TECHNICAL MEMORANDUM DRAFT

Clear Lake Water Quality Data Visualization Project

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1 Introduction

1.1 Background

The Big Valley Band of Pomo Indians has been collecting environmental data in Clear Lake for decades along with a few collaborators, stakeholders, and agencies actively engaged in the basin. To harness the potential power of this rich collection of data, the Big Valley Band of Pomo Indians has hired FlowWest to develop the Clear Lake water quality dashboard by acquiring, managing, and visualizing high quality environmental data to stakeholders and practitioners of ecosystem management in the basin.

1.2 Purpose

The overarching objective for this project is to implement the tools necessary to efficiently acquire, manage, and collaboratively analyze the large volume of complex environmental data. It is hoped that this dataset will guide collaborative water quality and ecosystem management in the Clear Lake Basin. The Big Valley Band of Pomo Indians has obtained times series water quality data from numerous sources to achieve this goal. FlowWest organized and displayed the Clear Lake water quality data using analysis tools to facilitate collaboration and analysis of data.

This document provides a brief overview of the project (Section 1) and work flow in Section 2, a detailed user guide operation of the Tableau data analytics and visualization dashboard in Section 3, instructions for updating the dashboard with new data in Section 4, and recommendations for developing a water quality sampling plan on Clear Lake in Section 5.

1.3 Data Sources

The Big Valley Band of Pomo Indians obtained Clear Lake water quality data from stakeholders and public agencies. The initial data incorporated into the master dataset included the following sources:

- Aquatic Pesticide Monitoring Program
- Sacramento Valley Water Quality Coalition
- Surface Water Ambient Monitoring Program (SWAMP)
- USGS water quality
- California Department of Water resources (DWR)
- Elem Indian Colony

- DWR CL chlorophyll-a
- EPA Sulfur Bank Mine
- Big Valley Band of Pomo Indians
- California Department of Food and Agriculture (CDFA)

Table 1 contains additional information about each of the datasets incorporated in the Clear Lake water quality data visualization. Appendix A lists the analytes and the number of records in each dataset. The DWR dataset provides the longest (1956-1991, 1998-2012) and most consistent water quality record for Clear Lake. The Sacramento Valley Water Coalition dataset includes the most parameters, but provides snapshots of water quality in Clear Lake at limited sampling events. The Big Valley Band of Pomo Indians water quality sampling program is the second largest dataset that we integrated.

Table 1 Datasets incorporated into the Clear Lake Water Quality Dashboard

Dataset	Period of Record	Total Records	Sampling Matrix (records)			
			Water	Air	Sediment	Interstitial Water
Aquatic Pesticide Monitoring Program	2002 - 2004	348			305	43
Sacramento Valley Water Quality Coalition	2007 – 2014	943	939		4	
SWAMP	2001 – 2014	790	790			
USGS Water Quality	1956 – 1977	2,890	2,890			
DWR	1956 – 1991, 1998 – 2012	52,637	52,637			
Elem Indian Colony	2014	1,488	1,154	334		
DWR CL chlorophyll-a	2005 – 2012	383	383			
EPA Sulfur Bank Mine	2005 – 2014	124	124			
Big Valley Band of Pomo Indians	1999 – 2014	19,962	18,765	1,149	48	
CDFA	2012 – 2014	2,083	2,083			

2 Data Exchange Work Flow

This section provides a general description of the Clear Lake water quality dashboard work flow. There are numerous steps in the work flow and this section provides context for the individual steps. Figure 1 is an illustration of the step-wise nature of how water quality information is processed and incorporated with other data sets for use in the visualization dashboard.

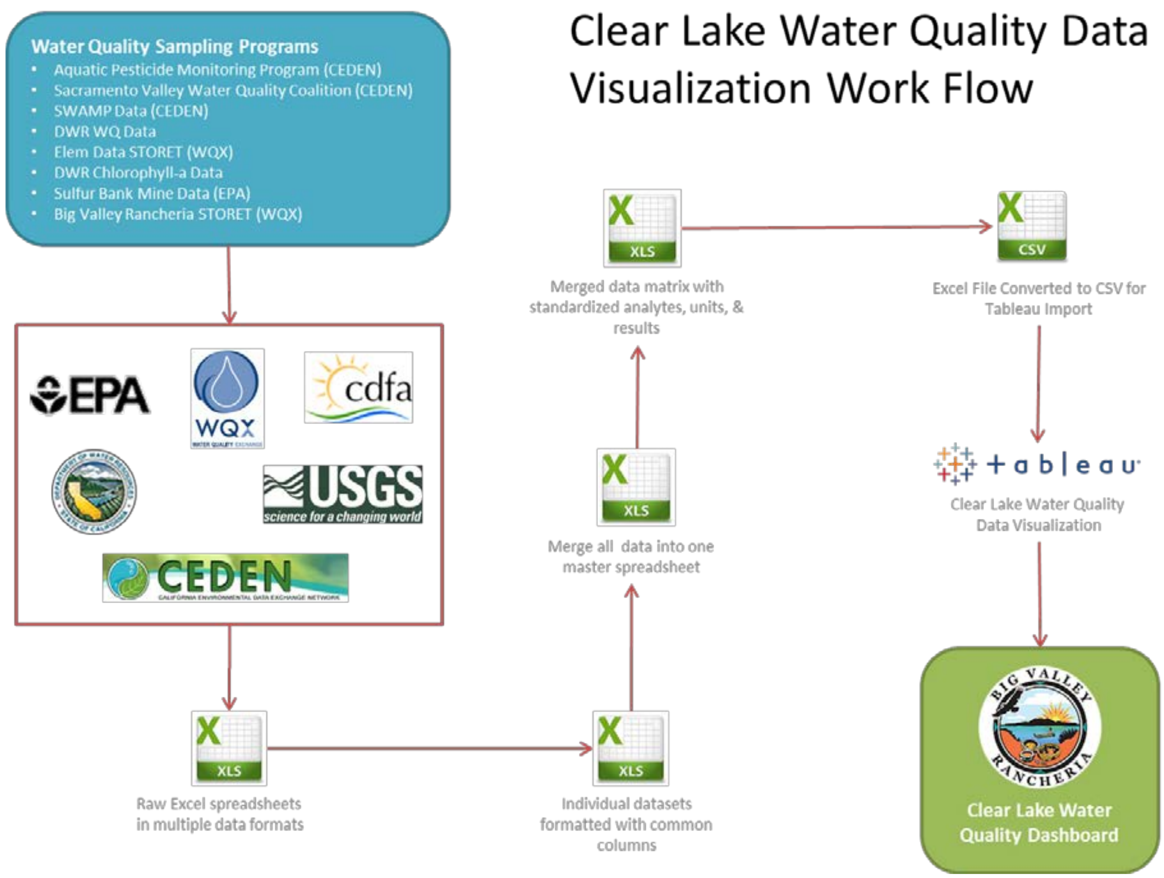

Figure 1 Clear Lake water quality data visualization work flow

Conceptually, there are five primary data processing steps in the Clear Lake water quality data visualization work flow:

1) Reorganize data from raw Excel water quality worksheets for each dataset with common columns including:
    a. Filename
    b. Program
    c. Parent project
    d. Station code
    e. Sample date
    f. Analyte
    g. Unit
    h. Result
    i. Latitude
    j. Longitude

k. Collection depth
l. Unit collection depth
m. Sample depth group
n. Matrix name
o. Collection time

2) Merge each individual Excel file into one master worksheet
3) Standardize names and units for the following columns:
    a. Ananlyte - standardize names across the different datasets by adding "Modified Analyte" column to master Excel worksheet
    b. Unit - converted units to standardized units across all datasets by adding "Unit Conversion" and "Modified Unit" columns to master Excel worksheet
    c. Result (converted the results to standardized the units for the all the datasets by adding "ResultConversion" and "Modified Result" column to master Excel worksheet
    d. Matrix name (standardized the names across all datasets by adding "Modified MatrixName" column to master Excel worksheet)
4) Export the master Excel worksheet to a csv file to import into Tableau
5) Convert USGS lake water surface stage from Excel file to csv

The csv file used for data import to the Tableau is formatted in a grid and no data from the original spreadsheets was deleted. New columns were added to the table to capture the data from each dataset. This results in null values in the columns that do not overlap between the different dataset.

