## Appendix 2.1

## Technical Advisory Committee (TAC) Members and Roles and Responsibilities

## **Technical Advisory Committee (TAC) Final List**

The City of Elk Grove is please to have convened a Technical Advisory Committee (TAC) of diverse, well qualified stormwater and groundwater experts. We have assembled eleven (11) outstanding individuals with expertise in stormwater, groundwater, dry wells, and monitoring wells with an interest in the Project's environmentally sustainable solutions to recharge groundwater with low impact development practices. The TAC's input and feedback will be of significant value to achieve the Project's goals and outcomes. The list of TAC members are as follows:

Na	me	Agency				
Ι.	Annalisa Kihara, PE, Water Resoucre	State Water Resources Control Board, Division of Water				
	Control Engineer, Stormwater Unit	Quality				
2.	Dana Booth, PG, QSD, Program	Sacramento County Department of Water Resources				
	Manager, Stormwater Quality	and Sacramento Stormwater Quality Partnership				
3.	Darrell Eck, Senior Civil Engineer	Water Supply Planning and Development				
		Sacramento County Water Agency				
4.	Chris Day, Environmental Scientist	Central Valley Regional Water Quality Control Board,				
		Stormwater MS4 Program				
5.	John Borkovich, PG, GAMA Program	State Water Resources Control Board, Division of Water				
	Manager	Quality				
6.	Julie Haas, PE, Senior Engineer	California Department of Water Resources, Division of				
		Integrated Regional Water Management				
7.	Mark Madison, General Manager	Elk Grove Water				
8.	Paul Marshall, P.G.	Laguna Creek Watershed Council				
9.	Rob Swartz, PG, CHG	Regional Water Authority, Sacramento Groundwater				
		Authority				
10.	Chris Hunley, REHS, Environmental	Sacramento County Environmental Health Department,				
	Specialist	Well Program – Permitting & Enforcement,				
		Environmental Compliance Division				
11.	Dr. Elaine Khan, PhD	Chief Water Toxicology Branch, Office of Environmental				
		Health Hazard Assessment (OEHHA), Cal/EPA				

## **Technical Advisory Committee Roles and Responsibilities**

The responsibility of the TAC is to provide advice and feedback on key aspects of the Project. The TAC represents a diversity of interests and perspectives: groundwater protection, stormwater management and environmental protection. As the Project advances and results are generated, the TAC will assist the Project team with interpretation of results as well as provide comments on all major documents. The responsibilities of the TAC members as follows:

Key Milestones	<b>Tentative Schedule</b>						
Attend kick-off meeting; and provide feedback on Monitoring Plan	June 25, 2013						
and dry well and monitoring wells 60% design <sup>1</sup>							
Review and provide feedback on 90% design <sup>2</sup>	June 28, 2013						
Attend meeting and review results of first year of monitoring	Individual Meetings						
Review and provide feedback on fact sheets							
• Dry Well Fact Sheet <sup>2</sup>	January, 2017						
Project Results Fact Sheet <sup>2</sup>	January, 2017						
Attend meeting and review Project results and interpretation <sup>3</sup>	January, 2017						
Attend presentation on Project results <sup>3</sup>	January, 2017						
<sup>1</sup> Attend meetings in-person or conference call. <sup>2</sup> Review and provide feedback through email.							

Review and provide feedback through email.

<sup>3</sup> Attend presentations or webinar.

## Appendix 2.2

## **Project Bulletins**

## Elk Grove Dry Well Project

Quarterly Update - October 2014

## So what is going on with the Project?

## **Monitoring Wells and Groundwater Sampling**

Late spring of 2014, eight monitoring wells were installed. In June, a trial sampling effort was performed to work out all of the bugs. Our first official, dry weather groundwater samples were collected in early August. To put the sampling results in a nutshell, we were unable to detect the presence of most of the organics. Metals were present at low but detectable levels. Arsenic concentrations ranged between non-detect at 4.4 ppb at both the Corporation Yard and the Strawberry Creek Water Quality Basin. Arsenic has an MCL of 10 ppb and a PHG of 0.004 ppb. Total chromium was highest at the Corporation Yard, where one sample had a concentration of 15 ppb. The total chromium MCL is 50 ppb. While the values for both of these metals are less than the MCLs, we plan to keep a close eye on these metals in all our

samples, especially after the dry wells are constructed. The only contaminant that exceeded the MCL was nitrate. Nitrate concentrations were between 15 – 57 ppm at the Corporation Yard and between ND – 11 ppm at Strawberry Creek Water Quality Basin; nitrate has an MCL and PHG of 45 ppm. We will be tracking exceedances of the PHG, as well as, any chemical that reaches 50% of the MCL.

## **Dry Well Installation**

Construction began on Monday, October 6th. We reviewed the design plans and specifications with the contractor and made some minor tweaks – focused on minimizing clogging in the dry well. We also made some modifications based on recommendations from Susan Williams, Environmental Management Division, Sacramento County that will reduce the risk of oil and grease entering the dry well.



Some have expressed an interest in coming out to watch the construction of the dry well system being installed. Please forward an email (<u>cnelson@elkgrovecity.org</u>) on what date and time you want to visit a site, and I will let you know where construction is for that day. Construction of the dry well system will be

approximately 20 days with the estimated construction end date of October 28<sup>th</sup>. We plan to take many pictures that will be posted on the project website.

## Water Board Tour

On October 1<sup>st</sup>, members of the State and Regional Water Boards visited Elk Grove to learn about our dry well project along with other similar work. This is a yearly tour to provide an educational forum to update Water Board Members on emerging issues and topics relevant to their respective roles in protecting the quality of the State's waters. Given the current drought, this year's meeting focused on stormwater reuse and groundwater issues. The tour showcased our dry well project and features of the Rain Garden Plaza as well as other projects/topics pertaining to water quality, stormwater, groundwater recharge, and low impact development.

The City of Elk Grove and the project team were honored to be selected by the executives at the State Water Board to be part of their tour. About 40 members of the Boards as well as an additional 15-20 local groundwater and stormwater managers who were invited attended the event. The City of Elk Grove Mayor, Gary Davis, welcomed the group and accepted awards of recognition for the Elk Grove Rain Garden Plaza from Kelly Rivas, Field Director for Congressman Ami Bera and Assemblyman Richard Pan. Rob Swartz, Manager of Technical Services, Regional Water Authority (RWA), then presented an overview of the region's hydrologic conditions. He specifically pointed out the need for site-specific solutions, citing the region's soil and groundwater characteristics as examples. He noted that the majority of our region's soils have poor infiltrative characteristics while the water table depths vary greatly. These varying depths might make the use of dry wells more desirable in certain locations while less helpful in others.

Carmel Brown, Executive Advisor, Integrated Regional Water Management Program (IRWMP)/ Groundwater Programs, California Department of Water Resources (DWR) and a former environmental consultant, spoke next. She addressed the need to apply integrative water resource solutions that consider both surface and groundwater. She spoke about the IRWMP and ways it could be used as a tool for identifying holistic solutions to the drought, stormwater management, and the future impacts of climate change. She also reviewed the history of the dry well project and was a key person in helping prepare the Proposition 84 grant which is funding this project. She recounted the challenges we faced when preparing our grant application, including gaining support from some local water resources' managers. In particular, Carmel emphasized how project partners are working outside their traditional silos and that this collaborative approach to pressing water resource issues will be resolved through integrative solutions.

Lastly our own team member, Barbara Washburn, PhD, Lead Scientist, Ecotoxicology Program, Office of Environmental Health Hazard Assessment (OEHHA)/ Cal/EPA presented an overview of our dry well project. Her presentation reviewed the design of the project's dry well systems, the suite of monitoring

wells, and the contaminants that we will be monitoring, among other topics. One of the Board members asked about the regulations and guidelines in California. A short discussion followed, highlighting regulations in other states and the lack of regulations in California.

The Water Board members next went on a tour of the Elk Grove Rain Garden Plaza led by Fernando Duenas, City of Elk Grove and Paul Mewton, Cosumnes Community Services District. They were peppered with questions about the plants, soil conditions, and the function of low impact development practices featured in the plaza.

Even in the hot weather, the Board members seemed tireless. The event was a great success. They had the opportunity to learn more about a variety of low impact development practices (LID) tool that could improve surface water quality, provide water conservation, reduce the adverse impacts of hydromodification on our waterways, and about dry wells, in particular.

## **Project Website**

We are planning to prepare a soft launch of the project website in the next few weeks. Project staff will be reviewing the website for clarity. If you would like a link to look at the new website prior to the official launch, please let me know. Otherwise, we'll be sending out an announcement as soon as the website is fully operational.

## **Project Presentation**

Barbara Washburn and I will be giving a project presentation at the American Basin Council of Watersheds on November 5<sup>th</sup>. Many presentations have been given in the last year regarding the project, including a presentation in Seattle, Washington at the Association of State Floodplain Managers (ASFPM) 2014 Conference, the Climate Change and the Future of Groundwater in California Conference at UC Davis, and the 24<sup>th</sup> Annual Meeting of Society of Environmental Toxicology and Chemistry (SETAC) Conference at UC Berkeley.

## Elk Grove Dry Well Project Quarterly Update – February 2015

**Dear TAC Members:** 

Greetings and a belated Happy New Year! The team has been busy these past four months. We have summarized below some of the key activities related to the Elk Grove Dry Well Project:

### **Dry Well Installation**

As previously noted in the last bulletin, construction of the dry well systems (pictures below) began in early October and was completed in early November, just prior to heavy rain events. Unfortunately, the sod placed in the swale at the Corporation Yard did not have time to sink its roots into the soil causing sloughing and erosion. To address this issue, the team consulted with one of the State's recognized experts on erosion issues, John McCullah, Salix Applied Earthcare. Following his recommendation, the erosion and sloughing is being repaired by installing a geotextiles to stabilize the slope and sod.



Challenges were also experienced at the Strawberry Creek Water Quality Basin with the location of the autosampler and flow meter which triggers sample collection. The equipment was repositioned and the issues have been resolved.

### Stormwater and Groundwater Sampling

I am sure you are aware of the fact that January has been the driest January in our region on record, and therefore, Mother Nature has caused a delay in the project's sampling efforts. However, February did bring us some rain and the team conducted sampling at the Strawberry Creek Water Quality Basin. The stormwater sampling began at 1:00 pm on February 6, 2015 and ended at 6:00 am on February 7, 2015. The sampling event lasted 18 hours (75% of the storm event) and we received 1.22" of rainfall. At 1:00 pm (beginning of sampling

event) the water quality basin was dry. By 1:30 pm, stormwater began to flow out of the outfall pipes and by 2:00 pm, water began to flow into the sedimentation basin and sampling commenced. By 3:00 pm the sedimentation was approximately ½' under water and remained inundated for most of the rain event.

Six days later, on February 12, 2015, groundwater samples were collected at all four monitoring wells at the water quality basin. The stormwater and groundwater is currently being analyzed and a summary will be prepared and included in the next project bulletin.

### Surface and Groundwater Connectivity

The question has been asked....How will the connection between surface and groundwater be verified at the two study sites?

The purpose of verifying the connectivity is to ensure that **if** contaminants are in the effluent from the dry well that they **may theoretically** reach the groundwater. If we find no evidence of contaminants in the groundwater over the course of the project, this could be for two reasons:

- 1. The pretreatment and/or sequestration of contaminants in the vadose zone has prevented pollutants from reaching groundwater; or
- 2. There is a lack of a hydraulic connection between surface and groundwater.

Therefore, demonstrating the hydraulic connection is an important component of this study. To verify this connection, the team has taken the following steps:

- Groundwater gradient at both study sites was estimated based on regional data (determined by Casey Meirovitz, formerly at LSCE, as part of his MS research).
- MODFLOW simulations at the two study sites suggested hydraulic connectivity between upper and lower portions of the aquifer.
- Multiple borings at each site suggest there are no lithologic layers that would prevent flow from surface to water table. Clay layers that underlay the bottom of each dry well were designed to attenuate and slow infiltration of stormwater, but should not restrict flow.
- At Strawberry Creek Water Quality Basin, water levels in the monitoring wells rose within 12 hours of storm events on multiple occasions. This suggests that the pressure exerted by the inflow of water to the basin influenced the aquifer, causing a rise in the water level within the wells. Graham Fogg, UCD Professor, Land Air and Water Resources Department expressed the view that this data provided good evidence of connectivity.

In the future, what does the team plan to do?

- Water level data recorded in 2014 were inconclusive as to a hydraulic connection between the monitoring wells and the dry well/bioswale at the Corporation Yard. This is most likely due to the fact that the area surrounding the monitoring wells at the Corporation Yard is approximately 90% impervious. However it is anticipated, that once the dry well at this site receives stormwater flows, water level data from the monitoring well network will be reviewed for evidence of a response to increased infiltration. If a response is not observed, an infiltration test will be performed to evaluate dry well performance.
- A tracer test using chloride or other appropriate non-reactive constituent will be performed at both study sites during the first stormwater and groundwater sampling season per the project's Quality Assurance Project Plan (QAPP). Consecutive collections of water from the monitoring wells will be made over 3-4 days to estimate time of travel. As an additional resource, the tracer test approach will be

discussed with Graham Fogg, UCD Professor, Land Air and Water Resources Department to help advise and provide input on the test design.

### **Project Website**

The soft launch of the website was completed. The website is ready to go live as soon as the new web mistress for the City of Elk Grove settles in to her new position. Stay tuned.

### **Presentations**

As noted in the last bulletin, the City of Elk Grove hosted the annual tour for the Regional and State Water Board members on October 1, 2014. The event went well and many Board Members were interested in the details of the Elk Grove Dry Well Project. Pictures of the event are presented below with opening remarks from Steve Moore, State Water Board Member (picture 1), Kelly Rivas, Field Director for Congressman Ami Bera, Richard Pan, State Senator, City of Elk Grove Mayor Gary Davis (picture 2), and project team member Barbara Washburn, Office of Environmental Health Hazard Assessment (OEHHA) (picture 3).





In addition, some of you might be aware that OEHHA, one of the project partners, has a contract with UCD Land Air and Water Resources Department to do modeling of subsurface contaminant movement for the project. Emily Edwards is the graduate student working with UCD Professors Graham Fogg and Thomas Harter on this task for her M.S. degree. Emily presented a project poster of the work performed to date at the American Geophysical Union Conference in San Francisco this past December. The poster will be posted on the project's website if you are interested in reviewing it.

### Outreach

The team completed two important project outreach deliverables in the last few months:

- A review of the literature on the risk of groundwater quality degradation associated with using dry wells. This Annotated Bibliography (attached) is considered a "living" document and will be updated as new information becomes available. We welcome any feedback.
- A factsheet on the guidelines and regulations for the use of dry wells in California (attached).

## That is it for now and let's hope for **RAIN THIS SPRING!!**

## Elk Grove Dry Well Project Project Update – April, 2016

Dear TAC Members:

We are happy to get some rain this season! This bulletin provides reporting information on the first two successful sampling events this rainy season.



Figure 1. SDB sampling site, November 2, 2015.

## First Sampling Event - November 2, 2015

Approximately 0.5" of rain fell on November 2<sup>nd</sup>, producing our "first flush" event. The first flush is the first rainfall of the season, which mobilizes contaminants that build up during the dry season. Two composite samples were collected for this rain event representing the first 20% and the next 60% of runoff from the storm, which captures the greatest concentration of contaminants. Groundwater samples

were collected two days after the event. Results from this rain event show a similar trend to last season:

- No detections of volatile or semi-volatile organic compounds, chlorinated herbicides, or TPH gas/diesel at either the Corporation Yard (CY) or Strawberry Creek Water Quality Basin (SDB).
- Drinking water metals (AI, Fe, Cr, Mn, vanadium) detected at both sites. Aluminum and iron exceeded the secondary MCL for organoleptic effects (AI-50 ppb and Fe-300 ppb).
- Four species of pyrethroids were detected at low levels (15 ng/L or less) entering the basin at SDB but most were reduced or not detected prior to entering the dry well.



Figure 2. Dry well at CY, November 2, 2015.

 High levels of coliform (>1,600 MPN/100 ml) were found in both stormwater and in water collected from the vadose zone at SDB.

You may recall that there was an issue in the past with slow infiltration through the dry well at SDB. Investigation into the issue revealed that over 5' of sand had been added to this dry well during construction instead of the 1' called for in the design plans. This excess sand was removed and replaced over the summer with 4' of pea gravel and 1'of dry well sand. Since then the infiltration rates have increased significantly. Over the course of the November 2nd rain event, approximately 28,000 gallons passed through the dry well. In contrast, the infiltration rate at the CY was 1,100 gallons which was considerably slower due to the small drainage area and short duration of the storm.

## Second Sampling Event - January 5, 2016

The second sampling event occurred on January 5, 2016. Composite samples were collected where water enters the vegetative pretreatment and where it enters the drywell to determine the degree to which the vegetated pretreatment feature reduced the concentration of contaminants. Since there has been no detection of volatile or semi-volatile organics to date, we asked the lab to report analytical results down to the detection limit (not the reporting limit) to learn more about mineral/physical measurements



Figure 3. The project team worked through the night to collect stormwater samples. This photo was taken at the CY, January 5, 2016.

from the analysis; and added motor oil which would be more relevant, particularly at the CY where the City houses its bus fleet.

Detections of common organics, such as di (2-ethylhexyl) phthalate (DEHP) and acetone, were found just above the detection limits in stormwater samples at both sites.

At the CY, samples collected from the upgradient water table well and downgradient vadose zone well had levels of acetone and DEHP below the reporting limits as well. The data suggests that the dry wells were not the source of the detected contaminants. There were no contaminants detected at SDB.

Aluminum and iron exceeded the secondary MCL for organoleptic effects (Al - 50 ppb and Fe - 300 ppb) at both sites, but were significantly higher at the CY. The concentration of aluminum was 2,100  $\mu$ g/L as water entered the drywell at the CY, more than double the MCL (1,000  $\mu$ g/L), but it was not detected in the downgradient water table wells. This finding along with preliminary results from researchers at UC Davis, modeling the fate and transport of contaminants through the vadose zone, suggests that the vadose zone sequesters aluminum and likely most other metals as well.



Figure 4. Looking into the sedimentation well at CY, January 5, 2016.

Results of pyrethroid analysis are not available at this time.

The rain event produced approximate 1" of rain in 12 hours. Stormwater infiltration amounts measured from the January 5<sup>th</sup> rain event are as follows:

- CY: 8,360 gallons
- SDB: 9,170 gallons

The rate of infiltration was significantly lower at SDB compared to the first event. The project team suspects this is due to saturation of the subsurface resulting from the numerous rain events that occurred in December, 2015.

## Summary

Key lessons learned from these two monitoring events are:

- The vegetated pre-treatment removed metals with an efficiency of about 35%.
- The infiltration problem at the SDB was resolved, resulting in good infiltration rates.
- There is no detection of contaminants in groundwater, with the exception of coliform.

## **Public Outreach**

A new factsheet on Oregon's Dry Well Program is now available on the project's website. <u>http://www.elkgrovecity.org/UserFiles/Servers/Server\_109585/File/Departments/Public%20Works/Drainage/Dr</u> <u>y%20Wells/OEHHA.pdf</u>

## Meetings with TAC members

The project's Quality Assurance Officer, Barbara Washburn, has been meeting with TAC members to review monitoring results to date. If you have not met with her, please send her a note to set up a convenient time (barbara.washburn@oehha.ca.gov).

Any Questions/Comments/Suggestions – please contact me: <u>cnelson@elkgrovecity.org</u>

# Appendix 3.1

## **Monitoring Well Design Plans**



### **PROJECT LOCATIONS** CITY OF ELK GROVE, CA

UTILITY	UTILITY COMPANY / CONTACT						
PROJECT MANAGER	CITY OF ELK GROVE	CONNIE NELSON	916-478-3638				
DRAINAGE	CITY OF ELK GROVE	FERNANDO DUENAS	916-627-3434				
CABLE TV	AT&T BROADBAND	ASTRID WILLARD	916-453-6136				
CABLE TV	COMCAST	STEVE ABELIA	916-830-6757 916-732-6643				
ELECTRIC	S.M.U.D.	JACK GRAHAM					
FIRE	COSUMNES COMMUNITY SERVICES DISTRICT	SHEILA WOLCOTT	916-405-7100				
GAS	PG&E	MIKE WILLIAMS	916-386-5013				
PARKS & RECREATION	COSUMNES COMMUNITY SERVICES DISTRICT	STEVE SIMS	916-947-1831				
PHONE	FRONTIER COMMUNICATION	EVA MOREDOCK	916-691-5615				
PHONE	SUREWEST	GRETCHEN HILLDEBRAND	916-691-5615				
SEWER	SACRAMENTO AREA SEWER DISTRICT	ROB ESPINOZA	916-876-6386 916-687-3030				
TRANSIT	e-TRAN	JEAN FOLETTA					
WATER	ELK GROVE WATER SERVICE	BRUCE KAMILOS	916-585-93B5				
WATER	SACRAMENTO COUNTY WATER AGENCY	IMELDA TABBADA	916-874-4261				
U.S.A.	UNDERGROUND SERVICE ALERT	811 or 1-800-227-2600					

NO.	REVISION	BY	DATE		
			-	LUHDORFF & SCALMANINI	DESIGNED:
_			CONSULTING ENGINEERS	DRAWN:	
				PHONE: (530) 661-0109	CHECKED:
FOR	REDUCED PLANS ORIGINAL	SCALE IS	IN INCHES	0 1 2 0 4	

**IMPROVEMENT PLANS FOR: INVESTIGATION BORINGS / MONITORING WELLS IMPROVEMENTS PROJECT** WDR019



100% SUBMITTAL SEPTEMBER 2013



ABBREVIATIONS LIST:

- AB aggregate base brk – break dia — diameter (ø) (E) – existing ad - around inv. - invert PVC - polyvinyl chloride sch – schedule SD - storm drain SRI - Silica Resources Incorporated
- (Typ) typical w/ - with

**INVESTIGATION BORINGS / M** IMPROVEMENTS P

TITLE SHE

## SHEET INDEX:

1. TITLE SHEET

SITE 1: STRAWBERRY CREEK WATER QUALITY BASIN 2. VICINITY MAP, AERIAL VIEW & SITE LAYOUT PLAN

SITE 2: CITY OF ELK GROVE CORPORATION YARD 3. VICINITY MAP, AERIAL VIEW & SITE LAYOUT PLAN

DETAILS: 4. INVESTIGATION BORINGS PROFILES 5. INVESTIGATION BORINGS STANDARD CONSTRUCTION DETAILS

IONITORING WELLS	DATE: SEPTEMBER 2013	SHEET:
PROJECT	SCALE: HORIZ: N/A VERT: N/A	OF
ET	PROJECT No.: WDR019	5







N	BORING DIMENSIONS	
	6.375"	
	8-3/4''	

$\leq$	
2.0"	
Ý.	
	(TYP)

3 WELL



## **Appendix 3.2**

## Dry Well Feasibility Study – Monitoring Well Construction Report

## City of Elk Grove Dry Well Feasibility Study Monitoring Well Construction Summaries



November 2013



City of Elk Grove Dry Well Feasibility Study Monitoring Well Construction Summaries

Table of	Contents
----------	----------

Project C	Dverview	р. 1
Strawber	p. 2-18	
W	ell Locations Map	p. 3
Pe	roject Overview trawberry Creek Detention Basin Monitoring Wells Well Locations Map Permit SC MW - 1 Construction Summary SC MW - 1 As-Built Profile SC MW - 1 Well Completion Report SC MW - 2 Construction Summary SC MW - 2 As-Built Profile SC MW - 2 Well Completion Report SC MW - 3 As-Built Profile SC MW - 3 As-Built Profile SC MW - 3 As-Built Profile SC MW - 4 Construction Summary SC MW - 4 As-Built Profile SC MW - 4 Well Completion Report SC MW - 4 Well Completion Report SC MW - 4 S-Built Profile SC MW - 4 S-Built Profile SC MW - 4 Well Completion Report SC MW - 4 S-Built Profile CY MW - 1 Construction Summary CY MW - 1 Construction Summary CY MW - 1 As-Built Profile CY MW - 2 As-Built Profile CY MW - 2 As-Built Profile CY MW - 3 Construction Summary CY MW - 3 As-Built Profile CY MW - 3 Construction Summary CY MW - 3 As-Built Profile CY MW - 3 As-Built Profile CY MW - 3 Construction Summary CY MW - 4 As-Built Profile CY MW - 4 As-Built Profile	p. 4-5
SC	C MW - 1 Construction Summary	p. 6
SC	CMW - 1 As-Built Profile	p. 7
SC	C MW - 1 Well Completion Report	p. 8
SC	C MW - 2 Construction Summary	p. 9
SC	CMW - 2 As-Built Profile	p. 10
SC	C MW - 2 Well Completion Report	p. 11
SC	C MW - 3 Construction Summary	p. 12
SC	C MW - 3 As-Built Profile	p. 13
SC	C MW - 3 Well Completion Report	p. 14-15
SC	t Overview perry Creek Detention Basin Monitoring Wells Well Locations Map Permit SC MW - 1 Construction Summary SC MW - 1 As-Built Profile SC MW - 1 Well Completion Report SC MW - 2 Construction Summary SC MW - 2 As-Built Profile SC MW - 2 Well Completion Report SC MW - 2 Well Completion Report SC MW - 3 Construction Summary SC MW - 3 As-Built Profile SC MW - 3 Well Completion Report SC MW - 4 Construction Summary SC MW - 4 As-Built Profile SC MW - 4 Well Completion Report <b>ration Yard Monitoring Wells</b> Well Locations Map Permit CY MW - 1 Construction Summary CY MW - 1 Construction Summary CY MW - 1 Construction Summary CY MW - 2 Construction Summary CY MW - 2 As-Built Profile CY MW - 2 As-Built Profile CY MW - 3 Well Completion Report CY MW - 3 Well Completion Report CY MW - 3 Well Completion Report CY MW - 4 As-Built Profile CY MW - 4 Well Completion Report CY MW - 4 As-Built Profile CY MW - 4 Well Completion Report CY MW - 4 Well Completion Report CY MW - 4 As-Built Profile	p. 16
SC	C MW - 4 As-Built Profile	p. 17
SC	C MW - 4 Well Completion Report	p. 18
Corporat	tion Yard Monitoring Wells	p. 19-37
W	ell Locations Map	p. 20
Pe	ermit	p. 21-22
C	Y MW - 1 Construction Summary	p. 23
C	Y MW - 1 As-Built Profile	p. 24
C	Y MW - 1 Well Completion Report	p. 25-26
C	Y MW - 2 Construction Summary	p. 27
C	Y MW - 2 As-Built Profile	p. 28
C	Y MW - 2 Well Completion Report	p. 29
C	Y MW - 3 Construction Summary	p. 30
C	Y MW - 3 As-Built Profile	p. 31
C	Y MW - 3 Well Completion Report	p. 32-33
C	Y MW - 4 Construction Summary	p. 34
C	Y MW - 4 As-Built Profile	p. 35
C	Y MW - 4 Well Completion Report	p. 36-37

## City of Elk Grove Dry Well Feasibility Study Monitoring Well Construction Summaries

## **Project Overview**

## Introduction

Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this summary report for the construction of City of Elk Grove monitoring wells located at the Strawberry Creek Detention Basin and Corporation Yard sites. This report consists of individual monitoring well construction summaries, asbuilt well construction drawings, lithologies encountered, well completions reports, location maps and permits.

## Background

In many areas throughout the State of California, the application of low impact development (LID) solutions to retain stormwater are thwarted by shallow clay-rich soils which limit infiltration to the subsurface. Stormwater program managers are looking for cost-effective LID solutions for space-limited urban areas underlain by these clay-rich soils to facilitate stormwater management and protect sensitive waterways by minimizing the damage caused by excessive runoff to the aquatic ecosystem. Dry wells constructed within the unsaturated vadose zone provide a pathway for surface water to bypass shallow impermeable soils and enter the groundwater system, reducing local runoff with the added benefit of providing groundwater recharge.

Although a review of existing literature suggests the risk of groundwater contamination is minimal, in many cases regulators and stormwater/groundwater program managers have been reluctant to use or permit these types of wells. Their primary concern is that dry wells allow stormwater to bypass the natural filtration of the uppermost soil units and pass directly into the vadose zone without reduction in contaminant concentrations. The purpose of this study is to fill in data gaps, quantify the risk, and investigate the effectiveness of eco-engineered pretreatment and natural attenuation through a systematic, field-based investigation.

### **Monitoring Wells**

Between September 23, 2013 and October 11, 2013, PeneCore Drilling of Woodland, California drilled and constructed eight monitoring wells for the City of Elk Grove. Four are located at the Strawberry Creek Detention Basin site, and four are located at the Corporation Yard site. The sites were chosen for their representative geology and land use. Monitoring wells were sited both up-gradient and down-gradient of a planned dry well at each site. The wells will be utilized to provide both baseline and post dry well construction water levels and water quality at the sites.



## **Strawberry Creek Detention Basin Monitoring Well Construction**

Site Plan Permit Construction Summaries As-Built Profiles Well Completion Reports



Path: X12012 Job Files112-001/GIS1SBCDB\_WCR\_WellLayout.mxd



Strawberry Creek Detention Basin Well Layout 3

AL CONTRACTOR	WELL APPLICATION AND PERMIT FORM
	ENVIRONMENTAL MANAGEMENT DEPARTMENT - ENVIRONMENTAL COMPLANC & DIVISION 10 590 ARMSTRONG AVENUE - SUITE A - MATHER, CA 050555 FXPENITE I
( Contraction	WELL INSPECTION LINE (010) 075-0624
CHARTER BURN	
Finishing in a subs	IS THIS PERMIT FOR A HAZARDOUS SUBSTANCE INVESTIGATION? [.] YES [.] NO
PROFFICE USE ONLY	EXPEDITED PROCESSING DYES
вү;	ON DATE: 9/20/13 DATE RECEIVED: 9/20/13 TOTAL FER: \$746.4\$1.07
FINAL INSPECTION BY:	DATE: RECEIPT NO: DEPTH TO WATER! DATE: WELL DEPTH: GROUT DEPTH: DATE: DATE: DEPTH TO WATER!
DESTRUCTION BY:	CRE & the way of the way of the wind with the state of th
COMMENTS.	see renance provisional sen)
SITE ADDRESS:	TRAWBERRY CREEK DETENTION BASIN
Job Address: Moun	tain Bell Drive, EKGning Major Cross Street: Zinnig Winy
Wall Contractors	e of Elle grove ( Parcel Number(s): 115-0150 - 536, 126,02:0-2)
Contractor's Address:	o Core Dotting CA License No.: 926 546, UND 11/30/13
Well/Boring Identification I	20 N. East. Strent Wordland, ch 97726 OF STON
	Dep Water Take/ Investigation Well, Vaclare Ene Welly
Vell construction	C-57License requireduntess noted otherwise)     Vault box repair (General A or B)     (i) Well destruction (SUPPLEMENT REQURED)
Pump replacement (or C Well Inscribution (Owner)	-61) UWell repair Expl oratory boring (C-57 if water prosent)
NTENDED USE:	Drivy) D Pump repair (or C-61)
] Domestic/private	Dewatering Geotechnical boring
Water/vapor monitoring/e	xtraction D Heat exchange D Other:
I Public water system:	(NAME OF WATER PURVEYOR WITH CONTACT NAME AND TELEPHONE NUMBER)
DRILLING METHOD:	
ETBACKS: (Wells only)	
s the well located within 50 f	eet of a: sewer line, I stream, I ditch, I drainage course, I pond or II like?
3 the wall located within 100	
OREHOLE: Diameter:	8,5, Depth: 120 CASING: Diameter: 1 Depth: 120
ONDUCTOR: Diameter:	Depth: IF STEEL: Gauge: or Thicknese:
NNULAR SEAL: Depth:	Let Material: IF PLASTIC: Type: (Must meet ASTM F-480) MULTIPLE COMPLETION? [] Yes (DIAGRAM REQUIRED)
OMMENTS:	-10,5 spick
UMP INSTALLATION/REP	AIB: Sand Cement
Icense Number:	Type of Pump: Horsepower:
will comply with all Codes, F	tules and Regulations of the State and County pertaining to or regulating wells and pumps, call (916) 875-
524 for a grout inspection equired) within 60 days of the	the completion of my work so a final inspection can be made, and obtain WPD approval before placing a
ell in service.	1 and
IGNATURE:	D Property Owner Of - OOV
OMPANY:	Cone and Dhilling Agent (REQUIRES AUTHORIZATION FORM)
	220 N. Fast Jil Ward (nel, CA 45776
	A SITE PLAN MUST BE SUBMITTED WITH EACH APPLICATION.
PERM	AIT EXPIRES ONE (1) YEAR AFTER DATE APPROVED (UNLESS EXTENDED)
192012 gfb Wildels/FORMSARCHIVEW	VPWELLENOT WELL APPLICATION AND PERMIT FORM.doc
A 1 11 -	

4

Generated by CamScanner from intsig.com

## Information For Parcel: 115-0150-036-0000

PROPERTY IN	NFORMATION
APN	11501500360000
Situs Address	0 CALVINE RD
Postal	ELK GROVE, CA 95624
City/St/Zip	8
Thomas Bros	338 E 7
Landuse Code	IABAAA
Jurisdiction	ELK GROVE
Sup. District	District 5 - Don Nottoli
OWNERSHIP	INFORMATION
Owner	<ul> <li>CITY OF ELK GROVE</li> </ul>
Mailing	8380 LAGUNA PALMS WAY
Address	ELK GROVE, CA 95758
Transfer Date	2001-10-24
Deed	View Property Transfer Document
<b>Owner</b> History	View Owner History
PARCEL DET.	AIL LINKS
General Info	View General Parcel Data
Districts	View District Data
Recorded Map	No maps are available.
Assessor Maps	View Assessor Map
Parcel History	View Splits and Merges History Data
Assessment	View Assessor Data
Info	
Building	View Permits
Permits	
Parcel Notes	View Parcel Notes
Business	No Business License Data available.
Licenses	
SHRA Info	View SHRA Data
CUBS Info	View CUBS Data
Refuse Pickup	No Refuse Pickup schedule available.
Water Meters	No Water Meter Data available

http://gisweb.msa.saccounty.net/website/ParcelViewer/

## WELL CONSTRUCTION SUMMARY

City of Elk Grove Strawberry Creek Detention Basin Monitoring Well No. 1 November 2013

## Introduction

Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this summary for the construction of the City of Elk Grove's Strawberry Creek Detention Basin Monitoring Well No. 1 (SC MW-1). Included are monitoring well construction and development details, an as-built well construction drawing, lithologies encountered, well completion report, and permit.

## **Monitoring Well Construction**

On October 1, 2013, PeneCore Drilling of Woodland, California (PeneCore) commenced SC MW-1 test hole drilling. The test hole was drilled to a depth of 120 feet below ground surface (bgs) at a diameter of 8 3/4-inches by the hollow stem auger method. Continuous core split spoon samples were collected and analyzed by LSCE. The formation lithologies encountered were used as the basis of the piezometer design. SC MW-1 consists of a single piezometer constructed of 2-inch ASTM F480-88A schedule 40 PVC pipe. The perforated well screen section has machine cut slots with 0.030-inch openings. The total completed depth of SC MW-1 is 120 feet bgs. The screened interval is from 115 to 100 feet bgs. The annular space from 120 to 97 feet bgs is filled with a SRI #8 gravel. A Cemex #60 fine sand transition seal was placed from 97 to 95 feet bgs. On October 3, 2013, an annular seal consisting of 11.8 sack sand/cement grout was placed from 95 feet to ground surface in accordance will all permitting requirements in the presence of the County of Sacramento inspector.

At the completion of construction activities, the piezometer was developed by a Waterra inertial pump for approximately three hours until the water was clean and free of solids.

## Note on Datum

All depths cited in this summary report are based on grade as it existed at the time of construction.





*The free	e Adobe Re	ader ma	ly be used to view	and complete this f	orm. However,	software m	ust be purchas	ed to compl	ete, save,	and reus	e a saved fo	orm.	
File Orig	jinal with	DWR			Sti Mall Ca	ate of Cali	fornia ·			DV	VR Use Onl	y – Do I	Not Fill In
Page <u>1</u>		of	1		Refer	to Instruction	Pamphlet		L			1	Number
Owner's	Well Nur	nber <u>S</u>	C MW-1		No.	e01905	05			Sta		nben/Sit	
Date Wo	ork Begar	10/01	/2013	Date Work	Ended 10/2	/2013		- 1		Latitude		<u></u>	Longitude
Local Pe	ermit Age	ncy Co	unty of Sacra	mento	100/40				1	1	APNOT	1 I	
Permit N	Number <u>5</u>	3186		Permit Date	/20/13			L			AFINI	Noroun	
1			Geolo	ogic Log	au - 140-1-2-3	- Alman -	1 a rates	1.00		Well	Owner		Lines astories
Ori	ientation	©Ve	rtical OHo	rizontal OA	ngle Specif	íy	- Name	City of Elk	Grove				
Denti	from Si	inface	am Auger	Descripti	ing Fluid		Mailing	Address	8401 La	iguna P	alms Wa	v	
Feet	t to F	eet	Des	cribe material, grain	size, color, etc		City El	< Grove			Sta	e CA	
0	2		Fill- road base	e sand and grav	el, dry				1242100000000	Well	Location		
2	5		Clay- brown,	medium plastici	ty, dry		Address	Mounta	in Bell D	Drive (S	trawbern	Cree	k Detention Basin)
5	15		Sandy Silt-ve	ry fine, light brow	wn mottled t	an, damp	City El	Grove			Cou	inty Sa	cramento
15	21	10-11-1	Sandy Silt- ve	ery fine to fine, to	an, damp		Latitude				N Longitu	de	w
21	25		Sandy Silt- ve	ery fine, light bro	wn mottled	tan, dam		Deq	Min	Sec.	Nucl_	D	eq. Min. Sec.
25	32		Sandy Silt- ve	ery fine to fine, ta	an, damp		Datum_		Dec. La			Dec. I	ong.
32	35		Sand-very fir	ne to medium, w	ell sorted, lig	ght brown	APN Bo	ok <u>115</u>	Pag	e <u>0150</u>	6	Parce	036
			moist				Townsh	ip	Rang	е	-	Sectio	on
35	37		Sand- very fir	ne to medium, b	rown, lenses	s of sand	Skatch	Local must be draw	tion Ske	etch	oditied 1	0.11	Activity
			silt, moist			1000	- Choich	AND DE UIGW	North	Section 19		OM	odification/Repair
37	47		Sand- very fir	ne to medium, w	ell sorted, lig	ght brown	<u>ч</u>	29.51	Sec. 1	12		0	Deepen
	_		moist				-11			· · · · ·	a (	00	Other
47	53		Sandy Claye	Silt- very fine t	o fine, light b	prown,	-11				1.0	De	scribe procedures and materials
			moist		GV2						1	Un	Diappod Lloss
53	57	-	Sandy Silt- ve	ery fine to fine, I	ght brown m	nottled ta	n					010	eter Supely
			moist										Domestic Public
57	59		Silty Sand- ve	ary fine to fine, b	prown, micad	ceous,	est				ast		rrigation Industrial
		_	wet				- 3					O Ca	athodic Protection
59	67		Sandy Silt- ve	ary fine to fine, li	ght brown m	nottled	-11					O De	ewatering
			brown, wet	. (125	1 100		-11					O He	eat Exchange
67	109		Clay-brown,	medium plastic,	trace fine si	and, wet	41					O Inj	ection
109	111	-	Sandy Clay-	ine to medium,	tan mottled	reddish	-11						onitoring
			brown, 3" sar	id lense at 110'	78		O Remediation O Sparging O Test Well						
111	120		Sandy Clay-	very fine to fine,	reddish bro	wn,							est Well
	_		medium plast	ic, wet	4		South O Vapor Extraction					apor Extraction	
	_			S.			rivers, etc. an	nd attach a map.	Use addition	al paper lined	essary.	0 0	her
		-					Water	evel and	i Yield	of Com	pleted W	lell	State of the state of the state of the
							Depth to	first wate	r 57			(Fee	t below surface)
				-ha-		3	Depth to	Static				_ (1 00	
			100		N		Water L	evel		(Fee	et) Date	Measu	red
Total	Depth of E	Soring	120	1	Feet		Estimate	ed Yield *		(GP	M) Test	Type	(Feet)
Total I	Depth of C	complet	ed Well 120		Feet		*May no	t he renre	sentative		urs) rotar Il's iong te	m viel	d (reet)
Mar		-	ant rendered	Casingo	Contraction of the	-		A be repre	T	of a we	Annul	or Mad	a.
Dep	th from	Boreh	ole _	Cashiys	Wall	Outside	Screen	Slot Size	Dep	th from	Annua	al mai	erial
Su	rface	Diame	ter Type	Material	Thickness	Diameter	Туре	if Any	Su	rface	Fil	I	Description
O	100	8 75	Blank	PVC Sch 40	(incries)	(incries)	1	(inches)	0	95	Cement	-	10.3 Sack sand/
100	115	8.75	Screen	PVC Sch 40		2	Milled Stots	0.030					cement
115	120	8.75	Blank	PVC Sch. 40		2			95	97	Fine San	d	Transition
		3							97	120	Filter Pac	k	SRI #8 Gravel
			2										
			P.X.										and the second
	an in the second	Attac	hments	production of the production o		Sector Contractor	A STATE AND	Certificat	tion Sta	tement	Constant of the		
	Geologic	Log	and the second second second	I, th	e undersigner	d. Rertify th	hat this report	t is comple	te and a	ccurate I	to the best	ofmy	knowledge and belief
	Well Cor	structio	n Diagram	Nan	Person	Firm or Corre	DY1111	aq	0	A 1	_		
	Geophys	ical Log	)(S)	12	20 N.	EAS	St.	- in	loud	and	<u> </u>	<u>A</u>	98176
	Soll/Wate	er Chen	nical Analyses	Sign	ned	Address			Cit	1.le	1. 2 50	9NP	ACG DP
Attach ad	ttach additional information, if it exists.												
DIA (D. 400	0511 4000	0			DITIONUL OF								

DWR 188 REV. 1/2

E IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

## WELL CONSTRUCTION SUMMARY

City of Elk Grove Strawberry Creek Detention Basin Monitoring Well No. 2 November 2013

## Introduction

Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this summary for the construction of the City of Elk Grove's Strawberry Creek Detention Basin Monitoring Well No. 2 (SC MW-2). Included are monitoring well construction and development details, an as-built well construction drawing, lithologies encountered, well completion report, and permit.

### **Monitoring Well Construction**

On September 26, 2013, PeneCore Drilling of Woodland, California (PeneCore) commenced SC MW-2 test hole drilling. The borehole was drilled to a depth of 57.5 feet below ground surface (bgs) at a diameter of 8 3/4-inches by the hollow stem auger method. Continuous core split spoon samples were collected and analyzed by LSCE. The formation lithologies encountered were used as the basis of the piezometer design. SC MW-2 consists of a single piezometer constructed of 2-inch ASTM F480-88A schedule 40 PVC pipe. The perforated well screen section has machine cut slots with 0.030-inch openings. The total completed depth of SC MW-2 is 57.5 feet bgs. The screened interval is from 52.5 to 22.5 feet bgs. The annular space from 57.5 to 20 feet bgs is filled with a SRI #8 gravel. A Cemex #60 fine sand transition seal was placed from 20 to 18 feet bgs. On September 30, 2013, an annular seal consisting of 11.8 sack sand/cement grout was placed from 18 feet to ground surface in accordance will all permitting requirements in the presence of the County of Sacramento inspector.

At the completion of construction activities, the piezometer was developed by a Waterra inertial pump for approximately three hours until the water was clean and free of solids.

### Note on Datum

All depths cited in this summary report are based on grade as it existed at the time of construction.



Cli	ient:	City of Elk Grove	Lat/Long:							
Project Name: Strawberry Creek Basin MW-2		GSE (ft-msl)						LTING ENGINEERS		
LS	CE #:	12-1-001	Drill Date:	09/26/20	13					
Lo	cation:	Mountain Bell Drive	Drilling Method:	Hollow S	tem Aug	er				
Ge	eologist:	W. Andrews/C. Jenkins	Driller:	Penecore	e Drilling					
		Lithologic Description			Strat- Column		Well Construction Diagram			
0	0-5' Silty Clay	- reddish brown, medium plastic, trace v	very fine sand							
Ē	5-7' Sandy Sil	t- very fine to fine, reddish brown, moist						7000		
- 10	7-11' Silty Cla	y- tan mottled light brown, medium plas	tic, moist						— Annular Seal 10.3 Sack	
-	11-14' Sandy	Silty Clay- very fine to fine, tan mottled	ight brown, moist		T				Sand/Cement Grout Well Casing 2-Inch	
-	14-18' Silty Cl	ay- tan, medium plastic, some white cla	y lenses			18			Dia. Sch. 40 PVC ASTM F480-88A Flush Threaded	
-20	18-20' Sandy	Silt- very fine to fine, tan, moist			17				Fine Sand	
_	20-22' Sand-	very fine to medium, well sorted, moist,	brown		20					
	22-23' Silty Cl	ay- tan, medium plastic, micaceous, mo	ist	T	22.5		24			
-	23-29' Sandy	Silt- very fine, tan, micaceous, moist						<ul> <li>Well Screen 2-Inch</li> <li>Dia. Sch. 40 PVC w/</li> </ul>		
- 30 - -	29-35' Sand-	very fine to medium, well sorted, micace	ous, damp, brown						0.030-Inch Slot Size Flush Threaded	
-	35-38' Sandy	Silt- very fine to fine, tan, micaceous, m	oist	T						
- 40	38-45' Sandy	Silty Clay- very fine, medium plastic, rec	ldish brown, micaceou	us, moist	アファファファ			•	Borehole Gravel Envelope #8 SRI	
- - - 50	45-52' Sand- moist to wet	very fine to medium, well sorted, loose w	// some hard lenses, t							
-	52-57.5' Silty	Clay- tan mottled light brown, medium p	lastic, moist	NENEN.	52.5					
60		3	•);							

*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.																			
File Origin	al with D	WR					St	ate of Cali	fornia		1	DWR Use Only - Do Not Fill In							
Rana 1 of 1 We								mpleti	on Re	po	ort								
Owner's M	Age Refer to Instruction   Refer to Instruction									State Well Number/Site Number									
Date Work	Began	09/2	6/20	013	Date	Work End	ed 9/26	/2013	Latitude Longitude										
Local Permit Agency County of Sacramento																			
Permit Number 53182 Permit Date 9/20/13														APN/	TRS/Ot	her			
	Geologic Log												Well	Owner					
Orier	Orientation OVertical OHorizontal OAnole Specify											Grove							
Drilling M	Drilling Method Hollow Stem Auger Drilling Fluid											940110							
Depth from Surface Description											Mailing Address 8401 Laguna Paims Way								
Feet	to Fe	et	0.11	Des	cribe material,	grain size,	color, etc		City Lik Grove State CA Zip 95758										
0	5		Silt	y Clay- red	dish brown	, mediun	n plastic	, trace		_			Well	Locatio	n				
-			ver	y fine sand					Address Mountain Bell Drive (Strawberry Creek Detention Basin)										
5	1		Sa	ndy Silt- ve	ry fine to fi	ne, reddi	sh brow	n, moist	City	Elk	Grove	_		Co	unty <u>S</u>	acramento			
1	11		Silt	ty Clay-tan	mottled lig	ht brown	, mediu	m plastic	Latitu	Jde				N Longiti	ude	W			
	-		mo	ist	and the second second				Detu		Dea	Min.	Sec.		Dee	Deg. Min Sec			
11	14		Sa	ndy Silty Cl	ay- very fir	e to fine,	tan mo	ttled light		<u> </u>		Dec. Lat	0450	_	Dec.	Long			
			bro	wn, moist				_	APN	BOC	DK <u>115</u>	Page	<u>0150</u>		Paro	el <u>030</u>			
14	18		Silt	y Clay-tan	, medium p	plastic, sc	ome whi	te clay	lowr	nshi	p	Rang	e		Sect	ion			
			len	ses					(Ska	deb r	Locat	tion Ske	etch	( hetring	-	Activity			
18	20		Sa	ndy Silt- ve	ry fine to fi	ne, tan, n	noist			/ion i	nost be drawn	North	Inter to initia	phines.		ew Well odification/Renair			
20	22	_	Sar	nd- very fin	e to mediu	m, well s	orted, m	noist,							l d d	Deepen			
	brown															Other			
22	23		Silt	y Clay-tan	, medium p	plastic, m	icaceou	s, moist								estroy escribe procedures and materials			
23	29	_	Sandy Silt- very fine, tan micaceous, moist													nder 'GEOLOGIC LOG'			
29	35		Sar	nd- very fin	e to mediu	m, well s	orted, m	icaceous						1	-	Planned Uses			
			dar	np, brown					- O Water Supply										
35	38		Sai	ndy Silt- ve	ry fine to fi	ne, tan, n													
38	45		Sar	ndy Silty Cl	ay- very fir	e, mediu	m plast	ic,	Š					ű		athedic Drotection			
1	reddish brown, micaceous, moist										O Dewatering								
45	52		Sar	nd- very fin	e to mediu	m, well s	orted, lo	ose with		O Heat Exchange									
			son	ne hard ler	ises, brown	, moist to	o wet								O In	jection			
52	57.5		Silt	y Clay-tan	mottled lig	ht brown	, mediu	m plastic							•м	onitoring			
			moi	ist				10							OR	emediation			
															O S	parging			
			No	ote: This is	version 2,	a depth o	orrectio	n was				South				est vvell			
			ma	ade. The s	ame Well (	Completio	on Repo	ort	Hustrate	ar de	scribe distance	of well from or	ids, buildings, baper if neces	fences,	lõõ	ther			
			nu	mber was	used.				Please be accurate and complete										
									Water Level and Yield of Completed Well										
									Depth to first water <u>45</u> (Feet below surface)										
									Upepth to Static     Water Level     (Feet) Date Measured										
Total De	oth of Bo	pring		57.5			Feet		Estimated Yield * (GPM) Test Type										
Tatal Da	-			57.5			-		Test	Len	gth		(Hou	rs) Total	Drawd	lown (Feet)			
Total De	pin or Co	ompiei		/veil		-	- Feet		*May	not	be repres	entative	of a well	's long te	rm yie	ld.			
		-			Casi	ngs	1.00.5							Annul	ar Ma	terial			
Depth 1 Surfa	from	Boreh Diame	ole ter	Туре	Mater	ial T	Wali hickness	Outside Diameter	Screen		Slot Size	Depti Sur	h from face	Fil		Description			
Feet to	Feet	(Inche	es)				(Inches)	(inches)	r	_	(Inches)	Feet	lo Feet	T					
0 2	23	8.75	_	Blank	PVC Sch. 40		-	2			0.000	0	18	Cement		10.3 Sack sand/			
23 8	53	8.75	-	Screen	PVC Sch. 40			2	Milled Slo	ts	0.030	10	20	Cine Dee	4	Cement			
53 5	57.5	8.75	-	Blank	PVC Sch. 40			2		-		18	20	Fine San		FRI #R Crovel			
		-	-							_		20	01.5	Pinter Pac	ar.	SRI #0 Glavel			
		-	-							-									
Attachments Certification Statement												knowledge and belief							
	eologic l Iell Cons	Lug structio	ם מו	iaoram		Name	ter	6 CBR	2	Dr	lliza	and at	54.010 10		- or my	internetige and bench			
	eophysic	cal Lo	q(s)	g.am		200 1	Person, F	im or Corpo	ration			Don 1	and	C	A	95776			
Ds	oil/Water	Cher	nica	I Analyses				Addreas	/	-		City	I	7 St	ate	Zip			
	ther					Signed		12	6	_			1/16	114	92	899			
Attach additional information, if it exists. C-57 Licensed Water Weil Contractor Date Signed C-57 License Number													Date Sig	ense Number					

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED USE NEXT CONSECUTIVELY NUMBERED FORM

## WELL CONSTRUCTION SUMMARY City of Elk Grove Strawberry Creek Detention Basin Monitoring Well No. 3 November 2013

## Introduction

Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this summary for the construction of the City of Elk Grove's Strawberry Creek Detention Basin Monitoring Well No. 3 (SC MW-3). Included are monitoring well construction and development details, an as-built well construction drawing, lithologies encountered, well completion report, and permit.

### **Monitoring Well Construction**

On September 23, 2013, PeneCore Drilling of Woodland, California (PeneCore) commenced SC MW-3 test hole drilling. The test hole was drilled to a depth of 120 feet below ground surface (bgs) at a diameter of 8 3/4-inches by the hollow stem auger method. Continuous core split spoon samples were collected and analyzed by LSCE. The formation lithologies encountered were used as the basis of the piezometer design. SC MW-3 consists of a single piezometer constructed of 2-inch ASTM F480-88A schedule 40 PVC pipe. The perforated well screen section has machine cut slots with 0.030-inch openings. The total completed depth of SC MW-3 is 120 feet bgs. The screened interval is from 115 to 105 feet bgs. The annular space from 120 to 102 feet bgs is filled with a SRI #8 gravel. A Cemex #60 fine sand transition seal was placed from 100 feet bgs. On September 26, 2013, an annular seal consisting of 11.8 sack sand/cement grout was placed from 100 feet to ground surface in accordance will all permitting requirements in the presence of the County of Sacramento inspector.

At the completion of construction activities, the piezometer was developed by a Waterra inertial pump for approximately three hours until the water was clean and free of solids.

### Note on Datum

All depths cited in this summary report are based on grade as it existed at the time of construction.



Client:		City of Elk Grove						
Project Name:		Strawberry Creek Basin MW-3	GSE (ft-msl)					NO ENGINEERS
LSCE #:		12-1-001	Drill Date:	09/23/20	13-09/25/201	3		
Location:		Mountain Bell Drive	Drilling Method:	Hollow S	tem Auger			
Ge	ologist:	W. Andrews/C. Jenkins	Driller:	Penecore	e Drilling			
		Lithologic Description	Strat- Column	Well Co	onstruction	Diagram		
_0 - -	0-10' Silty Cla	y-reddish brown, medium plastic w/ fine	sand, dry					
- 10	10-15' Sandy damp at 13' 15-18' Sandy	Clayey Silt- tan mottled yellowish brown Clayey Silt- reddish brown, medium pla	n, medium plastic, ve stic, very fine, damp	ry fine, dry,	シテレ			
-20	18-22' Sandy	Silty Clay- reddish brown, medium plast	tic, very fine, damp		77			
	22-23' Sandy	Silt- tan, very fine, damp		/	+ -			8.75-Inch Dia.
20	23-24' Silty Sa	and- very fine to fine, reddish brown, ab	undant mica, damp		T. I.I.			Borehole
50	24-25' Sandy	Clayey Silt- tan, medium plastic, very fir	ne, damp					
	25-27' No san	nple			·			
-40	27-28' Sand-	tan, very fine to fine, dry						
Ē	28-33' Sandy 33-38' Sandy	Silt- tan, very fine, damp Silt- tan mottled reddish brown, very fin	e to fine, damp		and the second second			
-50	38-45' Sand-	light brown, very fine to medium, damp	to moist		TT		Doda	Annular Seal
	45-46' Sandy	Clayey Silt- reddish brown, medium pla	stic, very fine, damp			D9a	AND A	10.3 Sack Sand/Cement Grout
-	46-48' Silty Sa	and- reddish brown, very fine to medium	w/ streaks of clay, o	lamp				Well Casing 2-Inch
-60	48-52' Sandy	Silty Clay- brown, medium plastic, very	fine to fine, damp					ASTM F480-88A
	52-62' Sand- 62-64' Silty Sand- 64-65' Sand-	brown, very fine to medium, moist, wet a and- light brown, very fine to medium, w brown, fine to coarse, wet	at 58' et	/				Flush Threaded
-70	65-67' Sandy	Silty Clay- tan mottled reddish brown, n	nedium plastic, fine, r	noist to wet	7/77		1000 1000	
	67-68' Silty Sa	and- light brown, very fine to fine, moist	to wet		T/T/			
- 80	68-78' Sandy 78-80' Sandy fine, moist 80-82' Sandy 82-84' Sandy 84-86' Sandy	Clayey Silt- tan mottled reddish brown, Clayey Silt- light brown mottled reddish Clayey Silt- reddish brown, medium pla Silt- reddish brown, very fine to fine, mo Clayey Silt- reddish brown, medium pla	medium plastic, very brown, medium plas stic, very fine, moist sist stic, very fine, moist	fine, moist tic, very	777			
-90	86-90' Silty C	lay- light brown, medium plastic, moist						
E	90-92' Sandy	Silt- tan, very fine to fine, damp						
F	92-96' Silty C	lay- brown mottled reddish brown, medi	um plastic, moist, we	t at 94'		D90		
- 100	96-105' Claye	ey Silt- tan mottled light brown, medium	plastic, wet		102			Fine Sand Transition Seal
-	105-106' Silty	v Sand- reddish brown, very fine to medi	um, wet					
- 110	106-107' San	dy Clay- tan, medium plastic, very fine t	o fine, wet		ТТ			Well Screen 2-Inch Dia. Sch. 40 PVC w/
-	107-110' Clay 110-112' Silty 112-116' Silty	yey Sand- brown, medium plastic, very f v Sand- reddish brown, very fine to medi v Sand- reddish brown, very fine to medi	ine to medium, wet um, sandy silt 111.7 um, wet	to 112', wet	115			0.030-Inch Slot Size Flush Threaded Gravel Envelope
- 120	116-120' San	dy Silt- tan mottled reddish brown, very	fine, moist to wet		120			#8 SRI

*The free File Oria	Adobe Re	ader ma DWR	y be used to view	and complete this fo	rm. However, St	software mate of Cali	ust be purchas fornia	ed to comple	ete, save,	and reuse	e a saved fo	v – Do Ne	at Fill In			
, no ong					Well Co	mpleti	on Repo	ort Î			webse only	J Do no				
Page 1		of	2		Refer	Pamphlet State Well Number/Site Number										
Owner's	Well Nun	nber S	<u>C MVV-3</u>	<b>D</b> ( ) ) ( )	No.											
Date vvo	nk Began	09/23	12013	Date work	Ended <u>9/25</u>	Latitude Longitude										
Permit N	lumber 5	3183	unity of Sacia	Permit Date 9/	20/13			— L		L	APN/T	RS/Other				
		-	Geolo	ndic Log			The second	ਜਦ ਸਦ ਹ	110 2011	Well	Owner	TECH				
Ori	entation	<b>⊙</b> Ve	rtical O Ho	rizontal OAn	ale Specif	fv		ity of Elk	Grove	were a	Owner	- S.L.				
Drilling	Method H	ollow Ste	em Auger	Drillir	g Fluid		Name S									
Depth	from Su	rface	AA.4.12. A.4.2. A.4.4(111)	n		Address _	5401 La	quna Pi	alms vva	CA	7- 05758					
Feet	to Fi	eet	Des	cribe material, grain s	size, color, etc	City_Eir	City Elk Grove State CA Zip 95758									
0	10		Silty Clay-red	dish brown, med	ium plastic	Birena .			Well	Location	b					
10	45		sand, dry	0111 4	In the second second		Address Mountain Bell Drive (Strawberry Creek Detention Basin)									
10	15		Sandy Clayey	Sit- tan mottled	demon of 1	orown,	City Elk Grove County Sacramento									
15	40		medium plast	C, very tine, dry,	damp at 1.	5	Latitude	Dea	Min	Sec	N Longitud	de :	W Nic Sec			
15	18		Sandy Clayey	Silt- readish bro	wn, meaiui	n plastic,	Datum	Deg	Dec. Lat	360		Dec. Lo	na.			
10			very line, dan	ip	un un alle une	alaatia	APN BO	ok 115	Page	0150	X P	Parcel	036			
10	22		Sandy Silly C	lay- reddish brov	vn, mealum	plastic,	Townshi	n	Rand			Section				
22	22		Sandy Silt to	ip n very fine dem	n			Locat	ion Ske	tch	in the second		Activity			
22	23		Silly Sond w	n, very line, dam	ddieb brow	0	(Sketch must be drawn by hand after form is printed.)     New Well									
25	24		abundant min	ay line to line, le		,			North	A	5	O Moo	dification/Repair			
24	25		Sandy Claves	a, uamp	lastic von	ine dame						O.	Deepen			
24	20		Sandy Clayes	Sill- tan,meu. p	lastic, very i	me,uamp	41					O Des	stroy			
20	21	-	Sand top ve	ny fino to fino, dr	,		-11				1.5	Desc	ribe procedures and materials			
20	20		Sand- tan, ve	ny nine to nine, un	y	1.000	-				Ī	P	lanned Uses			
20	38	-	Sandy Silt- ta	n mottled reddis	p brown ve	ny fine to	~					O Wat	ter Supply			
55	- 100		fine damn	in monieu reduisi	T DIOWII, VE	ay mie to					-	Do	omestic Public			
38	45	-	Sand- light hr	n very fine to me	dium dami	n to mois	Ves				Eas	nı 🗖	igation Industrial			
15	40		Sand- Iight bi	Silt. reddish br	wo mediu	m plaetic	41-					O Catl	hodic Protection			
45			very fine dan	none redulari bre	Min, mean	in plastic	-					O Dev	vatering			
46	48		Silty Sand- re	ddish brown ve	v fine to m	muibe										
40			w/ streaks of	clay damp	<b>y</b> mile to me	Monitorina										
48	52		Sandy Silly C	lav- brown med	um plastic	very fine	-					O Ren	nediation			
10			to fine damp	iaj bronn, moa	ium pidotio,	very mite					1	O Spa	arging			
52	62		Sand- brown.	verv fine to med	um, moist.	wet at 58	South O Test Well									
62	64		Silty Sand- lic	ht brown, very fi	ne to medi	um, wet	Illustrate ordescribe distance of well from roads, buildings, fences,									
64	65		Sand- brown.	fine to coarse, v	vet		Please be accurate and complete.									
65	67		Sandy Silty C	lav- tan mottled	reddish brn	medium	Water Level and Yield of Completed Well									
			plastic, fine, r	noist to wet			Depth to first water <u>58</u> (Feet below surface)									
67	68		Silty Sand- lic	ht brn., very fine	to fine, mo	ist to we	Depth to Static     Water Level     (Feet)     Date Measured									
Total C	Depth of B	iorina	120	1	Feet		Estimate	ed Yield *		(GP	M) Test 1	Гуре				
Total	lonth of	omplet	ad Well 120	1	East		Test Length (Hours) Total Drawdown (Feet)									
TOtal	Jeput of C	ompier	ed wen 120	14 A	Feel		*May no	t be repres	sentative	of a wel	Il's long ter	rm yield.				
				Casings	-u-state -u-sta		S.Q., 19,21.			1.11.1	Annula	ar Mate	rial			
Dept Su Feet	h from rface to Feet	Boreho Diame (Inche	ter Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)	Dept Su Feet	h from rface to Feet	Fill	i	Description			
0	105	8.75	Blank	PVC Sch. 40		2			0	100	Cement	1	0.3 Sack sand/			
105	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030				C	æment			
115	120	8.75	Blank	PVC Sch. 40		2			100	102	Fine Sand	1 T	ransition			
		11							102	120	Filter Pac	k S	SRI #8 Gravel			
			1		_				-							
-	1							1			1					
E .	and the second second	Attac	hments	a management of the second sec	R Verlagen		1) - in 1	Certificat	ion Sta	tement	ningi, cipatri		40 a 17 17 18 19 19 19 19 19 19 19 19 19 19 19 19 19			
	Geologic	Log		I, the	undersigne	d. certify th	this report	is comple	te and a	ccurate t	o the best	of my k	nowledge and belief			
	Well Con	structio	n Diagram	Name 2	Person	Firm or Corp	pration (	9 11	As di	hall		. 0	157712			
	Soil/Mate	rcar LOG	nical Analyses	5	LUN	City / State Zin										
	Other	. onon		Sign	ed	1			-14	11/5	13_	90K	899			
Attach add	ditional inform	nation, if i	t exists.		C-57 Lig	ensed Water	Well Contractor			Dale Si	gned C-	-57 Licer	nse Number			

