35	ND (<0.50)	65	270	18	1500
GLWC6.1_3 [t/ss]	GLWC6.1_3-20170208-10:05-1.2	2/8/2017	10:05	0.26 J	93	210	ND (<0.95)	1100
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170208-10:35-1.3	2/8/2017	10:35	0.46 J	88	220	ND (<0.95)	1200
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170208-10:35-1.3-FD	2/8/2017	10:35	0.25 J	89	230	ND (<0.95)	1100
LWC6.1_1 [t/ss]	LWC6.1_1-20170208-09:45-0.9	2/8/2017	9:45	0.39 J	100	220	ND (<0.95)	1100
LWC6.1_2 [t/ss]	LWC6.1_2-20170208-10:00-0.6	2/8/2017	10:00	ND (<0.25)	64	96	ND (<0.95)	630
LW5.9	LW5.9-20170208-10:35-0.4	2/8/2017	10:35	0.55	70	240	15	1500
LW5.3	LW5.3-20170208-10:00-1.0	2/8/2017	10:00	1.5	73	260	15	1400
LW5.3	LW5.3-20170208-10:03-2.0	2/8/2017	10:03	1.5	81	250	17	1400
LW4.95	LW4.95-20170208-10:30-1.1	2/8/2017	10:30	1.4	83	260	19	1400
GLW4.9	GLW4.9-20170208-10:50-1.2	2/8/2017	10:50	1.6	100	250	22	1400
GLW4.85	GLW4.85-20170208-09:45-0.6	2/8/2017	9:45	ND (<0.50)	1100	310	290	1600
GLW4.4	GLW4.4-20170208-10:07-1.1	2/8/2017	10:07	ND (<0.25)	120	270	27	1400
LW4.1	LW4.1-20170208-10:22-0.4	2/8/2017	10:22	ND (<0.25)	210	270	53	1400
LW4.1	LW4.1-20170208-10:22-0.4-FD	2/8/2017	10:22	ND (<0.50)	220	260	52	1400
LW3.85	LW3.85-20170208-09:27-0.5	2/8/2017	9:27	0.58 J	130	260	34	1400
LW3.85	LW3.85-20170208-09:27-0.5-FD	2/8/2017	9:27	0.52 J	130	260	34	1500
GLW3.78	GLW3.78-20170208-10:10-0.5	2/8/2017	10:10	0.62 J	210	260	52	1400
LW3.75	LW3.75-20170208-09:57-0.8	2/8/2017	9:57	0.56 J	120	260	26	1400
LWC3.7 [t/ss]	LWC3.7-20170208-09:48-0.5	2/8/2017	9:48	0.81 J	2000	340	570	2000
LW3.4	LW3.4-20170208-10:30-0.5	2/8/2017	10:30	0.60 J	170	260	50	1500
Mid Flow								
LW7.2	LW7.2-20170208-11:07-0.8	2/8/2017	11:07	0.54	86	220	ND (<0.95)	1300
LW6.05	LW6.05-20170208-12:35-0.8	2/8/2017	12:35	0.56	72	240	11 J	1500