3 Water Quality Data Visualization

Big Valley Band of Pomo Indians has been collecting environmental data in Clear Lake for decades. To harness the potential power of the Big Valley Band of Pomo Indians' rich collection of water quality data and to integrate it with other relevant data, FlowWest has developed a web-based dashboard to visualize and disseminate water quality data to stakeholders and practitioners of ecosystem management in the basin. The overarching objective for this project is to implement the technological architecture, systems, and tools necessary to efficiently acquire, manage, assure quality, share, and collaboratively analyze the large volume of complex environmental data that forms the basis for much of the collaborative ecosystem management in Clear Lake. To facilitate collaboration and analysis of data, FlowWest developed a Tableau Dashboard for data visualization, exploration, and analysis.

FlowWest and the Big Valley Band of Pomo Indians selected Tableau Software to visualize the water quality data. Tableau is a leader in the field of data visualization and produces a family of interactive data visualization products. The interactive Tableau dashboard allows for the visualization of the water quality data that goes beyond static charts to create multi-faceted views of data and explore relationships between different analytes and data collected at different sample sites throughout Clear Lake.

3.1.1 Tableau Water Quality Dashboard

In Tableau the Clear Lake water quality data is organized into interactive charts and a map assembled together in a dashboard to visualize the data and provide a web-based platform for data analysis. The dashboard has three main components (Figure 2):

- Two analyte time series charts
- Location map of the monitoring locations
- Time series chart of USGS Clear Lake water surface elevation (stage)

The following sections describe each of these three components of the Clear Lake water quality dashboard. The following section contains instructions on how to operate the different data visualization and analysis components of the dashboard. In Section 4 we provide instructions for updating the dashboard with new data when it becomes available.

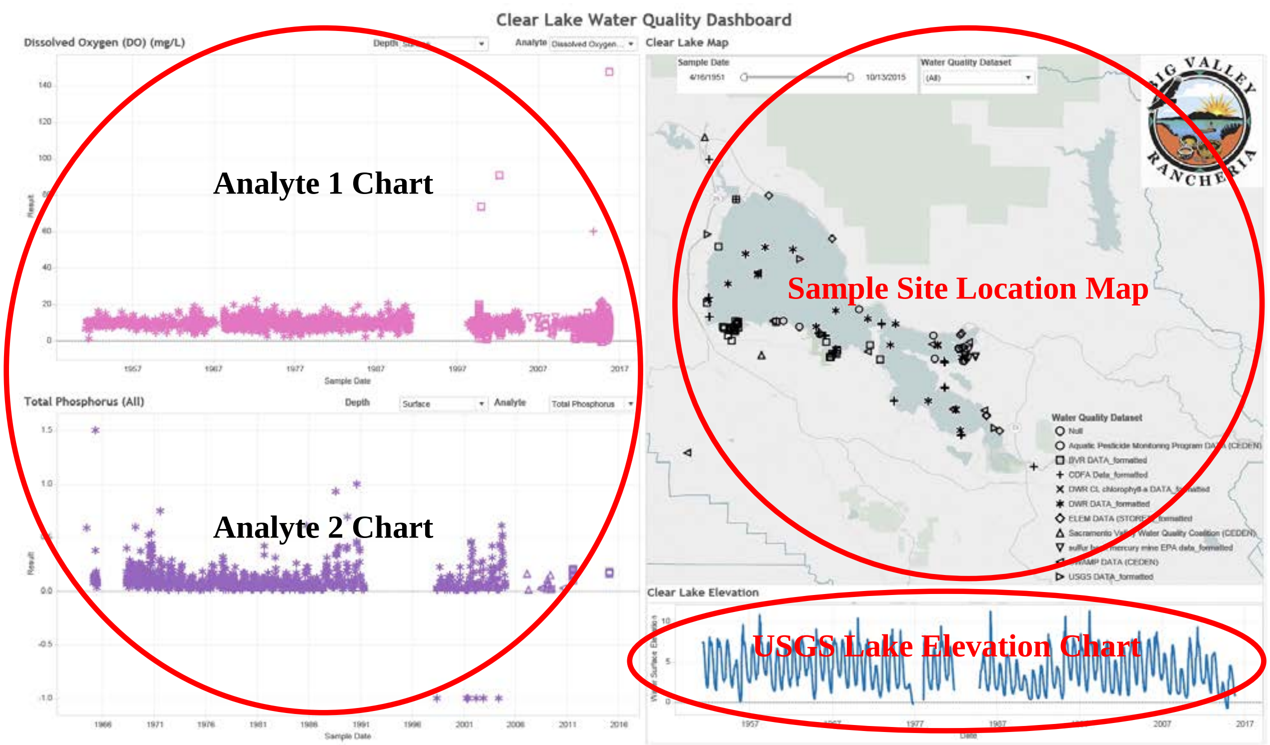

Figure 2 Clear Lake water quality dashboard components

Analytes from the various data sources described in section 1.3 are included in the dashboard. These data are presented in conjunction with a map of sampling locations and a time series of Clear Lake water surface elevation. Each of the dashboard components are described in detail in the following sections.

3.1.1.1 Clear Lake Map of Sampling Locations

Clear Lake water quality monitoring locations are shown as black icons on a map (Figure 3). Different icon shapes indicate which water quality dataset source, and a legend for all the sources are shown in the lower right corner of the map. The navigation tool bar in the upper left corner can be used to change the view or zoom level of the maps, and to select monitoring stations. Water quality monitoring stations can be selected individually or as a group by clicking and dragging. Monitoring locations can also be selected by dataset from the dropdown menu at the top of the map or by clicking on the dataset name in the legend. The location map can be used used to select water quality monitoring stations to display in the analyte chart section on the dash. The time period slider at the top of the map can be used to adjust the period of record for analyte results as well as the Clear Lake stage time series in the bottom right of the dashboard.