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

The face Addres Reden ray to used to ware all compares the form. However, shares must be purphered to complex, pays, or mano a suped from.  State of California a  Well Completion Report Well Completion  Geodogic Log  Geod																	
Bill Organization         Difference         Difference <thdifference< th="">         Differenc         Di</thdifference<>	*The free	*The free Adobe Reader may be used to view and complete this form. However, software must									ust be purchased to complete, save, and reuse a saved form.						
Page 2     of 2     Well Completion Program       Overare Weil Number SG MW-3     No. e01907.01       Date Work Regan 092322013     Date Work Ended 92552013       Date Work Regan 092322013     Date Work Ended 92552013       Date Work Regan 092322013     Date Work Ended 92552013       Orientation ® Vertical O Horizontal Date 0720713     AMUTRScher       Orientation ® Vertical O Horizontal Date 0720713     Name 21x of Elk Grove       Big More Status glass searching field     Mainy Admines 4001 Lagrange Table 92001       Degit from Surface     Degit from Surface Searchy       Big Sandy Clarger Sills Field brown incided reddish brown, medium plastic, wrolin endial Date 9200 Clarger Sills reddish brown, medium plastic, moist       Big Sandy Clarger Sills and clarger Sills reddish brown, medium plastic, moist       Big Sandy Clarger Sills reddish brown, medium plastic, moist       Big Sandy Clarger Sills reddish brown, medium plastic, wrolf red fine, wet fine fine in fine in mediatin, werg fine to fine, damp       Big Sandy Clarger Sills reddish brown, medium plastic, wrolf red fine, wet fine to fine, damp       Big Sandy Siller y thrown mediar reddish brown, redum plastic, wrolf red fine, wet fine fine in mediatin, werg fine to mediatin, werg fine	File Original with DWR						Sta	ate of Calif	ornia	, F	DWR Use Only - Do Not Fill In						
Owner's Will Number SC MWV-3       No. ed190749         Date Work Regim Operating Agency Count	Page 2		of 2			V	Vell CO	mpletic	nt	1	1	I.J.					
Date Work Rogen 02/22/013	Owner's	Well Num	ber SC	MW-3			No.	e019074	30749								
Local Permit Agency County of Starsmento         Weil Stab       Permit Number 23183         Weil Stab       Permit Number 23183         Weil Counce       Marketsian         Orientation & Vertical       Origination         Path from Strike       Description         Path from Strike       Description         Path from Strike       Description         Stardy Clavys Silt- tann otted oridids brown, medium plastic, wery fine, moist       Stardy Clavys Silt- reddish brown, medium plastic, wery fine, moist         84       86       Sandy Clavys Silt- reddish brown, medium plastic, wery fine to fine, doingt wery fine, moist       Arres doingt fine to mark the start origination         84       86       Sandy Clavys Silt- reddish brown, medium plastic, wery fine to fine, doingt wery fine, moist       Arres doingt fine to mark the start origination         84       86       Sandy Silt- van medium plastic, wery fine to fine, doingt sandy Silt- tan motted reddish trown, readium plastic, wery fine to fine, doingt sandy Silt- tan motted reddish trown, readium plastic, wery fine to fine, doingt sandy Silt- tan motted reddish trown, readium plastic, wery fine to fine, doingt sandy Silt- tan motted reddish trown, readium plastic, wery fine to fine doingt sandy Silt- tan motted reddish trown, readium size start origination in the s	Date Wo	rk Began	09/23/2	2013	Date	Work Er	nded 9/25	/2013	Latitude Longitude								
Parmit Number 23132     Permit Desk 2/2/13     Desk 1/2/13       Orientation ® Vertical     Orientation @ Vertical     Orientation @ Vertical       Orientation ® Vertical     Orientation @ Vertical     Orientation @ Vertical       Bigs 1/2     Sandy Claryey Sile light brown motiled reddish     Maing Address 24011 Laguna Palma Way       City Elk Grove     Standy Claryey Sile light brown motiled reddish       10     Based of Claryey Sile reddish brown, medium plastic, wry fine, moist       80     82     Sandy Claryey Sile reddish brown, medium plastic, wry fine, moist       82     84     Sandy Claryey Sile reddish brown, medium plastic, wry fine, moist       82     84     Sandy Claryey Sile reddish brown, medium plastic, wry fine, moist       82     90     Silty Clary Sile reddish brown, medium plastic, wry fine to fine, wret       91     92     Sandy Claryey Sile reddish brown, medium plastic, wry fine to fine, wret       92     93     Silty Clary Sile reddish brown, medium plastic, wry fine to medium, wret       106     107     Sandy Claryey Sile reddish brown, wrey fine to medium, wret       110     112     Sinty Sand- reddish brown, wrey fine to medium, wret       111     112     Sinty Sand- reddish brown, wrey fine to medium, wret       111     112     Sinty Sand- reddish brown, wrey fine to medium, wret       111     112     Sinty Sand- reddish brown, wrey fine	Local Pe	rmit Agen	cy <u>Cou</u>	ntv of Sacram	nento	0.0					L	1.1	1 ADM	1 I			
Geologic Log         Well Owner           Orientation Overtoratal         Oangie Speerly         Name City of Elk Grove         Maing Address & 8d01 Laguna Pairs Way           Desity from Stretce         Descondentific addition brown,         Maing Address & 8d01 Laguna Pairs Way           See 178         Sandy Clayey Silk tan motible reddish brown,         Well Access &	Permit N	Permit Number <u>53183</u> Permit Date <u>9/20/13</u>											APN/	IRS/OII	er		
Orientation         Overlag         Description         Description           Diring March Michael Sendug         Damage March Michael Sendug         Manage Active Sendu Lacuna Palms Way           Diring March Michael Sendug         Damage March Michael Sendug         Manage Active Sendu Lacuna Palms Way           Diring March Michael Sendug         Damage March Michael Sendug         Manage Active Sendu Lacuna Palms Way           Diring March Michael Sendug         Damage March Michael Sendug         Manage Active Sendu Lacuna Palms Way           Diring March Michael Sendug         Damage March Michael Sendug         March Michael Sendug         March Michael Sendug           80         Sandy Clayey Sills raddish brown, medium plastic, work fine moist         March Michael Sendug         Damage Michael Mic	2	Geologic Log									4	Well	Owner				
	Orie	entation	• Verti	ical O Horiz	zontal	OAngle	e Specif	ý	Name_C	ity of Elk	Grove						
Priori       Describe mediad plant allo decides brown, mediar plants allo docks, etc.       Chy Elk Crove       Stardy Clayy Silt- and decide holds.         78       80       Sandy Clayy Silt- lan mottled reddish brown, mediar plastic, very fine, moist	Denth	from Su	face	n Auger	Dos	Crintion		H-1	Mailing Address 8401 Laguna Palms Way								
66       76       Sandy Clayey Silt- tan motied reddsh brown, moist       Well Location         76       80       Sandy Clayey Silt- light frown motied reddsh       City_Elk Grove       County Statumento         80       62       Sandy Clayey Silt- reddish brown, medium plastic, very fine, moist       Datu	Feet	to Fe	et	Descr	grain siz	e, color, etc	City Elk	Grove			Sta	ate <u>CA</u>					
Image: Series (Jacobian Section Participation Partitinte Participation Participation Participation Participati	68	78	S	andy Clayey	nottled r	eddish br	Well Location										
76       80       Sandy Clayey Sitt-light brown, medium plastic, where the dist brown medium, wet the dist brown, medium plastic, where the dist brown, medium plastic, where the dist brown, medium plastic, where the dist brown and			m	edium plastic	, very find	e, moist			Address	Mountai	n Bell D	rive (Str	awberr	y Cree	k Detention Basin)		
borown, medium plastic, very fine, moist   a   a   b    b   b    b    b    b    b   b   b   b <td>78</td> <td>80</td> <td>S</td> <td>andy Clayey</td> <td>Silt- light</td> <td>brown n</td> <td>nottled rea</td> <td>dish</td> <td>City Eik</td> <td>Grove</td> <td></td> <td></td> <td>Co</td> <td>unty S</td> <td>acramento</td>	78	80	S	andy Clayey	Silt- light	brown n	nottled rea	dish	City Eik	Grove			Co	unty S	acramento		
80       82       Sandy Clayey Silt-reddish brown, medium plastic, very fine, moist       Total match of the second sec			b	rown, medium	n plastic, r	very fine	e, moist		Latitude			ħ	Longit	ude	W		
Image: second	80	82	S	andy Clayey	Silt- reddi	sh brow	/n, mediur	n plastic,		Deq.	Min.	Sec	1919	Ę	Dea Mín Sec.		
82       84       Sandy Silt-reddish brown, wery fine to fine, moist       APR book_115       Page 015       Parcel 035         84       96       Sandy Clayey Silt-reddish brown, medium plastic, monship       Range       Section Sketch         90       92       Sandy Silty Clay-light brown, medium plastic, monship       Description Sketch       Oneship         92       96       Silty Clay-brown mottled reddish brown, medium, wet       Description       Description         92       96       Silty Sand-reddish br., very fine to fine, wet       Total clayey Silt- tan mottled light br., med. plastic, wyr fine to medium, wet       Description       Description         105       Clayey Silt- tan mottled reddish brown, very fine to medium, wet       Total clayed Sandy Silt- tan mottled reddish brown, very fine to medium, wet       Total clayed Sandy Silt- tan mottled reddish brown, very fine, moist is accord and sandy silt 111.7. D 12, wet       Description       O ther			V	ery fine, moist	t				Datum_		Dec. Lat.	161		Dec.	Long		
B4       B6       Sandy Claye Silt reddish brown, medium plastic.       Convention       Range       Section         86       90       Silty Clay- light brown, medium plastic, moist       More than the dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama be dama by more than the dama by dama	82	84	S	andy Silt- red	dish brow	n, very	fine to fin	e, moist	APN Boo	ok <u>115</u>	Page	0150	:	. Parce	el <u>036</u>		
Be 90     Sitty Clay-tight brown, medium plastic, moist     Location Sketch     Activity       90     92     Sandy Sitt tan, very fine to fine, damp     Modification/Repair       92     96     Sitty Clay-brown motiled redish brown, medium     Modification/Repair       96     105     Clayey Sitt-tan motted light brn., med. plastic, werk into fine, wert     Modification/Repair       96     105     Clayey Sand-brown, medium plastic, very fine to medium, wet       107     110     Clayey Sand-brown, medium plastic, very fine to medium, wet       110     112     Sitty Sand- reddish brown, very fine to medium, wet       116     120     Sandy Sitt 117. To 112; wet       116     Sandy Sitt 117. To 112; wet       118     120     Sandy Sitt 117. To 112; wet       118     120     Sandy Sitt 117. To 112; wet       118     120     Sandy Sitt 117. To 112; wet       119     Total Depth of Boring     120       120     Feet       120     Feet <td>84</td> <td>86</td> <td>S</td> <td>andy Clayey</td> <td>Silt- reddi</td> <td>sh brow</td> <td>/n, mediu/</td> <td>n plastic,</td> <td>Townshi</td> <td>o</td> <td>Range</td> <td>- 14 -</td> <td>13.3</td> <td>Secli</td> <td>on</td>	84	86	S	andy Clayey	Silt- reddi	sh brow	/n, mediu/	n plastic,	Townshi	o	Range	- 14 -	13.3	Secli	on		
86       90       Sitty Clay- light brown, medium plastic, moist       Image: construction plastic, moist       0 New Veil         92       94       Sitty Clay- brown motiled reddish brown, medium       0 New Veil       0 New Veil         92       96       Sitty Clay- brown motiled reddish brown, medium       0 New Veil       0 New Veil         96       105       Clayes Sitt an mottle dight brm, med, plastic, wet       1 New Veil       0 New Veil         106       107       Sandy Clay- tan, med, plastic, wery fine to medium, wet       1 New Veil       0 New Veil         106       107       Sandy Sitt 11.7 to 112; wet       1 New Veil       0 New Veil         110       112       Sitty Sand- readish brown, very fine to medium, wet       1 New Veil       0 New Veil         110       112       Sitty Sand- readish brown, very fine to medium, wet       1 New Veil       0 New Veil         111       12       Sandy Sitt 1 an motiled reddish brown, very fine to medium, wet       New Veil       0 New Veil         1116       120       Sandy Sitt an motile diverties weet weet weet weet weet weet weet we			V	ery fine, mois	t				(Churton -	Locat	ion Sket	tch	dated 1		Activity		
90       92       Sandy Silt- tan, very fine to fine, damp         92       96       Sitty Clay- brown motiled reddish brown, medium         96       105       Clayey Silt- tan motiled light brn., med. plastic, very         105       106       Sitty Sand- reddish brown, very fine to fine, wet         105       107       Sandy Silt- tan motiled light brn., med. plastic, very fine to fine, wet         107       110       Clayey Sand- brown, medium plastic, very fine to fine, wet         110       112       Silty Sand- reddish brown, very fine to medium, wet         111       116       Silty Sand- reddish brown, very fine to medium, vert         112       116       Silty Sand- reddish brown, very fine to medium, vert         112       116       Silty Sand- reddish brown, very fine to medium, vert         112       116       Silty Sand- reddish brown, very fine to medium, vert         116       120       Sandy Silt- tan motiled reddish brown, very fine to medium, vert         116       120       Sandy Silt- tan motiled reddish brown, very fine to medium, vert         116       120       Sandy Silt- tan motiled reddish brown, very fine to medium, vert         116       120       Sandy Silt- tan motiled reddish brown, very fine to medium, vert         117       Total Depth of Boring       20	86	90	S	ilty Clay- light	brown, n	nedium	plastic, m	oist	15Kelch I	nust be drawn	North	er rottn is p	(inteo.)	ON	ew Well		
92       96       Silly Clay-brown mottled reddish brown, medium         98       105       Clayey Sit- Ian mottled light brn., med. plastic, wet         106       107       Silly Sand-reddish brown, medium plastic, very fine to medium, wet.         107       110       Clayey Sand-reddish brown, regrine to medium, wet.         107       110       Clayey Sand-reddish brown, very fine to medium, wet.         110       112       Silly Sand-reddish brown, very fine to medium, wet.         110       112       Silly Sand-reddish brown, very fine to medium, wet.         116       120       Sandy sill - tan mottled reddish brown, very fine to medium, wet.         116       120       Sandy Sill - tan mottled reddish brown, very fine to medium, wet.         116       120       Sandy Sill - tan mottled reddish brown, very fine to medium, wet.         116       120       Sandy Sill - tan mottled reddish brown, very fine to medium, wet.         116       120       Sandy Sill - tan mottled reddish brown, very fine to medium, wet.         116       120       Sandy Sill - tan mottled reddish brown, very fine to medium, wet.         116       120       Feet         117       Total Depth of Boring       120       Feet         Total Depth of Completed Well       120       Feet       Stata	90	92	S	andy Silt- tan	, very fine	e to fine.	, damp			1.000	Stille-	100	1		Deepen		
96       105       Clayey Silt: tan motiled light brn., wery fine to medium, wet.         105       106       Silty Sand- reddish brm., wery fine to medium, wet.         107       110       Clayey Sand- brown, medium plastic, very fine to medium, wet.         107       110       Clayey Sand- brown, wery fine to medium, wet.         108       Silty Sand- reddish brown, very fine to medium, wet.         110       112       Silty Sand- reddish brown, very fine to medium, wet.         112       116       Silty Sand- reddish brown, very fine to medium, wet.         112       116       Silty Sand- reddish brown, very fine to medium, wet.         112       116       Silty Sand- reddish brown, very fine to medium, wet.         110       120       Sandy Silt 11.7. to 112, wet.         111       120       Sandy Silt. 11.7. to 112, wet.         116       120       Sandy Silt. 11.7. to 112, wet.         116       120       Sandy Silt. 11.7. to 112, wet.         116       120       Sandy Silt. 11.7. to 112, wet.         117       120       Feet         118       120       Feet         120       Feet       Sufface         121       Total Depth of Boring       120         120       Feet <t< td=""><td>92</td><td>96</td><td>S</td><td>ilty Clay- brow</td><td>vn mottle</td><td>d reddis</td><td>h brown,</td><td>medium</td><td></td><td></td><td></td><td></td><td></td><td></td><td>Other</td></t<>	92	96	S	ilty Clay- brow	vn mottle	d reddis	h brown,	medium							Other		
96       105       Clayey Silt- tan mottled light brm, med. plastic, wet into a medium, wet, indiced and clayer tan, med. plastic, very fine to medium, wet, indiced and clayer start supply indit supply indiced and clayer start supply ind			p	lastic, moist, v	wet at 94'										estroy escribe procedures and materials		
105       106       Silty Sand-reddish brm, very fine to medium, vet,         106       107       Sandy Clay-tan, med. plastic, very fine to fine, wet         107       110       Clayey Sand-reddish brown, very fine to medium, wet         110       112       Silty Sand-reddish brown, very fine to medium, wet         110       112       Silty Sand-reddish brown, very fine to medium, wet         112       116       Silty Sand-reddish brown, very fine to medium, wet         118       120       Sandy Silt-tan motiled reddish brown, very fine,         118       120       Sandy Silt-tan motiled reddish brown, very fine,         116       moist to wet       South         Immediation       South       Immediation         116       Silty Sand-reddish brown, very fine,       South         Immediation       South       Immediation         Immediation       South       Immediation         Immediation       South       Immediation         Immediation       South       Immediation         Immediation       South       Immediation       South         Immediation       South       Immediation       South         Immediation       South       Immediation       South         Immediation	96	105	C	layey Silt- tar	mottled	light brn	n., med. pl	astic,wet						u	nder "GEOLOGIC LOG"		
106       107       Sandy Clay-tan, med. plastic, very fine to fine, wet         107       110       Clayey Sand- brown, medium plastic, very fine to imedium, wet         110       112       Sitty Sand- reddish brown, very fine to medium, wet         111       116       Sitty Sand- reddish brown, very fine to medium, wet         112       116       Sitty Sand- reddish brown, very fine to medium, wet         112       116       Sitty Sand- reddish brown, very fine, moist to wet       South         112       116       1120       Sandy Silt- tan motiled reddish brown, very fine, moist to wet       South         116       120       Sandy Silt- tan motiled reddish brown, very fine, moist to wet       South       South         116       120       Sandy Silt- tan motiled reddish brown, very fine, moist to wet       South       Water Subjeg, more         116       120       Feet       South       Vapor Extraction         117       118       120       Feet       Feet       Feet       (Feet) Date Measured         118       120       Feet       Feet       (Feet) Date Measured       Estimated Yield * (GPM) Test Type       Feet         118       120       Feet       Feet       South       South       South       South       South       South <td>105</td> <td>106</td> <td>S</td> <td>ilty Sand- red</td> <td>dish brn.,</td> <td>very fir</td> <td>ne to medi</td> <td>ium, wet</td> <td colspan="8">Planned Uses</td>	105	106	S	ilty Sand- red	dish brn.,	very fir	ne to medi	ium, wet	Planned Uses								
107       110       Clayey Sand- brown, medium plastic, very fine to medium, wet         110       112       Silly Sand- reddish brown, very fine to medium, wet         112       116       Silly Sand- reddish brown, very fine to medium, wet         116       120       Sandy Sill- tan mottled reddish brown, very fine, to medium, wet         116       120       Sandy Sill- tan mottled reddish brown, very fine, to medium, wet         116       120       Sandy Sill- tan mottled reddish brown, very fine, to medium, wet         116       120       Sandy Sill- tan mottled reddish brown, very fine, to medium, wet         116       120       Sandy Sill - tan mottled reddish brown, very fine, to medium, wet         116       120       Sandy Sill - tan mottled reddish brown, very fine, to medium, wet         116       120       Saudy Sill - tan mottled reddish brown, very fine, to medium, wet         117       Saudy Sill - tan mottled reddish brown, very fine, to medium, wet         118       120       Feet         120       Feet       Feet         121       Total Depth of Boring       120         120       Feet       Feet         121       Total Depth from Boring       Caeings         Surface       Barneter       Type         120       Feet       F	106	107	S	andy Clay- ta	n, med. p	lastic, v	ery fine to	o fine, wet									
Indextor       immedium, wet         110       112       Silty Sand-reddish brown, very fine to medium, standy silt 111.7 to 112, wet         112       116       Silty Sand-reddish brown, very fine to medium, wet         112       116       Silty Sand-reddish brown, very fine, omedium, wet         112       116       Silty Sand-reddish brown, very fine, omedium, wet         112       116       Silty Sand-reddish brown, very fine, omedium, wet         116       120       Sandy Silt-tan mottled reddish brown, very fine, omediation         116       120       South         117       120       South         118       120       Feet         119       120       Feet         110       120       Feet         111       120       Feet         111       120       Feet         112       120       Feet         111       120       Feet         111       120       Feet         111       120       Feet         1110       120       Feet         1111       120       Feet         1111       120       Feet         1111       120       Feet         1111	107	110	C	layey Sand-I	prown, me	edium p	lastic, ver	y fine to	- Frigation Industrial								
110       112       Sitty Sand-reddish brown, very fine to medium, wet         112       116       Sitty Sand-reddish brow, very fine to medium, wet         112       116       Sitty Sand-reddish brow, very fine to medium, wet         116       120       Sandy Sitt-tan mottled reddish brown, very fine, moist to wet <ul> <li>Suth</li> <li>Material</li> <li>Material</li> <li>Total Depth of Boring</li> <li>Total Depth of Completed Weil</li> <li>Total Depth</li></ul>		medium, wet											ш		athodic Protection		
intermediation       intermediation       intermediation       intermediation       intermediation         intermediation       intermediation       intermediation       intermediatintermediatintermediation       intermediation	110	112	S	ilty Sand- red	dish brow	n, very	fine to me	edium,	- O Dewatering								
112       116       Silly Sand-reddish Drw., very fine to medium, wet         116       120       Sandy Silt- tan mottled reddish brown, very fine,			Si	andy silt 111.	7 to 112',	wet			O Heat Exchange								
116       120       Sandy Sit- tan mottled reddish brown, very fine, moist to wet	112	116	S	ilty Sand- red	dish brn.,	very fir	ne to medi	ium, wet	41					O In	jection		
moist to wet       South         South       South         Image: south       South	116	120	IS	andy Silt- tan	mottled r	eddish	brown, ve	ry fine,									
South       Orasigned         South       Orasigned         Besteries of decrific distance of well contracting performance processor.       Orasigned         Depth form       South         Total Depth of Boring       120         Feed to Score decrific distance of well contractor       (Feet below surface)         Depth form       Borehole         Surface       (Feet below surface)         Depth form       Borehole         Surface       (Feet below surface)         Depth form       Borehole         Surface       (GPM) Test Type         Test Length       (Hours) Total Drawdown         Yay not be representative of a well's long term yield.         Casings       Screen         Surface       Fill         Depth from       Borehole         Surface       (Inches)         (Inches)       (Inches)         (Inches)       (Inches)         (Inches)       (Inches)         (Inches)       Inches         (Inches)       (Inches)         (Inches)       (Inches)         (Inches)       (Inches)         (Inches)       (Inches)         (Inches)       (Inches)         (Inches)		_	m	noist to wet		1-22											
South       South       O Vapor Extraction         Image: the scalar and completed with the scalar and complete and completed with the scalar and complete and completed wi						24.			-11		•			ΟT	est Well		
Image: Second		_							Illustrate or de	eoribe distance e	South	do buildinge	fantann	Ōv	apor Extraction		
Water Level and Yield of Completed Well         Depth to Boring       120         Total Depth of Boring       120         Feet       Feet         Depth for       Borehole         Surface       Diameter         Type       Material         Material       Wall         Outside       Screen         Surface       Diameter         Type       Material         Material       Material         Surface       Fill         Depth from       Borehole         Surface       (Inches)         Inches       (Inches)         Geologic Log       (Inches)         Meterial       Material         Depth from       Screen         Surface       Fill         Depth from       Screen </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td colspan="8">Inverse els accurate and complete     Inverse de accurate and complete     Inverse de accurate and complete     Inverse de accurate and complete</td>									Inverse els accurate and complete     Inverse de accurate and complete     Inverse de accurate and complete     Inverse de accurate and complete								
Total Depth of Boring       120       Feet         Total Depth of Boring       120       Feet         Total Depth of Completed Well       120       Feet         Borehole       Static       (GPM) Test Type         Borehole       Tippe       Material       Thickness         Surface       Diameter       Type       Material         Thickness       Cassings       Screen       Stot Size         Depth from       Borehole       Diameter       Type         Surface       Diameter       Type       Material         Thickness       Cassings       Screen       Stot Size         Depth from       Borehole       Diameter       Type         Surface       Fill       Description         Feet       Inches)       (Inches)       Feet         Geologic Log       Inchesioned, certify that this report is complete and accurate to the best of my knowledge and belief         Name       Velicent Core       Cassing       City       State         Soit/Water Chemical Analyses       Signed       City       State       Zip         Other       Geologic Log       Material       Core       City       State       Zip         Other       Geologic						114			Water Level and Vield of Completed Well								
Total Depth of Boring       120       Feet         Total Depth of Completed Well       120       Feet         Depth form       Borehole       Tast Length       (GPM)         Surface       Diameter       (GPM)       Total Depth of Completed Well       (GPM)         Depth form       Borehole       Type       Feet       Thickness       Screen       State       (GPM)       Total Depth from         Surface       Diameter       Type       Material       Wall       Outside       Screen       State       Depth from       Depth from       Screen       Fill       Description         Feet       Inchess       (Inches)       (Inches)       (Inches)       Feet       Feet       Feet       Feet       Depth from       Depth from       Screen       Fill       Description         Geologic Log       (Inches)       (Inches)       (Inches)       Feet       Feet       Feet       Feet       Fill       Description         Meal       Geologic Log       (Inches)       (Inches)       Feet       Fill       Description         Meal       Geologic Log       (Inches)       (Inches)       Certification Statement       State       State       Zip       State       Zip		_							Depth to	first water	58			(Fee	t helow surface)		
Image: Contract of Boring       120       Feet       Water Level       (Feet)       Date Measured         Total Depth of Boring       120       Feet       Feet       (GPM) Test Type       [Hours] Total Drawdown       [Feet]         Total Depth of Completed Well       120       Feet       Feet       (Hours) Total Drawdown       [Feet]         Depth from Surface       Borehole Diameter       Type       Material       Wall Thickness       Outside Diameter       Screen Type       Slot Size if Any (Inches)       Depth from Surface       Fill       Description         Feet       Inches       (Inches)       (Inches)       (Inches)       Feet       Image: Screen Stot Size if Any (Inches)       Depth from Surface       Surface       Fill       Description         Feet       Inches       (Inches)       (Inches)       (Inches)       Image: Screen Stot Size if Any (Inches)       Depth from Surface       Surface       Fill       Description         Geologic Log       Image: Screen Stot Size       Image: Screen Stot Size       Image: Screen Stot Size       Image: Screen Stot Size       Feet       Feet       Image: Screen Stot Size       Feet       Image: Screen Stot Size       Image: Screen Stot Size       Feet       Feet       Image: Screen Stot Size       Feet       Image: Screen Stot Size       Image								A	Depth to Static								
Total Depth of Boring       120       Feet         Total Depth of Completed Well       120       Feet         Depth from       Borehole       Diameter       Type         Material       Wall       Outside       Screen       Store presentative of a well's long term yield.         Depth from       Borehole       Diameter       Type       Material       Wall       Outside       Screen       Store presentative of a well's long term yield.         Surface       Diameter       Type       Material       Wall       Outside       Screen       Store presentative of a well's long term yield.         Material       Wall       Outside       Screen       Store presentative of a well's long term yield.         Material       Wall       Outside       Screen       Store presentative of a well's long term yield.         Material       Wall       Outside       Screen       Store presentative of a well's long term yield.         Material       Wall       Outside       Screen       Store presentative of a well's long term yield.         Material       Wall       Outside       Screen       Store presentative of a well's long term yield.         Material       Wall       Outside       Screen       Store presentative of a well's long term yield.         Mate			the state						Water Le	evel		(Feel	t) Date	Measu	ured		
Total Depth of Completed Well 120       Feet       Test Length	Total D	epth of Bo	oring	120		- de la com	Feet		Estimate	d Yield *			<li>Iest</li>	Type	(Caal)		
May not be representative of a went storing term yield.         Casings       Annular Material         Depth from Surface       Borehole Diameter (Inches)       Type       Material       Material       Description         Feet to Feet       Diameter (Inches)       Type       Material       Thickness Diameter (Inches)       Type       If Any (Inches)       Depth from Surface       Surface       Fill       Description         Image: Surface       Feet to Feet       Feet to Feet<	Total D	epth of Co	omplete	d Well 120			Feet		[ Test Length (Hours) Total Drawdown (Feet)								
Depth from Surface       Borehole Diameter       Type       Material       Wall Thickness Diameter (inches)       Streen Type       Stot Size if Any (inches)       Depth from Surface Feet to Feet       Fill       Description         Material       Material       Material       Inches       In			-		Con	Inco			A may hot be representative of a weir's long term yield.								
Surface       Diameter       Type       Material       Thickness Diameter       Type       if Any (inches)       Surface       Fill       Description         Feet to Feet       (inches)       (inches)       (inches)       (inches)       Feet to Feet       Feet to Feet       Fill       Description         Image: Surface       Fill       Image: Surface       Fill       Description         Image: Surface       Fill       Image: Surface       Fill       Description         Image: Surface       Fill       Image: Surface       Fill       Description         Image: Surface       Fill       Description       Feet to Feet       Feet to Feet         Image: Surface       Image: Surface       Fill       Description         Image: Surface       Image: Surface       Fill       Description         Image: Surface       Image: Surface       Feet to Feet       Feet to Feet         Image: Surface       Image: Surface       Image: Surface       Fill       Description         Image: Surface       Image: Surface       Image: Surface       Fill       Description         Image: Surface       Image: Surface       Image: Surface       Fill       Description         Image: Surface       Image: Surface <td< td=""><td>Depti</td><td>from</td><td>Borehol</td><td>e</td><td>Cas</td><td>mys</td><td>Wall</td><td>Outside</td><td>Screen</td><td>Slot Size</td><td>Depth</td><td>from</td><td>Annu</td><td>ar ma</td><td>Lenar</td></td<>	Depti	from	Borehol	e	Cas	mys	Wall	Outside	Screen	Slot Size	Depth	from	Annu	ar ma	Lenar		
Feet to Feet       (incres)       (incres)       Feet to Feet         Image: Sector Se	Sur	face	Diamete	г Туре	Mate	rial	Thickness	Diameter	Туре	if Any	Sur	face	Fi	ill	Description		
Attachments       Certification Statement         Geologic Log       I. the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Well Construction Diagram       I. the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Soil/Water Chemical Analyses       Other         Attach additional information, if it exists.       Address	Feet	Peet	(Inches)				(inches)	(incries)		(Inches)	Feet t	o reet			Y		
Attachments       Certification Statement				3.0													
Attachments       Certification Statement         Geologic Log       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and bellef         Well Construction Diagram       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and bellef         Geophysical Log(s)       Person, Firm or Corporation         Other       Address         Attach additional information, if it exists.       City         Other       City         Attach additional information, if it exists.       Contractor			1	2 5													
Attachments       Certification Statement         Geologic Log       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Well Construction Diagram       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Geophysical Log(s)       Person, Firm or Corporation         Soll/Water Chemical Analyses       Other         Attach additional information, if it exists.       Address			1														
Attachments       Certification Statement         Geologic Log       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Well Construction Diagram       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Geophysical Log(s)       Person, Firm or Corporation         Other       Address         Attach additional information, if it exists.       City         Contractor       Date Signed			i,							·							
Attachments       Certification Statement         Geologic Log       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Well Construction Diagram       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Geophysical Log(s)       Person, Firm or Corporation         Other       Address         Attach additional information, if it exists.       City         Construction       Date Signed				S													
Geologic Log       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Well Construction Diagram       Geophysical Log(s)         Soil/Water Chemical Analyses       Other         Attach additional information, if it exists.       Constructor	Attachments Certification Statement																
Well Construction Diagram         Geophysical Log(s)         Soil/Water Chemical Analyses         Other         Attach additional information, if it exists.		Geologic	Log			I, the u	ndersigner	, certify th	at this report	is complet	te and ac	curate to	the bes	at of my	knowledge and belief		
Image: Constraint of the state       Constate       Constraint of the state		Well Cons	struction	Diagram		Name	Person	Firm or Corpo	ation	nnd-	-	1			01171		
Attach additional information, if it exists.		Geophysical Log(s)								b	00dl	and	$+ \frac{1}{2}$		45116		
Attach additional information, if it exists.		Soil/Water Chemical Analyses     Signed     Address     Signed								City State Zip							
	Atlach add	Attach additional information, if it exists.								ar Well Contractor Date Signed C-57 License Number							

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM
### WELL CONSTRUCTION SUMMARY City of Elk Grove Strawberry Creek Detention Basin Monitoring Well No. 4

November 2013

#### Introduction

Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this summary for the construction of the City of Elk Grove's Strawberry Creek Detention Basin Monitoring Well No. 4 (SC MW-4). Included are monitoring well construction and development details, an as-built well construction drawing, lithologies encountered, well completion report, and permit.

#### **Monitoring Well Construction**

On September 26, 2013, PeneCore Drilling of Woodland, California (PeneCore) commenced SC MW-4 test hole drilling. The test hole was drilled to a depth of 120 feet below ground surface (bgs) at a diameter of 8 3/4-inches by the hollow stem auger method. Continuous core split spoon samples were collected and analyzed by LSCE. The formation lithologies encountered were used as the basis of the piezometer design. SC MW-4 consists of a single piezometer constructed of 2-inch ASTM F480-88A schedule 40 PVC pipe. The perforated well screen section has machine cut slots with 0.030-inch openings. The total completed depth of SC MW-4 is 120 feet bgs. The screened interval is from 115 to 100 feet bgs. The annular space from 120 to 97 feet bgs is filled with a SRI #8 gravel. A Cemex #60 fine sand transition seal was placed from 97 to 95 feet bgs. On September 30, 2013, an annular seal consisting of 11.8 sack sand/cement grout was placed from 95 feet to ground surface in accordance will all permitting requirements in the presence of the County of Sacramento inspector.

At the completion of construction activities, the piezometer was developed by a Waterra inertial pump for approximately three hours until the water was clean and free of solids.

#### Note on Datum

All depths cited in this summary report are based on grade as it existed at the time of construction.



Cli	ient:	City of Elk Grove	Lat/Long:			201		1.16.11296.51	
Pr	oject Name:	Strawberry Creek Basin MW-4	GSE (ft-msl)						TING ENDINEEDS
LS	CE #:	12-1-001	Drill Date:	09/27/20	13-09/30	0/2013			
Lo	cation:	Mountain Bell Drive	Drilling Method:	Hollow S	Stem Aug	er			
Ge	eologist:	W. Andrews/C. Jenkins	Driller:	Penecor	e Drilling				
		Lithologic Description			Strat- Column		Well C	onstructi	on Diagram
_0	0-5' Silty Clay	- reddish brown, medium plastic w/ fine	sand, moist		T'T				
-	5-9' Sandy Sil	t- yellowish brown, very fine to fine, moi	st						
- 10	9-18' Sandy S	ilty Clay- tan mottled light brown, mediu	ım plastic, very fine, n	noist	NY NY				
- 20	18-19' Sandy	Silt- tan, very fine to fine, moist			T -				
-	19-21' Silty Sa	and- brown, very fine to fine, micaceous	, moist						
-	21-23' Sandy	Silt- tan mottled light brown, very fine, m	noist						
- 30	23-24' Sand- b	prown, very fine to medium, moist		]	T				
-	24-27' Silty Cla	ay- tan, medium plastic, moist		]					
-40	27-33' Sandy	Silt- tan, very fine, moist			1.				
-	33-39 Sand- 0	Srown, very fine to medium, moist		/	1/2				
-	41-45' Sandy	Silty Clay- brown, medium plastic, very i	fine moist		771				— Annular Seal
- 50	45-48' Sandy	Clayey Silt- tan mottled light brown, mer	dium plastic, moist		·				10.3 Sack Sand/Cement Grout
-	48-51' Sand- b 51-54' Silty Sa	prown, very fine to medium, moist, wet a and- brown, very fine to fine, micaceous	nt 49' , moist to wet		7, T V7,				<ul> <li>Well Casing 2-Inch Dia. Sch. 40 PVC ASTM F480-88A</li> </ul>
-60	54-61' Sandy (	Clayey Silt- tan mottled light brown, med	dium plastic, very fine	, moist	TT T				Flush Threaded
	61-63' Silty Cla	ay- brown mottled reddish brown, mediu	ım plastic, moist	/	1/27				H 8.75-Inch Dia
- 70	63-67' Sandy ( 67-81' Sandy (	Clayey Silt- light brown, medium plastic, Clayey Silt- reddish brown, medium plas	moist stic, very fine, wet		TTTT				Borehole
-				777					
-					7/7		1000	200a	
-80	81-85' Sandy (	Clayey Silt- tan, medium plastic, very fin	ie, wet		1/17				
	85-91' Sandy (	Clayey Silt- tan, medium plastic, very fin	ie, moist		ידיד				
-90					777			1000	
-	91-115' Sandy wet	Clayey Silt- tan mottled yellowish brow	n, medium plastic, fin	e, moist to	777	95			
-					777	97	1.1.1		<ul> <li>Fine Sand Transition Seal</li> </ul>
- 100					77	100			- Well Screen 2-Inch
					777				Dia Sch 40 PVC w/
- 110									Flush Threaded
			T/T						- Gravel Envelope
-	115-120' No S	amples	7/ 115			115			#8 SRI
120						120	2.24		

X:\2012 Job Files\12-001\Log Plot\SC MW-4

*The free	e Adobe Re	eader ma	ay be used to view	and complete	this form. How	wever, :	software mi	ust t	be purchase	d to comple	ete, save,	and reuse	e a saved fo	្រាះ	
File Orio	ginal with	DWR				Sta	ate of Cali	forr	nia		1.05.	DV	VR Use Onl	y – Do	Not Fill In
Page 1	Í	of	1		Well	Col	mpleti	on	n Repo	rt			1	1	
Owner's	Well Nur	mber S	SC MW-4		_	No.	e019074	<b>49</b>	npriiei			Sta	Nun	nber/Si	te Number
Date W	ork Begar	09/27	7/2013	Date	Nork Ended	9/30	/2013	_				Latitude			Longitude
Local P	ermit Age	ncy Co	ounty of Sacra	mento	0/20/12							1	APN/T	I I RS/Oth	her
Permit	Number <u>o</u>	03104		Permit Da	e <u>9/20/13</u>						-				Contraction of the local division of the loc
0-	Instation	01/0	Geold	ogic Log	OApala	Pagaif		1		1 ( TTH	0	Well	Owner	1	
Drilling	Method H	follow St	tern Auger	nzontai	Drilling Fluid	Specin	y	-	Name C	ITY OF EIK	Grove				
Dept	h from Su	urface	a series of	Desc	ription	din te	A CHILDREN		Mailing A	ddress _	3401 La	quna Pa	alms wa	V CA	05759
Fee	t to F	eet	Des	scribe material,	grain size, col	or, etc.	100 J. 483	4	City Eik	Giove			Stat	e OA	Zip 95756
0	5		Silty Clay- red	adish brown	, medium p	lastic	w/ fine	-1	1. S.	te te		Well	ocation	-	
5	0		Sand, moist	lowish bro		o to fi	ino moio		Address	Mountai	n Bell D	rive (St	rawberry	Cree	ek Detention Basin)
9	18		Sandy Silty C	lav- tan mo	tled light h		medium	4	City EIK	Grove	_		Cou	nty 5	acramento
5			plastic very f	ine moist	aleu ngin bi	0001,	mediam		Latitude	Deg.	Min	Sec	N Longitu		Deg. Min. Sec. W
18	19		Sandy Silt- ta	n verv fine	to fine, moi	ist			Datum_		Dec. Lat		1	Dec.	Long.
19	21		Silty Sand- b	rown, verv fi	ne to fine.	mica.	moist		APN Boo	ok <u>115</u>	Page	0150		Parce	el 036
21	23		Sandy Silt- ta	n mottled lid	ht brown.	verv fi	ine. mois	t	Township	00	Range	00	Trigonal .	Secti	ion
23	24		Sand- brown	very fine to	medium, n	noist				Locat	ion Ske	tch		ŝ.	Activity
24	27	8	Silty Clay- tar	n, medium p	lastic, mois	st			(Sketch n	hust be drawn	by hand all	ter form is	printed.)	O N	lew Well
27	33		Sandy Silt- ta	in, very fine	moist									0	Deepen
33	39	_	Sand- brown,	very fine to	medium, n	noist							_	<u> </u>	Other
39	40		Sandy Silt- bi	rown, very fi	ne, moist								14 <sub>66</sub>	OD	escribe procedures and materials
40	41		Silty Clay- bro	own, mediur	n plastic, m	noist		_					1		Plannod Lloos
41	45		Sandy Silty C	lay-brn., m	ed. plastic,	very	fine,mois	st	10			10	1	010	Planned Uses
45	48		Sandy Claye	y Silt- tan m	ottled light	brown	n, mediur	n	18 <sup>00</sup>						Domestic Public
			plastic, moist				101		lest				ast	ō	Irrigation Industrial
48	51		Sand- brn., V	ery fine to m	edium, mo	ist, w	et at 49	-	5				۳	00	athodic Protection
51	54		Silty Sand- Di	n., very tine	to tine, mi	caimo	DIST to we	τ.						0 D	ewatering
54	- 101		plastic your	y Sill- tan m	ottieo light	om., r	nealum	-						OH	leat Exchange
61	63		Silby Clay- br	me, moist	reddich br	own	medium	-							
	- 05		plastic moist		Tequisit bi	Civil,	meaturn		1					ÖR	temediation
63	67		Sandy Clave	v Silt- light h	m med o	lastic	moist	-						Os	parging
67	81	-	Sandy Clave	v Silt- reddis	h brown, m	nediur	n plastic				South			OT	est Well
			very fine, wet	W.	55				Illustrateor des	scribe distance d	f well from ro	ads, buildings	, fences,		apor Extraction
81	85		Sandy Claye	y Silt-tan, m	ed. plastic	, very	fine, wet		Please be acc	curate and com	plete.	puper il ricol	ooury:	00	
85	91		Sandy Claye	y Silt- tan,m	ed. plastic,	very f	ine, mois	st	Water L	evel and	Yield o	of Com	pleted W	lell	
91	115		Sandy Claye	y Silt- tan m	ottled yello	wish I	orn., med	ł.,	Depth to	first water Static	49			_(Fee	et below surface)
			plastic, fine, r	noist to wet	No sample	es 11	5-120'		Water Le	evel		(Fee	et) Date	Measu	ured
Total	Depth of E	Boring	120			Feet			Estimate	d Yield *		(GP	M) Test	Гуре	
Total	Depth of C	Comple	ted Well 120	1997 - C.		Feet			Test Len	igth	antallus	(Hou	urs) Total	Drawo	down (Feet)
-	-	Sent La	and the second second	Creek	2) II			_	May no	t be repres	l	or a wei	rs long te	ini yie	
Dep	th from	Boreh	ole -	Casi	ngs	Nall	Outside	etin.	Screen	Slot Size	Dept	h from	Annua	ar ivia	lterial
Su	Inface	Diame	eter Type	Mater	al Thio	kness	Diameter		Туре	if Any	Su	rface	FA	ļ.	Description
0	100	8.75	Blank	PVC Sch. 40	0	iches)	(inches)	Т		(Inches)	O	95	Cement		10.3 Sack sand/
100	115	8.75	Screen	PVC Sch. 40			2	Mi	illed Slots	0.030			1		cement
115	120	8.75	Blank	PVC Sch. 40			2				95	97	Fine San	d	Transition
											97	120	Filter Pac	k	SRI #8 Gravel
	-		ā. jā			_		-							
	1		112		_			1			I	1	1	-	
No. of Concession, No.	anestra i vez	Attac	hments		0	A	L ac diff. it	100	C	ertificat	ion Sta	tement	o the bar	of	- knowledge and to be
	Geologic	c Log	no Disaram		Name	E Pre	COV	2	Dr. 1	is comple	te and a	ccurate t	o the best	or my	knowledge and belief
	Geophys	sical Lo	g(s)		770	Person, I	Firm or Corpo	ratio	phit c	1 1.	Im	lan	dc	Δ	95776
	Soil/Wat	er Che	mical Analyses		100	1	odress	-	.0.	21	City	indi	/ Sta	te	Zlp
	Other _				Signed	1	Jan Contraction	10 lon	Contractor	A		11/57	113	906	899
Attach ad	ditional infor	mation, if	it exists.			or Lici	unsed water	vveli	Contractor			Date Si	gned C	-57 Li	cense number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

## **Corporation Yard Monitoring Well Construction**

Site Plan Permit Construction Summaries As-Built Profiles Well Completion Reports



Path: X:\2012 Job Files\12-001\GIS\CY\_WCR Well Layout.mxd



Corporation Yard Well Layout 20

A A A A A A A A A A A A A A A A A A A		ATION AND PERMIT FO	RM
	ENVIRONMENTAL MANAGEMENT DEP	ARTMENT - ENVIRONMENTAL	
	TELEPHONE (9	16) 875-8400 FAX: (916) 875-8513	EXPEDIT
Presses and	WELL INSPEC	TION LINE: (916) 875-8	524
ALLONDO.	IS THIS PERMIT FOR A HAZARDOUS	SUBSTANCE INVESTIGATION	
APPROVED APPRO BY: INITIAL GROUT BY: FINAL INSPECTION BY: DESTRUCTION BY: COMMENTS:	DATE: WELL DE DATE: WELL DE DATE: WELL DE DATE: WELL DE DATE: WELL DE DATE: GPS: N: TSCL FULTURE	AUMBER(S): CEIVED: 90/13 TOTAL NO: 00/13 TOTAL DEPTI GROU 38 W: 12	L-3190
SITE ADDRESS: 1000			CORPUARD
Job Address:	SO I ROA Kerk Went	rest Major Opss Street: Elk N	Lont Wing
Property Owner. Cit	- SIL Gran	cel Number(s): 1244-06	30-0370
Well Contractor: D	CA CA	License No: 9+6855)	Q. 11/30/13
Contractor's Address:	2 - W Full Scheeder 1.	authort of 7573	y or San
Well/Boring Identification	Number(s):	Treation Delle	Valore Zore Well
) Domestic/private ) Irrigation/agricultural Water/vapor monitoring/	Cathodic protection     Heat exchange	Dither:	tal boring
DRILLING METHOD: Mud rotary	(NAME OF WATER PURVEYOR WITH CON	Driven Driven	E NUMBER)
SETBACKS: (Wells only) s the well located within 5 s the well located within 1	D feet of a: D sewer line, D stream, D c D feet of a: D septic tank, D leach line,	litch, □ drainage course, □ pond, □ deep trench, or □ animal encio	or lake? b-No sure? J_No
BOREHOLE: Diamete	R.S. Depth: 125	CASING: Diameter: 2" CASING: Diameter: 2"	Depth: 120 Depth: <u>CS</u>
CONDUCTOR: Diamete ANNULAR SEAL: Depth IRANSITION SEAL: 3	Material: Comp	IF STEEL: Gauge:	(Must meet ASTM F-480) (BIAGRAM REQUIRED)
PUMP INSTALLATION R	PAIR: Sand	Cement	4.5
Contractor:		Type of Pump:	Horsepower:
I will comply with all Codes 8524 for a grout inspec required) within 60 days of well in service.	Rules and Regulations of the State and Co ion at least 24 hours prior to the request f the completion of my work so a final inspe	unty pertaining to or regulating v ated appointment time, submit action can be made, and obtain	velis and pumps, call (916) 876- t a "Well Completion Report" (If WPD approval before placing a
SIGNATURE:	- forg	Property Owner     Property Owner     Property Owner	94-DON
PRINTED NAME:	Pare Cover Dilling	D Agent (REQUIRES	AUTHORIZATION FORM)
MAILING ADDRESS:	220 N. East Scheet	FIELD PHONE:	30 681-3158
PHONE NUMBER	1 10 -01 1101		
PHONE NUMBER:	A SITE PLAN MUST BE SUBMITTE	D WITH EACH APPLICATION.	ENDED)

Generated by CamScanner from intsig.com

## Information For Parcel: 134-0630-037-0000

PROPERTY IN	FORMATION
APN	13406300370000
Situs Address	10250 IRON ROCK WY
Postal	ELK GROVE, CA 95624
City/St/Zip	
	Additional Addresses for this Parcel
Thomas Bros	378 J 2
Landuse Code	WDAC0A
Jurisdiction	ELK GROVE
Sup. District	District 5 - Don Nottoli
OWNERSHIP	INFORMATION
Owner	<ul> <li>CITY OF ELK GROVE</li> </ul>
Mailing	10250 IRON ROCK WAY
Address	ELK GROVE, CA 95624
Transfer Date	2004-08-30
Deed	View Property Transfer Document
<b>Owner History</b>	View Owner History
PARCEL DET.	AIL LINKS
General Info	View General Parcel Data
Districts	View District Data
Recorded Map	No maps are available.
Assessor Maps	View Assessor Map
Parcel History	View Splits and Merges History Data
Assessment	View Assessor Data
Info	
Building	View Permits
Permits	
Parcel Notes	No Parcel Notes recorded.
Business	No Business License Data available.
Licenses	
SHRA Info	View SHRA Data
CUBS Info	View CUBS Data
Refuse Pickup	No Refuse Pickup schedule available.
Water Meters	00000000012118601

### WELL CONSTRUCTION SUMMARY

City of Elk Grove Corporation Yard Monitoring Well No. 1 November 2013

#### Introduction

Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this summary for the construction of the City of Elk Grove's Corporation Yard Monitoring Well No. 1 (CY MW-1). Included are monitoring well construction and development details, an as-built well construction drawing, lithologies encountered, well completion report, and permit.

#### **Monitoring Well Construction**

On October 10, 2013, PeneCore Drilling of Woodland, California (PeneCore) commenced CY MW-1 test hole drilling. The test hole was drilled to a depth of 120 feet below ground surface (bgs) at a diameter of 8 3/4-inches by the hollow stem auger method. Continuous core split spoon samples were collected and analyzed by LSCE. The formation lithologies encountered were used as the basis of the piezometer design. CY MW-1 consists of a single piezometer constructed of 2-inch ASTM F480-88A schedule 40 PVC pipe. The perforated well screen section has machine cut slots with 0.030-inch openings. The total completed depth of CY MW-1 is 115 feet bgs. The screened interval is from 110 to 80 feet bgs. The annular space from 120 to 77 feet bgs is filled with a SRI #8 gravel. A Cemex #60 fine sand transition seal was placed from 77 to 75 feet bgs. On October 11, 2013, an annular seal consisting of 11.8 sack sand/cement grout was placed from 75 feet to ground surface in accordance will all permitting requirements in the presence of the County of Sacramento inspector.

At the completion of construction activities, the piezometer was developed by a Waterra inertial pump for approximately three hours until the water was clean and free of solids.

#### Note on Datum

All depths cited in this summary report are based on grade as it existed at the time of construction.



С	ient:	City of Elk Grove	Lat/Long:					11140	
Pr	oject Name:				5	CONS	ULTING ENGISEEDS		
LS	SCE #:	12-1-001	Drill Date:	10/10/2013-	10/11/20	13			
Lo	ocation:	10250 Iron Rock Way	Drilling Method:	Hollow Sten	n Auger				
Ge	eologist:	W. Andrews/C. Jenkins	Driller:	Penecore D	rilling				
		Lithologic Descriptio	'n		Strat- Column		Well (	Constru	ction Diagram
0	0-5' Clay- red,	, hard, trace sand and silt, hardpan			1				
-	5-7' Clayey Si	lty Sand- brittle, hard, reddish brow	n, very fine to fine		171				5 6
- 10 -	7-9' Sandy Cla	ayey Silt- reddish brown, low plastic	c, very fine to fine	/					
- - - 20	9-15' Silty Sar 15-17' Sand- v 17-19' Silty Cl 19-22' Silty Sa 22-23' Sand- v	nd- very fine to fine, reddish brown, very fine to fine, tan, loose, slightly ayey Sand- very fine to fine, packe and- very fine to medium, tan, pack very fine to fine, well sorted, loose,	medium plastic, trace moist d, reddish brown, somo ed tan	clay e white clay	T T /7/5 T T				
-	23-25' Sandy 25-27' Clayey	Clayey Silt- hard, reddish brown, b Silt- light brown, medium plastic	rittle		T				
- 30	27-29' Silty Sa	and- very fine to fine, reddish browr	n, packed		ŦŢ.				
-	29-30' Sandy	Silt- very fine to fine, reddish browr	n, hard	]					
- 40	30-31' Silty Sa 31-47' Sand- v	and- very fine to medium, loose, tar very fine to medium, loose, light bro	ı wm						Annular Seal 10.3 Sack Sand/Cement Grout Well Casing 2-Inch Dia. Sch. 40 PVC
- 50	47-48' Clayey 48-49' Sandy 3	Silt- tan, brittle, hard Silt- very fine to fine, dark tan, brittl	e		<b>∓</b> ,⊤ ⊤				ASTM F480-88A Flush Threaded
È	49-50' Silty Sa	and- very fine to fine, loose, tannish	gray						
-60	50-52' Sandy	Silt- very fine to fine, hard, brown							0.75 lash Dis
-00	52-63' Sand- v	very fine to medium, tan to light bro	wn						Borehole
- - - 70 -	63-67' Sandy 3 67-71' Clayey 71-79' Sandy 3	Silt- very fine to fine, packed, moist Sandy Silt- tan, moist, packed, ver Silt- very fine to fine, moist, reddish	, tan y fine to fine brown			75			— Fine Sand
- 80	79-81' Silty Sa 81-82' Sand- fi	nd- fine to medium, wet, sub-round ine to medium, wet, brownish red, o	led, brown clean			80			I ransition Seal
-	82-85' Sandy 3	Silt- very fine to fine, hard, brownis	h red, wet						
-90	85-93' Silty Cla	ay- reddish brown, medium plastic,	moist		TT I				
-	93-95' Silty Sa	and- very fine to fine, reddish brown	, wet		T/T				Well Screen 2-Inch
- - 100 -	95-109' Silty C	Clay- reddish brown, medium plastic	c, moist to wet						Dia. Sch. 40 PVC w/ 0.030-Inch Slot Size Flush Threaded
-					Z				Gravel Envelope #8 SRI
- 110	109-113' Sand	I- fine to medium, brown, wet				110			
ž.	113-120' Silty	Clay- brown, medium plastic, wet			7	115			
120					T	120			

*The free	Adobe Re	ader m	ay be used to vie	w and complete	this form.	However,	software m	lust be purchas	ed to comple	ete, save,	and reus	e a saved fo	<b>ит</b> і.	
File Orig	jinal with	DWR				State	ate of Cal	ifornla		-17-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	DV	R Use Only	y – Do l	Not Fill In
Page 1		of	2		We	ell Co	mpleti	on Repo	ort	1	1	I. J.	1	
Owner's	Well Nu	nber	CY MW-1			Refer No.	e01904	n Pamphlet 55		[]	Sta	e Well Num	iber/Sit	e Number
Date We	ork Begar	10/1	0/2013	Date	Work End	ed 10/1	1/2013				Latitude	1 [19]		Longitude
Local Pe	ermit Age	ncy <u>C</u>	ounty of Sacra	amento				<u> </u>		[	i Li	1		
Permit N	Number 5	3187		Permit Da	ite <u>9/20/</u>	13			L	-		APN/II	RS/Oth	er
		- A. A.	Geol	ogic Log	방법은 생	Pit - mark		A DEST		NV R	Well	Owner		No. of Concession, No. of Conces
Or	ientation	ΟV	ertical OH	orizontal	OAngle	Specif	у	– Name 🤆	City of Elk	Grove				
Drilling	Method F	ollow a	stem Auger	Dee	Drilling Fl		maxin y	Mailing /	Address _8	8401 La	guna P	alms Way	/	
Feel	to F	eet	De	scribe material	grain size;	color, etc		City Elk	Grove			Stat	e <u>CA</u>	Zip95758
0	5		Clay- red, ha	ird, trace sa	nd and si	lt, hardp	an	A COLORES	مربع میں اور	125 La	Well I	ocation	e Aller H	
5	7		Clayey Silty	Sand- brittle	, hard, re	ddish bi	rown,	Address	10250 lr	on Roc	k Way	214		
			very fine to f	ine				City Elk	Grove			Cou	nty Sa	acramento
7	9		Sandy Claye	y Silt- reddi	sh brown	, low pla	istic,	Latitude				N Longitue	de	W
			very fine to f	ine				Datum	Dec		Sec.		Dec	kea, Min. Sec.
9	15		Silty Sand- v	ery fine to fi	ne, reddi	sh brow	n,	APN BO	ok 134	Dec. La	0630		Parce	0.37
45			medium plas	tic, trace cla	ly la la second	all alaths	in stat	Townebi	0K <u>10<del>7</del></u>	- Pano	. <u>0000</u>	Des L	Secti	00
10	17		Sand- very n	Ne to tine, ta	an, loose.	, siightiy	moist		Locat	ion Ska	tch	1	CCCI	Activity
17	19		Sitty Clayey	Sand- very	the clay	е, раске	ea,	(Sketch /	must be drawn	by hand al	ter form is	printed.)	O N	ew Well
10	22	-	Silty Sand	erv fine to n	nedium t	an nack	(od	-		North		JE.	ŌМ	odification/Repair
22	23		Sand- very fi	ne to fine w			÷.,	1	2	) Deepen				
23	25		Sandy Clave	v Silt- hard					OD	estroy				
25	27		Clavey Silt-	ight brown.	medium	olastic		-11				3.00	D. UT	escribe procedures and materials nder 'GEOLOGIC LOG'
27	29		Silty Sand- v	erv fine to fi	ne, reddi	sh brow	n, packe	d					102	Planned Uses
29	30		Sandy Silt- v	ery fine to fi	ne, reddi	sh brow	n, hard						OW	ater Supply
30	31		Silty Sand- v	ery fine to n	nedium, I	oose, ta	n	ts I				st	H	Domestic Public
31	47		Sand- very fi	ne to mediu	m, loose.	, light br	own	Š				ů	00	athodic Protection
47	48		Clayey Silt-	an, brittle, h	ard	11							O D	ewatering
48	49		Sandy Silt- v	ery fine to fi	ne, dark	tan, britt	le	5					Õн	eat Exchange
49	50		Silty Sand- v	ery fine to fi	ne, loose	, tannisl	h gray						Q In	jection
50	52		Sandy Silt- v	ery fine to f	ne, hard,	brown	1000						O M	onitoring
52	63		Sand- very f	ne to mediu	m, tan to	light bro	own	14					Os	parging
63	67	_	Sandy Silt- v	ery fine to f	ne, pack	ed, mois	st, tan	-		0			Õ T	est Well
6/	/1		Clayey Sand	ly Silt- tan, r	noist, pad	cked, ve	ry fine.	Eustrate or de	escribe distance	SOUTH of well from to	ads, building	s, fences,	OV	apor Extraction
74			to fine sand	100 100	in a second	. an shellow	6 1. marcan	rivers, etc. on Please be ac	d attach e map. curate and com	Use additions plete.	il paper if neo	essary.	00	ther
70	/9		Sandy Silt- V	ery line to i	me, mois	t, reddis	n brown	Water L	evel and	Yield o	of Com	pleted W	/ell	DOOL OF BRIDE STREET
19	01		Silly Saliu- I	ne to medic	m, wet, a	sub-roun	ided,	Depth to	first water	79			(Fee	et below surface)
81	82		Sand fine to	medium w	et brown	hich rod	clean	- Depth to	Static		(Ea)		Magai	rod
Total	Depth of I	Roring	120	modium, w		Feet	Cican	- Estimate	ever	_	(GP	M) Test	Гупе	
		Joing	110	ew (et				Test Ler	ngth		(Ho	urs) Total	Drawc	lown (Feet)
Total	Depth of C	Comple	eted Well 115	P.		- Feet		*May no	t be repres	entative	of a we	l's long te	rm yie	ld.
		11. 	HINDS	Cas	ings	a Secolaria	210.81					Annula	ar Ma	terial
Dep Su Feet	th from Irface Io Feet	Bore Dian (Incl	hole Type neter Type nes)	Mate	rial .	Wali Thickness (inches)	Outside Diamete (inches)	Screen r Type	Slot Size if Any (Inches)	Dept Su Feet	th from rface to Feet	Fil	I	Description
0 80 8.75 Blank PVC Sch. 40 2										0	75	Cement		10.3 sack sand/
80 110 8.75 Screen PVC Sch. 40 2									0.030					cement
110	115	8.75	Blank	PVC Sch. 4	)		2			75	77	Fine San	4	Transition
		-	2 1 1							11	120	Filter Pac	:к	SRI #8 Gravei
	-										-	1		
California (Maria	deserves the		ahmanta	-L	214 4.00	U=2411-7-11	dinor - p	a harrist stores	Contificati	on Sta	tomont	bener ten er		and the second second
100 V	Geologia	Atta	onments		I, the une	dersigner	d, certify t	hat this report	t is comple	te and a	ccurate t	o the best	of my	knowledge and belief
	Well Col	nstruct	ion Diagram		Name _	veneri	ove	Cilling						
	Geophy	sical L	og(s)		220	NOY	th eq	Stret	W	odla	nd	<u></u> <u></u>	<u>A</u>	95776
	Soil/Wat	er Che	emical Analyses		Signed	-	Address			Cit	. le	I Sta	ate	Zip
Attach ar	Other	mation	f it exists.			C-67,60	ensed Water	Well Contractor			Date S	aned C	-57 Lic	cense Number
E		1.1.201			No.		and an all and a						-	and the second se

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

*The free . File Origi	Adobe Reader nal with DWR	nay be used to view a	and complete this forr	n. However, Sti	software must	st be purchas ornia	ed to comple	ete, save, and reuse : DWF	a saved for	orm. Ily – Do Not Fill in
Page 2 Owner's V Date Wor	of Well Number rk Began <u>10/</u>	2 CY MW-1 10/2013	Date Work E	Refer No.	to Instruction F e019045 1/2013	Pamphlet 5		Latitude	Well Nur	
Local Per Permit Ni	mit Agency 1 umber 53187	County of Sacran	Permit Date 9/2	0/13					APN/T	I I I I I I I I I I I I I I I I I I I
CITIALITA		Geolo				Contraction of	dent de la	Well (	Jwner	and the second
Orie	ntation O	/ertical O Hori	zontal OAng	le Specif	у	Name	City of Elk	Grove	- miler	
Drilling	Method Hollow	Stem Auger	Drilling	Fluid		Mailing	Address 8	401 Laguna Pal	ms Wa	av
Depth	from Surface	Dec	Description	1 To color ato	1. 1	City Ell	Grove		Sta	te CA zin 95758
82	85	Sandy Silt- ver	v fine to fine ha	d brownis	sh red			Well	ocation	and a second
		wet				Address	10250 lr	on Rock Way	ACT IN	Street, and a street, and a street, and a
85	93	Silty Clay- redo	dish brown, medi	um plastic	, moist	City Ell	Grove		Coi	unty Sacramento
93	95	Silty Sand- ver	y fine to fine, rec	ldish brow	n, wet	Latitude		N	Longitu	ide V
95	109	Silty Clay- rede	dish brown, medi	um plastic	, moist	]	Deg.	Min. Sec.		Deg Min Sec.
		to wet				Datum_		Dec. Lat.		Dec. Long
109	113	Sand- fine to n	nedium, brown, v	vet		APN Bo	ok <u>134</u>	_ Page <u>0630</u>	1.10	Parcel US/
113	120	Silty Clay- brow	vn, medium plas	tic, wet		Townsh	ip	_ Range		Section
						(Sketch	must be drawn	by hand after form is or	inted.)	Activity New Well
								North	<u>u</u>	O Modification/Repair O Deepen
	_					1			-	O Destroy Describe procedures and materials under 'GEOLOGIC LOG'
						11				O Water Supply
						Vest			East	Domestic Public
					<u>с 1</u>	11				O Cathodic Protection O Dewatering
				~ ``		2 P				O Heat Exchange
			2.5	- C.,	1445	11	80.7			Monitoring
			18-			11				O Remediation
					100	11				O Sparging
			SUP OF			- 20		South		O Test Well
						Illustrate or de	escribe distance o d atlach a map. L	f well from roads, buildings, lise additional paper if neces	lences, Isary.	O Other
						Please be ac	curate and comp	plate.		
						Dorth f	ever and	70	erea M	(East holewaysface)
			W		à	Depth to	o static	18		_ (reel below surface)
						Water L	evel	(Feet)	Date	Measured
Total D	epth of Boring	120	and the second s	Feet		Estimate	ed Yield * _	(GPM	) Test	Type
Total D	epth of Comp	eted Well 115	W.E.	Feet		*May no	t be repres	entative of a well'	s long te	erm yield.
Denth	from Bor	hole	Casings	Wall	Outsida	Scroon	Slot Size	Depth from	Annul	ar Material
Sur Feet t	face Diar o Feet (Inc	neter Type hes)	Material	Thickness (Inches)	Diameter (Inches)	Туре	if Any (Inches)	Surface Feet to Feet	Fil	II Description
		rug								
		1.2 2								
		<u>i</u>								
		1					(			
C. 111. 1.40				au au						
	Atta	conments	I the	Indersigner	certify the	at this renor	certificati	on Statement	the her	t of my knowledge and balla
	Well Construct	tion Diagram	Name	PENER	OVE T	srilling	and complet		10 003	to my normedge and belie
	Geophysical L	og(s)	22	O NO	th En	St St.		joudiand	С	A 95776
	Soll/Water Ch	emical Analyses	Riggs	1	Address	2		City /	St	ate Zip
Attach add	Dther	if it exists	Signed	C-57 Lio	ensed Water V	Vell Contractor		Date Sig	ned C	-57 License Number
		n is aviara.						Date Sig		Cristing Number

DWR 168 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

## WELL CONSTRUCTION SUMMARY

City of Elk Grove Corporation Yard Monitoring Well No. 2 November 2013

#### Introduction

Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this summary for the construction of the City of Elk Grove's Corporation Yard Monitoring Well No. 2 (CY MW-2). Included are monitoring well construction and development details, an as-built well construction drawing, lithologies encountered, well completion report, and permit.

#### **Monitoring Well Construction**

On October 4, 2013, PeneCore Drilling of Woodland, California (PeneCore) commenced CY MW-2 test hole drilling. The test hole was drilled to a depth of 55 feet below ground surface (bgs) at a diameter of 8 3/4-inches by the hollow stem auger method. Continuous core split spoon samples were collected and analyzed by LSCE. The formation lithologies encountered were used as the basis of the piezometer design. CY MW-2 consists of a single piezometer constructed of 2-inch ASTM F480-88A schedule 40 PVC pipe. The perforated well screen section has machine cut slots with 0.030-inch openings. The total completed depth of CY MW-2 is 55 feet bgs. The screened interval is from 50 to 20 feet bgs. The annular space from 55 to 51 feet bgs is sealed with bentonite. The annular space from 51 to 20 feet bgs is filled with a SRI #8 gravel. A Cemex #60 fine sand transition seal was placed from 20 to 18 feet bgs. On October 8, 2013, an annular seal consisting of 11.8 sack sand/cement grout was placed from 18 feet to ground surface in accordance will all permitting requirements in the presence of the County of Sacramento inspector.

At the completion of construction activities, the piezometer was developed by a Waterra inertial pump for approximately three hours until the water was clean and free of solids.

#### Note on Datum

All depths cited in this summary report are based on grade as it existed at the time of construction.



