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:

Name		Agency
1.	Annalisa Kihara, PE, Water Resoucre Control Engineer, Stormwater Unit	State Water Resources Control Board, Division of Water Quality
2.	Dana Booth, PG, QSD, Program Manager, Stormwater Quality	Sacramento County Department of Water Resources 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 Manager	State Water Resources Control Board, Division of Water 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 Specialist	Sacramento County Environmental Health Department, 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	Tentative Schedule
Attend kick-off meeting; and provide feedback on Monitoring Plan and dry well and monitoring wells 60% design[1]	June 25, 2013
Review and provide feedback on 90% design[2]	June 28, 2013
Attend meeting and review results of first year of monitoring[1]	Individual Meetings
Review and provide feedback on fact sheets	
• Dry Well Fact Sheet[2]	January, 2017
• Project Results Fact Sheet[2]	January, 2017
Attend meeting and review Project results and interpretation[3]	January, 2017
Attend presentation on Project results[3]	January, 2017

[1] Attend meetings in-person or conference call.

[2] Review and provide feedback through email.

[3] 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.

Groundwater Sampling
Corporation Yard

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 (cnelson@elkgrovecity.org) 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 28th. We plan to take many pictures that will be posted on the project website.

Water Board Tour

On October 1st, 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 re-use 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^{th}. 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^{th} 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.

Strawberry Creek Water Quality Basin – Drilling Dry Well

Corporation Yard – Dry Well Casing Installation

Corporation Yard – Sedimentation Basin, Dry Well and Bioswale Construction

Corporation Yard – Bio Sod Placement

Challenges were also experienced at the Strawberry Creek Water Quality Basin with the location of the auto-sampler 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).

Picture 1

Picture 2

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 2nd, 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:

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

- 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 (Al, Fe, Cr, Mn, vanadium) detected at both sites. Aluminum and iron exceeded the secondary MCL for organoleptic effects (Al-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.
- 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 µg/L as water entered the drywell at the CY, more than double the MCL (1,000 µg/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 5th 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. http://www.elkgrovecity.org/UserFiles/Servers/Server_109585/File/Departments/Public%20Works/Drainage/Dry%20Wells/OEHHA.pdf

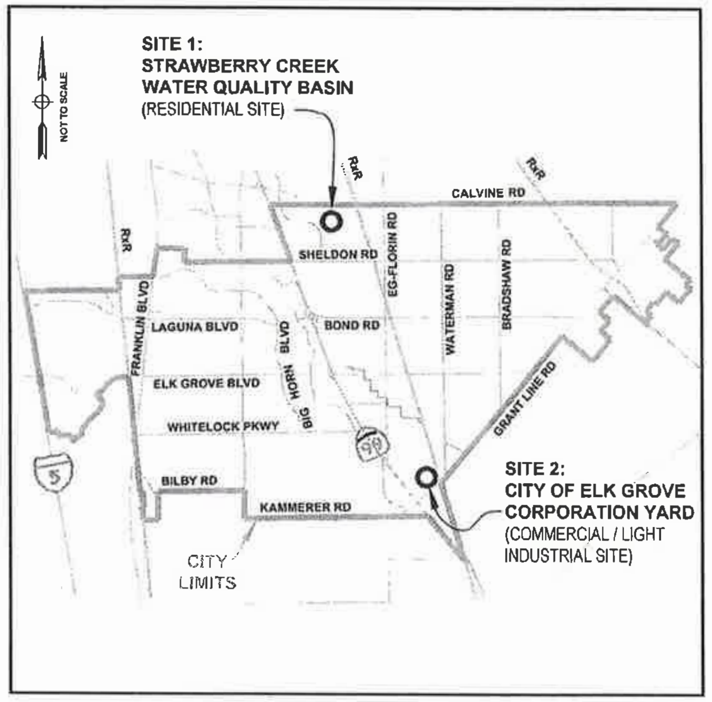
Meetings with TAC members

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: cnelson@elkgrovecity.org

Appendix 3.1

Monitoring Well Design Plans



PROJECT LOCATIONS
CITY OF ELK GROVE, CA

IMPROVEMENT PLANS FOR:

INVESTIGATION BORINGS / MONITORING WELLS 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	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
TRANSIT	e-TRAN	JEAN FOLETTA	916-687-3030
WATER	ELK GROVE WATER SERVICE	BRUCE KAMILOS	916-585-9385
WATER	SACRAMENTO COUNTY WATER AGENCY	IMELDA TABBADA	916-874-4261
U.S.A.	UNDERGROUND SERVICE ALERT		811 or 1-800-227-2600

811 Know what's below. Call before you dig.

100% SUBMITTAL
SEPTEMBER 2013

ABBREVIATIONS LIST:
AB – aggregate base
brk – break
dia – diameter (ø)
(E) – existing
gd – ground
inv. – invert
PVC – polyvinyl chloride
sch – schedule
SD – storm drain
SRI – Silica Resources Incorporated
(Typ) – typical
w/ – with

SHEET INDEX:

NO.	REVISION	BY	DATE

LUHDORFF & SCALMANINI CONSULTING ENGINEERS
500 FIRST STREET
WOODLAND, CALIFORNIA
PHONE: (530) 661-0109

DESIGNED: .
DRAWN: .
CHECKED: .

