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April 2016

Surface Water Sampling Plan

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

Final

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Surface Water Sampling Plan, Revision 0

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

Responsible Certified Environmental Manager (CEM) for this project

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

Sally Bilodeau — 4/4/16

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List of Acronyms

CAMP	Comprehensive Adaptive Management Plan
Downgradient Study Area	NERT RI – Downgradient Study Area
DQO	data quality objective
EB	equipment blank
EPA	United States Environmental Protection Agency
FB	field blank
FD	field duplicate
FGD	Field Guidance Document
HASP	Health and Safety Plan
ID	identification number
IDW	investigation-derived waste
LCS/LCSD	laboratory control sample/laboratory control sample duplicate
LVW	Las Vegas Wash
LVWCC	Las Vegas Wash Coordination Committee
µg/L	micrograms per liter
MS/MSD	matrix spike/matrix spike duplicate
NDEP	Nevada Division of Environmental Protection
NERT	Nevada Environmental Response Trust
NERT On-Site Study Area	on-site portion of the NERT RI Downgradient Study Area
±	plus or minus
PPE	personal protective equipment
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI	remedial investigation
RM	river mile
SM	Standard Method
SNWA	Southern Nevada Water Authority
SOPs	Standard Operating Procedures
SWSP	Surface Water Sampling Plan
USGS	United States Geological Survey

1.0 Introduction

This Surface Water Sampling Plan (SWSP) describes the sampling locations, procedures and methods for the initial surface water sampling and analyses for the Nevada Environmental Response Trust (NERT) Remedial Investigation (RI), Downgradient Study Area in Henderson, Nevada (herein referred to as the Downgradient Study Area or Project). The Downgradient Study Area is shown on **Figure 1**. This SWSP was developed at the direction of the Nevada Division of Environmental Protection (NDEP) and describes the procedures and methods for collecting and analyzing 21 surface water grab samples from various locations along the Las Vegas Wash (LVW). The surface water sample locations were proposed by NDEP (NDEP 2015) and consist of historical grab sampling locations previously sampled by Southern Nevada Water Authority (SWNA), among others.

The objective of the investigation of the Downgradient Study Area is to identify subsurface pathways downgradient and crossgradient of the NERT RI Study Area through which perchlorate-impacted groundwater is entering the LVW (**Figure 1**). While quarterly sampling has been conducted at a limited number of locations in the past few years, the majority of the locations previously sampled have not been sampled since 2011 or earlier.[1] As part of the planning phase for future investigation activities in the Downgradient Study Area, a comprehensive sampling of these historical surface water sample locations will be useful to assess current surface water conditions in the LVW. The proposed surface water sampling locations based on previous sampling events are shown on **Figures 1** and **2**. The previous sampling events were found using the NDEP Regional Database. Although this proposal is based on 21 historical surface water sampling locations identified by NDEP, it is possible that the construction of the weirs in the LVW may have altered surface water conditions. Extensive onshore riparian zone restoration has occurred, making it difficult to access the locations on foot. A boat will be used to access all sampling locations in the LVW; sample locations in seeps and the wastewater discharge stream will be accessed on foot. While no accessibility problems are anticipated, should any occur due to safety concerns or physical limitations, AECOM will immediately consult with NDEP.

The activities in this SWSP will be conducted in conformance with the Quality Assurance Project Plan (QAPP) and the site-specific Health and Safety Plan (HASP) developed by AECOM. Modifications to the HASP that specifically address on-water safety are also provided as **Appendix A** to this SWSP. The site-specific QAPP and HASP will be finalized by AECOM prior to mobilization into the field.

1.1 Surface Water Sampling Plan Organization

This document includes the following sections, which are summarized as follows:

- Section 1.0 provides an introduction, including the overall objectives and scope of the SWSP.
- Section 2.0 discusses the data quality objectives (DQOs) for the sampling and analyses.
- Section 3.0 describes the sampling and testing objectives for the SWSP and describes the sampling types, locations, and frequency along with pre-field and field activities to be conducted.
- Section 4.0 details the sampling procedures and equipment to be used during the investigation.
- Section 5.0 describes sample designations, sampling handling, and analytical methods to be conducted as part of the investigation.

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[1] SNWA has sampled the following locations in the Downgradient Study Area quarterly in 2013 and 2014: LW7.2, LW6.85, LW6.05, LW5.5, and LW3.4.

- Section 6.0 describes the schedule and report preparation that will document the results of this assessment.
- Section 7.0 provides references to sources of information used in the preparation of this SWSP.

2.0 Data Quality Objectives

In this section, the United States Environmental Protection Agency (EPA) DQO process is followed to assist with systematic planning for the proposed environmental sampling program described in this SWSP (EPA 2006). The DQO process is EPA's recommended planning process when environmental data are used to select between two alternatives or derive an estimate of contamination (EPA 2001). The DQO process is used to develop performance and acceptance criteria that clarify study objectives, and to define the appropriate type of data and specific tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. Performance criteria apply to new data collected for the Project, while acceptance criteria apply to existing data proposed for inclusion in the Project.

After performance criteria have been developed, the QAPP describes in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. The QAPP for the proposed sampling at the Downgradient Study Area will be a separate document adapted from the existing QAPP for the NERT RI and will be consistent with EPA guidance.

The DQO process as described in EPA guidance involves the following seven steps:

1. Define the problem.
2. Identify the goal of the study.
3. Identify information needed for the study.
4. Define the boundaries of the study.
5. Develop the analytic approach.
6. Specify the performance or acceptance criteria.
7. Develop the plan for obtaining data.

A summary of steps 1 through 6 is provided in this section. The sampling plan details in step 7 are described in Sections 3.0 through 5.0 of this SWSP.

2.1 State the Problem

The on-site portion of the NERT RI Downgradient Study Area (NERT On-Site Study Area) (**Figure 1**) has been the location of industrial operations since 1942 when it was developed by the United States government as a magnesium plant to support World War II operations. Following the war, this area continued to be used for industrial activities, including production of perchlorate, boron, and manganese compounds. Former industrial and waste management activities conducted at the NERT On-Site Study Area, as well as those conducted at adjacent properties, resulted in contamination of environmental media, including soil, groundwater, and surface water. Since 1979, the NERT On-Site Study Area has been the subject of numerous investigations and removal actions. Soil removal actions were conducted in 2010 and 2011 from the NERT On-Site Study Area to minimize potential health risks from impacted soil. Additional soil removal was performed in 2013 when the eastern end of the Beta Ditch was excavated. The soil removal activities and post-removal conditions are described in detail in the Revised Interim Soil Removal Action Completion Report (ENVIRON International Corporation 2012). On-site

groundwater removal actions include the installation of the groundwater extraction and treatment system, designed to capture and treat perchlorate and hexavalent chromium in shallow groundwater.

In the spring of 1999, SNWA hydrologists discovered a seep discharging to the LVW at approximately 400 gallons per minute. Perchlorate concentrations in the seep exceeded 100,000 micrograms per liter (µg/L) (**Figure 1**). The results of the seep samples indicated that a significant mass flux of perchlorate was entering the LVW; Kerr McGee subsequently implemented a capture system in November 1999 to reduce the migration of perchlorate to the LVW (ENSR International 2005). Groundwater seep samples in the LVW were collected in April 2000 by Kerr McGee before the installation of the weirs, which caused some of the seeps to be submerged below water surface of the LVW (**Figure 3**). Concentrations of perchlorate reported in the 2000 sampling were up to 57,000 µg/L (location KM70; approximately river mile [RM] 6). The perchlorate concentrations in the seeps from the 2000 seep sampling were highest near the seep discovered by SWNA; upstream concentrations were either non-detect or very low (31 µg/L at KM58; near the Duck Creek confluence). Downstream seep concentrations dropped from KM70 with distance downstream to KM53 (321 µg/L; approximately RM 5), but increased at KM91 (2,100 µg/L; approximately RM 4.7). Concentrations in the seeps again decreased with distance downstream from KM91.

Surface water in the LVW has been sampled from various locations on a routine basis by the SNWA in accordance with the Las Vegas Wash Coordination Committee's (LVWCC's) Las Vegas Wash Comprehensive Adaptive Management Plan (CAMP) (LVWCC 2000). However, it has been over a decade since all surface water locations listed in this SWSP have been sampled during the same event. Concentrations of perchlorate measured in the LVW by SWNA at the targeted locations are depicted in **Figure 4.** [2] Concentrations from samples collected from same year are averaged. While concentrations have varied over time, in general, concentrations increase in the area downstream of the seeps near Pabco Road. Concentrations also increase near the Three Kids Weir. Concentrations have generally decreased over time, but an increase in concentration around RM 4.6 (LW4.6) and RM 4.1 (LW4.1 and LWC4.1) were noted in 2010 and 2011. No sampling at these locations has been conducted since 2011. **Appendix B** provides charts of annual perchlorate concentrations with results of all sampling events by location.

Surface water sampling data are needed that represent the current nature and distribution of target contaminants, including perchlorate, chlorate, and dissolved total chromium and hexavalent chromium in the LVW within the limits of the Downgradient Study Area. In addition, the surface water sampling will include total dissolved solids, chloride, and bromide analyses to evaluate if these constituents can be used in identifying areas of potential groundwater flux to the LVW or, in the case of bromide, may be used as a tracer chemical in future groundwater tracer tests.

2.2 Identify the Goals of the Study

Principal Study Questions:

- What are the current nature and concentration distribution of the target contaminants in the LVW?
- Which of the target contaminants are currently present in significant concentrations to be included in future LVW investigations?
- Are contaminant concentrations different in 2016 than in previous years for which data are available?
- Are patterns of target contaminants in the LVW consistent over time?
- Can ratios of bromide and chloride and concentrations of total dissolved solids be used to help identify the loci of potential groundwater inputs to the LVW?
- Can bromide be considered a possible candidate for future tracer tests?

[2] Data for these figures were obtained from the NDEP Regional Database

The program will provide data to supplement the existing database of perchlorate, chlorate, chromium, and hexavalent chromium concentrations in the LVW. Specifically, the field data will be collected to:

- Further assess the concentrations of perchlorate, chlorate, chromium, and hexavalent chromium present in the LVW upstream, near, and downstream of the suspected sources of contamination;
- Refresh existing data by collecting quasi-synoptic samples from the LVW;
- Provide additional data to refine the larger surface water field sampling program; and
- Provide data to help track potential loci of groundwater inputs to the LVW, independent of contamination.

All samples will be analyzed for perchlorate, chlorate, chromium (dissolved), hexavalent chromium (dissolved), and total dissolved solids. These analytes have been analyzed previously in groundwater and/or surface water, and new data are required to establish current patterns of concentration. In addition, chloride and bromide will be analyzed to help evaluate potential groundwater inputs to the LVW. Analytical methods are provided in **Table 1**.

2.3 Identify the Information Inputs

Information required to answer the study questions will include existing field data and data to be obtained from the planned sampling event.

Existing data were collected by SNWA, NDEP, Kerr McGee, and others. Samples have been collected from the target locations, but often not during the same sampling event. Newly collected data, collected from all 21 target locations during a single event, will be used in conjunction with the historical data to provide a more refined view of the chlorate, perchlorate, and chromium (including hexavalent chromium) concentrations in the LVW. This updated understanding of concentrations of these constituents in the LVW will be used to help develop the DQOs for the future surface water investigations.

2.4 Define the Study Area Boundaries

Step 4 of the DQO process is to define the boundaries of the study area. The boundary of the study area for the Downgradient Study Area for the RI is shown on **Figure 1** and includes an approximately 3.5-mile stretch of the LVW. Surface water samples will be collected from 21 locations along the LVW, extending from approximately RM 7.2 downstream to RM 3.3. The surface water sample locations are also shown on **Figure 1** and listed in **Table 2**. This SWSP is focused on the area adjoining the LVW along the reach roughly between Duck Creek Confluence Weir and the Lake Las Vegas Intake (near Fire Station Weir) as shown on **Figure 1**. Locations downstream of RM 3.7 are outside of the boundaries of the Downgradient Study Area but are included to provide concentration data for the LVW beyond the area of suspected perchlorate inputs.

2.5 Develop the Analytic Approach

Step 5 of the process involves designing the approach to answer the questions and achieve the goals. QA/QC is considered during the design process.

Samples will be collected during the daily low flow. For purposes of this grab sampling event, daily low flow is defined from the daily minimum flow (occurring at approximately 0830 to 0930 during weekdays) to the daily average flows (occurring at approximately 1300 to 1400 daily) (**Figure 4**)[3]. The goal of this program is not to target the potential impact in concentrations from daily flow fluctuations, but to provide data during relatively consistent flows. The time of each sample will be compared to flows from the nearest gage (**Figure 1**) to allow

[3] Data obtained from the website for USGS gage 09419700: Las Vegas Wash at Pabco Road. Available online at http://waterdata.usgs.gov/nv/nwis/uv/?site_no=09419700&PARAmeter_cd=00065,00060

qualification of any apparently anomalous high or low concentrations. Three United States Geological Survey (USGS) gages on the LVW will be used: LVW at Pabco Road (USGS 09419700; approximately RM 6), LVW above Three Kids Wash (USGS 09419753; approximately RM 3.7), and LVW overflow at Las Vegas Inlet (USGS 09419756; approximately RM 2.9). All samples will be analyzed for perchlorate, chlorate, chromium (dissolved), hexavalent chromium (dissolved), total dissolved solids, chloride, and bromide. Methods are provided in **Table 1**.

Project reporting limits are provided in the QAPP. QA/QC samples will be analyzed with the surface water samples for each analytical method, as defined in the QAPP and as described below in Section 5.8. QA/QC samples will include field duplicates (FDs), field blanks (FBs), laboratory duplicates, laboratory control and matrix control spikes, and equipment blanks (EBs). Data verification and validation protocols are detailed in the QAPP and described below in Section 5.9.

2.6 Specify Performance or Acceptance Criteria

Step 6 of the process outlines the performance and acceptance criteria for the study. Major sources of uncertainty are identified and the measures taken to minimize the impacts of these uncertainties are defined. Uncertainty is always present in the measurement and interpretation of environmental data. In this case, the focus is on collecting and interpreting data to better characterize the nature and extent of contamination including identification of potential sources (i.e., contaminated groundwater inputs).

In the absence of defined decision tolerance limits, the sampling design should still strive to identify possible sources of error and minimize them, to the extent practical. The most significant type of error that may be encountered includes that of field sampling. Both random and systematic errors can be introduced during the physical collection of the sample, sample handling, sample analysis, and data handling.

Errors introduced through these steps will be controlled by preparing and following standard operating procedures (SOPs), and establishing appropriate controls for data quality. These controls apply to field procedures (e.g., adherence to SOPs, field equipment calibration, and FDs), laboratory analytical errors (e.g., calibration standard, internal standard, surrogate recoveries, and laboratory control samples), and data validation. The QAPP provides further detail on error control procedures, both in the field and in the laboratory, and details the target detection limits for the analytes.

Sampling design error is the result of the inherent variability of the sampled population over space and time, the sample collection design, and the number of samples available upon which to base the decision. Because it is impossible to sample every inch of the LVW, there is always a possibility that some feature of the natural variability is missed. Sampling design error can increase the chance for misrepresenting the natural variability by random error (imprecision) or systematic error (bias) in sampling.

Because the number of samples controls how well the sampled population (i.e., LVW surface water) is characterized, use of the DQO process requires that the variability of data be understood to evaluate the trade-off between uncertainty (confidence limit) and sampling intensity. This investigation is meant to characterize the physical and chemical qualities of the LVW using a small but robust data set of the LVW surface water. This data set has a characteristic natural variability that will be represented by this data set if all other sources of variability are minimized. By reducing the errors associated with sample collection handling, analyses, and reporting with the strict adherence and use of standardized and documented procedures, as well as the noting of deviations from these procedures, the induced variability of the data set is minimized and the data set is a better representation of the surface water.

2.7 Develop the Plan for Collecting Data

Step 7 is detailed in the following sections.

3.0 Sampling and Testing Objectives and Locations

Sampling objectives for surface water are discussed in the following subsections. In addition, the number and types of investigation locations (i.e., surface water sampling locations) are described in these subsections.

3.1 Surface Water Sampling Objectives

Previously, surface water samples from the LVW have been collected by the SNWA at many locations along the LVW including those proposed in this SWSP. Some locations have not been sampled for perchlorate analysis since the mid-2000s. Re-sampling of the 21 locations is proposed in order to obtain a current snap-shot assessment of perchlorate concentrations in the LVW (**Figure 1**).

3.2 Sampling of Previous Surface Water Sample Locations

During this sampling event, 21 surface water locations will be sampled. A list of the surface water locations are presented in **Table 2**. The surface water sample locations are shown on **Figure 1**. Surface water samples will be analyzed for the following constituents:

- Perchlorate (EPA Method 314.0);
- Chlorate (EPA Method 300.1);
- Chromium, (dissolved) (EPA Method 200.8 [ICP-MS]);
- Hexavalent chromium (dissolved) (EPA Method 218.7);
- Chloride (EPA Method 300.0);
- Bromide (EPA Method 300.0); and
- Total dissolved solids (Standard Method [SM] 2540C).

Water sampling activities for the NERT RI include field-filtering water samples analyzed for perchlorate using the sterile filtration method described in NDEP guidance document (2010). As directed by NDEP, field-filtering of water samples for perchlorate analysis is not required. Filtering for chromium analysis will be conducted in the field using a 0.45 micron filter. Details of the analytical program are listed in **Table 1**. Surface water sampling activities are described in Section 4.5.

3.2.1 Pre-field Activities

A site-specific HASP has been developed for the Downgradient Study Area and the planned field work. The existing NERT RI QAPP will be adapted to include the proposed Downgradient Study Area investigations, including the proposed surface water sampling described in this SWSP as well as future groundwater and subsurface investigations.

3.2.2 Field Activities

The program design is outlined in Section 2.5, Step 5 of the DQO process. Surface water samples will be collected from 21 locations in the LVW primarily using a peristaltic or comparable pump to allow for field-filtration of the metals samples (dissolved chromium and dissolved hexavalent chromium). Samples that do not require filtration may be sampled using a direct immersion of sampling bottles. The sampling methods to be used in the SWSP will be consistent with SNWA sample collection methods, with the exception of the use of a pump to collect some samples. SNWA collects samples from near shore along the bank or mid-channel using direct

immersion of bottles. Samples collected under this SWSP may be collected from near shore (e.g., the LWC tributary/seep samples), when possible and from mid-channel with the use of a boat. While SNWA does not use a pump to collect samples, samples collected for analytes (chromium and hexavalent chromium) requiring field filtration will be collected with a pump. For those samples that do not require field filtering, the sample may be collected via either direct immersion of or by using a pump. Samplers will conduct in-field measurements of pH, electrical conductivity, dissolved oxygen, turbidity, and temperature at surface water locations. An appropriate water quality meter, calibrated as recommended by the manufacturer, will be used.

Non-dedicated sampling and monitoring equipment that is exposed to environmental contaminants will be decontaminated prior to first use and between uses. At a minimum, decontamination procedures will include scrubbing the equipment with a brush or sponge in a solution of Alconox™ detergent (or equivalent) in potable water, followed by two rinses in distilled or deionized water. Instruments requiring calibration will be calibrated prior to first use and once per day following initial calibration, or the manufacturer's specifications. If necessary, instruments may be re-calibrated to confirm readings.

Sampling procedures and equipment are described in greater detail in Section 4.0.

4.0 Sampling Procedures and Equipment

Sampling or other data collection equipment and associated procedures are described in the following sections. Sampling equipment will generally include pumps with dedicated tubing and filters, but may also include direct immersion of sample bottles. Sampling methods and materials are generally based on the EPA publication SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA 1997a). SOPs for surface water sampling are provided in **Appendix C**.

4.1 Documentation Procedures

Records that may be generated during field work include field logs, photographic logs, sample chain-of-custody records, equipment inspection/calibration records, and others, as necessary. Units of measure for any field measurements and/or analyses will be clearly identified on the field forms and in notes and logs as necessary. The QA/QC Officer, or other appropriate person designated by the AECOM Project Manager, will review the field data to evaluate the completeness of the field records.

4.1.1 Field Notes

Field logbooks will provide the means of recording data collection activities at the time they take place. The logbooks will be bound field survey notebooks assigned to field personnel, but they will be stored with the project files in a centralized document repository at an AECOM office location when not in use. Activities will be described in as much detail as possible such that the activity being described can be reconstructed without reliance on memory. Entries will be made in language that is objective, factual, and free of personal opinions or terminology that might later prove unclear or ambiguous.

The cover of each logbook will be identified by the project name, project-specific document number, and the time period which the logbook describes (beginning and end dates). The title page of each logbook will have contact information for the AECOM Project Manager. Entries into the logbook will contain a variety of project-specific information. At the beginning of each entry, the date, start time, weather, names of all team members present, level of personal protection being used, and the signature of the person making the entry will be entered. Names and affiliations of visitors to the Downgradient Study Area and the purpose of their visit will be recorded.

Entries will be made in ink, signed and dated and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, initialed, and dated by the user. Whenever a sample is collected or a field water quality measurement is made it shall be recorded. Photographs taken will be identified by number and a description of the photograph will be provided. Equipment used to conduct water quality measurements will be identified including serial number and any calibration conducted will be recorded.

4.1.2 Photographs

Digital photographs will be taken if necessary to supplement and verify information entered into field logbooks. For each photograph taken, the following will be recorded in the field logbook:

- Date, time, and location;
- Number and brief description of the photograph; and
- Direction in which the photograph was taken, if relevant.

If a number of photographs are taken during a task, general notes will be sufficient on the group of photographs taken, so long as the information outlined above can be inferred from the information provided for each photograph.

4.2 Instrument Calibration Procedures

Instruments requiring calibration include water quality meters (e.g., pH, dissolved oxygen, specific conductivity, and turbidity meters). Equipment that can be field calibrated will be calibrated at least once per day prior to beginning sampling activities, with calibration results documented in the field logbook. Equipment that must be calibrated in a laboratory setting will be used only if a current calibration certificate is available (for example, a calibration certificate is provided with a piece of rental monitoring equipment). Calibration procedures will be consistent with manufacturer instruction manuals for each instrument. Calibration and maintenance procedures for field equipment are detailed in the QAPP.

4.3 Equipment Cleaning Procedures

Non-dedicated sampling and monitoring equipment that is exposed to environmental contaminants will be thoroughly decontaminated prior to first use and between uses. At a minimum, decontamination procedures will include scrubbing the equipment with a brush or sponge in a solution of Alconox™ detergent (or equivalent) in potable water, followed by two rinses in distilled or deionized water.

Equipment that is new from the factory must be wrapped in plastic as it is being transported to the Downgradient Study Area. If equipment is not wrapped in plastic during transport it must be decontaminated prior to use.

Instructions and guidance for decontamination of sampling equipment is included in each SOP that pertains to sampling or testing of environmental media. SOPs/Field Guidance Documents[4] (FGDs) are provided in the QAPP; surface water sampling SOPs are provided in **Appendix C**.

4.4 Investigation-Derived Waste Management

In general, investigation-derived waste (IDW) associated with the collection of surface water samples will consist mainly of purged surface water, used personal protective equipment (PPE) (disposable nitrile gloves) and household trash such as used paper towels, etc. The liquid IDW (i.e., surface water from purging) will be temporarily placed into a polyethylene tank or bucket and returned to the LVW upon completion of sampling at each location. The remaining IDW will be double-bagged in plastic trash bags and will be disposed as municipal trash. The SOP/FGD for IDW management is provided in the QAPP.

4.5 Surface Water Sampling

All sampling activities must comply with the HASP. Samplers need to take care to ensure skin does not contact the water. Appropriate PPE, as described in the HASP, will be used.

For this initial sampling event, surface water “grab” samples will generally be collected using a peristaltic pump (or comparable pump) and disposable tubing. Samples not requiring filtration or preservation may be collected through direct immersion of sampling bottles in the LVW. Use of a pump and tubing allows field-filtrations of chromium and hexavalent chromium samples. Samples will be collected from approximately mid-stream and mid-depth.

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[4] SOPs refer to procedural documents developed by AECOM for this program. FGDs are procedural documents already provided for this program by ENVIRON International Corporation.

