FINAL DRAFT

LOS OSOS BASIN PLAN
GROUNDWATER MONITORING PROGRAM
2018 ANNUAL MONITORING REPORT

Prepared for the

BASIN MANAGEMENT COMMITTEE

JUNE 2019

CLEATH-HARRIS GEOLOGISTS
71 Zaca Lane, Suite 140
San Luis Obispo, California 93401

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

EXECUTIVE SUMMARY

The 2018 Annual Report (Annual Report) describes The Los Osos Area Subbasin of the Los Osos Valley Groundwater Basin (Department of Water Resources (DWR) Basin No. 3-08) (Basin) activities related to the Los Osos Basin Plan (LOBP) Groundwater Monitoring Program, and provides results and interpretation of these activities in calendar year 2018. The LOBP Groundwater Monitoring Program is necessary to accomplish the following continuing goals set forth in Section 2.4 of the LOBP (ISJ Group, 2015):

1. Provide for a continuously updated hydrologic assessment of the Basin, its water resources and sustainable yield.

2. Create a water resource accounting which is able to meet the information needs for planning, monitoring, trading, environmental management, utility operations, land development and agricultural operations.

The LOBP Groundwater Monitoring Program is also necessary to support other goals of the LOBP, including prevention of seawater intrusion, establishing a long-term environmentally and economically sustainable and beneficial use of the Basin, and the equitable allocation of costs associated with Basin management.

Groundwater Production

Groundwater production for calendar year 2018 is summarized in Table ES-1 below. Purveyor production has decreased by 3 percent compared to 2017, while total Basin production has decreased by 2 percent compared to 2017.

Table ES-1. Groundwater Production for Calendar Year 2018

Description	Production in Acre-Feet
Los Osos Community Services District	522
Golden State Water Company	464
S&T Mutual Water Company	32
Purveyor Subtotal	**1,018**
Domestic wells	220
Community facilities	120
Agricultural wells	670
Total Estimated Production[1]	**2,030**

[1] Rounded to the nearest 10 acre-feet

<u>Basin Status</u>

The status of the Basin in terms of key parameters and metrics are as follows:

> **Precipitation**. The Basin received below normal rainfall in 2018. The drought condition for San Luis Obispo County ranged from abnormally dry (the lowest drought intensity) to severe drought during 2018 (NDMC/USDA/NOAA, 2018).
>
> **Seawater intrusion front movement**. The seawater intrusion front retreated toward the coast between Fall 2017 and Fall 2018 (an improvement).
>
> **Basin Yield Metric**. The Basin Yield Metric decreased between 2017 and 2018 (an improvement) and has met the LOBP goal for three consecutive years.
>
> **Water Level Metric**. The Water Level Metric increased between Spring 2017 and Spring 2018 (an improvement) but has not reached the target value.
>
> **Chloride Metric**. The Chloride Metric decreased between Fall 2017 and Fall 2018 (an improvement) but has not reached the target value.
>
> **Nitrate Metric**. The Nitrate Metric decreased between Winter 2017 and Winter 2018 (an improvement) but has not reached the target value.
>
> **Upper Aquifer Water Level Profile**. Water levels in the Upper Aquifer remain safely above the Protective Elevation, except for near well UA3. There is no evidence of seawater intrusion at UA3, based on chloride concentrations.

Recommendations for improving the quality and availability of data are contained in Chapter 9 of the Annual Report. The recommendations include developing a rating curve for the stream gage on Los Osos Creek, re-evaluating the Water Level Metric target, and monitoring FW5 for CECs.

<u>LOBP Metrics</u>

As described in Section 7 ("Data Interpretation") of this Annual Report, the LOBP established several metrics to measure nitrate impacts to the Upper Aquifer, seawater intrusion into the Lower Aquifer, and the effect of management efforts of the Basin Management Committee (BMC). These metrics allow the BMC, regulatory agencies, and the public to evaluate the status of nitrate levels and seawater intrusion, and the impact of implementation of the LOBP programs in the Basin through objective, numerical criteria that can be tracked over time. The status of key Basin metrics is summarized in Table ES-2.

Table ES-2. LOBP Metric Summary			
Metric	**LOBP Goal**	**Calculated Value from 2018 Data**	**Recommended Actions in Addition to LOBP Programs**
Basin Yield Metric	80 or less	74	Implement additional conservation measures to reduce indoor and outdoor demands (See Section 10.3.2)
Water Level Metric	8 feet above mean sea level or higher	2.0 feet above mean sea level	Implement additional conservation measures to reduce indoor and outdoor demands (See Section 10.3.2)
Chloride Metric	100 mg/L or lower	145 mg/L	Implement additional conservation measures to reduce indoor and outdoor demands (See Section 10.3.2)
Nitrate Metric	10 mg/L or lower	24 mg/L (NO_3-N)	None recommended

Adaptive Management Program

In addition to the programs described in the LOBP, the following additional measures are recommended in the context of adaptive management. Details regarding each program are provided in Section 10 of this Annual Report:

Potential Adaptation of Urban Water Use Efficiency Program. The BMC plans to evaluate the status and the effectiveness of the program throughout the year. The County has implemented a new series of rebates as described in Chapter 10.

Development of Contingency Plan. The BMC plans to develop a contingency plan and related actions in the event Basin Metric trends fail to demonstrate progress toward LOBP goals, including defined schedules and milestones.

Discussion and Development of Metrics for Future Growth. The BMC plans to provide input into the Los Osos Community Plan, including consideration of Basin Metrics and defined goals as they relate to the timing of future growth.

Additional Water Quality Metrics. The BMC intends to consider developing additional metrics and/or numerical goals as appropriate to protect the upper aquifer from water quality threats, such as seawater intrusion and chromium-6 contamination. An Upper Aquifer Water Level Profile was introduced in 2017, as described in Section 7.5 of this Annual Report.

LOBP Infrastructure Programs

The status of LOBP infrastructure programs is summarized Table ES- 3.

Table ES-3. Basin Infrastructure Projects				
Project Name	**Parties Involved**	**Funding Status**	**Capital Cost**	**Status**
Program A				
Water Systems Interconnection	LOCSD/ GSWC	Fully Funded	LOCSD/GSWC $103,550	Completed
Upper Aquifer Well (8th Street)	LOCSD	Fully Funded	$250,000	Well was drilled and cased in December 2016. Budget remaining $250,000 to equip the well. Design is 100% complete and District is pursuing IRWM matching funds. If available, it is hoped that matching funds will be available by Q2 of 2019. Completion of construction is expected by December 2019.
South Bay Well Nitrate Removal	LOCSD			Completed
Palisades Well Modifications	LOCSD			Completed
Blending Project (Skyline Well)	GSWC	Fully Funded	$1.15 mil	Completed
Water Meters	S&T			Completed
Program B				
LOCSD Wells	LOCSD	Not Funded	BMP: $2.7 mil	Project not initiated
GSWC Wells	GSWC	Not Funded	BMP: $3.2 mil	Project not initiated
Community Nitrate Removal Facility	LOCSD/GSWC	GSWC Portion Funded	GSWC: $1.23 mil	GSWC's portion completed

Project Name	Parties Involved	Funding Status	Capital Cost	Status
Program C				
Expansion Well No. 1 (Los Olivos)	GSWC	Fully Funded	$1.76 mil	Completed
Expansion Well No. 2	LOCSD is currently leading the project with potential GSWC and S&T involvement, depending on final location	LOCSD is currently leading the project with respect to funding	BMP: $2.0 mil	Property acquisition phase is on-going through efforts of LOCSD. Four sites are currently being reviewed and a community workshop was held on 8/30/2018. Due to community concerns over siting, environmental review and permitting is expected to be on going through Q1 of 2020, with construction complete by Q1 of 2021. The LOCSD authorized the preparation of bid documents for a test well at Site A (Los Osos Middle School) at their 11/1/18 meeting. Draft documents have been prepared, and staff is working on drilling details with the School District prior to going out to bid. The test hole is expected to be completed in Q2 of 2019.
Expansion Well 3 and LOVR Water Main Upgrade	GSWC/LOCSD	Cooperative Funding	BMP: $1.6 mil	This project has been deferred under Adaptive Management.
LOVR Water Main Upgrade	GSWC	May be deferred	BMP: $1.53 mil	Project may not be required, depending on the pumping capacity of the drilled Program C wells. It may be deferred to Program D.
S&T/GSWC Interconnection	S&T/ GSWC	Pending	BMP: $30,000	In conceptual design

Project Name	Parties Involved	Funding Status	Capital Cost	Status
Program M				
New Zone C/D/E Lower Aquifer monitoring well in Cuesta by the Sea	All Parties	Funded through BMC Budget	$115,000	A wetlands delineation was completed in July 2018. A Minor Use Permit was approved on February 1, 2019. The project has been submitted to SLO County Public Works for an encroachment permit with bidding to follow. Construction is expected in Q3 of 2019. The project implementation cost has been included in the 2019 budget for consideration under item 7c.
Program U				
Creek Discharge Program	All Parties	Funded through BMC Budget/grants	$582,000 through feasibility phase	The 2019 draft budget includes funding for limited baseline monitoring and Soil Aquifer Treatment evaluation in the amount of $50,000.

1. INTRODUCTION

The Los Osos Area Subbasin of the Los Osos Valley Groundwater Basin (Department of Water Resources (DWR) Basin No. 3-08) (Basin) was adjudicated in October 2015 (*Los Osos Community Services District v. Southern California Water Company [Golden State Water Company] et al.* (San Luis Obispo County Superior Court Case No. CV 040126) and is managed by the Los Osos Groundwater Basin Management Committee (BMC), consisting of representatives from Los Osos Community Services District (LOCSD), Golden State Water Company (GSWC), S&T Mutual Water Company (S&T), and the County of San Luis Obispo (County). This is the fourth Annual Report for the Basin.

The 2018 Annual Report (Annual Report) describes Basin activities related to the Los Osos Basin Plan (LOBP) Groundwater Monitoring Program and provides results and interpretation of these activities. The LOBP Groundwater Monitoring Program is necessary to accomplish the following continuing goals set forth in Section 2.4 of the LOBP (ISJ Group, 2015):

1. Provide for a continuously updated hydrologic assessment of the Basin, its water resources and sustainable yield.

2. Create a water resource accounting which is able to meet the information needs for planning, monitoring, trading, environmental management, utility operations, land development and agricultural operations.

The LOBP Groundwater Monitoring Program is also necessary to support other LOBP goals, including prevention of seawater intrusion, establishing a long-term environmentally and economically sustainable and beneficial use of the Basin, and the equitable allocation of costs associated with Basin management (ISJ Group, 2015). The program will provide significant overlap with several regulatory requirements, including:

- The Sustainable Groundwater Management Act (SGMA)

- California Statewide Groundwater Elevation Monitoring (CASGEM) Program

- State Water Resource Control Board's (SWRCB) salt and nutrient monitoring guidelines as adopted in the state Recycled Water Policy. The County Board of Supervisors adopted the Salt and Nutrient Management Plan (SNMP) for the Los Osos Groundwater Basin on January 23, 2018. The SNMP is currently being reviewed by the Regional Water Control Board.

- Recycled Water Management Plan requirements for the Los Osos Water Recycling Facility (LOWRF)

This report was prepared by Cleath-Harris Geologists (CHG). Wallace Group contributed to the Executive Summary and produced Chapter 10 (Adaptive Management).

2. BACKGROUND

In August 2008, the Superior Court of the State of California for the County of San Luis Obispo (Court) approved an Interlocutory Stipulated Judgment (ISJ) between LOCSD, GSWC, S&T, and the County. Under the ISJ, these Parties formed a working group, undertaking technical studies and management discussions that produced the LOBP in January 2015. The LOBP presents a comprehensive groundwater management strategy and serves as the cornerstone of a physical solution to address the significant problems facing the Basin, including seawater intrusion and elevated nitrate concentrations, and for restoration of Basin water resources, while respecting existing water rights. The LOBP Groundwater Monitoring Program is a key component of the LOBP, providing water level and water quality data that serve as measures of effectiveness for LOBP programs and activities with respect to the restoration of Basin water resources. A Stipulated Judgment was approved by the Court on October 14, 2015 and covers the area shown in Figure 1.

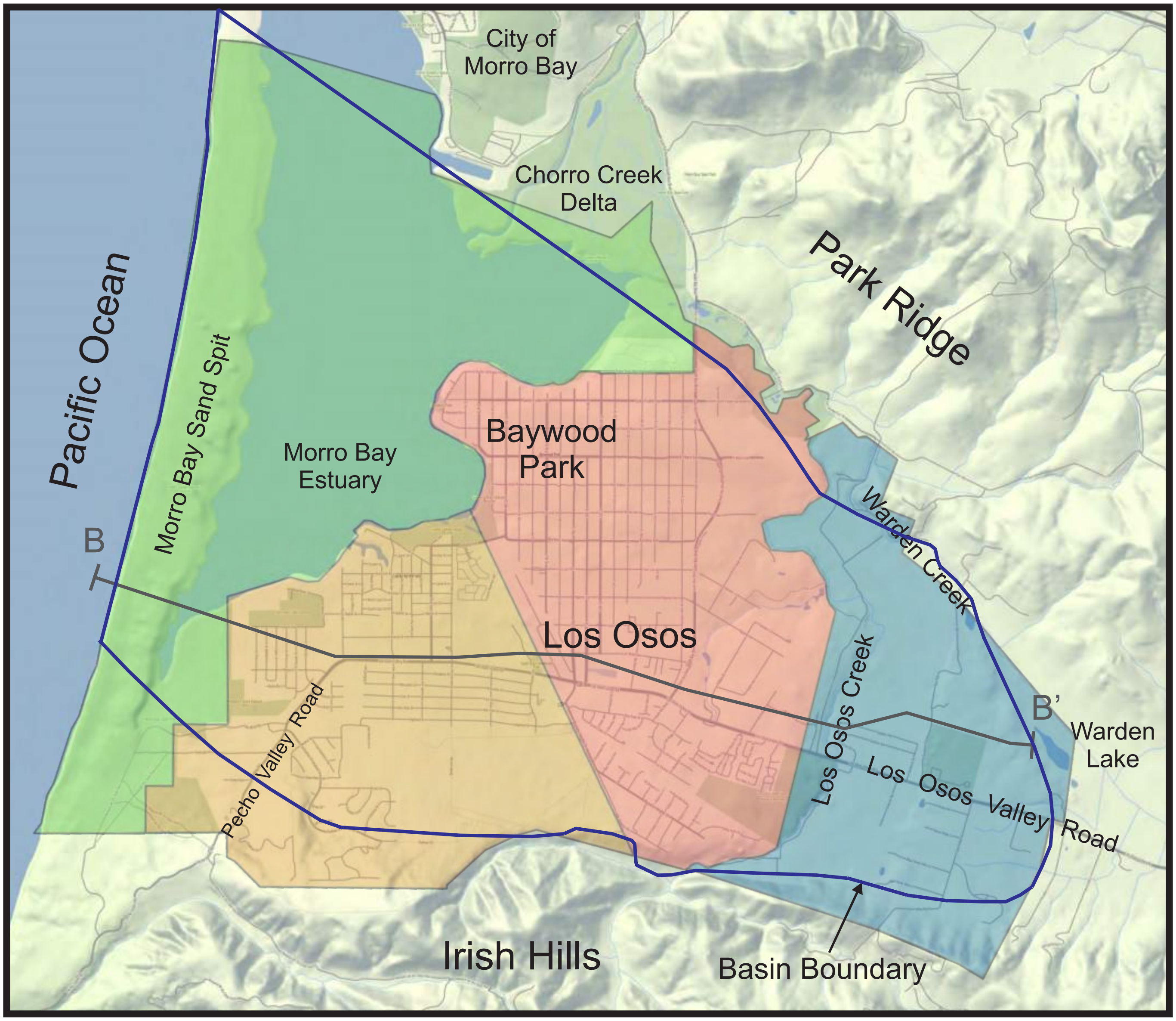
SGMA took effect on January 1, 2015 and requires that certain actions be taken in groundwater basins designated as either high or medium priority by DWR, including the Basin. DWR identified the Basin as a high priority basin subject to critical conditions of overdraft due to seawater intrusion and nitrate impairment (DWR, 2014, 2016, 2018a). The majority of SGMA requirements, including formation of a Groundwater Sustainability Agency (GSA) and development and implementation of a Groundwater Sustainability Plan, do not apply to the LOBP plan areas covered by the Stipulated Judgment, since this portion of the Basin is adjudicated. In order to comply with SGMA, the County formed a GSA to cover Basin areas between the Bulletin 118 Basin boundaries and the LOBP area boundary (see Section 2.2.4 for further details).

2.1 Groundwater Monitoring History

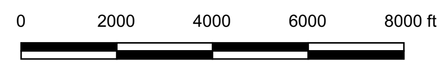
Groundwater monitoring has been performed by public agencies, water purveyors, and consultants for various Basin studies and programs over several decades. A list of historical investigations, monitoring reports, and monitoring programs with a major focus on Basin water levels and water quality through 2018 is included in Appendix A.

2.2 LOBP Groundwater Monitoring Program Design

The purpose of the LOBP Groundwater Monitoring Program is to collect and organize groundwater data on a regular basis for use in management of the Basin. Design of the LOBP Groundwater Monitoring Program is detailed in Chapter 7 of the LOBP. The basic elements of the program are as follows:



Base Image: Stamen-Terrain



Scale: 1 inch ≈ 4,000 feet

Explanation

Basin Plan Areas:

- Dunes and Bay Area
- Western Area
- Central Area
- Eastern Area

B — B' Cross-section alignment (Figures 5 and 19). Labeled B-B' to be consistent with Basin Plan.

Basin Boundary from Basin Plan

Figure 1
Basin Location and Plan Areas
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

- Monitor long-term groundwater level trends in a network of wells for three monitoring groups within the Basin: First Water (FW), Upper Aquifer (UA), and Lower Aquifer (LA).

- Monitor seasonal fluctuations and long-term water quality trends at selected wells in each of the three monitoring groups.

- Compare hydrologic data pertinent to Basin management, including groundwater production from the two principal water supply aquifers (Upper Aquifer and Lower Aquifer), wastewater disposal and recycled water use, local precipitation data and County stream gage records for Los Osos Creek.

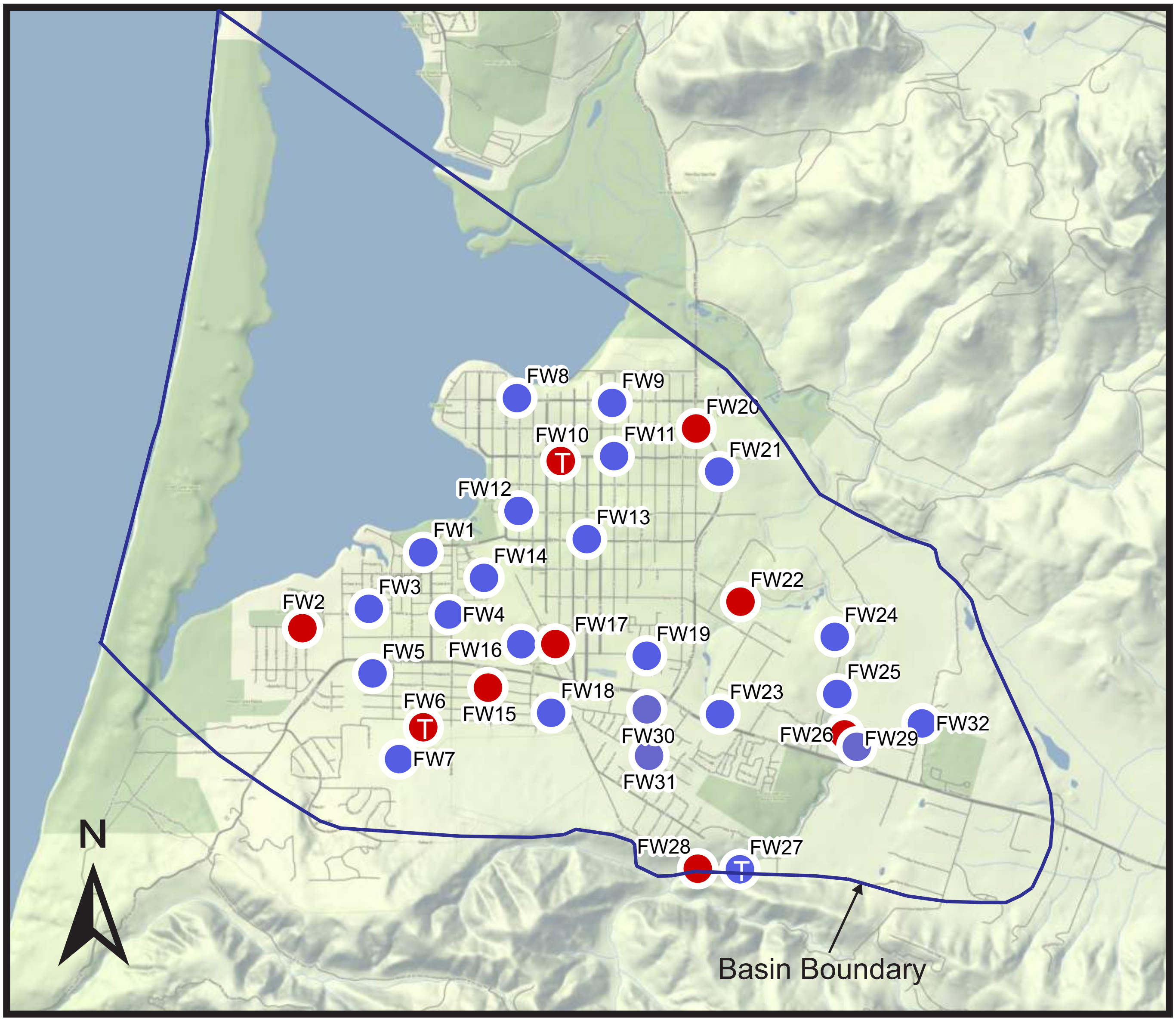
- Collect data sufficient to evaluate the effectiveness of Basin management strategies adopted in the LOBP via established metrics.

There were a total of 88 wells in the LOBP Groundwater Monitoring Program in 2017, including 38 BMC member agency monitoring wells, 17 municipal wells (active and inactive) and 33 private wells (CHG, 2017a). No new wells were added to the program in 2018. Private well participation in the monitoring program during 2018 was 76 percent (25 out of 33 wells).

Existing groundwater monitoring wells were chosen for their specific characteristics and to achieve, to the degree possible, horizontal and vertical coverage throughout the Basin. The LOBP Groundwater Monitoring Program coverage within the Basin is shown in Figures 2, 3, and 4. Correlation between LOBP Groundwater Monitoring Program well numbers and state well numbers, along with well construction information and monitoring tasks are included in Appendix B. Construction of Upper Aquifer and Lower Aquifer monitoring wells near the bay was recommended in the LOBP and approved in 2017 (budgeted for 2019). The nested monitoring well planned on Lupine Street will monitor Lower Aquifer Zone D and Zone E. Zone C monitoring would take place at an existing private well, pending an access agreement (in progress).

2.2.1 Water Level Monitoring

Water level monitoring is a fundamental tool in characterizing Basin hydrology and is performed at LOBP Groundwater Monitoring Program locations. Groundwater elevations in wells are measures of hydraulic head in an aquifer. Groundwater moves in the direction of decreasing head, and groundwater elevation contours can be used to show the general direction and hydraulic gradient associated with groundwater movement. Changes in the amount of groundwater in storage within an aquifer can also be estimated based on changes in hydraulic head, along with other parameters. Seven of the monitoring network wells have been equipped with transducers to provide an efficient and high level of resolution for tracking dynamic changes in Basin groundwater levels (see Section 7.2).



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

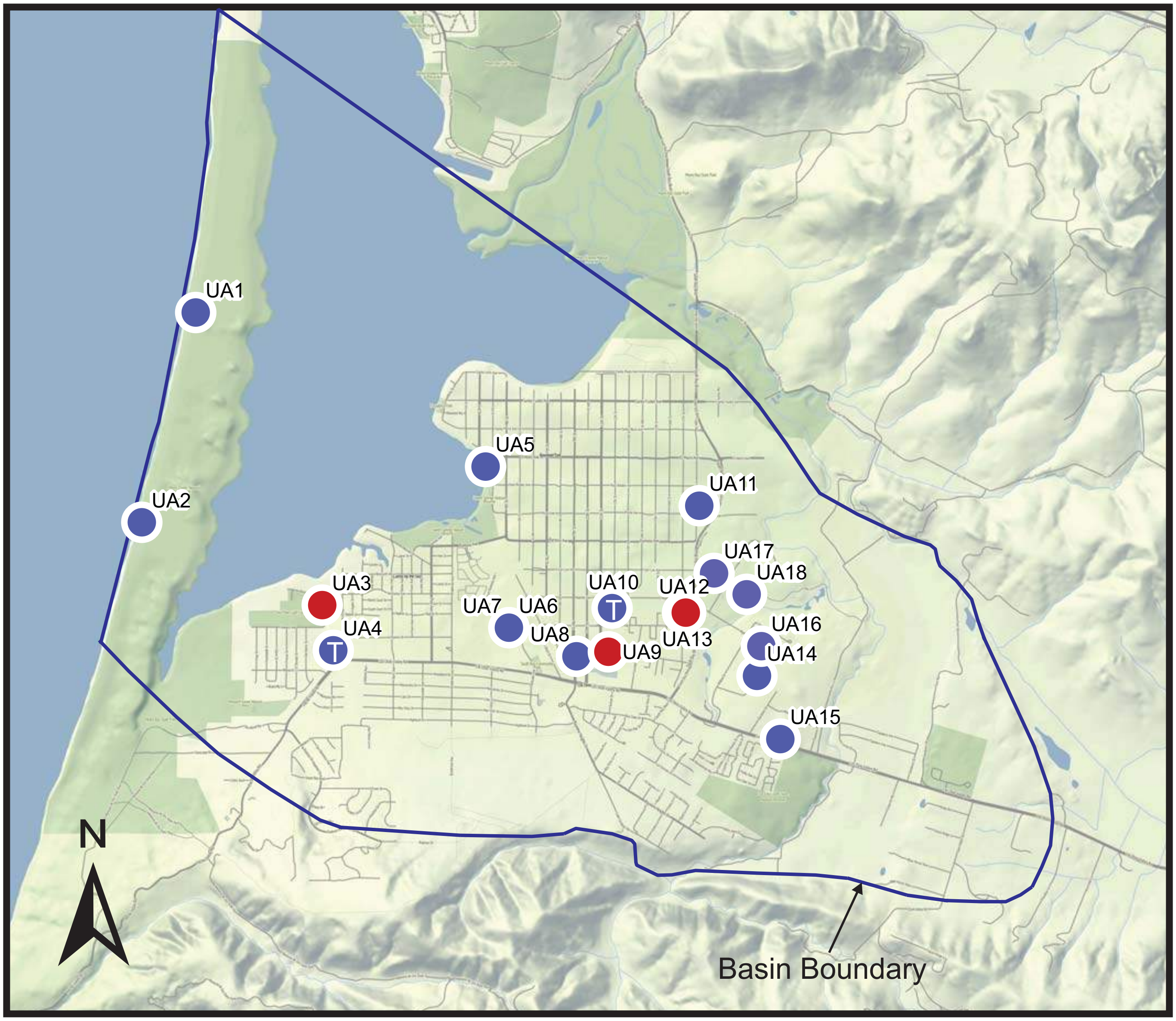
Explanation

- LOBP Water Level Monitoring Well
- Water Level Monitoring Well Addition (existing well)
- Water Level Transducer
- Water Level and Water Quality Monitoring Well
- Water Level Transducer and Water Quality Monitoring Well

Note: First Water wells refers to wells screened within the first 50 feet of saturated sediments across the basin, regardless of the aquifer.

Figure 2
Groundwater Monitoring Program
First Water Wells
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

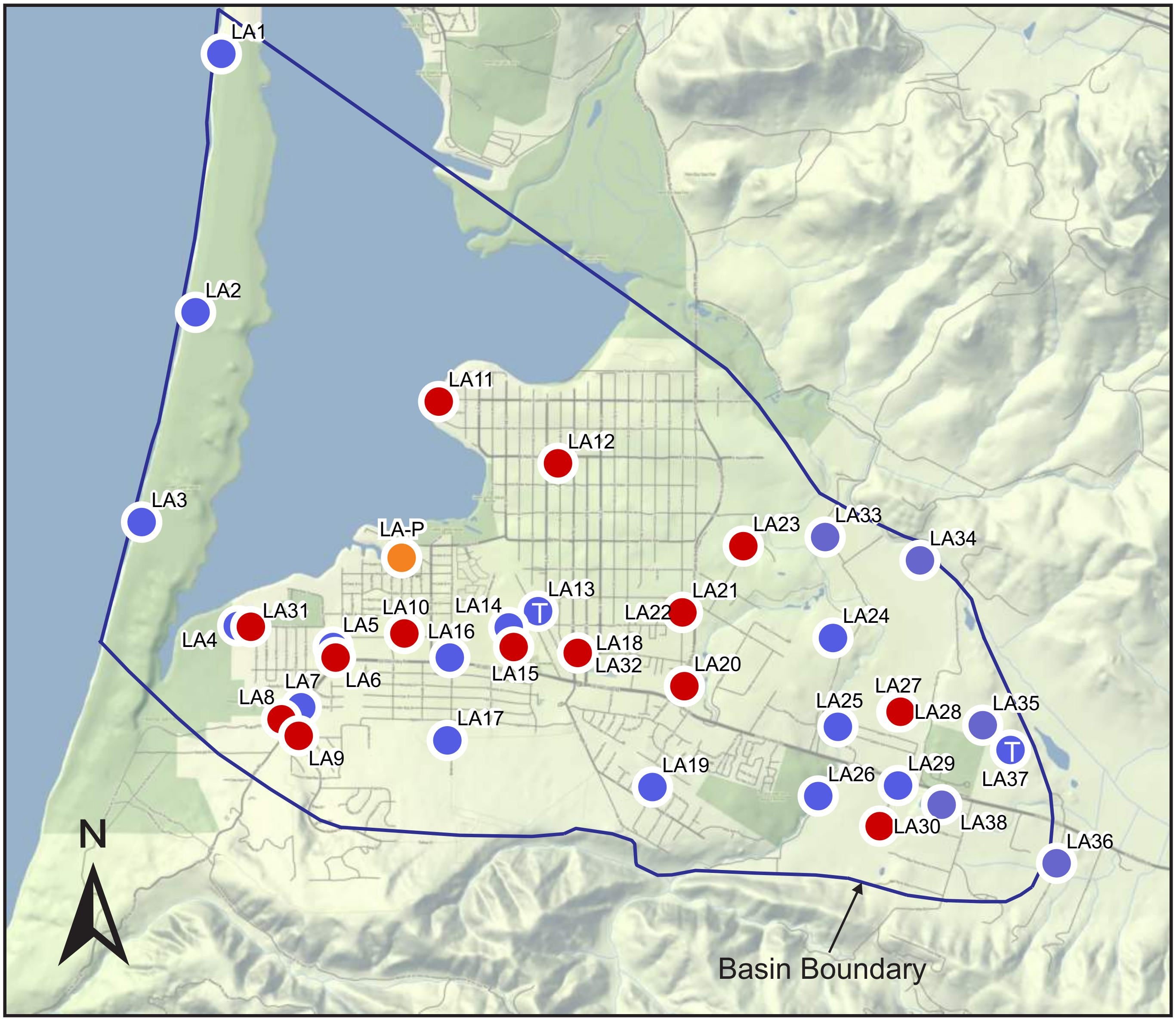
Scale: 1 inch ≈ 4,000 feet

Explanation

- LOBP Water Level Monitoring Well
- Water Level Monitoring Well Addition (existing well)
- Water Level Transducer
- Water Level and Water Quality Monitoring Well
- Water Level Transducer and Water Quality Monitoring Well

Figure 3
Groundwater Monitoring Program
Upper Aquifer Wells
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

Explanation

- LOBP Water Level Monitoring Well
- Water Level Monitoring Well Addition (existing well)
- Water Level Transducer
- Water Level and Water Quality Monitoring Well
- Water Level Transducer and Water Quality Monitoring Well
- Planned New Monitoring Well Construction

Note: LA24 and FW24 are nested wells (same borehole)

LA18 and LA32 at same site (two symbols used in 2016 Annual Report figure to indicate LA32 was a program addition).

Figure 4
Groundwater Monitoring Program
Lower Aquifer Wells
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

Of the 88 wells currently in the LOBP Groundwater Monitoring Program, 32 are representative of First Water, 18 are representative of the Upper Aquifer, and 38 wells are representative of the Lower Aquifer. Spatially, 5 water level monitoring wells are located in the Dunes and Bay Area, 25 wells are located in the Western Area, 38 wells are located in the Central Area, and 20 wells are located in the Eastern Area.

First Water

The First Water group refers to wells screened within the first 50 feet of saturated sediments across the Basin, regardless of the aquifer (Figure 5). First Water is the interface where percolating waters, including precipitation and return flows from irrigation and wastewater, mix with Basin waters. This 50-foot thick interface occurs within unconfined sediments and generally rises and falls seasonally with water level fluctuations. Where First Water is close to ground surface, it also impacts drainage and is associated with flooding issues in low-lying areas. First Water extends across the Basin, and may be present in dune sands, Paso Robles Formation deposits, or Los Osos Creek alluvium (Figure 5). Selected First Water wells, including those in downtown Los Osos are used to represent the perched aquifer (Zones A and B) and Alluvial Aquifer for water level contouring.

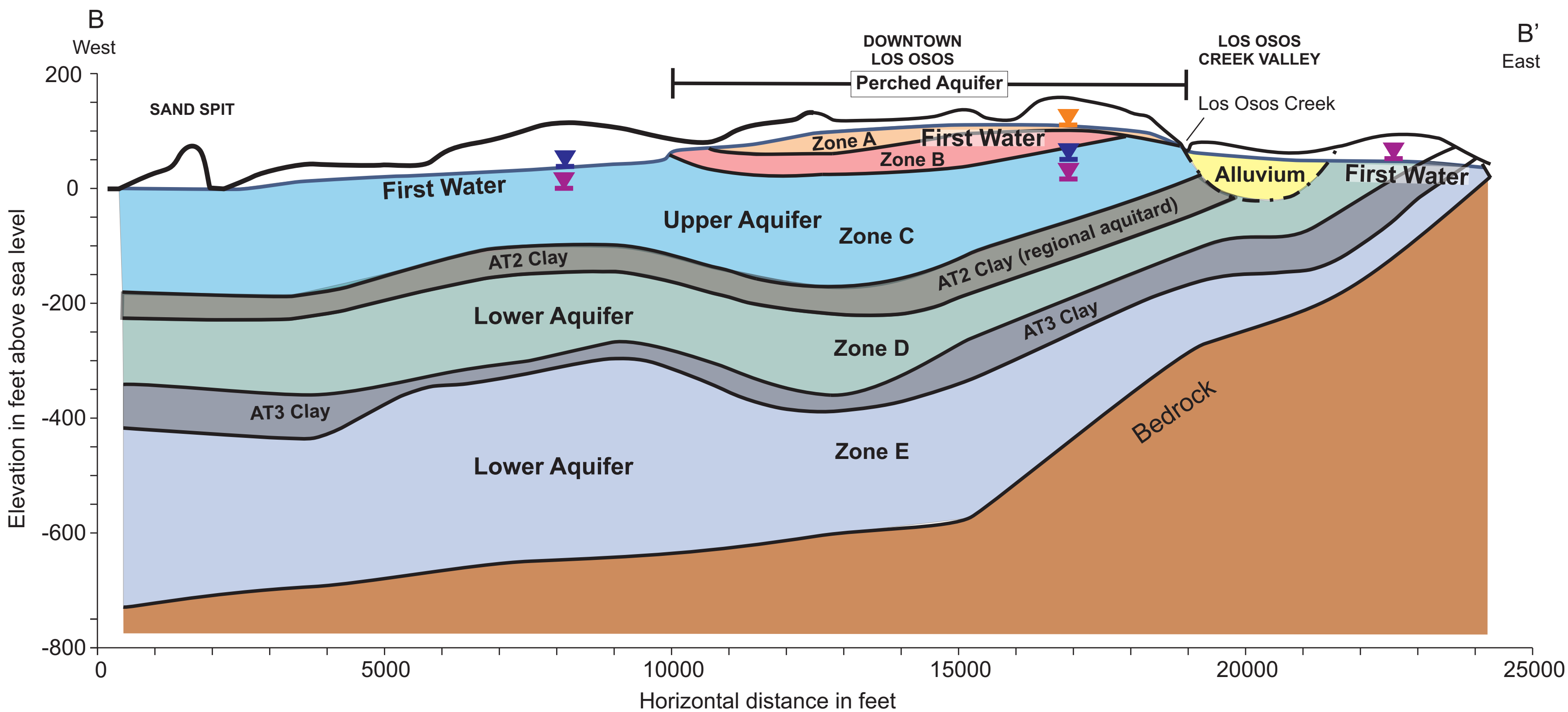
Upper Aquifer

The Upper Aquifer (Zone C) refers to the non-perched aquifer above the regional aquitard (Figure 5). As noted above, a portion of the Upper Aquifer may also be considered First Water in certain Basin areas. Historically, the Upper Aquifer was developed as the main water supply for the community and is still the main source of water for rural residential parcels. A significant increase in Upper Aquifer production is planned under infrastructure Program B. Monitoring the Upper Aquifer in the urban area (properties contained within the Urban Reserve Line as shown in Figure 10 of the LOBP) is important to both local purveyors and rural residential parcels.

Lower Aquifer

The Lower Aquifer refers to water bearing sediments below the regional aquitard. There are both Paso Robles Formation and Careaga Formation deposits in the Lower Aquifer. The base of the Lower Aquifer is claystone and sandstone bedrock, although the effective base of fresh water lies above bedrock at the western edge of the Basin. There are two generalized aquifer zones within the Lower Aquifer. Zone D lies between the regional aquitard (AT2 clay) and a deeper aquitard (AT3 clay). Zone E is below the AT3 clay (Figure 5).

Lower Aquifer Zone D is currently the main water supply source for the community. The seawater intrusion front has been advancing inland at increasing rates over time, and a significant reduction in Lower Aquifer production, together with other LOBP programs, is necessary to halt, slow and/or reverse intrusion.



Cross-section alignment shown in Figure 1

Explanation

Perched Aquifer Water level

Upper Aquifer Water level

Lower Aquifer Water level

Figure 5
Basin Aquifers
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

2.2.2 Groundwater Quality Monitoring

Groundwater quality monitoring refers to the periodic collection and chemical or physical analysis of groundwater from wells. The analytical requirements are highly variable, depending on the purpose of monitoring. General minerals and nitrate are common water quality constituents of analysis for groundwater basin investigations. There are many other classes of water quality constituents of concern, however, such as volatile organic compounds, inorganic compounds (metals), petroleum hydrocarbons or emerging contaminants. Hexavalent Chromium has also been a concern in several shallow wells as described in the 2015 Annual Groundwater Monitoring Report (CHG, 2015). Many water quality constituents are regulated and have drinking water standards.

Monitoring Constituents

Constituents of analysis for the LOBP Groundwater Monitoring Program have been selected to evaluate salt loading and associated nitrate impacts, seawater intrusion, and wastewater disposal. Table 1 lists the general mineral constituents, including nitrate, which will be monitored as part of the program, although additional constituents are quantified in the general minerals suite performed by the analytical laboratory (See Appendix C). Total Dissolved Solids (TDS) and specific conductance are standard measures for groundwater mineralization and salinity. Temperature and pH are parameters that are routinely measured during sampling to confirm that the groundwater samples represent the aquifer. Table 1 presents constituents to be tested in the wells designated for water quality monitoring, which are distributed laterally and vertically across the Basin (Figures 2, 3 and 4).

The Lower Aquifer (via Well LA4 and Well LA14) will also be monitored using down hole geophysics once every three years (natural gamma and induction logs) to provide a unique measure of seawater intrusion over time in one location within the Basin. Vertical movement of the freshwater-seawater interface has historically averaged 2-3 feet per year between 1985 and 2015 (CHG, 2015). The practical resolution of the methodology for measuring vertical interface movement is close to 5 feet, so a three-year monitoring frequency provides sufficient time to identify movement, based on the historical data. LA4 is located near the Sea Pines Golf Course in the Western Area, and LA14 is located at the north end of Palisades Avenue. Seawater is highly conductive, compared to fresh water, and an induction log performed in a borehole penetrating the fresh water/seawater interface shows the vertical transition from fresh water to seawater. Induction logging was performed in Fall of 2018 and the results are presented in Section 4.3 and Appendix D.

Table 1. Water Quality Monitoring Constituents[1]		
Constituent	**Reporting Limit**	**Units**
Specific Conductance	1.0	µS/cm
pH (field)	0.01	pH units
Temperature (field)	0.1	°F
TDS	20	mg/L
Carbonate Alkalinity	10	mg/L
Bicarbonate Alkalinity	10	mg/L
Total Alkalinity as $CaCO_3$	10	mg/L
Chloride	1.0	mg/L
Nitrate - Nitrogen	0.1	mg/L
Sulfate	2.0	mg/L
Boron	0.1	mg/L
Calcium	1.0	mg/L
Magnesium	1.0	mg/L
Potassium	1.0	mg/L
Sodium	1.0	mg/L

[1]From LOBP (ISJ Group, 2015)

Constituents of Emerging Concern

Monitoring Constituents of Emerging Concern (CECs) is a requirement of salt and nutrient management plans adopted pursuant to the SWRCB Recycled Water Policy (SWRCB, 2009). Such monitoring can measure potential dilution and soil-aquifer treatment of recycled water constituents, and travel time and movement of recycled water. As part of LOWRF operation, the County is also required by the Regional Water Quality Control Board Monitoring and Reporting Program (MRP) Order No. R3-2011-0001 to monitor recycled water for CECs on an annual basis.

The initial CECs to be monitored are listed in Table 2, and were selected based on the SWRCB Recycled Water Policy. There are three types of CECs, each of which has a different function. Health-based indicators directly monitor the presence of classes of constituents in groundwater, while performance-based and surrogate indicators measure the effectiveness of the wastewater treatment process. The list of CECs is not intended to be comprehensive, but meant to be representative. CECs may be added to (or removed from) the monitoring list once data has been collected and analyzed, subject to approval by the BMC.

Table 2. CEC Monitoring Constituents[1]			
Constituent or Parameter	**Type of Constituent**	**Type of Indicator**	**Reporting Limit (μg/L)**
17β-estradiol	Steroid Hormones	Health	0.001
Triclosan	Antimicrobial		0.050
Caffeine	Stimulant		0.050
NDMA (Nitroso-dimethylamine)	Disinfection Byproduct		0.002
Gemfibrozil	Pharmaceutical Residue	Performance	0.010
DEET (Diethyl-meta-toluamide)	Personal Care Product		0.050
Iopromide	Pharmaceutical Residue		0.050
Sucralose	Food additive		0.100
Ammonia	N/A	Surrogate	N/A
Nitrate-Nitrogen	N/A		N/A
Total Organic Carbon	N/A		N/A
UV Light Absorption	N/A		N/A
Specific Conductance	N/A		N/A

[1]From LOBP (ISJ Group, 2015)

2.2.3 Monitoring Frequency

Monitoring frequency is the time interval between data collection. Seasonal fluctuations relating to groundwater levels or quality are typically on quarterly or semi-annual cycles, correlating with seasonal precipitation, recharge, water levels, and often well production. The monitoring schedule for groundwater levels collected under the LOBP Groundwater Monitoring Program will coincide with seasonal water level fluctuations, with higher levels (i.e. elevations) in April (Spring) and lower levels in October (Fall). Spring water levels collected under the LOWRF Baseline Groundwater Monitoring Program (First Water and Upper Aquifer groups) may extend beyond April into June and Fall water levels may extend beyond October into December. A semi-annual monitoring frequency provides a measure of these seasonal cycles, which can then be distinguishable from the long-term trends. At the transducer-monitored locations, water level measurements will be recorded automatically on a daily basis and downloaded during the regular semi-annual water level monitoring events.

The monitoring frequency for water quality sampling and analyses performed under the LOBP Groundwater Monitoring Program will generally be once per year in October (Fall), when groundwater levels (i.e. elevations) are seasonally low and many water quality constituents have historically been at a higher concentration than their corresponding Spring measurement. Lower Aquifer groundwater monitoring will also be performed in April (Spring) as a means of tracking seawater intrusion in greater detail. The schedule for water quality testing performed under the LOWRF Groundwater Monitoring Program (First Water and Upper Aquifer) is in June and December.

2.2.4 SGMA Activities

SGMA took effect on January 1, 2015 and requires that certain actions be taken in groundwater basins designated as either high or medium priority by the DWR, including the Basin. DWR identified the Basin as a high priority basin subject to critical conditions of overdraft due to seawater intrusion and nitrate impairment (DWR, 2014, 2016, 2018a). SGMA does not apply to the LOBP plan areas covered by the Stipulated Judgment, which are shown in Figure 1.

In order to comply with SGMA, the County formed the GSA to cover Basin areas between the Bulletin 118 Basin boundaries (Basin 3-8) and the LOBP area boundary, which were designated as "fringe areas". A Basin Boundary Modification Request (BBMR) was initiated in 2018 (DWR, 2018b). In January 2019, DWR published the final decisions for all basin boundary modifications. The Los Osos BBMR included scientific external and jurisdictional subdivision modifications intended to improve the community's ability to sustainably manage the Basin. The proposed boundary modifications would better align DWR's Bulletin 118 Basin boundary with current scientific data as well as existing management boundaries in the Basin. Specifically, the boundary modification separates the Basin into two subbbasins, the Los Osos Area Subbasin and the Warden Creek Subbasin.

In Spring 2019, DWR is scheduled to publish the final basin boundary modifications to update Bulletin 118 and reassess groundwater basin prioritizations. Modifications approved by the DWR in February 2019 include dividing the Los Osos Valley Groundwater Basin into the Los Osos Area Subbasin (DWR Basin 3-8.01) and the Warden Creek Subbasin (DWR 3-8.02). The Los Osos Area Subbasin is within the adjudicated Basin plan area (DWR, 2018a). Prioritization of the new Subbasins will be reassessed by DWR in Spring/Summer 2019.

2.2.5 Additional Basin Studies

Several additional Basin studies were authorized or completed in 2018, including:

- The Los Osos Valley Groundwater Basin Fringe Areas Characterization Study (Fringe Area Study) was completed in March 2018 (CHG, 2018b). San Luis Obispo County had authorized the Fringe Area Study in 2017 as part of the BBMR preparations.
- A study was authorized by the BMC to review LOBP metric trends and perform a Program C infrastructure evaluation as part of adaptive management (CHG, 2019).
- An evaluation of Expansion Well Site C was completed in 2018 (CHG, 2018c). LOCSD, a BMC member, continues to move forward on the siting and development of a new Program C expansion well to serve the Los Osos Community.

3. CONDUCT OF WORK

This Annual Report covers monitoring activities performed during the 2018 calendar year. While information from prior years is included in data presentation and interpretation, the conduct of work and detailed groundwater monitoring results are reported for 2018.

3.1 Services Provided

All 2018 groundwater monitoring data compiled for this report, unless described otherwise, comes from the following monitoring programs:

- San Luis Obispo County Public Works, Semi-Annual Water Level Monitoring Program: water level data.
- Purveyor water supply well monitoring: water level, water quality and production data.
- LOWRF Waste Discharge Order R3-2011-0001 Groundwater Monitoring Program (CCRWQCB, 2011): water level and water quality data.
- LOBP Groundwater Monitoring Program: water level and water quality data.

3.2 Field Methods

Groundwater level measurement and groundwater sampling are the primary field activities performed for the LOBP Groundwater Monitoring Program. Field activities include measuring and recording water levels in wells and collecting groundwater samples for laboratory analytical testing. The field methods approved for use in the LOBP Groundwater Monitoring Program are presented in Appendix E. These methods are recommended for services performed directly for the BMC and for other monitoring programs that contribute data to the LOBP Groundwater Monitoring Program.

3.2.1 Elevation Datum

The original survey for wells in the County's Semi-Annual Water Level Monitoring Program was likely based on the National Geodetic Vertical Datum of 1929 (NGVD 29), which has been replaced in land surveying practice by the North American Vertical Datum of 1988 (NAVD 88). Several wells were re-surveyed in 2003 and 2005 using NAVD 88, but there are still wells with elevations based on NGVD 29, along with wells with no known elevation survey. For the Annual Report, wellhead elevations reported in Table 3 through Table 8 are from the latest available survey or estimated from topographic maps (with datum given). For water level contouring and storage calculations, the NGVD 29 reference point elevation have been adjusted to NAVD 88 datum using a 2.8 feet upward shift, based on North American Vertical Datum Conversion (VERTCON) data reviewed for the Basin, as published by the National Geodetic Society. A review of all reference points by a licensed surveyor is scheduled for 2019, after which all data may be expressed in the current NAVD 88 standard, including the Water Level Metric.

3.2.2 Water Level Monitoring Procedures

Groundwater level monitoring typically uses an electric sounder or steel tape. If the well is equipped and active, monitoring would take place when the pump is off, and the water level is relatively static. Seven monitoring network wells are currently equipped with a pressure transducer, allowing for automatic water level data collection between regular (manual) monitoring events. These devices are placed below water in a well and record changes in pressure that occur in response to changes in the height of the water column above the transducer. Detailed water level monitoring procedures are included in Appendix E.

3.2.3 Groundwater Sampling Procedures

Groundwater sampling procedures ensure collection of a representative groundwater sample from an aquifer for water quality analysis. Unused or unequipped wells are purged of standing or stagnant water prior to sampling. Stabilization of field measurements for conductivity, pH, and temperature, along with minimum purge volumes, are included in the approved methods. Sampling procedures for general mineral and nitrate sampling (with additional procedures for wastewater indicator compounds) are presented in Appendix E.

An induction electric log, which is used periodically at Wells LA4 and LA14, measures formation specific conductance using high frequency alternating currents that are induced into the formation. The technique may be used in open boreholes or wells cased with PVC, but not in steel-cased wells. Seawater is highly conductive, compared to fresh water, and an induction log performed in a borehole penetrating the fresh water/seawater interface will show the vertical transition from fresh water to seawater. By convention, conductivity measurements from the induction tool are put through an electrical reciprocator and converted to a resistivity curve on the log. The gamma ray log, which is also performed periodically at Wells LA4 and LA14, measures naturally occurring gamma emissions from the formation surrounding the borehole. These emissions can penetrate both PVC and steel-cased wells and are typically used to measure clay content when gamma active clays are present (Welenco, 1996). Since natural gamma emissions are not affected by changes in water quality, the gamma ray log can be used as a depth calibration tool when comparing induction logs from different monitoring events.

3.3 Monitoring Staff Affiliations

Monitoring services that contributed data to the 2018 Annual Report were performed by staff or consultants affiliated with the following agencies:

- San Luis Obispo County Department of Public Works, Water Resources Division. County staff performed semi-annual water level monitoring, collected and maintained precipitation and stream gage records. Rincon Consultants performed semi-annual (June and December) water level monitoring and water quality sampling at selected private wells and monitoring wells for the LOWRF Groundwater Monitoring Program (data from this program is used in the LOBP Groundwater Monitoring Program).

- Los Osos Water Purveyors (LOCSD, GSWC, S&T). Water agency staff performed semi-annual water level monitoring and water quality sampling at municipal water supply wells.

- Los Osos BMC (LOCSD, GSWC, S&T, and County). CHG performed semi-annual (April and October) water level monitoring, water quality sampling at private wells, monitoring wells, and municipal supply wells for the LOBP Groundwater Monitoring Program.

4. MONITORING RESULTS

The results of groundwater monitoring activities performed in 2018 for the various Basin monitoring programs are summarized below. Overlap between the LOBP Groundwater Monitoring Program and other ongoing monitoring programs are shown in Appendix B. Laboratory analytical reports of groundwater samples collected for the LOWRF Groundwater Monitoring Program are contained in their respective June and December 2017 monitoring program reports (Rincon Consultants, 2018b, 2019).

4.1 Water Level Monitoring Results

Tables 3 through 8 present the results of groundwater level measurements at LOBP Groundwater Monitoring Program wells, as reported by the various monitoring programs. Available water levels for wells labeled "private" are not reported herein, but those listed as measured have been used for aggregated water level contour maps. Private wells refer to domestic wells, agricultural irrigation wells, and monitoring wells that are not controlled by BMC member agencies.

Most of the Spring water levels were measured in April 2018 for the County Semi-Annual Water Level Monitoring Program and the LOBP Groundwater Monitoring Program, and in June and December for the LOWRF Groundwater Monitoring Program. Most of the Fall water levels were measured in October 2018 for the County Semi-Annual Water Level Monitoring Program and the LOBP Groundwater Monitoring Program. The LOWRF Groundwater Monitoring Program schedule moved from October to December beginning in Fall 2016. For consistency with the LOBP Groundwater Monitoring Program and various County monitoring programs, however, CHG also monitored water levels at selected LOWRF monitoring program wells in October 2018, rather than using the December 2018 LOWRF monitoring event values.

Table 3. Spring 2018 Water Levels - First Water					
Well ID	**State Well Number**	**R. P. Elevation and Datum (feet)**	**Date**	**Water Level (Feet)**	
				Depth	**Elevation**
FW1	30S/10E-13A7	PRIVATE (not measured)			
FW2	30S/10E-13L8	32.63 [1]	4/5/2018	23.24	9.4
FW3	30S/10E-13G	50.95 [1]	4/12/2018	41.39	9.6
FW4	30S/10E-13H	49.33 [1]	4/12/2018	20.65	28.7
FW5	30S/10E-13Q2	101.27 [1]	4/12/2018	84.89	16.4
FW6	30S/10E-24A	193.04 [1]	4/13/2018	156.02	37.0
FW7	30S/10E-24Ab	Not measured (damaged)			
FW8	30S/11E-7L4	45.76 [1]	4/5/2018	37.29	8.5
FW9	30S/11E-7K3	90.71 [1]	4/5/2018	53.00	37.7
FW10	30S/11E-7Q1	25.29 [1]	4/13/2018	8.01	17.3
FW11	30S/11E-7R2	61.93 [1]	4/5/2018	23.10	38.8
FW12	30S/11E-18C2	34.55 [1]	4/5/2018	19.21	15.3
FW13	30S/11E-18B2	79.89 [1]	4/5/2018	20.84	59.1
FW14	30S/11E-18E1	PRIVATE (not measured)			
FW15	30S/11E-18N2	125.53 [1]	4/5/2018	83.17	42.4
FW16	30S/11E-18L11	88.02 [1]	4/5/2018	46.78	41.2
FW17	30S/11E-18L12	103.85 [1]	4/5/2018	21.60	82.3
FW18	30S/11E-18P	150 [2]	4/11/2018	24.60	125.4
FW19	30S/11E-18J7	125.74 [1]	4/5/2018	26.22	99.5
FW20	30S/11E-8Mb	95 [2]	4/5/2018	43.50	51.5
FW21	30S/11E-8N4	95.99 [1]	4/12/2018	37.76	58.2
FW22	30S/11E-17F4	PRIVATE (measured)			
FW23	30S/11E-17N4	PRIVATE (measured)			
FW24	30S/11E-17J2	PRIVATE (measured)			
FW25	30S/11E-17R1	PRIVATE (not measured)			
FW26	30S/11E-20A2	PRIVATE (measured)			
FW27	30S/11E-20L1	PRIVATE (measured)			
FW28	30S/11E-20M2	PRIVATE (measured)			
FW29	30S/11E-20A1	PRIVATE (measured)			
FW30	30S/11E-18R1	PRIVATE (measured)			
FW31	30S/11E-19A	213 [2]	4/13/2018	29.87	183.1
FW32	30S/11E-21D14	PRIVATE (measured)			

NOTES: 1 NAVD88 elevation as reported by licensed land surveyor
2 estimated elevation (NAVD88)
3 elevation as reported by County (datum unknown, likely NGVD29)

Table 4. Spring 2018 Water Levels - Upper Aquifer					
Well ID	**State Well Number**	**R. P. Elevation and Datum (feet)**	**Date**	**Water Level (Feet)**	
				Depth	**Elevation**
UA1	30S/10E-11A1	16.01 [1]	4/24/2018	13.1	2.9
UA2	30S/10E-14B1	19.48 [1]	4/24/2018	16.94	2.5
UA3	30S/10E-13F4	19 [2]	4/10/2018	14	5.0
UA4	30S/10E-13L1	38.68 [3]	4/20/2018	31.3	7.4
UA5	30S/11E-7N1	9.13 [3]	4/19/2018	3.7	5.4
UA6	30S/11E-18L8	79.18 [1]	3/26/2018	56.89	22.3
UA7	30S/11E-18L7	79.16 [1]	3/26/2018	64.3	14.9
UA8	30S/11E-18K7	135.65 [3]	4/17/2018	120.89	14.8
UA9	30S/11E-18K3	121.18 [3]	4/9/2018	105	16.2
UA10	30S/11E-18H1	107.10 [3]	4/13/2018	93.2	13.9
UA11	30S/11E-17D	PRIVATE (not measured)			
UA12	30S/11E-17E9	105.85 [3]	4/16/2018	90.3	15.6
UA13	30S/11E-17E10	106 [2]	4/20/2018	93.7	12.3
UA14	30S/11E-17P4	PRIVATE (not measured)			
UA15	30S/11E-20B7	PRIVATE (not measured)			
UA16	30S/11E-17L4	PRIVATE (measured)			
UA17	30S/11E-17E1	PRIVATE (measured)			
UA18	30S/11E-17F2	PRIVATE (measured)			

NOTES:
1 NAVD88 elevation as reported by licensed land surveyor
2 estimated elevation (assume NAVD88)
3 elevation as reported by County (datum unknown, likely NGVD 29)
All NGVD 29 elevations are converted to NAVD 88 prior to contouring

Table 5. Spring 2018 Water Levels - Lower Aquifer					
Well ID	**State Well Number**	**R. P. Elevation and Datum (feet)**	**Date**	**Water Level (Feet)**	
				Depth	**Elevation**
LA1	30S/10E-2A1	23.13 [1]	4/24/2018	15.65	7.5
LA2	30S/10E-11A2	16.07 [1]	4/24/2018	11.3	4.8
LA3	30S/10E-14B2	19.47 [1]	4/24/2018	17.45	2.0
LA4	30S/10E-13M1	41.20 [3]	4/24/2018	44.7	-3.5
LA5	30S/10E-13L7	37 [2]	4/20/2018	33.1	3.9
LA6	30S/10E-13L4	68 [2]	4/18/2018	62	6.0
LA7	30S/10E-13P2	PRIVATE (not measured)			
LA8	30S/10E-13N	138.50 [2]	4/20/2018	134.2	4.3
LA9	30S/10E-24C1	178.32 [3]	4/10/2018	175	3.3
LA10	30S/10E-13J1	95.31 [3]	4/10/2018	79	16.3
LA11	30S/10E-12J1	8.43 [1]	4/10/2018	4.45	4.0
LA12	30S/11E-7Q3	24.30 [3]	4/19/2018	29.7	-5.4
LA13	30S/11E-18F2	100 [3]	4/13/2018	103.12	-3.1
LA14	30S/11E-18L6	79.36 [1]	3/26/2018	77.34	2.0
LA15	30S/11E-18L2	85 [2]	4/19/2018	91.5	-6.5
LA16	30S/11E-18M1	106.82 [3]	3/26/2018	98.6	8.2
LA17	30S/11E-24A2	210.40 [3]	3/27/2018	171.64	38.8
LA18	30S/11E-18K8	135.74 [3]	4/17/2018	136.24	-0.5
LA19	30S/11E-19H2	256.20 [3]	3/27/2018	270.01	-13.8
LA20	30S/11E-17N10	140 [2]	4/10/2018	145	-5.0
LA21	30S/11E-17E7	105.85 [3]	3/27/2018	108.4	-2.6
LA22	30S/11E-17E8	105.85 [3]	3/27/2018	122	-16.2
LA23 to LA30		PRIVATE (measured LA 24 - LA30)			
LA31	30S/10E-13M2	(Mixed aquifer - used for water quality only)			
LA32	30S/11E-18K9	(Mixed aquifer - used for water quality only)			
LA33	30S/11E-17A1	PRIVATE (measured)			
LA34	30S/11E-8F	26.15 [1]	4/13/2018	3.9	22.29
LA35	30S/11E-21Bb	86.8 [1]	4/13/2018	64	22.8
LA36	30S/11E-21Ja	PRIVATE (measured)			
LA37	30S/11E-21B1	81.4 [2]	4/13/2018	58.13	23.27
LA38	30S/11E-21E	PRIVATE (measured)			

NOTES: 1 NAVD88 elevation as reported by licensed land surveyor

2 estimated elevation (assume NAVD 88)

3 elevation as reported by County (datum unknown, likely NGVD 29)

+ added for current reporting year

All NGVD 29 elevations are converted to the NAVD 88 datum prior to contouring

Table 6. Fall 2018 Water Levels - First Water					
Well ID	State Well Number	R. P. Elevation and Datum (feet)	Date	Water Level (Feet)	
				Depth	Elevation
FW1	30S/10E-13A7	PRIVATE (not measured)			
FW2	30S/10E-13L8	32.63 [1]	10/3/2018	23.31	9.3
FW3	30S/10E-13G	50.95 [1]	10/3/2018	41.48	9.5
FW4	30S/10E-13H	49.33 [1]	10/3/2018	25.8	23.5
FW5	30S/10E-13Q2	101.27 [1]	10/16/2018	83.92	17.4
FW6	30S/10E-24A	193.04 [1]	10/9/2018	152.87	40.2
FW7	30S/10E-24Ab	Not measured (damaged)			
FW8	30S/11E-7L4	45.76 [1]	10/4/2018	38.11	7.7
FW9	30S/11E-7K3	90.71 [1]	10/4/2018	54.41	36.3
FW10	30S/11E-7Q1	25.29 [1]	10/9/2018	9.32	16.0
FW11	30S/11E-7R2	61.93 [1]	10/4/2018	24.65	37.3
FW12	30S/11E-18C2	34.55 [1]	10/4/2018	20.31	14.2
FW13	30S/11E-18B2	79.89 [1]	10/4/2018	23.31	56.6
FW14	30S/11E-18E1	PRIVATE (not measured)			
FW15	30S/11E-18N2	125.53 [1]	10/3/2018	83.14	42.4
FW16	30S/11E-18L11	88.02 [1]	10/3/2018	47.08	40.9
FW17	30S/11E-18L12	103.85 [1]	10/3/2018	20.89	83.0
FW18	30S/11E-18P	150 [2]	10/9/2018	25.52	124.5
FW19	30S/11E-18J7	125.74 [1]	10/4/2018	27.58	98.2
FW20	30S/11E-8Mb	95 [2]	10/4/2018	45.36	49.6
FW21	30S/11E-8N4	95.99 [1]	10/4/2018	39.82	56.2
FW22	30S/11E-17F4	PRIVATE (not measured)			
FW23	30S/11E-17N4	PRIVATE (measured)			
FW24	30S/11E-17J2	PRIVATE (measured)			
FW25	30S/11E-17R1	PRIVATE (not measured)			
FW26	30S/11E-20A2	PRIVATE (measured)			
FW27	30S/11E-20L1	PRIVATE (measured)			
FW28	30S/11E-20M2	PRIVATE (measured)			
FW29	30S/11E-20A1	PRIVATE (measured)			
FW30	30S/11E-18R1	PRIVATE (not measured)			
FW31	30S/11E-19A	213 [2]	10/9/2018	30.34	182.7
FW32	30S/11E-21D14	PRIVATE (measured)			

NOTES: 1 NAVD88 elevation as reported by licensed land surveyor
2 estimated elevation (NAVD 88)
3 elevation as reported by County (datum unknown, likely NGVD 29)
+ added for current reporting year

Table 7. Fall 2018 Water Levels - Upper Aquifer

Well ID	State Well Number	R. P. Elevation and Datum (feet)	Date	Water Level (Feet)	
				Depth	Elevation
UA1	30S/10E-11A1	16.01 [1]	11/7/2018	12.19	3.8
UA2	30S/10E-14B1	19.48 [1]	11/7/2018	16.85	2.6
UA3	30S/10E-13F4	19 [2]	10/22/2018	10.5	8.5
UA4	30S/10E-13L1	38.68 [3]	10/31/2018	31.2	7.5
UA5	30S/11E-7N1	9.13 [2]	10/12/2018	3.31	5.8
UA6	30S/11E-18L8	79.18 [1]	10/1/2018	57.76	21.4
UA7	30S/11E-18L7	79.16 [1]	10/1/2018	66.4	12.8
UA8	30S/11E-18K7	135.65 [3]	10/10/2018	120.64	15.0
UA9	30S/11E-18K3	121.18 [3]	10/9/2018	105	16.2
UA10	30S/11E-18H1	107.10 [3]	10/9/2018	95.44	11.7
UA11	30S/11E-17D	PRIVATE (not measured)			
UA12	30S/11E-17E9	105.85 [3]	10/10/2018	92.13	13.7
UA13	30S/11E-17E10	106 [2]	10/12/2018	93.67	12.3
UA14	30S/11E-17P4	PRIVATE (not measured)			
UA15	30S/11E-20B7	PRIVATE (not measured)			
UA16	30S/11E-17L4	PRIVATE (measured)			
UA17	30S/11E-17E1	PRIVATE (measured)			
UA18	30S/11E-17F2	PRIVATE (measured)			

NOTES:
[1] NAVD88 elevation as reported by licensed land surveyor
[2] estimated elevation (assume NAVD88)
[3] elevation as reported by County (datum unknown, likely NGVD 29)
All NGVD 29 elevations are converted to the NAVD 88 prior to contouring.

Table 8. Fall 2018 Water Levels - Lower Aquifer					
Well ID	State Well Number	R. P. Elevation and Datum (feet)	Date	Water Level (Feet)	
				Depth	Elevation
LA1	30S/10E-2A1	23.13 [1]	11/7/2018	15.45	7.7
LA2	30S/10E-11A2	16.07 [1]	11/7/2018	10.88	5.2
LA3	30S/10E-14B2	19.47 [1]	11/7/2018	12.45	7.0
LA4	30S/10E-13M1	41.20 [3]	10/17/2018	44.82	-3.6
LA5	30S/10E-13L7	37 [2]	10/7/2018	37.37	-0.4
LA6	30S/10E-13L4	68 [2]	10/9/2018	64	4.0
LA7	30S/10E-13P2	PRIVATE (not measured)			
LA8	30S/10E-13N	138.50 [2]	10/7/2018	137.5	1.0
LA9	30S/10E-24C1	178.32 [3]	10/9/2018	176	2.3
LA10	30S/10E-13J1	95.31 [3]	10/22/2018	94	1.3
LA11	30S/10E-12J1	8.43 [1]	10/2/2018	6.36	2.1
LA12	30S/11E-7Q3	24.30 [3]	10/12/2018	41.1	-16.8
LA13	30S/11E-18F2	100 [3]	10/9/2018	105.76	-5.8
LA14	30S/11E-18L6	79.36 [1]	10/1/2018	80.06	-0.7
LA15	30S/11E-18L2	85 [2]	10/12/2018	95.16	-10.2
LA16	30S/11E-18M1	106.82 [3]	10/1/2018	101.67	5.1
LA17	30S/11E-24A2	210.40 [3]	10/2/2018	182.27	28.1
LA18	30S/11E-18K8	135.74 [3]	10/10/2018	138.82	-3.1
LA19	30S/11E-19H2	256.20 [3]	10/2/2018	269.06	-12.9
LA20	30S/11E-17N10	140 [2]	10/9/2018	155	-15.0
LA21	30S/11E-17E7	105.85 [3]	10/2/2018	116.07	-10.2
LA22	30S/11E-17E8	105.85 [3]	10/2/2018	123.52	-17.7
LA23 to LA30		PRIVATE (measured LA 24 - LA27, LA29, LA30)			
LA31	30S/10E-13M2	(Mixed aquifer - used for water quality only)			
LA32	30S/11E-18K9	(Mixed aquifer - used for water quality only)			
LA33	30S/11E-17A1	PRIVATE (measured)			
LA34	30S/11E-8F	26.15 [1]	10/19/2018	8.07	18.1
LA35	30S/11E-21Bb	86.8 [1]	10/9/2018	93	-6.2
LA36	30S/11E-21Ja	PRIVATE (measured)			
LA37	30S/11E-21B1	81.4 [2]	10/9/2018	67.22	14.2
LA38	30S/11E-21E	PRIVATE (measured)			

NOTES:
1 NAVD88 elevation as reported by licensed land surveyor
2 estimated elevation (assume NAVD88)
3 elevation as reported by County (datum unknown, likely NGVD 29)
All NGVD 29 elevations are converted to the NAVD 88 prior to contouring.
+ added for current reporting year

4.2 Water Quality Results

Available Fall 2018 water quality results for First Water and Upper Aquifer monitoring wells designated for water quality reporting in the LOBP Groundwater Monitoring Program are presented in Table 9. The LOBP Groundwater Monitoring Program does not include Spring 2018 water quality monitoring at First Water or Upper Aquifer Wells. Available Spring and Fall 2018 water quality for Lower Aquifer monitoring wells designated for water quality reporting in the LOBP Groundwater Monitoring Program are presented in Tables 10 and 11. Groundwater monitoring field logs and laboratory analytical reports for the 2018 LOBP Groundwater Monitoring Program are included in Appendix C.