Table 16 Analytical Results: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Bromide (mg/L)	Chlorate (µg/L)	Chloride (mg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
LW6.05	LW6.05-20170208-12:35-0.8-FD	2/8/2017	12:35	0.70 J	70	250	8.0 J	1500
LW4.95	LW4.95-20170208-13:05-1.2	2/8/2017	13:05	1.7	81	250	14	1400
GLW4.4	GLW4.4-20170208-13:47-1.2	2/8/2017	13:47	ND (<0.25)	110	260	27	1400
LW3.4	LW3.4-20170208-14:18-0.6	2/8/2017	14:18	1.7	180	260	46	1400
High Flow								
LW7.2	LW7.2-20170208-14:40-0.9	2/8/2017	14:40	ND (<0.25)	49	220	ND (<0.95)	1100
LW6.7	LW6.7-20170208-15:02-0.6	2/8/2017	15:02	0.33 J	55	250	ND (<0.95)	1400
LW6.05	LW6.05-20170208-15:36-0.7	2/8/2017	15:36	0.32 J	55	240	7.7	1400
GLWC6.1_3 [t/ss]	GLWC6.1_3-20170208-15:00-1.0	2/8/2017	15:00	0.45 J	110	240	ND (<0.95)	1100
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170208-16:07-1.0	2/8/2017	16:07	0.54	81	250	ND (<0.95)	1100
LWC6.1_1 [t/ss]	LWC6.1_1-20170208-14:43-0.7	2/8/2017	14:43	0.49 J	90	240	ND (<0.95)	1100
LWC6.1_2 [t/ss]	LWC6.1_2-20170208-14:53-0.7	2/8/2017	14:53	0.32 J	64	110	ND (<0.95)	590
LW5.9	LW5.9-20170208-15:41-0.6	2/8/2017	15:41	0.55	61	240	9.6	1300
LW5.3	LW5.3-20170208-15:45-1.2	2/8/2017	15:45	1.3	60	240	8.9	1400
LW5.3	LW5.3-20170208-15:50-2.4	2/8/2017	15:50	1.4	64	240	9.0	1400
LW4.95	LW4.95-20170208-16:20-1.3	2/8/2017	16:20	1.3	2000	240	11	1300
GLW4.9	GLW4.9-20170208-16:35-1.4	2/8/2017	16:35	1.4 J	84	240	15	1400
GLW4.9	GLW4.9-20170208-16:35-1.4-FD	2/8/2017	16:35	1.0 J	84	240	14	1400
GLW4.85	GLW4.85-20170208-16:00-0.8	2/8/2017	16:00	1.0	940	270	270	1600
GLW4.4	GLW4.4-20170208-16:21-1.3	2/8/2017	16:21	0.56	110	230	17	1400
LW4.1	LW4.1-20170208-16:33-0.4	2/8/2017	16:33	0.54	170	250	ND (<0.95)	1500
LW3.85	LW3.85-20170208-16:05-0.5	2/8/2017	16:05	1.4	130	260	24	1500
GLW3.78	GLW3.78-20170208-16:42-1.4	2/8/2017	16:42	1.5	190	260	46	1500
LW3.75	LW3.75-20170208-16:30-1.0	2/8/2017	16:30	1.5	110	260	23	1500
LWC3.7 [t/ss]	LWC3.7-20170208-16:20-0.5	2/8/2017	16:20	1.6 J	80	360	770	2200
LW3.4	LW3.4-20170208-17:05-0.6	2/8/2017	17:05	1.4	150	260	32	1500
Day 4								
Low Flow								
LW7.2	LW7.2-20170209-08:56-0.7	2/9/2017	8:56	1.1	71	230	ND (<0.95)	1300
LW6.7	LW6.7-20170209-09:11-0.3	2/9/2017	9:11	1.7	76	270	ND (<0.95)	1700
LW6.05	LW6.05-20170209-09:31-0.5	2/9/2017	9:31	0.77	69	240	19	1500
GLWC6.1_3 [t/ss]	GLWC6.1_3-20170209-09:32-1.2	2/9/2017	9:32	0.39 J	87	230	ND (<0.95)	1100
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170209-10:33-1.3	2/9/2017	10:33	0.45 J	71	250	ND (<0.95)	1100
LWC6.1_1 [t/ss]	LWC6.1_1-20170209-09:10-1.0	2/9/2017	9:10	0.41 J	88	240	ND (<0.95)	1100
LWC6.1_2 [t/ss]	LWC6.1_2-20170209-09:25-0.6	2/9/2017	9:25	0.30 J	50	100	ND (<0.95)	610
LW5.9	LW5.9-20170209-10:01-0.4	2/9/2017	10:01	0.60 J	74	260	15	1400
LW5.3	LW5.3-20170209-10:00-1.0	2/9/2017	10:00	0.56	67	240	22	1500
LW5.3	LW5.3-20170209-10:03-2.0	2/9/2017	10:03	ND (<0.50)	120	280	30	1400
LW4.95	LW4.95-20170209-10:35-1.0	2/9/2017	10:35	0.65	82	240	24	1400
LW4.95	LW4.95-20170209-10:35-1.0-FD	2/9/2017	10:35	0.54	86	240	23	1400
GLW4.9	GLW4.9-20170209-10:50-1.2	2/9/2017	10:50	0.33	100	240	27	1400
GLW4.85	GLW4.85-20170209-09:58-0.7	2/9/2017	9:58	ND (<0.50)	1600	340	320	1600
GLW4.4	GLW4.4-20170209-10:22-1.1	2/9/2017	10:22	0.52	120	250	26	1400
LW4.1	LW4.1-20170209-10:38-0.3	2/9/2017	10:38	0.28 J	230	290	40	1400
LW3.85	LW3.85-20170209-10:30-0.5	2/9/2017	10:30	ND (<0.50)	140	260	28	1400