To collect a sample by dipping the sample bottle into the LVW, the Sampler will carefully wade into the LVW, so that the sampler is facing upstream. Samples must be collected so that the Sampler is not standing upstream of the bottle. The Sampler must then slowly lower the capped bottle into the water with the mouth of the bottle pointed toward upstream, until the lower lip of the opening is submerged to approximately mid-depth. The cap is then removed and the water fills the bottle very gradually, avoiding any turbulence (which would add sediment to the sample and possibly bias the analytical results). When the water level in the bottle has stabilized, the Sampler must slowly rotate the bottle upright and fill it completely before capping the bottle while still submerged) and affixing the label. The Sampler must then fill out the label and record the sample on the chain-of-custody form.

Samples requiring field filtration must be collected using a pump and tubing. When this method is used, the tubing will be purged with three volumes of water prior to sample collection. Tubing will be held at mid-depth in the water column by affixing the end of the tubing to a weighted line or pole. Prior to and during sample collection, care shall be taken to prevent the tubing from coming into contact with sediments.

4.6 Additional Seep Sampling

Several seeps have been identified previously and were sampled in 2000 by Kerr McGee (**Figure 3**). Review of an aerial photograph (dated March 22, 2015) of the LVW indicates that of the 18 sample locations from April 2000 that are located in the Downgradient Study Area, eight are currently submerged, two have been covered by a weir, and eight are located on land. The locations of these samples will be investigated during the SWSP sampling event. Based on existing conditions, it is anticipated that five sample locations may be accessible for sampling if seep and spring conditions still exist. If any of the seeps are accessible (i.e., not submerged or otherwise covered due to bank stabilization efforts) and flowing, the seeps will be sampled using methods described for the surface water sampling. Previous samples collected from pits will not be replicated because current access agreements do not authorize intrusive activities.

5.0 Sample Designation, Handling and Analysis

In general, field sampling personnel and subcontracted analytical laboratories will handle samples in a manner to maximize data quality. Samples will be collected, handled, and stored in such a manner that they are representative of their original condition and chemical composition. Identification of samples and maintenance of custody are important elements that will be utilized to ensure samples represent surface water conditions in the locations sampled. All samples will be properly identified and maintained under chain-of-custody protocol to protect sample integrity. The following sections discuss the sample handling and custody requirements in detail. It should be noted that this information is also provided in the QAPP where appropriate, and is included in this SWSP for ease of use by field staff during the investigation.

5.1 Sample Identification

To maintain consistency, a sample identification convention has been developed and will be followed throughout the implementation of the SWSP. The sample identification numbers (IDs) will be entered onto the sample labels, field forms, chain-of-custody forms, logbooks, and other records documenting sampling activities.

The identification system for Downgradient Study Area Investigation primary field samples from a surface location consists of the surface water location number (usually as RM) followed by the sample date in YYYYMMDD format. For example, a surface water sample collected from LW5.7 on March 6, 2016, will be identified as LW5.7-20160306.

5.1.1 Field QA/QC Sample Identification Numbers

Field QA/QC samples and procedures are discussed in Section 5.8. The field QC sample codes that may be applied include:

- EB for Equipment Blanks,
- FB for Field Blanks, and
- FD for Field Duplicates.

Field QA/QC sample codes will be appended to the end of the primary sample ID that is represented by the field QA/QC sample.

An EB should be named for the sample collected immediately prior to the collection of the EB.

The FB represents a group of samples: a batch of 20 for the FB. Thus, the FB should be named after the first sample of the batch.

The FD represents the primary sample that is being duplicated, thus the FD should be named after the corresponding primary sample. FDs are submitted blindly to the laboratory (i.e., not labeled as a duplicate).

For example, the first surface water sample collected is LW5.7-1-20160306. The sample is to be analyzed for total dissolved solids, and a duplicate sample is collected. An EB is collected immediately following the collection of the surface water sample (after decontamination of sampling equipment). The associated field QA/QC samples will be identified as:

- LW5.7-20160306-EB (Equipment Blank),

- LW5.7-20160306-FB (Field Blank), and
- LW5.7-20160306-FD (Field Duplicate).

Field QA/QC samples and the frequencies of collection are summarized in Section 5.8 of this SWSP and detailed in the QAPP.

5.2 Sample Labels

A sample label will be affixed to all sample containers sent to the analytical laboratory. Field personnel will complete an identification label for each sample with the following information written in waterproof, permanent ink:

- Client name (“NDEP”) and project number;
- Sample location;
- Unique sample identifier;
- Date and time sample collected;
- Filtering performed, if any;
- Preservative used, if any;
- Name or initials of sampler; and
- Analyses or analysis code requested.

The use of pre-printed sample labels is preferred in order to reduce sample misidentification problems due to transcription errors. Sample labels must be completed and affixed to the sample container in the field at the time of sample collection.

If errors are made on a sample label, corrections will be made by drawing a single line through the error and recording the correct information. All corrections will be dated and initialed.

5.3 Containers, Preservation, and Hold Time

The analytical methods, type of sample containers to be used for each sample type and analysis, preservation requirements for all samples, and holding times are provided in the QAPP.

Each lot of preservative and sampling containers will be certified as contaminant-free by the provider and/or the laboratory. The laboratories will maintain certification documentation in their files. Preserved samples will be clearly identified on the sample label and chain-of-custody form. If samples requiring preservation are not preserved, field records will clearly specify the reason for the discrepancy.

Surface water sample containers will be placed in airtight plastic bags, if possible, and refrigerated or placed in a cooler with ice to chill and maintain a sample temperature of 4 degrees (plus or minus [±] 2 degrees) Celsius.

Chemical activity continues in the sample until it is either analyzed or preserved. Once the sample has been preserved, the sample may be held for a period of time before analysis. The time from the collection of the sample to the analysis is defined as the holding time.

5.4 Sample Handling and Transport

Proper sample handling techniques are used to ensure the integrity and security of the samples. Field parameters will be measured prior to sample collection in the field by the sampling crew and recorded in the field logbook and

field data sheets. Samples for laboratory analysis will be transferred immediately to appropriate laboratory supplied containers in accordance with the following sample handling protocols:

- The Sampler will don clean gloves before touching any sample containers, and take care to avoid direct contact with the sample.
- Samples will be quickly observed for color, appearance, and composition and recorded as necessary.
- The sample container will be labeled before or immediately after sampling in accordance with Section 5.2 of this SWSP.
- Sample containers will be placed in Ziploc™-type plastic bags. The samples will be placed in an ice chest and cooled to 4 degrees (± 2 degrees) Celsius or lower for transport to the laboratory.
- All sample lids will stay with the original containers, and will not be mixed.
- Sample bottles will be wrapped in bubble wrap as necessary to minimize the potential for breakage or damage during shipment.
- The chain-of-custody form will be placed in a separate plastic bag and taped to the cooler lid or placed inside of the cooler. A custody seal will be affixed to the cooler.

The Samplers are responsible for proper handling practices until receipt at the laboratory, or by the courier, at which time the Laboratory Project Manager assumes responsibility of the samples through analysis and ultimately to the appropriate disposal of samples. Sample handling procedures specific to the laboratory are described in the individual laboratory QA Manuals provided in the QAPP.

5.5 Sample Custody

Standard sample custody procedures will be used to maintain and document sample integrity during collection, transportation, storage, and analysis. Custody documents must be written in waterproof, permanent ink. Documents will be corrected by drawing one line through the incorrect entry, entering the correct information, and initialing and dating the correction. The AECOM Project Manager is responsible for proper custody practices so that possession and handling of individual samples can be traced from the time of collection until receipt at the laboratory, or by the courier. The Laboratory Project Manager is responsible for establishing and implementing a control system for the samples in their possession that allows tracing from receipt of samples to disposal.

The chain-of-custody form provides an accurate written record that traces the possession of individual samples from the time of collection in the field until they are accepted at the analytical laboratory. The chain-of-custody form also documents the samples collected and the analyses requested. The Sampler will record the following information on the chain-of-custody forms:

- Client and project number;
- Name or initials and signature of Sampler;
- Name of destination analytical laboratory;
- Name and phone number of Project Manager and Deputy Project Manager in case of questions;
- Unique sample identifier for each sample;
- Data and time of collection for each sample;
- Number and type of containers included for each sample;
- Analysis or analyses requested for each sample;
- Preservatives used, if any, for each sample;
- Sample matrix for each sample;

- Signatures of all persons having custody of the samples;
- Dates and times of transfers of custody;
- Shipping company identification number, if applicable; and
- Any other pertinent notes, comments, or remarks.

Unused lines on the form will be crossed out and initialed.

A sample is considered to be under the control of, and in the custody of, the responsible person if the samples are in their physical possession, locked or sealed in a tamper-proof container, or stored in a secure area.

The person who collects the sample is the initial custodian of the sample. Any transfers are documented on the chain-of-custody form by the individuals relinquishing and receiving the sample, along with their signature, and the date and time of transfer. This transfer must continue until the custody is released to a commercial carrier (i.e. FedEx), or the laboratory (either at the laboratory or to a laboratory-employed courier). If relinquished to a commercial carrier, the carrier assumes custody through their shipping receipt. A copy of the shipping receipt should be attached to the chain-of-custody form as a permanent part of the custody control. If the sample is relinquished to a laboratory courier, the courier will then need to relinquish the sample to the stationary laboratory upon arrival. Once the sample has arrived at the stationary laboratory, it must be entered into the sample custody control system of the laboratory. If the sample is further transported to a subcontracted laboratory, the laboratory will produce an internal chain-of-custody form that will be available upon request. Chain-of-custody forms will be maintained in the digital project file by AECOM and at the analytical laboratory.

To discourage tampering during transport, a custody seal will be placed on each cooler after the samples are packed. These consist of a security tape or label with the date and initial of the sampler or person currently in possession of the sample. Receiving personnel at the laboratory will note on the cooler receipt form whether or not the custody seals are intact.

5.6 Shipping Procedures

If shipping samples using a commercial courier is necessary, each container sent will have a separate chain-of-custody form. Samples collected during the investigation will be identified as environmental samples. Samples will be packed in the same manner as when being transported from the sampler to the laboratory, with the following changes:

- Dry ice is not allowed to be used to chill samples requiring commercial shipment.
- Extra packing material will be used to fill the coolers in order to limit movement within the container.
- Ice should be contained in zip-closure bags and the cooler should be lined with plastic as described below.
- Coolers containing ice and/or liquid samples should be lined with a plastic bag (such as a contractor garbage bag) to limit the potential for leaks in the event of ice bags leaking or sample container breakage. All necessary precautions must be taken to prevent any liquids leaking from sample coolers while in transit.
- Coolers will be closed and taped shut. If the cooler has a drain, it too will be closed and taped shut to prevent leaks.
- A minimum of two custody seals will be affixed to the front and side openings of the cooler so that the cooler cannot be opened without breaking a seal. The seals will be covered with wide clear tape so that the seals do not accidentally break in transit.

- Non-perishable samples collected on the weekend may be held for more than 3 days if there is no threat of exceeding hold times. If the samples require being chilled and maintained at a cool temperature, they will be stored under refrigeration and shipped the following workday.

5.7 Field Measurement and Laboratory Analytical Methods

Field measurement methods and laboratory analytical methods will be utilized to analyze samples during implementation of the SWSP.

5.7.1 Field Measurement Methods

Samplers will conduct in-field measurements for depth of water; dissolved oxygen, pH, conductivity, turbidity, and temperature of the surface water at each location. For field parameter measurements, an appropriate water quality meter, calibrated as recommended by the manufacturer, will be used. Meter calibrations and field measurements will be recorded on the appropriate field forms and/or in the field logbook.

5.7.2 Laboratory Analytical Methods

The Project will involve the analysis of surface water samples for the target chemicals and physical parameters (**Table 1**). The laboratory analytical methods that will be used to analyze samples are summarized in the QAPP and listed on **Table 1**. Additional information about each analytical method and sampling requirements such as containers, preservation, and hold times is provided in the QAPP. Analytical methods and laboratory QA/QC procedures are further detailed in the QAPP.

5.8 Field QA/QC Procedures

Field QA/QC samples that will be collected during the proposed investigation include FD samples and EBs. The description and purpose of these samples is discussed in this section. In addition, matrix spike/matrix spike duplicate (MS/MSD) samples and laboratory control sample/laboratory control sample duplicate (LCS/LCSD) procedures are used as laboratory control measures. While not defined as field QA/QC samples, they may require additional sample volume as described in Section 5.8.3.

5.8.1 Equipment Blanks

EB samples are used to assess the effectiveness of decontamination procedures. EB samples are obtained by filling decontaminated sampling equipment with reagent-grade deionized water, sampling this water, and submitting the sample for analysis. Alternatively, deionized water can be poured over or through the decontaminated sampling equipment and then collected and submitted for analysis. EBs will be collected at a frequency of one in every 20 samples and will be analyzed for the same suite of parameters as the primary sample to assess the effectiveness of decontamination procedures.

5.8.2 Field Duplicates

The FD is a replicate sample collected as close as possible to the same time that the primary sample is collected and from the same location, depth, or source, and is used to document analytical precision. FD samples will be labeled and packaged in accordance with the identification scheme provided in Section 5.1.1. FD samples will have “FD” appended to the sample ID. FDs will be collected at a frequency of one in every 10 primary samples and will be analyzed for the same suite of parameters as the primary sample. The relative percent difference between the FD sample and the primary sample will be evaluated to assess the homogeneity of the sample matrix and to assess the reproducibility of laboratory and field sample collection techniques.

5.8.3 Matrix Spike/Matrix Spike Duplicates and Laboratory Control Samples/Laboratory Control Sample Duplicates

The MS/MSD is a laboratory control sample on which additional QA/QC analyses are performed in order to assess the effect of matrix interference on the analytical results. MS/MSD procedures will be performed on field samples at a frequency of one per 20 samples. Field samples to be used for MS/MSD analyses must be collected with a double sample volume. Similarly, LCS/LCSDs provide controls during laboratory analysis and may also require additional sample volume to be collected in the field.

5.9 Data Validation

Data generated from sampling activities will undergo two levels of review. For these samples, laboratory deliverables equivalent to EPA Level IV will be provided. Approximately 90 percent of the data will be validated to NDEP Stage-2b and approximately 10 percent of data will be validated to NDEP Stage-4. Additional details regarding data validation will be provided in the QAPP.

6.0 Schedule and Reporting

It is anticipated that the activities described in this SWSP will begin in mid-to late-March 2016 after the SWSP and QAPP have been approved, as applicable, by NDEP, EPA, and NERT. Surface water sampling will take approximately 5 days to complete.

The water samples will be analyzed by TestAmerica at their laboratory in Irvine, California, under standard turnaround time of 7 business days. Due to the restrictions in holding time (i.e., 24 hours), hexavalent chromium samples may be analyzed at Silver State Analytical Laboratories in Las Vegas, Nevada. Standard turnaround time for Silver State Analytical Laboratories is 10 business days. Once the final laboratory results have been transmitted to AECOM, data validation will be performed, which is estimated to take 4 weeks.

Dependent upon the results, maps showing the perchlorate, chlorate, chromium, hexavalent chromium, and total dissolved solids concentrations will be constructed to depict the current surface water conditions and analyte concentrations in the LVW. Chloride/bromide ratios will also be plotted. Figures depicting concentrations of all analytes with distance along the LVW (i.e., by RM) will be prepared. Summary tables of the laboratory data will be prepared.

A technical memorandum will be prepared that will summarize the results of this surface water evaluation. The technical memorandum will include a brief description of field methods used and will present the summary tables of analytical results and the maps. The technical memorandum will also include copies of the field data sheets, the final laboratory report and data validation summary report.

A draft of the technical memorandum will be issued within approximately 3 weeks of completion of data validation, for review by NDEP, NERT and EPA. Upon receipt of review comments, which will be consolidated by NDEP into one comment table, the technical memorandum will be finalized and distributed to NDEP, NERT, EPA, and other stakeholders.

A summary of the SWSP task is provided below.

Task	Approximate Schedule
Surface Water Sampling Activities	1 week following field mobilization
Laboratory Analytical Report	2 weeks following completion of sampling activities
Data Validation	4 weeks from receipt of laboratory analytical report
Draft Technical Memorandum	3 weeks from data validation

7.0 References

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.

EPA. 2001. EPA Requirements for Quality Assurance Project Plans (QA/R-5). March.

EPA. 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process (QA/G-4). February.

Las Vegas Wash Coordination Committee (LVWCC). 2000. Las Vegas Wash Comprehensive Adaptive Management Plan. Las Vegas Wash Project Coordination Team, Southern Nevada Water Authority, Las Vegas, Nevada.

Nevada Division of Environmental Protection (NDEP). 2010. Email from Sara Rairick, Lab Certification Officer, Nevada Division of Environmental Protection, re: Sterile Filtration Required for Perchlorate Sampling. July 9.

NDEP. 2015. Shape files showing sample locations in NERT Regional Groundwater Contractor (AECOM) Kick Off Meeting email from Weiquan Dong. November 17.

United States Environmental Protection Agency (EPA). 1997a. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Office of Solid Waste, Washington, DC 20460. June.

Tables

Table 1 Analytical Plan 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)
Chromium (dissolved)	Water	EPA Method 200.8 (ICP-MS) (2)	TestAmerica (Irvine, CA)
Hexavalent Chromium (dissolved)	Water	EPA Method 218.7 (2)	Silver State Analytical (Las Vegas, NV)
Total Dissolved Solids (TDS)	Water	SM 2540C	TestAmerica (Irvine, CA)
Chloride	Water	EPA Method 300.0	TestAmerica (Irvine, CA)
Bromide	Water	EPA Method 300.0	TestAmerica (Irvine, CA)

Notes:

EPA = United States Environmental Protection Agency

SM = Standard Method

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) Sampling activities for the NERT RI Study Area include field-filtering surface water samples analyzed for chromium and hexavalent chromium using a 0.45 micron filter.

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 2 List of Surface Water Locations Proposed for Sampling
NERT Remedial Investigation - Downgradient Study Area
Henderson, Nevada

Surface Water Location Sample ID	Location	Target Location[(1)]	
		Longitude	Lattitude
LW3.1	Downstream of Fire Station Weir	-114.9374811	36.10173043
LW3.4	Downstream of Rainbow Gardens Weir	-114.942616	36.10049065
LWC3.7	Downstream of Demonstration Replacement Weir	-114.9457275	36.09704899
LW3.75	Downstream of Demonstration Replacement Weir	-114.9463175	36.0966525
LW3.85	Upstream of Demonstration Replacement Weir	-114.9475306	36.09601536
LW4.1	Upstream of Homestead Weir	-114.9519108	36.09507867
LWC4.1	Upstream of Homestead Weir	-114.9526444	36.09526627
LWC4.6	Upstream of Lower Narrows Weir	-114.9586059	36.09422822
LW4.95	Upstream of Calico Ridge Weir	-114.9663297	36.09185999
LW5.3	Downstream of Historic Lateral Weir	-114.9730294	36.08982729
LW5.5	Downstream of Historic Lateral Weir	-114.9751197	36.08955999
LW5.7	Upstream of Historic Lateral Weir	-114.9791563	36.08756346
LW5.9	Downstream of Pabco Weir	-114.9835214	36.08781077
LW6.05	Near Pabco Weir	-114.9854297	36.08893999
LWC6.1	Wastewater Tributary Upstream of Pabco Road	-114.9860781	36.08710671
LWC6.1_1	Wastewater Tributary Upstream of Pabco Road	-114.9861896	36.08601586
LWC6.1_2	Wastewater Tributary Upstream of Pabco Road	-114.9862897	36.08589999
LWC6.3_1	Wastewater Tributary Upstream of Pabco Road	-114.9869079	36.08707229
LW6.7	Downstream of Duck Creek Confluence Weir	-114.9964458	36.08912947
LW6.85	Near Duck Creek Confluence Weir	-114.9994344	36.09050391
LW7.2	Upstream of Duck Creek Confluence Weir	-115.0002987	36.09096

Notes:
ID = Identification
(1) Location obtained from Neptune database.

Table 3. Seep and Surface Water Locations from 2000 Kerr McGee Sampling

NERT Remedial Investigation - Downgradient Study Area

Seep ID	Seep (S), Spring (SP), Pit (P)	2000 Perchlorate Concentration in µg/L	Location [1]	Currently Located on Land? [2]	Possible Sampling Location	Comments	Easting	Northing
KM60	S	ND	On peninsula of land; in 1999 on land on north side of LVW. This area has been regraded since 1999.	Yes	X		827831.1187	26735050.61
KM59	P	5	In LVW; in 1999 on land on north side of wash.	No			828518.6187	26735175.61
KM58	S	31	In LVW; in 1999 on land on north side of wash.	No			829164.452	26734779.78
KM57	SP	42	On weir; In 1999 on land on island on northern side of wash.	No			829831.1187	26734758.94
KM56	S	ND	In LVW; in 1999 on land on north side of wash.	No			830664.452	26734696.44
KM71	S	3,400	In LVW; in 1999 on land on north side of wash.	No			831497.7854	26734758.94
KM70	S	57,000	Appears to be at edge of LVW; in 1999 on land on north side of wash.	Yes	X		832164.452	26734488.11
KM45	P	43,000	On land near Pabco Trailhead between Pabco Road and weir; in 1999 on land on south side of wash, on south edge of sand bar/flood plain.	Yes		No sample will be collected because the previous sample was collected from a pit. Access agreements do not authorize intrusive activities.	832435.2854	26733925.61
KM55	S	4,500	Middle of graded road; in 1999 on land on south side of wash, on south edge of sand bar/flood plain.	Yes	X		833726.952	26733883.94
KM93	S	400	In LVW; in 1999 on land on north side of wash, on south edge of sand bar/flood plain.	No	X	Possibly sampling location if spring is still located on northern bank of wash.	834706.1187	26734196.44
KM54	P	280	On island in LVW upstream of weir; in 1999 on south side of wash, in central portion of sand bar/flood plain.	Yes		No sample will be collected because the previous sample was collected from a pit. Access agreements do not authorize intrusive activities.	835726.952	26734863.11
KM92	P	290	On south bank of LVW; in 1999 on south side of wash in floodplain with little vegetation.	Yes		No sample will be collected because the previous sample was collected from a pit. Access agreements do not authorize intrusive activities.	837289.452	26735446.44
KM53	S	321	On island in middle of LVW; in 1999 on north side of wash, on south edge of sand bar/flood plain.	Yes	X	Access may be limited by location in middle of wash and by dense vegetation.	838143.6187	26735696.44
KM91	S	2,100	In LVW; in 1999 in north side of wash, on north part of sand bar/flood plain.	No			839560.2854	26736196.44
KM65	SP	3,000	In LVW; in 1999 in north side of wash, dense vegetation.	No			840997.7854	26736592.28
KM90	S	170	In weir in LVW; in 1999 on land on north side of wash, on north edge of sand bar/flood plain.	No			842122.7854	26736967.28
KM66	S	460	In LVW; in 1999 on north side of wash.	No			843289.452	26736946.44
KM67	SP	2,100	On land on south side of LVW; in 1999 on north side of wash, dense vegetation.	No			844435.2854	26737675.61

Notes:

ID = Identification

µg/L = micrograms per liter

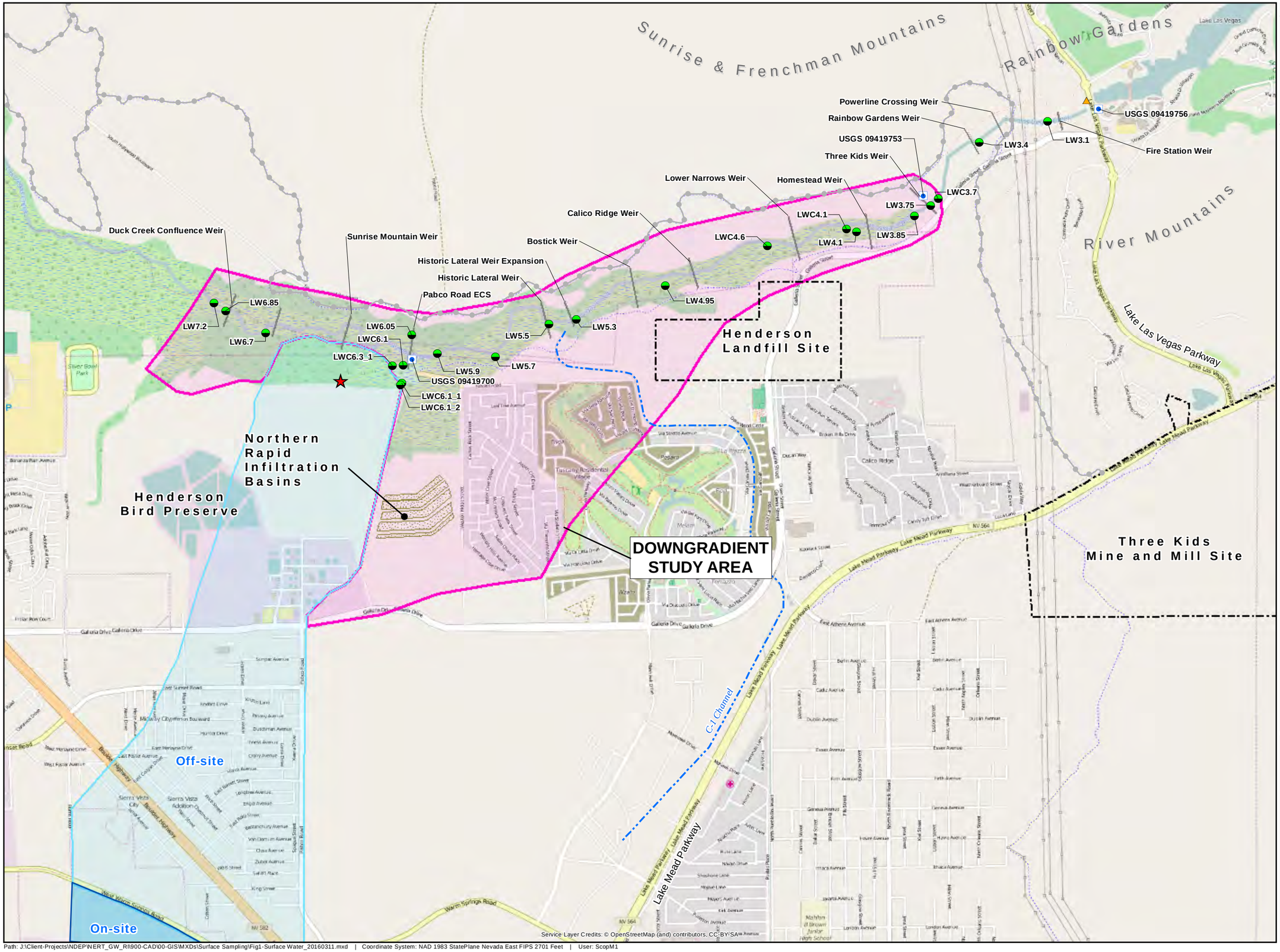
ND = non-detect

LVW = Las Vegas Wash

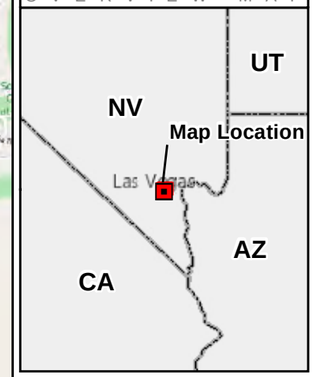
1. Current and historical conditions are based on Google Earth images on 3/22/2015 and 11/11/1999. KMZ file of samples in LVW were imported and reviewed in Google Earth Pro.

