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June 30, 2014

VIA U.S. MAIL AND ELECTRONIC MAIL

Ms. Dyan Whyte
Assistant Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, California 94612

Re: *Selenium Impact Assessment Study – Year 1 Report and Second Quarter 2014 Report – June 27, 2013 Amended Water Code section 13267 Order, Order No. R2-2013-1005-A1, Directive 10.b . - Selenium Impact Assessment Study (Study).*

Dear Ms. Whyte:

Enclosed, in accordance with the Regional Water Quality Control Board, San Francisco Bay Region's June 27, 2013 amended Water Code section 13267 Order, Order No. R2-2013-1005-A1, ("Order"), Lehigh Southwest Cement Company ("Lehigh") provides and encloses the Year 1 Report for the Selenium Impact Assessment Study and the associated Second Quarter 2014 Quarterly Report pursuant to Directive 10.b. of that Order. Please note that the Year 1 Report contains requests to modify aspects of the Study for Year 2; Lehigh would appreciate your prompt attention to those requests.

If you or your staff have any questions regarding the above report or enclosed documents, please do not hesitate to contact me or Greg Knapp at Lehigh.

Very truly yours,

Nicole E. Granquist

Nicole E. Granquist

Enclosure

Cc: Brian Thompson, Regional Water Quality Control Board, San Francisco Bay Region
Greg Knapp, Director Environmental Region West, Lehigh
Scott Rickman, Regional Counsel, Lehigh Hanson

PERMANENTE QUARRY AND CEMENT PLANT SELENIUM IMPACT ASSESSMENT STUDY: YEAR 1 REPORT AND SECOND QUARTER 2014 REPORT

Prepared for:

REGIONAL WATER QUALITY CONTROL BOARD, SAN FRANCISCO BAY REGION

On Behalf of:

LEHIGH SOUTHWEST CEMENT COMPANY

Prepared by:

ROBERTSON - BRYAN, INC.
Solutions for Progress

June 2014

Permanente Quarry and Cement Plant Selenium Impact Assessment Study: Year 1 Report and Second Quarter 2014 Report

Prepared for:
Regional Water Quality Control board, San Francisco Bay Region
1515 Clay St
Suite 1400
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On behalf of:
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June 2014

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APPENDICES

1 Introduction

The Lehigh Southwest Cement Company (Lehigh) operates the Permanente Quarry and Cement Plant (Facility) within the drainage of Permanente Creek in southwestern Santa Clara County, California. Lehigh recently obtained coverage for the Facility under an individual NPDES Permit (Order No. R2-2014-0010, NPDES No. CA0030210) and Cease and Desist Order (CDO No. R2-2014-0011). The facility has several discharges of water into the creek, including quarry dewatering, industrial stormwater, and industrial-related process water. Discharges from the quarry pit dewatering have a long-term average flow rate of 1000 gallons per minute (gpm), or 2.2 cubic feet per second (cfs), and can be as high as 2000 gpm during the wet season (SFBRWQCB 2013). In the dry season (May-November), Permanente Creek just upstream of the quarry discharge can be relatively dry, and thus, the discharge can make up a significant portion of the streamflow at the downstream end of Lehigh property. The quarry receives groundwater and stormwater inflows which are currently filtered for sediment, allowed to further settle out in a detention pond, and discharged to the creek. During dry years, the quarry may cease dewatering due to the lack of stormwater and low groundwater levels.

In 2006, Permanente Creek was added to the State's 303(d) list as impaired by selenium. Permanente Creek is listed as impaired for selenium because observed water column concentrations in the creek were above the applicable National Toxics Rule (NTR) water quality criterion for total selenium for the chronic protection of freshwater aquatic life of 5 micrograms/liter (µg/L), expressed as total recoverable. The 303(d) listing was based on data collected by the Water Board's Surface Water Ambient Monitoring Program (SWAMP) in 2002/2003 at an upper reach location of the Creek (PER070, which is the East Fork of Permanente Creek at Rancho San Antonio). Reported total selenium concentrations at this location were all above the chronic NTR criterion of 5 µg/L (5.8 µg/L, 10.3 µg/L, and 18.7 µg/L) (SFBRWQCB 2007, 2013).

Selenium is present in the limestone mined and used for cement manufacture at the Facility. Selenium is contained in quarry discharge water at levels greater than the NTR criterion.

The NPDES Permit contains an average monthly effluent limitation (AMEL) for selenium of 4.1 µg/L. Because the discharge cannot currently comply with this limit, the CDO requires that treatment facilities for selenium be constructed. The time schedule requires interim treatment of up to 400 gpm of discharge by October 1, 2014. By December 1, 2014, the treatment must achieve a 50% reduction in selenium concentrations (or achieve an effluent concentration of <10 µg/L when influent concentrations are < 20µg/L). By March 31, 2016, compliance with the AMEL must be achieved in the interim treatment facility discharge. By October 1, 2017, all non-stormwater flows must be treated to comply with the AMEL.

Findings Section C and Directive 9 of the Water Code section 13267 Investigative Order No R2-2013-0005-A1 (13267 Order) require that Lehigh conduct a Selenium Impact Assessment ("Study"). The findings section states:

"More information about selenium concentrations in Permanente Creek is needed in order for the Water Board to fulfill its regulatory requirements. Selenium that is discharged by the Permanente Facility into Permanente Creek is likely transported downstream where, through interaction with sediment and plants, transformation, deposition, uptake, and bio-accumulation of different elemental species of selenium may all occur. This process could result in significant impacts to the beneficial uses of Permanente Creek. Therefore it is important for the Discharger to submit a Selenium Impairment Assessment Study so the potential impacts to beneficial uses are better understood. Any proposed study should include water bodies that are influenced by the discharge, including reaches of Permanente Creek adjacent to the Permanente Facility and reaches of Permanente Creek and Stevens Creek downstream of the Permanente Facility and the Discharger's quarry discharge zone." (SFBRWQCB 2013)

The objectives of this Study are to: (1) evaluate flows and potential impacts, if any, to beneficial uses of selenium levels in receiving waters, and (2) develop the information needed for the Regional Water Board to fulfill its regulatory requirements.

2 Purpose of this First Year Study Report

Directive 10, section b, of the Water Code section 13267 Order states:

"The Discharger has the option to submit a first-year annual report, summarizing all the data collected for the first year, and request for changes to sampling frequency, sampling locations, or other adjustment of sampling scheme, based on first year's sampling results." (SFBRWQCB 2013)

The purposes of this first-year annual report are thus to:

- summarize data collected in the first year of sampling;
- conduct bioaccumulation modeling to support and inform potential changes to the sampling scheme for year 2; and
- submit requests and recommendations for changes for year 2, based on the first year's results.

In addition, this report includes results from sampling conducted in April of 2014, and thus, satisfies the quarterly reporting requirement for Q2 2014. No separate quarterly report for Q2 2014 will be submitted. Field data and selenium data tables for Q2 2014 are provided in Appendix E.

3 Monitoring and Assessment Methodology

The monitoring methodology followed that proposed in the Study Work Plan (RBI 2013), with the following deviations.

- The analytical lab determined that the July 2013 sediment samples at stations Pond 13 (and the FD at Pond 13), PER060, PER010, STE020 and STE010 were too fine and too moist to be analyzed for grain size by the dry sieve method (ASTM D-422M). These samples were analyzed for grain size by a laser particle size analyzer (ASTM D4464M). Since this first event, the lab has measured grain size by the sieve method, having developed a means to accommodate samples that are moist and dominated by fines.

- The sediment sample scheduled for collection in December 2013 at PER010 was inadvertently not collected. This sediment sample was collected at the next sampling event in January 2014.

- The station on Wild Violet Creek (WVC) was not visited on February 10, 2014 because the site was not safely accessible due to earth work at the Facility. Only water, and not sediment, was required to be sampled during this event. Based on hydrologic conditions, it is very unlikely there would have been flow at WVC to sample.

- WVC was not flowing during any of the sampling events. Therefore, no water samples were collected from WVC. In order to collect some data on waterborne constituents originating upstream of the Facility, sampling at Permanente Creek ~300 feet downstream of the confluence with Wild Violet Creek (Station “PER US”) was performed in April 2014. Flow was consistently observed at PER US throughout the study.

- The 13267 Order required that one of the sampling events occur during the wettest month of the year, after a major rain event. February is historically the wettest month of the year, and thus, sampling in February targeted a period after a major rain event. Persistent drought conditions meant no significant rainfall had occurred prior to February 6. On February 6-9, 1.84” of rain fell in the upper watershed, and 0.96” in the lower watershed. Samples were collected on February 10. However, flow conditions appeared approximately the same as during prior months when Permanente Creek was not influenced by rain events. There was likely very little runoff due to the exceptionally dry soils and the abundant storage capacity for precipitation to go into soil moisture. Because of this, we targeted sampling following a major rain event in March. However, no significant rain events occurred in March. The next significant event began very early in the morning of April 1, and samples were collected on that day. In total, 0.96” of rain fell in the upper watershed on April 1, and 0.6” in the lower watershed. Conditions were noticeably wetter during this event, and flows were higher in Permanente Creek where water was present.

The assessment methodology followed that proposed in the Study Work Plan (RBI 2013). More specific details regarding the methodology employed in the bioaccumulation modeling is included in this report in section 6.1.

4 Study Period Watershed Hydrology

Exceptionally dry conditions characterized the geographic study area, as well as California as a whole, during the first year of study (water year 2014). During the study period, the upper watershed received approximately 11.3” of rainfall (as measured by a gauge in Rancho San Antonio Open Space at 1000 ft elevation), while the lower watershed received approximately 7.4” (as measured by a gauge at Maryknoll Fields along Cristo Del Rey Dr. at 450 ft elevation). As shown in Figure 1 for the lower elevation gauge, rainfall events with greater than 0.5 inches of accumulation occurred only on three occasions (Feb. 6; Feb. 26-Mar. 1; and Apr. 1-2). Accumulated precipitation for the study period should be viewed as substantially below normal. For example, long-term annual average precipitation at Moffet Field (Mountain View) was 13.2” (water years 1945-2013), while during the study period the accumulated rainfall at this gauge was 6.5”. There were only two other years in the long-term history at this gauge where precipitation was less than 6.5” (water years 1976 and 1987).

Dewatering operations at the bottom of the Facility’s quarry are the primary source water to Pond 4A. When this dewatering is occurring, discharges from Pond 4A make up the majority of water discharged from the Facility to Permanente Creek. These operations were not needed much of year because of dry conditions (limited runoff and decreased groundwater seepage) and because earth moving work was focused in other areas of the quarry. Therefore, discharges from Pond 4A to Permanente Creek occurred when the study was initiated in July 2013, but ceased on July 16, 2013. For most of the study period, the Facility did not discharge from Pond 4A, as shown in Figure 1. Pond 4A discharges resumed on March 1, 2014 due to the preceding rain event and continued through April 22.

Another discharge from the Facility is Pond 9, a pond on the Facility’s property which receives both emergent groundwater as well as stormwater runoff and water from plant operations. As shown in Figure 1, low and infrequent discharges from Pond 9 to Permanente Creek occurred starting in October 2013, and increased in association with precipitation in February through April 2014.

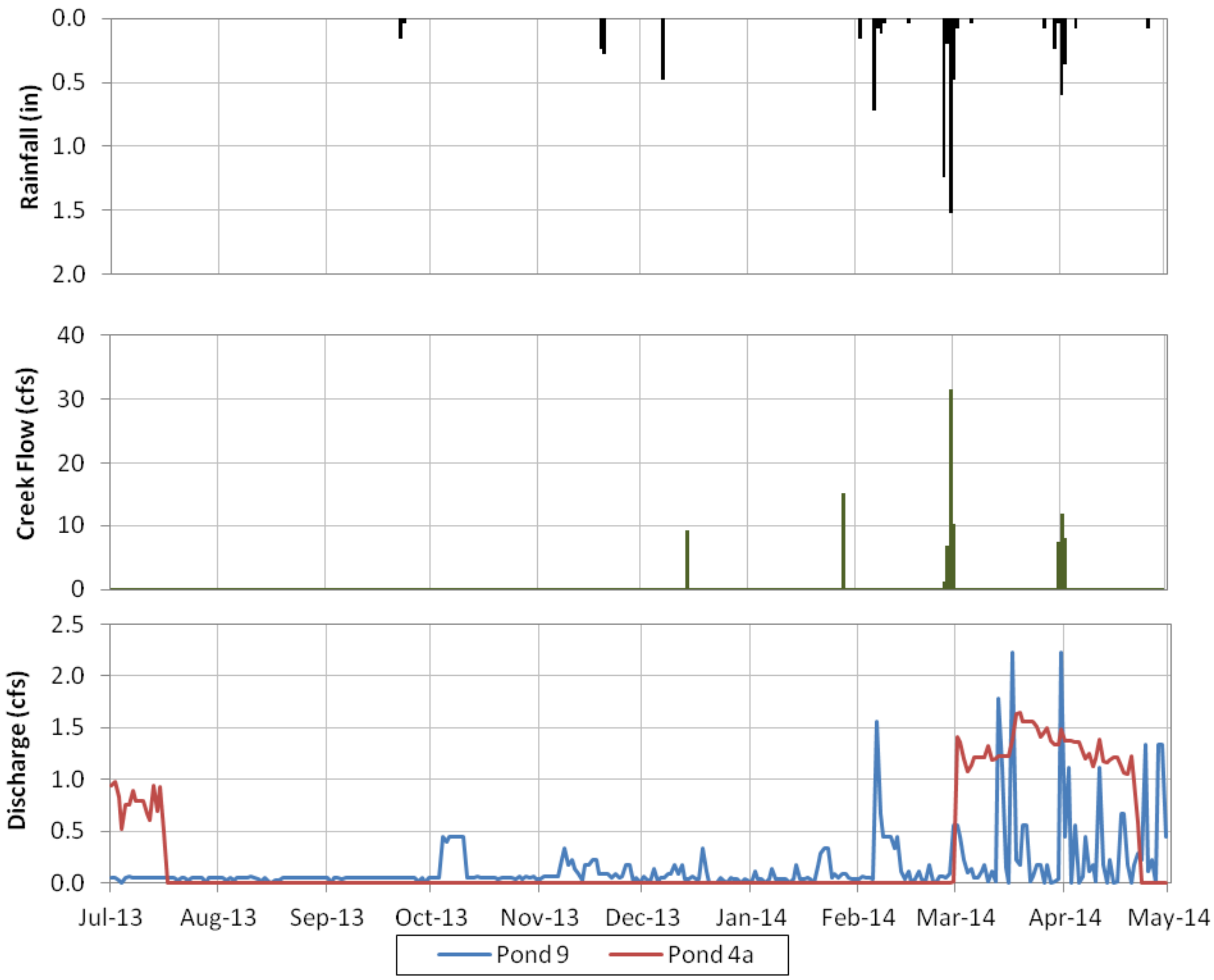

Figure 1. Daily rainfall, Permanente Diversion Channel Flow, and Pond 4A and Pond 9 discharge rates to Permanente Creek during the period July 2013 through April 2014 (data are from SCVWD Los Altos Rain Gage Station 144, SCVWD Berry Ave. Gage Station 32, and Golder Associates, respectively).

Flow in Permanente Creek downstream of the Facility was intermittent throughout the study period. The Santa Clara Valley Water District (SCVWD) has continuous records of flow in the Permanente Diversion Channel, below station PER045, from a gauge on Miramonte Avenue at the east end of Berry Avenue. Measurable flow was recorded at this station on four separate occasions (Figure 1). The presence of flow on December 14 and January 28 is not correlated with precipitation or discharges from the Facility and it is unknown whether there was actually measurable flow on these dates or if these are errant data. The latter two flow events coincided with the rainfall event in late-February/early March and the event in early April. These two rainfall events were likely the only occasions during the first year of the study when water discharged from the Facility (via Pond 4A and Pond 9) may have contributed to the flow measured at the gauge along Miramonte Avenue; given the dry conditions, it is unclear whether the limited flows had the potential to reach San Francisco Bay.

The flow observations from the sampling events are summarized in Table 1. The sampling events with the greatest frequency of observed flow occurred in July, February, March and April. WVC was dry throughout the first year of the study, although water was consistently observed at PER US during visits to WVC. Flow into Pond 13 was observed only during sampling events when discharges from Pond 4A to Permanente Creek occurred (July, March, April). Flow into Pond 14 was observed in February-April, coinciding with discharges from Pond 9. In July, and February through April, contiguous flow from the Facility was observed as far downstream as the PER060 sampling station. In December and January, flow was also observed at PER060 while conditions 0.5 miles upstream at PER070 were dry. Low flow was observed on West Permanente Creek at PER080 only in July and September. Dry conditions were always observed downstream of Rancho San Antonio at stations PER045, PER035, and STE040.