"Private" wells refer to domestic wells, agricultural irrigation wells, and monitoring wells that are not controlled by BMC member agencies. Private well participation in the monitoring program during 2018 was 66 percent (22 out of 33 wells).

Some of the constituents of analysis that are part of the LOBP Groundwater Monitoring Program listed in Table 1 are not included in the LOWRF Groundwater Monitoring Program. The missing constituents include specific conductance, alkalinity (bicarbonate, carbonate, and total), calcium, magnesium, and potassium.

Lower Aquifer wells LA2 and LA3 were not sampled in 2018. These are Morro Bay sand spit wells that are scheduled for water quality monitoring every five years to track changes in salinity at the coast (2015 LOBP). The next scheduled water quality sampling event on the sand spit will be in 2020.

4.2.1 Nitrate and Chloride Results

Results for First Water wells indicate elevated nitrate concentrations across much of the central and western areas. A more extensive compilation of shallow water quality, including nitrate and TDS concentration maps, are presented for June and December 2018 in the County's LOWRF Groundwater Monitoring Program reports (Rincon Consultants, 2018b, 2019). Nitrate concentration trends are tracked using the Nitrate Metric (see Section 7.5.3).

Lower Aquifer water quality results for 2018 show one water supply well (LA31) impacted by seawater intrusion, based on chloride concentrations over 250 mg/L. The overall trend in chloride concentration and seawater intrusion is tracked using the Chloride Metric (see Section 7.5.3).

4.2.2 CEC Results

CEC sampling was conducted at well FW5 and FW26 in October 2018. Well FW5 is hydraulically downgradient of the Broderson leach field site, where most of the recycled water from LOWRF is discharged into the Basin, and where high-density (>1 per acre) septic systems were active prior to being connected to the sewer. Well FW26 is located in the Los Osos Creek Valley, where there are low-density (<1 per acre) septic systems (Figure 2). CEC results are presented in Table 12, with laboratory reports included in Appendix C.

Table 9. Fall 2018 Water Quality Results - First Water and Upper Aquifer																	
LOBP Well	State Well Number	Date	SC	pH (field)	TDS	Alkalinity			Cl	NO3-N	SO4	B	Ca	Mg	K	Na	T (field)
						CO3	HCO3	Total as CaCO3									
			µS/cm	pH units	mg/L												°F
FW2*	30S/10E-13L8	12/11/18	--	6.45	488	--	--	--	137	29.6	41.3	0.24	--	--	--	121	65.3
FW6*	30S/10E-24A	12/13/18	--	6.69	500	--	--	--	152	3.2	54.6	ND	--	--	--	70	60.1
FW10*	30S/11E-7Q1	12/10/18	--	7.05	568	--	--	--	119	29.1	74.7	0.27	--	--	--	94	66.9
FW15*	30S/11E-18N2	12/11/18	--	6.42	506	--	--	--	109	32.5	34.0	0.22	--	--	--	73	67.6
FW17*	30S/11E-18L12	12/11/18	--	6.53	396	--	--	--	73	24.3	46.0	0.14	--	--	--	52	68.2
FW20*	30S/11E-8Mb	12/12/18	--	7.52	400	--	--	--	70	21.3	31.9	<0.1	--	--	--	--	69.4
FW22*	30S/11E-17F4	12/12/18	--	7.92	422	--	--	--	133	1.2	23.6	<0.1	--	--	--	62	63.5
FW26	30S/11E-20A2	10/16/2018	650	6.92	400	<10	210	249	70	<0.5	30.1	<0.1	37	38	<1	39	63.1
FW28	30S/11E-20M2	10/9/2018	857	7.35	540	<10	350	431	46	0.1	87.8	0.2	77	58	1	36	62.1
UA3	30S/10E-13F1	10/9/2018	508	6.70	300	<10	70	134	55	15.2	24.6	<0.1	24	18	2	55	66.0
UA9	30S/11E-18K3	10/9/2018	326	7.10	210	<10	60	95.9	39	8.6	8.6	<0.1	17	13	1	30	67.0
UA13	30S/11E-17E10	10/2/2018	519	8.10	320	<10	110	145	59	14.5	21.5	<0.1	22	22	<1	35	67.3

NOTES: "--" = no result available; SC = specific conductance; TDS = total dissolved solids; CO3 = carbonate; HCO3= bicarbonate; CaCO3 = total alkalinity as calcium carbonate; Cl = chloride; NO3-N = nitrate as nitrogen; SO4 = sulfate; B = boron; Ca = calcium; Mg = magnesium; K = potassium; Na = sodium; T = temperature; µS/cm = microsiemens per centimeter; mg/L = milligrams per liter; °F = degrees Fahrenheit; < indicates less than Practical Quantitation Limit as listed in laboratory report.
* = readings from LOWRF Groundwater Monitoring Program sampling event in December 2018 (Rincon Consultants, 2018)

Table 10. Spring 2018 Water Quality Results - Lower Aquifer

LOBP Well	State Well Number	Date	SC	pH (field)	TDS	Alkalinity			Cl	NO3-N	SO4	B	Ca	Mg	K	Na	T (field)
						CO3	HCO3	CaCO3									
			µS/cm	pH units	------------------------------------- mg/L -------------------------------------												°F
LA8	30S/10E-13N	04/11/18	440	8.89	260	<10	60	104	79	7.9	13.5	<0.1	17	15	1	39	63.3
LA9	30S/10E-24C1	04/24/18	486	6.81	300	<10	70	115	90	6.1	16.7	<0.1	18	17	1	43	66.0
LA10	30S/10E-13J1	04/24/18	620	6.97	400	<10	70	188	136	4.3	12.3	<0.1	29	28	1	29	66.9
LA11	30S/10E-12J1	04/10/18	1390	7.97	820	<10	350	595	173	<0.5	192	0.2	85	93	5	97	69.1
LA12	30S/10E-7Q3	04/10/18	814	7.89	440	<10	300	319	93	<0.5	46.2	0.2	52	46	2	56	66.7
LA15	30S/11E-18L2	04/10/18	767	8.22	420	<10	250	311	100	0.8	32.4	<0.1	52	44	2	40	70.3
LA18	30S/11E-18K8	04/17/18	625	7.64	390	<10	290	260	33	<0.5	39.9	<0.1	53	31	2	27	69.6
LA20	30S/11E-17N10	04/24/18	515	7.16	330	<10	200	166	43	3.2	23.2	0.1	27	24	2	31	68.0
LA22	30S/11E-17E8	04/16/18	473	7.62	310	<10	150	165	47	6.7	14.2	<0.1	25	25	1	29	67.8
LA23	PRIVATE (not sampled)																
LA28	PRIVATE (not sampled)																
LA31	30S/10E-13M2	04/24/18	3370	7.9	2020	<10	70	664	946	0.6	186	0.1	103	99	4	367	65.3
LA32	30S/11E-18K9	04/10/18	256	7.95	150	<10	50	75.2	35	6.5	5.0	<0.1	12	11	<1	23	68.0

NOTES: "--" = no result available; SC = specific conductance; TDS = total dissolved solids; CO3 = carbonate; HCO3= bicarbonate; CaCO3 = total alkalinity as calcium carbonate; Cl = chloride; NO3-N = nitrate as nitrogen; SO4 = sulfate; B = boron; Ca = calcium; Mg = magnesium; K = potassium; Na = sodium; T = temperature; µS/cm = microsiemens per centimeter; mg/L = milligrams per liter; °C = Celsius (some values converted from degrees Fahrenheit as reported on field logs); + indicates proposed addition to monitoring program; < indicates less than Practical Quantitation Limit as listed in laboratory report.

Table 11. Fall 2018 Water Quality Results - Lower Aquifer

Basin Plan Well	State Well Number	Date	SC	pH (field)	TDS	Alkalinity CO3	Alkalinity HCO3	Alkalinity Total as CaCO3	Cl	NO3-N	SO4	B	Ca	Mg	K	Na	T (field)
			µS/cm	pH units	mg/L												°F
LA8	30S/10E-13N	10/03/18	430	7.72	340	<10	60	107	66	6.7	12.9	<0.1	18	15	2	40	66.0
LA9	30S/10E-24C1	10/09/18	477	6.90	280	<10	60	135	76	5.8	17.2	<0.1	21	20	2	50	67.0
LA10	30S/10E-13J1	10/09/18	730	7.10	450	<10	70	265	152	3.2	12.7	<0.1	42	39	2	34	69.0
LA11	30S/10E-12J1	10/02/18	1340	7.68	870	<10	350	497	160	<0.5	160	0.2	69	79	3	87	71.2
LA12	30S10E-7Q3	10/02/18	822	7.62	470	<10	290	283	78	<0.5	50.1	0.1	46	41	1	53	70.2
LA15	30S/11E-18L2	10/23/18	772	7.36	440	<10	250	288	83	0.6	30.7	<0.1	48	41	1	38	69.4
LA18	30S/11E-18K8	10/10/18	608	7.53	360	<10	290	254	31	<0.5	39.8	<0.1	54	29	2	26	73.6
LA20	30S/11E-17N10	10/09/18	632	7.20	340	<10	290	273	38	0.6	29.2	<0.1	42	41	3	47	71.0
LA22	30S/11E-17E8	10/10/18	471	7.48	250	<10	150	160	43	6.1	15.0	<0.1	26	23	1	28	69.8
LA23	PRIVATE (not sampled)																
LA28	PRIVATE (not sampled)																
LA30	30S/11E-20H1	10/04/18	900	7.68	570	<10	390	434	50	<0.5	90.0	0.1	75	60	1	41	63.7
LA31	30S/10E-13M2	10/17/2018	3400	7.55	2180	<10	60	740	834	0.6	153.0	0.2	115	110	5	414	66.0
LA32	30S/11E-18K9	10/2/2018	492	7.77	270	<10	210	168	36	1.3	22.0	<0.1	26	25	<1	33	70.3

NOTES: "--" = no result available; SC = specific conductance; TDS = total dissolved solids; CO3 = carbonate; HCO3= bicarbonate; CaCO3 = total alkalinity as calcium carbonate; Cl = chloride; NO3-N = nitrate as nitrogen; SO4 = sulfate; B = boron; Ca = calcium; Mg = magnesium; K = potassium; Na = sodium; T = temperature; µS/cm = microsiemens per centimeter; mg/L = milligrams per liter; °F = degrees Fahrenheit

Table 12. CEC Monitoring Results						
Constituent or Parameter	**Units**	**FW5**	**FW26**	**QA1 Travel Blank**	**QA2 Equipment Blank**	**LOWRF Recycled Water[1]**
		October 16, 2018				**October 4, 2018**
Health-based						
17β-estradiol	ng/L	ND (<1)	ND (<1)	ND (<1)	ND (<1)	ND (<5)[2]
Triclosan	ng/L	ND (<2)	ND (<2)	ND (<2)	ND (<2)	ND (<20)
Caffeine[3]	ng/L	20	ND (<1)	1.1	1.0	51
NDMA	ng/L	ND (<2)	ND (<2)	--	--	ND (<2)
Performance-based						
Gemfibrozil	ng/L	ND (<1)	ND (<1)	ND (<1)	ND (<1)	170
DEET[3]	ng/L	1.8	1.5	1.8	13	320
Iopromide	ng/L	ND (<5)	ND (<5)	ND (<5)	ND (<5)	ND (<5)
Sucralose	ng/L	230	16	ND (<5)	ND (<5)	63,000
Surrogate						
Ammonia	mg/L	ND (<0.10)	0.21	--	--	--
Nitrate-Nitrogen	mg/L	38	ND (<0.2)	--	--	1.2[4]
Total Organic Carbon	mg/L	1.1	1.2	--	--	--
UV Light Absorption	1/cm	0.015	0.019	--	--	--
Specific Conductance	µmhos/cm	1100	680	--	--	--

[1] 2018 LOWRF CEC Blue Ribbon Report and Annual Report (SLO Co. 2018a, 2018b).
[2] As 17-alpha Ethinyl Estradiol
[3] Blank Contamination. Analyte also detected in the laboratory method blank.
[4] October 2018 30-day average for Total Nitrogen
ng/L = nanograms per liter; mg/L = milligrams per liter, µmhos/cm = micromhos per centimeter; : "--" = no result available
ND (<) = indicates less than Method Reporting Limit as listed in laboratory report ("not detected")

Caffeine, one of the health-based class indicators of CEC indicators, was detected in one groundwater sample, FW5, in both field blanks (QA1 and QA2), and in the laboratory method blank (CEC laboratory results in Appendix C). Although the laboratory blanks contained caffeine as well as the submitted samples, the level detected in FW5 was an order of magnitude greater than the field and method blanks and is interpreted to be in groundwater at FW5 (Table 12).

DEET (Diethyl-meta-toluamide), a personal care product used for insect repellent, was also detected in the groundwater samples and field blanks at concentrations close to the method reporting limit, as well as in the laboratory blank. DEET sample/equipment contamination in the laboratory blank was reported in the prior October 2017 sampling event (CHG, 2018a).

Sucralose, an artificial sweetener, was detected at 230 nanograms per liter (ng/L) in groundwater from FW5 and is an indicator of wastewater influence (i.e. originating from sources of wastewater including septic discharges or recycled water discharges). Sucralose was detected in groundwater from FW26 at 16 ng/L, which is a trace amount (close to the detection limit of 5 µg/L).

Total ammonia was detected at FW26 in 2017 and 2018 at concentrations close to the laboratory detection limit. Total ammonia includes NH_3 (ammonia) and its ionized form, NH_4^+ (ammonium). Ammonium is the principal form of dissolved nitrogen discharged from septic systems, and is typically converted to nitrate (NO_3^-) under aerobic conditions. The presence of trace amounts of total ammonia concentrations in groundwater at FW26 in 2017 and 2018, along with trace amounts of sucralose, suggests a potential for low level influence from septic tank discharges, although no nitrate has been detected at FW26 in 2017 or 2018.

Nitrate-nitrogen was reported at 38 mg/L in groundwater from FW5, and not detected in groundwater from FW26. Available CEC-constituent quality of recycled water from LOWRF is also provided in Table 12 for comparison.

Results of the CEC testing are interpreted to indicate wastewater influence at FW5, based on sucralose and nitrate concentrations, but not likely at FW26. The sucralose detection at FW26 is within the 10-20 ng/L range of common laboratory equipment contamination as observed in 2017 (CHG, 2018a), and no nitrate was detected.

Wastewater influence at FW5 is interpreted to be a residual from septic tank discharges, rather than from recycled water discharges at the Broderson leach field. A greater concentration of caffeine was detected at FW5 in 2018 compared to prior years, but there was no increase in sucralose, which would be expected given the high concentrations in LOWRF discharges (Table 12). The static water level in FW5 was a foot higher elevation in Fall 2018, compared to Spring 2018 (Table 6 and Table 3), which is unusual and suggests the potential arrival of increasing groundwater pressure from mounding beneath the Broderson site.

FW6, which is the first monitoring well hydraulically downgradient of the Broderson Site, was originally designated in the LOBP (along with FW26) as two CEC monitoring wells. Due to drought conditions, there was insufficient water for representative CEC testing at FW6, so FW5 was used as a replacement (CHG, 2017a). Now that the drought is over and groundwater mounding from the Broderson Site has reached FW6, there is sufficient water column to allow CEC testing. CHG recommends adding CEC testing at FW6 in Fall 2019. A comparison between CECs in LOWRF recycled water and in groundwater from FW5 and FW6 will help characterize the influence of recycled water on groundwater downgradient of the disposal site and help identify those compounds most useful for tracking recycled water as it moves into the Basin.

Changing the laboratory used for analyzing CEC's for Fall 2018 was considered, as recommended in the 2017 Annual Report, due to laboratory blank contamination issues at Weck Laboratories. A comparison with Eurofins Laboratory was conducted and indicated Weck offered lower overall costs at equivalent or better detection limits. In addition, DEET laboratory blank contamination was also common for Eurofins Laboratory at the lower detection limits, and no change was made in the CEC laboratory for 2018.

4.3 Geophysics

Induction and natural gamma logging was performed at Lower Aquifer monitoring well LA4 (30S/10E-13M1) and LA14 (30S/11E-18L6) in October 2018. Seawater is highly conductive, compared to fresh water, and an induction log performed in a borehole penetrating the fresh water/seawater interface will show the vertical transition from fresh water to seawater. Because natural gamma emissions are not affected by changes in water quality, the gamma ray log can be used as a depth calibration tool when comparing induction logs from different monitoring events. Geophysical monitoring events have been performed in 1985, 2004, 2009, 2014, 2015, and 2018. The fresh water/seawater interface at LA4 rose approximately 50 feet between 1985 and 2009, with Lower Aquifer production reaching historical highs. Since 2009, induction logging at well LA4 indicates the fresh water/seawater interface has dropped approximately 18 feet in elevation in response to a general reduction in the west side Lower Aquifer pumping (Appendix D).

No evidence of seawater intrusion was observed in geophysical logging at Lower Aquifer monitoring well LA14, which was drilled in 1985 and cased in Lower Aquifer Zones D and E. LA14 is approximately 500 feet north of LA15 (30S/11E-18L2) on Palisades Avenue (Figure 4), where Zone E seawater intrusion had been observed in the past (CHG, 2010).

5. GROUNDWATER PRODUCTION

Annual Basin groundwater production between 1970 and 2013 was reported in the LOBP (ISJ Group, 2015). Tables 13 and 14 present municipal and Basin production beginning in calendar year 2013.

Table 13. Municipal Groundwater Production (2013-2018)				
Year	LOCSD	GSWC	S&T	Total
	Acre-Feet[1]			
2013	726	689	55	1,470
2014	634	564	48	1,246
2015	506	469	32	1,007
2016	519	453	31	1,003
2017	568	450	32	1,050
2018	522	464	32	1,018

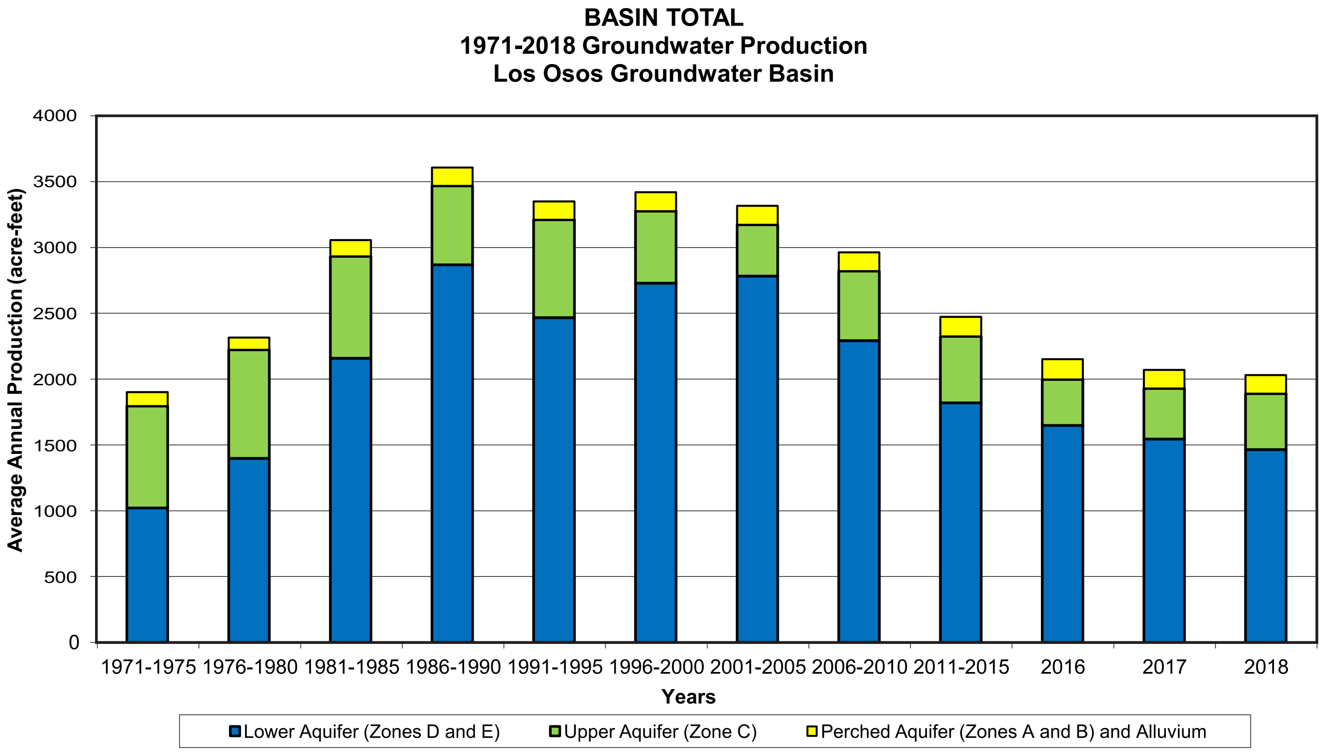
Note: [1]Metered production

Table 14. Basin Groundwater Production (2013-2018)					
Year	Purveyors	Domestic	Community	Agriculture	Total
	Acre-Feet[1]				
2013	1,470	200	140	750	2,560
2014	1,250	220	130	800	2,400
2015	1,010	220	140	800	2,170
2016	1,000	220	140	800	2,160
2017	1,050	220	130	670	2,070
2018	1,020	220	120	670	2,030

Note: [1]All figures rounded to the nearest 10 acre-feet

Figure 6 shows the historical pumping distribution between Basin aquifers since 1970, along with the pumping distribution in the Western Area. Figure 7 show the historical pumping distribution for the Central and Eastern Areas. There has been a 30 percent reduction in Basin production over the last 10 years, with current production similar to the values reported for the mid-1970s. The largest reduction in pumping has occurred in the Lower Aquifer Western Area (Figure 6).

Land use and water use areas overlying the Basin, including purveyor service areas, agricultural parcels, domestic parcels, and community facilities are included in Appendix F. Purveyor municipal production data are based on meter readings. Domestic groundwater production estimates are based on the last reported water use estimates for 2013 from the LOBP, with minor adjustments in 2016 for the inclusion of additional residences in the Eastern Area (CHG, 2017a). Production estimates for community facilities and agricultural wells are based on a soil-moisture budget using local precipitation, land use, and evapotranspiration data (Appendix G). Basin groundwater production estimates are reported to closest 10 acre-feet, which is considered within the accuracy of metered production, but not unmetered production. Unmetered production estimates account for approximately half of the total production in the Basin, of which agricultural irrigation is the greatest unmetered component. Potential uncertainty in Basin production has been estimated at 5 percent of the sustainable yield of the Basin (LOBP; ISJ Group, 2015).



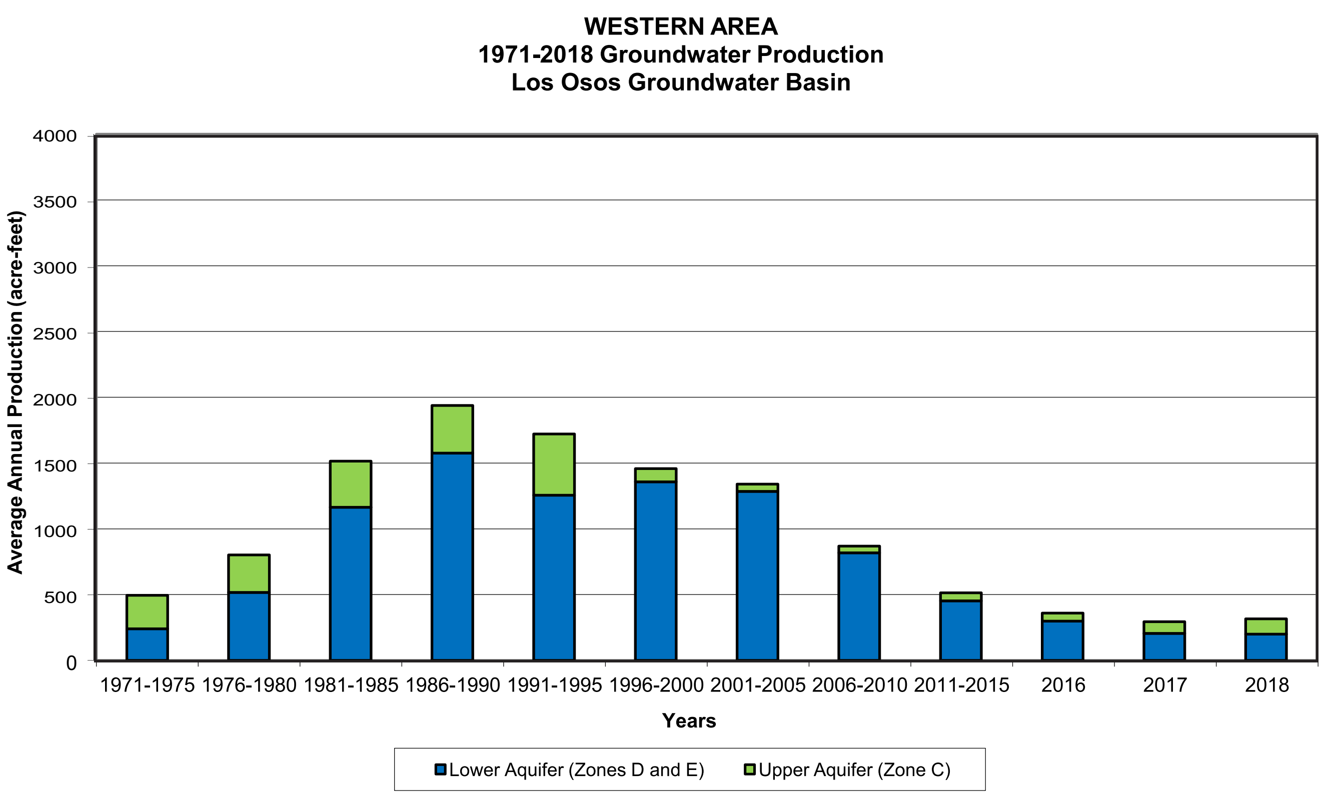
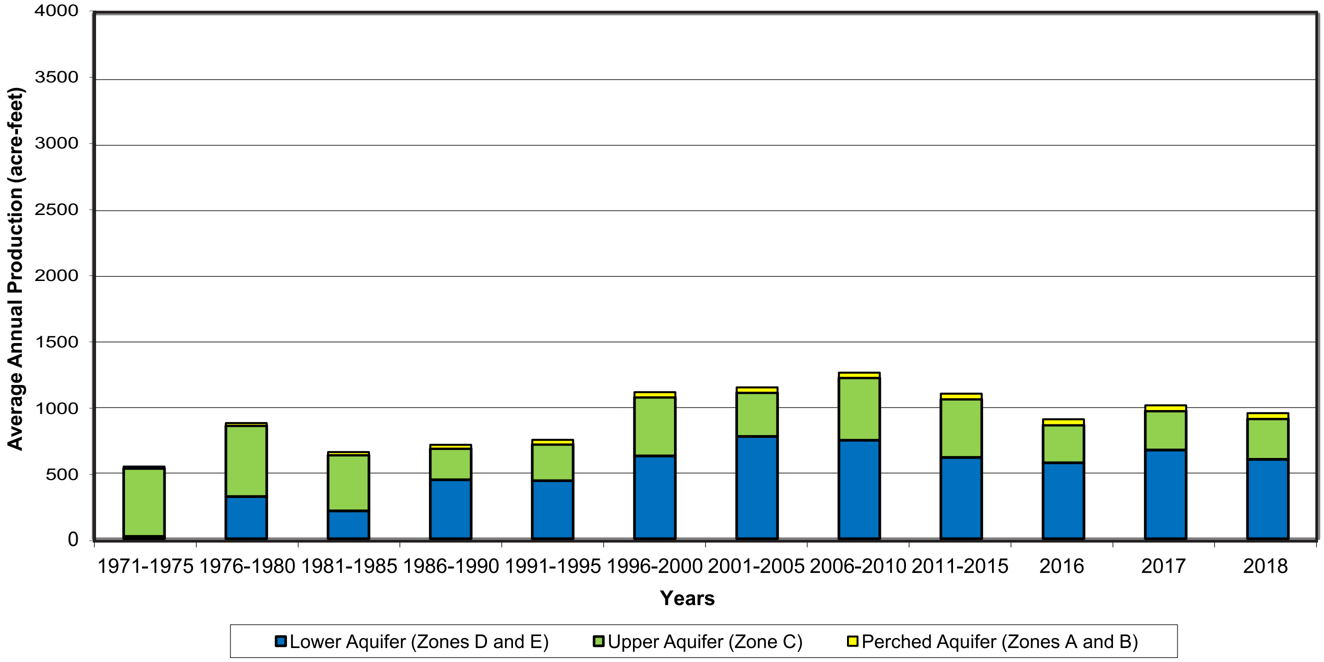


Figure 6
Basin Production 1971-2018
Basin Total and Western Area
Los Osos Goundwater Basin
2018 Annual Report

Cleath-Harris Geologists

CENTRAL AREA
1971-2018 Groundwater Production
Los Osos Groundwater Basin



EASTERN AREA
1971-2018 Groundwater Production
Los Osos Groundwater Basin

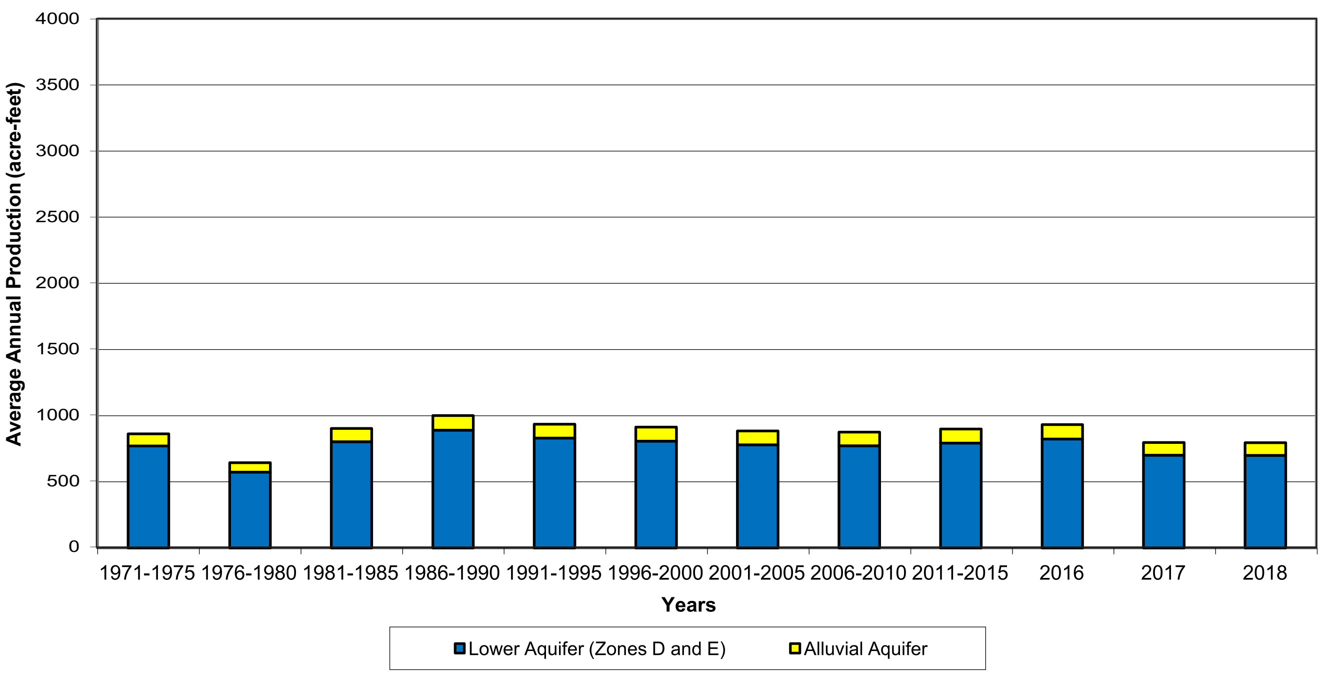


Figure 7
Basin Production 1971-2018
Central and Eastern Areas
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

6. PRECIPITATION AND STREAMFLOW

Precipitation data are currently available from a County gage located at the former Los Osos landfill (Station #727). Continuous precipitation records for Station #727 are available beginning with the 2006 rainfall year (July 2005 through June 2006), and show that rainfall has averaged 15.63 inches, with a minimum of 6.81 inches in the 2014 rainfall year and a maximum of 31.77 inches in the 2011 rainfall year. Precipitation for the 2018 rainfall year was reported at 13.63 inches. Records for Station #727 through the calendar year 2018 are included in Appendix H. The average rainfall at Station #727 is lower compared to other local rain gages due to a short period of record that includes seven years of below average rainfall.

Historically, precipitation records at rain gage stations were compiled by the County for the LOCSD maintenance yard on 8th Street (Station #177), at the South Bay fire station on 9th Street (Station #197), and at two private volunteer stations (Station #144.1 in the Los Osos Creek Valley and Station #201.1 on Broderson Avenue). The longest active period of record in the vicinity is at the Morro Bay fire department (Station #152). A summary of precipitation data for these stations is presented in Table 15.

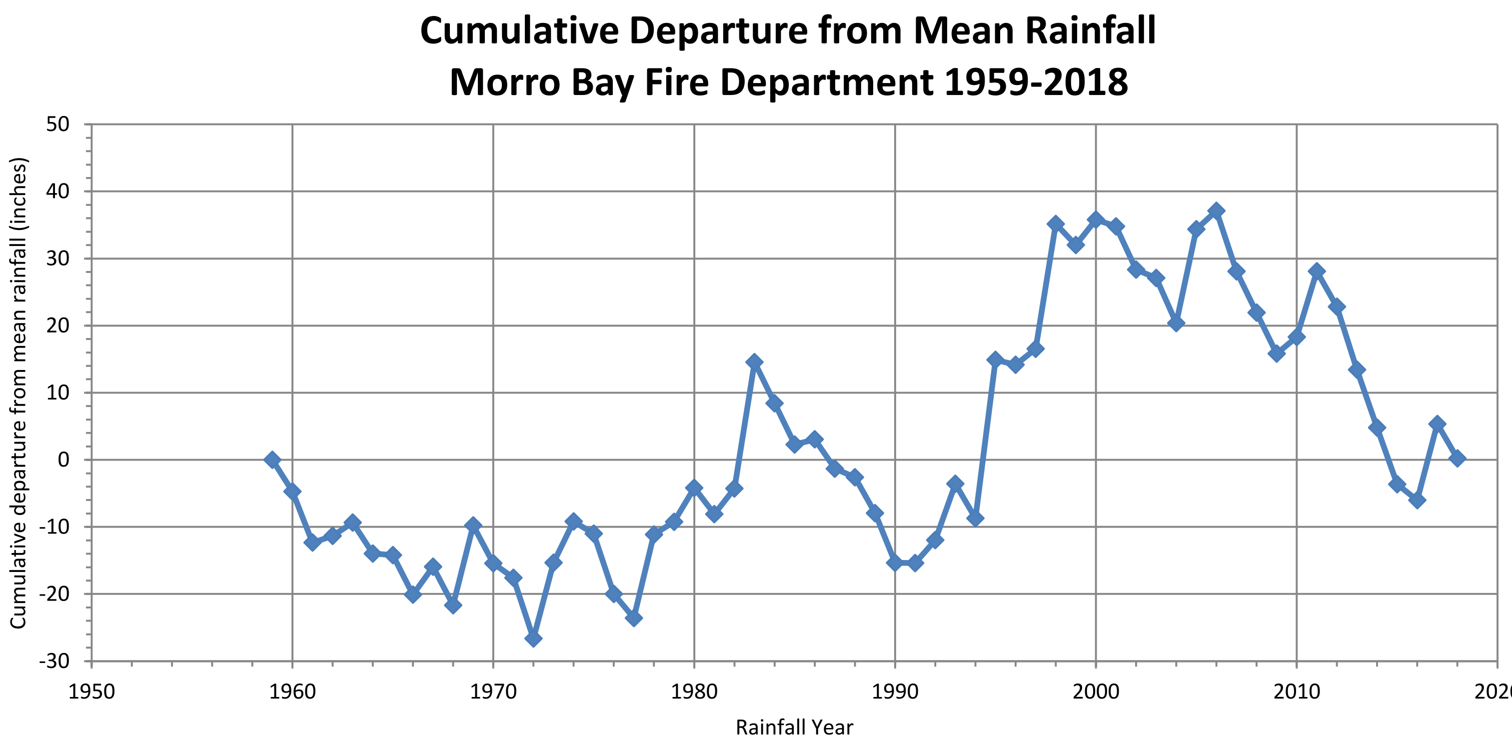
Table 15. Active and Former Precipitation Stations

Station No.	Name	Period of Record (rainfall years)	Average Annual Precipitation (inches)
144.1	Bender	1955-1987	19.17
152	Morro Bay Fire Dept.	1959-2018 (active)	16.20
177	CSA9 Baywood Park	1967-1980	17.49
197	South Bay Fire	1975-2001	19.52
201.1	Simas	1976-1983	21.16
727	Los Osos Landfill	2006-2018 (active)	15.63*

NOTE: *lower average due to short period of record that includes seven years of below normal rainfall.

Figure 8 shows the long-term cumulative departure from mean precipitation at Station #152. Once data for Los Osos Landfill Station #727 becomes representative of long-term climatic conditions, it would be appropriate to use the gage in the cumulative departure from mean precipitation graph.

San Luis Obispo County had been in exceptional drought conditions (D4 - the greatest intensity level) between 2014 and 2016, based on information from the U.S. Drought Monitor, a partnership of federal agencies (NDMC/USDA/NOAA, 2014-2016). In 2017, local drought conditions were relieved by above-normal rainfall. Between January and December 2018, however, San Luis Obispo County once again ranked between abnormally dry (the lowest drought intensity level) and severe drought (NDMC/USDA/NOAA, 2018).



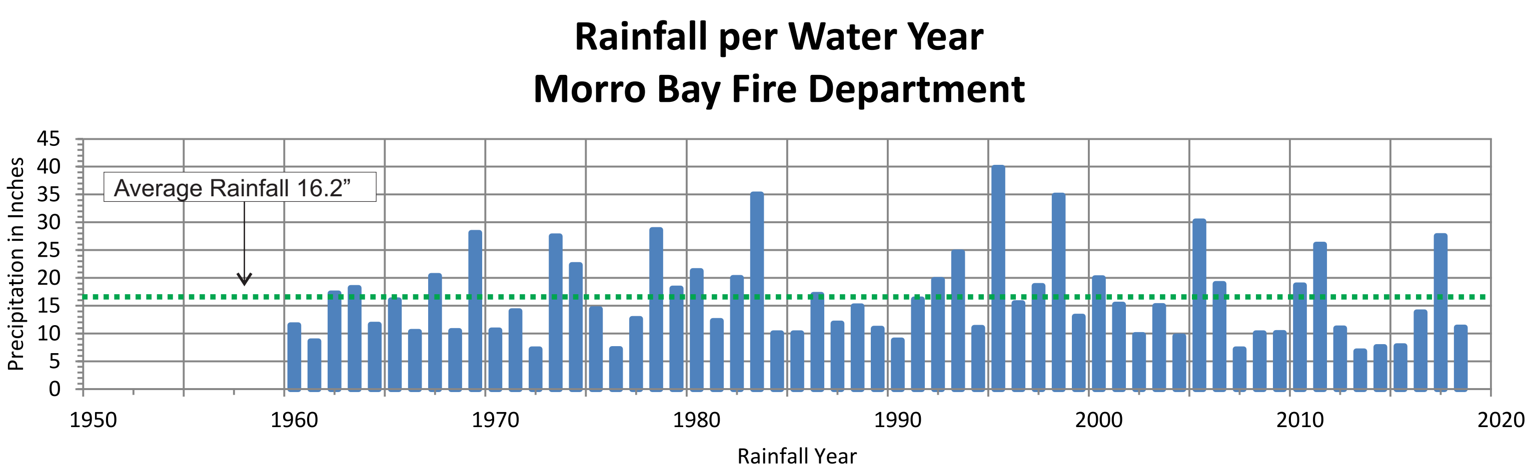


Figure 8
Cumulative Departure from
Mean Rainfall at Morro Bay Fire Department
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

Los Osos Creek drains the Clark Valley watershed. Streamflow on Los Osos Creek is monitored by a County gage (formerly Gage #6, now Sensor 751) at the Los Osos Valley Road bridge. The location has been gaged intermittently since 1976, with 18 years of flow records through 2001. The average measured flow on Los Osos Creek at the gage (drainage area of 7.6 square miles) was 3,769 acre-feet per year between 1976 and 2001 (San Luis Obispo County, 2005). A summary of the available annual streamflow data is in Appendix H.

Streamflow was recorded at the gage for 10 individual days during the 2018 water year (October 1, 2017 to September 30, 2018), including 8 days of continuous flow between March 21 and March 29, 2018. The dates and maximum stage value from Station #727 for the peak flow days in each month are listed below in Table 16.

Table 16. Maximum Stream Stage for Los Osos Creek, 2018 Water Year

Date	Maximum Stream Stage County Sensor #751 (feet)
1/9/2018	2.06
3/22/2018	6.05

There is no current rating curve for Sensor 751. A rating curve is needed to correlate stage records to streamflow volume records; therefore, no streamflow volumes are reported. Development of a rating curve for Sensor 751 is recommended. Graphs of the available stream stage data over time for water years 2011 through 2018 are included in Appendix H.

Warden Creek (Figure 1) drains approximately 9 square miles of the eastern Los Osos Valley. This creek flows along 3,700 feet of the northern Basin boundary, at low invert elevations (less than 20 feet above sea level) in an area underlain by shallow bedrock. The U.S. Geological Survey reported winter flows in Warden Creek similar to Los Osos Creek, but with larger baseflow during the summer, because Warden Creek serves as a drain (point of groundwater discharge) for shallow groundwater at the north end of the Los Osos Creek floodplain (Yates and Wiese, 1988).

7. DATA INTERPRETATION

Groundwater level and groundwater quality data for 2018, together with selected historical data and current induction logs, have been used to develop the following information:

- Groundwater elevation contour maps for the Perched Aquifer, Upper Aquifer (with Alluvial Aquifer), and Lower Aquifer for both Spring and Fall 2018 conditions.
- Water level hydrographs for wells representative of aquifers in the Western, Central, and Eastern Areas of the Basin.

- The lateral extent of seawater intrusion and the Fall 2018 position of the seawater intrusion front.

- Estimates of groundwater in storage for Spring and Fall 2018, including amount above mean sea level.

- Estimates of changes to groundwater in storage from Spring 2017 to Spring 2018, including the volume of seawater intrusion.

- Basin Yield Metric, Basin Development Metric, Water Level Metric, Chloride Metric, and Nitrate Metric.

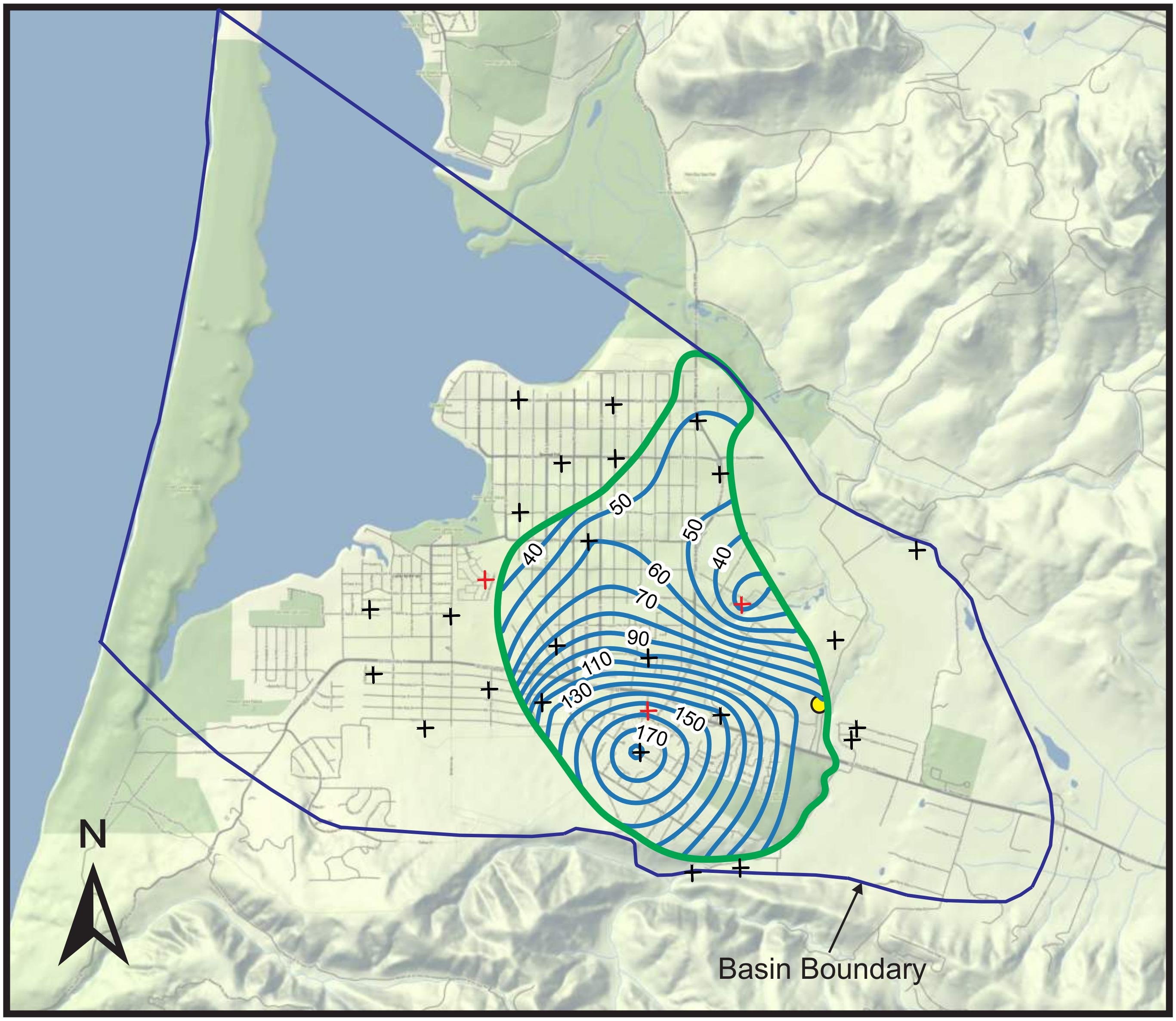
- Upper Aquifer Water Level Profile

7.1 Water Level Contour Maps

Water level contour maps for Spring 2018 are presented in Figures 9, 10, and 11 for the Perched Aquifer, Upper Aquifer with Alluvial Aquifer, and Lower Aquifer, respectively. Corresponding water level contour maps for Fall 2018 are presented in Figures 12, 13, and 14. The water level elevations are shown at a 5-foot contour interval for the Upper and Lower Aquifers, and a 10-foot contour interval for the perched aquifer, based on the ordinary kriging interpolation method, which provides a best (least-squares) estimate of values at unmeasured points based on the mapped values.

Water level data available from private irrigation and domestic wells were used in the development of the water level contour maps, although these water levels are not listed in the data tables in this report (Table 3 through 8). All groundwater elevations were adjusted to a common datum (NAVD 88) prior to contouring and groundwater storage calculations. These adjustments are approximate, pending a review of all reference point elevations by a licensed land surveyor.

Perched Aquifer water level contour maps (Figures 9 and 12) show the highest groundwater elevations at Bayridge Estates (Well FW31 at the Bayridge Estates recycled water disposal field), with a radial direction of groundwater flow from the higher topographic elevations to lower elevations. Although the Fall 2018 measurement at FW31 was slightly higher elevation than the Spring measurement due to recycled water discharge operations, overall Perched Aquifer groundwater levels declined approximately 3.3 feet from Spring to Fall 2018.



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

Explanation

40 Groundwater elevation contour in feet above sea level (NAVD 88 datum)

Approximate limits of Perched Aquifer

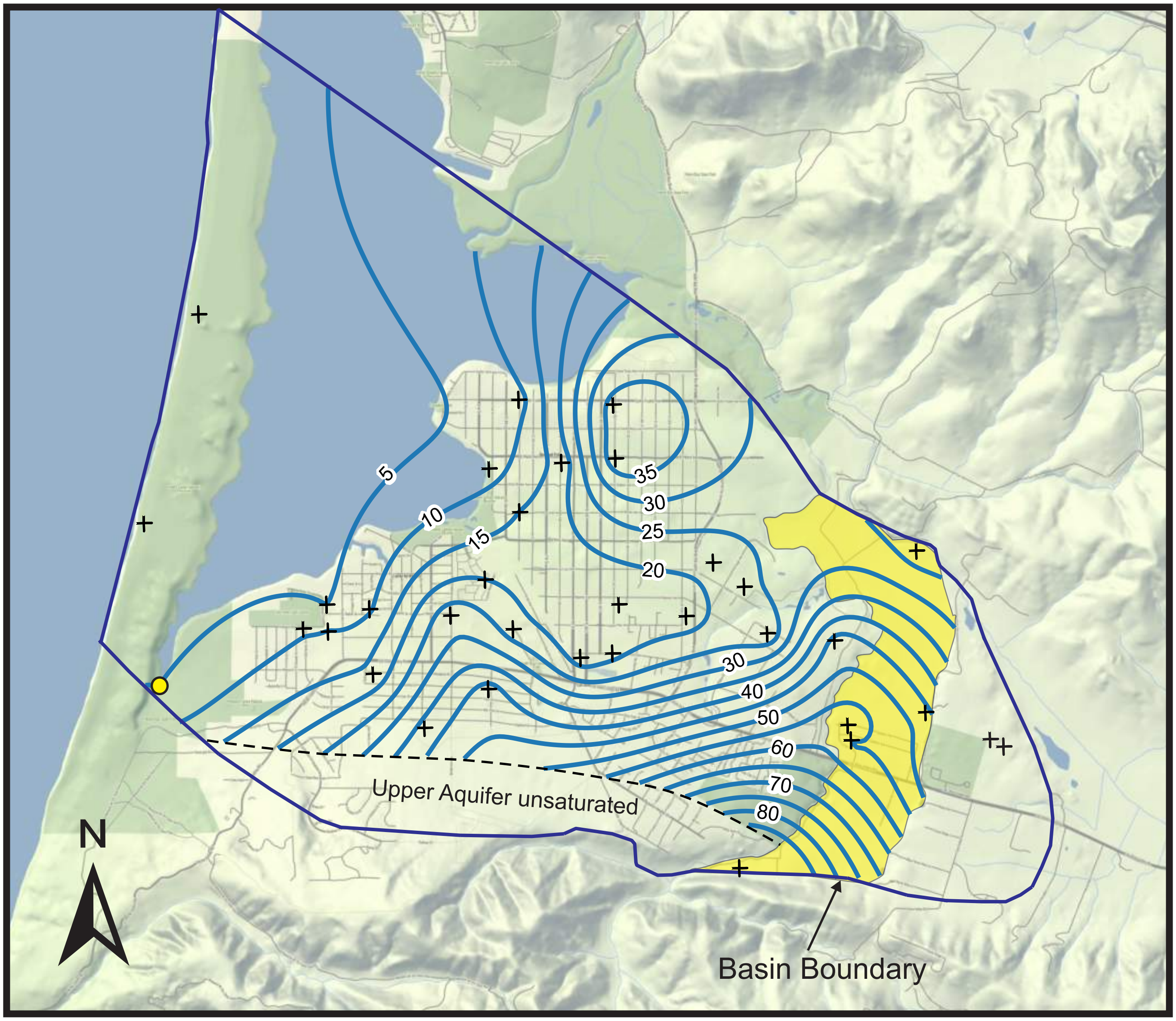
Spring 2018 groundwater elevation data point (contours not applicable outside of Perched Aquifer limits)

Alternate date groundwater elevation data point

Spring seep used for groundwater elevation

Figure 9
Spring 2018 Water Level Contours
Perched Aquifer
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

Explanation

40 — Groundwater elevation contour in feet above sea level (NAVD 88 datum)

Limits of Alluvial Aquifer

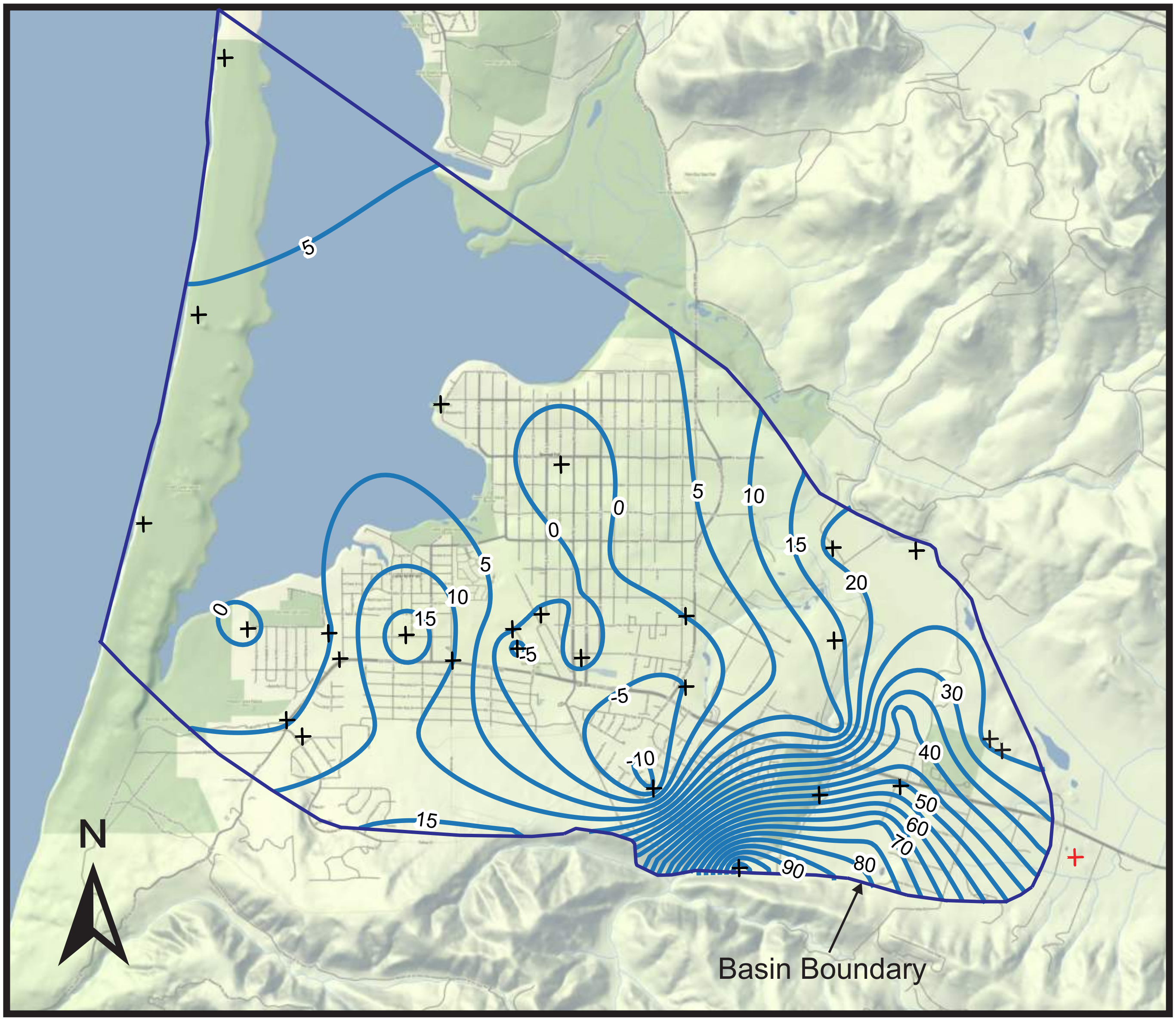
\+ Spring 2018 groundwater elevation data point (contours not applicable outside of Upper Aquifer and Alluvial Aquifer limits)

Spring seep used for groundwater elevation

NOTE: Area where Upper Aquifer is unsaturated along southern Basin boundary determined from comparison of water levels with aquifer base contours.

Figure 10
Spring 2018 Water Level Contours
Upper Aquifer and Alluvial Aquifer
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

Explanation

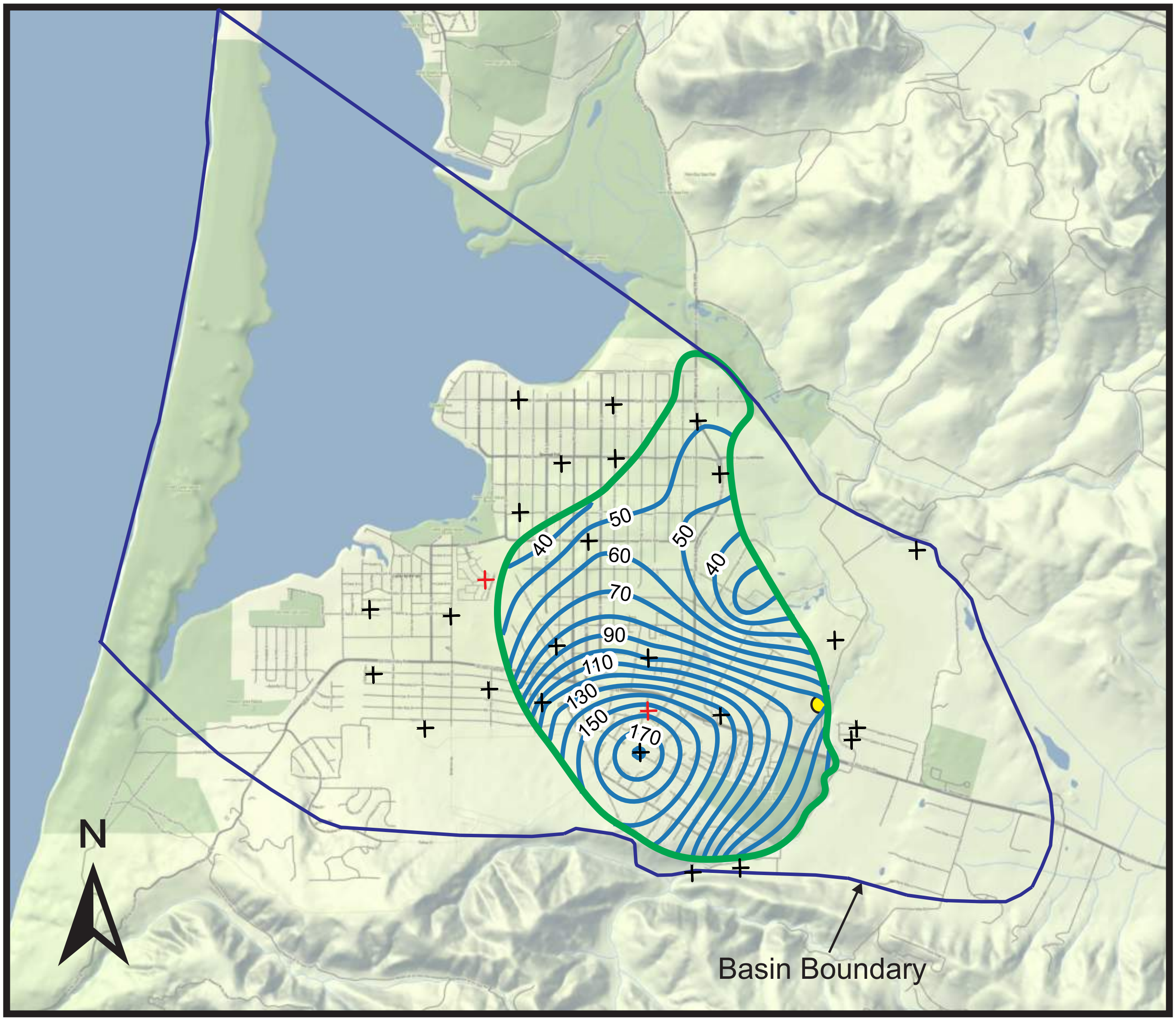
40 — Groundwater elevation contour in feet above sea level (NAVD 88 datum)

+ Spring 2018 groundwater elevation data point

+ Alternate date groundwater elevation data point

Figure 11
Spring 2018 Water Level Contours
Lower Aquifer
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

Explanation

40 — Groundwater elevation contour in feet above sea level (NAVD 88 datum)

Approximate limits of Perched Aquifer

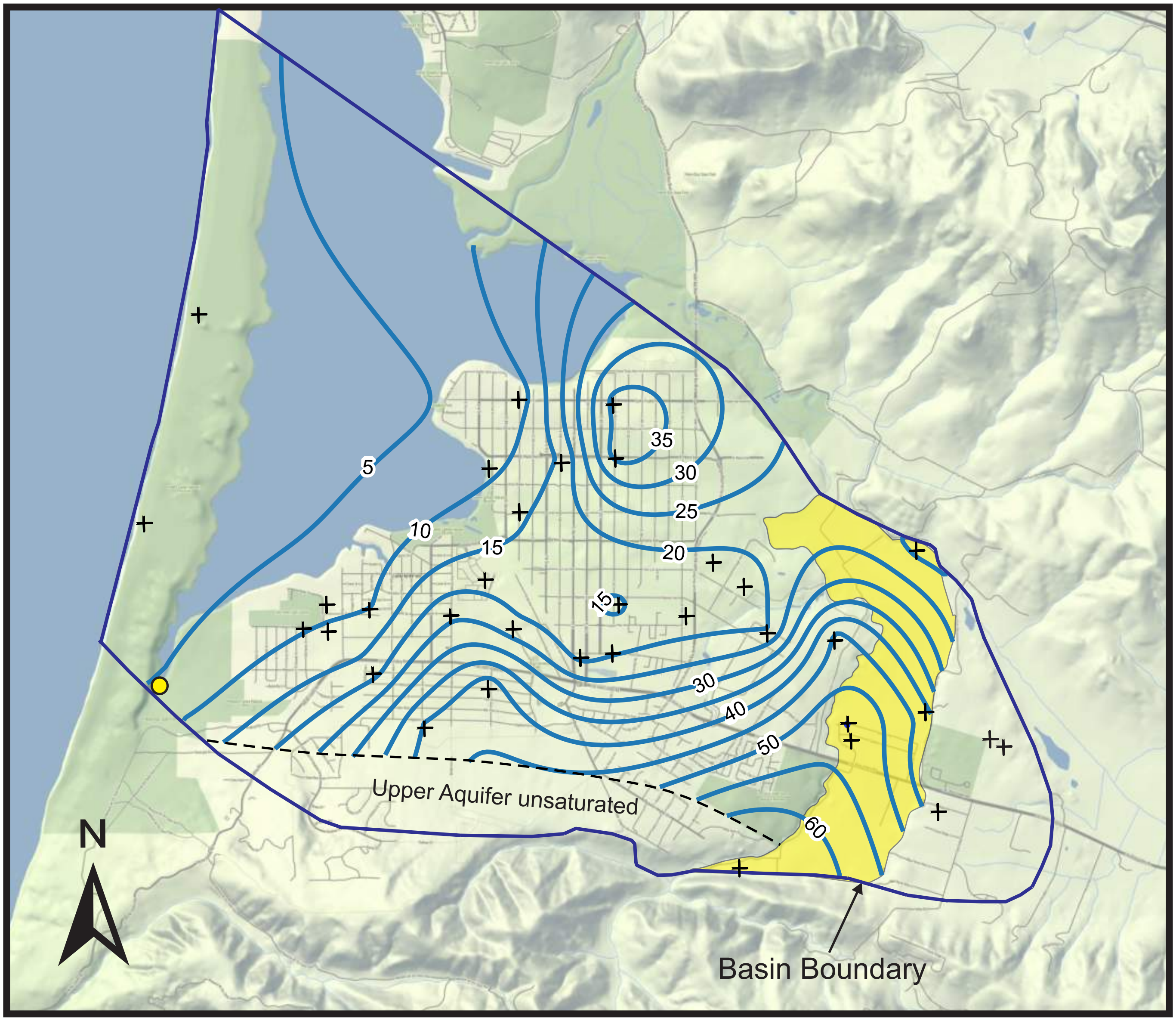
+ Fall 2018 groundwater elevation data point (contours not applicable outside of Perched Aquifer limits)

+ Alternate date groundwater elevation data point

○ Spring seep used for groundwater elevation

Figure 12
Fall 2018 Water Level Contours
Perched Aquifer
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

Explanation

40 — Groundwater elevation contour in feet above sea level (NAVD 88 datum)

Limits of Alluvial Aquifer

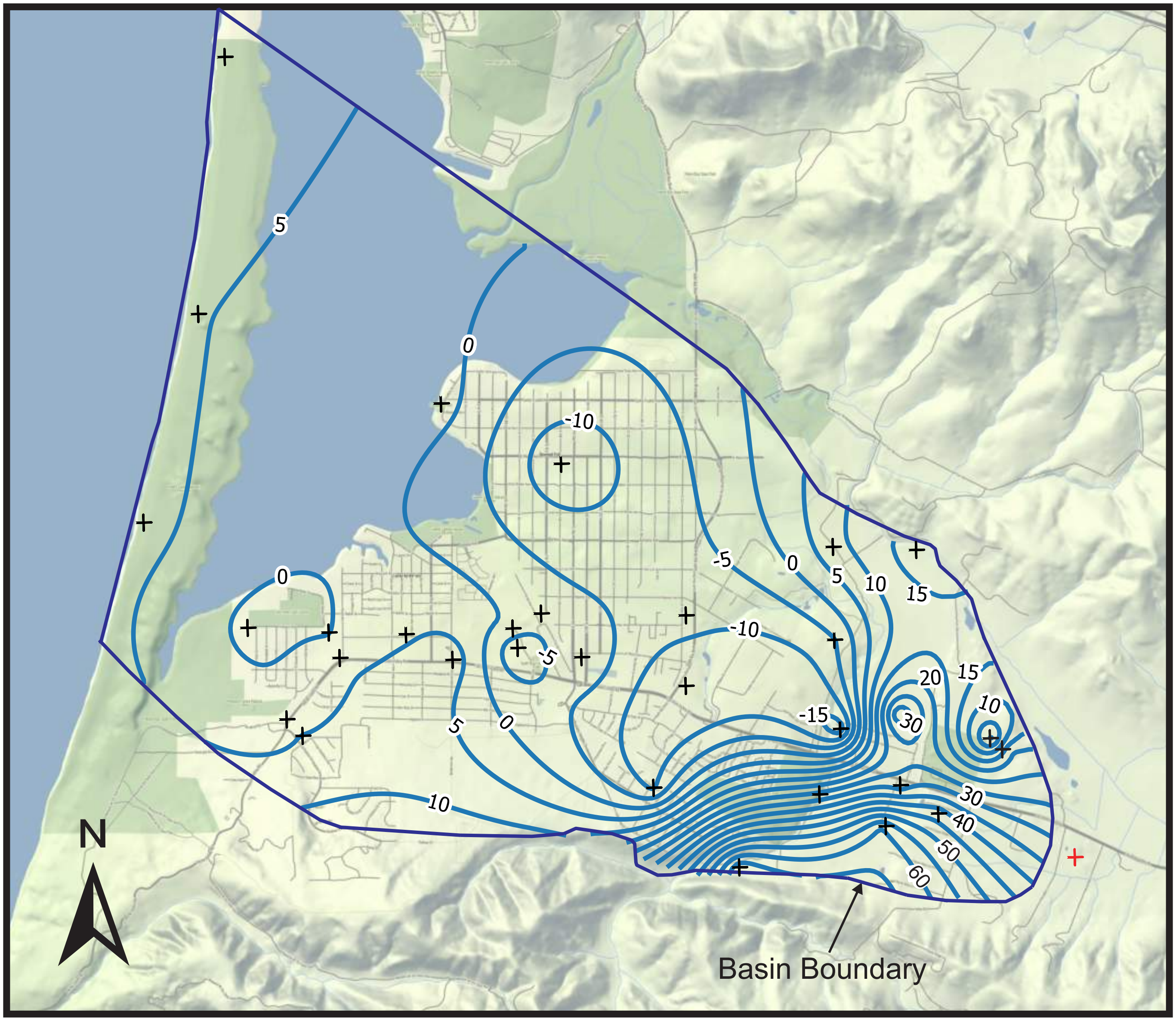
\+ Fall 2018 groundwater elevation data point (contours not applicable outside of Upper Aquifer and Alluvial Aquifer limits)

○ Spring seep used for groundwater elevation

NOTE: Area where Upper Aquifer is unsaturated along southern Basin boundary determined from comparison of water levels with aquifer base contours.