Table 16 Analytical Results: Discrete Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Location	Sample ID	Sample Date	Sample Time	Bromide (mg/L)	Chlorate (µg/L)	Chloride (mg/L)	Perchlorate (µg/L)	Total Dissolved Solids (mg/L)
GLW3.78	GLW3.78-20170209-11:28-0.3	2/9/2017	11:28	ND (<0.50)	230	260	47	1400
LW3.75	LW3.75-20170209-10:58-0.5	2/9/2017	10:58	0.59	140	260	27	1400
LWC3.7 [t/ss]	LWC3.7-20170209-10:48-0.4	2/9/2017	10:48	ND (<0.50)	1800	360	670	2100
LW3.4	LW3.4-20170209-12:00-0.5	2/9/2017	12:00	ND (<0.50)	190	260	42	1400
Mid Flow								
LW7.2	LW7.2-20170209-10:52-0.8	2/9/2017	10:52	0.27 J	69	250	ND (<0.95)	1300
LW6.05	LW6.05-20170209-12:00-0.6	2/9/2017	12:00	0.30 J	74	290	14	1600
LW4.95	LW4.95-20170209-12:30-1.1	2/9/2017	12:30	0.27 J	91	290	22 J	1500
GLW4.4	GLW4.4-20170209-13:11-1.2	2/9/2017	13:11	0.62 J	140	270	31 J	1400
LW3.4	LW3.4-20170209-13:33-0.5	2/9/2017	13:33	ND (<0.50)	200	290	52	1500
LW3.4	LW3.4-20170209-13:33-0.5-FD	2/9/2017	13:33	ND (<0.50)	200	290	57	1500
High Flow								
LW7.2	LW7.2-20170209-14:41-0.9	2/9/2017	14:41	0.35 J	67	200	ND (<0.95)	1200
LW7.2	LW7.2-20170209-14:41-0.9-FD	2/9/2017	14:41	0.33 J	69	200	ND (<0.95)	1200
LW6.7	LW6.7-20170209-15:04-0.6	2/9/2017	15:04	0.71	66	220	ND (<0.95)	1400
LW6.05	LW6.05-20170209-15:23-0.7	2/9/2017	15:23	0.31 J	60	220	6.8	1400
GLWC6.1_3 [t/ss]	GLWC6.1_3-20170209-14:57-1.1	2/9/2017	14:57	ND (<0.25)	76	270	ND (<0.95)	1100
GLWC6.1_4 [t/ss]	GLWC6.1_4-20170209-15:51-1.6	2/9/2017	15:51	0.35 J	72	290	ND (<0.95)	1200
LWC6.1_1 [t/ss]	LWC6.1_1-20170209-14:39-1.1	2/9/2017	14:39	ND (<0.25)	79	280	ND (<0.95)	1200
LWC6.1_1 [t/ss]	LWC6.1_1-20170209-14:39-1.1-FD	2/9/2017	14:39	ND (<0.25)	81	280	ND (<0.95)	1100
LWC6.1_2 [t/ss]	LWC6.1_2-20170209-14:52-0.8	2/9/2017	14:52	ND (<0.25)	51	100	ND (<0.95)	590
LW5.9	LW5.9-20170209-15:27-0.7	2/9/2017	15:27	0.26 J	61	260	6.9	1300
LW5.3	LW5.3-20170209-15:15-1.1	2/9/2017	15:15	0.54	66	230	9.1	1300
LW5.3	LW5.3-20170209-15:18-2.2	2/9/2017	15:18	0.51	69	240	8.8	1400
LW4.95	LW4.95-20170209-15:40-1.2	2/9/2017	15:40	0.54	78	240	10	1400
GLW4.9	GLW4.9-20170209-15:53-1.4	2/9/2017	15:53	0.54	91	230	14	1400
GLW4.85	GLW4.85-20170209-15:18-0.8	2/9/2017	15:18	ND (<0.50)	900	300	180	1600
GLW4.4	GLW4.4-20170209-15:44-1.3	2/9/2017	15:44	ND (<0.50)	110	260	23	1500
LW4.1	LW4.1-20170209-16:02-0.4	2/9/2017	16:02	ND (<0.50)	160	270	36	1500
LW4.1	LW4.1-20170209-16:02-0.4-FD	2/9/2017	16:02	ND (<0.50)	170	260	35	1500
LW3.85	LW3.85-20170209-15:45-0.6	2/9/2017	15:45	ND (<0.50)	130	290	32	1500
GLW3.78	GLW3.78-20170209-16:30-1.4	2/9/2017	16:30	ND (<0.50)	200	370	43	1500
LW3.75	LW3.75-20170209-16:11-0.8	2/9/2017	16:11	ND (<0.50)	130	320	31	1500
LWC3.7 [t/ss]	LWC3.7-20170209-16:00-0.6	2/9/2017	16:00	ND (<1.25)	3100	460	1100	2500
LW3.4	LW3.4-20170209-16:55-0.6	2/9/2017	16:55	0.27 J	160	290	38	1500