2. Determination of whether a location is currently located on land is based on Google Earth image dated 3/22/2015 and an overlay of the historical sampling locations.

Figures



OVERVIEW MAP



Legend

- Original Seep Location
- Lake Las Vegas Intake
- Targeted Historical Surface Water Location to be Sampled
- USGS Staff Gages
- Wetlands Trail
- Channels
- Weir
- Evaporation Basin
- NERT Downgradient Study Area
- NERT Off-site Study Area
- NERT On-site Study Area

NORTH

0 2,000

Feet

Scale 1:24,000

1 inch = 2,000 feet

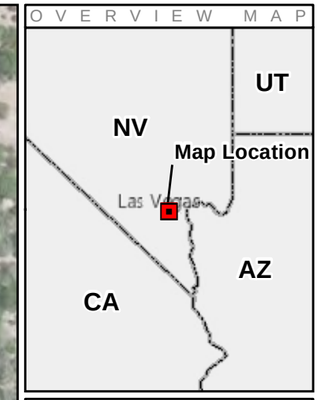
NERT
Remedial Investigation
Downgradient Study Area

TARGETED HISTORICAL SURFACE WATER SAMPLING LOCATIONS

Date: 3/17/2016 Project: 60477365

AECOM

Figure 1



Legend

- Original Seep Location
- Targeted Historical Surface Water Location to be Sampled
- USGS Staff Gages
- Weir
- NERT Off-site Study

NORTH

0 150

Feet

Scale 1:1,800

1 inch = 150 feet

NERT
Remedial Investigation
Downgradient Study Area

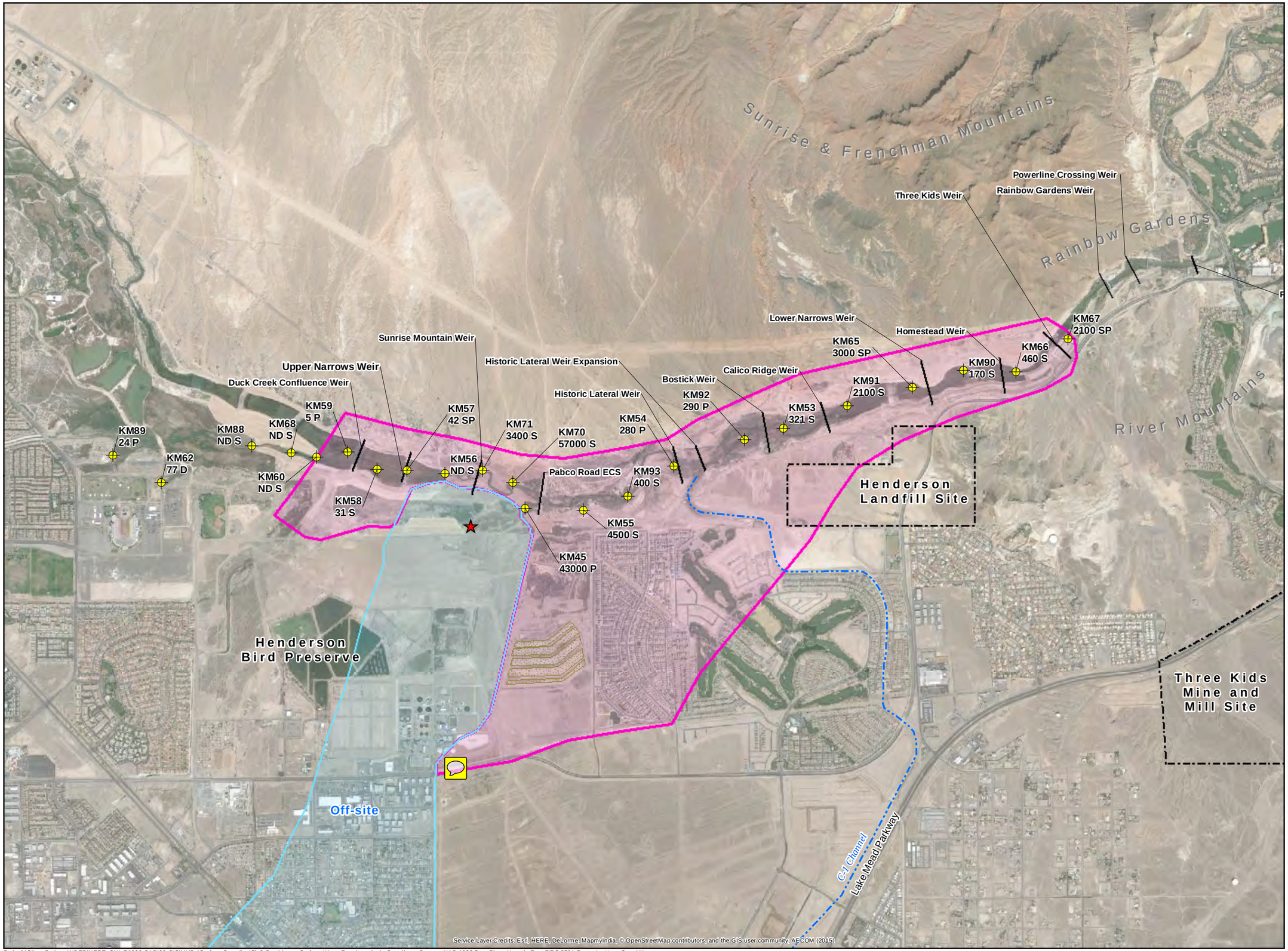
TARGETED HISTORICAL SURFACE WATER SAMPLING LOCATIONS IN TRIBUTARY / SEEPS

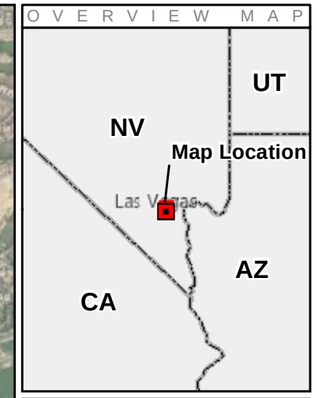
Date: 3/17/2016 Project: 60477365

AECOM

Figure 2

Path: J:\Client-Projects\NDEP\NERT_GW_RI\900-CAD\00-GIS\MXDs\Surface Sampling\Fig2-Surface Water Tributary_20160311.mxd | Coordinate System: NAD 1983 StatePlane Nevada East FIPS 2701 Feet | User: ScopM1





Legend

- Original Seep Location
- 2000 Seep Location
- Channels
- Weir
- Evaporation Basin
- KM66 460 S — Location ID; Perchlorate Result in microgram per liter (µg/l)

Category Chart

P = Pit
S = Seep
Sp = Spring

NORTH

0 2,000

Feet

Scale 1:24,000

1 inch = 2,000 feet

NERT
Remedial Investigation
Downgradient Study Area

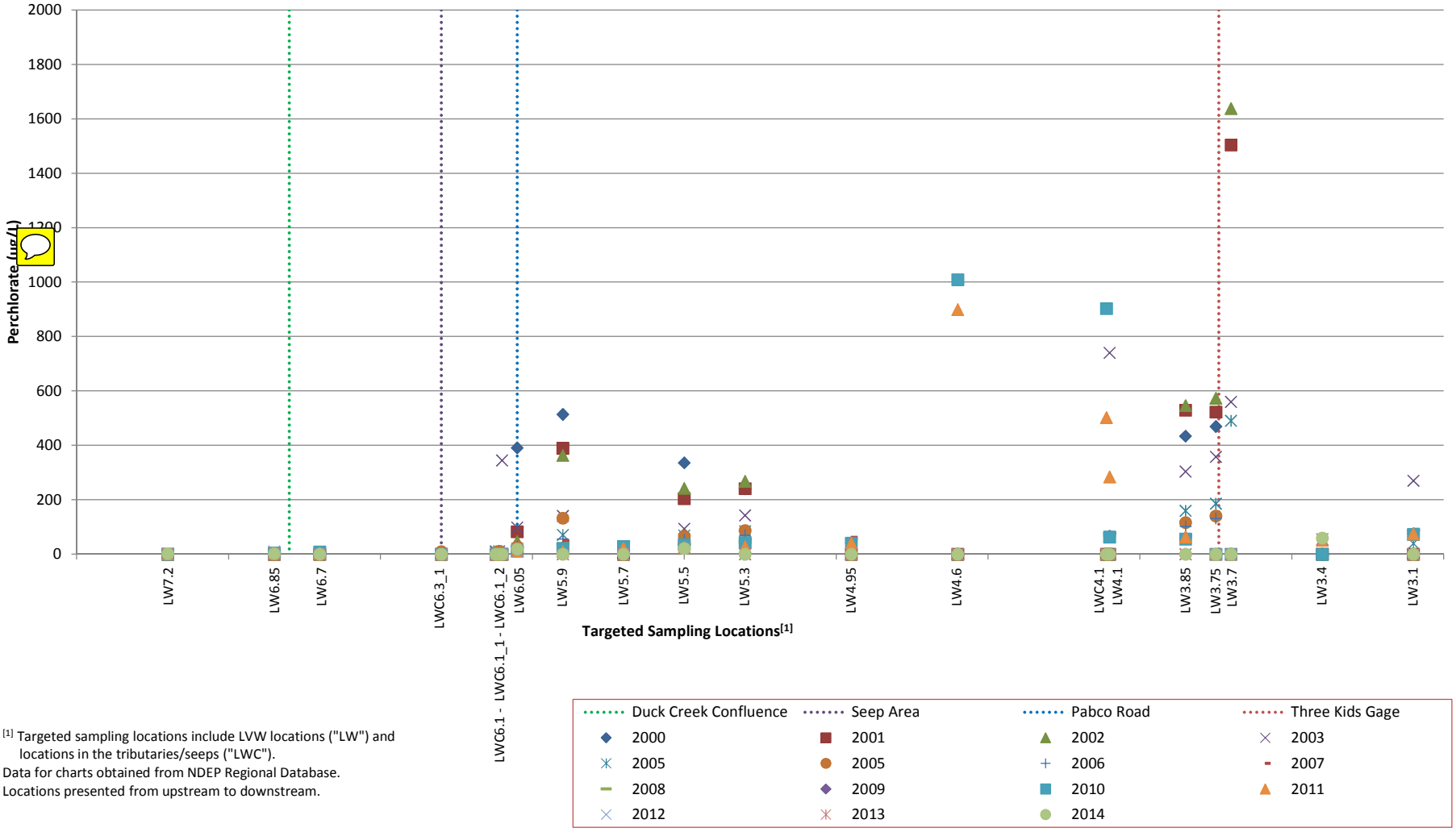
SEEP AND SURFACE WATER SAMPLING CONDUCTED BY KERR MCGEE IN 2000

Date: 3/17/2016 Project: 60477365

AECOM

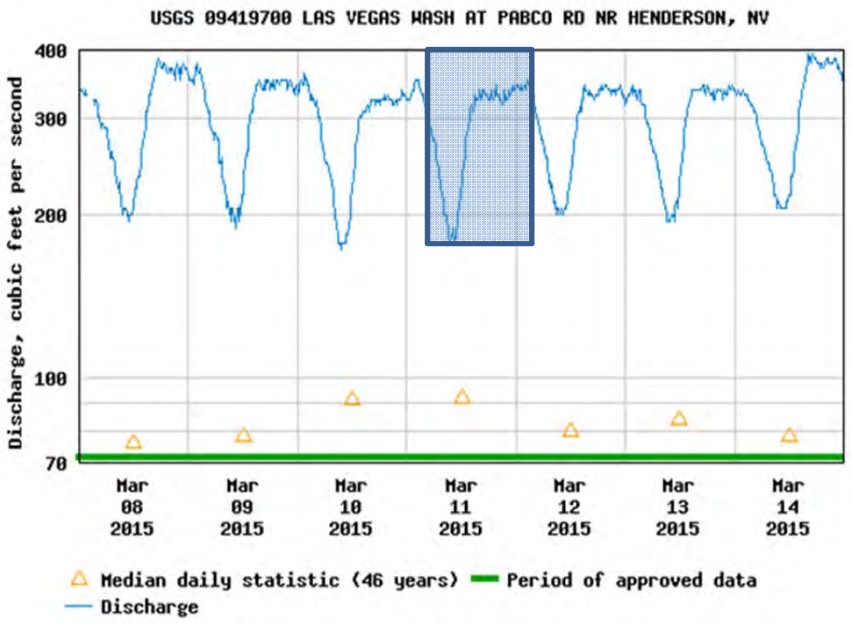
Figure 3

Figure 4. Annual Average Concentrations of Perchlorate at Targeted Sampling Locations (2000 - 2014)

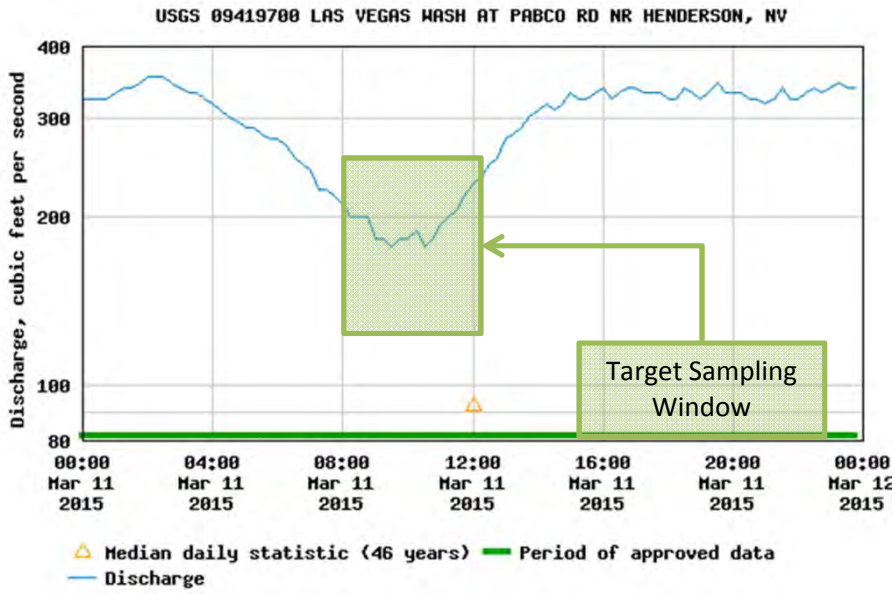


[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries/seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure 5. Example Flow Pattern at Pabco Road Gage



Above: Weekly discharge with 03/11/2015 highlighted.



Above: Close up of daily flow on 03/11/2015.

Source: USGS website for Pabco Road gage.
http://waterdata.usgs.gov/nv/nwis/uv/?site_no=09419700&PARAmeter_cd=00065,00060

Appendix A

On-Water Safety

1.1 Working on Water

Surface water samples are being collected from the Las Vegas Wash by boat (jon boat or canoe) and by wading.

1.1.1 Wading from Shore

If it is necessary to wade into the river, site workers will be required to wear hip waders, or knee high boots, depending on the specific conditions at hand. Because of the increased chance of a slip or fall while wading, it is necessary that all site workers exercise additional care and caution while performing such sampling activities. Site workers are cautioned not to wade into water that are more than knee high in depth, or where the employee cannot visibly see the stream bottom. All water work must be conducted via the buddy system. NO site worker will be permitted to work on or near the water alone. An appropriate personal flotation device (PFD) must be worn at all times when working in or near the water's edge.

1.1.2 Use of Jon Boat or Canoe

A jon boat or canoe may be used in areas of the project site where the water depth limits the practicality of wading. When working from a jon boat or other similar boat, the following precautions will be adhered to:

- Make sure that the right boat is chosen for the work. Evaluate the conditions at the work location and the waterways you must cross to reach that location. Select a boat that is appropriate for the most hazardous waterway. Small, flat bottom boats tend to be unstable and are easily capsized. In addition they often have little freeboard (i.e., distance between the actual water line and the top of the boat's side shell) making them prone to swamping, particularly in rough water.
- The on board sampling team should be comfortable about working on the water (i.e., minimally, each occupant should know how to swim) and should have experience in handling the type of boat that is chosen for the work.
- Do not load the boat beyond its safe loading capacity (SLC), typically found on a label or plate mounted near the stern of the boat. Don't forget to include the weight of equipment brought on board.
- If there is no capacity label, use the following formula to determine the SLC: # People = (length of boat x width) ÷15
- Be aware that the SLC is determined for calm conditions and should be reduced if rough water is anticipated.
- Once on board, distribute the load (people and equipment) evenly and secure all equipment to prevent it from shifting.
- While on the boat, Coast Guard approved Type III or Type V PFDs must be worn at all times by all occupants. PFDs will also be worn while transferring from boat to boat, boat to shore, or during portage.
- Boats longer than 16 feet must also be equipped with at least one Coast Guard approved Type IV throwable PFD.
- No less than two people shall be in the boat during sampling activities. In addition, an on-shore observer should maintain visual contact with the sampling team at all times. The on shore observer must be equipped with communications equipment to contact either the client or emergency responders directly in the event that an emergency situation occurs (e.g., man overboard).
- If work is to be done away from shore or the use of an observer is simply not feasible, the boat or the occupants must be equipped with emergency communications equipment.

- All sampling should be conducted from a seated or otherwise stable position. Do not stand in the boat.
- Samples shall be collected from the bow or stern of the boat (not over the side) to ensure stability.

1.1.3 General Boat Safety

This project presents unique hazards to the sampling team when compared to land-based investigation programs. No effort has been made to incorporate all applicable USCG regulations; however, some selected excerpts from USCG regulations have been included to provide general guidance. The boat operator is ultimately responsible for having knowledge of, and complying with, all USCG and any other applicable marine regulations. The Site Saftey Officer (SSO) for the project will verify that the boat captain (i.e., the AECOM team lead) adheres to USCG requirements.

1.1.3.1 Boat Inspection

Before being placed in service, boats will be inspected by the boat captain and in consultation with the SSO and determined to be in safe operating condition. The boat captain also must verify that all required safety gear is aboard before use. A pre-use inspection of the watercraft also must be performed by the boat captain before each daily use. A daily inspection sheet is provided.

The boat captain must provide written documentation of the initial boat inspection and the daily inspections to the SSO. These inspections will be documented on standard inspection forms used by the boating contractor.

Watercraft determined to be in unsafe condition shall be taken out of service and its use prohibited until unsafe conditions have been corrected.

1.1.3.2 Boat Registration

All watercraft must meet USCG or state watercraft registration and numbering requirements. The USCG requires that all motorized watercraft be numbered in the state of principal use. A valid certificate showing the numbers issued to the watercraft is required to be on board the watercraft whenever the watercraft is in use. Watercraft registration numbers are required to be painted or permanently attached to each side of the forward half of the watercraft. Watercraft registration must be updated as the governing laws require.

1.1.3.3 Boat Capacity

Support watercraft shall not be loaded (passengers and gear) beyond the weight capacity printed on the USCG information plate attached to the stern. If there is no capacity label, use the following formula to determine the safe loading capacity:

- # People = (length of boat x width) ÷15

Support watercraft shall have sufficient room, freeboard, and stability to safely carry the cargo and number of passengers allowed, with consideration given to the weather and water conditions in which the water craft will be operated. Once on board, distribute the load (people and equipment) evenly and secure all equipment to prevent shifting.

1.1.3.4 Personal Flotation Devices

Site workers working over or near water, where the danger of drowning exists, shall wear a USCG-approved PFD. When selecting the appropriate type and style of PFD, the type of activity being conducted and the required mobility of the user must be considered because some activities may require a PFD which is less restrictive.

Site workers will be required to wear a USCG-approved Type III or Type V PFD work vest when working on the boat. Prior to and after each use, each PFD shall be inspected for defects that would alter their strength or buoyancy. Defective units shall be discarded and suitably replaced.

In situations where the water temperature has fallen below 50˚F, a USCG-approved Mustang flotation suit shall be worn in place of the Type III or Type V PFD work vest.

1.1.3.5 Float Plan

Prior to leaving shore, a plan of the day's activities, including time and place of departure, anticipated return time, and list of employees working on the project, will be filed with the PM. In the event the boat crew does not check in at the designated time stated on the float plan, the PM will be responsible for implementing the emergency procedures outlined in the float plan. A Float Plan Form is presented below.

1.1.3.6 Emergency Equipment

All site personnel conducting activities on all boat(s) are to be informed of the locations of all safety equipment on the boat, including communication with the shore (i.e., VHF radio or cellular phone) and emergency contact list, first-aid kit, fire extinguishers, and throw-ring, as applicable to the specific boat being used. Additionally, each site worker shall be provided written instructions in "Abandon ship/boat" and "person overboard" procedures during their marine safety briefing and verbally prior to the first departure of the work day by the boat captain.

1.1.4 Portage

When using a boat in the Las Vegas Wash, the vessel will need to be carried (portaged) over or around a series of erosion control weirs. These weirs are generally rocky with varying amounts and types of vegetation, depending on the age of the weir. The Pabco Road Weir is a concrete structure that will require circumventing.

When portaging the boat or canoe, field team members should remove heavy items from the boat and carry them separately. The boat should be emptied enough to allow for ease of transport of the vessel across or around the weirs. Dragging the boat may be required at times.