Flow was always observed at PER010, STE020, and STE010, the sites with the lowest elevation and closest to San Francisco Bay (Table 1**)**. Water at these sites is primarily emergent groundwater at low tide. The groundwater elevation in the Santa Clara Plain is between 60 and 90 feet above msl, while PER010, STE010, and STE020 are at approximately 8, 4, and 10 feet above mean sea level (msl), respectively. Station STE010 is characterized by salt-water marsh vegetation and on occasions of high-tide, flow was upstream and electrical conductivity measured at the site was characteristic of brackish water.

Table 1. Observed Hydrological Conditions at Sampling Sites on Permanente Creek and Stevens Creek, by Sampling Event, for the First Year of the Study Period (July 2013 – April 2014).

Station	7/9/13	9/4/13	11/4/13	12/9/13	1/15/14	2/10/14	3/20/14	4/1/14
WVC	No Flow	No Flow	No Flow	No Flow	--	No Flow	No Flow	No Flow
PER US[a]	Flow (NM)	Flow (NM)	Flow (NM)	Flow (NM)	--	Flow (NM)	Flow (NM)	Flow (NM)
Pond 13	Flow (0.42)	No Flow	No Flow	No Flow	No Flow	No Flow	Flow (0.59)	Flow (0.74)
Pond 14	No Flow	No Flow	No Flow	No Flow	No Flow	Flow (0.15)	Flow (0.70)	Flow (0.73)
PER 080	Flow (0.06)	Flow (Low)	No Flow	No Flow	--	--	No Flow	No Flow
PER 070	Flow (NM)	No Flow	--	No Flow	No Flow	Flow (NM)	Flow (NM)	Flow (NM)
PER 060	Flow (0.07)	No Flow	--	Flow (NM)	Flow (NM)	Flow (0.37)	Flow (1.31)	Flow (1.49)
PER 045	No Flow	No Flow	--	No Flow	--	No Flow	No Flow	No Flow
PER 035	No Flow	No Flow	--	No Flow	--	--	No Flow	--
HAL 010	--	--	--	--	--	--	--	--
PER 010	Flow (NM)	Flow (NM)	Flow (NM)	Flow (NM)	Flow (NM)	Flow (NM)	Flow (NM)	Flow (NM)
STE 040	No Flow	No Flow	--	No Flow	No Flow	No Flow	No Flow	--
STE 020	Flow (NM)	Flow (NM)	--	Flow (NM)	--	--	Flow (NM)	--
STE 010	Flow (NM)	Flow (NM)	--	Flow (NM)	--	--	Flow (NM)	--

Notes:
[a] Site was not sampled until April 1, 2014. This site was visited while in route to sample WVC, and flow was present during each visit.
Flow (#.##) = Flow was present and the number in parentheses is the measured flow rate in CFS.
Flow (NM) = Flow was present, but was not measured because flow measurement was not required at that station.
Flow (Low) = Flow was present, but was too low to measure.
“--" = Site not visited.

5 Monitoring Results

Results from the monitoring of water and sediment are presented below. To ensure the representativeness and accuracy of monitoring data, the Quality Assurance/Quality Control (QA/QC) program was implemented as described in the Work Plan (RBI 2013). Results from QA/QC sampling and QA/QC issues encountered by the analytical laboratories are described in Appendix A.

5.1 Selenium

5.1.1 Water Column

Across all samples, the average portion of total Se that was in the dissolved form was 92%, and the range was 53%-122%[1]. Samples containing greater than 8 µg/L total Se had a narrower range of 96%-109%. Because of this, the discussion and presentation of Se concentrations in water below is focused on the results of dissolved Se, which are also most relevant for the bioaccumulation modeling presented in section 6. The 5 µg/L NTR criterion (expressed as total recoverable) was exceeded only at stations Pond 13, Pond 14, PER060, and PER070. Dissolved Se concentrations measured at the various sampling stations are presented by date in Figure 2 and by station in Figure 3.

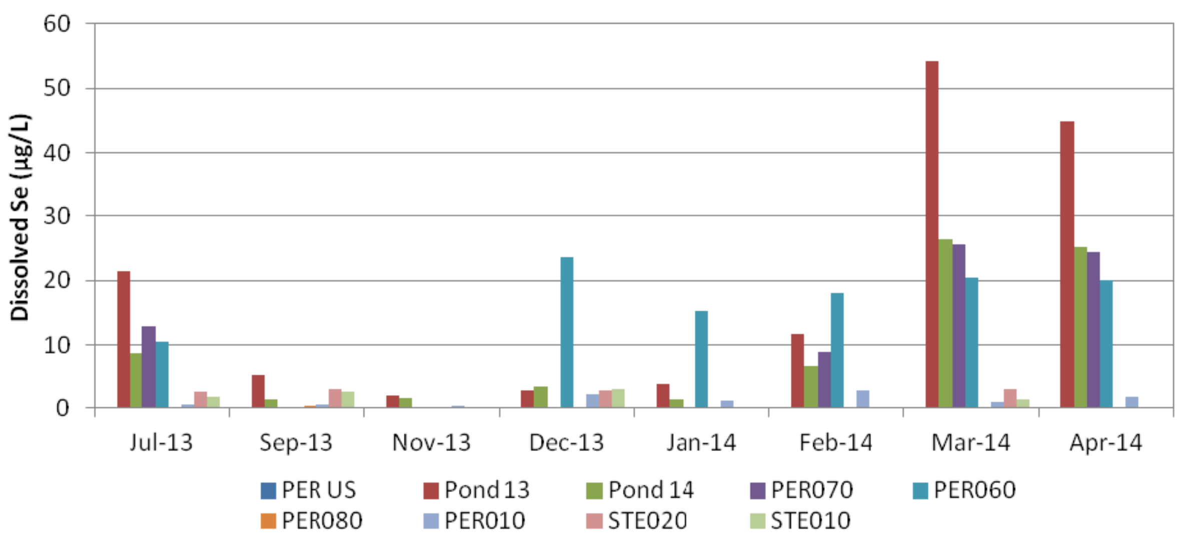

Figure 2. Dissolved Se concentrations measured in water samples collected in Permanente Creek and Stevens Creek from July 2013 through April 2014, shown by date.

[1] Dissolved Se made up > 100% total Se due to imprecision in the analytical method. This imprecision is magnified when Se levels are low, which allows small absolute errors to translate into large, relative errors.

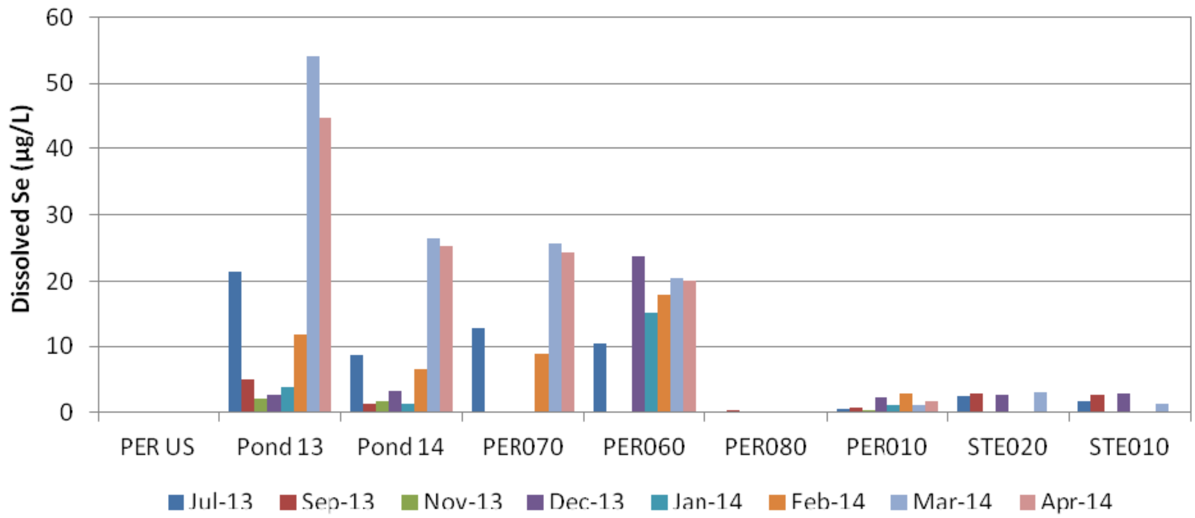

Figure 3. Dissolved Se concentrations measured in water samples collected in Permanente Creek and Stevens Creek from July 2013 through April 2014, displayed by sampling site.

Dissolved Se at the background station PER US and the station on West Permanente Creek (PER080) were below 1 µg/L. Selenium concentrations in discharge from the Facility had a noticeable effect on dissolved Se levels in Pond 13, Pond 14, PER070, and PER060. Dissolved Se levels at Pond 13, Pond 14, and PER070 were initially elevated, but decreased after the discharge from the Facility (via Pond 4A) ceased in July 2013 (during this time, water levels in Pond 13 and Pond 14 decreased and PER070 went dry). As runoff in the upper watershed increased in February, flow was again observed in Permanente Creek downstream of the Facility and dissolved Se concentrations started to rise. More precipitation and the recommencement of discharge from the Facility to Permanente Creek via Pond 4A in March also resulted in an increase in dissolved Se levels at Pond 13 and downstream. It is likely that dissolved Se concentrations at Pond 13 were greater than Pond 14 and areas downstream because of low-Se stormwater runoff and discharges from Pond 9 to Permanente Creek containing lower Se concentrations which diluted the Se concentrations in water exiting Pond 13.

Dissolved Se levels at PER060 were influenced by both the Facility discharge as well as emergent groundwater. When the Facility was discharging to Permanente Creek via Pond 4A, sufficient flow was present to reach PER060; this occurred during July, March, and April, and during these events, dissolved Se levels at PER060 were similar to those measured at upstream stations. During December and January, flow from emergent groundwater was observed at this site, even though the creek was dry upstream (e.g., at PER070). Dissolved Se levels at PER060 were higher than measured at upstream stations in December, January, and February. Emergent groundwater made up the entire flow at PER060 in December and January, and it was likely a major source of water during February, even though there was surface flow connectivity between PER060 and areas upstream (e.g., PER070).

The impact of Se discharged by the Facility on sites downstream of PER060 is dependent upon the flow in the upper watershed of Permanente Creek being connected to the lower watershed. Flow has yet to be observed in Permanente Creek and Stevens Creek at stations PER045, PER035, and STE040 during routine sampling events. As discussed previously, flow in Permanente Creek just upstream of the Diversion Channel was limited to brief episodes during rain events. At other times, Permanente Creek and Stevens Creek (at STE040) were dry and sites nearest San Francisco Bay (PER010, STE020, STE010) were isolated from the upper watershed throughout the entire year. Thus, the fate of Se from the Facility discharge into lower watershed in a more normal year, when creek flow may be more consistent, could not be determined. Nonetheless, at sampling stations nearest San Francisco Bay (PER010, STE020, and STE010) dissolved Se levels were below 5 µg/L (Figure 2 and Figure 3).

5.1.2 Sediment

Levels of total Se in sediment are shown in Figure 4 and Figure 5. Pond 13 and Pond 14 contained the highest concentrations of total Se observed for all sampling events. If sediment Se concentrations were in equilibrium with Se in the overlying water, a positive correlation between dissolved Se and total Se in sediment would be expected. However, Pond 13 sediment Se concentrations were inversely related to water column Se concentrations—levels of total Se in Pond 13 were lowest during periods when the dissolved Se concentrations were highest. During the exceptionally dry period of July through December, total Se concentrations in Pond 13 sediment increased. Since there was no inflow or outflow from the pond during this period, the only mechanistic explanation for such an increase would be phase transfer of Se from the water column into sediment. However, based on water column concentrations observed in July just prior to the ceasing of inflow/outflow, there was not nearly enough mass in the water column to explain the large increase in sediment concentrations. Because of this, it is likely that the changes in selenium concentrations evident from the samples are not representative of sediment concentrations in the pond as a whole, and that there is considerable heterogeneity in sediment Se concentrations around the pond, particularly when there is very little inflow to provide mixing. Large variability in total Se concentrations from field duplicate sampling of Pond 13 sediment was observed in two of four field duplicate samples (see Appendix A), further reinforcing this finding.

The sediment sampling in March, which occurred approximately two weeks after the largest runoff event of the season, yielded lower total Se concentrations at Pond 13 than previous events. Fresh sediment deposition into Pond 13 was visibly evident in March.

At the sediment sampling stations upstream and downstream of Pond 13 and Pond 14, total Se concentrations in sediment were consistently lower and fairly constant from one sampling event to the next. The exception is the March sampling event at PER045 and PER035, where total Se levels were noticeably higher than observed in previous samples. This increase in sediment Se is correlated with increased silt composition at PER045, but is unrelated to grain size at PER035. It is currently unknown whether the elevated Se levels in sediment at PER035 and PER045 were caused by heterogeneity in sediment Se or deposition of higher Se concentration sediment carried to the sites during runoff from the March rainfall event.

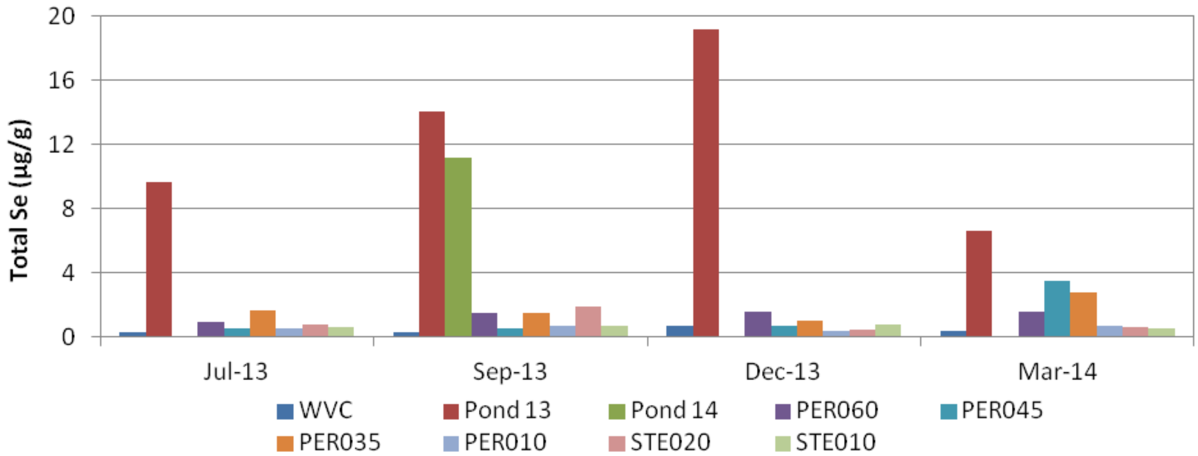

Figure 4. Total Se concentrations measured in sediment samples collected from Wild Violet Creek, Permanente Creek, and Stevens Creek from July 2013 through April 2014, displayed by date. Note that the December 2013 PER010 sample was collected 1/15/2014.

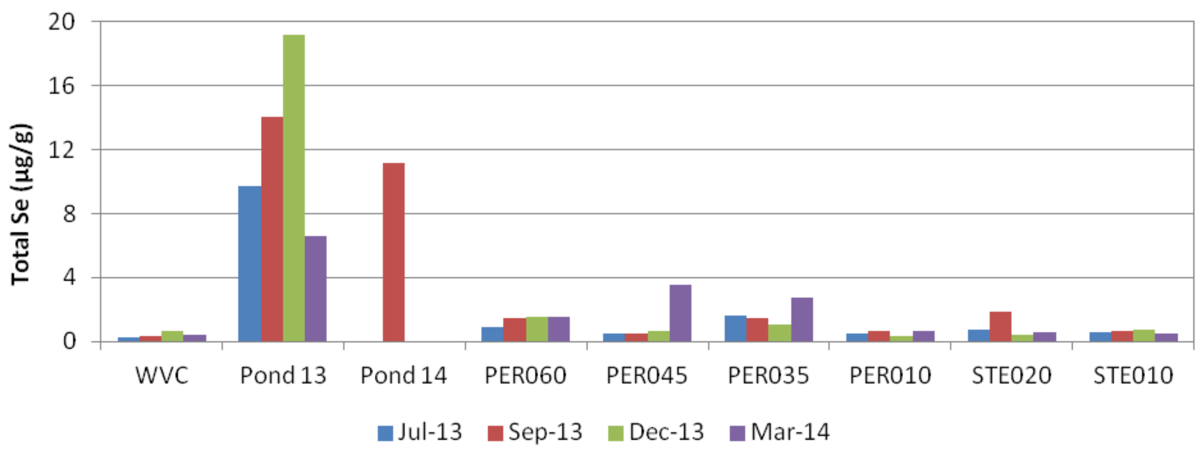

Figure 5. Total Se concentrations measured in sediment samples collected from Wild Violet Creek, Permanente Creek, and Stevens Creek from July 2013 through April 2014, displayed by site. Note that the December 2013 PER010 sample was collected 1/15/2014.