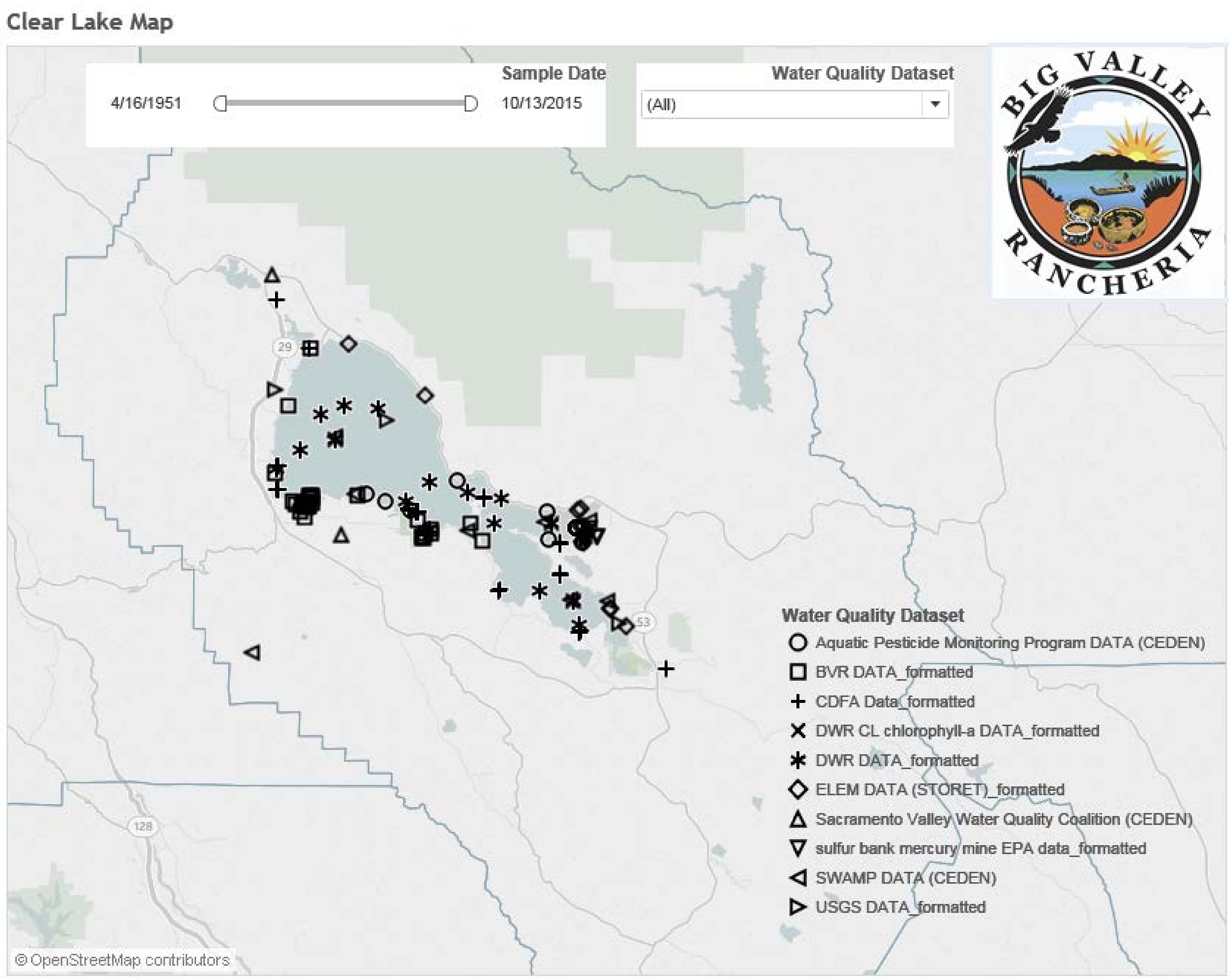

Figure 3 Monitoring locations map in the dashboard

3.1.1.2 Time Series Chart of USGS Clear Lake Stage:

Clear Lake stage in feet is plotted for the Clear Lake at Lakeport California USGS gage 11450000 and shown here in Figure 4. The time period for the data shown in the chart can be adjusted with the time slider on the Clear Lake Map (Figure 3). The Clear Lake water surface elevation is listed as a stage relative to a local datum (1,318.26 feet above NGVD29) and does not list the actual elevation of the lake surface relative to sea level.

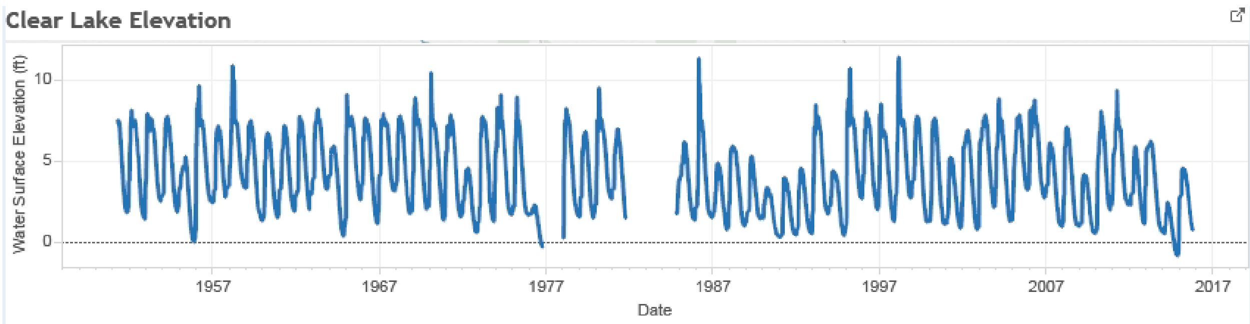

Figure 4 USGS Clear Lake stage time series in the dashboard

3.1.1.3 Analyte Time Series (titles vary depending on analyte selected):

The left side of the dashboard consists of two charts displaying time series for water quality analytes. The two charts allow the user to compare two different analytes on two charts with the same time scale. We setup the dashboard to plot two charts instead of plotting multiple analytes on the same chart because the units of the analytes vary making a direct comparison on the same chart confusing.

The dropdown menus in the upper right corner allows the user to select one or multiple analyte results to display. In the example shown here (Figure 5), dissolved oxygen and pH have been selected from the dropdown list. All sites were selected in location map and are plotted on the charts using a different symbol for each station. Individual or multiple stations can be selected from the location map and plotted.