Figure 13
Fall 2018 Water Level Contours
Upper Aquifer and Alluvial Aquifer
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

Explanation

40 Groundwater elevation contour in feet above sea level (NAVD 88 datum)

+ Fall 2018 Groundwater elevation data point

+ Alternate date groundwater elevation data point

Figure 14
Fall 2018 Water Level Contours
Lower Aquifer
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

Contour maps for the Upper Aquifer and Alluvial Aquifer (Figures 10 and 13) show the highest groundwater elevations are at the southern edge of the Los Osos Creek alluvial valley. The general direction of groundwater flow is to the northeast along the creek valley and to the northwest toward the Morro Bay estuary. Significant features include a pumping depression interpreted to be present in the area of downtown Los Osos, and a groundwater high interpreted to be present beneath dune sand ridges in Baywood Park. Upper Aquifer groundwater elevation contours averaged approximately 2.4 feet of water level decline from Spring 2018 to Fall 2018.

Contour maps for the Lower Aquifer (Figures 11 and 14) show the highest groundwater elevations are at the southern edge of the Los Osos Creek alluvial valley and near the eastern Basin boundary. The steep hydraulic gradient between the Upper Creek Valley and downtown Los Osos suggests significant permeability restrictions between these two areas, possibly fault related (Yates and Weise, 1988; Cleath & Associates, 2005). Groundwater flow in the Lower Aquifer is generally toward Central Area pumping depressions which are below sea level. Lower Aquifer groundwater elevations averaged approximately 6.2 feet of water level decline from Spring 2018 to Fall 2018, compared to estimated seasonal declines of 4.5 feet in both 2016 and 2017.

7.2 Water Level Hydrographs

Water levels hydrographs for representative First Water, Upper Aquifer, and Lower Aquifer wells have been compiled for the Western and Central Basin Areas, including one of the Lower Aquifer wells in the Dunes and Bay Area. These wells present the general water level trends. The hydrographs are shown in Figures 15, 16, and 17, respectively.

In previous reports, trends for the First Water wells have been analyzed in ten-year spans. There was a lapse in monitoring between 2006 and 2012 for three of the five representative First Water wells, however, so beginning in 2017 a five-year trend will be analyzed, increasing by one year with each subsequent report until the First Water trend analysis returns to a ten-year span.

The Spring to Spring water level trend for the last 6 years (2012-2018), based on First Water hydrographs in Western and Central Area wells was 0.45 feet of decline per year (Figure 15). For Upper and Lower Aquifer wells, the Spring to Spring water level trend over the last ten years (2008-2018), based on Central and Western wells was 0.05 feet of decline per year (relatively flat) in the Upper Aquifer, and 0.61 feet of rise per year in Lower Aquifer water levels (Figures 16 and 17, respectively).

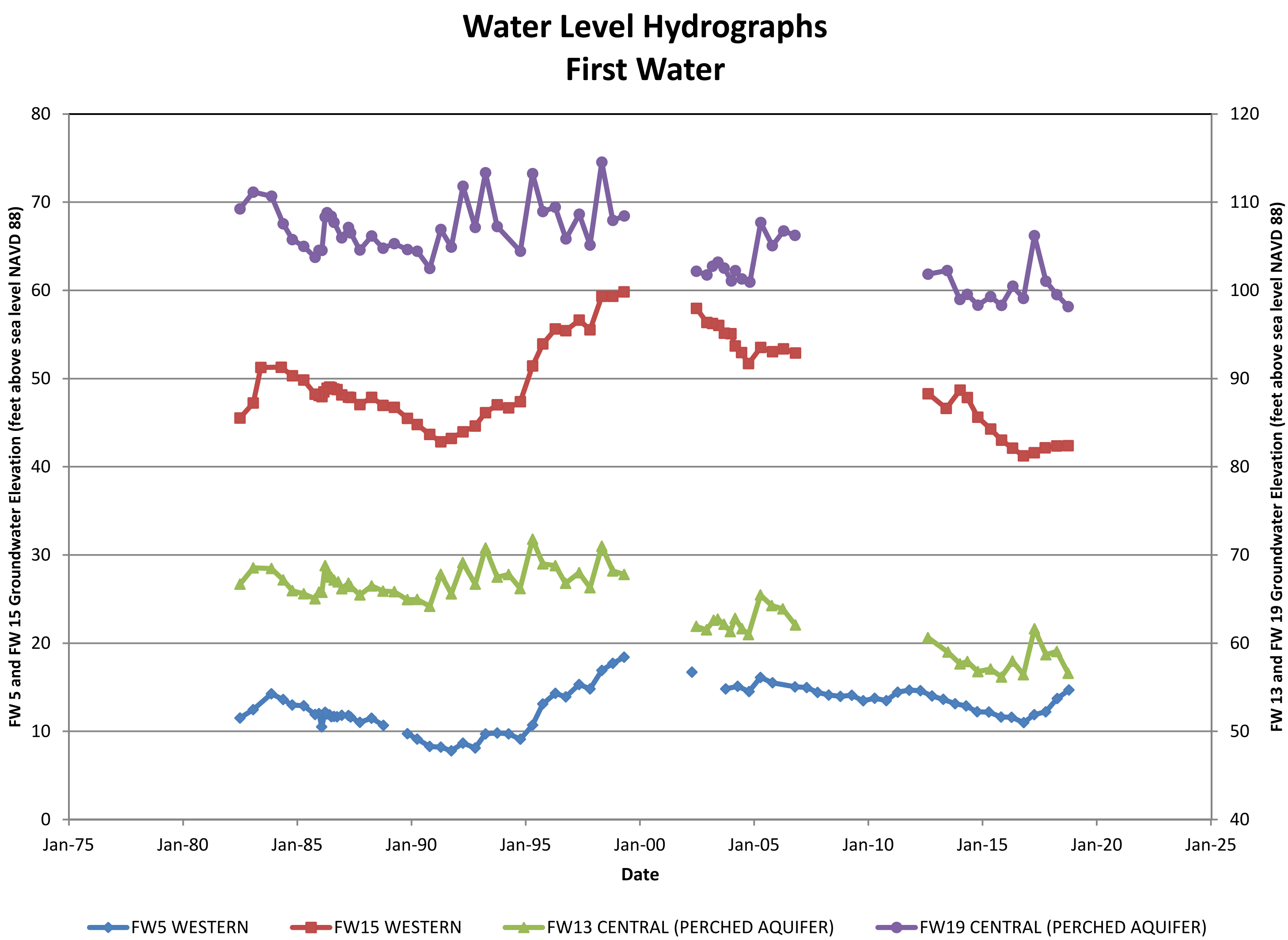


Figure 15
Water Level Hydrographs
Perched Aquifer / First Water
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

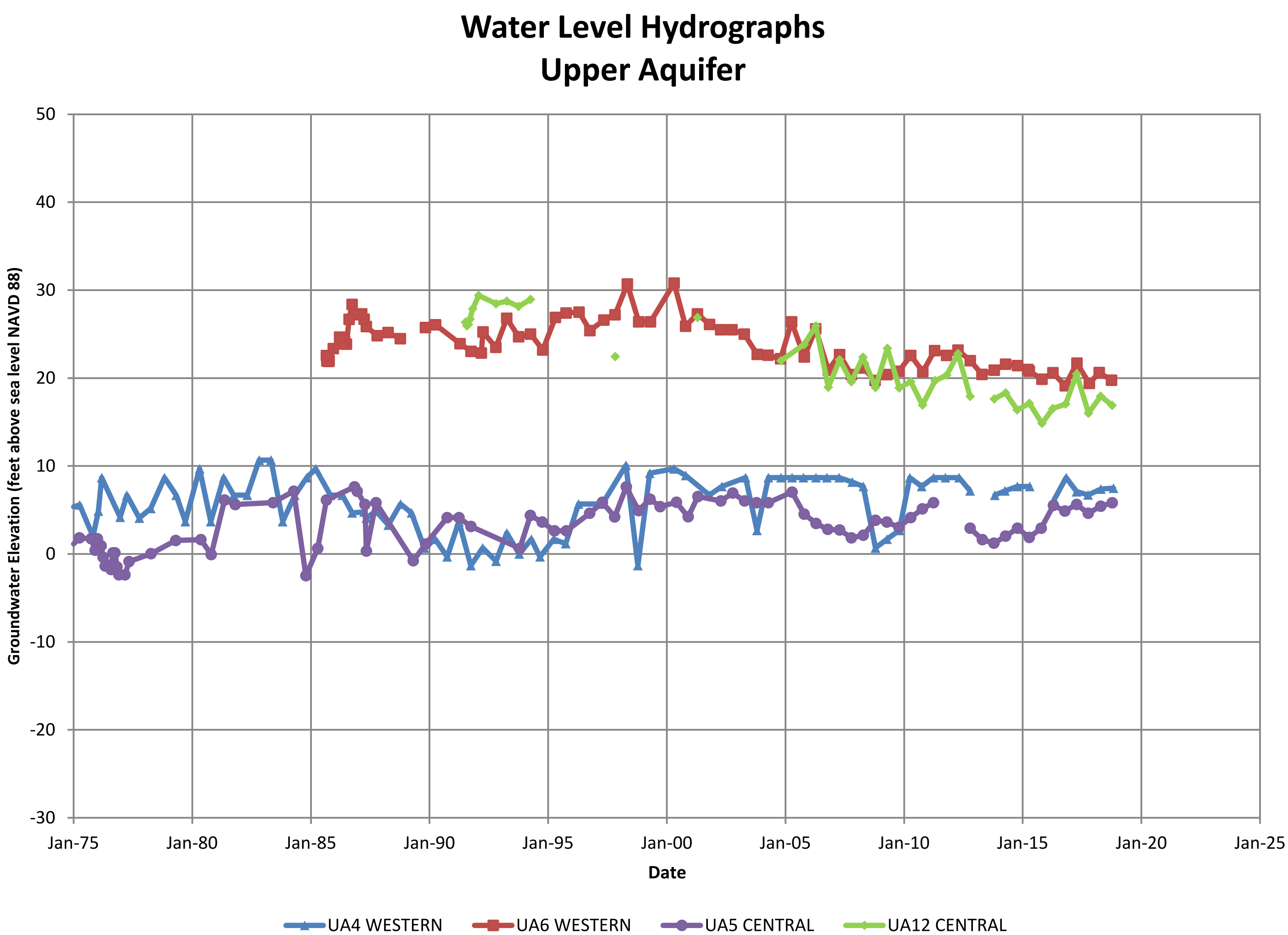


Figure 16
Water Level Hydrographs
Upper Aquifer
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

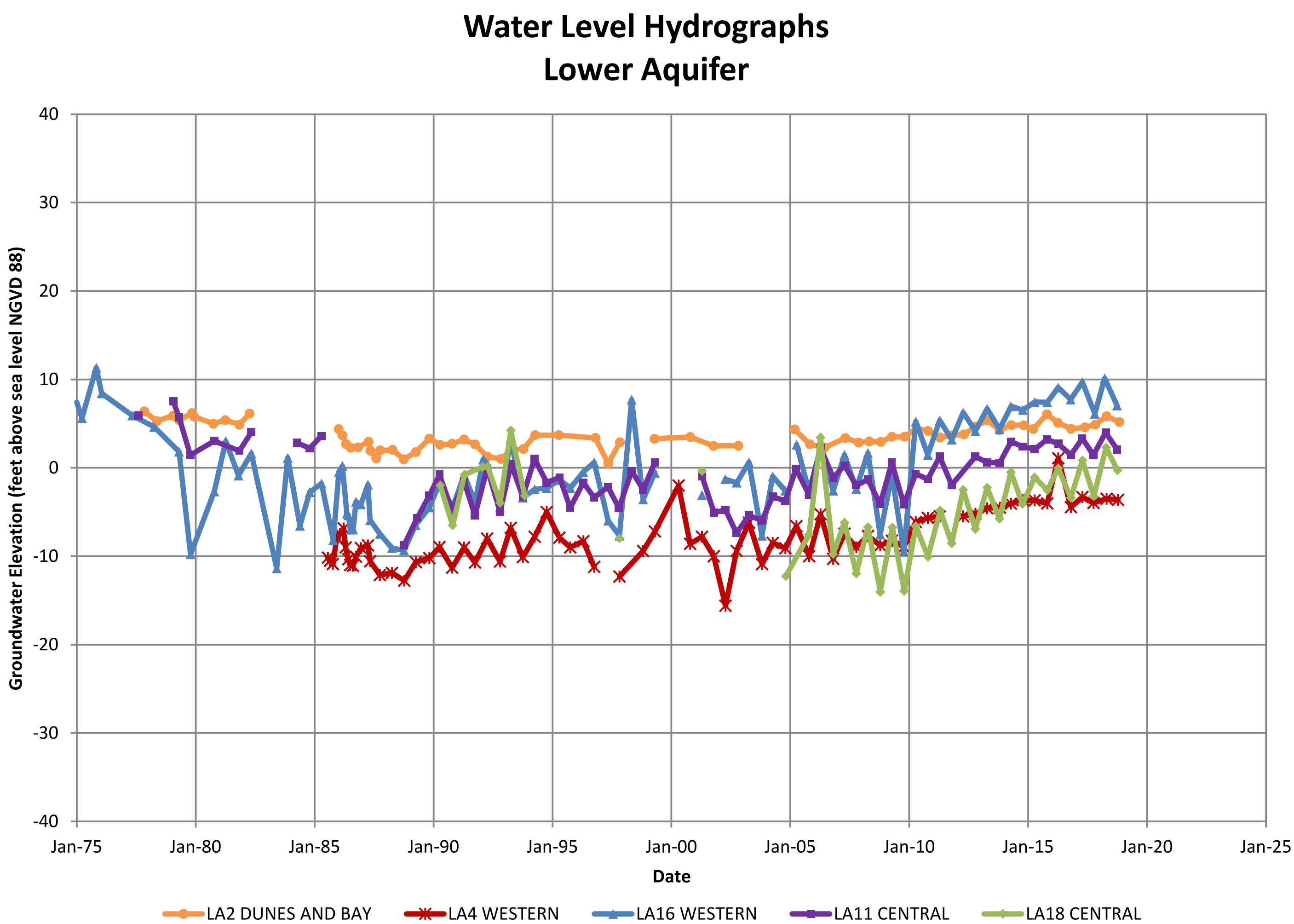


Figure 17
Water Level Hydrographs
Lower Aquifer
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

Hydrographs for seven wells equipped with pressure transducers are shown in Appendix I. The transducers have been installed to provide greater detail of water level trends and fluctuations. There are three First Water wells, two Upper Aquifer wells, and two Lower Aquifer wells equipped with transducers.

The transducer hydrographs have been interpreted to show the following short-term trends:

- FW6 is screened in the top of the Upper Aquifer near the Broderson leach field in the Western Area of the Basin. The hydrograph showed a relatively flat water level trend between January and June of 2017, followed by a water level increase of ten feet through December 2018. The rise in water level is credited to groundwater mounding on the regional aquitard beneath the Broderson leach field. This mounding is expected to increase the downward hydraulic gradient and promote leakage through the regional aquitard, which will help to mitigate seawater intrusion in the Western Area.

- FW10 is screened at the top of the Upper Aquifer in the Central Area of the Basin, while UA4 and UA10 are screened at the bottom of the Upper Aquifer in the Western Area and Central Area of the Basin respectively. These wells displayed seasonal fluctuations of 2-5 feet (i.e., lower elevations during the summer and higher elevations during the winter and spring), including 1-2 feet of interference related to nearby pumping wells.

- FW27 is screened in the Alluvial Aquifer in the Eastern Area of the Basin. The well was equipped with a transducer in April of 2017, near the seasonal high water period, and has shown seasonal fluctuations since then between 25 and 35 feet. The relatively large seasonal fluctuation is attributable to the well's location in the upper Los Osos Creek alluvial valley (Figure 2), where the majority of seasonal recharge from stream seepage in the Basin occurs.

- LA13 and LA37 are screened in Lower Aquifer in the Central Area and Eastern Area of the Basin, respectively. These wells displayed a seasonal fluctuation of approximately 7-9 feet, including interference related to nearby pumping wells.

7.3 Seawater Intrusion

The position of the Fall 2018 seawater intrusion front in Lower Aquifer Zone D is shown in Figure 18, along with the positions of the seawater intrusion front in 2015-2017 and 2005. The seawater intrusion front corresponds to the position of the 250 mg/L chloride isopleth, based on water quality samples from six Lower Aquifer wells: LA8, LA10, LA11, LA12, LA15 and LA31. The intrusion front retreated toward the coast up to 270 feet between Fall 2017 and Fall 2018, which represents the continued reversal of seawater intrusion. However, it is worth noting that Figure 18 is a simplification of Basin conditions, and the calculated position of the intrusion front and associated velocity of the intrusion front movement can vary significantly from year to year, and from Spring to Fall due to localized chloride fluctuations, particularly at well LA10.

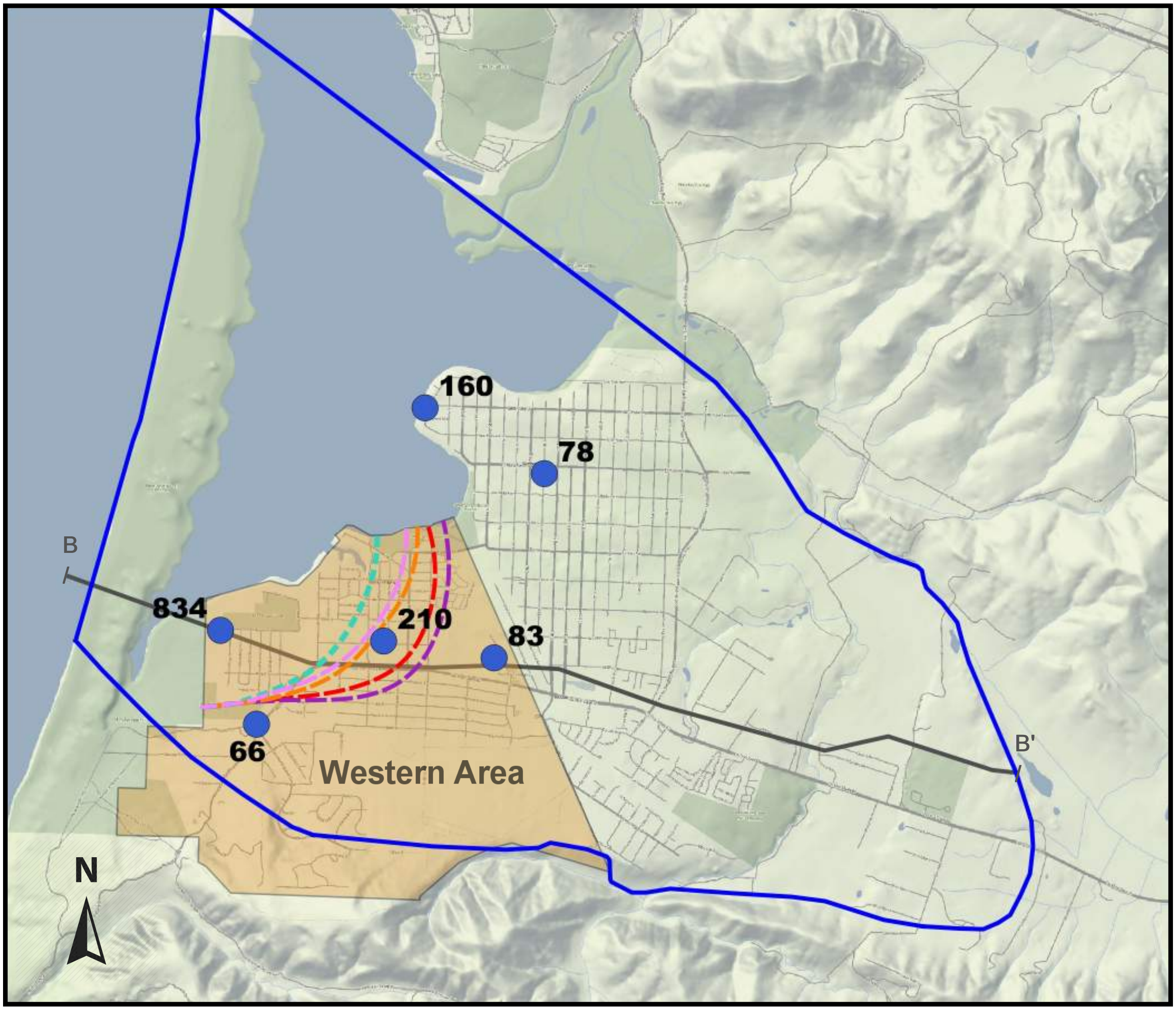
Contouring for the intrusion front (250 mg/L chloride isopleth) shown in Figure 18 uses the ordinary kriging interpolation method, which provides a best (least-squares) estimate of values at unmeasured points based on the mapped values. Chloride concentrations at Dunes and Bay Area wells LA2 and LA3 are two orders of magnitude greater than the Western Area wells and were not used for contouring the intrusion front in the Western Area. The ordinary kriging interpolation method involves weighted linear interpolation, whereas the chloride concentrations approaching wells LA2 and LA3 on the sandspit do not appear to follow linear gradients.

The location of the intrusion front is also shown in cross-section on Figure 19. Lower Aquifer Zone D intrusion is discussed above. There is insufficient information to represent Lower Aquifer Zone E intrusion in a plan view figure. The only Western Area well which represents Zone E water quality is LA4, located near Sea Pines Golf Course. Water quality at LA4 has been close to seawater since first sampled in 1985 (Cleath & Associates, 2005). Other control points for Zone E water quality along the B-B' cross-section orientation in Figure 19 are LA15 and LA18 in the Central Area. The seawater front reached LA15 in 2009, but there has been no evidence of further inland movement toward LA18, and geophysics in 2018 at nearby deep monitoring well LA14 continues to show no sign of intrusion. This is interpreted as an indication that historical Zone E intrusion toward the Well LA15 was through a relatively narrow preferential pathway. In 2013, LA15 was modified to remove Zone E production (CHG, 2014).

Wellbore Leakage at LA10

A decline in chloride concentrations beginning in 2017 and continuing in 2018 at Chloride Metric well LA10 was accompanied by reduced well production and an increase in nitrate concentrations. Nitrate concentrations in the Upper Aquifer are elevated in the Upper Aquifer, while chloride concentrations are low, which suggests wellbore leakage from the Upper Aquifer may be influencing LA10 water quality by lowering chloride concentrations (and the Chloride Metric) more than would otherwise occur. Wellbore leakage refers to water moving vertically through the filter pack within the annular space between the well casing and the borehole wall.

An analysis of wellbore leakage at LA10 is presented in Appendix J. Based on the results of the analysis, chloride concentrations at LA10 during 2017 and 2018 that were not affected by wellbore leakage have been used for Chloride Metric calculations and are incorporated into Figure 18 and Section 7.5.3 of this Annual Report.



Base Image: Stamen-Terrain

Scale: 1 inch ≈ 4,000 feet

Explanation

834 Groundwater with Fall 2018 lower aquifer chloride concentration in milligrams per liter (mg/L)

Cross-section alignment (Figures 5 and 19)

Basin boundary

Seawater intrusion front in Western Area (250 mg/L chloride isopleth)

2005

2015

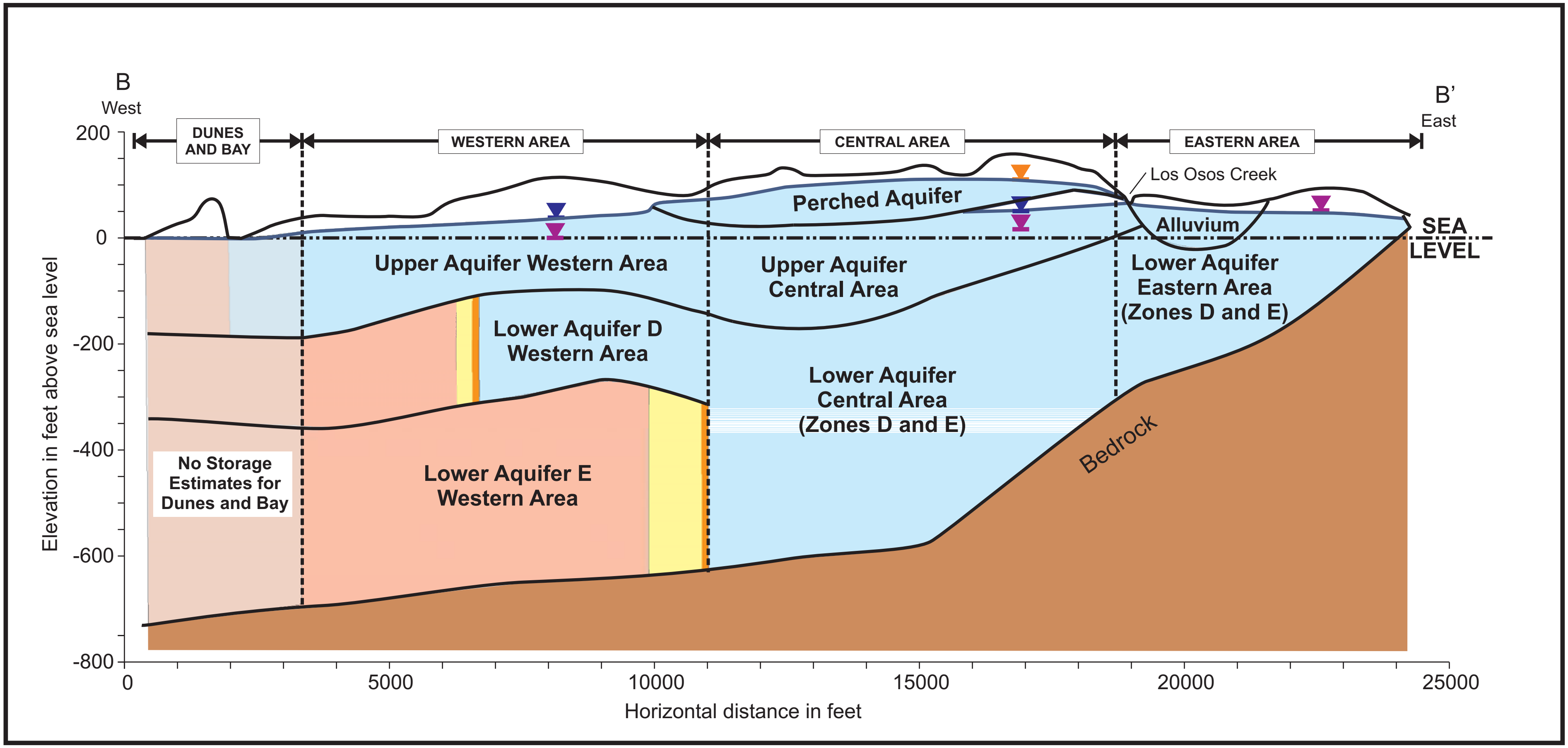
2016

2017

2018

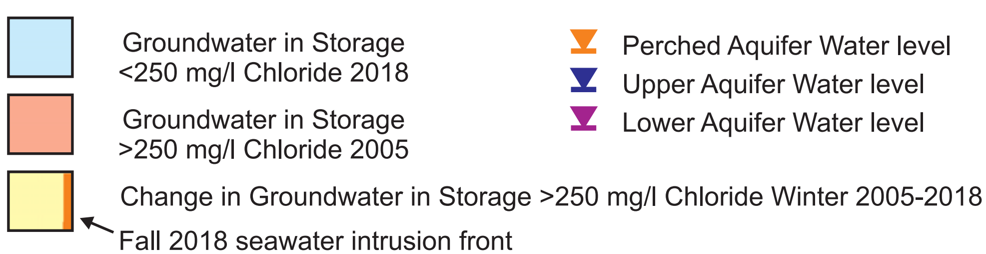
Figure 18
Seawater Intrusion Front
Western Area Lower Aquifer Zone D
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists



Cross-section alignment shown in Figure 18

Explanation



NOTE: Inland movement of intrusion front between Fall 2017 and Fall 2018 shown in Figure 18 is for Lower Aquifer Zone D. There is no evidence of further inland movement of the intrusion front in Zone E.

Figure 19
Basin Storage Compartments
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

7.4 Groundwater in Storage

Groundwater in storage for Basin areas and aquifers has been estimated through a systematic approach of water level contouring, boundary definition, volume calculations, and aquifer property estimation. The methodology was developed to facilitate change in storage calculations from year to year. An example storage calculation for the Eastern Area is shown in Appendix K. Storage estimates were performed for Spring and Fall 2018 and included separate estimates for the following areas and aquifers shown in Figure 19:

- Perched Aquifer
- Western Area Upper Aquifer
- Western Area Lower Aquifer
- Central Area Upper Aquifer
- Central Area Lower Aquifer
- Eastern Area Alluvial and Lower Aquifer

The various storage compartments are shown conceptually in Figure 19. Storage estimates for the Lower Aquifer in the Western and Central Areas combine fixed pore space volume and confined pore space volume components. The fixed volume component of storage is based on the specific yield of the aquifer sediments and is fixed because the Lower Aquifer is never dewatered in the Western and Central Areas. The confined component adds a relatively small volume of transient storage associated with the aquifer pressure and is based on the storativity of the aquifer. Specific yield values for aquifer zones are shown in Table 17 (with log correlations in Appendix K).

Table 17. Estimated Specific Yield Values

Aquifer Zone	Specific yield [1] (percent of volume)
Zone A&B	12.8
Zone C	10.2
Zone D	8.8
Zone E	10.5
Qal	13.0
Zones D&E [2]	9.8
Qal, Zones D&E [3]	10.1

Notes: [1] Weighted specific yield values based on log correlations in Appendix K.
[2] Used for Central Area storage calculations
[3] Used for Eastern Area storage calculations

Storage calculations prior to this Annual Report had assumed a fixed specific yield value of 10 percent. Beginning in 2018, storage calculations are based on specific yields for each individual aquifer zone and are more representative of Basin conditions.

Confined and semi-confined aquifer storativity values are typically orders of magnitude less than the specific yield. The average specific yield for Basin sediments is estimated to range from 9.8 percent to 13 percent (Table 17). The storativity value used for the confined aquifer in the Western and Central Areas is estimated at 0.0008 (Cleath & Associates, 2005).

The storage component of the Lower Aquifer in the Western Area Zone D represents the groundwater volume with a chloride concentration of 250 mg/L or less. Zone E in the Western Area is excluded from the storage calculations, because chloride concentrations are mostly above 250 mg/L (Figure 19).

All storage calculations were based on upper and lower contoured surfaces specific to the aquifer (fixed volume and confined volume were combined). For example, elevation contours on the base of the Perched Aquifer were used as the lower bounding surface for Perched Aquifer storage calculations, so no storage was assigned to unsaturated pore space between the base of the perched aquifer and saturated Upper Aquifer sediments (Figure 19). Appendix K includes a list of wells used for 2018 groundwater elevation contours and associated upper surfaces for storage calculations. Fixed upper and lower surfaces used for storage calculations (base of perched aquifer, top and bottom of regional clay aquitard, and base of permeable sediments were developed from existing contour maps and control points presented in prior reports (Cleath & Associates, 2003, 2005; CHG, 2015). Table 18 summarizes the estimates of fresh groundwater in storage for 2018.

Table 18. Groundwater in Storage Spring and Fall 2018 (<250 mg/L Chloride)

Basin Area	Aquifer	Zone	Spring 2018		Fall 2018	
			Total	Above Sea Level	Total	Above Sea Level
			ACRE-FEET			
Western and Central	Perched	A, B	5,800	5,800	5,500	5,500
	Upper	C	28,600	6,700	27,800	5,900
Western	Lower[1]	D[2]	14,200	<10	14,300	<10
Central	Lower[1]	D, E	55,100	<10	55,100	<10
Eastern	Alluvial and Lower	Alluvial, D, E	19,000	4,500	18,200	3,700
TOTAL			122,700	17,000	120,900	15,100

NOTES: [1] Includes fixed and confined storage.
[2] Western Area Zone E not included due to chloride >250 mg/L.

Total estimated fresh groundwater in storage for the Basin (excluding Dunes and Bay Area) averaged 122,700 acre-feet in Spring 2018, with an estimated 17,000 acre-feet above sea level (Table 18). There was a calculated net seasonal storage decline of 1,800 acre-feet between Spring

2018 and Fall 2018, although there was an estimated gain of 100 acre-feet of freshwater storage in Lower Aquifer Zone D due to a retreating seawater intrusion front in the western Lower Aquifer. The increase in freshwater storage from Spring to Fall is based on movement of the 250 mg/L chloride isopleth in Zone D, similar to what is shown in Figure 18.

There is approximately 70,000 acre-feet of fresh groundwater in storage within the Lower Aquifer in the Western Area Zone D and Central Area Zones D and E (Table 18). Because groundwater levels in the Lower Aquifer within the Western and Central Areas average more than 100 feet above the top of the aquifer, dewatering is unlikely, and this volume of storage will only change with movement of the seawater intrusion front. The Lower Aquifer storage includes a relatively small component (less than 200 acre-feet) of confined pore space volume, representing water that is available without dewatering any portion of the Lower Aquifer (the pressure component). Water is relatively incompressible, so once the pore spaces of an aquifer have been filled, substantial confining pressure is required to further increase the storage volume. Conversely, there is a much greater drop in aquifer water levels for storage withdrawals under confined conditions, compared to unconfined conditions. This smaller storage volume assumes a confined aquifer storativity of 0.0008, compared to the unconfined specific yields of 0.098 to 0.13. Table 19 compares Spring 2017 groundwater in storage with Spring 2018. Note that Spring 2017 storage values shown below are based on the updated specific yield values in order to estimate the change in storage.

Table 19. Change in Storage Spring 2017 to Spring 2018 (<250 mg/L Chloride)

Basin Area	Aquifer	Zone	Spring 2017[1]		Change from Spring 2017 to Spring 2018	
			Total	Above Sea Level	Total	Above Sea Level
			ACRE-FEET			
Western and Central	Perched	A, B	6,000	6,000	-200	-200
	Upper	C	28,500	6,600	100	100
Western	Lower[2]	D[3]	13,000	<10	1,200	0
Central	Lower[2]	D, E	55,100	<10	0	0
Eastern	Alluvial and Lower	Alluvial, D, E	19,200	4,700	-200	-200
TOTAL			121,800	17,300	900	-300

NOTES: [1] Spring 2017 storage based on updated specific yield values
[2] Includes fixed and confined storage.
[3] Western Area Zone E not included due to chloride >250 mg/L.

As shown in Figure 18 and Table 19, the retreating seawater intrusion front resulted in a gain of 1,200 acre-feet of freshwater storage in the Lower Aquifer between Spring 2017 and Spring 2018 due to the retreating seawater intrusion front. There was also a loss of 300 acre-feet in storage above sea level over the same period, for a net gain of 900 acre-feet of storage between Spring 2017 and Spring 2018.

7.5 Basin Metrics

The LOBP established two methods for measuring progress in management of seawater intrusion (ISJ Group, 2015): one based on comparing annual groundwater extractions with the estimated sustainable yield of the Basin as calculated by the Basin numerical groundwater model, and one based on evaluating water level and water quality data from the LOBP Groundwater Monitoring Program. The first method involves the Basin Yield Metric and the Basin Development Metric, while the latter method involves the Water Level Metric, The Chloride Metric, and the Nitrate Metric.

7.5.1 Basin Yield Metric

The Basin Yield Metric compares the actual amount of groundwater extracted in a given year with the estimated sustainable yield of the Basin under then-current conditions. Sustainable yield is estimated using the Basin model as the maximum amount of water that may be extracted from the Basin with none of the active wells producing water with chloride concentration in excess of 250 mg/L (ISJ Group, 2015). A chloride concentration of 250 mg/L is the recommended limit for drinking water (one-half of the Secondary Maximum Contaminant Level Upper Limit of 500 mg/L). The Basin Yield Metric for 2018 is a ratio expressed as follows:

$$\frac{\text{2018 Groundwater Production}}{\text{2018 Sustainable Yield}} * 100$$

Groundwater production in 2018 was 2,030 acre-feet. The sustainable yield of the Basin with the infrastructure in place at year-end 2016 was estimated using the Basin model to be 2,760 acre-feet per year (CHG, 2017b). The 2016 estimate included the first Program C well and is applicable to year-end 2018, therefore, the Basin Yield Metric in 2018 is 74. The corresponding Basin Yield Metric was 78 in 2016, which was the first year the metric has been below 80 since the early 1970's. The LOBP objective for the Basin Yield Metric is 80 or less and has been met in each of the last three years.

Figure 20 compares the Basin Yield Metric and area production in the Basin since 2005. The Basin Yield Metric has dropped from an average of 125 between 2005 and 2009 to 74 in 2018. Two development scenarios from the LOBP are also provided for comparison in Figure 20.

Estimated sustainable yield in the equation above is not simply a volume of water, however, but is also the distribution of groundwater pumping across the Basin that maintains a stationary seawater front, with no active well producing water with chloride concentrations above 250 mg/L. Long-term climatic conditions are assumed for the estimated sustainable yield.

The estimated sustainable yield of the Basin has been reported to the closest 10 acre-feet, similar other water balance components estimated using the Basin model (LOBP, 2015). This level of rounding is based on the precision, not the accuracy, of the Basin model. Estimating the sustainable yield of the Basin is directly associated with mitigating seawater intrusion. The ability of the Basin model to accurately simulate seawater intrusion was evaluated during model conversion to Equivalent Freshwater Head (EFH) in 2005 (Cleath & Associates 2005) and again during model conversion to SEAWAT in 2009 (CHG, 2009a). In 2005, the EFH model estimated 620 acre-feet per year of seawater intrusion along the coast under long-term climatic conditions with 1999-2001 Basin pumping, while an analytical approach using available hydrogeologic data and Darcy's Law estimated 500 acre-feet per year of intrusion, indicating the numerical analysis (flow model) was more conservative as a Basin management tool than the analytical approach. A subsequent comparison of seawater intrusion at the coast between the EFH model and upgraded SEAWAT model of seawater intrusion at the coast showed the two models were within 2 percent of each other. The SEAWAT model also matched the historical average velocity of sea water intrusion into the Lower Aquifer of 50-60 feet per year (from water quality data), although the simulated velocity was higher in Zone D (80 feet per year) and lower in Zone E (40 feet per year).

7.5.2 Basin Development Metric

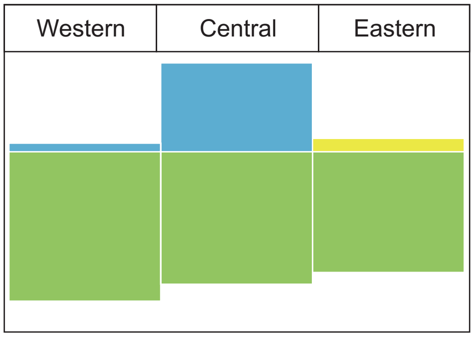
The Basin Development Metric compares the estimated sustainable yield of the Basin in a given year with the estimated maximum sustainable yield of the Basin with all potential LOBP Projects implemented (see Section 10 for a brief overview of LOBP Programs). The Basin Development Metric for 2018 is a ratio expressed as follows:

$$\frac{\text{2018 Sustainable Yield}}{\text{Maximum Sustainable Yield}} * 100$$

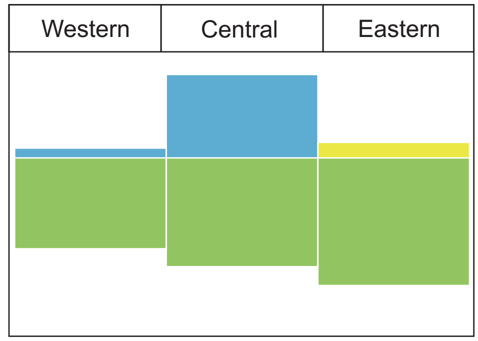
The 2018 sustainable yield is estimated at 2,760 acre-feet. The maximum sustainable yield with all LOBP projects implemented is estimated at 3,500 acre-feet. Therefore, the Basin Development Metric in 2018 is 79, which is the same value as 2017. The purpose of the metric is to inform the BMC on the percentage of the Basin's maximum sustainable yield that has been developed. There is no LOBP objective for the Basin Development Metric.

As presented in the LOBP, the estimated sustainable yield of the Basin will increase beginning with urban water reinvestment Program U and Basin infrastructure Programs A and C, both of which are currently in progress.

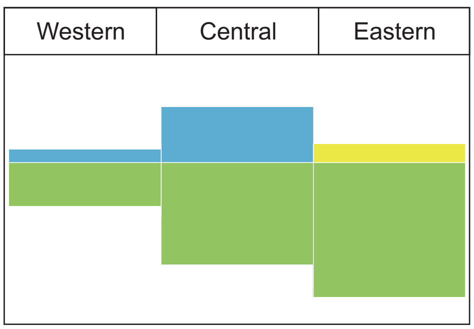
2005-2009
Average Production 3,060 AFY
Basin Yield Metric = 128



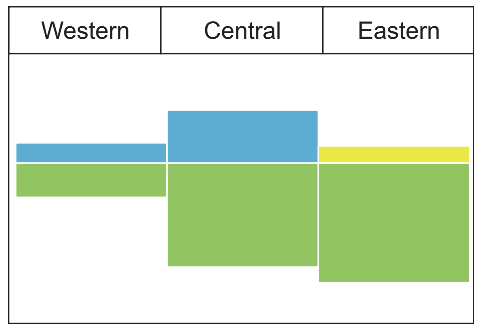
2010-2014
Average Production 2,600 AFY
Basin Yield Metric = 106



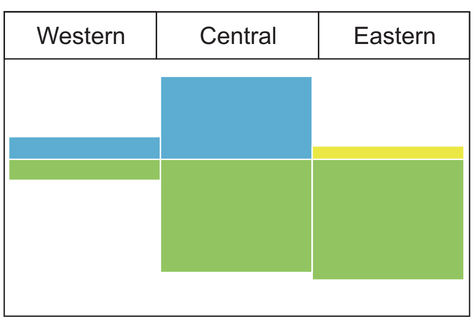
2015-2017
Average Production 2,130 AF
Basin Yield Metric = 77



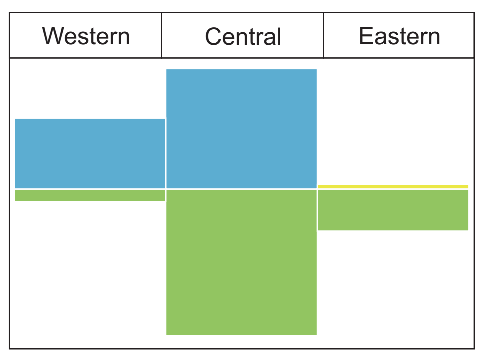
Year 2018
Average Production 2,030 AF
Basin Yield Metric = 74



E+AC+U (No Further Development Scenario)
refer to Basin Plan for full description
Average Production 2,230 AFY
Basin Yield Metric = 74



E+UG+ABC (Buildout Scenario)
refer to Basin Plan for full description
Average Production 2,380 AFY
Basin Yield Metric = 71



Explanation:

Size of rectangle is proportional to groundwater production

Alluvial Aquifer

Upper and Perched Aquifer

Lower Aquifer

Note: historical (pre-2015) and future/projected Basin Yield Metrics are from LOBP

Figure 20
Basin Yield Metric Comparison
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

7.5.3 Water Level, Chloride, and Nitrate Metrics

The Water Level, Chloride, and Nitrate Metrics are measurements of the effectiveness of Basin management. The Water Level and Chloride Metrics address changes in the Lower Aquifer related to seawater intrusion mitigation, while the Nitrate Metric addresses changes in First Water and the Upper Aquifer related to nitrate contamination mitigation.

Water Level Metric

The Water Level Metric is defined as the average Spring groundwater elevation, measured in feet above mean sea level, in five Lower Aquifer wells. These wells are LA2, LA3, LA11, LA14, and LA16 (Figure 4).

Two Water Level Metric wells (LA14 and LA16) are positioned in the Western Area near the current seawater intrusion front (250 mg/L chloride isopleth) and one well is in the Central Area on the bay front (LA11). As Basin production is redistributed through the Basin infrastructure program, these Water Level Metric wells will monitor Lower Aquifer groundwater levels in critical areas near the seawater intrusion front.

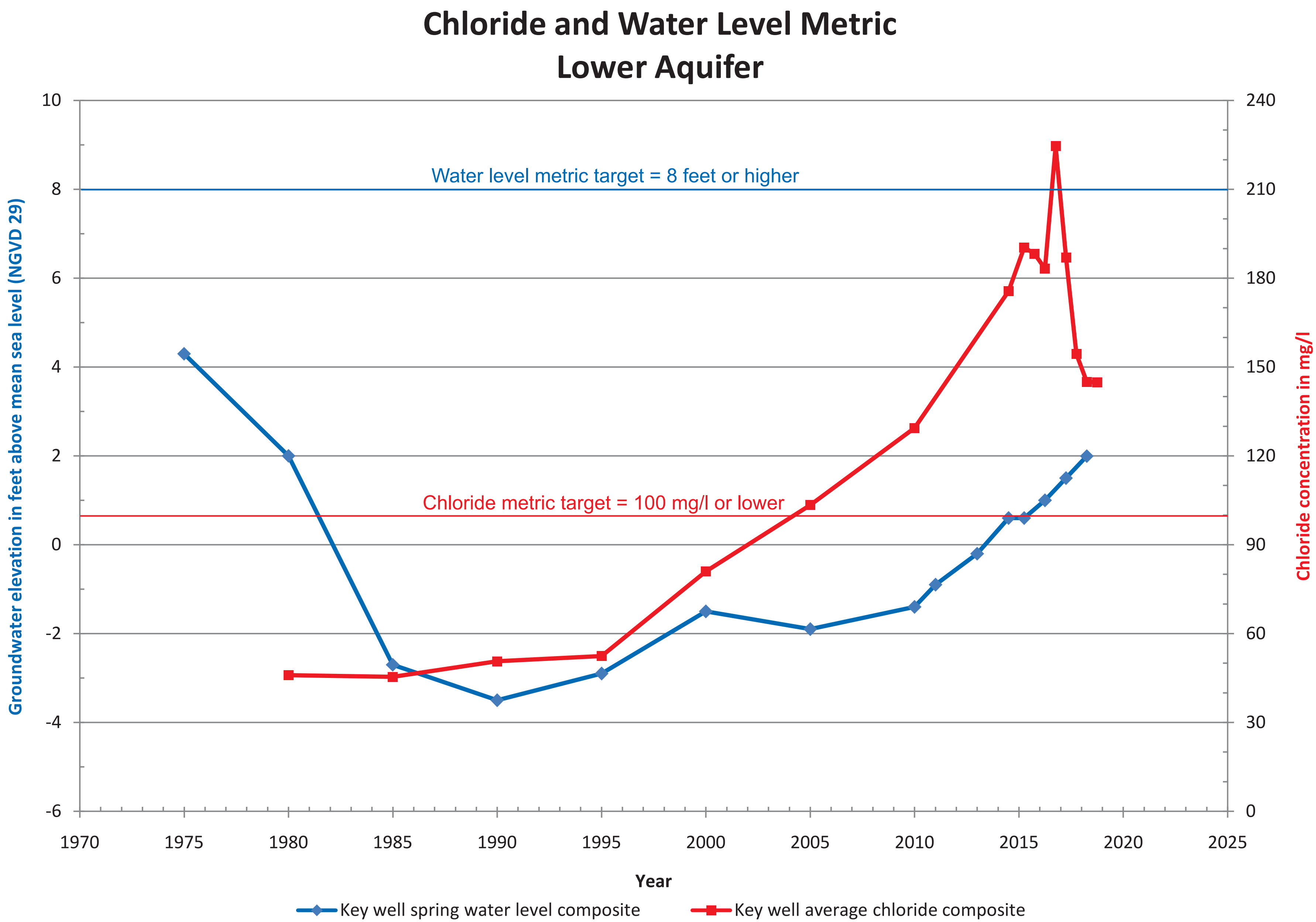
The last two Water Level Metric wells are located on the Morro Bay sand spit (LA2 and LA3), where monitoring will help evaluate regional effects, rather than just localized water level rebound. Figure 21 graphs historical trends in the metric. Table 20 presents the 2018 Water Level Metric.

Table 20. 2018 Water Level Metric

Metric Well	Spring 2018 Groundwater Elevation (feet above sea level - NGVD 29 Datum)
LA2	1.97[1]
LA3	-0.78[1]
LA11	1.18[1]
LA14	-0.78
LA16	8.22[1]
Water Level Metric (average)	2.0 feet

Data Source: LOBP and County Groundwater Monitoring Programs
[1]Subtracted 2.8 feet from NAVD 88 elevations in Table 5 to convert to NGVD 29 datum for metric.

The Spring 2018 Water Level Metric is 2.0 feet NGVD 29 (approximately 4.8 feet NAVD 88). Mean sea level is approximately 0 feet in the NGVD 29 datum, and 2.8 feet in the NAVD 88 datum for the central coast of California, where the Basin is located. The metric was rising (an improvement) from 2005 through 2014, likely in response to a decrease in Lower Aquifer production, did not change between 2014 and 2015, and has begun rising again (Figure 21). The LOBP objective for the Water Level Metric is 8 feet or higher (ISJ Group, 2015). Removal of the



Note: 2017 Chloride Metric revised per analysis of Upper Aquifer influence from borehole leakage at LA10 (Appendix J)

Figure 21
Chloride and Water Level Metric
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

density correction at the sandspit wells, and adjustment of reference point elevations to the NGVD 29 datum has lowered the metric by a few feet compared to prior calculations (CHG 2016b). Reevaluation of the metric objective may be appropriate, however, a review of all well elevation reference points by a licensed surveyor is recommended prior to considering a change in the water level metric objective.

Chloride Metric

The Chloride Metric is defined as the weighted average concentration of chlorides in four key Lower Aquifer wells. One key well (LA10) is within the historical path of seawater intrusion (Cleath & Associates, 2005). Reduction in pumping from the Lower Aquifer should result in measurable declines in chloride concentrations at this well, as the hydraulic head in the Lower Aquifer increases and the inland movement of seawater decreases or is reversed. The LOBP Groundwater Monitoring Program schedule for measuring the Chloride Metric is in the Spring and Fall.

There are also three key wells on the perimeter of the seawater intrusion front (LA8, LA11, and LA12). Wells LA11 and LA12 monitor Lower Aquifer chloride concentrations in the northern portion of the Basin, while LA8 monitors chloride concentrations in the southern portion. When calculating the Chloride Metric, the concentration of Well LA10 is given twice the weight of the other three wells, in order to increase the sensitivity of the metric to management actions (refer to the LOBP for a description of the development of the metric). Table 21 presents the Spring and Fall 2018 Chloride Metric. Figure 21 graphs historical values in the metric. The Chloride Metric is a simplification of Basin conditions and can vary significantly from year to year due to localized chloride fluctuations, particularly at well LA10. The Chloride Metric target level is 100 mg/L or lower.

Table 21. 2018 Chloride Metric

Metric Well	Spring 2018 Chloride Concentrations	Fall 2018 Chloride Concentrations
LA8	79 mg/L	66 mg/L
LA10[1]	190 mg/L (double counted for average)	210 mg/L (double counted for average)
LA11	173 mg/L	160 mg/L
LA12	93 mg/L	78 mg/L
Chloride Metric (weighted average)	145 mg/L	145 mg/L

Data Source: LOBP Groundwater Monitoring Program (Appendix C) except LA10
[1]Spring and Fall 2018 chloride concentrations in LA10 are from a purveyor sampling event (Appendix J)

The 2018 water quality monitoring results indicate a retreat of the seawater intrusion front, compared to prior years. Seawater intrusion is typically greatest in the fall, when water levels are lowest. A comparison between Spring 2018 and Fall 2018 shows no change in the metric, however, the Chloride Metric has decreased relative to the target value between Fall 2017 (154 mg/L) and Fall 2018 (145 mg/L), indicating improvement in 2018 (Figure 21). Note that the Fall 2017 Chloride Metric was revised from 132 mg/L to 154 mg/L following an analysis of Upper Aquifer influence due to borehole leakage at LA10 (Appendix J).

Nitrate Metric

The Nitrate Metric is defined as the average concentration of nitrate in five First Water key wells located in areas of the Basin that have been impacted by elevated nitrate concentrations. The Nitrate Metric data is obtained from the LOWRF Groundwater Monitoring Program's winter sampling event and focuses on shallow, adversely impacted wells to track changes in nitrate concentrations in groundwater over time. Table 22 presents the Nitrate Metric for 2018. Figure 22 graphs historical values in the metric, along with the 5-year average for 2002-2006 and a 5-year running average beginning in 2016. The Nitrate Metric target level is 10 mg/L or lower.

Table 22. 2018 Nitrate Metric

Metric Well	Winter 2018 Nitrate-Nitrogen (NO_3-N) Concentrations
FW2	30 mg/L
FW6	3 mg/L
FW10	29 mg/L
FW15	32 mg/L
FW17	24 mg/L
Nitrate Metric (average)	24 mg/L

Data Source: LOWRF Groundwater Monitoring Program (Rincon Consultants, 2018)

The Nitrate Metric was measured at 24 mg/L nitrate-nitrogen (NO_3-N), which is more than twice the Maximum Contaminant Level of 10 mg/L (the drinking water standard). There was an 8 mg/L decrease in the Nitrate Metric from Winter 2017 (32 mg/L), to Winter 2018 (24 mg/L), a significant improvement compared to several years of metric increases (Figure 22). The greatest decease in NO_3-N was measured at key well FW6, where concentrations measured 15 mg/L in 2016, 10 mg/L in 2017, and 3 mg/L in 2018. FW6 is hydraulically downgradient of the Broderson site, and NO_3-N declines are attributable to recycled water discharges.

Independent of LOBP actions, construction and operation of the community sewer system and LOWRF will largely stop nitrate loading in the Basin from septic disposal within the wastewater service area. Nitrate concentrations in the Basin are expected to begin declining over the next decade, and in 2018 the Nitrate Metric declined for the first time since 2012. The five-year running average, however, which represents long term trends, is still increasing through 2018 (Figure 22).

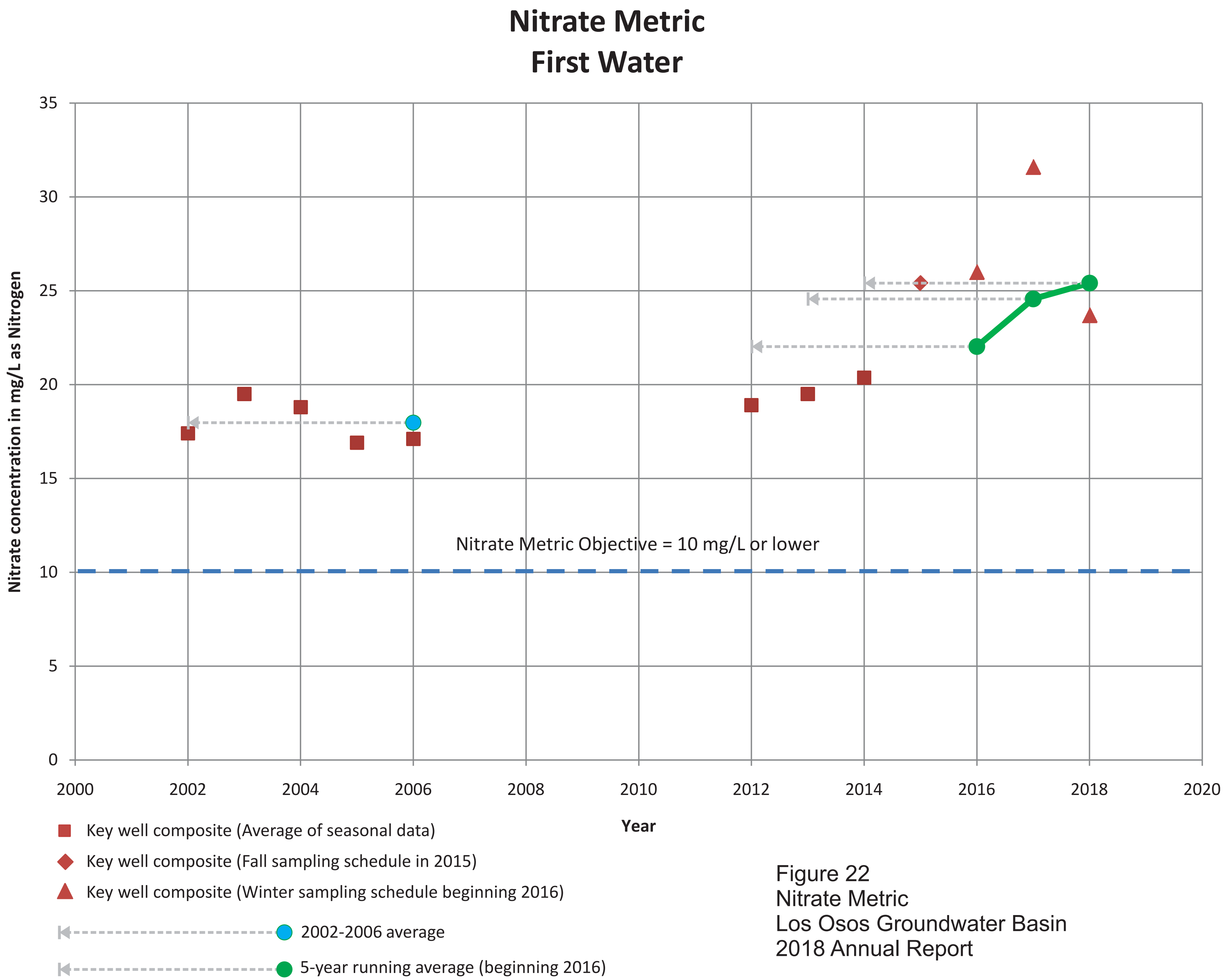


Figure 22
Nitrate Metric
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

7.5.4 Upper Aquifer Water Level Profile

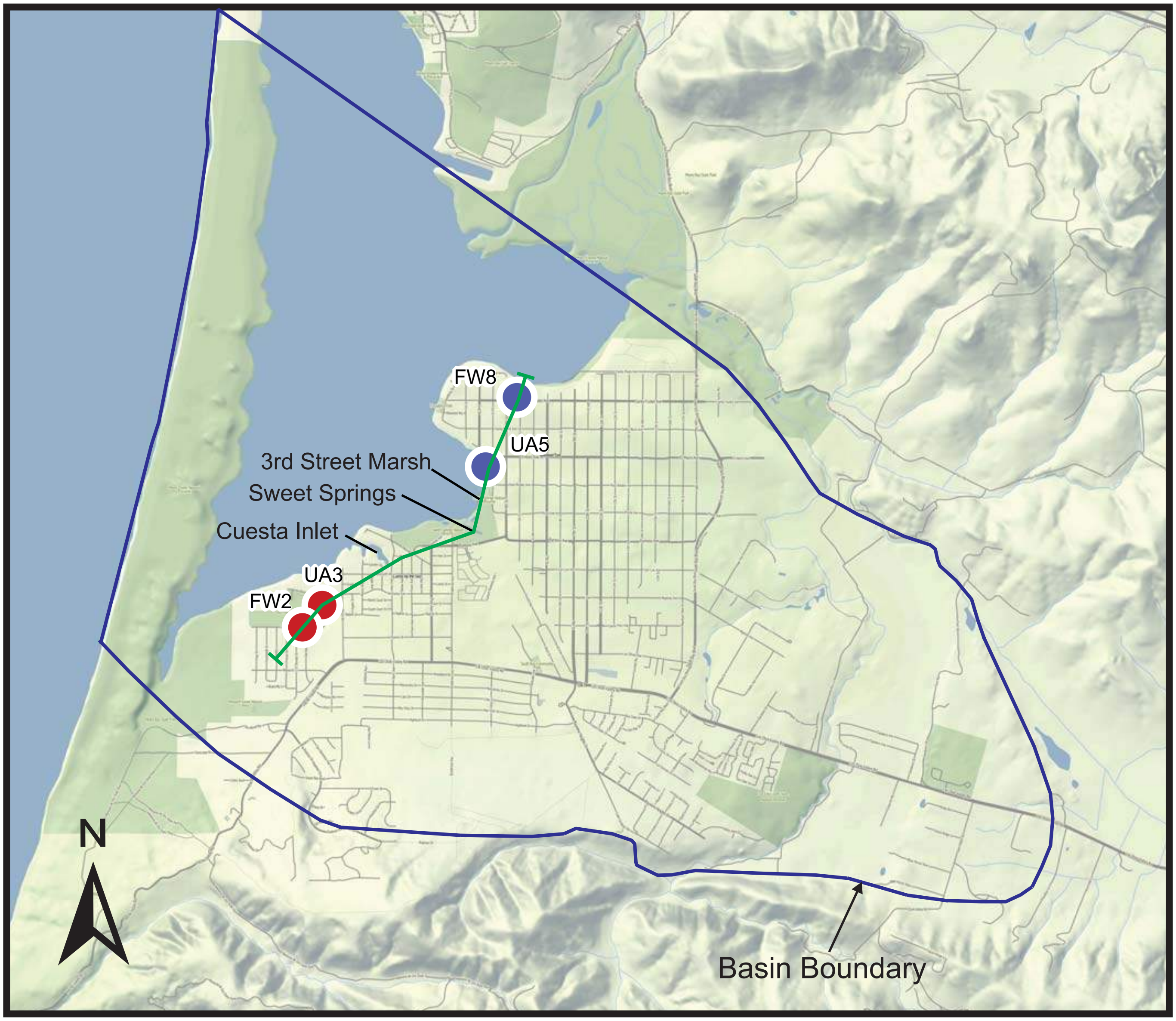
Metrics allow the BMC, regulatory agencies, and the public to evaluate the status of nitrate concentrations and seawater intrusion in the Basin through objective, numerical criteria that can be tracked over time (LOBP, 2015). The Upper Aquifer has a Nitrate Metric, but does not have Water Level Metric or Chloride Metric because seawater intrusion is not occurring in the Upper Aquifer. Seawater intrusion affects chloride concentrations in groundwater and moves primarily in response to changes in water levels and associated hydraulic head in an aquifer.

A Water Level Metric and Chloride Metric for the Upper Aquifer was recommended in the 2016 Annual Report to provide the BMC with a management tool for addressing the potential for seawater intrusion into the Upper Aquifer as Upper Aquifer production increases. There are only a few Upper Aquifer wells, however, along the shoreline of the Morro Bay estuary where seawater intrusion would be most likely to occur. An alternative management tool proposed for the Upper Aquifer is the Water Level Profile. The benefit of a profile, rather than a metric, is that spatial information is included. Conditions for seawater intrusion along the Water Level Profile could occur before an equivalent metric-based threshold is reached, since there is no averaging in the Water Level Profile. Metrics were not designed for early detection, which is what is needed for Upper Aquifer seawater intrusion monitoring.

Seawater has a density that is 1.025 times greater than fresh water. For every foot of fresh water head above sea level, the seawater interface will be displaced 40 feet below sea level, according to the Gyhben-Herzberg relation (Freeze and Cherry, 1979). Using the Ghyben-Herzberg relation and elevation contours on the base of the Upper Aquifer, a profile showing the groundwater elevations needed to avoid seawater intrusion beneath the bay shoreline (the Protective Elevation) has been prepared, along with the Spring 2018 Upper Aquifer groundwater elevations along the same profile, adjusted to the NGVD 29 datum. The resulting comparison of the Upper Aquifer Water Level Profile and the Protective Elevation is shown in Figures 23 and 24.

Water levels along the Water Level Profile in Spring 2018 were above the Protective Elevation except for the area near UA3, which is an Upper Aquifer supply well (Figure 24). Spring water levels shown above ground surface in low-lying areas near the bay represent artesian pressures in the aquifer, and incorporate an estimated pressure at an artesian well at Sweet Springs. Groundwater seeps and springs are common along the bay shoreline, including Sweet Springs and the 3rd Street marsh.

If water levels decline below the Protective Elevation, there would be a theoretical potential under hydrostatic conditions (zero hydraulic gradient) for seawater intrusion to occur at the base of the Upper Aquifer. However, water levels have been below the Protective Elevation in the past along portions of the profile without any seawater intrusion detected, particularly during drought periods (e.g. mid 1970's at UA5 and early 1990's at UA3). Chloride concentrations at UA3 were lower in Fall 2018 (55 mg/L) compared to Fall 2017 (73 mg/L), when the water level was above the Protective Elevation. There is no indication of seawater intrusion at UA3, based on chloride concentrations.



Base Image: Stamen-Terrain

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

Explanation

- LOBP Water Level Monitoring Well
- Water Level and Water Quality Monitoring Well

Water Level Profile Alignment

Figure 23
Upper Aquifer
Water Level Profile Alignment
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

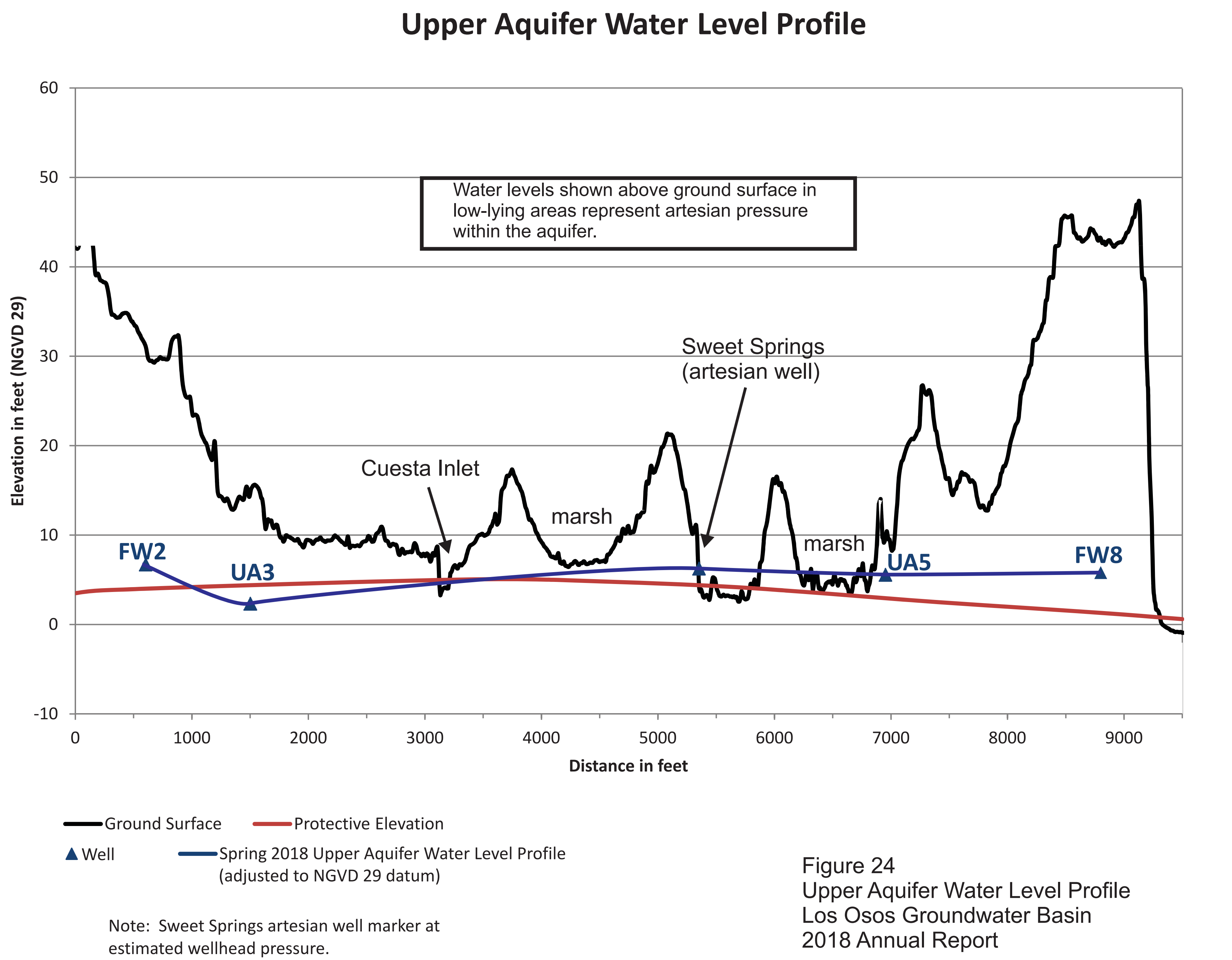


Figure 24
Upper Aquifer Water Level Profile
Los Osos Groundwater Basin
2018 Annual Report

Cleath-Harris Geologists

8. BASIN STATUS

The status of the Basin in 2018 is summarized as follows:

- The Basin received below normal rainfall in 2018. Drought conditions for San Luis Obispo County ranged from abnormally dry (the lowest drought intensity level) to severe drought during 2018, based on information from the U.S. Drought Monitor, a partnership of federal agencies (NDMC/USDA/NOAA, 2018).