5.2 Distribution Coefficient, K_d

The distribution coefficient, K_d, as described in the Work Plan, is defined as the instantaneous ratio of the particulate-bound selenium concentration to the dissolved concentration in the water column, as

$$K_d = \frac{[Se]_{part}\left(\mu g/kg\right)}{[Se]_{diss}\left(\mu g/L\right)}$$

where $[Se]_{part}$ is the particulate selenium concentration, and $[Se]_{diss}$ is the dissolved selenium concentration (RBI 2013). For this study, the distribution coefficient was calculated using the bed sediment total Se concentration as $[Se]_{part}$. Efforts to calculate K_d using a derived suspended particulate Se concentration, as described in the Work Plan, were unsuccessful at all locations except STE010 due to very low TSS concentrations. At STE010, higher TSS caused by fine sediments and tidal action allowed for this calculation. Results are shown in Table 2.

Table 2. Values of Distribution Coefficient K_d Calculated for Locations and Events in the First Year of Study.

Location [a]	Jul-13	Sep-13	Dec-13	Mar-14
Pond 13 [bed]	453	2773	6982	122
Pond 14 [bed]	NS	8194	NS	NS
PER060 [bed]	85	NW	66	76
PER010 [bed]	834	1000	314	602
STE020 [bed]	290	641	166	191
STE010 [bed]	333	257	259	362*
STE010 [suspended]	566	177	389	2211*

NS – no sediment collected.
NW – no water present/collected.
[a] – [bed] = K_d calculated using bed sediment concentration; [suspended] = K_d calculated using suspended particulate concentration (derived via TSS and total Se minus dissolved Se).
* Site was brackish due to tidal influence.

The value K_d can only be calculated when both water and particulate Se is available. Its usefulness to the bioaccumulation modeling is only that, if it can be shown to be typical for a given location under similar hydrologic conditions, it could be used with just water concentrations to drive bioaccumulation modeling when sediment concentrations are not available. The only sites that showed consistent values of K_d were PER060 and STE010 (calculated using bed sediment concentration). Due to the variability in K_d at most locations, and the fact that sediment concentrations were more consistent throughout the study period, K_d was not used to model bioaccumulation when sediment concentrations were not available. Rather, the model was run directly from sediment concentrations for events when sediment was collected, as described in more detail in Section 6.

5.3 Other Constituents

Results for other water quality constituents measured in water and sediment are provided in Appendix B. During the March sampling event, the sample from STE010 was brackish and yielded high hardness and sulfate. Otherwise, hardness measured in water across all sites averaged 567 mg/L as CaCO3, and ranged from 234 at PER US to 698 at STE010 mg/L as $CaCO_3$. Sulfate (as SO_4^{2-}) levels were lowest at PER US and PER080 (14-46 mg/L); were typically highest at Pond 14, Pond 13, PER070 and PER060 (120-500 mg/L); and were lower at PER010, STE020, and STE010 (99-180 mg/L). Chlorophyll *a* levels were below 0.12 mg/L, with only 12 of 44 samples, all occurring at PER010, STE020 and Pond 14, having concentrations greater than the reporting level of 0.01 mg/L. Total alkalinity (as $CaCO_3$) ranged from 90 mg/L at Pond 13 to 390 mg/L at STE010, and averaged 241 mg/L across all sites. Total organic carbon (TOC) was high at Pond 13 and Pond 14 (0.98-6.33 mg/L), particularly during dry periods with no inflow or outflow. PER010 also had high TOC levels (1.46-8.4 mg/L), which was probably associated with high rates of algal productivity due to warm water temperatures, ample sunlight, and high residence time from the slow moving water. TSS levels were typically low (<27 mg/L) across all sites, with the exception of STE010, where TSS averaged 1123 mg/L. This site is tidal, and the substrate is very fine-grained and soft. High suspended sediment concentrations are caused by the tidal action and fine grained sediment at this site.

Sediment TOC, sulfate and grain size data are summarized in Appendix B. As shown in Figure B-5 and Table B-1, Pond 13 and Pond 14 were characterized by fine grain size (typically, silt+clay > 70%), appreciable TOC (20-40 g/kg), and seasonally variable sulfate. Sulfate levels (as S, dry weight) were low in July (290 mg/kg), high in September/December (2300-4000 mg/kg), and low again in March (360 mg/kg). The seasonal fluctuation in sediment sulfate was probably related to the build-up of sulfide-rich iron and manganese minerals in Pond 13 and Pond 14. These minerals are by-products of the breakdown of organic matter in sediment by anaerobic bacteria (via dissimilatory sulfate reduction). High sulfate would be measured in sulfide-rich sediment samples because sulfide is reoxidized to sulfate in the presence of oxygen, which is necessarily introduced to samples from ambient air during sample preparation. The low sulfate levels in July and March could suggest that fresh sediments had been deposited in Pond 13 prior to these sampling events and that relatively little organic matter breakdown had occurred in the new surface strata.

With the exception of STE010, sediments from stations upstream and downstream of Pond 13 and Pond 14 were characterized by course substrates, variable TOC, and low sulfate. The proximity to San Francisco Bay and influence of the tides was evident in the composition of STE010 sediment, which was composed almost exclusively of silt and clay, and contained variably elevated sulfate and moderate TOC.

5.4 Logger Data

Temperature, DO, and pH data loggers were deployed quarterly for durations of approximately 30 days during the first year of the study (logging interval of 15 min). Data from these logging events have been summarized in Appendix C. Throughout the four monitoring periods, temperatures ranged from 40 to 75ºF and pH ranged from 7.0 to 8.2. During the warm summer to late fall period (July/October/November), DO levels fluctuated approximately 2 mg/L diurnally, while daily average DO levels ranged from 6 to 18 mg/L. Low levels of DO were observed episodically in December and February, although the cause of low DO is not certain. While the severe drought conditions and lack of quarry discharge during July-February of the 2014 water year make these data unrepresentative of more typical hydrologic conditions, information provided by the pH and DO loggers provides little utility in assessing the impact of Se from the facility on the beneficial uses of Permanente Creek.

Selenium fate, transport, and bioaccumulation in Permanente Creek is more closely linked with Se levels in the quarry discharge, the hydrology of the creek, and the local food web, rather than DO and pH levels of the aquatic environment. Further, DO and pH have little influence on the mechanisms governing Se bioaccumulation and trophic transfer of Se to the food chain in this environment.

6 Bioaccumulation Modeling

6.1 Methodology

6.1.1 Overview

As discussed above, the partitioning coefficient, K_d, varied substantially between sites and sampling events for which it was derived. Thus, to eliminate uncertainty added to the modeling effort by using K_d, modeling was initiated with the particulate selenium concentration, as recommended by Presser and Luoma (2010). Using sediment Se concentrations as input to the bioaccumulation model, the concentration of selenium in invertebrates, fish, and bird tissue was estimated. Tissue Se concentrations were then compared to ranges of concentrations that define typical risk categories found in the literature in order to determine the risk category associated with a particular assessment area.

6.1.2 Food Webs and Trophic Transfer Factors

Defining the local food webs is important in predicting tissue concentrations in fish and birds. Although extensive biological surveys have not been conducted in Permanente Creek for this purpose, some data are available. The best information that could be found regarding species present in the assessment areas is provided in Table 3.

Table 3. Invertebrates, Fish, and Raptors/Shorebirds/Waterfowl Found in Permanente Creek That Make Up Assumed Food Webs for Purposes of Modeling.

	Permanente Creek, upstream	Permanente Creek, on-site	Permanente Creek, downstream	Whisman and Mountain View Slough and South San Francisco Bay
Invertebrates	Aquatic Insects (mayflies, stoneflies, caddisflies, other) [a]	Aquatic Insects (mayflies, stoneflies, caddisflies, other) [a]	Aquatic Insects (chironimids, black flies, mayflies) [b,c]	Chironimids, shrimp, worms, snails, bivalves [c,d]
Fish	Rainbow trout [a]	Rainbow Trout, Sacramento Sucker, Western Mosquitofish [a]	Sacramento Sucker, California Roach [b]	Numerous (anchovy, topsmelt, shad, striped bass, sculpin, surfperch, herring, jacksmelt, halibut, etc.) [d]
Birds	Great Blue Heron, ducks (mallard, wigeon, shoveler, merganser, goldeneye, bufflehead), Turkey Vulture, raptors (osprey, kite, hawks, falcons, kestrel), other non-fish eating birds [a]		Ducks, geese, occasional birds-of-prey [d]	Numerous special status and common raptors/shorebirds/ waterfowl (rail, snipe, curlew, sandpiper, owl, kite, egret, heron, duck, etc.) [d]

[a] – WRA Environmental Consultants 2011.

[b] – Santa Clara Valley Urban Runoff Pollution Prevention Program 2007.

[c] – San Francisco Bay Regional Water Quality Control Board 2007 (Mountain View Slough).

[d] – LSA Associates 2011 (Mountain View Slough).

Based on the information in Table 3, the food web pathways modeled for selenium exposure in fish and birds in Permanente Creek are the following:

Particulates > aquatic insects > fish (rainbow trout, sucker, western mosquitofish)

For this pathway, the modeling assumes:

1. Particulates ingested by aquatic insects have the concentration measured in bed sediment. In reality, in addition to bed sediment, particulates ingested can include suspended particulates, detritus, algae, and biofilms, which may have a higher concentration of selenium than bed sediment.

2. Fish eat a diet of 100% aquatic insects. In reality, fish may eat a variety of invertebrates, including amphipods, zooplankton, terrestrial insects, worms, etc.

However, most of these other invertebrates have TTFs lower than used in the modeling (2.8, aquatic insect (average) (Presser and Luoma 2010). Therefore, this assumption is conservative for the purposes of initial assessment.

Particulates > aquatic insects > non-fish-eating birds (ducks, geese, most shorebirds/waterfowl)

For this pathway, the modeling assumes:

3. Assumption 1 noted above.
4. Non-fish eating birds eat a diet of 100% aquatic insects. In reality, these birds eat a varied diet including other aquatic and terrestrial invertebrates. Again, because most of these other invertebrates have TTFs lower than used in the modeling (2.8, aquatic insect (average) (Presser and Luoma 2010), this assumption is conservative for the purposes of initial assessment.

Particulates > aquatic insects > fish > fish-eating birds (heron, merganser, and birds-of-prey)

For this pathway, the modeling assumes:

5. Assumptions 1 and 2 above.
6. Fish-eating birds eat a diet of 100% fish. In reality, these birds eat a varied diet including invertebrates, reptiles, amphibians, small mammals. To the extent that these birds eat some invertebrates as opposed to fish, bioaccumulation would be expected to be lower than modeled. Most of the birds in this area that eat fish would be expected to get the majority of their food from invertebrates, and thus it is likely that the assumption made in this modeling is conservative.

Food web pathways for Mountain View Slough, Whisman Slough, and South San Francisco Bay are unknown. For the purposes of this preliminary modeling and risk characterization, food webs for areas upstream were assumed for this assessment area as well.

Trophic transfer factors (TTFs) define the relationship between concentrations in an animal and its food. An experimentally derived TTF accounts for assimilation efficiency from ingested particles, ingestion rate of particles, efflux rates, and growth rates. TTFs can be experimentally derived for site-specific conditions, but have been derived for many species in the literature. Literature values found in Presser and Luoma 2010b were used in this study. Table 4 summarizes the TTFs used for various food-webs in the modeling.

Table 4. Trophic Transfer Factors (TTFs) Used in the Bioaccumulation Modeling for Assessment Areas in Permanente Creek.

Food-Web	TTF invertebrate	TTF fish	TTF bird egg
Particulates > aquatic insects > rainbow trout	2.8	0.98	N/A
Particulates > aquatic insects > sucker	2.8	0.97	N/A
Particulates > aquatic insects > western mosquitofish	2.8	1.25	N/A
Particulates > aquatic insects > non-fish eating birds	2.8	N/A	1.8
Particulates > aquatic insects > fish > fish eating birds	2.8	1.1	1.8

SOURCE: Presser and Luoma 2010b.

6.1.3 Protective Dietary or Tissue Concentrations

There is currently no consensus among toxicologists on a value for dietary or bioaccumulated selenium concentrations that is protective of all species. In the Work Plan, a summary of the available literature and risk thresholds was provided, and four risk categories were defined based on diet and tissue guidelines (RBI 2013). These thresholds are presented in Table 5 for reference. For the purposes of this assessment, these thresholds were used to assess potential impacts on beneficial uses.

It should be noted that the risk categories associated with concentrations in Table 5 are specifically applicable to measured tissue and bird egg concentrations, and are indicators of environmental risk, not predictions of actual effects. In this report, tissue and bird egg concentrations were not measured, but were modeled based on selenium concentrations measured in water and sediment. Thus, results of the modeling that are compared with these thresholds should be interpreted as indications of potential environmental risk, not predictions of actual effects in the receiving waters.

Table 5. Risk Categories and Typical Ranges of Diet, Fish Tissue, and Bird Egg Selenium Concentrations Cited in the Literature.

Risk Category	Diet (µg/g dw)	Fish Tissues (µg/g dw)	Bird Eggs (µg/g dw)
R1: No adverse effects likely	≤3	<3	<4
R2: Some effects on individuals detectable. Effects on sensitive populations possible but uncertain	2-10	4-10	6-15
R3: Deformities in some species and reproductive failure in sensitive species.	10-20	10-40	20-40
R4: Expect evidence of gross deformities and examples of reproductive failure.	>20	>40	>40

SOURCE: Larry Walker Associates et al. 2007.

6.2 Results

A summary of results of the bioaccumulation modeling is shown in Table 6. Modeled tissue concentrations assume long-term exposure to and consumption of a diet containing selenium, and thus median values are the most appropriate and likely the most accurate metric with which to compare to values in Table 5. Minimum and maximum values are shown for reference.

Permanente Creek upstream of the facility exhibits a low probability for environmental risk (median concentrations fall within risk category R1).

Permanente Creek downstream of the facility likewise exhibits a low probability for environmental risk (median concentrations fall within risk category R1). Maximum modeled concentrations fall within risk categories R2 and R3. These were the result of sediment concentrations at PER035 and PER045 in March. However, these sites never had any water at them during any of the sampling events of the study. Moreover, of the seven sites representing this assessment area, only two sites were wet year-round, while three sites (including PER035 and PER045) never had water present. Thus, these maximum values do not indicate actual environmental risk, since there was no aquatic food web exposed at the locations from which the maximum values were derived. The hydrology was that of an exceptionally dry year, as discussed above. It is unknown whether similar sediment concentrations would be present in a more typical year.

Modeled tissue concentrations for the assessment area containing Mountain View Slough, Whisman Slough, and South San Francisco Bay are represented by site STE010. As mentioned above, food webs have not been derived for this area, since uncertainties in the modeling would be substantial absent an actual determination of the food webs. However, the modeled food webs from assessment areas upstream were applied to this assessment area for reference. This resulted in a low probability for environmental risk (median concentrations fall within risk category R1).

Modeled concentrations in Permanente Creek on the Facility (i.e., Pond 13 and Pond 14) represent the greatest risk to invertebrates, fish, and birds (median concentrations are in risk categories R3 and R4 in Table 5). Under conditions measured to date in sediment from Pond 13 and Pond 14, the risk represented by the modeling results is high, and indicates potential impacts to beneficial uses in Permanente Creek on the Facility property.

Table 6. Concentrations of Selenium in Water and Sediment Measured from July 2013 through April 2014 and the Corresponding Modeled Selenium Tissue Concentrations for Invertebrates, Fish, and Birds, Summarized by Assessment Area.

Assessment Area	Statistic	Water Dissolved Se (µg/L)	Sediment Total Se (µg/g-DW)	K_d	Modeled Selenium Tissue Concentrations [a] Invertebrates (mg/kg)	Sucker (mg/kg)	Rainbow Trout (mg/kg)	Western Mosquitofish (mg/kg)	Non-fish eating bird egg (mg/kg)	Fish eating bird egg (mg/kg)
Permanente Creek, upstream of the Facility [b]	Min	0.20	0.26	0	0.7	0.7	0.7	0.9	1.3	1.4
	Max	0.20	0.70	0	2.0	1.9	1.9	2.4	3.5	3.9
	Median	0.20	0.35	0	1.0	1.0	1.0	1.2	1.8	2.0
Permanente Creek, on the Facility [c]	Min	1.3	6.6	122	19	18	18	23	33	37
	Max	54	19	8194	53	52	53	67	97	106
	Median	5.8	11	2773	31	30	31	39	56	62
Permanente Creek and Stevens Creek, downstream of Facility [d]	Min	0.37	0.35	66	1.0	0.9	1.0	1.2	1.7	1.9
	Max	26	3.5	1000	9.8	9.5	9.6	12	18	20
	Median	3.0	0.82	290	2.3	2.2	2.2	2.9	4.1	4.1
Mountain View Slough, Whismsan Slough, and South San Francisco Bay [e]	Min	1.3	0.48	257	1.3	1.3	1.3	1.7	2.4	3.0
	Max	3.0	0.77	362	2.1	2.1	2.1	2.7	3.9	4.8
	Median	2.2	0.63	296	1.8	1.7	1.7	2.2	3.2	3.9

[a] Color coding of values indicates their respective Risk Category: Category 1 (no color), Category 2, and Category 3 & 4. See Table 2 for a description of the risk categories.
[b] Represented by site WVC and PER-US.
[c] Represented by sites Pond 13 and Pond 14.
[d] Represented by sites PER070, PER060, PER045, PER035, PER010, STE040, and STE020.
[e] Represented by site STE010.