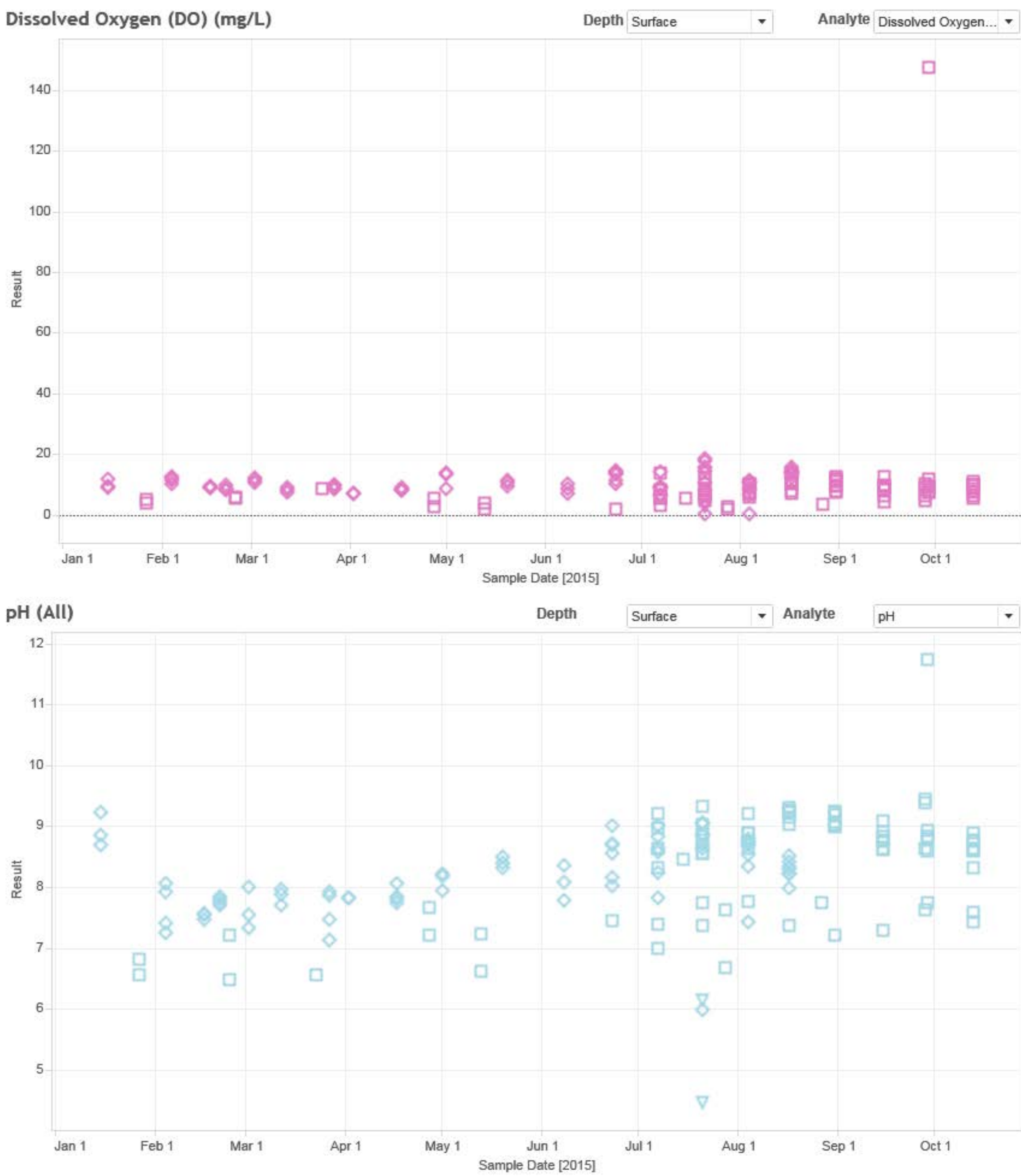

Figure 5 Example water quality analyte results time series

3.1.2 The Interactive Dashboard

This describes how to select a date range for plotting analytes and how to select monitoring stations from the location map.

3.1.2.1 The Time Slider

On the top right of the dashboard is a time slider that operates on all of the charts presented in the dashboard. In Figure 6, it is expanded to encompass the entire time series for all of the water quality and Clear Lake stage data.

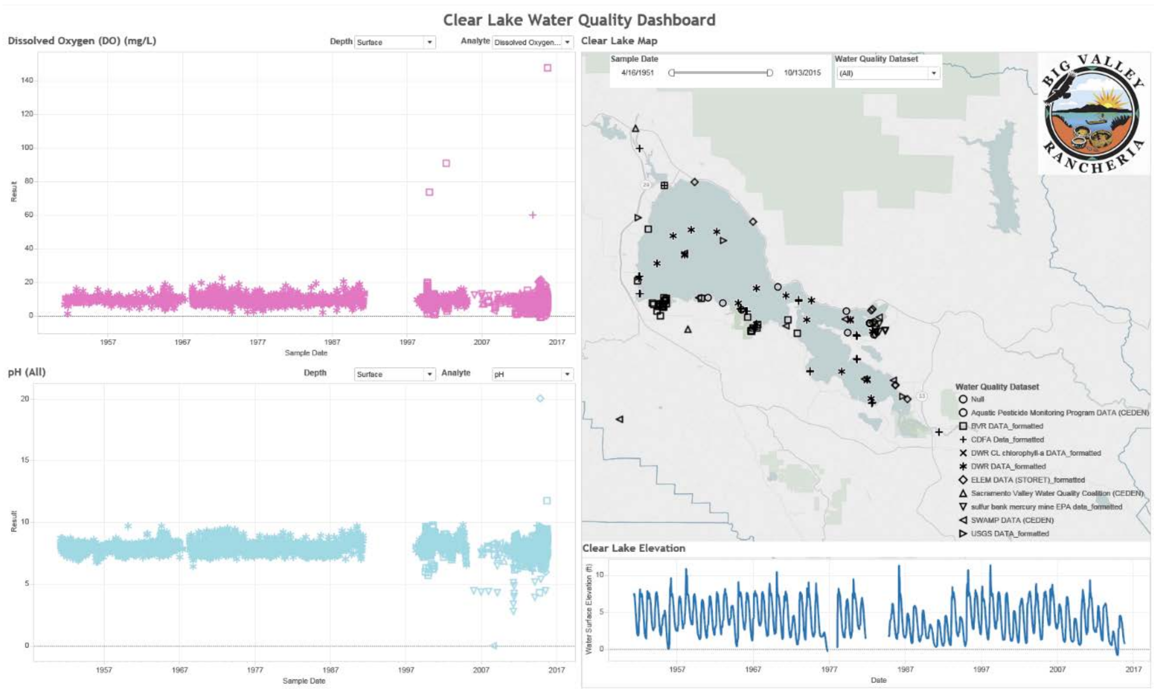

Figure 6 Dashboard shown with time slider expanded to full range at top

To examine a period of interest, the user can adjust the edge of the time slider to zoom in on a particular period of time. Figure 7 depicts the time slider adjusted to show the date range of June 1, 2015 to October 13, 2015. Note the change in the water quality analyte graphs, as well as in the chart for the Clear Lake stage data.

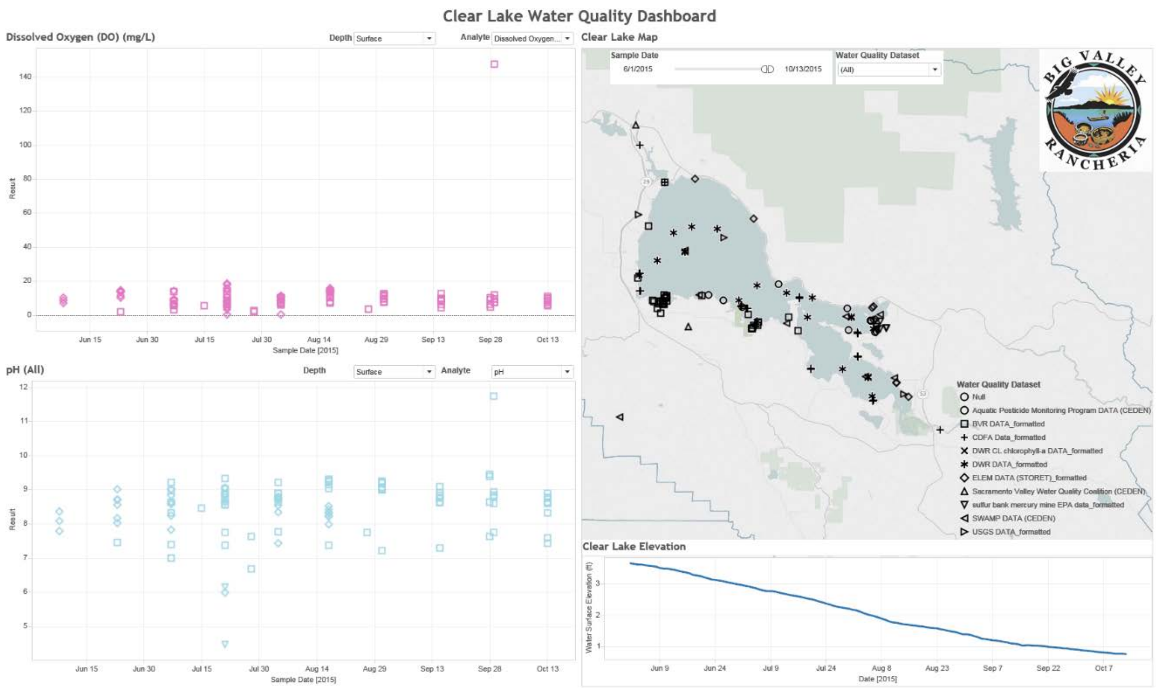

Figure 7 Dashboard with adjusted time range

The user can also enter specific dates into the time slider, to allow for a more precise date selection. This is done by clicking the mouse on each of the dates shown in the time slider, and selecting a date from drop-down calendar or by simply typing in a date within the date box, as shown in Figure 8.