- Groundwater production for the Basin totaled 2,030 acre-feet in the 2018 calendar year, compared to 2,070 acre-feet in 2017. Purveyor groundwater production decreased by approximately 30 acre-feet while community facilities decreased by an estimated 10 acre-feet in 2018, compared to 2017.

- Long-term water level trends over the last 6 years in First Water wells averaged 0.33 feet of decline per year. Long-term water level trends over the last 10 years in Upper Aquifer wells averaged 0.05 feet of decline per year, and in Lower Aquifer wells averaged 0.6 feet of rise per year.

- A retreating seawater intrusion front resulted in a gain of 1,200 acre-feet of freshwater storage in the Lower Aquifer between Spring 2017 and Spring 2018. There was also a loss of 300 acre-feet in storage above sea level over the same period, for a net gain of 900 acre-feet of storage between Spring 2017 and Spring 2018.

- The seawater intrusion front retreated toward the coast up to 270 feet between Fall 2017 and Fall 2018.

- The Basin Yield Metric decreased from 75 in 2017 to 74 in 2018. The metric has met the LOBP goal of 80 or less for three consecutive years.

- The Basin Development Metric in 2018 indicates that 79 percent of the estimated maximum potential sustainable yield of the Basin has been developed. There is no LOBP objective for the Basin Development Metric. The metric has not changed from 2017, meaning that no new infrastructure projects affecting Basin sustainable yield have been completed.

- The Water Level Metric rose by 0.4 feet between Spring 2017 (1.5 foot) and Spring 2018 (1.9 feet), indicating improvement in 2018, although it remains several feet below the target value of 8 feet.

- The Chloride Metric decreased relative to the 100 mg/L target value between Fall 2017 (154 mg/L) and Fall 2018 (145 mg/L), indicating improvement in 2018. Chloride concentrations at LA10 are interpreted to be influenced by wellbore leakage from the Upper Aquifer and were adjusted for 2017 and 2018 accordingly.

- Upper Aquifer water levels were above the Protective Elevation along the bay, except for near UA3. There is no indication of seawater intrusion at UA3, based on chloride concentrations.

- The Nitrate Metric decreased relative to the 10 mg/L target value, from 32 mg/L NO_3-N in 2017 to 24 mg/L NO_3-N in 2018, indicating improvement in 2018.

9. RECOMMENDATIONS

The following LOBP Groundwater Monitoring Program recommendations from the 2018 Annual Report were completed, are in progress, or are planned for completion in 2019:

- Add a new Upper Aquifer and Lower Aquifer monitoring well near the bay, as recommended in the LOBP (ISJ Group, 2015). **- *In progress***

- Retain a licensed surveyor to review all available documentation on reference point elevations and to perform wellhead surveys as needed (Section 3.2.1). **– *In progress in coordination with County Public Works***

- Evaluation of borehole leakage at Chloride Metric well LA10 – ***Completed***

- Develop specific yield values for individual aquifers to improve groundwater storage estimates – ***Completed***

- Consider changing CEC laboratory – review costs and laboratory blank contamination issues – ***Completed***

The following additional LOBP Groundwater Monitoring Program recommendations are provided for BMC consideration. Recommendations on Adaptive Management are provided in Section 10:

- Analyze FW6 for CEC's in Fall 2019 (Section 4.2.2).

- Develop a rating curve for stream flow Sensor 751 on Los Osos Creek (Section 6).

- Re-evaluate Water Level Metric target after completion of wellhead surveys (Section 7.5.3)

- Implementation of a pre-defined pumping program at LA10 would be recommended to address wellbore leakage and ensure better data quality during the Spring and Fall monitoring events.

10. ADAPTIVE MANAGEMENT PROGRAM AND STATUS OF LOBP PROGRAM IMPLEMENTATION

The LOBP describes seven potential programs of action, each of which focuses on a different aspect of Basin management (see Section 10.3). Implementation of the identified combination of the LOBP Programs is expected to result in sustainable use of the Basin.

The LOBP also provides for periodic review of the implementation of the LOBP through establishment of an Adaptive Management Plan that allows the BMC to do the following:

- Evaluate trends of key Basin metrics;
- Identify additional data needs;
- Report the data analysis to various interested parties;
- Modify the LOBP programs and schedule, if necessary, in response to current conditions and observed trends in the Basin;
- Modify procedures to utilize current best management practices; and
- Modify pumping, treatment, and/or water reuse procedures in response to Basin conditions and trends that show signs of degradation of water quality, including increased levels of contamination and/or increased levels of seawater intrusion.

The Adaptive Management Program will provide a status update on the implementation of the LOBP Programs, assess the overall effectiveness of the LOBP, and offer a tool with which to modify the LOBP programs to better meet overall LOBP objectives.

10.1 Basin Metrics

As noted in Section 7 ("Data Interpretation") of this Annual Report, the LOBP established several metrics to measure nitrate impacts to the Upper Aquifer, seawater intrusion into the Lower Aquifer, and the effect of management efforts to the BMC. These metrics allow the BMC, regulatory agencies and the public to evaluate the status of nitrate levels and seawater intrusion, and the impact of implementation of the LOBP programs, in the Basin through objective, numerical criteria that can be tracked over time. The 2018 metric values are summarized in Table 23 for easy reference during discussion and evaluation of the LOBP programs.

As discussed in Section 7.5.4, an Upper Aquifer Water Level Profile has been developed to track the potential for sea water intrusion in the Upper Aquifer. This profile currently shows that water levels in the Upper Aquifer remain safely above the Protective Elevation, except for near well UA3. There is no indication of seawater intrusion at UA3, based on chloride concentrations. The profile will be evaluated annually as Upper Aquifer production increases under Program A.

10.2 Adaptations to LOBP Programs

Based on the Basin status (Section 8) and recommendations (Section 9), the BMC intends to continuously develop and pursue additional measures related to the Groundwater Monitoring and Urban Water Use Efficiency programs. The following is an update on additional measures related to the Groundwater Monitoring and Urban Water Use Efficiency program:

Table 23. LOBP Metric Summary			
Metric	**LOBP Goal**	**Calculated Value from 2018 Data**	**Recommended Actions in Addition to LOBP Programs**
Basin Yield Metric: Comparison of current well production to sustainable yield	80 or less	74	Implement additional conservation measures to reduce indoor and outdoor demands (See Section 10.3.2)
Water Level Metric: Average groundwater elevation in 5 key wells in the Lower Aquifer	8 feet above mean sea level or higher	2.0 feet above mean sea level	Implement additional conservation measures to reduce indoor and outdoor demands (See Section 10.3.2)
Chloride Metric: Weighted average chloride concentration in 4 key wells in the Lower Aquifer	100 mg/L or lower	145 mg/L	Implement additional conservation measures to reduce indoor and outdoor demands (See Section 10.3.2)
Nitrate Metric: Average nitrate concentration in 5 key wells in the Upper Aquifer	10 mg/L or lower	24 mg/L (NO_3-N)	None recommended

Additional Water Quality Metrics. In addition to the Upper Aquifer Water Level Profile, the BMC will continue to consider developing additional metrics and/or numerical goals to protect the Upper Aquifer from water quality threats.

Contingency Plan Development. As metric trends and Basin response become better defined, the BMC intends to develop contingency plans to respond to unforeseen conditions. As funding and siting for Program C projects progress, detailed milestone schedules will also be developed.

Adaptation of Water Conservation Measures. Evaluate the Urban Water Use Efficiency Program to determine which conservation measures are the most efficient and effective to meet the LOBP's goals.

Discussion and Recommendation of Criteria for Future Growth. Provide input into the Los Osos Community Plan (LOCP), including consideration of Basin Metrics and defined goals as they relate to the timing of future growth within the Basin. In its May 2017 meeting, the BMC authorized the release of a letter to the County Planning Department and Coastal Commission staff recommending that future development should be subject to the following provisions:

1. Any growth projections in the updated Los Osos Community Plan should be consistent with the water supply estimates provided in the Basin Management Plan.
2. The Community Plan should acknowledge any infrastructure projects contemplated by the Basin Plan that would require coastal planning action subject to the authority of the Coastal Commission. This provision would help expedite completion of any affected projects.
3. Amendments to the County's Growth Management Ordinance [separate from the Community Plan/LCP] should provide a growth rate for Los Osos consistent with the adaptive management provision of the Basin Plan. In particular, the rate of growth must be set so that the monitoring provisions of the Basin Plan confirms the adequacy of a sustainable water supply in support of any contemplated future growth.

10.3 LOBP Programs

The LOBP outlines a number of programs developed to meet the goals of the various metrics outlined above. The BMC has analyzed the impacts of implementing various combinations of programs on the Basin.[1] In particular, the BMC modeled the impact of each combination on the Basin Yield Metric, Water Level Metric and Chloride Metric. Based on this analysis, the LOBP recommends the following programs for immediate implementation:[2]

- Groundwater Monitoring Program;
- Urban Water Use Efficiency Program;
- Urban Water Reinvestment Program;
- Basin Infrastructure Programs A and C; and
- Wellhead Protection Program.

10.3.1 Groundwater Monitoring Program

In order to allow calculation of the above metrics with a higher degree of accuracy, the BMC has implemented the Groundwater Monitoring Program. The Groundwater Monitoring Program is designed to collect, organize and report data regarding the health of the Basin from a current

1 The LOBP analyzed the following seven potential programs: (1) Groundwater Monitoring Program; (2) Urban Water Use Efficiency Program: (3) Water Reinvestment Program; (4) Basin Infrastructure Program; (5) Supplemental Water Program; (6) Imported Water Program; (7) Wellhead Protection Program.

2 The LOBP also recommends the following programs for potential implementation if the County and the Coastal Commission were to allow future development in Los Osos as part of the LOCP and the Los Osos Habitat Conservation Plan (LOHCP): (1) Basin Infrastructure Program B; and (2) either Basin Infrastructure Program D or the Agricultural Water Reinvestment Program. Since additional development has not been authorized, these additional programs have not been included in this Annual Report.

network of 88 wells.[3] In addition to facilitating the calculation of metrics, this data provides information needed to manage the Basin for long-term sustainability. Implementation of the Groundwater Monitoring Program also satisfies various external monitoring requirements, such as the California Statewide Groundwater Elevation Monitoring Program (CASGEM) and waste discharge and recycled water permits for the LOWRF. Monitoring under the program began in 2014 and will continue to occur in the spring and fall of each year when water levels are typically at their highest and lowest. This Annual Report represents the third monitoring event under the Groundwater Monitoring Program. The BMC plans to continue to report the values for all Basin metrics and other relevant, non-proprietary data to the Parties, the Court and the public in its future Annual Reports. Additional recommendations and planned actions relating to the Groundwater Monitoring Program are described in Section 9. Table 24 summarizes the status of the various implementation tasks set forth in the LOBP that related to the Groundwater Monitoring Program.

10.3.2 Urban Water Use Efficiency Program

In order to reduce annual groundwater production from the Basin, and thus reduce the Basin Yield Metric, the LOBP recommends implementation of the Urban Water Use Efficiency Program. In October 2012, the San Luis Obispo County Board of Supervisors adopted a Water Conservation Implementation Plan ("County Water Conservation Plan"), the details of which are described in Table 25. The County Water Conservation Plan was configured to provide detailed financial and administrative structure, while substantially conforming to the LOBP. Under this program, all properties connecting to the sewer project are required to be retrofitted prior to connection, and the program is essentially complete with the exception of 107 unconnected properties. Table 26 shows the total fixtures retrofitted and the total rebates provided as of December 2018.

3 The wells are distributed laterally across the Western, Central and Eastern Areas and vertically among First Water and the Upper and Lower Aquifers. Twelve existing wells were added to the program since 2015.

Table 24. Basin Groundwater Monitoring Program Status			
Recommended Implementation Measure	**Current Status**	**Funding Status**	**Projected Completion**
Wellhead Surveys: Perform wellhead surveys to establish reference point elevations and locations	*Not initiated		
Protocols and Objectives: Establish well monitoring protocols and data quality objectives	Complete		
Water Level Monitoring: Assign water level monitoring responsibilities to the Parties or other stakeholders	Complete		
Access to Private Wells: Contact private well owners to request permission for participation in the groundwater elevation and water quality portions of the Groundwater Monitoring Program	Most contacts made as of April 2019.	Fully funded	Ongoing
Water Quality Monitoring: Assign water quality monitoring responsibilities. The BMC will adopt a set of procedures for recording groundwater elevations and sampling for water quality.	Complete		
Data: Assign data compilation, organization and reporting duties	Complete		

* The wellhead survey project requires approval of temporary access from private landowners. Obtaining this approval has been started but is expected to be a complicated process.

Table 25. Summary from Adopted 2012 County Water Conservation Plan					
Implementation Program Plan Measure Number	**Measure**	**Customer Category**	**Program Length**	**Total Estimated Activities**	**Total Estimated Budget**
Category 1. Residential Programs					
1A	Subsidize Partial Community Retrofit, Residential	Single-Family Residential Toilets	3 Years	8,000	$2,061,375
		Single-Family Residential Showerheads	3 Years	8,000	$368,575
		Single-Family Residential Faucet Aerators	3 Years	13,500	$100,769
1B	Residential Clothes Washer Rebate	Single-Family Residential Washer	5 years	2,000	$385,000
1C	Options for Fully Retrofitted Residences	Hot Water on Demand; Dishwashers,	3 years	500	199,525
1D	Retrofit on Resale	Single-Family Residential: Owners complete retrofits through this ongoing water conservation measure.			$0
Category 2 - Commercial and Institutional					
2A	Subsidize Partial Community Retrofit, Commercial	Commercial	3 years	141	$192,223
2B	Replace Restaurant Spray Nozzles	Commercial	3 years	45	$3,649
2C	Institutional Building Retrofit	Institutional	3 years	13	$38,588
2D	Commercial High Efficiency Clothes Washer Rebate	Commercial	3 years	40	$14,280
Category 3 - Education and Outreach Program					
3A	Residential Water Surveys	Single-Family Residential	3years	5,000	$824,250
3B	Commercial, Industrial and	Commercial	3 years	141	$35,102

Table 25. Summary from Adopted 2012 County Water Conservation Plan					
Implementation Program Plan Measure Number	**Measure**	**Customer Category**	**Program Length**	**Total Estimated Activities**	**Total Estimated Budget**
	Institutional Surveys				
3C	Public Information Program	Single-Family Residential	10 years	23,000	$220,500
3D	Media Campaign	Single-Family Residential	10 years	7,000	$178,500
Category 4 - New Development (developer pays to implement water conservation measures)					$0
Contingency for Additional Measures in Years 4-10					$327,600
Plan Development Cost to Date					$50,000
Total Funding Commitment					$5,000,000

Table 26. Summary of Conservation Rebates Provided through December 2018			
Fixture	**Cumulative Total Thru 2016**	**Cumulative Total Thru 2017**	**Cumulative Total Thru 2018**
Toilets	3,246	3,325	3,338
Showerheads	2,362	2,385	2,387
Faucet aerators	3,211	3,226	3,226
Clothes washers	101	110	120
Total Value of Provided Rebates	$907,270	$924,474	$936,048

In 2016 the BMC recommended programs to be added to the County Water Conservation Plan. The proposed BMC programs are outlined in Table 26. The County has included all of the proposed rebates within the Los Osos Wastewater Project rebate program with the exception of measures Outdoor 1 and Outdoor 2. The County has indicated that these two programs were not included due to a lack of nexus with the wastewater project. Table 27 shows the current rebates available to customers in the wastewater project service area.

Table 27. BMC Recommended Water Conservation Measures							
Item No.	**Conservation Measure Name**	**Draft Rebate Amount**	**Water Savings Potential and Assumptions (ac-ft/year)**	**Estimated Savings per Unit (gal/yr)**	**Fixture or Program Estimated Lifespan**	**Cost of rebate per acre-ft saved**	**Approximate Savings Potential (AFY)[4]**
Indoor-1	Hot water recirculation system	$300	EPA Water Sense estimates > 10,000 gal/year, assume 5,000 to 10,000 gal/year	7,000	10	$1,396	50 to 100
Indoor -2	High efficiency clothes washer	$250	3,000 to 5,000 gal/year, depending on household size	3,300	5	$4,936	40 to 60
Indoor - 3	Replace 1.6 gpf toilets with 1.28 or below	$250	1,000 to 2,000 gal/year, depending on use	1,500	20	$2,715	30 to 50 (See Note 5)
Indoor - 4	Replace 2.0 gpm showerheads with 1.5 gpm	$40	1,000 to 2,000 gal/year, depending on use	1,500	10	$869	30 to 50 (See Note 5)
Outdoor - 1	Septic tank repurpose - roof water only	$500 (see Note 3)	Assume 3 to 4 tank volumes, at 1,000 gallons each	3,500	20	$2,327	40 to 60 (See Note 1)
Outdoor - 2	Septic tank repurpose - with recycled water hauling	$500 (see Note 3)	Potentially eliminate outdoor potable usage	6,000	20	$1,358	70 to 90 (See Note 1)
Outdoor - 3	Gray water system	$500 (see Note 3)	Potentially eliminate outdoor potable usage	6,000	20	$1,358	70 to 90 (See Note 1)
Outdoor - 4	Laundry to landscape program	$50 (see Note 3)	1,000 to 1,500 gallons per year, depending on use	1,250	5	$2,606	10 to 20 (see Note 1)

Notes:
1. Total savings for outdoor programs are not additive. For example, outdoor use can be addressed through gray water or hauled recycled water.
2. All estimates depend on use patterns and other factors. Values are stated for comparison.
3. Only one $500 rebate will be provided per property under programs Outdoor -1, 2, and 3. Participants in these programs are not eligible for program Outdoor - 4. Property owners who have already backfilled their septic tank will receive a rebate of $500 for implementation of an alternative storage tank/basin with a minimum of 500 gallons of capacity.
4. Approximate Savings Potential assumes total 4,500 unit participation.
5. Assumes 2 replacement fixtures per household unit.

Table 28. Updated County Water Conservation Plan Los Osos Wastewater Project Proposed Rebate Program			
Measures Required for Connection to the Wastewater System			
Fixture or Appliance	**Existing Fixture Flow Rate**	**New Fixture Flow Rate Eligible for Rebate**	**Rebates**
Toilets Residential & Commercial	Greater than 1.6 gpf	1.28 gpf or less	$160
Showerheads Residential & Commercial	Greater than 2.0 gpm	1.5 gpm or less	$30
Faucet Aerators Residential	Greater than 1.5 gpm	1.5 gpm or less	$0
Faucet Aerators Commercial	Greater than 0.5 gpm	0.5 gpm	$0
Urinals Commercial	Greater than 1.0 gpf	0.5 gpf or less	$0
Pre-rinse Spray valves Commercial	Greater than 1.15 gpm	1.15 gpm or less	N/A
Optional Measures Eligible for Rebates (Requires Connection to the Wastewater System and Compliance with Above Measures)			
Toilets Residential & Commercial	Equal to 1.6 gpf	1.28 gpf or less	$160
Washers Residential & Commercial	Less than Tier 3, Water Factor 4	Tier 3, Water Factor 4 or Less	$450[1]
Hot Water Recirc System Residential & Commercial	N/A	N/A	$350
Showerheads Residential & Commercial	1.5 gpm or more	Less than 1.5 gpm	$30
Complete Gray Water System	N/A	N/A	$500
Laundry only Gray Water System	N/A	N/A	$50
Recycled Water Irrigation Commercial & Institutional	N/A	N/A	Negotiated

gpf = gallons per flush
gpm = gallons per minute

Notes: [1] Rebate not retroactive to prior rebated or prior purchased appliances.

10.3.3 Urban Water Reinvestment Program

Implementation of the Urban Water Reinvestment Program was recommended in the LOBP to increase the sustainable yield of the Basin (and thus reduce the Basin Yield Metric). The Water Reinvestment Program will accomplish the LOBP's goal of reinvesting all water collected and treated by the LOWRF in the Basin, either through direct percolation to the aquifers or reuse. Water treated by the LOWRF will be of a sufficient quality to directly percolate into the Basin or to reuse for landscape or agricultural irrigation purposes. The planned uses of that water are listed in Table 29, along with the actual uses from 2018.[4]

Table 29. Planned Recycled Water Uses in the Urban Water Reinvestment Program

Potential Use	Estimated Annual Volume (AFY)	Actual Annual Volume in 2018 (AFY)
Broderson Leach Fields	448	486
Bayridge Estates Leach Fields	33	20
Urban Reuse	63	0
Sea Pines Golf Course	40	0
Los Osos Valley Memorial Park	50	0
Agricultural Reuse	146	0
Total	**780**	**505**

The LOWRF construction was completed in March 2016. Through the end of 2018, the sewer service area had connected 97.7 percent of 4,583 parcels (excluding vacant lots and properties with no structures with sewer facilities) that are required to connect. Flows from the wastewater plant in December 2018 were averaging approximately 470,000 gallons per day, with weekend peaks of 500,000 gallons per day (approximately 530 AFY). With 97.7 percent of the required parcels connected, average wastewater flows are lower than anticipated. Projecting the actual average flow per connection through the remainder of the project results in a total estimated volume of 540 AFY, which is 240 AFY less than the anticipated 780 AFY.

Treated water in 2018 was conveyed to the Broderson and Bayridge Estates leach fields. The anticipated groundwater mound resulting from localized recharge of recycled water was detected hydraulically downgradient of the Broderson site beginning in June 2017. Recycled water for irrigation will be provided to the schools, parks, and various agricultural areas within the Basin once flows at the wastewater plant approach anticipated volumes.

4 This Table was reproduced (with slight edits) from Table 2 of the LOBP.

The BMC is currently analyzing the feasibility, cost, and water supply benefits of a dry weather discharge to Los Osos Creek as a means of recharging the Lower Aquifer and enhancing Basin yield. The results of the current study will be summarized in future Annual Reports.

10.3.4 Basin Infrastructure Programs

Implementation of the Basin Infrastructure Program is designed to reduce Purveyor groundwater production from the Lower Aquifer in the Western Area and replace it with additional pumping from the Upper Aquifer and Central and Eastern Areas. This shift will also increase the Basin's sustainable yield, which in turn will help to drive down the Basin Yield Metric.

The Program is divided into four parts, designated Programs A through D. Programs A and B shift groundwater production from the Lower Aquifer to the Upper Aquifer, and Programs C and D shift production within the Lower Aquifer from the Western Area to the Central and Eastern Areas, respectively. A fifth program, Program M, was also established in the Basin Management Plan for the development of a Groundwater Monitoring Program (See Chapter 7 of the BMP), and a new Lower Aquifer monitoring well in the Cuesta by the Sea area was recommended in the 2015 Annual Report. Table 30 provides an overview of status of the Projects that are currently moving forward or have been completed. Note, no projects are currently moving forward in Program D, thus they are not shown in Table 30.

10.3.5 Wellhead Protection Program

The Wellhead Protection Program is designed to protect water quality in the Basin by managing activities within a delineated source area or protection zone around drinking water wells. This program consists primarily of the Purveyors conducting Drinking Water Source Assessment and Protection surveys for each of their wells, as well as construction and operation of the LOWRF. The BMC will identify specific actions to protect water quality in the Basin as deemed appropriate in the future, though no specific actions are recommended at this time.

Table 30. Basin Infrastructure Projects				
Project Name	**Parties Involved**	**Funding Status**	**Capital Cost**	**Status**
Program A				
Water Systems Interconnection	LOCSD/ GSWC	Fully Funded	LOCSD/GSWC $103,550	Completed
Upper Aquifer Well (8th Street)	LOCSD	Fully Funded	$250,000	Well was drilled and cased in December 2016. Budget remaining $250,000 to equip the well. Design is 100% complete and District is pursuing IRWM matching funds. If available, it is hoped that matching funds will be available by Q2 of 2019. Completion of construction is expected by December 2019.
South Bay Well Nitrate Removal	LOCSD			Completed
Palisades Well Modifications	LOCSD			Completed
Blending Project (Skyline Well)	GSWC	Fully Funded	$1.15 mil	Completed
Water Meters	S&T			Completed
Program B				
LOCSD Wells	LOCSD	Not Funded	BMP: $2.7 mil	Project not initiated
GSWC Wells	GSWC	Not Funded	BMP: $3.2 mil	Project not initiated
Community Nitrate Removal Facility	LOCSD/GSWC	GSWC Portion Funded	GSWC: $1.23 mil	GSWC's portion completed

Project Name	Parties Involved	Funding Status	Capital Cost	Status
Program C				
Expansion Well No. 1 (Los Olivos)	GSWC	Fully Funded	$1.76 mil	Completed
Expansion Well No. 2	LOCSD is currently leading the project with potential GSWC and S&T involvement, depending on final location	LOCSD is currently leading the project with respect to funding	BMP: $2.0 mil	Property acquisition phase is on-going through efforts of LOCSD. Four sites are currently being reviewed and a community workshop was held on 8/30/2018. Due to community concerns over siting, environmental review and permitting is expected to be on going through Q1 of 2020, with construction complete by Q1 of 2021. The LOCSD authorized the preparation of bid documents for a test well at Site A (Los Osos Middle School) at their 11/1/18 meeting. Draft documents have been prepared, and staff is working on drilling details with the School District prior to going out to bid. The test hole is expected to be completed in Q2 of 2019.
Expansion Well 3 and LOVR Water Main Upgrade	GSWC/LOCSD	Cooperative Funding	BMP: $1.6 mil	This project has been deferred under Adaptive Management.
LOVR Water Main Upgrade	GSWC	May be deferred	BMP: $1.53 mil	Project may not be required, depending on the pumping capacity of the drilled Program C wells. It may be deferred to Program D.
S&T/GSWC Interconnection	S&T/ GSWC	Pending	BMP: $30,000	In conceptual design

Project Name	Parties Involved	Funding Status	Capital Cost	Status
Program M				
New Zone C/D/E Lower Aquifer monitoring well in Cuesta by the Sea	All Parties	Funded through BMC Budget	$115,000	A wetlands delineation was completed in July 2018. A Minor Use Permit was approved on February 1, 2019. The project has been submitted to SLO County Public Works for an encroachment permit with bidding to follow. Construction is expected in Q3 of 2019. The project implementation cost has been included in the 2019 budget for consideration under item 7c.
Program U				
Creek Discharge Program	All Parties	Funded through BMC Budget/grants	$582,000 through feasibility phase	The 2019 draft budget includes funding for limited baseline monitoring and Soil Aquifer Treatment evaluation in the amount of $50,000.

11. REFERENCES

Burt, C.M., Mutziger, A., Howes, D.J., and Solomon, K.H., 2002, Evaporation from Irrigated Agricultural Land in California, January.

Brown and Caldwell, 1983, Los Osos - Baywood Park Phase I Water Quality Management Study, prepared for San Luis Obispo Service Area No. 9, April 1983.

Carollo, 2012, San Luis Obispo County Master Water Report, prepared for the San Luis Obispo County Flood Control and Water Conservation District, May 2012. http://www.slocountywater.org/site/Frequent%20Downloads/Master%20Water%20Plan/

Central Coast Regional Water Quality Control Board (CCRWQCB), 2011, Waste Discharge/Recycled Water Requirements for the Los Osos Water Recycling Facility, San Luis Obispo County, Order No. R3-2011-001, May 5. https://www.waterboards.ca.gov/centralcoast/board_decisions/adopted_orders/2011/2011_0001_wdr_order.pdf.

Cleath & Associates, 2005, Sea Water Intrusion Assessment and Lower Aquifer Source Investigation of the Los Osos Valley Ground Water Basin, San Luis Obispo County, California, prepared for the Los Osos Community Services District, October 2005.

Cleath & Associates, 2006, Task 3 Upper Aquifer Water Quality Characterization, prepared for the Los Osos Community Services District, June 2006.

Cleath & Associates, 2002-2006, Quarterly Groundwater Monitoring Reports for the Los Osos Nitrate Monitoring Program, prepared for the Los Osos Community Services District.

Cleath & Associates, 2002-2006, Semi-Annual Groundwater Monitoring Reports for the Los Osos Nitrate Monitoring Program, prepared for the Los Osos Community Services District.

Cleath-Harris Geologists, 2009a, Flow Model Conversion and Urban Area Yield Update, Technical Memorandum prepared for the Los Osos ISJ Group, July 29, 2009.

Cleath-Harris Geologists, 2009b, Water Use Estimates for Private Domestic Wells, Technical Memorandum prepared for the Los Osos ISJ Group, July 29, 2009.

Cleath-Harris Geologists, 2009c, Water Use Estimates for Los Osos Creek Valley Irrigation Wells, Technical Memorandum prepared for the Los Osos ISJ Group, July 29, 2009.

Cleath-Harris Geologists, 2010, Water Quality Monitoring Results Summary, November 2009-January 2010, Los Osos Valley Groundwater Basin, Technical Memorandum prepared for the Los Osos ISJ Group, April 26, 2010.

Cleath-Harris Geologists, 2012, Los Osos Water Recycling Facility Baseline Groundwater Quality Monitoring, August 2012, prepared for San Luis Obispo County Department of Public Works, October 2012.

Cleath-Harris Geologists, 2013, Los Osos Water Recycling Facility Baseline Groundwater Quality Monitoring, June 2013, prepared for San Luis Obispo County Department of Public Works, July 2013.

Cleath-Harris Geologists, 2014, Seawater Intrusion Monitoring, Los Osos Valley Groundwater Basin, Technical Memorandum, prepared for the Los Osos ISJ Group, October 7, 2014.

Cleath-Harris Geologists, 2015a, April 2015 Lower Aquifer Monitoring, Los Osos Groundwater Basin, Draft Technical Memorandum prepared for the Los Osos ISJ Group, May 26, 2015.

Cleath-Harris Geologists, 2015b, October 2015 Lower Aquifer Monitoring, Los Osos Groundwater Basin, Technical Memorandum prepared for the Los Osos ISJ Group, December 28, 2015.

Cleath-Harris Geologists, 2015c, Los Osos Water Recycling Facility Baseline Groundwater Quality Monitoring, May 2015, prepared for San Luis Obispo County Department of Public Works, June 2015.

Cleath-Harris Geologists, 2015d, Los Osos Water Recycling Facility Baseline Groundwater Quality Monitoring, November 2015, prepared for San Luis Obispo County Department of Public Works, December 2015.

Cleath-Harris Geologists, 2016a, Los Osos Valley Groundwater Basin Boundary Modification Request, Technical Memorandum prepared for San Luis Obispo County Department of Public Works, March 25, 2016.
http://sgma.water.ca.gov/basinmod/docs/download/2071

Cleath-Harris Geologists, 2016b, Los Osos Basin Plan, Groundwater Monitoring Program 2015 Annual Monitoring Report, prepared in association with Wallace Group for the Los Osos Groundwater Basin Management Committee, September 2016.
https://www.slocountywater.org/site/Water%20Resources/LosOsos/pdf/Los%20Osos%20BMC%202015%20Annual%20Report%20Final.pdf

Cleath-Harris Geologists, 2017a, Los Osos Basin Plan, Groundwater Monitoring Program 2016 Annual Monitoring Report, prepared for the Los Osos Groundwater Basin Management Committee, June 2017.
http://www.slocountywater.org/site/Water%20Resources/LosOsos/pdf/2016%20Annual%20Report%20Final.pdf

Cleath-Harris Geologists, 2017b, Basin Yield Metric Response to reduced long-term precipitation in the Los Osos Groundwater Basin, Technical Memorandum prepared for the Los Osos Groundwater Basin Management Committee and Morro Bay National Estuary program, March 3, 2017.
http://www.slocountywater.org/site/Water%20Resources/LosOsos/pdf/TM%20Basin%20Yield%20Metric%20Los%20Osos%20GW%20Basin%2020180303.pdf

Cleath-Harris Geologists, 2018a, Los Osos Basin Plan, Groundwater Monitoring Program 2017 Annual Monitoring Report, prepared for the Los Osos Groundwater Basin Management Committee, June 2017.
http://www.slocountywater.org/site/Water%20Resources/LosOsos/pdf/2017%20Annual%20Report%20Final.pdf

Cleath-Harris Geologists, 2018b, Los Osos Valley Groundwater Basin Fringe Areas Characterization, prepared for San Luis Obispo County Flood Control and Water Conservation District, May 2017.
https://www.slocountywater.org/site/Water%20Resources/SGMA/lososos/pdf/Report_Fringe%20Area%20Technical%20Memorandum_Los%20Osos%20Basin.pdf

Department of Water Resources (DWR), State of California, 1973, Los Osos - Baywood Ground Water Protection Study, Southern District Report, October 1973.

Department of Water Resources (DWR), State of California, 2014, California Groundwater Elevation Monitoring Basin Prioritization Process, Appendix A, June 2014.

Department of Water Resources (DWR), State of California, 2016, California's Groundwater, Working Toward Sustainability, Bulletin 118 Interim Update 2016, December 22, 2016.
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Files/Statewide-Reports/Bulletin_118_Interim_Update_2016.pdf

Department of Water Resources (DWR), State of California, 2018a, Bulletin 118 Groundwater Basins Subject to Critical Conditions of Overdraft – Update based on 2018 Final Basin Boundary Modifications.
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Bulletin-118/Critically-Overdrafted-Basins/Files/2018CODBasins.pdf?la=en&hash=3014D2F2299AA503C469D41BBC0E8DCFCE0267F8

Department of Water Resources (DWR), State of California, 2018b, Basin Boundary Modification Request System – San Luis Obispo County 3-008 Los Osos Valley
https://sgma.water.ca.gov/basinmod/basinrequest/preview/238

Department of Water Resources (DWR), State of California, 2019, Basin Boundary Modifications – Final Decisions, February 11, 2019. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Basin-Boundary-Modifications/Files/2018_BBM_SummaryTable.pdf?la=en&hash=5DAF7E8CA73DB0FED363D5C6BF78C25E96A33ADD

Freeze, R. A., and Cherry, J. A., 1979, Groundwater, Prentice-Hall, 604 p.

ISJ Group, 2015, Updated Basin Plan for the Los Osos Groundwater Basin, January 2015, http://www.slocountywater.org/site/Water%20Resources/LosOsos/pdf/Los%20Osos%20Groundwater%20Basin%20Plan%20January%202016.pdf

Johnson, A.I., 1967, Specific Yield - Compilation of Specific Yields for Various Materials, U. S. Geological Survey Water-Supply Paper 1662-D, prepared in cooperation with the California Department of Water Resources. https://pubs.usgs.gov/wsp/1662d/report.pdf

Los Osos Community Services District v. Southern California Water Company [Golden State Water Company] et al. (San Luis Obispo County Superior Court Case No. CV 040126).

National Drought Mitigation Center / U.S. Department of Agriculture / National Oceanic and Atmospheric Association, 2018, U.S. Drought Monitor, California maps. Website access: https://droughtmonitor.unl.edu/Maps/MapArchive.aspx

Rincon Consultants, 2014a, Baseline Groundwater Quality Monitoring Report for the Los Osos Water Recycling Facility, prepared for San Luis Obispo County Department of Public Works, February 2014.

Rincon Consultants, 2014b, May 2014 Baseline Groundwater Quality Monitoring Report, Los Osos Water Recycling Facility, prepared for San Luis Obispo County Department of Public Works, June 2014.

Rincon Consultants, 2014c, October 2014 Baseline Groundwater Quality Monitoring Report, Los Osos Water Recycling Facility, prepared for San Luis Obispo County Department of Public Works, December 2014.

Rincon Consultants, 2017a, December 2016 Baseline Groundwater Quality Monitoring Report, Los Osos Water Recycling Facility, prepared for San Luis Obispo County Department of Public Works, December 2016.

Rincon Consultants, 2017b, June 2017 Semiannual Groundwater Quality Monitoring Report, Los Osos Water Recycling Facility, prepared for San Luis Obispo County Department of Public Works, July 2017.

Rincon Consultants, 2018a, December 2017 Semiannual Groundwater Quality Monitoring Report, Los Osos Water Recycling Facility, prepared for San Luis Obispo County Department of Public Works, January 2018.

Rincon Consultants, 2018b, June 2018 Semiannual Groundwater Quality Monitoring Report, Los Osos Water Recycling Facility, prepared for San Luis Obispo County Department of Public Works, August 2018.

Rincon Consultants, 2019, December 2018 Semiannual Groundwater Quality Monitoring Report, Los Osos Water Recycling Facility, prepared for San Luis Obispo County Department of Public Works, release date pending.

San Luis Obispo County Flood Control & Water Conservation District, 2014, CASGEM Monitoring Plan for High and Medium Priority Groundwater Basins in the San Luis Obispo County Flood Control & Water Conservation District, September 2014. http://www.slocountywater.org/site/Water%20Resources/Reports/pdf/20141002%20SLO%20FC&WCD%20CASGEM%20Monitoring%20Plan.pdf

Smith, C. T., and Griggs, A. B., 1944, Chromite Deposits near San Luis Obipo, San Luis Obispo County, California, U. S. Geological Survey Bulletin 945-B. https://pubs.er.usgs.gov/publication/b945B

SWRCB, 2009, Recycled Water Policy, adopted in Resolution No. 2009-0011 - Adoption of Policy for Water Quality Control for Recycled Water. http://www.swrcb.ca.gov/board_decisions/adopted_orders/resolutions/2009/rs2009_0011.pdf

San Luis Obispo County Public Works Department, 2005, Water Years 2001-02 and 2002-03 Hydrologic Report, May 16, 2005. http://slocountywater.org/site/Water%20Resources/Reports/pdf/Hydrologic%20Report%202002.pdf

San Luis Obispo County Public Works Department, 2018a, Los Osos Water Recycling Facility Laboratory Report for CEC Blue Ribbon, prepared by Eurofins-Eaton Analytical, November 11, 2018. https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/PublicReportEsmrAtGlanceServlet?reportID=2&isDrilldown=true&documentID=1754256

San Luis Obispo County Public Works Department, 2018b, Los Osos Water Recycling Facility 2018 Semi-Annual Report. https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/PublicReportEsmrAtGlanceServlet?reportID=2&isDrilldown=true&documentID=1754245

Welenco, 1996, Water and Environmental Geophysical Well Logs, Volume 1 - Technical Information and data, 8th Edition, March 1996.

Yates, E.B., and Wiese, J. H., 1988, Hydrogeology and Water Resources of the Los Osos Valley Ground-Water Basin, San Luis Obispo County, California, U. S. Geological Survey, Water-Resources Investigations Report 88-4081.
http://pubs.usgs.gov/wri/1988/4081/report.pdf

APPENDIX A

Groundwater Monitoring History

Groundwater Monitoring History

Groundwater monitoring has been performed by public agencies, water purveyors, and consultants for various basin studies and programs over several decades. The following lists include historical investigations, monitoring reports, and monitoring programs with a major focus on basin water levels and water quality through December 31, 2018, which is the end of the period covered by this Annual Report.

<u>Historical Investigations</u>

- *Los Osos-Baywood Ground Water Protection Study* (DWR, 1973);
- *Morro Bay Sandspit Investigation* (DWR, 1979);
- *Los Osos - Baywood Park Phase I Water Quality Management Study* (Brown & Caldwell, 1983);
- *Hydrogeology and Water Resources of the Los Osos Valley Ground-Water Basin, San Luis Obispo County, Water-Resources Investigation 88-4081* (U.S. Geological Survey, 1988);
- *Task F - Sanitary Survey and Nitrate Source Study* (Metcalf & Eddy, 1995);
- *Sea Water Intrusion Assessment and Lower Aquifer Source Investigation of the Los Osos Valley Groundwater Basin* (Cleath & Associates, 2005);
- *Task 3 Upper Aquifer Water Quality Characterization* (Cleath & Associates, 2006);

<u>Monitoring Reports</u>:

- *Baywood Groundwater Study - Fourth Quarter 1998 (San Luis Obispo County Engineering Department, 1999)*;
- *Quarterly and Semi-Annual Groundwater Monitoring Reports for the Los Osos Nitrate Monitoring Program* (Cleath & Associates, 2002-2006)
- *Water Quality Monitoring Results Summary, November 2009-January 2010, Los Osos Valley Groundwater Basin* (CHG, 2010);
- *Semi-Annual Groundwater Monitoring Reports for Los Osos Water Recycling Facility Baseline Groundwater Quality Monitoring* (CHG, 2012-2013);
- *Semi-Annual Groundwater Monitoring Reports for Los Osos Water Recycling Facility Baseline Groundwater Quality Monitoring* (Rincon Consultants, 2014a, 2014b, 2014c, 2017a, 2017b, 2018a, 2018b, 2019; CHG 2015a, CHG 2015b, CHG 2015c, 2015d);
- *Semi-Annual Groundwater Monitoring Reports for Lower Aquifer* (CHG, 2014-2015);

- *Annual Groundwater Monitoring Reports for Los Osos Basin Plan* (CHG, 2015, 2016, 2017);

- Consumer Confidence Reports (Water Quality Reports) published annually by the water purveyors.

<u>Monitoring Programs</u>:

- San Luis Obispo County Public Works, Semi-Annual Water Level Monitoring Program. Period of record for individual wells varies; most begin in 1970's and 1980's, and some end in 1999; program remains active.

- Purveyor Water Supply Well Monitoring per SWRCB-Division of Drinking Water requirements. Period of record for individual wells varies; program remains active.

- 2002-2006 Los Osos Nitrate Monitoring Program. Water levels measured quarterly to semi-annually; program ended October 2006.

- 2012-2018 Los Osos Water Recycling Facility Groundwater Monitoring Program. Water levels measured semi-annually, currently on a June and December schedule; program remains active.

- 2014-2015 Lower Aquifer Monitoring Program. Water levels measured semi-annually; program ended in 2015 (replaced by LOBP Groundwater Monitoring Program).

In addition to water quality and water level reporting, this 2018 Annual Report compiles groundwater production, precipitation, and stream flow data from the following sources:

- Water purveyors (LOCSD, GSWC, and S&T) provide metered production records.

- San Luis Obispo County Department of Public Works provides precipitation at the Los Osos Landfill and stream flow data for Los Osos Creek.

Purveyor municipal production data are based on meter readings. Domestic groundwater production estimates are based on the last reported water use estimates for 2013 from the LOBP, with minor adjustments in 2016 for the inclusion of additional residences in the Eastern Area (CHG, 2016). Production estimates for community facilities and agricultural wells are based on a soil-moisture budget using local precipitation, land use, and evapotranspiration data (Appendix G).

APPENDIX B

Los Osos Basin Plan
Groundwater Monitoring Program Well Information

Los Osos Basin Plan
Monitoring Well Network
First Water/Perched Aquifer Group

Program ID	State Well Number	Name/Location	Basin Area	Coordinates			Well Type	Current Well Owner	Well Data			Aquifer				
				Latitude	Longitude	RP Elevation* (feet amsl)			Screened Interval (feet bgs)	Well Depth (feet bgs)	Casing Diameter (inches)	Creek Valley Alluvium	Zone A/B	Zone C	Zone D	Zone E
FW1	30S/10E-13A7							PRIVATE								
FW2	30S/10E-13L8	Howard/ Del Norte	Western	35.3149	120.8552	32.63	MW	LOCSD	26-36	37	2			x		
FW3	30S/10E-13G	South Court	Western	35.3162	120.8498	50.95	MW	LOCSD	47-52	54	2			x		
FW4	30S/10E-13H	Broderson/Skyline	Western	35.3158	120.8432	49.33	MW	LOCSD	154-164	164	2			x		
FW5	30S/10E-13Q2	Woodland Dr.	Western	35.3119	120.8495	101.27	MW	LOCSD	97-100	105	2			x		
FW6	30S/10E-24A	Highland/Alexander	Western	35.3083	120.8453	193.04	MW	LOCSD	154-164	164	2			x		
FW7	30S/10E-24Ab	Broderson leach field	Western	35.3065	120.8460	255	MW	LOCSD	200-240	240	5			x		
FW8	30S/11E-7L4	Santa Ysabel/5th	Central	35.3302	120.8377	45.76	MW	LOCSD	40-50	50	2			x		
FW9	30S/11E-7K3	12th/ Santa Ysabel	Central	35.3299	120.8300	90.71	MW	LOCSD	55-65	70	2			x		
FW10	30S/11E-7Q1	LOCSD 8th Street - shallow	Central	35.3260	120.8342	25.29	MW	LOCSD	29-43, 54-75	75	8			x		
FW11	30S/11E-7R2	El Moro/12th St.	Central	35.3263	120.8298	61.93	MW	LOCSD	25-35	35	2			x		
FW12	30S/11E-18C2	Pismo Ave./ 5th St.	Central	35.3227	210.8376	34.55	MW	LOCSD	25-35	35	2			x		
FW13	30S/11E-18B2	Ramona/10th	Central	35.3208	120.8320	79.89	MW	LOCSD	25-35	35	2		x			
FW14	30S/11E-18E1							PRIVATE								
FW15	30S/11E-18N2	Manzanita/Ravenna	Central	35.3109	120.8401	125.53	MW	LOCSD	85-95	95	2		x			
FW16	30S/11E-18L11	Palisades Ave.	Western	35.3138	120.8374	88.02	MW	LOCSD	43-53	53	2		x			
FW17	30S/11E-18L12	Ferrell Ave.	Central	35.3138	120.8346	103.85	MW	LOCSD	25-35	35	2		x			
FW18	30S/11E-18P	Sunnyside #1	Western	35.3095	120.8352	150	MW	SLCUSD	15-35	35	2		x			
FW19	30S/11E-18J7	Los Olivos/Fairchild	Central	35.3130	120.8271	125.74	MW	LOCSD	25-35	35	2		x			
FW20	30S/11E-8Mb	Santa Maria/18th Street	Central	35.3287	120.8233	95	MW	LOCSD	37-47	47	2		x			
FW21	30S/11E-8N4	South Bay Blvd. OBS	Central	35.3253	120.8213	95.99	MW	LOCSD	40-50	50	2		x			
FW22	30S/11E-17F4							PRIVATE								
FW23	30S/11E-17N4							PRIVATE								
FW24	30S/11E-17J2	USGS Eto North - shallow	Eastern	35.3142	120.8119	87	MW	PRIVATE[1]	50-70	70	2			x		
FW25	30S/11E-17R1							PRIVATE								
FW26	30S/11E-20A2							PRIVATE								
FW27	30S/11E-20L1							PRIVATE								
FW28	30S/11E-20M2							PRIVATE								
FW29	30S/11E-20A1							PRIVATE								
FW30	30S/11E-18R1							PRIVATE								
FW31	30S/11E-19A	Bayridge Field #2	Central	35.3066	120.8276	213	MW	LOCSD	18-38	38	4		x			
FW32+	30S/11E-21D14							PRIVATE								

[1] FW24 is former USGS monitorng well (information in public domain)

*Datum varies between NGVD 29 and NAVD 88 (see report Tables 4-8 for details).

+ New for 2018 Reporting Year

MW = Monitoring Well

State Well Numbers for Reconstructed Wells

	NEW (2002)	OLD (1982)
FW2	30S/10E-13L8	30S/10E-13L5
FW5	30S/10E-13Q2	30S/10E-13Q1
FW8	30S/11E-7L4	30S/11E-7L3
FW9	30S/11E-7K3	30S/11E-7K2
FW11	30S/11E-7R2	30S/11E-7R1
FW12	30S/11E-18C2	30S/11E-18C1
FW13	30S/11E-18B2	30S/11E-18B1
FW15	30S/11E-18N2	30S/11E-18N1
FW16	30S/11E-18L11	30S/11E-18L3
FW17	30S/11E-18L12	30S/11E-18L4
FW19	30S/11E-18J7	30S/11E-18J6
FW21	30S/11E-8N4	30S/11E-8N2

Los Osos Basin Plan
Monitoring Well Network
Upper Aquifer Group

Program ID	State Well Number	Name/Location	Basin Area	Coordinates			Well Type	Current Well Owner	Well Data			Aquifer				
				Latitude	Longitude	RP Elevation* (feet amsl)			Screened Interval (feet bgs)	Well Depth (feet bgs)	Casing Diameter (inches)	Creek Valley Alluvium	Zone A/B	Zone C	Zone D	Zone E
UA1	30S/10E-11A1	Sandspit #1 West	Dunes and bay	35.3358	120.8638	16.01	MW	SLO CO.	150-160	160	2			x		
UA2	30S/10E-14B1	Sandspit #3 Shallow	Dunes and bay	35.3219	120.8682	19.48	MW	SLO CO.	190-200	200	1.5			x		
UA3	30S/10E-13F4	GSWC Skyline #1	Western	35.3165	120.8533	19	M	GSWC	90-195	206	14			x		
UA4	30S/10E-13L1	S&T Mutual #1	Western	35.3148	120.8531	38.68	M	S&T	100-141	141	8			x		
UA5	30S/11E-7N1	LOCSD 3rd St. Well	Central	35.3256	120.8401	9.13	M	LOCSD	56-84	80	8			x		
UA6	30S/11E-18L8	USGS Palisades OBS East 2"	Western	35.3149	120.8381	79.18	MW	SLO CO.	100-140	140	2			x		
UA7	30S/11E-18L7	USGS Palisades OBS West 2"	Western	35.3149	120.8381	79.16	MW	SLO CO.	180-220	220	2			x		
UA8	30S/11E-18K7	LOCSD 10th St. Observation West	Central	35.3130	120.8326	135.65	MW	LOCSD	200-220	220	2			x		
UA9	30S/11E-18K3	GSWC Los Olivos #3	Central	35.3133	120.8300	121.18	M	GSWC	148-202, 222-232	232	8			x		
UA10	30S/11E-18H1	LOCSD - 12th St.	Central	35.3161	120.8297	107.10	M	LOCSD	112-125, 145-159, 172-186, 216-231	232	10			x		
UA11	30S/11E-17D							PRIVATE								
UA12	30S/11E-17E9	So. Bay Blvd OBS shallow	Central	35.3158	120.8240	105.85	MW	LOCSD	184-194	204	2			x		
UA13	30S/11E-17E10	LOCSD South Bay upper	Central	35.3159	120.8239	106	M	LOCSD	170-210	220	8			x		
UA14	30S/11E-17P4							PRIVATE								
UA15	30S/11E-20B7							PRIVATE								
UA16	30S/11E-17L4							PRIVATE								
UA17	30S/11E-17E1							PRIVATE								
UA18	30S/11E-17F2							PRIVATE								

*Datum varies between NGVD 29 and NAVD 88 (see report Tables 4-8 for details).

M = Municipal
MW = Monitoring Well

Los Osos Basin Plan
Monitoring Well Network
Lower Aquifer Group

Program ID	State Well Number	Name/Location	Basin Area	Coordinates			Well Type	Well Owner	Well Data			Aquifer				
				Latitude	Longitude	RP Elevation* (feet amsl)			Screened Interval (feet bgs)	Well Depth (feet bgs)	Casing Diameter (inches)	Creek Valley Alluvium	Zone A/B	Zone C	Zone D	Zone E
LA1	30S/10E-2A1	Sandspit #2 North	Dunes and Bay	35.3530	120.8617	23.13	MW	SLO CO.	220-230	230	2					x
LA2	30S/10E-11A2	Sandspit #1 East	Dunes and Bay	35.3358	120.8638	16.07	MW	SLO CO.	234-244	244	2				x	
LA3	30S/10E-14B2	Sandspit #3 Deep	Dunes and	35.3219	120.8682	19.47	MW	SLO CO.	270-280	280	2				x	
LA4	30S/10E-13M1	USGS Howard West	Western	35.3149	120.8597	41.20	MW	PRIVATE	477-537	820	6					x
LA5	30S/10E-13L7	S&T Mutual #4	Western	35.3146	120.8531	37	M	S&T	160-300	300	8					
LA6	30S/10E-13L4	GSWC Pecho #1	Western	35.3129	120.8522	68	M	GSWC	240-380	675	14				x	
LA7	30S/10E-13P2							PRIVATE								
LA8	30S/10E-13N	S&T Mutual #5	Western	35.3088	120.8565	138.50	M	S&T	260-340	350	8				x	
LA9	30S/10E-24C1	GSWC Cabrillo #1	Western	35.3077	120.8552	178.32	M	GSWC	250-500	508	10				x	
LA10	30S/10E-13J1	GSWC Rosina #1	Western	35.3145	120.8468	95.31	M	GSWC	290-406	409	10				x	x
LA11	30S/10E-12J1	Morro Bay Observation #5	Central	35.3299	120.8440	8.43	MW	SLO CO.	349-389	389	2					x
LA12	30S/11E-7Q3	LOCSD 8th St. Lower	Central	35.3259	120.8342	24.30	M	LOCSD	230-270	270	10				x	
LA13	30S/11E-18F2	LOCSD Ferrell #2	Central	35.3159	120.8358	100	M	LOCSD	425-620	625	12				x	x
LA14	30S/11E-18L6	USGS Palisades OBS 6"	Western	35.3149	120.8381	79.36	MW	SLO CO.	355-375, 430-480, 550-600	620	6				x	x
LA15	30S/11E-18L2	LOCSD Palisades	Western	35.3136	120.8377	85	M	LOCSD	340-380	394	12				x	
LA16	30S/11E-18M1	Former CCW #5 - Broderson OBS	Western	35.3128	120.8430	106.82	MW	PRIVATE	330-355, 395-415, 465-505, 530-575	577	10				x	x
LA17	30S/11E-24A2	USGS Broderson	Western	35.3074	120.8433	210.40	MW	SLO CO.	800-860	860	6				x	x
LA18	30S/11E-18K8	10th St. Observation East	Central	35.3130	120.8325	135.74	MW	LOCSD	630-650	650	2					x
LA19	30S/11E-19H2	USGS Bayview Heights 6"	Central	35.3043	120.8266	256.20	MW	SLO CO.	280-380	740	6				x	
LA20	30S/11E-17N10	GSWC South Bay #1	Central	35.3111	120.8240	140	M	GSWC	225-295, 325-395, 485-695	715	12			x	x	x
LA21	30S/11E-17E7	So. Bay Blvd OBS deep #3	Central	35.3158	120.8240	105.85	MW	LOCSD	480-490, 500-510	520	2					x
LA22	30S/11E-17E8	So. Bay Blvd OBS middle #2	Central	35.3158	120.8240	105.85	MW	LOCSD	270-280, 370-380	390	2				x	
LA23	30S/11E-17C1							PRIVATE								
LA24	30S/11E-17J1	USGS Eto North - deep	Eastern	35.3142	120.8119	71.62	I	PRIVATE[1]	160-190, 245-260	260	6				x	x
LA25	30S/11E-20Aa							PRIVATE								
LA26	30S/11E-20G2	USGS Eto South	Eastern	35.3037	120.8131	99.66	I	PRIVATE[1]	300-360	370	6					x
LA27	30S/11E-16Nb							PRIVATE								
LA28	30S/11E-16Na							PRIVATE								
LA29	30S/11E-21E3							PRIVATE								
LA30	30S/11E-20H1							PRIVATE								
LA31	30S/11E-13M2							PRIVATE								
LA32	30S/11E-18K9	LOCSD 10th Street Production	Central	35.3103	120.8325	135	M	LOCSD	235-270, 350-49(	490	14			x	x	
LA33	30S/11E-17A1							PRIVATE								
LA34	30S/11E-8F	Los Osos Landfill MW-11	Eastern	35.3201	120.8052	26.15	MW	SLO CO.	37.5-47.5	47.5					x	
LA35	30S/11E-21Bb	LOWRF South Well	Eastern	35.3076	120.7993	96	Ind	SLO CO.	180-230	230						x
LA36	30S/11E-21Ja							PRIVATE								
LA37+	30S/11E-21B1	Andre Windmill Well	Eastern	35.3069	120.7976	81.4	MW	SLO CO.			6					x
LA38+	30S/11E-21E							PRIVATE								

[1] LA24 amd LA26 are former USGS monitorng wells (information in public domain)

*Datum varies between NGVD 29 and NAVD 88 (see report Tables 4-8 for details).	M = Municipal
	MW = Monitoring Well
	Ind = Industrial Well
+ New for 2017 Reporting Year	I = Irrigation

Los Osos Basin Plan
Monitoring Well Network 2018
FIRST WATER

Program Well ID	CASGEM Program Reporting	Basin Plan Monitoring Code	County Water Level Program	LOWRF Groundwater Monitoring Program[1]	**2019 Basin Plan Monitoring Program[2]**
FW1	no	L			**L**
FW2	yes	L, G		L, G	**L**
FW3	yes	L		L	**L**
FW4	yes	L		L	**L**
FW5	yes	L		L	**L, CEC**
FW6	yes	TL, G, CEC		G	**TL, G**
FW7	yes	L			**L**
FW8	yes	L		L	**L**
FW9	yes	L		L	**L**
FW10	yes	TL, G		G	**TL, G**
FW11	yes	L		L	**L**
FW12	yes	L		L	**L**
FW13	yes	L		L	**L**
FW14	no	L		L	**L**
FW15	yes	L, G		L,G	**L**
FW16	yes	L		L	**L**
FW17	yes	L, G		L,G	**L**
FW18	no	L			**L**
FW19	yes	L		L	**L**
FW20	yes	L, G		L, G	**L**
FW21	yes	L		L	**L**
FW22	no	L, G		L, G	**L**
FW23	no	L		L	**L**
FW24	no	L	L		
FW25	no	L	L		
FW26	no	L, G, CEC			**L, G, CEC**
FW27	no	TL			**TL**
FW28	no	L, G	L		**G**
FW29[3]	no	L	L		
FW30[3]	no	L		L	**L**
FW31[3]	no	L			**L**
FW32[3]	no	L			**L**

L = WATER LEVEL
G = GENERAL MINERAL
CEC = CONSTITUENTS OF EMERGING CONCERN
TL = TRANSDUCER WATER LEVEL

NOTES:
1 - Summer and winter monitoring schedule
2 - Spring and fall monitoring schedule
3 - Well added to LOBP program

Los Osos Basin Plan
Monitoring Well Network 2018
UPPER AQUIFER

Program Well ID	CASGEM Program Reporting	Basin Plan Monitoring Code	County Water Level Program	LOWRF Groundwater Monitoring Program[1]	**2019 Basin Plan Monitoring Program[2]**
UA1	yes	L	L		
UA2	yes	L	L		
UA3	no	L, G			**L, G**
UA4	no	TL			**TL**
UA5	no	L		L	**L**
UA6	no	L	L		
UA7	yes	L	L		
UA8	yes	L			**L**
UA9	no	L, G			**L, G**
UA10	no	TL			**TL**
UA11	no	L		L	**L**
UA12	no	L		L	**L**
UA13	no	L, G			**L, G**
UA14	no	L			**L**
UA15	no	L			**L**
UA16[3]	no	L	L		
UA17[3]	no	L	L		
UA18[3]	no	L	L		

L = WATER LEVEL
G = GENERAL MINERAL
TL = TRANSDUCER WATER LEVEL

NOTES:
1 - Summer and winter monitoring schedule
2 - Spring and fall monitoring schedule
3 - Well added to LOBP program

Los Osos Basin Plan
Monitoring Well Network 2018
LOWER AQUIFER

Program Well ID	Well Owner	Basin Plan Monitoring Code	County Water Level Program	**2019 Basin Plan Monitoring Program[2]**
LA1	yes	L	L	
LA2	yes	L	L	
LA3	yes	L	L	
LA4	no	L, GL		**L**
LA5	no	L	L	
LA6	no	L	L	
LA7	no	TL		**TL**
LA8	no	L, G		**L , G**
LA9	no	L, G		**L , G**
LA10	no	L, G		**L , G**
LA11	no	L, G		**L , G**
LA12	no	L, G		**L , G**
LA13	no	TL		**TL**
LA14	no	L, GL	L	**GL**
LA15	no	L, G		**L , G**
LA16	no	L	L	
LA17	no	L	L	
LA18	yes	L, G		**L , G**
LA19	yes	L	L	
LA20	no	L, G		**L , G**
LA21	no	L	L	
LA22	no	L, G	L	**G**
LA23	no	L, G		**L , G**
LA24	no	L	L	
LA25	no	L		**L**
LA26	no	L	L	
LA27	no	TL		**L**
LA28	no	L, G		**L**
LA29	no	L	L	
LA30	no	L, G		**L**
LA31[3]	no	G		**G**
LA32[3]	no	G		**G**
LA33[3]	no	L		**L**
LA34[3]	no	L	L	
LA35[3]	no	L		**L**
LA36[3]	no	L		**L**
LA37[3]	no	L		**TL**
LA38[3]	no	L		**L**

L = WATER LEVEL
G = GENERAL MINERAL
GL = GEOPHYSICAL LOG (2018)
TL = TRANSDUCER WATER LEVEL

NOTES:
1 - Remove G from LA6 - out of service.
2 - Add G to LA9 and LA22
3 - Well added to LOBP program
Well IDs with both April and October water quality monitoring in Italics

APPENDIX C

Field Logs and Laboratory Analytical Reports for 2018 BMC Monitoring

Note: There are no Groundwater Monitoring Field Logs for Wells LA9, LA10, LA20, UA9, and UA3; These wells were sampled by owner (GSWC).

Spring 2018 Field Logs and Analytical Results

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 4/11/2018
Operator: A. Berge
Well number and location: 30S/11E-13N (LA8)
Site and wellhead conditions: Overcast, cool, windy. Well enclosure secure.

Static water depth (feet): 134.2 on 4/20/18
Well depth (feet): 350
Water column (feet): 215.8
Casing diameter (inches): 8
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 9:06

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
9:07	2	432.8	8.89	17.4	Clear, colorless, odorless
					Sampled @ 9:08

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 4/10/2018
Operator: A. Berge
Well number and location: 30S/11E-12J1 (LA11)
Site and wellhead conditions: Sunny and warm, site secure

Static water depth (feet):	4.45
Well depth (feet):	389
Water column (feet):	384.55
Casing diameter (inches):	2
Minimum purge volume (gal)	190.00
Purge rate (gpm):	1.8
Pumping water level (feet):	--
Pump setting (feet):	25
Minimum purge time (min):	90
Time begin purge:	9:24 AM

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
9:24	1	1,073	8.82	20.2	Slightly turbid, odorless
9:27	5	1,115	8.08	18.4	Slightly turbid, odorless
9:30	10	1,124	7.87	18.3	Clear, colorless, odorless
9:36	20	1,126	7.67	18.6	Clear, colorless, odorless
9:50	45	1,097	8.57	19.9	Clear, colorless, odorless
10:08	75	1,350	7.59	20.7	Slight yellow tinge, odorless
10:23	100	1,333	7.71	20.6	Clear, colorless, odorless
10:36	120	1,327	7.63	20.6	Clear, colorless, odorless
10:51	145	1,316	7.78	20.5	Clear, colorless, odorless
11:08	170	1,282	8.18	20.7	Clear, colorless, odorless
11:19	190	1,284	7.97	20.6	Clear, colorless, odorless
					Sampled @ 11:20 am

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 4/10/2018
Operator: A. Berge
Well number and location: 30S/11E-7Q3 (LA12)
Site and wellhead conditions: Sunny, warm

Static water depth (feet):	29.10 on 4/19/18
Well depth (feet):	270'
Water column (feet):	240.9
Casing diameter (inches):	10"
Minimum purge volume (gal)	flush line
Purge rate (gpm):	--
Pumping water level (feet):	--
Pump setting (feet):	--
Minimum purge time (min):	flush line
Time begin purge:	12:03 PM

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
12:04	1	809.5	7.89	19.3	Clear, colorless, odorless
					Sampled @ 12:05

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 4/10/2018
Operator: A. Berge
Well number and location: 30S/11E-18L2 (LA15)
Site and wellhead conditions: Sunny, warm

Static water depth (feet): 91.5 on 4/19/18
Well depth (feet): 394
Water column (feet): 302.5
Casing diameter (inches): 12"
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 13:11

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
13:12	2	733.5	8.22	21.3	Clear, colorless, odorless
					Sampled @ 13:13

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 4/17/2018

Operator: A. Berge

Well number and location: 30S/11E-18K8 (LA18)

Site and wellhead conditions: Sunny, breezy, site secure.

Static water depth (feet):	136.24
Well depth (feet):	650
Water column (feet):	513.76
Casing diameter (inches):	2"
Minimum purge volume (gal)	240
Purge rate (gpm):	1.4
Pumping water level (feet):	139.24
Pump setting (feet):	155
Minimum purge time (min):	300
Time begin purge:	9:31

Time	Gallons	EC (µS)	pH	Temp. (°C)	Comments*
9:32	1	482.4	7.56	20	Slightly cloudy, odorless
9:38	5	479.5	7.30	19.9	Slightly cloudy, odorless
9:45	10	591.8	7.51	19.8	Clear, colorless, odorless
9:58	20	607.2	7.71	20.1	Clear, colorless, odorless
10:10	30	602.1	7.71	20.4	Clear, colorless, odorless
10:32	40	604.7	7.75	20.7	Clear, colorless, odorless
11:12	80	614.5	7.73	21.3	Clear, colorless, odorless
12:17	120	643.0	8.48	22.4	Clear, colorless, odorless
13:38	170	617.9	7.61	22.1	Clear, colorless, odorless
15:04	220	604.2	8.30	21.2	Clear, colorless, odorless
15:31	240	592.6	7.64	20.9	Clear, colorless, odorless
					Sampled @ 15:32

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 4/16/2018
Operator: A. Berge
Well number and location: 30S11E-17E8 (LA22)
Site and wellhead conditions: Overcast and breezy, site secure

Static water depth (feet): 122.91
Well depth (feet): 380
Water column (feet): 257.09
Casing diameter (inches): 2"
Minimum purge volume (gal) 125
Purge rate (gpm): 1.6
Pumping water level (feet): 124
Pump setting (feet): 160
Minimum purge time (min): --
Time begin purge: 12:25

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
12:25	1	519.8	8.2	19.6	Slightly cloudy, odorless
12:28	5	510.5	8.35	19.6	Faintly cloudy, odorless
12:32	10	508.4	8.21	19.5	Clear, colorless, odorless
12:35	15	505.5	8.14	19.9	Clear, colorless, odorless
12:41	25	474.6	7.59	20	Clear, colorless, odorless
12:48	35	471.2	7.64	20.1	Clear, colorless, odorless
12:58	45	470.6	7.54	20.2	Clear, colorless, odorless
13:04	55	473.0	7.58	19.5	Clear, colorless, odorless
13:18	75	471.7	7.62	19.9	Clear, colorless, odorless
13:32	95	469.6	7.62	19.9	Clear, colorless, odorless
	100				pump control box malfunctioning
					Sampled @ 13:47

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 4/24/2018
Operator: A. Berge
Well number and location: 30S/10E-13M2 (LA31)
Site and wellhead conditions: Sunny and breezy, site secure

Static water depth (feet): 39.23
Well depth (feet): --
Water column (feet): --
Casing diameter (inches): 8
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 13:58

Time	Gallons	EC (µS)	pH	Temp. (°C)	Comments*
13:58	1	3,130	8.39	19.6	Clear, colorless, odorless
14:00	5	3,210	8.20	19.3	Clear, colorless, odorless
14:01	10	3,230	7.97	19	Clear, colorless, odorless
14:02	15	3,240	7.90	18.5	Clear, colorless, odorless
					Sampled @ 14:03

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 4/10/2018
Operator: A. Berge
Well number and location: 30S/11E-18K9 (LA32)
Site and wellhead conditions: Sunny, warm

Static water depth (feet): 153.6 on 4/19/18
Well depth (feet): --
Water column (feet): --
Casing diameter (inches): --
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 13:22

Time	Gallons	EC (µS)	pH	Temp. (°C)	Comments*
13:23	4	497.4	7.95	20	Clear, colorless, odorless
					Sampled @ 13:25

*Turbidity, color, odor, sheen, debris, etc.