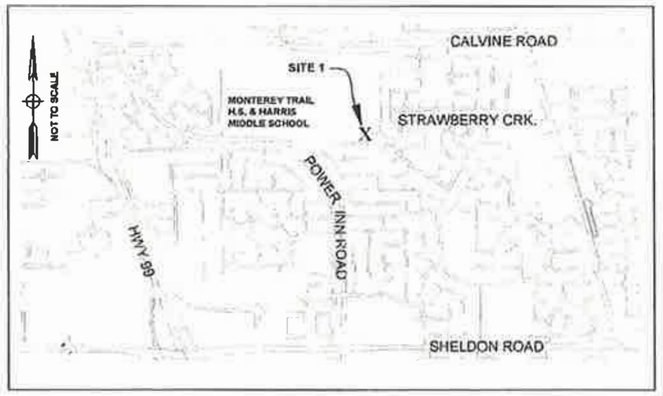
PROFESSIONAL GEOLOGIST CASEY DONALD MEIROVITZ No. 9074 STATE OF CALIFORNIA

INVESTIGATION BORINGS / MONITORING WELLS IMPROVEMENTS PROJECT

TITLE SHEET

DATE: SEPTEMBER 2013
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3 4

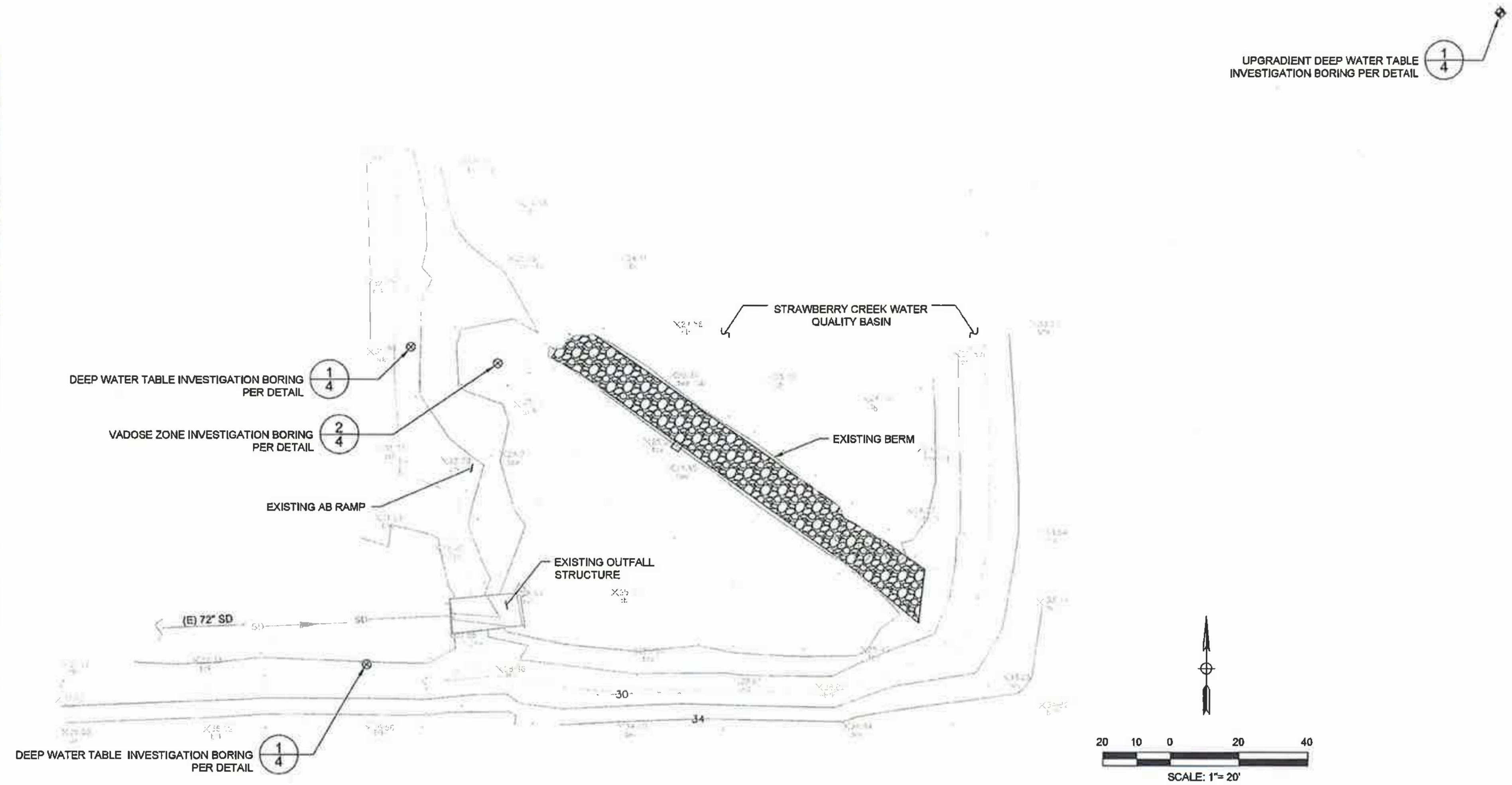


SITE 1 - VICINITY MAP
STRAWBERRY CREEK WATER QUALITY BASIN

NOTES:

1. CONTRACTOR TO VERIFY EXISTING UTILITIES PRIOR TO COMMENCEMENT OF WORK.
2. INVESTIGATION BORING LOCATIONS TO BE CONFIRMED BY DESIGN ENGINEER PRIOR TO CONSTRUCTION.

SITE 1 - AERIAL VIEW
STRAWBERRY CREEK WATER QUALITY BASIN



100% SUBMITTAL
SEPTEMBER 2013

SITE 1 - LAYOUT PLAN
STRAWBERRY CREEK WATER QUALITY BASIN

NO.	REVISION	BY	DATE

LUHDORFF & SCALMANINI CONSULTING ENGINEERS
500 FIRST STREET
WOODLAND, CALIFORNIA
PHONE: (530) 661-0109

DESIGNED:
DRAWN:
CHECKED:

PROFESSIONAL GEOLOGIST
CASEY DONALD MEIROVITZ
No. 9074
STATE OF CALIFORNIA

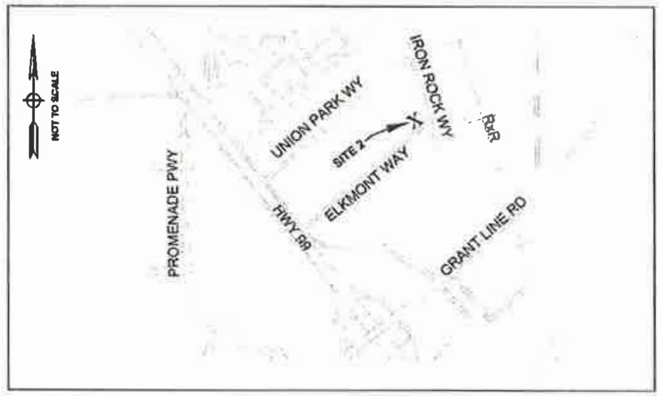
INVESTIGATION BORINGS / MONITORING WELLS IMPROVEMENTS PROJECT
SITE 1: STRAWBERRY CREEK WATER QUALITY BASIN
VICINITY MAP, AERIAL VIEW & SITE LAYOUT PLAN

DATE: SEPTEMBER 2013
SCALE: HORIZ: 1"= 20' VERT: N/A
PROJECT No.: WDR019
SHEET: 2 OF 5

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3 4

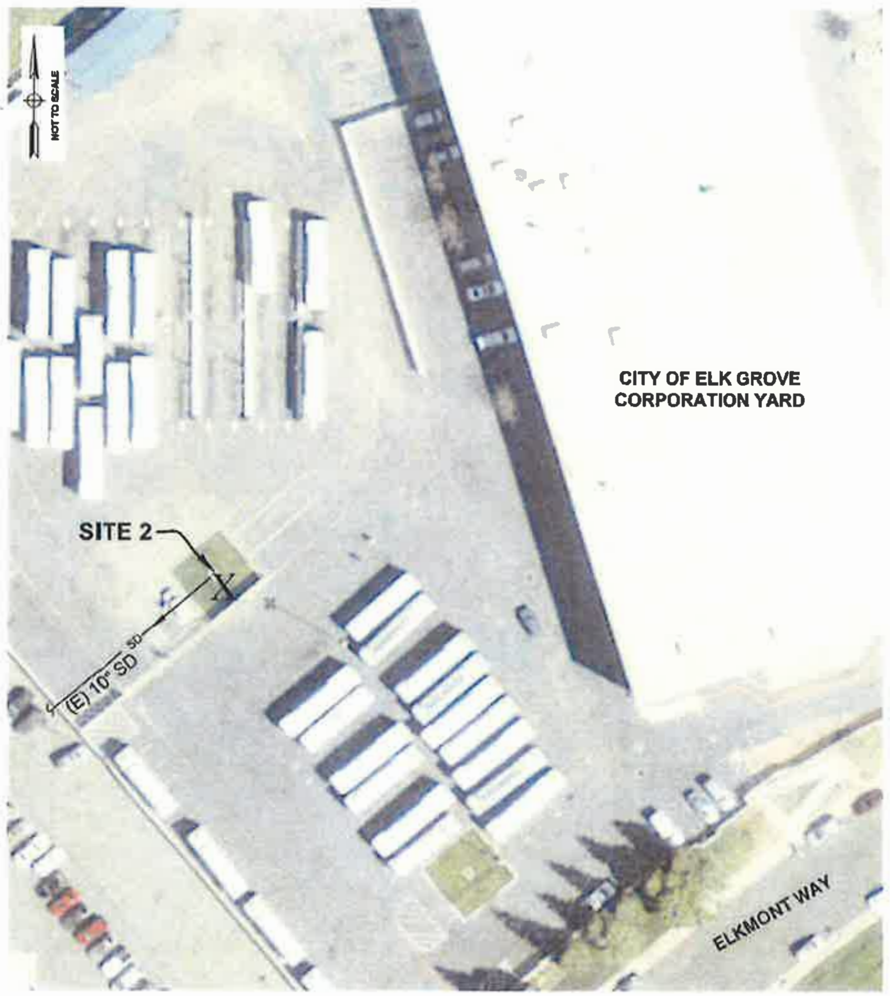
NOTES:

1. CONTRACTOR TO VERIFY EXISTING UTILITIES PRIOR TO COMMENCEMENT OF WORK.
2. INVESTIGATION BORING LOCATIONS TO BE CONFIRMED BY DESIGN ENGINEER PRIOR TO CONSTRUCTION.
3. PROTECT EXISTING IRRIGATION SYSTEM IN PLACE.



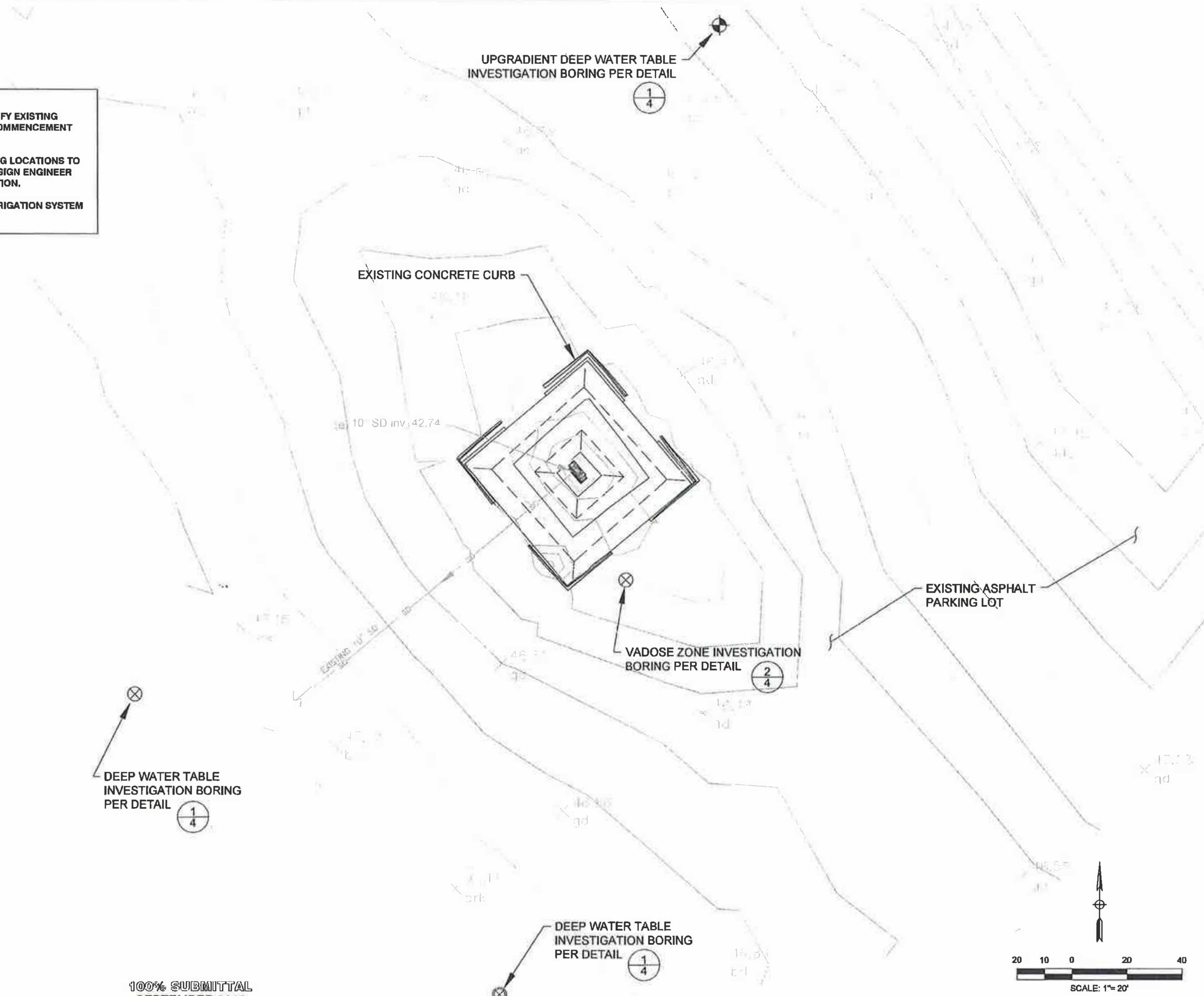
SITE 2 - VICINITY MAP

10250 IRON ROCK WAY



SITE 2 - AERIAL VIEW

10250 IRON ROCK WAY



SITE 2 - LAYOUT PLAN

10250 IRON ROCK WAY

100% SUBMITTAL
SEPTEMBER 2013

PROFESSIONAL GEOLOGIST
CASEY DONALD MEIROVITZ
No. 9074
STATE OF CALIFORNIA

WDR019 - INVESTIGATION WELLS / MONITORING WELLS

NO.	REVISION	BY	DATE

LUHDORFF & SCALMANINI CONSULTING ENGINEERS
500 FIRST STREET
WOODLAND, CALIFORNIA
PHONE: (530) 661-0109

DESIGNED: -
DRAWN: -
CHECKED: -

INVESTIGATION BORINGS / MONITORING WELLS IMPROVEMENTS PROJECT
SITE 2: CITY OF ELK GROVE CORPORATION YARD
VICINITY MAP, AERIAL VIEW & SITE LAYOUT PLAN