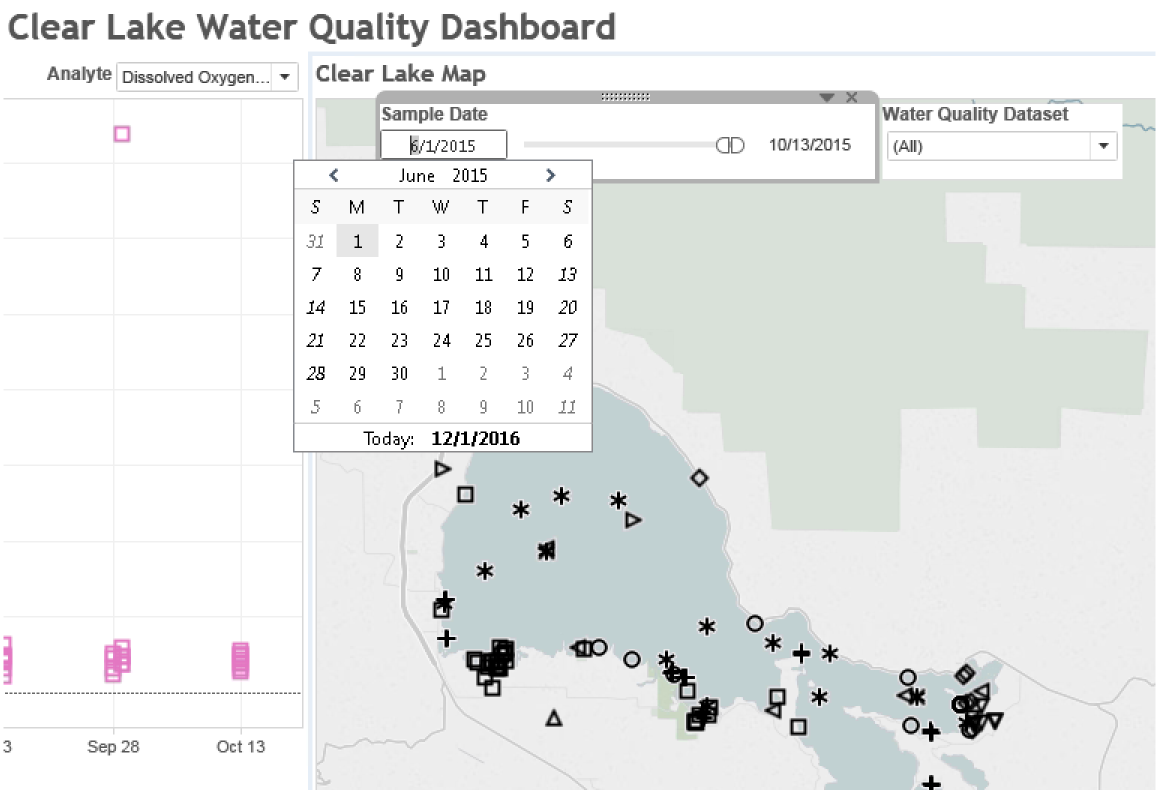

Figure 8 Selecting a specific date in the time slider

3.1.2.2 Selecting Water Quality Monitoring Results by Location

By selecting a site in the monitoring locations map, the user can filter the results shown in the analytes charts by location.

For example, to look at water quality data on the northeast shore of Clear Lake, hover the mouse over a monitoring site. A dialog box pops up—providing information on the dataset source file name, the station code, geolocation, as well as the original data source. Note in Figure 9, the analyte graphs on the left are showing the results for conductance (EC) and water temperatures for all the monitoring locations within the period specified in the time slider.

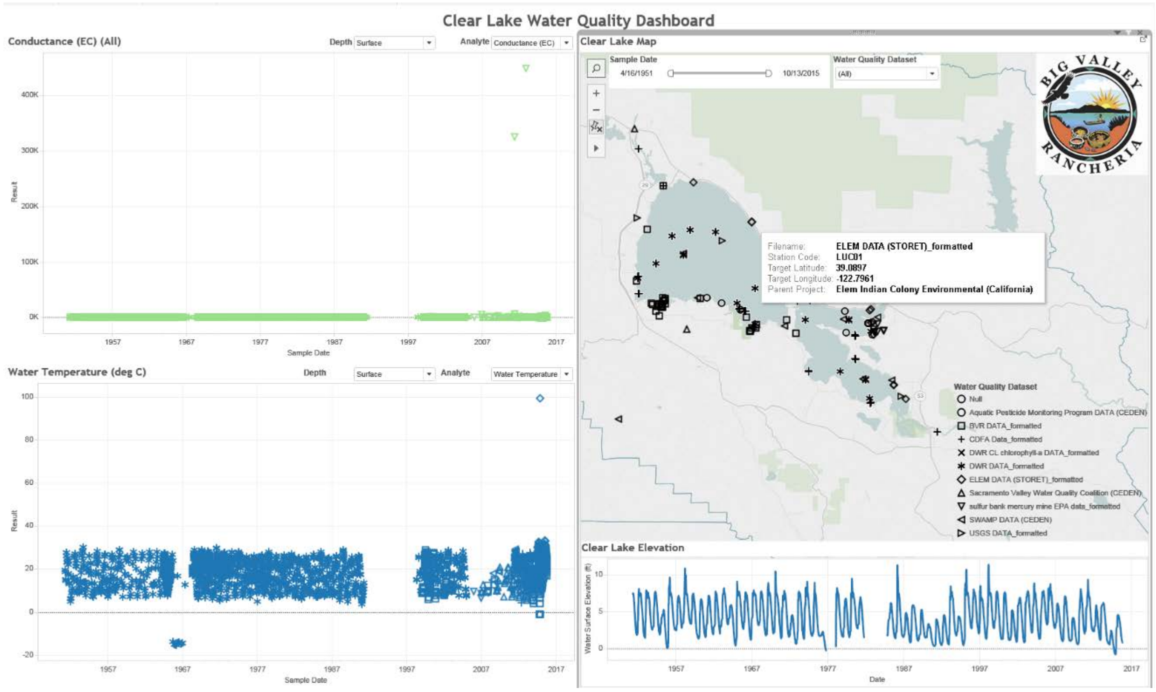

Figure 9 The tool tip dialog boxes provide information about each monitoring site or result when the user hovers over the site on the location map or a result in the time series charts with the mouse

By clicking on this monitoring site (Station Code = LUC01), the analyte charts are filtered to only show the results for this monitoring site (Figure 10).