May 4, 2018

Lab ID : CC 1881066-001
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : 13N (LA 8) LA-8
Project : Los Osos BMC Monitoring

Sampled On : April 11, 2018-09:08
Sampled By : Andrea Berge
Received On : April 11, 2018-12:49
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	104	--	mg/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Calcium	17	1	mg/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Magnesium	15	1	mg/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Potassium	1	1	mg/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Sodium	39	1	mg/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Total Cations	3.8	--	meq/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Boron	ND	0.1	mg/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Copper	20	10	ug/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Iron	ND	30	ug/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Manganese	ND	10	ug/L		200.7	04/12/18:204162	200.7	04/13/18:205284
Zinc	ND	20	ug/L		200.7	04/12/18:204162	200.7	04/13/18:205284
SAR	1.7	--	--		200.7	04/12/18:204162	200.7	04/13/18:205284
Total Alkalinity (as CaCO3)	50	10	mg/L		2320B	04/13/18:204173	2320B	04/13/18:205238
Hydroxide as OH	ND	10	mg/L		2320B	04/13/18:204173	2320B	04/13/18:205238
Carbonate as CO3	ND	10	mg/L		2320B	04/13/18:204173	2320B	04/13/18:205238
Bicarbonate as HCO3	60	10	mg/L		2320B	04/13/18:204173	2320B	04/13/18:205238
Sulfate	13.5	0.5	mg/L		300.0	04/12/18:204401	300.0	04/12/18:205342
Chloride	79	1	mg/L		300.0	04/12/18:204401	300.0	04/12/18:205342
Nitrate as NO3	34.8	0.4	mg/L		300.0	04/12/18:204401	300.0	04/12/18:205342
Nitrite as N	ND	0.2	mg/L		300.0	04/12/18:204401	300.0	04/12/18:205342
Nitrate + Nitrite as N	7.9	0.1	mg/L		300.0	04/12/18:204401	300.0	04/12/18:205342
Fluoride	ND	0.1	mg/L		300.0	04/12/18:204401	300.0	04/12/18:205342
Total Anions	4.1	--	meq/L		2320B	04/13/18:204173	2320B	04/13/18:205238
pH	7.0	--	units		4500-H B	04/16/18:204302	4500HB	04/16/18:205283
Specific Conductance	440	1	umhos/cm		2510B	04/13/18:204181	2510B	04/13/18:205157
Total Dissolved Solids	260	20	mg/L		2540CE	04/16/18:204303	2540C	04/17/18:205309
MBAS Screen	Negative	0.1	mg/L		5540C	04/12/18:204389	5540C	04/18/18:205374
Aggressiveness Index	10.3	--	--		4500-H B	04/16/18:204302	4500HB	04/16/18:205283
Langelier Index (20°C)	-1.5	--	--		4500-H B	04/16/18:204302	4500HB	04/16/18:205283
Nitrate Nitrogen	7.9	--	mg/L		300.0	04/12/18:204401	300.0	04/12/18:205342

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 3, 2018

Lab ID : CC 1881188-003
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : Cabrillo Well LA-9
Project : Los Osos BMC Monitoring

Sampled On : April 24, 2018-13:20
Sampled By : Zac Reineke
Received On : April 24, 2018-14:47
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	115	--	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Calcium	18	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Magnesium	17	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Potassium	1	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Sodium	43	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Total Cations	4.2	--	meq/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Boron	ND	0.1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Copper	ND	10	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Iron	ND	30	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Manganese	ND	10	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Zinc	ND	20	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
SAR	1.7	--	--		200.7	04/27/18:204835	200.7	04/29/18:205956
Total Alkalinity (as CaCO3)	50	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Hydroxide as OH	ND	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Carbonate as CO3	ND	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Bicarbonate as HCO3	70	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Sulfate	16.7	0.5	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Chloride	90	1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrate as NO3	27.2	0.4	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrite as N	ND	0.2	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrate + Nitrite as N	6.1	0.1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Fluoride	ND	0.1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Total Anions	4.5	--	meq/L		2320B	04/25/18:204682	2320B	04/25/18:205821
pH	7.8	--	units		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Specific Conductance	486	1	umhos/cm		2510B	04/26/18:204746	2510B	04/26/18:205820
Total Dissolved Solids	300	20	mg/L		2540CE	04/27/18:204826	2540C	04/30/18:205962
MBAS Screen	Negative	0.1	mg/L		5540C	04/25/18:204715	5540C	04/25/18:205777
Aggressiveness Index	11.2	--	--		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Langelier Index (20°C)	-0.7	--	--		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Nitrate Nitrogen	6.1	--	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 3, 2018

Lab ID : CC 1881188-003
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : April 24, 2018-13:20
Sampled By : Zac Reineke
Received On : April 24, 2018-14:47
Matrix : Ground Water

Description : Cabrillo Well LA-9
Project : Los Osos BMC Monitoring

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Field Test								
pH (Field)	6.81		units			04/24/18 13:20	4500-H B	04/24/18 13:20
Conductivity	0.52		mS/cm			04/24/18 13:20	2510B	04/24/18 13:20
Temperature	66.0		°F			04/24/18 13:20	2550B	04/24/18 13:20

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 3, 2018

Lab ID : CC 1881188-001
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : April 24, 2018-10:20
Sampled By : Zac Reineke
Received On : April 24, 2018-14:47
Matrix : Ground Water

Description : Rosina Well LA-10
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	188	--	mg/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Calcium	29	1	mg/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Magnesium	28	1	mg/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Potassium	1	1	mg/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Sodium	29	1	mg/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Total Cations	5.0	--	meq/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Boron	ND	0.1	mg/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Copper	ND	10	ug/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Iron	240	30	ug/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Manganese	ND	10	ug/L		200.7	04/27/18:204835	200.7	04/28/18:205956
Zinc	ND	20	ug/L		200.7	04/27/18:204835	200.7	04/28/18:205956
SAR	0.9	--	--		200.7	04/27/18:204835	200.7	04/28/18:205956
Total Alkalinity (as CaCO3)	60	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Hydroxide as OH	ND	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Carbonate as CO3	ND	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Bicarbonate as HCO3	70	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Sulfate	12.3	0.5	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Chloride	136	3*	mg/L		300.0	04/25/18:204854	300.0	04/26/18:205945
Nitrate as NO3	19.0	0.4	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrite as N	ND	0.2	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrate + Nitrite as N	4.3	0.1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Fluoride	ND	0.1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Total Anions	5.5	--	meq/L		2320B	04/25/18:204682	2320B	04/25/18:205821
pH	7.4	--	units		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Specific Conductance	620	1	umhos/cm		2510B	04/26/18:204746	2510B	04/26/18:205820
Total Dissolved Solids	400	20	mg/L		2540CE	04/27/18:204826	2540C	04/30/18:205962
MBAS Screen	Negative	0.1	mg/L		5540C	04/25/18:204715	5540C	04/25/18:205777
Aggressiveness Index	11.0	--	--		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Langelier Index (20°C)	-0.8	--	--		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Nitrate Nitrogen	4.3	--	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 3, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : Rosina Well LA-10
Project : Los Osos BMC Monitoring

Lab ID : CC 1881188-001
Customer ID : 8-514

Sampled On : April 24, 2018-10:20
Sampled By : Zac Reineke
Received On : April 24, 2018-14:47
Matrix : Ground Water

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Field Test								
pH (Field)	6.97		units			04/24/18 10:20	4500-H B	04/24/18 10:20
Conductivity	0.67		mS/cm			04/24/18 10:20	2510B	04/24/18 10:20
Temperature	66.9		°F			04/24/18 10:20	2550B	04/24/18 10:20

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 4, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : 12J1 (LA11) LA-11
Project : Los Osos BMC Monitoring

Lab ID : CC 1881051-001
Customer ID : 8-514

Sampled On : April 10, 2018-11:20
Sampled By : Andrea Berge
Received On : April 10, 2018-14:00
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
General Mineral								
Total Hardness as CaCO3	595	--	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Calcium	85	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Magnesium	93	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Potassium	5	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Sodium	97	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Total Cations	16.2	--	meq/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Boron	0.2	0.1	mg/L		200.7	04/11/18:204113	200.7	04/16/18:205312
Copper	ND	10	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Iron	80	30	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Manganese	40	10	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Zinc	ND	20	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
SAR	1.7	--	--		200.7	04/11/18:204113	200.7	04/13/18:205284
Total Alkalinity (as CaCO3)	290	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Hydroxide as OH	ND	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Carbonate as CO3	ND	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Bicarbonate as HCO3	350	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Sulfate	192	0.5	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Chloride	173	3*	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrate as NO3	ND	0.4	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrite as N	ND	0.2	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrate + Nitrite as N	ND	0.1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Fluoride	0.1	0.1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Total Anions	14.6	--	meq/L		2320B	04/12/18:204130	2320B	04/12/18:205119
pH	7.6	--	units		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Specific Conductance	1390	1	umhos/cm		2510B	04/12/18:204140	2510B	04/12/18:205109
Total Dissolved Solids	820	20	mg/L		2540CE	04/13/18:204206	2540C	04/16/18:205237
MBAS Screen	Negative	0.1	mg/L		5540C	04/11/18:204115	5540C	04/11/18:205085
Aggressiveness Index	12.4	--	--		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Langelier Index (20°C)	0.5	--	--		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Nitrate Nitrogen	ND	--	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 4, 2018

Lab ID : CC 1881051-002
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : 7Q3 (LA12) LA-12
Project : Los Osos BMC Monitoring

Sampled On : April 10, 2018-12:05
Sampled By : Andrea Berge
Received On : April 10, 2018-14:00
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	319	--	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Calcium	52	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Magnesium	46	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Potassium	2	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Sodium	56	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Total Cations	8.9	--	meq/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Boron	0.2	0.1	mg/L		200.7	04/11/18:204113	200.7	04/16/18:205312
Copper	10	10	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Iron	2290	30	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Manganese	80	10	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Zinc	80	20	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
SAR	1.4	--	--		200.7	04/11/18:204113	200.7	04/13/18:205284
Total Alkalinity (as CaCO3)	240	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Hydroxide as OH	ND	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Carbonate as CO3	ND	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Bicarbonate as HCO3	300	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Sulfate	46.2	0.5	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Chloride	93	1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrate as NO3	ND	0.4	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrite as N	ND	0.2	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrate + Nitrite as N	ND	0.1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Fluoride	ND	0.1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Total Anions	8.5	--	meq/L		2320B	04/12/18:204130	2320B	04/12/18:205119
pH	7.7	--	units		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Specific Conductance	814	1	umhos/cm		2510B	04/12/18:204140	2510B	04/12/18:205109
Total Dissolved Solids	440	20	mg/L		2540CE	04/13/18:204206	2540C	04/16/18:205237
MBAS Screen	Negative	0.1	mg/L		5540C	04/11/18:204115	5540C	04/11/18:205085
Aggressiveness Index	12.2	--	--		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Langelier Index (20°C)	0.3	--	--		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Nitrate Nitrogen	ND	--	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 4, 2018

Lab ID : CC 1881051-003
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : 18L2 (LA15) LA-15
Project : Los Osos BMC Monitoring

Sampled On : April 10, 2018-13:13
Sampled By : Andrea Berge
Received On : April 10, 2018-14:00
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	311	--	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Calcium	52	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Magnesium	44	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Potassium	2	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Sodium	40	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Total Cations	8.0	--	meq/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Boron	ND	0.1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Copper	10	10	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Iron	ND	30	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Manganese	ND	10	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Zinc	ND	20	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
SAR	1.0	--	--		200.7	04/11/18:204113	200.7	04/13/18:205284
Total Alkalinity (as CaCO3)	200	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Hydroxide as OH	ND	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Carbonate as CO3	ND	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Bicarbonate as HCO3	250	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Sulfate	32.4	0.5	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Chloride	100	1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrate as NO3	3.4	0.4	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrite as N	ND	0.2	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrate + Nitrite as N	0.8	0.1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Fluoride	ND	0.1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Total Anions	7.6	--	meq/L		2320B	04/12/18:204130	2320B	04/12/18:205119
pH	7.3	--	units		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Specific Conductance	767	1	umhos/cm		2510B	04/12/18:204140	2510B	04/12/18:205109
Total Dissolved Solids	420	20	mg/L		2540CE	04/13/18:204206	2540C	04/16/18:205237
MBAS Screen	Negative	0.1	mg/L		5540C	04/11/18:204115	5540C	04/11/18:205085
Aggressiveness Index	11.7	--	--		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Langelier Index (20°C)	-0.1	--	--		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Nitrate Nitrogen	0.8	--	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 4, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : 18K8 (LA18) LA-18
Project : Los Osos BMC Monitoring

Lab ID : CC 1881132-001
Customer ID : 8-514

Sampled On : April 17, 2018-15:32
Sampled By : Andrea Berge
Received On : April 17, 2018-16:09
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
General Mineral								
Total Hardness as CaCO3	260	--	mg/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Calcium	53	1	mg/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Magnesium	31	1	mg/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Potassium	2	1	mg/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Sodium	27	1	mg/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Total Cations	6.4	--	meq/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Boron	ND	0.1	mg/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Copper	ND	10	ug/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Iron	ND	30	ug/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Manganese	80	10	ug/L		200.7	04/18/18:204414	200.7	04/19/18:205439
Zinc	ND	20	ug/L		200.7	04/18/18:204414	200.7	04/19/18:205439
SAR	0.7	--	--		200.7	04/18/18:204414	200.7	04/19/18:205439
Total Alkalinity (as CaCO3)	240	10	mg/L		2320B	04/19/18:204432	2320B	04/19/18:205492
Hydroxide as OH	ND	10	mg/L		2320B	04/19/18:204432	2320B	04/19/18:205492
Carbonate as CO3	ND	10	mg/L		2320B	04/19/18:204432	2320B	04/19/18:205492
Bicarbonate as HCO3	290	10	mg/L		2320B	04/19/18:204432	2320B	04/19/18:205492
Sulfate	39.9	0.5	mg/L		300.0	04/18/18:204524	300.0	04/18/18:205546
Chloride	33	1	mg/L		300.0	04/18/18:204524	300.0	04/18/18:205546
Nitrate as NO3	ND	0.4	mg/L		300.0	04/18/18:204524	300.0	04/18/18:205546
Nitrite as N	ND	0.2	mg/L		300.0	04/18/18:204524	300.0	04/18/18:205546
Nitrate + Nitrite as N	ND	0.1	mg/L		300.0	04/18/18:204524	300.0	04/18/18:205546
Fluoride	0.3	0.1	mg/L		300.0	04/18/18:204524	300.0	04/18/18:205546
Total Anions	6.5	--	meq/L		2320B	04/19/18:204432	2320B	04/19/18:205492
pH	7.3	--	units		4500-H B	04/19/18:204434	4500HB	04/19/18:205434
Specific Conductance	625	1	umhos/cm		2510B	04/19/18:204435	2510B	04/19/18:205440
Total Dissolved Solids	390	20	mg/L		2540CE	04/19/18:204454	2540C	04/20/18:205491
MBAS Screen	Negative	0.1	mg/L		5540C	04/18/18:204437	5540C	04/19/18:205441
Aggressiveness Index	11.8	--	--		4500-H B	04/19/18:204434	4500HB	04/19/18:205434
Langelier Index (20°C)	-0.05	--	--		4500-H B	04/19/18:204434	4500HB	04/19/18:205434
Nitrate Nitrogen	ND	--	mg/L		300.0	04/18/18:204524	300.0	04/18/18:205546

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 3, 2018

Lab ID : CC 1881188-002
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : South Bay Well LA-20
Project : Los Osos BMC Monitoring

Sampled On : April 24, 2018-10:50
Sampled By : Zac Reineke
Received On : April 24, 2018-14:47
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	166	--	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Calcium	27	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Magnesium	24	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Potassium	2	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Sodium	31	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Total Cations	4.7	--	meq/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Boron	0.1	0.1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Copper	ND	10	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Iron	ND	30	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Manganese	ND	10	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Zinc	50	20	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
SAR	1.0	--	--		200.7	04/27/18:204835	200.7	04/29/18:205956
Total Alkalinity (as CaCO3)	160	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Hydroxide as OH	ND	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Carbonate as CO3	ND	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Bicarbonate as HCO3	200	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Sulfate	23.2	0.5	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Chloride	43	1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrate as NO3	14.1	0.4	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrite as N	ND	0.2	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrate + Nitrite as N	3.2	0.1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Fluoride	0.1	0.1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Total Anions	5.2	--	meq/L		2320B	04/25/18:204682	2320B	04/25/18:205821
pH	7.4	--	units		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Specific Conductance	515	1	umhos/cm		2510B	04/26/18:204746	2510B	04/26/18:205820
Total Dissolved Solids	330	20	mg/L		2540CE	04/27/18:204826	2540C	04/30/18:205962
MBAS Screen	Negative	0.1	mg/L		5540C	04/25/18:204715	5540C	04/25/18:205777
Aggressiveness Index	11.4	--	--		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Langelier Index (20°C)	-0.4	--	--		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Nitrate Nitrogen	3.2	--	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 3, 2018

Lab ID : CC 1881188-002
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : April 24, 2018-10:50
Sampled By : Zac Reineke
Received On : April 24, 2018-14:47
Matrix : Ground Water

Description : South Bay Well LA-20
Project : Los Osos BMC Monitoring

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Field Test								
pH (Field)	7.16		units			04/24/18 10:50	4500-H B	04/24/18 10:50
Conductivity	0.58		mS/cm			04/24/18 10:50	2510B	04/24/18 10:50
Temperature	68.0		°F			04/24/18 10:50	2550B	04/24/18 10:50

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 4, 2018

Lab ID : CC 1881109-001
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : April 16, 2018-13:47
Sampled By : Andrea Berge
Received On : April 16, 2018-15:02
Matrix : Ground Water

Description : 17E8 LA22 LA-22
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
General Mineral								
Total Hardness as CaCO3	165	--	mg/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Calcium	25	1	mg/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Magnesium	25	1	mg/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Potassium	1	1	mg/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Sodium	29	1	mg/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Total Cations	4.6	--	meq/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Boron	ND	0.1	mg/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Copper	ND	10	ug/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Iron	ND	30	ug/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Manganese	ND	10	ug/L		200.7	04/18/18:204414	200.7	04/18/18:205439
Zinc	ND	20	ug/L		200.7	04/18/18:204414	200.7	04/18/18:205439
SAR	1.0	--	--		200.7	04/18/18:204414	200.7	04/18/18:205439
Total Alkalinity (as CaCO3)	130	10	mg/L		2320B	04/18/18:204385	2320B	04/18/18:205388
Hydroxide as OH	ND	10	mg/L		2320B	04/18/18:204385	2320B	04/18/18:205388
Carbonate as CO3	ND	10	mg/L		2320B	04/18/18:204385	2320B	04/18/18:205388
Bicarbonate as HCO3	150	10	mg/L		2320B	04/18/18:204385	2320B	04/18/18:205388
Sulfate	14.2	0.5	mg/L		300.0	04/17/18:204480	300.0	04/17/18:205511
Chloride	47	1	mg/L		300.0	04/17/18:204480	300.0	04/17/18:205511
Nitrate as NO3	29.7	0.4	mg/L		300.0	04/17/18:204480	300.0	04/17/18:205511
Nitrite as N	ND	0.2	mg/L		300.0	04/17/18:204480	300.0	04/17/18:205511
Nitrate + Nitrite as N	6.7	0.1	mg/L		300.0	04/17/18:204480	300.0	04/17/18:205511
Fluoride	ND	0.1	mg/L		300.0	04/17/18:204480	300.0	04/17/18:205511
Total Anions	4.6	--	meq/L		2320B	04/18/18:204385	2320B	04/18/18:205388
pH	6.4	--	units		4500-H B	04/20/18:204525	4500HB	04/20/18:205524
Specific Conductance	473	1	umhos/cm		2510B	04/18/18:204393	2510B	04/23/18:205378
Total Dissolved Solids	310	20	mg/L		2540CE	04/18/18:204400	2540C	04/19/18:205432
MBAS Screen	Negative	0.1	mg/L		5540C	04/18/18:204404	5540C	04/18/18:205399
Aggressiveness Index	10.3	--	--		4500-H B	04/20/18:204525	4500HB	04/20/18:205524
Langelier Index (20°C)	-1.5	--	--		4500-H B	04/20/18:204525	4500HB	04/20/18:205524
Nitrate Nitrogen	6.7	--	mg/L		300.0	04/17/18:204480	300.0	04/17/18:205511

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 10, 2018

Lab ID : CC 1881189-001
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : April 24, 2018-14:03
Sampled By : Andrea Berge
Received On : April 24, 2018-14:47
Matrix : Ground Water

Description : 13M2 LA31 LA-31
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	664	--	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Calcium	103	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Magnesium	99	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Potassium	4	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Sodium	367	1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Total Cations	29.4	--	meq/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Boron	0.1	0.1	mg/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Copper	ND	10	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Iron	ND	30	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Manganese	ND	10	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
Zinc	ND	20	ug/L		200.7	04/27/18:204835	200.7	04/29/18:205956
SAR	6.2	--	--		200.7	04/27/18:204835	200.7	04/29/18:205956
Total Alkalinity (as CaCO3)	50	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Hydroxide as OH	ND	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Carbonate as CO3	ND	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Bicarbonate as HCO3	70	10	mg/L		2320B	04/25/18:204682	2320B	04/25/18:205821
Sulfate	186	0.5	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Chloride	946	19*	mg/L		300.0	04/25/18:204854	300.0	04/26/18:205945
Nitrate as NO3	2.8	0.4	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrite as N	ND	0.2	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Nitrate + Nitrite as N	0.6	0.1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Fluoride	ND	0.1	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945
Total Anions	31.7	--	meq/L		2320B	04/25/18:204682	2320B	04/25/18:205821
pH	7.2	--	units		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Specific Conductance	3370	1	umhos/cm		2510B	04/26/18:204746	2510B	04/26/18:205820
Total Dissolved Solids	2020	20	mg/L		2540CE	04/27/18:204826	2540C	04/30/18:205962
MBAS Screen	Negative	0.1	mg/L		5540C	04/25/18:204715	5540C	04/25/18:205777
Aggressiveness Index	11.3	--	--		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Langelier Index (20°C)	-0.6	--	--		4500-H B	04/26/18:204764	4500HB	04/26/18:205842
Nitrate Nitrogen	0.6	--	mg/L		300.0	04/25/18:204854	300.0	04/25/18:205945

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

May 4, 2018

Lab ID : CC 1881051-004
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : April 10, 2018-13:25
Sampled By : Andrea Berge
Received On : April 10, 2018-14:00
Matrix : Ground Water

Description : 18K9 (LA32) LA-32
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	75.2	--	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Calcium	12	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Magnesium	11	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Potassium	ND	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Sodium	23	1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Total Cations	2.5	--	meq/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Boron	ND	0.1	mg/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Copper	20	10	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Iron	90	30	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Manganese	ND	10	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
Zinc	ND	20	ug/L		200.7	04/11/18:204113	200.7	04/13/18:205284
SAR	1.2	--	--		200.7	04/11/18:204113	200.7	04/13/18:205284
Total Alkalinity (as CaCO3)	40	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Hydroxide as OH	ND	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Carbonate as CO3	ND	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Bicarbonate as HCO3	50	10	mg/L		2320B	04/12/18:204130	2320B	04/12/18:205119
Sulfate	5.0	0.5	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Chloride	35	1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrate as NO3	28.6	0.4	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrite as N	ND	0.2	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Nitrate + Nitrite as N	6.5	0.1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Fluoride	ND	0.1	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125
Total Anions	2.4	--	meq/L		2320B	04/12/18:204130	2320B	04/12/18:205119
pH	7.7	--	units		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Specific Conductance	256	1	umhos/cm		2510B	04/12/18:204140	2510B	04/12/18:205109
Total Dissolved Solids	150	20	mg/L		2540CE	04/13/18:204206	2540C	04/16/18:205237
MBAS Screen	Negative	0.1	mg/L		5540C	04/11/18:204115	5540C	04/11/18:205085
Aggressiveness Index	10.8	--	--		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Langelier Index (20°C)	-1.0	--	--		4500-H B	04/16/18:204270	4500HB	04/16/18:205255
Nitrate Nitrogen	6.5	--	mg/L		300.0	04/11/18:204152	300.0	04/11/18:205125

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

Fall 2018 Field Logs and Analytical Results

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/9/2018
Operator: A. Berge
Well number and location: 30S/11E-20M2 (FW28)
Site and wellhead conditions: Sunny and hot, location secure, pump turned off since 10:00 am

Static water depth (feet): 29.32
Well depth (feet): 102
Water column (feet): 72.68
Casing diameter (inches): 12
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 12:52

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
12:53	1	858	7.75	21.8	Initially brown, clearing up
12:55	10	824.9	7.73	17.3	Slightly cloudy, odorless
12:58	20	812.8	7.41	16.9	Slightly cloudy, odorless
13:00	40	812.5	7.35	16.7	Clear, colorless, odorless
					Sampled @ 13:02

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/2/2018
Operator: A. Berge
Well number and location: 30S/11E-17E10 (UA13)
Site and wellhead conditions: Sunny, warm, well has been on since 7:00

Static water depth (feet): 93.67 on 10/12/18
Well depth (feet): 142
Water column (feet): 48.33
Casing diameter (inches): 8
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 13:12

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
13:13	3	503.4	8.06	19.6	Clear, colorless, odorless
					Sampled @ 13:16

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/3/2018
Operator: A. Berge
Well number and location: 30S/11E-13N (LA8)
Site and wellhead conditions: Overcast, drizzle.

Static water depth (feet): 137.5 on 10/7/18
Well depth (feet): 350
Water column (feet): 212.5
Casing diameter (inches): 8
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 12:24

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
12:25	4	434.6	7.72	18.9	Clear, colorless, odorless
					Sampled @ 12:25

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/2/2018
Operator: A. Berge
Well number and location: 30S/11E-12J1 (LA11)
Site and wellhead conditions: Overcast, cool, site secure and cap in place.

Static water depth (feet): 6.36
Well depth (feet): 389
Water column (feet): 382.64
Casing diameter (inches): 2
Minimum purge volume (gal) 190.00
Purge rate (gpm): 1.8
Pumping water level (feet): 11.82
Pump setting (feet): 25
Minimum purge time (min): 120
Time begin purge: 9:21 AM

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
9:22	1	938.6	8.31	18.3	Clear, colorless, odorless
9:24	5	967.8	8.18	18.5	Clear, colorless, odorless
9:28	10	973.7	7.74	18.6	Clear, colorless, odorless
9:34	20	983.8	7.76	19.1	Clear, colorless, odorless
9:49	45	1,000	7.55	20.3	Clear, colorless, odorless
9:52	55	1,136	7.61	20.2	Slightly cloudy, odorless
10:08	75	1,175	7.54	20.7	Slightly cloudy, odorless
10:22	100	1,175	7.55	21.3	Clear, colorless, odorless
10:34	120	1,168	7.52	21.3	Clear, colorless, odorless
10:50	145	1,179	7.75	21.5	Clear, colorless, odorless
11:06	170	1,167	7.75	21.4	Clear, colorless, odorless
11:17	190	1,158	7.68	21.8	Clear, colorless, odorless
					Sampled @ 11:18

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/2/2018
Operator: A. Berge
Well number and location: 30S/11E-7Q3 (LA12)
Site and wellhead conditions: Sunny, warm, well has been on since 7:05

Static water depth (feet): 41.10 on 10/12/18
Well depth (feet): 270'
Water column (feet): 228.9
Casing diameter (inches): 10"
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 12:59

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
13:00	5	749.9	7.62	21.2	Clear, colorless, odorless
					Sampled @ 13:02

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/23/2018
Operator: A. Berge
Well number and location: 30S/11E-18L2 (LA15)
Site and wellhead conditions: Sunny, clear, well has been on since 8:00

Static water depth (feet): 95.16 on 10/12/18
Well depth (feet): 394
Water column (feet): 298.84
Casing diameter (inches): 12"
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 11:08

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
11:09	1	768.1	7.60	21	Clear, colorless, odorless
11:10	5	761.5	7.36	20.8	Clear, colorless, odorless
					Sampled @ 11:12

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/10/2018
Operator: A. Berge, B. Pfeifle
Well number and location: 30S/11E-18K8 (LA18)
Site and wellhead conditions: Overcast, site secure.

Static water depth (feet):	138.82
Well depth (feet):	650
Water column (feet):	511.18
Casing diameter (inches):	2"
Minimum purge volume (gal)	240
Purge rate (gpm):	2
Pumping water level (feet):	141.5
Pump setting (feet):	160
Minimum purge time (min):	150
Time begin purge:	9:01

Time	Gallons	EC (µS)	pH	Temp. (°C)	Comments*
9:02	1	503.1	7.71	20.6	Clear, colorless, odorless
9:07	5	589.7	7.08	23.5	Clear, colorless, odorless
9:12	10	610.8	7.17	21.9	Clear, colorless, odorless
9:18	20	613.0	7.38	22.1	Clear, colorless, odorless
9:25	30	611.2	7.40	21.9	Clear, colorless, odorless
9:36	50	613.6	7.38	22.7	Clear, colorless, odorless
9:50	80	613.8	7.48	22.8	Clear, colorless, odorless
10:16	120	618.0	7.47	23.4	Clear, colorless, odorless
10:46	170	618.0	7.47	23.6	Clear, colorless, odorless
11:10	220	619.1	7.51	23.6	Clear, colorless, odorless
11:19	240	617.0	7.53	23.1	Clear, colorless, odorless
					Sampled @ 11:20

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/10/2018
Operator: A. Berge, B. Pfeifle
Well number and location: 30S11E-17E8 (LA22)
Site and wellhead conditions: Overcast, site secure

Static water depth (feet): 124.41
Well depth (feet): 380
Water column (feet): 255.59
Casing diameter (inches): 2"
Minimum purge volume (gal) 125
Purge rate (gpm): 2
Pumping water level (feet): 127.53
Pump setting (feet): 130
Minimum purge time (min): 90
Time begin purge: 11:59

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
12:00	1	526.9	7.96	19.6	Clear, colorless, odorless
12:04	5	523.1	8.07	20.2	Clear, colorless, odorless
12:07	10	522.8	8.09	20.1	Slightly cloudy, odorless
12:10	15	523.7	8.03	20.2	Slightly cloudy, odorless
12:16	25	499.7	7.82	20.4	Slightly cloudy, odorless
12:20	35	480.4	7.65	20.5	Clear, colorless, odorless
12:26	45	477.0	7.46	20.8	Clear, colorless, odorless
12:31	55	477.9	7.49	20.8	Clear, colorless, odorless
12:41	75	478.7	7.49	20.7	Clear, colorless, odorless
12:52	95	479.5	7.41	20.6	Clear, colorless, odorless
13:02	115	477.5	7.36	20.8	Clear, colorless, odorless
13:10	125	477.7	7.48	21	Clear, colorless, odorless
					Sampled @ 13:09

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/4/2018
Operator: A. Berge
Well number and location: 30S/11E-20H1 (LA30)
Site and wellhead conditions: Overcast, muggy, site secure

Static water depth (feet): 28.02
Well depth (feet): 140
Water column (feet): 111.98
Casing diameter (inches): 6
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 9:55

Time	Gallons	EC (µS)	pH	Temp. (°C)	Comments*
9:55	1	782.1	8.22	18.3	Slight sulfur odor, cloudy
9:57	5	784.9	7.79	18	Slight sulfur odor, cloudy
9:59	10	786.9	7.85	17.9	Cloudy, odorless
10:02	25	789.9	7.68	17.6	Clear, colorless, odorless
					Sampled @ 10:05

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/17/2018
Operator: A. Berge
Well number and location: 30S/10E-13M2 (LA31)
Site and wellhead conditions: Sunny and breezy, site secure, well has been ran today

Static water depth (feet):	39.38
Well depth (feet):	--
Water column (feet):	--
Casing diameter (inches):	8
Minimum purge volume (gal)	flush line
Purge rate (gpm):	--
Pumping water level (feet):	--
Pump setting (feet):	--
Minimum purge time (min):	flush line
Time begin purge:	10:51

Time	Gallons	EC (µS)	pH	Temp. (°C)	Comments*
10:52	1	3,180	7.60	19	Clear, colorless, odorless
10:54	7	3,270	7.67	18.5	Clear, colorless, odorless
10:55	10	3,260	7.55	18.9	Clear, colorless, odorless
					Sampled @ 10:57

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/2/2018
Operator: A. Berge
Well number and location: 30S/11E-18K9 (LA32)
Site and wellhead conditions: Sunny, warm, well running since 7:05

Static water depth (feet): 159.65 on 10/12/18
Well depth (feet): --
Water column (feet): --
Casing diameter (inches): --
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 12:47

Time	Gallons	EC (µS)	pH	Temp. (°C)	Comments*
12:48	2	483.8	7.77	21.3	Clear, colorless, odorless
					Sampled @ 12:50

*Turbidity, color, odor, sheen, debris, etc.

October 31, 2018

Lab ID : CC 1883216-001
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : October 16, 2018-12:00
Sampled By : Andrea Berge
Received On : October 16, 2018-14:35
Matrix : Ground Water

Description : 20A2 FW26 FW-26
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
General Mineral								
Total Hardness as CaCO3	249	--	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Calcium	37	1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Magnesium	38	1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Potassium	ND	1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Sodium	39	1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Total Cations	6.7	--	meq/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Boron	ND	0.1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Copper	ND	10	ug/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Iron	2050	30	ug/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Manganese	480	10	ug/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Zinc	ND	20	ug/L		200.7	10/19/18:212498	200.7	10/20/18:215474
SAR	1.1	--	--		200.7	10/19/18:212498	200.7	10/20/18:215474
Total Alkalinity (as CaCO3)	180	10	mg/L		2320B	10/23/18:212595	2320B	10/23/18:215650
Hydroxide as OH	ND	10	mg/L		2320B	10/23/18:212595	2320B	10/23/18:215650
Carbonate as CO3	ND	10	mg/L		2320B	10/23/18:212595	2320B	10/23/18:215650
Bicarbonate as HCO3	210	10	mg/L		2320B	10/23/18:212595	2320B	10/23/18:215650
Sulfate	30.1	0.5	mg/L		300.0	10/17/18:212424	300.0	10/17/18:215334
Chloride	70	1	mg/L		300.0	10/17/18:212424	300.0	10/17/18:215334
Nitrate as NO3	ND	0.4	mg/L		300.0	10/17/18:212424	300.0	10/17/18:215334
Nitrite as N	ND	0.2	mg/L		300.0	10/17/18:212424	300.0	10/17/18:215334
Nitrate + Nitrite as N	ND	0.1	mg/L		300.0	10/17/18:212424	300.0	10/17/18:215334
Fluoride	ND	0.1	mg/L		300.0	10/17/18:212424	300.0	10/17/18:215334
Total Anions	6.0	--	meq/L		2320B	10/23/18:212595	2320B	10/23/18:215650
pH	6.6	--	units		4500-H B	10/18/18:212467	4500HB	10/18/18:215364
Specific Conductance	650	1	umhos/cm		2510B	10/22/18:212551	2510B	10/22/18:215492
Total Dissolved Solids	400	20	mg/L		2540CE	10/19/18:212510	2540C	10/20/18:215475
MBAS Screen	Negative	0.1	mg/L		5540C	10/18/18:212465	5540C	10/18/18:215362
Aggressiveness Index	10.8	--	--		4500-H B	10/18/18:212467	4500HB	10/18/18:215364
Langelier Index (20°C)	-1.0	--	--		4500-H B	10/18/18:212467	4500HB	10/18/18:215364
Nitrate Nitrogen	ND	--	mg/L		300.0	10/17/18:212424	300.0	10/17/18:215334

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : FW28-20M2 FW-28
Project : Los Osos BMC Monitoring

Lab ID : CC 1883158-002
Customer ID : 8-514

Sampled On : October 9, 2018-13:02
Sampled By : Andrea Berge
Received On : October 9, 2018-14:17
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	431	--	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Calcium	77	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Magnesium	58	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Potassium	1	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Sodium	36	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Cations	10.2	--	meq/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Boron	0.2	0.1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Copper	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Iron	310	30	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Manganese	50	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Zinc	ND	20	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
SAR	0.8	--	--		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Alkalinity (as CaCO3)	290	10	mg/L		2320B	10/21/18:212546	2320B	10/21/18:215497
Hydroxide as OH	ND	10	mg/L		2320B	10/21/18:212546	2320B	10/21/18:215497
Carbonate as CO3	ND	10	mg/L		2320B	10/21/18:212546	2320B	10/21/18:215497
Bicarbonate as HCO3	350	10	mg/L		2320B	10/21/18:212546	2320B	10/21/18:215497
Sulfate	87.8	0.5	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Chloride	46	1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate as NO3	0.5	0.4	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrite as N	ND	0.2	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate + Nitrite as N	0.1	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Fluoride	0.2	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Total Anions	8.9	--	meq/L		2320B	10/21/18:212546	2320B	10/21/18:215497
pH	7.3	--	units		4500-H B	10/12/18:212206	4500HB	10/12/18:215018
Specific Conductance	857	1	umhos/cm		2510B	10/11/18:212144	2510B	10/11/18:214941
Total Dissolved Solids	540	20	mg/L		2540CE	10/11/18:212161	2540C	10/12/18:215017
MBAS Screen	Negative	0.1	mg/L		5540C	10/10/18:212119	5540C	10/10/18:214911
Aggressiveness Index	12.0	--	--		4500-H B	10/12/18:212206	4500HB	10/12/18:215018
Langelier Index (20°C)	0.2	--	--		4500-H B	10/12/18:212206	4500HB	10/12/18:215018
Nitrate Nitrogen	0.1	--	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Lab ID : CC 1883159-003
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : Skyline UA-3
Project : Los Osos BMC Monitoring

Sampled On : October 9, 2018-09:30
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	134	--	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Calcium	24	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Magnesium	18	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Potassium	2	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Sodium	55	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Cations	5.1	--	meq/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Boron	ND	0.1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Copper	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Iron	ND	30	ug/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Manganese	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Zinc	ND	20	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
SAR	2.1	--	--		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Alkalinity (as CaCO3)	60	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Hydroxide as OH	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Carbonate as CO3	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Bicarbonate as HCO3	70	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Sulfate	24.6	0.5	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Chloride	55	1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate as NO3	67.4	0.4	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrite as N	ND	0.2	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate + Nitrite as N	15.2	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Fluoride	ND	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Total Anions	4.3	--	meq/L		2320B	10/18/18:212466	2320B	10/18/18:215431
pH (Field)	6.7	--	units		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Specific Conductance	508	1	umhos/cm		2510B	10/11/18:212144	2510B	10/11/18:214941
Total Dissolved Solids	300	20	mg/L		2540CE	10/12/18:212223	2540C	10/15/18:215118
MBAS Screen	Negative	0.1	mg/L		5540C	10/10/18:212119	5540C	10/10/18:214911
Aggressiveness Index	10.3	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Langelier Index (20°C)	-1.6	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Nitrate Nitrogen	15.2	--	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : Skyline UA-3
Project : Los Osos BMC Monitoring

Lab ID : CC 1883159-003
Customer ID : 8-514

Sampled On : October 9, 2018-09:30
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Field Test								
Temperature	66		°F			10/09/18 09:30	2550B	10/09/18 09:30
Conductivity	0.58		umhos/cm			10/09/18 09:30	2510B	10/09/18 09:30

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Lab ID : CC 1883159-001
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : October 9, 2018-08:10
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Description : Los Olivos 3 UA-9
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	95.9	--	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Calcium	17	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Magnesium	13	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Potassium	1	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Sodium	30	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Cations	3.2	--	meq/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Boron	ND	0.1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Copper	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Iron	ND	30	ug/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Manganese	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Zinc	ND	20	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
SAR	1.3	--	--		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Alkalinity (as CaCO3)	50	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Hydroxide as OH	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Carbonate as CO3	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Bicarbonate as HCO3	60	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Sulfate	8.6	0.5	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Chloride	39	1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate as NO3	38.2	0.4	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrite as N	ND	0.2	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate + Nitrite as N	8.6	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Fluoride	ND	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Total Anions	2.9	--	meq/L		2320B	10/18/18:212466	2320B	10/18/18:215431
pH (Field)	7.1	--	units		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Specific Conductance	326	1	umhos/cm		2510B	10/11/18:212144	2510B	10/11/18:214941
Total Dissolved Solids	210	20	mg/L		2540CE	10/12/18:212223	2540C	10/15/18:215118
MBAS Screen	Negative	0.1	mg/L		5540C	10/10/18:212119	5540C	10/10/18:214911
Aggressiveness Index	10.4	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Langelier Index (20°C)	-1.4	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Nitrate Nitrogen	8.6	--	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : Los Olivos 3 UA-9
Project : Los Osos BMC Monitoring

Lab ID : CC 1883159-001
Customer ID : 8-514

Sampled On : October 9, 2018-08:10
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
Field Test								
Temperature	67		°F			10/09/18 08:10	2550B	10/09/18 08:10
Conductivity	0.73		umhos/cm			10/09/18 08:10	2510B	10/09/18 08:10

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Description : 17E10 (UA13) UA-13
Project : Los Osos BMC Monitoring

Lab ID : CC 1883078-005
Customer ID : 8-514

Sampled On : October 2, 2018-13:16
Sampled By : Andrea Berge
Received On : October 2, 2018-14:09
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
General Mineral								
Total Hardness as CaCO3	145	--	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Calcium	22	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Magnesium	22	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Potassium	ND	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Sodium	35	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Total Cations	4.4	--	meq/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Boron	ND	0.1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Copper	ND	10	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Iron	ND	30	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Manganese	ND	10	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Zinc	ND	20	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
SAR	1.3	--	--		200.7	10/04/18:211874	200.7	10/04/18:214604
Total Alkalinity (as CaCO3)	90	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Hydroxide as OH	ND	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Carbonate as CO3	ND	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Bicarbonate as HCO3	110	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Sulfate	21.5	0.5	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Chloride	59	1	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Nitrate as NO3	64.0	0.4	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Nitrite as N	ND	0.2	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Nitrate + Nitrite as N	14.5	0.1	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Fluoride	ND	0.1	mg/L		300.0	10/10/18:212412	300.0	10/10/18:215318
Total Anions	4.9	--	meq/L		2320B	10/04/18:211859	2320B	10/04/18:214618
pH	7.0	--	units		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Specific Conductance	519	1	umhos/cm		2510B	10/04/18:211853	2510B	10/04/18:214556
Total Dissolved Solids	320	20	mg/L		2540CE	10/05/18:211924	2540C	10/08/18:214699
MBAS Screen	Negative	0.1	mg/L		5540C	10/03/18:211829	5540C	10/03/18:214531
Aggressiveness Index	10.7	--	--		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Langelier Index (20°C)	-1.1	--	--		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Nitrate Nitrogen	14.5	--	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : 13N(LA8) LA-8
Project : Los Osos BMC Monitoring

Lab ID : CC 1883101-001
Customer ID : 8-514

Sampled On : October 3, 2018-12:50
Sampled By : Andrea Berge
Received On : October 3, 2018-14:58
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	107	--	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Calcium	18	1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Magnesium	15	1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Potassium	2	1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Sodium	40	1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Total Cations	3.9	--	meq/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Boron	ND	0.1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Copper	30	10	ug/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Iron	ND	30	ug/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Manganese	ND	10	ug/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Zinc	ND	20	ug/L		200.7	10/08/18:212010	200.7	10/08/18:214782
SAR	1.7	--	--		200.7	10/08/18:212010	200.7	10/08/18:214782
Total Alkalinity (as CaCO3)	50	10	mg/L		2320B	10/09/18:212036	2320B	10/09/18:214866
Hydroxide as OH	ND	10	mg/L		2320B	10/09/18:212036	2320B	10/09/18:214866
Carbonate as CO3	ND	10	mg/L		2320B	10/09/18:212036	2320B	10/09/18:214866
Bicarbonate as HCO3	60	10	mg/L		2320B	10/09/18:212036	2320B	10/09/18:214866
Sulfate	12.9	0.5	mg/L		300.0	10/04/18:212018	300.0	10/04/18:214636
Chloride	66	1	mg/L		300.0	10/04/18:212018	300.0	10/04/18:214636
Nitrate as NO3	29.5	0.4	mg/L		300.0	10/04/18:212018	300.0	10/04/18:214636
Nitrite as N	ND	0.2	mg/L		300.0	10/04/18:212018	300.0	10/04/18:214636
Nitrate + Nitrite as N	6.7	0.1	mg/L		300.0	10/04/18:212018	300.0	10/04/18:214636
Fluoride	0.2	0.1	mg/L		300.0	10/04/18:212018	300.0	10/04/18:214636
Total Anions	3.6	--	meq/L		2320B	10/09/18:212036	2320B	10/09/18:214866
pH	6.5	--	units		4500-H B	10/11/18:212173	4500HB	10/11/18:214965
Specific Conductance	430	1	umhos/cm		2510B	10/05/18:211908	2510B	10/05/18:214616
Total Dissolved Solids	340	20	mg/L		2540CE	10/08/18:212002	2540C	10/09/18:214801
MBAS Screen	Negative	0.1	mg/L		5540C	10/05/18:211907	5540C	10/05/18:214614
Aggressiveness Index	9.9	--	--		4500-H B	10/11/18:212173	4500HB	10/11/18:214965
Langelier Index (20°C)	-2.0	--	--		4500-H B	10/11/18:212173	4500HB	10/11/18:214965
Nitrate Nitrogen	6.7	--	mg/L		300.0	10/04/18:212018	300.0	10/04/18:214636

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Lab ID : CC 1883159-002
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : October 9, 2018-09:00
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Description : Cabrillo LA-9
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	135	--	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Calcium	21	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Magnesium	20	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Potassium	2	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Sodium	50	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Cations	4.9	--	meq/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Boron	ND	0.1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Copper	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Iron	ND	30	ug/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Manganese	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Zinc	ND	20	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
SAR	1.9	--	--		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Alkalinity (as CaCO3)	50	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Hydroxide as OH	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Carbonate as CO3	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Bicarbonate as HCO3	60	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Sulfate	17.2	0.5	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Chloride	76	1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate as NO3	25.7	0.4	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrite as N	ND	0.2	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate + Nitrite as N	5.8	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Fluoride	ND	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Total Anions	3.9	--	meq/L		2320B	10/18/18:212466	2320B	10/18/18:215431
pH (Field)	6.9	--	units		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Specific Conductance	477	1	umhos/cm		2510B	10/11/18:212144	2510B	10/11/18:214941
Total Dissolved Solids	280	20	mg/L		2540CE	10/12/18:212223	2540C	10/15/18:215118
MBAS Screen	Negative	0.1	mg/L		5540C	10/10/18:212119	5540C	10/10/18:214911
Aggressiveness Index	10.3	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Langelier Index (20°C)	-1.5	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Nitrate Nitrogen	5.8	--	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Lab ID : CC 1883159-002
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : October 9, 2018-09:00
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Description : Cabrillo LA-9
Project : Los Osos BMC Monitoring

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
Field Test								
Temperature	67		°F			10/09/18 09:00	2550B	10/09/18 09:00
Conductivity	0.61		umhos/cm			10/09/18 09:00	2510B	10/09/18 09:00

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : Rosina LA-10
Project : Los Osos BMC Monitoring

Lab ID : CC 1883159-004
Customer ID : 8-514

Sampled On : October 9, 2018-10:00
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	265	--	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Calcium	42	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Magnesium	39	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Potassium	2	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Sodium	34	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Cations	6.8	--	meq/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Boron	ND	0.1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Copper	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Iron	400	30	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Manganese	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Zinc	ND	20	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
SAR	0.9	--	--		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Alkalinity (as CaCO3)	60	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Hydroxide as OH	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Carbonate as CO3	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Bicarbonate as HCO3	70	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Sulfate	12.7	0.5	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Chloride	152	3*	mg/L		300.0	10/10/18:212416	300.0	10/11/18:215336
Nitrate as NO3	14.2	0.4	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrite as N	ND	0.2	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate + Nitrite as N	3.2	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Fluoride	ND	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Total Anions	5.9	--	meq/L		2320B	10/18/18:212466	2320B	10/18/18:215431
pH (Field)	7.1	--	units		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Specific Conductance	730	1	umhos/cm		2510B	10/11/18:212144	2510B	10/11/18:214941
Total Dissolved Solids	450	20	mg/L		2540CE	10/12/18:212223	2540C	10/15/18:215118
MBAS Screen	Negative	0.1	mg/L		5540C	10/10/18:212119	5540C	10/10/18:214911
Aggressiveness Index	10.9	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Langelier Index (20°C)	-1.0	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Nitrate Nitrogen	3.2	--	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Lab ID : CC 1883159-004
Customer ID : 8-514

Sampled On : October 9, 2018-10:00
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Description : Rosina LA-10
Project : Los Osos BMC Monitoring

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Field Test								
Temperature	69		°F			10/09/18 10:00	2550B	10/09/18 10:00
Conductivity	0.81		umhos/cm			10/09/18 10:00	2510B	10/09/18 10:00

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : 12J1 (LA11) LA-11
Project : Los Osos BMC Monitoring

Lab ID : CC 1883078-001
Customer ID : 8-514

Sampled On : October 2, 2018-11:18
Sampled By : Andrea Berge
Received On : October 2, 2018-14:09
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	497	--	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Calcium	69	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Magnesium	79	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Potassium	3	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Sodium	87	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Total Cations	13.8	--	meq/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Boron	0.2	0.1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Copper	ND	10	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Iron	100	30	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Manganese	40	10	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Zinc	ND	20	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
SAR	1.7	--	--		200.7	10/04/18:211874	200.7	10/04/18:214604
Total Alkalinity (as CaCO3)	290	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Hydroxide as OH	ND	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Carbonate as CO3	ND	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Bicarbonate as HCO3	350	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Sulfate	160	0.5	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Chloride	160	3*	mg/L		300.0	10/03/18:211930	300.0	10/04/18:214638
Nitrate as NO3	ND	0.4	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Nitrite as N	ND	0.2	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Nitrate + Nitrite as N	ND	0.1	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Fluoride	0.1	0.1	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Total Anions	13.6	--	meq/L		2320B	10/04/18:211859	2320B	10/04/18:214618
pH	7.4	--	units		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Specific Conductance	1340	1	umhos/cm		2510B	10/04/18:211853	2510B	10/04/18:214556
Total Dissolved Solids	870	20	mg/L		2540CE	10/05/18:211924	2540C	10/08/18:214699
MBAS Screen	Negative	0.1	mg/L		5540C	10/03/18:211829	5540C	10/03/18:214531
Aggressiveness Index	12.1	--	--		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Langelier Index (20°C)	0.2	--	--		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Nitrate Nitrogen	ND	--	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Lab ID : CC 1883078-004
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : October 2, 2018-13:02
Sampled By : Andrea Berge
Received On : October 2, 2018-14:09
Matrix : Ground Water

Description : 7Q3 (LA12) LA-12
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	283	--	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Calcium	46	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Magnesium	41	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Potassium	1	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Sodium	53	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Total Cations	8.0	--	meq/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Boron	0.1	0.1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Copper	ND	10	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Iron	90	30	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Manganese	50	10	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Zinc	ND	20	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
SAR	1.4	--	--		200.7	10/04/18:211874	200.7	10/04/18:214604
Total Alkalinity (as CaCO3)	240	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Hydroxide as OH	ND	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Carbonate as CO3	ND	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Bicarbonate as HCO3	290	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Sulfate	50.1	0.5	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Chloride	78	1	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Nitrate as NO3	ND	0.4	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Nitrite as N	ND	0.2	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Nitrate + Nitrite as N	ND	0.1	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Fluoride	ND	0.1	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638
Total Anions	8.0	--	meq/L		2320B	10/04/18:211859	2320B	10/04/18:214618
pH	7.3	--	units		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Specific Conductance	822	1	umhos/cm		2510B	10/04/18:211853	2510B	10/04/18:214556
Total Dissolved Solids	470	20	mg/L		2540CE	10/05/18:211924	2540C	10/08/18:214699
MBAS Screen	Negative	0.1	mg/L		5540C	10/03/18:211829	5540C	10/03/18:214531
Aggressiveness Index	11.7	--	--		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Langelier Index (20°C)	-0.1	--	--		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Nitrate Nitrogen	ND	--	mg/L		300.0	10/03/18:211930	300.0	10/03/18:214638

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

November 5, 2018

Lab ID : CC 1883284-001
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : October 23, 2018-11:12
Sampled By : Andrea Berge
Received On : October 23, 2018-12:03
Matrix : Ground Water

Description : 18L2(LA15) LA-15
Project : Ground Water Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	288	--	mg/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Calcium	48	1	mg/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Magnesium	41	1	mg/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Potassium	1	1	mg/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Sodium	38	1	mg/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Total Cations	7.4	--	meq/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Boron	ND	0.1	mg/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Copper	ND	10	ug/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Iron	ND	30	ug/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Manganese	ND	10	ug/L		200.7	10/26/18:212818	200.7	10/26/18:215829
Zinc	ND	20	ug/L		200.7	10/26/18:212818	200.7	10/27/18:215859
SAR	1.0	--	--		200.7	10/26/18:212818	200.7	10/26/18:215829
Total Alkalinity (as CaCO3)	210	10	mg/L		2320B	10/31/18:212980	2320B	10/31/18:216077
Hydroxide as OH	ND	10	mg/L		2320B	10/31/18:212980	2320B	10/31/18:216077
Carbonate as CO3	ND	10	mg/L		2320B	10/31/18:212980	2320B	10/31/18:216077
Bicarbonate as HCO3	250	10	mg/L		2320B	10/31/18:212980	2320B	10/31/18:216077
Sulfate	30.7	0.5	mg/L		300.0	10/24/18:212869	300.0	10/24/18:215962
Chloride	83	1	mg/L		300.0	10/24/18:212869	300.0	10/24/18:215962
Nitrate as NO3	2.8	0.4	mg/L		300.0	10/24/18:212869	300.0	10/24/18:215962
Nitrite as N	ND	0.2	mg/L		300.0	10/24/18:212869	300.0	10/24/18:215962
Nitrate + Nitrite as N	0.6	0.1	mg/L		300.0	10/24/18:212869	300.0	10/24/18:215962
Fluoride	ND	0.1	mg/L		300.0	10/24/18:212869	300.0	10/24/18:215962
Total Anions	7.1	--	meq/L		2320B	10/31/18:212980	2320B	10/31/18:216077
pH	7.7	--	units		4500-H B	10/26/18:212815	4500HB	10/26/18:215805
Specific Conductance	772	1	umhos/cm		2510B	10/25/18:212711	2510B	10/25/18:215707
Total Dissolved Solids	440	20	mg/L		2540CE	10/25/18:212747	2540C	10/26/18:215774
MBAS Screen	Negative	0.1	mg/L		5540C	10/25/18:212712	5540C	10/25/18:215706
Aggressiveness Index	12.1	--	--		4500-H B	10/26/18:212815	4500HB	10/26/18:215805
Langelier Index (20°C)	0.2	--	--		4500-H B	10/26/18:212815	4500HB	10/26/18:215805
Nitrate Nitrogen	0.6	--	mg/L		300.0	10/24/18:212869	300.0	10/24/18:215962

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 31, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : LA-18,-18K8 LA-18
Project : Los Osos BMC Monitoring

Lab ID : CC 1883179-001
Customer ID : 8-514

Sampled On : October 10, 2018-11:20
Sampled By : Andrea Berge
Received On : October 10, 2018-14:03
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
General Mineral								
Total Hardness as CaCO3	254	--	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Calcium	54	1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Magnesium	29	1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Potassium	2	1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Sodium	26	1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Total Cations	6.3	--	meq/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Boron	ND	0.1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Copper	ND	10	ug/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Iron	ND	30	ug/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Manganese	80	10	ug/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Zinc	ND	20	ug/L		200.7	10/12/18:212228	200.7	10/13/18:215109
SAR	0.7	--	--		200.7	10/12/18:212228	200.7	10/13/18:215109
Total Alkalinity (as CaCO3)	240	10	mg/L		2320B	10/15/18:212296	2320B	10/15/18:215206
Hydroxide as OH	ND	10	mg/L		2320B	10/15/18:212296	2320B	10/15/18:215206
Carbonate as CO3	ND	10	mg/L		2320B	10/15/18:212296	2320B	10/15/18:215206
Bicarbonate as HCO3	290	10	mg/L		2320B	10/15/18:212296	2320B	10/15/18:215206
Sulfate	39.8	0.5	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Chloride	31	1	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Nitrate as NO3	ND	0.4	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Nitrite as N	ND	0.2	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Nitrate + Nitrite as N	ND	0.1	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Fluoride	0.3	0.1	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Total Anions	6.5	--	meq/L		2320B	10/15/18:212296	2320B	10/15/18:215206
pH	7.5	--	units		4500-H B	10/11/18:212173	4500HB	10/11/18:214965
Specific Conductance	608	1	umhos/cm		2510B	10/12/18:212200	2510B	10/12/18:215013
Total Dissolved Solids	360	20	mg/L		2540CE	10/16/18:212356	2540C	10/17/18:215273
MBAS Screen	Negative	0.1	mg/L		5540C	10/11/18:212201	5540C	10/15/18:215127
Aggressiveness Index	12.0	--	--		4500-H B	10/11/18:212173	4500HB	10/11/18:214965
Langelier Index (20°C)	0.2	--	--		4500-H B	10/11/18:212173	4500HB	10/11/18:214965
Nitrate Nitrogen	ND	--	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Lab ID : CC 1883159-005
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : October 9, 2018-11:00
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Description : South Bay LA-20
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	273	--	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Calcium	42	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Magnesium	41	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Potassium	3	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Sodium	47	1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Cations	7.6	--	meq/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Boron	ND	0.1	mg/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Copper	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Iron	ND	30	ug/L		200.7	10/10/18:212126	200.7	10/11/18:215004
Manganese	ND	10	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
Zinc	20	20	ug/L		200.7	10/10/18:212126	200.7	10/11/18:214942
SAR	1.2	--	--		200.7	10/10/18:212126	200.7	10/11/18:215004
Total Alkalinity (as CaCO3)	230	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Hydroxide as OH	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Carbonate as CO3	ND	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Bicarbonate as HCO3	290	10	mg/L		2320B	10/18/18:212466	2320B	10/18/18:215431
Sulfate	29.2	0.5	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Chloride	38	1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate as NO3	2.8	0.4	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrite as N	ND	0.2	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Nitrate + Nitrite as N	0.6	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Fluoride	0.2	0.1	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336
Total Anions	6.5	--	meq/L		2320B	10/18/18:212466	2320B	10/18/18:215431
pH (Field)	7.2	--	units		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Specific Conductance	632	1	umhos/cm		2510B	10/11/18:212144	2510B	10/11/18:214941
Total Dissolved Solids	340	20	mg/L		2540CE	10/12/18:212223	2540C	10/15/18:215118
MBAS Screen	Negative	0.1	mg/L		5540C	10/10/18:212119	5540C	10/10/18:214911
Aggressiveness Index	11.6	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Langelier Index (20°C)	-0.3	--	--		4500-H B	10/09/18:212359	4500HB	10/09/18:215223
Nitrate Nitrogen	0.6	--	mg/L		300.0	10/10/18:212416	300.0	10/10/18:215336

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : South Bay LA-20
Project : Los Osos BMC Monitoring

Lab ID : CC 1883159-005
Customer ID : 8-514

Sampled On : October 9, 2018-11:00
Sampled By : Seth Stocking
Received On : October 9, 2018-14:17
Matrix : Ground Water

Sample Result - Support

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
Field Test								
Temperature	71		°F			10/09/18 11:00	2550B	10/09/18 11:00
Conductivity	0.69		umhos/cm			10/09/18 11:00	2510B	10/09/18 11:00

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 31, 2018

Lab ID : CC 1883179-002
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : LA-22,-17E8 LA-22
Project : Los Osos BMC Monitoring

Sampled On : October 10, 2018-13:09
Sampled By : Andrea Berge
Received On : October 10, 2018-14:03
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation		Sample Analysis	
					Method	Date/ID	Method	Date/ID
General Mineral								
Total Hardness as CaCO3	160	--	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Calcium	26	1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Magnesium	23	1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Potassium	1	1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Sodium	28	1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Total Cations	4.4	--	meq/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Boron	ND	0.1	mg/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Copper	20	10	ug/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Iron	320	30	ug/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Manganese	20	10	ug/L		200.7	10/12/18:212228	200.7	10/13/18:215109
Zinc	20	20	ug/L		200.7	10/12/18:212228	200.7	10/13/18:215109
SAR	1.0	--	--		200.7	10/12/18:212228	200.7	10/13/18:215109
Total Alkalinity (as CaCO3)	120	10	mg/L		2320B	10/15/18:212296	2320B	10/15/18:215206
Hydroxide as OH	ND	10	mg/L		2320B	10/15/18:212296	2320B	10/15/18:215206
Carbonate as CO3	ND	10	mg/L		2320B	10/15/18:212296	2320B	10/15/18:215206
Bicarbonate as HCO3	150	10	mg/L		2320B	10/15/18:212296	2320B	10/15/18:215206
Sulfate	15.0	0.5	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Chloride	43	1	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Nitrate as NO3	26.9	0.4	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Nitrite as N	ND	0.2	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Nitrate + Nitrite as N	6.1	0.1	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Fluoride	ND	0.1	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588
Total Anions	4.4	--	meq/L		2320B	10/15/18:212296	2320B	10/15/18:215206
pH	7.5	--	units		4500-H B	10/11/18:212173	4500HB	10/11/18:214965
Specific Conductance	471	1	umhos/cm		2510B	10/12/18:212200	2510B	10/12/18:215013
Total Dissolved Solids	250	20	mg/L		2540CE	10/16/18:212356	2540C	10/17/18:215273
MBAS Screen	Negative	0.1	mg/L		5540C	10/11/18:212201	5540C	10/15/18:215127
Aggressiveness Index	11.4	--	--		4500-H B	10/11/18:212173	4500HB	10/11/18:214965
Langelier Index (20°C)	-0.4	--	--		4500-H B	10/11/18:212173	4500HB	10/11/18:214965
Nitrate Nitrogen	6.1	--	mg/L		300.0	10/11/18:212417	300.0	10/11/18:215588

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401
Description : 20H1 (LA30) LA-30
Project : Los Osos BMC Monitoring

Lab ID : CC 1883115-001
Customer ID : 8-514

Sampled On : October 4, 2018-10:05
Sampled By : Andrea Berge
Received On : October 4, 2018-14:50
Matrix : Ground Water

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	434	--	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Calcium	75	1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Magnesium	60	1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Potassium	1	1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Sodium	41	1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Total Cations	10.5	--	meq/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Boron	0.1	0.1	mg/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Copper	ND	10	ug/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Iron	850	30	ug/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Manganese	230	10	ug/L		200.7	10/08/18:212010	200.7	10/08/18:214782
Zinc	ND	20	ug/L		200.7	10/08/18:212010	200.7	10/08/18:214782
SAR	0.9	--	--		200.7	10/08/18:212010	200.7	10/08/18:214782
Total Alkalinity (as CaCO3)	320	10	mg/L		2320B	10/09/18:212036	2320B	10/09/18:214866
Hydroxide as OH	ND	10	mg/L		2320B	10/09/18:212036	2320B	10/09/18:214866
Carbonate as CO3	ND	10	mg/L		2320B	10/09/18:212036	2320B	10/09/18:214866
Bicarbonate as HCO3	390	10	mg/L		2320B	10/09/18:212036	2320B	10/09/18:214866
Sulfate	90.0	0.5	mg/L		300.0	10/05/18:211955	300.0	10/05/18:215303
Chloride	50	1	mg/L		300.0	10/05/18:211955	300.0	10/05/18:215303
Nitrate as NO3	ND	0.4	mg/L		300.0	10/05/18:211955	300.0	10/05/18:215303
Nitrite as N	ND	0.2	mg/L		300.0	10/05/18:211955	300.0	10/05/18:215303
Nitrate + Nitrite as N	ND	0.1	mg/L		300.0	10/05/18:211955	300.0	10/05/18:215303
Fluoride	0.3	0.1	mg/L		300.0	10/05/18:211955	300.0	10/05/18:215303
Total Anions	9.7	--	meq/L		2320B	10/09/18:212036	2320B	10/09/18:214866
pH	7.3	--	units		4500-H B	10/12/18:212206	4500HB	10/12/18:215018
Specific Conductance	900	1	umhos/cm		2510B	10/08/18:211973	2510B	10/08/18:214690
Total Dissolved Solids	570	20	mg/L		2540CE	10/09/18:212063	2540C	10/10/18:214877
MBAS Screen	Negative	0.1	mg/L		5540C	10/05/18:212297	5540C	10/05/18:215126
Aggressiveness Index	12.1	--	--		4500-H B	10/12/18:212206	4500HB	10/12/18:215018
Langelier Index (20°C)	0.2	--	--		4500-H B	10/12/18:212206	4500HB	10/12/18:215018
Nitrate Nitrogen	ND	--	mg/L		300.0	10/05/18:211955	300.0	10/05/18:215303

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

ENVIRONMENTAL FGL AGRICULTURAL
Analytical Chemists

November 2, 2018

Lab ID : CC 1883221-001
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : October 17, 2018-10:57
Sampled By : Andrea Berge
Received On : October 17, 2018-12:58
Matrix : Ground Water

Description : 13M2 LA31 LA-31
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	740	--	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Calcium	115	1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Magnesium	110	1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Potassium	5	1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Sodium	414	1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Total Cations	32.9	--	meq/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Boron	0.2	0.1	mg/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Copper	ND	10	ug/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Iron	ND	30	ug/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Manganese	ND	10	ug/L		200.7	10/19/18:212498	200.7	10/20/18:215474
Zinc	ND	20	ug/L		200.7	10/19/18:212498	200.7	10/20/18:215474
SAR	6.6	--	--		200.7	10/19/18:212498	200.7	10/20/18:215474
Total Alkalinity (as CaCO3)	50	10	mg/L		2320B	10/25/18:212748	2320B	10/25/18:215804
Hydroxide as OH	ND	10	mg/L		2320B	10/25/18:212748	2320B	10/25/18:215804
Carbonate as CO3	ND	10	mg/L		2320B	10/25/18:212748	2320B	10/25/18:215804
Bicarbonate as HCO3	60	10	mg/L		2320B	10/25/18:212748	2320B	10/25/18:215804
Sulfate	153	0.5	mg/L		300.0	10/18/18:212500	300.0	10/18/18:215423
Chloride	834	15*	mg/L		300.0	10/18/18:212500	300.0	10/18/18:215423
Nitrate as NO3	2.7	0.4	mg/L		300.0	10/18/18:212500	300.0	10/18/18:215423
Nitrite as N	ND	0.2	mg/L		300.0	10/18/18:212500	300.0	10/18/18:215423
Nitrate + Nitrite as N	0.6	0.1	mg/L		300.0	10/18/18:212500	300.0	10/18/18:215423
Fluoride	ND	0.1	mg/L		300.0	10/18/18:212500	300.0	10/18/18:215423
Total Anions	27.7	--	meq/L		2320B	10/25/18:212748	2320B	10/25/18:215804
pH	7.3	--	units		4500-H B	10/26/18:212815	4500HB	10/26/18:215805
Specific Conductance	3400	1	umhos/cm		2510B	10/22/18:212551	2510B	10/22/18:215492
Total Dissolved Solids	2180	20	mg/L		2540CE	10/20/18:212545	2540C	10/22/18:215489
MBAS Screen	Negative	0.1	mg/L		5540C	10/18/18:212784	5540C	10/18/18:215771
Aggressiveness Index	11.5	--	--		4500-H B	10/26/18:212815	4500HB	10/26/18:215805
Langelier Index (20°C)	-0.5	--	--		4500-H B	10/26/18:212815	4500HB	10/26/18:215805
Nitrate Nitrogen	0.6	--	mg/L		300.0	10/18/18:212500	300.0	10/18/18:215423

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

October 23, 2018

Lab ID : CC 1883078-003
Customer ID : 8-514

Cleath-Harris Geologists
Attn: Spencer Harris
71 Zaca Lane
Suite 140
San Luis Obispo, CA 93401

Sampled On : October 2, 2018-12:50
Sampled By : Andrea Berge
Received On : October 2, 2018-14:09
Matrix : Ground Water

Description : 18K9 (LA32) LA-32
Project : Los Osos BMC Monitoring

Sample Result - Inorganic

Constituent	Result	PQL	Units	Note	Sample Preparation Method	Sample Preparation Date/ID	Sample Analysis Method	Sample Analysis Date/ID
General Mineral								
Total Hardness as CaCO3	168	--	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Calcium	26	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Magnesium	25	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Potassium	ND	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Sodium	33	1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Total Cations	4.8	--	meq/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Boron	ND	0.1	mg/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Copper	ND	10	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Iron	ND	30	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Manganese	ND	10	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
Zinc	ND	20	ug/L		200.7	10/04/18:211874	200.7	10/04/18:214604
SAR	1.1	--	--		200.7	10/04/18:211874	200.7	10/04/18:214604
Total Alkalinity (as CaCO3)	170	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Hydroxide as OH	ND	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Carbonate as CO3	ND	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Bicarbonate as HCO3	210	10	mg/L		2320B	10/04/18:211859	2320B	10/04/18:214618
Sulfate	22.0	0.5	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Chloride	36	1	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Nitrate as NO3	5.9	0.4	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Nitrite as N	ND	0.2	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Nitrate + Nitrite as N	1.3	0.1	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899
Fluoride	0.1	0.1	mg/L		300.0	10/10/18:212412	300.0	10/10/18:215318
Total Anions	5.0	--	meq/L		2320B	10/04/18:211859	2320B	10/04/18:214618
pH	7.3	--	units		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Specific Conductance	492	1	umhos/cm		2510B	10/04/18:211853	2510B	10/04/18:214556
Total Dissolved Solids	270	20	mg/L		2540CE	10/05/18:211924	2540C	10/08/18:214699
MBAS Screen	Negative	0.1	mg/L		5540C	10/03/18:211829	5540C	10/03/18:214531
Aggressiveness Index	11.3	--	--		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Langelier Index (20°C)	-0.5	--	--		4500-H B	10/04/18:211881	4500HB	10/04/18:214583
Nitrate Nitrogen	1.3	--	mg/L		300.0	10/03/18:211931	300.0	10/04/18:214899

ND=Non-Detected. PQL=Practical Quantitation Limit. * PQL adjusted for dilution.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

CEC Testing

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/16/2018
Operator: A. Berge
Well number and location: 30S/10E-13Q2 (FW5)
Site and wellhead conditions: Sunny and clear

Static water depth (feet): 83.93
Well depth (feet): 105
Water column (feet): 21.07
Casing diameter (inches): 2
Minimum purge volume (gal) 30.00
Purge rate (gpm): 1.30
Pumping water level (feet): --
Pump setting (feet): 100.00
Minimum purge time (min): --
Time begin purge: 9:55

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
9:56	1	968.9	6.97	18.9	Cloudy orange
10:00	5	1,005	7.01	18.7	Slightly cloudy, odorless
10:03	10	1,019	7.01	18.9	Slightly cloudy, odorless
10:07	15	1,023	6.58	18.7	Clear, colorless, odorless
10:12	20	1,029	6.48	18.8	Clear, colorless, odorless
10:16	25	1,031	6.31	18.9	Clear, colorless, odorless
10:20	30	1,035	6.27	18.8	Clear, colorless, odorless
10:25	35	1,036	6.20	18.8	Clear, colorless, odorless
10:28	40	1,036	6.25	18.9	Clear, colorless, odorless
					Sampled @ 10:30

*Turbidity, color, odor, sheen, debris, etc.