7 Data Gaps

Although preliminary bioaccumulation modeling indicates a potentially high risk for impacts to aquatic life beneficial uses at the Facility and low risk in other assessment areas, there are several data gaps that limit the ability to make definitive findings. These include:

- The first year of study was exceptionally dry. Discharges from the Facility were minimal, resulting in stagnant or near-stagnant conditions in Ponds 13 and 14. Additionally, there was very infrequent surface flow connectivity (if any at all) between PER060 and PER045 and areas downstream during the first year of study. It is unknown what risk would be predicted by the modeling during more typical water years, when Ponds 13 and 14 would be flow-through impoundments year-round, and discharges from the Facility had potential surface flow connectivity to Mountain View Slough, Whisman Slough, or San Francisco Bay.

- It is unknown if the model is predicting accurate tissue concentrations. That is, no validation has been performed of the model for these sites. Elements of the model that may not reflect reality, and thus, result in underestimates or overestimates of tissue concentrations include:

  - Modeling results are heavily dependent on bed sediment concentrations. Bed sediment concentrations, particularly in Ponds 13 and 14, may not be representative of particulates ingested at the start of the food chain.

  - Trophic transfer factors used are based on the literature, and are field-derived TTFs for other sites. Although studies have shown that TTFs generally do not vary substantially from site to site, there is nonetheless uncertainty in these factors.

  - The specific food web preferences and diet proportions of fish and birds is unknown. For example, if a substantial portion of the fish or bird diet is terrestrial insects that have low selenium body burdens, modeling results would be expected to overestimate actual tissue concentrations.

- Modeling results are not accurate for sites that are very infrequently wetted, as these sites do not contain aquatic food webs. However, it is unknown whether the results are accurate predictors of risk. That is, it is unknown whether sediment concentrations at these sites would be approximately the same if these sites contained water.

- The modeling effort is an attempt to characterize risk, not predict actual effects to beneficial uses. The risk thresholds used are based on literature, but it is unknown whether these effects thresholds are appropriate and reflective of local conditions. It is possible that fish and wildlife in Permanente Creek have higher tolerances for selenium due to site-specific factors. For example, the high level of sulfate in Permanente Creek may provide some degree of protection from the effects of selenium to resident fish species.

- The food web in the most downstream assessment area, which includes Mountain View Slough, Whisman Slough, and South San Francisco Bay, is unknown. Using assumed food webs for areas upstream, the model predicted low risk for this assessment area.

8 Requested/Recommended Changes to Work Plan for Second Year of Study

The following sections describe requested changes to the Work Plan for the second year of study, including refinement of the parameters, locations, and schedule, which will allow for better information to assess impacts, if any, to Permanente and Stevens Creeks and a targeting of resources toward information that is useful to this end.

8.1 Parameters

Lehigh requests that Chlorophyll *a*, alkalinity, and continuous water column monitoring of temperature, DO, and pH (at Pond 13) be removed.

- Chlorophyll *a* levels have been low regardless of time of year, and organic Se compounds which are associated with excretion from/breakdown of algal biomass are insignificant in comparison to levels of other Se species. The 24 hour hold-time for chlorophyll *a* adds logistical complexity to the monitoring schedule, which at times has been difficult to capture in one day (which is the preference of the SFBRWQCB).

- Alkalinity has shown no relation to Se concentration and does not provide any utility in assessing impacts from Se to Permanente Creek.

- The same can be said of continuous monitoring of DO, pH, and temperature in Pond 13; logistical and financial resources are spent on this monitoring, with the data providing little to no utility in assessing the impacts from Se on beneficial uses of Permanente Creek. Note that field measurement of pH, DO, and temperature of grab samples will be retained.

A revised parameter list is provided in Table 7. This list is intended to replace Table 5 of the Work Plan.

Table 7. Analytes to be Measured in Year 2 of the Study, the Associated Analytical Method, Reporting Units, Reporting Limits (RL) and Method Detection Limits (MDL). Modified Entries are Shown in Orange.

Matrix	Analyte	Analytical Method	Units	RL	MDL
Water Column, Flow	Total organic carbon	SM5310C	mg/L	0.3	0.04
	Temperature	Meter	°C	--	--
	pH	Meter	Standard Unit	--	--
	DO	Meter	mg/L, % saturation	--	--
	Electrical Conductivity	Meter	µS/cm	--	--
	Total hardness	SM2340B	mg/L as $CaCO_3$	5	1
	TSS	SM2540D	mg/L	1	0.3
	~~Chlorophyll a~~	~~SM1020-OH~~	~~µg/L~~	~~10~~	~~0.05~~
	Sulfate	EPA 300.0	mg/L as SO_4^{2-}	0.5	0.09
	Oxidation reduction potential	Meter	mV	--	--
	~~Total alkalinity~~	~~SM2320B~~	~~mg/L as $CaCO_3$~~	~~5~~	~~0.05~~
	Stream flow	USGS Rantz 1982	cfs	--	--
	Total Se	EPA 200.8	µg/L	0.10 [a]	0.020 [a]
	Dissolved Se	EPA 200.8	µg/L	0.05 [a]	0.003 [a]
	Dissolved Se speciation (Se(VI), Se(IV), $SeCN^-$)	IC-ICP-DRC-MS	µg/L	0.10 [a]	0.020 [a]
	Particulate Se	Calculation	µg/kg	0.10 [a]	0.020 [a]
Sediment	Total Se	EPA 3050B/200.8	mg/kg, dry wt	0.020	0.005
	Sulfate	EPA 300.0	mg/kg as SO_4^{2-}, dry wt	5	0.5
	Grain size	ASTM D422	--	--	--
	Total organic carbon	EPA 9060A	%	120	500
~~Cont. Water Column~~	~~Temperature~~	~~Continuous Logger~~	~~°C~~	~~--~~	~~--~~
	~~pH~~	~~Continuous Logger~~	~~Standard Unit~~	~~--~~	~~--~~
	~~DO~~	~~Continuous Logger~~	~~mg/L~~	~~--~~	~~--~~

[a] RLs and MDLs are for typical reagent water, and are not representative of those that will be obtained from field samples, since any samples will need to be diluted depending on their complexity (e.g., TDS).

8.2 Locations

To ensure that the most appropriate and representative data are collected, various changes to monitoring locations are recommended. The recommended modifications to the monitoring locations are as follows.

- Add station "PER US" as a background station to be sampled for water and sediment if WVC is not flowing. Flow was observed at PER US throughout 2013/2014, while WVC was chronically dry. Modify WVC to require monitoring of water and sediment only when flow is present.

- Remove flow measurement from STE020 because such measurements at this location are infeasible due to channel geometry and vegetation.

- Add station “STE040 US” to collect water samples on Stevens Creek upstream of the Diversion Channel. This station will be used to collect data on background levels of Se in Stevens Creek prior to mixing of Stevens Creek with water diverted from Permanente Creek.

The recommended modifications to the monitoring locations have been incorporated into Table 8. This table is intended to replace Table 6 of the Work Plan. Appendix D provides maps and photos of the current and recommended sampling sites.

Table 8. Revised Monitoring Locations and Parameter Types to be Measured at Each Location for Year 2 of the Study. Modified Entries are Shown in Orange.

Station	Description	Latitude	Longitude	Water	Sediment	Flow	Continuous Water Column
STE010 [a]	Near-shore Station on Stevens Cr	37.42822	-122.06881	Yes	Yes	--	--
PER010 *	Permanente Cr at Charleston Rd	37.42118	-122.08673	Yes	Yes	--	--
HAL010	Hale Cr at Mountain View Ave.	37.38292	-122.09074	Yes	--	Yes	--
PER035	Permanente Cr at Covington Rd, 1000' downstream of diversion channel/PER040	37.36488	-122.08491	Yes	Yes	Yes	--
STE020 *	Stevens Cr at La Avenida	37.41357	-122.06865	Yes	Yes	~~Yes~~--	--
STE040 *	Stevens Cr Below Diversion Channel Outfall	37.36475	-122.06224	Yes	--	Yes	--
STE040 US	Stevens Cr Upstream Diversion Channel Outfall	37.36362	-122.06239	Yes	--	--	--
PER045	Heritage Oaks Park	37.35954	-122.08717	Yes	Yes	Yes [b]	--
PER060	Permanente Cr at Rancho San Antonio Lower Bridge (Deer Meadow Trailhead)	37.33634	-122.09104	Yes	Yes	Yes	--
PER070 *	Permanente Cr at Rancho San Antonio Upper Bridge (South Meadow Trailhead)	37.32941	-122.08586	Yes	--	--	--
PER080 [c,*]	West Branch Permanente Cr	37.33335	-122.09381	Yes	--	Yes	--
WLD010 [d]	Wildcat Creek, Upstream of Confluence with West Branch Permanente Cr	37.33324	-122.10150	-- [d]	--	-- [d]	--
Pond 14	Pond 14 (Permanente Cr on Quarry Property)	37.32323	-122.08358	Yes	Yes, Sept 1-Oct 31 only [e]	Yes	--
Pond 13	Pond 13 (Permanente Cr on Quarry Property)	37.31661	-122.10168	Yes	Yes	Yes	~~Yes~~--
PER US [f]	Permanente Creek, upstream of Pond 4A discharge & 300 ft downstream of WVC	37.31914	-122.13125	Yes	Yes	--	--
WVC [fg]	Wild Violet Creek, Background Station	37.32026	-122.13183	Yes	Yes	--	--

[a] This station satisfies the requirement in the 13267 Order under the section titled "Near-Shore Location".

[b] Under high flow conditions, flow data may be obtained from the existing Santa Clara Valley Water District flow measurement station in the diversion channel, 900 feet downstream of PER045.
[c] This station satisfies the requirement in the 13267 Order under the section titled "Potential North Side WMSA Runoff pathway leading to Permanente Creek", since runoff pathways on the north side of WMSA drain via Wildcat Creek to the West Branch of Permanente Creek. Monitoring at this station will be able to quantify additional selenium loadings from storm water runoff from upstream areas. Loading at this station may originate from Wildcat Creek, which may contain storm water runoff from the north side of the WMSA, or from upstream areas on the West Branch Permanente Creek.
[d] Monitoring is not required at this station unless and until directed by Water Board staff. Water Board staff will evaluate the need to sample at this location based on data collected at PER080, site accessibility, and need to quantify loadings from storm water runoff from the north side of the WMSA into Wildcat Creek.
[e] The United States Fish and Wildlife Service has indicated that sediment sampling in Pond 14 will only be allowed between September 1 and October 31, to protect the endangered population of red-legged frogs in the pond.
[f] When flow is not present at WVC and flow is present at PER US, this station shall be sampled as the background station in lieu of WVC.
[~~f~~g] This station is the proposed background station, based on the requirement in the 13267 Order under the section titled "Background Station". It shall only be monitored when flow is present. If flow is not present at both WVC and PER US, WVC shall be monitored for sediment.
* Denotes SWAMP monitoring location (SFBRWQCB 2007).

8.3 Schedule

The monitoring and reporting schedule provided in the Work Plan will be retained with the exception that the June monitoring event will be moved to July, and data from this event will be reported in the Q3 report. This modification is necessary to allow the SFRWQCB time to review parameter, monitoring location, and schedule changes proposed herein. The revised monitoring frequency is shown in Table 9, and this table is intended to replace Table 7 of the Work Plan. The revised monitoring and reporting schedule is shown in Table 10, and is intended to replace Table 8 of the Work Plan. These tables have also incorporated the request to omit continuous water column monitoring.

Table 9. Revised Monitoring Frequency for Different Types of Constituents for Year 2 of the Study. Modified Entries are Shown in Orange.

Matrix/Type [a]	Frequency
Water Column, Flow	Monthly wet season (November – April), Quarterly dry season (June, September)
Sediment	Quarterly (June, September, December, March)
Continuous Water Column	~~30-day continuous monitoring once every quarter (June, September, December, March)~~Discontinued

[a] Constituents in each category are defined in Table 7.

Table 10. Revised Monitoring Schedule and Reporting Deadlines for Year 2 of the Study. Modified Entries are Shown in Orange.

Year	Quarter	Month	Water Column, Flow	Sediment	Continuous Water Column	Quarterly Reporting Deadline	1st year, Final Report Deadline
Year 1	Q2	Jun-13	x[c]	x[c]	x[c]	30-Jul-13	30-Jun-14
	Q3	Jul-13				30-Oct-13	
		Aug-13					
		Sep-13	x	x	x		
	Q4	Oct-13				30-Jan-14	
		Nov-13	x				
		Dec-13	x	x	x		
	Q1	Jan-14	x			30-Apr-14	
		Feb-14	x				
		Mar-14	x	x	x		
	Q2	Apr-14	x			30-Jul-14[a]	
		May-14					
Year 2		Jun-14	~~x~~	~~x~~	~~x~~		30-Jun-15
	Q3	Jul-14	x	x		30-Oct-14	
		Aug-14					
		Sep-14	x	x	~~x~~		
	Q4	Oct-14				30-Jan-15	
		Nov-14	x				
		Dec-14	x	x	~~x~~		
	Q1	Jan-15	x			30-Apr-15	
		Feb-15	x				
		Mar-15	x	x	~~x~~		
	Q2	Apr-15	x			30-Jul-15[b]	
		May-15					

[a] This report reports on samples collected in April 2014, and thus no separate Q2 2014 report will be submitted.

[b] It is anticipated that the final report, due June 30, 2015 will include results from Q2 2015, and thus no separate Q2 2015 report will be submitted.

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Appendix A

QA/QC Summary

Quality Assurance and Quality Control

The quality assurance and quality control measures described in the Work Plan were implemented as required throughout the first year of the study and were reported in the quarterly reports. This section describe the results of QC sampling (field blanks, field duplicates, and splits), as well as QA/QC issues encountered in the field and by the analytical laboratories.

Water

- The field blank sample taken during the first sampling event (July 2013) and analyzed for TSS, Total Se, Dissolved Se, and Se Speciation, met the measurement quality objectives (MQO). No additional field blank samples have been taken.
- Three field duplicate samples for total se, dissolved Se, Se speciation, and TSS were taken during the first year of sampling. The FD sampling frequency (3 FDs per 44 water samples) exceeded the MQO of 5% of the total project sample count.
- The total Se, dissolved Se, and Se speciation measurements on the FDs were all within the 25% relative percent difference (RPD) MQO.
- Calcium and magnesium analyses were performed as part of the EPA method utilized to calculate total hardness. Recovery of these species in matrix spikes (MS) and matrix spike duplicates (MSD) were routinely outside the laboratory's MQO. In all events, the spike concentrations of calcium and magnesium were very low compared to the native sample concentration, inflating recoveries due to random error.
- For other conventional measured by Alpha Analytical (TSS, sulfate, chlorophyll *a*, total alkalinity, total Se, dissolved Se, Se speciation), all recoveries and RPD for laboratory QC samples (matrix spike, matrix spike duplicates, laboratory spike, laboratory spike duplicates) were within acceptable limits.
- With regards to total Se, dissolved Se, and selenium species measured by ASC, all recoveries and RPD for laboratory QC samples (matrix spike, matrix spike duplicates, laboratory spike, laboratory spike duplicates) were consistently within acceptable limits.
- BRL encountered a number of minor QA/QC issues with samples associated with waterborne selenium analyses that are documented in their reports, but none of these issues were determined to be significant enough to call into question the validity of the data.
- The samples taken on 3/20/14 on the Lehigh property (Pond 13 and Pond 14) were out of preservation and hold-time requirements for several parameters. The case narrative from the report issued by Alpha Analytical reads:
    - Robertson Bryan Consulting scheduled a courier pickup on 3-19 to Robbie Phillips (Laboratory Project Manager). The pickup confirmed for 3-20 (by Alpha Labs) never got routed on a courier truck. The samples sat at the pickup site until 4-1 when our courier noticed this set of samples while performing a separate

project pickup at the same location. The COC inside the cooler, as well as staff from Robertson Bryan, indicated that a custody seal had been left on the cooler. The custody seal was not received during receipt of samples. It was either not present or the Alpha Labs courier broke the custody seal to verify COC and confirm samples. The samples were out of temperature requirements and many of the analyses were passed their method hold time during the 12 days sitting idle. The samples were consolidated into another ice chest during transit and were received at the laboratory @ 4.4c temperature. We notified the client (Robertson Bryan Consulting) immediately and decided to analyze the samples and flag the issues accordingly.