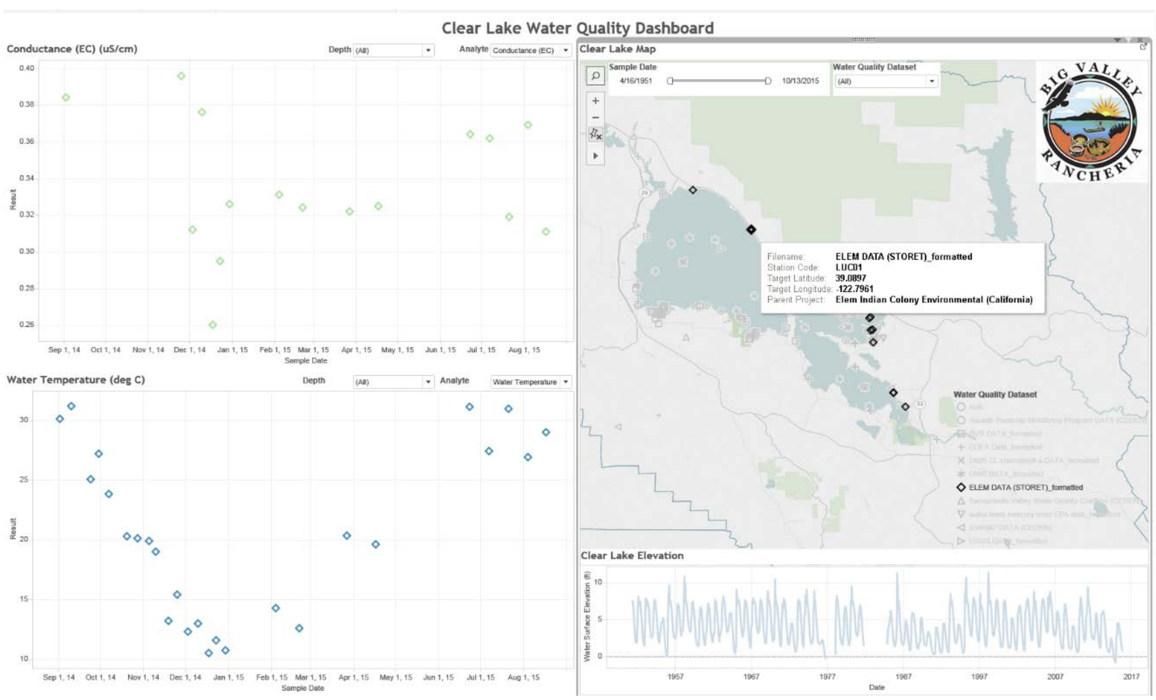

Figure 10 Selecting a monitoring location and filtering the analyte results in the charts on the left

The user can also use the mouse to select several monitoring sites at once, using one of the selection tools in the map tool bar (Figure 11).

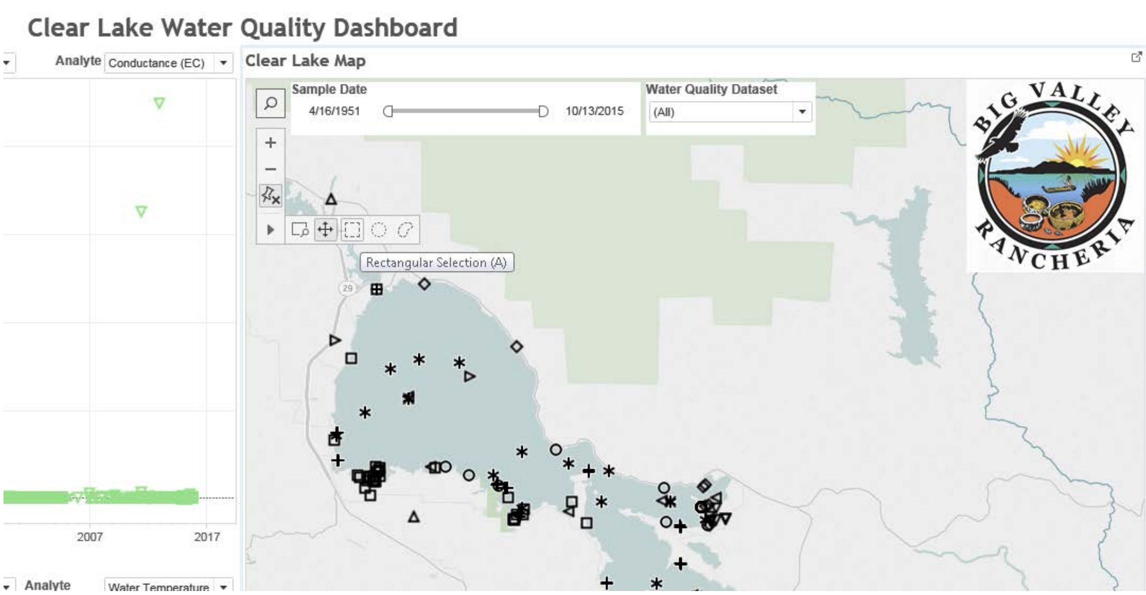

Figure 11 Selection tools to filter analyte charts for several monitoring locations

Using the Rectangular Selection tool, three site on Clear Lake are now selected (Figure 12).

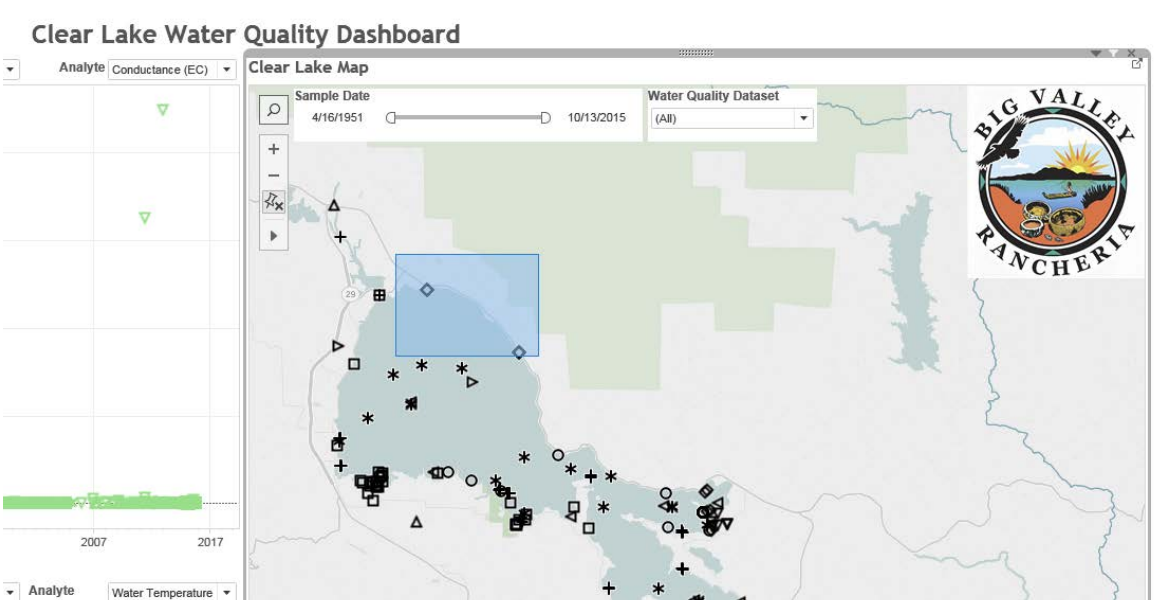

Figure 12 Two sites selected with the rectangular selection tool

The analyte charts now show conductance and water temperature results for the two selected monitoring locations on Clear Lake during the period (Figure 13). On the map all of the stations in the dataset containing those sites are highlighted, and the selected stations are shown in a more weighted highlight.