Cli	ient:	City of Elk Grove	Lat/Long:						MILE C CONTAL & AANAN
Pro	oject Name:	Corp Yard MW-2	GSE (ft-msl)				5		LTING ENDINCERS
LS	CE #:	12-1-001	Drill Date:	10/04/2013					
Lo	cation:	10250 Iron Rock Way	Drilling Method:	Hollow Sten	n Auger				
Ge	eologist:	W. Andrews/C. Jenkins	Driller:	Penecore D	rilling				
		Lithologic Descripti	on		Strat- Column		Well C	onstruc	tion Diagram
- 10	0- 5' Silty Clay 5-13' Sandy S 13-17' Clayey 17-19' Silty Sa 19-25' Sand- v	y- reddish brown, medium plastic, silt- very fine to fine, reddish brown Silty Sand- very fine to medium, r and- very fine to medium, reddish very fine to medium, light brown, d	dry , dry to damp eddish brown, damp brown, damp amp			16 18 20			<ul> <li>Annular Seal 10.3 Sack Sand/Cement Grout</li> <li>Well Casing 2-Inch Dia. Sch. 40 PVC ASTM F480-88A Flush Threaded</li> <li>Fine Sand Transition Seal</li> </ul>
	25-29' Silty Sa	and- very fine to medium, light bro	wn, damp		T T T T T T T T				<ul> <li>■ 8.75-Inch Dia.</li> <li>Borehole</li> </ul>
- 30	29-30' Sandy	Silty Clay- very fine to fine, reddis	h brown, medium plasti	c	12				
	30-31' Gravell	ly Sand- fine to coarse, gravel up t	o 1/2", damp, reddish b	rown	KZ.			2010	
- 40	31-33' Sandy 33-34' Silty Cl 34-35' Sandy 35-36' Silty Cl 36-37' Sandy 37-38' Silty Cl 38-44' Clay- ta	Silty Clay- very fine to fine, reddisi ay- light brown, medium plastic, d Silty Clay, very fine to fine, medium ay- light brown, medium plastic, lig Silty Clay- light brown, medium plastic, ay- light brown, medium plastic, lig an, medium plastic, some black or	h brown, medium plasti amp n plastic ght brown astic ght brown ganics	c, damp					<ul> <li>Gravel Envelope #8 SRI</li> <li>Well Screen 2-Inch Dia. Sch. 40 PVC w/ 0.030-Inch Slot Size Flush Threaded</li> </ul>
10	44-49' Silty Sa	and- very fine to fine, brown, moist							
- 50	49-51' Sandy	Sitty Clay- very fine to fine, micace	eous, light brn., medium	plastic, damp	T/F	50			
-	51-53' Silty Cl	ay- tan mottled light brown, mediu	m plastic, moist		7	01			
-	53-55' Sand- v	very fine to medium, light brown, n	noist			55		1	— Bentonite Seal

				a and complete		Cia	to of Call	arnia		oro, 3540,				11 <b>P</b>
rie Ofi	de 1 of 1 Well Completion Report													
Page _	1	of 1			AA6	Refer t	o Instruction I	Pamphlet				Laul		
Owner'	Well Nur	nber <u>CY</u>	MW-2			No.	e019045	8		[ ] ]	Sta	N N	mber/Si	ite Number
Date W	ork Begen	10/04/2	2013	Date	Work Ende	ed <u>10/4/</u>	2013				Latitude		L	Longitude
Local P	ermit Ager	ncy Cour	nty of Sacra	amento								1		
Permit	Number 5	3188		Permit Da	ite 9/20/1	13			L			APN/1	RS/Oth	ner
2	and the last of	Half	Geol	ogic Log		See 1	- 12/F3	Sec. 19	3.772	u de la faction de la composition de la Composition de la composition de la comp	Well	Owner		a fini of the set
Q	lentation	⊙Verti	cal OH	orizontal	OAngle	Specify		Name C	ity of Elk	Grove				
Drillin	Method H	ollow Sten	n Auger		Drilling Flu	uid		Mailing	Address &	8401 La	ouna P	alms Wa	V	
Dept	h from Su	rtace	De	Des scribe material	cription	nlor etc		City Ell	Grove			Sta	te CA	Zip 95758
0	5	Is	ilty Clav- re	ddish brown	, medium	plastic.	dry	Perers i bear	· · · · · · · · · · · · · · · · · · ·		Wall	ocation	141.0	
5	13	S	andy Silt- v	ery fine to fi	ne, reddis	h brown	, dry to	Address	10250 1	ron Roc	k Wav	-oouuo,		A REPORT
		da	amp					City El	Grove			Ca	Inter S	Sacramento
13	17	C	lavev Siltv	Sand- verv	ine to me	dium, re	ddish		COLORE					201
		b	rown, damp	)		,			Deg	Min	Sec	N LUIGH		Deq. Min. Sec.
17	19	S	ilty Sand- v	erv fine to m	edium, re	ddish b	rown.	Datum		Dec. Lat		30.02	Dec.	Long:
		d	amp					APN Bo	ok <u>134</u>	Page	0630	1	Раго	el 037.
19	25	S	and- verv fi	ne to mediu	m. light br	rown, da	amp	Townshi	p	Range	e	Santa	Sect	ion
25	29	S	ilty Sand- v	erv fine to n	nedium lic	abt brow	n damn		Locat	ion Ske	tch	1	1	Activity
29	30	S	andy Silty (	lav- very fit	e to fine	reddish	brown	(Sketch i	must be drawn	1 by hand at	ter form is	printed.)	0 N	lew Well
		m	edium nlas	tic	in the fitter,			1		North	-	- the	ON	odification/Repair
30	31	G	ravelly San	d- fine to co	arse aray	vel un to	1/2"	11					2	Other
	0         31         Gravely sand- line to coarse, gravel up to 1/2,         O Destroy           damp, reddish brown         Destroy         Destroy													
31	1     33     Sandy Silty Clay- very fine to fine, reddish brown,													
	1 33 Sandy Silty Clay- very fine to fine, reddish brown, medium plastic, damp													
33	34	S	ilty Clay- lin	ht brown m	edium nla	actic da	mn	11			en,		OV	Vater Supply
34	35	9	andy Silty (	lav ven fir	e to fine	modium	nlactic							Domestic  Public
35	36	S	ilty Clay- lig	ht brown m	edium ola	nieulun	nt brown	Kes				Eas		Irrigation Industrial
36	37	0	andy Silty (	Nav light br	own mod	ium pla	nt biowii						00	athodic Protection
37	38	0	ith Clay lig	ht brown	own, med	num pla	at brown	11						Dewatering
39	14	0	lay tan me	dium placti	eulum pla	lack org	onice	11						neat Exchange
14	10	0	ity Sand- v	any fine to fi	no brown	moiet	arnes						ΘM	Ionitoring
44	51	0	andu Siltu (	lay work fir	ne, brown	mionee	2110						<b>O</b> R	Remediation
40	- 1.	lie	andy Silly C	nedium play	tic domn	micaced	Jus,	11					Os	sparging
51	53	0	ity Clay, ta	n mottled lic	ht brown	modium	nlastic	11		South			OT	est Well
01			nity Clay- la	in mouled ng	nit brown,	medium	i plasuc,	Illustrate or de	escribe distance	of well from ro	ads, building	a, fences,		apor Extraction
52	EE		and work f	no to modily	na Umht ha		alat	rivers, etc. an Please be ac	d attach a map curate and com	Use additiona plete.	A paper if nec	еввагу.		other
55	- 55		and-very ii	ne to mediu	m, light bi	rown, m	oist	Water L	evel and	Yield o	of Com	pleted V	Vell	Contraction of the second s
			A land	tere and				Depth to	first water	ſ			(Fee	et below surface)
			W.	- 12			F	Depth to	Static		(E.a.c	t) Deta	Magai	urad
Tetel						Fact		Vvater L	evel		- (Fee	() Date	Measu	
rotai	Jepth of E	oring	00	State -		- Feel		Test Ler	ath		(Un)	urs) Total	Draw	down (Feet)
Total	Depth of C	ompleted	Well 55	et		Feet		*May no	t be renres	entative	of a wel	l's long te	rm vie	Id.
ond inter				Cas	nas		P.CL ST			1		Annul	ar Ma	torial
Den	th from	Borehole	Ture	Cas	ingo .	Wall	Outside	Screen	Slot Size	Dept	h from	AUTUR	anind	with the second second second
S	Inface	Diameter	rype	Mater	TI TI	hickness	Diameter	Туре	if Any	Su	face	Fil	4	Description
0	20	8.75	Blank	PVC Sch. 40		110108)	2		(incres)	O	16	Cement		10.3 sack sand/
20	50	8.75	Screen	PVC Sch. 40			2	Milled Slots	0.030					cement
50	55	8.75	Blank	PVC Sch. 40			2			16	18	Fine San	d	Transition
		ų.								18	51	Filter Pac	:k	SRI #8 Gravel
		in.	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1							51	55	Bentonite	,	
11-25-7	Attachments Certification Statement													
E	Geologic Log I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief													
	Well Construction Diagram													
	Geophysical Log(s) 220 N Past St. Wouldand CA 95776													
	Signed													
Attach	ditional inform	nation if it of	xists.		Chighed	C-57 Kicer	fised Water W	lell Contractor	10 U		Date Si	aned C	-5711	cense Number
DWR 18	REV 1/2006	A not the state of				AL SPACE	IS NEEDED	USE NEXT CO	NSECUTIVE	Y NUMBER	RED FORM		of Lit	

### WELL CONSTRUCTION SUMMARY City of Elk Grove Corporation Yard Monitoring Well No. 3 November 2013

#### Introduction

Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this summary for the construction of the City of Elk Grove's Corporation Yard Monitoring Well No. 3 (CY MW-3). Included are monitoring well construction and development details, an as-built well construction drawing, lithologies encountered, well completion report, and permit.

#### **Monitoring Well Construction**

On October 9, 2013, PeneCore Drilling of Woodland, California (PeneCore) commenced CY MW-3 test hole drilling. The test hole was drilled to a depth of 120 feet below ground surface (bgs) at a diameter of 8 3/4-inches by the hollow stem auger method. Continuous core split spoon samples were collected and analyzed by LSCE. The formation lithologies encountered were used as the basis of the piezometer design. CY MW-3 consists of a single piezometer constructed of 2-inch ASTM F480-88A schedule 40 PVC pipe. The perforated well screen section has machine cut slots with 0.030-inch openings. The total completed depth of CY MW-3 is 120 feet bgs. The screened interval is from 115 to 90 feet bgs. The annular space from 120 to 87 feet bgs is filled with a SRI #8 gravel. A Cemex #60 fine sand transition seal was placed from 87 to 85 feet bgs. On October 11, 2013, an annular seal consisting of 11.8 sack sand/cement grout was placed from 85 feet to ground surface in accordance will all permitting requirements in the presence of the County of Sacramento inspector.

At the completion of construction activities, the piezometer was developed by a Waterra inertial pump for approximately three hours until the water was clean and free of solids.

#### Note on Datum

All depths cited in this summary report are based on grade as it existed at the time of construction.



Cli	ent:	City of Elk Grove	Lat/Long:			-		
Pro	oject Name:	Corp Yard MW-3	GSE (ft-msl)					BULLING ENDINEERS
LS	CE #:	12-1-001	Drill Date:	10/09/2013				
Lo	cation:	10250 Iron Rock Way	Drilling Method:	Hollow Sten	n Auger			
Ge	ologist:	W. Andrews/C. Jenkins	Driller:	Penecore D	rilling			
		Lithologic Description	วท		Strat- Column	١	Well Const	truction Diagram
_0	0-4' Clay- darl	k brown, medium plastic, damp			/		201 10 201 10	
- 10	4-17' Sandy S	ilty Clay- very fine to fine, reddish	brown, medium plastici	ty, dry	NY NY NY			
-20	17-19' Sand- v	very fine to medium, brown, damp,	some silt, moderately	sorted	17-71	0	$\geq d$	84
	19-25' Sandy	Clayey Silt- very fine, reddish brow	/n, damp, medium plasi	tic	777		284 D	
- 30	25-29' Silty Sa 29-33' Sand- v	and- very fine to fine, light brown, d very fine to coarse, trace gravel, da	lamp amp		TTT TT			a de la de l
F,	33-39' Sandy	Silty Clay- light brown/reddish brow	vn, medium plastic, dar	np	7	DX		
-40	39-51' Sandy	Clayey Silt- very fine, tan, black or	ganics					Annular Seal 10 3 Sack Sand/Cement Grout Well Casing 2-Inch
E	51-53' Silty Sa	and- very fine to fine, tan, damp			TTT			Dia. Sch. 40 PVC ASTM F480-88A
	53-55' Sandy	Clayey Silt- very fine to fine, tan, d	amp		T T.	20		Flush Threaded
-60	55-57' Silty Sa	and- very fine to fine, tan, damp			T			<ul> <li>8.75-Inch Dia.</li> <li>Borehole</li> </ul>
	57-61' Sandy	Silt- very fine, tan, damp						
-70	61-63' Silty Sa	and- very fine to fine, tan, moist, we	ell sorted		777			
-80	63-65' Sandy 65-69' Sandy 69-81' Sandy 81-89' Sandy	Silt- very fine, tan, damp Clayey Silt- very fine, light brown n Silt- very fine, tan to reddish brown Clayey Silt- very fine, reddish brow	nottled reddish brown, d 1, damp to moist vn, moist	damp		2022 2022 2022		a a a
Ē					7/	85 87	27 <i>0</i> 72	Fine Sand
- 90	89-90' Silty Cl	ay- brown, medium plastic, moist			1.1.1	90		Transition Seal
	90-91' Sandy	Clayey Silt- very fine, reddish brow	/n, moist		T.	-		Well Screen 2-Inch
100	91-94' Clay- b	rown mottled reddish brown, medi	um plastic, moist			-		Dia. Sch. 40 PVC w/ 0.030-Inch Slot Size
	94-97' Sandy	Silt- very fine, reddish brown, mois	t to wet		17			Flush Threaded
	97-99' Silty Cl	ay- reddish brown, medium plastic	, wet		/			#8 SRI
- 110	99-101' Claye	y Silt- reddish brown, wet						
	101-103' Silty	Clay- light brown mottled reddish l	prown, medium plastic,	wet	17	115		
- 120	103-105' Sand	dy Clayey Silt- very fine to medium	, reddish brown, wet		T	120		
-	105-115' Clay	- reddish brown/brown, medium pla	astic, wet					
-	115-117' Sand	dy Clayey Silt- very fine, tan mottle	d brown,wet					
- 130 -	117-120' Silty	Clay- brown, medium plastic, wet						

*The free	Adobe Re	ader may I	be used to view	and complete	this form.	However, I	software m	usi be purchas	ed to compl	ete, save,	and reuse	a saved for	m.	Not Cillia
riie Ong					W		moleti	on Reno	art İ		DW	R USE Only	- 00	
Page <u>1</u>		of $\frac{2}{2}$				Refer	to Instruction	Pamphlet	" I		Stat	e Well Num	ber/Sit	le Number
Owner's	Well Nun	nber <u>CY</u>	MW-3	Date	Alarda Frank	No.	e01904	59			11	N	_1	
	ork Began	10/09/2	ty of Sacra	Date		ed <u>10/9</u>	2013			<b>—</b>	Latitude	7.1.2	1 6	Longitude
Permit N	Jumber 5	3189		Permit Da	te 9/20/	13		1			السياري	APN/TR	S/Oth	er
1		and the second	Geol	paic Loa		De		The second second	120-20-	10.000	Well	Owner	31-11	100 C
Ori	entation	⊙ Verti	cal OHo	rizontal	OAngle	Specif	v	Name (	ity of Elk	Grove	44011	OWNER		Second and the second of the second s
Drilling	Method H	ollow Sten	Auger	neorita.	Drilling Fi	uid		Name S	ILY OF LIK	9404 1 0				
Depti	n from Su	rface	(1999) (2009)	Desc	ription	C. C. Service	1997 - 400 mar	Mailing	Address	5401 La	una Pa	aims vvay	CA	74. 05758
Feel	to F	eet	Des	cribe material,	grain size,	color, etc	S= 334	City Lin	GIOVE			State	9. UA	Zip <u>95756</u>
0	4	C	ay- dark bro	own, mediur	n plastic	, damp		un entration		Jenson in St	Well L	ocation	utv.	
4	17	Si	andy Silty C	lay-very fin	e to fine	, reddish	brown,	Address	10250	ron Roc	k Way		_	
47	- 10	m	edium plast	icity, dry				City El	Grove			Cour	nty Sa	acramento
17	19	Si	and-very fir	ne to mediui	n, browr	n, damp,	some	Latitude		Mar	1	V Longitud	le	W
10		SI	t, moderate	ly sorted				Datum	Deq.	Min. Dec. Lat	Sec		Dec	long
19	25	Si	andy Clayey	/ Silt- very fi	ne, redd	ish brow	n, damp		ok 134	Dec. La	0630		Dec.	037
	-	m	edium plast					- Tournohi	OK 104	Page	0000	ALC: NOT	Conti	
25	29	SI	Ity Sand- ve	ery fine to fir	ne, light l	orown, d	amp	Townsn	p	Range		1	Secu	A-01-01
29	33	S	and-very fir	ne to coarse	, trace g	ravel, da	amp	(Sketch)	Local must be draw	tion Ske	ter form is a	minted.)	O NI	Activity
33	39	S	andy Silty C	lay- light bro	own/redo	lish brov	vn,	_		North		128	Ő M	odification/Repair
		m	edium plast	ic, damp			-11		- Alas	1	- 3 B	ç	) Deepen	
39	51	S	andy Clayey	/ Silt- very fi	ne, tan,	black or	-11					00	Other	
51	53	S	ity Sand- ve	ery fine to fir	ne, tan, c	lamp		-11 -				1000	000	escribe procedures and materials
53	55	S	andy Clayey	/ Silt- very fi	ne to fin	e, tan, d	amp	R COL				F		Planned Llese
55	57	S	Ity Sand- ve	ery fine to fir	ne, tan, o	lamp		3 C - C					0.14	Inter Supply
57	61	S	andy Silt- ve	ery fine, tan,	damp									Domestic Public
61	63	S	ity Sand- ve	ery fine to fir	ne, tan, r	noist, we	ell sorted	est				ast		Irrigation Industrial
63	65	S	andy Silt- ve	ery fine, tan,	damp		- Ka	3				ω.	O C	athodic Protection
65	69	S	andy Claye	/ Silt- very f	ine, light	brown n	nottled						O D	ewatering
		re	ddish brow	n, damp	3			3					Ōн	eat Exchange
69	81	S	andy Silt- ve	ery fine, tan	to reddis	sh brown	n, damp						O In	jection
		to	moist		-5								O M	onitoring
81	89	S	andy Clayey	/ Silt- very fi	ine, redd	lish brow	/n,moist							emediation
89	90	S	ity Clay- bro	own, medium	m plastic	, moist	20							parging est Well
90	91	S	andy Claye	/ Silt- very fi	ine, redd	lish brow	n, moist			South			ŏ v	apor Extraction
91	94	C	ay-brown r	nottled redo	lish brow	n, medi	um	fivers, etc. an	ascribe distance d attach a map	of well from ro Use additional	ada, buildings paper if nece	, ferices, issary.	00	ther
		pl	astic, moist	dis.				Please be ad	curate and con	Viold o	1 Com	Lotor MA	all	and the second second
94	97	S	andy Silt- ve	ery fine, red	dish brow	vn, mois	t to wet	water	everanc	Tield C	Com	Jelea w	ell	4 h a laur a unfa a a \
97	99	S	Ity Clay- ree	ddish brown	, mediur	n plastic	, wet	Depth to	Static	r <u>94</u>			_ (Fee	t below surface)
99	101	C	layey Silt- re	eddish brow	n, wet	402		Water L	evel		(Fee	t) Date N	Aeasu	ired
Total I	Depth of E	loring	120	- A	Yaer S	Feet		Estimate	ed Yield *		(GPN	A) Test T	ype _	
Total [	Depth of C	ompleter	Well 120		10 B	Feet		Test Ler	ngth		(Hou	rs) ⊤otal [	Drawd	iown (Feet)
					Contraction of the			*May no	t be repre	sentative	of a well	's long ten	m yiel	d.
1 Part	No. of Street,		VIII BULLIN	Casi	ngs		main strategy of	and the state of the	.141	1.	and the second	Annula	r Ma	terial
Su Feet	to Feet	Diameter (Inches)	Туре	Mater	ial 1	(inches)	Diameter (Inches)	Type	If Any (Inches)	Sur Feet	face to Feet	Fill		Description
0	90	8.75	Blank	PVC Sch. 40			2			0	85	Cement		10.3 sack sand/
90	115	8.75	Screen	PVC Sch. 40			2	Milled Slots	0.030					cement
115	120	8.75	Blank	PVC Sch. 40			2			85	87	Fine Sand	4	Transition
		10	5.75							87	120	Filter Pack	(	#8 SRI Gravel
	-		J.											
	1											1		
Call Call		Attach	nents		Large St.	in an	S. H	and said	Certificat	ion Stat	ement	n nga santas Mata santas	1.000	a sumation for
	Geologic	Log			I, the un	dersigned	. certify t	hat this report	t is comple	te and ad	curate to	the best	of my	knowledge and belief
	Well Con	struction	Diagram		Name 1	Person,	Eirm or Corp	oration	,	00.11			-	057-
	Geophys	ical Log(s	s)		220	N.T	ASI	84.	- in	0001	and	<u>C</u>	4	40176
	Other	er Unemio	ai Analyses		Signed		- ALINA	-		City	uldi	3	900	899
Attach ad	ditional infor	nation, if it e	xists.		~	C-52-Cic	ented Water	Well Contractor			Date/Si	ned C-	57 Lic	ense Number
					S. 455-72-22,25	.1.			and the second second					and the second se

CUTIVELY NU

*The free . File Origi	Adobe Read	dermaybı WR	e used to view a	and complete t	his form. Ho	wever, Sta	software mu ate of Califo	st be purchase ornia	ed to comple	ete, save, a	and reuse a	a saved f Use On	orm. Iy – Do N	Jot Fill In
Page <u>2</u> Owner's V Date Wor	Well Numb	of 2 per CY 1 10/04/20	WW-3 013	Date V	Vork Ended	Refer No.	to Instruction F e019045 /2013	Pamphlet 9	""		State	Well Nui	mber/Site	Number
Local Pel Permit Ni	umber <u>53</u>	189	V UI Saciali	Permit Dat	e 9/20/13				— L			APN/1	RS/Othe	al and a second and a
			Geolog	nic Loa			100	198580	CONTRACTOR OF	Melawara	Well C	Owner	en juur	ARE SERVICE
Orie	ntation	⊙ Vertic	al O Hori	zontal (	DAngle	Specif	y	Name C	ity of Elk	Grove				
Drilling	Method Hol	low Stem	Auger		Drilling Fluid			Mailing	Address 8	3401 Lac	una Pal	ms Wa	iv	
Depth	from Sur	face	Desc	Desc Descipe material	ription	lor etc.		City Elk	Grove			Sta	te CA	Zip 95758
101	103	Sill	v Clav- light	t brown mo	ttled reddi	sh bro	wn.		and the second of the		Well Lo	ocation	10000	
	1	me	dium plastic	, wet				Address	10250 Ir	on Rock	Way	- 4 <u>1</u>		
103	105	Sa	ndy Clayey	Silt- very fir	ne to medi	um, re	eddish	City Elk	Grove			Co	unty Sa	icramento
		bro	wn, wet					Latitude			N	Longitu	ude	w
105	115	Cla	y- reddish b	prown/brow	n, medium	n plast	tic, wet		Deq.	Min. S	Sec.	10 Mar	De	ag. Min. Sec.
115	117	Sa	ndy Clayey	Silt- very fil	ne, tan mo	ttled i	prown,wet		1. 424	Dec. Lat.	0620		Dec. L	.ong
117	120	Sil	y Clay- brow	wn, medium	n plastic, v	vet		APN Bot	ok <u>154</u>	_ Page	0630	u	Parce	1 001
								Townshi	P	ion Ske	ch	1	Secul	Activity
	-							(Sketch r	nust be drawn	by hand aft	er form is pri	ntea.)	O Ne	w Well
									, William	North	les		Ŏ Mc	odification/Repair Deepen
	_	_										hugest	O De	Sofie procedures and materials
											a.	27	I	Planned Uses
	_							at the second seco			10 	ast		Domestic Public
							1990 - 1997 - 19	Š				ш	O Ca O Dé	athodic Protection
	-				- 3								О Не О Inj	at Exchange
								11					O Mo	onitoring
					1	1.2	-							mediation
	_							11						arging st Well
	_			1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -				alt.	andhu diabanna	South	da huildhaa	lanoan	O Va	apor Extraction
	_			41				rivers, etc. an Please be ac	d stlach a map	os weil from ruz Uae additional plote	paper if neces	sary.	O Ot	her
					2		4.7 × 1	Water L	evel and	Yield o	f Comp	leted V	Vell	
								Depth to Depth to	first water Static	94	(5)		(Feet	t below surface)
Total D	enth of Pa	ring	120		~	Feet		Estimate	ever		(GPM	) Date	Type	
TOLATE	eptit of bo	my	120	2.14	Contraction of the local division of the loc	reet		Test Ler	nath		(Ur w	s) Total	I Drawd	own (Feet)
Total D	epth of Co	mpleted	Well 120	0	0 .6	Feet		*May no	t be repres	sentative	of a well's	s long te	erm yiek	d.
Dept	from	Borehole	Type	Casir Materi	igs al	Wall	Outside	Screen	Slot Size	Dept	from	Annu	ar Mat	erial
Feet	tace o Feet	(inches)		1.2.2		cknees nches)	(Inches)	туре	(inches)	Feet	tace to Feet	FI	u	Description
				<u>.</u>		-								
		1	1. X.											
and the		Attachm	ients						Certificat	ion Stat	ement	dhe b		lunaudadan and ball d
	Geologic L	-og truction F	liagram		i, the under Name	ENE	COYE	Drillin	is comple	te and ac	curate to	ine bes	t of my	knowledge and belief
	Geophysin	auction L cal Log(s)	лаугат		220	Person,	Firm of Corpor	ation	5	ondia	nd	0	24	actilo
	Soil/Water	Chemic	al Analyses		<u> </u>	- 14	Address	a.t.		City	1 /		tate	Zip
	Other				Signed	C-57 16	and Minine I	Vall Contractor			11/5/	China -	9068	99
Attach add	Itional informa	ation, if it exi	sts.			-Si elo	priacu vyater V	ten connactor			Date Sig	ned (	2-57 LIC	ense wumber

DWR	166	REV.	1/2008
-----	-----	------	--------

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

### WELL CONSTRUCTION SUMMARY

City of Elk Grove Corporation Yard Monitoring Well No. 4 November 2013

#### Introduction

Luhdorff and Scalmanini, Consulting Engineers (LSCE) has prepared this summary for the construction of the City of Elk Grove's Corporation Yard Monitoring Well No. 4 (CY MW-4). Included are monitoring well construction and development details, an as-built well construction drawing, lithologies encountered, well completion report, and permit.

#### **Monitoring Well Construction**

On October 7, 2013, PeneCore Drilling of Woodland, California (PeneCore) commenced CY MW-4 test hole drilling. The test hole was drilled to a depth of 120 feet below ground surface (bgs) at a diameter of 8 3/4-inches by the hollow stem auger method. Continuous core split spoon samples were collected and analyzed by LSCE. The formation lithologies encountered were used as the basis of the piezometer design. CY MW-4 consists of a single piezometer constructed of 2-inch ASTM F480-88A schedule 40 PVC pipe. The perforated well screen section has machine cut slots with 0.030-inch openings. The total completed depth of CY MW-4 is 120 feet bgs. The screened interval is from 115 to 90 feet bgs. The annular space from 120 to 87 feet bgs is filled with a SRI #8 gravel. A Cemex #60 fine sand transition seal was placed from 87 to 85 feet bgs. On October 8, 2013, an annular seal consisting of 11.8 sack sand/cement grout was placed from 85 feet to ground surface in accordance will all permitting requirements in the presence of the County of Sacramento inspector.

At the completion of construction activities, the piezometer was developed by a Waterra inertial pump for approximately three hours until the water was clean and free of solids.

#### Note on Datum

All depths cited in this summary report are based on grade as it existed at the time of construction.



Clie	ent:	City of Elk Grove	Lat/Long:					UNDON	
Pro	oject Name:	Corp Yard MW-4	GSE (ft-msl)				اك	ION BUL	TING ENGINEEDE
LS	CE #:	12-1-001	Drill Date:	10/07/2013					
Loc	cation:	10250 Iron Rock Way	Drilling Method:	Hollow Sten	n Auger				
Ge	ologist:	W. Andrews/C. Jenkins	Driller:	Penecore D	rilling				
		Lithologic Description	on		Strat- Column		Well C	onstructio	n Diagram
-0	0-4' Clay- dari	k brown, medium plastic, damp							
- 10	4-13' Sandy S	ilty Clay- very fine to fine, medium	plastic, reddish brown	, dry	NY YYYY		2404040		
-	13-15' Silty Cl	ay- tan mottled light brown, mediur	n plastic						
-20	15-19' Silty Sa	and- very fine to medium, light brov	vn, damp		T T				
-	19-24' Sand- 1	fine to coarse, trace gravel, brown,	damp						
-	24-25' Silty Sa	and- very fine to fine, tan, micaceou	s						
- 30	25-27' Sand- 1	fine to coarse, loose, tan, damp							
-	27-29' Silty Sa	and- very fine to medium, light brov	vn, moist		TT T			D C C	
-40	29-31' Sand-	very fine to coarse, trace gravel to	1/4", brown, damp		77				
	31-41' Sandy	Silty Clay- very fine, reddish brown	n, medium plastic, mois	it/	VT_				Annular Seal
	41-44' Silty Cl	ay- tan, medium plastic, black orga	anics	/				100	Sand/Cement Grout
- 50	44-47' Silty Sa	and- very fine to fine, tan, damp		]	Τ <u>.::</u> :		109a	DOM DOM DOM DOM	Well Casing 2-Inch Dia. Sch. 40 PVC
-	47-53' Sandy	Silt- very fine, tan, damp		/	<b>F</b> t				ASTM F480-88A Flush Threaded
-	53-55' Silty Cl	ay- tan, black organics, medium pl	astic	/	K.T.				
- 60	55-57' Sand-	very fine to medium, tan, damp		]	νT				<ul> <li>8.75-Inch Dia. Borehole</li> </ul>
-	57-59' Silty Cl	ay- tan, black organics, medium pl	astic		V-				
-70	59-61' Sand-	very fine to medium, reddish browr	n, moist						
	61-67' Silty CI 67-69' Sandy	ay- tan, medium plastic, damp Silty Clay- very fine, brown, mediu	m plastic		F.				
	69-71' Silty Sa	and- very fine to fine, light brown, d	amp		TTT			DOM N	
- 80	71-73' Sandy	Silt- very fine, tan, damp							
-	73-77' Sandy	Silty Clay- very fine, tan mottled lig	ht brown medium plas	tic, damp	T	85	10,0	70,0	- Fine Sand
-90	77-80' Sandy	Clayey Silt- very fine to fine, reddis	sh brown, micaceous, r	noist	47	90			Transition Seal
-	80-83' Sand-	very fine to coarse, micaceous, we	t		171				- Mall Caroon 2 Inch
- - 100	83-85' Silty Cl 85-89' Sandy 89-93' Silty Cl	ay- light brown, medium plastic, m Silty Clay- very fine to fine, tan, me ay- reddish brown, medium plastic	oist-wet edium plastic, moist , moist		PT				Dia. Sch. 40 PVC w/ 0.030-Inch Slot Size Flush Threaded
-	93-95' Clayey	Silty Sand- very fine to fine, reddis	sh brown, moist to wet						<ul> <li>Gravel Envelope #8 SRI</li> </ul>
- - 110	95-97' Sandy 97-101' Silty ( 101-108' Clay	Silty Clay- very fine to fine, reddish Clay- reddish brown, medium plasti - reddish brown, medium plastic, w	n brown, medium plasti c, wet vet	c, wet					
-	108-111' Sand	dy Silt- very fine to fine, tan, wet			1	115	1.1		3
- 120	111-112' Sand	d- very fine to coarse, brown, well s	sorted, wet		7	120	1.50		
	112-117' Clay 117-120' Silty	- brown, medium plastic, wet Clay- reddish brown, medium plas	tic, wet						

File Orig	inal with	bWR	ay be used to view	w and complete this for	m. However, software State of Ca	nust be purchas lifornia	ed to comp	lete, save,	and reus DV	e a saved f VR Use On	orm. ly – Do Not Fill In	
Page 1		of	2		Refer to Instruct		nr		L			
Owner's	Well Nur	nber _	CY MW-4		No. e0190	478		[	Sta	te Well Nur	mber/Site Number	
Date Wo	ork Begar	10/0	7/2013	Date Work	Ended 10/7/2013			ل	Latitude	<u> </u>	Longitu	de
Local Pe	ermit Age	ncy Co	ounty of Sacra	mento					. L.I			
Permit M	Number 5	3190		Permit Date 9/	20/13	1				APN/1	RS/Other	
1		10 - 10 - 10 - 10 - 10 - 10	Geol	ogic Log	ten de carde antide	AM PARTY APP		With the second	Well	Owner.	-	
Ori	entation	OVe	ertical OHo	orizontal OAng	le Specify	Name C	City of Elk	Grove			×	
Drilling	Method F	follow S	tem Auger	Drillin	g Fluid	- Mailing /	Address	8401 La	quna P	alms Wa	V	
Feet	to F	eet	De	Scribe material, grain s	n ize. color. etc	City Elk	Grove			Sta	te CA zip	95758
0	4		Clay- dark br	own, medium pla	stic, damp	y .	0	period.	Well	ocation		seed of the set
4	13		Sandy Silty (	Clay-very fine to f	ine, medium plastic	Address	10250	Iron Roc	k Wav	and and a	All shares of the	and a real file
			reddish brow	n, ɗrỵ		City El	Grove	10200 0.1000		Col	inty Sacrament	0
13	15		Silty Clay- ta	n mottled light bro	wn, medium plasti	C Latitude				N Longitu	ide .	W.
15	19		Silty Sand- v	ery fine to mediun	n, light brown, dam	р	Deq.	Min.	Sec	n congito	Deg. Min	Sec
19	24		Sand- fine to	coarse, trace gra	vel, brown, damp	Datum_		Dec. La			Dec. Long	
24	25		Silty Sand- v	ery fine to fine, tai	n, micaceous	APN Bo	ok <u>134</u>	Page	<u>    0630    </u>	0	Parcel 037	
25	27		Sand- fine to	coarse, loose, tai	n, damp	Townshi	p	Rang	e	1	Section	
27	29		Silty Sand- v	ery fine to mediun	n, light brown, mois	st	Loca	tion Ske	otch		Activ	lity
29	31		Sand-very fi	ne to coarse, trac	e gravel to 1/4",	(Sketch)	must be draw	n by hand a North	tter form is	printed.)	New Well	
			brown, damp	8			9.510	Hora	28	100	O Modification O Deepen	VRepair
31	41		Sandy Silty C	lay-very fine, rec	dish brown,						O Other_	
	-		medium plas	tic, moist						10	O Destroy	and materials
41	44		Silty Clay- ta	n, medium plastic	black organics					126	under 'GEOLOG	IC LOG"
44	47		Silty Sand- v	ery fine to fine, ta	n, damp						Planned	Uses
47	53		Sandy Silt- v	ery fine, tan, dam	0	1.0					O Water Supp	oly El Dublio
53	55		Silty Clay- ta	n, black organics,	medium plastic	ti				st		
55	57		Sand-very fi	ne to medium, tar	damp	%			62	Ea		
57	59		Silty Clay- ta	n, black organics,	medium plastic					1		OLECHOIT
59	61		Sand-very fi	ne to medium, rec	dish brown, moist						O Heat Excha	inge
61	67		Silty Clay- ta	n, medium plastic	damp						O Injection	
67	69		Sandy Silty C	lay-very fine, bro	wn, medium plast	c					Monitoring	
69	71		Silty Sand- v	ery fine to fine, lig	ht brown, damp	Li Ca				1	O Remediatio	n
71	73		Sandy Silt- v	ery fine, tan, dam	0						O Sparging	
73	77		Sandy Silty C	lay- very fine, tar	mottled light brow	South O Vapor Extraction						action
Ĩ			medium plas	tic, damp	97	Illustrate or describe distance of well from roade, buildings, fences, from the standard a map. Use additional paper if necessary.						
77	80		Sandy Claye	y Silt- very fine to	fine, reddish brow	Please be accurate and complete.						
			micaceous		a. 5.	Water L	evel and	d Yield d	of Com	pleted W	/ell	Contraction of the
80	83		Sand-very fi	ne to coarse, mica	aceous, wet	Depth to	Depth to first water <u>93</u> (Feet below surface)					
83	85		Silty Clay- lig	ht brown, medium	plastic, moist-wet	Water L	evel		(Fee	et) Date	Measured	
Total D	Depth of E	Boring	120	1	Feet	Estimate	ed Yield *		(GP	M) Test	Туре	
Total	anth of C	ampla	ad Mall 120			Test Ler	Test Length (Hours) Total Drawdown (Feet)					
TOTAL	pepar or c	Joinipie		-1i 0	Feet	*May no	t be repre	sentative	of a wel	I's long te	rm yield.	
				Casings	Same and the	T and the	10	Passan and		Annul	ar Material	
Dept	h from	Boreh	ole Type	Material	Wall Outside	Screen	Slot Size	Dept	h from	Fil		scription
Feet	to Feet	(Inche	38)	- 28	(inches) (inches)	, i ybe	(Inches)	Feet	to Feet			
0	90	8.75	Blank	PVC Sch. 40	2			0	85	Cement	10.3 sa	ck sand/
90	115	8.75	Screen	PVC Sch. 40	2	Milled Slots	0.030				cement	
115	120	8.75	Blank	PVC Sch, 40	2			85	87	Fine Sar	Id Transitio	on
								87	120	Filter Pac	K SRI #8	Gravel
		-	- P							· · · · · · · · · ·		
			125				1	1				
	interest	Attac	hments	and a second second second			Certificat	tion Stat	tement		16-17-18-18-2-18-4 19-19-19-19-19-19-19-19-19-19-19-19-19-1	and the second second
	Geologic	Log		I, the	undersigned, certify t	hat this report	is comple	ete and ad	ccurate t	o the best	of my knowledg	le and belief
	Well Con	structio	on Diagram	Name	Person, Firm or Con	apration al	3			1 0		
H	SoilAMate	ar Cher	y(8) nical Analyses	2	20 N. 60	121 94.	- 121	ood	an	$A = \frac{C}{St}$	A 95	10
	Other	oner	nical Analyses	Signe	d Address			City	11/5	113	9069.59	P
Attach ad	ditional inform	nation, if	it exists		C-57-Licensed Wate	r Well Contractor			Date S	gned C	-57 License Nun	nber

*The free	Adobe Reader	may be used to view and comple	te this form. However, software mus	st be purchased to com	plete, save, and reuse a saved	form.
File Origi	inal with DWF	2	State of California	ornia	DWR Use C	nly – Do Not Fill In
Page 2	0	: )	Well Completic	on Report		
Owner's	Well Number	CY MW-4	Refer to Instruction F	Pamphiet B	State Well N	umber/Site Number
Date Wo	rk Began 10	/07/2013 Date	Work Ended 10/7/2013	Ģ		
Local Per	rmit Agency	County of Sacramento				
Permit N	umber <u>5319</u>	0 Permit D	bate 9/20/13		APN	/TRS/Other
a di des	TS Wanter 1	Geologic Log			Well Owner	
Orie	entation O	Vertical O Horizontal	OAngle Specify	Name City of E	lk Grove	
Drilling	Method Hollow	/ Stem Auger	Drilling Fluid	Mailing Address	8401 Laguna Palms W	ay
Feet	to Feet	e De Describe materia	scription Il grain size, color, etc	City Elk Grove	St	ate CA Zip 95758
85	89	Sandy Silty Clay- very f	ine to fine, tan, medium		Well Locatio	'n
		plastic, moist		Address 10250	Iron Rock Way	
89	93	Silty Clay- reddish brow	n, medium plastic, moist	City Elk Grove	Co	ounty_Sacramento
93	95	Clayey Silty Sand- very	fine to fine, reddish brown,	Latitude	N Longi	tude w
		moist to wet		Deg	Min, Sec.	Dea Min. Sec.
95	97	Sandy Silty Clay- very f	ine to fine, reddish brown,	Datum	Dec. Lat	_ Dec. Long
		medium plasticity, wet		APN Book 134	Page 0630	_ Parcel _037
97	101	Silty Clay- reddish brow	n, medium plastic, wet	i ownship	Range	
101	108	Clay- reddish brown, m	edium plastic, wet	LOC (Sketch must be dra	ation Sketch awn by hand after form is printed.)	Activity
108	111	Sandy Silt- very fine to	rine, tan, wet		North	O Modification/Repair
111	112	Sand- very fine to coars	se, prown, well sorted, wet			O Deepen
112	117	Clay- brown, medium p	lastic, wet			O Destroy
11/	120	Sitty Clay-Teddisti Drow	n, medium plastic, wet		-	Dosoribe procedures and materials under "GEOLOGIC LOG"
						Planned Uses
						O Water Supply
				1	- 10	
			201 - 3	Ne	а Э	
						O Cathodic Protection
			-			O Heat Exchange
			11 11	11 5		O Injection
			2 C			Monitoring
			En a d			O Remediation
			Ut .			O Sparging
		-0 <sup></sup>	1	- ¥	South	O Vapor Extraction
		- All	28.	illustrate or describe dister rivers, elc. and atlach a ma	nce of well from roads, buildings, fences, ap. Use additional paper if necessary.	O Other
			1	Mator Loval a	ad Viold of Completed	JL Well
		01		Denth to first wa	ter 93	(Feet below surface)
	_		in a state of the	Depth to Static		
				Water Level	(Feet) Date	e Measured
Total D	epth of Borin	g <u>120</u>	Feet	Estimated Yield	* (GPM) Tes	t Type
Total D	epth of Comp	bleted Well 120	Feet	*May not be repu	(Hours) 100	al Drawdown(Feet)
17 - 11 (M)	at aligned	Ca	singe		Annu	lar Material
Depth	from Bor	rehole Time Mat	Wall Outside	Screen Slot Sk	ze Depth from	iai materiai
Sur	face Dia	meter Type Mat	(Inches) (Inches)	Type if Any (Inches	Surface F	ill Description
1001						
		262				
		12				
}						
		N 50				
_						
10.71.553	Att	achments	La contra line di Parra di	Certific	ation Statement	
	Geologic Log	rtion Diagram	Name	Drallinci	nete and accurate to the be	at of my knowledge and belief
	Geophysical i	Log(s)	27 Person, Firm or Corport	ation st. 1	Noodland	CA 957710
	Soil/Water Ci	nemical Analyses	Addrese		City / /	State Zip
	Other		Signed	All Contractor	<u> </u>	906999
Attach add	itional information	, if it exists.	C-or Usensed Water W	Ven Contractor	Date Signed	C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

## **Appendix 3.3**

# Well Head Survey and Construction Summary

## Table1. Well Heads Survey and Construction Summary

					XY_							TO	TOC h		Course limit	Alt_FIELD
NAMF	Fasting	Northing	XY DATUM	XY SURVEY ORG	DESC	ATF	FFF DATF	FLEVATION	DATUM	ORG	FLFV_DFSC	bgs	a_201	BOS_D	bgs	_PT_NAIVI F
										00		~ 00	00		_~80	_
			NAD_1983_StatePlane_Californi							cbec						
CY-DW1	6745024.43	1902922.04	a_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/22/2014	47.67	NAVD88	Ecoengineers	Top of Stilling Pipe	45	7	45		CY-DW1
			NAD 1002 State Diana Californi													
CY-M/W/1	67/15078 19	190310676	NAD_1983_StatePlane_Californi	chec Ecoengineers	GPS	11/19/2014	10/11/2013	50 1/		CDEC	Top of Casing	115	80	110	80-110	CV-M/M/1
	0745078.15	1505100.40	a_ii_i ii 5_0402_i eet	cbec Ecoengineers		11/13/2014	10/11/2013	50.14	INAV DOO	Leoengineers		115	00	110	00-110	
			NAD_1983_StatePlane_Californi							cbec						
CY-MW2	6745026.65	1902905.48	a_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/4/2013	48.37	NAVD88	Ecoengineers	Top of Casing	55	20	50	20-50	CY-MW2
			NAD_1983_StatePlane_Californi							cbec						
CY-MW3	6744955.59	1902888.11	a_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/9/2013	49.11	NAVD88	Ecoengineers	Top of Casing	120	90	115	90-115	CY-MW3
			NAD 1983 StatePlane Californi							chec						
CY-MW4	6744989.93	1902844.55	a II FIPS 0402 Feet	cbec Ecoengineers	GPS	11/19/2014	10/7/2013	49.30	NAVD88	Ecoengineers	Top of Casing	120	90	115	90-115	CY-MW4
-						, -, -										-
			NAD_1983_StatePlane_Californi							cbec						
SDB-DW1	6736132.27	1925708.15	a_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/22/2014	29.54	NAVD88	Ecoengineers	Top of Stilling Pipe	40	7	40		SDB-DW1
	6726452.15	1025769.21	NAD_1983_StatePlane_Californi	chao Feografia are	CDC	11/10/2014	10/2/2012	25.17		cbec	Top of Cosing	120	100	115	100 115	
2DR-IVLVV T	0/30452.15	1925768.21		cbec Ecoengineers	GPS	11/19/2014	10/2/2013	35.17	NAVD88	Ecoengineers	Top of Casing	120	100	115	100-115	SC-IVI VV I
			NAD 1983 StatePlane Californi							cbec					22.5-	
SDB-MW2	6736129.29	1925733.17	a_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	9/26/2013	28.82	NAVD88	Ecoengineers	Top of Casing	58	22.5	52.5	52.5	SC-MW2
			NAD_1983_StatePlane_Californi							cbec						
SDB-MW3	6736100.98	1925659.18	a_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	9/25/2013	35.31	NAVD88	Ecoengineers	Top of Casing	120	105	115	105-115	SC-MW3
	6736125.01	1925752 /19	NAU_1983_Stateriane_Californi	chec Ecoengineers	GPS	11/10/2014	9/30/2012	<u>רד פר</u>		Ecoengineers	Top of Casing	120	100	115	100-115	SC-M/M/A
SDB-MW3	6736100.98 6736125.01	1925659.18 1925752.48	a_II_FIPS_0402_Feet NAD_1983_StatePlane_Californi a_II_FIPS_0402_Feet	cbec Ecoengineers	GPS GPS	11/19/2014	9/25/2013 9/30/2013	35.31	NAVD88	Ecoengineers cbec Ecoengineers	Top of Casing Top of Casing	120	105	115	105-115	SC-MW3

CY = Corporation Yard

SDB = Strawberry Creek Water Quality

DW = dry well

MW1 - Monitoring Well 1 (upgradient well)

MW2 = Vadose Zone Well

MW3 = Monitoring Well 3 (downgradient well)

MW4 = Monitoring Well 4 (downgradient well)

Appendix 3.4 Dry Well Design Plans



CITY OF ELK GROVE ,CA



## **CITY OF ELK GROVE**

DEPARTMENT OF PUBLIC WORKS 8401 LAGUNA PALMS WAY • ELK GROVE, CALIFORNIA 95758

**IMPROVEMENT PLANS FOR:** 

## DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT WDR019

UTILITY COMPANY / CONTACT TELEPHONE PROJECT MANAGER CITY OF ELK GROVE CONNIE NELSON 916-478-3638 DRAINAGE CITY OF ELK GROVE FERNANDO DUENAS 916-627-3434 CABLE TV AT&T BROADBAND ASTRID WILLARD 916-453-6136 CABLE TV COMCAST STEVE ABELIA 916-830-6757 ELECTRIC S.M.U.D. JACK GRAHAM 916-732-6643 FIRE COSUMNES COMMUNITY SERVICES DISTRICT 918-405-7100 SHEILA WOLCOTT GAS MIKE WILLIAMS 916-386-5013 PG&E PARKS & RECREATION COSUMNES COMMUNITY SERVICES DISTRICT 916-947-1831 STEVE SIMS PHONE FRONTIER COMMUNICATION EVA MOREDOCK 916-691-5615 PHONE SUREWEST GRETCHEN HILLDEBRAND 916-691-5615 SEWER SACRAMENTO AREA SEWER DISTRICT ROB ESPINOZA 91 6-876-6386 TRANSIT e-TRAN JEAN FOLETTA 91 6-687-3030 WATER ELK GROVE WATER SERVICE BRUCE KAMILOS 91 6-585-9385 SACRAMENTO COUNTY WATER AGENCY WATER IMELDA TABBADA 91 6-874-4261 UNDERGROUND SERVICE ALERT U.S.A. 611 or 1 -800-227-2600

To Be Supplemented By: City of Elk Grove Improvement Standards & Standard Drawings, Latest Edition City of Elk Grove Standard Construction Specifications, Latest Edition State of California Department of Transportation, Standard Plans & Specifications, 2006



 Image: Non-All State in Increase
 Market Circle - Suite 100
 Designed in the circle - S

.....

SH 1. 2. <u>SITE</u> 3. 4. <u>SITE</u> 5. 6. 8. <u>DET/</u> 9.	EET INDEX: TITLE SHEET ABBREVIATIONS LIST & GENERAL 1: STRAWBERRY CREEK WATER O VICINITY MAP, AERIAL VIEW & SIT SURFACE FLOW & WATER QUALT 2: CITY OF ELK GROVE CORPORA VICINITY MAP, AERIAL VIEW & SIT SURFACE FLOW & WATER QUALT DRAINAGE INLET DETAIL SWALE DETAIL MLS: DRY WELL DETAIL	NOTES IUALITY BASIN E LAYOUT PLAN FY PLAN, ELEVATION TION YARD TE LAYOUT PLAN TY PLAN, ELEVATION	& DETAILS & DETAILS	WDR019 - UNDERGROUND INJECTION CONTROLS AS LOW IMPACT DEVELOPMENT			
	APPROVED BY:						
	RICHARD R. CARTER, P.E #C5633 CAPITAL PROGRAM MANAGER	82	<u>G-18-14</u> Date				
1	SUBMITTED BY:						
	JENNIFER MAXWELL, P.E #C5430 CIP SERVICE MANAGER	36	6-19-14 DATE				
	REVIEWED BY:						
	JOHN R. SCOTT DATE DATE						
	PREPARED BY:						
	FERNANDO DUENAS, P.E #C64070 DATE						
	PMENT	DATE: JUNE 2014 SCALE:	SHEET: 1				
		HORIZ: N/A VERT: N/A PROJECT No.:	OF 9				
		WDR019					

CITY OF ELK GROVE GENERAL NOTES:

- 1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE CITY OF ELK GROVE STANDARD CONSTRUCTION SPECIFICATIONS AND IMPROVEMENT STANDARDS. WHERE INCONSISTENCIES EXIST, THE LATEST EDITION SHALL TAKE PRECEDENCE.
- PUBLIC SAFETY AND TRAFFIC CONTROL SHALL BE PROVIDED IN ACCORDANCE WITH SECTION 6-13 OF THE STANDARD CONSTRUCTION SPECIFICATIONS AND AS DIRECTED BY THE CITY INSPECTOR. SAFE VEHICULAR AND PEDESTRIAN ACCESS SHALL BE PROVIDED AT ALL TIMES DURING CONSTRUCTION.
- 3. THE CONTRACTOR SHALL NOTIFY THE CITY OF ELK GROVE CONSTRUCTION INSPECTION OFFICE TWO WORKING DAYS PRIOR TO THE COMMENCEMENT OF WORK. THE CONTRACTOR SHALL NOT START ANY GRADING UNTIL THE CITY COMPLETES A PRE-CONSTRUCTION MEETING. PLEASE CALL (916) 478-2212 TO SCHEDULE A PRE-CONSTRUCTION MEETING.
- 4. THE CITY OF ELK GROVE IS A MEMBER OF THE UNDERGROUND SERVICE ALERT (U.S.A.) ONE-CALL PROGRAM. THE CONTRACTOR OR ANY SUB-CONTRACTOR FOR THIS CONTRACT SHALL NOTIFY MEMBERS OF U.S.A. TWO WORKING DAYS IN ADVANCE OF PERFORMING AND EXCAVATION WORK BY CALLING 811 OR 1-800-227-2600.
- 5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL EXISTING SURVEY MONUMENTS AND OTHER SURVEY MARKERS DURING CONSTRUCTION. ALL SUCH MONUMENTS OR MARKERS DESTROYED DURING CONSTRUCTION SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE.
- 6. EROSION CONTROL MEASURES SHALL BE IN ACCORDANCE WITH SECTION 11 OF THE CITY OF ELK GROVE IMPROVEMENT STANDARDS
- 7. THE TYPES, LOCATIONS, SIZES, AND/OR DEPTHS OF EXISTING UNDERGROUND UTILITIES AS SHOWN ON THESE IMPROVEMENT PLANS WERE OBTAINED FROM SOURCES OF VARYING RELIABILITY. THE CONTRACTOR IS CAUTIONED THAT ONLY ACTUAL EXCAVATION WILL REVEAL THE TYPES, EXTENT, SIZES, LOCATIONS, AND DEPTHS OF SUCH UNDERGROUND UTILITIES. A REASONABLE EFFORT HAS BEEN MADE TO LOCATE AND DELINEATE ALL KNOWN UNDERGROUND UTILITIES. HOWEVER, THE ENGINEER CAN ASSUME NO RESPONSIBILITY FOR THE COMPLETENESS OR ACCURACY OF ITS DELINEATION OF SUCH UNDERGROUND UTILITIES, NOR FOR THE EXISTENCE OF OTHER BURIED OBJECTS OR UTILITIES WHICH MAY BE ENCOUNTERED, BUT ARE NOT SHOWN ON THESE PLANS. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE EXACT LOCATION, SIZE AND DEPTH OF ALL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION, WHICH MAY INCLUDE POTHOLING. PRIOR TO CONSTRUCTION, WHICH MAY INCLUDE POTHOLING.

#### CITY OF ELK GROVE DRAINAGE NOTES:

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

- ALL CONSTRUCTION AND MATERIALS FOR DRAINAGE SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE CITY OF ELK GROVE IMPROVEMENT STANDARDS AND STANDARD CONSTRUCTION SPECIFICATIONS. WHERE DISCREPANCIES EXIST, APPROPRIATE NOTES SHALL BE ADDED TO THE PLANS, TAKING PRECEDENCE OVER THE STANDARD CONSTRUCTION SPECIFICATIONS.
- 2. THE MINIMUM COVER REQUIREMENTS DURING CONSTRUCTION FOR TEMPORARY CONSTRUCTION VEHICLE LOADING SHALL BE 4-FEET FOR METAL AND PLASTIC PIPE AND 3-FEET FOR REINFORCED CONCRETE PIPE.
- THE CONTRACTOR SHALL PLACE THE PROPER STRENGTH PIPE IF TRENCH CONDITIONS 3. ENCOUNTERED DIFFER FROM THE DESIGN TRENCH.
- STORM DRAIN PIPES IN THE PUBLIC RIGHT-OF-WAY (ROW) AND DRAINAGE EASEMENTS SHALL CONFORM TO THE STANDARD CONSTRUCTION SPECIFICATIONS: DRAINAGE PIPE MATERIAL SHALL CONFORM TO SECTION 36 AND SECTION 50 (EXCLUDING 50-20, WHICH IS NOT ALLOWED). 4.

  - DRAINAGE MANHOLES SHALL CONFORM TO SECTION 39.
- 5. STORM DRAIN PIPES SHALL BE TESTED IN CONFORMANCE WITH THE STANDARD CONSTRUCTION SPECIFICATIONS: • DRAINAGE PIPES, INCLUDING DRAIN INLET LATERALS, SHALL BE TESTED IN
  - CONFORMANCE WITH SECTION 38-9. STORM DRAIN MANHOLES SHALL BE TESTED IN CONFORMANCE WITH SECTION
  - 39-4.01
- RESILIENT CONNECTORS, IN CONFORMANCE WITH SECTION 39-2.01 AND STANDARD DRAWING (STD. DWG.) SD-7 OF THE STANDARD CONSTRUCTION SPECIFICATIONS, ARE REQUIRED BETWEEN PRE-CAST MANHOLE AND PIPE AND BETWEEN PRE-CAST DROP INLET AND PIPE. WATER STOPS ARE REQUIRED FOR PIPE TO CAST-IN-PLACE MANHOLE / DROP INLET CONNECTIONS.
- 7. EROSION CONTROL STRUCTURES (STD. DWGS. SD-26, SD-27, SD-28.1, SD-28.2, SD-28.3 AND SD-28.4) SHALL BE CLASS B CONCRETE, NOT GROUTED COBBLE,
- ALL DRAINAGE INLETS IN THE PUBLIC ROW AND DRAINAGE EASEMENTS SHALL HAVE A 8. PERMANENT STORM DRAIN MESSAGE "NO DUMPING - FLOW TO CREEK" OF OTHER APPROVED MESSAGE CONSISTENT WITH SECTION 11-15 AND STD. DWGS. SQ~10.1 AND SQ-10.2 OF THE CITY OF ELK GROVE IMPROVEMENT STANDARDS.

#### **CITY OF ELK GROVE EROSION & SEDIMENT CONTROL NOTES:**

- 1. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CONSTRUCTED AND MAINTAINED IN ACCORDANCE WITH THE CITY OF ELK GROVE IMPROVEMENT STANDARDS, CURRENT EDITION (OCTOBER 2007), AND THE CITY OF ELK GROVE EROSION AND SEDIMENT CONTROL GUIDELINES, DATED OCTOBER 2007.
- 2. EROSION CONTROL BEST MANAGEMENT PRACTICES (BMPs) SHALL BE INSTALLED AND MAINTAINED ALL YEAR ROUND.
- 3. ALL DRAINAGE INLETS IMMEDIATELY DOWNSTREAM OF THE WORK AREAS AND WITHIN THE WORK AREAS SHALL BE PROTECTED WITH SEDIMENT CONTROL AND INLET FILTER BAGS, YEAR ROUND. INLET FILTER BAGS SHALL BE REMOVED FROM THE DRAINAGE INLETS UPON ACCEPTANCE OF THE PUBLIC IMPROVEMENTS BY THE CITY
- 4. ALL STABILIZED CONSTRUCTION ACCESS LOCATIONS SHALL BE CONSTRUCTED PER STANDARD DRAWING SQ-1. WHERE CONSTRUCTION TRAFFIC ENTERS OR LEAVES PAVED AREAS, THE STABILIZED ACCESS SHALL BE MAINTAINED ON A YEAR ROUND BASIS UNTIL THE COMPLETION OF THE CONSTRUCTIONS.
- 5. ALL AREAS DISTURBED DURING CONSTRUCTION. BY GRADING, TRENCHING, OR OTHER ACTIVITIES, SHALL BE PROTECTED FROM EROSION
- SENSITIVE AREAS AND AREAS WHERE EXISTING VEGETATION IS BEING PRESERVED SHALL BE PROTECTED WITH CONSTRUCTION FENCING. SEDIMENT CONTROL BMP# SHALL BE INSTALLED WHERE ACTIVE CONSTRUCTION AREAS DRAIN INTO SENSITIVE OR PRESERVED VEGETATION AREAS
- 7. SEDIMENT CONTROL BMPS SHALL BE PLACED ALONG THE PROJECT PERIMETER WHERE DRAINAGE LEAVES THE PROJECT. SEDIMENT CONTROL BMPS SHALL BE MAINTAINED YEAR ROUND UNTIL THE CONSTRUCTION IS COMPLETE OR THE DRAINAGE PATTERN HAS BEEN CHANGED AND NO LONGER LEAVES THE SITE.
- THE FOLLOWING AREAS ON ALL PROJECTS ARE TO RECEIVE HYDROSEEDING OR OTHER FROSION CONTROLS:
  - FOR RESIDENTIAL PROJECTS; LOT FRONT YARDS BEHIND THE SIDEWALK THE
  - FIRST 18 FEET OR TOP OF SLOPE (WHICHEVER IS GREATER). FOR RESIDENTIAL PROJECTS; SIDEYARDS BEHIND THE SIDEWALK THE FIRST 7.5 FEET OR TOP OF SLOPE (WHICHEVER IS GREATER).
  - . FOR ALL COMMERCIAL PROJECTS; ALL NON ACTIVE DISTURBED SOIL AREAS MUST BE STABILIZED.
  - SLOPES ALL SLOPES GREATER THAN 10:1
- 9. ALL NON-ACTIVE DISTURBED SOIL AREAS MUST BE STABILIZED WITH EROSION CONTROLS WITHIN 14 CALENDAR DAYS OR PRIOR TO A FORECASTED RAIN EVENT (WHICHEVER COMES FIRST).

#### CITY OF ELK GROVE SUPPLEMENTAL NOTES:

- 1. WHENEVER THE WORK AREA IS ADJACENT TO A TRAFFIC LANE AND THERE IS A CUT, DITCH OR TRENCH MORE THAN 2 INCHES DEEP, THE CONTRACTOR SHALL MAINTAIN CONTINUOUS BARRICADES SPACED AT APPROXIMATELY 20-FOOT MAINTAIN CONTINUOUS BARKICADES SPACED AT APPROXIMATELY 20-FOOT INTERVALS FOR THE FIRST 100 FEET FROM THE BEGINNING OF THE CUT, DITCH OR TRENCH, AND APPROXIMATELY 50-FOOT INTERVALS THEREAFTER. IF THE CUT, DITCH OR TRENCH IS MORE THAN TEN FEET FROM A TRAFFIC LANE, THE BARRICADE SPACING MAY BE GREATER BUT SHALL NOT EXCEED 200 FEET.
- 2. UNLESS SPECIFICALLY SET FORTH AS SPECIAL PROVISIONS, ALL MARKED LANES OF TRAFFIC SHALL BE UNOBSTRUCTED IN EACH DIRECTION DURING THE PEAK TRAFFIC HOURS OF 7:00 TO 8:00 A.M. AND 3:30 TO 6:00 P.M. A TRAFFIC LANE SHALL BE CONSIDERED UNOBSTRUCTED IF IT IS SURFACED WITH ASPHALT AND IS AT LEAST TEN FEET WIDE.
- 3. A TRAFFIC CONTROL PLAN SHALL BE PREPARED BY THE CONTRACTOR AND SUBMITTED TO THE CITY OF ELK GROVE CONSTRUCTION INSPECTION FOR REVIEW AT LEAST 15 DAYS PRIOR TO COMMENCEMENT OF ANY WORK. AN ENCROACHMENT PERMIT OR PLAN APPROVAL MUST FIRST BE OBTAINED PRIOR TO ANY WORK COMMENCING WITHIN THE CITY RIGHT-OF-WAY.

1000							
ALTERNAL AND ALTERNAL		DESIGNED:	CITY OF ELK GROVE DEPARTMENT OF PUBLIC WORKS		DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT	DATE: JUNE 2014 SCALE: HORIZ: N/A	SHEET: 2 OF
304450 m	Engineering           9281 Office Park Circle ~ Buite 100           Eik Grove, CA 95755 916.478.6002	CHECKED:	8401 LAGUNA PALMS WAY ELK GROVE, CALIFORNIA 95758 916.883.7111	A CONTRACT	ABBREVIATIONS LIST & GENERAL NOTES	VERT: N/A PROJECT No.: WDR019	9
	FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES						

ABBREVIATIONS LIST: AB - aggregate base ac- acre brk - break cfs - cubic feet per second CLR - clearance dia - diameter (Ø) DI - drain inlet (E) - existing Elev - elevation ft - feet fps - feet per second gd - ground inv. - invert min - minimum/ minutes N.A.P.O.T.C. - not a part of this contract 0.C. - on center PVC - polyvinyl chloride RC~ reinforced concrete pipe SD - storm drain (Typ) - typical w/ - with





N

5 6 3 1 1 1 1 1 1 1









FOR REDUCED FLANE ORIGINAL SCALE IS IN INCHES

8 NOL



WDR019 - UNDERGROUND INJECTION CONTROLS AS LOW IMPACT DEVELOPMEN

-----

# Appendix 4.1

# **Dry Well Permits**

AR0067878

WELL AF ENVIRONMENTAL MANAGEMEI 10590 ARMSTR TELEPHO WELL IS THIS BERMIT FOR A HAZAG	PLICATION AND PERMIT FORM NT DEPARTMENT – ENVIRONMENTAL COMPLIANCE DIVISION ONG AVENUE · SUITE A · MATHER CA 95655 NE (916) 875-8400 FAX: (916) 875-8513 LINSPECTION LINE: (916) 875-8524 RDOLIS SUBSTANCE INVESTIGATION 2 - ELVES - 20 NO					
IS THIS PERMIT FOR A HAZAR	ROOUS SUBSTANCE INVESTIGATION? DITES BINO					
FOR OFFICE USE ONLY     E       APPROVED (X) APPROVED W/CONDITIONS (ATTACHED)     PE       BY:     DATE:       INITIAL GROUT BY:     DATE:       FINAL INSPECTION BY:     DATE:       DESTRUCTION BY:     DATE:       GI     COMMENTS:	XPEDITED PROCESSING?         U YES         NO           ERMIT NUMBER(S):         54047         TOTAL FEE:         \$05389           ATE RECEIVED:         9/26/14         TOTAL FEE:         \$05389           ECEIPT NO:         100363229         DEPTH TO WATER:					
	DO EG CT 93,22					
SITE ADDRESS: 0 Calvine Road, Elk Grove 95624						
Job Address: Ed Harris Middle School/Monterey Trail High School	Nearest Major Cross Street: Power Inn Road					
Property Owner: City of Blk Grove	Parcel Number(s): 115-0150-036-0000					
Well Contractor: Fox Loomis, Inc.	CA License No.7 372314 (Expiration Date: 9/30/2015)					
Contractor's Address: 6901 McComber Street, Sacramento, CA 95828	049, 9/30/15 Gratow					
Well/Boring Identification Number(s): Site 1	Wa exp. 10/1/15 4					
TYPE OF WORK: (California C-57 License required unless noted of Well construction       □ Vault box repair (General A         Pump replacement (or C-61)       □ Well repair         Well inactivation (Owner only)       □ Pump repair (or C-61)         INTENDED USE:       □ Domestic/private         □ frigation/agricultural       □ Cathodic protection	or B) □ Well destruction (SUPPLEMENT REQUIRED) □ Exploratory boring (C-57 if water present) ♂ Other: Dry Well □ Geotechnical boring □ Environmental boring					
Water/vapor monitoring/extraction     Heat exchange	X Other: Dry Well TORM WATER					
(NAME OF WATER PURVEYOR WITH	CONTACT NAME AND TELEPHONE NUMBER)					
DRILLING METHOD:	Driven Kother BUCKET AVGER					
SETBACKS:       (Wells only)         Is the well located within 50 feet of a:       Beswer line, Distreat         Is the well located within 100 feet of a:       Beswer line, Distreat	n, □ ditch <mark>, ⊠drainage course,</mark> □ pond, or □ lake? No h line, □ deep trench, or □ animal enclosure? (X No					
SPECIFICATIONS:         BOREHOLE:       Diameter;       44"       Depth;       45'         Diameter;       Diameter;       Depth;       Depth;       45'         CONDUCTOR:       Diameter;       30"       Depth;       45'         ANNULAR SEAL:       Depth;       Material;       45'	CASING: Diameter: <u>30"</u> Depth <mark>: 45'</mark> CASING: Diameter: Depth: <u>45'</u> IF STEEL: Gauge: or Thickness: IF PLASTIC: Type <mark>: Polypropylene (M</mark> ust meet ASTM F-480)					
COMMENTS: Dry Well 2' Collar						
PUMP INSTALLATION/REPAIR: Contractor: License Number: Horsepower:						
I will comply with all Codes, Rules and Regulations of the State and 8524 for a grout inspection at least 24 hours prior to the re required) within 60 days of the completion of my work so a final i well in service.	d County pertaining to or regulating wells and pumps, call (916) 875- quested appointment time, submit a "Well Completion Report" (If nspection can be made, and obtain WPD approval before placing a					
SIGNATURE: PRINTED NAME: COMPANY: MAILING ADDRESS: PHONE NUMBER: COMPANY: COMPANY: COMPANY: COMPANY: City of Elk Grove 8401 Laguna Palms Way, Elk Grove, CA 9575 (016) 478-2356	Agent (REQUIRES AUTHORIZATION FORM)					
A SITE PLAN MUST BE SUBMI PERMIT EXPIRES ONE (1) YEAR AFTER	TTED WITH EACH APPLICATION.					

SE 04/09/2009 WIDdata FORMSARCHIVE WP NEWWELLSWELL APPLICATION AND PERMIT FORM.doc
Environmental Management Department Val F. Siebal, Director



Divisions Environmental Compliance Environmental Health

County of Sacramento

## ATTACHMENT WELL APPLICATION & PERMIT FORM

Pursuant to the Sacramento County Code, Chapter 6.28, Section 6.28.030.E.1, Permit Numbers 54847 and 54848 are conditioned as follows:

- Both wells shall be registered with the United States Environmental Protection Agency's Underground Injection Control program. Copies of the "Injection Wells Registration Form" shall be submitted to EMD within 60 days of well construction completion. Guidance is available at <u>http://www.epa.gov/region9/water/groundwater/uic-classv.html</u>.
- EMD permit approval is contingent on concurrence from the California Regional Water Quality Control Board, Central Valley Region, on the design and construction specifications of the project. No documentation of concurrence is requested.
- Polypropylene casing material is approved pursuant to Sacramento County Code, Chapter
   6.28, Section 6.28.040.A.5.a.(8).
- The annular surface seal shall consist of Portland cement and aggregate mixed at a ratio of at least six ninety-four (94) pound sacks of Portland cement per cubic yard of aggregate. In no case shall the size of the aggregate be greater than one-fifth the radial thickness of the annular seal. Water shall be added to concrete mixes to attain proper consistency for placement, setting, and curing. Cement used in sealing mixtures shall meet the requirements of American Society for Testing and Materials C150, "Standard Specification for Portland Cement," including the latest revisions thereof.
- The minimum annular surface seal depth requirement is waived pursuant to Enforcement Agency discretion. Each well shall have a minimum annular surface seal depth of at least 3 feet. The radial thickness of this seal shall be approximately 7 inches, unless modified prior to seal inspection.
- All reports to the State Water Resources Control Board shall be copied to EMD (<u>Attention</u>: Cheryl Hawkins, Supervising Environmental Specialist).

- The applicant is required to comply with Section 10.11 ("Contingency Plan" for spills and/or detection of groundwater impact) of the November 8, 2013, Version 2, "Quality Assurance Project Plan" as a permit condition.
- All other applicable provisions of Chapter 6.28 of the Sacramento County Code remain in full force and effect.

Land By: B. Williams, M.S.