DATE: SEPTEMBER 2013
SCALE: HORIZ: 1"=20' VERT: N/A
PROJECT No.: WDR019
SHEET: 3 OF 5

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
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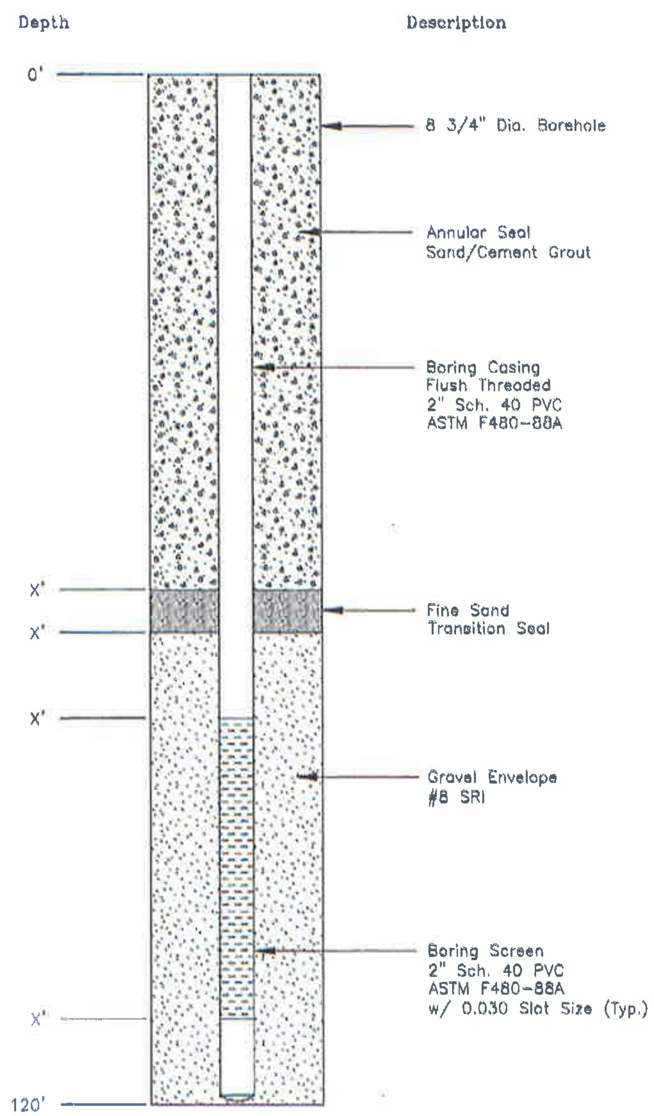
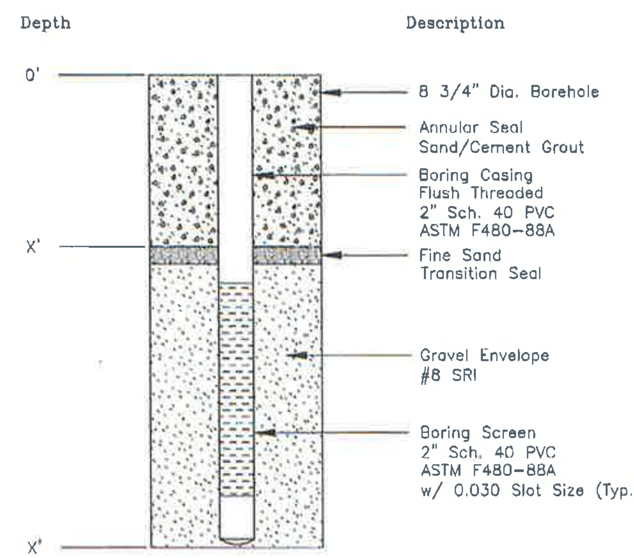


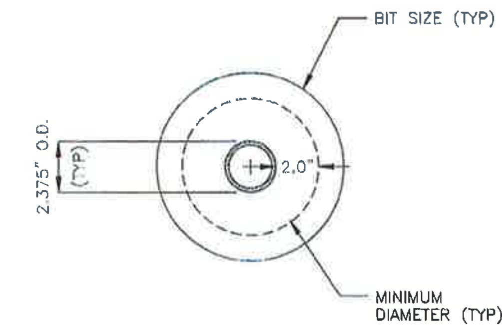
1 UPGRADIENT/ DEEP WATER TABLE INVESTIGATION BORING

NOT TO SCALE



2 VADOSE ZONE INVESTIGATION BORING

NOT TO SCALE



3 INVESTIGATION BORING PLAN VIEW

NOT TO SCALE

INVESTIGATION BORING DIMENSIONS

MIN. DIAMETER	6.375"
BIT SIZE	8-3/4"

100% SUBMITTAL
SEPTEMBER 2013

NO.	REVISION	BY	DATE

LUHDORFF & SCALMANINI CONSULTING ENGINEERS
500 FIRST STREET
WOODLAND, CALIFORNIA
PHONE: (530) 661-0109

DESIGNED:
DRAWN:
CHECKED:

PROFESSIONAL GEOLOGIST
CASEY DONALD MEIROVITZ
No. 8074
STATE OF CALIFORNIA

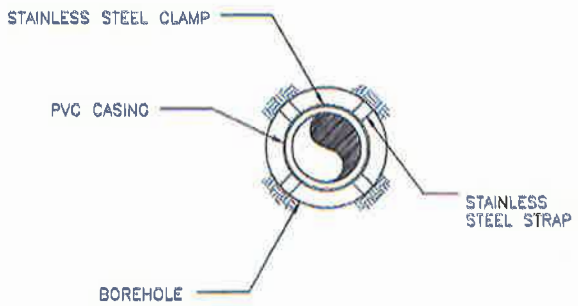
INVESTIGATION BORINGS / MONITORING WELLS IMPROVEMENTS PROJECT

INVESTIGATION BORINGS PROFILES

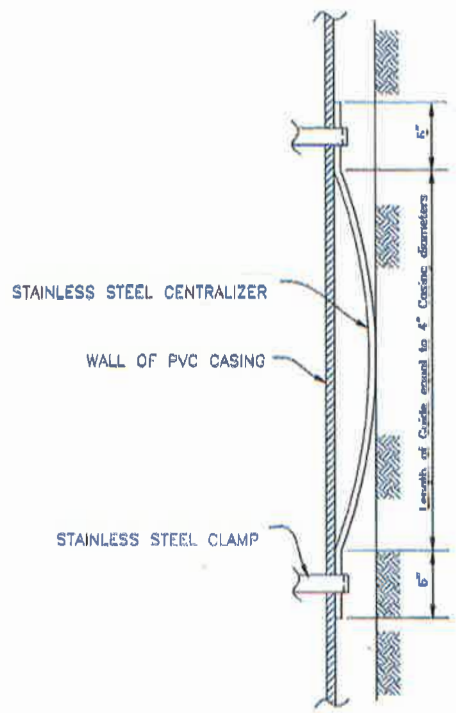
DATE: SEPTEMBER 2013
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019