- The affected data for Pond 13 and Pond 14 includes:
  - Out of preservation requirements: calcium, magnesium, chlorophyll a, TSS, alkalinity, hardness, TOC, and sulfate
  - Out of hold time: calcium, magnesium, chlorophyll a, TSS, alkalinity, hardness, and sulfate

Sediment

- Four field duplicates of sediment were taken at Pond 13, one during each sediment sampling event. A FD was also collected at Pond 14 during the sediment sampling event in September 2013. The frequency of sediment FD collection (5 FDs for 33 samples) exceeded the MQO of 5% of the total project sample count.
- For two of the FDs collected from Pond 13, the RPD of the FD compared to the routine sample exceeded the MQO of 25%. To a degree, differences in the grain size distribution may account for the variance in sediment total Se between the FD and sample. Nonetheless, results from the FDs suggest that the distribution of total Se in Pond 13 sediment is highly heterogeneous.
- Recovery of sediment Total Se in ASC's laboratory control samples (LS, LSD, MS, and MSD) were consistently within the lab's control limits.
- On one occasion, sediment sulfate recoveries for the MS and MSD were slightly below the Alpha Analytical's lower control limit.
- During two of the four sediment sampling events, sediment TOC recoveries were below the lab's lower recovery control limit of 75%. The other laboratory control samples for sediment TOC were within the control limits, and based on these results, no action was taken or additional flags/qualifiers placed on the data.

Split Water and Sediment Samples

Split samples of sediment and water were taken for QA/QC purposes on December 9, 2013 and March 20, 2014. Split water samples were taken by collecting two samples for Total Se in rapid succession using the lab-provided containers. Aliquots of the total Se samples were then field-filtered to produce the Dissolved Se and Se speciation samples. The preservation requirements for the samples were identical between ASC and BRL, with the exception that BRL recommended samples for Se speciation be acid preserved with HCl. Analytical methods for Total Se and Dissolve Se followed the analytical procedure of EPA 200.8/1638. For Se speciation, ASC utilizes an in-house ion chromatography (IC) method to separate Se species ahead of an ICP-CRC-MS, while BRL uses a slightly different method – high pressure liquid chromatography (HPLC) to separate Se species ahead of an ICP-DRC-MS.

Results from the split water samples are presented in Table A-1 and Table A-2. Total Se measurements on the split samples met the measurement quality objective of 25% RPD in the concentrations reported by separate labs, except at Pond 13 in December 2013. Dissolved Se measurements were in agreement between the two labs, yielding RPDs less than 25% for all samples. When detected, BRL generally reported higher concentrations of selenium species in water than ASC, although selenium speciation concentrations were in good agreement between the labs. High RPDs for selenium species occurred only when concentrations were less than ~3µg/L. In general, results from BRL validate ASC measurements.

Sub-samples of the Pond 13, FD Pond 13, and PER060 sediment samples were sent from ASC to BRL for analysis of total Se. The methods used by ASC and BRL to measure "total recoverable Se" (total Se) extracts almost all elements that could become "environmentally available." Differences between the ASC and BRL methods include the type of reagent mixtures and type of digestion devices (ASC = HNO_3/H_2O_2 + hot block; BRL = HNO_3/HCl + oven). The results from ASC and BRL from these two events showed acceptable agreement for the Pond 13 and FD Pond 13 samples, as indicated in Table A-3. The %RPD for PER060 was above the data quality objective of 25% for total Se (dry wt). The low concentrations, relative to the method detection/reporting limits are likely responsible for the discrepancy.

Table A-1. Results of Selenium Analyses on Split Water Samples Taken on December 9, 2013. Concentration Units are in µg/L.

Analysis	Pond 13			Pond 14			STE010			PER010		
	ASC [a]	BRL [a]	RPD (%) [b]	ASC [a]	BRL [a]	RPD (%) [b]	ASC [a]	BRL [a]	RPD (%) [b]	ASC [a]	BRL [a]	RPD (%) [b]
Total Se	2.61	3.37	29%	3.64	3.60	1.1%	4.23	3.68	13%	2.42	2.43	0.4%
Diss.Se	2.75	3.17	15%	3.33	3.43	3.0%	2.96	3.14	6.1%	2.25	2.11	6.2%
Se (IV)	0.994	1.41	42%	0.716	1.08	51%	0.244 J	0.329 J	35%	0.083 J	< 0.150 U	NC
Se (VI)	0.755	0.997	32%	1.60	2.04	28%	2.18	2.79	18%	1.81	2.18	20%
SeCN [c]	< 0.014 U	0.28 F,J	NC	< 0.014 U	0.16 J	NC	< 0.014 U	< 0.15 U	NC	< 0.014 U	< 0.15 U	NC
Additional Se Species [d]	0.288	< 0.150 U	NC	0.234	< 0.150 U	NC	0.080	< 0.150 U	NC	0.068	< 0.150 U	NC

[a] ASC = Applied Speciation and Consulting; BRL = Brooks Rand Laboratories.
[b] Relative percent difference (RPD) = 100 x Abs(ASC concentration – BRL concentration) / ASC concentration.
[c] SeCN = Selenocyanate
[d] Additional Se Species = Sum of all additional Se species observed by IC-ICP-MS
Qualifier Symbols:
U = Sample concentration is below the estimated method detection limit (eMDL)
J = Sample concentration is between the eMDL and the reporting limit (RL)
F = Flagged data. Estimated value.
NC = Not calculated due to one of the sample concentrations < eMDL.

Table A-2. Results of Selenium Analyses on Split Water Samples Taken on December 9, 2013 and March 20, 2014. Concentration Units are in µg/L.

Analysis	Pond 13			FD Pond 13			PER060		
	ASC [a]	BRL [a]	RPD (%) [b]	ASC [a]	BRL [a]	RPD (%) [b]	ASC [a]	BRL [a]	RPD (%) [b]
Total Se	50.7	63.3	24.9	51.8	63.6	22.8	20.8	23.1	11.1
Diss.Se	54.1	63.6	17.6	55.6	64.1	15.3	20.4	23.8	16.7
Se (IV)	1.61	3.38	109.9	1.64	2.57	56.7	0.774	1.63	110.6
Se (VI)	51.1	46.5	9.0	49.9	47.8	4.2	17.8	15.7	11.8
SeCN [c]	<0.058 U	<0.3 U	NC	<0.058 U	<0.3 U	NC	<0.058 U	<0.3 U	NC
Additional Se Species [d]	0.118	0.431	265.3	0.092	0.475	416.3	0.076	<0.15 U	NC

[a] ASC = Applied Speciation and Consulting; BRL = Brooks Rand Laboratories.
[b] Relative percent difference (RPD) = 100 x Abs(ASC concentration – BRL concentration) / ASC concentration.
[c] SeCN = Selenocyanate
[d] Additional Se Species = Sum of all additional Se species observed by IC-ICP-MS
Qualifier Symbols:
U = Sample concentration is below the estimated method detection limit (eMDL)
J = Sample concentration is between the eMDL and the reporting limit (RL)
F = Flagged data. Estimated value.
NC = Not calculated due to one of the sample concentrations < eMDL.

Table A-3. Results of Total Se Analyses on Split Samples of Pond 13 and FD Pond 13 Sediment Samples Taken on December 9, 2013.

Date	Sediment Sample [a]	Total Se (mg/kg)		RPD (%) [c]
		ASC [b]	BRL [b]	
December 9, 2013	Pond 13	19.2	15.7	18
	FD Pond 13	9.79	10.6	8.3
March 20, 2014	Pond 13	6.62	5.36	19
	FD Pond 13	5.91	6.19	4.7
	PER060	1.54	0.68	56

[a] FD = Field duplicate.
[b] ASC = Applied Speciation and Consulting; BRL = Brooks Rand Laboratories.
[c] Relative percent difference (RPD) = 100 x Abs(ASC concentration – BRL concentration) / ASC concentration.

Appendix B

Other Constituent Monitoring Results

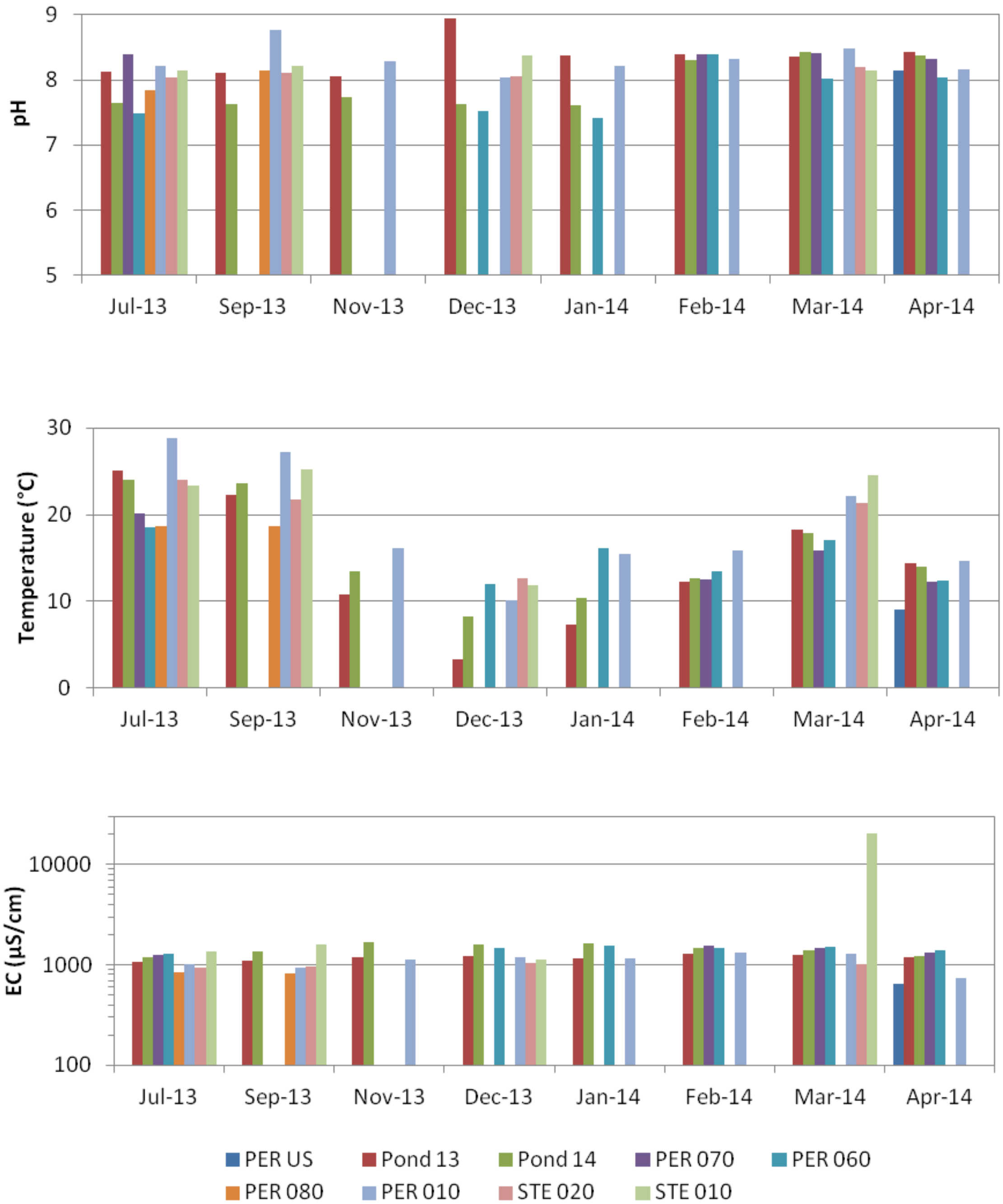


Figure B-1. pH, temperature, and electrical conductivity (EC) measured in water samples taken July 9, 2013 through April 1, 2014.

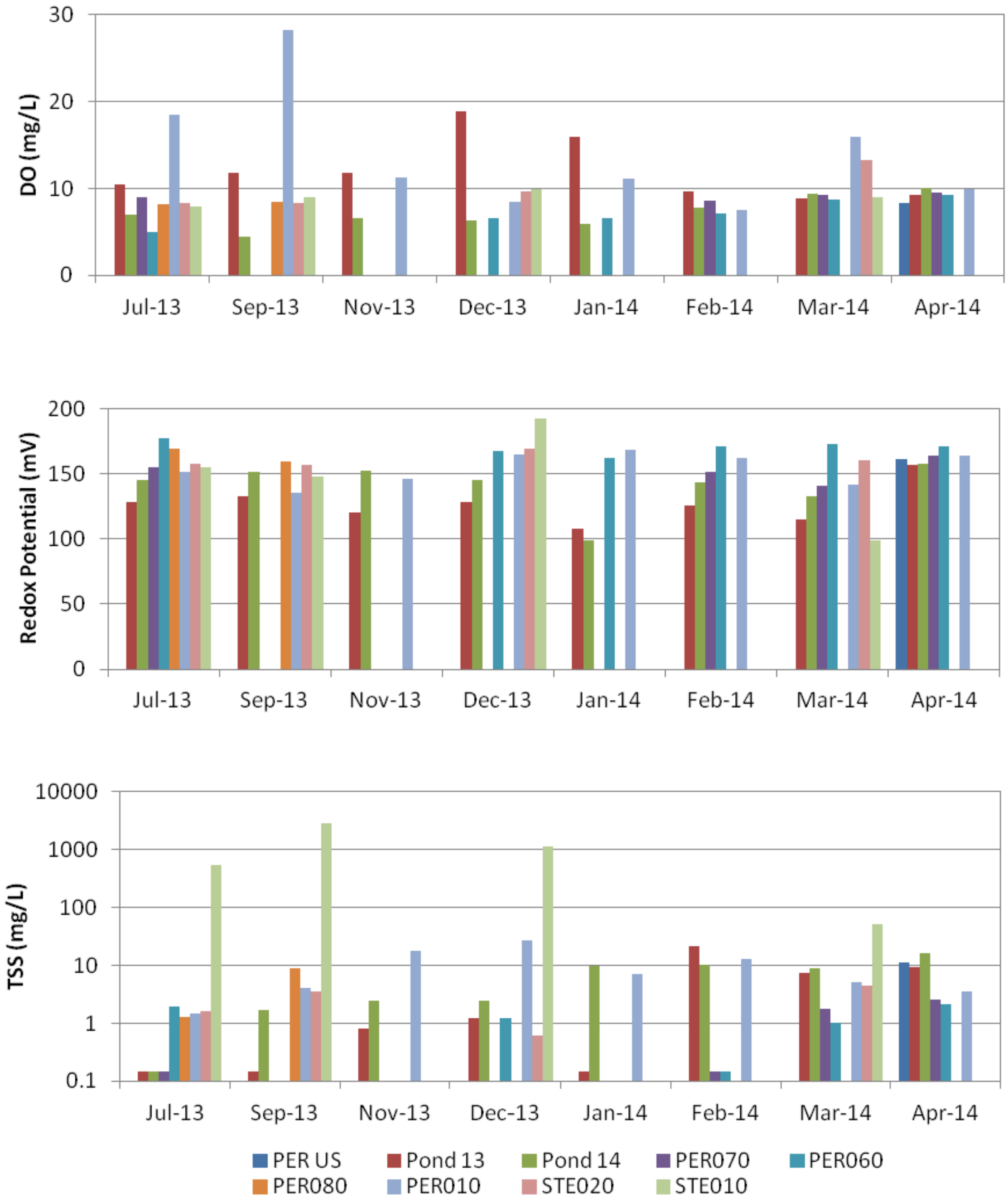


Figure B-2. Dissolved oxygen (DO), oxidation-reduction (redox) potential, and TSS measured in water samples taken July 9, 2013 through April 1, 2014.