Permitting & Enforcement

Date: September 30, 2014

W:\DATA\WILLIAMSS\WELLPERMITATTACHMENTS\CITYOFELKGROVE\_54847-54848.DOC

#### Page 2

### ENVIRONMENTAL MANAGEMENT DEPARTMENT ENVIRONMENTAL COMPLIANCE DIVISION 10590 ARMSTRONG AVENUE, SUITE A MATHER CA 95655 (916) 875-8400

## ENVIRONMENTAL COMPLIANCE SITE PLAN FOR WELL AND SEWAGE DISPOSAL SYSTEM PERMITS

SITEL

W



Ε

8/16/2012 gfb W:\Data\FORMSARCHIVE\WP\WELLS\03 SITEPLAN.doc



2001

INSAMOJEVED TOARM WOL BA EJONTNOO NOTTOBWI GNUOMOREGUN - \$10HGW

ł

l



Information For Parcel: 115-0150-036-0000

PROPERTY INFORMATION APN 11501500360000 Situs Address 0 CALVINE RD Postal ELK GROVE, CA 95624 City/St/Zip Thomas Bros 358 E 1 Kappa Maps 81 E 5 Landuse Code IABAAA Jurisdiction **ELK GROVE** Sup. District District 5 - Don Nottoli **OWNERSHIP INFORMATION** Owner CITY OF ELK GROVE Mailing 8380 LAGUNA PALMS WAY Address ELK GROVE, CA 95758 Transfer Date 2001-10-24 Deed View Property Transfer Document Owner History View Owner History PARCEL DETAIL LINKS General Info View General Parcel Data Districts View District Data Recorded Map No maps are available. Assessor Maps View Assessor Map Parcel History View Splits and Merges History Data Assessment View Assessor Data Info No Permit record available. Building Permits Parcel Notes View Parcel Notes No Business License Data available. **Business** Licenses SHRA Info View SHRA Data No CUBS data available. CUBS Info Refuse Pickup No Refuse Pickup schedule available. Water Meters No Water Meter Data available. Easements View Easements Data Planning View Planning Parcel Page Parcel Page

Home | Online Services | License Details

# Contractor's License Detail for License # 372314

DISCLAIMER: A license status check provides information taken from the CSLB license database. Before relying on this information, you should be aware of the following limitations. (hide/show disclaimer)

CSLB complaint disclosure is restricted by law (B&P 7124.6) If this entity is subject to public complaint disclosure, a link for complaint disclosure will appear below. Click on the link or button to obtain complaint and/or legal action information.

Per B&P 7071.17, only construction related civil judgments reported to the CSLB are disclosed.

Arbitrations are not listed unless the contractor fails to comply with the terms of the arbitration.

Due to workload, there may be relevant information that has not yet been entered onto the Board's license database.

**Business Information** 

#### FOX LOOMIS INCORPORATED 6901 MC COMBER STREET SACRAMENTO, CA 95828 Business Phone Number: (916) 383-2140

Entity Corporation Issue Date 04/17/1979 Reissue Date 09/15/1993 Expire Date 09/30/2015

License Status

This license is current and active.

All information below should be reviewed.

Classifications

A - GENERAL ENGINEERING CONTRACTOR

C57 - WELL DRILLING (WATER)

C42 - SANITATION SYSTEM

#### **Bonding Information**

#### **Contractor's Bond**

This license filed a Contractor's Bond with AMERICAN CONTRACTORS INDEMNITY COMPANY.

Bond Number: SC6008744

Bond Amount: \$12,500

Effective Date: 03/02/2009

Contractor's Bond History

Bond of Qualifying Individual

The Responsible Managing Officer (RMO) FOX SAMUELL ERIC certified that he/she owns 10 percent or more of the voting stock/equity of the corporation. A bond of qualifying individual is not required.

Effective Date: 11/05/2009

**BQI's Bond History** 

Workers' Compensation

This license has workers compensation insurance with the OAK RIVER INSURANCE COMPANY so allacted at a

Policy Number:2200054068 Effective Date: 10/01/2012 Expire Date: 10/01/2014

Workers' Compensation History

Miscellaneous Information

09/15/1993 - LICENSE REISSUED TO ANOTHER ENTITY

**Personnel List** 

ACORD CER	TIF	IC	ATE OF LIA	BIL	ITY IN	SURA		DATE ( 09/29	<b>uwdd/yyyy)</b> //2014			
THIS CERTIFICATE IS ISSUED AS A CERTIFICATE DOES NOT AFFIRMA BELOW. THIS CERTIFICATE OF IN REPRESENTATIVE OR PRODUCER, MPORTANT: If the certificate holds	MATT TIVEL ISURA AND TI IS an	Y OF	OF INFORMATION ONLY NEGATIVELY AMEND, DOES NOT CONSTITUT ERTIFICATE HOLDER. DITIONAL INSURED, the	AND EXTE	CONFERS N ND OR ALT CONTRACT ( (les) must be	O RIGHTS C ER THE CO BETWEEN T endorsed.	UPON THE CERTIFICAT VERAGE AFFORDED E HE ISSUING INSURER If SUBROGATION IS W	IE HOL BY THE (S), AU	DER. THIS POLICIES THORIZED			
the terms and conditions of the polic	y, cert	ein p	olicies may require an ei	idorse	ment. A stat	ement on th	ls certificate does not c	onfer r	ghts to the			
Certificate noider in Neu of Such endo	rseme	inu(s)		CONTA	CT Charl Gra							
John O. Bronson Co. / #0425149				PHONE	916.48	0-4153	FAX	916-99	1.7258			
3636 American River Drive Suite	om	/10 //.										
Sacramento, CA 95864 NSUBER(S) AFFORDING COVERAGE												
916-974-7800				INSURE	RA: National	Fire Insurance	e of Hartford					
INSURED Fox Loomis Inc.				INSUR	RB: Contine	ntal Casualty						
				INSUR	AC: Oak Riv	er Insurance C	lompany					
Secremento, CA 95828				INSUR	AD:							
			10746	INBUR	RF:							
	RIFIC		NUMBER: 19740		N ISSUED TO		REVISION NUMBER:					
INDICATED. NOTWITHSTANDING ANY I CERTIFICATE MAY BE ISSUED OR MAY EXCLUSIONS AND CONDITIONS OF SUC	REQUIP PERT H POLI	AEME	NT, TERM OR CONDITION THE INSURANCE AFFORD LIMITS SHOWN MAY HAVE	OF AN ED BY BEEN	Y CONTRACT THE POLICIE REDUCED BY	OR OTHER I S DESCRIBEI PAID CLAIMS	DOCUMENT WITH RESPE	CT TO Y	WHICH THIS THE TERMS,			
LTR TYPE OF INSURANCE	INSR	WVD	POLICY NUMBER		(MM/DD/YYYY)	(MIA/DD/YYYY)		18	1 000 000			
GENERAL LIABILITY			404 6000746		1001114	10/01/15	EACH OCCURRENCE	\$	1,000,000			
X COMMERCIAL GENERAL LIABILITY			4010889/40		1001/14	10/01/15	PREMISES (Ea occurrence)	5	5.000			
			Des Draiget Agements Age	iae		1	MED EXP (Any one person)	3	1 000 000			
			When Required By Written	les				6	2,000,000			
OFNI ACODECATE LINUT ADDI LES DEG.	-		Contract				PRODUCTR - COUPIOP AGO	e le	2,000,000			
POLICY X PRO- LOC						1	THOUGHTU- COMPTON ACC	s				
AUTOMOBILE LIABILITY							COMBINED SINGLE LIMIT (Ea accident)	\$	1,000,000			
X ANY AUTO			4016889777		10/01/14 10/01/15 BODILY INJURY			\$				
A ALL OWNED AUTOS						4	BODILY INJURY (Per accident)	\$				
							(Per socident)	\$				
	_							\$				
X UMBRELLA LIAB X OCCUR			4016889763		10/01/14	10/01/15	EACH OCCURRENCE	\$	3,000,000			
B EXCESSIONS CLAIMS-MAD	뜨	1					AGGREGATE	\$	3,000,000			
WORKERS COMPENSATION	-	-					V WOSTATU- OTH	5				
AND EMPLOYERS' LIABILITY	N I	. 1	2200054068		10/01/14	10/01/15			1.000.000			
C OFFICER/MEMBER EXCLUDED?	_ N/A						EL DISEASE - FA EMPLOYER	8	1.000.000			
If yos, doscribe under DESCRIPTION OF OPERATIONS below							EL DISEASE - POLICY LIMIT	5	1,000,000			
A Limited Pollution Liability			4016889476		10/01/14	10/01/15	\$1,000,000 Each Inciden \$2,000,000 Aggregate L	ıt imit				
DESCRIPTION OF OPERATIONS/LOCATIONS/VEH RE: License # 372314	IÇLES (	Attach	ACORD 101, Additional Remarks	Scheduk	, if more space in	noquired)						
Add') Interests:												
CERTIFICATE HOLDER				CAN	CELLATION							
CONTRACTORS STATE LICE WORKERS COMPENSATION PO BOX 26000	ISE B UNIT	OAR	D	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.								
SACRAMENTO, CA 95826							Paul 7 By	triow	shi			

© 1988-2010 ACORD CORPORATION. All rights reserved. The ACORD name and logo are registered marks of ACORD Home | Online Services | License Detail | Personnel List

## Contractor's License Detail (Personnel List)

Contractor License # 372314 Contractor Name FOX LOOMIS INCORPORATED

Click on the person's name to see a more detailed page of information on that person

Personnel Currently Associated with License

Name SAMUELL ERIC FOX

 Title
 RMO / CEO / PRES

 Association Date
 04/16/2008

 Classification
 A

 Additional Classification
 There are additional classifications that can be viewed by selecting this link.

## Personnel No Longer Associated with License

 Name
 DALE WAYNE FOX

 Title
 DECEASED

 Association Date
 04/17/1979

 Disassociation Date
 02/02/2008

 Classification
 A

 Additional Classification
 There are additional classifications that can be viewed by selecting this link.

Copyright © 2013 State of California

**Contractors State License Board** 



JAR0058876



## WELL APPLICATION AND PERMIT FORM

ENVIRONMENTAL MANAGEMENT DEPARTMENT -- ENVIRONMENTAL COMPLIANCE DIVISION 10590 ARMSTRONG AVENUE • SUITE A • MATHER, CA 95655 TELEPHONE (916) 875-8400 FAX: (916) 875-8513

## WELL INSPECTION LINE: (916) 875-8524

IS THIS PERMIT FOR A HAZARDOUS SUBSTANCE INVESTIGATION?

FOR OFFICE USE ONLY	EXPEDITED PROCESSING? TO YES NO
BY: Date:	PERMIT NUMBER(S)
INITIAL GROUT BY: DATE DATE	RECEIPTING ACTOR DEPTH TO WATER
DESTRUCTION BY: DATE	GPS: N: <u>38</u> W: <u>-121</u>
COMMENTS:	
SITE ADDRESS: O - GALLYINE BD.	514 607-15 90174 15
Job Address: Sic, NHLCR, B., ZIO, TP, HERL	ZAS Nearest Major Cross Street: Pales 2 14-54-5 4/5
Property Owner: LITY DI ELK GREAT	Parcel Number(s):115-0150-036-0000 93.2
Well Contractor: Frith Leontals, 1420	CA License No.: 372314 90930-15
Contractor's Address: 6901 FALLETABER	5 95928 KA
Well/Boring Identification Number(s): STE	CANCELLED
TYPE OF WORK: (California C-57	ise)
Pump replacement (or C-61)	20 Well destruction (SUPPLEMENT REQUIRED)
Well inactivation (Owner only)	WOther: DRY USEL
Domestic/private	D Geotechnical boring
Irrigation/agricultural	D Environmental boring
Public water system:  Public water system:	ONE BOTHER DECKELL
DRILLING METHOD:	TACT NAME AND TELEPHONE NUMBER)
Mud rotary     Air Rotary	Driven C Other:
SETBACKS: (Wells only)	
Is the well located within 100 feet of a:	Theach line, D deep trench, or D animal enclosure?
SPECIFICATIONS:	CARING Disputer Dank Dank Art
Diameter: Depth:	CASING: Diameter: <u></u> Deptn: <u></u>
ANNULAR SEAL: Depth: 45	IF STEEL: Gauge: or Thickness:
TRANSITION SEAL: Material: LECTOR	MULTIPLE COMPLETION? CI Yes (DIAGRAM REQUIRED)
PUMP INSTALLATION/REPAIR	
Contractor:	Tune of Dume.
I will comply with all Codes. Rules and Regulations of the St	Type of Pump Horsepower:
8524 for a grout inspection at least 24 hours prior to (	the requested appointment time, submit a "Well Completion Report" (If
well in service.	final inspection can be made, and obtain WPD approval before placing a
SIGNATURE: Some The	Property Owner
COMPANY:	
MAILING ADDRESS: GO THELOTABER ST.	SALEALASTED, CLA 95828
A SITE PLAN MUST BE S PERMIT EXPIRES ONE (1) YEAR A	UBMITTED WITH EACH APPLICATION. AFTER DATE APPROVED (UNLESS EXTENDED)

8/19/2012 gfb W: Data FORMBARCHIVE: WP: WELLS: 107 WELL APPLICATION AND PERMIT FORM. doc

## WELL PERMIT TIME LOG SHEET

FIR	RST PERMIT	T: <u>WP0054847</u> E: <u>4 hours</u>	SITE ADDRESS: <u>0 Calvine Rd.</u> <u>OTTY OF FUL OF WE</u> - <u>1 Injection Well</u>								
Date	Specialist	Activity		Hours	Time Remaining	Envision Updated					
9/17/14	LBC	Permit processing /sche	eduling	0.5	3.5	x					
9/29/14	Spon	Preliminary persi	ew, e-mark	1.0	2.5						
9/30/14	SBW	and phone cal Conditional ap	lis spiaval	2.0	0.5	X					

W:\DATA\WELLS\WELL TIME LOG SHEET.DOC

AR0067878

WE	LL APPLICATION AND PERMIT FORM											
ENVIRONMENTAL MANA 10590 AU TE	AGEMENT DEPARTMENT - ENVIRONMENTAL COMPLIANCE DIVISION RMSTRONG AVENUE • SUITE A • MATHER CA 95655 ELEPHONE (916) 875-8400 FAX: (916) 875-8513											
Contraction of the second second	WELL INSPECTION LINE: (916) 875-8524											
IS THIS PERMIT FOR A HAZARDOUS SUBSTANCE INVESTIGATION?												
FOR OFFICE USE ONLY	EXPEDITED PROCESSING2 UYES INO											
APPROVED APPROVED WICONDITIONS (ATTACHED	PERMIT NUMBER(S): 218 TO											
BY: DATE: DA	DATE RECEIVED:       12C/14       TOTAL FEE:       9 6 5 3 6         RECEIPT NO:       1000032221       DEPTH TO WATER:											
COMMENTS:												
	D5 E6 CT 93,10											
SITE ADDRESS: 10250 Iron Rock Way, Elk Grove, CA 95624 (C	ity Corporation Yard)											
Job Address: Samo	Nearest Major Cross Street: Interchange 99 & Grant Line Road											
Property Owner: City of Elk Grove	Parcel Number(s): 134-0630-037-0000											
Well Contractor: Fox Loomis, Inc.	CA License No.: 372314 (Expiration Date: 9/30/2015)											
Contractor's Address: 6901 McComber Street, Sacramento, CA 9	5828 Drfp. 9/30/15 61 XAN											
Well/Boring Identification Number(s): Site 2	WC exp. 10/1/15 01											
TYPE OF WORK: (California C-57 License required unless         Well construction       Uault box repair (Ge         Pump replacement (or C-61)       Well repair         Well inactivation (Owner only)       Pump repair (or C-6	inoted otherwise)         ineral A or B)         □         Well destruction (SUPPLEMENT REQUIRED)         □         Exploratory boring (C-57 if water present)         1)											
INTENDED USE:												
Domestic/private     Dewatering     Irrigation/agricultural     Cathodic p	rotection											
Water/vapor monitoring/extraction     Heat excha     Public water system:	Inge CX Other: Dry Well ST2KMWATTER											
DRILLING METHOD:	uger Driven Kother: <u>BVC/ETAVEEK</u>											
SETBACKS: (Wells only)         Is the well located within 50 feet of a:         Is the well located within 100 feet of a:         Is the well located within 100 feet of a:	□ stream, <mark>⊠ ditch, □</mark> drainage course, □ pond, or □ lake? □ No , □ leach line, □ deep trench, or □ animal enclosure? <mark>※ N</mark> o											
SPECIFICATIONS: BOREHOLE: Diameter:44" Depth:45'	CASING: Diameter: Depth:											
CONDUCTOR: Diameter: 30" Depth; 45' ANNULAR SEAL: Depth; 6' Material: Concrete TRANSITION SEAL: Material: Collar	IF STEEL: Gauge: or Thickness: IF PLASTIC: Type: Polypropylene. (Must meet ASTM F-480) MULTIPLE COMPLETION? □ Yes (DIAGRAM REQUIRED)											
COMMENTS: Dry Well - 6.0' Concrete Collar												
PUMP INSTALLATION/REPAIR: Contractor:	Type of Pump: Homosower											
I will comply with all Codes. Bules and Regulations of the	State and County pertaining to or regulating wells and pumps, call (918) 875-											
8524 for a grout inspection at least 24 hours prior to required) within 60 days of the completion of my work so well in service.	the requested appointment time, submit a "Well Completion Report" (if a final inspection can be made, and obtain WPD approval before placing a											
SIGNATURE:	Property Owner (City of Elk Grove)											
COMPANY: City of Elk Grove	Well Contractor     Agent (REQUIRES AUTHORIZATION FORM)											
MAILING ADDRESS: 8401 Laguna Palms Way, Elk Grove	CA 95738											
A SITE DI AN MIST DE												
A JILE FLAN MUOT DE												

PERMIT EXPIRES ONE (1) YEAR AFTER DATE APPROVED (UNLESS EXTENDED)

SE 04/08/2009 W:\Data\FORMSARCHIVE\WP NEW\WELLS\WELL APPLICATION AND PERMIT FORM.doc



**County of Sacramento** 

## ATTACHMENT WELL APPLICATION & PERMIT FORM

Pursuant to the Sacramento County Code, Chapter 6.28, Section 6.28.030.E.1, Permit Numbers 54847 and 54848 are conditioned as follows:

- Both wells shall be registered with the United States Environmental Protection Agency's Underground Injection Control program. Copies of the "Injection Wells Registration Form" shall be submitted to EMD within 60 days of well construction completion. Guidance is available at <u>http://www.epa.gov/region9/water/groundwater/uic-classv.html</u>.
- EMD permit approval is contingent on concurrence from the California Regional Water Quality Control Board, Central Valley Region, on the design and construction specifications of the project. No documentation of concurrence is requested.
- Polypropylene casing material is approved pursuant to Sacramento County Code, Chapter
   6.28, Section 6.28.040.A.5.a.(8).
- The annular surface seal shall consist of Portland cement and aggregate mixed at a ratio of at least six ninety-four (94) pound sacks of Portland cement per cubic yard of aggregate. In no case shall the size of the aggregate be greater than one-fifth the radial thickness of the annular seal. Water shall be added to concrete mixes to attain proper consistency for placement, setting, and curing. Cement used in sealing mixtures shall meet the requirements of American Society for Testing and Materials C150, "Standard Specification for Portland Cement," including the latest revisions thereof.
- The minimum annular surface seal depth requirement is waived pursuant to Enforcement Agency discretion. Each well shall have a minimum annular surface seal depth of at least 3 feet. The radial thickness of this seal shall be approximately 7 inches, unless modified prior to seal inspection.
- All reports to the State Water Resources Control Board shall be copied to EMD (<u>Attention</u>: Cheryl Hawkins, Supervising Environmental Specialist).

- The applicant is required to comply with Section 10.11 ("Contingency Plan" for spills and/or detection of groundwater impact) of the November 8, 2013, Version 2, "Quality Assurance Project Plan" as a permit condition.
- All other applicable provisions of Chapter 6.28 of the Sacramento County Code remain in full force and effect.

Want By: Suşan B. Williams, M.S.

**Permitting & Enforcement** 

Date: September 30, 2014

W:\DATA\WILLIAMSS\WELLPERMITATTACHMENTS\CITYOFELKGROVE\_54847-54848.DOC

#### Page 2



8/16/2012 gfb W:\Data\FORMSARCHIVE\WP\WELLS\03 SITEPLAN.doc

Ε



WOR019 - UNDERGROUND INJECTION CONTROLS AS LOW IMPACT DEVELOPMENT :

÷



Information For Parcel: 134-0630-037-0000

PROPERTY IN	IFORMATION
APN	13406300370000
Situs Address	10250 IRON ROCK WY
Postal	ELK GROVE, CA 95624
City/St/Zip	
	Additional Addresses for this Parcel
Thomas Bros	378 J 2
Kappa Maps	92 C 7
Landuse Code	WDAC0A
Jurisdiction	ELK GROVE
Sup. District	District 5 - Don Nottoli
<b>OWNERSHIP</b>	INFORMATION
Owner	<ul> <li>CITY OF ELK GROVE</li> </ul>
Mailing	10250 IRON ROCK WAY
Address	ELK GROVE, CA 95624
Transfer Date	2004-08-30
Deed	View Property Transfer Document
Owner History	View Owner History
PARCEL DET.	AIL LINKS
General Info	View General Parcel Data
Districts	View District Data
Recorded Map	No maps are available.
Assessor Maps	View Assessor Map
Parcel History	View Splits and Merges History Data
Assessment	View Assessor Data
Info	
Building	No Permit record available.
Permits	
Parcel Notes	View Parcel Notes
Business	No Business License Data available.
Licenses	
SHRA Info	View SHRA Data
CUBS Info	View CUBS Data
Refuse Pickup	No Refuse Pickup schedule available.
Water Meters	00000000012118601
Easements	View Easements Data
Planning	View Planning Parcel Page
Parcel Page	

Home | Online Services | License Details

# Contractor's License Detail for License # 372314

DISCLAIMER: A license status check provides information taken from the CSLB license database. Before relying on this information, you should be aware of the following limitations. (hide/show disclaimer)

CSLB complaint disclosure is restricted by law (<u>B&P 7124.6</u>) If this entity is subject to public complaint disclosure, a link for complaint disclosure will appear below. Click on the link or button to obtain complaint and/or legal action information.

Per <u>B&P 7071.17</u>, only construction related civil judgments reported to the CSLB are disclosed.

Arbitrations are not listed unless the contractor fails to comply with the terms of the arbitration.

Due to workload, there may be relevant information that has not yet been entered onto the Board's license database.

**Business Information** 

#### FOX LOOMIS INCORPORATED 6901 MC COMBER STREET SACRAMENTO, CA 95828 Business Phone Number:(916) 383-2140

Entity Corporation Issue Date 04/17/1979 Reissue Date 09/15/1993 Expire Date 09/30/2015

License Status

This license is current and active.

All information below should be reviewed.

Classifications

A - GENERAL ENGINEERING CONTRACTOR

C57 - WELL DRILLING (WATER)

C42 - SANITATION SYSTEM

#### **Bonding Information**

#### **Contractor's Bond**

This license filed a Contractor's Bond with AMERICAN CONTRACTORS INDEMNITY COMPANY.

Bond Number: SC6008744

Bond Amount: \$12,500

Effective Date: 03/02/2009

Contractor's Bond History

Bond of Qualifying Individual

The Responsible Managing Officer (RMO) FOX SAMUELL ERIC certified that he/she owns 10 percent or more of the voting stock/equity of the corporation. A bond of qualifying individual is **not** required.

Effective Date: 11/05/2009

**BQI's Bond History** 

Workers' Compensation

This license has workers compensation insurance with the OAK RIVER INSURANCI

Policy Number:2200054068 Effective Date: 10/01/2012 Expire Date: 10/01/2014

Workers' Compensation History

Miscellaneous Information

09/15/1993 - LICENSE REISSUED TO ANOTHER ENTITY

Personnel List

Home | Online Services | License Detail | Personnel List

# Contractor's License Detail (Personnel List)

Contractor License # 372314 Contractor Name FOX LOOMIS INCORPORATED

Click on the person's name to see a more detailed page of information on that person

Personnel Currently Associated with License

Name SAMUELL ERIC FOX

 Title
 RMO / CEO / PRES

 Association Date
 04/16/2008

 Classification
 A

 Additional Classification
 There are additional classifications that can be viewed by selecting this link.

## Personnel No Longer Associated with License

 Name
 DALE WAYNE FOX

 Title
 DECEASED

 Association Date
 04/17/1979

 Disassociation Date
 02/02/2008

 Classification
 A

 Additional Classification
 There are additional classifications that can be viewed by selecting this link.

Copyright © 2013 State of California

**Contractors State License Board** 

ACORD CER	<b>TIFI</b>	CATE OF LIA	BIL		SURA	NCE	DAT	E (MWDD/YYYY) 29/2014
THIS CERTIFICATE IS ISSUED AS A CERTIFICATE DOES NOT AFFIRMAT BELOW. THIS CERTIFICATE OF IN REPRESENTATIVE OR PRODUCER, A	MATTE IVELY SURAN ND THE	R OF INFORMATION ONL OR NEGATIVELY AMEND CE DOES NOT CONSTITU E CERTIFICATE HOLDER.	Y AND , EXTENTE TE A C	CONFERS N ND OR ALTI CONTRACT I	IO RIGHTS ER THE CO BETWEEN 1	UPON THE CERTIFIC VERAGE AFFORDED THE ISSUING INSURE	ATE HO BY TH R(S), A	DLDER. THIS HE POLICIES AUTHORIZED
the terms and conditions of the policy certificate holder in lieu of such endor	, certal	n policies may require an e	ndorse	ment. A stat	ement on th	is certificate does not	confer	rights to the
PRODUCER			CONTA	CT Cheri Gree	0			
John O. Bronson Co. / #0425149			PHONE	Ent): 916-48	0-4153	FAX (A/C, No	916-9	93-7258
3636 American River Drive Suite	200		E-MAIL ADDRES	ss: cgreco@jo	hnobronson.c	om		
Sacramento, CA 95864 916-974-7800			_	NS	URER(S) AFFOR	IDING COVERAGE		NAIC #
710 714 7000			INSURE	RA: National	Fire Insurance	e of Hartford		
INSURED Fox Loomis Inc.			INBURE	RB: Contine	ntal Casualty			
6001 Ma Cambor Street			INSURE	RC: Oak Riv	er Insurance (	Company		
Sacramento, CA 95828			INSURE	RD:				
			INSURE	R E :				
00//504.050		TE MUMPER, 10746	INSURE	A.F.:	_	OCURAION NUMBER.		-
THIS IS TO CEPTIEV THAT THE POLICIE		ATE NUMBER: 19740				HEVISION NUMBER:		
INDICATED. NOTWITHSTANDING ANY R CERTIFICATE MAY BE ISSUED OR MAY EXCLUSIONS AND CONDITIONS OF SUCH	EQUIRE PERTAI POLICI	MENT, TERM OR CONDITION N, THE INSURANCE AFFORD ES. LIMITS SHOWN MAY HAVE	OF AND DED BY E BEEN F	CONTRACT	OR OTHER I S DESCRIBE	DOCUMENT WITH RESP D HEREIN IS SUBJECT	ECT TO	WHICH THIS THE TERMS,
NSR TYPE OF INSURANCE	ADDL SU	VD POLICY NUMBER		POLICY EFF (MM/DD/YYYY)	POLICY EXP (MAUDD/YYYY)	UU	IT\$	
GENERAL LIABILITY						EACH OCCURRENCE	\$	1,000,000
X COMMERCIAL GENERAL LIABILITY		4016889746		10/01/14	10/01/15	PREMISES (Ea occurrence)	8	100,000
CLAIMS-MADE X OCCUR						MED EXP (Any one person)	5	5,000
^		Per Project Aggregate App	lies			PERSONAL & ADV INJURY	\$	1,000,000
		Contract	n j			GENERAL AGOREGATE	\$	2,000,000
GENL AGOREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGO	\$	2,000,000
POLICY X JECT LOC						COMBINED SINGLE LIMIT	5	
AUTOMOBILE LIABILITY		4016889777		10/01/14	10/01/15	(Ea accident)		1,000,000
ALL OWNED SCHEDULED						BODILY INJURY (Per perion)		
						PROPERTY DAMAGE	17 Ø	
HIHED AUTOS AUTOS						(Per eccident)	15	
X UMBRELLA LIAB X OCOUR		4016889763		10/01/14	10/01/15	EACH OCCUPRENCE	1	3 000 000
					10,01,10	AGOREGATE	8	3.000.000
DED X RETENTION & 10.000						AUGILLATE	8	
WORKERS COMPENSATION		2200064069	215	100044	IODIUE	X WC STATU- OI		
ANY PROPRIETOR PARTNER EXECUTIVE		2200034008		10/01/14	10/01/15	EL EACH ACCIDENT	5	1,000,000
C OFFICER/MEMBER EXCLUDED?						EL DISEASE - EA EMPLOY	E \$	1,000,000
If yes, describe under DESCRIPTION OF OPERATIONS below						EL DISEASE - POLICY LIMI	r s	1,000,000
A Limited Pollution Liability		4016889476		10/01/14	10/01/15	\$1,000,000 Each Incide \$2,000,000 Aggregate 1	ent Limit	
XESCRIPTION OF OPERATIONS / LOCATIONS / VEHIC RE: License # 372314	LES (Au	ach ACORD 101, Additional Remarks	schedule,	, if more space is	(berluper			
interests: Forms:								
CERTIFICATE HOLDER			CANC	ELLATION				
CONTRACTORS STATE LICEN WORKERS COMPENSATION U PO BOX 26000 SACRAMENTO, CA 95826	se Bo. Nit	ARD	SHO THE ACC	ULD ANY OF T EXPIRATION ORDANCE WT	THE ABOVE D DATE THI TH THE POLK NTATIVE	ESCRIBED POLICIES BE EREOF, NOTICE WILL CY PROVISIONS.	CANCE BE D	
				0.19	88-2010 AC	Tene 7 Dy	tro	oski

The ACORD name and logo are registered marks of ACORD





contaminants not previously will serve as a final site of attentuation and lateral dispersion for any captured.

AL 0058876 . .



## WELL APPLICATION AND PERMIT FORM

ENVIRONMENTAL MANAGEMENT DEPARTMENT – ENVIRONMENTAL COMPLIANCE DIVISION 10590 ARMSTRONG AVENUE • SUITE A • MATHER, CA 95655 TELEPHONE (916) 875-8400 FAX: (916) 875-8513

## WELL INSPECTION LINE: (916) 875-8524

IS THIS PERMIT FOR A HAZARDOUS SUBSTANCE INVESTIGATION?

FOR OFFICE USE ONLY	
APPROVED       APPROVED W/CONDITIONS (ATTACHED)       PERMIT NUMBER(S)       S       1       0         BY:       DATE:	ised credit # # 532,50,
SITE ADDRESS: 10250 ROW ROLLING, ELV GRENE 95624	715
Job Address: SATA = Nearest Major Cross Street: PQ & GRANDT LINE F	26
Property Owner: LITYOF ELK CIRCULE Parcel Number(s):134-0630-037-000	TC .
Well Contractor: Forthe Low this, INC. CA License No.: 372314 24 930-15	Dor
Contractor's Address: GRO (442 CECISER 51) Well/Boring Identification Number(s): GTE 2 CANCELLED	ABC .
TYPE OF WORK: (California C-57 License required unless noted otherwise)         Well construction         Vault box repair (General A or B)         Well inactivation (Owner only)         INTENDED USE:	=.
Domestic/private     Irrigation/agricultural     Water/vapor monitoring/extracti     Druct DP	_
DRILLING METHOD:       (NAME         Mud rotary       Air Rotary	έα° ε
SETBACKS: (Wells only) Is the well located within 50 feet of Is the well located within 100 feet of Is the well located within 100 feet	5 5
SPECIFICATIONS:         BOREHOLE:       Diameter:       4411         Diameter:       Depth:       451         CONDUCTOR:       Diameter:       3014         Depth:       451         CASING:       Diameter:       Depth:         Material:       Depth:       451         COMMENTS:       Depth:       451             CASING:       Diameter:       Depth:         Diameter:       Depth:       451         Depth:       451       IF STEEL:         Gauge:       or Thickness:       1         IF PLASTIC:       Type <sup>#10-1</sup> PRof YLEN (Must meet ASTM F-480)         MULTIPLE COMPLETION?       Yes (DIAGRAM REQUIRED	)) I)
PUMP INSTALLATION/REPAIR: Contractor: Horsepower:	
License Number: Type of Pump: Noisepower:	875-
8524 for a grout inspection at least 24 hours prior to the requested appointment time, submit a "Well Completion Report required) within 60 days of the completion of my work so a final inspection can be made, and obtain WPD approval before place well in service.	rt" (if ing a
SIGNATURE: PRINTED NAME: COMPANY: MAILING ADDRESS: PHONE NUMBER: SIGNATURE: PRINTED NAME: COMPANY: MAILING ADDRESS: PHONE NUMBER: SIGNATURE: PRINTED NAME: FIELD PHONE: SIGNATURE: PRINTED NAME: FIELD PHONE: SIGNATURE: PRINTED NAME: SIGNATURE: PRINTED NAME: SIGNATURE: SIGNATURE: PRINTED NAME: SIGNATURE: PRINTED NAME: SIGNATURE: SIG	
A SITE PLAN MUST BE SUBMITTED WITH EACH APPLICATION. DEPMIT EXPIRES ONE (1) YEAR AFTER DATE APPROVED (UNLESS EXTENDED)	

8/19/2012 gfb WIDeta/FORMSARCHIVE/WP/WELLS/07 WELL APPLICATION AND PERMIT FORM.doc

## WELL PERMIT TIME LOG SHEET

FIR	RST PERMIT PAID TIME	T: <u>WP0054848</u> E: <u>4 hours</u>	SITE ADDRESS: <u>10250 Iron Rock Wy.</u> CAT <u>I OF ELY GROVE</u> - 1 Injection Well							
Date	Specialist	Activity	/	Hours	Time Remaining	Envision Updated				
9/17/14	LBC	Permit processing /sche	eduling	0.5	3.5	x				
9/30/14	Ebu	Conditional	approval	5.0	1.5	×				
		s.			*					
			:							

W:\DATA\WELLS\WELL TIME LOG SHEET.DOC

Appendix 4.2

# **Well Completion Logs**

Bills Organ J     ORE     Description       Owner's UNK     Well Completion Report Metric injunce Amprov Metric injunce Amprov Metr	"The free Adobe Reader may be used to vie	w and complete this form.	However, software mus	st be purchase	d to comple	te, save, a	and reuse	a saved form	n.		
Page 1       of 2       Well Completion Keyport         No. 0019046 bit No. 001904 bit No. 0019046 bit No. 001904 bit No. 00190	File Original with DWR		State of Califo	California DWR Use Only - Do Not Fill In							
Owner's Well Number         Owner's Work         Owner's Work           Deale Work Reage         Parrit Due's 20013         Image: State Carbon State State Carbon Stat	Page 1 of 2	We	Befer to Instruction E	on Repo	rt						
Date Work Redgem 10/10/2013       Date Work Finded 30/11/2013       Lattuss       Longibility         Parma Number 33187       Permit Dite 37/20/13       APM/TR&Obiem       APM/TR&Obiem         Orientation ® Vertical O Hotizonal O Angle Server, Diffex Meet Professore and and Sit, hardpann Structure City of Elk Grove       Name City of Elk Grove       Name City of Elk Grove         Origing Meet Professore Sufficience       Departmention, and Sit, hardpann Structure City of Elk Grove       Name City of Elk Grove       Name City of Elk Grove         O Is Clay versity Sith Fadd and thrown, Dury plastic, trace clay       Sandy Clays Sith Sand-very fine to fine, reddish brown, Darked       Name City of Elk Grove       Name City of Elk Grove         9 IS Sithy Sand-very fine to fine, reddish brown, Darked       Sandy Clays Sith Very fine to fine, reddish brown, Darked       Dec Lai       Dec Lai </td <td>Owner's Well Number CY MW-1</td> <td></td> <td>No. e019045</td> <td>5</td> <td></td> <td>L I</td> <td>State</td> <td></td> <td></td> <td>I W</td>	Owner's Well Number CY MW-1		No. e019045	5		L I	State			I W	
Codel Fermit Agency CoUNT of Sacramento       Ment Sacramento         Cell column       Geologic Log         Orientation & Vertical       Angle Spectry         Delay form Sacramento       Delay form Sacramento         Description       Sacramento         2       Clay-red, hard material gamb Bac allocates         3       7       Clay-red, hard material gamb Bac allocates         4       Sacramento       Sacramento         7       9       Sardy Claysy Sill- Grade and addith, and Bac allocates         7       9       Sacramento       Columno Clay form Sacramento         1       way fine to fine, hand, and Bith, and Bac allocates       Columno Clay form Sacramento         1       way fine to fine, trace aand and Bith, and Bac allocates       Columno Clay form Sacramento         1       Toreadian brown, some withe clay       Data fin and Sacramento       Columno Clay form Sacramento         22       23       Sand-very fine to fine, decidah brown, braite       Columno Clay form Sacramento       Columno Clay form Sacramento         23       Sand-very fine to medium, lobes, light brown       Columno Clay form Sacramento       Columno Clay form Sacramento         24       Sand-very fine to medium, kat bit gamb Add, modit and       Data fine to medium, wet, brownish red, dena       Columno Clay form Sacramento <td< td=""><td>Date Work Began 10/10/2013</td><td> Date Work Ende</td><td>ed 10/11/2013</td><td></td><td></td><td>1</td><td>Latitude</td><td></td><td>Longitude</td><td></td></td<>	Date Work Began 10/10/2013	Date Work Ende	ed 10/11/2013			1	Latitude		Longitude		
Minimular Boold       Clight reduction book minimum       Well Owner         Orientation © Vertical       O Horizonta       Orientation © Vertical       Other of the Street Program Plad         Digit form Street       Department minimular book minimum       Department minimular book minimum       Name City of Elk Grove       State A zip Street Program View         0       S and very fine to fine       Department minimum book minimum       Department minimum       Name City of Elk Grove       State A zip Street Program View         9       15       Stilly Sand-very fine to fine, nacked, stilly search very fine to fine, nacked, losse, fain       Name City of Elk Grove       County Statements         16       17       Sand-very fine to fine, nacked, losse, fain       Parcel QS2       Parcel QS2         17       19       Stilly Sand-very fine to fine, nacked, losse, fain       Parcel QS2       Parcel QS2         22       Sand-very fine to fine, nacked, losse, fain       Parcel QS2       Parcel QS2       Parcel QS2         23       Sand-very fine to fine, nacked, losse, fain       Parcel QS2       Parcel QS2       Parcel QS2         24       Sand-very fine to fine, nacked, now fine       Parcel QS2       Parcel QS2       Parcel QS2         25       Sand-very fine to fine, nacked, now fine       Parcel QS2       Parcel QS2       Parcel QS2      <	Local Permit Agency <u>County of Sacr</u> Permit Number, 53187	Amento Permit Date 9/20/1	13			<u> </u>		APN/TRS	S/Other		
Orientation         Overlag         Origin by the form Surface         Description           Peet In         Description         State CA         zp	Gen			1	-		Well	Owner	2		
Defining Puid         Description           Description         Description           Description         Description           Series         Discription           Series         Discription           Series         Discription           Series         Discription           Series         Clay-red, Intrace sand and sith, hardjan           Series         Open and sith, hardjan           Personal         Open and sith, hardjan           Personal         Open and sith, hardjan           Personal         Very fine to fine         Open and sith, hardjan           Personal         Open and sith, hardjan         Personal         Description           Send-very fine to fine, and loss and sith, hardjan         Personal         Description         Personal           Send-very fine to fine, and sith, hardjan         Personal         Description         Personal         Description           Sithy Sand-very fine to fine, enddish brown, hardd         Description         Description         Description         Description           Sithy Sand-very fine to fine, enddish brown, hardd         Description         Description         Description           Sithy Sand-very fine to fine, enddish brown, bardd         Description         Description         Description	Orientation Overtical OH	orizontal OAngle	Specify	Name City of Elk Grove							
Depth from Surface         Description           0         5         Clay-red, hard, trace sand and silt, hardpan           1         Very fine to fine,         Well Location           1         Very fine to fine, reddish brown, low plastic,         Well Location           1         Wery Sitt reddish brown, low plastic,         Data           1         Media         Media         Data           1         Media         Media         Data           1         Media         Media         Data           1         Media         Data         Data           1         Media         Data         Data           1         Sitty Sand-very fine to fine, very fine to fine, packed,         Data         Data           22         Sand Clayey Sitth and, reddish brown, packed         Data         Data         Data           23         Sand Sitty Sand-very fine to fine, dark tan, brittle         Data         Data         Data           24         Sandy Sitty very fine to fine, dark tan, brittle         Data         Data	Drilling Method Hollow Stem Auger	Drilling Flu	biu	Mailing A	ddress 8	401   a	una Pa	lms Wav			
Obs       Clay-red, hard, race sand and sit, hardpan         3       7       Clayuy Sity Sand- brittle, hard, racedish brown,         7       9       Sandy Clayuy Sity Sand- brittle, hard, racedish brown,         7       9       Sandy Clayuy Sity Sand- brittle, hard, racedish brown,         9       15       Sity Sand- very fine to fine, readish brown,         16       17       Sand- very fine to fine, tan, loose, slightly moist         17       19       Sity Clayuy Sith- very fine to fine, tan, loose, slightly moist         17       19       Sity Sand- very fine to fine, tan, loose, slightly moist         17       19       Sity Sand- very fine to medium, loose, lang brown, brittle         22       Sand- very fine to medium, loose, tan         23       Sand- very fine to fine, tan, raddish brown, packed         29       30       Sand- very fine to fine, fand dan, brown         31       47       Sand- very fine to fine, fand, dan, brittle         24       Sand- very fine to fine, fand, dan, brittle         26       Sand- very fine to medium, loose, tan         31       47       Sand- very fine to fine, fand, dan, brittle         26       Sand- very fine to fine, fand, dan, brittle         27       28       Sand- very fine to fine, fand, dan, brittle	Depth from Surface	Description	color atc	City Elk	Grove	101 003		State	CA zip 957	58	
S       7       Clayey Sity Sand- brittle, hard, reddish brown, wery fine to fine, tredish brown, in the start of the start o	0 5 Clav-red ha	ard, trace sand and sil	t, hardpan				WellL	ocation			
image: start of fine       county: Sacrametro         7       9       Sandy Clayey Silt-reddish brown, low plastic, ivery fine to fine       chine       inc       inc       county: Sacrametro         9       15       Sitty Sand-very fine to fine, reddish brown, low plastic, inc ddiah brown, some white day inc ddiah brown, some white ddiah brown is ddiah brown, some white ddiah br	5 7 Clayey Silty	Sand- brittle, hard, re	ddish brown,	Address	10250 Ir	on Rock	< Way				
7       9       Sandy Clayey Sith reddish brown, low plastic, werey fine to fine, reddish brown, low plastic, tree clay, meeting plastic, tree clay, meeting plastic, tree clay, meeting, lows, law, Page GB30       Particle Clay, Clayer Clayer, Clayer, Clayer, Clayer, Clayer, Sith ten, note, acked, treedish brown, acrew white clay, clayer, Sith ten, note, well sorted, loose, tan, packed, treedish brown, particle, acked, sorted, low clayer, Sith ten, reddish brown, particle, acked, treedish brown, tard treedish	very fine to f	ine		City Elk	Grove			Count	y Sacramento		
Wery fine to fine       Draw Mr. Sec.       Dee. Min. Sec.         9       15       Sitty Sand-very fine to fine, reddish brown, indraw formation file clay       Datum	7 9 Sandy Claye	y Silt- reddish brown,	low plastic,	Latitude				Longitude		w	
9     15     Sitty Sand-very fine to fine, redish brown, medium plastic, trace clay     Deter to fine, and the page 0.030     Parcel 0.32.       16     17     Sand-very fine to fine, tan, loose, slightly moist     Township	very fine to t	ìne		Datum	Deq	Min.∷ Doolot	Sec,	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Deg. Min.	Sec.	
Image: Image	9 15 Silty Sand-	ery fine to fine, reddis	sh brown,	ADN Rog			0630	100	Parcel 037		
15     17     19     Sand- Very fine to line, fan, loose, signify moist       17     19     Silty Cardy Silt very fine to line, packed,       19     22     Sand- Very fine to line, well sorted, loose, tan       23     Sand- Very fine to line, vell sorted, loose, tan       24     25     Sand- Very fine to line, reddish brown, packed       27     29     Silty Sand- very fine to line, reddish brown, packed       29     30     Sand- Very fine to line, edish brown, packed       29     30     Sand- Very fine to line, edish brown, battle       21     24     Clayey Silt- vary fine to line, edish brown, battle       29     Silty Sand- very fine to line, dark tan, brittle       31     47     Sand- very fine to line, dark tan, brittle       31     47     Sand- very fine to line, dark tan, brittle       48     49     Sandy Silt- very fine to line, dark tan, brittle       49     50     Sandy Silt- very fine to line, dark tan, brittle       50     52     Sandy Silt- very fine to line, batdy brown       52     63     Sand- very fine to line, batdy brown       52     Sandy Silt- very fine to line, batdy brown       52     Sandy Silt very fine to line, batdy brown       54     Sandy Silt very fine to line, batdy brown       71     79     Sandy Silt very fine to line, hatdy brown	medium plas	stic, trace clay	P.1 B. 2-1	Townshir	<u> </u>	Pange	0000		Section		
17       19       Silly Usey Sardy Very Mile Logy         19       22       Silly Sand- very fine to medium, tan, packed         22       23       Sand- very fine to fine, reddish brown, packed         23       25       Sand- very fine to fine, reddish brown, packed         24       30       Sand- very fine to fine, reddish brown, packed         29       30       Sand- very fine to fine, reddish brown, packed         29       30       Sand- very fine to fine, reddish brown, packed         29       30       Sand- very fine to fine, reddish brown, packed         29       30       Sand- very fine to fine, fine, reddish brown, packed         47       48       Clayey Silt- tan, brittle, hard         48       49       Sand- very fine to fine, fine, longt, tank tan, brittle         49       50       Silty Sand- very fine to fine, packed, moist, tan         61       fine sand         71       79       Sandy Silt- very fine to fine, packed, moist, tan         63       67       Sandy Silt- very fine to fine, packed, moist, tan         71       79       Sandy Silt- very fine to fine, packed, moist, tan         70       Both form subalter deveload deveload of of the mack tan, brittle         81       52       Sand- very fine to fine, packed, moist, tan	15 1/ Sand- very 1	Sand ways find to find	slightly moist	Townsing	Locati	on Ske	tch		Activity		
19       22       Sity Sand-very fine to medium, tan, packed         22       23       Sand-very fine to fine, well sorted, loose, tan         23       25       Sandy Clayey Sith-light brown, britte         25       27       Clayey Sith-light brown, medium plastic         27       29       Sity Sand-very fine to fine, reddish brown, parked         30       31       Sity Sand-very fine to fine, reddish brown, parked         31       47       Sandy Sith-very fine to fine, doash tan, brittle         48       49       Sandy Sith-very fine to fine, doash tan, brittle         49       50       Sity Sand-very fine to fine, hard, brown         50       Sandy Sith-very fine to fine, hard, brown         51       63       Sand-very fine to fine, hard, brown         52       Sandy Sith-very fine to fine, hard, brown         52       Sandy Sith-very fine to fine, moist, reddish brown         52       Sandy Sith-very fine to fine, moist, reddish brown         53       Sand-fine to medium, wet, sub-rounded,         64       63       Sandy Sith-very fine to fine, moist, reddish brown         71       79       Sandy Sith-very fine to fine, moist, reddish brown         74       79       Sandy Sith-very fine to medium, wet, sub-rounded,         163       67<	17 19 Sitty Clayey	sand-very line to line		Sketch m	nust be drawn	by hand ali	ter form is p	minted.)	New Well	19	
122       23       Sand-very fine to fine, well sorted, loose, tan         23       25       Sandy Clayey Silt- lard, reddish brown, medium plastic         27       29       Silty Sand-very fine to fine, reddish brown, hard         30       31       Sinty Sand-very fine to medium, loose, tan         31       47       Sand-very fine to medium, loose, tan         31       47       Sand-very fine to medium, loose, tan         31       47       Sand-very fine to fine, loose, tan ish gray         30       Sandy Silt-very fine to fine, loose, tan ish gray         50       Sandy Silt-very fine to fine, loose, tan ish gray         50       Sandy Silt-very fine to fine, loose, tan ish gray         50       Sandy Silt-very fine to fine, loose, tan ish gray         50       Sandy Silt-very fine to fine, moist, packed, wory fine         63       Sandy Silt-very fine to fine, moist, packed, wory fine         63       Sandy Silt-very fine to fine, moist, packed, wory fine         71       79       Sandy Silt-very fine to fine, moist, reddish brown         71       79       Sandy Silt-very fine to fine, moist, reddish brown         71       79       Sandy Silt-very fine to fine, moist, reddish brown         70       Barby Silt-very fine to fine, moist, reddish brown         71       <	19 22 Silty Sand- v	very fine to medium to	an nacked	1		North	17		Modification/Re	epair	
23       25       Sandy Clayey Silt- hard, reddish brown, brittle         25       27       Clayey Silt- light brown, medium plastic         27       29       Silty Sand- very fine to fine, reddish brown, packed         28       30       Sandy Silt- very fine to fine, reddish brown, packed         29       30       Sandy Silt- very fine to medium, loose, tan         31       47       Sand- very fine to fine, loose, lannish gray         48       49       Sandy Silt- very fine to fine, loose, lannish gray         50       52       Sandy Silt- very fine to fine, loose, lannish gray         50       52       Sandy Silt- very fine to fine, packed, worg fine         63       67       Sandy Silt- very fine to fine, packed, worg fine         71       Clayey Sandy Silt- very fine to fine, packed, worg fine         73       Sandy Silt- very fine to fine, moist, packed, worg fine         74       10 fine sand         77       Clayey Sandy Silt- very fine to fine, moist, reddish brown         78       Silt Sand- fine to medium, wet, sub-rounded,         79       Sing Silt- very fine to fine, doist, rand, clean         70       Sandy Silt- very fine to fine, moist, reddish brown         70       Sandy Silt- very fine to fine, moist, reddish brown         71       79 <td>22 23 Sand- very</td> <td>ine to fine, well sorted</td> <td>l loose, tan</td> <td>11</td> <td></td> <td></td> <td></td> <td></td> <td>O Other</td> <td></td>	22 23 Sand- very	ine to fine, well sorted	l loose, tan	11					O Other		
25       27       Clayey Silt- light brown, medium plastic         27       29       Silty Sand- very fine to fine, reddish brown, packed         30       31       Silty Sand- very fine to fine, reddish brown, hard         30       31       Silty Sand- very fine to medium, loose, tan         31       47       Sand- very fine to medium, loose, tan         48       49       Sandy Silt- very fine to fine, dark tan, brittle         49       50       Silty Sand- very fine to fine, dark tan, brittle         50       52       Sandy Silt- very fine to fine, packed, moist, tan         63       67       Sandy Silt- very fine to fine, packed, wery fine         71       79       Sandy Silt- very fine to fine, moist, reddish brown         78       110       fine to medium, wet, sub-rounded, braw et wells the attend the a	23 25 Sandy Claye	ey Silt- hard, reddish t	prown, brittle	11					Destroy	nd materials	
27       29       Silty Sand- very fine to fine, reddish brown, packed         29       30       Sandy Silt- very fine to fine, reddish brown, hard         30       31       Sitty Sand- very fine to medium, loose, light brown         31       47       Sandy Silt- very fine to medium, loose, light brown         47       48       Calayey Silt- tan, brittle, hard         48       49       Sondy Silt- very fine to fine, loose, tannish gray         50       52       Sandy Silt- very fine to fine, loose, tannish gray         50       52       Sandy Silt- very fine to fine, hard, brown         63       67       Sandy Silt- very fine to fine, packed, very fine         66       Sandy Silt- very fine to fine, packed, very fine       Mathew effective file         71       79       Sandy Silt- very fine to fine, moist, reddish brown         79       81       Silty Sand- fine to medium, wet, sub-rounded,         16       brown       120       Feet         71       79       Sandy Silt- very fine to fine, noist, reddish brown       (Feet)       Sate Measured         79       Sandy Silt- very fine to fine, noist, reddish brown       (Feet)       Other sub-sub-sub-sub-sub-sub-sub-sub-sub-sub-	25 27 Clayey Silt-	light brown, medium p	plastic	11					under "GEOLOGIC LO	G*	
29       30       Sandy Silt-very fine to fine, reddish brown, hard         30       31       Silty Sand-very fine to medium, loose, tan         47       48       Clayey Silt-tan, brittle, hard         47       48       Clayey Silt-tan, brittle, hard         48       49       Sandy Silt-very fine to fine, loose, tannish gray         50       52       Sandy Silt-very fine to fine, loose, tannish gray         50       52       Sandy Silt-very fine to fine, hard, brown         63       67       Sandy Silt-very fine to fine, hard, brown         63       67       Sandy Silt-very fine to fine, hard, brown         64       10 fine sand       Monitoring         79       Sandy Silt-very fine to fine, boxe, tannish, packed, wery fine         70       Sandy Silt-very fine to fine, boxe, tannish, red, clean         79       81       Silty Sand- fine to medium, wet, sub-rounded, boxed and state and talk and and tyleid of Completed Well         79       81       Silty Sand- fine to medium, wet, brownish red, clean         70       Sandy Silt-very fine to fine, browdia of the browdia to the fire to fine to medium, wet, brownish red, clean         70       Sandy Silty Sandy San	27 29 Silty Sand-	very fine to fine, reddi	sh brown, packed						Planned Us	Bes	
30       31       Sitty Sand-very fine to medium, loose, light brown         31       47       A8       Clayey Sitt- very fine to fine, dark tan, brittle         48       49       Sandy Sitt- very fine to fine, dark tan, brittle         49       50       Sitty Sand- very fine to fine, hard, brown         52       63       Sand- very fine to fine, packed, moist, tan         67       71       Clayey Sitt- very fine to fine, packed, moist, tan         67       71       Clayey Sandy Sitt- very fine to fine, bard, brown         79       81       Sitty Sand- very fine to fine, bard, brown         70       81       Sitty Sand- very fine to fine, bard, brown         79       81       Sitty Sand- very fine to fine, bard, brown         79       81       Sitty Sand- fine to medium, wet, sub-rounded,         1       brown       Depth of fine to medium, wet, brownish red, clean         70al Depth of Completed Well 115       Feet         70al Depth of Completed Well 115       Feet         70al Depth form       Borehole         80       87.5         81       87.5         80       87.5         80       87.5         80       87.5         81       87.5         8	29 30 Sandy Silt-	very fine to fine, reddi	sh brown, hard						Vvater Supply	Public	
31       47       Sand-very fine to medium, loose, light brown         47       48       Clayey Silt-tan, brittle, hard         48       49       Sandy Silt-very fine to fine, dark tan, brittle         49       50       Sitty Sand-very fine to fine, hard, brown         52       63       Sandy Very fine to fine, backed, moist, tan         63       67       Sandy Silt-very fine to fine, backed, moist, tan         67       71       Clayey Sandy Silt-tan, moist, packed, very fine         71       79       Sandy Silt-very fine to fine, moist, reddish brown         79       81       Silty Sand-fine to medium, wet, sub-rounded,         1       brown       Feet         70tal Depth of Boring       120       Feet         70tal Depth of Boring       120       Feet         70tal Depth of Completed Well       116       Feet         70tal Depth form       Brenchele       Sorth         80       8.75       Blank       PVC Sch. 40       2         80       110       8.75       Blank       PVC Sch. 40       2         80       110       8.75       Blank       PVC Sch. 40       2         80       110       8.75       Blank       PVC Sch. 40       2 <td>30 31 Silty Sand-</td> <td>ery fine to medium, lo</td> <td>oose, tan</td> <td>est</td> <td></td> <td></td> <td></td> <td>ast</td> <td></td> <td>Industrial</td>	30 31 Silty Sand-	ery fine to medium, lo	oose, tan	est				ast		Industrial	
47       48       Clayey Sitt- tan, brittle, hard         48       49       Sandy Sitt- very fine to fine, dark tan, brittle         50       52       Sandy Sitt- very fine to fine, hard, brown         52       63       Sandy Sitt- very fine to fine, packed, moist, tan         63       67       Sandy Sitt- very fine to fine, packed, very fine         63       67       Sandy Sitt- very fine to fine, packed, very fine         71       Clayey Sandy Sitt- very fine to fine, moist, tan         63       67       Sandy Sitt- very fine to fine, moist, tan         71       Clayey Sandy Sitt- very fine to fine, moist, raddish brown         79       S1       Sity Sand- fine to medium, wet, sub-rounded,         9       81       Sity Sand- fine to medium, wet, sub-rounded,         9       81       Sandy fine to medium, wet, brownish red, clean         70tal Depth of Boring       120         70tal Depth of Completed Weil       115         71       Classings       Outside         82       Sand- fine to medium, wet, brownish red, clean         70tal Depth of Completed Weil       115         70tal Depth of Soring       120         70tal Depth of Soring       120         80       10.8 75       Blank <t< td=""><td>31 47 Sand- very 1</td><td>ine to medium, loose,</td><td>light brown</td><td>5</td><td></td><td></td><td></td><td> (</td><td>Cathodic Prote</td><td>ction</td></t<>	31 47 Sand- very 1	ine to medium, loose,	light brown	5				(	Cathodic Prote	ction	
48       49       Sandy Silt-Very fine to fine, loads, tanish gray         50       52       Sandy Silt-Very fine to fine, hard, brown         52       63       Sandy Silt-Very fine to fine, hard, brown         63       67       Sandy Silt-Very fine to fine, packed, moist, tan         67       71       Clayey Sandy Silt-Very fine to fine, packed, very fine         67       1       Clayey Sandy Silt-Very fine to fine, packed, very fine         1       to fine sand       to fine sand         71       79       Sandy Silt-Very fine to fine, moist, reddish brown         79       81       Silty Sand- fine to medium, wet, sub-rounded,         1       borwn       Betwee baccade and weed addate and early and early fine and early and early fine and fin	47 48 Clayey Silt-	tan, brittle, hard	- Clim	41					Dewatering		
49       50       Starty start-very fine to time, toolse, tarinish gray         50       52       Sandy Silt-very fine to time, hard, brown         52       63       Sandy Silt-very fine to fine, packed, worst, tan         67       71       Clayey Sandy Silt-very fine to fine, packed, worst, tan         67       71       Clayey Sandy Silt-very fine to fine, moist, packed, worst, tan         71       79       Sandy Silt-very fine to fine, moist, packed, very fine         71       79       Sandy Silt-very fine to fine, moist, packed, very fine         71       79       Sandy Silt-very fine to fine, moist, reddish brown         79       81       Silty Sand-fine to medium, wet, sub-rounded,         1       brown       Evel and Yield of Completed Well         70       Depth of Boring       120         71       79       Sandy Silt-very fine to fine, moist, reddish brown         70       Boring       120         71       Feet       Feet         71       Clayer Sandy Silt-very fine to fine, moist, reddish brown         72       81       82         82       Sand-fine to medium, wet, sub-rounded,         70       Evel and Yield of Completed Well         70       Borinhor       Material         70<	48 49 Sandy Silt-	ery fine to fine, dark t	tan, brittle	ł1					Heat Exchange	•	
0.0       0.2       Standy offer days mile to medium, tan to light brown         63       63       Sandy Silt- very fine to medium, tan to light brown         67       71       Clayey Sandy Silt- very fine to fine, packed, very fine         1       10       10       fine sand         79       Sandy Silt- very fine to fine, moist, reddish brown       Image: the addition area. the addit	49 50 Silty Salid-	very fine to fine, loose	hrown	11 .	10				<ul> <li>Monitorina</li> </ul>		
02       03       67       Sandy Silt-very fine to fine, packed, moist, tan,         63       67       Sandy Silt-very fine to fine, packed, very fine       Image: state of the fine to fine, packed, very fine       Image: state of the fine, packed, very fine       Image: state of fine, packed, very fine       Image: state of fine, packed, very fine       Image: s	52 63 Sand- very	ine to medium, tan to	light brown		X0				O Remediation		
67       71       Clayey Sandy Silt-tan, moist, packed, very fine         67       71       Clayey Sandy Silt-tan, moist, packed, very fine         71       79       Sandy Silt-very fine to fine, moist, reddish brown         79       81       Silty Sand- fine to medium, wet, sub-rounded,         81       82       Sandy fine to medium, wet, sub-rounded,         81       82       Sand-fine to medium, wet, brownish red, clean         Total Depth of Boring       120       Feet         Total Depth of Completed Well       115       Feet         Surface       Sorreen       Stort surface         Surface       Depth from       Borehole       Water Level         Surface       Diagram       (Feet)       Date Measured         Surface       Sorreen       Stort surface       Sorreen         9       80       8.75       Blank       Pvc Sch. 40       2         0       80       8.75       Blank       Pvc Sch. 40       2       Milled Slots       0.030       Feet to Feet       Sorreen         10       115       Screen       PvC Sch. 40       2       Milled Slots       0.030       Cernent       10.3 sack sand/         80       10       8.75       Blank	63 67 Sandy Silt-	erv fine to fine, packe	ed, moist, tan						O Sparging		
to fine sand         71       79       Sandy Silt- very fine to fine, moist, reddish brown         79       81       Silty Sand- fine to médium, wet, sub-rounded, brown       Water Level and Yield of Completed Well       O ther	67 71 Clayey Sand	ly Silt- tan, moist, pac	ked, very fine	South O Vapor Extraction							
71       79       Sandy Silt- very fine to fine, moist, reddish brown         79       81       Silty Sand- fine to medium, wet, sub-rounded, brown       Water Level and Yield of Completed Weil         81       82       Sand- fine to medium, wet, brownish red, clean       Creat be accurate and emplete.       Creat be accurate and emplete.         Total Depth of Boring       120       Feet       Feet       Genetic and Static       Creat be accurate and emplete.         Total Depth of Completed Well       115       Feet       Feet       Genetic and Static       Genetic and Static       Genetic and Static         Depth form       Borehole       Type       Material       Wall       Outside       Screen       Slot Size       Depth form       Surface       Fill       Description         Sourface       Diameter       Type       Material       Mall       Outside       Screen       Slot Size       Depth form       Surface       Fill       Description         Sourface       Biank       PVC Sch. 40       2       Milled Slots       0.030       75       Cernent       10.3 sack sand/         10       115       8.75       Blank       PVC Sch. 40       2       Milled Slots       0.030       75       77       Fine Sand       Transition	to fine sand			titustrate or describe distance of well from roads, buildings, fences, rivera, etc. and attach a map. Use additional paper if necessary.							
79       81       Silty Sand- fine to medium, wet, sub-rounded, brown       Water Level and Predor and Trend of Completed Weil Depth to Static         81       82       Sand- fine to medium, wet, brownish red, clean       Depth to first water 79       (Feet below surface)         701       Depth of Boring       120       Feet       (Feet)       Date Measured         Total Depth of Completed Weil       115       Feet       (Hours) Total Drawdown       (Feet)         Casings         Valider Level       (Hours) Total Drawdown       (Feet)         Surface       Diameter       Type       Material       Wall       Outside       Screen       Slot Size       Depth from       Surface       Fill       Description         Surface       Diameter       Type       Material       Wall       Outside       Screen       Slot Size       Depth from       Surface       Fill       Description         Surface       Diameter       Type       Material       Wall       Surface       Fill       Description         Surface       Diameter       Type       If Annular Material       Depth from       Surface       Fill       Description         100       10.5       8.75       Blank       PVC Sch. 40	71 79 Sandy Silt-	ery fine to fine, moist	, reddish brown	Please be accurate and complete.							
Image: Bit in the strength of Boring Borehole Strength of Completed Well 115       Feet Image: Borehole State	79 81 Silty Sand-1	ine to medium, wet, s	ub-rounded,	Depth to	firet water	70	Com	Jieted We	(Feet below surfa	(e)	
B1       B2       Sand-fine to medium, wet, brownish red, clean       Water Level       (Feet)       Date Measured         Total Depth of Boring       120       Feet       Feet       (GPM) Test Type	brown	1	the state	Depth to	Static	.19			(i ber below band	00)	
Total Depth of Boring       120       Feet         Total Depth of Completed Well       115       Feet         Depth from       Borehole       115       Feet         Casings       Annular Material         Depth from       Borehole       Diameter       Type         Surface       Diameter       Type       Material       Material         Thickness       Diameter       Type       Screen       Slot Size         0       80       8.75       Blank       PVC Sch. 40       2       Milled Slots       0.030         110       115       8.75       Blank       PVC Sch. 40       2       Milled Slots       0.030       Cernent       10.3 sack sand/         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2 <t< td=""><td>81  82  Sand-fine to</td><td>o medium, wet, brown</td><td>lish red, clean</td><td>Water Le</td><td>evel</td><td>-</td><td>(Fee</td><td>t) Date M</td><td>easured</td><td></td></t<>	81  82  Sand-fine to	o medium, wet, brown	lish red, clean	Water Le	evel	-	(Fee	t) Date M	easured		
Total Depth of Completed Well 115       Feet       Total Depth of Completed Well 115       (colspan="2">(colspan="2")         Total Depth for mean Borehole       Casings       Annular Material         Depth from Borehole       Diameter Type       Material       Outside Diameter Type       Slot Size of Annular Material         Depth from Surface       Diameter (Inches)       Material       Wall Outside Diameter Type       Slot Size (Inches)       Depth from Surface Fill       Description         0       80       8.75       Blank       PVC Sch. 40       2       0       75       Cement       10.3 sack sand/         110       115       8.75       Blank       PVC Sch. 40       2       0       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       0       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       1       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       1       75       77	Total Depth of Boring 120	-15V	Feet	Test Len	a riela ". ath		(GPI	vi) test ty urs) Total D	rawdowo	(Feet)	
Casings       Annular Material         Depth from Surface       Borchole Diameter (Inches)       Type       Material       Wall Thickness       Outside Diameter (Inches)       Screen Type       Slot Size if Any (Inches)       Depth from Surface (Inches)       Surface Feet to Feet       Fill       Description         0       80       8.75       Blank       PVC Sch. 40       2       0       75       Cement       10.3 sack sand/         80       110       8.75       Screen       PVC Sch. 40       2       Milled Slots       0.030       iccment       10.3 sack sand/         110       115       8.75       Blank       PVC Sch. 40       2       Milled Slots       0.030       iccment       iccment       iccment         110       115       8.75       Blank       PVC Sch. 40       2       iccment       iccment       iccment         110       115       8.75       Blank       PVC Sch. 40       2       iccment       iccment       iccment         110       115       8.75       Blank       PVC Sch. 40       2       iccment       iccment       iccment         10       10       10       10       110       110       iccment       iccment	Total Depth of Completed Well 115	N. 8. 1	Feet	*May not	t be repres	entative	of a well	's long term	n yield.		
Depth from Surface Feet to Feet       Borehole Diameter       Type       Material       Wall Thickness       Outside Diameter       Screen Type       Slot Size if Any (Inches)       Depth from Surface if Any (Inches)       Depth from Surface Feet to Feet       Depth from Surface Feet to Feet       Depth from Surface Feet to Feet       Description         0       80       8.75       Blank       PVC Sch. 40       2       0       75       Cement       10.3 sack sand/         80       110       8.75       Screen       PVC Sch. 40       2       Milled Slots       0.030       Cement       10.3 sack sand/         110       115       8.75       Blank       PVC Sch. 40       2       Milled Slots       0.030       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       77       120       Filter Pack       SRI #8 Gravel         110       115       8.75       Blank       PVC Sch. 40       2       77       120       Filter Pack       SRI #8 Gravel         110       115       Screen       Name       Certification Statement       77       120       Filter Pack       SRI #8 Gravel         110       Geologic Log       In undersigned, certify tha		Casings						Annular	Material		
Feet to Feet       (Inches)       (Inches)       (Inches)       Feet to Feet       Feet to Feet       Feet to Feet         0       80       8.75       Blank       PVC Sch. 40       2       0       75       Cement       10.3 sack sand/         80       110       8.75       Screen       PVC Sch. 40       2       Milled Slots       0.030       cement       cement         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       77       120       Filter Pack       SRI #8 Gravel         Image: Second seco	Depth from Borehole Type	Material	Wall Outside	Screen Type	Slot Size	Dept	h from rface	Fill	Descr	otion	
0       80       8.75       Blank       PVC Sch. 40       2       0       75       Cement       10.3 sack sand/         80       110       8.75       Screen       PVC Sch. 40       2       Milled Slots       0.030       cement       cement         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       77       120       Filter Pack       SRI #8 Gravel         110       Geologic Log       Image: Certification Statement       Image: Certification Statement <td>Feet to Feet (Inches)</td> <td></td> <td>(Inches) (Inches)</td> <td>.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</td> <td>(Inches)</td> <td>Feet</td> <td>to Feet</td> <td>1</td> <td></td> <td></td>	Feet to Feet (Inches)		(Inches) (Inches)	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	(Inches)	Feet	to Feet	1			
80       110       8.75       Screen       PVC Sch. 40       2       Milled slots       0.030       Certific         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       75       77       Fine Sand       Transition         110       115       8.75       Blank       PVC Sch. 40       2       77       Totol       Screen       Transition         110       115       8.75       Blank       PVC Sch. 40       2       77       Totol       Screen       Transition         110       115       8.75       110       77       120       Filter Pack       SRI #8 Gravel         110       116       Geologic Log       1       11       the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Name       Vent OY C       Oriting       1       State       210         Name       Vent OY C       Oriting       1       State       210         110       11       Address       C-57 License Number       C-57 License Number	0 80 8.75 Blank	PVC Sch. 40	2	Milled Clete	0.020	0	75	Cement	10.3 sack	sand/	
Attachments       Certification Statement         Geologic Log       1, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Well Construction Diagram       1, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Soil/Water Chemical Analyses       0, the undersigned certify that this report is complete and accurate to the best of my knowledge and belief         Attach different in the undersigned certify that this report is complete and accurate to the best of my knowledge and belief         Name       Vell COYE         Person, Firm or Corporation       1, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Name       Vell COYE         Person, Firm or Corporation       1         Yes       1         Other       20         Attach address       City         Up for the dests       1         Coty of the report of the dests       1         Coty of the report of the dests       1         Coty of the report of the dests       2         Coty o	110 115 8.75 Blank	PVC Sch. 40	2	Milled Slots	0.030	75	77	Fine Sand	Transition		
Attachments       Certification Statement         Geologic Log       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Well Construction Diagram       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Geophysical Log(s)       Person, Film or Corporation         Soil/Water Chemical Analyses       Other         Other       Address         Coty       Life Joint State		1 VO DOM. NO	<u> </u>	-	-	77	120	Filter Pack	SRI #8 Gra	avel	
Attachments       Certification Statement         Geologic Log       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Well Construction Diagram       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Geophysical Log(s)       Person, Firm or Corporation       VOCIONA         Soil/Water Chemical Analyses       Other       City       State         Attach address       City       I of S 5 5         Cother       C-57 License Number											
Attachments       Certification Statement         Geologic Log       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Well Construction Diagram       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         Geophysical Log(s)       Person, Firm or Corporation       VOCICAND       CA       95170         Soil/Water Chemical Analyses       Other       City       1/5/13       State       Zip         Attach address       City       1/5/13       104.555       C-57 License Number							L				
□ Geologic Log       I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief         □ Well Construction Diagram       □ Geophysical Log(s)         □ Soil/Water Chemical Analyses       □ Other         □ Other	Attachments		nation descention of a	·	ertificati	ion Stat	tement		2011-00-00-00-00-00-00-00-00-00-00-00-00-	на - 1997 1972 — А	
Well Construction Diagram       Reading and the reason firm or corporation         Geophysical Log(s)       220 Nor the Cast of the cast of the reason firm or corporation         Other       Address         Attach additional information. If it exists.       Corporation	Geologic Log	1, the uno	tersigned, certify th	at this report	is complet	te and ad	ccurate t	o the best o	of my knowledge a	ind belief	
Image: Construction of the exists.     Construction     Const	Well Construction Diagram	Name _	Person, Firm or Corpor	ration	1.10	ndla	ad	~	95771	~	
Other     Signed     1/5/13     906.9.9.9.       Attach additional information. #It exists.     C-57, License Number     Date Stand     C-57, License Number	Soil/Water Chemical Analyses	120	Address	i șr		City	14	T State			
Attach additional information, if it exists. Unservice water weil Contractor Date Stoned C-57 License Number	Other	Signed _	- Ar	Alall Contractor			-11/5	13	901 899		
	Attach additional information, if it exists.	IE ADDITIO	NA SPACE IS NEEDED	USE NEXT CO	NSECUTIVE		Date S	gned C-5	T LICENSE NUMBE		