SHEET: 4 OF 5

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3 4



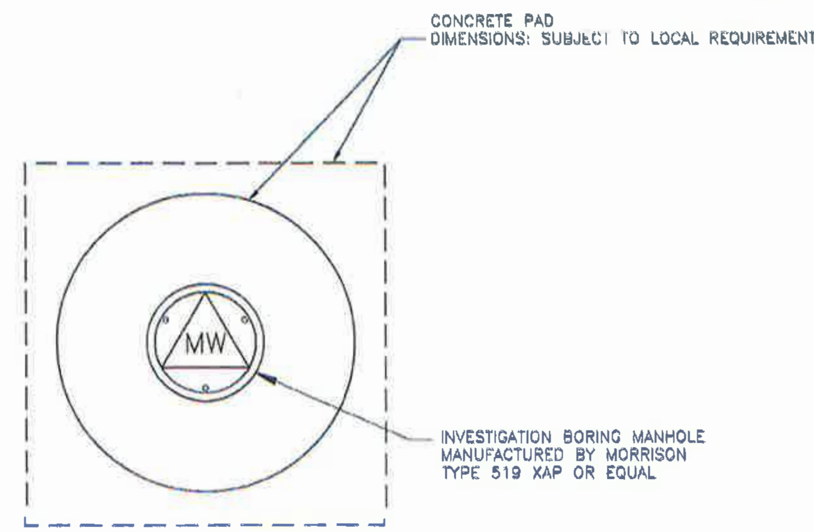
PLAN



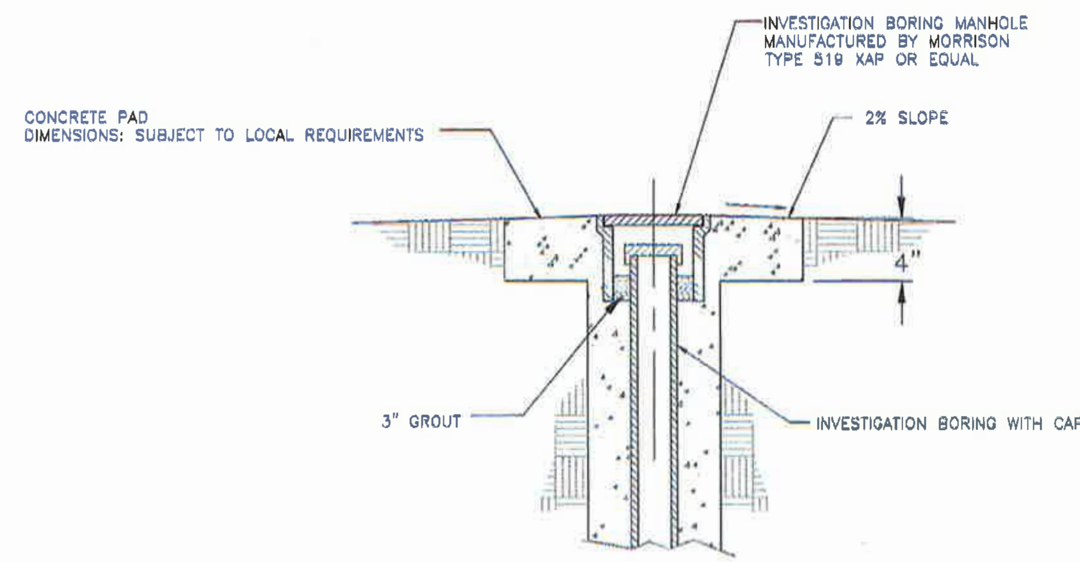
PROFILE

1 CENTRALIZER DETAIL

NOT TO SCALE



PLAN



FLUSH-MOUNT PROFILE

2 INVESTIGATION BORING SURFACE COMPLETION DETAILS

NOT TO SCALE

100% SUBMITTAL
SEPTEMBER 2013

PROFESSIONAL GEOLOGIST
CASEY DONALD MEIROVITZ
No. 8074
STATE OF CALIFORNIA

NO.	REVISION	BY	DATE

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS
500 FIRST STREET
WOODLAND, CALIFORNIA
PHONE: (530) 661-0109

DESIGNED:
DRAWN:
CHECKED:

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

INVESTIGATION BORINGS / MONITORING WELLS
IMPROVEMENTS PROJECT
INVESTIGATION BORINGS
STANDARD CONSTRUCTION DETAILS

DATE: SEPTEMBER 2013
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019

SHEET: 5 OF 5

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

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

City of Elk Grove

Dry Well Feasibility Study
Monitoring Well Construction Summaries

Table of Contents

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, as-built well construction drawings, lithologies encountered, well completions reports, location maps and permits.

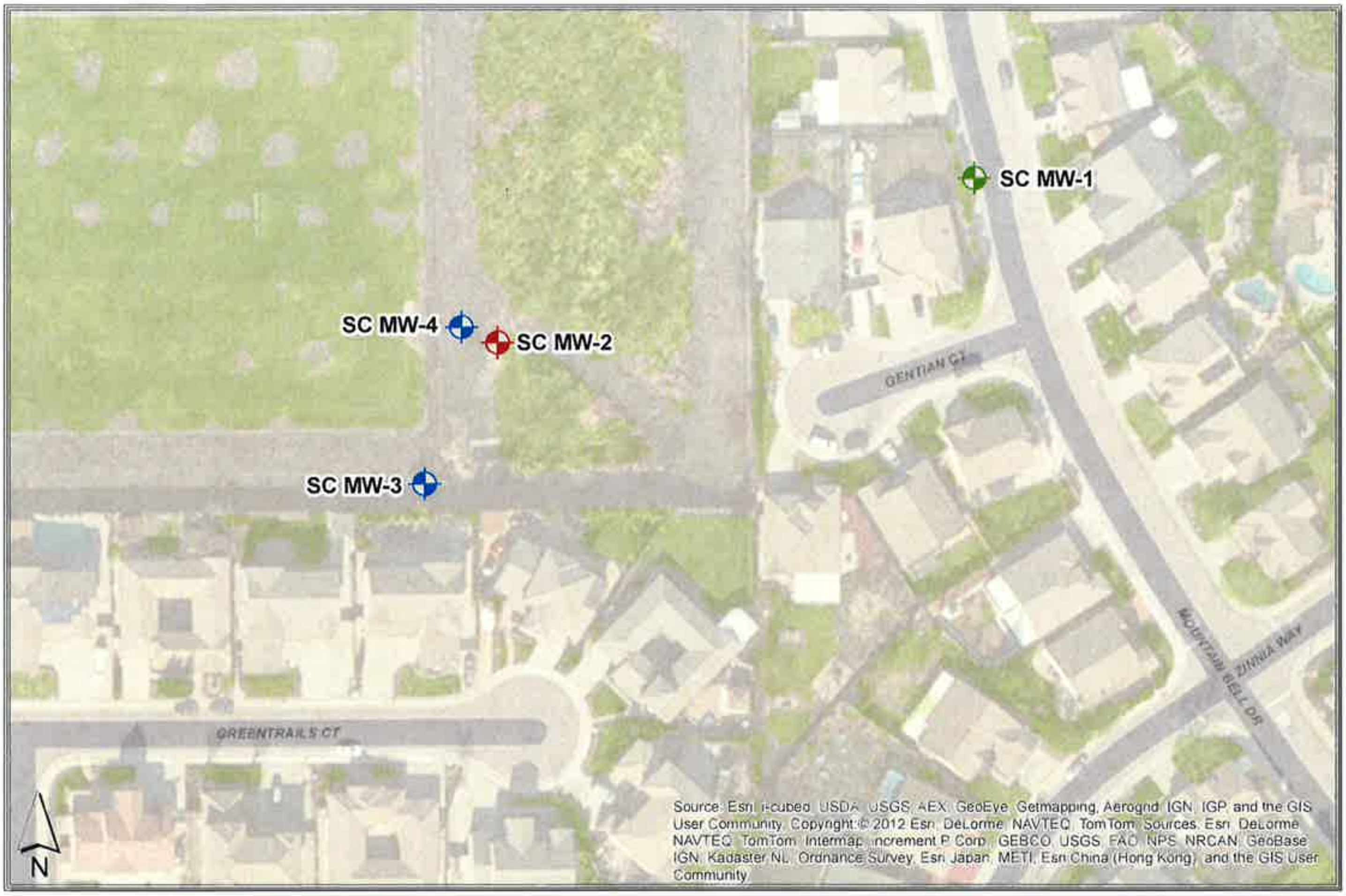
Background
In many areas throughout the State of California, the application of low impact development (LID) solutions to retain stormwater are thwarted by shallow clay-rich soils which limit infiltration to the subsurface. Stormwater program managers are looking for cost-effective LID solutions for 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: X:\2012 Job Files\12-001\GIS\SBCDB_WCR_WellLayout.mxd

LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

Strawberry Creek Detention Basin Well Layout

WELL APPLICATION AND PERMIT FORM

ENVIRONMENTAL MANAGEMENT DEPARTMENT – ENVIRONMENTAL COMPLIANCE DIVISION
10 590 ARMSTRONG AVENUE • SUITE A • MATHER, CA 95655
TELEPHONE (916) 875-8400 FAX: (916) 875-8513

EXPEDITED

WELL INSPECTION LINE (916) 875-8524

IS THIS PERMIT FOR A HAZARDOUS SUBSTANCE INVESTIGATION? ☐ YES ☐ NO

FOR OFFICE USE ONLY
☒ APPROVED ☐ APPROVED W/CONDITIONS (ATTACHED)
EXPEDITED PROCESSING? ☐ YES ☐ NO
PERMIT NUMBER(S): 5382-5384 and 5386
BY: SBW DATE: 9/20/13
DATE RECEIVED: 9/20/13
TOTAL FEE: $746 + $107 expedited permit fee SBW
INITIAL GROUT BY: ______ DATE: ______ RECEIPT NO: ______ DEPTH TO WATER: ______
FINAL INSPECTION BY: ______ DATE: ______ WELL DEPTH: ______ GROUT DEPTH: ______
DESTRUCTION BY: ______ DATE: ______ GPS: N: 38 W: -121
COMMENTS: See LSCE technical provisions (SBW)

SITE ADDRESS: STRAWBERRY CREEK DETENTION BASIN
Job Address: Mountain Bell Drive, Elk Grove
Nearest Major Cross Street: Zinnia Way
Property Owner: City of Elk Grove
Parcel Number(s): 115-0150-036, 126-0250-0..
Well Contractor: PenoCore Drilling
CA License No.: 906956 Exp. 11/30/13 OK SBW
Contractor's Address: 220 N. East Street Woodland, CA 95776
Well/Boring Identification Number(s): Deep Water Table/ Investigation Wells, Vadose Zone Wells

TYPE OF WORK: (California C-57 License required unless noted otherwise)
☒ Well construction
☐ Pump replacement (or C-61)
☐ Well Inactivation (Owner only)
☐ Vault box repair (General A or B)
☐ Well repair
☐ Pump repair (or C-61)
☐ Well destruction (SUPPLEMENT REQUIRED)
☐ Exploratory boring (C-57 if water present)
☐ Other: ______

INTENDED USE:
☐ Domestic/private
☐ Irrigation/agricultural
☒ Water/vapor monitoring/extraction
☐ Public water system: ______
(NAME OF WATER PURVEYOR WITH CONTACT NAME AND TELEPHONE NUMBER)
☐ Dewatering
☐ Cathodic protection
☐ Heat exchange
☐ Geotechnical boring
☐ Environmental boring
☐ Other: ______

DRILLING METHOD:
☐ Mud rotary ☐ Air Rotary ☐ Cable tool ☒ Auger ☐ Driven ☐ Other: ______

SETBACKS: (Wells only)
Is the well located within 50 feet of a: ☐ sewer line, ☐ stream, ☐ ditch, ☐ drainage course, ☐ pond or ☐ lake? ☒ No
Is the well located within 100 feet of a: ☐ septic tank, ☐ leach line, ☐ deep trench, or ☐ animal enclosure? ☒ No

SPECIFICATIONS:
BOREHOLE: Diameter: 8.5" Depth: 120' CASING: Diameter: 2" Depth: 120'
Diameter: 8.5" Depth: 55' CASING: Diameter: 2" Depth: 55'
CONDUCTOR: Diameter: ______ Depth: ______ IF STEEL: Gauge: ______ or Thickness: ______
ANNULAR SEAL: Depth: 100' Material: ~~Cement~~ 10.3 sack Sand Cement IF PLASTIC: Type: ______ (Must meet ASTM F-480)
TRANSITION SEAL: Material: ______ MULTIPLE COMPLETION? ☐ Yes (DIAGRAM REQUIRED)
COMMENTS: ______

PUMP INSTALLATION/REPAIR:
Contractor: ______
License Number: ______ Type of Pump: ______ Horsepower: ______

will comply with all Codes, Rules and Regulations of the State and County pertaining to or regulating wells and pumps, call (916) 875-524 **for a grout inspection at least 24 hours prior to the requested appointment time**, submit a "Well Completion Report" (if equired) within 60 days of the completion of my work so a final inspection can be made, and obtain WPD approval before placing a ell in service.

SIGNATURE: [signature]
PRINTED NAME: Thanh Nguyen
COMPANY: PenoCore Drilling
MAILING ADDRESS: 220 N. East St. Woodland, CA 95776
PHONE NUMBER: 530 661-3600
☐ Property Owner
☒ Well Contractor OK-SBW
☐ Agent (REQUIRES AUTHORIZATION FORM)
FIELD PHONE: 530 681-3198

A SITE PLAN MUST BE SUBMITTED WITH EACH APPLICATION.
PERMIT EXPIRES ONE (1) YEAR AFTER DATE APPROVED (UNLESS EXTENDED)

10/2012 gfb W:\Data\FORMSARCHIVE\WP\WELLS\07 WELL APPLICATION AND PERMIT FORM.doc

Information For Parcel:
115-0150-036-0000

PROPERTY INFORMATION	
APN	11501500360000
Situs Address	0 CALVINE RD
Postal City/St/Zip	ELK GROVE, CA 95624
Thomas Bros	338 E 7
Landuse Code	IABAAA
Jurisdiction	ELK GROVE
Sup. District	District 5 - Don Nottoli
OWNERSHIP INFORMATION	
Owner	• CITY OF ELK GROVE
Mailing Address	8380 LAGUNA PALMS WAY 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 Info	View Assessor Data
Building Permits	View Permits
Parcel Notes	View Parcel Notes
Business Licenses	No Business License Data available.
SHRA Info	View SHRA Data
CUBS Info	View CUBS Data
Refuse Pickup	No Refuse Pickup schedule available.
Water Meters	No Water Meter Data available.

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.