Daily Float Plan

Name of vessel's operator:	
Telephone Number:	
Name of Vessel:	
Registration No.:	
Description of Vessel: Type: Make: Color of Hull/Trim Most distinguishing identifiable feature:	

Rafts/Dinghies: Number: __ Size: __ Color: __

Radio/Communication Type:

Number of persons onboard:

Name:	Age:	Address & Telephone:

Engine Type:_____ H.P.:_____ Normal Fuel Supply (days):_____

Survival equipment on board: (check as appropriate)

☐ Life Jackets	☐ Flares	☐ Smoke Signals
☐ Medical Kit	☐ EPIRB	☐ Paddles
☐ Anchor	☐ Loran/GPS	☐ Life Ring

Trip:

Date & Time of Departure:	
Departure From:	Departure To:

Expected to arrive by:_____ In no case later than:_____

Date & Time of Arrival:	Boat Lead Signature at Arrival:

Boat Safety Checklist

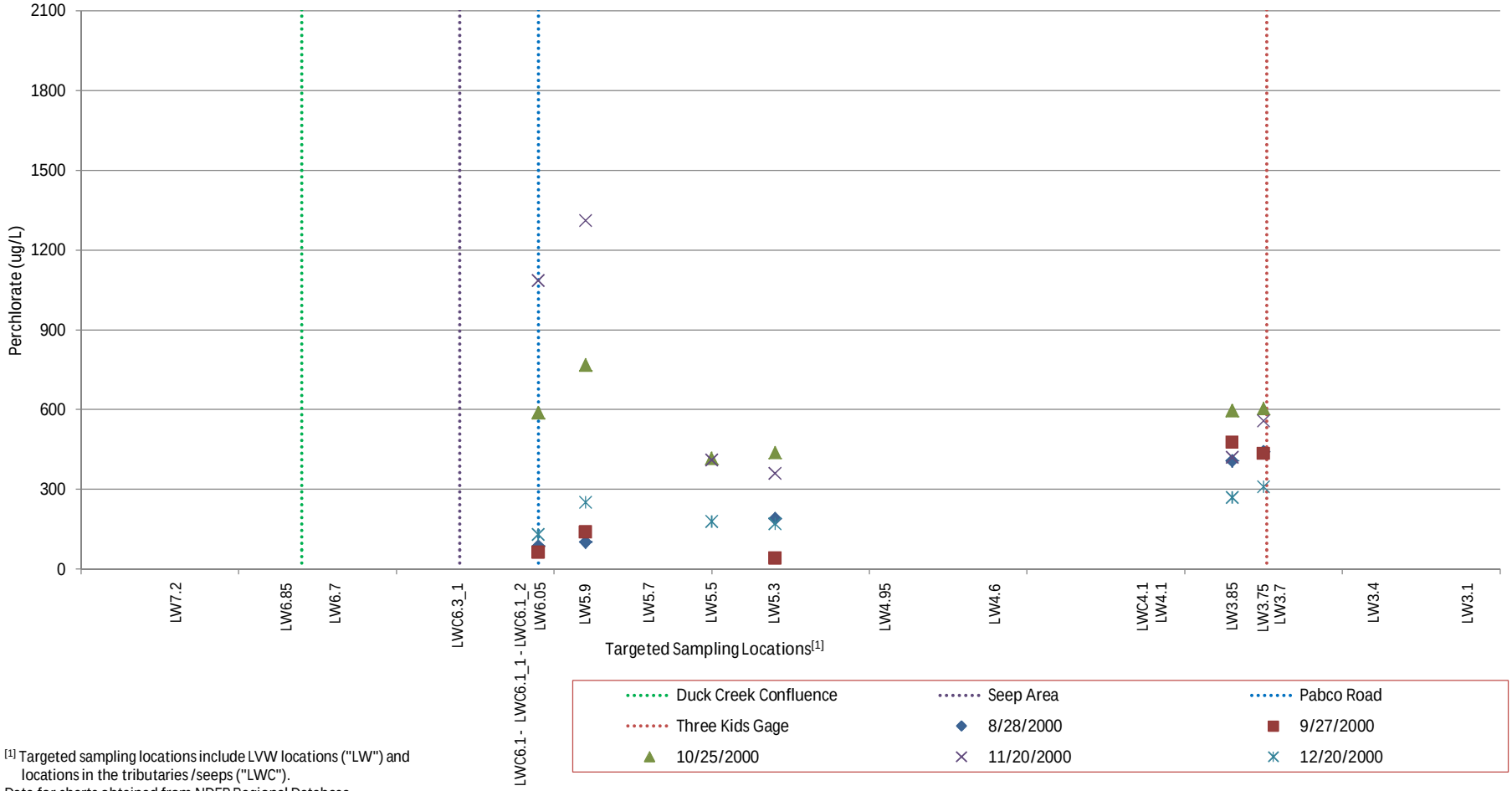
Keep this page with your boat, ready for inspection. By using this checklist, or one fine-tuned by yourself, you'll be sure that everything is on board and in good working order. Your passengers will appreciate knowing you're concerned about boating safety.

- [ ] Float plan--let a friend or relative know when you're leaving, where you're going, when you expect to return, what to do if you don't, and a description of your boat
- [ ] Registration certificate or documentation
- [ ] Personal Flotation Devices (wearable and throw able)--USCG approved, good condition, readily accessible, assigned and fitted
- [ ] Fire Extinguishers--right number, size, and class for boat; charged, not corroded, nozzle clear, bracketed, readily accessible
- [ ] Visual Distress Signals--current dates on flares, proper number, batteries good if lights or EPIRB
- [ ] Anchors and Line--adequate anchor for bottom, adequate line for water depth
- [ ] Bilge device --bilge pump operable, alternative bailing device available
- [ ] Watch or clock--operable
- [ ] Bright flashlight or searchlight
- [ ] Navigation lights --tested and operable, spare bulbs
- [ ] Batteries--fully charged, encased in plastic boxes or terminals covered, securely fastened down
- [ ] Sound-producing device--horn, whistle appropriate for boat
- [ ] Alternate propulsion--paddle or oar
- [ ] First Aid Kit
- [ ] Tools, spare outboard prop and lock nut
- [ ] Compass
- [ ] Sunscreen
- [ ] Weather Radio

Appendix B

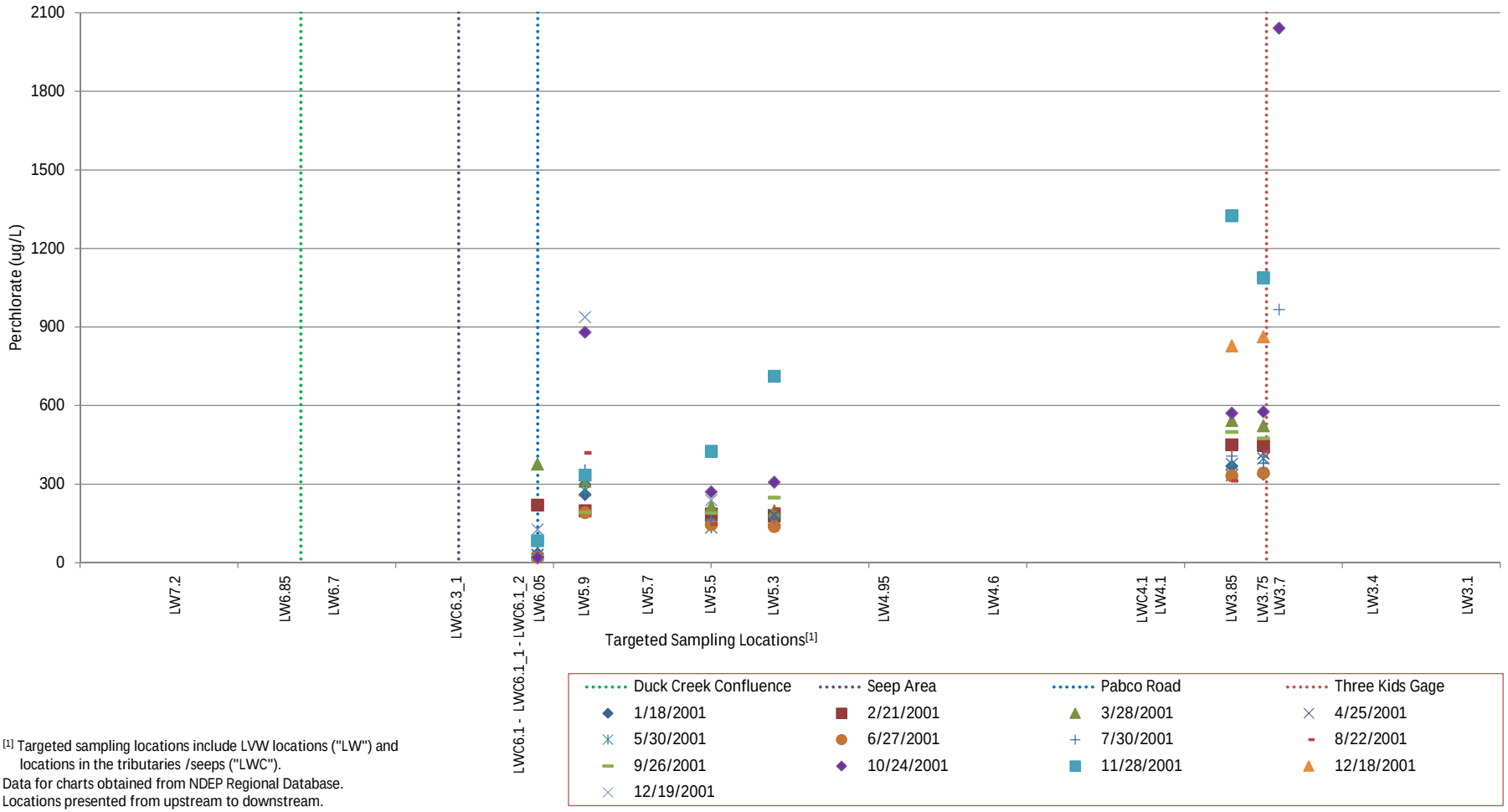
Yearly Charts of Perchlorate Concentrations in the Las Vegas Wash at Proposed Sampling Locations

Figure B-1. Concentrations of Perchlorate at Targeted Sampling Locations (2000)



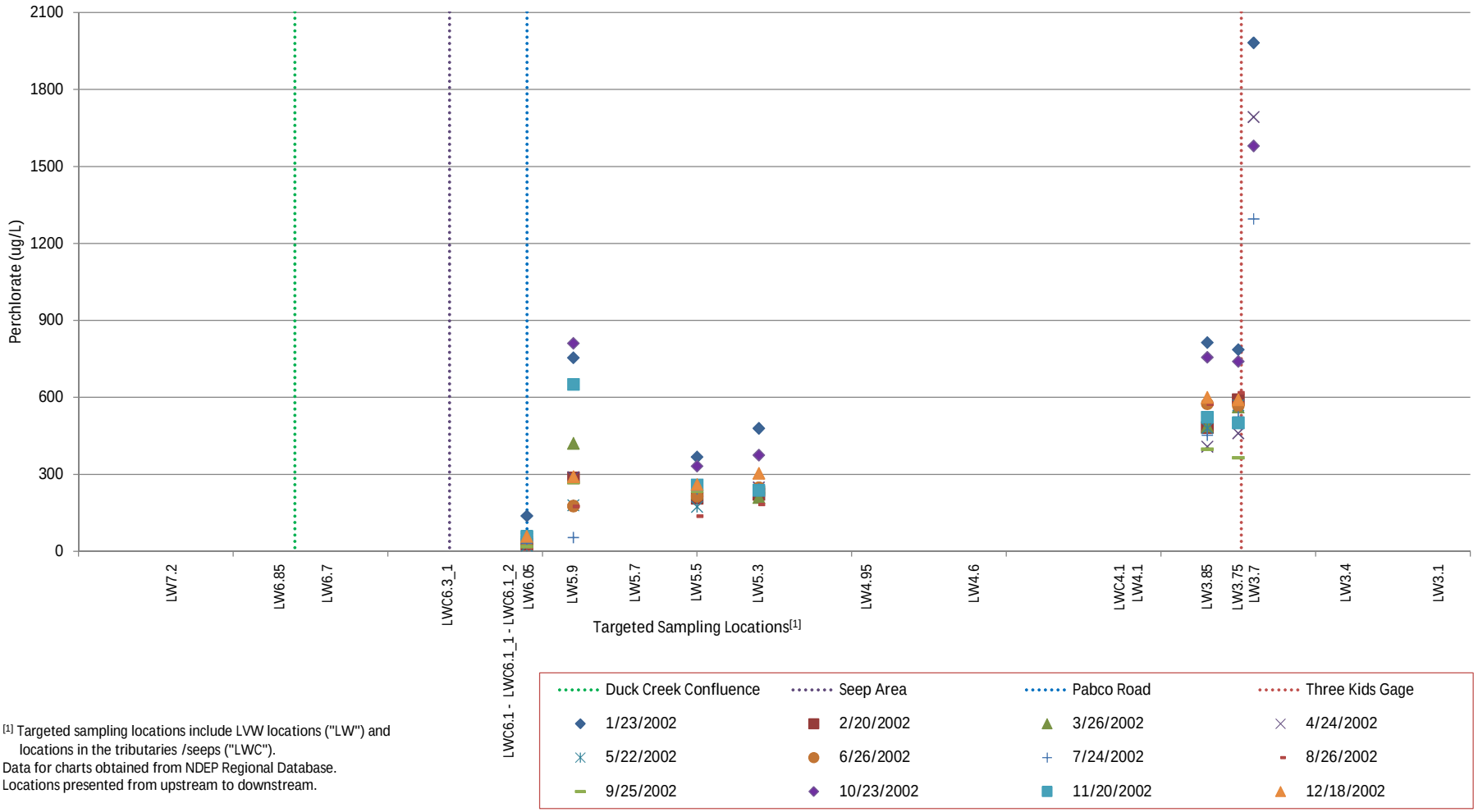
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-2. Concentrations of Perchlorate at Targeted Sampling Locations (2001)



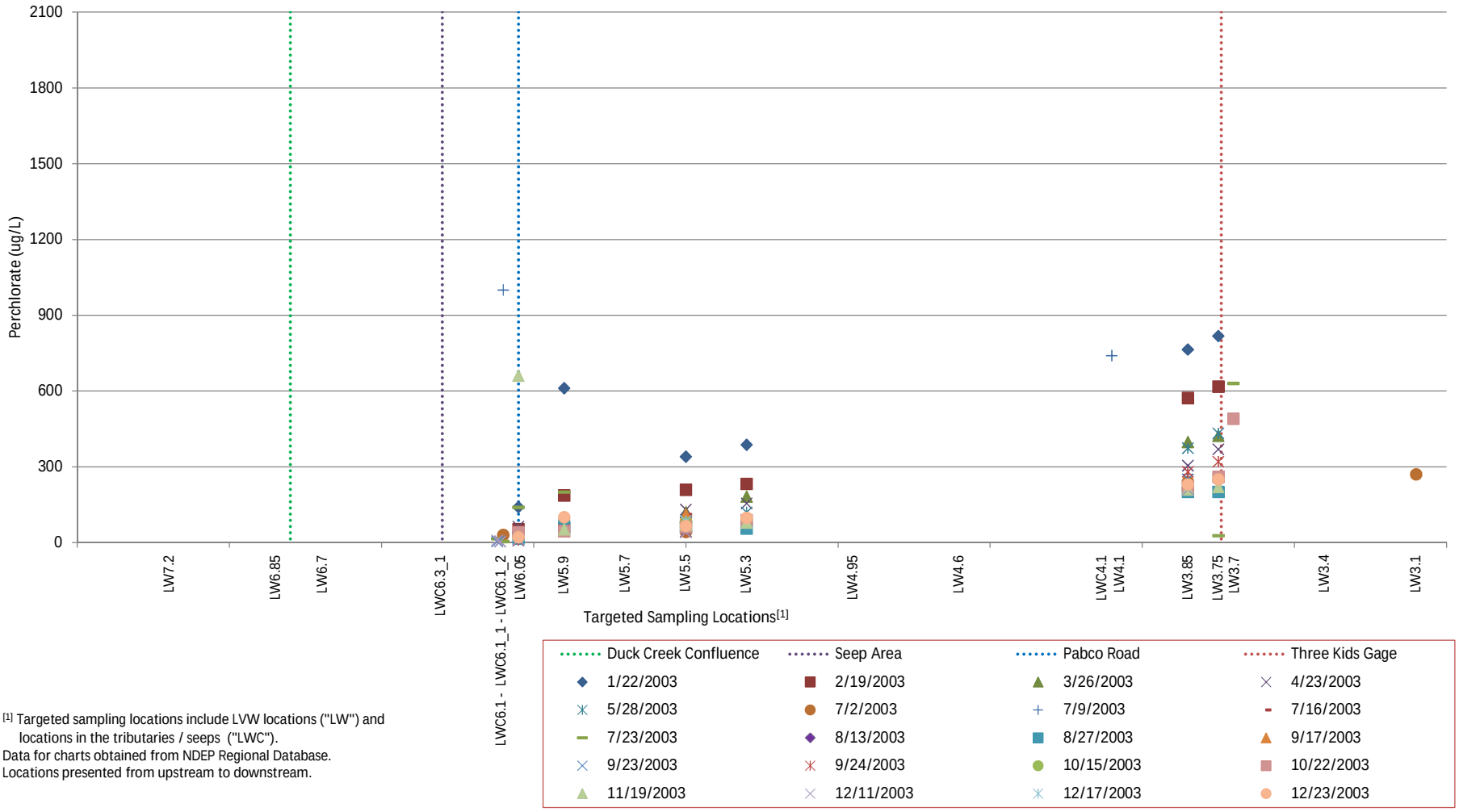
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-3. Concentrations of Perchlorate at Targeted Sampling Locations (2002)



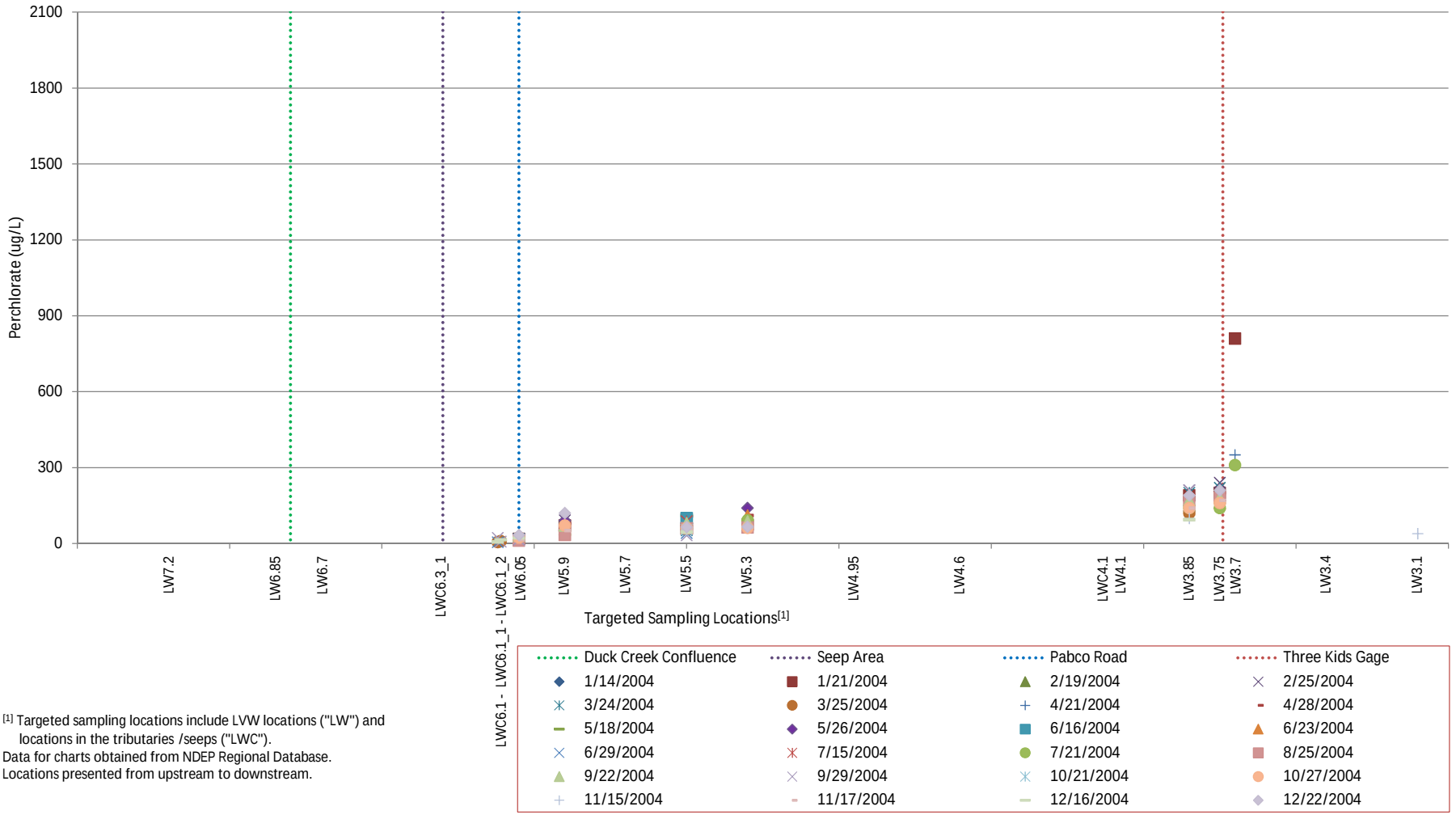
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-4. Concentrations of Perchlorate at Targeted Sampling Locations (2003)



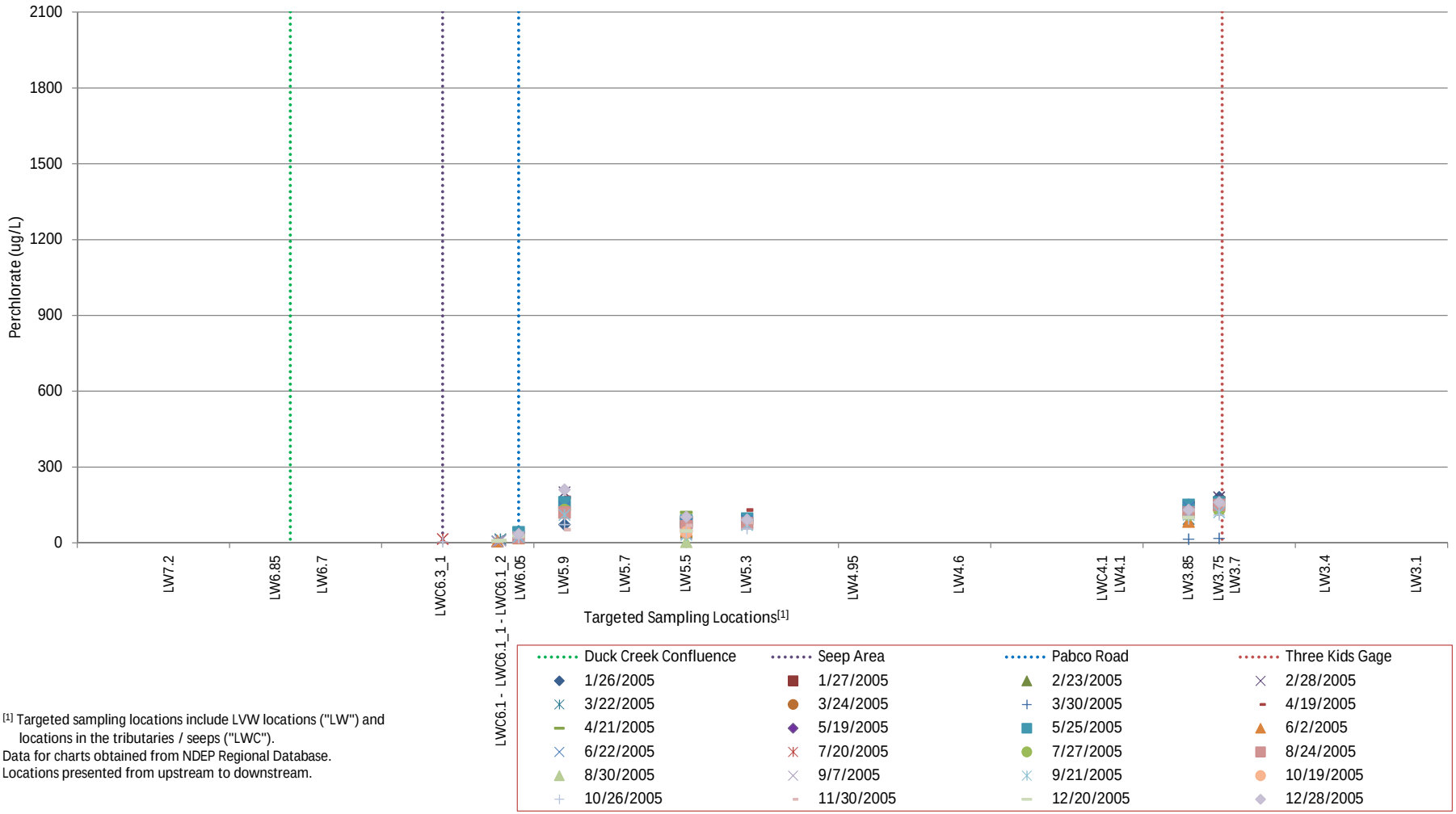
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries / seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-5. Concentrations of Perchlorate at Targeted Sampling Locations (2004)