*The free J	Adobe Rea	ader may	y be used to view an	nd complete th	nis form. Ho	wever, s	oftware mus	t be purchase	d to complet	e, save, and	reuse a	saved for	orm.		
File Origi	nal with [	WR			107.0	Sta	te of Califo	rnia <b>D</b>	_ E	1.912.1.1.1.1	DWR	Use On	y - Do N	Not Fill In	
Page 2		of 2	2		Wei	I Cor	npletion Pa	n kepo	rt	1 1		1			
Owner's	Well Num	ber C	Y MW-1		_	No.	e0190455				State	N	nber/Site		
Date Wor	rk Began	10/10	/2013	Date W	Jork Ended	10/11	/2013			Lati	tude			Longitude	
Local Per	mit Agen	cy <u>Co</u>	unty of Sacram	ento											
Permit Ni	umber 5	3187		Permit Date	9/20/13	3		-	L			01.001	TTO/Othe		
			Geolog	ic Log		111	ALC: N	La solution	ni kashata atau		Well C	wner	1127	and the second	
Orie	ntation	<ul><li>O Ver</li></ul>	tical O Horiz	ontal (	DAngie	Specify		Name <u>C</u>	ity of Elk (	Grove					
Drilling	Method H	bliow Ste	em Auger	Decer	Unilling Fluid	1		Mailing A	ddress 8	401 Lagur	na Pal	ms Wa	<u>v</u>		
Feet	to Fe	et	Descri	be material, g	rain size, co	lor, etc		City Elk	Grove			Sta	te <u>CA</u>		
82	85		Sandy Silt- very	fine to fine	e, hard, b	rownis	h red,	129- AN-	4	M	Vell Lo	catior	б <sup>ана с</sup>	and the second	
		1	wet					Address	10250 Irc	on Rock V	Vav	****S			
85	93		Silty Clay- redd	ish brown,	medium	plastic,	moist	City Elk	Grove			Cou	inty Sa	acramento	
93	95		Silty Sand- very	fine to fine	e, reddish	h brown	i, wet	Latitude			N	Longitu	ide 🔄	W	
95	109		Silty Clay- redd	ish brown,	medium	plastic,	moist	Deturn	Deq.	Min Sec	20	- <sup>20</sup>	Dec. I	ea Min. Sec.	
		1	to wet								620	1	Dec. L	037	
109	113		Sand- fine to m	edium, bro	wn, wet			APN BO	эк <u>тэ</u> ч	_ Page <u>v</u>	030	Cure P	Conth		
113	120		Silty Clay- brow	/n, medium	i plastic, v	wet		Townshi	0	_ Range _		-	Secul	A - Aludeu	
								(Sketch n	LOCAU nust be drawn i	by hand after f	n orm is pri	nted.)	( Nr	ACTIVITY ew Well	
									1	North	_	dit-	OM	odification/Repair	
										- 19 A	14	- 1		Deepen	
	_												ODE	estroy	
												-500	De	escribe procedures and materials ider "GEOLOGIC LOG"	
													0.1111	Planned Uses	
	+						1.4						OW	ater Supply	
												77	말	Domestic Public	
							N	Wes				East			
														athodic Protection	
														ewatering eat Exchange	
	-				10.00		J.		19.1			- 1	O in	jection	
		_		7	p-	S.,		11	50				• м	onitoring	
		-			100	1.00		11						emediation	
					3i		1	11						parging	
				1200				22		South				apor Extraction	
								Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and ettach a map. Use additional paper if necessary.							
							7	Please be accurate and complete.							
								Water L	evel and	Yield of a	comp	letea v	ven		
			1.4.1.	444		1. 19 1981	n	Depth to	o first water. Static				_ (⊦ee	et below surface)	
		10	-10.			164. 164		Water L	evel		(Feet)	) Date	Measu	ured	
Total D	epth of E	oring	120		Ici. A	Feet		Estimate	ed Yield *		(GPM	) Test	Туре		
Total D	epth of C	omplet	ed Well 115	15		Feet		Test Ler	ngth		_ (Hour	s) Tota	I Drawd	lown (Feet)	
	optit of a		The second second	ų.	1 X.			"May no	t be repres	entative of	a well	s long ti	erm yiel		
5				Casi	ıgs	111-11	Outside	Cassar	Clat Cine	Danth 6		Annu	ar Ma	terial	
Dept	face	Diame	ter Type	Materi	al Tr	van lickness	Diameter	Туре	if Any	Surfac	ce	F	iH	Description	
Feet	to Feet	(Inche	15)		(	Inches)	(Inches)		(Inches)	Feet to	Feet			1	
			2-9 1al												
		3										1			
		1	() (												
			100												
Upper and the second		Attac	hments		New Street	ar da ta c	erg-anniky-		Certificati	on Stater	ment	(14)=1) (15)	and a start of a	2000(2)[2][9] 	
	Geologic	Log	and the second se		I, the und	ersigned	, certify that	at this report	t is complet	e and accu	irate to	the bes	st of my	knowledge and belief	
	Well Cor	structio	on Diagram	1	Name	Person	Firm or Corpor	Corporation							
	Geophys	ical Lo	g(s)		220	NO	th E	EAST St. Woodland CA 45110							
	Soll/Wat	er Cher	nical Analyses		Signed	/	Julioss /		S	l	1/5/	3	9068	99	
Attach add	ditional infor	nation, if	It exists		ð	C-57 Lic	ensed Water V	Vell Contractor		D	ate Sig	ned (	2-57 Lic	cense Number	
						and the second s									

*The free	e Adobe Re	ader may	be used to view	and complete this form	n. However, s	oftware mu	st be purchase	d to comple	ete, save, a	and reuse	a saved fo	srm.		
File Orig	ginal with I	DWR			Stat	te of Calif	ornia	111	N 459765	DW	R Use Onl	y – Do I	Not FIII In	
Page 1	l	of 1		V		npietic	on kepo Pamohlet	rt		1	L I	1		
Owner's	Well Nur	nber <u>C</u>	Y MW-2		No.	e019045	8			State		iber/Sit	e Number	
Date W	ork Began	10/04	2013	Date Work E	nded 10/4/2	2013			<u></u>	atitude		<u> </u>	Longitude	
Local P	ermit Ager	ncy Col	inty of Sacrai	mento	0/40		APN/TRS/Other							
Permit I	Number <u>5</u>	3188		Permit Date 9/2	0/13									
		-	Geolo	ogic Log						Well	Owner			
Drilling	Method H	Ver Inline Ste	ncal OHOI m Auger	rizontai OAngi Drilling	E Specity		Name C	ity of Elk	Grove	_		an de		
Dept	h from Su	irface	in / lager	Description	1	1997 - 1996 1997 - 1996 1997 - 1996	Mailing A	ddress _6	3401 Lac	<u>una Pa</u>	ims vva	V CA	05759	
Fee	t to F	eet	Des	cribe material, grain siz	ze, color, etc	he see	City Elk	Grove		-	Stat	e <u>CA</u>	Zip 95756	
0	5		Silty Clay- rec	dish brown, medi	um plastic,	dry	-			Well L	ocation			
5	13		Sandy Slit- ve	ery tine to tine, red	aisn brown	, ary to	Address	10250 Ir	on Rock	VVav	tere ella	0		
12	17		amp Clovey Silty S	and you fine to	modium ro	ddieb	City Elk	Grove			Cou	inty <u>Sa</u>	acramento	
13			prown damn	anu-very me to	neuluin, le	uuisii	Latitude	Deg	Min	Sec	V Longitu	de	req. Min. Sec.	
17	19		Silty Sand- ve	erv fine to medium	reddish br		Datum_		Dec. Lat.		10.15	Dec.	Long:	
			lamn	ing the to modulin	1 10001011 01	0111,	APN Boo	k <u>134</u>	Page	0630	<u></u>	Рагсе	037	
19	25		Sand- verv fir	ne to medium. liah	t brown, da	am	Township	o (	Range			Section	on	
25	29		Silty Sand- ve	erv fine to medium	, light brow	n, damp		Locat	ion Sket	tch			Activity	
29	30		Sandy Silty C	lay- very fine to fi	ne, reddish	brown,	(Sketch m	nust be drawn	by hand att North	er form is p	vinted.)	O N	ew Well	
		1	nedium plast	ic			1	days	Service of	19	1	O M	Deepen	
30	31	1	Gravelly Sand	d- fine to coarse, g	gravel up to	1/2",	]					Q C	Other	
			damp, reddisl	h brown							- A.	OD	escribe procedures and materials	
31	33	1	Sandy Silty C	lay- very fine to fi	ne, reddish	brown,					21	u	Diappod Liece	
			medium plast	ic, damp			2	24				0.14	later Supply	
33	34		Silty Clay- lig	ht brown, medium	plastic, da	mp				1			Domestic Dublic	
34	35		Sandy Silty C	lay, very fine to fir	ne, medium	plastic	fest				ast		Irrigation 🔲 Industrial	
35	36		Silty Clay- ligh	nt brown, medium	plastic, ligi	nt brown	- 5	2.5				Oc	athodic Protection	
36	37		Sandy Silty C	lay- light brown, n	nedium plas	STIC						O D	ewatering	
37	38		Slity Clay- ligi	dium plaatia com	plastic, ligi	nt brown	-						eat Exchange	
30	44		Silty Sand ve	olum plastic, som	wwn moiet	anics	-					Юм	onitorina	
10	51		Sandy Silty C	lav- very fine to fi	ne micace	1115	- O Remediation							
40			ight brown m	nedium plastic da	mp	503,	11					Qs	parging	
51	53		Silty Clay- tar	mottled light bro	wn. mediun	n plastic.			South				est Well	
			moist	1		Protection of	- Illustrate or de	scribe distance	of well from roa	ida, buildings	, fences,		apor Extraction	
53	55		Sand- very fir	ne to medium, ligh	t brown, m	oist	Please be act	curate and com	plete.					
							Water L	evel and	Yield o	f Com	pleted V	Vell		
			1				Depth to	first water Static	·			_ (Fee	et below surface)	
			ŶĮ.				Water Le	evel		(Fee	t) Date	Measu	ured	
Total	Depth of E	Boring	55		Feet		Estimate	d Yield *		(GPI	VI) Test	Туре		
Total	Depth of C	Complete	ed Well 55	10	Feet		Test Ler	igth	antativo	(Hou	irs) Total Palong te	Drawo	down (Feet)	
-	digitized and			Challenge	1 The new section	- Smithe	May no	t be repres	Sericative		Annul	ar Ma	torial	
Der	th from	Boreho	ole _	Casings	Wall	Outside	Screen	Slot Size	Depti	h from	Aintu	al ina	uemai.	
S	to Feet	Diamel (Inche	er Type	Material	Thickness (Inches)	Diameter (Inches)	Туре	if Any (inches)	Sur Feet	face to Feet	Fil	it	Description	
0	20	8.75	Blank	PVC Sch. 40		2			0	16	Cement		10.3 sack sand/	
20	50	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030					cement	
50	55	8.75	Blank	PVC Sch. 40		2			16	18	Fine San	d	Transition	
-		-							51	55	Bentonite	3	GRI #0 Gravel	
		1	1000		-									
for the same		A49-11	amonto		and services			ortificat	ion Stat	omont		NY SYL	and the second	
Story Con	Geologia	Attac	nnents,	L the	undersigned	certify th	at this report	is comple	te and ac	curate t	o the bes	t of my	knowledge and belief	
	Well Con	nstructio	n Diagram	Name	peneco	n D	rilling	Fie						
Ē	Geophys	sical Log	(s)	27	LU Person F	EGZ1	St.	- 10	oudi	and	<u></u>	A	95776	
	Soil/Wat	er Chen	nical Analyses	Signa	d	ddress	sl. /		City	11/e	-les SI	ate 97	Zip	
Attach a	J Other	mation. if it	exists.	C	C-57, Lice	nsed Water	WellContractor			Date Si	gned C	-57 Lie	cense Number	
									_					

*The free	Adobe Re	ader may	be used to view	and complete	this form.	However, :	software mi	ust be purchase	ed to comple	ete, save, a	and reuse	a saved fo	orm.		
File Orig	inal with I	OWR				Sta	ate of Cali	fornia	0. H		DW	R Use Onl	y - Do	Not Fill In	
Dogo 1		of 2			W	ell Co	mpleti	on Repo	n Report						
Page <u>(</u>	Mall Num	$\frac{10}{2}$	( MAAL 3			Refer	to Instruction	Pamphlet			State	e Well Nun	nber/Sit	le Number	
Date Ma	rk Bogan	10/09/	2013	Date \		10/0.	019040	33		LL	-		1	I W	
	mit Ager		inty of Sacra	mento		ueu <u>10/3</u>	2015								
Permit N	umber 5	3189		Permit Dat	e 9/20	/13		APN/TRS/Other							
-		60-10.00-0	Geole	alc Loa	o star	21		1	-	- 112 - 117	Well	Owper	C. (.)	the second second second second	
Ori	antation	OVer	ical ÖHo	rizontal	OAngle	Specifi	No.		ity of Elk	Gravo	even.	Owner		and the second second	
Drilling	Method H	ollow Ste	m Auger		Drilling F	Fluid									
Depth	from Su	rface		Desc	ription		and a monthly little	Mailing Address 8401 Laguna Palms Way							
Feet	to Fe	et	Des	cribe material,	grain size	, color, etc		City Elk	Grove			Stat	te <u>CA</u>	Zip95758	
0	4	0	lay-dark bro	own, mediur	n plasti	c, damp		to a constant		the state	Well L	ocation	l		
4	17	S	Sandy Silty C	lay- very fin	e to fine	e, reddish	brown,	Address	10250 lr	ron Rock	Wav	- <u></u>			
	Imedium plasticity, dry         City Elk Grove         County Sacramento           17         10         Sand yogy fing to modium brown down some         City Elk Grove         County Sacramento														
17 19 Sand- very fine to medium, brown, damp, some LatitudeN LongitudeW															
silt, moderately sorted Dea. Min. Sec. Dea. Min. Sec.															
19	19 25 Sandy Clayey Silt- very fine, reddish brown, damp, Datum Dec. Lat Dec. Long														
	medium plastic APN Book 134 Page 0630 Parcel 037														
25	25 29 Silty Sand- very fine to fine, light brown, damp Township Range Section														
29	33	5	and- very fir	ne to coarse	trace g	gravel, da	amp	200 TES	Locat	ion Ske	tch			Activity	
33	39	5	Sandy Silty C	lay- light bro	wn/red	dish brov	vn,	(Sketch r	nust be drawn	by hand aft	er form is p	printed.)	O N	ew Well	
-		r	nedium plast	ic, damp					Altar	NUTUT	100		OM	odification/Repair	
39	51	5	Sandy Clavey	/ Silt- verv fi	ne, tan.	black on	anics	11	1000				5	Other	
51	53	0	silty Sand- ve	erv fine to fir	ne tan	damo		11 .			10	S. 1	OD	estroy	
53	55		andy Claves	/ Silt_verv fi	ne to fir	ne tan d	amn	11 1				in all	D 10	Describe procedures and materials Inder "GEOLOGIC LOG"	
55	57		silty Sand- ve	ary fine to fir	no tan	damn	amp	(4) 2 -				- 1° 1	1	Planned Uses	
57	61		andy Silt- ve	any fine to n	domo	uamp		-					OW	later Supply	
61	62		Sandy Sill- ve	ny fino to fir	uamp	moint w	all cortod							Domestic Public	
60	03		Silly Sand- ve	ay me to m	demo	moist, we	sil solleu	Kes			81	Eas		Irrigation Industrial	
03	00		Sandy Sil- ve	ery nne, tan,	uamp	f la naviora in	addlad						00	athodic Protection	
60	69		sandy Clayey	/ Silt- very fi	ne, lign	t brown n	nottied						O D	ewatering	
	-		eddish browi	n, damp	-10	· · · · · · · · · · · · · · · · · · ·	- deconstant	31					ОН	eat Exchange	
69	81	2	Sandy Silt- ve	ery fine, tan	to redd	ish brown	n, damp	-11				1		jection	
		t	o moist					-11						ionitoring	
81	89	5	Sandy Clayey	/ Silt- very fi	ne, red	dish brow	n,moist	-11	O Sparging						
89	90	5	Silty Clay- bro	own, mediur	n plasti	c, moist		-11	O Test Well						
90	91	5	Sandy Clayey	/ Silt- very fi	ne, red	dish brow	vn, moist			South			Ōv	apor Extraction	
91	94	C	Clay-brown r	nottled redd	ish brow	wn, medi	um	rivers, alc. an	d attach a map.	Use additional	paper if nece	essary.	00	other	
		F	lastic, moist	ile.			115	Mator	ovel and	Viold o	f Com	alotod M	loll		
94	97	5	Sandy Silt- ve	ery fine, red	dish bro	wn, mois	st to wet	Vvaler L	everanu		Com	Jieteu v	/En	at heleu eufeer)	
97	99	5	Silty Clay- red	ddish brown	, mediu	im plastic	, wet	Depth to	Static	94	_	_	- (Fee	et below sunace)	
99	101		Clayey Silt- re	eddish brow	n, wet	1.10		Water Le	evel		(Fee	t) Date	Measu	ured	
Total D	epth of B	oring	120			Feet		Estimate	ed Yield *		(GPI	M) Test	Туре _		
Total F	enth of C	omplete	d Mall 120	Ser.	M 196	Eeet		Test Ler	igth		(Hou	irs) Total	Drawo	down(Feet)	
TULATL	eptil one	omplete			£ #		-	*May no	t be repres	sentative	of a well	's long te	rm yie	ld.	
	1102 20 20			Casi	ngs		Statistical states	(HN) I	etter juices	1		Annul	ar Ma	terial	
Dept	h from	Boreho	le Type	Mater	ial	Wall	Outside	Screen	Slot Size	Depti	from	EU		Description	
Feet	to Feet	(Inches	)	100		(Inches)	(Inches)	iybe	(Inches)	Feet	to Feet			Description	
0	90	8.75	Blank	PVC Sch. 40			2			0	85	Cement		10.3 sack sand/	
90	115	8.75	Screen	PVC Sch. 40			2	Milled Slots	0.030					cement	
115	120	8.75	Blank	PVC Sch. 40			2			85	87	Fine Sar	nd	Transition	
		199	1.11							87	120	Filter Pac	ck	#8 SRI Gravel	
			1					· · · · · · · · · · · · · · · · · · ·							
			1									1			
dist-	Attachments Certification Statement														
	Geologic Log I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief														
	Well Con	structior	n Diagram		Name _	Person	Eirm or Corry	DYIIIIY	}					0/52-	
	Geophys	ical Log	(s)		220	NT	ZASI	87.	IN_	1000	and	<u>C</u>	A	45176	
	Soll/Wate	er Chem	ical Analyses		Signed		Address			City	uleli	St	ate	Zip 899	
Attech art	Uther	nation if it	exists		S.S. E	C-57-Cic	ensed Water	Well Contractor			Date/Si	aned C	-57 Lic	cense Number	
7 HILLOST GU	and an	and a li				-6									

*The free	Adobe Reader	may be used to view and co	omplete this form. However, software mus	t be purchased to com	plete, save, and reuse a saved	form.				
File Origi	nal with DWF	2	State of Califo	DWR Use Only Do Not Fill In						
		. n	Well Completio	n Report	Report					
Page 2	01	2	Refer to Instruction P	Pamphlet State Well Number/Site Number						
Owner's	Well Number		No. e0190459	)		w i				
Lange Der	rk Began 10.	County of Socramont	Date Work Ended 10/4/2013		Latitude	Longitude				
Permit N	umber 5318	9 Per	mit Date 9/20/13		APN/	TRS/Other				
<b></b>		Geologic I	00		Well Owner	in a Mercury and were				
Orie	entation (O)	Vertical O Horizonta	A OAngle Specify	Name City of E	lk Grove	the second s				
Drilling	Method Hollow	Stem Auger	Drilling Fluid	Marilies Address	8401 Loguno Bolmo M					
Depth	from Surfac	9	Description	City Elk Grove	0401 Lauuna Fainis W	ate CA 71- 95758				
Feet	to Feet	Describe n	aterial, grain size, color, etc	City Lik Orove						
101	103	Silty Clay- light bro	wh mottled redaish brown,	10050	Well Locatio	n				
102	105	Eandy Clayov Silt	uon, fino to modium, raddiab	Address 10250	Iron Rock Way	Occurrente				
103	105	brown wet	very line to medium, reduisin	City Elk Grove	Co	ounty Sacramento				
105	115	Clow roddich brow	Norwa modium plastia wat	Latitude	Min Sec N Longit	udeW				
115	117	Sandy Clayov Silt	word fine, the mottled brown wot	Datum	Dec. Lat.	Dec. Long.				
117	120	Silty Clay brown	nedium plastic wet	APN Book 134	Page 0630	Parcel 037				
	120	Silty Clay- DiOWII, I	neurum plastic, wet	Township	Range	Section				
				1.00	ation Sketch	Activity				
				(Sketch must be dra	wn by hand after form is printed.)	New Well				
					North	O Modification/Repair				
		-	and the second sec	1997 B	1. 1. <u>1. 1. 1.</u> 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	O Deepen				
						O Destroy				
				1 E.		Describe procedures and materials under "GEOLOGIC LOG"				
	-			per ny		Planned Uses				
		-			2.09	O Water Supply				
						Domestic Public				
			and the sector of the sector of the sector of	Wes	Eas	L Iπigation LIndustrial				
			in the second	O Cathodic Protection						
			5. 5			O Dewatering				
			and the second							
		e i como con obiero				Monitoring				
			and the second			O Remediation				
						O Sparging				
			215		South	O Test Well				
			farmer et also and a second and a	Mustrate or describe distan	ce of well from roads, buildings, fences,	O Vapor Extraction				
			1	rivers, etc. and attach a ma Please be accurate and c	p. Use additional paper if necessary, omplete.					
				Water Level an	d Yield of Completed	Well				
			The second se	Depth to first wat	ter <u>94</u>	(Feet below surface)				
			a a series a series a series de la series de l	Depth to Static	(Eeet) Date	Measured				
Total D	enth of Borin	120	Feet	Estimated Vield	(GPM) Test	t Tyne				
Total D	optil of bonn	400		Test Length	(Hours) Tota	I Drawdown (Feet)				
Total D	epth of Comp	bleted Well	Feet	*May not be repr	esentative of a well's long t	erm yield.				
			Casings		Annu	lar Material				
Depth	from Bo	ehole Type	Material Wall Outside	Screen Slot Siz	e Depth from					
Feet	tace Dia to Feet (in	meter ches)	(Inches) (Inches)	Type If Any (Inches	Feet to Feet	u Description				
		22								
		(F)								
		Les mailes and			_					
	LL_									
-ru	Att	achments	- T the second sec	Certifica	ation Statement					
	Geologic Log		I, the undersigned, certify that	this report is comp	lete and accurate to the be	st of my knowledge and belief				
	Well Constru	ction Diagram	Person, Firm or Corport	ation	las llas d	0. 0-771-				
	Geophysical SollAMator Cl	LUY(S) Demical Analyses	LU N. CUST	<u>II-</u>	Joodiana	State Zip				
	Other	,onnour / that yooo	Signed		11/5/13	906899				
Attach add	itional information	, if it exists.	C-57 Licensed Water W	ell Contractor	Date Signed	C-57 License Number				

*The free	Adobe Re	ader may !	be used to viev	v and complete	this form. H	lowever, softwa	are must	be purchase	d to comple	ete, save,	and reuse	a saved fo	srm.	New Carlo	
File Original with DWR						State of California Wall Completion Benert			et	DWR Use Only - Do Not Fill in					
Page <u>1</u>	age <u>1</u> of <u>2</u> Refer to instruction Page														
Owner's	wner's Weil Number CY MW-4 No. e0190478									1 J					
Date Wo	ork Began	10/07/2	2013	Date	Nork Ende	ed <u>10/7/201</u>	3			[	Latitude			Longitude	
Local Pe	ermit Ager	icy Cou	nty of Sacra	mento	0/00/4	2						APN/T	L L		
Permit N	lumber 5	3190		Permit Da	te <u>9/20/1</u>	3			L.					(Alianteen and a second and a second s	
Se		Werti	Geol	ogic Log			801 <u>85</u> 78	1. C. C. P. D.	0 m (0) 20		Well	Owner	ener i	almaan oo ahaang	
Ori	entation	⊙ Verti	cal OHo	rizontal	O Angle	Specify		Name <u>C</u>	ty of Elk	Grove	_				
Doning Method Honow Stern Auger Draining Fluid							Mailing A	ddress <u></u>	8401 La	duna Pa	alms Wa	<u>/</u>			
Feet to Feet Describe material, grain size, color, etc							City Elk	Grove			Stat	e <u>CA</u>	Zip 95758		
0	4	C	lay- dark br	own, mediu	n plastic,	damp		6.1.a.			Well L	ocation		277	
4	13	S	andy Silty C	Clay- very fin	e to fine,	medium pla	astic,	Address 10250 Iron Rock Way							
		re	ddish brow	n, dry				City Elk	Grove			Cou	nty S	acramento	
13	15	IS	ilty Clay- ta	n mottled lig	ht brown,	medium pla	astic	Latitude				N Longitu	de	<u></u> W	
15	19	S	ilty Sand- v	ery fine to m	edium, lig	ght brown, c	damp	Datum	Deq.	Min. Dog Lat	Sec.		Dec	Long	
19	24	S	and- fine to	coarse, trac	e gravel,	brown, dan	np	ADM Rec	121	Dec. Lat	0630	9	Dec.		
24	25	S	ilty Sand- v	ery fine to fi	ne, tan, m	nicaceous		Townshir	K <u>104</u>	_ Faye	<u> </u>	1	Sout		
25	27	S	and- fine to	coarse, loo	se, tan, d	amp		Township	1	Range	tab	-	0.000	Activity	
27	29	S	ilty Sand- v	ery tine to m	edium, lig	ght brown, r	moist	(Sketch m	LOCAT	by hand af	ter form is	onnted.)		lew Well	
29	31	S	and-very fi	ne to coarse	, trace gr	ravel to 1/4"	·			North			0N	iodification/Repair	
0.4		b	rown, damp	N		h. (h			7.34	1	1910	- 1 B	5	Deepen	
31	41	S	andy Silty C	lay-very fir	e, reddisi	n brown,							OD	Destrov	
	-	m	edium plas	tic, moist								Sec	Ē	Describe procedures and materials inder "GEOLOGIC LOG"	
41	44	S	ity Clay- ta	n, medium p	lastic, bla	ack organics	S	2					16.5	Planned Uses	
44	4/		ity Sand- V	ery fine to fil	ne, tan, o	amp							OV	Vater Supply	
4/	53	5	andy Silt- V	ery tine, tan	damp	بالاسم ماممان							Ŭ	Domestic Public	
53	55	5	Silty Clay- tan, black organics, medium plastic									East		Irrigation 🔲 Industrial	
55	5/	0	Sand- very fine to medium, tan, damp										00	Cathodic Protection	
5/	59	0	Sitty Clay- tan, black organics, medium plastic										OD.	Dewatering	
59	67	0	and-very in	ne to medium r	Il, reduis	mp								leat Exchange	
67	60	0	Sirty Clay- tan, medium plastic, damp									- 1		Aonitorina	
60	71	- 0	illy Sand y	any fine to fi	be light h	rown dam	n	200					ŌF	Remediation	
71	73	9	andy Silt_ v	erv fine tan	damp	nown, dann	-						08	Sparging	
73	77	5	andy Silty (	lav. very fir	e tan mo	ottled light h	rown			South		1	OT	est Well	
13			andy only c	tic damp	io, tan mi	ottiou ngin b		Illustrate or de	scribe distance	of well from ro	oads, building	s, fences,	0 V	/apor Extraction	
77	80	S	andy Clave	v Silt- verv f	ine to fine	e reddish b	Please be acc	urate and com	plete.	а рареги пес	essary				
11		m	icaceous.	y one yory		5,100001115		Water L	evel and	Yield o	of Com	pleted W	/ell	an de constant de la	
80	83	S	and-very fi	ne to coârse	micace	ous wet		Depth to	first water	93			_ (Fe	et below surface)	
83	85	S	ilty Clay- lic	ht brown, m	edium pla	astic, moist-	-wet	Depth to	Static		(Fee	t) Date	Meas	ured	
Total	Denth of F	lorina	120			Eeet		Estimate	d Yield *		(GP	M) Test	Туре		
- Cottain		igning .	120	1000	1.75			Test Len	gth		(Hou	urs) Total	Draw	down (Feet)	
Total	Depth of C	Complete			Feet			*May not	be repres	sentative	of a wel	I's long te	rm yie	eld.	
1		$a^{\mu} = 1 \alpha^{\mu}$		Casi	ngs	TISES DOM:		in the second				Annul	ar Ma	aterial	
Dep	th from	Borehol	e Type	Mater	ial _	Wall Ou	Itside	Screen	Slot Size	Dept	th from			Denedation	
Feet	to Feet	(Inches)			Т	(Inches) (Inches)	ches)	гурө	(Inches)	Feet	to Feet	-11	<u>'</u>	Description	
0	90	8.75	Blank	PVC Sch. 40		2				0	85	Cement		10.3 sack sand/	
90	115	8.75	Screen	PVC Sch. 40		2	M	Ailled Slots	0.030					cement	
115	120	8.75 Blank PVC Sch. 40			2				85	87	Fine Sar	ld	Transition		
										87	120	Filter Pac	ж	SRI #8 Gravel	
		4	100												
-	1		1		,						1	1			
5	58 · · · ·	Attach	ments	194				(	ertificat	ion Sta	tement	- 4h	h of a	uknowledge t»-f	
	Geologic	Log	Dise		i, the une	UNE CO	ruly that	DY IIIIN	a comple	te and a	ccurate		t or my	y knowledge and belief	
	vvell Cor	istruction	Diagram		000	Person, Firm o	or Cotbda	17 noi	1	and	Inn	do	· A	957710	
Soil/Water Chemical Analyses						LOT	- 421	Cit	yary		ate	Zip			
	Other				Signed	-7	2				11/5	13	90	6859	
Attach ad	ditional infor	nation, if it e	xists			C-57-Licensed	Water We	ell Contractor			Daté S	gned C	-57 Li	icense Number	
DWR 188	REV. 1/200	6			IF ADDITIO	NAL SPACE IS N	EEDED. L	JSE NEXT CO	NSECUTIVE	Y NUMBE	RED FORM	1			

*The free A	dobe Reader r	nay be used to view and complet	e this form. However, software mus	st be purchased to com	plete, save, and reuse a saved	form.			
File Origina	al with DWR	•	State of California	ornia	DWR Use O	nly – Do Not Fill in			
_ 0		0	Well Completio	on Report					
Page <u>2</u>	of		Refer to Instruction F	Pamphlet	State Well Nu	imber/Site Number			
Owner's V	Penan 10/	07/2013 Det	No. e01904/	8					
Local Pern	nit Agency	County of Sacramento	WORK LINGEN						
Permit Nur	nber <u>53190</u>	Permit D	ate 9/20/13		APN/	TRS/Other			
	And the second se	Geologic Log		Contraction of the	Well Owner				
Orien	tation O	/ertical O Horizontal	OAngle Specify	Name City of E	lk Grove				
Drilling M	ethod Hollow	Stem Auger	Drilling Fluid	Mailing Address	8401 Laguna Palms W	ay			
Depth fi	to Feet	e Describe materia	scription I. orain size, color, etc	City Elk Grove	Sta	ate CA _ Zip _ 95758			
85	89 Sandy Silty Clay- very fine to fine, tan, medium				Well Locatio	n			
		plastic, moist		Address 10250	Iron Rock Way				
89	93	Silty Clay- reddish brow	n, medium plastic, moist	City Elk Grove	Co	unty Sacramento			
93	95	Clayey Silty Sand- very	fine to fine, reddish brown,	Latitude	N Longit	udeW			
		moist to wet		Deq.	Min, Sec.	Deg Min, Sec			
95	97	Sandy Silty Clay- very f	ine to fine, reddish brown,	APN Book 134	_ Dec. Lat	Parcel 037			
	101	medium plasticity, wet	li su de ll'accedent	Townshin	Rance	Section			
97	101	Silty Clay- reddish brow	n, medium plastic, wet	Township	ation Skotch	Activity			
101	108	Clay- redaish brown, m	eulum plastic, wet	(Sketch must be dra	wn by hand after form is printed.)	New Well			
108	112	Sand your fine to com	nne, tan, wet		North	O Modification/Repair			
111	117	Clave brown, medium n	lastic wet		- A	O Deepen			
112	120	Silty Clay- reddish brow	n medium plastic wet			O Destroy			
	120	City city roddion bron	n, moduli placed not			under "GEOLOGIC LOG"			
				10		Planned Uses			
			·····	11		O Water Supply			
				1 5	st				
			al <sup>it</sup> h <sup>1</sup>	Š	Ш				
						O Dewatering			
			HH	i.		O Heat Exchange			
	_		ije na stanije se stanije	1 S		<ul> <li>Injection</li> <li>Monitoring</li> <li>Remediation</li> <li>Sparging</li> <li>Test Well</li> </ul>			
			Contraction of the second seco	41					
					South				
	-		Ng No	Illustrate or describe distan	ce of well from roads, buildings, fences,	O Vapor Extraction			
				rivers, elc. and attach a ma Please be accurate and c	ip. Use additional paper if necessary. complete.				
	-	W. Th		Water Level an	nd Yield of Completed	Well			
		DECESSION .		Depth to first wa	ter <u>93</u>	(Feet below surface)			
			н й — <u>М</u>	Water Level	(Feet) Dat	e Measured			
Total De	pth of Boring	120	Feet	Estimated Yield	* (GPM) Tes	t Туре			
Total De	oth of Comp	leted Well 120	Feet	Test Length (Hours) Total Drawdown (Feet)					
Total Do	pur of comp			May not be rep	resentative of a well's long	term yield.			
		Ca	sings	Caroon Clat Ci	Annu Donth from	ilar Material			
Depth	trom Bor ace Diar	enole Type Mat	erial Thickness Diameter	Type if Any	Surface	ill Description			
Feet to	Feet (Ind	ches)	(Inches) (Inches)	(Inches	5) Feet to Feet				
		N				an a			
		3							
		n C.C.							
ar an eise Ar seite	Atta	achments	and the second sec	Certific	ation Statement	and the second			
	eologic Log		I, the undersigned, certify the	at this report is comp	plete and accurate to the be	st of my knowledge and belief			
	Vell Construc	tion Diagram	Person, Firm or Corpor	ation of the	londland				
	copnysical l	Log(s) Jemical Analyses	Addresso	1 94 7	City / /	State Zip			
	Other		Signed		11/5/12	906899			
Attach additi	ional Information	if it exists.	C-57 Ligensed Water V	Vell Contractor	Date Signed	C-57 License Number			

*The free	e Adobe Re	eader m	ay be used to vie	w and complete	this form.	However, s	oftware m	ust be purcha	sed to comple	ste, save,	and reuse	e a saved fo	orm.		
File Original with DWR State of Califor						fornia '	rnia DWR Use Only - Do Not Fill in								
Page 1 Of 1 Well Completion						on Rep	ort		1	I. I.	1				
Dwner's Well Number SC MW-1 Refer to instruction Page							Pampniet 05			Stat	e Well Nun	nber/Si	te Number		
Date Work Began 10/01/2013 Date Work Ended 10/2/2013								1	انصاحبا	Latitude	J	lel	Longitude		
Local Pe	ermit Age	ncy Co	ounty of Sacra	amento						1	1	ADNOT			
Permit N	Number <u>5</u>	53186		Permit Da	te <u>9/20</u>	/13			۲ <b>L</b>			APN/1	RSIOU		
	F. F.		Geol	ogic Log	1.0		일다. 소신	A HOLLES	5		Well	Owner		land and survey	
Ori	ientation	⊙ Ve	ertical OH	orizontal	OAngle	Specify		- Name	City of Elk	Grove					
Denth from Surface Description							Mailing	Address _	3401 La	<u>guna Pa</u>	alms Wa	v			
Feet to Feet Describe material, grain size, color, etc.							City E	k Grove			Stat	e CA			
0	2		Fill- road bas	se sand and	gravel,	dry		DIT .	A		Well L	ocation	P	Marine and Street and	
2	5		Clay- brown,	medium pla	sticity, c	liry		Addres	s Mountai	n Bell D	Drive (St	rawberry	Cree	ek Detention Basin)	
5	15		Sandy Silt-ve	ery fine, light	brown	mottled ta	in, damp	City E	k Grove	_		Cou	inty S	acramento	
15	21		Sandy Silt- V	ery fine to fil	ne, tan,	damp	a a alava	Latitud		Min	Sec	N Longitu	de	Deg Min Sec	
21	25	-	Sandy Silt- V	ery fine, lign	t brown	mottled t	an, dam	Datum	Ded	Dec. La			Dec.	Long:	
25	32		Sandy Silt- V	ery line to li	ie, tan,	aamp	ht brow	APN B	ook 115	Page	e 0150		Parc	el 036	
32	- 35		moist	me to meditu	n, wen a	soneu, ny	ILC DI UWI	Towns	nip	Rang	e	New W	Sect	ion	
35	37		Sand- very f	ine to mediu	n brow	n lenses	of sand		Locat	ion Ske	etch	100		Activity	
	- 57		silt moist		11, 01044		or gand	(Sketc)	must be drawn	by hend a	fter form is	printed.)	0 N	lew Well	
37	47	-	Sand- very f	ine to mediu	m. well	sorted lic	ht brow		1.00	North	-swi		ON	Nodification/Repair	
07			moist										2	O Other	
47	53		Sandy Clave	ev Silt- verv f					2	OD	estroy				
			moist	1					1		under "GEOLOGIC LOG"				
53	57		Sandy Silt- v	very fine to fi	n						Planned Uses				
			moist									1		Vater Supply	
57	59		Silty Sand-	very fine to fi					Ist	ΙH	Irrigation				
			wet									ü		Cathodic Protection	
59	67		Sandy Silt- v	very fine to fi	ne, light	brown m	ottled							Dewatering	
			brown, wet		-	et i							Ō⊦	leat Exchange	
67	109		Clay-brown	, medium pla	istic, tra	ce fine sa	and, wet						0	njection	
109	111		Sandy Clay- fine to medium, tan mottled reddish											Aonitoring	
			brown, 3" sa	ind lense at	2						Sparging				
111	120		Sandy Clay-	wn,	-11		0		O Test Well						
			medium plastic, wet						tilustrate or describe distance of well from roads, buildings, fences,					apor Extraction	
									and utlach a map. accurate and com	Use addition	al peper if neo	севвагу.	00	Other	
							44	Water Level and Yield of Completed Well							
				T C				Depth	Depth to first water 57 (Feet below surface)						
			, Company and Comp						to Static		(Ear	at) Data	Moos	urod	
Total	Dooth of I	Poring	120	3		Eeet		Estima	ted Yield *	(Q	(Fer	M) Test	Type		
TOLA	Deptiloli	bornig	120	- 18 <sup>1</sup>	81 24			Test L	ength		(Hoi	urs) Total	Draw	down (Feet)	
Total	Depth of (	Comple	eted Well 120	4. T		Feet		*May r	not be repre	sentative	ofawe	I's long te	erm yle	eld.	
				Cas	ings			Sec			1999 - San	Annul	ar Ma	aterial	
Dep Su Feet	th from urface to Feet	Borel Diam (Inch	nole Type eter Type ies)	Mate	rial	Wall Thickness (inches)	Outside Diamete (Inches)	Screen r Type	Slot Size if Any (Inches)	Dep Su Feet	th from Irface to Feet	Fi	n	Description	
0	100	8.75	Blank	PVC Sch. 40	)		2			0	95	Cement		10.3 Sack sand/	
100	115	8.75	Screen	PVC Sch. 4	)		2	Milled Slots	0.030		1		-	cement	
115	120	8.75	Blank	PVC Sch. 40	)		2		_	95	97	Fine Sar	nd	I ransition	
	_	-			-					197	120	Filter Pa	CK	SKI #8 Gravel	
			1 8								-				
-		all and a loss		1.2	di Angela		1	1 2011 (N	0		and white	an analyze alte		William Sector March 10	
1. C 12	Louise	Atta	chments	建加盟制度	I the tr	atereignor	I cortified	hat this ren	Certificat	te and s	courate	to the bes	t of m	v knowledge and belief	
	Well Co	c LOG nstructi	on Diagram		Name	Pene	OVE	DUIL	ing					, menneege und seller	
Geophysical Log(s)						TSt.	Jin	loud	and		A	98776			
	Soil/Wa	ter Che	mical Analyses	ŝ	0		Address			Ci	y /	J s	tate	Zip	
	Other _		111 - Jaka		Signed	C-57 110	ensed Wate	Well Contracto	r		Dates	Inned C	-571	icense Number	
Attach a	oditional info	mation, i	r it exists.			0.01 119				-	Date 0	gridu C		Control Humber	

DWR	188	REV.	1/2008														
*The fre	e Adobe	Reader	may be used	to vi	ew and comp	lete this fo	rm. Howeve	er, software	mu	ist be purch:	ased to com	plete, sav	e, and re	use a save	d form.		
---------------------	--------------------	-----------------	----------------------	---------	-------------------	--------------	---------------------	---------------------	--------------	-----------------	------------------	-----------------	-------------------------------	-----------------	------------	-----------------------------------	--
File Ori	ginal wit	h DWR						State of C	alif	ornia			DWR Use Only - Do Not Fill in				
Page _	1_	of	1				Well C	omple	etic	on Rep	ort		1	1.1			
Owner's	s Well N	umber	SC MW-2	2			N	o. e019(	007 ) 051	6			Ś	tate Well N	lumber	/Site Number	
Date W	ork Bega	an <u>09/</u>	26/2013		Da	te Work	Ended <u>9/2</u>	26/2013					Latitud	e		Longitude	
Local P Permit I	ermit Ag Number	ency ( 53182	County of	Sacr	ramento Permit	Date 9/	20/13		-					APN			
				Geo		Duto			-	1	-		14/-				
Or	ientatio	n O\	/ertical	Он	orizontal	QAnd	le Spe	cify	-	11	City of El	k Crow	vve	il Owne	r		
Drilling	Method	Hollow	Stem Auger			Drillin	g Fluid			Name	City of El	K Grove	9				
Dept	h from s	Surface	)		D	scriptio	n			Mailing	Address	8401 L	aguna	Palms W	lay		
Fee	1 10	Feet	0.0	De	escribe mater	ial, grain s	ze, color, et	c		City E	ik Grove	_	_	Si	tate _C	<u>A Zip 95758</u>	
Ľ—			Silty Cla	iy- re	adish bro	wn, mea	ium plast	ic, trace	-				Well	Locatio	)n		
5	7		Sondy C	sar	10	6	datte to the second			Addres	s <u>Mounta</u>	ain Bell	Drive (	Strawber	ry Cre	eek Detention Basin)	
7	11		Sandy a	ont- v	very fine to	tine, red	aaish brov	wn, mois	t	City E	lk Grove			C	ounty_	Sacramento	
<u> </u>			Silly Cia	y- te	an mottled	light bro	wn, meai	um plast	IC,	Latitude	e			N Longi	tude _	w	
11	14		Sondy S	ilter /		fine to f		- 44 172		Datum	L)eq.	Min. Dec. Li	Sec. at		Dec	Dea, Min, Sec.	
<u> </u>			brown n	noio	Glay- very	ime to n	ne, tan m	ottied lig	nt		ook 115	_ DC0. Li	0150		- Det	. Long	
14	19		Silby Cla		L m. modium	plantic		14 - SOLE2007		Tournet	JOK <u>110</u>	Fay			_ Par	cel <u>050</u>	
	- 10		Jongoo	y- la	in, mealun	plastic,	some wr	lite clay		TOWIS		Ran	ge		Sec		
18	20		Sandy S	il+	on fina ta	fine ter	maint			(Sketch	must be draw	n by hand	after form is	s printed.)		Activity	
20	20		Sand u	m-v	ery line to	tine, tar	n, moist					North			<b>I</b> Ö	New Well Modification/Repair	
20			brown	ery i	ine to med	ium, we	soned, I	noist,	-						ľ	O Deepen	
22	23		Silty Cla	v_ to	n modium	plantia	minnen		-							O Other	
23	29		Sandy S	ilt v	on fine to	plastic,	micaceo	us, mois	<u>د</u>							Describe procedures and materials	
29	35		Sand- ve	arv fi	ne to med	ium wol	eous, mo	nicocco	10						<b> </b>	Planned Llees	
			damp h				soned, i	mcaceou	12							Water Supply	
35	38		Sandy S	ilt_ v	erv fine to	fine ton	micacor									Domestic Dublic	
38	45		Sandy S	ilty (	lav-verv	line me	ium plac	tic	51	Vest				East		Irrigation Industrial	
			reddish t	brow	n micacer		st	110,	-	-				_	00	Cathodic Protection	
45	52		Sand- ve	rv fi	ne to medi	um wei	sorted k	oose wit	h					1	Q	Dewatering	
			some ha	rd le	inses brow	vn mois	t to wet	oose with	-							Heat Exchange	
52	57.5	i	Silty Clay	/- ta	n mottled l	ight brow	vn medi	m nlasti	~	1						njection	
		_	moist			ginturoi	in, moure	in plast	<u>,</u>						۱ŏ,	Remediation	
									-						lõs	Sparging	
			Note: Th	nis is	version 2	a depti	correctio	on was				South			01	Fest Well	
			made.	The	same Wel	Comple	tion Rep	ort		tilustrate or d	escribe distance	of well from r	oads, building	is, fancas,		/apor Extraction	
			number	was	used.	2000000				Please be ac	curate and com	plete.	al paper if nei	cessary.	00	Other	
										Water L	.evel and	Yield (	of Com	pleted V	Vell		
										Depth to	first water	45	_		_ (Fe	et below surface)	
										Water L	o Static evel		(Fee	at) Date	Меас	ured	
Total D	epth of E	Boring	5	7.5			Feet			Estimate	ed Yield *		(F C(	M) Test	Type		
Total D	enth of (	Complet	ted Well 5	7.5			Eeet			Test Ler	ngth			urs) Total	Draw	down (Feet)	
		sompic		_	-		Feel			*May no	t be repres	entative	of a wel	I's long te	rm yie	eld.	
					Cas	ings		1,11,100				Шî		Annul	ar Ma	iterial	
Depth Sur	from face	Boreh Diame	ole Type ter Type	9	Mate	rial	Wall Thicknese	Outside Diameter	6) F	Screen Type	Slot Size	Dept Su	th from rface	Fil	1	Description	
0	23	8.75	Blank	_	PVC Sch. 4	0	(1101/08)	2	T		(inches)		18	Cement		10.3 Sack sand/	
23	53	8.75	Screen		PVC Sch. 4	0		2	м	lilled Stots	0.030	Ľ.	1.0			cement	
53	57.5	8.75	Blank		PVC Sch. 4	0		2	1			18	20	Fine San	d	Transition	
				_								20	57.5	Filter Pac	ĸ	SRI #8 Gravel	
				_													
		Attac	hmente		1 72-11			H		C	ertificati	on Stat	ement		1		
	Geologic	Log				I, the un	ndersigned	l, certify th	nat	this report	is complet	e and ac	curate to	o the best	of my	knowledge and belief	
	Vell Con	structio	n Diagram		9	ivame .	Person, F	firm or Corpo	oratio	on'	mag	0	a a		_		
	seupriys	or Chen	y(s) Nicel Anelw	-		220	N Ear	4 the	2	/	<u> </u>	Bed	and	<u><u> </u></u>	<u>A</u> _	75776	
	Other					Signed		1	1		/	City	(/1	lif Sta	9N	895	
Itach addit	ional inform	ation, if it	exists.				C-57 (100	insed Water	Well	Contractor			Date Sig	ned C-	57 Lic	ense Number	

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED USE NEXT CONSECUTIVELY NUMBERED FORM

*The free /	Adobe Re	ader ma	y be used to view	v and complete th	is form. However,	software mi	ist be purchase	ed to comple	ete, save, a	and reuse	a saved fo	nn.	
File Origi	nai with I	OWR			St	tate of Calif	ornia	Γ	10.121	DW	R Use Onl	y – Do I	Not Fill In
Page 1		of	2		Well Co	mpleti	on Repo	rt		1	1 1	1	
Owner's \	Nell Nun	nber S	C MW-3		Refer No	r to Instruction	Pemphlet 19	. 1		Stat	e Well Nun	nber/Sit	e Number
Date Wor	k Began	09/23	/2013	Date W	ork Ended 9/25	5/2013			L	atitude	1	L	Longitude
Local Per	mit Ager	ncy Co	unty of Sacra	amento	·····						1		
Permit Nı	umber 5	3183		Permit Date	9/20/13			L			APN/1	RS/Oth	er
	* - 3	50.4	Geol	ogic Log		1				Well	Owner		
Orie	ntation	⊙ Ve	rtical O Ho	orizontal C	Angle Speci	fy	Name C	ity of Elk	Grove				
Denth	from Su	rface	em Auger	Descri	ntion	distant of the second	Mailing A	ddress _	3401 Lac	juna Pa	alms Wa	٧	
Feel	to Fi	inaco iet	De	scribe material, gr	ain size, color, etc		City Elk	Grove	_	_	Stat	e CA	Zip95758
0	10		Silty Clay-rec	ldish brown, n	nedium plastic	w/ fine	Sincesia.			Well L	ocation		
	-		sand, dry				Address	Mountai	n Bell D	rive (St	rawberry	Cree	k Detention Basin)
10	15		Sandy Claye	y Silt- tan mot	tied yellowish	brown,	City Elk	Grove		121-1122	Cou	inty St	acramento
45	- 10		medium plas	tic, very tine, o	ary, damp at 1	3	Latitude	Den	Min	Sac. 1	N Longitu	de	W Sec
15	18	- des	Sandy Claye	y Silt- redaisn	prown, meaiu	m plastic,	Datum	Ded.	Dec. Lat.	240.	12 24	Dec. I	Lona.
10	100		Very line, dar	np Nov. coddish k	rown modium	a plantia	APN Bo	ok 115	Page	0150	1	Parce	036
10	- 22		very fine day	nay-requisit i	nown, meaium	i plastic,	Townshi	0	Range		Harris	Sectio	on
22	23		Sandy Silt- ta	an very fine o	lamn		188 200	Locat	ion Ske	tch			Activity
23	24		Silty Sand- v	erv fine to fine	reddish brow	/n.	(Sketch r	nust be drawn	by hand aft	er torm is p	printed.)	() N	ew Well
20			abundant mi	ca, damp	,		-		North	- Carton		OM	odification/Repair
24	25		Sandy Clave	v Silt- tan,med	. plastic, very	fine,damp						2	Other
25	27		no sample	£			11				-	OD	estroy
27	28		Sand- tan, ve	ery fine to fine	, dry							ur	nder "GEOLOGIC LOG"
28	33		Sandy Silt- ta	an, very fine, o	lamp							0.11	Planned Uses
33	38		Sandy Silt- ta	an mottled red	dish brown, ve	ery fine to						O W	ater Supply
			fine, damp			Ni	st				ast		Irrigation Industrial
38	45		Sand- light b	rn,very fine to	medium, dam	p to mois	3				μ	00	athodic Protection
45	46		Sandy Claye	y Silt- reddish	brown, mediu	im plastic,	-11					Õ D	ewatering
	_		very fine, dar	np								Oн	eat Exchange
46	48		Silty Sand- re	addish brown,	very fine to m	edium	-11						jection
40	50		W/ streaks of	clay, damp	منام ما م مر الم	unas fina						0 R	emediation
48	52		Sandy Silly C	Jay- brown, n	realum plastic	, very me	۹I					Ōs	parging
52	62		Sand- brown	very fine to m	edium moist	wet at 58			South			OT	est Well
62	64		Silty Sand- li	abt brown ve	v fine to medi	um wet	Illustrate or de	ssoribe distance	of wall from ro	ada, buildinge	, fancas,	O V	apor Extraction
64	65	_	Sand- brown	fine to coars	e wet	un, not	Please be ac	d allach a map. curate and com	ose additional plote.	paper il neo	assary.	00	ner
65	67		Sandy Silty (	Clav- tan mottl	ed reddish brr	n.medium	Water L	evel and	I Yield o	f Com	oleted W	/ell	
			plastic, fine,	moist to wet			Depth to	first water	r <u>.58</u>			_ (Fee	et below surface)
67	68		Silty Sand- li	ght brn., very	fine to fine, mo	oist to wet	Water L	evel	110000000000000	(Fee	t) Date	Measu	ured
Total D	epth of E	ioring	120	s ski s	Feet		Estimate	ed Yield *		(GPI	M) Test	Туре _	
Totel D	enth of C	omplet	ed Well 120	28 <sup>73</sup>	Feet		Test Ler	ngth		(Hou	irs) Total	Drawo	down (Feet)
TOUTE	opurore	Cimpion					*May no	t be repres	sentative	of a wel	I's long te	rm yie	ld.
		-		Casin	gs	Outside	Sector Soft	Clat Clas	ALC: NO		Annul	ar Ma	terial
Sur Feet t	face • Feet	Diame (Inche	ter Type (s)	Materia	Thicknes (Inches)	a Diameter (Inches)	Туре	If Any (Inches)	Sur Feet	face to Feet	Fil	1	Description
0	105	8.75	Blank	PVC Sch. 40		2		-	0	100	Cement		10.3 Sack sand/
105	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030	100	102	Eine Son	4	Transition
115	120	0.75	Diank	PVC Sch. 40		12			100	120	Filter Pac	u :k	SRI #8 Gravel
	- Ar 2000	7	1.12										
			14.654										
1	and a spec	Attac	hments		anter a several			Certificat	ion Stat	ement			
	Geologic	Log		1	the undersigne	d. certify th	at this report	is comple	te and ac	curate t	o the best	t of my	knowledge and belief
	Well Con	structio	n Diagram	M	lame <u>VUNE</u>	Firm or Corpe	vv (III V)	1		1			0,000
	Geophys	ical Lo	g(s)		120 N	J. Eas	st St.	- 77	ODDIC	ind,	<u> </u>	<u>A</u>	73110
	ooii/vvate Other	er oner	nical Analysés	s	Signed	Autress			City	ula	13 3	70	6899
Attach add	itional inform	nation, If I	t exists.		C-57 LI	censed Water	Well Contractor			Dale Si	gned C	-57 Lio	cense Number

DWR 188 REV. 1/2008

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

*The free A	dobe Reader	may be used to view and complete	this form. However, software mus	t be purchased to com	plete, save, and reuse a saved	form.
File Origina	al with DWF		State of Califo	rnia Deuteurt	DWR Use O	1ly – Do Not Fill In
Page 2	of	2		n keport		
Owner's W	/ell Number	SC MW-3	No. e0190749	)		mber/Site Number
Date Work	Began 09/	23/2013 Date	Work Ended 9/25/2013		Latitude	Longitude
Permit Nur	mber <u>5318</u>	B Permit Da	ate 9/20/13		APN/	TRS/Other
		Geologic Log		1. S. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	Well Owner	
Orien	tation	Vertical O Horizontal	OAngle Specify	Name City of E	k Grove	
Drilling M	ethod Hollow	Stem Auger	Drilling Fluid	Mailing Address	8401 Laguna Palms W	av
Depth f	rom Surfac	e Describe material	cription	City Elk Grove	St	ate CA zip 95758
68	78	Sandy Clavey Silt- tan m	offled reddish brown	0.07	Well Locatio	n
		medium plastic, very fine	e, moist	Address Mount	ain Bell Drive (Strawber	v Creek Detention Basin)
78	80	Sandy Clayey Silt- light I	prown mottled reddish	City Elk Grove	Co	unty Sacramento
		brown, medium plastic,	/ery fine, moist	Latitude	Nionait	ude W
80	82	Sandy Clayey Silt- reddi	sh brown, medium plastic,	Deq.	Min. Sec	Dea. Min. Sec.
		very fine, moist		Datum	Dec. Lat.	Dec. Long.
82	84	Sandy Silt- reddish brow	n, very fine to fine, moist	APN Book 115	Page 0150	_ Parcel 036
84	86	Sandy Clayey Silt- reddi	sh brown, medium plastic,	Township	Range	Section
		very fine, moist		Loca	ation Sketch	Activity
86	90	Silty Clay- light brown, n	nedium plastic, moist	(energi india perdia	North	Modification/Repair
90	92	Sandy Silt- tan, very fine	to fine, damp	27852		O Deepen
92	96	Silty Clay- brown mottled	d reddish brown, medium			O Other
		plastic, moist, wet at 94'				Describe procedures and materials
96	105	Clayey Silt- tan mottled	ight brn., med. plastic,wet			Planned Uses
105	106	Silty Sand- reddish brn.,	very fine to medium, wet			O Water Supply
100	1107	Sandy Clay- tan, med. p	lastic, very line to line, wet			Domestic Public
107		madium wot	sulum plastic, very life to	New York	East Last	Irrigation Industrial
110	112	Silty Sand, reddich brow	in very fine to medium			O Cathodic Protection
110		sandy silt 111 7 to 112	wet			O Dewatering
112	116	Silty Sand- reddish brn	very fine to medium, wet			O Injection
116	120	Sandy Silt- tan mottled r	eddish brown, very fine.	1		Monitoring
		moist to wet				O Remediation
			5 <sub>50</sub> 8			O Sparging
					South	O Test Well
			1 I S. A	Illustrate or describe distan	ce of well from roads, buildings, fances, p. Use additional paper if necessary.	O Other
				Please be accurate and o	omplete.	
				water Level ar	a riela or completed	/Veil
		1/*		Depth to first wat Depth to Static	ier <u>28</u>	(Feet below surface)
		An and a second se		Water Level	(Feet) Date	Measured
Total De	pth of Borin	120	Feet	Estimated Yield	* (GPM) Test	Туре
Total De	pth of Comp	leted Well 120	Feet	Test Length	(Hours) Tota	I Drawdown (Feet)
menterner	112. No. 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1			May not be repr	esentative of a well's long t	lar Matarial
Depth	from Bor	ehole	Wall Outside	Screen Slot Siz	Depth from	iai materiai
Surfa	ice Dia	meter Type Mate	rial Thickness Diameter	Type If Any	Surface F	ili Description
Feet to	reet (in	cnes)	(incres) (incres)	(incres	) reet to reet	
		A A A				
		R				
		6				
		19. E				
Series and a	Att	achments		Certifica	ation Statement	
	eologic Log	New Disease	Name VOWCOVC	t this report is comp	lete and accurate to the be	st of my knowledge and belief
	ennhysicel	ction Diagram	27 Person, Firm or Corpora	tot cl	Indianal	05776
	oll/Water Cl	nemical Analyses	Address		City City	State Zip
	ther		Signed		1/5/13	906889
Attach additi	onal information	, if it exists.	C-97 Licensed Water W	eii Contractor	Dáte Signed	C-57 License Number

DWR 186 REV. 1/2008

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

*The free	Adobe Re	ader ma	ay be used to view	and complete	ihis form. Ho	wever, s	oftware mu	ist be purchase	ed to comple	te, save, i	and reuse	a saved for	rm.	
File Origi	nal with [	OWR			14/-1	Sta	te of Calif	ornia Domo	-	THE ST	DW	R Use Only	- Do I	Not Fill In
Page 1		of	1		wei	Refer to	npietion	on kepo	πĮ				1	
Owner's	Well Nun	1ber 5	SC MW-4	Date \		No.	e019074	<b>19</b>			Latitude			
Local Pe	rmit Ager	ICV CC	ounty of Sacrar	nento	VOIN ENGO	0.000	2010			1		1	Lat	
Permit N	umber 5	3184		Permit Dat	e 9/20/13	;						APN/TF	RS/Oth	or
7.2 WENCE			Geolo	aic Loa	a la traverse	11.12	-				Well	Owner		
Orie	entation	OVe	ertical O Hor	izontal	OAngle	Specify		Name C	ity of Elk	Grove				
Drilling	Method H	ollow S	tem Auger		<b>Drilling</b> Fluid	1	-	Mailino A	ddress 8	401 La	ouna Pa	alms Way	ē	
Depth	from Su	rface	Dee	Desc	ription	lar ola		City Elk	Grove			State	CA	Zip 95758
C Heet	5	901	Silty Clay- red	dieb brown	medium	nlastic :	w/ fine		de altre de la composition de	90 - E	Wall	ocation		
<u> </u>			sand moist		moulain		the three	Address	Mountair	Bell	rive (St	rowberry	Cree	k Detention Basin)
5	9		Sandy Silt- ve	llowish brow	vn. verv fi	ne to fi	ne mois	CIN Fik	Grove	T DOIL D	1110101	Cou	atu Si	acremento
9	18		Sandy Silty C	av- tan mot	tled light b	prown.	medium		GIUVO				ity	10/
-			plastic, very fi	ne, moist	g.				Deq.	Min.	Sec.	a Longitut		ea. Min. 'Sec.
18	19		Sandy Silt- ta	n, verv fine	to fine, mo	oist		Datum_	I	Dec. Lat		است	Dec.	Long
19	21		Silty Sand- br	own, very fi	ne to fine.	mica, I	moist	APN Boo	ok <u>115</u>	Page	0150		Parce	036
21	23		Sandy Silt- ta	n mottled lig	ht brown,	very fil	ne, mois	Townshi	p	Range	9	hand the	Secti	on
23	24		Sand-brown,	very fine to	medium,	moist		and the second	Locati	on Ske	tch		1	Activity
24	27		Silty Clay- tan	, medium p	lastic, mol	st		(Sketch r	nust be drawn	by hand at North	ter form is p	(.bafnha	O N	ew Well
27	33		Sandy Silt- ta	n, very fine,	moist			1		(torat			OM	Deepen
33	39		Sand- brown,	very fine to	medium,	moist							5	Other
39	40		Sandy Silt- br	own, very fi	ne, moist							- I	OD	estroy rescribe procedures and materials
40	41		Silty Clay- bro	wn, mediur	n plastic, i	moist						- Park	U	nder "GÉOLOGIC LOG"
41	45		Sandy Silty C	lay- brn., m	ed. plastic	, very f	ïne,mois	t				ŀ	0.11	Planned Uses
45	48		Sandy Clayey	Silt- tan m	ottled light	brown	, mediun	n					O M	ater Supply
			plastic, moist				b	X				ast	H	Irrigation Industrial
48	51		Sand- brn., ve	ary fine to m	edium, m	oist, we	et at 49'	Ň				ш	00	athodic Protection
51	54		Silty Sand- br	n., very fine	to fine, m	lica,mo	ist to we	t					ÕĎ	ewatering
54	61	-	Sandy Clayey	Silt- tan m	ottled light	brn., n	nedium			10 <sup>10</sup>		- 1	Õн	eat Exchange
			plastic, very fi	ne, moist	No.								Q Ir	jection
61	63		Silty Clay- bro	wn mottled	reddish b	rown, r	medium						<b>⊙</b> M	lonitoring
		_	plastic, moist					10					OR	emediation
63	67		Sandy Clayey	/ Silt- light b	rn., med.	plastic,	moist						ÕT	est Well
67	81		Sandy Clayey	Silt- reddis	h brown,	mediun	n plastic	-		South	Donker with which		Ōv	apor Extraction
			very fine, wet	ц£ <sup>7</sup>	201			filustrate or d rivers, etc. an	escribe distance o id attach e map.	Use addition	al poper if nec	essary.	00	other
81	85		Sandy Clayey	/ Silt- tan, n	ned. plasti	c, very	fine, we	Water	evel and	Vield	ofCom	pleted W	lla	in the state of the second second
85	91		Sandy Clayey	/ Silt- tan,m	ed. plastic	,very fi	ne, mois	Denth to	first water	49	on oonn	pictou ii	(Fer	et below surface)
91	115		Sandy Clayey	/ Silt- tan m	ottled yell	owish b	orn., med	Depth to	Static				_ (, 0,	
		4	plastic, fine, r	noist to wet	No samp	les 11	5-120'	Water L	evel		(Fee	et) Date	Measu	ured
Total D	Depth of E	Boring	120		20	Feet		Estimate	ed Yield *		(GP	M) Testi ) Tetal	Гуре	
Total D	Depth of C	Comple	ted Well 120	<u>1</u>	10 may	Feet		1 est Lei	ngin	ontative		urs) iotai I's long tei	Drawo m vie	down(reet)
-	100		training and the second	-	13	11111111	- Lines	Way no	n be lepies	I	or a we	Appul	In Ma	torial
Dept	h from	Borel	hole Type	Mater	ial TH	Wall	Outside	Screen	Slot Size	Dept	th from	FIL	21 .1410	Description
Feet	to Feet	(Inch	ies)		(	Inches)	(Inches)	Type	(Inches)	Feet	to Feet			
0	100	8.75	Blank	PVC Sch. 40			2			0	95	Coment		10.3 Sack sand/
100	115	8.75	Screen	PVC Sch. 40	)		2	Milled Slots	0.030		07	E. Du		Cement
115	120	8.75	Blank	PVC Sch. 40			2			95	9/	Fine San	а 	SPI #9 Group
		-	1				11			191	120	Filler Pac	-N	GRI #0 Glavel
		-	N											
		1		Canal Concerning of the	L.			1				-	Solles	
2		Atta	chments	1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	L the und	mianos	oodify th	hat this repor	Certificat	to and a	rement	o the heel	of m	knowledge and belief
	Geologic	CLOğ	Ion Diegram		Name	rene	COV	e Dril	lin a				or my	
	Geophy	sicel L	on Diagram		771	Person, I	Firm or Corp	-CANE (	St. 1.	Jm	lan	d c	A	95776
6	Soil/Wat	er Che	mical Analyses			1	Address			Cit	v /	T SU	ate	Zip
	Other _				Signed	1.20	ansod Water	Wall Contractor			11/5	713	5711	Sere Number
Attach ad	ditional infor	mation, i	f it exists.		6	A Bruch	anaou water	Frei Contractor			Date S	igned C	-97 LI	CONSE INUMORI