Client:	City of Elk Grove	Lat/Long:	
Project Name:	Strawberry Creek Basin MW-1	GSE (ft-msl)	
LSCE #:	12-1-001	Drill Date:	10/01/2013-10/02/2013
Location:	Mountain Bell Drive	Drilling Method:	Hollow Stem Auger
Geologist:	W. Andrews/C. Jenkins	Driller:	Penecore Drilling

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Lithologic Description	Strat-Column	Well Construction Diagram

0-2' Fill- road base sand and gravel, dry

2-5' Clay- brown, medium plastic, dry

5-15' Sandy Silt-very fine, light brown mottled tan, damp

15-21' Sandy Silt- very fine to fine, tan, damp

21-25' Sandy Silt- very fine, light brown mottled tan, damp

25-32' Sandy Silt- very fine to fine, tan, damp

32-35' Sand- very fine to medium, well sorted, light brown, moist
35-37' Sand- very fine to medium, brown, lenses of sandy silt, moist
37-47' Sand- very fine to medium, well sorted, light brown moist

47-53' Sandy Clayey Silt- very fine to fine, light brown, moist

53-57' Sandy Silt- very fine to fine, light brown mottled tan, moist

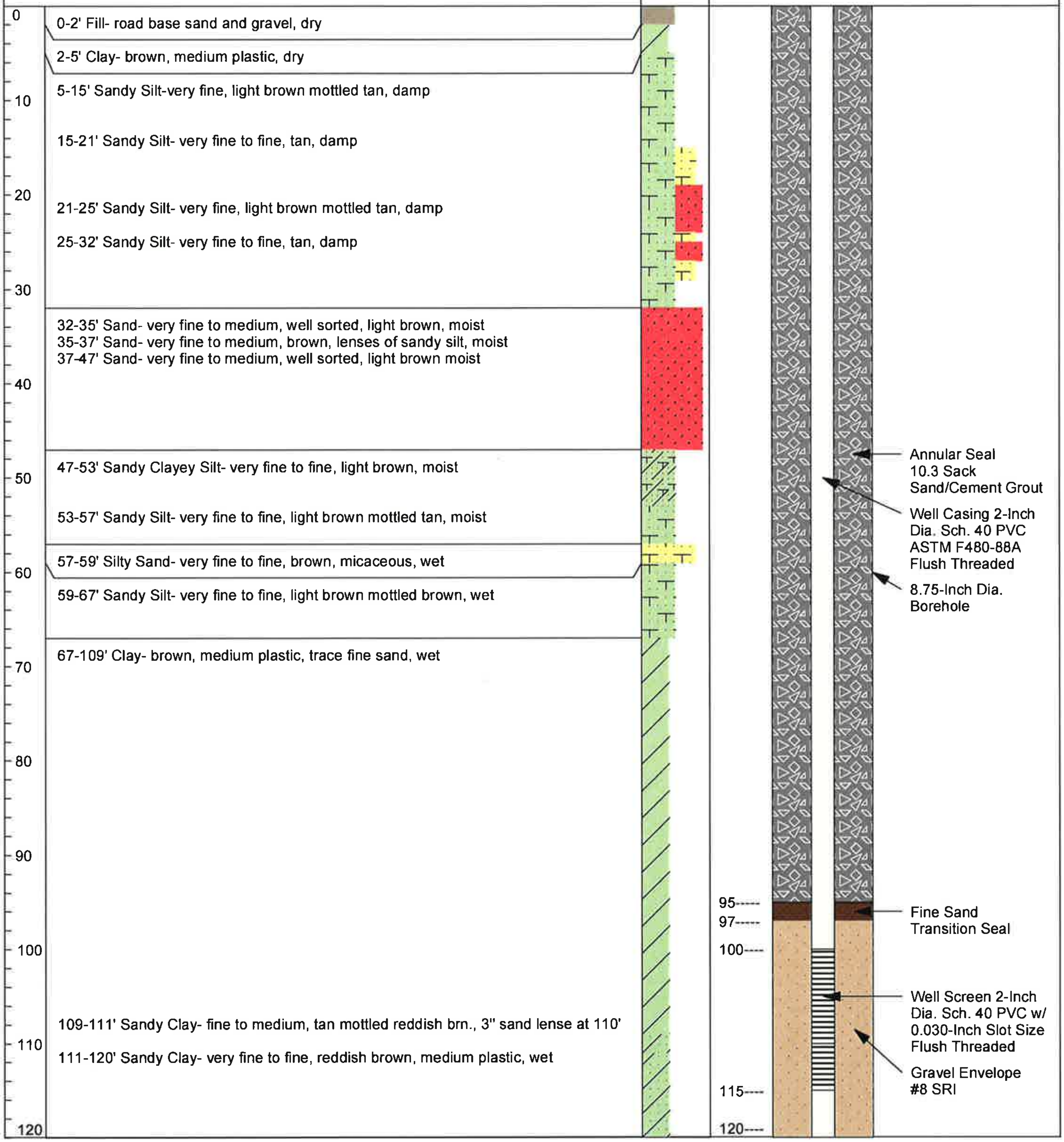
57-59' Silty Sand- very fine to fine, brown, micaceous, wet

59-67' Sandy Silt- very fine to fine, light brown mottled brown, wet

67-109' Clay- brown, medium plastic, trace fine sand, wet

109-111' Sandy Clay- fine to medium, tan mottled reddish brn., 3" sand lense at 110'

111-120' Sandy Clay- very fine to fine, reddish brown, medium plastic, wet



*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190505

Page 1 of 1

Owner's Well Number SC MW-1

Date Work Began 10/01/2013 Date Work Ended 10/2/2013

Local Permit Agency County of Sacramento

Permit Number 53186 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	2	Fill- road base sand and gravel, dry
2	5	Clay- brown, medium plasticity, dry
5	15	Sandy Silt-very fine, light brown mottled tan, damp
15	21	Sandy Silt- very fine to fine, tan, damp
21	25	Sandy Silt- very fine, light brown mottled tan, damp
25	32	Sandy Silt- very fine to fine, tan, damp
32	35	Sand- very fine to medium, well sorted, light brown
		moist
35	37	Sand- very fine to medium, brown, lenses of sandy
		silt, moist
37	47	Sand- very fine to medium, well sorted, light brown
		moist
47	53	Sandy Clayey Silt- very fine to fine, light brown,
		moist
53	57	Sandy Silt- very fine to fine, light brown mottled tan
		moist
57	59	Silty Sand- very fine to fine, brown, micaceous,
		wet
59	67	Sandy Silt- very fine to fine, light brown mottled
		brown, wet
67	109	Clay- brown, medium plastic, trace fine sand, wet
109	111	Sandy Clay- fine to medium, tan mottled reddish
		brown, 3" sand lense at 110'
111	120	Sandy Clay- very fine to fine, reddish brown,
		medium plastic, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude ____ Deg. ____ Min. ____ Sec. N Longitude ____ Deg. ____ Min. ____ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 115 Page 0150 Parcel 036

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well

○ Modification/Repair

○ Deepen

○ Other ____

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

⦿ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other ____

Water Level and Yield of Completed Well

Depth to first water 57 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	100	8.75	Blank	PVC Sch. 40		2		
100	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	95	Cement	10.3 Sack sand/
			cement
95	97	Fine Sand	Transition
97	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log

☐ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pene Cove Drilling (Person, Firm or Corporation)

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed ____ (C-57 Licensed Water Well Contractor) 10/5/13 (Date Signed) 906899 (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. 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.