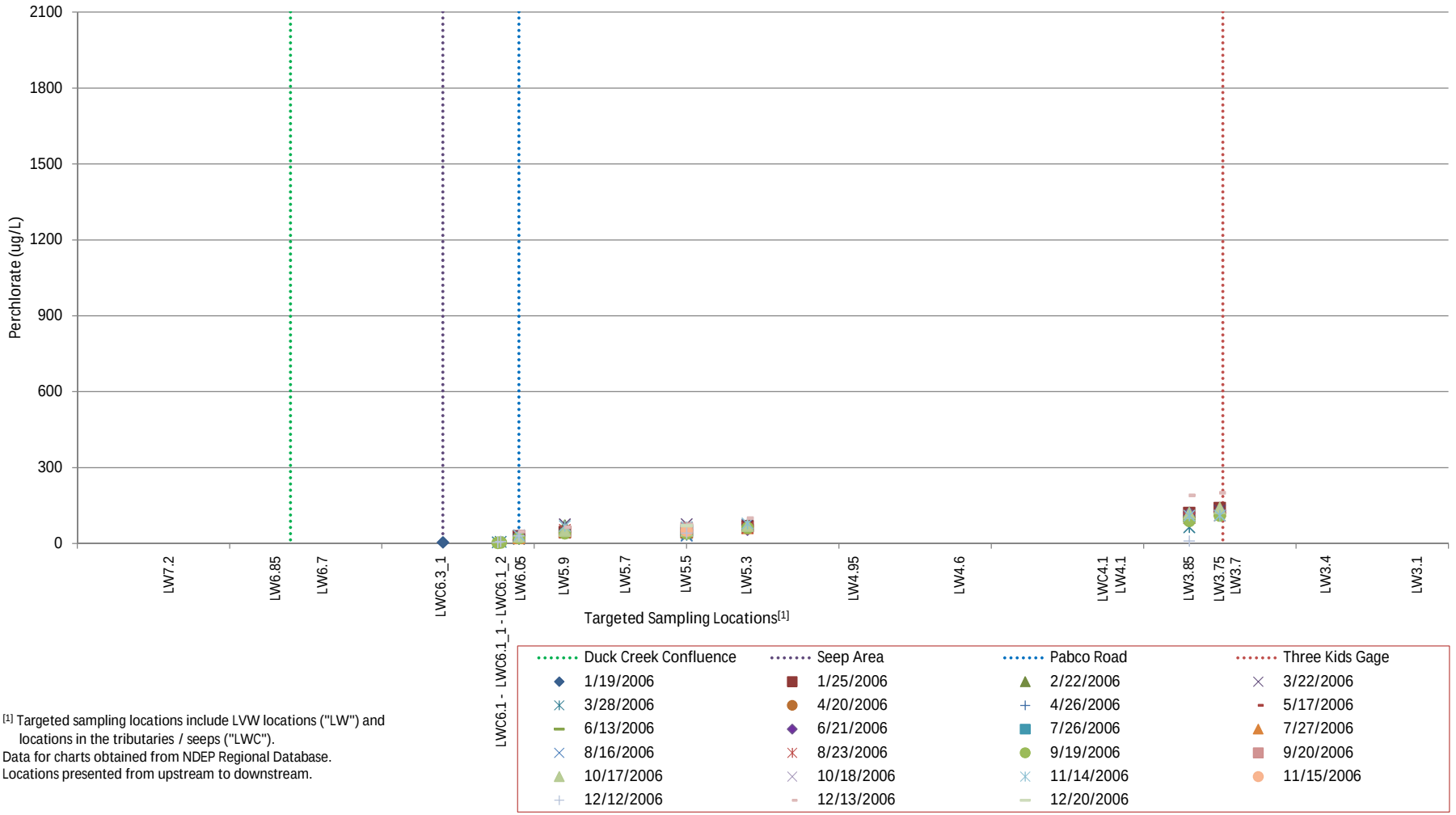
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-6. Concentrations of Perchlorate at Targeted Sampling Locations (2005)



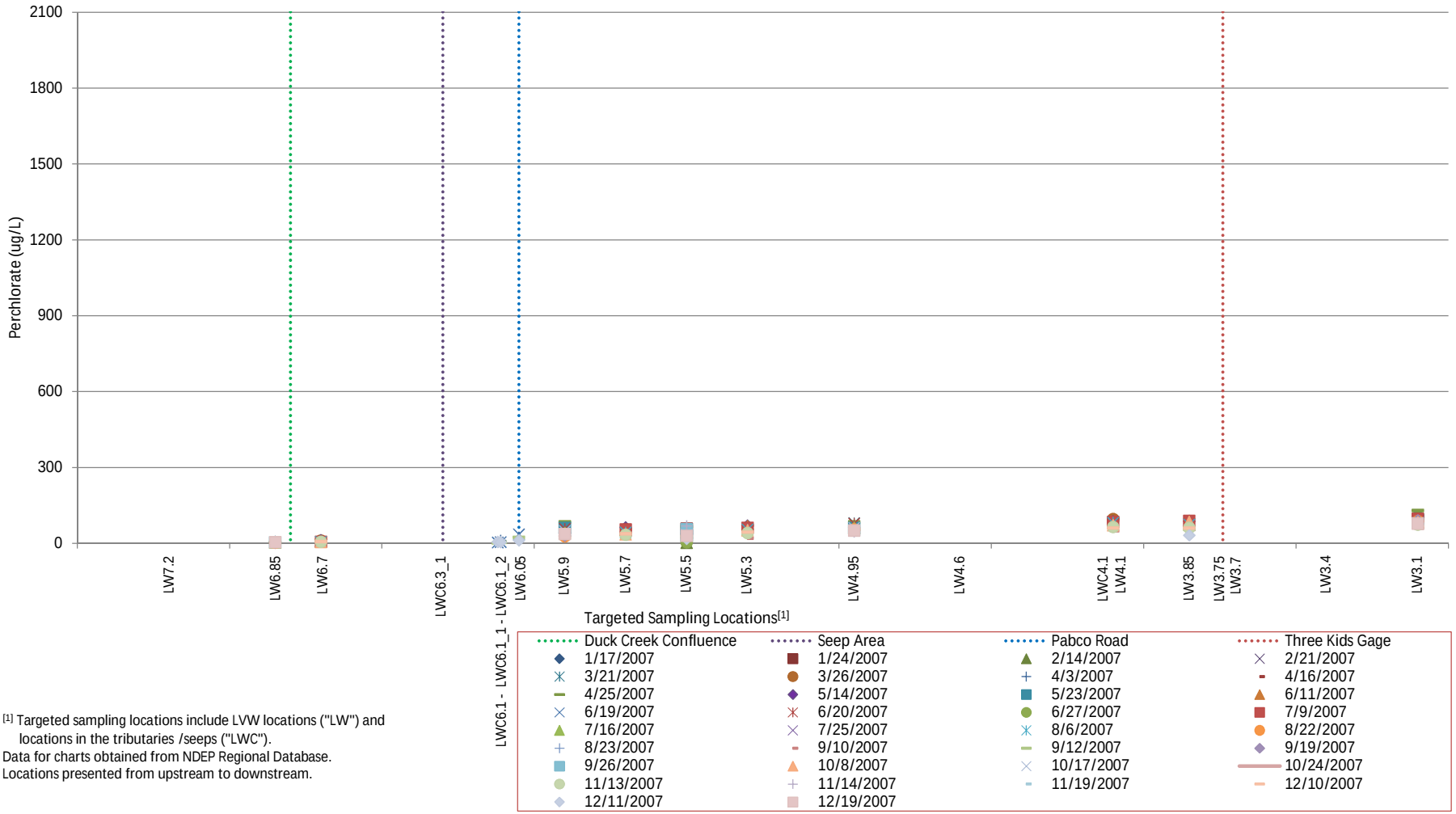
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries / seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-7. Concentrations of Perchlorate at Targeted Sampling Locations (2006)



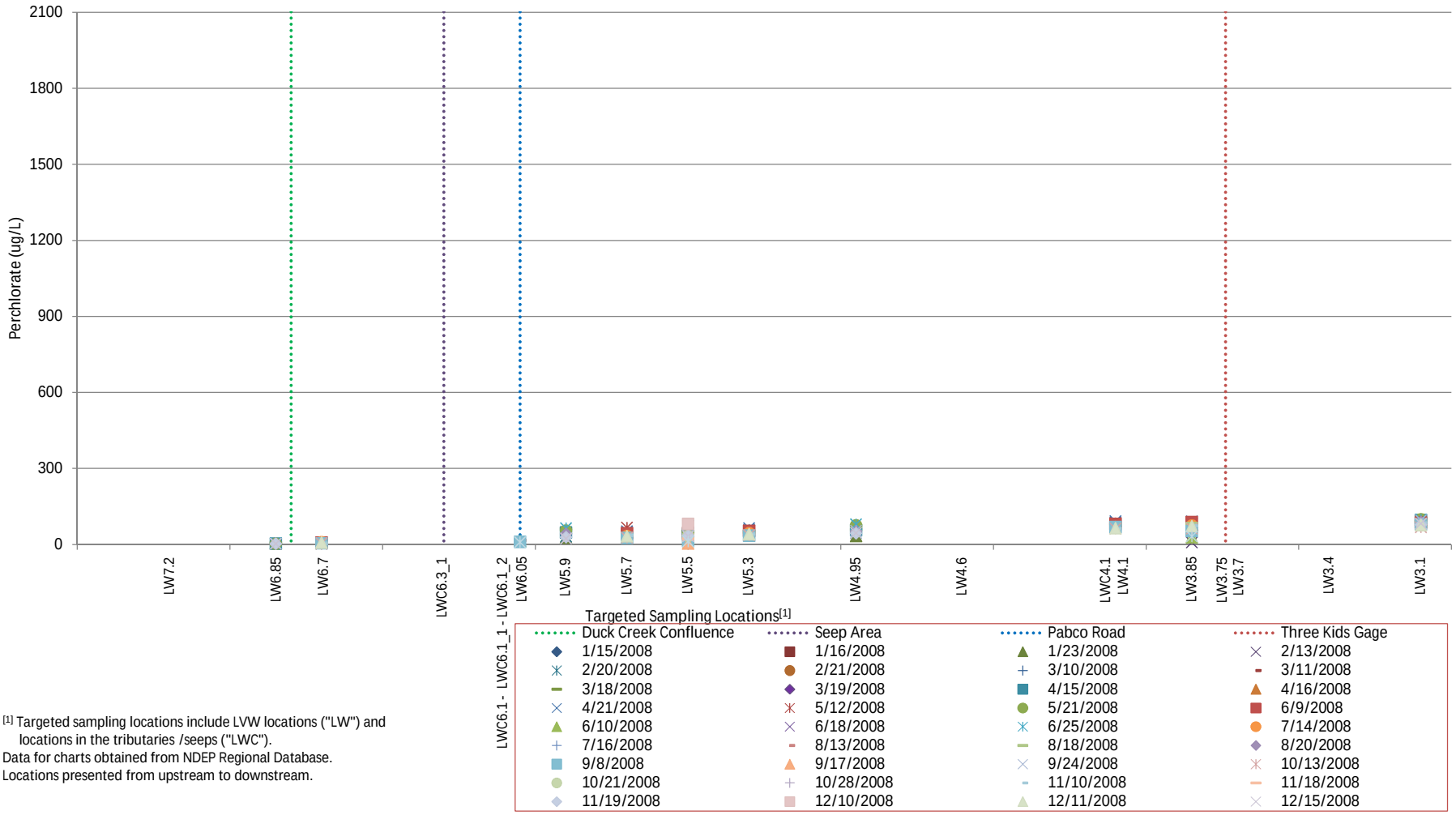
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries / seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-8. Concentrations of Perchlorate at Targeted Sampling Locations (2007)



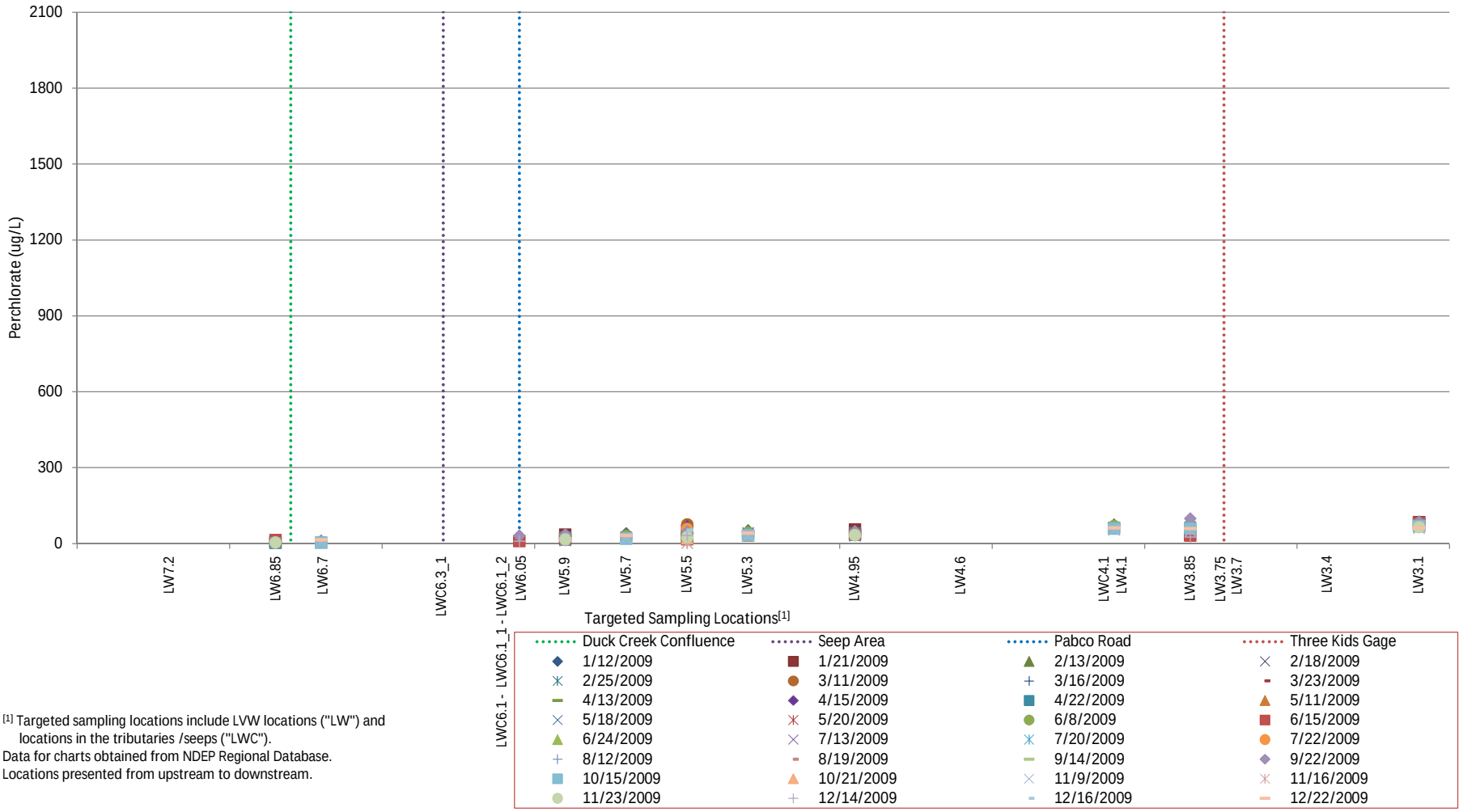
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-9. Concentrations of Perchlorate at Targeted Sampling Locations (2008)



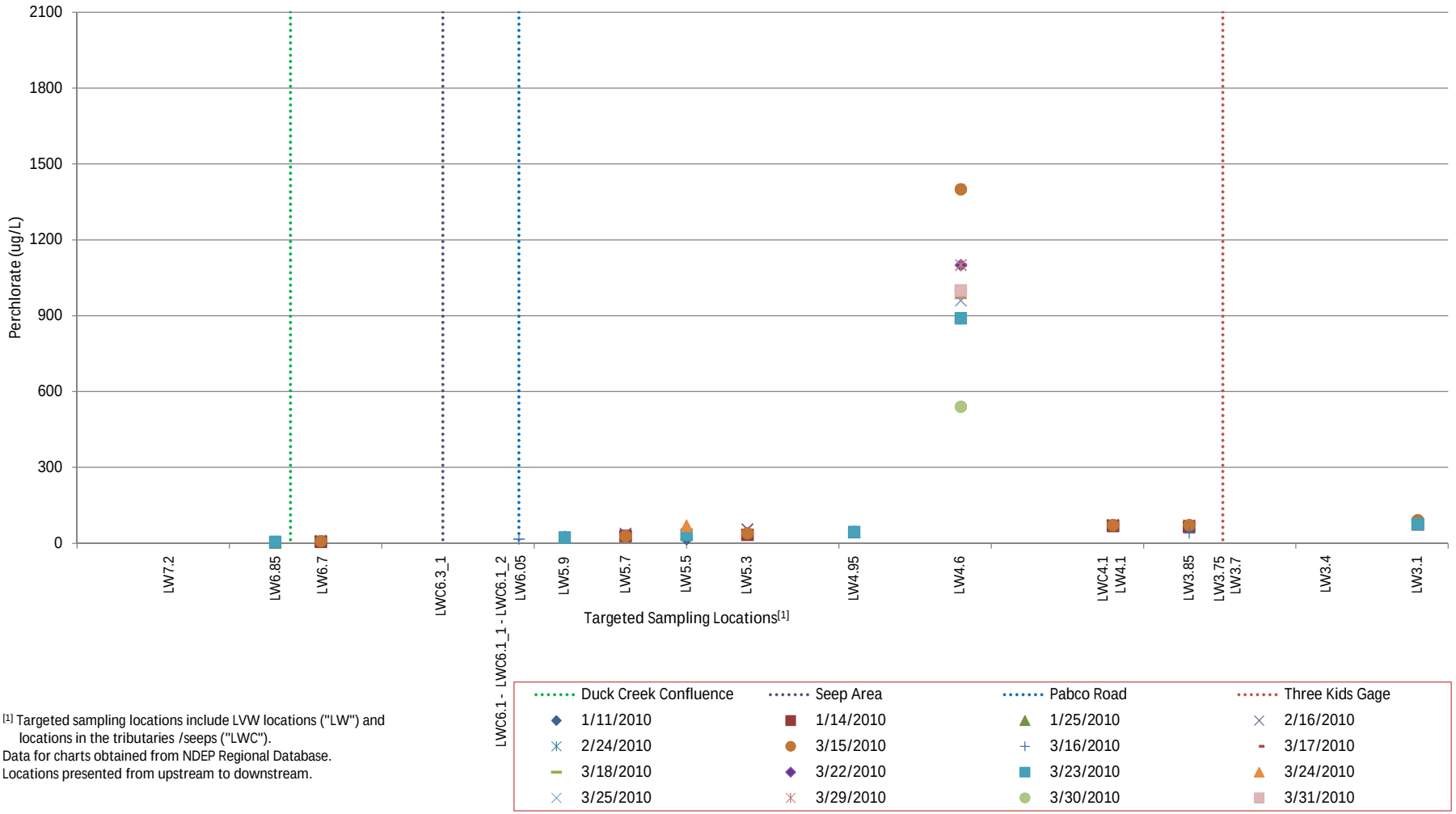
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-10. Concentrations of Perchlorate at Targeted Sampling Locations (2009)



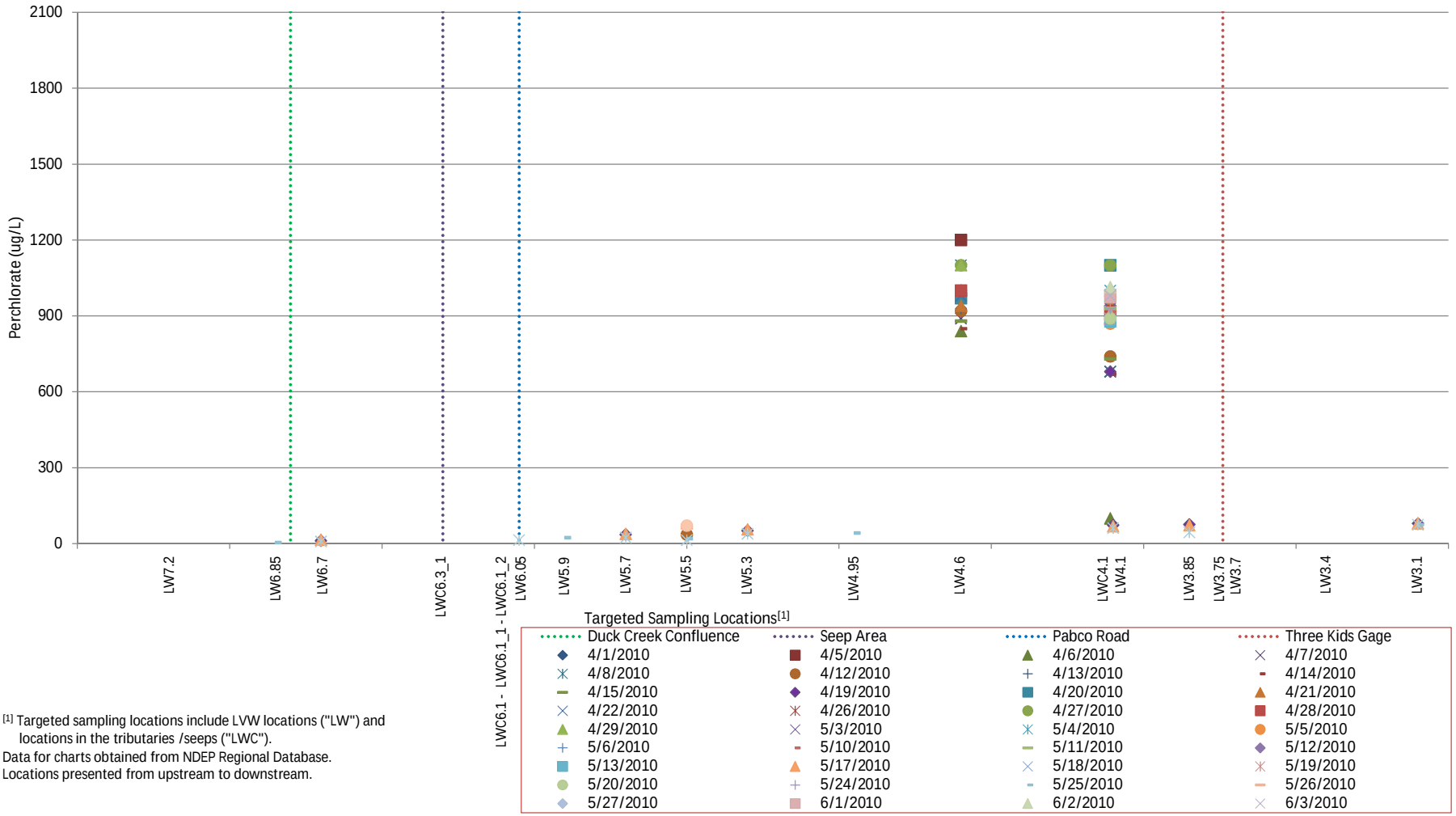
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-11. Concentrations of Perchlorate at Targeted Sampling Locations (2010 - Q1)



[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-12. Concentrations of Perchlorate at Targeted Sampling Locations (2010 - Q2)

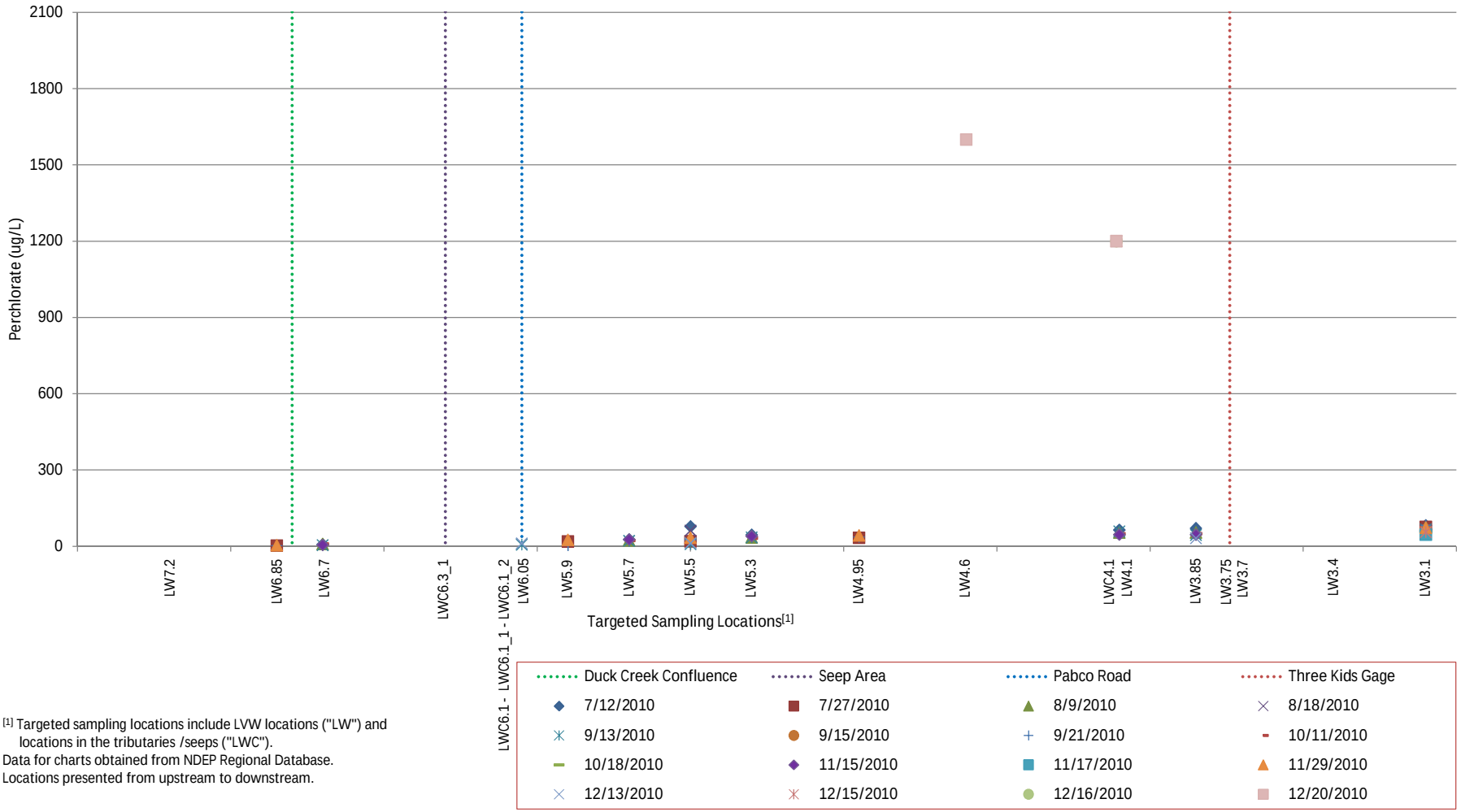


[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").