DWR 188 REV. 1/2008

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Owner's	Copy					v	VEI	LL (	COMP.	LETI	ORN	REP	ORT				I		
Page 1	_of	600	-	x					Refer to In No	struction	Pam	287			s l l	TATE W	ELL NO.	I I	IIII
Date Wo	rk Began	10-	1-	12	-	, Er	nded .	10-	22-1	4	90	LUT	- 99		ATITUDE			LO	NGITUDE
Local	Permit Ag	ency 4	20	27	ing.	0	F 4	incl	ZALA	=413	6	E.t.A	P		1	1		11	
Peri	nit No. 🚅	548	24	T			P	ermit	Date	-30	-	14	·>		my r		D	JINEN	
		-	GE	JLU	GIC		)G -		unal c	(0050100	N	a Diani	No 1	St 1	TELL C	JWNE	12-1	1	
ORIENTA	110N (오)	DRILLING	G S	20	10-3	IOHIZO	UNTAL		ANGLE	(SPECIPY)	M	ailing Add	ress	100	12	22.4.5	TAS	224	HIS WALA
DEPTI	H FROM		-#	بالمعاد		DES	CRIPT	TION			2	J.S. C	TEE	Lin	>'	6	An		95758
Ft,	to Ft.		Desci	ribe	mat	erial	l, gra	in stze	, calor, etc	2	Cit	497	12.1.1		ELL LO	CATIC	)N	SIA	TE ZIP
0	15	MIT	41	1.1	~	r.	1 20.5	7514	IL BR	all same	AC	Idress	PD -	NOTICE	211	100	ile VI	Libe	4 L
5	17	Sput	24	621	LA	F	14.2	E Rea	CHANG	Regar	G	ounty	alter.	E E da	- C	TO	6-m 10	-0	N TEL
7	11	SILT	41	1-6	5-1	-1-	Lit	TH	Brau	NO.	AI	N Book	113	Page 📿	150	Parcel	123	<u>(</u> ~=	0000
11	14	404-00	44	11-	TY	in	=1	1-16	HTRE	MH	To	ownship 🤟	<u>.                                    </u>	Range _	1.11	Sectio	n		
14.	10	1511	Æ	6-6-	15	T	-	PX-	X		La	DEG.	MIN.	SEC.	<u>N</u>	Long.	DE	<b>G</b> .	MIN. SEC.
20	27-	15 hours	D	E	5	2.7	di	1200	Lord Bi	2044			LOCAT	ION SKE NORTH -	тсн			-AC	TIVITY (2)
22	123	SILT	YZ	1	5	13	T	5+	1			1.4						MODIF	ICATION/REPAIR
23	29	12bm	1Z	14	11-	54	7.2	Tim		200 1 1	-	1 1							Deepen . Other (Specify
29	120	- Anto	P	+F	14	12==	FZ-T	Thet	AUTAL P	SKELALY	9	1 8	-10	> 1					
36	AS	11 hurs	2	21	Y/	I.	241	220	DKALE	Bi Lun \		2.2			1			0	ESTROY (Describe rocedures and Mate
182	1.161	UT.	1.		1.							R 4 8			4			USES	(⊻)
		1	- 5	12	1	-						P.C.						WATER	I SUPPLY
	<u> </u>		-	_						-	ST	1 1		1.6	1		ta l	1/	rigallon Indu
1.1						-					M	93 M		0			ă		MONITORING
	1	1				-						11 x 11		<u> </u>				CATHO	DIC PROTECTION
	1	1					100				100	64865	Free		1		12.1		HEAT EXCHANGE
in the		1	-					-		-	$V_{E}$	more a	a la a por		1				INJECTION
	1					-				-		4	inera a	APEC	TS ME	PT 60	ins	VAF	SPARGING
	1	1					-		12		111	ustrate or Des	cribe Dist	SOUTH -	from Roe	uls Build	ines.		REMEDIATION
	1	1								1281	Fe	mces, Rivers, e cessory. PLE/	te and att	ach a map. CCURATE	Use addit & COMI	ional pap PLETE.	erif	FEL	OTHER (SPECIFY)
	<u> </u>	<u>j</u>							m		-	W	TER L	EVEL &	YIELD	OF C	OMPL	ETED	WELL
					-					100	D	EPTH TO FIF	ST WATE	R	(Ft.) B	ELOW S	URFACE	0	
1.12	ł	1									D	EPTH OF ST	ATIC	<			IBED		
	1	1	_								E	STIMATED YI	ELD *		(GPM) &	TEST T	PE	. å.,	
TOTAL E	DEPTH OF	BORING	4	5	()	Feet)	-				TI	EST LENGTH		(Hrs.) TOT	AL DRAV	VDOWN_	1.124	(FL)	
TOTAL L	DEPTH OF	COMPLET	ED	NEL	<u>ــــــــــــــــــــــــــــــــــــ</u>	T	0	(Feet)			L."	May not be	represent	atrue of a	well's lo	ng-term	yield.		all seattle
DE	PTH	BORE-	-					C	ASING (S	)			1.	DEPT	H	-	ANN	ULAR	MATERIAL
FHOM S	SUHFACE	HOLE DIA.	E	PE (	(上)	-	MATER	HAL /	INTERNAL	GAUG	E	SLOT SIZ	E	HOM SU	HFACE	CE-	BEN-		
. FL	to Ft.	(Inches)	BLAN	SCREE	DUCIT		GRA	DE	DIAMETER (Inches)	OR WA	ESS	IF ANY (Inches)		Ft. to	FL.	MENT	TONITE	FILL	(TYPE/SIZE)
t	17	44	V			FO	LEIPH	CIYL	30	314 44	4-			01	2	-	1-1		C SACK
	1					1				FIFE	200			1					
7	:40	+4		M	-	6' 52	- al	1-11-1	35	D'LLA	E.C.	THE P		2 1	45	-		5	16 470
			++	-+-	-	-	-			P. P.								-	
			+-+	-		-	-		-					i			1.000		
	- ATTAC	HMENTS	(三)		1	1	-					CERTI	FICATIO	N STAT	EMENT		-		
21	Geologi	c Log					I, t	he und	ersigned, c	ertify that	this r	eport is cor	nplete ar	id accurat	e to the	best of	r my kr	belwor	ge and belief.
	Well Co	onstruction D	lagran	n			NA		ON, FIRM, OR	CORPORATION	TYP	PED OR PRINTED	))	-	-		-		1
-		(a)noi i noi(e)				1.1		1.40/2010	and the second second second	Λ	Calif								and the state of t
	Geophy	and Log(a)					110	2511	A In	and the real	8 6	at in	N. 172	halds	4-1-5-2	044	al.	1	10.6.76
-	Geophy Soil/Wa Other	ter Chemica	I Anat	yses			ADDI	RESS	ALCO ST	19	5	54, 10	SUZ	AHAS	CITY	214	2	STATE	ZIP

Date W Local Per	's Well No /ork Began I Permit Ag rmit No. $\leq$	517 10-6 548A	GEO			, Ender	l 10-		4.	5288	₽ ₽			N/TRS/C		
ORIENT	ration (또)	VE	RTICAL		+	ORIZONTA	L	NGLE	(SPECIFY)	Name	LOF.	File.	AR	2	E	
DEP	TH FROM	METHOD	-	-		DESCRI	FL	UID		Mailing Addre	ss EAC	1124	Chic	S.F.S	ATA	Smart
FL.	INFACE	1 1	Descr	ibe	mat	erial, gr	ain size,	, color, etc	9.	CITY	-C-TAT	-WELL LO	CATIO		STA	TE ZIP
_	-	ļ	1						2.0	Address 102	Stine	- WELL LU		14.22	+	
0	15	SUT	- 14	4	100	172	175	1. 50,000	have '	City	6357-	ALXE.			-	- Partie
5	113	KANE	24	4	HT,	16.73	17171	AL ER	Jus-	County 2	A Dama	tide to	Dama	2		
12	1.1	1000		C.C.	- 1	Int	Shall G	A rank		Township	Range	re	Sectio	n	-1-	
17	119	BUT	in	L	1.1		CTT-	Tubo	77-	Lat		N	Long		- 1	
		1-des	Su	24	-	, BI	Zaly			DEG.	MIN. E	SKETCH		DEC	а. — АС	MIN, SEC. CTIVITY (스)
19	125	1200431	Pr	13	er.	444	TE TE		und	(	NORT	н ———				NEW WELL
25	120	1461	T	À	R	and a	141	F.L.F		1					MODIF	Deepen
1000	int	117124	1	2	1	P-M	1		100	1 60	e g					Other (Specify
29	130	1 desana	-		117	rel	14.7	(SOTOR)	Grow	5		1				DESTROY (Describe
30	31	ALL	国	1	6.64	man	, triy	ETO		~ \		1			F L	Procedures and Mate Inder "GEOLOGIC L
	+	100 A	212	k-	iay	Bill 1	RETAR	ALL BA	CALL S	4 1		19			USES	S( <u>∠</u> )
31	133	Chart	4	54	F	140	Y REF	DRISILE	the sug-	911		12			[	Domestic Publ
24	120	ALTS	141		7	Like	HT I	5 C + 6	* 2	EST ST		r /		AST	"	MONITORING
35	136	YALTH	T	14	57	HOT !!	10 LLT	THUEA	111-5	A GAN		L	-	a		TEST WELL .
35 36 HETYELDY, 114							Sec. 141			122	1		1	- 1	CATHO	DIC PROTECTION
36	137	Shar	444	44		1 614	and the second second	With the	chell -	20	-	1.1.2.0	2			UEAT EVOLANOE
36	37	SHOW	45	44	34	1116	14-	WITH D	to the second	10	1000	5 Leb	21			HEAT EXCHANGE
36736	37	Shar Shar Las	75	4	3	1116		ATTORNO	Le Le	30 8. au	KANON	~ 440	21			HEAT EXCHANGE DIRECT PUSH . INJECTION .
36730	37	Shar Shar La De	76	44	173+	1110		ACCE THE	Le Le	P au	E-A NOW	× 440	21		VAI	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING
36700	37 36 45	500 00; 51:27 12:00 12:00 12:00	44 7 4 7 4	4	144	1110 1110 6-5			bere -	P =	SOUT	H Well from Box	ads. Build	lines.	VAR	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION
36738	37 38 45	54.05 54.75 12.65 5.77	75		1244	(1116) (1116) (200)		100000 1000000 10000000000000000000000	bere -	B B Illustrate or Descri Fonces, Rivers, etc. necessary, PLEASU	SOUT	H Well from Roc map. Use addit ATE & COMI	ads, Build tonal pap PLETE.	lings, ær if	VAI	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY)
367-36	37 36 45		14 14 1		1244	(11.10			bere -	Bustrate or Descriptions, Rivers, etc. necessary. PLEASE	SOUT be Distance of and attach a E BE ACCUR ER LEVEI	H Well from Roc map. Use addit ATE & COMI	ods, Build tonal pap PLETE. OF CO	lings, ær if OMPLI	VAR	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL
36758	37 36 45		7.6			(1116) (1116) (2)			beeke	Illustrate or Descri Fonces, Ricers, etc. necessary. PLEASI WAT DEPTH TO FIRST	SOUT be Distance of and ottach a BE ACCUR ER LEVEI WATER	H Well from Roc map. Use addit ATE & COMI - & YIELD 	ods, Build tonal pop PLETE. OF CO ELOW S	lings, ær if OMPLI		HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY)
36758	37 38 45		×45 7.6 1.5			( 1, 10 ( 1, 10 (				Illustrate or Descrit Fonces, Ricers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATI	SOUT be Distance of and attance of E BE ACCUR ER LEVEI WATER C	H Well from Roc map. Use addit ATE & COMI & YIELD 	ods, Build tonal pop PIETE. OF CO ELOW S	lings, ser if OMPLI URFACE	VAR	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY)
36736	37	5157 5157 14.55				( 1) 40 ( 1) 40 ( 1) 40 ( 1) 40				Hustrate or Description Fonces, Ricers, etc. necessary. PLEASE WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED VIEU	SOUT be Distance of and ottach of ER LEVEI WATERC	H Well from Roc map. Use addit ATE & COMI & YIELD (Ft.) B (Ft.) & DAT (GPM) A	nds, Build tonal pap PLETE. OF CO ELOW S E MEASU	lings, we if OMPLI URFACE JRED	VAR ETED	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL
36 37 36 36	137 36 45 DEPTH OF	BORING	Y S			( - , - e - , - , - e 				Illustrate or Descrit Fonces, Rivers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIELU TEST LENGTH	SOUT be Distance of and attach a BE ACCUR ER LEVEI WATERC C (Hrs.)	H Well from Roc map. Use addit ATE & COMI . & YIELD 	ods, Build tonal pop PLETE: OF CO ELOW S E MEASU TEST TO VOOWN_	lings, ær if OMPLI URFACE JRED YPE	VAF ETED	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL
TOTAL TOTAL	DEPTH OF	BORING	× (×	VEL		(	(Feet)			Illustrate or Description Fonces, Rivers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIELI TEST LENGTH * May not be rej	SOUT be Distance of and attach a BE ACCUR ER LEVEI WATERC (Hrs.) presentative	H Well from Roo map. Use addit ATE & COMI & YIELD (Ft.) & DAT (Ft.) & DAT (GPM) & TOTAL DRAV of a well's loss	ads, Build tonal pap TLETE. OF CO ELOW S E MEASU TEST TO VDOWN_ ng-term	lings per if OMPLI URFACE JRED YPE YpeL.	VAF ETED = 	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY)
TOTAL	DEPTH OF	BORING		VEL		(	(Feet)	CASING (S		Hustrate or Description Fonces, Ricers, etc. necessary: PLEASI WATE DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIELD TEST LENGTH* May not be rej	SOUT be Distance of and ottach o ER LEVEI WATERC C C C C C C C C C C C C C C C C	H Well from Roo may. Use addit ATE & COMI & YIELD 	ads, Build tonal pap TETE. OF CO ELOW S E MEASU TEST TO VDOWN_ mg-term	lings, ser if OMPLJ URFACE JRED YPE yield. ANNI	VAF ETED = 	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL WELL
TOTAL TOTAL	DEPTH OF DEPTH OF DEPTH OF SURFACE	BORING COMPLET		WEL		( 2, 2) ( 1, 1, 6) ( 2, 2) ( 2, 2	(Feet)	CASING (S		Illustrate or Description Fonces, Ricers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIEL TEST LENGTH * May not be rej	SOUT be Distance of and attach a BE ACCUR ER LEVEI WATERC (Hrs.) bresentative	H Well from Roc map. Use addit ATE & COMI . & YIELD 	ods, Build tonal pap PLETE. OF CO ELOW S E MEASU TEST TO VDOWN_ mg-term	lings, ser if OMPLI URFACE JRED YPE yield. ANNI	VAI ETED 	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL WELL
TOTAL TOTAL	DEPTH OF SURFACE	BORING COMPLET BORE- HOLE DIA. (Inches)		VEL PE IS		Feet)	(Feet) C ERIAL / BADE	CASING (S	) GAUGE OR WALE	Illustrate or Describ Fonces, Ricers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIELU TEST LENGTH * May not be re SLOT SIZE IF ANY	SOUT be Distance of and ottach o ER LEVEI WATERC C C C FROM Ft	H Well from Roo map. Use addit ATE & COMI . & YIELD 	ods, Build tonal pap PLETE. OF CO ELOW S E MEASU TEST TO VDOWN_ mg-term Mg-term	lings, xer if OMPLJ URFACE JRED YPE YPE yield. ANNI BEN- TONITE	VAI ETED (Ft.) Fill	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL WELL MATERIAL YPE FILTER PACI (TYPE/SIZE)
TOTAL TOTAL TOTAL FROM	DEPTH OF DEPTH OF DEPTH OF SURFACE	BORING COMPLET BORE- HOLE DIA. (Inches)	ED V	A COREN PE		Feet)	(Feet) C ERIAL / BADE	CASING (S INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNES	Hlustrate or Description Fonces, Ricers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATH WATER LEVEL ESTIMATED YIELI TEST LENGTH	SOUT be Distance of and attach a E BE ACCUR ER LEVEI WATERC C 	H Well from Roc map. Use addit ATE & COMI . & YIELD 	ods. Build tonal pap- PLETE. OF CO ELOW S E MEASU TEST TO VDOWN_ ng-term MENT (≤)	lings, ser if OMPLJ URFACE JRED YPE yield. ANNI BEN- TONITE (∠)	VAF ETED 	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL WELL MATERIAL YPE FILTER PACI (TYPE/SIZE)
TOTAL TOTAL TOTAL FROM	DEPTH OF DEPTH OF DEPTH OF DEPTH OF The sumpace	BORING COMPLET BORE- HOLE DIA. (Inches)	ED V	VEL PE		Feet)	(Feet) C ERIAL / PRC PY L	ASING (S INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNES	Illustrate or Description Fonces, Rivers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIELI TEST LENGTH * May not be rejust SLOT SIZE IF ANY (Inchere)	SOUT be Distance of and attach o BE ACCUR ER LEVEI WATERC C (Hrs.) bresentative FROM Ft.	H Well from Roc map. Use addit ATE & COMI . & YIELD 	ods, Build tonal pap PLETE. OF CO ELOW S E MEASU TEST TO VDOWN_ mg-term MENT ( $\leq$ )	lings, ser if OMPLJ URFACE JRED PE yield. ANNI BEN- TONITE ( $\leq$ )	VAI ETED 	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL WELL FILTER PACI (TYPE/SIZE)
TOTAL TOTAL FROM Ft.	DEPTH OF DEPTH OF DEPTH OF SURFACE	BORING COMPLET BORE- HOLE DIA. (Inches)	ED V	NEL PE		Feet)	(Feet) CC ERIAL / RADE	CASING (S INTERNAL DIAMETER (Inches)	) GAUGE OR WALL THICKNESS	Illustrate or Describ Fonces, Ricers, etc. necessary. PLEASE WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIELU TEST LENGTH * May not be re SS SLOT SIZE IF ANY (Inchere)	SOUT be Distance of and ottach o ER LEVEI WATERC C C C C C C C C C C C C C C C C	H Well from Roomany. Well from Roomany. Well from Roomany. Well from Roomany. Well from Roomany. Well from Roomany. (Ft.) & DAT (GPM) & TOTAL DRAW of a well's low OF PTH SURFACE to Ft. 	nds, Build tonal pap PIETE. OF CO ELOW S E MEASL TEST TO VDOWN_ mg-term CE- MENT (∠)	lings, xer if OMPLJ URFACE JRED YPE YPE YPE YPE YIEL ANNI BEN- TONITE ( $\leq$ )	VAI ETED 	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL WELL FILTER PAC (TYPE/SIZE)
TOTAL TOTAL TOTAL TOTAL	DEPTH OF DEPTH OF DEPTH OF DEPTH OF SURFACE	BORING COMPLET BORE- HOLE DIA. (Inches)		VEI SOBER P		Feet)	(Feet) CC ERIAL / PRC PY L PRC PY L	CASING (S INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNES	Hlustrate or Description Fonces, Ricers, etc. necessary: PLEASI WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED VIELI TEST LENGTH * May not be rej SLOT SIZE IF ANY (Inchere)	SOUT be Distance of and attach a E BE ACCUR ER LEVEI WATERC (Hrs.) bresentative FROM Ft.	H Well from Roc map. Use addit ATE & COMI . & YIELD 	ads. Build tonal pop PLETE. OF CO ELOW S E MEASL TEST TO VOOWN_ ng-term MENT (∠)	lings, ser if OMPLJ URFACE JRED rPE ryield. ANNI BEN- TONITE (∠)	VAF ETED = (Pl.) 	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL MATERIAL YPE FILTER PACI (TYPE/SIZE)
TOTAL TOTAL TOTAL FROM Ft.	DEPTH OF DEPTH OF DEPTH OF DEPTH OF SURFACE	BORING COMPLET BORE- HOLE DIA. (Inches)	ED V	A SCHEEN PE		Feet)	(Feet) C ERIAL / PRC PY L FILL ?	ASING (S INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNES	Illustrate or Descriptions Fonces, Rivers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIELI TEST LENGTH	SOUT be Distance of and attach o BE ACCUR ER LEVEI WATERC C (Hrs.) bresentative FROM Ft.	H- Well from Roc map. Use addit ATE & COMI . & YIELD 	ods, Build tonal pap PLETE. OF CO ELOW S E MEASU TEST TO VDOWN_ mg-term MENT (∠)	lings, ser if OMPLJ URFACE JRED PE Pyield. ANNI BEN- TONITE ( $\leq$ )	VAI ETED 	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL MATERIAL YPE FILTER PAC: (TYPE/SIZE)
TOTAL TOTAL FROM Ft.	DEPTH OF DEPTH OF DEPTH OF DEPTH OF	BORING COMPLET BORE- HOLE DIA. (Inches)	ED V	VEL PE		Feet)	_(Feet) (Feet) CC ERIAL / BADE	CASING (S INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	Hlustrate or Describ Fonces, Ricers, etc. necessary: PLEASE WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIEL TEST LENGTH * May not be re SS SLOT SIZE IF ANY (Inchem)	SOUT De Distance of and attach a ER LEVEI WATERC C (Hrs.) bresentative FROM Ft. EL EL EL EL EL EL EL EL EL EL	H Well from Roc may, Use addit ATE & COMI & & YIELD (Ft.) & DAT (GPM) & TOTAL DRAW of a well's loss DEPTH SURFACE to Ft 	ads. Build tonal pap PIETE. OF CO ELOW S E MEASL TEST TO VDOWN_ mg-term (∠)	lings, xer if OMPLJ URFACE JRED YPE ANNI BEN- TONITE (∠)	VAI ETED 	HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL MATERIAL (PE FILTER PACI (TYPE/SIZE)
TOTAL TOTAL TOTAL	DEPTH OF DEPTH OF DEPTH OF SURFACE	BORE- HOLET DIA. (Inches)	ED V TY WWN	WEI PE			(Feet) C ERIAL / RADE PRC Py L PRC Py L	CASING (S INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNES	Hlustrate or Descriptions Fonces, Ricers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATH WATER LEVEL ESTIMATED YIEL TEST LENGTH * May not be rej SLOT SIZE IF ANY (Inches)	SOUT be Distance of and attach a E BE ACCUR ER LEVEI WATERC C C 	H Well from Roc map. Use addit ATE & COMI & & YIELD (Ft.) & DAT (GPM) & TOTAL DRAY of a well's loss DEPTH SURFACE to Ft. TATEMENTIC curate to the	ods. Build tonal pap- PLETE. OF CO ELOW S E MEASU TEST TO VDOWN_ mg-term (≤)	lings, ser if OMPLJ URFACE JRED (PE Pyield. ANNI BEN- TONITE (∠)		HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL MATERIAL YPE FILTER PAC (TYPE/SIZE)
TOTAL TOTAL TOTAL FROM	DEPTH OF DEPTH OF DEPTH OF DEPTH OF SURFACE	BORING COMPLET BORING COMPLET BORE- HOLE DIA. (Inches) CLOS		A SOBER A		Feet)	(Feet) CC ERIAL / PRC Py L PRC Py L PRC Py L	ASING (S INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNES	Illustrate or Descriptions Fonces, Rivers, etc. necessary. PLEASI WAT DEPTH TO FIRST DEPTH OF STATI WATER LEVEL ESTIMATED YIELI TEST LENGTH * May not be rej SS (Inches)	SOUT be Distance of and attach o BE ACCUR ER LEVEI WATER C  bresentative FROM Ft. E E CATION ST hete and acc	H Well from Roc map. Use addit ATE & COMI . & YIELD 	ods. Build tonal pop PLETE. OF CO ELOW S E MEASU TEST TO VOOWN_ mg-termin (∠)	lings, xer if OMPLJ URFACE JRED rPE ryield. ANNI BEN- TONITE (∠) f my kr		HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL MATERIAL FILTER PAC (TYPE/SIZE)
TOTAL TOTAL TOTAL	DEPTH OF DEPTH OF DEPTH OF DEPTH OF DEPTH OF CONTRACE	BORING COMPLET BORING COMPLET BORE- HOLE DIA. (Inches) HMENTS c Log mstruction D	ED V TYNNYB	VEL PE STORE		Feet)	(Feet) CC ERIAL / PRC PY L PRC PY L PRC PY L PRC PY L	ASING (S INTERNAL DIAMETER (Inches)	) GAUGE OR WALL THICKNESS	Hustrate or Descriptions of the second secon	SOUT be Distance of and attach a is BE ACCUR ER LEVEI WATERC C bresentative FROM Ft. E E CATION ST Note and accurate Notes and accurate Continent St	H- Well from Rooman. Use addit ATE & COMI . & YIELD 	ds, Build tonal pap PIETE. OF CO ELOW S E MEASL TEST TO VDOWN_ mg-term (∠) best o	lings, xer if OMPLJ URFACE JRED YPE YPE ANNI BEN- TONITE (∠) f my kr		HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL MATERIAL (TYPE/SIZE) FILTER PACI (TYPE/SIZE)
TOTAL TOTAL TOTAL	DEPTH OF DEPTH OF DEPTH OF DEPTH OF SURFACE	BORE- HOLET BORING COMPLET BORE- HOLE DIA. (Inches) AAA AAA AAA AAA AAA AAA AAA AAA AAA A	ED V TY XX B Iagram	WEL SOUCH			(Feet) C ERIAL / RADE PRC PY L PRC PY L PRC PY L PRC PY L	CASING (S INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNES BAUGH B	Hlustrate or Descriptions Fonces, Ricers, etc. necessary: PLEASE WAT DEPTH TO FIRST DEPTH OF STATH WATER LEVEL. ESTIMATED YIELD TEST LENGTH * May not be rej SLOT SIZE IF ANY (Inchera)	SOUT be Distance of and attach a E BE ACCUR ER LEVEI WATER	H Well from Roc map. Use addit ATE & COMP & & YIELD (Ft.) & DAT (GPM) & TOTAL DRAV of a well's loss DEPTH SURFACE to Ft 	ds. Build tonal pap PLETE. OF CO ELOW S E MEASU TEST TO VDOWN_ mg-term (≤)	lings, ser if OMPLJ URFACE JRED (PE TONITE (∠) f my kr		HEAT EXCHANGE DIRECT PUSH INJECTION POR EXTRACTION SPARGING REMEDIATION OTHER (SPECIFY) WELL MATERIAL (TYPE/SIZE)

## **Appendix 4.3**

# 90-Day Stormwater and Groundwater Summary Report – April 7, 2015

#### Separating Fact from Fiction: Assessing the Use of Dry Wells as an Integrated LID Tool for Reducing Stormwater Runoff While Protecting Groundwater in Urban Watersheds 12-424-550-0 Elk Grove Dry Well Project

#### 90-Day Stormwater and Groundwater Monitoring Summary Report April 7 and April 24, 2015 Rain Events

#### **Project Overview**

The purpose of the project is to determine whether dry wells, in concert with other low impact development (LID) practices, are a cost-effective way to infiltrate stormwater, alleviate localized flooding, and recharge the aquifer without adversely affecting groundwater quality. The project is located at two sites in Elk Grove, California: a stormwater quality basin located in a residential neighborhood (Strawberry Creek Water Quality Basin (SDB)) and a parking lot (Elk Grove Corporation Yard (CY).

At each site a monitoring well network and dry well pretreatment system was constructed. Water quality monitoring will be performed four times a year for two years. Stormwater samples will be collected from the dry well pretreatment system at two locations and post-rain event groundwater samples will be collected from all monitoring wells. Analytes will be measured such as volatile and semi-volatile organics, pesticides/herbicides, combustion by-products (polycyclic aromatic hydrocarbons, PAHs), metals, and conventional water quality parameters. In addition, flow rates will be measured and estimates of groundwater recharge capacity will be made. The risk of groundwater quality degradation associated with dry well use will be determined with various reporting mechanisms.

#### **Stormwater and Groundwater Overview**

This 90-Day Stormwater and Groundwater Monitoring Summary Report discuss two rain events that occurred on April 7 and April 24, 2015, and summarize the associated monitoring efforts. A location map of the groundwater monitoring well network at both sites is located in Appendix A to help better understand the narrative in the following monitoring overview.

#### Field Activities April 7, 2015 Rain Event: Strawberry Creek Water Quality Basin and City of Elk Grove Corporation Yard Monitoring

#### **Overview Infiltration Rate Monitoring**

A rain event, with total precipitation of just under 1 inch in 24-hours, occurred on April 7, 2015. Dry well infiltration rate monitoring was conducted at both the SDB and CY sites during the rain event. The purpose of the April 7<sup>th</sup> monitoring event was to measure and evaluate infiltration rates through the dry wells. The dry well infiltration rate monitoring consisted of multiple rounds of falling head

test measurements to assess infiltration rates at different depths within each dry well. The testing also included an evaluation of infiltration through the upper sand layer<sup>1</sup> within the dry well casing.

Falling head measurements were performed by observing water level declines over time after closing the gate valve located on the dry well inflow pipe. Falling head test data provided a means for calculating rates of infiltration and effective hydraulic conductivity for the subsurface materials receiving flow from the dry wells. Water level changes were measured by recording: 1) the time for water to recede a known depth interval at the top of the dry well and 2) the water level below the upper sand layer, using a water level sounder. When electric sounders were used, water levels were recorded at 30-second or 5-minute intervals.

The effective saturated hydraulic conductivity values calculated using falling head test data were compared with estimated values of subsurface materials at each dry well site. This calculation was made to evaluate observed dry well performance relative to anticipated performance.

#### Falling Head and Saturated Hydraulic Conductivity Measurements

Water level data recorded during the falling head trials provided information on the rate of infiltration at each dry well and the rate of flow through the dry well sand layer. Since dry well infiltration rates are head dependent, falling head test data were used to determine the effective saturated hydraulic conductivity of the subsurface materials receiving water from the dry well. Saturated hydraulic conductivity values were calculated using an empirical method developed by the U.S. Bureau of Reclamation for steady-state infiltration in boreholes completed in the unsaturated zone (USBR, 1990<sup>2</sup>). Table 1 presents the calculated saturated hydraulic conductivity values for each dry well.

Site	Ks (in/hr)
SBD	0.72
СҮ	0.55

#### Table 1. Mean calculated effective saturated hydraulic conductivity (Ks).

Falling head test data were also used to calculate rates of flow through the dry well sand layer in order to address concerns about whether the sand layer was restricting dry well performance. **Table 2** summarizes the observed flow rates, as measured by the rate of water level change, for water moving through the sand layer. The flow rate through the sand layer at the CY dry well was more

<sup>&</sup>lt;sup>1</sup> The "sand layer", the approximately 1-foot thick layer of sand placed near the top of the gravel within the dry well, was added to reduce potential clogging by retaining debris in an accessible location.

<sup>&</sup>lt;sup>2</sup> U.S Bureau of Reclamation, 1990, "Procedure for Performing Field Permeability Testing by the Well Permeameter Method (USBR 7300-89)", in Earth Manual, Part 2, A Water Resources Technical Publication, 3rd. Ed., Denver, CO.

than three times the flow rate of the sand layer of the SDB dry well. This result suggests that the SDB sand layer may have experienced some clogging.

Site	ft³/sec	gpm
SDB	0.05	24
СҮ	0.22	97

#### Table 2. Infiltration rates through the sand layer

#### Anticipated Saturated Hydraulic Conductivities and Infiltration Rates

In order to evaluate the falling head test data, comparisons were made between the falling head test data and anticipated saturated hydraulic conductivity values and infiltration rates for each dry well. **Table 3** summarizes the data for each dry well. Both sets of data were derived using the USBR (1990) method for evaluating steady-state infiltration in boreholes completed in the unsaturated zone. The anticipated saturated hydraulic conductivity values are based on interpretation of the drilling logs for the vadose zone monitoring well (MW2) boreholes at each site. Anticipated values for each lithologic unit were used to calculate an effective saturated hydraulic conductivity based on both horizontal groundwater flow in a layered system and vertical flow through the bottom of each dry well. Although the USBR method assumes steady-state conditions, which may not be fully realized at each site depending on the rain event and the duration on dry well inflow, it nevertheless provides a conservative estimate for infiltration rates relative to the range of possible initial conditions and infiltration events.

Site	Values Derived fro Falling Ho	m the April 7, 2015 ead Tests	Anticipated Values Based on Site- Specific Lithology				
Bitte	Ks (in/hr)	Infiltration Rate (gpm)	Ks (in/hr)	Infiltration Rate (gpm)			
SBD	0.723	11.77	1.72	28.05			
СҮ	0.545	14.78	0.770	20.88			

## Table 3. Comparison of infiltration rates and effective saturated hydraulic conductivities (Ks) derived from the April 7, 2015 falling head test and anticipated values.

The data suggests that the performance of the SDB dry well could be compromised due to clogging of the subsurface materials adjacent to the dry well. Further testing to address this possibility is described in the Issues and Recommendations section of this report. **Table 3** shows less difference between the values derived from the April 7th falling head test data and anticipated values at the CY dry well. While the relative difference between the two infiltration rates is less at the CY than at SDB, these results do indicate the need to ensure that pretreatment BMPs limit introduction of fine materials that could clog subsurface sediments adjacent to the dry well.

#### Confounding Effects of Apparent Clogging at Strawberry Creek Water Quality Basin Dry Well

As described in the previous 90-Day Stormwater and Groundwater Monitoring Summary, the sand layer at the SDB dry well was removed over the course of the infiltration testing. While initial observations indicated that rates of flow into the dry well increased, an air gap persisted between the water level at the top of the dry well and the water level lower in the dry well, as measured in the 4-inch stilling pipe. These head differences were confirmed both with manual measurements and a transducer data. Based on subsequent discussions among the project team and input from Jim Mayer of Torrent Resources, a consultant firm specializing in dry well design and installation, the data indicate that clogging is occurring within the dry well gravel pack below the sand layer at approximately 7 to 15 feet below ground surface.

#### Quality Assurance and Quality Control (QA/QC)

During the infiltration testing performed on April 7<sup>th</sup>, the gate valve, located in the inflow pipe connecting the sedimentation and dry wells, was not able to fully stop inflow to the dry well. The project team was able to manually plug the inflow pipe with sandbags to reduce the inflow for the purposes of the test. However, some error in measurements likely occurred. The City of Elk Grove has since cleaned and repaired the valve to ensure that it functions properly.

#### **Issues and Recommendations**

**Issue 1. Dry Well Infiltration Rates at Strawberry Creek Water Quality Basin Dry Well:** Having addressed the potential for restricted air displacement through installation of a stilling well vent and potential clogging of the upper sand layer through testing and temporary removal, the project team is developing an approach to resolve the apparent clogging within the dry well gravels. Data from the April 7th infiltration testing also suggest that the subsurface materials adjacent to the dry well may have clogged as well. While the latter cannot be directly mitigated, future clogging can be limited by ensuring effective pretreatment BMPs. The project team is also developing an approach to modify the pretreatment features at the SDB to improve its performance.

#### Conclusions

Infiltration testing performed on April 7, 2015 provided data on saturated hydraulic conductivity and infiltration rates at each dry well. When compared with anticipated values based on site-specific lithology, it appears that the SDB dry well may be impacted by some degree of clogging of subsurface materials adjacent to the dry well (**Table 3**). Data from April 7th also indicate that the upper sand layer at the CY dry well is not restricting inflow beyond the capacity of the subsurface to receive flow under steady-state conditions. Further, at the SDB the mean measured flow rate through the upper sand layer was 24 gpm, lower than the anticipated 28 gpm steady-state capacity of the subsurface. This indicates the existence of clogging or some impedance to flow within the upper portion of the gravels within the dry well casing. The project team is currently evaluating potential adaptive management efforts in response to these findings to address the clogging within the dry well casing.

#### Field Activities April 24, 2015 Rain Event: Strawberry Creek Water Quality Basin and City of Elk Grove Corporation Yard Monitoring

#### **Overview Stormwater and Groundwater Monitoring**

A rain event, with a total precipitation 0.82" in 24-hours, began on April 24, 2015. Stormwater and groundwater monitoring was conducted at the CY and stormwater monitoring was performed at SDB. The goal of the April 24<sup>th</sup> monitoring event was to capture stormwater runoff during the early phase of the rain event to optimize the chances of detecting any pollutants that might be present in the runoff.

Within one hour of the beginning of the rain event, stormwater began flowing into the sedimentation well and dry well at both sites. Grab samples for analysis of water quality were collected approximately 2 hours after the initiation of rain. Flow measurements and conventional water quality parameters were also measured during the rain event. Five days after the rain event, on April 29<sup>th</sup>, groundwater samples were collected.

Results from stormwater and groundwater monitoring at both sites indicated no detectable levels of most pollutants. Past stormwater monitoring events that were conducted involved flow-weighted composites collected over the course of the rain events where the concentration of contaminants in these samples was low or non-existent.

The attached pdf Portfolio contains a complete set of lab reports including chain of custody forms for stormwater and groundwater. The table below describes the file names and content of the pdf Portfolio, as follows:

File Name	Content (all files contain relevant chain of custody forms)
CLS GW combo	All contaminants and conventional parameters measured in the groundwater
4_24_15	by the California Laboratory Services (CLS). This includes volatiles, semi-
	volatiles, PAHs, herbicides, metals, and general physical/mineral parameters.
CLS SW combo	Same contaminants measured in groundwater by CLS, but using stormwater
4_24_15	samples.
WPCL GW pry	Analysis of pyrethroids in groundwater, performed by the Water Pollution
4_24_15	Control Lab (WPCL).
WPCL SW combo	Analysis of pyrethroids and total suspended solids in stormwater performed
4_24_15	by the WPCL.

#### **Highlights of Stormwater and Groundwater Monitoring**

At the SDB, bifrenthrin was detected at the stormwater outfall and sedimentation well at 2.2 and 5.0 ng/L respectively. Iron and manganese were detected at low levels in stormwater; no other metals were identified. Water collected at the sedimentation well had highly elevated concentrations of e.coli, fecal, and total coliform. Groundwater samples were not collected at SDB because the gate valve, which controls flow from the sedimentation well to the dry well, could not be fully opened, thereby restricting flow into the dry well. Since little stormwater infiltrated through the dry well, the project team determined that little new information would be obtained from analyzing groundwater for contaminants. However, analysis of contaminants during the early phase of the rain event would provide valuable data on stormwater quality.

At the CY, with one exception, there were no detections of any organic contaminants (e.g., volatiles, semi-volatiles, PAHs) in stormwater or groundwater. Bifenthrin was detected at 4.0 ng/L in runoff collected at the entrance to the vegetated swale. In contrast to organics, a number of metals were detected in stormwater and groundwater at levels that exceeded criteria values for taste and odor. Nitrates were detected above the MCL, at 64 ppm, in the upgradient water table well (MW1) at the CY. Lastly, very high levels of total and fecal coliform (>1600 MPN/100 ml) were detected in water entering the sedimentation well; none was detected in any of the subsurface water samples.

#### Pyrethroids

At the SDB, bifenthrin was the only pyrethroid detected on April 24<sup>th</sup>, in contrast to the February event, when deltamethrin and permethrin were measured at very low concentrations (2-4 ng/L) as indicated in **Table 4**. Pesticide concentrations in stormwater were lower in April 24th than in February, possibly due to the overall wash-off of contaminants over the course of the winter rains. Whereas in February, we observed a 30% decrease in bifenthrin concentration due to pretreatment BMPs, the same pattern was not observed on April 24<sup>th</sup>. This could be related to greater uncertainty regarding the exact concentration or the timing of the sample collection. Both vadose zone (MW2) and all water table well samples contained no detectable bifenthrin.

Date	Site	Stormwater prior to pre- treatment	Stormwater after pre- treatment	Vadose zone (MW2)	Downgradient water table (MW3 and 4)	Upgradient water table well (MW1)	MCL or advisory level
February 7, 2015	SDB	96.8	62.9	7.0	ND	ND	n/a
	СҮ	÷	æ.	1050	3 <b>8</b> 1	-	n/a
April 24, 2015	SDB	2.2	5.0	ND	ND	ND	n/a
-	СҮ	4.0	ND	ND	ND	ND	n/a

**Table 4.** Bifenthrin concentrations at the two study sites. All units are ng/L. ND = not detected; "-" = sample not collected; n/a = not applicable. No advisory levels exist for bifenthrin.

At the CY, only a single detection of any pyrethroid was identified in the stormwater and groundwater samples that were analyzed. Stormwater runoff entering the swale contained 4.0 ng/L bifenthrin.

#### Metals

At the SDB, only manganese and iron were detected at low levels (190 and 70  $\mu$ g/L respectively) in stormwater, and groundwater samples were not collected at this site.

At the CY, in contrast, numerous metals were detected in both stormwater and groundwater samples (**Table 5**). The metals detected were primarily those associated with organoleptic effects, such as iron and managanese. For example, iron exceeded secondary drinking water standards in both stormwater, one downgradient well (MW3) and the upgradient well (MW1). Insufficient data is available at this time to assess the relationship between iron in stormwater and its detection in groundwater. Of potentially more concern, chromium was detected in the upgradient well (MW1) at the CY. Hexavalent chromium was present at the MCL –  $10 \mu g/L$  – in water collected from this well. Similar to arsenic, chromium is naturally occurring in the region. Arsenic was also present at low levels, as observed previously at SDB.

Metal	Stormwater	Vadose Zone	Downgradient WT wells (MW 3 and 4)	Upgradient WT well (MW1)	MCL or advisory level
AI	ND	n/a	MW3: <b>1100</b> MW4: 150	1600	50 - 200
As	ND	n/a	MW3: 4.2 MW4: 4	3.6	10
Cr	ND	n/a	ND	Total: 12 Cr6: <b>10</b>	Cr6: 10
Fe	700	n/a	MW3: <b>1100</b> MW4: 130	1700	300
Mn	23	n/a	ND	37	50
Va	4.6	n/a	MW3: 25 MW4: 22	22	50

Table 5.	Summary of metals in stormwater and groun	dwater at the City of E	k Grove Corporation
Yard.			

The concentration of all metals analyzed in the stormwater and groundwater for the April 24<sup>th</sup> event are included in the pdf portfolio (CLS GW combo 4\_24\_15 and CLS SW combo 4\_24\_15).

#### **Total Coliform**

Total coliform was detected in the stormwater at both sites during the April 24th rain event. The levels, measured as most probable number/100 ml, were much higher than anticipated.

At the SDB, water entering the dry well had highly elevated levels of coliform, with value greater than **1600 MPN/100 ml** for fecal, E. coli, and total coliform. Groundwater samples were not collected at the SDB during this rain event.

At the CY, total and fecal coliform exceeded **1600 MPN/100 ml** in stormwater entering the dry well. Coliform in groundwater was below background values.

The MCL for coliform is not quantitative. The MCL was developed for qualitative testing: no more than 5% of samples taken in a month can be positive. The large number of bacteria observed at each of the sites cannot be directly compared to the MCL but reflects a problem nonetheless.

The source of the high level of coliform at the CY, which is surrounded by fencing, is 95% hardscape, and contains no trees in which birds might roost, is difficult to explain. To eliminate the possibility of accidental contamination during handling and processing of the sample, blanks will be submitted to the laboratories along with the actual sample for future monitoring events.

#### **Conventional Parameters: Total Suspended Solids and Nitrate**

At the SBD, the difference in the concentration of TSS at the stormwater outfall and the entrance to the dry well was approximately 60%, slightly higher than what was observed in February (**Table 6**). This data suggests that the vegetated pretreatment at SDB is playing an important role in keeping particles and the pollutants they carry out of the dry well.

Table 6. Nitrate and total suspended solid concentrations in the two study sites. Note:Groundwater samples were not collected at SDB. ND = non-detect. n/a = not applicable. " - " = noanalysis performed.

Constituent /	Site	Stormwater prior to pretreatment	Stormwater prior to entering dry well	Vadose zone (MW2)	Downgradient water table (MW3 & 4)	Upgradient water table well (MW1)	MCL or advisory level
NO₃ (mg/L)	СҮ	in .	ND	n/a	MW3: 18 MS4: 18	64	45
	SDB	ND		n/a	ND	ND	45
TSS (mg/L)	СҮ	28.7	25.5	9 <b>8</b> 3	0=1	-	n/a
	SDB	32.5	10.8	-	30 <b>#</b> 1	-	n/a

At the CY, in contrast, the data suggests that the swale and sedimentation well did little to reduce the concentration of suspended solids entering the dry well (**Table 6**). The swale and sedimentation well

combined reduced TSS concentration by approximately 10%, considerably less than at SDB. Additionally, at the CY, nitrate concentrations exceeded the MCL in the upgradient well (MW1). It is possible that historic or continued use of fertilizers in the agricultural area that are found to the north of the CY site could account for this observation. No other exceedances of conventional parameters were noted.

#### **Issues of Concern and Resolution**

**Issue 1: Sediment removal at Elk Grove Corporation Yard:** Pretreatment BMPs do not appear to be sufficiently removing suspended solids. While it would be ideal to have additional data to verify this single observation, the project team decided to take advantage of the off-season (Summer, 2015) and try to identify appropriate retrofits. At the CY, the steepness of the slopes of the grassy swale and inadequate depth of the sedimentation well to permit settling of fines could be two of the reasons for the lack of sediment removal. A variety of constraints at the site could be contributing to this situation. The existing pavement limited the size of the grassy swale, causing the slopes to be quite steep and an existing storm drain restricted the placement of the pipe connecting the sedimentation well to the dry well. This resulted in reduced sedimentation well depth to permit settling of particles.

As preparations are being made for monitoring in 2015-16, steps to try and improve sediment removal efficiency at this site is being made.

**Issue 2: High levels of coliform at both sites:** Previous data identified coliform in stormwater runoff at the SDB. This observation was consistent with a site frequented by birds, wildlife, and adjacent to a neighborhood with numerous dogs and cats, all of which are sources of coliform. However, at the CY, no sources could be identified. This led the project team to consider the possibility that there was contamination of the samples. The source could be the field crew or the laboratory.

In the future, the method of collecting the sample will be modified to reduce the risk of contamination by the field crew. The project team will also work with the laboratory to identify any oversights in sample handling protocols that might have cross-contaminated the samples. Lastly, all future samples submitted to the laboratory will include a field blank specifically for quantification of total coliform.

#### Quality Assurance/Quality Control (QA/QC)

QA/QC data from CLS and the WPCL was reviewed for both sites. In general, parameters for recoveries, matrix spikes, matrix spike duplicates, field blanks, and laboratory control samples and blanks fell within acceptable limits. Two samples that were collected to determine of NO<sub>3</sub> in stormwater exceeded the hold time at the laboratory by a few hours. Values returned for NO<sub>3</sub> at the two sites were both "non-detects." While it is likely that the modest delay had little effect on the results, the interpretation of the data will be considered in light of this fact. This omission was discussed with Dr. James Chiang, CLS Director, and will be avoided with future samples. Overall, the data is of appropriate quality for the purposes of the project.

#### Conclusions

Results from the April 24, 2015 monitoring event, which involved sample collection during the first phase of the rain event, were consistent with previous sampling results. Stormwater contained few pollutants. Organic contaminants (eg., volatiles, semi-volatiles, PAHs) were not identified in samples collected from either site. Bifenthrin and a small number of metals were detected at concentrations in runoff that pose no known risk to human health. Bacteria strongly adsorb to clay and have short lifespans in soil low in oxygen, such as found in the subsurface. This behavior is the basis for the use of dry wells in septic systems in rural areas of Sacramento County and elsewhere. None of the project results to date suggest that groundwater quality has been degraded or compromised.

Appendix A - Locations of dry wells and monitoring wells at the two study sites.





## **Appendix 4.4**

# Operation and Maintenance (O&M) and Monitoring Plan

## Operation and Maintenance Plan for Strawberry Creek Water Quality Basin Dry Well System and Monitoring Well

## 1.0 Introduction

The importance of maintaining the integrity and serviceability of the dry well and monitoring wells at the Strawberry Creek Water Quality basin (SBD) is critical to protecting groundwater supplies. Regular and effective maintenance is crucial to ensure effective well performance. Improperly maintained wells may allow flood waters and/or surface contaminants such as fertilizers, pesticides, sewage, coliform bacteria, fuels, hazardous materials, or other waste to pollute groundwater supplies. The purpose of this Operation and Maintenance (O&M) Plan is to document the future operations and maintenance (O&M) procedures.

### 2.0 Dry Wells and Monitoring Wells

Dry wells are gravity-fed excavated pits lined with perforated casing and backfilled with gravel or stone. Typically, they are constructed of a pipe about 3 feet wide and 20 to 50 feet deep, containing perforated holes through much of the length. Dry wells penetrate layers of clay soils with poor infiltration rates to reach more permeable layers of soil, allowing for more rapid infiltration of stormwater. They can be used in conjunction with low impact development (LID) practices to help repurpose stormwater

Dry wells collect stormwater runoff and allow it to percolate into the soil.

runoff as a resource to combat drought and the effects of climate change. Dry wells not only aid in stormwater runoff reduction, but they can also recharge groundwater supplies and to help maintain or restore the site's natural hydrology to help combat drought.

Monitoring wells are used for groundwater quality samples and hydrogeologic information. They provide a controlled access for sampling groundwater.

## 3.0 Overview

The O&M of the SBD dry well system and monitoring wells will entail general maintenance to avoid clogging, and to prevent contamination from materials that collect in the dry well over time and to ensure the integrity of the wells. The following general practices to help maintain wells function includes:

- Pretreatment for solids removal is recommended to ensure protection of long-term infiltration capacity and reduced frequency of maintenance.
- Pretreatment will also reduce the long-term accumulation of contaminants in the vadose zone.
- Frequent inspections and regular maintenance will improve the long-term performance of the facilities.
- The removal of debris and sediment from the dry well prevents the buildup of materials that could inhibit infiltration.



A dry well can last up to 30 years or more with proper construction and maintenance.

### 4.0 Implementation

The City's has a well-established O&M Program for drainage inlets and detention basins. The SBD site will be added to the drainage inlet list for cleaning out the sedimentation and dry well system on an annual basis prior to the rainy season. The detention basins are cleaned periodically to remove trash and over grown vegetation. Any clogging or additional repairs of the dry well system will also be addressed, when necessary. Annual inspections will be performed.

Monitoring will also be performed as part of the O&M. The monitoring efforts will include wet weather sampling of stormwater and groundwater. A simple report will be produced annually with the results of the sampling. The monitoring efforts will be part of the City's Aquatic Resources and Water Quality Protection Management Program.

There is adequate funding in both Programs to maintain the dry well system, monitoring wells, and to complete monitoring efforts at the SBD site. The O&M will be in place for 20-years for the SBD site per a grant that the City received from the State Water Control Resources Board on January 1, 2013.

#### 5.0 Site Description and Access Point

The Strawberry Creek Water Quality Basins (SDB) is located adjacent to a residential neighborhood in northeast Elk Grove. The single family residential neighborhood's drainage shed is approximately 168 acres. Runoff is collected in two large storm drains (36" and 72" in diameter) that release water into the water quality basin. Contaminants commonly found in a residential neighborhood are from landscaping and street runoff, including nitrogen, phosphorus, and pesticides (National Stormwater Quality Database<sup>1</sup>). The City of Elk Grove is the property owner of this site.

The access to the detention basin is from Power Inn Road. A dirt maintenance road that follows the perimeter of the ball field at Monterey Trails High School leads to the water quality basin, where the dry well and monitoring wells are located. This is a fenced area and the gate is locked at the access point. A drainage key is necessary to open the gate. The gate shall be locked after staff or consultants exit the site.

<sup>1</sup> Posted at: http://rpitt.eng.ua.edu/Research/ms4/Paper/Mainms4paper.html

### 6.0 Design Plans

The design plans are located in **Appendix A** for the dry well system and monitoring wells.

#### 7.0 Operation and Maintenance

### 7.1 Overview

Effective dry well and monitoring performance requires regular and effective maintenance. Periodical inspections of the well systems will ensure proper operation and structural stability. Maintenance should include controlling erosion, sediment removal, trash and debris removal, vegetation management, cleaning and repairing inlet and outlet pipes, and cleaning sedimentation well and dry well.

### 7.2 Inspections

A dry well and monitoring well should be inspected at least two times annually as well as after every storm exceeding 1 inch of rainfall. The inspection will assess the need for cleaning, and inspecting the functional and structural continuity of the system. At the same time, surface aspects of the drainage way are evaluated for evidence of staining or standing water. The following inspections shall be performed:

- All structural components inspected, at least once annually, for cracking, subsidence, spalling, erosion and deterioration.
- Components expected to receive and/or trap debris inspected for clogging at least two times annually, as well as after every storm exceeding 1 inch of rainfall.
- Inspect for ponding and standing water. Failure to percolate may indicate that the dry well is underperforming and there may be a clog.
- Ensure water path to dry well is not blocked.

## 7.3 General Maintenance

The dry well and sedimentation well shall be cleaned once a year prior to the rainy season. The cleaning will consist of pressure washing and a vactor truck. A truck mounted hydro-vactor is recommended when silt and sediment are found to occupy 15% or more of the original effective settling capacity in the dry well chamber. Air and high-pressure water will dislodge the built up material, which is then suctioned through a piping system into the vactor truck and disposed of offsite. Also, obstructions or accumulation of debris in remote inlets and connecting piping shall be removed by jet-rodding. The thorough cleaning may remove obvious blockages and restore the wells to optimal service.

The monitoring wells shall be inspected for structural integrity. Debris and trash shall be picked up and removed around the site. Debris shall be removed in drainage inlets. Disposal of soil, gravel, sludge debris, liquids, or other material shall be removed from the site and around the dry well according to all applicable federal, State and local regulations and requirements.

Overgrowth of vegetation shall be removed. Erosion problems shall be addressed and stabilized in the area of the wells. If ponding occurs in dry well, the top layers of the sand (1 foot) and pea gravel layers will be replaced. If the ponding or infiltration continues to be impaired, a groundwater hydrologist will be retained to evaluate the problem. If the well cannot be repaired, the well will need to be decommissioned. If other maintenance is required, the repair will be assessed on a case by case basis.

## 7.4 Clogging

The most common problem with a dry well over time is accumulation of lint, solids, soap, and scum in waste water that can clog the openings of the well's walls and the pores of the surrounding soil. As this build up continues, water does not filter out of the well at an adequate rate. Eventually, these clogs prevent water from draining and filtering into the groundwater altogether. When this happens, it can become a huge problem. Water can back up and begin to pool causing standing water which is a breeding ground for disease-carrying mosquitoes.

## 8.0 Monitoring Plan

## 8.1 Dry Well System Design and Stormwater Sample Locations

The dry well system at SBD is composed of three parts: a vegetated pretreatment feature, a structural pretreatment feature and the dry well. **Figure 1** illustrates the dry well system design and the three key components, as well as the location of stormwater sample collections.

The dry well design system collects stormwater runoff in the water quality basin. This basin serves as the vegetated pretreatment, holding stormwater for at least 7 minutes, per the Sacramento Stormwater Quality Partnership Design Guide Manual<sup>2</sup>. The vegetated pretreatment system conveys runoff to the structural pretreatment feature, a concrete sedimentation well, which then conveys water via a pipe placed one foot above the bottom, to the dry well. A shut-off value is located in this pipe to allow for sealing of the dry well in case of an emergency (not shown in **Figure 1**). The dry well was designed to be completed at a depth to optimize infiltration; at 40 feet bgs (below ground surface). It is constructed of 30-inch wide perforated corrugated plastic pipe that will release stormwater into pervious lithologic layers underlain by a clay layer. The pervious layer facilitates a high infiltration rate while the clay layer causes stormwater to move horizontally to obtain further treatment of potential contaminants and will function as a final step of attenuation.

The dry well design also includes a 2" stilling pipe, installed in the middle of the dry well that is used to groundwater sampling and/or to house a pressure transducer/electric conductivity meter to monitor conditions in the well. The dry well is filled with pea gravel. The design of the

<sup>2</sup> Posted at: http://www.cityofsacramento.org/utilities/mediaroom/documents/SWQ\_DesignManual\_May07\_062107.pdf

dry well contains a shallow layer of coarse sand at the top of the dry well to help filter out any debris and fine particles not captured by the sedimentation well.

## 8.2 Vegetated and Structural Pretreatment Designs

The vegetated pretreatment (Figure 1) was designed to promote retention/detention of particulate matter and associated contaminants. Since approximately 70% of stormwater contaminants are sorbed to particles, removal of particulate matter aides not only in reducing clogging of the dry well but also in reducing the quantity of contaminants that enter the dry well. The vegetated pretreatment of stormwater that was used was an existing water quality basin filled with large amounts of vegetation, including trees and bulrush that has grown in the basin over the past 15 years.

The structural pretreatment consists of a sedimentation basin (Figure 1). In principle, the concrete box slows the movement of water, allowing additional sediment and associated pollutants to fall out of the stormwater runoff. As solids settle to the bottom of the chamber, the stormwater flows through a 12" diameter PVC pipe into the dry well. However, the design of the sedimentation well was not sufficiently deep to permit sufficient settling of sediment. As a consequence, this feature does not function as envisioned.



Figure 1. Dry well system and the location of stormwater sampling sites.

## 8.3. Groundwater Monitoring Network Design

A total of four groundwater monitoring wells were constructed. At SDB (Figure 2), one upgradient and two downgradient wells have been constructed and completed at 110 feet bgs. The upgradient well is approximately 300 feet from the dry well while the two downgradient wells are approximately 45 and 55 feet from the dry well location. A fourth vadose zone well was completed at 55 feet bgs and is approximately 15 feet downgradient of the dry well.

## 8.4. Sampling Plan

Stormwater samples will be collected once a year during the rainy season for storm events that are forecasted to produce a minimum of 0.5" rainfall within 24 hours. Grab samples will be collected from water that flows into the dry well (via the connector pipe linking dry well to sedimentation well).

Chain-of-custody template forms will be prepared for each monitoring event (stormwater and groundwater). These will be 'fine-tuned' a week before each sampling event, including review by all relevant consultants and the laboratories to ensure clarity and accuracy. Samples will be collected in appropriate vials with designated preservatives.

Groundwater samples will be collected from the vadose zone and water table wells within a period of time that coincides with a rise in water associated with the storm event. Data from the dry well project suggests that this period is 24-48 hours after a storm event. Groundwater collections will be performed by first purging the wells using three wet casing volumes or until indicator parameters have stabilized (less than 5% variation in three consecutive readings taken 5 minutes apart) prior to sample retrieval. The indicator parameters include temperature, pH, electric conductivity, dissolved oxygen, and turbidity. After completion of purging activities, a sufficient amount of ground water will be collect to perform laboratory testing. The laboratory will supply the appropriate bottles and vials. Samples will be delivered to the analytical laboratories with the proper chain-of-custody documentation within the required holding times. Between each well, the pump assembly and discharge hosing will be wiped down with a solution of bleach and flushed with tap to reduce the risk of cross-contamination.

At any time during the O&M, the sampling protocol could be modified to meet specific objectives.

Location of Dry Well and Monitoring Well Network Strawberry Creek Water Quality Basin Figure 2



## 8.5 Analytical Chemistry

Laboratory measurements and associated US EPA method that could be sampled for are described below:

- 1. Total suspended solids (EPA 160.2).
- 2. Pyrethroid pesticides (WPCL #53).
- 3. Drinking water metals, and chromium 6 when indicated (EPA 200 series).
- 4. Imidacloprid (WPCL method).
- 5. Fipronil (WPCL method).
- 6. Total coliform (SM 9221).

## 8.6 Monitoring Schedule

The schedule for monitoring for both stormwater and groundwater are provided in **Table 1** below.

## Table 1. Stormwater and Groundwater Monitoring Schedule

Frequency	Туре	Timing	Sample type
Yearly	Wet Weather (Stormwater)	<ol> <li>Beginning of rainy season</li> <li>End of rainy season</li> </ol>	grab samples
	Wet Weather (Groundwater)	After stormwater sampling	grab sample

Yearly monitoring will be performed, unless otherwise required.

## 8.7 Sample Handling

All samples will be collected using standard clean handling protocols to avoid sample contamination. Stormwater samples will be collected manually. Once collected the samples will be stored on ice. All water samples will be maintained on ice until delivery to the laboratories within the appropriate hold times. Arrangements will be made to meet lab staff after hours or on weekends, if necessary. Chain of custody forms for all analytical work will be filled out in advance of the monitoring date. Once samples are delivered, copies will be retained by the City of Elk Grove, the consultants, as well as the laboratories.

For groundwater sampling, the water pump tubing will be sponged off with dilution solution of bleach as it is being reeled up. Once collected, sample bottles will be wrapped in a sleeve to prevent breakage, stored on ice and taken to laboratories for analysis.

Total coliform samples have a required 6 hour hold time, while all others will be delivered within 12 hours of collection.

#### 8.8 Documentation and Data Reduction

Operation and maintenance best practices need to be documented, as lack of maintenance is the main cause of dry well performance decline and failure. A simple report documenting the rain event will be produced along with a spreadsheet of the analytical chemistry results. Field and laboratory data will be entered into spreadsheets. Results will be analyzed using statistical program to compare contaminant concentration in downgradient water table and vadose zone wells relative to water quality in the upgradient water table well. Differences in the water quality of samples collected from runoff, the vadose zone, and groundwater as well as between stormwater events, and before and after pretreatment will also be assessed. Changes over time in the concentration of contaminants in the groundwater, if any are detected, will be evaluated as well. Non-parametric statistics will be used for analysis.

## 8.9 Controls for Variability and Bias

Managing variability in sample collection and handling will be controlled by standardizing the protocols and ensuring that all personnel involved in sample collection are properly trained and have sufficient practice to ensure collections and field measurements have a consistent degree of accuracy and precision. Further, instruments will be calibrated prior to each sampling event to verify accuracy.

Variability in the concentration of contaminants in stormwater samples is expected, as the size of the rain event and the antecedent moisture conditions will affect the contaminants contained in runoff. Additionally, fate and transport mechanisms will affect travel time of the constituent from its source of origin to the monitoring location. Finally, if there is high turbidity in the stormwater sample, analytical results may not be measured without dilution or filtering; these actions could alter the analytical results.

Some natural variability in sample results between groundwater sampling events is expected. Factors that can introduce groundwater quality variability may be reduced by ensuring a consistent sampling and purging methodology. In order to ensure that samples are representative of groundwater conditions (described above). Purged groundwater is disposed of by spreading it on the ground at a reasonable distance from the sampled well to avoid the potential for purge water to enter the well casing.

Furthermore, standard laboratory and field control measures will be utilized. Field blanks and field blank duplicates will be used to verify that volatiles are not being inadvertently introduced into the sample in the field. Field duplicates, a sample of unknown origin to the laboratory, will also be collected and analyzed to verify analytical accuracy. Matrix spike and matrix spike duplicates will also be included in the analysis to evaluate the role of the matrix (water) in the analytical measurements. Additional laboratory controls and calibration measurements will also be used at the lab.

## 8.10 Contingency Plan

There is the possibility that a chemical spill may occur, allowing contaminants to enter the dry wells and potentially compromise the safety of groundwater. Additionally, it is possible that during the course of the O&M, contaminants may be detected in the groundwater. The following Contingency Plan has been developed to safeguard groundwater quality and the following actions will take place if there is a chemical spill:

### 1. Nearby Chemical Spill or Accident:

The City of Elk Grove and local Fire and Police Departments, as well as the City of Elk Grove's maintenance and operations staff have been informed of the dry well location. They will be given a list of contact information should an accident occur. The contact person can instruct emergency personnel on the methods for closing the valve to shut off flow into the dry well. Contact information will also be posted at the site in case the first responder is unfamiliar with the project and City staff.

#### 2. Spill Equipment:

Maintaining an adequate supply of spill containment equipment is of primary importance to spill containment measures. The City of Elk Grove maintains spill kits for accidental occurrences.

## 3. Contaminants Detected in Groundwater Above Baselines Levels during Routine Monitoring:

If contaminants are detected in one of the vadose zone monitoring well that exceeds the baseline concentration established in the upgradient well by 20 percent, a meeting of the City staff and consultants will be called to evaluate the situation. Because the alert level is below the regulatory level (Maximum Contaminant Level or MCL), there is not a requirement to inform authorities. The vadose zone well was selected as the trigger point, not the groundwater itself, so the situation could be evaluated before potential contaminants could reach groundwater. The group will determine if it is prudent to conduct additional sampling, continue to utilize the dry well in future planned monitoring or to abandon the dry well all together.

## 9.0 Housekeeping

Maintaining good housekeeping and vegetation practices within SBD site area is a critical component of O&M program.

- Use blowers to remove and direct fine sediments and vegetative debris away from dry well system.
- Collect and bag all debris directly adjacent to dry well system.
- Do not stockpile any debris (raked leaves, mulch, etc.) on site by the wells.
- Manage adjacent vegetated areas to ensure no loose soils or debris can erode into dry well system.
- Clean up after maintenance and monitoring efforts.