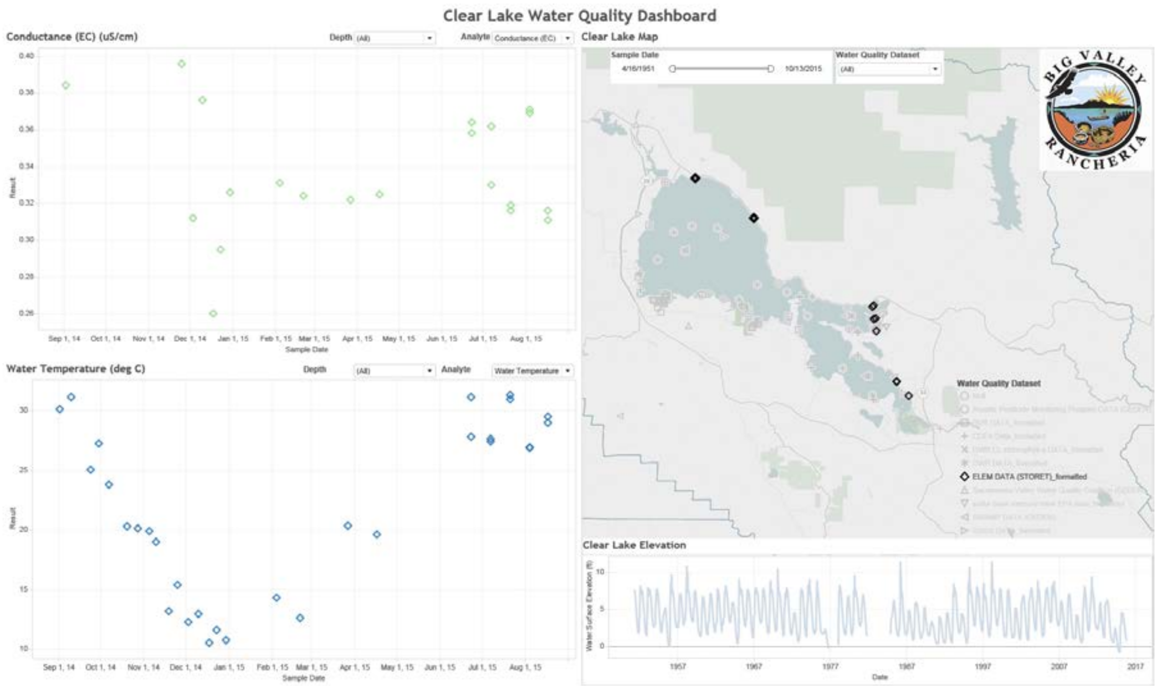

Figure 13 Analyte results filtered for the two monitoring sites selected

Escape out of this selection by simply clicking anywhere on the map. Note, the analyte charts will not be filtered by selected a water quality dataset from the *Water Quality Dataset* legend or dropdown menu. The user must select the sites within the map itself.

4 Update Annual Water Quality Data in the Tableau Water Quality Dashboard

To update the Tableau workbook with additional data, follow the steps below:

1. Create a copy of the current workbook for archival and rename it to give it a meaningful suffix such as the last year of record that the workbook included also archive the existing csv files in the Tableau directory.
2. Standardize the new data to be consistent with the common fields and modified fields in the in the Excel worksheet. This steps will require unit conversions and name conversions and defined in the existing schema.
3. Add new data to the appropriate section of the Excel worksheet by appending existing data or add new datasets to the bottom of the worksheet.
4. Convert the revised Excel worksheet to a csv file.

5. Download current flow gage data for the USGS gage (http://waterdata.usgs.gov/ca/nwis/dv/?site_no=11450000&agency_cd=USGS&referred_module=sw) and append new stage data to the existing csv file.
6. Using Tableau Desktop open the Clear Lake workbook.
7. From main menu, select Data / New data source and select refresh data.
8. Go to main dashboard tab. Verify that new data are visible.
9. Save workbook
10. Create a new extract for both the water quality and stage data csv files.
11. Save the new extracts in the project directory.
12. Update the dashboard in Tableau Public.

5 Recommendations for Future Data Integration and Water Quality Sampling

This effort is the first time that Clear Lake water quality data has been integrated and made available publicly. During this process, we developed the following recommendations for future data integration and water quality sampling. The following recommendations are based on our observations during the development of the Clear Lake water quality dashboard. These recommendations are not based on a detailed data gaps analysis, which is outside of the scope of this project. Our recommendations are summarized in the following list of next steps:

- Review the existing nutrient (http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/clear_lake_nutrients/index.shtml) and mercury (http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/clear_lake_hg/index.shtml) TMDLs and incorporate into the sampling protocol
- Review the Central Valley Regional Water Quality Control Board Basin Plan (http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/) for region-wide and Clear Lake specific water quality thresholds to protect identified beneficial uses
- Determine which analytes are important to monitor with regards to human contact and threatened species (Clear Lake hitch) and identify related water quality objectives
- Conduct detailed data gaps analysis for Clear Lake water quality data
  - Include Lake County data
  - Include water quality samples collected at municipal water supply diversion points
  - Determine if analytes with stated water quality objectives are not being sampled
  - Determine whether sampling frequencies needed to meet the water quality objectives are being met (e.g., bacteria objectives for REC-1 require fecal coliform concentration based on a geometric mean of 5 samples in a 30-day period)
- Sample for cyanobacteria at recreation areas and traditional collection areas for public safety
- Sample water quality at the mouth of tributaries to Clear Lake that support hitch runs

- Standardize analyte collection methods and result units
- Ensure all method detection limits (MDLs) are less than stated water quality objectives
- Investigate if there is a connection between groundwater and surface water quality
- QA/QC water quality datasets (some results are outside of the expected range)

These action items should be considered an initial step towards developing a comprehensive water quality monitoring program for Clear Lake. Clear Lake is California's largest freshwater lake. It is home to endemic, endangered species, culturally significant to Native Americans; and is a source of drinking water and recreation for residents of the communities surrounding Clear Lake. A coordinated water quality monitoring program should be developed for Clear Lake to protect this important resource in the context of potentially increasing impacts related to climate change.

Appendix A

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
2,4,5-T		2									2
2,4-D		2									2
2,4-DB		2									2
Acifluorfen		2									2
AFDM_Algae, Particulate									4		4
Air Temperature		1,149				334					1,483
Aldicarb							2				2
Aldrin							4				4
Alkalinity					913				4	101	1,018
Aluminum, Dissolved					208						208
Aluminum, Total					182						182
Ametryn							2				2
Aminocarb							2				2
Ammonia					2,951		17		39		3,007
Ammonia + Ammonium										6	6
Ammonia as NH3							1				1
Ammonium		16									16
AMPA (glyphosate metabolite)		2									2

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Anatoxin-A		4							35		39
Antimony, Dissolved							1				1
Antimony, Total							1				1
Arsenic, Dissolved					213		2				215
Arsenic, Total		3			285		2				290
Atraton							2				2
Atrazine							2				2
Azinphos Methyl							2				2
Barban							2				2
Barium, Dissolved					15						15
Barium, Total					18						18
Barometric pressure		258									258
Benomyl							2				2
Bentazon		2									2
Beryllium, Dissolved					25		1				26
Beryllium, Total							1				1
Bicarbonate										175	175
Biochemical Oxygen Demand		25									25
Bismuth, Dissolved					25						25
Bolstar							3				3
Boron, Dissolved					1,445						1,445
Boron, Total							2			167	169

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Bromacil							2				2
Cadmium, Dissolved					210		2				212
Cadmium, Total					212		2				214
Calcium					415					80	495
Calcium, Dissolved					1,102						1,102
Carbaryl							2				2
Carbofuran							2				2
Carbon dioxide										175	175
Carbonate (CO3)										175	175
Chlordane, cis-							4				4
Chlordane, trans-							4				4
Chloride										175	175
Chloride, Dissolved					997				4		1,001
Chlorophyll a				383					39		422
Chlorothalonil							1				1
Chloroxuron							2				2
Chlorpropham							2				2
Chlorpyrifos							3				3
Chromium, Dissolved					215		1				216
Chromium, Total					209		1				210
Clay, <0.0039 mm							1				1
Clopyralid		2									2
Cobalt, Dissolved					25						25