ND - Not Detected above associated method detection limit
J - Estimated concentration between method detection limit and method reporting limit
µg/L - Micrograms per liter
mg/L - Milligrams per liter
t/ss - tributary/side stream; added for clarity and not part of actual Location ID

Table 17 Flux Estimates: Transect Sampling
NERT Remedial Investigation, Downgradient Study Area
Henderson, Nevada

Transect	Date/Time	Perchlorate Concentration (µg/l)[1]	Representative Samples[2]	Non-representative Samples (perchlorate µg/L) [3]	Flow (cfs)[4]	Perchlorate Load (Flux) (lb/day)
T6.8	2/3/17 9:30	ND (<0.95)[5]	A, B, D, E	C(1.6J)	194	<1
T6.35	2/3/17 9:30	18	A,B,C,D	-	188	18
T6	2/2/17 9:15	15	A,B,C,D	-	174	15
T5.3	2/2/17 10:00	18	B,C	A(32 µg/l)	172	17
T4.75	2/1/17 10:15	23	B,C	A(820), D(420)	202	25
T4.65	1/31/17 11:00	31	C,D	A(57),B(51)	210	35
T4.6	1/31/17 11:00	31	C,D	A(64),B(57)	210	35
T4.2	2/1/17 10:30	26	C,D	A(66),B(40)	215	30
T3.8	1/30/17 11:45	32	C	A(57),B(45), D(46)	213	37
T3.75	1/30/17 12:00	31	C	A(63),B(51), D(85)	209	35
T3.5[6]	2/2/17 12:15	43	E,F	A(73),B(140), C(98),D(66)	185	43

Notes:
µg/L - micrograms per liter
cfs - cubic feet per second
lb/day - pounds per day
ND - Not Detected above associated method detection limit
J - Estimated concentration between method detection limit and method reporting limit
< - less than
1) Sample concentration representative of the mixed waters near the center of the channel and is median of representative samples
2) Three to seven samples were collected across each transect, with sample "A" collected near the southern bank
3) Samples not included in representative concentration due to influence of nearby groundwater input
4) See text for explanation of flow used in flux estimates.
5) Perchlorate not detected. Detection limit shown and used in flux estimates.
6) This transect was originally T3.6 but the identification was changed to T3.5 during the field program.

Table 18 Flux Estimates: Discrete Sampling
NERT Remedial Investigation, Downgradient Study Area
Henderson, Nevada

Station	Low Flow Sampling			Mid Flow Sampling			High Flow Sampling		
	Perchlorate Concentration µg/L[1]	Flow (cfs)[2]	Perchlorate Load (Flux) (lb/day)	Perchlorate Concentration µg/L[1]	Flow (cfs)[2]	Perchlorate Load (Flux) (lb/day)	Perchlorate Concentration µg/L[1]	Flow (cfs)[2]	Perchlorate Load (Flux) (lb/day)
LW7.2	ND (<0.95)[3]	178	<1	ND (<0.95)[3]	262	<1.5	ND (<0.95)[3]	325	<2
LW6.7	ND (<0.95)[3]	180	<1				ND (<0.95)[3]	317	<2
LW6.05	18	184	18	14	239	18	7.3	319	12
LW5.9	16	191	16				8.3	346	15
LW5.3[4]	18	214	21				9.4	346	17
LW4.95	23	209	25	17	293	26	12	341	22
GLW4.9	25	213	29				15	341	29
GLW4.4	27	207	30	27	315	45	19	344	33
LW3.85	34	205	37				30	347	56
LW3.75	28	205	31				27	350	50
LW3.4	51	203	57	52	309	75	38	347	71

Notes:
µg/L - micrograms per liter
cfs - cubic feet per second
lb/day - pounds per day
< - less than
1) Concentration of perchlorate is median concentrations from four days' of samples.
2) See text for explanation of flow used in flux estimates.
3) Perchlorate not detected. Detection limit shown and used in flux estimates.
4) Water depths at LW5.3 were greater than 3 feet; samples were collected near bottom and near top.
The concentration presented is the median of all concentrations from four days' of samples.