Appendix A See appendix 3.1 and 3.4

## Appendix 5.1

# California Office of Environmental Health Hazard Assessment (OEHHA) Technical Memorandum

## ELK GROVE DRY WELL PROJECT

Prepared by Barbara Washburn and Bennett Lock Ecotoxicology Program Office of Environmental Health Hazard Assessment March 2017

> Submitted to Connie Nelson Project Manager City of Elk Grove

÷.

#### Table of Contents

I.	0	verview	7		
II.	Project Performance Goals				
III.		Study Design	8		
A		Dry Well and Monitoring Locations	8		
В		Stormwater Monitoring	8		
С	•	Groundwater Monitoring	10		
D	•	Methodology	11		
	0	Collection of Groundwater and Stormwater Samples	11		
	0	Analysis of Contaminants	12		
	0	Statistical Methods	12		
	0	Flow Measurements	13		
	0	Groundwater Gradient	14		
	0	Evaluation of Stormwater-Groundwater Connectivity	14		
	0	Fate and Transport Modeling	15		
	0	Potential for Mobilization of Naturally Occurring Metals	16		
IV.		Results of Analyses	16		
Α		Contaminants in Stormwater and Groundwater	16		
	0	Pyrethroids	17		
	0	Motor Oil	20		
	0	Metals	21		
	0	Coliform bacteria	29		
	0	Nitrate	30		
В		Mobilization of Naturally Occurring Contaminants	32		
С		Effectiveness of Vegetated Pretreatment	33		
D		Groundwater Gradient Analysis	35		
Е		Evaluation of Surface Water-Groundwater Connectivity	35		
F.		Flow and Infiltration Volume	36		
G		Fate and Transport Modeling	37		
Н	•	Volume and Pollutant Load Reduction	39		
Ι.		Scientific Literature and Reports	39		
V. F	<sup>o</sup> e	rformance Goals	13		
A	A. Performance Goal No. 1				
B		Pertormance Goal No. 2	14		
VI. [	VI. Discussion/Conclusions				
Cita	Citations				

÷

### List of Figures

Figure 1. Locations from which samples were collected, highlighted with red arrows	. 11
Figure 2. Orifice drilled in the cap of the pipe connecting the sedimentation well to the dry well	14
Figure 3. Bifenthrin concentrations in stormwater and groundwater at the CY (top) and SDB	
(bottom).	18
Figure 4. Cyfluthrin concentrations at SDB.	. 19
Figure 5. Permethrin concentrations at the CY	20
Figure 6. The concentration of motor oil at the Corporation Yard and Strawberry Detention Basin.	21
Figure 7a. Aluminum concentrations in stormwater and groundwater at the CY	. 22
Figure 7b. Aluminum concentrations in stormwater and groundwater at the SDB.	. 23
Figure 8. Iron concentration in stormwater and groundwater at the CY (top) and SDB (bottom)	. 24
Figure 9. Concentrations of manganese at the CY	25
Figure 10. Total chromium concentration in stormwater and groundwater at the CY (top) and	
SDB (bottom)	26
Figure 11. Hexavalent chromium concentrations in groundwater at both sites	27
Figure 12. Arsenic concentrations in stormwater and groundwater at the CY (top) and SDB	
(bottom).	. 28
Figure 13. Total coliform concentrations at the Corporation Yard (top) and Strawberry Detention	
Basin (bottom).	. 29
Figure 14. Nitrate (as N) concentration in stormwater and groundwater at the CY (top) and SDB	
(bottom).	. 31
Figure 15. Hexavalent chromium concentrations in upgradient (MW1) and downgradient (MW 3	
and 4) wells at the SDB	32
Figure 16. Relationship between dissolved iron and total arsenic in samples collected from water	
table wells at the Corporation Yard and Strawberry Detention Basin	33
Figure 17. Total suspended solids (TSS) concentration at the curbcut (curb) or stormwater outfall	
(SWout) at the CY (left) and SDB (right).	34

4

.
# List of Tables

Table 1.	Summary of Project Performance Goals	8
Table 2.	Schedule of stormwater monitoring	9
Table 3.	Schedule for groundwater monitoring	10
Table 4.	Percent reduction in contaminants by the vegetated pretreatment	34
Table 5.	Calculated gradient between dry well and monitoring wells	35
Table 6.	Flow rates and infiltration volumes through the dry wells	36
Table 7.	Modeling results for selected contaminants	38
Table 8.	Mass of various contaminants and suspended solids diverted	39
Table 9.	Contaminants in groundwater that exceeded the criteria value.	43

# I. Overview

The Office of Environmental Health Hazard Assessment (OEHHA) worked with the City of Elk Grove to assess the risks to groundwater quality associated with infiltrating stormwater runoff through dry wells. OEHHA served as the scientific advisor for the project and worked with other consultants to monitor contaminants in stormwater and groundwater. OEHHA also compiled and analyzed data for statistical significance, reviewed scientific literature, and prepared a series of factsheets. OEHHA also contracted with the University of California, Davis to model the movement of contaminants through the vadose zone as well as work with Dr. Xue Li, who assessed risks associated with mobilizing naturally-occurring metals. This information is summarized in detail in this report and the two attached appendices.

During the 2014-15 and 2015-16 water years, stormwater and groundwater data were collected at the two dry well sites. Monitoring for a wide variety of contaminants was conducted during the dry and wet seasons for these two consecutive years. The monitoring efforts included examining the following:

- A difference in stormwater quality before and after runoff has passed through the pretreatment features in order to evaluate the effectiveness of removing sediment from runoff.
- The differences between contaminant concentrations in stormwater as it enters the dry well, in the vadose zone, and at the water table. This information will provide insight into contaminant sequestration in the vadose zone.
- The differences in groundwater quality upgradient and downgradient of the dry wells. This data will help to interpret the source of contaminants in groundwater, should any be detected.

To address these questions, stormwater and groundwater samples were collected during and after six rain events and three dry season groundwater collections. Water was analyzed for a wide range of contaminants. In addition, flow measurements were calculated and modeling performed to assess the fate and transport of key contaminants.

# II. Project Performance Goals

The performance goals identified at the beginning of the project guided the work (Table 1).

Table 1. Summary of Project Performance Goals

Performance Goals	Performance Targets	
Assess the potential for contamination of groundwater associated with the use of dry wells with pretreatment features for infiltrating stormwater runoff from different land uses.	Concentrations of contaminants in the aquifer will remain below the California Maximum Contaminant Levels (MCLs) for all anthropogenic contaminants. There will be no statistically significant difference in the groundwater quality in the upgradient and downgradient monitoring wells.	
Assess the ability of the various pretreatment features to remove total suspended solids (TSS) and contaminants from stormwater.	Statistically significant reduction in TSS and pyrethroids in stormwater by the pretreatment features. Sedimentation well and dry well requires cleaning to rer sediment less than one time per year.	

# III. Study Design

# A. Dry Well and Monitoring Locations

Two locations were selected for installation of the dry well systems and monitoring well network, both owned by the City of Elk Grove. The Strawberry Detention Basin (SDB) is located in a 168 acre drainage shed that is composed primarily of a single family residential neighborhood. The dry well and associated pretreatment and monitoring wells were situated near the edge of a water quality basin. The site of the second system, the City's Corporation Yard (CY), is a 0.64 acre drainage shed that serves as a bus fleet servicing, maintenance and parking facility. Dry wells, pretreatment, vadose and water table wells were installed at both sites.

# B. Stormwater Monitoring

Stormwater samples were collected each year from the first flush event and from two additional rain events that were forecasted to produce a minimum of 0.5" rainfall within 24 hours for a total of six monitoring events over a two-year period. The purpose of one of these monitoring events was infiltration testing; the remaining five were stormwater and groundwater sampling events. Samples were collected to obtain flow-proportional composites for approximately 80% of the storm volume with one exception. At the April 24, 2105 event, only grab samples were collected due to the very short nature of the storm. Table 2 summarizes the project's stormwater monitoring schedule.

Runoff samples were collected at the storm drain outfall (SDB) or curbcut (CY), where runoff first entered the pretreatment feature, and as water flowed into the dry well. Flow-weighted composite stormwater samples were collected at the dry well during all five monitoring events. During two events, composite samples were also collected at the stormwater outfall or curbcut. The remainder of the samples collected at the curbcut/outfall were grab samples for the analysis of pyrethroids and TSS (total suspended solids) only.

Water Year	Stormwater Monitoring Events	Date	Monitoring Activities	Endpoints
Year 1	1 <sup>st</sup> wet weather SDB (first flush)	February. 6-7, 2015	SDB: Flow weighted composite and grab samples	Tier 1 <sup>a</sup> suite of analytes
	Infiltration testing	April 7, 2015	SDB & CY: infiltration testing	Infiltration testing above and below sand layer; measure flow rates (through dry well, to vadose zone, to water table)
	1 <sup>st</sup> wet weather CY (not first flush)	April 24, 2015	CY: Grab samples only	Tier 1 suite of analytes
Year 2	2 <sup>nd</sup> wet weather (first flush)	November 2, 2015	SDB & CY: Seasonal first flush, flow weighted composites (early and mid/late phase of rain event) and grab samples	Tier 1 suite of all analytes
	3 <sup>rd</sup> wet weather	January 5, 2016	SDB & CY: Flow weighted composites (2) influent and effluent	Tier 2 <sup>b</sup> suite of analytes
	4 <sup>th</sup> wet weather	March 4, 2016	SDB & CY: Flow weighted composites and grab samples	Tier 2 <sup>b</sup> suite of analytes
	5 <sup>th</sup> wet weather	April 22, 2016	SDB & CY: Flow weighted composites (2) influent & effluent	Modified Tier 2 <sup>c</sup> suite of analytes

## Table 2. Schedule of stormwater monitoring

## Table 3. Schedule for groundwater monitoring

Water Year	Groundwater Monitoring Events	Date	Monitoring Activities	Endpoints
	1 <sup>st</sup> dry weather	June 4, 2014	Water table wells	Tier 1 suite of analytes
Year 1	(Pre-construction)	August 14, 2014		
	1 <sup>st</sup> wet weather SDB'	February 13, 2015	SDB: Water table and vadose zone wells	Tier 1 suite of analytes
	1 <sup>st</sup> wet weather CY	April 29, 2015	CY: Water table and vadose zone wells	Tier 1 suite of analytes
Year 2	2 <sup>nd</sup> dry weather event	September 17, 2015	SDB and CY: Water table wells	Tier 1 suite of all analytes
	2 <sup>nd</sup> wet weather	November 4, 2015	SDB and CY: Water table and vadose zone wells	Tier 2 suite of analytes
	3 <sup>rd</sup> wet weather	January 6, 2016	SDB and CY: Water table and vadose zone wells	Tier 2 suite of analytes
	4 <sup>th</sup> wet weather	March 5 & 8, 2016	SDB and CY: Water table and vadose zone wells	Modified Tier 2 suite of analytes
	5 <sup>th</sup> wet/dry weather	May 17, 2016	SDB and CY: Water table wells	Modified Tier 2 suite of analytes

<sup>a</sup>Tier 1: Includes volatile and semi-volatile organic compounds, pyrogenic PAHs (combustion by-products), chlorophenoxy herbicides, pyrethroids, drinking water metals, general physical and mineral.

<sup>b</sup>Tier 2: a reduced number of contaminants; chlorophenoxy herbicides and PAHs were eliminated.

<sup>c</sup> In cases where a contaminant was not detected for 2 monitoring events, the contaminant was removed from the Tier 2 list.

This sampling strategy was a modification of the original Monitoring Plan (MP), which specified that grab samples only were to be collected at the stormwater outfall or curbcut.

The original suite of contaminants identified for analysis included volatile and semi-volatile organic compounds (VOCs and SVOCs), herbicides, polycyclic aromatic hydrocarbons (PAHs), metals, TSS, and pyrethroids. As the Project progressed, many of the contaminants were not detected after multiple monitoring events and were eliminated from further evaluation. Specifically, the independent measurement of PAHs (US EPA Method 8310) and the chlorophenoxy herbicides (US EPA Method 8151) were eliminated. The cost savings from collecting these samples was redirected to cover the costs of the additional composite samples that were collected at the stormwater outfall or curbcut.

# C. Groundwater Monitoring

Groundwater samples were collected from three groundwater monitoring wells and a vadose zone well at each site after each stormwater monitoring event was performed. Dry-weather groundwater samples were also collected for post construction and baseline monitoring. In addition, groundwater levels were also regularly monitored using a combination of manual and continuous measurements. Information

gained from the monitoring helped to guide the timing of vadose zone sample collections. The project's schedule for groundwater monitoring is shown in Table 3.

# D. Methodology

# • Collection of Groundwater and Stormwater Samples

Analysis of stormwater was performed on flow-proportional samples. Samples were collected from the entrance to the vegetated pretreatment and just before water entered the dry well (Figure 1). Runoff was collected every 15 – 60 minutes, depending on the intensity of the precipitation and duration of the storm. Samples were collected to represent approximately 80% of the runoff volume. Sufficient volumes were collected at each time point during the storm event so that adequate final volume of flow-proportioned stormwater samples would meet the volume requirements, about 5 gallons, for all the analytical chemistry.



# Figure 1. Locations from which samples were collected, highlighted with red arrows.

During the rainy season, groundwater samples were collected approximately one to two days after the storm event at the vadose zone well and approximately two to seven days after each storm event for the upgradient and downgradient wells (deeper wells). Water level rises in the wells informed the timing of these collections. In addition to wet season monitoring, three groundwater monitoring events occurred during the dry season. The vadose zone well did not have sufficient water present to collect a sample during the dry season monitoring.

Groundwater monitoring consisted of flushing three volume casings through the tubing and pumping and dispensing samples directly into the appropriate containers for each particular type of analysis. All

groundwater samples that were used for analysis of metals were filtered in the field, thus the analysis reflects dissolved concentrations. This was not the case with stormwater samples, which were not filtered. This inconsistency in the method of collection could result in the overestimate of metals in stormwater than might actually exist. Outside of this issue, all other sample were collected in the same manner.

## • Analysis of Contaminants

Flow-weighted composite and grab samples of stormwater and groundwater samples were analyzed for the following contaminants:

- Total suspended solids (US EPA 160.2)
- Pyrethroid pesticides (WPCL #53)
- Chlorophenoxy herbicides (US EPA 8151A)
- Total petroleum hydrocarbons and motor oil (US EPA 8015-diesel and gas)
- Pyrogenic polycyclic aromatic hydrocarbons (US EPA 8310)
- Semi-volatile organics (US EPA 625)
- Volatile organics (US EPA 8260B)
- Drinking water metals, and hexavalent chromium when indicated (US EPA 200 series)
- General physical (US EPA STDM)
- General mineral (US EPA STDM)
- Total coliform (SM 9221)
- Glyphosate (final monitoring event only).

Field blank, field blank duplicates, and field duplicates were also collected to control for field contamination and reproducibility of collection methods. These contaminants were analyzed in ELAP-certified laboratories using standard quality control/quality assurance methods.

# • Statistical Methods

Non-parametric statistics were used to analyze contaminant data. Contaminant concentrations at the sites of sample collections were compared to assess the relationships between concentrations in stormwater collected as it entered the dry well system after pretreatment, in the vadose zone, and in the one upgradient and two downgradient water table wells.

Kruskal-Wallis tests were performed on those contaminants with a single reporting limit. If significance was identified at the  $p \le 0.05$  level, the concentrations of contaminants at each of the study sites were ranked, then Tukey's test of honestly significant differences was used to identify differences between groups. By analyzing differences in ranks, not the actual values, Tukey's test substituted for Bonferroni's correction for Type I errors. This evaluation helped to determine the false discovery rate. For those contaminants with two or greater reporting limits, generalized Wilcoxon tests were performed. Gehan's test was used to identify differences between groups, and correlation analysis was performed on data used to investigate redox couples and oxidation-reduction reactions in the subsurface. Statistical analysis was not performed on the hydrologic data.

#### o Flow Measurements

To measure water levels in the dry well and monitoring wells, non-vented pressure transducers (water level gauges) were installed at four locations at each site. Attempts to use an electromagnetic area velocity meter to measure flows into the dry well were unsuccessful due to the design of the 12" connecter pipe from the sedimentation well to the dry well, which allowed more flow than the dry well could infiltrate. This 12" pipe typically became rapidly backwatered during storm events, and resulted in velocities too low for the electromagnetic meter to measure. To address this issue, an orifice plate was added to cover the pipe to both limit the quantity of water flowing from the sedimentation well into the dry well, as well as measure the flow with the use of a calibrated equation developed in the laboratory based on simulated scenarios. Electroconductivity sensors were also deployed. Local rainfall was measured using a standard graduated rain gauge at each site. The flow measurements informed calculations for aliquoting the water samples for a single 5-gallon sample.

Water level gauges were installed at three locations along with a corresponding barometric pressure transducer. At each site, 1) a gauge was installed in the 4" pipe going down through the center of the dry well, 2) one gauge was installed on top of the gravel filter in the dry well to indicate if and when the dry well was receiving water faster than the infiltration rate, and 3) two gauges were installed in the sedimentation well for redundancy because the water levels in the sedimentation well was directly correlated with the flow rate through the orifice leading to the dry well. This task was performed to ensure an accurate reading of the gauges. Data from each gauge were downloaded before and after every sampling event. The gauges were preprogrammed to take measurements every 15 minutes between rain events and once per minute during the rain event. The water level data collected during the rain event was processed immediately after to produce the flow, volume, and aliquot calculations.

During the dry well monitoring of water year 2014-15, the Hach Flo-Tote 3 flow meter and water sampler that were intended to measure water flowing into the dry well, and hence inform sampling timing and frequency, did not function properly. This instrument uses an electromagnetic field to measure velocity and a pressure transducer to measure depths. These values are then used to calculate flow measurements based on the area of the conduit. The issues included low velocity that could not be measured by the flow meter and sediment obstructing the instrument, which frequently resulted in invalid measurements.

To address this issue, both dry well systems were retrofitted with either a pipe or cap containing 5 precision drilled orifices, ranging in size from 0.5 - 2.5 inches. These orifices permitted project staff to open or close different orifices during the course of a storm, thereby controlling the flow into the dry well to simulate constant head conditions. This ensured that inflow was approximately equal to infiltration capacity. Equations were developed in laboratory testing to determine the flow rate associated with each orifice.

$$Q = C_d A \sqrt{2gh}$$

Q = flow (cubic feet per second) C<sub>d</sub> = discharge coefficient A = area of orifice (square feet) g = acceleration from gravity

#### h = head acting on the centerline (feet)

The discharge coefficients were estimated by measuring the amount of water draining from a 6-foot-tall pipe at the Project team's laboratory. Real time stage measurements were recorded at half-second intervals to obtain flow and head. The discharge coefficient was calculated using the equation:



**Figure 2.** Orifice drilled in the cap of the pipe connecting the sedimentation well to the dry well. By removing the plug (not shown) of the appropriate orifice, runoff flowed into the dry well at a predetermined rate that was designed to maintain constant, steady flow into the dry well.

$$C_d = \frac{Q}{A\sqrt{2gh}}$$

This was repeated for each orifice size and an equation that linked head of water in the sedimentation well to the flow rate through the pipe was developed. A constant head of greater than 1" was maintained above the orifice. A spreadsheet used the above equation and the depth of water above the orifice to calculate the flow rate into the dry well.

#### o Groundwater Gradient

The network of water table wells that were used for contaminant analysis were assigned an upgradient or downgradient relationship to the dry well based on existing information from previous studies in the region. To confirm these estimates, groundwater level data was interpolated to calculate gradients. At the CY, the designation for the upgradient well was MW1; the two downgradient wells were MW3 and MW4. However, the gradient analysis showed that at SDB, MW1 was upgradient to the dry well in the wet season, but downgradient in the dry season. MW3 had the inverse relationship to the dry well. MW4 remained downgradient throughout the year.

#### Evaluation of Stormwater-Groundwater Connectivity

Verification of a hydraulic connection between the dry well and the water table, where samples were collected, helped to validate a possible path for contaminants present in runoff to reach the water table. Two approaches were used to make this determination vadose zone modeling of chloride, which serves as a tracer for water, and changes in electric conductivity of water collected from the vadose zone and water table.

One dimensional modeling (described below) of chloride movement through the vadose zone was the primary approach used to make this assessment. Since chloride travels with water, it can serve as a useful marker for the movement of water. Results suggested it would take 1-3 days at the SDB and 3 – 5 days at CY for runoff released from the dry well to reach the water table. The travel time is presented as a range, dependent upon values used to estimate hydraulic conductivity of the various geologic

units. In other words, in less than 1 week at both sites, water that infiltrated through the dry well is likely to reach the water table. Factors such as runoff volume, rain intensity, and degree of saturation in the vadose zone would also influence the timing.

In addition, changes in electric conductivity in groundwater were also used to assess connectivity with influent stormwater. During the first season of stormwater and groundwater monitoring, three conductivity transducers were deployed at each of the two project sites to record continuous water quality data during two storm events. This monitoring was conducted to determine the influence of stormwater infiltrated at the dry wells on groundwater at the project sites, both in the vadose zone and near the water table. Continuous conductivity monitoring provided data on changes in groundwater concentrations over multiple days following the storm events to provide an understanding of the degree to which groundwater sampling conducted within hours or days of a rain event were likely to reflect the influence of previous storms. This approach differed from a typical tracer test in that the inherent difference in conductivity between groundwater and surface water served as a marker of the influence of stormwater on groundwater.

#### • Fate and Transport Modeling

The goal of the vadose zone contaminant transport modeling analysis was to estimate the potential groundwater quality effects of allowing long term infiltration of stormwater through the dry wells. Modeling was performed using the vadose zone modeling software HYDRUS 1D, with site-specific geologic and hydrochemical parameters obtained during the field study and laboratory analyses. Two model domains for both sites were developed to represent the sites' separation distances (the vertical length between the bottom of the dry well and the seasonal high water table). Site lithologies were estimated from driller's logs created during the monitoring well and dry well construction, and these lithologies were used to estimate the material composition of the separation distances. The CY separation distance is 32 feet and composed of seven layers of clay, silt, sand, and mixtures of the three subsurface soil types. The SDB separation distance is 9.1 feet and composed of two layers: a layer of sandy silty clay on top of a layer of sand. Water is dispersed at the top of the model domain at a level representative of the water levels observed in the dry wells over the course of a calendar year. The contaminants chosen for model analysis were aluminum, bifenthrin, chromium (total and hexavalent), DEHP (diethyl hexyl phthalate, a plasticizer), iron, manganese, permethrin, and TBA (tertbutyl alcohol). These contaminants and their input concentrations were chosen based on the results of the stormwater monitoring efforts from the project. Fipronil and imidacloprid were also modeled, although not detected in stormwater at either site. This effort was performed in anticipation of possible future contamination risk associated with the increased use of fipronil and imidacloprid in California.

The project modeling results provide the following information: 1) estimated times for contaminant breakthrough at each of the sites' water tables (initial and at concentrations above the Public Health Goal [PHG] or Maximum Contaminant Level [MCL]); 2) the time for each contaminant to reach a peak concentration at the water table; 3) the time for each contaminant to reach the PHG or MCL at the water table; and 4) the estimated concentration of each contaminant at the water table after 500 years of constant stormwater infiltration. Eight scenarios were run for each contaminant at each site. The scenarios represent a range of possible vadose zone attenuation capacities, influenced by such factors as fractional organic carbon, hydraulic conductivity, the rate of degradation ( $t_{1/2}$ ), and contaminant input concentrations as found in stormwater. These different scenarios were used in an attempt to capture

the possible worst case results along with more realistic results from the project's data. The input contaminant concentrations was the estimated dissolved concentration. To estimate dissolved concentration, total measured concentration derived using established equations and values for dissolved and total organic carbon and relevant distribution coefficients, discussed in detail in the UC Davis Tech Memo.

# • Potential for Mobilization of Naturally Occurring Metals

Oxidation-reduction reactions associated with influent bicarbonate, oxygen, iron, and/or manganese can alter the valence state of the metals that arsenic or chromium are bound to, thus releasing these toxic compounds. Ion exchange reactions associated with sulfides or iron can also cause mobilization of As and Cr. To investigate this possibility, the concentrations of As and Cr in upgradient and downgradient water table wells was compared as well as the relationship between key redox metals such as iron and manganese and As and Cr.

Using data on total metal concentrations as well as convention chemistry, two types of analyses were performed. Differences in concentrations of arsenic and chromium in upgradient and downgradient water table wells was examined. If constituents in stormwater runoff were causing desorption of either metal, their concentration should be greater in monitoring wells downgradient of the dry well. Additionally, correlation analysis between known redox couples with arsenic and chromium as well as ions known to displace As and/or Cr was performed. One of the limitations of this analysis is that most of the chemical analyses reflected total concentrations of moetals, not the more relevant dissolved concentrations. With this caveat in mind, the project staff thought that a review of relevant literature and estimates of potential differences would be worth examining.

# IV. Results of Analyses

# A. Contaminants in Stormwater and Groundwater

The project results indicated that few contaminants were detected in stormwater. The major classes of organic contaminants, including polycyclic aromatic hydrocarbons, semi-volatile contaminants (which included pyrene, fluoranthene, numerous phthalates, nitrophenol, and benzo[a]pyrene) and volatile organics (such as carbon tetrachloride, chloroform, toluene, benzene, and acetone) were detected only a handful of times, and in most cases at levels below the reporting limit, and therefore not quantifiable. No quantifiable organics of any class were detected in groundwater. The specific organic contaminants identified in stormwater were:

- Diethylhexyl phthalate concentration at the CY curbcut was 6.01 µg/L, which is above the California Maximum Contaminant Level (MCL) of 6.0 µg/L. The concentration was reduced in half by the time stormwater reached the dry well.
- Toluene (at SDB), acetone (at CY), and tert-butyl alcohol (at SDB) concentrations were reported at 0.84 µg/L, 15 µg/L, and 20 µg/L, respectively. In each case, the contaminant level was just above the reporting limit and below the MCL for toluene.

There was a single detection of dalapon, a member of the family of chlorophenoxy herbicides that includes 2,4-D, dicamba, and pentachlorophenol. Dalaphon was detected at  $3.1 \mu g/L$ , below the MCL,

in water collected from a downgradient water table well at SDB. None was detected in any stormwater samples. Testing for herbicides was not continued into 2016 due to the lack of findings.

Glyphosate was measured once during the project, at the April 22, 2016 rain event. It was detected at  $11 \mu g/L$ , below the MCL, as stormwater entering the dry well at SDB. None was detected at CY or in any groundwater samples.

# o Pyrethroids

In contrast, pyrethroids were consistently detected in stormwater at both project sites. The three most commonly observed were bifenthrin, followed by cyfluthrin and cyhalothrin. Stormwater collected at the SDB site, located in a residential neighborhood, had more frequent detections of pyrethroids than samples from the CY.

*Bifenthrin*: As shown in Figure 3, at the CY, bifenthrin was as high as 4 ng/L in stormwater as it entered the grassy swale through the curbcut. None was detected by the time the stormwater reached the dry well or in any subsurface water sample. None of these concentrations were significantly different. In contrast, at SDB, concentrations of bifenthrin were much higher, reaching as high as 100 ng/L. The median values at the stormwater outfall and the dry well were about 10 ng/L. This contrasts with concentrations below the reporting limit found in the groundwater samples. Bifenthrin is one of the most widely used pyrethroids for the control of ants and other insects in residential and commercial settings. Its elevated concentrations at SDB are consistent with common use by consumers. No advisory or regulatory criteria values for bifenthrin have been established. Based on results of the 1-dimensional (1D) vadose zone modeling, it is unlikely to pose a risk to groundwater quality due to its hydrophobic properties and degradation rate in the subsurface. Pyrethroids in general, and bifenthrin in particular, is highly hydrophobic; literature values suggest that about 2% of its concentration in stormwater would be in the dissolved state, the remainder being bound to particles. Modeling results suggest that it would not reach the water table for greater than 3,000 years.

**Figure 3. Bifenthrin concentrations in stormwater and groundwater at the CY (top) and SDB (bottom).** Each point represents the median concentration at each of six sampling sites; the box reflects the  $25^{th}$  and  $75^{th}$  percentile values, and the whiskers represent the minimum and maximum values measured. n = 2 – 5. Units of concentration (y- axis) are ng/L. Sampling groups are as follows: Curb or SWout = location where stormwater first entered the dry well system; Drywell, as runoff entered the well; MW2=vadose zone well; MW3 and 4=downgradient water table; MW1=upgradient well. The blue line indicates the reporting limit.



*Cyhalothrin and Cyfluthrin:* Small concentrations of cyhalothrin and cyfluthrin and two other pyrethroids were detected infrequently at both sites. Cyhalothrin isomers are often added to other mixtures of pesticides to increase their half-lives. They are marketed to consumers as an ant and pest killer under the name Spectracide Bug Off. Not surprisingly, higher levels of cyhalothrin were detected in stormwater at SDB than at CY. None were detected in groundwater. Cyfluthrin (Figure 4) is the third pyrethroid that was detected on more than one occasion, although the median concentration was below the reporting limit. Most of the detections occurred in water table wells (MW 1, 3, and 4). At the CY, the single detection was in a downgradient water table well, while at SDB, cyfluthrin was detected in both stormwater and groundwater in both upgradient and downgradient wells.





The results of cyfluthrin analysis in stormwater and groundwater at SDB presented a pattern of distribution that suggests the detention basin itself, not the dry well, was responsible for the detections at the water table (Figure 4). In this case, there were occasional detections of cyfluthrin in the two downgradient wells (MW 3 and 4) and one upgradient (MW1) monitoring well, yet concentrations in stormwater were much lower than the highest groundwater samples. This is likely explained by the fact that runoff infiltrates through the large detention basin independent of the dry well.

*Permethrin*: This pyrethroid was detected in a subsurface monitoring well a single time at the Corporation Yard (Figure 5). At SDB, permethrin was detected at the storm drain outfall only, suggesting pretreatment sequestered the pesticide. At the CY, permethrin was not detected in stormwater, perhaps because the timing of the sample collections missed the pulse in stormwater that was present in a later phase of the rain event. Due to the presence of permethrin in the vadose zone well (MW2), modeling was performed to assess risk to groundwater quality. Similar to bifenthrin, permethrin is highly hydrophobic. 'Using the most conservation assumptions (low organic carbon, large hydraulic conductivity, only vertical migration), it would not reach the water table at concentrations above the reporting limit (5 ng/L) within the modeling timeframe (3000 years). The source of the permethrin was perimeter spraying that occurred around the office building at the CY a week before the March 2016 storm. This building was approximately 150 feet from the swale surrounding the dry well with nothing but pavement between the two.





Regular detections of other pyrethroids were also made, especially at the detention basin. In all cases but one, concentrations of less than 10 ng/L were found in stormwater, but not in groundwater. This suggests that, in general, the pretreatment combined with the attentuation in the subsurface prevented pyrethroids from reaching groundwater at any level.

#### o Motor Oil

Motor oil was detected in stormwater at both sites; however, at the CY it was at a ten-fold higher concentration than at SDB (Figure 6). Visible oil sheens on stormwater runoff were commonly observed during rain events at the CY. None was detected in groundwater. As shown in Figure 6, the median concentration declined 3-fold or about 65% as runoff moved through the grassy swale to the dry well. None was detected in the subsurface samples (MW 2, 3, 4) downgradient of the dry well. The pattern of motor oil detections were similar at SDB.



**Figure 6.** The concentration of motor oil at the Corporation Yard and Strawberry Detention **Basin.** Notations are as for other figures. N=2. Motor oil concentrations in stormwater and groundwater were not significantly different at the CY due to the small sample size (n=2).

#### o Metals

Metals were the primary contaminant detected in stormwater and groundwater samples at both of the study sites. Of the 20 drinking water metals analyzed, numerous metals were detected at concentrations that fell below the reporting limits. A smaller number of metals were detected at quantifiable concentrations (i.e., above the reporting limit). These metals can be grouped into two categories based on their characteristics: 1) contaminants that are anthropogenic and were elevated in stormwater, and 2) contaminants that are naturally occurring and were elevated in groundwater. AArsenic and chromium were the two primary metals that fell into the first group while aluminum, iron, and manganese fell into the second group.

In many cases, the concentrations of metals dropped by greater than 50%, in some cases by as much as 300% as the contaminants passed through the vegetated pretreatment (grassy swale or water quality basin). Due to the limited the number of samples collected at the curbcut and stormwater outfall (n=2), the ability to identify statistical significance was challenged. While statistically significant differences in concentrations of various metals and other contaminants could not be documented, the differences were environmentally meaningful. For example, the median concentration of aluminum declined about 3-fold as it passed through the grassy swale at the CY, yet significance at the p = 0.05 level was not detected due to the small sample size (n=2) and variability of the data.

*Aluminum*: Significant concentrations of aluminum (AI) were detected in stormwater at the CY. On multiple occasions, levels exceeded the MCL of 1,000 µg/L in stormwater as it entered the grassy

swale from the curbcut (Figure 7). After passing through the grassy swale, the concentration decreased by greater than 2-fold, although this difference was not statistically significant. Although detected in both upgradient and downgradient water table wells, the median concentration of Al in all groundwater samples fell below the reporting limit. Vadose zone modeling suggested that aluminum would not reach quantifiable concentrations (> 50  $\mu$ g/L) the water table within the modeling timeframe of 3000 years.

At SDB, the groundwater samples with detectable concentrations of AI were about one-third of those at the CY, but followed a similar pattern (Figure 7). The highest concentration was measured at the storm drain outfall, and then fell by about 50% when measured at the dry well. The AI levels in vadose and water table well samples were all significantly lower; the median value was below the reporting limit. As reported for the CY, modeling results suggest the concentrations of AI were too low to reach the water table as a result of infiltration through the dry well.

On a few occasions, the concentration of AI at the water table exceeded the MCL (1 mg/L) but these were upgradient wells at both the CY and SDB, suggesting the source of AI was not stormwater that had passed through the dry wells. In fact, aluminum is the most abundant element in the Earth's crust, typically present at a concentration of about 17,000 mg/L. Desorption of naturally occurring aluminum could explain the occasional detections in groundwater. Taken together, AI monitoring and modeling results do not suggest stormwater would pose a risk to groundwater quality.



Figure 7a. Aluminum concentrations in stormwater and groundwater at the CY. Notations are as described in Figure 2. Units of concentration are  $\mu$ g/L. In addition, the red line indicates the MCL; teal blue line is the PHG.



Figure 7b. Aluminum concentrations in stormwater and groundwater at the SDB. Notations are as described in Figure 3. Units of concentration are  $\mu$ g/L. In addition, the red line indicates the MCL; teal blue line is the PHG.

*Iron*: Concentrations of iron in stormwater were also elevated. Concentration of iron in influent stormwater were much greater at the CY than at SDB (Figure 8). Iron concentrations at the CY curbcut were ten-fold greater than the secondary MCL of 300 µg/L but fell by 50% after pretreatment. In groundwater samples, the median concentration was below the reporting limit of 100 µg/L. At SDB, concentrations of iron in stormwater were 5½ times lower than at the CY; however, concentrations in groundwater were similar at both project sites. The handful of detections of iron in groundwater are likely associated with existing conditions given that there were measurable levels of iron in both upgradient and downgradient wells and the abundance of iron in the geological formations of the vadose zone. Differences in iron concentrations in stormwater are likely attributable to differences in surrounding land use. Iron is a relatively mobile metal and modeling results suggest it would take about 7 years for iron to reach detectable levels at the water table at the CY in contrast to >3000 years at SDB. This difference is the result of different input concentrations (0.16 mg/L at the CY and 0.042 mg/L at SDB).

Notable as well is the role of pretreatment on iron concentrations in stormwater. Like aluminum, at the CY the concentration of iron was reduced by about 65% as a result of adsorption and settling in the grassy swale. Also similar to aluminum, about 35% of iron was removed from stormwater at SDB. These types of removal characteristics are consistent with a handful of reports on swales and filter strips that show about a 40% change in the concentration of iron (International Stormwater BMP database, 2014).



Figure 8. Iron concentration in stormwater and groundwater at the CY (top) and SDB (bottom). Notations are as in previous figures.



*Manganese*: Manganese was another metal observed at higher concentrations at the cy and primarily in stormwater. The median concentrations in influent stormwater at the CY was 66  $\mu$ g/L while it was below the reporting limit at SDB (Figure 9; data for SDB not shown).



**Figure 9. Concentrations of manganese at the CY.** Notations are as for other figures. Significant differences in concentration were seen between stormwater and groundwater

The pattern of elevated concentrations of metals (AI, Fe, and Mn) in stormwater at the CY was a major factor in the decision to decommission the dry well at that site. Manganese data also provided greater evidence of the role of the grassy swale in sequestering contaminants. The concentration of Mn fell by 55% as runoff passed through the swale. Slightly elevated concentrations were found in the vadose zone well, but none in the water table wells. Vadose zone modeling suggested that manganese is unlikely to ever reach the water table at measureable concentrations, based on a modeling timeframe of 3000 years.

*Chromium and Arsenic*: The second group of metals are those that are naturally occurring, have a higher concentration in groundwater than stormwater, and included arsenic and chromium. Arsenic and chromium followed the same pattern and none was detected in stormwater at either site. Total chromium generally fell below 10  $\mu$ g/L in groundwater, the MCL for hexavalent chromium (Figure 10). Because the ratio of hexavalent chromium can be as great as 95:5, 10  $\mu$ g/L served as the benchmark that triggered the analysis for hexavalent chromium, a common contaminant in groundwater in the Sacramento region. Hexavalent Cr was analyzed fewer than 10 times. On none of those occasions did the concentration in groundwater exceed the MCL.

**Figure 10.** Total chromium concentration in stormwater and groundwater at the CY (top) and SDB (bottom). Notations described in Figure 3. The blue line represents the reporting limit; the dark red line represents the MCL Total chromium in runoff or groundwater never exceeded the MCL for total chromium of 50 µg/L. No significant differences between sites were noted.





**Figure 11.** Hexavalent chromium concentrations in groundwater at both sites. Notations are as for other figures. The blue line represents the reporting limit and PHG (they are the same number); the dark red line represents the MCL. The highest concentration, 10 ug/L, was measured on a single occasion in a sample from the upgradient monitoring well at the CY. The MCL for hexavalent chromium is 10 µg/L.



The pattern of arsenic (As) concentrations in runoff and groundwater followed that of chromium; it was significantly higher in groundwater than stormwater (Figure 12). In general, deeper wells (MW 3, 4, and 1) had significantly higher concentrations of arsenic than stormwater, as one would expect for a metal that was naturally occurring. However, at SDB, the concentration in samples from the vadose zone was not significantly different than stormwater, likely due to the large amount of stormwater that infiltrates through the basin and dry well, diluting the naturally occurring concentration of arsenic. Arsenic concentrations ranging from 0.50 to 4.4  $\mu$ g/L were found in groundwater at CY and SDB. This range of concentrations is common in the Sacramento region and does not exceed the MCL of 10  $\mu$ g/L for As.

While there is no suggestion of a stormwater contribution that might increase the concentration of either chromium or arsenic in groundwater, a geochemical analysis was undertaken to investigate the possibility that naturally-occurring arsenic and/or chromium could be mobilized by constituents or other contaminants in stormwater (Li, X. 2016). Redox couples and competing anions could influence the dissolved concentration of both contaminants in groundwater. To examine this potential, the relationships between iron, manganese, aluminum, sulfate, and bicarbonate to arsenic and chromium concentrations were examined using non-parametric methods and correlation analysis. This analysis is reviewed later in this report.





In summary, there is no evidence that, during the period of this project, metals posed a risk to groundwater quality. Further, modeled simulations extended for up to 3,000 years suggested that

metals of various valence states will not reach the water table at concentrations sufficient to measure (i.e., the reporting limit) at either project location. The details of this analysis can be found in the modeling portion of this report.

## • Coliform bacteria

High levels of coliform were reported at both sites in stormwater and groundwater. In stormwater, bacteria concentrations >1600 MPN/100 ml were reported on more than one occasion (Figure 12). Most of the detections of coliform in subsurface water samples came from the vadose zone well, although 3 measurements greater than 900 MPN/100 ml were made in the downgradient water table well (MW4). While the dry well could serve as a conduit for this exceedance, infiltration of water through the large water quality basin in which the dry well was situated is just as likely a source, especially given the use of that open space by birds, feral cats, and other small mammals. The transport of viable microbes in the vadose zone does not occur readily; in fact, this is one of the reasons that dry wells can be used in septic systems in the region's rural areas. However, the fact that stormwater runoff contains bacteria is the primary reason that most other states require large setbacks from public supply and domestic drinking water wells. The ubiquitous nature of bacteria in runoff highlights the need for these setbacks.







#### o Nitrate

Median nitrate-nitrogen (NO<sub>3</sub>-N) concentrations above the MCL of 10 mg/L were found consistently in groundwater sampled at the CY and SDB (Figure 13). Concentrations were low in stormwater, elevated in the vadose zone well, and highest in the groundwater at both project sites.

At the CY, low levels were measured in stormwater while groundwater had significantly higher concentrations. This fact suggests that sources other than stormwater infiltrating through the dry wells were the origin. Additionally, samples collected prior to the installation of the dry wells showed the concentration of NO<sub>3</sub>-N to be 13 mg/L (n=2) in MW1, a water table well. This demonstrates that the elevated NO<sub>3</sub>-N levels pre-dated stormwater infiltration via the dry well. The data also shows that the downgradient wells had lower concentrations of nitrate than the upgradient well, although the difference was not statistically significant. This circumstance could be due to dilution of the downgradient wells with stormwater. This phenomenon has been reported elsewhere (LASGRWC, 2010). While the source of the nitrogen at the CY is unclear, it is most likely legacy NO<sub>3</sub> associated with historic agricultural activities in the Elk Grove area. It has been well established that NO<sub>3</sub> can leach out of the soil for decades after its local use ceases (Tesoriero et. al. 2013; Dubrovsky et. al., 2010).

At SDB, the pattern was similar; but with higher concentrations of NO<sub>3</sub> in the vadose zone and water table wells. The one difference at SDB is that the MW1 had lower concentrations than the other wells. During the wet season, MW1 served as the reference upgradient well. But during the spring until winter rains began, groundwater contours (see Tech Memo, Ludhorff & Scalmanini) showed that the groundwater gradient changed; MW1 was downgradient of the dry well and MW3 became an upgradient well. The slightly lower concentrations of NO<sub>3</sub> found in MW1 suggest that stormwater infiltration might have actually diluted and reduced the NO<sub>3</sub> profile in groundwater while NO<sub>3</sub>

concentrations were elevated in MW3. Taken together, the concentration of contaminants in stormwater and groundwater do not present a picture that is consistent with groundwater quality degradation caused by stormwater infiltration through the dry wells.



## **B.** Mobilization of Naturally Occurring Contaminants

In a US Geological Survey (USGS) study, Jurgens et. al. (2008) reported that the naturally-occurring uranium in Modesto were mobilized by constituents in stormwater, raising concerns that similar processes might affect arsenic or chromium at the Elk Grove locations. Both metals are found in geological units bound to commonly occurring metals such as iron and aluminum. Oxidation-reduction reactions associated with influent bicarbonate, oxygen, iron, and/or manganese can alter the valence state of metals that arsenic or chromium are bound to, thus releasing these toxic compounds. Ion exchange reactions associated with sulfides or iron can also cause mobilization of As and Cr. To investigate the possibility that these two metals were mobilized, the concentrations of As and Cr in upgradient and downgradient water table wells was compared and the relationship between key redox metals such as iron and manganese and As and Cr was assessed.

No statistically significant differences between upgradient and downgradient wells were found for either metal, suggesting that mobilization As and Cr as a result of stormwater influx is unlikely to occur. However, at SDB, the differences in hexavalent chromium between upgradient and downgradient wells were noted; the sample size being small (analysis of hexavalent chromium was performed only on those groundwater samples that exceeded 10  $\mu$ g/L total chromium; at SDB, n=5) making differences between the 3 groups difficult to discern.



Figure 15. Hexavalent chromium concentrations in upgradient (MW1) and downgradient (MW 3 and 4) wells at the SDB. The blue line is the reporting limit. No significant differences were found. The MCL for total chromium is 50 µg/L.

Correlation analysis was also performed to investigate the relationship between metals known to be involved in mobilization of As and Cr. No significant relationship was identified, with the exception of a weak relationship ( $p \le 0.06$ ) between iron and arsenic (Figure 16). This finding along with the hexavalent chromium data (Figure 15) suggests further analysis of the potential for metal mobilization would be worth pursuing. The complete summary of this geochemical analysis is attached (Appendix B).



Figure 16. Relationship between dissolved iron and total arsenic in samples collected from water table wells at the Corporation Yard and Strawberry Detention Basin. A weak correlation was detected, strongly influenced by a few data points.

### C. Effectiveness of Vegetated Pretreatment

In most cases, the vegetated pretreatment was effective at reducing the contaminants before runoff entered the dry well. The structural pretreatment feature, i.e., sedimentation well, was ineffective at capturing sediment due to insufficient depth. Therefore, the assumption was made that the overwhelming majority of pollutant load reduction was associated with either the grassy swale at the CY or the water quality basin at the SDB. TSS concentration was the primary metric used to assess the ability to capture sediment and associated pollutants (Figure 16). The water quality basin removed about 50% of TSS, which is in the lower 25th percentile of national data (median value of 65%; (International Stormwater BMP database, 2014), and the grassy swale at the CY reduced TSS by 63%, similar to the national median. The grassy swale might have been more effective at removing TSS due to the uniform nature of the grassy vegetation and the geotextile netting (Enkamat) that was used along the slope and bottom of the swale to stabilize the soil. The water quality basin had vegetation of all varieties and at various degrees of density. There were a couple of small patches of bare dirt where vegetation was poorly established, which could have led to the release of unconsolidated material as stormwater passed through the basin. In contrast, the uniform and stable nature of vegetation at the CY appeared to be more effective at sequestering TSS. On numerous occasions, water ponded in the entire water quality basin due to the volume of stormwater runoff. When this occurred, sediment carried in the runoff covered vegetation with fine particles, which were mobilized by subsequent rain events, which could have increased the sediment load in stormwater.

Figure 17. Total suspended solids (TSS) concentration at the curbcut (curb) or stormwater outfall (SWout) at the CY (left) and SDB (right). Notations are the same as for previous figures.



A similar analysis of reduction in concentration of additional pollutants performed on composite stormwater samples showed significant variability in % reduction at SDB compared to the CY (Table 4).

Contaminant	% reduction		
	СҮ	SDB	
Aluminum	65	50	
Bifenthrin	100	42	
Manganese	53	- 44	
NO3-N	0	-25	
Motor oil	67	55	
TSS	63	50	

Table 4. Percent reduction in contaminants bythe vegetated pretreatment at the CY and SDB.Sample size = 2. Calculations were based solely onflow-weighted composites collected from influentstormwater and at the dry well during two stormevents (January and April 2016).

Large variability in removal efficiency observed here has been reported elsewhere and linked to poor reliability of using percent removal as a metric of BMP effectiveness (Center for Watershed Protection (CWP, 2006). The

CWP's International Stormwater BMP Database Project does not use percent removal efficiency as a metric for this reason. A few of the multiple cautions on the use of this metric noted in the CWP report include 1) percent removal is often more reflective of how "dirty" the influent runoff is than how well the BMP is actually performing, 2) this metric generally has a high variability, and 3) outliers often dominate the averages used in the calculation. It is not possible to rule out that the difference in treatment efficiency of TSS is due to the fact that there was a greater amount of suspended material in stormwater at the CY, so more could be removed. Given these limitations, the results for percent removal at the CY and SDB should be viewed as rough estimates. The one characteristic that does

seem apparent and consistent is that the removal efficiency for the list of six contaminants (Table 4) for the grassy swale at the CY have less variability than for the water quality basin.

# D. Groundwater Gradient Analysis

Results of the gradient analysis at SDB suggested what was assumed to be an upgradient well, MW1, was actually a downgradient well during the dry season, and the downgradient well MW3 functioned as an upgradient well during that period. MW4 was the most downgradient well throughout the year at SDB. This difference altered the interpretation of nitrate data, as discussed in the previous section. In contrast to SDB, the groundwater gradient at the CY remained constant (Table 5).

Table 5. Calculated gradient between dry well and monitoring wells at Corporation Yard (top) and Strawberry Detention Basin (bottom). Gradients calculated in February 2015 and 2016, when mounding near the dry well is observed in the interpolated groundwater level data. These data are based on the high point of the interpolated groundwater surface in the vicinity of the dry well.

	Distance to Dry Well (ft.)	2/1/2015	5/16/2015	10/1/2015	2/15/2016	5/9/2016
CY-MW1	191.4			Upgradient		
CY-MW3	76.71	0.000417	0.000534	0.000612	0.000646	0.000557
CY-MW4	84.39	0.000712	0.000932	0.000898	0.00051	0.000113

	Distance to Dry Well (ft.)	2/1/2015	5/16/2015	10/1/2015	2/15/2016	5/9/2016
SDB-MW1	325.04	upgradient	0.000196	0.000241	upgradient	0.000244
SDB-MW3	58.69	0.001547	upgradient	upgradient	0.001635	upgradient
SDB-MW4	44.08	0.002068	0.000075	0.000122	0.002257	0.000147

# E. Evaluation of Surface Water-Groundwater Connectivity

Modeling results suggested a connection between runoff passing through the dry wells and the water table. One-dimensional modeling results suggested that chloride, and the water that carries it, would move from the bottom of the dry well to the water table (breakthrough time) in about 3-5 days at the CY. At SDB, the breakthrough time was 1-3 days. The window for breakthrough times reflects a range of estimates of the hydraulic conductivity for clay and the thickness of these units at the two sites. In other words, in less than 1 week at both sites, water that infiltrated through the dry well should reach the water table. Factors such as runoff volume, rain intensity, and degree of saturation in the vadose zone would also influence the timing.

The evidence from changes in electric conductivity of groundwater at SDB was weaker. This was due to the fact that during the winter, the water table rose to 51 feet below ground surface (bgs) above the bottom of the screen (extending from 22.5 to 52.5 bgs) in the vadose zone well. This permitted runoff

from the dry well to laterally move through a sandy unit and enter the vadose zone wells, causing an increase in conductivity. There was a spike in the specific conductance (SC) in the vadose zone sensor within about 75 minutes after the start of dry well infiltration (Figure 18). This very rapid change is unlikely to occur as a result of vertical movement of runoff, but could occur as a result of lateral movement. Additional sensors in the deeper water table wells would have provided the needed data, however, the cost of additional analysis prevented further efforts.

A more ambiguous picture emerged at the CY. At this site, no change in SC was noted in either the vadose zone or downgradient well. This is likely due to the relatively limited volume of stormwater runoff that entered the dry well relative to depth of the water table. While the vertical separation between the bottom of the dry well and the water table was 9 feet at SDB, it was 32 feet at the CY. Given the depth of the water table and the small volume of water that passed through the dry well, it is not surprising that changes in SC were not detected.

## F. Flow and Infiltration Volume

Flow measurements into the dry wells at each site were calculated for each rain event (Table 6). Due to the drought and technical challenges, flow measurements for the 2014-15 water year could not be accurately made. During the second year of monitoring, the average flow rate at the CY was about 15 gallons per minute (gpm). This low flow rate was associated with a number of factors including: 1) the small volume of runoff in the drainage shed, which was only 0.64 acres, 2) the relatively small size of the rain events, and 3) the composition of the vadose zone, which had only a few geologic units that could accept water.

**Table 6.** Flow rates and infiltration volumes through the dry wells, 2015-16 water year. Average flow rates through the dry wells at the CY and SDB, based on estimates made under near static conditions. Estimates for total precipitation were made from rain gauges at each site, except at SDB in March and April, when rain gauges were vandalized. These data were collected from the closest county monitoring gauge (Laguna at Waterman).

	Corporation Yard			Strawberry Detention Basin		
Event Date	Average flow (gpm)	Total volume infiltrated (gallons)	Total rainfall (inches)	Average flow (gpm)	Total volume infiltrated (gallons)	Total rainfall (inches)
11/2/2015	8.46	1,000	0.085	46.72 (0.1 cfs )	28,500	0.53
1/5/2016	26.38 (0.06 cfs)	8,400	0.93	36.09	9,200	1.09
3/4/2016	10.41	1,600	0.20	21.54	3,200	0.2
4/22/2016	14.29	1,300	0.22	20.15	2,500	0.2

The average rate of infiltration at the CY was variable throughout the 2015-16 water year, suggesting that the rate of flow was linked to the size of the storm. Another factor that appears to have influenced the flow measurements is the lack of saturation in the vadose zone over the course of the rainy season. The area at the CY surrounding the dry well is 95% impervious, therefore the dry well provided the

primary source for runoff to infiltrate the subsurface. Due to these conditions, the vadose zone received little water, remained unsaturated throughout the winter, and did not limit the infiltration rate through the dry well.

At the CY, most of the water in the drainage shed was captured in the dry well whereas at SDB, a very small portion of the large volume of runoff was infiltrated through the dry well, although much larger volumes of water flowed through the dry well as compared to the CY. At this site, the large area of the drainage shed produced much greater quantities of water than the single dry well at the site could absorb. The average flow rate at SDB was 31 gpm. The highest infiltration rate was 47 gpm, or about 0.1 cfs, the rate used by some professionals as the design standard. It is likely that the infiltration rate was controlled by the degree of saturation in the vadose zone. As the rainy season progressed, the flow measurements through the dry well decreased by greater than 50% and total volume of stormwater that was infiltrated (Table 8) declined. These decreases appear to be primarily due to saturation of the vadose zone by runoff that infiltrates into the water quality basin independent of the dry well.

The total infiltration volumes during the 2015-16 water year were estimated using data from four rain events (Table 8). The total amount of rain for the 2015-16 water year, based on data from the Waterman/Laguna Creek gauge station, was 13.72 inches. The four storms for which samples were collected reflected about 20% of this total. Using that data, we estimated the total volume infiltrated for the entire water year at the CY was 0.2 acre/feet (AF) and 0.7 AF at SDB. The amount of runoff produced at SDB over the course of a water year such as in 2015-16 would be about 132 AF. Assuming 50% of that volume would not be captured and flow into Strawberry Creek (environmental flows), about 116 AF would be available for recharge. Given the estimated recharge capacity of each dry well, over 100 dry wells would be needed to capture this volume of runoff.

In considering this hypothetical, it is worth noting that both the average flow per event and the total gallons infiltrated at SDB decreased over the course of 2015-16 water year. Saturation of the vadose zone in and surrounding the detention basin is the most obvious explanation. This raises the question of the prudence of placing dry wells in locations where the subsurface is likely to become saturated quickly, such as water quality basins. An alternative approach would be to construct dry wells throughout the drainage shed in order to minimize the chance of reduced infiltration rates and volumes as the rain year progresses. Such a strategy is used in certain neighborhoods in Portland, OR, where dry wells are located on multiple street corners in areas with large amounts of hardscape.

### G. Fate and Transport Modeling

Results of the vadose zone modeling suggested that many contaminants are unlikely to ever reach the water table (Table 7 and 8). Included in this group are aluminum, manganese, DEHP, and permethrin, a pyrethroid. Iron, a more water soluble metal, would reach the water table in less than a decade. The three most mobile contaminants were the volatile organic tertiary butyl alcohol, detected at both the CY and SDB, and two pesticides that were not evaluated in the monitoring effort, fipronil and imidacloprid. All three would reach the water table on the order of days. Input concentrations used reflected the dissolved fraction. In addition to contaminants detected at the two project sites, modeling was used to

analyze the behavior of two pesticides, fipronil and imidacloprid, whose use is becoming more commonplace. Both of these pesticides are highly water soluble and therefore, are likely to migrate quickly through the vadose zone. Additionally, there are many other contaminants that were not modeled that might pose a concern. Guidance on performing 1-D modeling is being developed by UC

Davis hydrologists to inform stormwater and groundwater managers of possible methods to conduct their own assessment of contaminants of concern in their communities.

These results call into question the value of performing extensive groundwater monitoring. Given that many of the contaminants analyzed are unlikely to reach the water table in measurable concentrations into the indefinite future, the value of constructing a network of monitoring wells and conducting expensive analysis is unclear. This is likely the reason that in Oregon, new installations of dry wells require 1-D modeling using local data for the input parameters. For a limited number of water soluble contaminants, construction of a small network of water table wells could provide assurance that groundwater was being protected.

**Table 7. Modeling results for selected contaminants at the Corporation Yard and Strawberry Detention Basin.** Input concentration are dissolved, travel time through the vadose zone (reporting limit) under average conditions; time it would take for the concentration to reach the lowest regulatory level under the worst case scenario, and the peak concentration under worst case scenario after 500 years.  $\Psi$  = does not reach relevant value after 3000 years; n/a = not applicable, no regulatory value. Fipronil and imidacloprid were not measured at either site, only modeled. \* The secondary MCL was the criteria value used to evaluate these contaminants.

Contaminant and input concentration	Travel time to water table (reporting limit)	Worst case time to regulatory level	Worst case peak concentration at WT in 500 yrs.
Corporation Yard	CONTRACTOR OF ST		
AI 0.042 mg/L	ψ	Ψ	0.04 mg/L
DEHP 0.062 ug/L	ψ	Ψ	0.06 ug/L
Fe 0.16 mg/L	7 yrs.	Ψ	0.160 mg/L
Mn 10 ug/L	ψ	Ψ	10 ug/L
permethrin 2.4 ng/L	ψ	n/a	1.70 ng/L
TBA 19 ug/L	12 days	12 days*	18 ug/L
Fipronil 0.5 ug/L	134 days	n/a	0.47 ug/L
Imidacloprid 0.9 ug/L	17 days	n/a	0.85 ug/L
Strawberry Detention	Basin		Sector Sector Sector
Al 6 µg/L	ψ	Ψ	6 µg/L
Bifenthrin 11 ng/L	470 yrs.	n/a	10 ng/L
Fe 42 µg/L	ψ	Ψ	42 µg/L
Mn 14 ug/L	Ψ	Ψ	14 ug/L
TBA 20 ug/L	19 days	4 days*	20 ug/L
Fipronil 0.5 ug/L	154 days	n/a	0.47 ug/L
Imidacloprid 0.9 ug/L	20 days	n/a	0.89 ug/L

# H. Volume and Pollutant Load Reduction

In 2015-16, the volume of stormwater that was captured in the dry wells at each site, and therefore diverted from local waterways, was estimated to be 61,200 gallons at the CY and 216,900 gallons at SDB. This is equivalent to approximately 0.2 AF at the CY and 0.7 AF at SDB. This very large difference is primarily related to the volume of runoff, which is dependent on the size of the two drainage sheds: 0.64 acres at the CY and 168 acres at SDB, and precipitation amount, 13.5". The mass of pollutants diverted from local waterways based on one year's worth of data (2015-16) was significant (Tale 8).

Pollutant	Location	Gallons infiltrated 2015-16 WY	Median concentration. (µg/L)	Total mass (g)
Aluminum	CY	61,235	2,850	660
	SDB	216,900	510	420
Iron	CY	r.	3,000	695
	SDB	216,900	530	435
Bifenthrin	CY	61,235	3	0.0007
	SDB	216,900	14	0.012
TSS	CY	61,235	29	6720
	SDB	216,900	32	26,680
NO3-N	CY	61,235	2	580
	SDB	216,900	4	3,285

# Table 8. Mass of various contaminants and suspended solids diverted from local waterways by the infiltration of stormwater through dry wells.

# I. Scientific Literature and Reports

Part of the analytical work performed for this project involved reviewing the scientific literature and reports produced by Underground Injection Control System (UIC) programs in other states. A series of factsheets and an annotated bibliography contain the results of these investigations.

The first factsheet, *Dry Wells: Uses, Regulations, and Guidelines in California and Elsewhere*, summarizes the current state of dry well regulation in California as well as regulations governing neighboring states. The US Environmental Protection Agency (US EPA) retains primacy<sub>1</sub> over dry wells in California. They require registration of new wells via a web-based form as well as provide information on design and appropriate siting of dry wells. They authorize the Regional Water Quality

<sup>&</sup>lt;sup>1</sup> Pimacy refers the management of the Class V Underground Injection Control Program, associated with shallow infiltration of stormwater. In some cases the state assumes rule-making, in other cases, the US EPA retains that authority.

Control Boards or other local entities to promulgate standards more restrictive than US EPA's. The Regional Water Quality Control Boards currently do not have standards for dry wells, but many local governments do. In Southern California, for example, many local governments have written standards and design guidelines for dry well use and permit their installation and construction. California's antidegradation policy, the requirement to protect high quality surface or groundwater unless overriding state needs are demonstrated, sets the regulatory foundation for assessing the safety of dry well use. Some state regulations, specifically Department of Water Resources Bulletin 74-81, act as a barrier to using dry wells. This DWR bulletin establishes standards for the construction, oversight, and closure of water wells. The bulletin also prescribes that dry wells and drainage wells fall under the purview of Bulletin 74-81. The challenge with applying these standards to dry wells is that the regulations are designed to limit access of surface water to the subsurface, while dry wells are designed to increase infiltration of surface water into the vadose zone. Considering this bulletin was written in 1981, then updated in 1990, it does not reflect current thinking on the management of stormwater and in fact, serves as a barrier to using stormwater as a resource. In contrast to California, neighboring states make extensive use of dry wells, also known as UICs (underground injection control systems) for stormwater management. Washington and Oregon both have a registration process and permitting of UICs, depending on the number of UICs and associated risks. They have set design and siting requirements, including a 500-foot setback from a public supply well, prohibition in areas in which hazardous chemicals are used (industrial areas, vehicle servicing stations, gas stations, etc.), and a requirement for pretreatment, with an exclusion for roof runoff.

The second factsheet, Oregon's Experience with Dry Wells: The UIC Program, reviews the regulations and practices of communities in Oregon, a state with tens of thousands of dry wells. Most dry wells are used in Oregon as a stormwater management tool. In some areas of Portland, they are the only drainage infrastructure. It is common to utilize drainage inlets in streets and roads to collect stormwater, convey it to a sedimentation manhole that removes particulates and associated pollutants, and then pipe the runoff to the actual UIC for infiltration. Common guidelines for use include a 5 -10 foot vertical separation from the bottom of the dry well to the water table, prohibition of use in areas with hazardous substances, and regular monitoring to ensure stormwater runoff does not contain contaminants at concentrations that exceed the Maximum Allowable Discharge Level (MADL), commonly equivalent to the MCL. To ensure this is the case, regular monitoring is required for a variety of common stormwater pollutants. If exceedances occur, a protocol for mitigation is set in motion that involves additional monitoring, source identification and control, and closure if necessary. In addition, 1-D vadose zone modeling is required for all new dry well installations of any significant size. The UIC Program in Oregon has been in place for close to 20 years without any detectable groundwater guality degradation. In a 15-year period, there were 25 exceedances of the MADL out of 45,000 stormwater samples tested. This suggests that the 2-stage dry well systems being used are effective at protecting groundwater. The Annotated Bibliography produced as part of this project contains literature from the 1980s to the present that addressed the risks of groundwater quality degradation associated with the use of dry wells. A small number of studies have been conducted to test the safety of using dry wells for stormwater management and aquifer recharge. Three highly informative analyses stood out among those reviewed. The first was conducted by the US EPA to determine if existing federal UIC regulations were sufficient to mitigate risks to underground sources of drinking water, if additional federal regulations were necessary, and options for well regulation (US EPA, 1999). The second is an in-depth study of groundwater and drinking water quality in Modesto, CA conducted by USGS (Jurgens et al., 2001). The third, the Los Angeles and San Gabriel Rivers Water
Augmentation Study, was conducted to assess the potential for stormwater infiltration practices to contaminate groundwater as well as to assess the volume of water that could be collected for recharge.

The US EPA reviewed existing literature, conducted a survey of state and regional UIC programs, investigated incidents of groundwater contamination associated with dry well use, and reviewed common pollutants in stormwater runoff. The study included an assessment of construction, siting, design, operation, and BMP standards and guidelines for dry wells used in different states and regions. Proper siting and preventative measures, such as the use of pretreatment, prohibiting dry wells in high-risk areas, and monitoring were identified as practices that can greatly reduce the risk of contamination. Additionally, providing guidance documents and BMP recommendations, developing spill prevention plans, understanding local geology, and educating industry and the public on best practices can further minimize risk. Although some states' UIC programs are stronger than others, many have additional regulations and/or recommendations on dry well use beyond what US EPA recommends. After this study was concluded, it was determined that Class V UICs do not pose a threat to drinking water because documented cases of contamination associated with dry well use are rare. It was decided that additional Federal UIC regulation was not warranted (Federal Register, 2002).

USGS conducted a large nationwide study assessing drinking water quality in six cities, one of which was Modesto, CA. Dry wells are Modesto's primary stormwater management practice and have been in use there since the 1950s. This study shed light on the potential long term effects of infiltrating runoff through dry wells on groundwater quality. The shallow part of the aquifer under the study area was unconfined, allowing contaminants to move downward relatively freely to the semi-confined, higher clay soils below. The USGS study found that urban contaminants collected from groundwater monitoring wells did not exceed their respective MCLs. The only two contaminants detected above the MCLs, uranium and nitrate, were associated with the geology of the region and historic agricultural practices, respectively. Both contaminants were detected in high concentrations in the shallow monitoring wells, but similarly to other contaminants, their concentrations decreased with depth. Volatile organics, associated with urban land use, were generally detected beneath urban land while pesticides were present beneath both agricultural and urban land uses. Aguifer recharge influenced the shallow zone of the aquifer, and to a lesser extent the intermediate zone. Key organic and metal contaminants examined in these aquifer zones were associated with agriculture, not urban land use. However, elevated alkalinity, a product of both agricultural and urban irrigation practices, increased desorption of uranium from aquifer sediment.

The Los Angeles and San Gabriel Rivers Water Augmentation Study tested a variety of infiltration practices over a range of land uses. Their study included only two sites with dry wells, one commercial and one residential. The various infiltration practices examined in this study did not appear to contribute to groundwater contamination during the six-year period of the study. The use of a dry well with no pretreatment at the commercial site with a relatively high water table did not cause detectable vadose zone or groundwater contamination. Additionally, the use of a dry well at the residential site did not contribute to vadose zone contamination. All pollutant concentrations in groundwater at the commercial site showed variable or statistically significant negative trends, suggesting that pollutant concentrations did not build up in the groundwater over the 6-year period of this study. Furthermore, most pollutant concentrations in the vadose zone at both sites showed variable or statistically significant negative trends, by well contained few pollutants (sampling did not occur at the entry point to the dry well), b) the timing of the vadose zone sampling missed the pulse of pollutants, and/or c) pollutants did not accumulate near the vadose zone monitoring well. The results of this study also suggested that if infiltration practices were

widely developed in the Los Angeles region, it would result in a 384,000 acre-feet/year increase in groundwater recharge, enough to supply 750,000 Southern California families for a year.

Additional reports included in the Annotated Bibliography were studies that occurred in in Arizona, Hawaii, Montana, New Jersey, Oregon, Washington and Wisconsin. These reports addressed issues of dry well design, siting, hydrogeology, stormwater contaminants, and monitoring. Siting of dry wells should be based on site-specific hydrogeological conditions, including vadose zone lithology and land uses in the area. Ideally dry wells should be built in areas of multi-layered soils with sufficient clay composition to attenuate pollutants, areas where runoff carries low levels of contaminants, and where the water table is low. Several studies recommend a separation distance between the bottom of the dry well and the seasonal high water table level ranging from 5 to 75 feet. Various reports suggested placing dry wells a minimum of 100 feet from water supply wells to avoid contamination associated with the lateral migration of stormwater into cracks in water well casings. Generalized models cannot be used to predict the potential of a dry well to contaminate groundwater because contamination heavily depends on site-specific conditions and hydrogeology. The design of dry wells can vary depending on site specific conditions, runoff constituents, and land use, but pretreatment features were highly recommended to remove sediments and contaminants from stormwater entering the well. Pretreatment can also prevent clogging, thereby extending the lifespan of the dry well. Dry well systems with both vegetated and structural pretreatments are the most effective at removing contaminants from stormwater runoff. PAHs and other contaminants are often adsorbed to sediments in the bottom of dry wells and surrounding area. Periodic monitoring of both stormwater, dry well sediments, and groundwater was recommended by some studies to understand which contaminants are entering the well and which, if any, are attenuated. Operations and maintenance for the dry wells should be periodically performed to remove/replace sediment and gravel at the bottom of the wells.