Data for charts obtained from NDEP Regional Database.

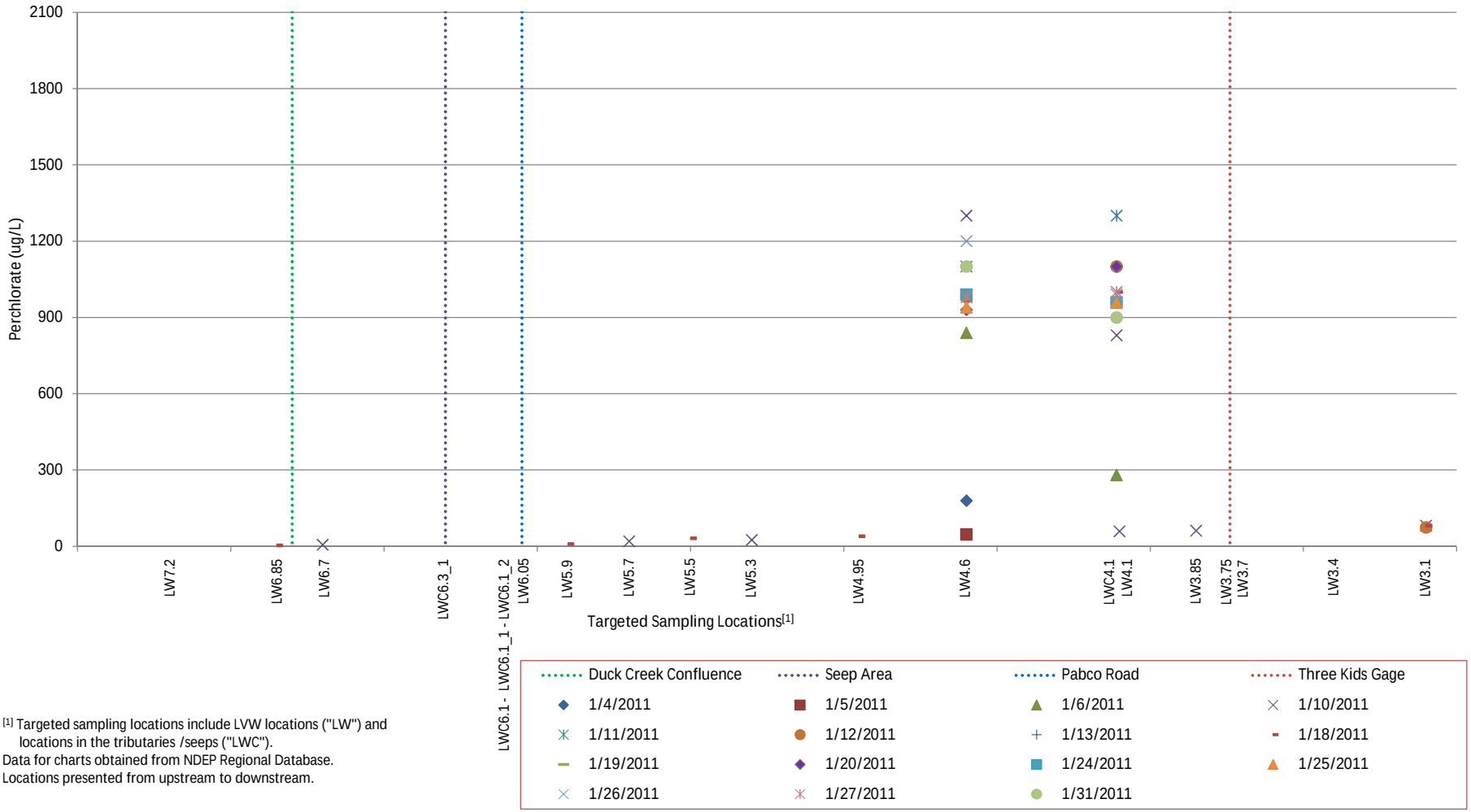
Locations presented from upstream to downstream.

Figure B-13. Concentrations of Perchlorate at Targeted Sampling Locations (2010 - Q3-Q4)



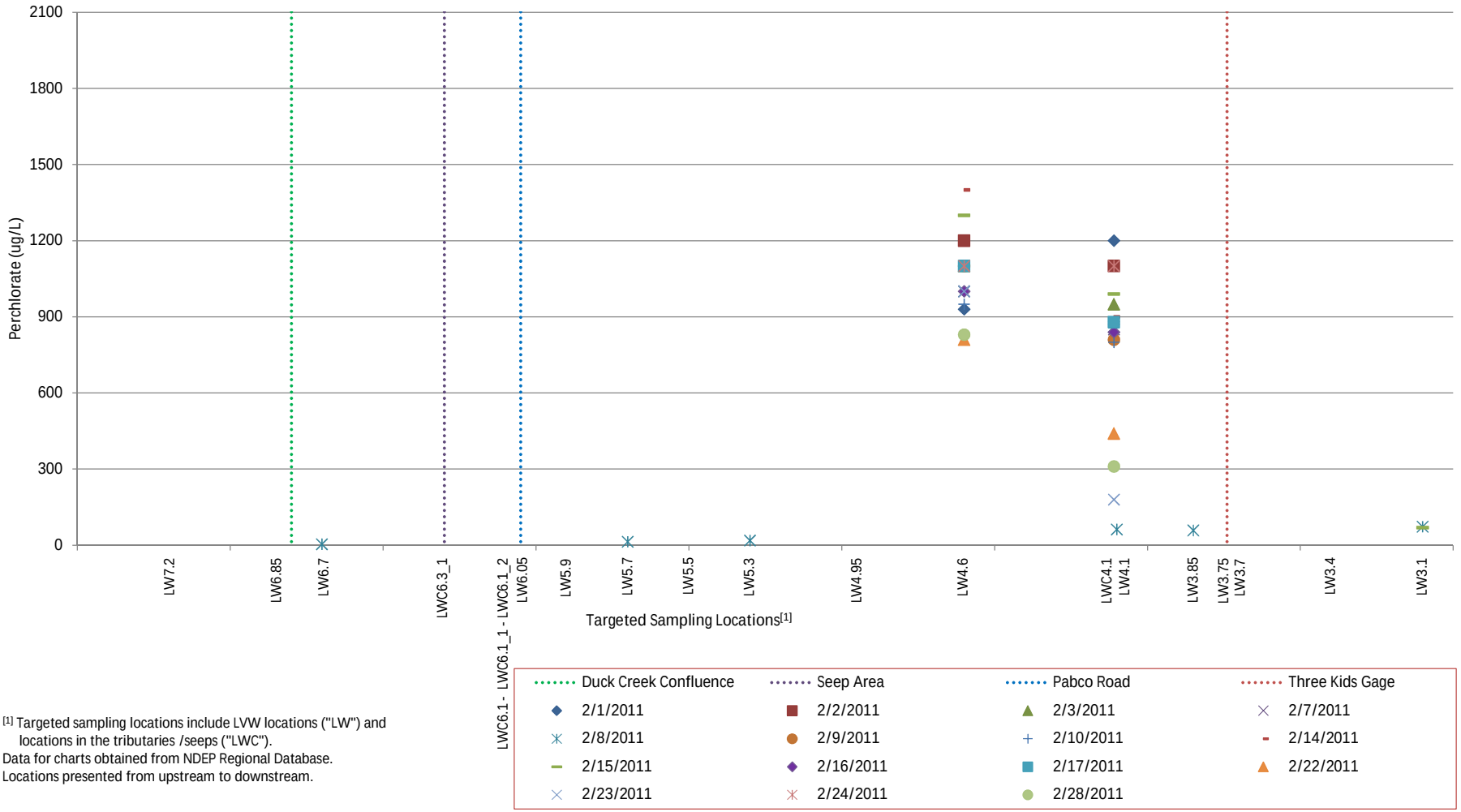
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-14. Concentrations of Perchlorate at Targeted Sampling Locations (2011 - Q1:January)



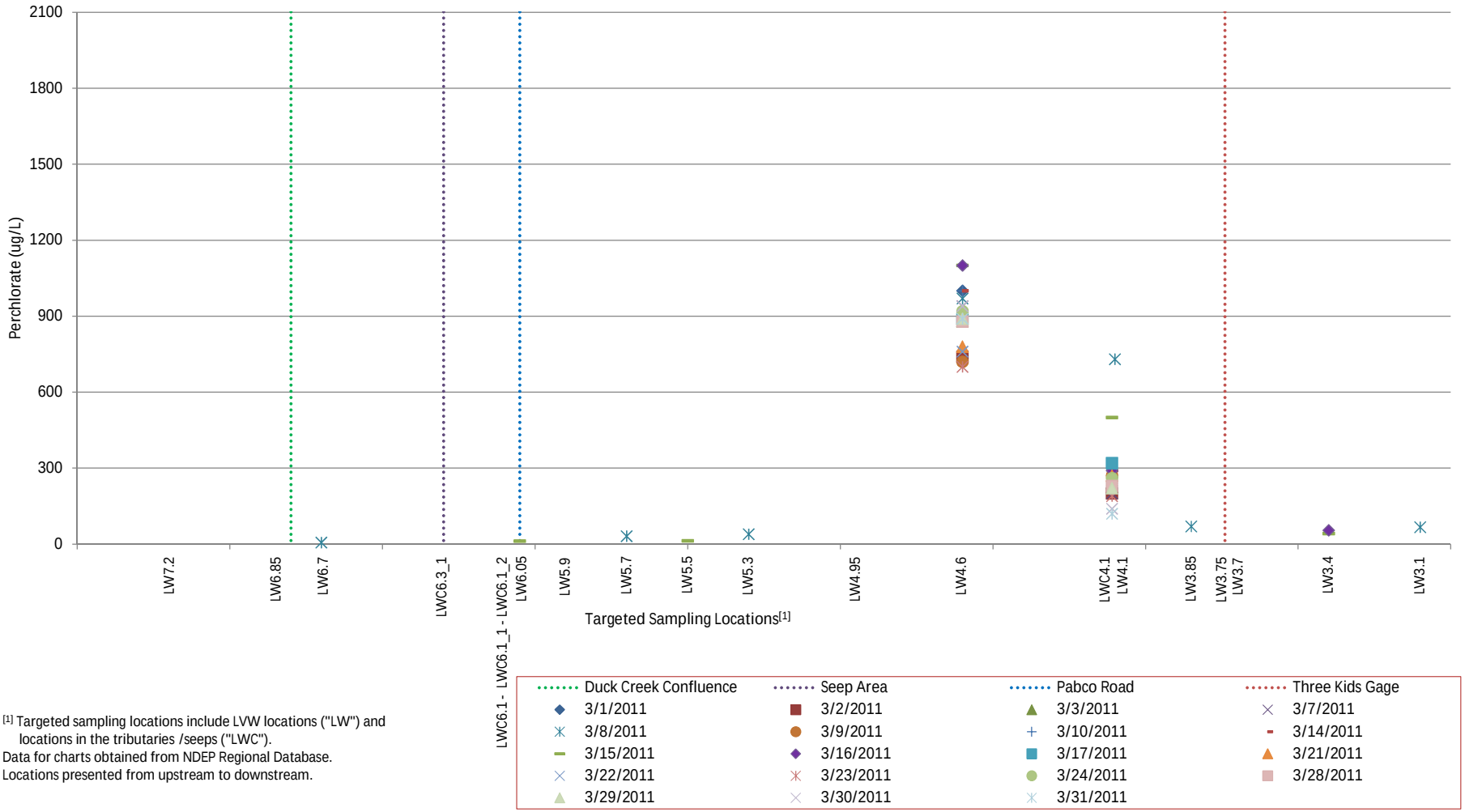
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-15. Concentrations of Perchlorate at Targeted Sampling Locations (2011 - Q1:February)



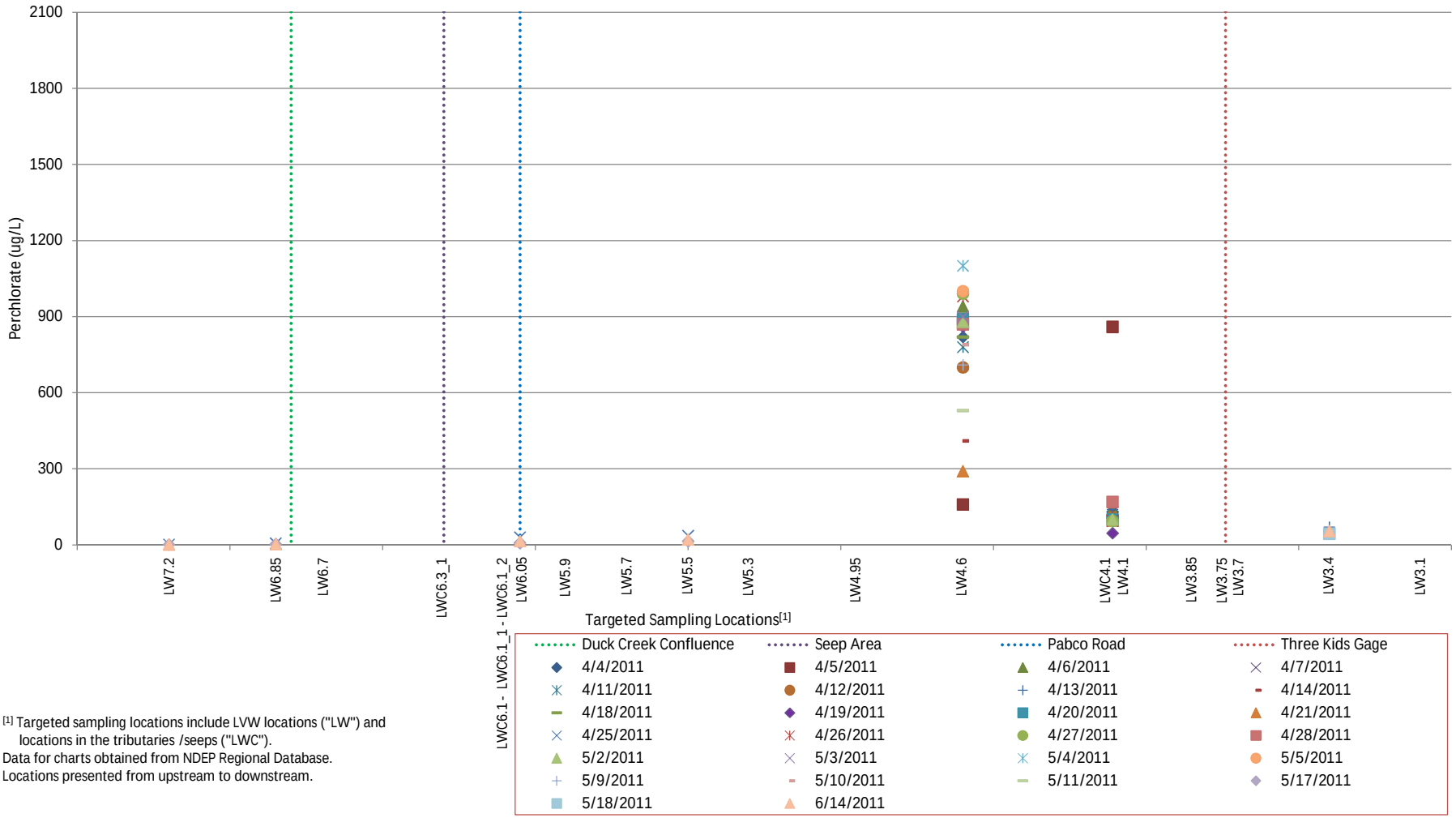
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-16. Concentrations of Perchlorate at Targeted Sampling Locations (2011 - Q1:March)



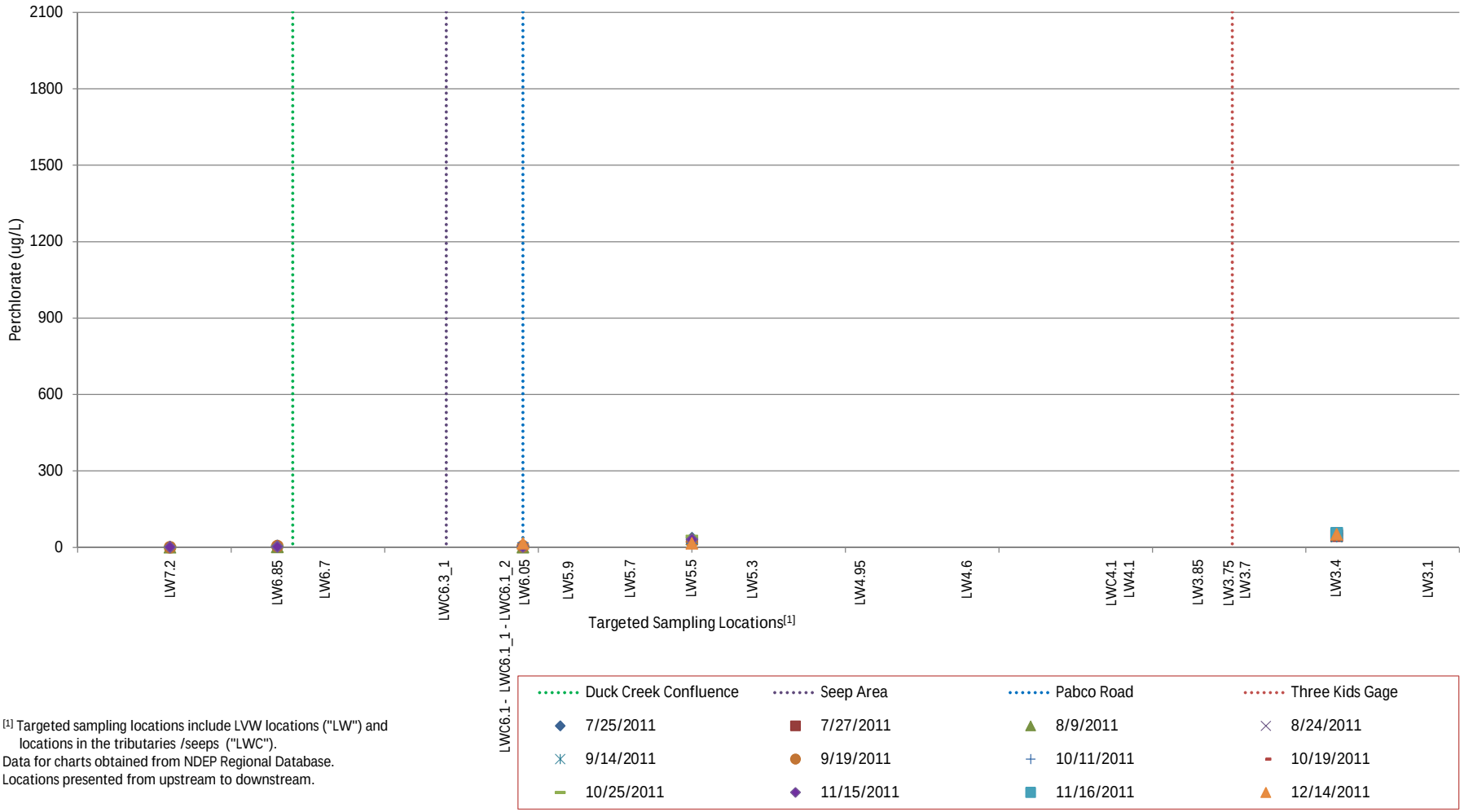
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-17. Concentrations of Perchlorate at Targeted Sampling Locations (2011 - Q2)