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Color							2				2
Conductance (EC)		1,964	321		3,908	121	54	20	39	185	6,612
Copper, Dissolved					231		5				236
Copper, Total		3	81		255		5				344
Cyanazine							2				2
Cylindrospermopsin		4							35		39
Dacthal							2				2
DDD(o,p')							4				4
DDD(p,p')							4				4
DDE(o,p')							4				4
DDE(p,p')							4				4
DDT(o,p')							4				4
DDT(p,p')							4				4
Demeton							3				3
Depth						174					174
Diazinon							3				3
Dicamba		2									2
Dichlorprop		2									2
Dichlorvos							3				3
Dicofol							3				3
Dieldrin							4				4
Dimethoate							2				2
Dinoseb		2									2
Discharge							51				51
Dissolved Organic Carbon									39		39

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Dissolved Oxygen (DO)		1,962	321		3,512	170	54	22	39	9	6,089
Dissolved Oxygen Saturation (%)		1,959							35		1,994
Disulfoton							3				3
Diuron							2				2
Endosulfan I							4				4
Endosulfan II							4				4
Endosulfan Sulfate							4				4
Endrin							4				4
Endrin Aldehyde							4				4
Endrin Ketone							4				4
Escherichia coli		2					43				45
Ethoprop							3				3
Fecal Coliform		102					3				105
Fenchlorphos							3				3
Fensulfothion							3				3
Fenthion							3				3
Fenuron							2				2
Field Notes					2,834						2,834
Fine, <0.075 mm	27										27
Fluometuron							2				2
Fluoride										27	27
Fluoride, Dissolved					41						41
Fluridone	44	2	334								380
Gage Height					94						94

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Gallium, Dissolved					25						25
Germanium, Dissolved					25						25
Glyphosate		2					1				3
Granule + Pebble, 2.0 to <64 mm							1				1
Gravel, 4.75 to <75 mm	27										27
Hardness, non-carbonate										172	172
HCH, alpha-							4				4
HCH, beta-							4				4
HCH, delta-							4				4
HCH, gamma-							4				4
Heptachlor							4				4
Heptachlor Epoxide							4				4
Hexachlorobenzene							1				1
Hydrogen ion										183	183
Iron, Dissolved					644						644
Iron, Total					596					19	615
Lead, Dissolved					223		2				225
Lead, Total		3			212		2				217
Linuron							2				2
Lyngbyatoxin-a									35		35
Magnesium, Dissolved					1,102						1,102

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Magnesium, Total					415					80	495
Malathion							3				3
Manganese, Dissolved					225						225
Manganese, Total					290						290
MCPA		2									2
Mecoprop		2									2
Mercury, Total	40	7			105						152
Merphos							2				2
Methamidophos							2				2
Methidathion							2				2
Methiocarb							2				2
Methomyl							2				2
Methoxychlor							4				4
Methylene Blue Active Substances (MBAS)					14						14
Metolachlor							1				1
Mevinphos							3				3
Mexacarbate							2				2
Microcystin LA		36							35		71
Microcystin LR		36							35		71
Microcystin RR		36							35		71
Microcystin YR		35							35		70
Mirex							3				3
Moisture	41										41

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Molinate							1				1
Molybdenum, Dissolved					25						25
Molybdenum, Total							6				6
Monuron							2				2
Neburon							2				2
Nickel, Dissolved					195		2				197
Nickel, Total					182		2				184
Nitrate		16			1,578				35	116	1,745
Nitrate	27	9					3				39
Nitrate + Nitrite					1,420		50		4	2	1,476
Nitrite		1			1		3		39		44
Nitrite		16									16
Nitrogen, mixed forms (NH3), (NH4), organic, (NO2) and (NO3)										2	2
Nonachlor, cis-							3				3
Nonachlor, trans-							3				3
Oil and Grease		3									3
Orthophosphate					2,838		18		39	2	2,897
Oryzalin							2				2
Oxamyl							2				2
Oxidation-Reduction Potential								16			16
Oxychlordane							3				3

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Oxyfluorfen							8				8
Paraquat							1				1
Parathion, Ethyl							2				2
Parathion, Methyl							3				3
Pendimethalin							1				1
Perthane							3				3
pH		1,960	321		4,316	170	54	22	39	183	7,065
Phorate							3				3
Phosmet							2				2
Phosphorus, Dissolved					1						1
Picloram		2									2
Potassium										77	77
Potassium, Dissolved					1,071						1,071
Prometon							2				2
Prometryn							2				2
Propachlor							2				2
Propargite							1				1
Propazine							2				2
Propham							2				2
Propoxur							2				2
Quinclorac		2									2
Resistivity		1,955									1,955
Salinity		1,300							4		1,304

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Sand, 0.0625 to <2.0 mm							1				1
Sand, 0.075 to <4.75 mm	27										27
Saxitoxins									35		35
Secbumeton							2				2
Secchi Disk Depth		1,616			235				35		1,886
Selenium, Dissolved					185		2				187
Selenium, Total					242		2				244
Siduron							2				2
Silica										37	37
Silica as SiO2, Dissolved									4		4
Silica, Dissolved					52						52
Silt, 0.0039 to <0.0625 mm							1				1
Silver, Dissolved					171		1				172
Silver, Total					176		1				177
Silvex		2									2
Simazine							2				2
Simetryn							2				2
Sodium										175	175
Sodium adsorption ratio										175	175
Sodium, Dissolved					1,263						1,263
Sodium, percent total cations										77	77

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Sulfate										35	35
Sulfate, Dissolved					870				4		874
Suspended Sediment Concentration, Particulate									4		4
Suspended Solids					25						25
Tebuthiuron							2				2
Terbuthylazine							2				2
Terbutryn							2				2
Tetrachlorvinphos							3				3
Thallium, Dissolved							1				1
Thallium, Total							1				1
Thiobencarb							1				1
Titanium, Dissolved					25						25
Tokuthion							3				3
Total Coliform		104					1				105
Total Dissolved Solids		1,962			619		9			91	2,681
Total Hardness			63		1,689		5		4	175	1,936
Total Kjeldahl Nitrogen	27	19			1,219		15		2	1	1,283
Total Nitrogen	20								2		22
Total Organic Carbon	27						41				68
Total Organic Nitrogen					1,287					1	1,288

Analyte	Aquatic Pesticide Monitoring Program	Big Valley Rancheria	CDFA	DWR CL chlorophyll-a	DWR	Elem Indian Colony	Sacramento Valley Water Quality Coalition	Sulfur Bank Mercury Mine	SWAMP	USGS	Total
Total Phosphorus		35			2,674		53		4	3	2,769
Total Solids	41										41
Total Suspended Solids					383		42		2		427
Toxaphene							3				3
Trichloronate							3				3
Triclopyr		2									2
Trifluralin							1				1
Turbidity		1,359	321		1,418	169	42	22	4		3,335
Vanadium, Dissolved					25						25
Velocity									4		4
Volatile Suspended Solids					24						24
Water Temperature		1,964	321		3,528	170	54	22	39	9	6,107
Weather comments						180					180
Zinc, Dissolved					223		2				225
Zinc, Total		3			261		2				266
Total	**348**	**19,962**	**2,083**	**383**	**52,637**	**1,488**	**943**	**124**	**790**	**2,890**	**81,648**