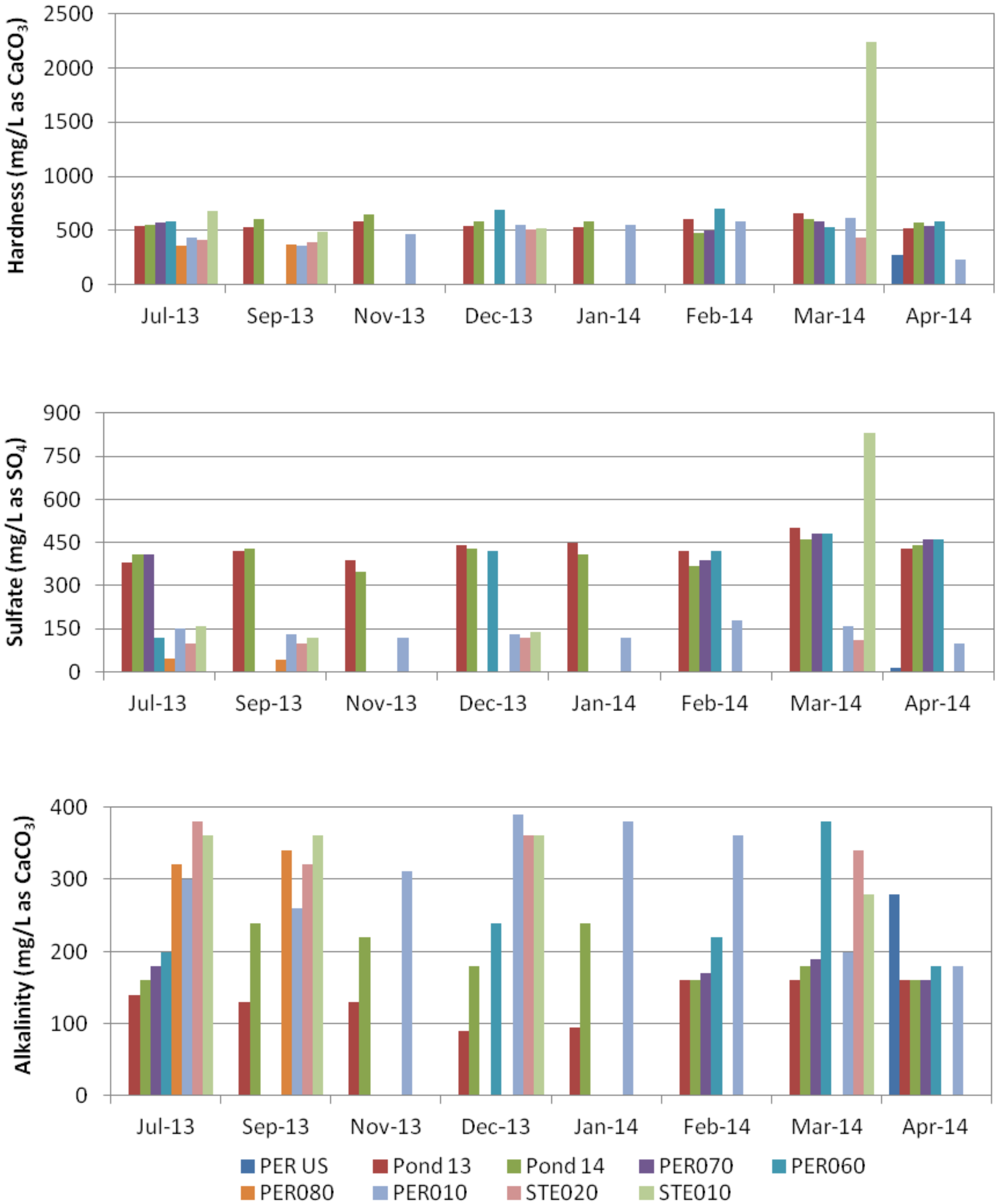
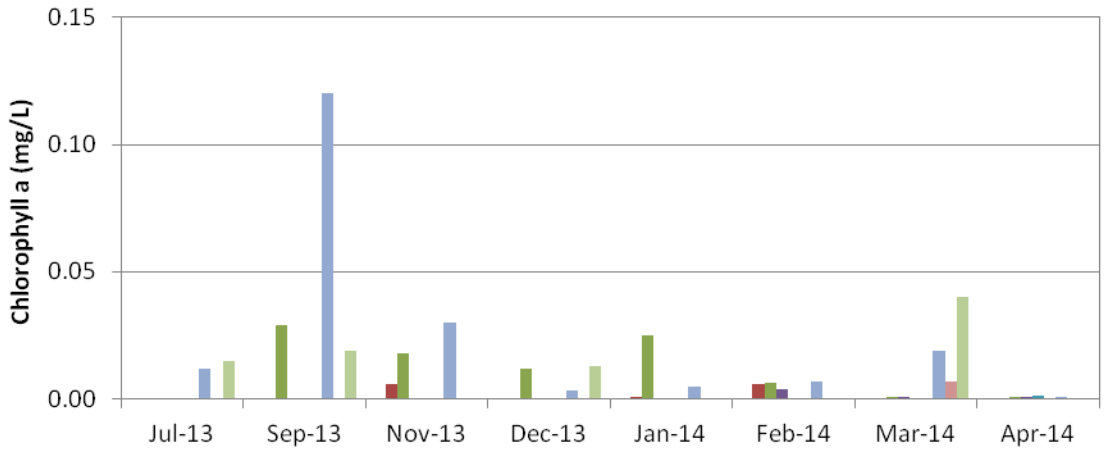


Figure B-3. Hardness, sulfate, and total alkalinity measured in water samples taken July 9, 2013 through April 1, 2014.



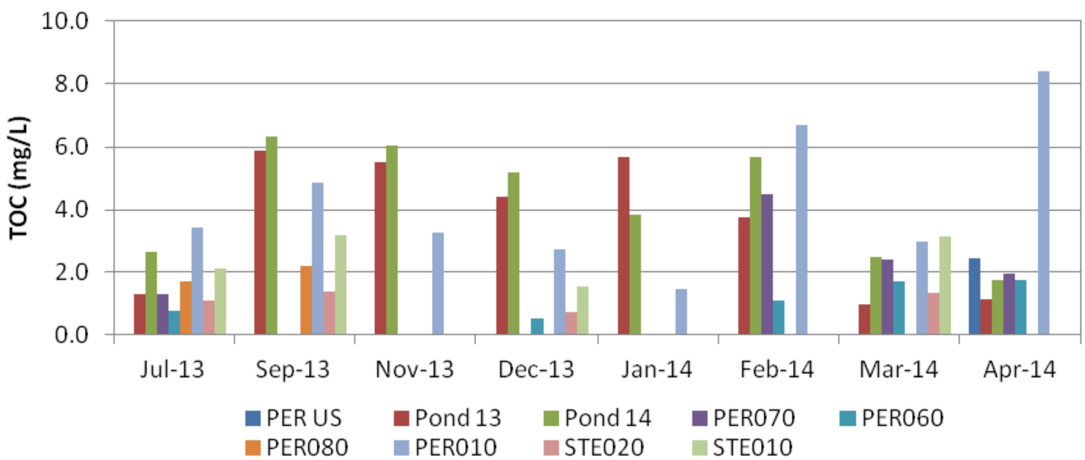
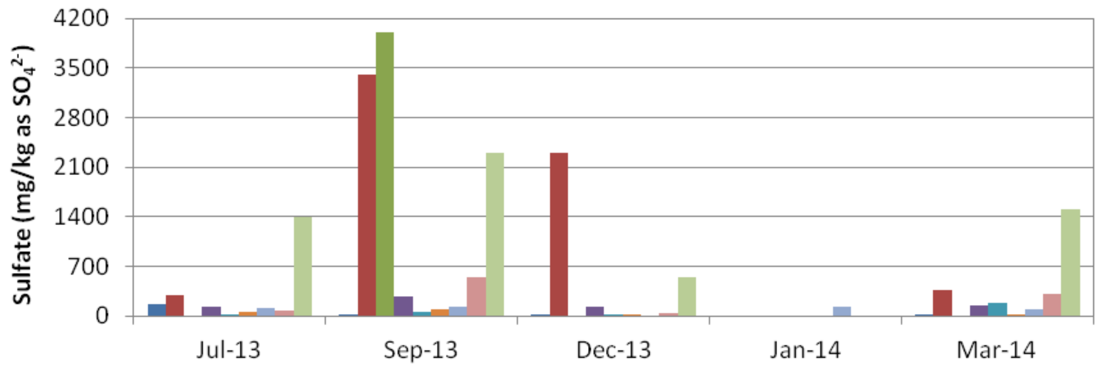


Figure B-4. Chlorophyll *a* and TOC measured in water samples taken July 9, 2013 through April 1, 2014.



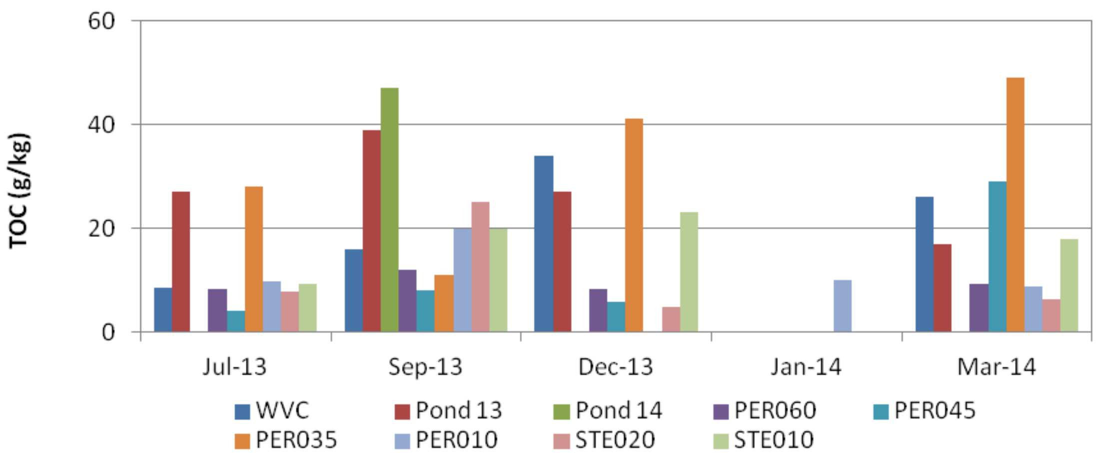


Figure B-5. Sulfate and TOC measured in sediment samples taken July 9, 2013 through April 1, 2014.

Table B-1. Sediment Grain Size Distribution by Sampling Station and Date. Red-Shaded Cells Indicate Dominant Fractions (>10% by Weight).

Sample ID	Date Collected	Gravel, Medium [a]	Gravel, Fine [a]	Sand, Very Coarse	Sand, Coarse	Sand, Medium	Sand, Fine	Sand, Very Fine	Silt [a]	Clay [a]
Size Fraction (mm)		>4.75	2.0<X≤4.75	0.85<X≤2.0	0.425<X≤0.85	0.25<X≤0.425	0.106<X≤0.25	0.075<X≤0.106	0.005<X≤0.075	X≤0.005
WVC	7/9/2013	41.1		27.5	18.1	6.1	1.8	0.8	0.6	
	9/4/2013	19.09	31.78	26.97	11.45	4.58	3.59	0.89	2.8	0.09
	12/9/2013	30.74	31.2	19.22	8.1	3.37	3.63	0.96	5.29	1.17
	3/20/2014	30.15	32.64	15.67	8.75	4.56	4.78	1.16	5.3	<0.01
Pond 13	7/9/2013	<0.01		<0.01	1.6	5.24	16.79	20.99	45.08	10.29
	9/4/2013	0.41	1.56	2.5	2.03	1.72	8.93	8.2	65.35	10.28
	12/9/2013	<0.01	6.39	2.61	1.93	1.76	7.91	5.97	48.99	23.65
	3/20/2014	7.12	2.72	2.57	1.65	1.42	9.62	7.53	53	16.34
Pond 14	9/4/2013	0	0.15	0.26	0.67	1.29	10.44	8.52	53.74	15.75
PER060	7/9/2013	44.99		8.36	14.86	16.18	7.21	2.21	4.75	1.45
	9/4/2013	10.62	9.32	13.74	12.85	15	15.01	3.33	13.06	7.23
	12/9/2013	21.11	18.35	15.92	15.1	14.25	10.31	1.39	5.24	1.83
	3/20/2014	<0.01	6.27	20.62	32.62	21.7	10.51	1.49	8.51	1.21
PER045	7/9/2013	53.3		16.9	13.1	6.1	1.6	0.7	0.7	
	9/4/2013	21.97	37.25	28.58	7.85	1.65	0.81	0.09	0.19	0.11
	12/9/2013	21.34	40.15	29.46	6.71	1.24	0.72	0.12	0.34	0.23
	3/20/2014	40.23	15.25	10.87	6.92	5.98	10.68	2.51	9.33	1.69
PER035	7/9/2013	42.4		16.9	12.5	9.5	8.2	4.7	4.3	
	9/4/2013	18.47	30.39	25.85	12.87	6.05	4.09	0.44	1.48	0.06
	12/9/2013	27.64	24.52	19.01	11.21	7.16	6.05	1.01	3.39	0.35
	3/20/2014	44.3	24.71	13.69	8.34	4.56	4.1	0.69	0.96	0.14
PER010	7/9/2013	29.52		4.51	14.31	17.83	8.18	5.26	18.18	2.21
	9/4/2013	28.16	22.26	11.4	16.33	12.81	3.86	0.42	5.9	0.5
	1/15/2014	13.77	17.5	17.08	19.16	16.15	11.14	1.38	4.67	0.35
	3/20/2014	11.03	24.9	18.12	15.01	14.65	9.68	0.93	2.83	0.51
STE020	7/9/2013	48.81		17.7	11.36	7.83	3.98	2.62	7.16	0.55
	9/4/2013	2.86	6.24	5.35	9.14	24.68	26.97	2.88	11.26	1.71
	12/9/2013	65.74	12.23	6.46	6.5	7.42	4.21	0.31	1.1	0.45
	3/20/2014	20.29	16.48	10.65	14.93	22.09	14.92	0.92	2.24	0.14
STE010	7/9/2013	<0.01		<0.01	<0.01	<0.01	<0.01	2.77	56.59	40.64
	9/4/2013	<0.01	<0.01	0.17	0.21	0.17	0.38	0.2	41.51	61.12
	12/9/2013	<0.01	0.06	0.26	0.21	0.24	0.36	0.07	36.01	67.04
	3/20/2014	0.26	0.05	0.11	0.07	0.05	0.1	0.08	38.2	70.65

[a] Grain size from 7/9/2013 reported “total gravel” (>2 mm), rather than fine and medium gravel. For WVC, PER045 and PER035, “total silt+clay” was reported, rather than “silt” and ”clay”, individually.

Appendix C

Continuous Logger Monitoring Results

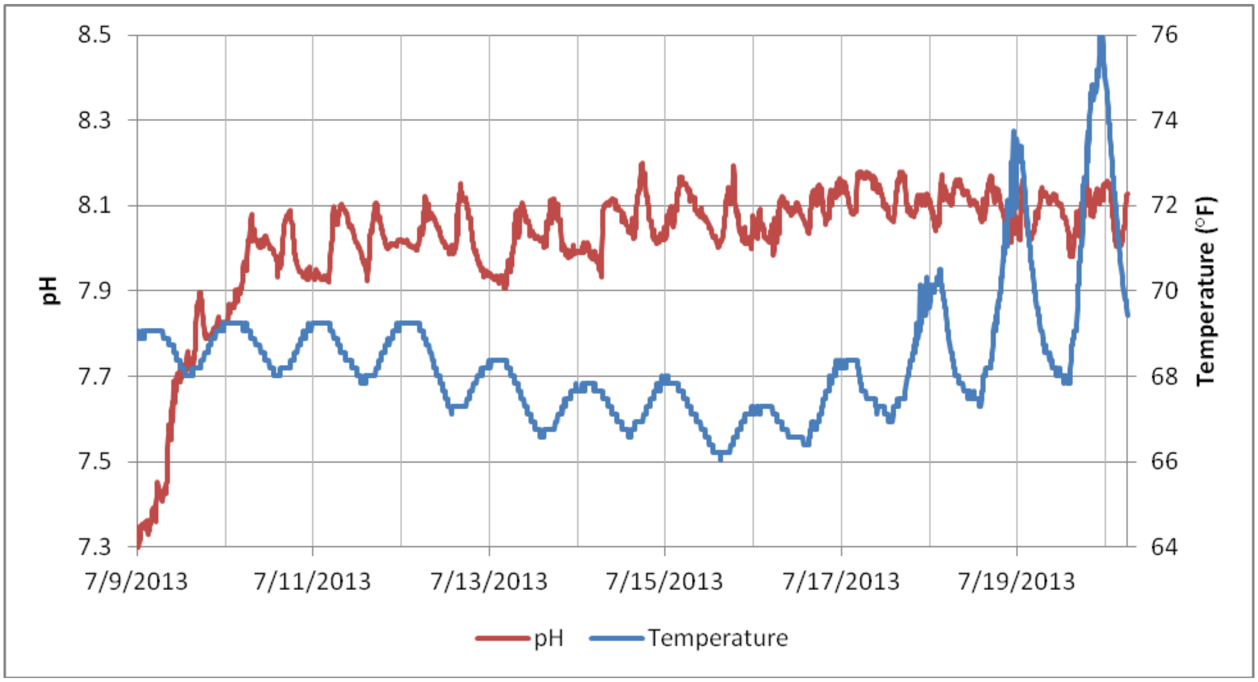


Figure C-1. pH and temperature in Pond 13 from the time logging started at 18:00 on 7/9/13 until end of 7/20/13. Around that time, the pond level dropped below the level of the loggers and future data was invalid. The initial pH readings (until approximately the start of 7/11/13) are believed to be in error and related to a time of equilibration of the logger. Temperature readings after 7/17/13 show larger fluctuations because the sensor was very near the surface of the water.