The quality of the field studies reviewed in the annotated bibliography varies widely. For example, one high quality study used radioisotopes to determine the age of the groundwater and thereby accurately estimate the influence of surface water on groundwater, while another relatively poor quality study used analytical instruments which had a higher reporting limits than the MCLs for some of contaminants, making it impossible to determine exceedances. In several studies, the dry wells used had no pretreatment features (Barraud et al., 1999; Lindemann et al. 1999) so it was difficult to compare the risk to groundwater quality from these studies with other studies that evaluated impacts of runoff that passed through dry wells with pretreatment. Due to the variability in quality of different studies, it was challenging to interpret and compare the results.

Two field studies in Arizona were conducted to assess potential contamination linked to dry well infiltration. In both studies, stormwater, sediment, vadose zone and groundwater sampling was performed, allowing researchers to analyze more stages of contaminant reduction or attenuation. In one of the studies, however, only grab samples were collected (Wilson et al., 1989). Grab samples represent the moment in which they were collected, whereas composite samples represent the entire duration of the rain event. The highest quality study of the two, conducted in Tucson, sampled eight dry wells from residential, commercial, and industrial areas (Olson et al., 1987). This study found that metals were adsorbed or attenuated in the vadose zone and that organic pollutants, particularly semi-volatiles, appeared to undergo adsorption and accumulated in the dry well settling chamber over time. The Tucson study concluded that runoff infiltration had not degraded groundwater quality because no contaminants, except for trace amounts of zinc, were detected in water pumped from public supply wells located near dry wells.

The Tucson, Arizona study, along with several other studies reviewed, found that infiltration of stormwater via dry wells did not degrade groundwater quality (Olson, 1987; Dallman et al., 2012; LA and San Gabriel Water Augmentation Study, 2010). Stormwater infiltration may even dilute concentrations of contaminants already present in groundwater (Dallman et al., 2012). Other studies similarly found that stormwater infiltration via dry wells did not degrade groundwater quality, however, the lower quality of those studies makes it difficult to interpret the results and compare them with studies of higher quality (Barraud et al., 1999; Lindemann, 1999; Wilson et al., 1989).

#### V. Performance Goals

#### A. Performance Goal No. 1

The project met the goal of assessing the potential for groundwater contamination associated with the use of dry wells. In general, contaminant concentrations in groundwater were not detectable. In a few cases, contaminant levels in groundwater did exceed the MCL; however, this was not attributable to infiltration through the dry well (Table 9). A single instance of permethrin detected in a vadose zone well sample collected at the CY, could be linked to infiltration through the dry well. The source of the pyrethroid was perimeter spraying for ants at the CY office building. One week later, on March 4, 2016, there was a large rain event from which stormwater and groundwater samples were collected. It is likely that the stormwater sample collections missed the pulse of permethrin that entered the dry well. Modeling results suggested that it is unlikely that this pesticide would ever reach the water table at measurable concentrations (> 5 ng/L).

Contaminant	Location of detection above criteria value	Explanation	Evidence for dry well linked degradation
Aluminum	CY MW1 and 3	Both upgradient and downgradient wells had a single measurement above the MCL; 220 year breakthrough time for Al to reach the aquifer at detectable levels	Negative
Iron	CY MW1, 3, and 4; SDB MW 1 and 4	Both upgradient and downgradient water table wells had some detections above secondary MCL; 4 year travel time to reach aquifer at detectable levels	Negative
Vanadium	All water table wells at CY and SDB	Both upgradient and downgradient water table wells exceeded notification levels; concentration similar to wells in region	Negative
Manganese	SDB MW3 and 4 (downgradient)	Median values in stormwater and down- gradient wells were < reporting limit but a few values exceed the secondary MCL in groundwater; travel time from dry well 4 years	Negative
Nitrate	SDB and CY MW1, 3, and 4	All water table wells exceed MCL of 10 mg/L. Very low concentrations in stormwater; historic agricultural use in area suggests legacy NO <sub>3</sub>	Negative

#### Table 9. Contaminants in groundwater that exceeded the criteria value.

Another target for Performance Goal No. 1 addressed the difference in pollutant concentration in upgradient and downgradient wells. There were no instances when the downgradient water table well had significantly higher concentrations of a pollutant than the upgradient well. The one difference that was noted showed the reverse relationship: the upgradient water table well at the CY had a significantly higher concentration of NO<sub>3</sub> than MW3, a downgradient well. This suggests that stormwater moving through the dry well could have diluted nitrate concentrations, improving the quality of groundwater.

#### B. Performance Goal No. 2

The second key performance goal was to assess the effectiveness of various pretreatment features at removing suspended solids and contaminants (TSS and f) from stormwater. As noted earlier, the sedimentation well was not sufficiently deep to permit settling of suspended material. The depths ranged from 1-2 feet below the invert of pipe connecting the sedimentation well with the dry well. As a consequence, the vegetated pretreatment feature was relied upon to remove sediment and contaminants from stormwater. Statistically

significant decreases in concentrations of contaminants as a result of pretreatment were seen in rare cases. There were numerous cases where a large reduction in concentrations, on the order of 2-3-fold, were observed. However, due to the small sample size (n=2 where influent stormwater was measured), statistical significance could not be detected. Setting the target of statistical significance in the first place reflected a lack of appreciation for the high variability in this metric, as previously discussed. However, clearly, the pretreatment feature was effective at removing large amounts of contaminants. If the sedimentation well had been designed appropriately, the experience of others suggests that pollutant concentrations could have been reduced by over 90%. Specifically, data from Torrent Resources<sub>2</sub>, an Arizona-based firm that has been designing and installing dry wells for 40 years, suggests that a sufficiently deep sedimentation well removes about 50% of suspended material and associated pollutants (Report from HydroSystems, 2011). Coupled with a grassy swale similar to the one used at the CY, which achieved about the same degree of pollutant removal, the overwhelming majority of contaminants would be expected to be removed from stormwater prior to it entering the dry well.

Another outcome indicator/target of Performance Goal 2 was to determine how often the dry well system would require cleaning. Because the sedimentation well did not function properly, sediment did not accumulate and no maintenance was required. In the dry well itself, small amounts of debris accumulated on the top of the gravel layer. It was estimated that twice yearly inspections to assess the need for debris removal from the top of the dry well should be sufficient.

#### **VI. Discussion/Conclusions**

This project produced no evidence, either from direct monitoring, the review of the literature, or from modeling, that dry wells pose a risk to groundwater quality when appropriate siting and design considerations are used.

Two different stormwater-groundwater contaminant patterns were observed: one in which the concentration of contaminants were elevated in stormwater but low in groundwater, and the reverse,

<sup>&</sup>lt;sup>2</sup> This mention does not constitute an endorsement of services or products.

where contaminants were elevated in groundwater but detected at low levels in stormwater. These patterns are consistent with the findings of the LASGRWC's Water Augmentation Study (2010) which examined the risk to groundwater quality degradation associated with the use of LID features, including dry wells. The failure to detect contaminants in water table samples is linked to both effective sequestration and slow movement through the vadose zone. Modeling suggested that, in most cases, it would take centuries beyond the duration of a short project such as this one to be able to detect contaminants at the water table. Vadose zone modeling also suggested that some contaminants will never reach the water table in measurable concentrations. These findings raise the question of the value of monitoring the groundwater given the extended, in some cases centuries-long, period of migration of many contaminants. This appears to be the conclusion that the Department of Environmental Quality in Oregon has reached. They require vadose zone modeling and stormwater monitoring to ensure groundwater safety of UIC systems.

The second pattern observed was linked to naturally occurring metals such as arsenic and chromium. Concentrations in the groundwater were not found to be a consequence of stormwater infiltration. However, the risk of desorption of these metals due to exposure to constituents in stormwater was investigated. The analysis of redox reactions that could result in increased solubility of As or Cr showed that this is unlikely to occur because the relevant constituents in stormwater, such as manganese or bicarbonate, were not present in sufficient concentrations to cause solubilization or desorption reactions. In fact, some of the data, such as for nitrate, suggested that groundwater quality might have actually been improved by dry well infiltration. Specifically, water table wells downgradient of the CY dry well had slightly lower concentrations of nitrate than those upgradient, although this finding was not statistically significant.

Additional research on two contaminant-related issues would be useful to further characterize the risks associated with dry well use. First, development of risk reduction strategies related to water soluble pesticides such as fipronil and imidacloprid is needed. These pesticides have short transit times through the vadose zone, therefore removal prior to entering the dry well is the key to protecting the aquifer. Further information is needed on their concentration and association with various urban land uses. Since these pesticides are unlikely to be captured by sedimentation, identification of the nature of vegetated pretreatment that would work best to reduce their concentration in runoff would be very useful. For example, do broadleaf plants vs. grasses more efficiently sequester these pesticides? Second, greater knowledge of the risk of desorption of naturally-occurring arsenic and chromium would also increase confidence in using dry wells. While the preliminary analysis performed as part of this project did not find evidence of desorption, a longer-term and more carefully-crafted study would be helpful to bolster this preliminary data.

Infiltration rates at the two sites varied. At the CY, they were quite modest, averaging 15 gpm. The rate was 3.5 times higher at SDB, averaging 57 gpm. The difference between the two sites is likely linked to the size of the drainage area and therefore the volume of runoff, differences in the lithology, degree of saturation of the vadose zone, and the depth to the water table. A rough estimate of the total volume infiltrated over the course of the 2015-16 water year was 0.2 AF at the CY and 0.7 AF at SDB. If precipitation amounts had reached the yearly average for the Sacramento region, the SDB dry well could have passed about 1 AF for the year. This suggests that significant amounts of stormwater can be used to recharge the aquifer even in the presence of clay soils.

In conclusion, dry wells provide an option for reducing the harmful effects of hydromodification on aquatic ecosystems while at the same time serve as a tool for adapting to the changing precipitation

patterns associated with climate change with minimal risk to the aquifer. The keys to minimizing the risk are a) proper siting, design, and maintenance, b) periodic stormwater monitoring, and c) vadose zone modeling, in order to ensure that important safeguards are in place.

#### Citations

Bandeen, R.F. 1987. Additional case study simulations of dry well drainage in the Tucson basin." Pima County Transportation and Flood Control District. Tucson, Posted at: http://arizona.openrepository.com/arizona/bitstream/10150/306934/1/wrrc\_219.pdf

Barraud, S., Gautier, A., Bardin, J.P., and V. Riou. 1999. The impact of intentional stormwater infiltration on soil and groundwater. Wat. Sci. Tech 39 (2): 185-192.

City of Portland Underground Injection Control Program documents. Posted at: https://www.portlandoregon.gov/bes/50442

Dallman, S. and M. Spongberg. 2012. Expanding local water supplies: Assessing the impacts of stormwater infiltration on groundwater quality. The Prof. Geographer. 64: 1 – 18.

Dubrovsky, N.M., Burow, K.R., Clark, G.M., Gronberg, J.M., Hamilton P.A., Hitt, K.J., Mueller, D.K., Munn, M.D., Nolan, B.T., Puckett, L.J., Rupert, M.G., Short, T.M., Spahr, N.E., Sprague, L.A., and Wilber, W.G., 2010, The quality of our Nation's waters—Nutrients in the Nation's streams and groundwater, 1992–2004: U.S. Geological Survey Circular 1350, Posted at: <u>http://water.usgs.gov/nawqa/nutrients/pubs/circ1350</u>

Federal Register. 2002. Underground Injection Control Program—Notice of Final Determination for Class V Wells; Final Rule. 40 (144): 39584-39593.

International Stormwater BMP Database. 2014. Posted at: http://www.bmpdatabase.org/

HydroSystems Inc. 2011. Advances in Stormwater Drainage - The MaxWell Plus Drywell; A Case Study in Phoenix Arizona. Consultant report prepared for Torrent Resources.

Jurgens, B.C., K.R. Burow, B.A. Dalgish, & J.L. Shelton. 2008. Hydrogeology, water chemistry, and factors affecting the transport of contaminants in the zone of contribution of a public-supply well in Modesto, eastern San Joaquin Valley, California. National Water Quality Assessment Program, U.S. Geological Survey, Scientific Investigation Report 2008-5156.

Lindemann, J. 1999. Evaluation of Urban Runoff Infiltration and Impact to Groundwater Quality in Park Ridge, Wisconsin. Master's Thesis, College of Natural Resources, University of Wisconsin, Stevens Point, Wisconsin.

Office of Environmental Health Hazard Assessment. 2016. Dry Wells and the Risk of Groundwater Contamination: An Annotated Bibliography. California Environmental Protection Agency. Posted at: <u>http://oehha.ca.gov/media/downloads/ecotoxicology/document/annotbibliodrywells2015.pdf</u>

Olson, K.L. 1987. Urban stormwater injection via dry wells in Tucson, Arizona and its effect on groundwater quality. Master's Thesis, Department of Hydrology and Water Resources, University of Arizona. Posted at: <u>http://watershedhealth.org/programsandprojects/was.aspx</u>

Tesoriero, A.J., Duff, J.H., Saad, D.A., Spahr, N.E., Wolock, D.M. 2013. Vulnerability of Streams to Legacy Nitrate Sources. Env Sci Tech, 47(8), 3623-3629.

The Los Angeles and San Gabriel Rivers Watershed Council. 2005. Los Angeles Basin Water Augmentation Study, Phase II Final Report. Los Angeles, CA. Posted at: <u>http://watershedhealth.org/Files/document/265\_2005\_WAS%20Phase%2011%20Final%20Report\_200\_5.pdf</u>

US EPA. 1999. The Class V Underground Injection Control Study: Volume 3, Stormwater Drainage Wells Office of Ground Water and Drinking Water. 96 pgs. Posted at: <u>https://www.epa.gov/uic/class-v-underground-injection-control-study</u>

Wilson, L.G., Osborn, M.D., Olson, K.L., Maida, S.M., and L.T. Katz. 1990. The groundwater recharge and pollution potential of dry wells in Pima County, Arizona. Groundwater Monitoring & Remediation. Summer: 114-121. Posted at:

http://arizona.openrepository.com/arizona/bitstream/10150/306470/1/wrrc 250 w.pdf

Wright Water Engineers and Geosyntec Consultants, 2007. Frequently Asked Questions Fact Sheet for the International Stormwater BMP Database: Why does the International Stormwater BMP Database Project omit percent removal as a measure of BMP performance? (Posted at: <u>www.bmpdatabase.org</u>)

# Appendix 5.2

# **UC Davis Technical Memorandum**

#### **Technical Memorandum**

Date: February 24, 2017

To: Barbara Washburn, PhD, Cal EPA Office of Environmental Health and Hazard Assessment From: Emily Edwards, BS, UC Davis department of Land, Air, and Water Resources

RE: Results of Stormwater Contaminant Vadose Zone Fate and Transport Modeling for Elk Grove Dry Wells Project

Presented here are the results of contaminant transport modeling performed using the modeling software HYDRUS 1D for the Corporation Yard (CY) and Strawberry Detention Basin (SDB) drywell sites. The goal of the vadose zone contaminant transport modeling analysis was to estimate the potential groundwater quality effects of allowing stormwater to infiltrate through the Elk Grove drywells for hundreds of years into the future. Eight scenarios were run for each contaminant at each site. The scenarios represent a range of possible vadose zone attenuation capacities, and contaminant input concentrations as found in stormwater (total and dissolved concentrations). Because dissolved concentrations were not measured during Elk Grove stormwater sample analysis, dissolved concentrations had to be estimated using equations and literature values. Methods for calculating dissolved concentrations are explained in Appendix A. Different scenarios were run to attempt to capture the possible worst case results along with more realistic results.

Most of the variables used in the modeling are sediment hydraulic properties or contaminant chemical properties that affect transport. The variables that were changed to create the eight scenarios are contaminant input concentration, saturated hydraulic conductivity (Ks) values, and fraction organic carbon (foc) values for organic contaminants or soil-water partitioning coefficient (Kd) values for metals. The results obtained using total stormwater concentrations, higher Ks values, and lower foc or Kd values provide worst case scenario results. The results obtained using dissolved stormwater concentrations and lower Ks values are more representative of actual site conditions, because these Ks values were calculated using site data. Foc and Kd values were obtained from relevant literature, and it is not possible to determine which of those values are more representative of reality without extensive laboratory testing.

Presented here are also the results of contaminant transport modeling performed using the modeling software HYDRUS 1D for sediment profiles representative of subsurface conditions in

Los Angeles, CA. The goal of the vadose zone contaminant transport modeling analysis was to estimate the potential groundwater quality effects of allowing stormwater to infiltrate through drywells installed in Los Angeles for hundreds of years into the future. Four scenarios were run for most selected contaminant. The scenarios represent a range of possible vadose zone attenuation capacities, and measured total and calculated dissolved contaminant input concentrations. These different scenarios were run to attempt to capture the possible worst case results along with more realistic results.

Most of the variables used in the modeling are sediment hydraulic properties or contaminant chemical properties that affect transport. Average case and worst case sediment profiles were created to represent different possible vadose zone compositions based on driller's logs from the Los Angeles area. Average or literature values were used for parameters. Hydraulic conductivities of clay or lower permeability materials were held constant between runs, as were sediment foc and metal Kd values. It was not determined necessary to vary hydraulic and chemical parameters between model runs, as the two sediment profiles created already represent theoretical average and worst case subsurface scenarios, and so further variation could not add accuracy to the results.

Included in this report are:

1.	Results for Corporation Yard Drywell site	р. 4
2.	Results for Strawberry Detention Basin Drywell site	p. 10
3.	Results for Los Angeles Theoretical drywell sites	p. 15
Ref	erences	p. 20
Ap	pendix A: Dissolved concentration calculations	p. 21
Ap	pendix B: Model domain 1D sediment profiles	p. 25
Ap	pendix C: Selected contaminant breakthrough curves	p. 29

#### Definitions of abbreviations and acronyms

cm - centimeter foc - fraction organic carbon Ks - saturated hydraulic conductivity L - liter MCL - maximum contaminant levels mg - milligram ng - nanogram NL - notification level PHG - public health goal RL- reporting limit ug - microgram WT - water table

#### **Symbols**

 $\varphi$  - input concentration of contaminant is not high enough for the RL, PHG, or MCL to be reached at the WT

 $\beta$  - contaminant does not reach water table within a 1,000 year time period

 $\varepsilon$  - no established PHG, MCL, or other regulatory levels exist for the contaminant

[] - breakthrough time of contaminant at water table at a concentration above the

contaminants' reporting limit (reporting limits listed for each contaminant in table heading)

#### **1.** Corporation Yard HYDRUS 1D Results

#### Site-Specific Information

The contaminants modeled for the CY site are aluminum, di(2-ethylhexyl)phthalate (DEHP), iron, manganese, permethrin, and tert-butyl alcohol (TBA). Contaminants were chosen based on the results of stormwater monitoring, and the frequency of a contaminants detection, its highest concentration measured in stormwater, its toxicity, and its mobility. All contaminant model input concentrations are the total concentrations detected in site stormwater and estimated dissolved concentrations. Fipronil and imidacloprid were also modeled for this site, although they were not detected in site stormwater. These two contaminants were added due to their increasing use and detection in urban stormwater runoff. Input concentrations for fipronil and imidacloprid are reasonable estimations for possible local stormwater contaminant concentrations based on reports in the scientific literature (Bower and Tjeerdema, 2016; Fossen, 2006).

The CY model domain's upper water flow boundary condition is a constant pressure head of 400 cm for 230 days, and 0 flux for 135 days. This annual boundary condition is repeated as needed for each model run to capture the full breakthrough curve of each contaminant under each scenario (model run time period ranges from one year to 3,000 years). The modeled sediment profile represents the separation distance between the bottom of the drywell and the seasonal high water table. The profile is 9.75 m in length and composed of seven layers of sediment (from top to bottom: 70 cm of clay, 165 cm of silty sand, 60 cm of sandy silty clay, 60 cm of silty clay, 285 cm of sand, 85 cm of silty clay, and 250 cm of sandy silt). See Figure 1 in Appendix B.

The chloride breakthrough time for a model run with a clay hydraulic conductivity of 6 cm/day is five days when the input concentration is 2.0 mg/L (based on chloride concentrations found in CY stormwater). Chloride reaches its input concentration after 21 days. The chloride breakthrough time for a model run with a clay hydraulic conductivity of 10 cm/day is four days when the input concentration is 2.0 mg/L. Chloride reaches its input concentration after 20 days.

4

# Results for CY numerical modeling analysis

Input Concentration (mg/L)	Ks clay (cm/day)	Kd (mL/g)	Time of breakthrough at WT [0.05 mg/L RL] (years)	Time of highest concentration at WT (years)	Time to PHG (0.6 mg/L) at WT [MCL 1 mg/L] (years)	Highest conc. at WT after 500 years (mg/L)
0.042	6.0	1500	115 [φ]	753 (0.04100 mg/L)	φ	0.04087
	-	( <b>-</b> *	¥.	4	÷	-
	10.0	1500	114 [φ]	811 (0.04177 mg/L)	φ	0.04144
	-	<b>.</b>	· .	₩	÷	
2.1	6.0	1500	109 [276]	561 (2.047 mg/L)	332 [355]	2.041
	-	-	-	-	-	-
	10.0	1500	108 yrs [274]	867 (2.100 mg/L)	329 [351]	2.069
	Ξ.	<u>.</u>	-	-	5	2

# Aluminum

Kd value was available in literature sources.

#### DEHP

Input Concentration (ug/L)	Ks clay (cm/day)	foc of clay layer	Time of breakthrough at WT [10 ug/L RL] (years)	Time of highest concentration at WT (years)	Time to PHG (12 ug/L) at WT [MCL 4 ug/L]	Highest conc. at WT after 500 years (ug/L)
0.062	6.0	0.01	51 [φ]	254	φ	0.05613
	6.0	0.001	5 [φ]	29	φ	0.05625
	10.0	0.01	50 [φ]	255	φ	0.05613

	10.0	0.001	5 [φ]	29	φ	0.05628
3.01	6.0	0.01	48 [φ]	255	φ	2.728
	6.0	0.001	5 [φ]	28	φ	2.731
	10.0	0.01	48 [φ]	250	φ	2.728
	10.0	0.001	5 [φ]	27	φ	2.732

÷

Iron

Input Concentration (mg/L)	Ks clay (cm/day)	Kd (mL/g)	Time of breakthrough at WT [0.1 mg/L RL] (years)	Time of highest concentration at WT (years)	Time to sec. std at WT (0.3 mg/L) (years)	Highest conc. at WT after 500 years (mg/L)
0.16	6.0	100	8 [25]	46	φ	0.1600
	6.0	25	2 [7]	10	φ	0.1600
	10.0	100	8 [25]	57	φ	0.1600
	10.0	25	2 [7]	10	φ	0.1600
1.6	6.0	100	8 [20]	42	22	1.600
	6.0	25	2 [5]	10	6	1.600
	10.0	100	8 [20]	49	22	1.600
	10.0	25	2 [5]	10	6	1.600

6

# Manganese

Input Concentration (ug/L)	Ks clay (cm/day)	Kd (mL/g)	Time of breakthrough at WT [20 ug/L RL] (years)	Time of highest concentration at WT (years)	Time to sec. std at WT (50 ug/L) [NL 500 ug/L]	Highest conc. at WT after 500 years (ug/L)
10	6.0	90	7 [φ]	69	φ	9.999
	6.0	30	3 [φ]	12	φ	9.999
	10.0	90	7 [φ]	75	φ	9.998
	10.0	30	3 [φ]	11	φ	9.999
31	6.0	90	7 [23]	83	φ	31.00
	6.0	30	3 [8]	12	φ	31.00
	10.0	90	7 [23]	53	φ	30.99
	10.0	30	3 [8]	12	φ	31.00

#### Permethrin

Input Concentration (ng/L)	Ks clay (cm/day)	foc of clay layer	Time of breakthrough at WT [5 ng/L RL] (years)	Time of highest concentration at WT (years)	Time to PHG or MCL at WT	Highest conc. at WT after 500 years (ng/L)
2.4	6.0	0.01	54 [φ]	317	3	1.736
	6.0	0.001	6 [φ]	27	ε	1.722
	10.0	0.01	53 [φ]	290	٤	1.733
	10.0	0.001	6 [φ]	27	3	1.725

12.2	6.0	0.01	52 [166]	282	3	8.823
	6.0	0.001	6 [17]	110	3	8.770
	10.0	0.01	52 [164]	285	3	8.810
	10.0	0.001	5 [17]	95	3	8.782

# Tertiary-butyl Alcohol

Input Concentration (ug/L)	Ks clay (cm/day)	foc of clay layer	Time of breakthrough at WT [5 ug/L DL] (days)	Time of highest concentration at WT (days)	Time to NL at WT (12 ug/L) (days)	Highest conc. at WT after 500 years (ug/L)
19	6.0	0.01	5 [12]	18	13	17.99
	6.0	0.001	_**	-	-	( <b>*</b> (
	10.0	0.01	4 [10]	17	12	17.99
	10.0	0.001	-		14	1 <b>-</b> 1

\*\*Difference between modeled transport using high and low foc values was not enough to cause differences between results.

# Fipronil

Input Concentration (ug/L)	Ks clay (cm/day)	foc of clay layer	Time of breakthrough at WT [0.0015 ug/L RL]	Time of highest concentration at WT (years)	Time to PHG or MCL at WT	Highest conc. at WT after 500 years (ug/L)
0.5	6.0	0.01	3 yrs [6 yrs]	14	3	0.4678
	6.0	0.001	56 days [134 days]	2	3	0.4729
	10.0	0.01	3 угs [6 yrs]	18	3	0.4681
	10.0	0.001	55 days [133 days]	2	3	0.4731

# Imidacloprid

Input Concentration (ug/L)	Ks clay (cm/day)	foc of clay layer	Time of breakthrough at WT [0.05 ug/L RL] (days)	Time of highest concentration at WT (days)	Time to PHG or MCL at WT	Highest conc. at WT after 500 years (ug/L)
0.9	6.0	0.01	29 [85]	183	ε	0.8545
25	6.0	0.001	7 [17]	36	3	0.8545
	10.0	0.01	28 [83]	183	ε	0.8545
	10.0	0.001	5 [16]	36	3	0.8545

#### 2. Strawberry Detention Basin HYDRUS 1D Results

#### Site-Specific Information

The contaminants modeled for the SDB site are aluminum, bifenthrin, iron, manganese, and tert-butyl alcohol (TBA). Contaminants were chosen based on the results of stormwater monitoring, and the frequency of a contaminant's detection, its highest concentration measured in stormwater, its toxicity, and its mobility. All contaminant model input concentrations are the total concentrations detected in site stormwater and estimated dissolved concentrations. Fipronil and imidacloprid were also modeled for this site, although they were not detected in site stormwater. These two contaminants were added due to their increasing use and detection in urban stormwater runoff. Input concentrations for fipronil and imidacloprid are reasonable estimations for possible local stormwater contaminant concentrations based on reports in the scientific literature (Bower and Tjeerdema, 2016; Fossen, 2006).

The SDB model domain's upper water flow boundary condition is a constant pressure head of 300 cm for 215 days, and 0 flux for 150 days. This annual boundary condition is repeated as needed for each model run to capture the full breakthrough curve of each contaminant under each scenario (model run time period ranges from one year to 3,000 years). The modeled sediment profile represents the separation distance between the bottom of the drywell and the seasonal high water table. The profile is 2.78 m in length and composed of two layers of sediment (from top to bottom: 150 cm of sandy silty clay, and 128 cm of sand). See Figure 2 in Appendix B.

The chloride breakthrough time for a model run with a clay hydraulic conductivity of 1.7 cm/day is three days when the input concentration is 7.2 mg/L (based on chloride concentrations found in SDB stormwater). Chloride reaches 7.0 mg/L (concentration found in groundwater near drywell two days after stormwater sampling) after 22 days. The chloride breakthrough time for a model run with a clay hydraulic conductivity of 15.0 cm/day is one day when the input concentration is 7.2 mg/L. Chloride reaches 7.0 mg/L after three days.

# Results for SDB numerical modeling analysis

## Aluminum

Input Concentration (mg/L)	Ks sandy silty clay (cm/day)	Kd (mL/g)	Time of breakthrough at WT [0.05 mg/L RL] (years)	Time of highest concentration at WT (years)	Time to PHG (0.6 mg/L) at WT [MCL 1 mg/L]	Highest conc. at WT after 500 years (mg/L)
0.006	1.7	1500	93 [φ]	1000 (0.005773 mg/L)	φ	0.002151
		-*	ų.	-		4
	15.0	1500	11 [φ]	126	φ	0.005996
	*	Ħ		۲		1
0.3	1.7	1500	87 [251]	1000 (0.2881 mg/L)	φ	0.1076
	-	-	-	14 M	5 <b>4</b> 51	₩
	15.0	1500	10 [29]	140	φ	0.2989
				8	۰.	2

\*Only one Kd value was available in literature sources.

# Bifenthrin

Input Concentration (ng/L)	Ks sandy silty clay (cm/day)	foc of sandy silty clay layer	Time of breakthrough at WT [2 ng/L RL] (years)	Time of highest concentration at WT (years)	Time to PHG or MCL at WT	Highest conc. at WT (ng/L)
11	1.7	0.01	123 [470]	914 (9.725 ng/L)	3	2.959
	1.7	0.001	12 [48]	121	ε	10.08
	15.0	0.01	14 [54]	118	ε	10.85

	15.0	0.001	2 [6]	14	3	10.85
100	1.7	0.01	117 [372]	912 [88.13 ng/L]	3	26.90
	1.7	0.001	12 [38]	127	3	91.61
	15.0	0.01	14 [43]	130	3	98.66
	15.0	0.001	2 [5]	28	٤	98.62

×.

Iron

Input Concentration (mg/L)	Ks sandy silty clay (cm/day)	Kd (mL/g)	Time of breakthrough at WT [0.1 mg/L RL]	Time of highest concentration at WT (years)	Time to sec. std at WT (0.3 mg/L) (years)	Highest conc. at WT after 500 years (mg/L)
0.042	1.7	100	6 yrs [φ]	91	φ	0.04198
	1.7	25	2 yrs [φ]	21	φ	0.4199
	15.0	100	140 days [φ]	10	φ	0.04199
	15.0	25	35 days [φ]	3	φ	0.04200
0.42	1.7	100	6 yrs [31 yrs]	126	41	0.4199
	1.7	25	2 yrs [8 yrs]	22	11	0.4199
	15.0	100	134 days [4 yrs]	10	5	0.4199
	15.0	25	34 days [190 days]	3	2	0.4200

# Manganese

Input Concentration (ug/L)	Ks sandy silty clay (cm/day)	Kđ (mL/g)	Time of breakthrough at WT [20 ug/L RL]	Time of highest concentration at WT (years)	Time to sec. std at WT (50 ug/L) [NL 500 ug/L]	Highest conc. at WT after 500 years (ug/L)
14	1.7	90	6 yrs [φ]	121	φ	14.00
	1.7	30	2 yrs [φ]	30	φ	14.00
	15.0	90	128 days [φ]	9	φ	14.00
	15.0	30	43 days [φ]	3	φ	14.00
41	1.7	90	7 yrs [33 yrs]	145	φ	40.98
	1.7	30	2 yrs [11 yrs]	29	φ	40.99
	15.0	90	126 days [4 yrs]	9	φ	40.99
	15.0	30	42 days [2 yrs]	4	φ	41.00

# **Tertiary-butyl Alcohol**

Input Concentratio n (ug/L)	Ks sandy silty clay (cm/day)	foc of sandy silty clay layer	Time of breakthrough at WT [5 ug/L DL] (days)	Time of highest concentration at WT (days)	Time to NL at WT (12 ug/L) (days)	Highest conc. at WT after 500 years (ug/L)
20 ug/L	1.7	0.01	7 [19]	39	23	18.57
	1.7	0.001	-**	-	-	-
	15.0	0.01	2 [3]	11	4	19.79
	15.0	0.001	3 <b>9</b> 3	<del>-</del> :	-	<b>11</b>

\*\*Difference between modeled transport using high and low foc values was not enough to cause differences between results.

# Fipronil

Input Concentration (ug/L)	Ks sandy silty clay (cm/day)	foc of sandy silty clay layer	Time of breakthrough at WT [0.0015 ug/L RL]	Time of highest concentration at WT	Time to PHG or MCL at WT	Highest conc. at WT after 500 years (ug/L)
0.5 ug/L	1.7	0.01	2 yrs [7 yrs]	30 yrs	٤	0.2435
	1.7	0.001	42 days [154 days]	3 yrs	ε	0.2640
	15.0	0.01	47 days [165 days]	4 yrs	ε	0.4595
	15.0	0.001	5 days [18 days]	93 days	3	0.4683

# Imidacloprid

Input Concentration (ug/L)	Ks sandy silty clay (cm/day)	foc of sandy silty clay layer	Time of breakthrough at WT [0.05 ug/L DL] (days)	Time of highest concentration at WT	Time to PHG or MCL at WT	Highest conc. at WT after 500 years (ug/L)
0.9	1.7	0.01	22 [103]	2 yrs	ε	0.8588
	1.7	0.001	5 [20]	67 days	ε	0.8591
	15.0	0.01	3 [12]	43 days	3	0.8944
	15.0	0.001	1 [3] ∞	28 days	ε	0.8947

#### 3. Los Angeles, CA, theoretical drywell sites HYDRUS 1D Results

#### **Theoretical Site-Specific Information**

The contaminants modeled for the LA site are benzo(a)pyrene, bifenthrin, copper, fipronil, imidacloprid, lead, naphthalene, and zinc. Contaminants were chosen based on detection in Los Angeles area stormwater, and toxicity and mobility. Most of the stormwater input concentrations were estimated from Los Angeles stormwater literature (Stein et al., 2006; Tiefenthaler et al., 2008). The input concentration for bifenthrin is that used for Elk Grove contaminant transport modeling, and the input concentrations for fipronil, and imidacloprid, are reasonable estimates based on relevant literature values (Bower and Tjeerdema, 2016; Fossen, 2006). Contaminants were modeled at measured total and calculated dissolved concentrations.

Two model domains were created for the LA model runs: an average scenario domain, and a worst case scenario domain. The average case domain's upper water flow boundary condition is a constant pressure head of 300 cm for 200 days, and 0 flux for 165 days. This annual boundary condition is repeated as needed for each model run to capture the full breakthrough curve of each contaminant under each scenario (model run time period ranges from one year to 2,000 years). The average case scenario's modeled sediment profile represents the separation distance between the bottom of a theoretical drywell and the average seasonal high water table depth for the area of LA from which the sediment profile was derived. The profile is 10.7 m in length and composed of three materials with five layers (from top to bottom: 2.00 m clay, 1.50 cm sandy loam, 1.87 cm sand, 1.52 cm sandy loam, and 3.80 m sand). See Figure 3 in Appendix B. The chloride breakthrough time for a model run with the average case scenario profile is 11 days when the input concentration is 5.0 mg/L. Chloride reaches its input concentration after 30 days.

The worst case scenario's upper water flow boundary condition is a constant pressure head of 300 cm for 200 days, and 0 flux for 165 days. This annual boundary condition is repeated as needed for each model run to capture the full breakthrough curve of each contaminant under each scenario (model run time period ranges from one year to 500 years). The worst case scenario's modeled sediment profile represents the separation distance between the bottom of a theoretical drywell and the average seasonal high water table depth for the area of LA from which the sediment profile was derived. The profile is 2.0 m in length and composed of two materials with four layers (from top to bottom: 0.20 m loam, 0.72 m sand, 0.20 m loam, and 0.88 m sand). See Figure 4 in Appendix B. The chloride breakthrough time for a model run with

the worst case scenario profile is less than one day when the input concentration is 5.0 mg/L, and chloride reaches its input concentration after one day.

#### **Results for Los Angeles theoretical sites numerical modeling analysis**

## Benzo(a)pyrene

Input Concentration (ng/L)	Scenario	Time of breakthrough at WT [10 ug/L RL]	Time of highest concentration at WT (years)	Time to PHG (7 ng/L) at WT [MCL 200 ng/L]	Highest conc. at WT after 500 years (ng/L)
29	average case	107 yrs [φ]	661 (26.81 ng/L)	338 yrs [φ]	25.01
100		105 yrs [φ]	719 (48.21 ng/L)	294 yrs [φ]	86.11
29	worst case	34 days [φ]	3	174 days [φ]	28.97
100		33 days [φ]	3	145 days [φ]	99.91

#### Bifenthrin

Input Concentration (ng/L)	Scenario	Time of breakthrough at WT [2 ng/L RL]	Time of highest concentration at WT (years)	Time to PHG or MCL at WT	Highest conc. at WT after 500 years (ng/L)
9	average case	414 yrs [β]	1.511 ng/L after 1000 yrs	8	3.5E-9
100		42 yrs [107 yrs]	352	ε	91.15
9	worst case	14 days [69 days]	2	3	8.992
100		13 days [51 days]	2	3	99.91

16

# Copper

Input Concentration (ug/L)	Scenario	Time of breakthrough at WT [50 ug/L RL]	Time of highest concentration at WT	Time to PHG (150 ug/L) at WT [MCL 1.0 mg/L]	Conc. at WT after 500 years (ug/L)
18	average case	7 yrs [φ]	31 yrs	φ	18.00
18	worst case	6 days [φ]	117 days	φ	18.00

## Fipronil

Input Concentration (ug/L)	Scenario	Time of breakthrough at WT [0.0015 ug/L RL]	Time of highest concentration at WT	Time to PHG or MCL at WT	Highest conc. at WT after 500 years (ug/L)
0.5	average case	2 yrs [3 yrs]	9 yrs	٤	0.2102
0.5	worst case	1 day [2 days]	6 days	3	0.4939

# Imidacloprid

Input Concentration (ug/L)	Scenario	Time of breakthrough at WT [0.05 ug/L RL] (days)	Time of highest concentration at WT (days)	Time to PHG or MCL at WT	Highest conc. at WT after 500 years (ug/L)
0.9	average case	15 [38]	95	ε	0.8455
0.9	worst case	1 [1]	2	3	0.8988

### Lead

Input Concentration (ug/L)	Scenario	Time of breakthrough at WT [5 ug/L RL]	Time of highest concentration at WT (years)	Time to PHG (2 ug/L) at WT [MCL 50 ug/L] (years)	Highest conc. at WT after 500 years (ug/L)
1.6	average case	171 yrs [φ]	1.565 ug/L after 1000 yrs	φ	0.8990
8.0		168 yrs [512 yrs]	7.841 ug/L after 1000 yrs	449 [φ]	4.494
1.6	worst case	160 days [φ]	14	φ	1.600
8.0		155 days [7 yrs]	17	5 [φ]	8.000

# Naphthalene

Input Concentration (ng/L)	Scenario	Time of breakthrough at WT [500 ng/L RL] (days)	Time of highest concentration at WT	Time to NL at WT (17 ug/L) [MCL 170 ug/L]	Highest conc. at WT after 500 years (ng/L)
35	average case	83 [φ]	3 yrs	φ	31.16
35	worst case	1 [φ]	2 days	φ	34.91

# Zinc

Input Concentration (ug/L)	Scenario	Time of breakthrough at WT [50 ug/L RL]	Time of highest concentration at WT (years)	Time to sec. std. at WT (5.0 mg/L)	Highest conc. at WT after 500 years (ug/L)
77	average case	11 yrs [φ]	71	φ	76.97
77	worst case	10 days [φ]	2	φ	77.00

#### References

Asaf, L., R. Nativ, D. Shain, M. Hassan, S. Geyer. 2004. Controls on the chemical and isotopic compositions of urban stormwater in a semiarid zone. Journal of Hydrology.

ATSDR. 2008. Toxicological Profile for Aluminum. United States Department of Health and Human Services. https://www.atsdr.cdc.gov/toxprofiles/tp22.pdf

Bower, J., R.S. Tjeerdema. 2016. Water and sediment quality criteria report for fipronil. Draft. UC Davis.

Chin, Y., P. M. Gschwend. 1992. d. Partitioning of polycyclic aromatic hydrocarbons to marine porewater organic colloids. Environmental Science Technology. 26, 1621-1626.

Clark, S.E., P.D. Johnson, S. Gill, M. Pratap. 2004. Recent measurements of heavy metal removals using stormwater filters. Proceedings of the Water Environment Federation, Watershed 2004. Water Environment Federation. p 1390-1417.

Fossen, M. 2006. Environmental fate of imidacloprid. Environmental Monitoring Dept. of Pesticide Regulation.

Larry Walker Associates. 2013. Urban runoff Discharge monitoring report. City of Sacramento.

Muthukrishnan, Swarna. 2006. Treatment Of Heavy Metals In Stormwater Runoff Using Wet Pond And Wetland Mesocosms. Proceedings of the Annual International Conference on Soils, Sediments, Water and Energy: Vol. 11, Article 9. Available at: http://scholarworks.umass.edu/soilsproceedings/vol11/iss1/9

Stein, E.D., L.L. Tiefenthaler, K. Schiff. 2006. Watershed-based sources of polycyclic aromatic hydrocarbons in urban storm water. Environ Toxicol Chem. 2. 373-385.

Tiefenthaler, L.L., E.D. Stein, K.C. Schiff. 2008. Watershed and land-use based sources of trace metals in urban stormwater. SETAC. Environmental Toxicology and Chemistry. Vol 27, 277-287

#### **Appendix A**

Dissolved concentration calculations

Depending on the chemical parameters of a contaminant, total concentration can be a gross overestimation of the mobile concentration of the contaminant in stormwater, and so dissolved concentrations were needed for use in the numerical modeling. A contaminant will bind to suspended sediment, particulate and dissolved organic carbon in stormwater depending on whether it is a metal or organic contaminant. Equations 1 and 2 represent the methods used to determine the dissolved concentrations ([dis]) for metals and organics respectively in site stormwater:

$$[dis] = [tot](lit. ratio) (Eq. 1)$$
  
[dis] = [tot]/(1+ K<sub>oc</sub>[POC] + K<sub>doc</sub>[DOC]) (Eq. 2)

where [tot] is the measured total concentration of contaminant in site stormwater in ng/L, lit. ratio is the ratio of dissolved to total concentrations of the metal as derived from a literature search (unitless), K<sub>oc</sub> is the organic carbon-water partitioning coefficient in L/kg, [POC] is the concentration of particulate organic carbon in stormwater in kg/L, K<sub>doc</sub> is the dissolved organic carbon-water partitioning coefficient in L/kg, and [DOC] is the concentration of dissolved organic carbon in stormwater in kg/L (Chin, 1992). An equation exists for the calculation of dissolved metal concentrations that is similar to equation 6, but uses metal K<sub>d</sub> (L/kg) and [TSS] (mg/L) in place of K<sub>oc</sub>, [POC], K<sub>doc</sub>, and [DOC].

TSS concentrations were measured at both field sites during each monitored storm event, and Kd and Koc were determined from a range of possible values gathered for each modeled contaminant from relevant literature. A range of possible DOC and POC concentration were determined from data taken for stormwater from 20 storms occurring during the 2016 water year in the Sacramento region (Larry Walker Associates, 2013). Kdoc values were taken from literature and calculated using equation 3a and b:

$K_{doc} = 0.08 K_{ow}$	(Eq. 3a)
K <sub>doc</sub> = 0.11K <sub>ow</sub>	(Eq. 3b)

where  $K_{ow}$  is the contaminant's octanol-water partitioning coefficient in L/kg (Burkhard, 2000). Equations 7a and 7b were both derived experimentally using slightly different methods, and so when calculating  $K_{doc}$  values both equations were used, and multiple iterations of equation 6 were performed using the different  $K_{doc}$  values. Dissolved to total concentration ratios for metals were determined using stormwater data from the Sacramento area and other literature sources (Asaf et al., 2004; ATSDR, ; Clark et al., 2004; Larry Walker Associates, 2013; Muthukrishnan, 2006).

The results of these calculations are presented in tables 1 through 6. Median values were chosen for use in the numerical modeling. If calculated dissolved concentrations were greater

than 35% of the total concentration, models were only run using the total concentration, as the results of running dissolved concentrations would be too similar to the total results to provide additional useful information.

Contaminant	[total](ng/L)	Koc (L/kg)	DOC	POC (kg/L)	Kdoc	[dissolved]
			(kg/L)		(kg/L)	(ng/L)
DEHP	3010	1.20E5	2.89E-5	1.00E-6	2.52E6	41.8
					3.48E6	30.6
			1.63E-5	1.03E-6	2.52E6	71.2
					3.48E6	52.1
		-	8.10E-6	1.10E-6	2.52E6	139.2
					3.48E6	213.1
Permethrin	12.2	1.20E5	2.89E-5	1.00E-6	1.01E5	3.10
					9.58E5	0.36
			1.63E-5	1.03E-6	1.01E5	4.42
					9.58E5	0.53
			8.10E-6	1.10E-6	1.01E5	6.26
					9.58E5	1.77
ТВА	19000	2	2.89E-5	1.00E-6	0.179	18999.9
					0.246	18999.8
			1.63E-5	1.03E-6	0.179	18999.9
					0.246	18999.9
			8.10E-6	1.10E-6	0.179	18999.9
					0.246	18999. <del>9</del>
Fipronil	500	6000	2.89E-5	1.00E-6	800	486.2
					1100	482.3
			1.63E-5	1.03E-6	800	490.6
					1100	488.3
			8.10E-6	1.10E-6	800	493.5
					1100	492.4
Imidacloprid	900	300	2.89E-5	1.00E-6	0.296	8 <del>99</del> .7
					0.407	899.7
			1.63E-5	1.03E-6	0.296	8 <del>99</del> .7
					0.407	899.7
			8.10E-6	1.10E-6	0.296	899.7
					0.407	899.9

Table 1. Calculated dissolved concentrations for CY organics.

metal	[total] (mg/L)	lit. ratio of dissolved/total (mg/L/mg/L)	calculated [dissolved] (mg/L)
Aluminum	2.1	0.02	0.042
Iron	1.6	0.10	0.16
Manganese	31	0.33	10

Table 2. Calculated dissolved concentrations for CY metals.

Table 3. Calculated dissolved concentrations for SDB organics

Contaminant	[total](ng/L)	Koc (L/kg)	DOC	POC (kg/L)	Kdoc	[dissolved]
			(kg/L)		(kg/L)	(ng/L)
Bifenthrin	100	2.37E5	2.80E-5	8.00E-6	2.01E5	11.7
					1.74E6	1.20
			1.18E-5	2.28E-6	2.01E5	25.6
					1.74E6	3.22
			7.00E-6	1.00E-7	2.01E5	41.1
					1.74E6	10.9
ТВА	20000	2	2.89E-5	1.00E-6	0.179	19999.6
					0.246	19999.5
			1.63E-5	1.03E-6	0.179	19999.9
					0.246	19999.9
			8.10E-6	1.10E-6	0.179	20000.0
					0.246	20000.0
Fipronil	500	6000	2.89E-5	1.00E-6	800	467.1
					1100	463.5
4			1.63E-5	1.03E-6	800	488.7
					1100	487.1
			8.10E-6	1.10E-6	800	496.9
					1100	496.8
Imidacloprid	900	300	2.89E-5	1.00E-6	0.296	897.8
					0.407	897.8
			1.63E-5	1.03E-6	0.296	899.4
					0.407	899.4
			8,10E-6	1.10E-6	0.296	900.0
					0.407	900.0

Table 4. Calculated dissolved concentrations for SDB metals.

metal	[total] (mg/L)	lit. ratio of dissolved/total (mg/L/mg/L)	calculated [dissolved] (mg/L)
Aluminum	0.30	0.02	0.0060
Iron	0.42	0.10	0.042
Manganese	41	0.33	14

Table 5. Calculated dissolved concentrations for LA organics.

Contaminant	[total](ng/L)	Koc (L/kg)	DOC	POC (kg/L)	Kdoc	[dissolved]
			(kg/L)		(kg/L)	(ng/L)
Benzo(a)pyrene	100	1.350E6	3.30E-5	2.00E-6	1.08E5	17.4
					1.49E5	14.1
			1.47E-5	9.75E-7	1.08E5	31.6
					1.49E5	26.6
			8.20E-6	8.00E-7	1.08E5	42.4
					1.49E5	37.2
Bifenthrin	100	2.370E5	3.30E-5	2.00E-6	2.01E5	12.3
					1.74E6	1.50
			1.47E-5	9.75E-7	2.01E5	23.9
					1.74E6	3.26
			8.20E-6	8.00E-7	2.01E5	35.2
					1.74E6	5.37
Naphthalene	35	1500	3.30E-5	2.00E-6	160	34.7
					220	34.6
			1.47E-5	9.75E-7	160	34.9
					220	34.8
			8.20E-6	8.00E-7	160	34.9
					220	35.0

Table 6. Calculated dissolved concentrations for LA metals.

metal	[total] (ug/L)	lit. ratio of dissolved/total (ug/L/ug/L)	calculated [dissolved] (ug/L)
Copper	18	0.5	9.0
Lead	8.0	0.20	1.6
Zinc	77	0.75	58

24

# Appendix B

HYDRUS 1D site sediment profiles



Figure 1. HYDRUS 1D sediment profile for the Corporate Yard drywell site.



Figure 2. HYDRUS 1D sediment profile for the Strawberry Detention Basin drywell site.



Figure 3. HYDRUS 1D sediment profile for the Los Angeles theoretical average case drywell site.


Figure 4. HYDRUS 1D sediment profile for the Los Angeles theoretical worst case drywell site.

### **Appendix C**

Selected contaminant breakthrough curves chosen to represent the breakthrough (arrival of a contaminant at a specified location) of contaminants at the Elk Grove sites that display different transport trends.



**Figure 1.** The concentration of iron at the Corporation Yard water table over time. The input concentration is the total concentration measured in stormwater. Because iron is a metal degradation was not taken into account in the modeling, and so the highest concentration reached at the water table remains constant over time. Kd seems to dominate transport at the CY site, as the scenarios with the same Kd values show very similar breakthrough curves, while the differences between hydraulic conductivity values of the clay seem to have very little effect on transport.

29



**Figure 2.** The concentration of permethrin at the Corporation Yard water table over time. The input concentration is the total concentration measured in stormwater. Although permethrin was assumed to degrade in the subsurface, oscillations in concentration at the water table are not seen because the contaminant is fairly immobile and arrives at the water table gradually; therefore interannual trends are not discernable.



**Figure 3.** The concentration of fipronil at the Corporation Yard water table over time. The oscillations in the breakthrough curve show the degradation that fipronil undergoes during the dry season. While water containing fipronil is arriving at the water table, the concentration increases, and during the dry season, when no water is arriving at the water table, the concentration present in the soil at the water table degrades out. This is seen to different extents for the four different modeled scenarios.



### SDB bifenthrin breakthrough

### Time (years)

**Figure 4.** The concentration of bifenthrin at the Strawberry Detention Basin water table over time. The input concentration is the total concentration measured in stormwater. Although bifenthrin was assumed to degrade in the subsurface, oscillations in concentration at the water table are not seen because the contaminant is fairly immobile and arrives at the water table gradually; therefore interannual trends are not discernable. Both fraction organic carbon in the sediment and hydraulic conductivity of the clay layer affect transport at the SDB site, as can be seen in the differences in breakthrough curves for all four scenarios. Foc seems to have a slightly greater effect on arrival times, as the two scenarios with high focs arrive at the water table later than the two scenarios with low focs. However, hydraulic conductivity in the clay layer seems to play the greater role in the peak concentration occurring at the water table, as the two scenarios with clay Ks 15 cm/day have higher peak concentrations. This is most likely due to the degradation occurring within the sediment profile: more degradation occurs before the contaminant arrives at the water table when the contaminant moves through the profile more slowly.







**Figure 6.** The concentration of fipronil at the Strawberry Detention Basin water table over time. The oscillations in the breakthrough curve show the degradation that fipronil undergoes during the dry season. While water containing fipronil is arriving at the water table, the concentration increases, and during the dry season, when no water is arriving at the water table, the concentration present in the soil at the water table degrades out. This is seen to different extents for the four different modeled scenarios.

## Appendix 5.3

# Technical Email (Luhdorff & Scalmanini Consulting Engineers)

Elk Grove Dry Well Project – Evaluation of Groundwater Level Contours, Continuous Water Quality Data and Estimated Travel Times to Vadose Zone and Saturated Zone Monitoring Wells

#### Groundwater Gradients and Directions of Groundwater Flow

At the Strawberry Creek Detention Basin groundwater levels and calculated gradients show consistency between the years; however, the data do indicate seasonal variability (**Table 1**). In both February 2015 and February 2016 groundwater level data indicate a mounding of groundwater in the vicinity of the dry well, with lower groundwater elevations at the other three monitoring wells. This signal is consistent with and influence from recharge occurring at the dry well and was not observed in 2014 prior to construction of the dry well. The steepest gradient is seen in both the February 2015 and February 2016 contours in the direction of monitoring well 4 (SDB-MW4). At other times of the year, both in late spring and fall, groundwater level gradients were oriented in a more eastward direction, towards monitoring well 1 (SDB-MW1). SDB-MW4 remained downgradient of SDB-MW3 in those months as well, consistent with groundwater level contours mapped for 2014.

## Table 1. Strawberry Creek Detention Basin Groundwater Level Gradients Between Monitoring Wells and Dry Well, Excluding Upgradient and Dry Wells

		Calculated Groundwater Gradient Between Monitoring Wells and Dry Well, Excluding Upgradient and Dry Wells* (ft/ft)				
	Distance to Dry Well (ft)	2/1/2015	5/16/2015	10/1/2015	2/15/2016	5/9/2016
SDB-MW1	325.04	0.000524	0.000196	0.000241	0.000629	0.000244
SDB-MW2	24.5	0.001057	n/a	n/a	0.000244	n/a
SDB-MW3	58.69	0.001547	upgradient	upgradient	0.001635	upgradient
SDB-MW4	44.08	0.002068	0.000075	0.000122	0.002257	0.000147

n/a = Not applicable, water table was below the monitoring well screen interval.

\* Gradients calculated in February 2015 and 2016, when mounding near the dry well is observed in the interpolated groundwater level data, are based on the high point of the interpolated groundwater surface in the vicinity of the dry well.

Groundwater levels recorded by pressure transducers in the monitoring wells at the Corporation Yard show that groundwater level gradients in the vicinity of the dry well were strongest in the direction of monitoring well 4 (CY-MW4) throughout 2014 (**Table 2**). During the winter and spring of 2015 the gradient transitioned to a more westward direction suggesting that groundwater flow was in the direction of monitoring well 3 (CY-MW3) by May 2016. The groundwater level contour maps for the Corporation Yard do not show the same mounding effect seen at the Strawberry Creek Detention Basin. This is could be due to differences in the subsurface geologic stratigraphy and smaller drainage area for the Corporation Yard dry well. The latter likely limited the volume of water recharged by the dry well relative to the dry well at the Strawberry Creek Detention Basin, resulting in a subtle effect on groundwater level gradients.

Calculated Groundwater Gradient (ft/ft) Distance to Dry Well (ft) 2/1/2015 5/16/2015 10/1/2015 2/15/2016 5/9/2016 CY-MW1 191.4 upgradient CY-MW2 15.84 n/a CY-MW3 76.71 0.000417 0.000534 0.000612 0.000646 0.000557 CY-MW4 0.000702 0.000932 0.00051 84.39 0.000898 0.000113

 Table 2. Corporation Yard Groundwater Level Gradients Between Monitoring Wells and Dry Well, Excluding

 Upgradient and Dry Wells

n/a = Not applicable, water table was below the monitoring well screen interval.

## Monitoring Continuous Conductivity in Stormwater and Groundwater to Evaluate Surface Water-Groundwater Connectivity

During the first season of stormwater and groundwater monitoring three conductivity transducers were deployed at each of the two project sites to record continuous water quality data during two storm events. This monitoring was conducted to determine the influence of stormwater infiltrated at the dry wells on groundwater at the project sites, both in the vadose zone and near the water table. Continuous conductivity monitoring provided data on changes in groundwater concentrations over multiple days following storm events to inform the understanding of the degree to which groundwater samples conducted within hours or days of a storm event were likely to reflect the influence of previous storms. This approach differed from a typical tracer test in that the inherent difference in conductivity concentrations between groundwater and surface water served as a naturally-occurring tracer to indicate the influence of stormwater.

Conductivity transducers were deployed for storm that occurred on April 7, 2015 and April 24-25, 2015. The length of deployment was limited due to the availability of the equipment, which was loaned to the project by cbec ecoegnineers. The water quality transducers (Solinst LTC Levelogger Junior) were deployed in the dry well, at the inflow from the sedimentation well and at the bottom of the dry well by way of the 4-inch pipe, and in the vadose zone monitoring well (MW2) at each site during April 7 storm. For the second storm, the transducer at the dry well inflow was moved to Monitoring Well 4 (MW4) at each site to record conductivity data in the groundwater monitoring well that was most downgradient from the dry well. The LTC Levelogger Junior transducers recorded data on conductivity and temperature, as well as water levels.

Precipitation totals for each storm recorded at the Sacramento County operated gage on Laguna Creek at Waterman Rd (Facility ID: A37) were 0.86 inches during the April 7 storm and 0.83 inches during the April 24 to 25 storm. All conductivity transducers were field calibrated and deployed on the night of April 6. The transducer deployed in the 4-inch pipe at the Strawberry Creek Detention Basin dry well malfunctioned during the deployment, resulting in erroneous conductivity and water level data, which are omitted from the figures that follow.

Figures A and B show the specific conductance and temperature time series data for the Strawberry Creek Detention Basin (SDB) site in response to the April 7 storm. Water temperature data were available from SDB-MW4 from the water level transducer installed at that location as part of the continuous water level monitoring at each site. Water entering the dry well, SDB-Dry Well Inflow, showed a rapid decrease as inflow began. Specific conductance dropped to below 50 µS/cm, values consistent with non-saline surface water. The conductivity data from SDB-MW2 began to decrease at a similar rate 88 minutes after dry well inflow began. The temporary rebound in conductivity values seen in SDB-MW2 occurred during the period of falling head infiltration rate testing at this dry well, when flow into the dry well was stopped and re-started multiple times at intervals of a few minutes to a few hours. The temporary increase in conductivity at SDB-MW2 during this time indicates that inflow from the dry well was the dominant hydraulic influence on SDB-MW2 at those times, as opposed to water infiltrating from the detention basin itself.

Temperature data recorded during the April 7 storm even show a similarly abrupt response at the dry well inflow (Figure B). A response at SDB-MW2 occurred 68 minutes later, though the magnitude of the response was more muted compared to the response seen in the conductivity data, likely due the exchange of heat between infiltrating water and the subsurface geologic materials.

Figure C and D show specific conductance and temperature data from the same site for the April 24-25 storm. As during the April 7 storm, SDB-MW2 showed a response in conductivity values that resulted in an overall reduction following the storm event, indicating the infiltration of lower conductivity stormwater. Unlike the data form the April 7 storm, conductivity at SDB-MW2 rose to about 150  $\mu$ S/cm. Although continuous conductivity data from the dry well are not available for that storm event due to the previously described transducer malfunction and the repositioning of the second conductivity transducer from the dry well to SDB-MW4, the initial rise in conductivity at SDB-MW2 is in the direction of the specific conductance concentration of the stormwater grab sample collected as part of the stormwater sampling effort. The response in conductivity at SDB-MW2 began 73 minutes following the start of dry well infiltration, as indicated by the SDB-Dry Well temperature record.

Data from these two storm events at the Strawberry Creek Detention Basin indicate a strong connection between the vadose zone monitoring well and dry well. Water level data recorded across all four of the monitoring wells at this site and the depth of the vadose zone well (SDB-MW2) relative to the depth to water in SDB-MW4 indicate that the response in conductivity concentrations in the vadose zone well may also be reflective of the time of travel for water to reach the water table at this site. The vadose zone well at the Strawberry Creek Detention Basin has a screened interval extending to 52.5 feet below ground surface. Groundwater levels in both the vadose zone well and the surrounding monitoring wells have consistently been very near to a few feet above that level, suggesting that travel times to the vadose zone well reflect travel through the full thickness of the unsaturated zone at this site.

Figures E, F, H, and I show conductivity and water temperature data for the April 7 and April 24-25, 2015 storms at the Elk Grove Corporation Yard site, respectively. These data are supplemented with water level data in Figures G and J. While conductivity data collected at the dry well, within the 4-inch pipe, showed a reduction during the storm that was similar to the conductivity data collected at the Strawberry Creek Detention Basin dry well, the conductivity data collected at the vadose zone well (C-MW2) did not show a corresponding response (Figures E and H). Conductivity values recorded in CY-MW2 were stable throughout both storm events. Conductivity values in CY-MW4 were also stable during and for several days after the April 24-25 storm (Figure H)

Water temperature data collected during the two storm events also showed substantial reductions in water temperature at the dry well during and after the storm, with almost no response in the vadose zone monitoring well (CY-MW2) and no response in the downgradient monitoring well (CY-MW4) (Figures F and I). Temperatures in CY-MW2 did decline by a few tenths of a degree early on 4/25; however, that was likely influenced by the transducer being briefly removed from the monitoring well.

Water level data collected during these two storms show groundwater levels in the vadose zone well rising a few feet in response to infiltration at the dry well. On April 7 the vadose zone well response occurred 217 minutes after water began to accumulate in the dry well (Figure G). On April 25 water levels in the vadose zone well increased

slightly, showing temporary saturation in the unsaturated zone, 233 minutes after water began to accumulate in the dry well (Figure J). Groundwater level responses were not observed in the downgradient monitoring well (CY-MW4) in response to either storm.

Land use at the Corporation Yard site is notable for the continuous paving near all monitoring wells. Apart from the project dry well and an approximately 250 square foot area of permeable pavement located about 200 feet north of the dry well the immediate project site vicinity is believed to be impermeable. The absence of a clear water quality response at either the vadose zone well or the downgradient monitoring well at the Corporation Yard may be a result of relatively limited inputs at the dry well relative to the thickness of the unsaturated zone and depth to the water table at this site compared to the Strawberry Creek Detention Basin site. However, continuous water level data collected during the April 7 and April 24-25 storms indicate that water infiltrated at the Corporation Yard dry began to reach the vadose zone monitoring well between three and four hours later. The time of travel to the downgradient monitoring well is not clear from the data collected for this analysis, likely due to the relatively small volumes of water infiltrated at the dry well and greater vertical separation between the dry well and the water table at this site, which was between 30 and 35 feet during these storms, relative to the Strawberry Creek Detention Basin site.

### Summary

Groundwater levels recorded by continuous pressure transducers installed in monitoring wells from 2014 through 2016 show that the vadose zone and shallow groundwater were influenced by recharge from the Strawberry Creek Detention Basin dry well. Groundwater levels observed during February 2015 and 2016, during the winter storm season, show a mounding of groundwater below the dry well that was not present at other times of the year. The degree to which groundwater at the Corporation Yard dry well were directly influenced by recharge at the project dry well is less clear from the continuous pressure transducer data. Groundwater level contours do not show a mounding of groundwater at this site during the winter of 2015 or 2016. The absence of this effect is likely due to a combination of factors including the relatively smaller volumes of water infiltrated by the Corporation Yard dry well, due to its smaller watershed area, and the greater thickness and increased storage capacity of the vadose zone at this site relative to the other project site.

Estimates of the time of travel for a conservative water quality constituent in stormwater infiltrated at the dry well at each site were separately developed assuming vertical, saturated flow through the layered lithologic beds encountered between the bottom of the dry well at each site and highest seasonal groundwater level. The estimates assumed a constant head and vertical flow. Results indicate that travel times could be as little as one to three days. Results were highly sensitive to the assumed values for saturated hydraulic conductivity value for the various lithologic materials observed during the monitoring well construction.

Time series data recorded by the conductivity transducers installed during the April 7, 2015 and April 24-25, 2015 storms, did not show a decrease in the specific conductance at the downgradient monitoring well nor the vadose zone monitoring well at the Corporation Yard during data collection over a multi-day period following the storm events. This suggests that actual travel times to the regional water table were longer than the shortest one to three day estimates.

Conductivity transducer data did show an influence at the vadose zone wells at the Strawberry Creek Detention Basin consistent with stormwater infiltrated at the dry well reaching the vadose zone monitoring location. Based on the similarity of groundwater elevations recorded in SDB-MW2 and SDB-MW4 the conductivity response time observed at SDB-MW2 may also be reflective of the time of travel for water to reach the water table at this site.



1



























Strawberry Cr. Detention Basin Dry Well Bottom Elevation: -10.5 ft, NAVD88 SDB-MW1 WSE = -20.94 ft., msl 2/1/2015 -20.9 -20.88 -20.86 -20.84 SDB-MW4 WSE = -20.86 ft., msl 2/1/2015 ¢ SDB-MW2 WSE = -20.8 ft., msl 2/1/2015 SDB-MW3 WSE = -20.86 ft., msl 2/1/2015 Path: X:\2012 Job Files\12-001\GIS\mapfiles\GWL contours\_working.mxd 100 Feet Monitoring Wells 50 Dry Well 0  $\odot$ ¢









CONSULTING ENGINEERS









Path: X:\2012 Job Files\12-001\GIS\mapfiles\GWL contours\_working.mxd





Strawberry Cr. Detention Basin Dry Well Bottom Elevation: -10.5 ft, NAVD88 21.6 SDB-MW1 WSE = -21.61 ft., msl 10/1/2015 21.56 • 21.52 0 ¢ SDB-MW4 WSE = -21.53 ft., msl 10/1/2015 SDB-MW3 WSE = -21.51 ft., msl 10/1/2015 Path: X:\2012 Job Files\12-001\GIS\mapfiles\GWL contours\_working mxd 100 Monitoring Wells 50 Dry Well 0 0  $\odot$ 







Monitoring Wells

¢

Note: Groundwater elevations are reported in feet relative to the North American Vertical Datum of 1988.

Path: X:\2012 Job Files\12-001\GIS\mapfiles\GWL contours\_working.mxd





Strawberry Cr. Detention Basin Dry Well Bottom Elevation: -10.5 ft, NAVD88 SDB-MW1 WSE = -20.55 ft., msl 2/15/2016 -20.52 20.48 20 02 • 0 SDB-MW4 WSE = -20.45 ft., msl 2/15/2016 SDB-MW2 WSE = -20.36 ft., msl 2/15/2016 SDB-MW3 WSE = -20.44 ft., msl 2/15/2016 Path: X:\2012 Job Files\12-001\GIS\mapfiles\GWL contours\_working.mxd Feet 100 50 \*\*\* Monitoring Wells Dry Well 0 0  $\odot$ 











Strawberry Cr. Detention Basin Dry Well Bottom Elevation: -10.5 ft, NAVD88 19.74 SDB-MW1 WSE = -19.73 ft., msl 5/9/2016 19.68 0,19.64 SDB-MW4 WSE = -19.65 ft., msl 5/9/2016 SDB-MW3 WSE = -19.63 ft., msl 5/9/2016 Path: X:\2012 Job Files\12-001\G(S\mapfiles\GWL contours\_working.mxd **T**Feet 100 **Monitoring Wells** 50 Dry Well 0  $\odot$ •