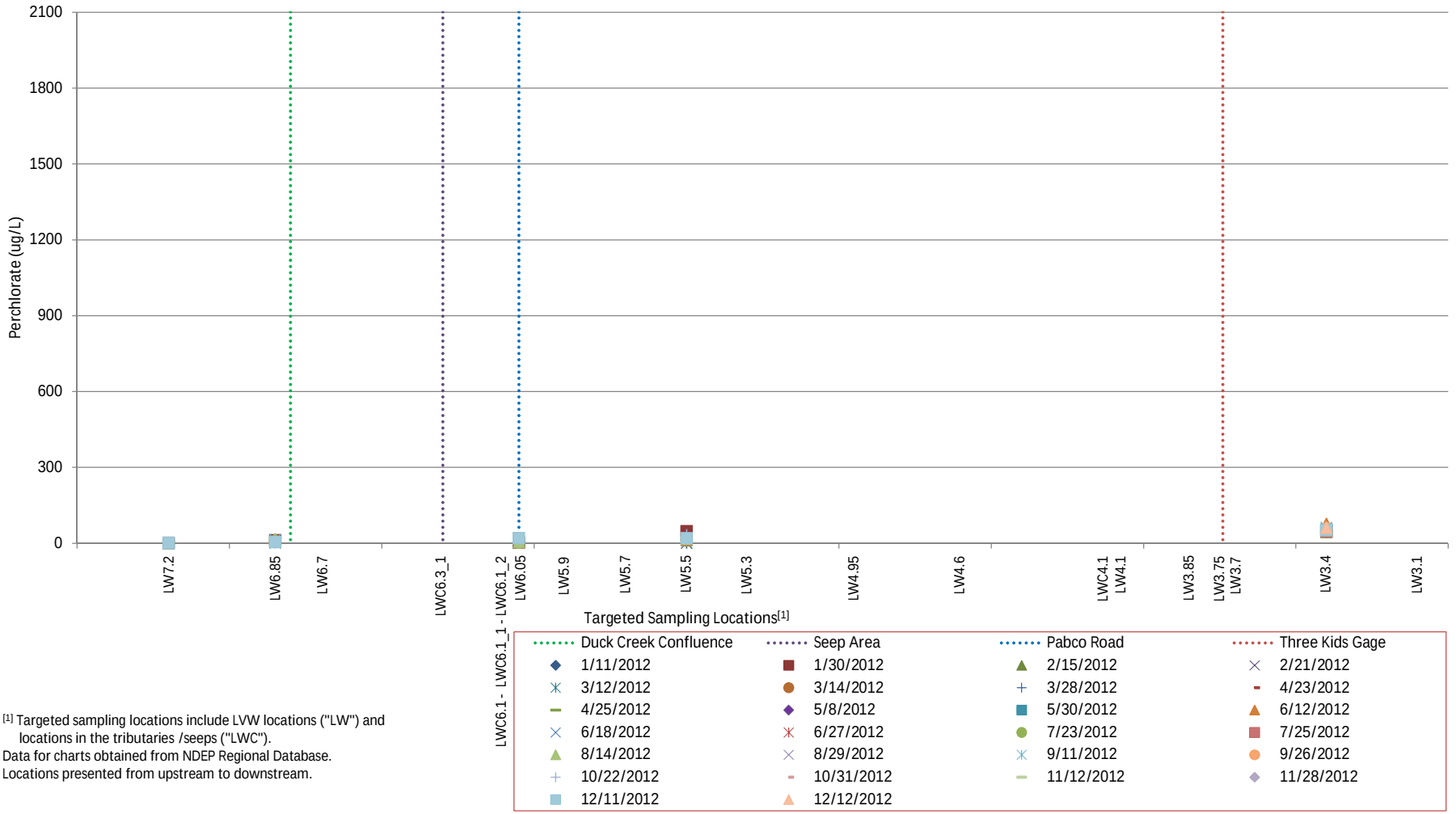
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-18. Concentrations of Perchlorate at Targeted Sampling Locations (2011 - Q3-Q4)



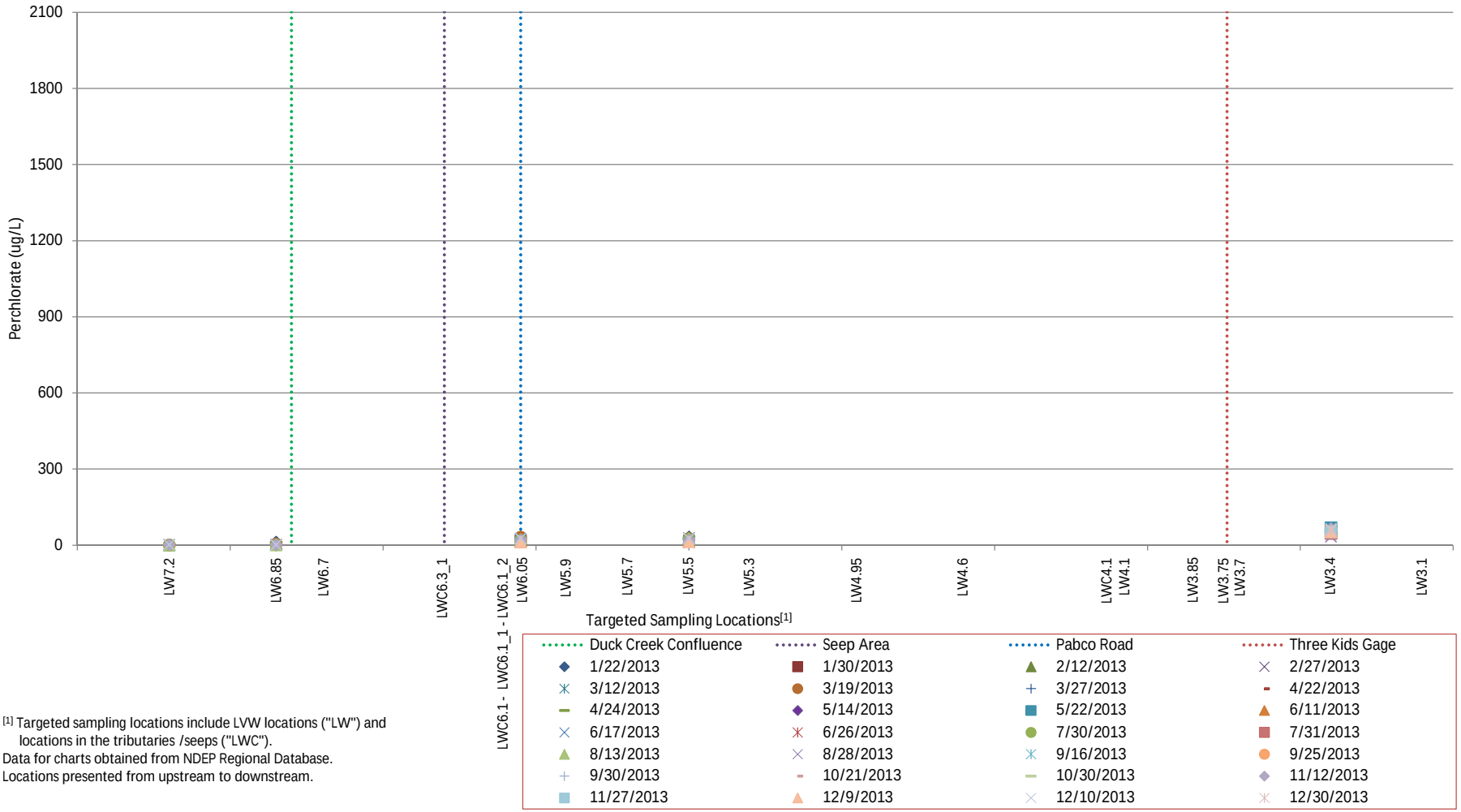
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-19. Concentrations of Perchlorate at Targeted Sampling Locations (2012)



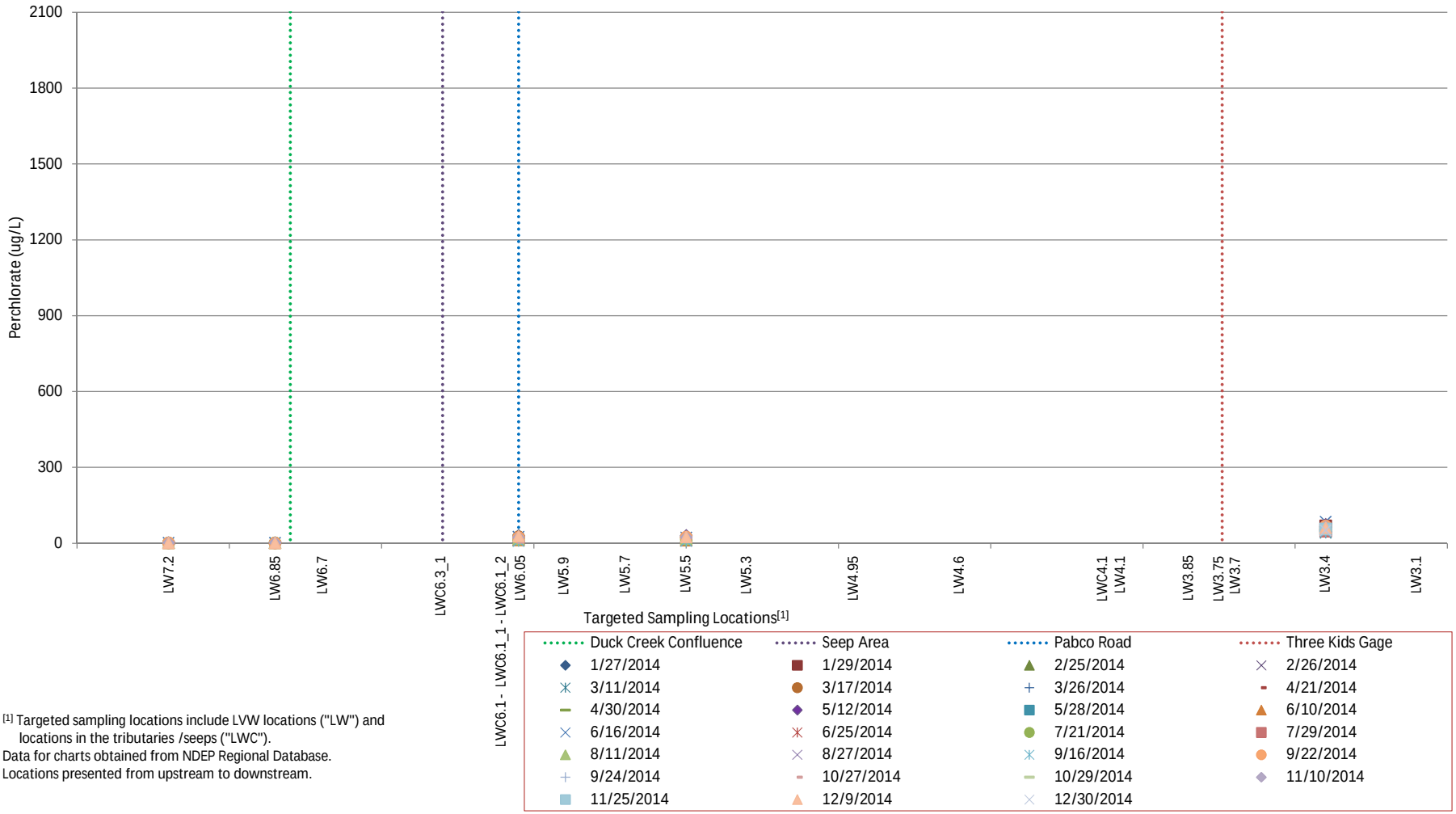
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

Figure B-20. Concentrations of Perchlorate at Targeted Sampling Locations (2013)



[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

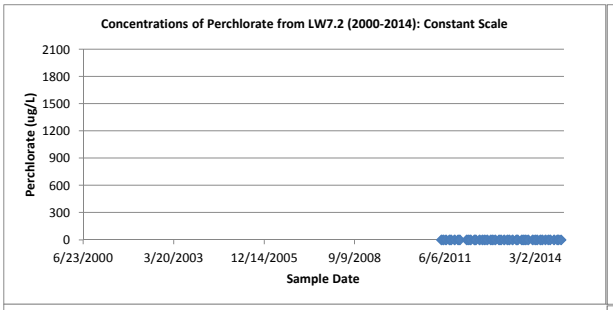
Figure B-21. Concentrations of Perchlorate at Targeted Sampling Locations (2014)

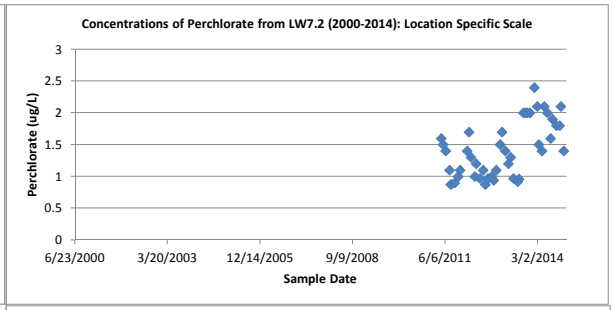


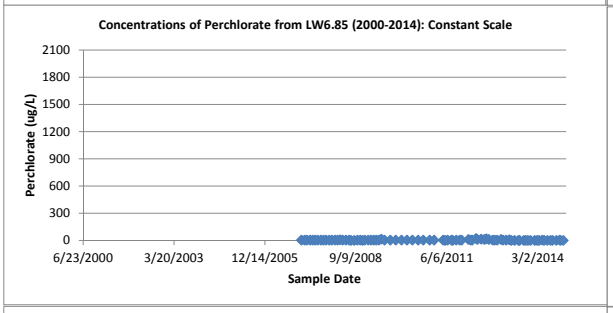
[1] Targeted sampling locations include LVW locations ("LW") and locations in the tributaries /seeps ("LWC").
Data for charts obtained from NDEP Regional Database.
Locations presented from upstream to downstream.

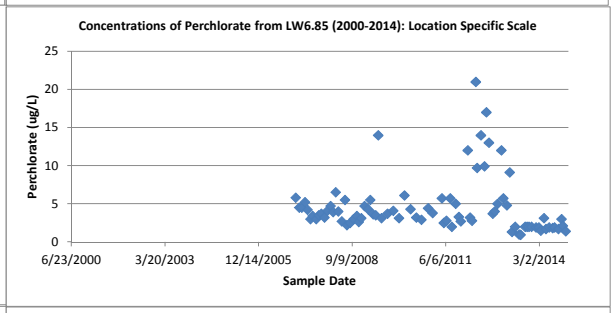
Appendix B2 - Concentrations of Perchlorate at Targeted Sample Locations

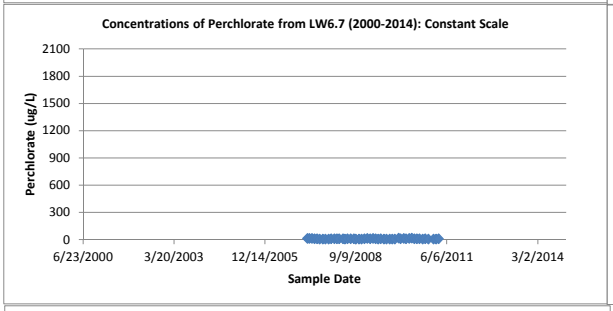
NERT Remedial Investigation - Downgradient Study Area

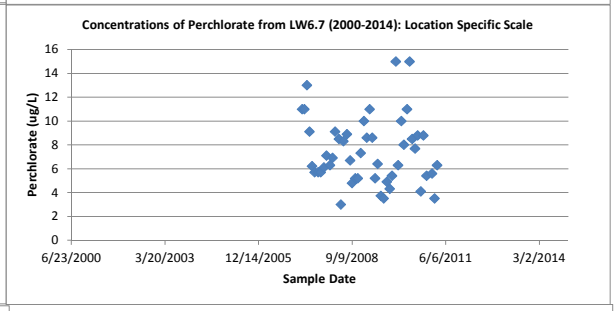


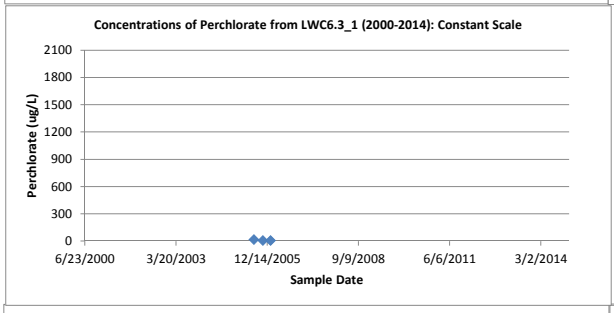


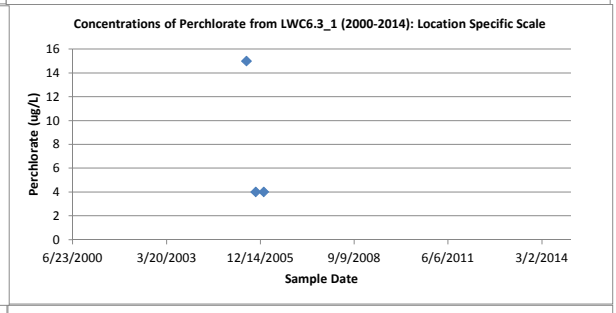


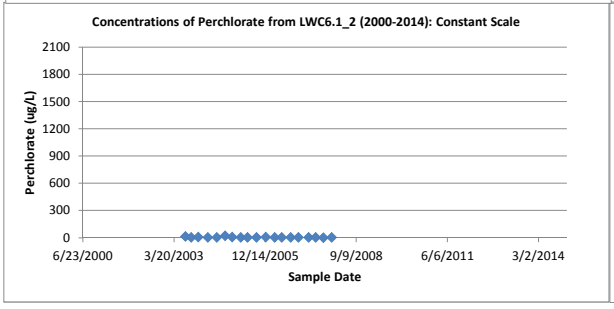


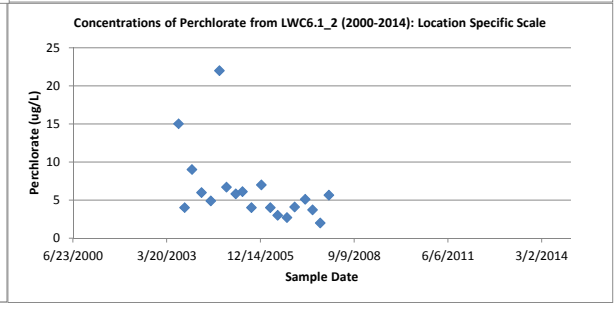








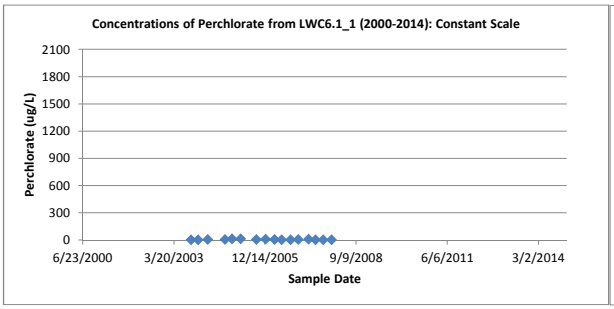


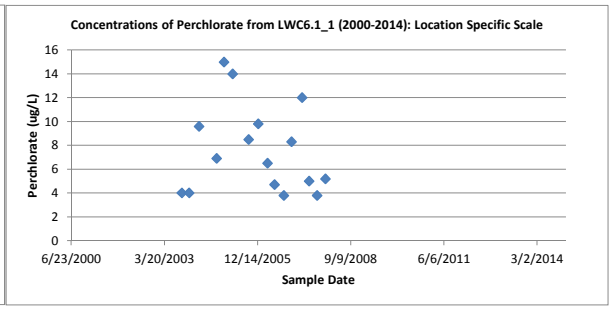


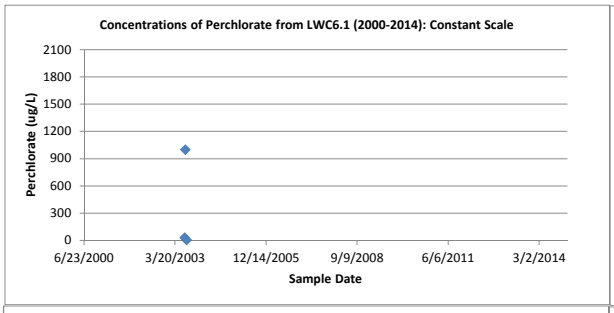
Note: Data is presented by sample date. For comparison, each sample location is presented on a "Constant Scale" (on left) and on a "Location-Specific Scale" (on right). The "Location-Specific Scale" was inlcuded to better show the details of the data.

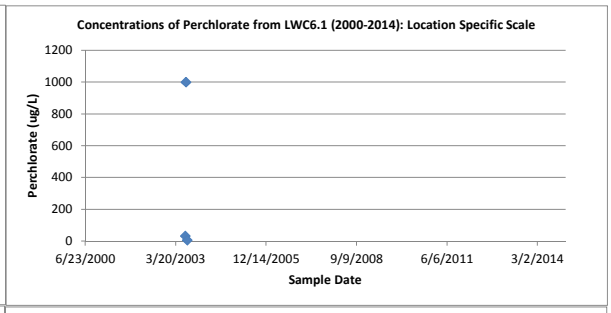
Appendix B2 - Concentrations of Perchlorate at Targeted Sample Locations

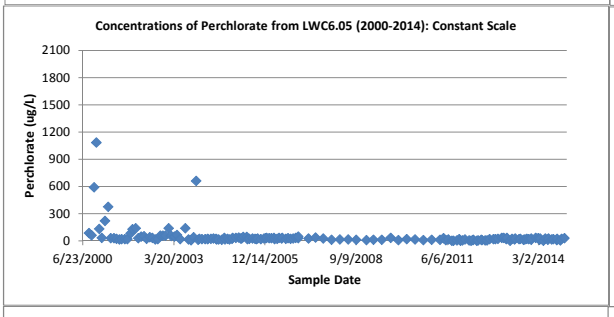
NERT Remedial Investigation - Downgradient Study Area

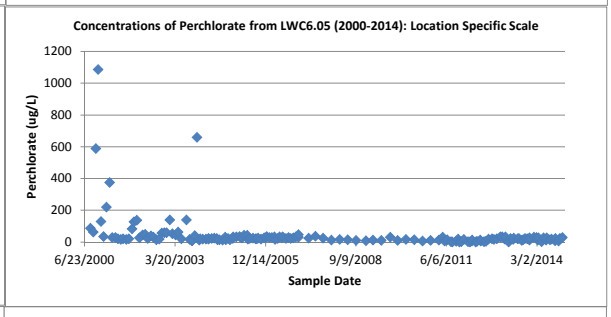


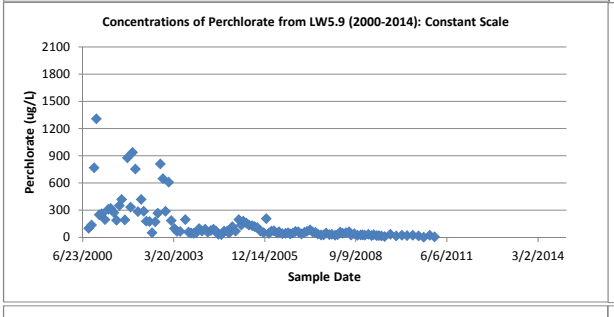


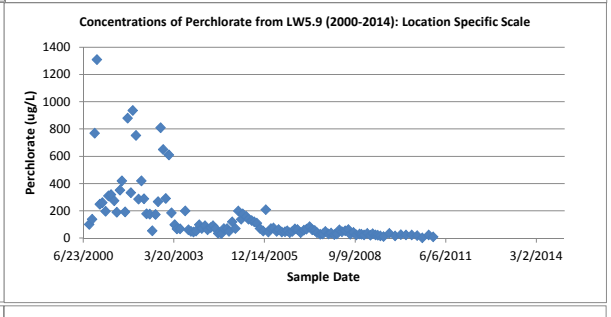


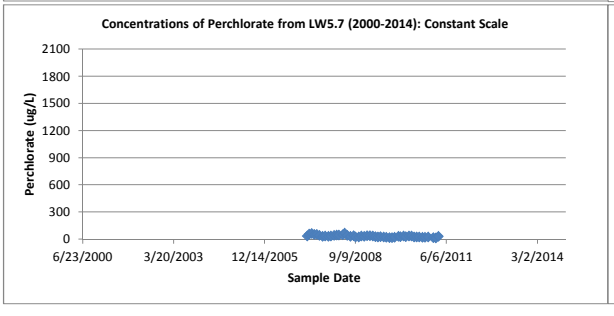


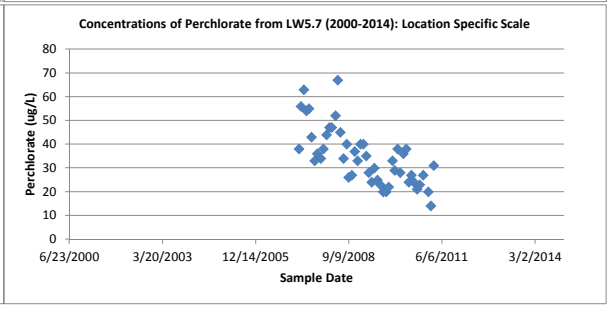












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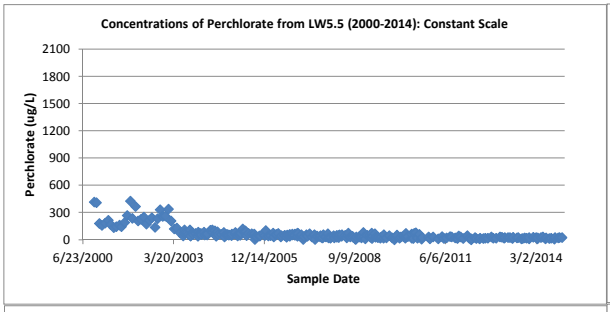
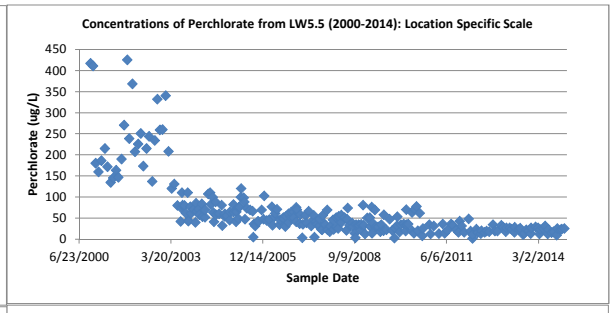
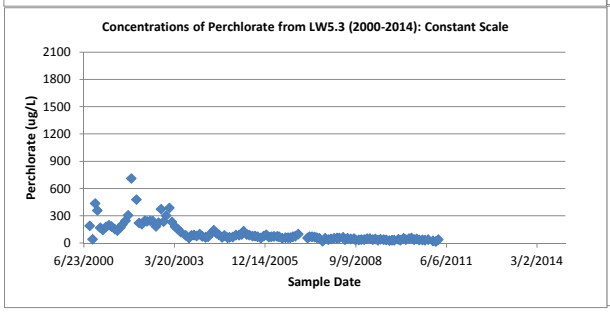
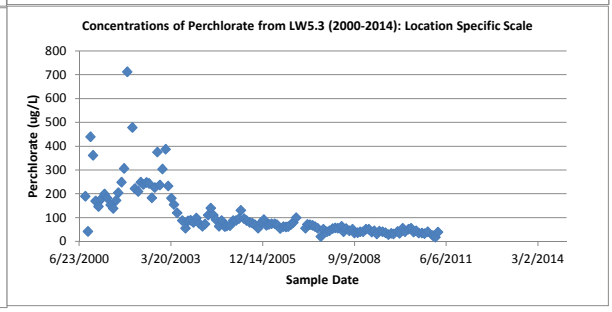
Appendix B2 - Concentrations of Perchlorate at Targeted Sample Locations