Groundwater Monitoring Field Log
LOBP Monitoring Program

Date: 10/16/2018
Operator: A. Berge
Well number and location: 30S/11E-20A2 (FW26)
Site and wellhead conditions: Sunny and clear

Static water depth (feet): 24.32
Well depth (feet): 60
Water column (feet): 35.68
Casing diameter (inches): 8
Minimum purge volume (gal) flush line
Purge rate (gpm): --
Pumping water level (feet): --
Pump setting (feet): --
Minimum purge time (min): flush line
Time begin purge: 11:44

Time	Gallons	EC (µS/cm)	pH	Temp. (°C)	Comments*
11:44	5	664	7.05	17.7	Clear, colorless, slight sulfur odor
11:46	35	655.8	7.01	17.3	Clear, colorless, faint sulfur odor
11:48	65	654.8	6.95	17.1	Clear, colorless, faint sulfur odor
11:50	95	654.3	6.94	17.1	Clear, colorless, odorless
11:52	125	653.7	6.93	17.2	Clear, colorless, odorless
11:54	155	654.8	6.91	17.2	Clear, colorless, odorless
11:56	185	653.3	6.92	17.2	Clear, colorless, odorless
11:58	215	653.7	6.92	17.3	Clear, colorless, odorless
					Sampled @ 12:00

*Turbidity, color, odor, sheen, debris, etc.

WECK LABORATORIES, INC.

Certificate of Analysis

FINAL REPORT

Work Orders:	8J17043	**Report Date:**	12/17/2018
		Received Date:	10/17/2018
Project:	Los Osos CEC Monitoring	**Turnaround Time:**	Normal
		Phones:	(805) 543-1413
		Fax:	-
Attn:	Spencer Harris	**P.O. #:**	
Client:	Cleath-Harris Geologists, Inc. 71 Zaca Lane, Suite 140 San Luis Obispo, CA 93401	**Billing Code:**	

ELAP-CA #1132 • EPA-UCMR #CA00211 • Guam-EPA #17-008R • HW-DOH # • ISO 17025 #L2457.01 • LACSD #10143 • NELAP-CA #04229CA • NELAP-OR #4047 • NJ-DEP #CA015 • NV-DEP #NAC 445A • SCAQMD #93LA1006

This is a complete final report. The information in this report applies to the samples analyzed in accordance with the chain-of-custody document. Weck Laboratories certifies that the test results meet all requirements of TNI unless noted by qualifiers or written in the Case Narrative. This analytical report must be reproduced in its entirety.

Dear Spencer Harris,

Enclosed are the results of analyses for samples received 10/17/18 with the Chain-of-Custody document. The samples were received in good condition, at 5.1 °C and on ice. All analyses met the method criteria except as noted in the case narrative or in the report with data qualifiers.

Reviewed by:

Brandon Gee
Operations Manager/Senior PM

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

WECK LABORATORIES, INC.

Certificate of Analysis

FINAL REPORT

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring

Project Manager: Spencer Harris

Reported: 12/17/2018 15:49

Sample Summary

Sample Name	Sampled By	Lab ID	Matrix	Sampled	Qualifiers
QA1 - Clean Water/Travel Blank	A.Berge	8J17043-01	Water	10/16/18 09:15	
QA2 - Equipment Blank	A.Berge	8J17043-02	Water	10/16/18 09:30	
FW5 (13Q2)	A.Berge	8J17043-03	Water	10/16/18 10:30	
FW26 (20A2)	A.Berge	8J17043-04	Water	10/16/18 12:00	

Analyses Accreditation Summary

Analyte	CAS #	Not By NELAP	By ANAB
SM 5910B in Water			
UV 254		✓	

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

WECK LABORATORIES, INC.

Certificate of Analysis

FINAL REPORT

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring

Project Manager: Spencer Harris

Reported: 12/17/2018 15:49

Sample Results

Sample: QA1 - Clean Water/Travel Blank — Sampled: 10/16/18 9:15 by A.Berge

8J17043-01 (Water)

Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
PPCPs - Hormones by LC/MSMS-APCI						
Method: EPA 1694M-APCI **Batch ID:** W8K0377 **Instr:** LCMS02 **Prepared:** 11/07/18 13:15 **Analyst:** kan						
17-b-Estradiol	ND	1.0	ng/l	1	12/11/18 22:36	
PPCPs - Pharmaceuticals by LC/MSMS-ESI-						
Method: EPA 1694M-ESI- **Batch ID:** W8K0378 **Instr:** LCMS02 **Prepared:** 11/07/18 13:16 **Analyst:** kan						
Gemfibrozil	ND	1.0	ng/l	1	12/04/18 19:59	
Iopromide	ND	5.0	ng/l	1	12/04/18 19:59	
Triclosan	ND	2.0	ng/l	1	12/04/18 19:59	
PPCPs - Pharmaceuticals by LC/MSMS-ESI+						
Method: EPA 1694M-ESI+ **Batch ID:** W8K0376 **Instr:** LCMS02 **Prepared:** 11/07/18 13:12 **Analyst:** kan						
Caffeine	**1.1**	1.0	ng/l	1	12/10/18 23:27	B
DEET	**1.8**	1.0	ng/l	1	12/10/18 23:27	B
Sucralose	ND	5.0	ng/l	1	12/10/18 23:27	

Sample: QA2 - Equipment Blank — Sampled: 10/16/18 9:30 by A.Berge

8J17043-02 (Water)

Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
PPCPs - Hormones by LC/MSMS-APCI						
Method: EPA 1694M-APCI **Batch ID:** W8K0377 **Instr:** LCMS02 **Prepared:** 11/07/18 13:15 **Analyst:** kan						
17-b-Estradiol	ND	1.0	ng/l	1	12/11/18 22:56	
PPCPs - Pharmaceuticals by LC/MSMS-ESI-						
Method: EPA 1694M-ESI- **Batch ID:** W8K0378 **Instr:** LCMS02 **Prepared:** 11/07/18 13:16 **Analyst:** kan						
Gemfibrozil	ND	1.0	ng/l	1	12/04/18 20:15	
Iopromide	ND	5.0	ng/l	1	12/04/18 20:15	
Triclosan	ND	2.0	ng/l	1	12/04/18 20:15	
PPCPs - Pharmaceuticals by LC/MSMS-ESI+						
Method: EPA 1694M-ESI+ **Batch ID:** W8K0376 **Instr:** LCMS02 **Prepared:** 11/07/18 13:12 **Analyst:** kan						
Caffeine	**1.0**	1.0	ng/l	1	12/10/18 23:44	B
DEET	**13**	1.0	ng/l	1	12/10/18 23:44	B
Sucralose	ND	5.0	ng/l	1	12/10/18 23:44	

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634

www.wecklabs.com

Certificate of Analysis

FINAL REPORT

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring

Project Manager: Spencer Harris

Reported: 12/17/2018 15:49

Sample Results

(Continued)

Sample: FW5 (13Q2)
8J17043-03 (Water)

Sampled: 10/16/18 10:30 by A.Berge

Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods						
Method: EPA 350.1 **Batch ID:** W8J1442 **Instr:** AA06 **Prepared:** 10/23/18 11:24 **Analyst:** ymt						
Ammonia as N	ND	0.10	mg/l	1	10/24/18 17:28	
Method: EPA 353.2 **Batch ID:** W8J1124 **Instr:** AA01 **Prepared:** 10/17/18 11:24 **Analyst:** mnq						
Nitrate as N	**38**	2.0	mg/l	10	10/17/18 15:28	
Method: SM 2510B **Batch ID:** W8J1355 **Instr:** Inst **Prepared:** 10/22/18 11:01 **Analyst:** anb						
Specific Conductance (EC)	**1100**	2.0	umhos/cm	1	10/24/18 13:58	
Method: SM 5310B **Batch ID:** W8J1175 **Instr:** TOC02 **Prepared:** 10/18/18 09:00 **Analyst:** jlp						
Total Organic Carbon (TOC)	**1.1**	0.10	mg/l	1	10/18/18 14:59	
Method: SM 5910B **Batch ID:** W8J1137 **Instr:** UVVIS04 **Prepared:** 10/17/18 14:36 **Analyst:** mcs						
UV 254	**0.015**	0.009	1/cm	1	10/17/18 19:25	
Nitrosamines by isotopic dilution GC/MS CI Mode						
Method: EPA 1625M **Batch ID:** W8J1221 **Instr:** GCMS09 **Prepared:** 10/18/18 12:38 **Analyst:** mld						
N-Nitrosodimethylamine	ND	2.0	ng/l	1	10/22/18 15:31	
PPCPs - Hormones by LC/MSMS-APCI						
Method: EPA 1694M-APCI **Batch ID:** W8K0377 **Instr:** LCMS02 **Prepared:** 11/07/18 13:15 **Analyst:** kan						
17-b-Estradiol	ND	1.0	ng/l	1	12/11/18 23:16	
PPCPs - Pharmaceuticals by LC/MSMS-ESI-						
Method: EPA 1694M-ESI- **Batch ID:** W8K0378 **Instr:** LCMS02 **Prepared:** 11/07/18 13:16 **Analyst:** kan						
Gemfibrozil	ND	1.0	ng/l	1	12/04/18 20:30	
Iopromide	ND	5.0	ng/l	1	12/04/18 20:30	
Triclosan	ND	2.0	ng/l	1	12/04/18 20:30	
PPCPs - Pharmaceuticals by LC/MSMS-ESI+						
Method: EPA 1694M-ESI+ **Batch ID:** W8K0376 **Instr:** LCMS02 **Prepared:** 11/07/18 13:12 **Analyst:** kan						
Caffeine	**20**	1.0	ng/l	1	12/11/18 00:00	B
DEET	**1.8**	1.0	ng/l	1	12/11/18 00:00	B
Sucralose	**230**	5.0	ng/l	1	12/11/18 00:00	

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

WECK LABORATORIES, INC.

Certificate of Analysis

FINAL REPORT

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring

Project Manager: Spencer Harris

Reported: 12/17/2018 15:49

Sample Results

(Continued)

Sample: FW26 (20A2)
8J17043-04 (Water)

Sampled: 10/16/18 12:00 by A.Berge

Analyte	Result	MRL	Units	Dil	Analyzed	Qualifier
Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods						
Method: EPA 350.1 **Batch ID:** W8J1442 **Instr:** AA06 **Prepared:** 10/23/18 11:24 **Analyst:** ymt						
Ammonia as N	**0.21**	0.10	mg/l	1	10/24/18 17:28	
Method: EPA 353.2 **Batch ID:** W8J1124 **Instr:** AA01 **Prepared:** 10/17/18 11:24 **Analyst:** mnq						
Nitrate as N	ND	0.20	mg/l	1	10/17/18 15:27	
Method: SM 2510B **Batch ID:** W8J1355 **Instr:** Inst **Prepared:** 10/22/18 11:01 **Analyst:** anb						
Specific Conductance (EC)	**680**	2.0	umhos/cm	1	10/24/18 13:58	
Method: SM 5310B **Batch ID:** W8J1175 **Instr:** TOC02 **Prepared:** 10/18/18 09:00 **Analyst:** jlp						
Total Organic Carbon (TOC)	**1.2**	0.10	mg/l	1	10/18/18 14:59	
Method: SM 5910B **Batch ID:** W8J1137 **Instr:** UVVIS04 **Prepared:** 10/17/18 14:36 **Analyst:** mcs						
UV 254	**0.019**	0.009	1/cm	1	10/17/18 19:25	
Nitrosamines by isotopic dilution GC/MS CI Mode						
Method: EPA 1625M **Batch ID:** W8J1221 **Instr:** GCMS09 **Prepared:** 10/18/18 12:38 **Analyst:** mld						
N-Nitrosodimethylamine	ND	2.0	ng/l	1	10/22/18 16:00	
PPCPs - Hormones by LC/MSMS-APCI						
Method: EPA 1694M-APCI **Batch ID:** W8K0377 **Instr:** LCMS02 **Prepared:** 11/07/18 13:15 **Analyst:** kan						
17-b-Estradiol	ND	1.0	ng/l	1	12/11/18 23:37	
PPCPs - Pharmaceuticals by LC/MSMS-ESI-						
Method: EPA 1694M-ESI- **Batch ID:** W8K0378 **Instr:** LCMS02 **Prepared:** 11/07/18 13:16 **Analyst:** kan						
Gemfibrozil	ND	1.0	ng/l	1	12/04/18 20:45	
Iopromide	ND	5.0	ng/l	1	12/04/18 20:45	
Triclosan	ND	2.0	ng/l	1	12/04/18 20:45	
PPCPs - Pharmaceuticals by LC/MSMS-ESI+						
Method: EPA 1694M-ESI+ **Batch ID:** W8K0376 **Instr:** LCMS02 **Prepared:** 11/07/18 13:12 **Analyst:** kan						
Caffeine	ND	1.0	ng/l	1	12/11/18 00:17	
DEET	**1.5**	1.0	ng/l	1	12/11/18 00:17	B
Sucralose	**16**	5.0	ng/l	1	12/11/18 00:17	

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring

Project Manager: Spencer Harris

Reported: 12/17/2018 15:49

Quality Control Results

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Batch: W8J1124 - EPA 353.2										
Blank (W8J1124-BLK1)				**Prepared & Analyzed: 10/17/18**						
Nitrate as N	ND	0.15	mg/l							
LCS (W8J1124-BS1)				**Prepared & Analyzed: 10/17/18**						
Nitrate as N	0.944	0.15	mg/l	1.00		94	90-110			
Matrix Spike (W8J1124-MS1)	**Source: 8J08008-02**			**Prepared & Analyzed: 10/17/18**						
Nitrate as N	11.6	0.15	mg/l	2.00	9.66	97	90-110			
Matrix Spike (W8J1124-MS2)	**Source: 8J16027-21**			**Prepared & Analyzed: 10/17/18**						
Nitrate as N	8.60	0.15	mg/l	2.00	6.90	85	90-110			MS-02
Matrix Spike Dup (W8J1124-MSD1)	**Source: 8J08008-02**			**Prepared & Analyzed: 10/17/18**						
Nitrate as N	11.7	0.15	mg/l	2.00	9.66	102	90-110	0.9	20	
Matrix Spike Dup (W8J1124-MSD2)	**Source: 8J16027-21**			**Prepared & Analyzed: 10/17/18**						
Nitrate as N	8.68	0.15	mg/l	2.00	6.90	89	90-110	0.9	20	MS-02
Batch: W8J1137 - SM 5910B										
Blank (W8J1137-BLK1)				**Prepared & Analyzed: 10/17/18**						
UV 254	ND	0.009	1/cm							
LCS (W8J1137-BS1)				**Prepared & Analyzed: 10/17/18**						
UV 254	0.084	0.009	1/cm	0.0880		95	90-110			
Duplicate (W8J1137-DUP1)	**Source: 8J17043-03**			**Prepared & Analyzed: 10/17/18**						
UV 254	0.015	0.009	1/cm		0.015			0	10	
Duplicate (W8J1137-DUP2)	**Source: 8J17043-04**			**Prepared & Analyzed: 10/17/18**						
UV 254	0.019	0.009	1/cm		0.019			0	10	
Batch: W8J1175 - SM 5310B										
Blank (W8J1175-BLK1)				**Prepared & Analyzed: 10/18/18**						
Total Organic Carbon (TOC)	ND	0.10	mg/l							
LCS (W8J1175-BS1)				**Prepared & Analyzed: 10/18/18**						
Total Organic Carbon (TOC)	1.01	0.10	mg/l	1.00		101	85-115			
Duplicate (W8J1175-DUP1)	**Source: 8J13021-01**			**Prepared & Analyzed: 10/18/18**						
Total Organic Carbon (TOC)	29.1	0.10	mg/l		28.8			1	20	
Duplicate (W8J1175-DUP2)	**Source: 8J15073-02**			**Prepared & Analyzed: 10/18/18**						
Total Organic Carbon (TOC)	8.03	0.10	mg/l		8.38			4	20	
Matrix Spike (W8J1175-MS1)	**Source: 8J15065-01**			**Prepared & Analyzed: 10/18/18**						
Total Organic Carbon (TOC)	5.34	0.10	mg/l	5.00	0.291	101	76-115			
Matrix Spike Dup (W8J1175-MSD1)	**Source: 8J15065-01**			**Prepared & Analyzed: 10/18/18**						
Total Organic Carbon (TOC)	5.34	0.10	mg/l	5.00	0.291	101	76-115	0.2	20	
Batch: W8J1355 - SM 2510B										
Blank (W8J1355-BLK1)				**Prepared: 10/22/18 Analyzed: 10/24/18**						
Specific Conductance (EC)	ND	2.0	umhos/cm							
LCS (W8J1355-BS1)				**Prepared: 10/22/18 Analyzed: 10/24/18**						

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring
Project Manager: Spencer Harris
Reported: 12/17/2018 15:49

Quality Control Results (Continued)

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods (Continued)

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Batch: W8J1355 - SM 2510B (Continued)										
LCS (W8J1355-BS1)				**Prepared: 10/22/18**	**Analyzed: 10/24/18**					
Specific Conductance (EC)	189	2.0	umhos/cm	180		105	95-105			
Duplicate (W8J1355-DUP1)	**Source: 8J04002-01**			**Prepared: 10/22/18**	**Analyzed: 10/24/18**					
Specific Conductance (EC)	3650	10	umhos/cm		3600			1	5	
Batch: W8J1442 - EPA 350.1										
Blank (W8J1442-BLK1)				**Prepared: 10/23/18**	**Analyzed: 10/24/18**					
Ammonia as N	ND	0.10	mg/l							
Blank (W8J1442-BLK2)				**Prepared: 10/23/18**	**Analyzed: 10/24/18**					
Ammonia as N	ND	0.10	mg/l							
LCS (W8J1442-BS1)				**Prepared: 10/23/18**	**Analyzed: 10/24/18**					
Ammonia as N	0.248	0.10	mg/l	0.250		99	90-110			
LCS (W8J1442-BS2)				**Prepared: 10/23/18**	**Analyzed: 10/24/18**					
Ammonia as N	0.248	0.10	mg/l	0.250		99	90-110			
Matrix Spike (W8J1442-MS1)	**Source: 8J18078-01**			**Prepared: 10/23/18**	**Analyzed: 10/24/18**					
Ammonia as N	0.255	0.10	mg/l	0.250	ND	102	90-110			
Matrix Spike (W8J1442-MS2)	**Source: 8J22107-06**			**Prepared: 10/23/18**	**Analyzed: 10/24/18**					
Ammonia as N	0.256	0.10	mg/l	0.250	ND	102	90-110			
Matrix Spike Dup (W8J1442-MSD1)	**Source: 8J18078-01**			**Prepared: 10/23/18**	**Analyzed: 10/24/18**					
Ammonia as N	0.254	0.10	mg/l	0.250	ND	102	90-110	0.4	15	
Matrix Spike Dup (W8J1442-MSD2)	**Source: 8J22107-06**			**Prepared: 10/23/18**	**Analyzed: 10/24/18**					
Ammonia as N	0.263	0.10	mg/l	0.250	ND	105	90-110	3	15	

Nitrosamines by isotopic dilution GC/MS CI Mode

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Batch: W8J1221 - EPA 1625M										
Blank (W8J1221-BLK1)				**Prepared: 10/18/18**	**Analyzed: 10/22/18**					
N-Nitrosodimethylamine	ND	2.0	ng/l							
LCS (W8J1221-BS1)				**Prepared: 10/18/18**	**Analyzed: 10/22/18**					
N-Nitrosodimethylamine	2.65	2.0	ng/l	3.00		88	50-150			
LCS Dup (W8J1221-BSD1)				**Prepared: 10/18/18**	**Analyzed: 10/22/18**					
N-Nitrosodimethylamine	3.16	2.0	ng/l	3.00		105	50-150	17	50	

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring

Project Manager: Spencer Harris

Reported: 12/17/2018 15:49

Quality Control Results

(Continued)

PPCPs - Hormones by LC/MSMS-APCI

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Batch: W8K0377 - EPA 1694M-APCI										
Blank (W8K0377-BLK1)				Prepared: 11/07/18 Analyzed: 12/11/18						
17-b-Estradiol	ND	1.0	ng/l							
LCS (W8K0377-BS1)				Prepared: 11/07/18 Analyzed: 12/11/18						
17-b-Estradiol	10.5	1.0	ng/l	10.0		105	65-146			
LCS Dup (W8K0377-BSD1)				Prepared: 11/07/18 Analyzed: 12/11/18						
17-b-Estradiol	12.2	1.0	ng/l	10.0		122	65-146	15	30	

PPCPs - Pharmaceuticals by LC/MSMS-ESI-

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Batch: W8K0378 - EPA 1694M-ESI-										
Blank (W8K0378-BLK1)				Prepared: 11/07/18 Analyzed: 12/04/18						
Gemfibrozil	ND	1.0	ng/l							
Iopromide	ND	5.0	ng/l							
Triclosan	ND	2.0	ng/l							
LCS (W8K0378-BS1)				Prepared: 11/07/18 Analyzed: 12/04/18						
Gemfibrozil	10.3	1.0	ng/l	10.0		103	76-122			
Iopromide	64.9	5.0	ng/l	50.0		130	0.1-163			
Triclosan	11.2	2.0	ng/l	10.0		112	76-139			
LCS Dup (W8K0378-BSD1)				Prepared: 11/07/18 Analyzed: 12/04/18						
Gemfibrozil	11.4	1.0	ng/l	10.0		114	76-122	10	30	
Iopromide	72.0	5.0	ng/l	50.0		144	0.1-163	10	30	
Triclosan	11.9	2.0	ng/l	10.0		119	76-139	6	30	

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring

Project Manager: Spencer Harris

Reported: 12/17/2018 15:49

Quality Control Results

(Continued)

PPCPs - Pharmaceuticals by LC/MSMS-ESI+

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Batch: W8K0376 - EPA 1694M-ESI+										
Blank (W8K0376-BLK1)				**Prepared: 11/07/18 Analyzed: 12/10/18**						
Acetaminophen	ND	20	ng/l							
Amoxicillin	ND	10	ng/l							
Atenolol	ND	1.0	ng/l							
Atorvastatin	ND	1.0	ng/l							
Azithromycin	ND	10	ng/l							
Caffeine	2.17	1.0	ng/l							B
Carbamazepine	ND	1.0	ng/l							
Ciprofloxacin	31.2	5.0	ng/l							B
Cotinine	ND	2.0	ng/l							
DEET	2.16	1.0	ng/l							B
Diazepam	ND	1.0	ng/l							
Fluoxetine	ND	1.0	ng/l							
Meprobamate	ND	1.0	ng/l							
Methadone	ND	1.0	ng/l							
Phenytoin (Dilantin)	ND	1.0	ng/l							
Primidone	ND	1.0	ng/l							
Sucralose	ND	5.0	ng/l							
Sulfamethoxazole	ND	1.0	ng/l							
TCEP	1.22	1.0	ng/l							B-06
TCPP	3.75	1.0	ng/l							B-06
Trimethoprim	ND	1.0	ng/l							
Blank (W8K0376-BLK2)				**Prepared: 11/07/18 Analyzed: 12/13/18**						
TDCPP	ND	1.0	ng/l							QC-2
LCS (W8K0376-BS1)				**Prepared: 11/07/18 Analyzed: 12/10/18**						
Acetaminophen	223	20	ng/l	200		112	66-156			
Amoxicillin	153	10	ng/l	100		153	14-167			
Atenolol	11.0	1.0	ng/l	10.0		110	56-164			
Atorvastatin	29.3	1.0	ng/l	10.0		293	0.1-173			Q-08
Azithromycin	102	10	ng/l	100		102	52-166			
Caffeine	9.53	1.0	ng/l	10.0		95	55-152			
Carbamazepine	9.66	1.0	ng/l	10.0		97	60-135			
Ciprofloxacin	52.5	5.0	ng/l	50.0		105	51-168			
Cotinine	10.5	2.0	ng/l	10.0		105	68-155			
DEET	15.6	1.0	ng/l	10.0		156	45-135			BS-H
Diazepam	10.1	1.0	ng/l	10.0		101	58-127			
Fluoxetine	11.4	1.0	ng/l	10.0		114	55-150			
Meprobamate	19.4	1.0	ng/l	10.0		194	11-166			Q-08
Methadone	11.3	1.0	ng/l	10.0		113	62-137			
Phenytoin (Dilantin)	9.65	1.0	ng/l	10.0		96	69-138			

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring

Project Manager: Spencer Harris

Reported: 12/17/2018 15:49

Quality Control Results

(Continued)

PPCPs - Pharmaceuticals by LC/MSMS-ESI+ (Continued)

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Batch: W8K0376 - EPA 1694M-ESI+ (Continued)										
LCS (W8K0376-BS1)				**Prepared: 11/07/18 Analyzed: 12/10/18**						
Primidone	10.7	1.0	ng/l	10.0		107	54-147			
Sucralose	59.2	5.0	ng/l	50.0		118	50-150			
Sulfamethoxazole	10.9	1.0	ng/l	10.0		109	60-133			
TCEP	7.94	1.0	ng/l	10.0		79	25-149			
TCPP	5.41	1.0	ng/l	10.0		54	24-149			
Trimethoprim	12.1	1.0	ng/l	10.0		121	67-139			
LCS Dup (W8K0376-BSD1)				**Prepared: 11/07/18 Analyzed: 12/10/18**						
Acetaminophen	239	20	ng/l	200		120	66-156	7	30	
Amoxicillin	93.4	10	ng/l	100		93	14-167	48	30	Q-12
Atenolol	10.4	1.0	ng/l	10.0		104	56-164	6	30	
Atorvastatin	24.8	1.0	ng/l	10.0		248	0.1-173	17	30	Q-08
Azithromycin	111	10	ng/l	100		111	52-166	8	30	
Caffeine	13.1	1.0	ng/l	10.0		131	55-152	32	30	Q-12
Carbamazepine	12.1	1.0	ng/l	10.0		121	60-135	22	30	
Ciprofloxacin	56.3	5.0	ng/l	50.0		113	51-168	7	30	
Cotinine	10.9	2.0	ng/l	10.0		109	68-155	4	30	
DEET	15.6	1.0	ng/l	10.0		156	45-135	0	30	BS-H
Diazepam	10.7	1.0	ng/l	10.0		107	58-127	6	30	
Fluoxetine	9.45	1.0	ng/l	10.0		94	55-150	19	30	
Meprobamate	19.9	1.0	ng/l	10.0		199	11-166	3	30	Q-08
Methadone	11.5	1.0	ng/l	10.0		115	62-137	2	30	
Phenytoin (Dilantin)	8.53	1.0	ng/l	10.0		85	69-138	12	30	
Primidone	11.8	1.0	ng/l	10.0		118	54-147	10	30	
Sucralose	40.0	5.0	ng/l	50.0		80	50-150	39	30	Q-12
Sulfamethoxazole	10.3	1.0	ng/l	10.0		103	60-133	6	30	
TCEP	9.62	1.0	ng/l	10.0		96	25-149	19	30	
TCPP	7.17	1.0	ng/l	10.0		72	24-149	28	30	
Trimethoprim	9.04	1.0	ng/l	10.0		90	67-139	29	30	

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

Cleath-Harris Geologists, Inc.
71 Zaca Lane, Suite 140
San Luis Obispo, CA 93401

Project Number: Los Osos CEC Monitoring

Project Manager: Spencer Harris

Reported: 12/17/2018 15:49

Notes and Definitions

Item	Definition
B	Blank contamination. The analyte was found in the associated blank as well as in the sample.
B-06	This analyte was found in the method blank, which was possibly contaminated during sample preparation. The batch was accepted since this analyte was either not detected or more than 10 times of the blank value for all the samples in the batch.
BS-H	The recovery of this analyte in the BS/LCS was over the control limit. Sample result is suspect.
MS-02	The RPD and/or percent recovery for this QC spike sample cannot be accurately calculated due to the high concentration of analyte inherent in the sample.
Q-08	High bias in the QC sample does not affect sample result since analyte was not detected or below the reporting limit.
Q-12	The RPD result exceeded the QC control limits; however, both percent recoveries were acceptable. Sample results for the QC batch were accepted based on the percent recoveries and/or other acceptable QC data.
QC-2	This QC sample was reanalyzed to complement samples that require re-analysis on different date. See analysis date.
ND	NOT DETECTED at or above the Method Reporting Limit (MRL). If Method Detection Limit (MDL) is reported, then ND means not detected at or above the MDL.
Dil	Dilution
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
% Rec	Percent Recovery
Source	Sample that was matrix spiked or duplicated.
MDL	Method Detection Limit
MRL	The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The MRL is also known as Limit of Quantitation (LOQ) and Detection Limit for Reporting (DLR)
MDA	Minimum Detectable Activity
NR	Not Reportable
TIC	Tentatively Identified Compound (TIC) using mass spectrometry. The reported concentration is relative concentration based on the nearest internal standard. If the library search produces no matches at, or above 85%, the compound is reported as unknown.

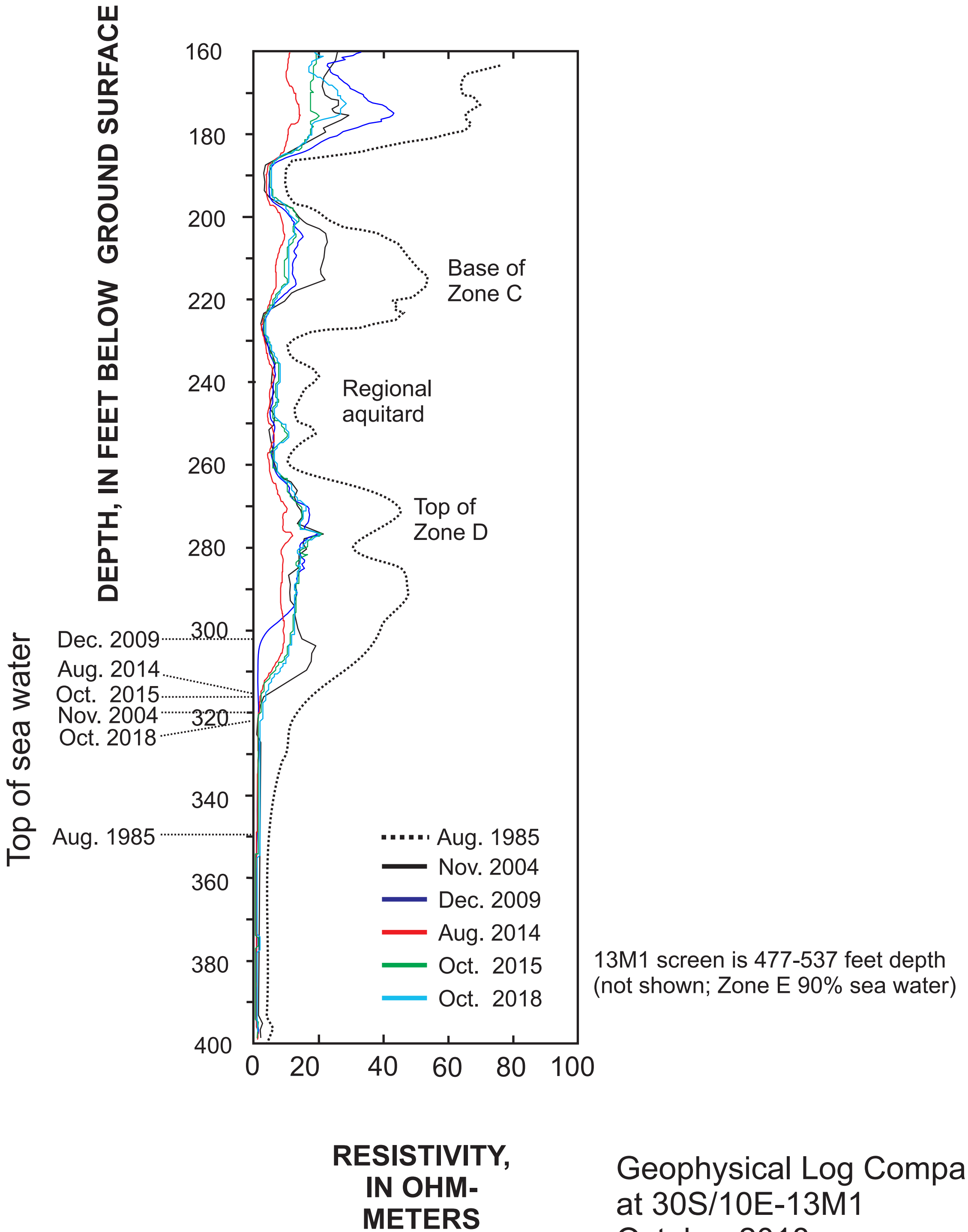
Any remaining sample(s) will be disposed of one month from the final report date unless other arrangements are made in advance.
An Absence of Total Coliform meets the drinking water standards as established by the California State Water Resources Control Board (SWRCB)
All results are expressed on wet weight basis unless otherwise specified.
All samples collected by Weck Laboratories have been sampled in accordance to laboratory SOP Number MIS 002.

14859 Clark Avenue,City of Industry CA, 91745 | Phone: (626) 336-2139 | Fax: (626) 336-2634
www.wecklabs.com

APPENDIX D

Geophysics at Well 30S/10E - 13M1

Well 30S/10E-13M1



Geophysical Log Comparison
at 30S/10E-13M1
October 2018
Lower Aquifer Monitoring
Los Osos ISJ

Cleath-Harris Geologists

APPENDIX E

Field Methods

Groundwater Level Measurement Procedures for the
Los Osos Basin Plan Groundwater Monitoring Program

Introduction

This document establishes procedures for measuring and recording groundwater levels for the Los Osos Basin Plan (LOBP) Groundwater Monitoring Program, and describes various methods used for collecting meaningful groundwater data.

Static groundwater levels obtained for the LOBP Groundwater Monitoring Program are determined by measuring the distance to water in a non-pumping well from a reference point that has been referenced to sea level. Subtracting the distance to water from the elevation of the reference point determines groundwater surface elevations above or below sea level. This is represented by the following equation:

$$E_{GW} = E_{RP} - D$$

Where:

E_{GW} = Elevation of groundwater above mean sea level (feet)

E_{RP} = Elevation above sea level at reference point (feet)

D = Depth to water (feet)

References

Procedures for obtaining and reporting water level data for the LOBP Groundwater Monitoring Program are based on a review of the following documents.

- State of California, Department of Water Resources, 2010, *Groundwater Elevation Monitoring Guidelines*, prepared for use in the California Statewide Groundwater Elevation Monitoring (CASGEM) program, December. http://www.water.ca.gov/groundwater/casgem/pdfs/CASGEM%20DWR%20GW%20Guidelines%20Final%20121510.pdf
- State of California, Department of Water Resources, 2014, *Addendum to December 2010 Groundwater Elevation Monitoring Guidelines for the Department of Water Resources' California Statewide Groundwater Elevation Monitoring (CASGEM) Program*, October 2. http://www.water.ca.gov/groundwater/casgem/pdfs/PSW_addendum.pdf
- U.S. Geological Survey, 1977, *National Handbook of Recommended Methods for Water-Data Acquisition*, a Unites States contribution to the International Hydrological Program. https://pubs.usgs.gov/chapter11/
- U.S. Geological Survey, Office of Ground Water, 1997, *Ground Water Procedure Document 1, Water-level measurement using graduated steel tape, draft stand-alone procedure document.* http://pubs.usgs.gov/tm/1a1/pdf/GWPD1.pdf

- U.S. Geological Survey, Office of Ground Water, 1997, *Ground Water Procedure Document 4, Water-level measurement using an electric tape, draft stand-alone procedure document.* http://pubs.usgs.gov/tm/1a1/pdf/GWPD4.pdf
- U.S. Geological Survey, Office of Ground Water, 1997, *Ground Water Procedure Document 13, Water-level measurement using an air line, draft stand-alone procedure document.* http://pubs.usgs.gov/tm/1a1/pdf/GWPD13.pdf
- U.S. Geological Survey, 2001, *Introduction to Field Methods for Hydrologic and Environmental Studies*, Open-File Report 2001-50, 241 p. https://pubs.er.usgs.gov/publication/ofr0150

Well Information

Table 1 below lists important well information to be maintained in a well file or in a field notebook. Additional information that should be available to the person collecting water level data include a description of access to the property and the well, the presence and depth of cascading water, or downhole obstructions that could interfere with a sounding cable.

Table 1
Well File Information

Well Completion Report	Hydrologic Information	Additional Information to be Recorded
Well name	Map showing basin boundaries and wells	Township, Range, and ¼ ¼ Section
Well Owner	Name of groundwater basin	Latitude and Longitude (Decimal degrees)
Drilling Company	Description of aquifer	Assessor's Parcel Number
Location map or sketch	Confined, unconfined, or mixed aquifers	Description of well head and sounding access
Total depth	Pumping test data	Reference point elevations
Perforation interval	Hydrographs	Well use and pumping schedule if known
Casing diameter	Water quality data	Date monitoring began
Date of well completion	Property access instructions/codes	Land use

Reference Points and Reference Marks

Reference point (RP) elevations are the basis for determining groundwater elevations relative to sea level. The RP is generally that point on the well head that is the most convenient place to measure the water level in a well. In selecting an RP, an additional consideration is the ease of surveying either by Global Positioning System (GPS) or by leveling.

The RP must be clearly defined, well marked, and easily located. A description, sketch, and photograph of the point should be included in the well file. Additional Reference Marks (RMs) may be established near the wellhead on a permanent object. These additional RMs can serve as a benchmark by which the wellhead RP can be checked or re-surveyed if necessary. All RMs should be marked, sketched, photographed, and described in the well file.

All RPs for Groundwater Monitoring Program wells should be reported based on the same horizontal and vertical datum by a California licensed surveyor to the nearest tenth of one foot vertically, and the nearest one foot horizontally. The surveyor's report should be maintained in the project file.

In addition to the RP survey, the elevation of the ground surface adjacent to the well should also be measured and recorded in the well file. Because the ground surface adjacent to a well is rarely uniform, the average surface level should be estimated. This average ground surface elevation is referred to in the U.S.G.S. Procedural Document (GWPD-1, 1997) and DWR guidelines as the Land Surface Datum (LSD).

Water Level Data Collection

Prior to beginning the field work, the field technician should review each well file to determine which well owners require notification of the upcoming site visit, or which well pumps need to be turned off to allow for sufficient water level recovery. Because groundwater elevations are used to construct groundwater contour maps and to determine hydraulic gradients, the field technician should coordinate water level measurements to be collected within as short a period of time as practical. Any significant changes in groundwater conditions during monitoring events should be noted in the Annual Monitoring Report. For an individual well, the same measuring method and the same equipment should be used during each sampling event where practical.

A static water level should represent stable, non-pumping conditions at the well. When there is doubt about whether water levels in a well are continuing to recover following a pumping cycle, repeated measurements should be made. If an electric sounder is being used, it is possible to hold the sounder level at one point slightly above the known water level and wait for a signal that would indicate rising water. If applicable, the general schedule of pump operation should be determined and noted for active wells. If the well is capped but not vented, remove the cap and wait several minutes before measurement to allow water levels to equilibrate to atmospheric pressure.

When lowering a graduated steel tape (chalked tape) or electric tape in a well without a sounding tube in an equipped well, the tape should be played out slowly by hand to minimize the chance of the tape end becoming caught in a downhole obstruction. The tape should be held in such a way that any change in tension will be felt. When withdrawing a sounding tape, it should also be brought up slowly so that if an obstruction is encountered, tension can be relaxed so that the tape can be lowered again before attempting to withdraw it around the obstruction.

Despite all precautions, there is a small risk of measuring tapes becoming stuck in equipped wells without dedicated sounding tubes. If a tape becomes stuck, the equipment should be left on-site and re-checked after the well has gone through a few cycles of pumping, which can free the tape due to movement/vibration of the pump column. If the tape remains stuck, a pumping contractor will be needed to retrieve the equipment. A dedicated sounding tube may be installed by the pumping contractor at that time.

All water level measurements should be made to an accuracy of 0.01 feet. The field technician should make at least two measurements. If measurements of static levels do not agree to within 0.02 feet of each other, the technician should continue measurements until the reason for the disparity is determined, or the measurements are within 0.02 feet.

Record Keeping in the Field

The information recorded in the field is typically the only available reference for the conditions at the time of the monitoring event. During each monitoring event it is important to record any conditions at a well site and its vicinity that may affect groundwater levels, or the field technician's ability to obtain groundwater levels. Table 2 lists important information to record, however, additional information should be included when appropriate.

Table 2
Information Recorded at Each Well Site

Well name	Changes in land use	Presence of pump lubricating oil in well
Name and organization of field technician	Changes in RP	Cascading water
Date & time	Nearby wells in use	Equipment problems
Measurement method used	Weather conditions	Physical changes in wellhead
Sounder used	Recent pumping info	Comments
Reference Point Description	Measurement correction(s)	Well status

Measurement Techniques

Four standard methods of obtaining water levels are discussed below. The chosen method depends on site and downhole conditions, and the equipment limitations. In all monitoring situations, the procedures and equipment used should be documented in the field notes and in final reporting. Additional detail on methods of water level measurement is included in the reference documents.

<u>Graduated Steel Tape</u>
This method uses a graduated steel tape with a brass or stainless steel weight attached to its end. The tape is graduated in feet. The approximate depth to water should be known prior to measurement.

- Estimate the anticipated static water level in the well from field conditions and historical information;
- Chalk the lower few feet of the tape by applying blue carpenter's chalk.
- Lower the tape to just below the estimated depth to water so that a few feet of the chalked portion of the tape is submerged. Be careful not to lower the tape beyond its chalked length.
- Hold the tape at the RP and record the tape position (this is the "hold" position and should be at an even foot);

- Withdraw the tape rapidly to the surface;
- Record the length of the wetted chalk mark on the graduated tape;
- Subtract the wetted chalk number from the "hold" position number and record this number in the "Depth to Water below RP" column;
- Perform a check by repeating the measurement using a different RP hold value;
- All data should be recorded to the nearest 0.01 foot;
- Disinfect the tape by wiping down the submerged portion of the tape with single-use, unscented disinfectant wipe, or let stand for one minute in a dilute chlorine bleach solution and dry with clean cloth.

The graduated steel tape is generally considered to be the most accurate method for measuring static water levels. Measuring water levels in wells with cascading water or with condensing water on the well casing causes potential errors, or can be impossible with a steel tape.

<u>Electric Tape</u>

An electric tape operates on the principle that an electric circuit is completed when two electrodes are submerged in water. Most electric tapes are mounted on a hand-cranked reel equipped with batteries and an ammeter, buzzer or light to indicate when the circuit is completed. Tapes are graduated in either one-foot intervals or in hundredths of feet depending on the manufacturer. Like graduated steel tapes, electric tapes are affixed with brass or stainless steel weights.

- Check the circuitry of the tape before lowering the probe into the well by dipping the probe into water and observe if the ammeter needle or buzzer/light signals that the circuit is completed;
- Lower the probe slowly and carefully into the well until the signal indicates that the water surface has been reached;
- Place a finger or thumb on the tape at the RP when the water surface is reached;
- If the tape is graduated in one-foot intervals, partially withdraw the tape and measure the distance from the RP mark to the nearest one-foot mark to obtain the depth to water below the RP. If the tape is graduated in hundredths of a foot, simply record the depth at the RP mark as the depth to water below the RP;
- Make all readings using the same needle deflection point on the ammeter scale (if equipped) so that water levels will be consistent between measurements;
- Make check measurements until agreement shows the results to be reliable;
- All data should be recorded to the nearest 0.01 foot;
- Disinfect the tape by wiping down the submerged portion of the tape with single-use, unscented disinfectant wipe, or let stand for one minute in a dilute chlorine bleach solution and dry with clean cloth;
- Periodically check the tape for breaks in the insulation. Breaks can allow water to enter into the insulation creating electrical shorts that could result in false depth readings.

The electric tape may give slightly less accurate results than the graduated steel tape. Errors can result from signal "noise" in cascading water, breaks in the tape insulation, tape stretch, or missing tape at the location of a splice. All electric tapes should be calibrated semi-annually against a steel tape that is maintained in the office and used only for calibration.

Air Line

The air line method is usually used only in wells equipped with pumps. This method typically uses a 1/8 or 1/4-inch diameter, seamless copper tubing, brass tubing, stainless steel tubing, or galvanized pipe with a suitable pipe tee for connecting an altitude or pressure gage. Plastic (i.e. polyethylene) tubing may also be used, but is considered less desirable because it can develop leaks as it degrades. An air line must extend far enough below the water level that the lower end remains submerged during pumping of the well. The air line is connected to an altitude gage that reads directly in feet of water, or to a pressure gage that reads pressure in pounds per square inch (psi). The gage reading indicates the length of the submerged air line.

The formula for determining the depth to water below the RP is: $\mathbf{d = k - h}$ where d = depth to water; k = constant; and h = height of the water displaced from the air line. In wells where a pressure gage is used, h is equal to 2.31 ft/psi multiplied by the gage reading. The constant value for k is approximately equivalent to the length of the air line.

- Calibrate the air line by measuring an initial depth to water (d) below the RP with a graduated steel tape. Use a tire pump, air tank, or air compressor to pump compressed air into the air line until all the water is expelled from the line. When all the water is displaced from the line, record the stabilized gage reading (h). Add d to h to determine the constant value for k.
- To measure subsequent depths to water with the air line, expel all the water from the air line, subtract the gage reading (h) from the constant k, and record the result as depth to water (d) below the RP.

The air line method is not as accurate as a graduated steel tape or electric and is typically accurate to the nearest one foot at best. Errors can occur from leaky air lines, or when tubing becomes clogged with mineral deposits or bacterial growth. The air line method is not desirable for use in the Groundwater Monitoring Program.

Pressure Transducer

Electrical pressure transducers make it possible to collect frequent and long-term water level or pressure data from wells. These pressure-sensing devices, installed at a fixed depth in a well, sense the change in pressure against a membrane. The pressure changes occur in response to changes in the height of the water column in the well above the transducer membrane. To compensate for atmospheric changes, transducers may have vented cables or they can be used in conjunction with a barometric transducer that is installed in the same well or a nearby observation well above the water level.

Transducers are selected on the basis of expected water level fluctuation. The smallest range in water levels provides the greatest measurement resolution. Accuracy is generally 0.01 to 0.1 percent of the full scale range.

Retrieving data in the field is typically accomplished by downloading data through a USB connection to a portable computer or data logger. A site visit to retrieve data should involve several steps designed to safeguard the stored data and the continued useful operation of the transducer:

- Inspect the wellhead and check that the transducer cable has not moved or slipped (the cable can be marked with a reference point that can be used to identify movement);
- Ensure that the instrument is operating properly;
- Measure and record the depth to water with a graduated steel or electric tape;
- Document the site visit, including all measurements and any problems;
- Retrieve the data and document the process;
- Review the retrieved data by viewing the file or plotting the original data;
- Recheck the operation of the transducer prior to disconnecting from the computer.

A field notebook with a checklist of steps and measurements should be used to record all field observations and the current data from the transducer. It provides a historical record of field activities. In the office, maintain a binder with field information similar to that recorded in the field notebook so that a general historical record is available and can be referred to before and after a field trip.

Quality Control

The field technician should compare water level measurements collected at each well with the available historical information to identify and resolve anomalous and potentially erroneous measurements prior to moving to the next well location. Pertinent information, such as insufficient recovery of a pumping well, proximity to a pumping well, falling water in the casing, and changes in the measurement method, sounding equipment, reference point, or groundwater conditions should be noted. Office review of field notes and measurements should also be performed by a second staff member.

Groundwater Sampling Procedures for the
Los Osos Basin Plan Groundwater Monitoring Program

Introduction

This document establishes groundwater sampling procedures for the Los Osos Basin Plan (LOBP) Groundwater Monitoring Program. Groundwater sampling procedures facilitate obtaining a representative groundwater sample from an aquifer for water quality analysis. The water sampling procedures for general mineral and dissolved nitrogen sampling are presented below, along with special procedures for collecting samples for analyzing Constituents of Emerging Concern (CECs).

References

The procedures used for the LOBP Groundwater Monitoring Program have been developed through consideration of the constituents of analysis, well construction and type, and a review of the following references:

- U.S. Environmental Protection Agency, 1999, *Compendium of ERT Groundwater Sampling Procedures*, EPA/540/P-91/007, January 1999.
https://www.epa.gov/sites/production/files/2015-06/documents/fieldsamp- ertsops.pdf
- Wilde, F. D., 2004, *Cleaning of Equipment for Water Sampling* (ver 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapter A3, revised April 2004.
http://water.usgs.gov/owq/FieldManual/chapter3/Ch3_contents.html
- Wilde, F. D., 2008, *Guidelines for Field-Measured Water Quality Properties* (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapter A6, Section 6, October 2008.
http://water.usgs.gov/owq/FieldManual/Chapter6/6.0_contents.html

Well Information

Table 1 below lists important well information to be maintained in a well file or in a field notebook. Additional information that should be available to the person collecting groundwater samples include a description of access to the property and the well, the presence and depth of cascading water, or downhole obstructions that could interfere with sampling equipment.

Table 1
Well File Information

Well Completion Report	Hydrologic Information	Additional Information to be Recorded
Well name	Map showing basin boundaries and wells	Township, Range, and ¼ ¼ Section
Well Owner	Name of groundwater basin	Latitude and Longitude (Decimal degrees)
Drilling Company	Description of aquifer	Assessor's Parcel Number
Location map or sketch	Confined, unconfined, or mixed aquifers	Description of well head and sounding access
Total depth	Pumping test data	Reference point elevations
Perforation interval	Hydrographs	Well use and pumping schedule if known
Casing diameter	Water quality data	Date monitoring began
Date of well completion	Property access instructions/codes	Land use

Groundwater Sampling Procedures

Non-equipped wells

1) Calibrate field monitoring instruments each day prior to sampling;
2) Inspect wellhead condition and note any maintenance required (perform at earliest convenience);
3) Measure depth to static water (record to 0.01 inches) from surveyed reference point;
4) Install temporary purge pump to at least three feet below the water surface (deeper setting may be needed if water level draw down is too great);
5) Begin well purge, record flow rate;
6) Measure discharge water EC (measured to 10 µmhos/cm), pH (measured to 0.01 units), and temperature (measured to 0.1 degrees C) at regular intervals during well purging. Record time and gallons purged. Note discharge water color, odor, and turbidity (visual);
7) A minimum of three casing volumes of water should be removed during purging, or one borehole volume opposite perforated interval, whichever is greater*. In addition, a set of at least three consecutive field monitoring measurements with stable values should be recorded. For EC, stability within 5 percent of the first value in the set is sufficient (typically within 20-50 µmhos/cm). For pH, stability within 0.3 units is sufficient. For temperature, stability within 0.2 degrees C is sufficient;
8) Collect sample directly from discharge tube, note sample color, odor, turbidity (visual). Use only laboratory-provided containers. Wear powder-free nitrile gloves when collecting groundwater samples;
9) Place samples on-ice for transport to the laboratory;
10) Remove temporary pump and rinse with clean water;
11) Close well and secure well box lid;

*note: If well is pumped dry at the minimum pumping rate, the well may be allowed to recover and then sampled by bailer within 24 hours.

Equipped wells

The sampling port for an equipped well must be upstream of any water filtration or chemical feeds. Sample from the discharge line as close to the wellhead as possible. Sampling procedures for equipped wells will vary. For active wells (i.e. wells used daily), the need for purging three casing volumes is unnecessary. Flush supply line from well or holding tank to sampling port, and record one set of EC, pH, and temperature readings prior to sampling. For inactive wells, a field monitoring procedure similar to that described for non-equipped wells above is appropriate. Static water level measurements should also be taken before sampling. Water samples should always be transported on-ice to the laboratory.

Chain-of-Custody

The chain-of-custody and associated sample bottle labels are used to document sample identification, specify the analyses to be performed, and trace possession and handling of a sample from the time of collection through delivery to the analytical laboratory. The sampler should fill out the sample identification labels and affix them to the sample bottles prior to, or upon, sample collection. A chain-of-custody form should be filled out by the sampler and a signature and date/time of sample transfers are required for each relinquishing and receiving party between sample collection and laboratory delivery.

Groundwater Sampling Equipment Decontamination

Field equipment should be cleaned prior to the sampling event and between sampling locations. Sampling pumps and hand bailers should be brushed with a nylon-bristle brush using a solution of 0.1 to 0.2-percent (volume/volume) non-phosphate soap in municipal-source tap water. The equipment should then be triple-rinsed with deionized water. Purge the pump hose of well water between sampling locations by pumping deionized through the hose. Groundwater sampling equipment should be protected from contact with the ground, or other potentially contaminating materials, at all times.

Special procedures for sampling for CEC compounds from unequipped well:

1) A new, teflon-lined polyethylene discharge hose or bailer will be used at each unequipped well sampling location;
2) The sampling pump will be decontaminated prior to each well sampled: Decontamination will consist of brushing pump body, inlet screen, and submerged portion of power cable in a phosphate-free cleaning solution, followed by rinsing, pumping distilled water, and final rinse;

3) Personnel collecting the sample will use powder-free nitrile gloves and observe special precautions for testing as directed by the laboratory (such as no caffeinated drink consumption on day of sampling, standing downwind of sampling port during sample collection, double-bag sample bottles, etc.);
4) Equipment blanks of distilled water pumped through the sampling pump are recommended;
5) A clean water/travel blank of distilled water (from the same source used for pump decontamination) is recommended.

APPENDIX F

Land Use and Water Use Areas
(from LOBP)

Figure 5. Land Uses in the Plan Area

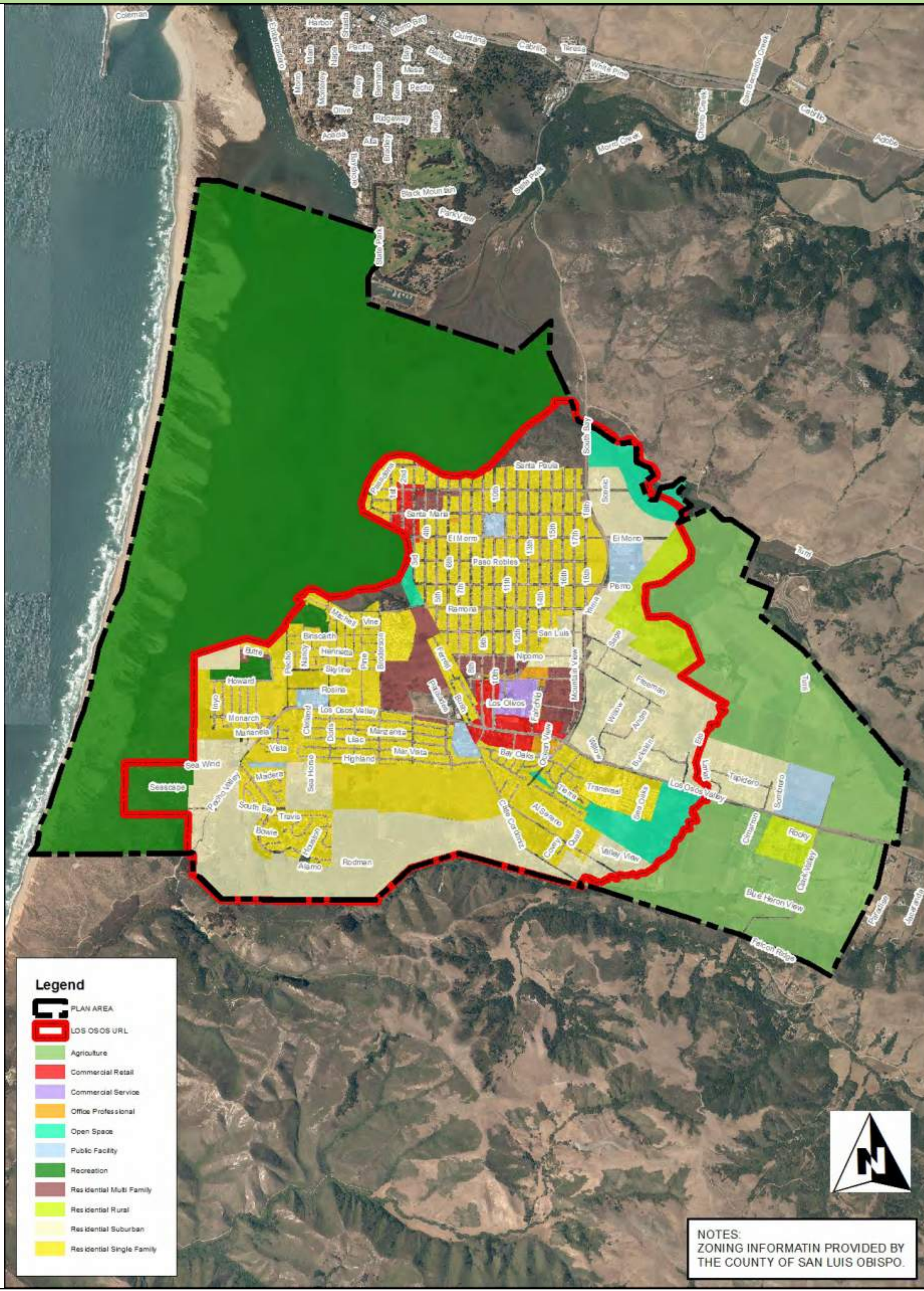
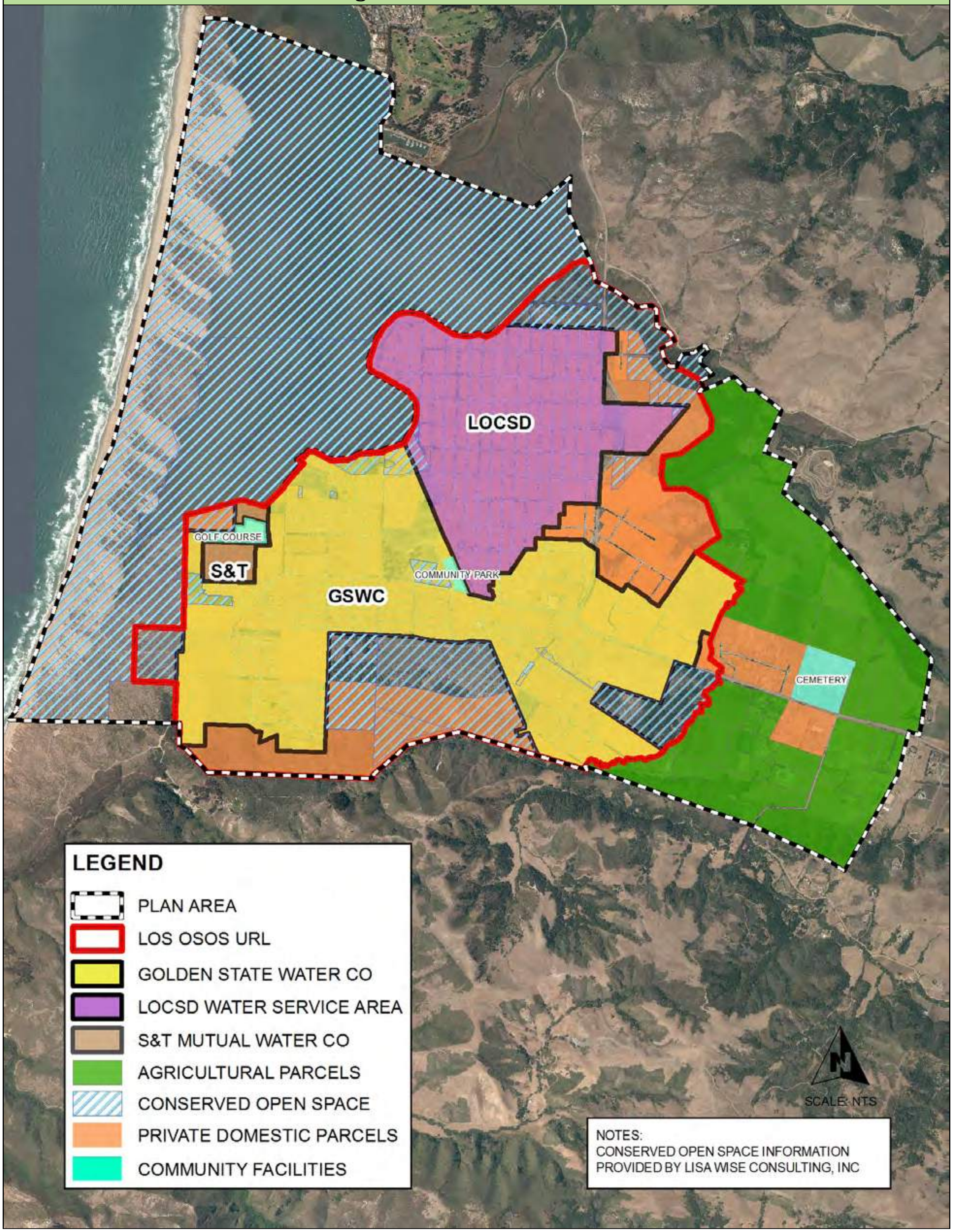


Figure 10. Water Use Areas



APPENDIX G

2018 Agricultural Water Use Estimates

Agriculture and Turf Applied Irrigation Water Estimate - 2018

Groundwater production estimates for agriculture and turf irrigation were developed using a daily soil-moisture budget with local data input. Sources of data included:

- The most recent land use survey by the County for estimating irrigated acreages (2018).
- Daily rainfall from County rain gage 727 (former Los Osos Landfill).
- Daily reference evapotranspiration from the California Irrigated Management Information System (CIMIS) Station 160 (San Luis Obispo West - Chorro Valley) located in DWR Climate Zone 6, which is the same climate zone as the Los Osos Valley.
- Water holding capacity and rooting depths from UC Davis Cooperative Extension at http://UCManageDrought.ucdavis.edu
- Crop Coefficients (Kc) from prior work in the Los Osos basin.

The soil-moisture budget methodology used accounts for soil holding capacity, crop rooting depth, leaching fraction, irrigation efficiency, local precipitation, and local reference evapotranspiration. The following equation, modified from a general formula for irrigation water requirements, was used for the soil-moisture budget (Carollo, 2012, modified from Burt et al., 2002):

Applied Irrigation Water = (ETc - ER) / (EF)

Where:

ETc [Crop evapotranspiration] = ETo [reference evapotranspiration] x Kc [crop coefficient]
ER [effective rainfall] = rainfall stored in soil and available to crop
EF [efficiency factor] = (1-LF[leaching fraction]) x IE [irrigation efficiency]
Assumes no frost protection for crops in the Los Osos Creek Valley.

Crop data used in this annual report comes from a GIS shapefile provided by the SLO County Agricultural Commissioner's office and represents irrigated agricultural acreage for 2017. This data includes areas of irrigated fields, orchards and greenhouses and is verified by the County using aerial photography and site visits. The data is generally released after the summer following the year for which the data is compiled and prepared. This 2017 dataset was used as the basis for irrigated acreage in the adjudicated area and updated for 2018 using Normalized Difference Vegatation Index (NDVI) satellite images. Irrigated fields that were included in previous Ag Commissioner's datasets but were not included in the most recently available (2017) dataset and showed evidence of irrigation in 2018 NDVI images were added to a modified 2018 shapefile. 2018 crop acreages were then estimated using this updated dataset for use in soil moisture budget modeling.

A land use survey map for 2018 is shown in Figure G-1. Tabulation of the irrigated acreages is presented in Table G-1 below.

Table G-1
2018 County Crop Survey
Eastern Area

Crop Type	Acres
Nursery	3.6
Pasture[1]	8.7
Vegetables	281.9
Vineyard	0.8
Total	295

[1]Sod farm listed as nursery in survey

Crop acreages listed in Table G-1 are in the Eastern Area (Los Osos Creek Valley and Cemetery Mesa). In addition, the turf areas for community facilities were calculated from areal images. Table G-2 presents these areas below.

Table G-2
Community Irrigated Turf Areas

Location	Acres
Memorial Park	12.5
Community Park	1.2
Sea Pines	24

Turf areas for schools, parks, cemeteries, and golf courses are generally classified in land use surveys as urban landscape, rather than given an agricultural designation. Turf grown for sod farms falls under an agricultural classification (pasture). For the purposes of the soil-moisture budget, the turf for community facilities and sod farms are considered as pasture.

The soil-moisture budget was constructed as a spreadsheet. Irrigation was applied as needed to offset soil moisture deficits after accounting for crop evapotranspiration, rainfall, rooting depths, and soil holding capacities. Example calculations are shown in the 2017 Annual Report (CHG, 2018a). An efficiency factor of 92 percent was estimated by calibrating the average annual irrigation requirement from a daily soil-moisture budget prepared for 2006-2008 to the irrigation estimate from prior work, which was also based on the 2006-2008 period (CHG, 2018a). Results of the soil-moisture budget method for estimating applied irrigation for agriculture and community facilities are included in tables below.

Tables G-3 and G-4 present irrigation demand for calendar years 2017 and 2018. Irrigation demand for vegetables and pasture/turf in 2017 is slightly more than 2018, despite having more rainfall during the calendar year. This is due to the daily rainfall distribution over each year.

In 2017, the majority of rainfall (16.67 inches) fell in January and February, when crop evapotranspiration (ETc) is at the lowest level of the year. By comparison, only 3.94 inches of rain fell during January and February of 2018, leaving more rainfall to offset demand in higher ET months.