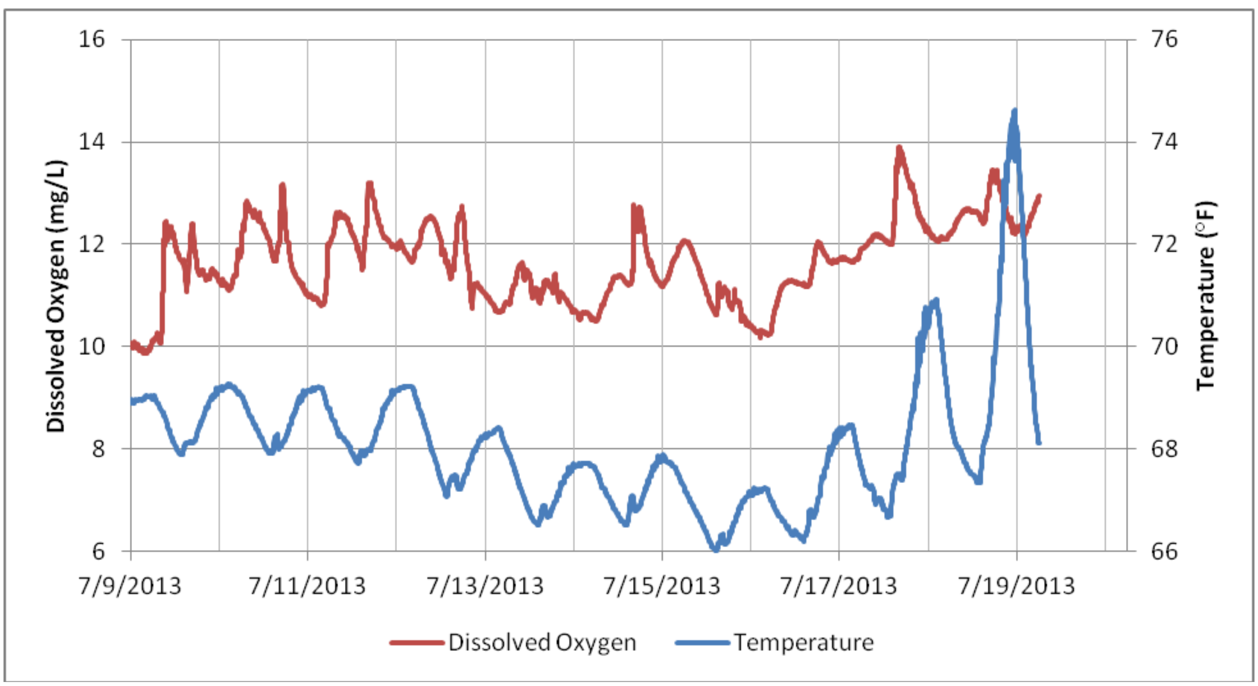


Figure C-2. Dissolved oxygen and temperature in Pond 13 from the time logging started at 18:00 on 7/9/13 until end of 7/19/13. Around that time, the pond level dropped below the level of the loggers and future data was invalid. Temperature readings after 7/17/13 show larger fluctuations because the sensor was very near the surface of the water.

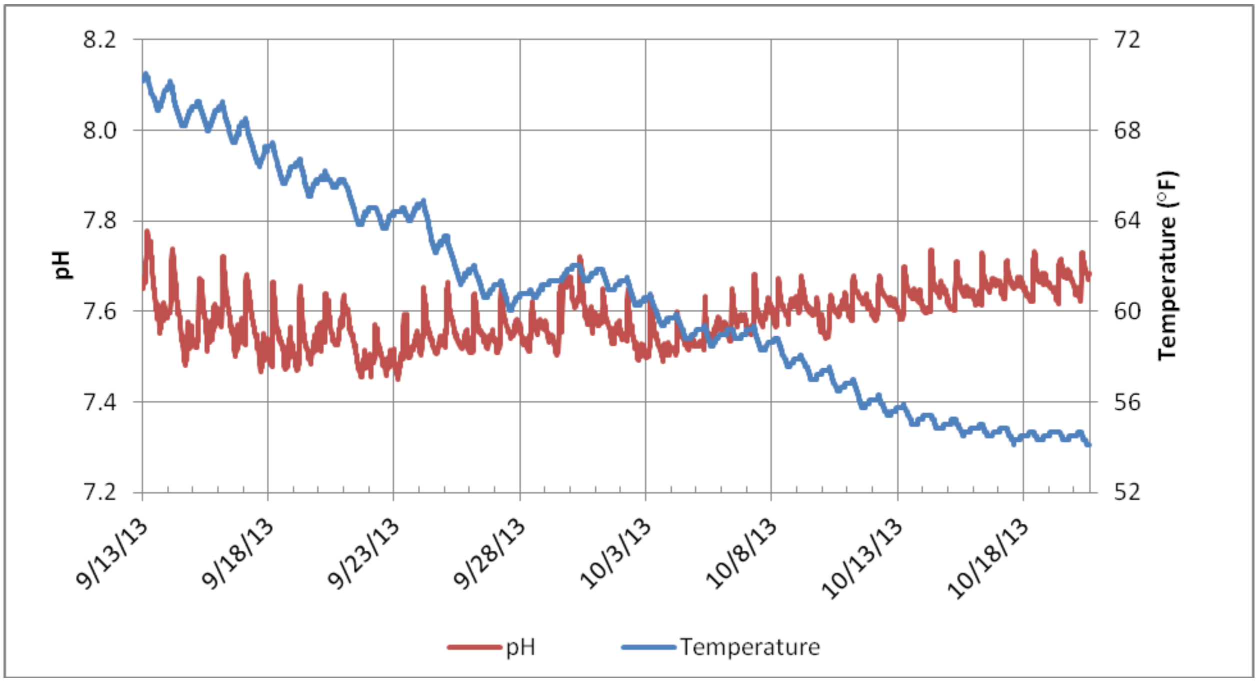


Figure C-3. pH and temperature in Pond 13 from the time logging started at 18:00 on 9/13/13 until 9:15 on 10/21/13.

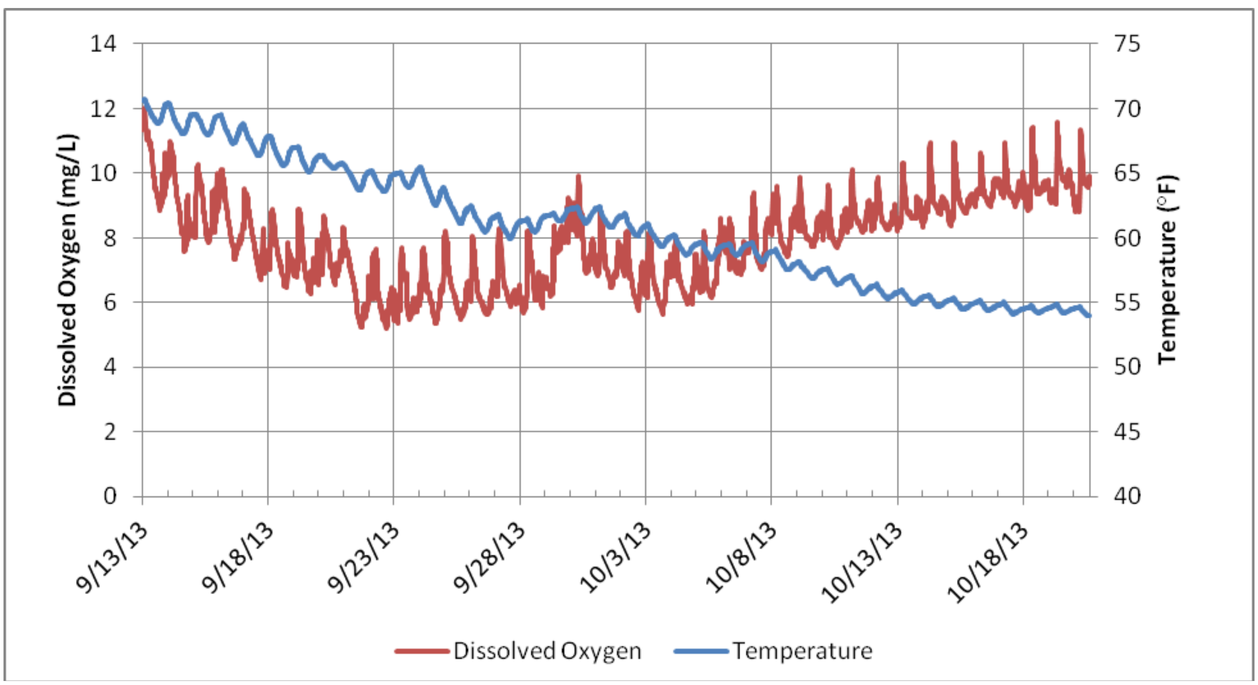


Figure C-4. Dissolved oxygen and temperature in Pond 13 the time logging started at 18:00 on 9/13/13 until 9:15 on 10/21/13.

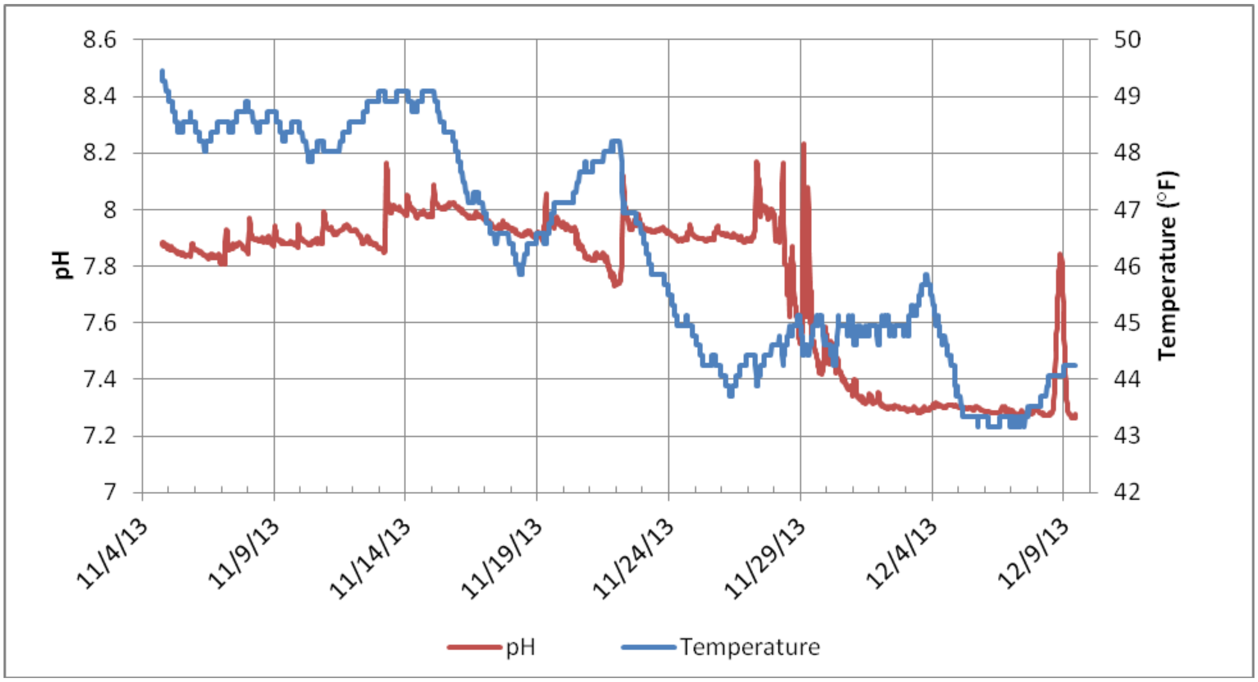


Figure C-5. pH and temperature in Pond 13 from the time logging started at 18:00 on 11/4/13 until 11:00 on 12/9/13.

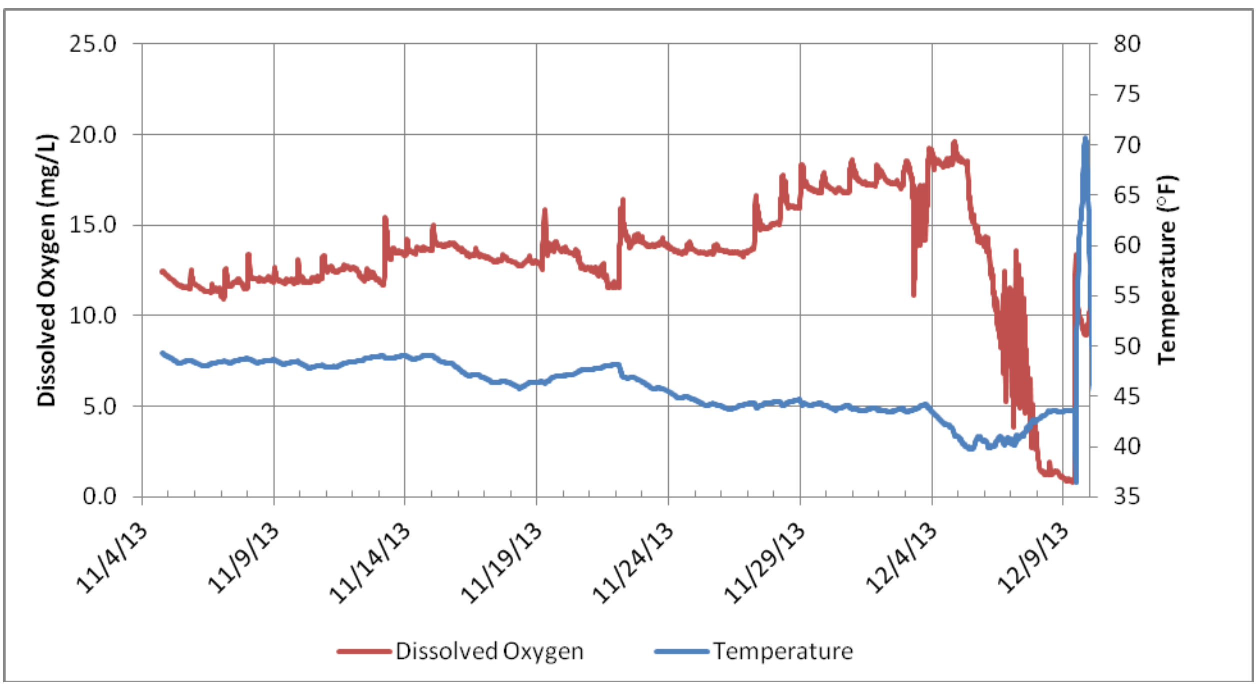


Figure C-6. Dissolved oxygen and temperature in Pond 13 the time logging started at 18:00 on 11/4/13 until 11:00 on 12/9/13.

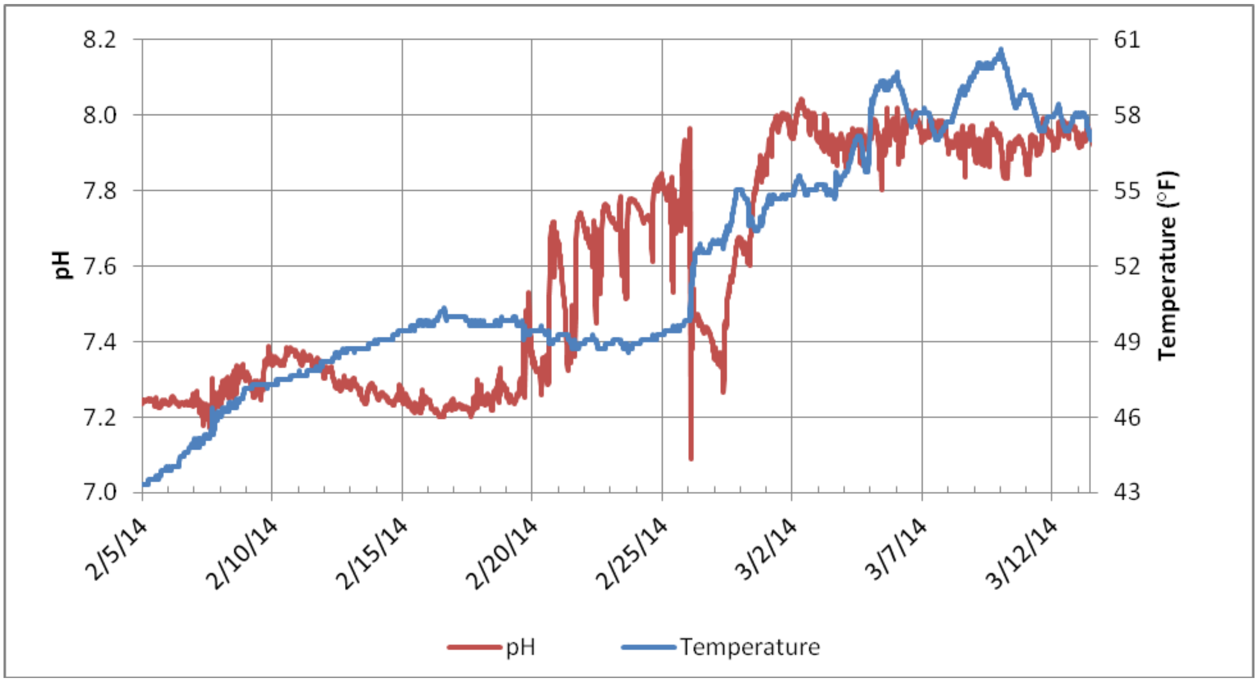


Figure C-7. pH and temperature in Pond 13 from the time logging started at 18:00 on 2/5/14 until 8:30 on 3/14/14.