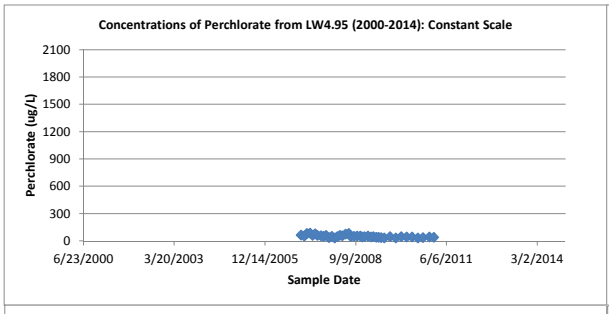
NERT Remedial Investigation - Downgradient Study Area

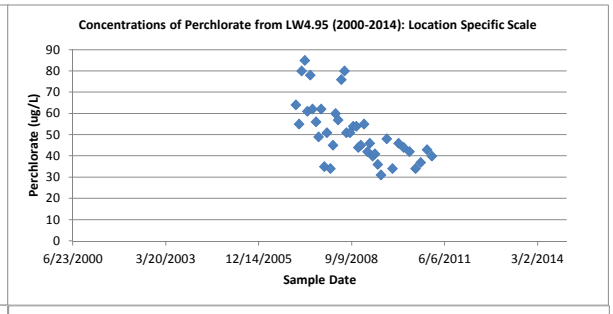


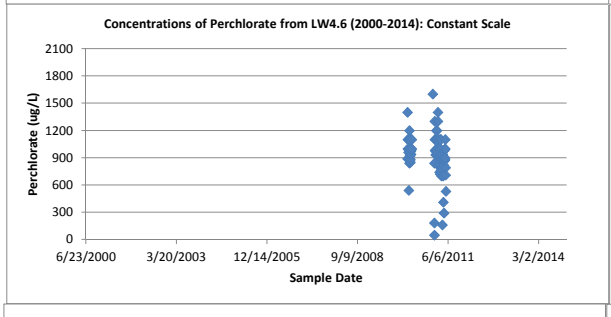


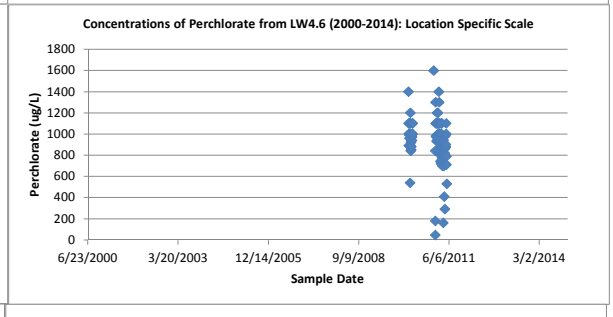


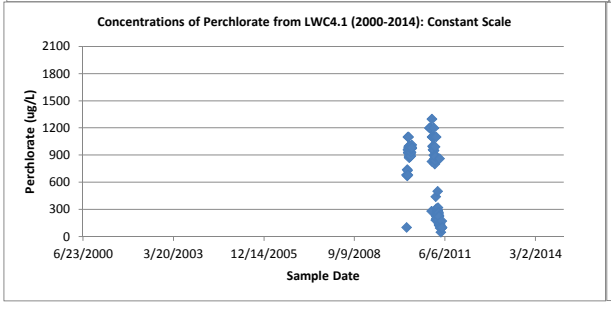


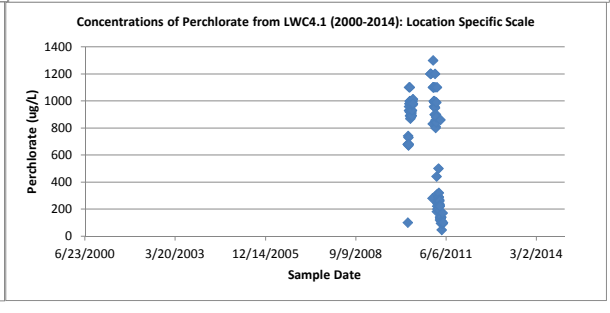












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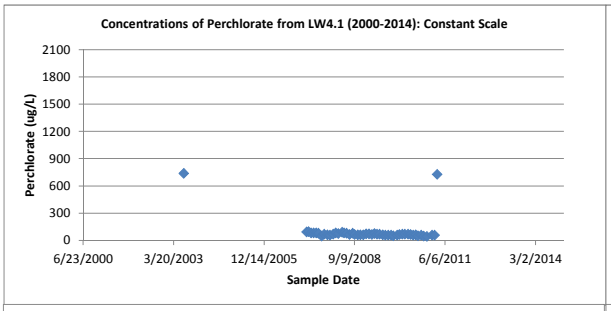

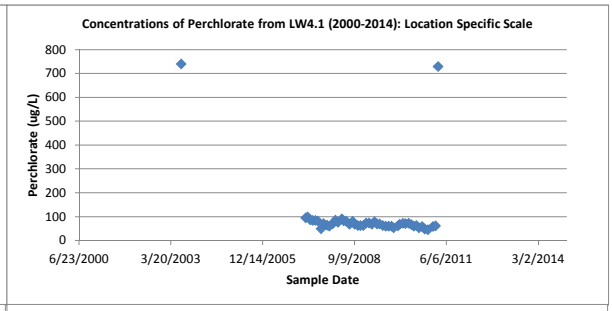

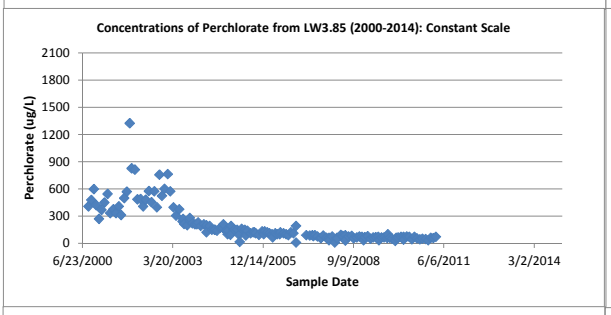

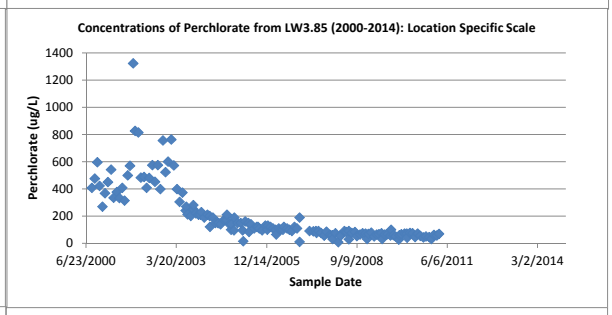

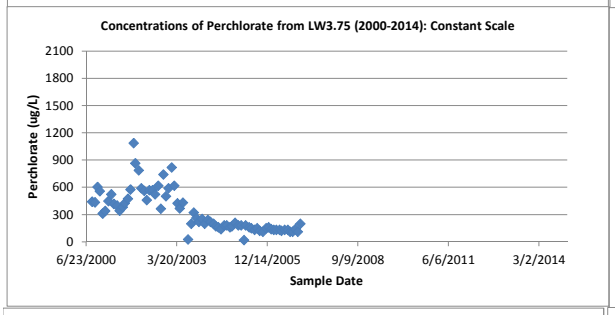

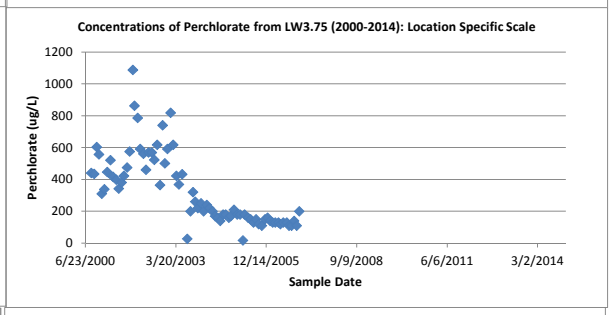

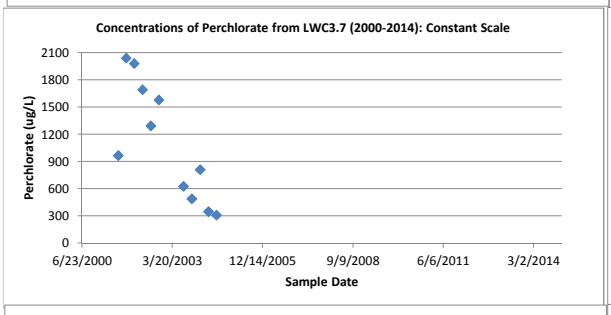

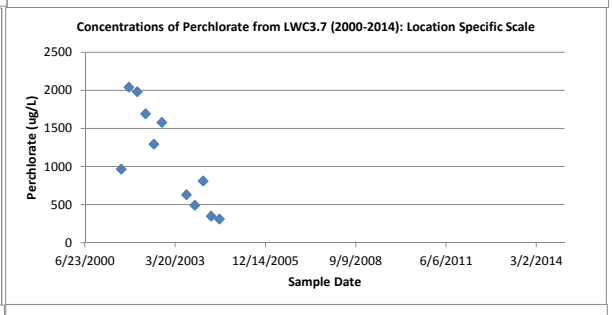

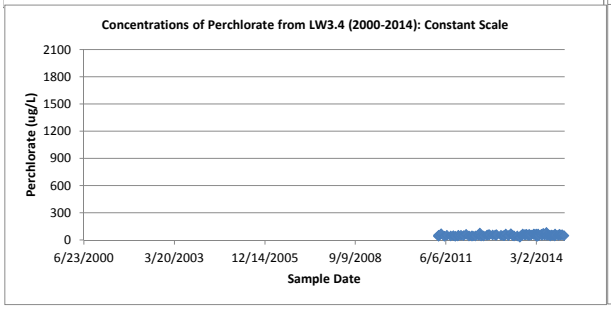

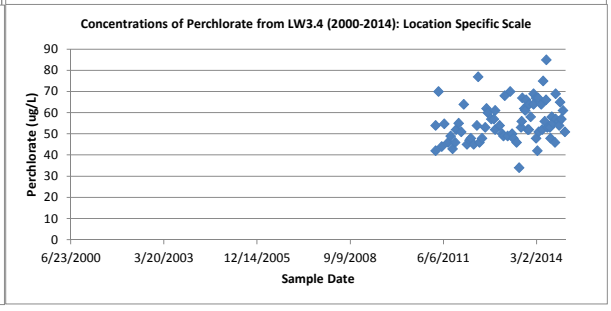

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Appendix B2 - Concentrations of Perchlorate at Targeted Sample Locations

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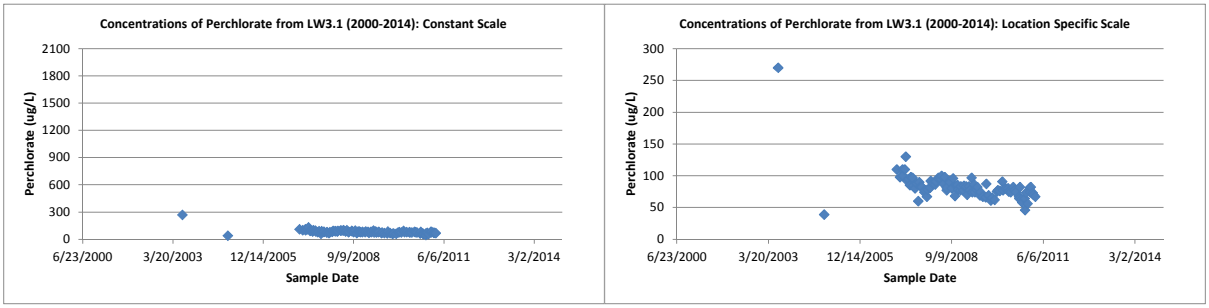

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Appendix C

Standard Operating Procedures

Project Operating Procedure
NERT RI - Downgradient Study Area

Water Quality Data Collection and Surface Water Sampling

Procedure Number: NERT-FI-01

Revision No.: 0

Revision Date: January 2016

Prepared by

Dion Lewis

Reviewed by:

Date: _____

Sally Bilodeau. CEM #1953, Project Manager

Date: _____

Kristen Durocher, Surface Water Task Manager

Field Guidance Document
NERT RI - Downgradient Study Area

Water Quality Data Collection and Surface Water Sampling

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Date: _____

Sally Bilodeau. CEM #1953, Project Manager

Date: _____

Kristen Durocher, Surface Water Task Manager

Contents

1.0 Scope and applicability

1.1 This project Field Guidance Document (FGD) defines the operating procedures for the collection of water samples and in-situ water property data associated with the Nevada Environmental Response Trust (NERT) Remedial Investigation (RI) for the Downgradient Study Area. In-situ water property data (temperature, conductivity, dissolved oxygen, turbidity), hereafter referred to as water quality (WQ) data, are collected using multiparameter sensors from a boat or other sampling platform during field activities. Water samples are collected either directly, by immersing and filling sampling containers, or with the aid of a peristaltic (or other equivalent) water pump.

1.2 Samples will be collected for chemical, microbiological, and physical analyses. Analytes for a particular program are specified in the Quality Assurance Project Plan (QAPP).

1.3 It is fully expected that the procedures outlined in this FGP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this FGD will be approved in advance by the Project QA Manager and the RI Task Manager and communicated to NDEP. Deviations from this FGD will be documented in the field records.

2.0 Health and safety considerations

2.1 The health and safety considerations for the work associated with this FGD, including physical, chemical, and biological hazards are addressed in the site specific Health and Safety Plan (HASP; AECOM, 2015). The major health and safety considerations for the work associated WQ data collections are the near and on-water safety aspects of the program.

2.2 Daily safety briefs are to be conducted at the start of each working day before any work commences. These daily briefs are to be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

3.1 Cross-contaminations of samples may result if sample handling equipment is inadequately or improperly decontaminated.

3.2 Contamination of samples may result if samples are exposed to certain environmental conditions. Exposure to potential sources of contamination (e.g., exhaust fumes) will be minimized.

3.3 Care must be taken to avoid disturbing the river bed sediment during sampling. Re-suspended bed sediments may contaminate/ artificially bias the surface water samples.

3.4 Inappropriate sampling equipment, such as that manufactured from non-inert plastics, may contaminate samples. Using Teflon, polymer, or stainless steel sampling equipment will minimize contamination during sample collection activities.

3.5 Purging of the tubing and pump system with a minimum of three volumes of site water prior to sample collection will ensure a representative sample.

3.6 Ensuring that the in-situ sensors are maintained/ calibrated properly and that samples are preserved in accordance with the specified laboratory method will help reduce interference risks related to these sample and data collection efforts.

4.0 Equipment and materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this FGD. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, depending on the field conditions encountered:

- Peristaltic water pump, variable speed, capable of ~5 L/minute discharge
- 12-volt battery (as needed)
- CFLEX or equivalent polymer tubing (typical configuration requires 1.2 in. OD); A 25 foot length will meet all project sampling (depth) requirements
- Voss Technologies 0.45 micron inline metals filter (or equivalent)
- Sample containers as specified in the Field Sampling Plan (FSP)/ Quality Assurance Project Plan (QAPP)
- Multiparameter instrument package that includes temperature, pH, dissolved oxygen (DO), and turbidity (YSI sonde or equivalent)
- Connective (serial) cabling
- Weight bearing line/cable
- Field computer (if applicable)
- Project specific field log book
- Chemical-free wipes
- Disinfectant wipes
- Approved plans, including target sampling locations
- Insulated coolers with wet ice
- Field notebook, pen, standardized forms (as needed)
- Chain-of-custody forms and seals
- Multiparameter WQ sensor operating manual
- Replacement batteries
- GPS
- Safety gear (work vests, HASP specified PPE)
- Nitrile gloves
- Gauntlet gloves

- Storage bags
- Boat (jon boat, canoe, or similar) with all applicable safety equipment (anchor, etc)
- Storage cooler

5.0 Procedures

5.1 In-situ Sensor Testing/Calibration

Make sure sensor/probes are clean and free of visible defects (housing cracks, etc.). Check the DO sensor for excessive wear and ensure that no air bubbles exist beneath the sensor membrane.

Instrument calibration is to be accomplished following the instrument manual. Ensure that all sensors are immersed in the calibration solutions for this activity. An instrument-specific calibration cup is standard equipment available for this purpose. Readings should be stable for ~30 seconds before accepting each calibration point. Sensors should be returned to the manufacturer if they are not operating within the specified accuracy/precision limits.

5.2 Water Pump/Tubing Set-up

Connect the pump to a 6-volt battery. The water pumps and associated tubing used on this investigation should be dedicated to the project and rinsed with tap water before and after each (daily) use. Project tubing should be new at the project start, and rinsed thoroughly with deionized water. The tubing should be sealed in a bag when not in use; open tube ends should also be covered and protected when not in use, including between stations. Between-station rinsing is not generally required but flushing the system with site water at each sampling location is to be performed. The number of minutes required to purge the pump and tubing will be calculated as follows:

$(((\pi r^2 \times l)/10)/f) \times 3$ = minutes to purge the pump

Where:
π = pi
r = half the inner diameter of the tubing (cm)
l = length of tubing used on station (meters)
f = flow rate of the pump (liters/min)

5.3 Field Data and Sample Collections

5.3.1 Navigate to sampling stations outlined in the project sampling plan using the GPS unit.

5.3.2 Estimate and record the depth of the water. Water depth may be recorded using a weighted line with 0.1 ft increments marked.

5.3.3 At each station, the instruments should be lowered to the depth of interest and allowed to stabilize. If a profile is desired, then the instruments should be lowered to the near bottom and slowly raised between data collection points. Avoid contacting the river bed sediments, if possible. Data may be recorded electronically or entered into field log books. Water collections are typically made after the WQ data are collected.

Profile collection from a boat: At the station of interest, the datasonde should be lowered through the water column until it is near bottom as determined by the weighted line. If the operator "feels" the bottom with the weight, the instrument should be raised and data collection delayed to allow any resuspended sediment to dissipate as determined by monitoring real-time turbidity readings. Based on the water depth provided by the datasonde, field technicians will determine the water column structure and define the desired depths for data and sample collection. The datasonde should be allowed to equilibrate at bottom depth for at least one minute (or until readings for all parameters stabilized) before beginning profiling.

Profile collection from wading or shore point: At the station of interest, the field team should lower the datasonde through the water column until the probes and tubing inlet are completely submerged and at least 3 inches below the water surface. If the instrument package makes contact with the bottom profiling should be delayed for 5 minutes to allow for any suspended sediments to dissipate as confirmed by monitoring real-time turbidity readings. The datasonde should be allowed to equilibrate at sample depth for at least one minute (or until readings for all parameters stabilized) before beginning profiling.

5.3.4 In areas that require pumped collections (i.e., deep water or sampled from the boat) or for parameters that require filtration (i.e., total and hexavalent chromium), flush the tubing with water collected at the depth of interest. Given the small (typically ¼ in) tube diameter, flushing will be complete for a 25-foot tube well within 10 seconds with a flow rate of ~5 L/min or better (Section 5.2).

When the purge is complete, wearing nitrile gloves, fill each sample container while avoiding contact between the sampling tube and the bottle. Bottles that contain preservatives should not be overfilled.

5.3.5 In areas and for parameters that allow direct/grab sampling, storage containers may be used to collect the sample unless they contain preservatives (e.g., nitric acid). Put on clean nitrile gloves and gauntlets, select an empty storage container, immerse below the water surface, uncap and allow the bottle to fill. Note: submerging the bottle before uncapping avoids collection of the surface film. Cap the container tightly, and remove from the water. Place the capped container in a bag and on ice in a cooler.

5.3.6 If a parameter has a pre-preserved storage container, use a clean (laboratory provided) unpreserved bottle and collect the sample in the same way. Gently pour the water sample into the storage bottle containing the preservative, avoid over-filling, cap tightly, seal in a plastic bag, and place on ice in a cooler.

5.3.7 Samples will be placed in coolers and stored on ice (refer to the QAPP for containerization and storage specifications) until shipment or transfer to the laboratory.

5.3.8 All discrete water samples should be collected and stored/transferred to laboratories according to the procedures described in FGDs for Packaging and Shipping.

6.0 Quality assurance / quality control

It is the responsibility of the Field Team Leader (FTL) to check the calibration information, to spot check instrument operations, and to check the documentation accuracy of all field staff.

Quality control (QC) samples may include equipment blanks, field and laboratory duplicates.

6.1 Equipment blanks

Equipment blanks will be collected at the frequency specified in the QAPP, and from each set of sampling gear (e.g., tubing, tubing outfitted with a filter, and bottle sampler with tubing, etc.), after the sampling gear is decontaminated.

Equipment blanks may be collected if required by the FSP for pumped samples by flushing the collection tube with deionized water and filling a set of containers with deionized water that has been pumped through the system.

If required, bottle blanks may be used to evaluate potential contamination associated with the direct grab sampling technique. In this case, bottles may be filled directly with deionized, capped, bagged, and stored on ice for transfer to the laboratory.

6.2 Field and laboratory duplicates

Field and laboratory duplicates will be collected at the frequency specified in the FSP. In the case of field duplicates, each container will be filled in parallel: First one bottle will be filled ¼ full, then the corresponding replicate will be filled ¼ full, and the sequence repeated until both are ready to cap.

If multiple bottles are required for evaluating laboratory accuracy and precision, then the same parallel filling approach will apply.

7.0 Data and records management

Calibration records will be recorded in the field log. Field records will be generated and maintained as outlined in the FSP. The FSP addresses all aspects of collection including data and sample types, station locations, and chronology of events.

Deviations to the procedures detailed in the FGD must be recorded in the field logbook and communicated to the RI Task Manager and the QA Officer at the end of the day.

8.0 Personnel qualifications and training

The individuals executing these procedures must have read, and be familiar with, the requirements of this FGD and the corresponding FSP. WQ data and water sample collections are relatively simple procedures requiring minimal training. However, initial instrument calibrations and sample/data collections should be supervised by the FTL.

9.0 References

AECOM, 2015. NERT GW RI Health and Safety Plan. Winter 2015 Field Programs.

10.0 Revision history