Table G-3
Soil-Moisture Budget Results (Vegetables)

Year	Irrigation demand	ETo	ETc	Precip*
	(inches)			
2017	24.92	51.19	33.18	19.74
2018	24.55	53.04	34.19	18.08

*calendar year

Table G-4
Soil-Moisture Budget Results (Pasture/Turf)

Year	Irrigation Demand	ETo	ETc	Precip*
	(inches)			
2017	41.27	51.19	51.19	19.74
2018	38.99	53.04	53.04	18.08

*calendar year

Table G-5 summarizes the estimated applied irrigation for the various agricultural land uses. Due to the relatively minor acreage involved, vineyard and nursery were converted to equivalent acres in vegetables based on water demand estimates from the County Water Master Plan table A1 (Carollo, 2012). The estimated applied irrigation for calendar year 2018 is 670 acre-feet (the same value as 2017).

Table G-5
Applied Irrigation for Agriculture

Description	Units	2017	2018
Irrigation demand vegetables[1]	inches	24.92	24.55
Irrigation demand pasture[2]	inches	41.27	38.99
Irrigation Efficiency Factor[3]	factor	0.92	0.92
Applied irrigation vegetables	feet	2.26	2.22
Applied irrigation pasture	feet	3.74	3.53
Vegetables acreage[4]	acres	282.2	286.5
Vegetables applied water	acre-feet	637.8	636
Pasture acreage[5]	acres	8.7	8.7
Pasture applied water	acre-feet	32.5	30.7
TOTAL applied agricultural irrigation[6]	acre-feet	670	670

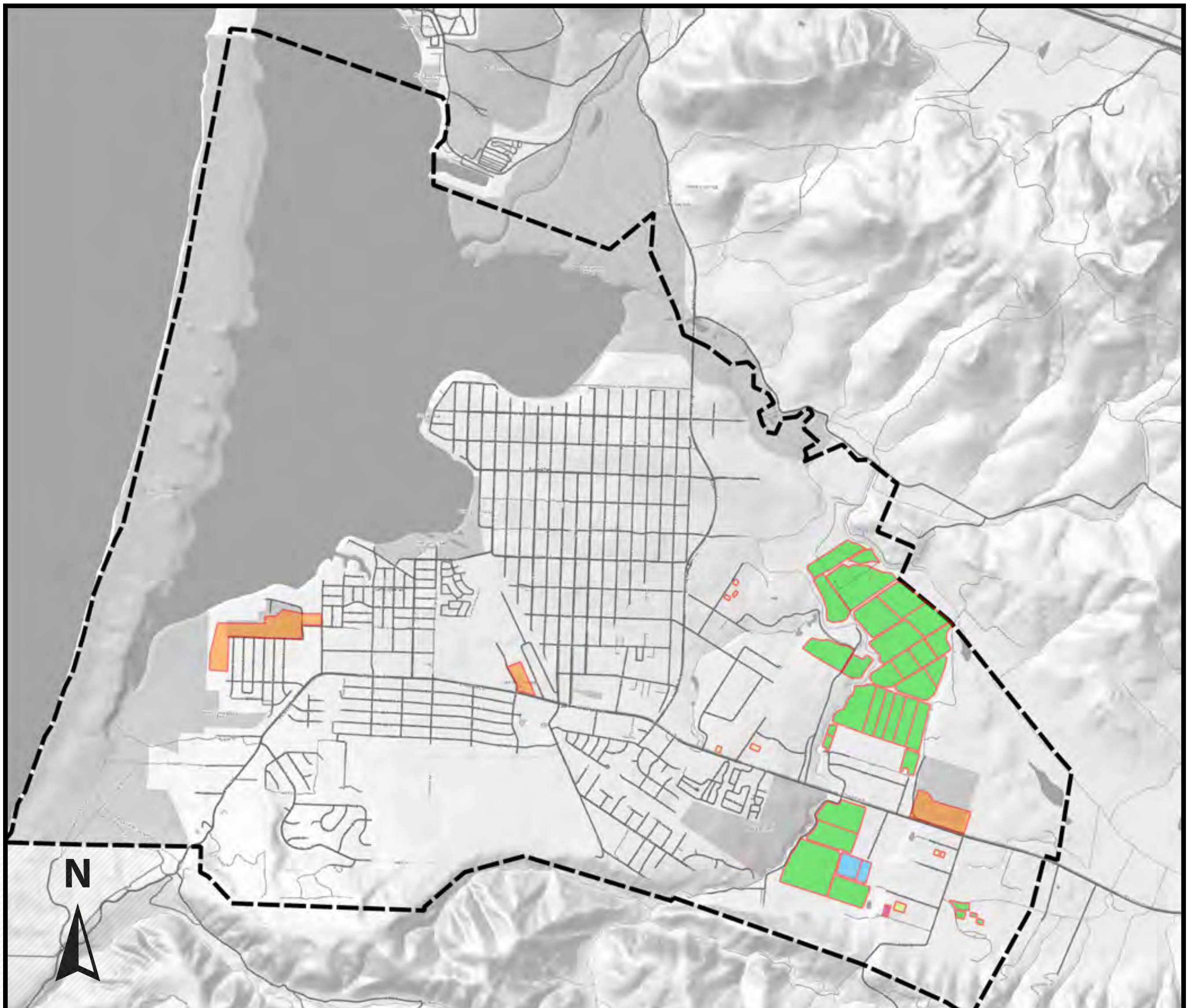
[1]From Table G-3;
[2]From Table G-4;
3From 2006-2009 calibration (CHG 2018a)
[4] 2018 acreage modified from County GIS 2017 layer. vineyard and nursery acres counted as 4.6 acres in vegetables, based on equivalent water demand conversion using 2012 County Master Water Plan Table A1 [Carollo, 2012).
[5]From Table G-1
[6]Rounded to closest 10 acre-feet

Table G-6 summarizes the estimated applied irrigation for community facilities. The total estimated water demand for community facilities in the 2018 calendar year was 133 acre-feet.

Table G-6
2018 Applied Irrigation for Community Facilities

Description	Units	Memorial Park	Sea Pines Golf*	Community Park	Total
Turf Area (from Table G-2)	acres	12.5	24	1.2	37.7
Applied Irrigation (from Table G-5)	feet	3.53	3.53	3.53	3.53
TOTAL Applied Irrigation	acre-feet	44.1	84.7	4.2	133

*includes estimated 15 acre-feet of recycled water (70 acre-feet net production)



Base Image: Stamen Terrain in Greyscale

0 2000 4000 6000 8000 ft

Scale: 1 inch ≈ 4,000 feet

Explanation

Crop Type - 2017 County of SLO Data (Modified for 2018)

- Nursery
- Pasture
- Vegetables
- Vineyard

- Adjudicated Plan Area
- Community Facilities with Turf Areas

Figure G1

2018 Crop Types
Los Osos Groundwater Basin

2018 Annual Report

Cleath-Harris Geologists

APPENDIX H

Precipitation and Streamflow Data

San Luis Obispo County Public Works

Recording Rain Station

MONTHLY PRECIPITATION REPORT

Station Name - Los Osos Landfill # 727

Station Location -

Latitude - 35° 19' 19"

Longitude - 120° 48' 03"

Description - Northeast Los Osos South of Turri Road

Water Years -

Beginning - 2005-2006

Ending - 2017-2018

Station Statistics -

Month	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
Minimum	0.00	0.00	0.00	0.00	0.04	0.12	0.00	0.16	0.00	0.20	0.00	0.00	6.81
Average	0.15	0.02	0.08	1.00	0.93	2.77	3.92	2.80	2.59	0.94	0.31	0.12	15.63
Maximum	1.93	0.20	0.63	6.22	2.76	11.46	10.47	7.65	8.03	3.70	2.64	1.10	31.77

Notes -

Earlier data may be available. Contact Public Works for more information.

San Luis Obispo County Public Works

Recording Rain Station

MONTHLY PRECIPITATION REPORT

Station Name and no. Los Osos Landfill # 727

*** All units are in inches ***

Water Year	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Total
2017-2018	0.00	0.00	0.16	0.16	0.47	0.12	3.78	0.16	7.99	0.79	0.00	0.00	13.63
2016-2017	0.00	0.00	0.00	1.65	2.76	3.39	9.02	7.65	1.34	0.55	0.27	0.00	26.63
2015-2016	1.93	0.00	0.08	0.08	1.26	1.85	5.04	0.86	4.85	0.20	0.00	0.00	16.15
2014-2015	0.00	0.00	0.00	0.00	0.28	5.20	0.08	0.91	0.43	0.67	0.12	0.00	7.68
2013-2014	0.00	0.00	0.00	0.24	0.28	0.12	0.00	4.06	1.42	0.71	0.00	0.00	6.81
2012-2013	0.00	0.00	0.00	1.18	1.69	2.64	1.02	0.67	0.43	0.31	0.12	0.04	8.11
2011-2012	0.00	0.08	0.04	1.06	2.17	0.16	2.28	0.35	2.68	2.24	0.00	0.00	11.06
2010-2011	0.00	0.00	0.12	1.54	1.85	11.46	3.03	3.78	8.03	0.28	0.59	1.10	31.77
2009-2010	0.00	0.00	0.04	6.22	0.04	2.87	9.76	4.13	1.14	1.93	0.04	0.00	26.18
2008-2009	0.00	0.00	0.00	0.04	0.04	0.75	0.71	4.61	1.06	0.20	0.20	0.35	7.95
2007-2008	0.00	0.00	0.00	0.43	0.12	2.68	10.47	2.99	0.00	0.24	0.00	0.00	16.93
2006-2007	0.00	0.00	0.00	0.12	0.43	2.28	1.26	2.56	0.43	0.35	0.04	0.00	7.48
2005-2006	0.04	0.20	0.63	0.24	0.75	2.52	4.45	3.70	3.90	3.70	2.64	0.00	22.76

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2017-2018**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1									0.82				1
2									0.16				2
3					0.03				0.24				3
4							0.19						4
5													5
6													6
7										0.40			7
8					0.04		1.42						8
9					0.12		1.77						9
10			0.08						0.51				10
11			0.08										11
12									0.04	0.04			12
13									0.35				13
14									0.28				14
15										0.04			15
16					0.04				0.35	0.19			16
17									0.08				17
18							0.08						18
19							0.08			0.12			19
20				0.12		0.12			0.48				20
21									2.16				21
22									2.48				22
23													23
24													24
25							0.24						25
26					0.16			0.16					26
27					0.08								27
28													28
29													29
30													30
31				0.04					0.04				31

Total	0.00	0.00	0.16	0.16	0.47	0.12	3.78	0.16	7.99	0.79	0.00	0.00	
Cum. Total	0.00	0.00	0.16	0.32	0.79	0.91	4.69	4.85	12.84	13.63	13.63	13.63	

Season Total **13.63**

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2016-2017**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1													1
2								0.24					2
3								0.16					3
4							2.25						4
5							0.23	0.55	0.35				5
6								0.51					6
7							0.52	0.63		0.15	0.27		7
8						1.18	1.10	0.04		0.04			8
9						0.08	0.12	0.28					9
10						0.12	0.23	0.43					10
11							0.04	0.04					11
12							0.59						12
13										0.08			13
14										0.04			14
15				0.08		1.07							15
16				0.08		0.55		0.31					16
17				0.08				3.27		0.08			17
18							0.56	0.32		0.16			18
19							0.27	0.08					19
20					1.90		1.22	0.51					20
21					0.04		0.16	0.24	0.20				21
22							1.26		0.47				22
23						0.35	0.43						23
24							0.04		0.12				24
25									0.20				25
26					0.67			0.04					26
27				0.67	0.15								27
28				0.71									28
29													29
30				0.03		0.04							30
31													31

Total	0.00	0.00	0.00	1.65	2.76	3.39	9.02	7.65	1.34	0.55	0.27	0.00	
Cum. Total	0.00	0.00	0.00	1.65	4.41	7.80	16.82	24.47	25.81	26.36	26.63	26.63	

Season Total **26.63**

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2015-2016**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1													1
2					0.59								2
3						0.04							3
4				0.04									4
5							1.02		1.54				5
6							0.75		0.35				6
7							0.23		1.06				7
8					0.23					0.08			8
9					0.04		0.04						9
10					0.04	0.04	0.08		0.04				10
11						0.39			1.22				11
12													12
13						0.08	0.04		0.36				13
14			0.08						0.20				14
15				0.04	0.28		0.04						15
16							0.08						16
17								0.67					17
18							0.28	0.19					18
19	1.69					0.51	0.86						19
20	0.24								0.04				20
21						0.28			0.04				21
22						0.47	0.16			0.12			22
23							0.08						23
24						0.04							24
25					0.08								25
26													26
27													27
28													28
29													29
30							0.27						30
31							1.11						31
Total	1.93	0.00	0.08	0.08	1.26	1.85	5.04	0.86	4.85	0.20	0.00	0.00	
Cum. Total	1.93	1.93	2.01	2.09	3.35	5.20	10.24	11.10	15.95	16.15	16.15	16.15	

Season Total **16.15**

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2014-2015**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1									0.43				1
2						0.51							2
3													3
4						0.67							4
5						0.04							5
6								0.12					6
7								0.51					7
8					0.04			0.20					8
9													9
10								0.08					10
11					0.04	1.22							11
12						1.22							12
13					0.04								13
14											0.12		14
15						0.71				0.47			15
16						0.71							16
17						0.08							17
18						0.04							18
19					0.08								19
20													20
21													21
22					0.04								22
23													23
24													24
25										0.20			25
26													26
27							0.08						27
28													28
29					0.04								29
30													30
31													31

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	
Total	0.00	0.00	0.00	0.00	0.28	5.20	0.08	0.91	0.43	0.67	0.12	0.00	
Cum. Total	0.00	0.00	0.00	0.00	0.28	5.47	5.55	6.46	6.89	7.56	7.68	7.68	

Season Total **7.68**

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2013-2014**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1									0.59	0.24			1
2								0.87	0.20	0.28			2
3								0.04					3
4													4
5													5
6								0.31					6
7						0.12							7
8								0.04					8
9								0.04					9
10								0.08					10
11													11
12													12
13													13
14								0.04					14
15													15
16													16
17													17
18													18
19													19
20					0.20								20
21					0.08								21
22													22
23													23
24													24
25										0.16			25
26								0.87	0.04	0.04			26
27								0.28					27
28				0.24				1.50					28
29									0.16				29
30									0.04				30
31									0.39				31

Total	0.00	0.00	0.00	0.24	0.28	0.12	0.00	4.06	1.42	0.71	0.00	0.00	
Cum. Total	0.00	0.00	0.00	0.24	0.51	0.63	0.63	4.69	6.10	6.81	6.81	6.81	

Season Total **6.81**

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2012-2013**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1						0.12				0.28			1
2						0.55							2
3													3
4										0.04			4
5							0.39						5
6							0.31				0.12		6
7									0.24				7
8								0.47	0.08				8
9					0.04								9
10				0.24									10
11				0.87									11
12						0.04							12
13													13
14									0.04				14
15						0.04							15
16					0.08	0.08							16
17					0.47	0.16							17
18					0.24								18
19								0.20					19
20													20
21				0.04									21
22						0.75							22
23						0.24							23
24							0.28					0.04	24
25						0.28	0.04						25
26						0.04							26
27													27
28					0.55								28
29					0.08	0.35							29
30				0.04	0.24				0.04				30
31									0.04				31

Total	0.00	0.00	0.00	1.18	1.69	2.64	1.02	0.67	0.43	0.31	0.12	0.04	
Cum. Total	0.00	0.00	0.00	1.18	2.87	5.51	6.54	7.20	7.64	7.95	8.07	8.11	

Season Total **8.11**

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2011-2012**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1													1
2													2
3				0.08	0.04								3
4				0.04	0.28								4
5				0.91									5
6					0.28								6
7								0.04					7
8													8
9													9
10				0.04				0.04		0.55			10
11					0.31					0.16			11
12						0.16				0.28			12
13								0.08		1.02			13
14													14
15								0.08					15
16									0.12				16
17									1.46				17
18									0.12				18
19													19
20					1.26		0.20						20
21							0.87						21
22													22
23							1.22						23
24													24
25									0.63	0.20			25
26		0.04								0.04			26
27													27
28									0.16				28
29								0.12					29
30		0.04	0.04										30
31									0.20				31

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	
Total	0.00	0.08	0.04	1.06	2.17	0.16	2.28	0.35	2.68	2.24	0.00	0.00	
Cum. Total	0.00	0.08	0.12	1.18	3.35	3.50	5.79	6.14	8.82	11.06	11.06	11.06	

Season Total **11.06**

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2010-2011**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1							0.39						1
2							2.52		0.08				2
3													3
4			0.04			0.04			0.04			0.59	4
5				0.31		0.75						0.35	5
6				0.24	0.04				0.12			0.12	6
7					0.47								7
8													8
9						0.04							9
10					0.04								10
11									0.04				11
12													12
13						0.04							13
14								0.04					14
15						0.04					0.16		15
16								0.59	0.08		0.16		16
17			0.04	0.04		0.43		0.47			0.16		17
18				0.08		2.95		1.54	0.47		0.08		18
19					0.24	2.24		0.55	2.28				19
20			0.04		0.71	1.06		0.04	2.91				20
21				0.04	0.24	0.35			0.24	0.28			21
22				0.04		1.57			0.04				22
23				0.08	0.12				0.87				23
24				0.28					0.63				24
25						0.79		0.51	0.04				25
26								0.04	0.16				26
27													27
28						0.31			0.04				28
29				0.35		0.83					0.04	0.04	29
30				0.08									30
31							0.12						31
Total	0.00	0.00	0.12	1.54	1.85	11.46	3.03	3.78	8.03	0.28	0.59	1.10	
Cum. Total	0.00	0.00	0.12	1.65	3.50	14.96	17.99	21.77	29.80	30.08	30.67	31.77	

Season Total **31.77**

San Luis Obispo County Public Works

DAILY PRECIPITATION

(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2009-2010**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1										0.04			**1**
2									0.08				**2**
3									0.43				**3**
4								0.08	0.04				**4**
5								0.51		0.31			**5**
6								0.39	0.20				**6**
7						0.47							**7**
8									0.04				**8**
9								0.63					**9**
10						0.75			0.04				**10**
11										0.98			**11**
12						1.22	0.51		0.08	0.08			**12**
13				5.43		0.04	0.31	0.04					**13**
14				0.79		0.04							**14**
15													**15**
16													**16**
17							0.55				0.04		**17**
18							1.14						**18**
19							0.91						**19**
20					0.04		2.36	0.04		0.51			**20**
21						0.16	2.01	0.12					**21**
22							1.22		0.04				**22**
23			0.04				0.04	0.04					**23**
24								0.39					**24**
25													**25**
26							0.59	1.42					**26**
27						0.08		0.47					**27**
28													**28**
29							0.08		0.04				**29**
30						0.12	0.04		0.04				**30**
31									0.12				**31**
Total	0.00	0.00	0.04	6.22	0.04	2.87	9.76	4.13	1.14	1.93	0.04	0.00	
Cum. Total	0.00	0.00	0.04	6.26	6.30	9.17	18.94	23.07	24.21	26.14	26.18	26.18	

Season Total **26.18**

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2008-2009**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1					0.04						0.04		1
2							0.08		0.16		0.12		2
3									0.59				3
4				0.04					0.08				4
5											0.04	0.35	5
6								0.87					6
7										0.20			7
8													8
9								1.10					9
10													10
11								0.04					11
12								0.04					12
13								0.63					13
14								0.04					14
15													15
16						0.12							16
17								1.10					17
18													18
19													19
20													20
21						0.08							21
22						0.43		0.47	0.24				22
23							0.51	0.31					23
24							0.12						24
25						0.12							25
26													26
27													27
28													28
29													29
30													30
31													31

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	
Total	0.00	0.00	0.00	0.04	0.04	0.75	0.71	4.61	1.06	0.20	0.20	0.35	
Cum. Total	0.00	0.00	0.00	0.04	0.08	0.83	1.54	6.14	7.20	7.40	7.60	7.95	

Season Total **7.95**

San Luis Obispo County Public Works

DAILY PRECIPITATION

(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2007-2008**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1								0.08					1
2					0.04			0.24		0.20			2
3								1.02		0.04			3
4							3.66						4
5							0.20						5
6						0.24	0.39						6
7						0.08							7
8							0.08						8
9							0.04						9
10													10
11					0.08								11
12													12
13													13
14													14
15													15
16				0.28									16
17				0.08									17
18						2.24							18
19								0.20					19
20						0.12		0.16					20
21							0.08	0.08					21
22							2.32	0.12					22
23							1.06	0.87					23
24							0.87	0.24					24
25							0.31						25
26							0.63						26
27				0.08			0.67						27
28							0.08						28
29							0.04						29
30							0.04						30
31													31
Total	0.00	0.00	0.00	0.43	0.12	2.68	10.47	2.99	0.00	0.24	0.00	0.00	
Cum. Total	0.00	0.00	0.00	0.43	0.55	3.23	13.70	16.69	16.69	16.93	16.93	16.93	

Season Total **16.93**

San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2006-2007**

Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1													1
2								0.04					2
3													3
4							0.12				0.04		4
5													5
6													6
7								0.20					7
8						0.39							8
9						0.94							9
10						0.31		0.71					10
11					0.08								11
12								0.04					12
13				0.08	0.20								13
14					0.08								14
15													15
16													16
17					0.04	0.04	0.04						17
18													18
19										0.04			19
20									0.28	0.24			20
21						0.04							21
22								0.87		0.08			22
23				0.04				0.12					23
24													24
25								0.08					25
26					0.04	0.43		0.16	0.08				26
27						0.12	0.83	0.20	0.08				27
28							0.20	0.16					28
29							0.08						29
30													30
31													31

Total	0.00	0.00	0.00	0.12	0.43	2.28	1.26	2.56	0.43	0.35	0.04	0.00	
Cum. Total	0.00	0.00	0.00	0.12	0.55	2.83	4.09	6.65	7.09	7.44	7.48	7.48	

Season Total **7.48**

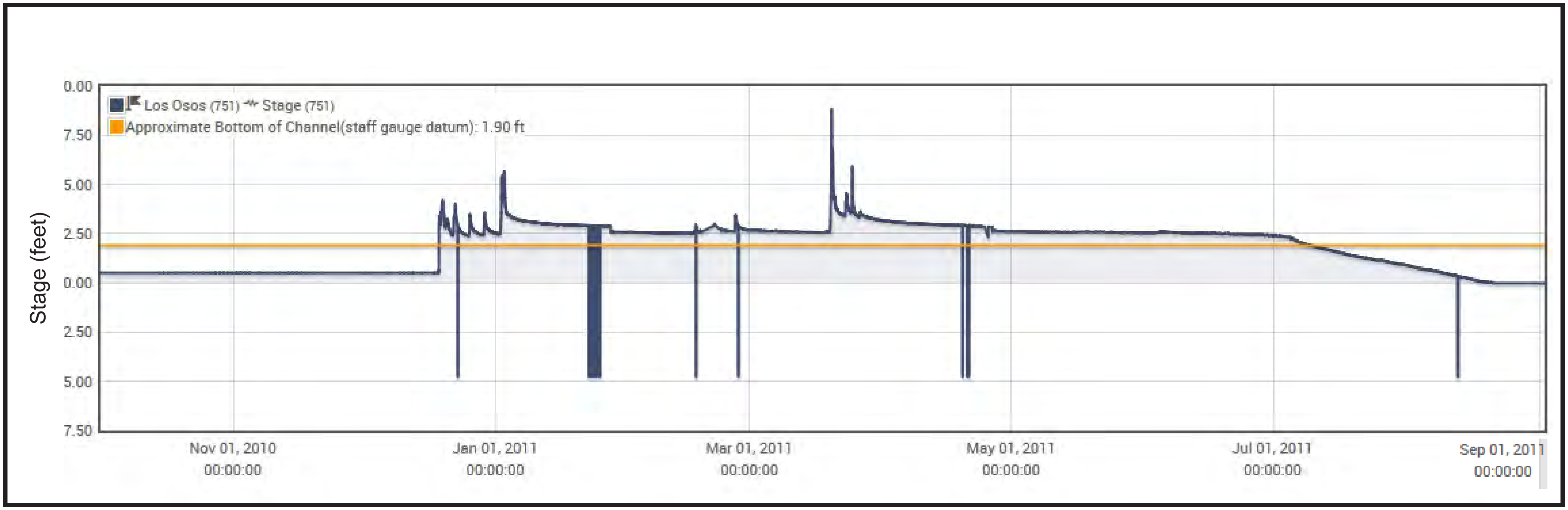
San Luis Obispo County Public Works

DAILY PRECIPITATION
(inches)

Station Name and no. **Los Osos Landfill # 727** Season **2005-2006**

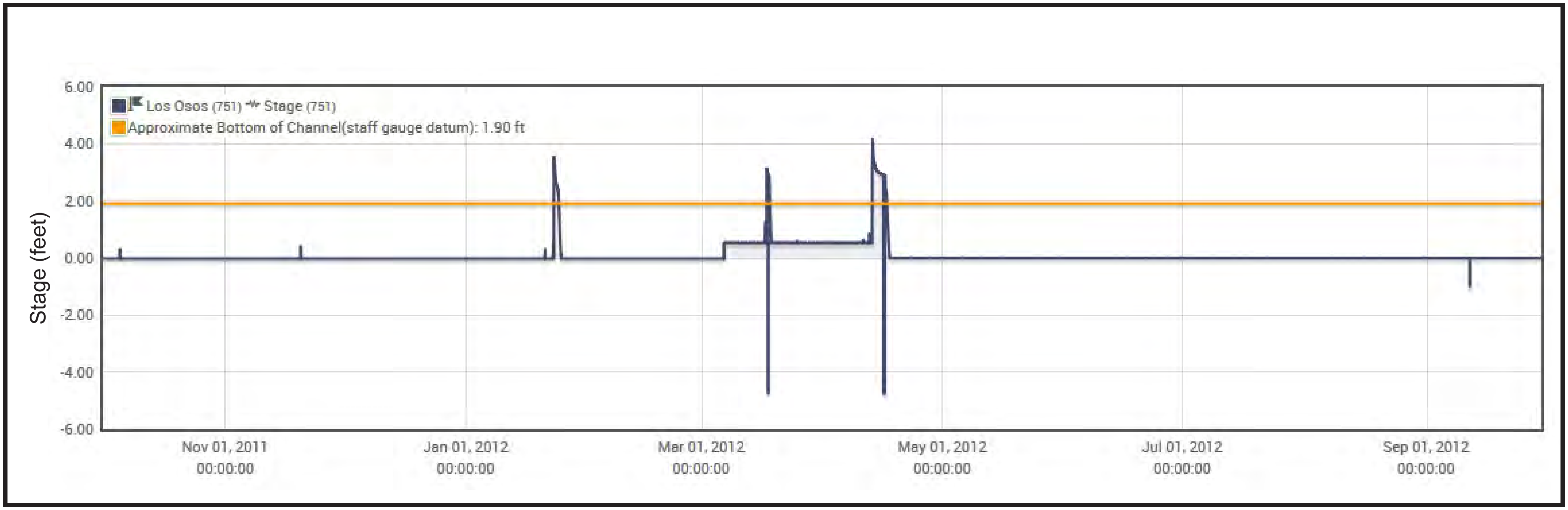
Day	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Day
1							1.61						**1**
2			0.63			0.55	2.32			0.24			**2**
3								0.04		1.18			**3**
4										0.59			**4**
5										0.39			**5**
6													**6**
7										0.08			**7**
8						0.47							**8**
9					0.59				0.04				**9**
10									0.28	0.43			**10**
11		0.16			0.04				0.12				**11**
12		0.04							0.28				**12**
13													**13**
14	0.04						0.24		0.04	0.04			**14**
15													**15**
16										0.08			**16**
17				0.12					0.24	0.04			**17**
18						0.16	0.16	3.66					**18**
19													**19**
20				0.04					0.35				**20**
21						0.04			0.04		2.60		**21**
22						0.04					0.04		**22**
23						0.04							**23**
24													**24**
25					0.08	0.12			0.12				**25**
26				0.08		0.04	0.08			0.63			**26**
27									0.43				**27**
28						0.12			1.38				**28**
29									0.16				**29**
30					0.04		0.04						**30**
31						0.94			0.43				**31**
Total	0.04	0.20	0.63	0.24	0.75	2.52	4.45	3.70	3.90	3.70	2.64	0.00	
Cum. Total	0.04	0.24	0.87	1.10	1.85	4.37	8.82	12.52	16.42	20.12	22.76	22.76	

Season Total **22.76**



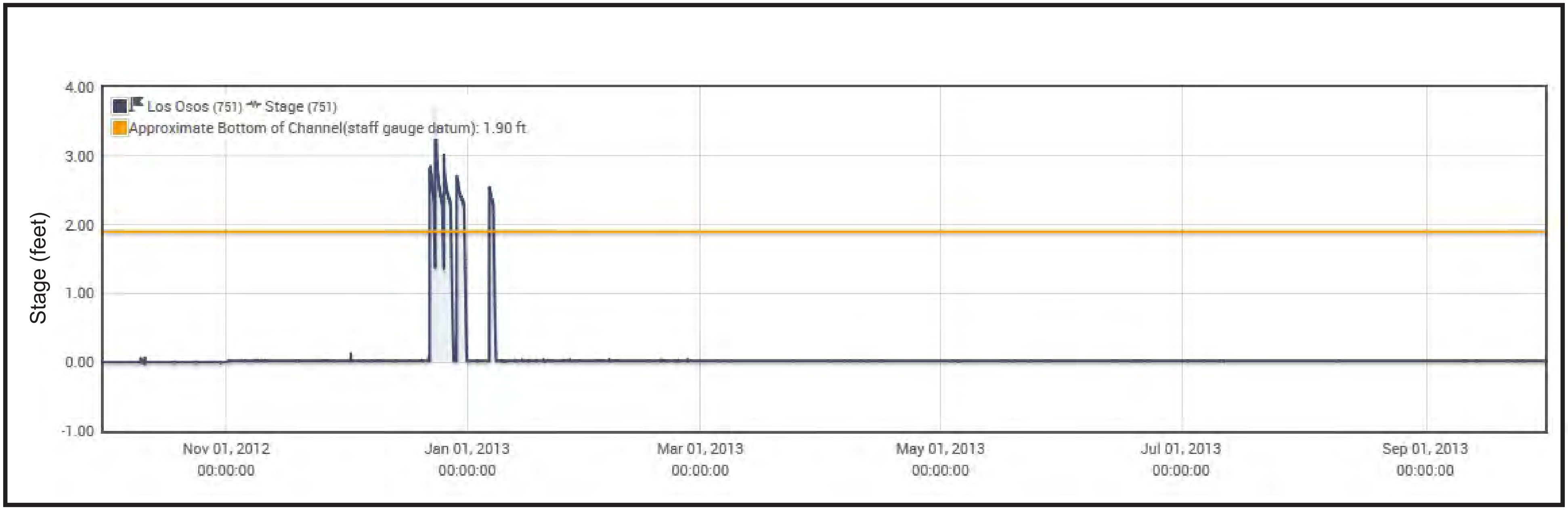
Source: County of San Luis Obispo Public Works Department, Stream Gage #751

Figure H1
Stream Stage for 2011 Water Year
Los Osos Creek, Gage #751



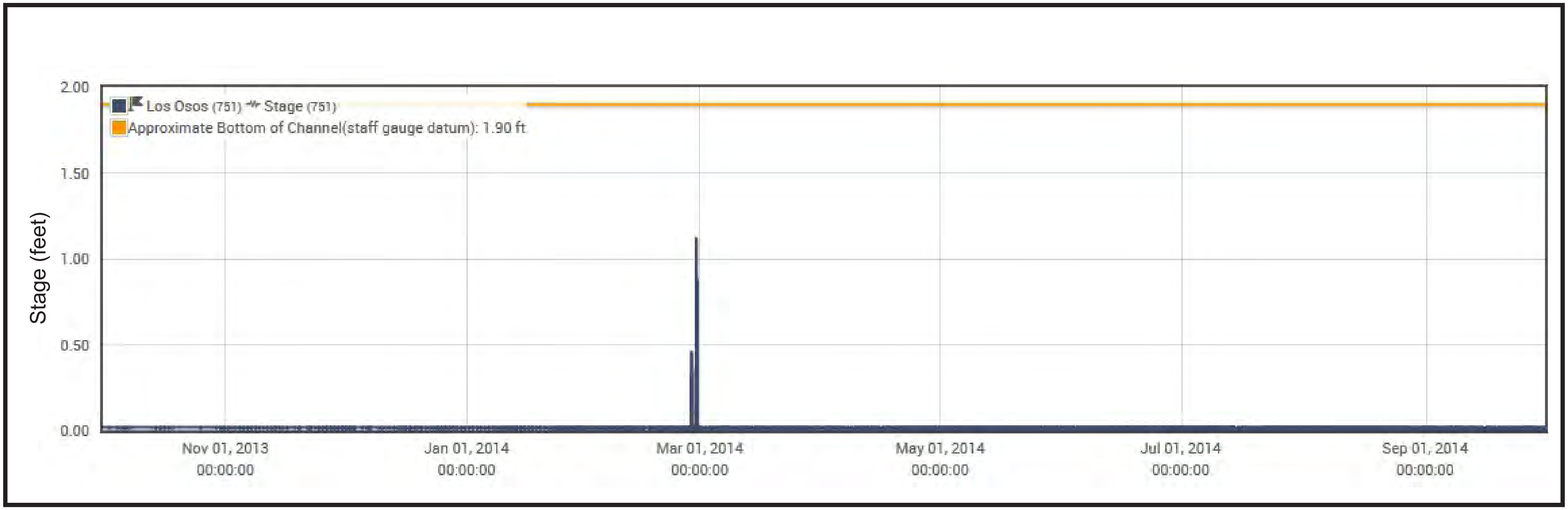
Source: County of San Luis Obispo Public Works Department, Stream Gage #751

Figure H2
Stream Stage for 2012 Water Year
Los Osos Creek, Gage #751



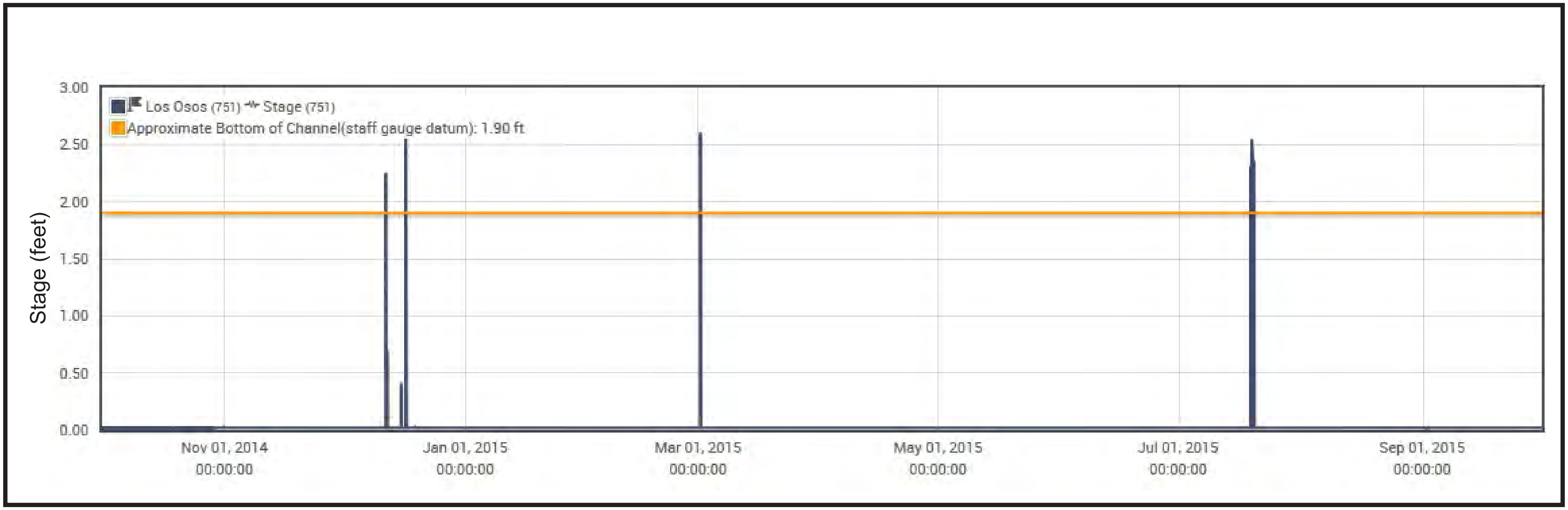
Source: County of San Luis Obispo Public Works Department, Stream Gage #751

Figure H3
Stream Stage for 2013 Water Year
Los Osos Creek, Gage #751



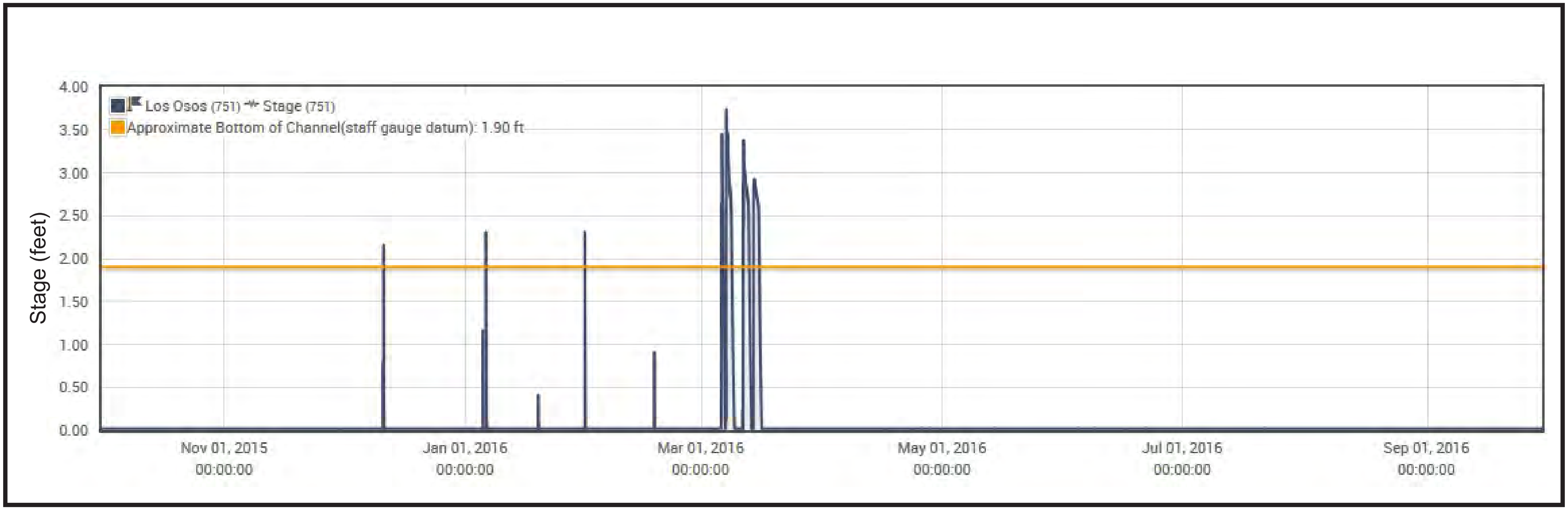
Source: County of San Luis Obispo Public Works Department, Stream Gage #751

Figure H4
Stream Stage for 2014 Water Year
Los Osos Creek, Gage #751



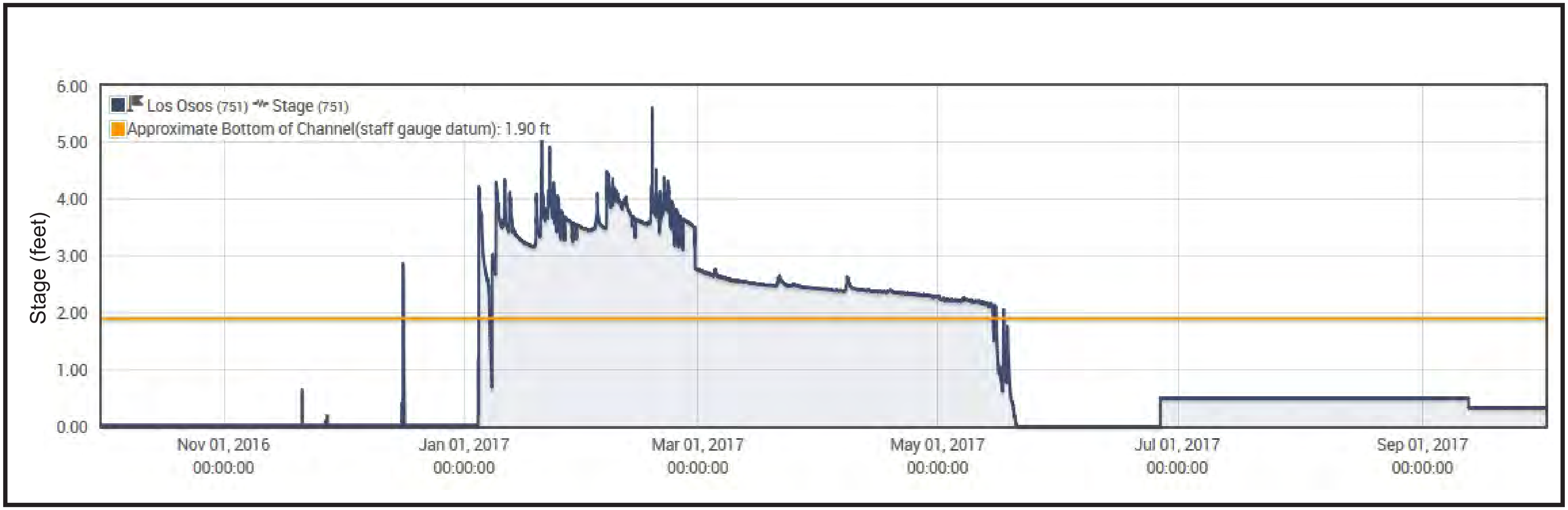
Source: County of San Luis Obispo Public Works Department, Stream Gage #751

Figure H5
Stream Stage for 2015 Water Year
Los Osos Creek, Gage #751



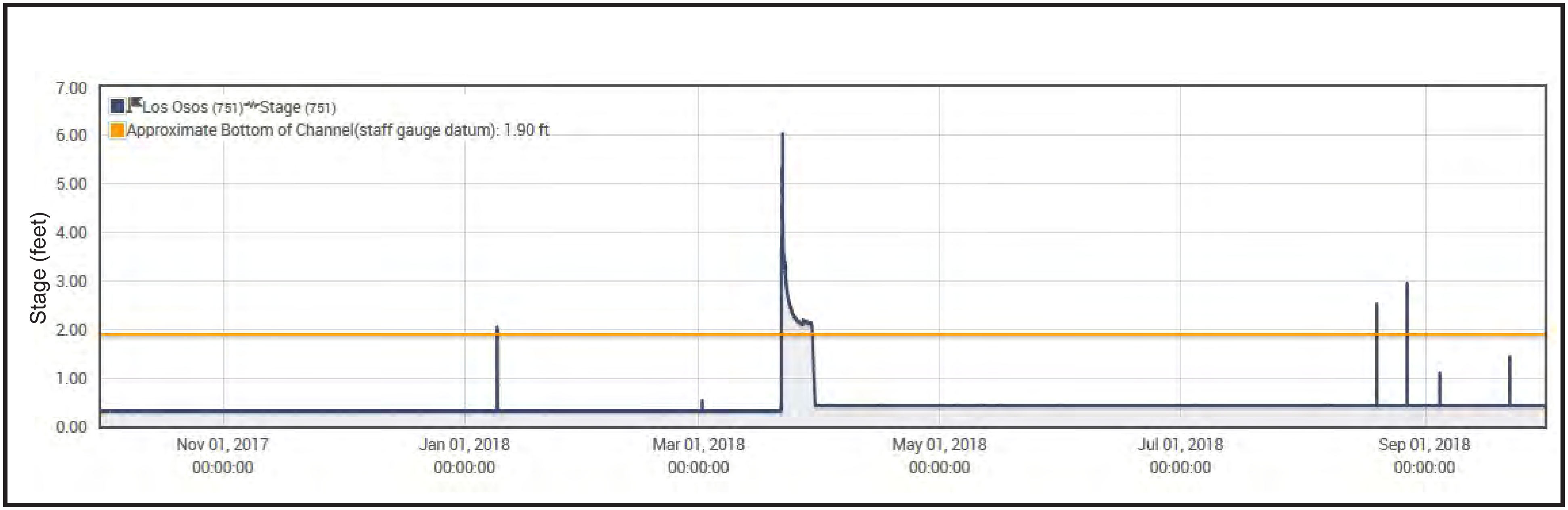
Source: County of San Luis Obispo Public Works Department, Stream Gage #751

Figure H6
Stream Stage for 2016 Water Year
Los Osos Creek, Gage #751



Source: County of San Luis Obispo Public Works Department, Stream Gage #751

Figure H7
Stream Stage for 2017 Water Year
Los Osos Creek, Gage #751

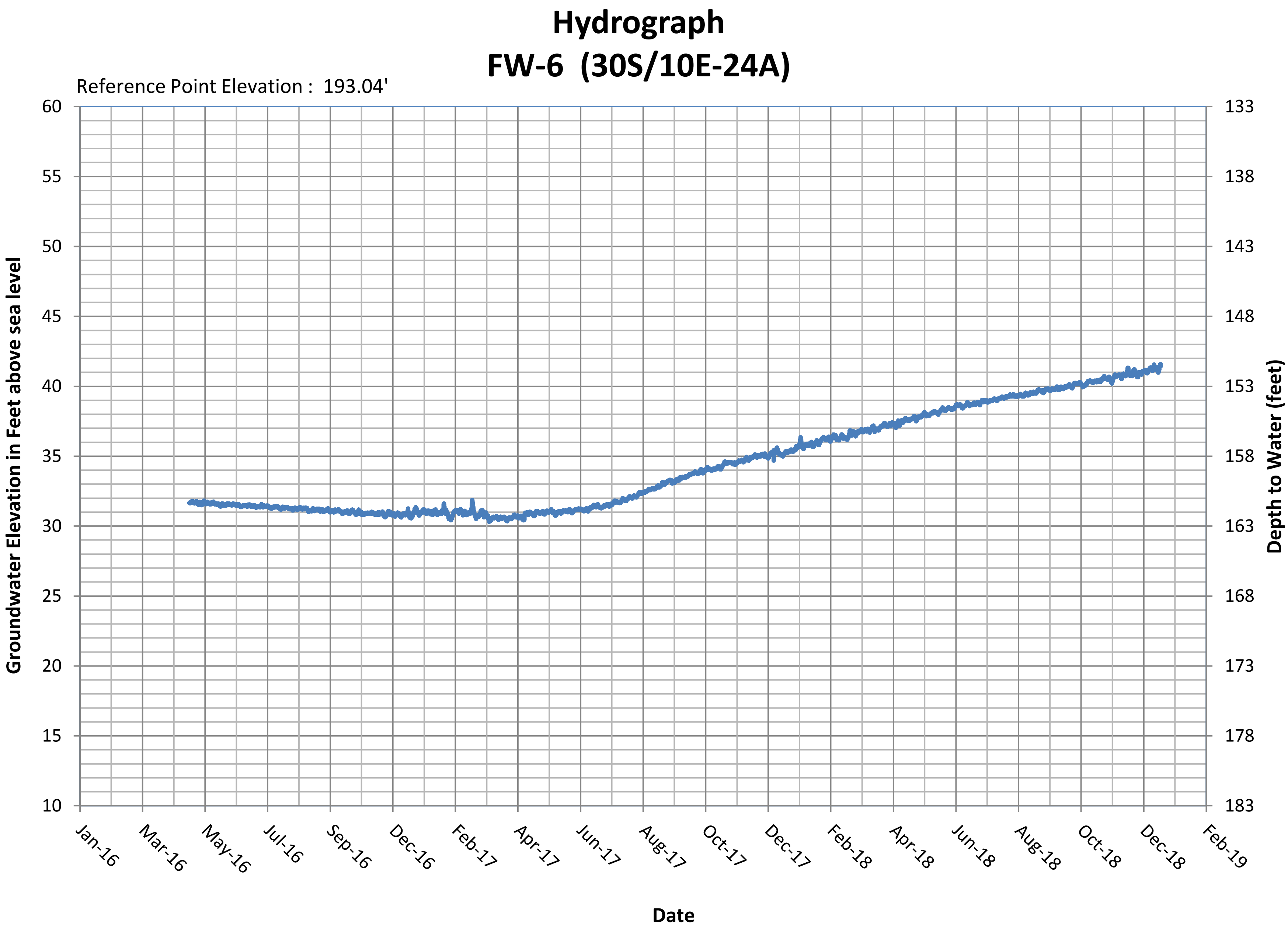


Source: County of San Luis Obispo Public Works Department, Stream Gage #751

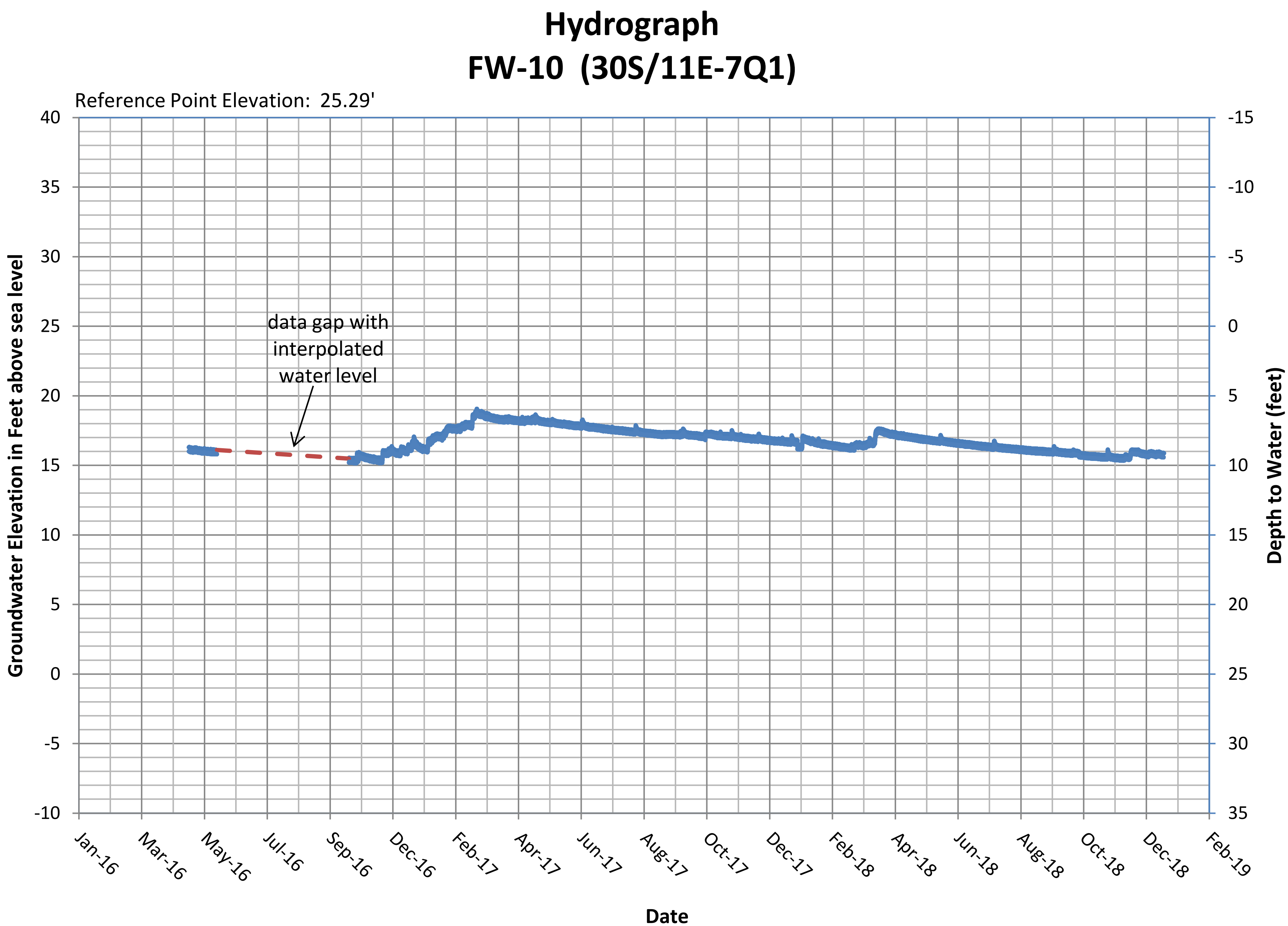
Figure H8
Stream Stage for 2018 Water Year
Los Osos Creek, Gage #751

APPENDIX I

Transducer Hydrographs

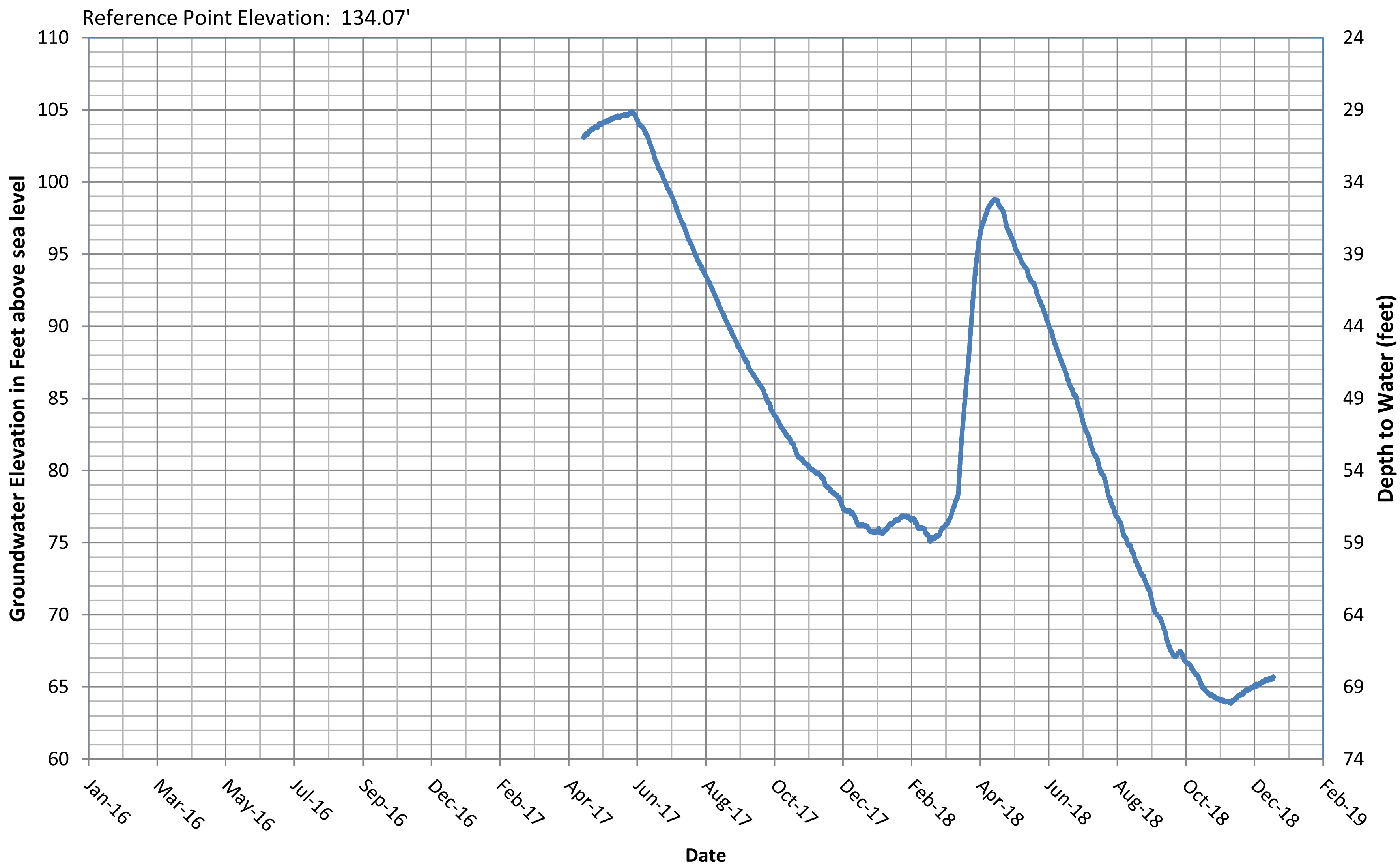


Hydrograph
FW-6 (30S/10E-24A)
Reference Point Elevation : 193.04'
Groundwater Elevation in Feet above sea level
Depth to Water (feet)
60
55
50
45
40
35
30
25
20
15
10
133
138
143
148
153
158
163
168
173
178
183
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19
Date

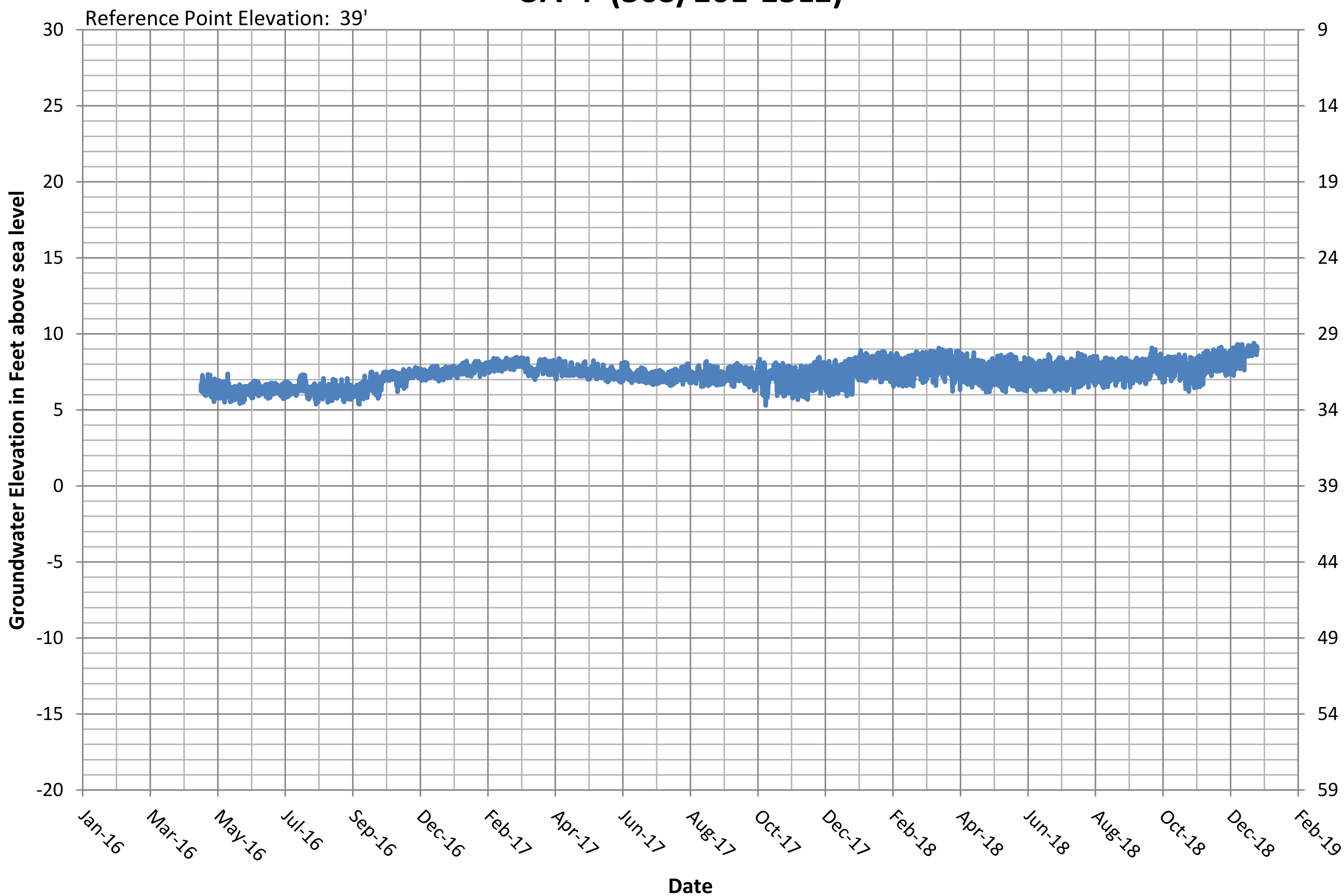


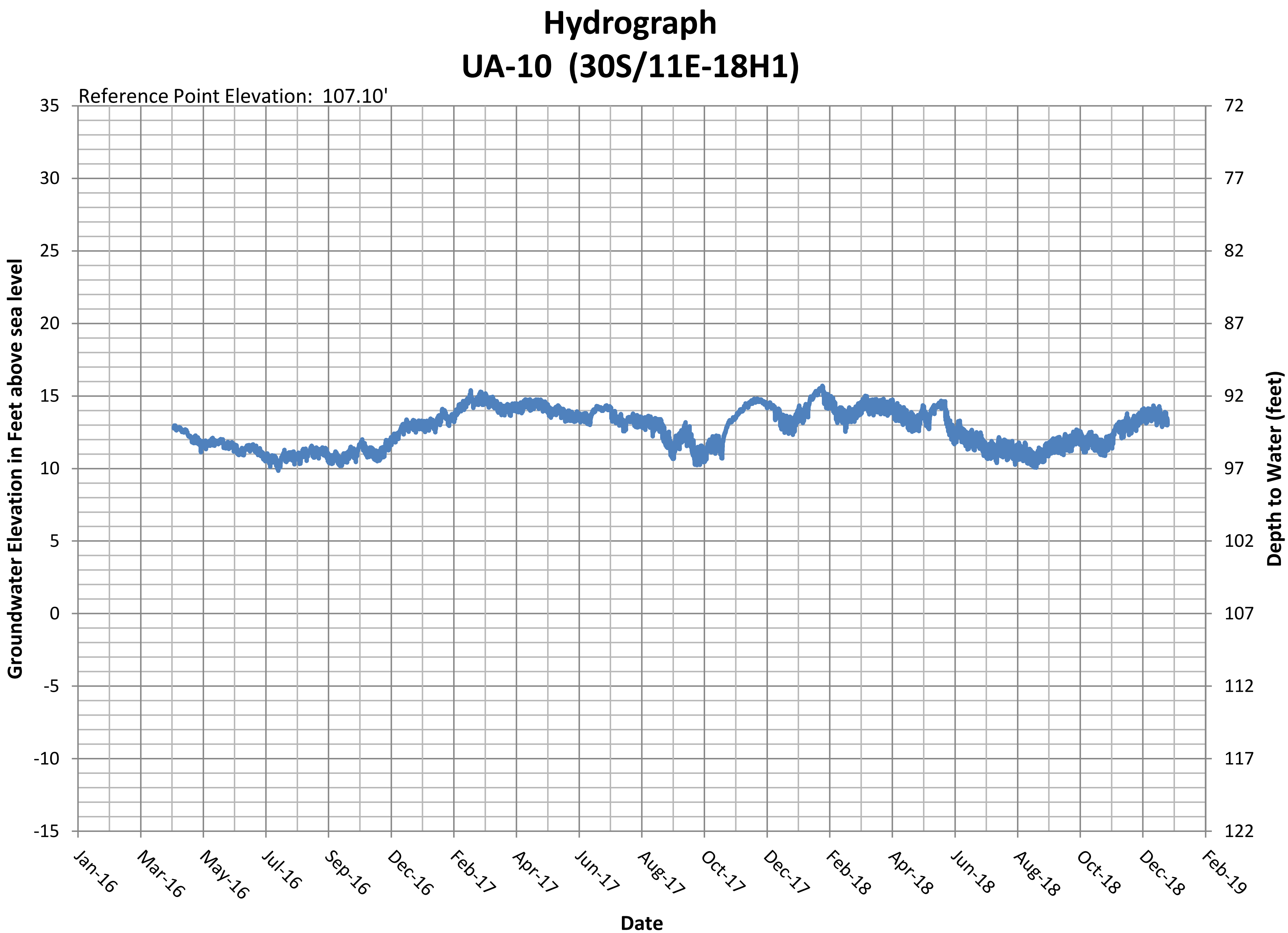
Hydrograph
FW-10 (30S/11E-7Q1)
Reference Point Elevation: 25.29'
Groundwater Elevation in Feet above sea level
Depth to Water (feet)
data gap with interpolated water level
40
35
30
25
20
15
10
5
0
-5
-10
-15
-10
-5
0
5
10
15
20
25
30
35
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19
Date

Hydrograph
FW-27 (30S/10E-20L1)



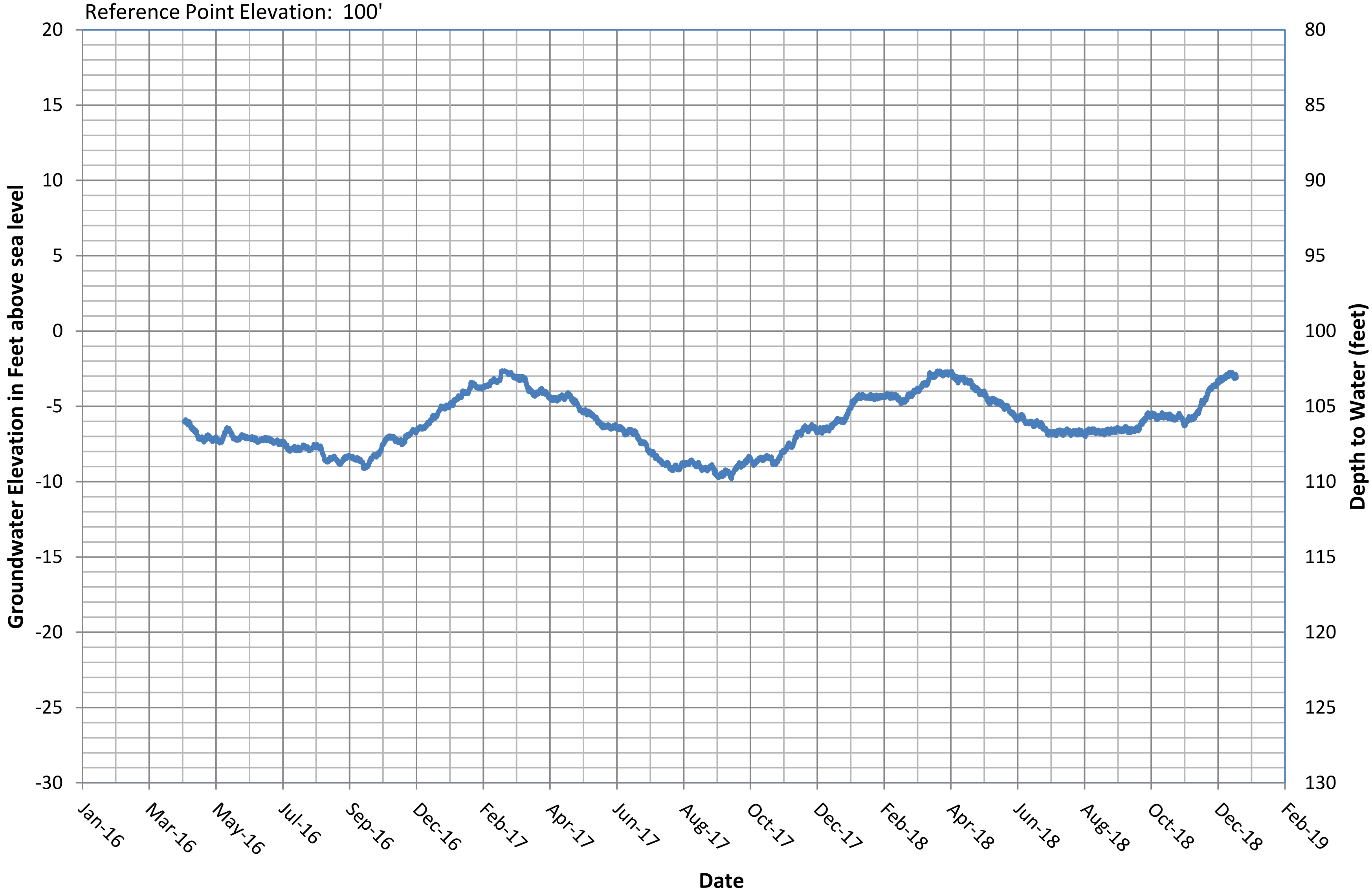
Hydrograph
UA-4 (30S/10E-13L1)



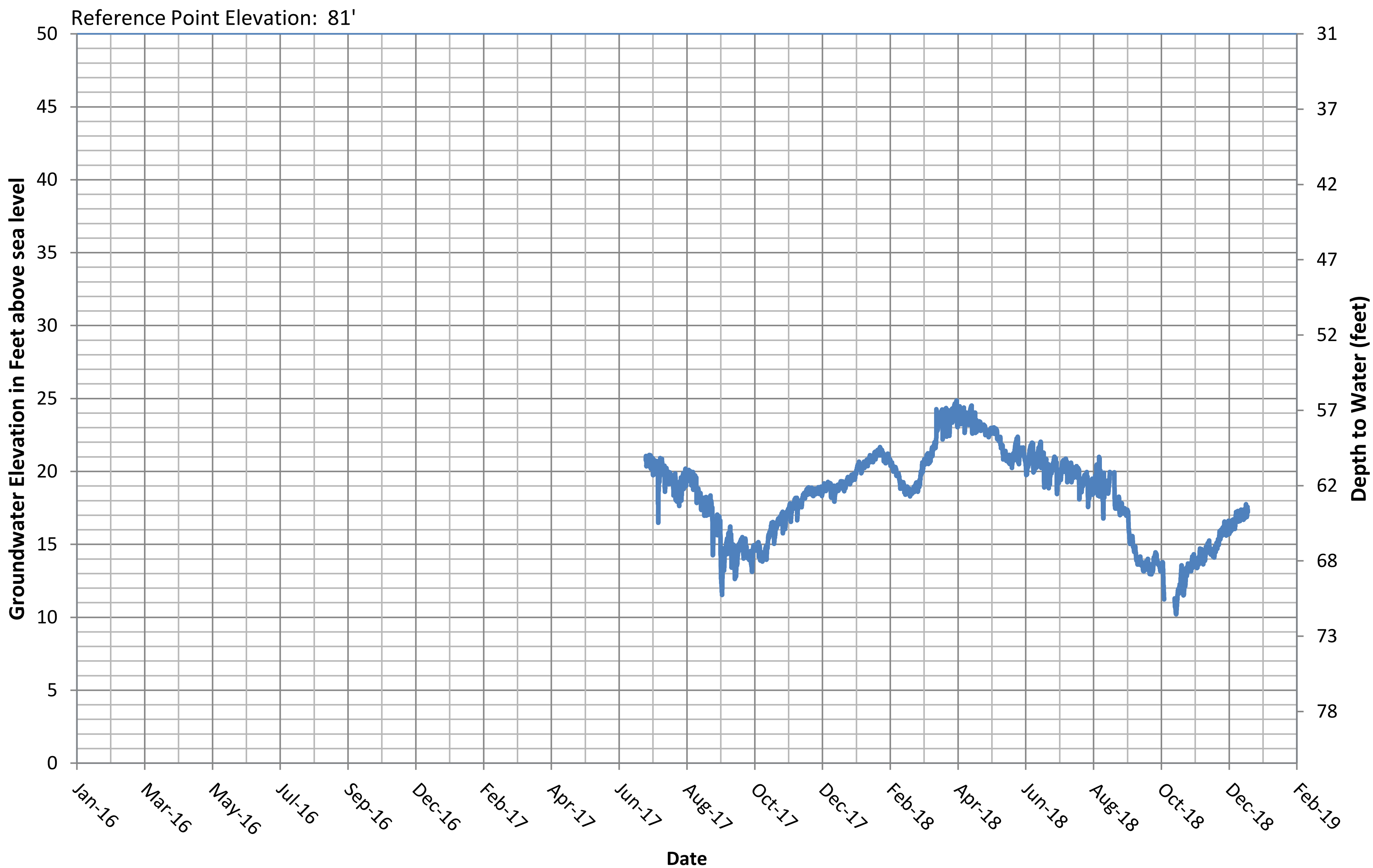


Hydrograph
UA-10 (30S/11E-18H1)
Reference Point Elevation: 107.10'
Groundwater Elevation in Feet above sea level
Depth to Water (feet)
Date
35
30
25
20
15
10
5
0
-5
-10
-15
72
77
82
87
92
97
102
107
112
117
122
Jan-16
Mar-16
May-16
Jul-16
Sep-16
Dec-16
Feb-17
Apr-17
Jun-17
Aug-17
Oct-17
Dec-17
Feb-18
Apr-18
Jun-18
Aug-18
Oct-18
Dec-18
Feb-19

Hydrograph
LA-13 (30S/11E-18F2)



Hydrograph
LA-37 (30S/11E-21B1)



APPENDIX J

Metric Well LA10 Borehole Leakage Analysis

Appendix J - Metric Well LA10 Borehole Leakage Analysis

<u>Background</u>

LA10 was constructed in April 1980. Chloride concentrations in groundwater from LA10 were relatively stable between May 1980 and January 1997, averaging 30 mg/L. By January 2000, chloride was above 100 mg/L in response to seawater intrusion, beginning a long-term trend of increasing chloride concentrations that continued through Fall 2016. Table J1 presents historical chloride and nitrate as nitrogen (NO^3-N) concentrations, with production information, at LA10.