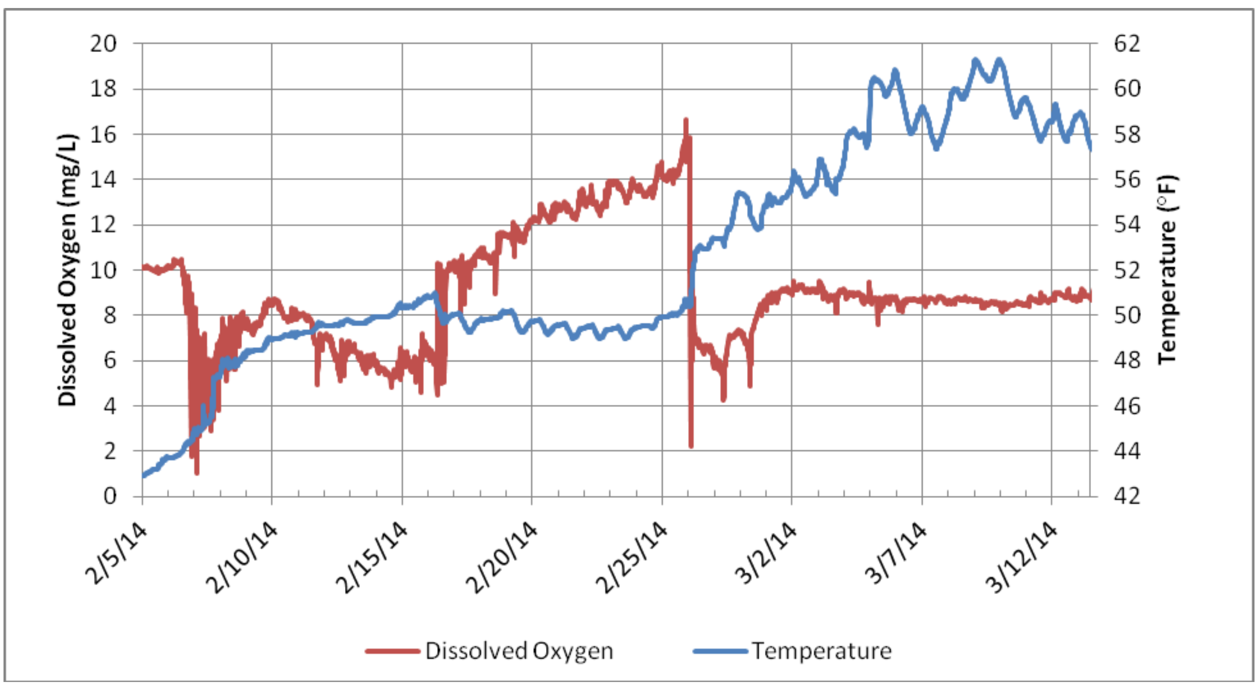
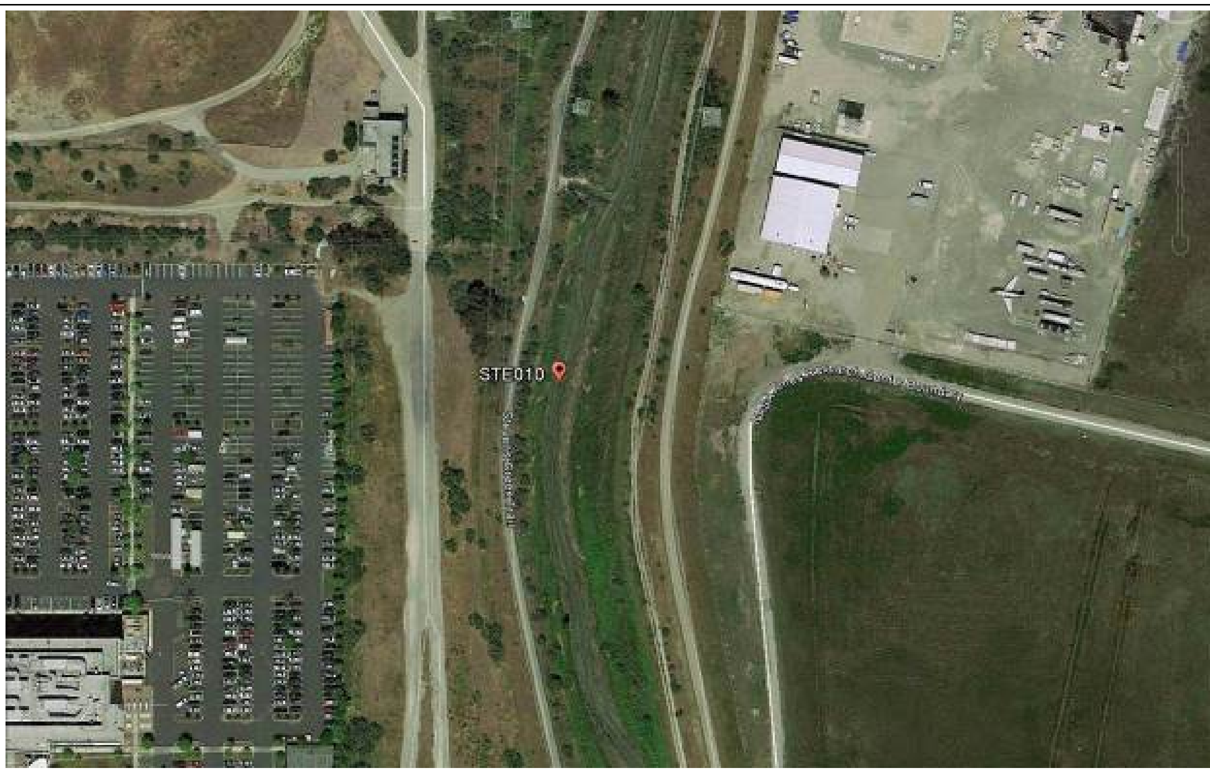


Figure C-8. Dissolved oxygen and temperature in Pond 13 from the time logging started at 18:00 on 2/5/14 until 8:30 on 3/14/14.

Appendix D

Photos of Field Sampling Stations

Stevens Creek near South San Francisco Bay (facing North/downstream)



Map of STE010

Figure D-1. STE010 sampling station on Stevens Creek.

Permanente Creek crossing at Charleston Rd. (facing North/downstream)

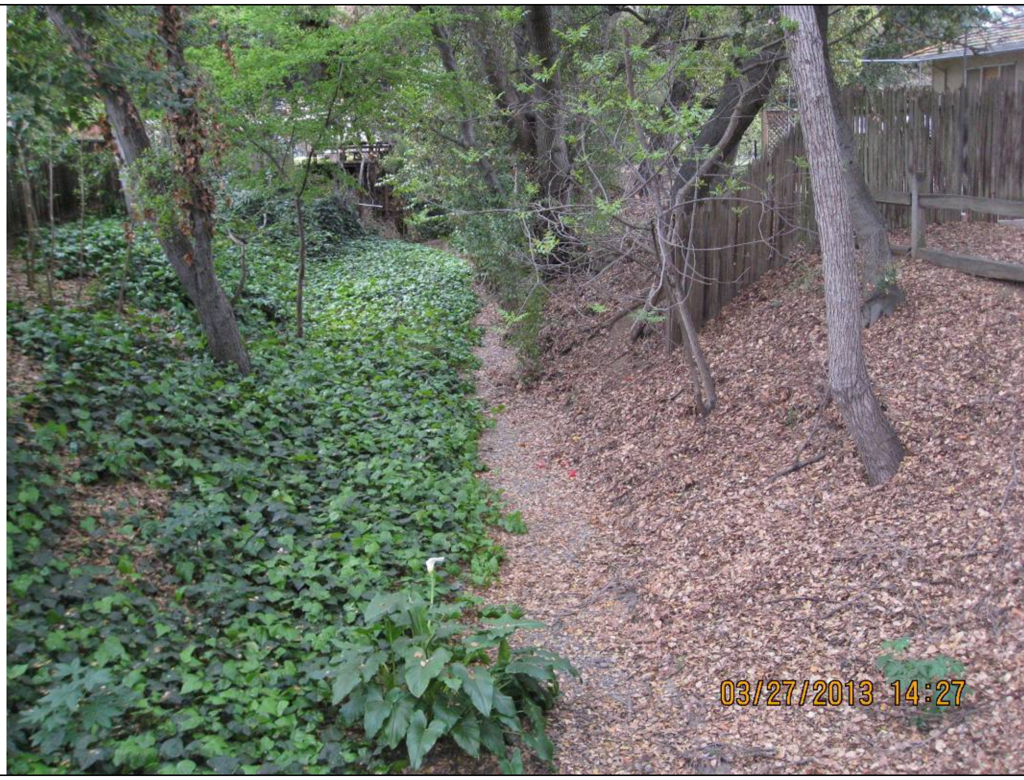
Map of PER010

Figure D-2. PER010 sampling station on Permanente Creek.

Hale Creek crossing at Mountain View Ave. (facing Northeast/downstream)

Map of HAL010

Figure D-3. HAL010 sampling stations on Hale Creek.



Permanente Creek crossing at Covington Rd. (facing South/upstream)

Map of PER035

Figure D-4. PER035 sampling station on Permanente Creek.

Stevens Creek crossing at La Avenida St. (facing South/upstream)

Map of STE020

Figure D-5. STE020 sampling station on Stevens Creek.

Stevens Creek downstream of the diversion channel (downstream to the left)

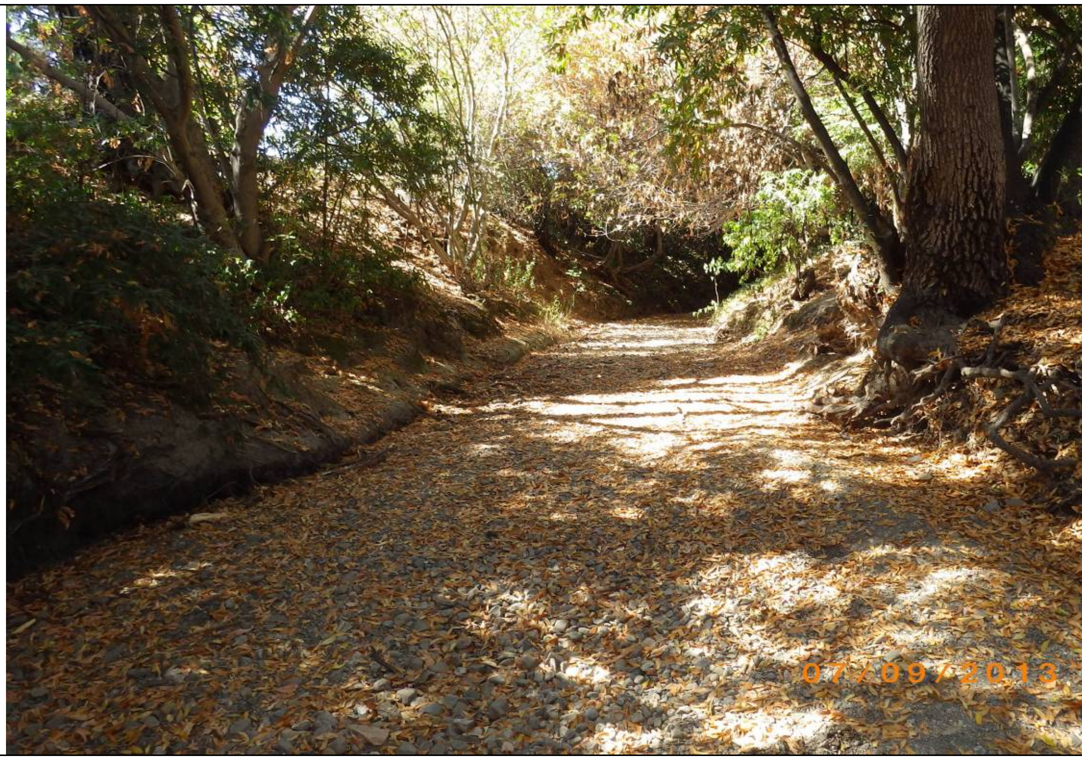
Map of STE040

Figure D-6. STE040 sampling station on Stevens Creek.

Stevens Creek upstream of the diversion channel (downstream to the left)

Map of STE040 US

Figure D-7. STE040 US sampling station on Stevens Creek.



Heritage Oaks Park off of Miramonte Ave.

Map of PER045

Figure D-8. PER045 sampling station on Permanente Creek.

Permanente Creek at Rancho San Antonio Open Space Preserve downstream of the Lower Bridge

Map of PER060

Figure D-9. PER060 sampling station on Permanente Creek.

Permanente Creek at Rancho San Antonio Open Space Preserve (facing downstream)

Map of PER070

Figure D-10. PER070 sampling station on Permanente Creek.

West Branch Permanente Creek at Rancho San Antonio Open Space Preserve (facing downstream)

Map of PER080

Figure D-11. PER080 sampling station on Permanente Creek.

Pond 14 located in Permanente Creek on Facility property (facing downstream)

Map of Pond 14

Figure D-12. Pond 14 sampling station.

Pond 13 located in Permanente Creek on Facility property (facing the pond inlet/upstream)

Map of Pond 13

Figure D-13. Pond 13 sampling station.

Permanente Creek (facing downstream)

Map of PER US and WVC

Figure D-14. PER US sampling station.

Wild Violet Creek (downstream is to the right)

Map of WVC and PER US

Figure D-15. WVC sampling station.

Appendix E

Quarter 2, 2014 Field Data Table and Selenium Data

Table E-1. Selenium Results for Water Samples Taken on April 1, 2014.

Sample ID	Date Collected	Units	Total Se	Diss. Se	Se(IV)	Se(VI)	SeCN	Additional Se Species (n)
PER - US	4/1/2014	µg/L	0.204 J	0.204 J	< 0.021 U	0.152 J	< 0.064 U	0 (0)
POND 13	4/1/2014	µg/L	43.8	44.9	2.67	41.4	< 0.064 U	0 (0)
POND 14	4/1/2014	µg/L	26.3	25.3	0.794	25.1	< 0.064 U	0 (0)
PER070	4/1/2014	µg/L	25.2	24.4	0.940	21.2	< 0.064 U	0 (0)
PER060	4/1/2014	µg/L	19.6	20.1	0.745	17.1	< 0.064 U	0 (0)
PER010	4/1/2014	µg/L	1.63	1.73	0.168 J	1.23	< 0.064 U	0 (0)

All results reflect the applied dilution and are reported in µg/L
U = Sample concentration is below the estimated method detection limit (eMDL)

J = Sample concentration is between the eMDL and the reporting limit (RL)

SeCN = Selenocyanate
Additional Se Species = Sum of all additional Se species observed by IC-ICP-MS

n = number of unknown Se species observed

Table E-2. Field Measurements and Data Collected on April 1, 2014.

Sample ID	Date Collected	Begin Time	End Time	Flow Condition	Water Collected	Sediment Collected	Continuous Water Column	Flow Measured	Flow (cfs)	pH	Temp (°C)	EC (µS/cm)	DO (mg/L)	DO (%)	ORP (mV)	Notes
WVC	4/1/2014	--	--	No Flow	No	--	--	--	--	--	--	--	--	--	--	No flow and dry.
PER US	4/1/2014	8:25	8:32	Flow	Yes	--	--	--	--	8.14	9	650	8.36	74	161	Clear and flowing.
Pond 13	4/1/2014	9:35	9:40	Flow	Yes	--	--	Yes	0.74	8.42	14.4	1175	9.32	91.4	157	Pond full with inflow and outflow. Turbid opaque color. Clear surface with no floating vegetation.
Pond 14	4/1/2014	10:18	10:30	Flow	Yes	--	--	Yes	0.73	8.37	14	1236	10.03	98.8	158	Pond is high and turbid from recent runoff.
PER 080	4/1/2014	--	--	No Flow	--	--	--	--	--	--	--	--	--	--	--	No flow and dry.
PER 070	4/1/2014	10:59	11:07	Flow	Yes	--	--	--	--	8.32	12.3	1312	9.58	91.6	164	Clear water.
PER 060	4/1/2014	11:25	11:34	Flow	Yes	--	--	Yes	1.49	8.03	12.4	1384	9.27	88.8	171	Clear water. More flow than seen in many months.
PER 045	4/1/2014	--	--	No Flow	--	--	--	--	--	--	--	--	--	--	--	No flow and dry.
PER 035	4/1/2014	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Site not visited.
HAL 010	4/1/2014	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Site not visited.
PER 010	4/1/2014	12:40	12:50	Flow	Yes	--	--	--	--	8.16	14.6	742	9.91	99.2	164	Higher flow than past many months.
STE 040	4/1/2014	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
STE 020	4/1/2014	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Site not visited.

-- No data to report.