Table J1. Historical Water Quality and Production at LA10

Sample Date	Chloride (mg/L)	NO_3-N (mg/L)	Annual Production (acre-feet)
05/16/1980	28	1.3	79
04/24/1985	31	0.9	1981-1996 annual production ranged from 145-537 acre-feet, averaging 329 acre-feet
07/15/1987	24	1	
09/06/1988	35	0.7	
01/03/1994	29	1.3	
09/20/1994	32	1.1	
01/14/1997	30	2.9	
01/18/2000	104	1.4	1997-2013 annual production ranged from 120-543 acre-feet, averaging 320 acre-feet
08/09/2001	110	1.3	
02/18/2003	98	1.7	
12/20/2004	150	1.6	
01/14/2010	200	1.6	
07/24/2014	303	1.7	69
04/22/2015	331	1.9	70
10/05/2015	329	1.6	
04/26/2016	299	1.8	85
10/12/2016	389	1.8	
04/10/2017	231	2.6	35
10/12/2017	164	3.4	
04/24/2018	136	4.3	14
10/09/2018	152	3.2	

Data Sources: GSWC (1980-2003); Cleath &Associates (2004); CHG (2010 – 2018)

The decline in chloride concentrations beginning in Spring 2017 and continuing into 2018 at Chloride Metric well LA10 was accompanied by reduced groundwater production and an increase in NO^3-N concentrations. In 2014, LA10 annual production dropped below 100 acre-feet for the first time since 1980, and the well has produced less than 50 acre-feet over the last two years combined. NO3-N concentrations, which had been relatively stable between 2003 and 2016 (averaging 1.7 mg/L), averaged 3.4 mg/L over the last two years of semi-annual testing for the LOBP Groundwater Monitoring Program (Table J1).

NO^3-N concentrations are elevated in the Western Area Upper Aquifer, while chloride concentrations are low (e.g., 15.2 mg/L NO3-N and 55 mg/L chloride in Spring 2018 at UA3), which suggests wellbore leakage from the Upper Aquifer may be influencing LA10 water quality by lowering chloride concentrations (and the Chloride Metric) more than would otherwise occur. Wellbore leakage refers to water moving vertically through the filter pack within the annular space between the well casing and the borehole wall.

Vertical Hydraulic Gradients

Downward vertical hydraulic gradients have been measured in the Basin where adjacent or nested wells are perforated at separate depth intervals. The U.S. Geological Survey reported downward head gradients ranging from 0.036 to 0.66 ft/ft (Yates and Weise, 1988). Groundwater contour maps in this Annual Report (Figures 9 through 14) and prior Annual Reports consistently show the highest groundwater elevations in the Perched Aquifer, the next highest elevations in the Upper Aquifer, and the lowest groundwater elevations in the Lower Aquifer.

In the Western Area, differential head pressures create downward wellbore leakage (from the Upper Aquifer into the Lower Aquifer). For example, at the Western Area nested monitoring well on Palisades Avenue, groundwater elevations in Spring 2018 (see Tables 4 and 5) measured 22.3 feet in the shallowest well (UA6; Zone C), 14.9 feet in the middle-depth well (UA7; also Zone C), and 2 feet in the deepest well (LA14; Zone D and E). The resulting downward vertical gradients, based on the change in head over the vertical distances between mid-screen elevations at each well, are 0.093 ft/ft within Zone C and 0.046 ft/ft between Zone C and Zones D/E.

The vertical hydraulic gradient between Lower Aquifer Zone D and Zone E is monitored at the LOCSD South Bay yard in the Central Area, where water elevation data show an upward gradient between the two zones. For example, groundwater elevations in Spring 2018 (Tables 4 and 5) measured -16.2 feet in Zone E (LA22) and -2.6 feet in Zone D (LA21), resulting in a 0.080 upward vertical gradient. By comparison, the water elevation in the Zone C well at that location measured 15.6 feet (UA12). Note that the planned Lower Aquifer nested well at Lupine Avenue will provide measured vertical gradients between Zone D and Zone E in the Western Area.

Wellbore Leakage at LA10

Figure J1 presents a conceptual model of wellbore leakage at well LA10. Groundwater elevations for Spring 2018 show the Upper Aquifer at approximately 5 feet greater hydraulic head than the Lower Aquifer in the vicinity of LA10 (Figures 4, 10, and 11). When the well is not pumping, wellbore leakage from the Upper Aquifer moves down the annular space and into the Lower Aquifer, which is under a lower hydraulic head. If the well is pumping, wellbore leakage moves down the annular space and then into the well toward the pump. The less a well is pumped, the greater potential there is for wellbore leakage (with different water quality from the screened aquifer) to collect in the lower pressure zones and impact water quality when the well is finally turned on. An analysis of wellbore leakage in Basin wells, based on annular space cross-sectional area, hydraulic gradient, filter pack hydraulic conductivity and vertical hydraulic gradients, estimated up to 10 acre-feet per year of flow through an average inactive borehole (Cleath & Associates, 2005).

Well LA10 construction includes the original casing (1980) and a casing liner, installed in November 2002 to prevent formation sand from entering the well. The casing liner does not change the permeability of the original filter pack in the annular space between the Upper and Lower Aquifer, which is the conduit for wellbore leakage (Figure J1). Average annual production at LA10 decreased following placement of the casing liner, from an average of 476 acre-feet per year from 1999 through 2002, to an average of 328 acre-feet per year from 2003 through 2006. Chloride concentrations continued increasing following liner placement. NO3-N concentrations averaged 1.3 mg/L prior to liner placement (1980-2001) and averaged 1.7 mg/L following liner placement (2003-2016). This long-term, low level increase in NO3-N at LA10 is not interpreted to be related to the casing liner or changes in production, however.

Wellbore leakage is not the only mechanism for Upper Aquifer influence at LA10 or at other Basin wells. In fact, leakage directly through the regional aquitard (AT2 Clay) is one of the main sources of recharge to the Lower Aquifer, and would explain the gradual increase in baseline NO3-N concentrations at LA10 from close to 1 mg/L in the mid-1980's to approximately 2 mg/L in recent years. Wellbore leakage can create rapid fluctuations in chloride and NO^3-N concentrations at a well, while Upper Aquifer groundwater moving through the regional aquitard would have a more gradual effect on Lower Aquifer water quality. The effects on Lower Aquifer water quality from Upper Aquifer leakage through the regional aquitard are part of basin dynamics and something the LOBP Groundwater Monitoring Program and Chloride Metric is designed to measure. This analysis is only concerned with addressing local Upper Aquifer influence due to wellbore leakage at LA10.

An NO3-N concentration of 2.9 mg/L was reported in January 1997, which suggests Upper Aquifer influence due to wellbore leakage. Prior to the onset of seawater intrusion at LA10, however, Western Area chloride concentrations in the Lower Aquifer were similar to the Upper Aquifer, so borehole leakage at that time would not have affected the chloride concentrations at LA10.

An overall downward hydraulic gradient is necessary for creating wellbore leakage between the Upper Aquifer into the Lower Aquifer. The effect of an upward gradient between Lower Aquifer Zone D and Zone E, if present, would primarily involve water mixing between these Zones within the well casing itself, not through wellbore leakage (both Zone D and Zone E water can enter the well directly through the screen). The amount of Zone D and Zone E mixing when the pump is off will depend on the head pressure distribution within the casing, and may be limited by pressure associated with wellbore leakage from the Upper Aquifer. When LA10 is pumping, the contributions of each Zone will depend on screened area and permeability (Zone D likely has a much greater contribution of flow to LA10 than Zone E).

The direction of the vertical hydraulic gradient, if any, between Lower Aquifer Zone D and Zone E does not affect the analysis of Upper Aquifer influence. Changes in Lower Aquifer chloride concentrations, whatever the individual Zone D and Zone E contributions are, are what the Chloride Metric is designed to measure.

<u>2016-2008 Data Analysis</u>

Chloride concentrations at LA10 started to decline sharply in 2017, therefore, monthly purveyor monitoring data between 2016 and 2018 were used to evaluate Upper Aquifer influence from borehole leakage on LA10 water quality. Data from 2016 provides the baseline to which potential influence from wellbore leakage in 2017 and 2018 may be compared. Figure J2 shows the relationship between NO_3-N and chloride concentration at LA10. There is no apparent correlation between chloride and NO_3-N when NO_3-N concentrations are at 2 mg/L or less. At concentrations greater than 2 mg/L, however, there is a trend of decreasing chloride as NO_3-N concentrations increase. The mechanism for this trend is dilution of chloride concentrations in water produced by LA10 caused by the mixing of Upper Aquifer water with Lower Aquifer water.

Figure J3 shows the relationship between NO_3-N and average monthly production at LA10. For production rates above 1,000 CCF (cubic feet x 100), NO_3-N concentrations remain mostly below 2 mg/L. When production falls below 1,000 CCF, NO_3-N concentrations begin to rise above 2 mg/L, indicating Upper Aquifer influence (from Figure J2).

Fluctuations in NO^3-N above 2 mg/L can occur at LA10 at monthly production rates above 1,000 CCF. Regardless of production rate, once the well pump is turned off, Upper Aquifer water leaking downward through the borehole begins to accumulate in Lower Aquifer formation sediments. The timing of sample collection after the pump is turned back on will factor into the measured NO3-N concentration.

A nominal production rate of 1,000 CCF per month (equivalent to 2.3 acre-feet per month), with water quality monitoring at the end of a pumping cycle, would likely minimize Upper Aquifer influence on chloride concentrations due to wellbore leakage at LA10. Implementation of a pre-defined pumping program, such as the above program or another program, would be recommended to ensure better data quality during the Spring and Fall monitoring events.

Chloride Metric Revisions

The Chloride Metric is one way of evaluating Basin management efforts to mitigate seawater intrusion. LA10 is within the historical path of seawater intrusion, which parallels the synclinal axis of the basin. When calculating the Chloride Metric, the concentration at LA10 is given twice the weight of the other three metric wells, in order to increase the sensitivity of the metric to management actions.

Revisions to LA10 chloride concentrations for Spring and Fall 2017, and the associated Chloride Metric calculations, were performed by substituting chloride values from the purveyor data set that matched with NO_3-N concentrations of 2 mg/L or less. The same process was used to assign representative chloride values at LA10 for Spring and Fall 2018. The purpose of revising these chloride concentrations at LA10 was to remove the influence of wellbore leakage, to the extent practicable, on the Chloride Metric.

Tables J1 and J2 present the Chloride Metric values for 2017 and 2018 using chloride values for LA10 that have minimal influence from borehole leakage, as described above. Table J3 provides the purveyor water quality dataset used for selecting the LA10 chloride concentration replacement values.

Table J1. 2017 Chloride Metric Corrected for LA10 Upper Aquifer Influence		
Metric Well	**Spring 2017 Chloride Concentrations**	**Fall 2017 Chloride Concentrations**
LA8	77 mg/L	78 mg/L
LA10	300 mg/L (was 231 mg/L)	220 mg/L (was 164 mg/L)
LA11	167 mg/L	162 mg/L
LA12	91 mg/L	92 mg/L
Chloride Metric (weighted average)	187 mg/L (was 159 mg/L)	154 mg/L (was 132 mg/L)

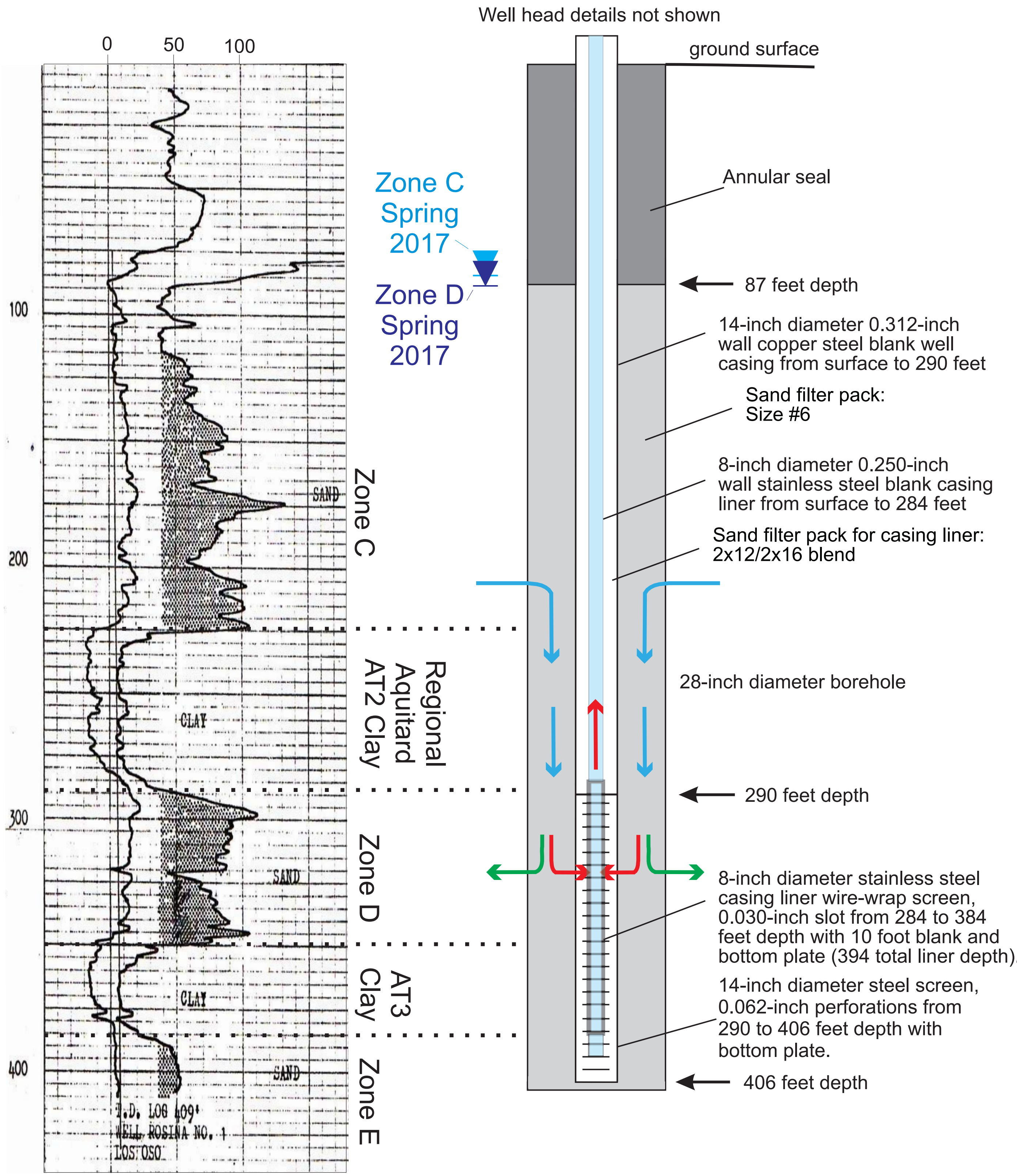
Data Source: LOBP Groundwater Monitoring Program (Appendix C) with highlighted values from Table J3

Table J2. 2018 Chloride Metric Corrected for LA10 Upper Aquifer Influence		
Metric Well	**Spring 2018 Chloride Concentrations**	**Fall 2018 Chloride Concentrations**
LA8	79 mg/L	66 mg/L
LA10	190 mg/L (was 136 mg/L)	210 mg/L (was 152 mg/L)
LA11	173 mg/L	160 mg/L
LA12	93 mg/L	78 mg/L
Chloride Metric (weighted average)	145 mg/L	145 mg/L

Data Source: LOBP Groundwater Monitoring Program (Appendix C) with highlighted values from Table J3

Table J3. LA10 Water Quality		
Sample Date/Time	**Chloride (mg/L)**	**NO^3-N (mg/L)**
1/6/2016 9:00:00 AM	290	1.9
3/9/2016 8:30:00 AM	230	1.7
4/6/2016 8:50:00 AM	240	1.8
5/4/2016 8:00:00 AM	300	1.9
6/1/2016 7:45:00 AM	360	2.2
7/6/2016 8:05:00 AM	360	1.8
7/27/2016 7:30:00 AM	350	2.2
8/3/2016 8:20:00 AM	370	1.7
8/17/2016 8:00:00 AM	370	1.9
8/24/2016 8:00:00 AM	360	1.9
8/31/2016 7:42:00 AM	340	2.3
9/14/2016 7:50:00 AM	360	1.7
11/2/2016 8:35:00 AM	330	2
11/30/2016 7:55:00 AM	220	2.6
12/14/2016 8:05:00 AM	270	1.8
1/10/2017 10:05:00 AM	290	1.9
2/7/2017 9:00:00 AM	290	1.8
3/7/2017 8:45:00 AM	280	1.9
4/4/2017 10:35:00 AM	300	1.9
5/2/2017 8:20:00 AM	340	1.8
6/6/2017 7:05:00 AM	430	1.7
7/11/2017 8:25:00 AM	370	1.8
9/5/2017 8:25:00 AM	140	4.6
11/7/2017 9:05:00 AM	220	1.9
12/12/2017 8:50:00 AM	120	5
1/16/2018 9:52:00 AM	130	4.1
1/30/2018 10:00:00 AM	130	4.1
2/6/2018 9:20:00 AM	120	3.8
3/6/2018 9:47:00 AM	130	4.2
4/3/2018 7:40:00 AM	110	4.2
6/5/2018 10:10:00 AM	180	2
6/12/2018 10:25:00 AM	190	2
6/12/2018 10:30:00 AM	170	3.4
6/26/2018 9:40:00 AM	170	2.1
7/2/2018 9:25:00 AM	190	2.4
7/10/2018 8:00:00 AM	180	2.3
8/6/2018 10:45:00 AM	200	2
10/1/2018 11:45:00 AM	210	1.9
11/5/2018 9:05:00 AM	200	2
12/3/2018 9:15:00 AM	210	1.9
12/26/2018 12:20:00 PM	170	3

Note: Values used to replace LA10 chloride concentrations for Chloride Metric are highlighted in yellow



Vertical Scale: 1”=55’
No Horizontal Scale

Explanation

Resistivity Curve

Borehole Leakage Flow (static and pumping)

Static flow condition

Pumping condition

Figure J1
Metric Well LA10
Conceptual Borehole Leakage
2018 Annual Report

Cleath-Harris Geologists

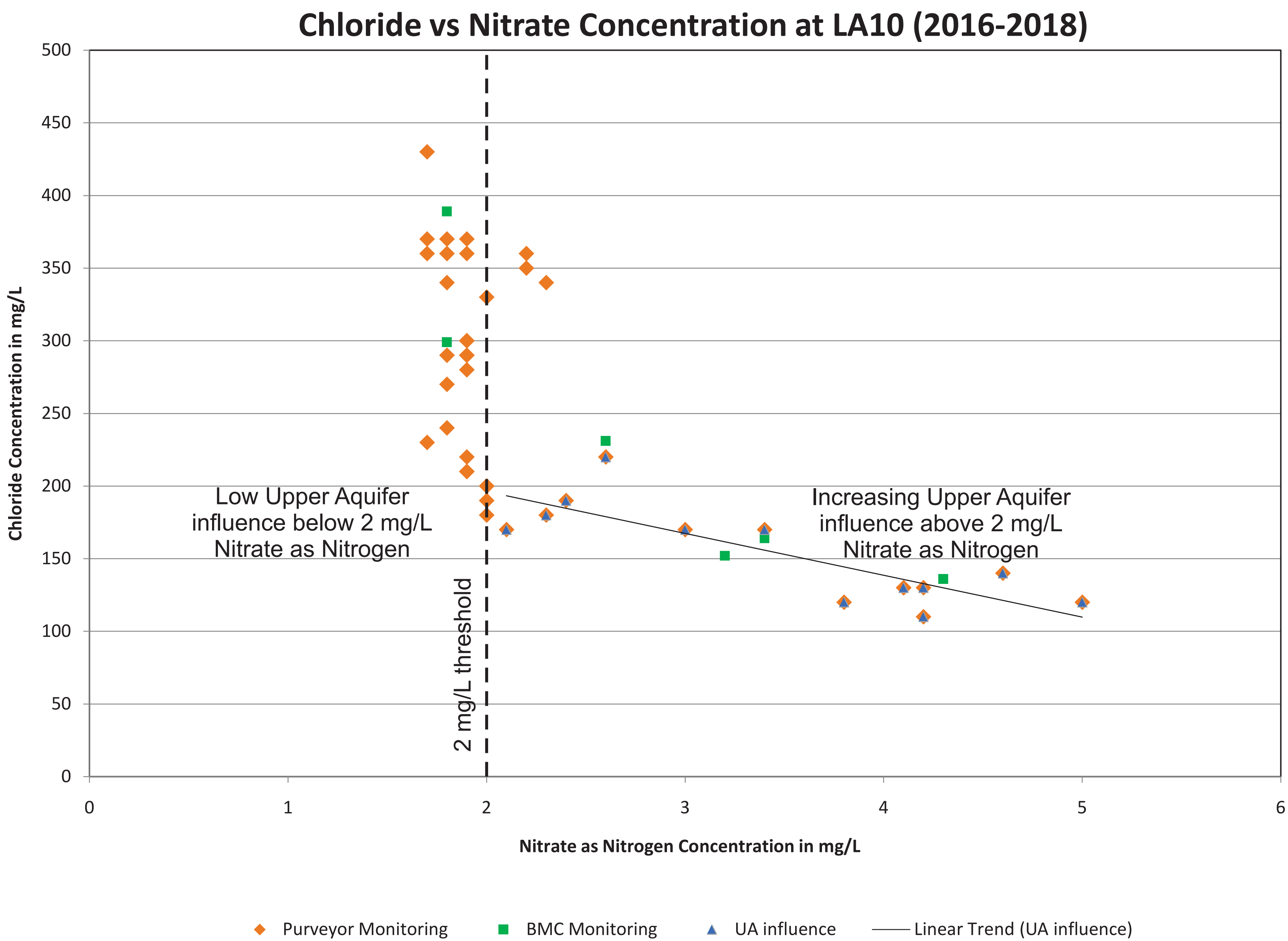


Figure J2
Chloride vs Nitrate
Metric Well LA10
Purveyor Monitoring Data
2018 Annual Report

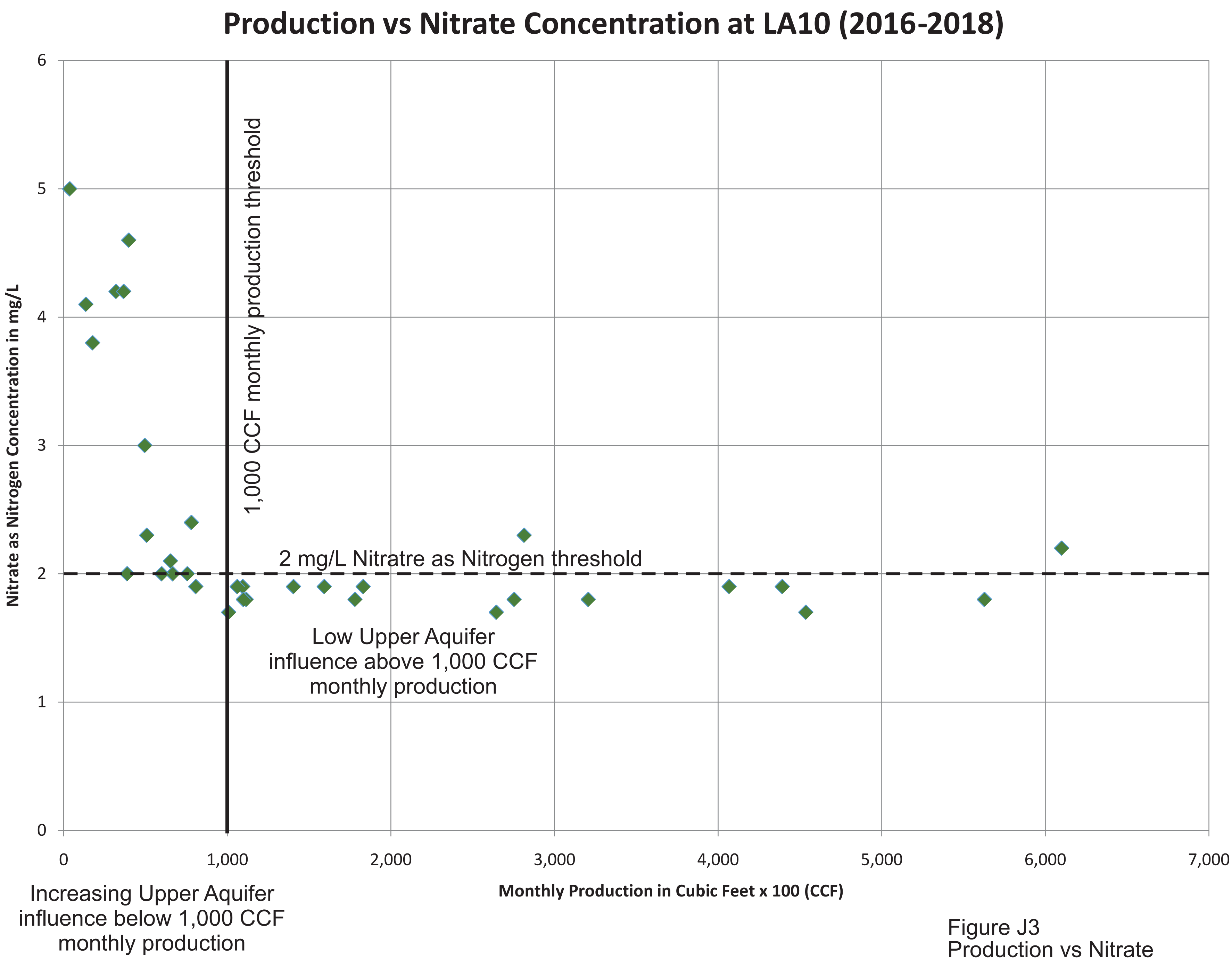


Figure J3
Production vs Nitrate
Metric Well LA10
Purveyor Monitoring Data
2018 Annual Report

APPENDIX K

Groundwater Storage Calculation Example and Specific Yield Estimates

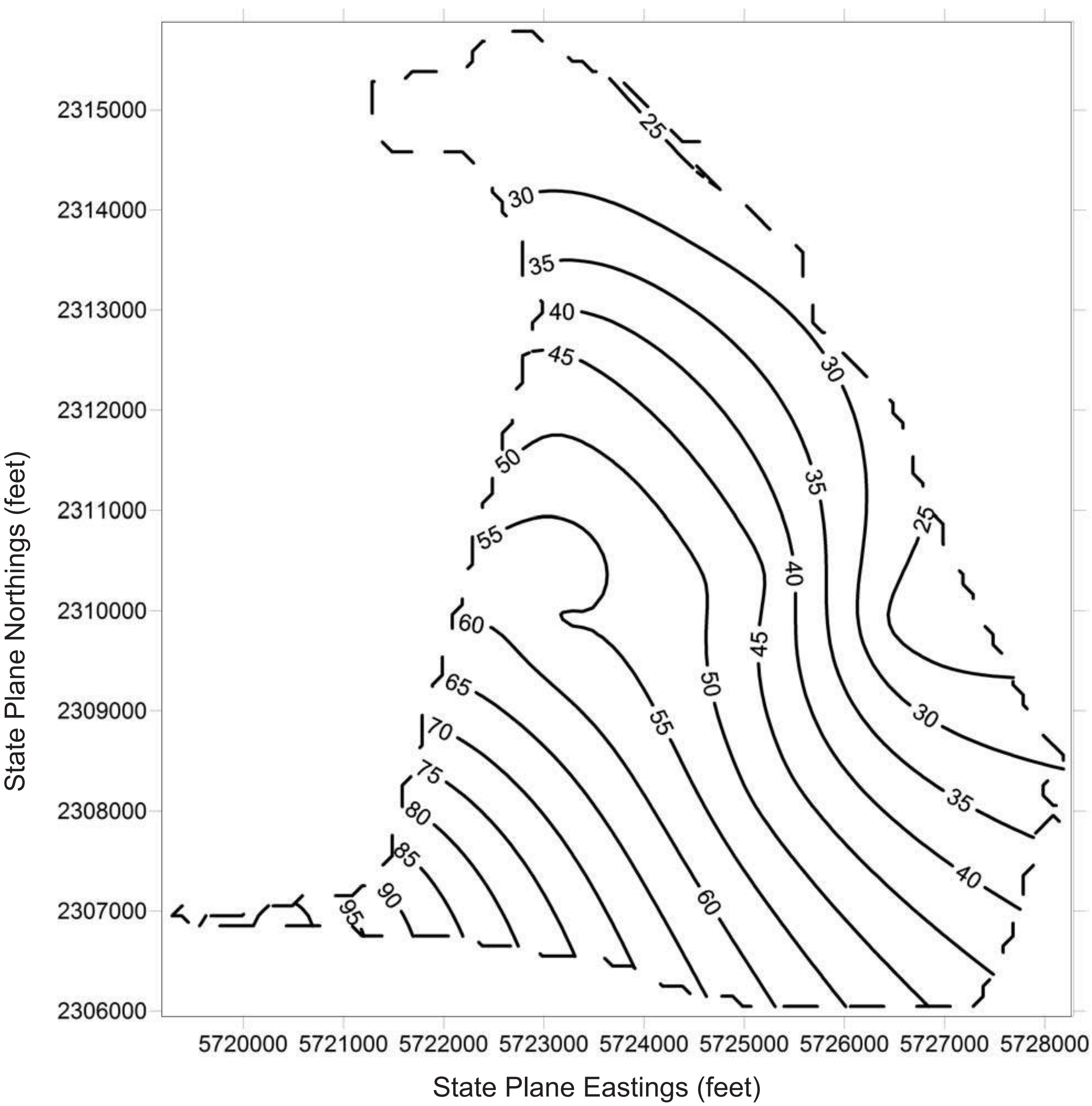
WELLS USED FOR GROUNDWATER ELEVATION CONTOURS
2018 GROUNDWATER STORAGE CALCULATIONS

FIRST WATER		UPPER AQUIFER		LOWER AQUIFER	
SPRING	FALL	SPRING	FALL	SPRING	FALL
FW2	FW2	UA1	UA1	LA1	LA1
FW3	FW3	UA2	UA2	LA2	LA2
FW4	FW4	UA3	UA3	LA3	LA3
FW5	FW5	UA4	UA4	LA4	LA4
FW6	FW6	UA5	UA5	LA5	LA5
FW8	FW8	UA6	UA6	LA6	LA6
FW9	FW9	UA8	UA8	LA8	LA8
FW10	FW10	UA9	UA9	LA9	LA9
FW11	FW11	UA10	UA10	LA10	LA10
FW12	FW12	UA12	UA12	LA11	LA11
FW13	FW13	UA16	UA16	LA12	LA12
FW15	FW15	UA17	UA17	LA13	LA13
FW17	FW17	UA18	UA18	LA14	LA14
FW18	FW18	FW2	FW2	LA15	LA15
FW19	FW19	FW3	FW3	LA16	LA16
FW20	FW20	FW4	FW4	LA18	LA18
FW21	FW21	FW5	FW5	LA19	LA19
FW22	FW22	FW6	FW6	LA20	LA20
FW23	FW23	FW8	FW8	LA21	LA21
FW24	FW24	FW9	FW9	LA24	LA24
FW26	FW26	FW10	FW10	LA25	LA25
FW27	FW27	FW11	FW11	LA26	LA27
FW28	FW28	FW12	FW12	LA27	LA29
FW29	FW29	FW15	FW15	LA29	LA30
FW30	FW30	FW24	FW24	LA30	LA33
FW31	FW31	FW26	FW26	LA33	LA34
FW32	FW32	FW27	FW27	LA34	LA35
LA34	LA34	FW29	FW29	LA35	LA36
LA35	LA35	FW32	FW32	LA37	LA37
LA36	LA36	LA34	LA34	LA38	LA38
LA37	LA37	LA35	LA35	FW27	FW27
LA38	LA38	LA37	LA36		
		LA38	LA37		
			LA38		

NOTE: Wells LA34, LA35, LA37, and LA38 represent the shallowest available water level data in the Eastern Area, and are included in the First Water and Upper Aquifer contour data sets for improved lateral control. Well FW27 is located where maximum recharge to lower aquifer from stream seepage likely occurs and provides control for all aquifers locally.

EXAMPLE STORAGE CALCULATION FOR EASTERN AREA:

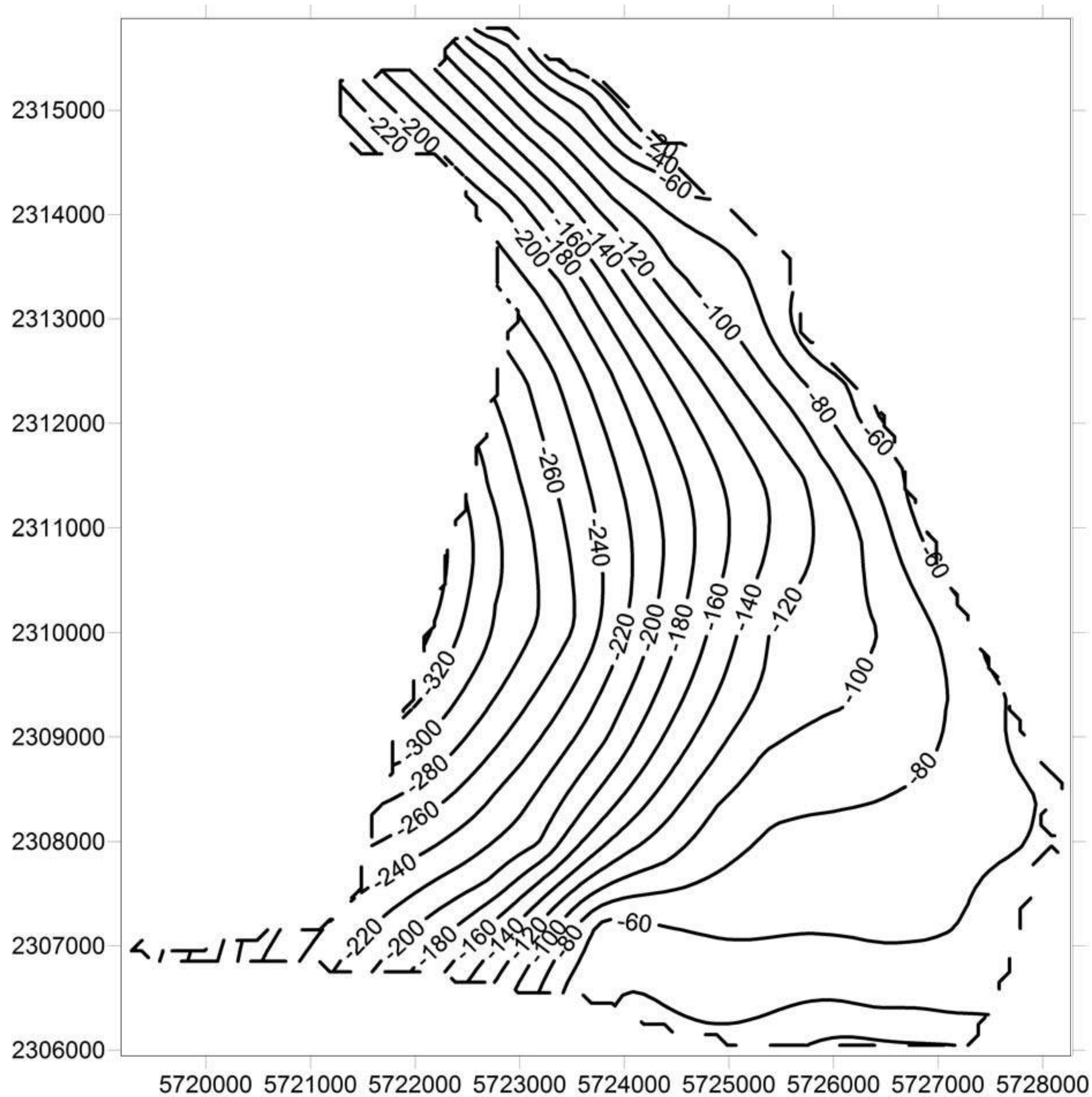
STEP 1: GRID AND TRIM WATER LEVEL CONTOURS



Spring 2018
Eastern Area Water Levels
Alluvial Aquifer and Lower Aquifer

EXAMPLE STORAGE CALCULATION FOR EASTERN AREA:

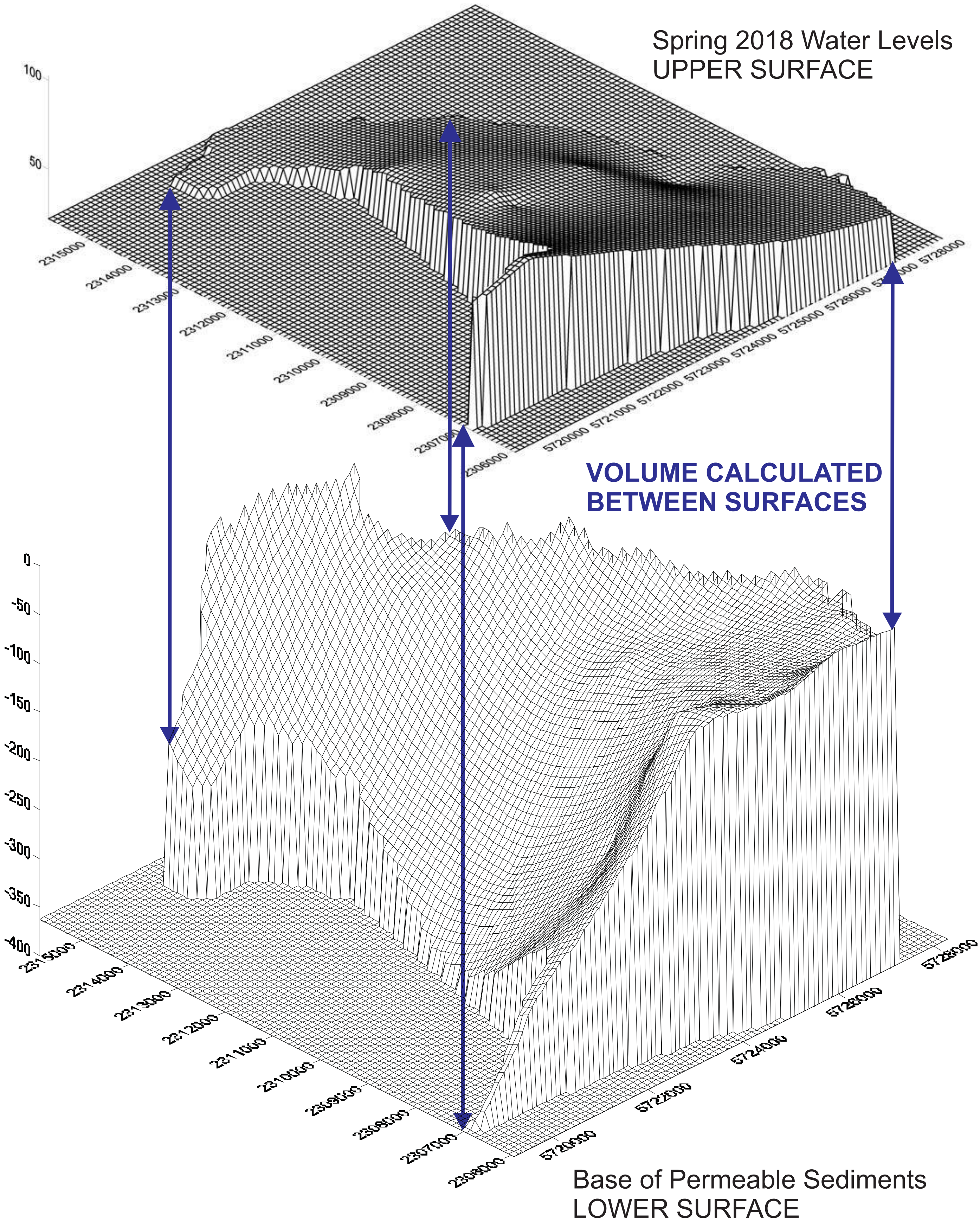
STEP 2: GRID AND TRIM BASE OF PERMEABLE SEDIMENTS



Eastern Area
Base of Permeable Sediments

EXAMPLE STORAGE CALCULATION FOR EASTERN AREA:

STEP 3: MATCH UPPER AND LOWER SURFACE GRIDS



EXAMPLE STORAGE CALCULATION FOR EASTERN AREA:

STEP 4: VOLUME COMPUTATION

Upper Surface

Grid File Name: C:\CHG9\CHG 2019\Projects\BMC 2019\2018 Annual Report\Rough Draft\Contouring and Storage\BLANKED FILES\EASTERN\upper eastern spring 2018 blanked QAQC LA36.grd
Grid Size: 100 rows x 92 columns

X Minimum: 5719189
X Maximum: 5728284
X Spacing: 99.945054945055

Y Minimum: 2305947
Y Maximum: 2315886
Y Spacing: 100.39393939394

Z Minimum: 21.746570242722
Z Maximum: 102.31270139537

Lower Surface

Grid File Name: C:\CHG9\CHG 2019\Projects\BMC 2019\2018 Annual Report\Rough Draft\Contouring and Storage\BASE GEOMETRY\EASTERN\BOP Eastern blanked.grd
Grid Size: 100 rows x 92 columns

X Minimum: 5719189
X Maximum: 5728284
X Spacing: 99.945054945055

Y Minimum: 2305947
Y Maximum: 2315886
Y Spacing: 100.39393939394

Z Minimum: -362.32467224801
Z Maximum: 2.39586300134

Volumes

Z Scale Factor: 1

Total Volumes by:

Trapezoidal Rule: 8207058880.8698
Simpson's Rule: 8202508244.4609
Simpson's 3/8 Rule: 8198775144.096

EXAMPLE STORAGE CALCULATION FOR EASTERN AREA:

STEP 5: CALCULATE GROUNDWATER IN STORAGE

Cut & Fill Volumes

Positive Volume [Cut]:	8207058880.8698
Negative Volume [Fill]:	0
Net Volume [Cut-Fill]:	8207058880.8698

Areas

Planar Areas

Positive Planar Area [Cut]:	41665677.518315
Negative Planar Area [Fill]:	0
Blanked Planar Area:	48729527.481685
Total Planar Area:	90395205

Surface Areas

Positive Surface Area [Cut]:	41785986.634391
Negative Surface Area [Fill]:	0

STORAGE CALCULATION

Positive Volume: 8,207,058,880 ft^3 * 0.101 specific yield ÷ 43,560 acre-feet per ft^3 = 19,029 acre-feet

BINSCARTH TEST HOLE (C&A, 2005)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
						Weighted Specific Yield
sand	0	33	33	20	C	
clayey sand	33	38	5	10		
sand	38	48	10	20		
clayey sand	48	56	8	10		
sand	56	114	58	20		
clayey sand	114	152	38	10		Weighted Specific Yield
sand and gravel	152	214	62	18		17
clayey sand	214	228	14	10	D	
sandy clay	228	234	6	5		
clayey sand	234	254	20	10		
sandy clay	254	262	8	5		
sand	262	288	26	20		
sandy clay	288	298	10	5		
clayey sand	298	320	22	10		Weighted Specific Yield
sand	320	346	26	20		13
clayey sand	346	364	18	10	E	
sand	364	378	14	20		
clay	378	386	8	3		
sand and gravel	386	510	124	18		
sandstone with gravel	510	550	40	15		Weighted Specific Yield
sandstone	550	580	30	15		16.1
siltstone	580	640	60		BEDROCK	
silty clay	640	660	20			
Total Depth	660	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**15.7**

Cleath & Assoc., Seawater Intrusion Assessment and Lower Aquifer Source Investigation of the Los Osos Valley Groundwater Basin , October 2005

ML-2 (Webber, Hayes & Assoc., 2001)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
sand	0	17	17	unsaturated	A+B	
silty sand	17	51	34			
clayey sand	51	62	11	10		
silty sand	62	89	27	10		Weighted Specific Yield
sandy clay	89	94	5	5		9.4
Total Depth	94	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**9.4**

Webber, Hayes & Assoc., Site Investigation Report, Bear Valley Chevron, August 29, 2001

ML-3 (Webber, Hayes & Assoc., 2001)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
sand	0	22	22	unsaturated	A+B	
sand with silt	22	26.5	4.5			
sand	26.5	29	2.5			
silty sand	29	50	21	10		
clayey sand	50	55	5	10		
silty sand	55	91	36	10		
sandy clay	91	92	1	5		Weighted Specific Yield
clay	92	97	5	3		9.4
Total Depth	97	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**9.4**

ML-4 (Webber, Hayes & Assoc., 2001)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
sand	0	22	22	unsaturated	A+B	
silty sand	22	30	8			
sand	30	33	3			
silty sand	33	51	18	10		
clayey sand	51	56.5	5.5	10		
silty sand	56.5	103.5	47	10		Weighted Specific Yield
clay	103.5	107	3.5	3		9.7
clayey gravel	107	109	2		C	
clay	109	110	1			
Total Depth	107	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**9.7**

ML-7 (Webber, Hayes & Assoc., 2001)

Lithology	*Start Depth*	*End Depth*	*Thicknes s*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
sand	0	19	19	unsaturated	A+B	
silty sand	19	32.5	13.5			
sand	32.5	37.5	5			
silty sand	37.5	101.5	64	10		Weighted Specific Yield
clay	101.5	108	6.5	3		9.4
clayey gravel with sand	108	111	3	7	C	
sandy clay	111	115	4	5		
clayey gravel with sand	115	118	3	7		
sandy clay	118	136	18	5		
clayey gravel with sand	136	154	18	7		Weighted Specific Yield
silty sand	154	175	21	10		7.3
Total Depth	175	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**8.3**

Webber, Hayes & Assoc., Site Investigation Report, Bear Valley Chevron, August 29, 2001

ML-8 (Webber, Hayes & Assoc., 2001)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
sand	0	17	17	unsaturated	A+B	
silty sand	17	26	9			
sand	26	36	10			
silty sand	36	51	15			
clay	51	52	1			
clayey sand with gravel	52	58	6			
silty sand	58	101.5	43.5	10		Weighted Specific Yield
clay	101.5	103	1.5	3		9.8
silty sand	103	105	2	10	C	
sandy clay	105	112	7	5		
clayey gravel with sand	112	114	2	7		
silty sand	114	115.5	1.5	10		
clayey gravel with sand	115.5	118	2.5	7		
sandy clay with gravel	118	120	2	7		
clayey sand	120	132	12	10		
sandy clay with gravel	132	136	4	7		
clayey gravel with sand	136	140	4	7		
clayey sand	140	144	4	10		
clayey gravel with sand	144	150	6	7		Weighted Specific Yield
silty sand	150	175	25	10		8.7
Total Depth	175	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**9.1**

WELL 30S/11E-7Q03 (LA12)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
sandy brown soil	0	6	6	unsaturated	C	
sand	6	17	11	20		
clay some gravel	17	20	3	7		
sand	20	48	28	20		
clay	48	52	4	3		Weighted Specific Yield
cemented sand	52	127	75	15		16
clay	127	230	103	3	D	
sand some gravel	230	245	15	18		Weighted Specific Yield
gravel	245	276	31	18		7.6
clay	276	325	49	3	E	
sand	325	332	7	20		
clay	332	343	11	3		
sand	343	350	7	20		
sand and gravel	350	356	6	18		
rock	356	357	1	15		Weighted Specific Yield
sand and gravel	357	402	45	18		11.1
clay	402	411	9	3	BEDROCK	
Total Depth	411	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**11.3**

WELL 30S/10E-12J01 (LA11)

Lithology	***Start Depth***	***End Depth***	***Thickness***	***Specific Yield (percent)****	***Zone***	***Weighted Specific Yields (percent)***
sand	5	27	22	20	C	
clay	27	32	5	3		
sand and peat	32	70	38	5		
clay	70	72	2	3		Weighted Specific Yield
gravel	72	82	10	18		10.8
clay	82	96	14	3	D	
sand	96	100	4	20		
silt	100	135	35	5		
clay	135	157	22	3		
gravel	157	158	1	18		
sand	158	169	11	20		
sand and clay	169	194	25	5		
gravel	194	205	11	18		Weighted Specific Yield
sand and clay	205	217	12	5		7.3
clay	217	222	5	3	E	
sand and clay	222	245	23	5		
sand and gravel	245	257	12	18		
sand	257	264	7	20		
sand and gravel	264	274	10	18		
sand	274	290	16	20		
sand and silt	290	304	14	5		
sand	304	323	19	20		
sand and clay	323	330	7	5		
clay	330	339	9	3		
sand	339	341	2	20		
clay	341	346	5	3		
sand	346	352	6	20		
sand and clay	352	356	4	5		
sand	356	370	14	20		Weighted Specific Yield
sand and gravel	370	386	16	18		13.4
clay	386	392	6		BEDROCK	
shale	392	402	10			
Total Depth	402	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**10.5**

** Johnson, A. I., 1967, Specific Yield - Compilation of Specific Yields for Various Materials, U.S. Geological Survey Water Supply Paper 1662-D*

WELL 30S/10E-13L04 (LA6)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
top soil	0	19	19	unsaturated	A+B	
clay, some gravel and sand	19	26	7			
gravel, clay and sand	26	41	15			Weighted Specific Yield
fine sand	41	61	20	20		20
clay, sand, small rocks	61	71	10	7	C	
clay, few pebbles	71	75	4	3		
fine gravel and sand	75	81	6	18		
sandy clay	81	95	14	5		
hard clay	95	97	2	3		
fine sand	97	115	18	20		
clay	115	118	3	3		
sand and gravel	118	149	31	18		
reddish brown clay, pebbly	149	164	15	7		
gravel	164	170	6	18		Weighted Specific Yield
sand and clay	170	190	20	5		11.7
tan clay, some gravel	190	210	20	7	D	
hard green clay	210	240	30	3		
tan sand	240	248	8	20		
clay and sand	248	260	12	5		
fine sand	260	277	17	20		
gravel	277	283	6	18		
fine sand	283	293	10	20		
fine gravel	293	310	17	18		
sand and clay	310	340	30	5		
coarse gravel	340	356	16	18		Weighted Specific Yield
gravel and clay	356	370	14	7		10.8
fine sand	370	394	24	20	E	
coarse gravel boulders	394	426	32	18		
gravel	426	456	30	18		
clay sand and gravel	456	500	44	7		
sand clay and gravel	500	570	70	7		
gravel and clay	570	600	30	7		
silt and clay	600	619	19	5		
black mud	619	621	2	3		Weighted Specific Yield
gravel	621	670	49	18		12
hard clay, sandstone	670	675	5		BEDROCK	Weighted Specific Yield
Total Depth	675	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**11.8**

WELL 30S/11E-16Na (LA28)

Lithology	***Start Depth***	***End Depth***	***Thickness***	***Specific Yield (percent)****	***Zone***	***Weighted Specific Yields (percent)***
soil	0	12	12	unsaturated	Qal	
clay	12	20	8			
fine sand	20	30	10	15		
shale and gravel	30	32	2	21		
fine sand	32	40	8	15		
fine sand and clay	40	57	17	5		Weighted Specific Yield
gravel and wood	57	60	3	21		11.5
clay and sand	60	65	5	5	D	
clay	65	70	5	3		
sand	70	100	30	20		
sand and clay	100	108	8	5		
sand and gravel	108	135	27	18		
clay	135	171	36	3		
clay and sand	171	200	29	5		Weighted Specific Yield
sand	200	207	7	20		10.6
clay	207	225	18	3	E	
fine sand	225	250	25	20		
clay and sand	250	255	5	5		
clay	255	258	3	3		
fine sand and gravel	258	275	17	18		
clay and sand	275	290	15	5		
fine sand	290	320	30	20		Weighted Specific Yield
sandstone gravel	320	340	20	18		14.5
sandstone	340	358	18	15	BEDROCK	Weighted Specific Yield
Total Depth	358	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**12.3**

WELL 30S/11E-17A01 (LA33)

Lithology	***Start Depth***	***End Depth***	***Thicknes s***	***Specific Yield (percent)****	***Zone***	***Weighted Specific Yields (percent)***
adobe and gravel	0	11	11	unsaturated	Qal	
clay	11	25	14			
gravel	25	28	3	21		
clay and gravel	28	34	6	7		Weighted Specific Yield
gravel	34	38	4	21		14.5
clay	38	70	32	3	D	
sand some gravel	70	71	1	18		
clay	71	78	7	3		
sand and gravel	78	86	8	18		
clay	86	90	4	3		
gravel and sand	90	92	2	18		
hard clay	92	95	3	3		
gravel and sand	95	101	6	18		Weighted Specific Yield
hard clay	101	107	6	3		6.7
Total Depth	107	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**7.9**

WELL 30S/11E-17C01 (LA23)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
sandy soil	0	3	3	unsaturated	A+B	
sand	3	28	25			
sandy clay	28	34	6	5		Weighted Specific Yield
sand	34	48	14	20		15.5
clay	48	52	4	3	C	
sand and gravel	52	56	4	18		
clay	56	76	20	3		
clay and gravel	76	80	4	7		
sandy clay	80	91	11	5		
sand	91	104	13	20		
clay	104	108	4	3		Weighted Specific Yield
sand	108	114	6	20		9.4
silty clay	114	148	34	5	D	
sandy clay	148	165	17	5		
sand	165	183	18	20		Weighted Specific Yield
sand and gravel	183	230	47	18		12.6
clay	230	236	6	3	E	
sandy clay	236	246	10	5		
sand and gravel	246	254	8	18		Weighted Specific Yield
clay	254	270	16	3		6.5
Total Depth	270	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**11**

WELL 30S/11E-17E7 (LA21)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
sand	0	55	55	unsaturated	C	
sandy clay	55	60	5	5		
sand	60	94	34	20		Weighted Specific Yield
sandy clay	94	126	32	5		12.2
sand with gravel	126	136	10	18	D	
sandy clay	136	168	32	5		
silty sand	168	180	12	10		
sandy clay	180	184	4	5		
sand with gravel	184	210	26	18		
silty clay	210	220	10	5		
silty sand	220	230	10	10		
silty /sandy clay	230	270	40	5		
silty sand	270	290	20	10		
clay	290	314	24	3		
silt and sand	314	320	6	10		
sandy / silty clay	320	352	32	5		
clayey sand	352	364	12	10		Weighted Specific Yield
silty sand	364	382	18	10		8.2
sandy clay	382	430	48	5	E	
silty sand	430	434	4	10		
clay	434	442	8	3		
silty sand	442	468	26	10		
sand	468	474	6	20		
sandstone	474	492	18	15		
clay	492	498	6	3		Weighted Specific Yield
sandstone	498	518	20	15		9.4
franciscan	518	560	42		BEDROCK	Weighted Specific Yield
Total Depth	560	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**9.9**

WELL 30S/11E-17J01 (LA24)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
all inferred from e-log						
no data	0	8	8	unsaturated	C	
clay	8	15	7			
sandy clay	15	37	22	5		
clay	37	40	3	3		
sandy clay	40	48	8	5		Weighted Specific Yield
sand	48	72	24	20		11.2
sandy clay	72	118	46	5	D	
sand	118	128	10	20		
sandy clay	128	150	22	5		
sand	150	163	13	20		
clay	163	168	5	3		Weighted Specific Yield
sand	168	189	21	20		10.6
sandy clay	189	214	25	5	E	
sand	214	220	6	20		
clay with sand beds	220	232	12	5		
sand, some clay	232	244	12	15		
clay	244	262	18	3		
sandy clay	262	271	9	5		
clay	271	278	7	3		
sandy clay	278	291	13	5		
clay	291	297	6	3		
sandy clay and clay	297	315	18	5		
clay	315	319	4	3		Weighted Specific Yield
sand	319	329	10	20		7.1
rock	329	333	4		BEDROCK	
Total Depth	333	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**9.1**

17N4

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
top soil	0	4	4	unsaturated	A+B	
sand	4	25	21	20		
sand	25	38	13	20		
clay	38	40	2	3		Weighted Specific Yield
sand	40	68	28	20		19.5
Total Depth	68	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**19.5**

WELL 30S/11E-17N10 (LA20)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
fill	0	3	3	unsaturated	A+B	
sand	3	37	34			
clay	37	42	5	3		
gravelly clay	42	50	8	7		
clay	50	58	8	3		
sand and gravel	58	81	23	18		
sand	81	92	11	20		Weighted Specific Yield
sand and gravel	92	98	6	18		13.7
clayey sand	98	120	22	5	C	
sand and gravel	120	150	30	18		
clayey gravel	150	170	20	7		
gravelly sand	170	187	17	18		
gravelly clay	187	197	10	7		Weighted Specific Yield
sandy gravel	197	210	13	18		12.5
clay	210	225	15	3	D	
sand and gravel	225	250	25	18		
sandy clay	250	260	10	5		
sand and gravel	260	270	10	18		
gravelly clay	270	275	5	7		
gravelly sand	275	290	15	18		
sandy clay	290	320	30	5		Weighted Specific Yield
sand	320	400	80	20		14.6
sandy clay	400	480	80	5	E	
gravelly sand	480	530	50	18		
sand / silty sand	530	630	100	5		Weighted Specific Yield
sandy clay	630	750	120	5		6.9
Total Depth	750	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**9.9**

WELL 30S/11E-18F02 (LA13)						
Lithology	***Start Depth***	***End Depth***	***Thickness***	***Specific Yield (percent)****	***Zone***	***Weighted Specific Yields (percent)***
sand	0	45	45	unsaturated	C	
clay	45	65	20			
gravel and sand	65	70	5			
clay	70	80	10			
clay and gravel	80	105	25	7		
clay	105	117	12	3		
shale gravel	117	120	3	18		
sandy clay	120	170	50	5		
sand and gravel	170	180	10	18		
clay	180	245	65	3		Weighted Specific Yield
gravel and sand	245	255	10	18		6.1
clay	255	280	25	3	D	
sand, some gravel	280	285	5	18		
clay	285	300	15	3		
clay, gravel sand	300	340	40	10		
sandy clay	340	420	80	5		Weighted Specific Yield
sandy shale gravel	420	455	35	5		5.9
clay	455	537	82	3	E	
hard sandstone	537	555	18	15		
sand and gravel	555	600	45	18		Weighted Specific Yield
gravel and sea shells	600	610	10	18		9.7
shale	610	645	35		BEDROCK	
Total Depth	645	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**6.2**

WELL 30S/11E-18K08 (LA18)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
Sand	50	110	60	20	A & B	20.00
sandy clay	110	132	22	5	C	
cemented sand	132	151	19	15		
sandy clay	151	158	7	5		
sand	158	195	37	20		
sandy clay	195	200	5	5		
sand	200	225	25	20		
sandy clay	225	235	10	5		
sand	235	254	19	20		
sandy clay	254	260	6	5		Weighted Specific Yield
sand with gravel	260	264	4	18		14.5
sandy clay	264	288	24	5	D	
clayey sand	288	305	17	10		
sandy clay	305	310	5	5		
clayey sand	310	324	14	10		
clay with sand	324	350	26	5		
silty sand	350	370	20	10		
sandy clay	370	380	10	5		
sand	380	386	6	20		
sandy clay	386	395	9	5		Weighted Specific Yield
silty sand	395	490	95	10		8.6
clay sandy clay	490	515	25	3	E	
silty sand	515	592	77	10		Weighted Specific Yield
sand with seashells	592	660	68	20		13
Total Depth	660	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**12.4**

WELL 30S/11E-18M01 (LA16)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
fine brown sand	40	70	30	20	C	
sand, sandy clay	70	160	90	5		Weighted Specific Yield
sand	160	165	5	20		9.2
sandy clay	165	245	80	5	D	
sandy clay with gravel	245	275	30	7		
sandy clay	275	350	75	5		Weighted Specific Yield
sand and gravel	350	372	22	18		6.7
sandy clay with gravel	372	392	20	7	E	
sandy clay	392	460	68	5		
sandy clay with gravel	460	490	30	7		
sandy clay	490	536	46	5		
sand and gravel	536	562	26	18		Weighted Specific Yield
sandy clay with gravel	562	630	68	7		7.2
Total Depth	630	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**7.4**

WELL 30S/11E-19H2 (LA19)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
sand	0	73	73	unsaturated	C	
silty mudstone with gravel	73	93	20			
sand and clay	93	103	10			
gravel	103	180	77			Weighted Specific Yield
gravel, clay, silt	180	220	40			
gravel, clay, silt	220	260	40	15	D	
clay, silt, some sand and gravel	260	290	30	7		Weighted Specific Yield
sand with silty clay	290	380	90	7		9
silty clay	380	460	80	5	E	
silty clay, gravel	460	520	60	15		
gravel and clay	520	535	15	15		
silty fine sand	535	680	145	10		Weighted Specific Yield
silt with clay	680	740	60	5		9.1
Total Depth	740	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**9.1**

WELL 30S/11E-20Aa (LA25)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
soil	0	2	2	unsturated	Qa	
clay	2	18	16			
sand and gravel	18	40	22	21		Weighted Specific Yield
fine sand	40	60	20	15		18.1
clay	60	110	50	3	D	
fine sand	110	123	13	15		
clay	123	130	7	3		
fine sand and gravel	130	133	3	18		
clay	133	135	2	3		
sand and gravel	135	137	2	18		
clay and sand	137	152	15	5		
sand and gravel	152	154	2	18		
clay	154	165	11	3		
fine sand	165	175	10	15		Weighted Specific Yield
fine sand and gravel	175	180	5	18		7.1
clay	180	230	50	3	E	
fine sand	230	240	10	15		Weighted Specific Yield
sand and gravel	240	350	110	18		13.4
sandstone	350	360	10		BEDROCK	Weighted Specific Yield
Total Depth	360	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**11.7**

WELL 30S/11E-20A02 (FW26)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
top soil	0	18	18	unsaturated	Qal	
clay	18	33	15	3		
gravel	33	44	11	21		
clay	44	46	2	3		
gravel and clay	46	58	12	7		Weighted Specific Yield
gravel	58	65	7	21		10.9
clay	65	95	30		D	
Total Depth	95	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**10.9**

WELL 30S/11E-20G02 (LA26)

Lithology	*Start Depth*	*End Depth*	*Thickness*	*Specific Yield (percent)**	*Zone*	*Weighted Specific Yields (percent)*
silty-clay-soil	0	11	11	unsaturated	Qal	
gravel	11	15	4			
clayey sand	15	53	38	10		Weighted Specific Yield
gravel	53	55	2	21		10.6
clayey sand	55	75	20	10	C	10
clay	75	117	42	3	D	
gravel	117	120	3	18		
sand	120	197	77	20		Weighted Specific Yield
coarse sand and gravel	197	213	16	18		14.6
clayey sand	213	290	77	10	E	
sand	290	315	25	20		Weighted Specific Yield
gravelly sand	315	335	20	18		13.4
bedrock, tight rock	335	380	45	15	BEDROCK	
Total Depth	380	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**13.3**

WELL 30S/11E-24A2 (LA17)						
Lithology	***Start Depth***	***End Depth***	***Thickness***	***Specific Yield (percent)****	***Zone***	***Weighted Specific Yields (percent)***
					C	
sand	0	207	207	unsaturated		
gravelly clay	207	276	69	7	D	
gravel some clay and sand	276	328	52	18		
sand	328	346	18	20		
clay	346	370	24	3		Weighted Specific Yield
clay and sand	370	380	10	5		11
clay	380	432	52	3	E	
clay and sand	432	650	218	5		
sand and gravel	650	817	167	18		Weighted Specific Yield
sand and gravel	817	960	143	18		11.8
Total Depth	960	**BOREHOLE WEIGHTED SPECIFIC YIELD (PERCENT)**				**11.6**

** Johnson, A. I., 1967, Specific Yield - Compilation of Specific Yields for Various Materials, U.S. Geological Survey Water Supply Paper 1662-D*