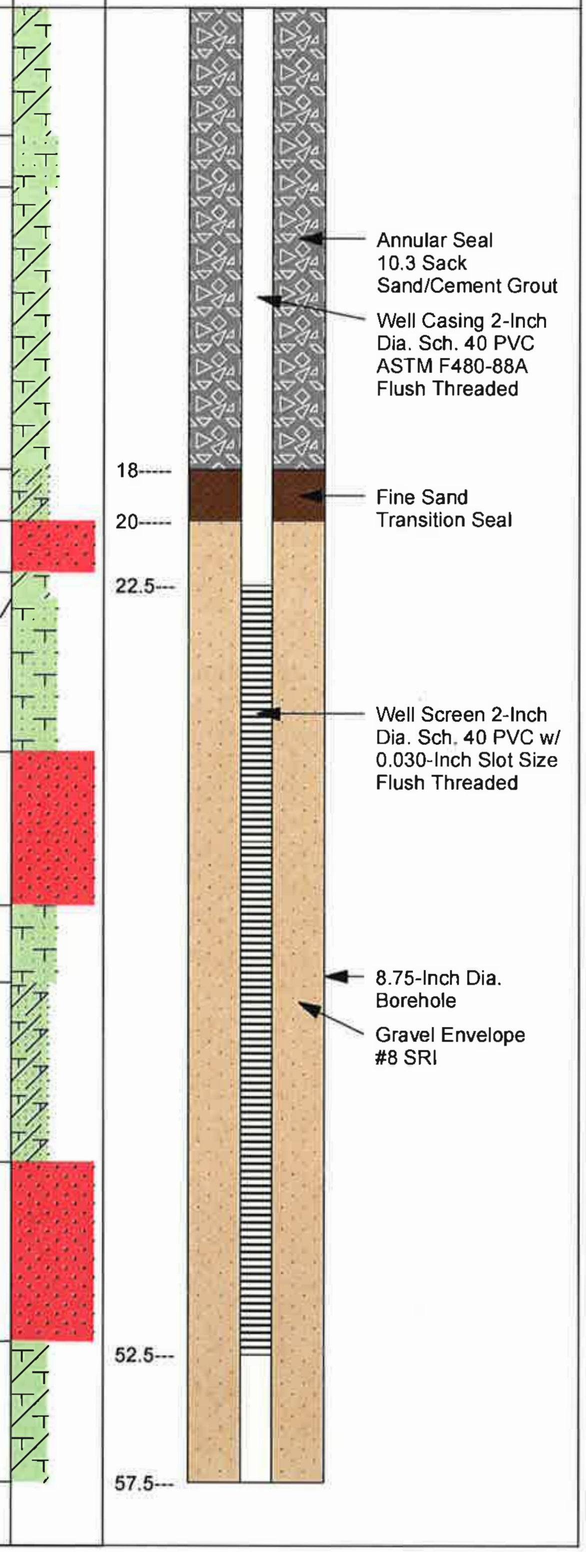
Note on Datum
All depths cited in this summary report are based on grade as it existed at the time of construction.

Client:	City of Elk Grove	Lat/Long:	
Project Name:	Strawberry Creek Basin MW-2	GSE (ft-msl)	
LSCE #:	12-1-001	Drill Date:	09/26/2013
Location:	Mountain Bell Drive	Drilling Method:	Hollow Stem Auger
Geologist:	W. Andrews/C. Jenkins	Driller:	Penecore Drilling

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Depth (ft)	Lithologic Description
0	0-5' Silty Clay- reddish brown, medium plastic, trace very fine sand
	5-7' Sandy Silt- very fine to fine, reddish brown, moist
	7-11' Silty Clay- tan mottled light brown, medium plastic, moist
10	11-14' Sandy Silty Clay- very fine to fine, tan mottled light brown, moist
	14-18' Silty Clay- tan, medium plastic, some white clay lenses
	18-20' Sandy Silt- very fine to fine, tan, moist
20	20-22' Sand- very fine to medium, well sorted, moist, brown
	22-23' Silty Clay- tan, medium plastic, micaceous, moist
	23-29' Sandy Silt- very fine, tan, micaceous, moist
30	29-35' Sand- very fine to medium, well sorted, micaceous, damp, brown
	35-38' Sandy Silt- very fine to fine, tan, micaceous, moist
	38-45' Sandy Silty Clay- very fine, medium plastic, reddish brown, micaceous, moist
40	
	45-52' Sand- very fine to medium, well sorted, loose w/ some hard lenses, brown, moist to wet
50	52-57.5' Silty Clay- tan mottled light brown, medium plastic, moist
60	

Strat-Column / Well Construction Diagram



*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190516

Page 1 of 1

Owner's Well Number SC MW-2

Date Work Began 09/26/2013 Date Work Ended 9/26/2013

Local Permit Agency County of Sacramento

Permit Number 53182 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	5	Silty Clay- reddish brown, medium plastic, trace very fine sand
5	7	Sandy Silt- very fine to fine, reddish brown, moist
7	11	Silty Clay- tan mottled light brown, medium plastic, moist
11	14	Sandy Silty Clay- very fine to fine, tan mottled light brown, moist
14	18	Silty Clay- tan, medium plastic, some white clay lenses
18	20	Sandy Silt- very fine to fine, tan, moist
20	22	Sand- very fine to medium, well sorted, moist, brown
22	23	Silty Clay- tan, medium plastic, micaceous, moist
23	29	Sandy Silt- very fine, tan micaceous, moist
29	35	Sand- very fine to medium, well sorted, micaceous damp, brown
35	38	Sandy Silt- very fine to fine, tan, micaceous, moist
38	45	Sandy Silty Clay- very fine, medium plastic, reddish brown, micaceous, moist
45	52	Sand- very fine to medium, well sorted, loose with some hard lenses, brown, moist to wet
52	57.5	Silty Clay- tan mottled light brown, medium plastic, moist
		Note: This is version 2, a depth correction was made. The same Well Completion Report number was used.

Total Depth of Boring 57.5 Feet

Total Depth of Completed Well 57.5 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude ____ Deg ____ Min ____ Sec N Longitude ____ Deg ____ Min ____ Sec W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 115 Page 0150 Parcel 036

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

- ⦿ New Well
- ○ Modification/Repair
  - ○ Deepen
  - ○ Other ____
- ○ Destroy
  - Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

- ○ Water Supply
  - ☐ Domestic ☐ Public
  - ☐ Irrigation ☐ Industrial
- ○ Cathodic Protection
- ○ Dewatering
- ○ Heat Exchange
- ○ Injection
- ⦿ Monitoring
- ○ Remediation
- ○ Sparging
- ○ Test Well
- ○ Vapor Extraction
- ○ Other ____

Water Level and Yield of Completed Well

Depth to first water 45 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	23	8.75	Blank	PVC Sch. 40		2		
23	53	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
53	57.5	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	18	Cement	10.3 Sack sand/ cement
18	20	Fine Sand	Transition
20	57.5	Filter Pack	SRI #8 Gravel

Attachments

- ☐ Geologic Log
- ☐ Well Construction Diagram
- ☐ Geophysical Log(s)
- ☐ Soil/Water Chemical Analyses
- ☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pene Co Re Drilling
Person, Firm or Corporation

220 N East St Woodland CA 95776
Address City State Zip

Signed [signature] 1/16/14 906899
C-57 Licensed Water 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. 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 102 to 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.

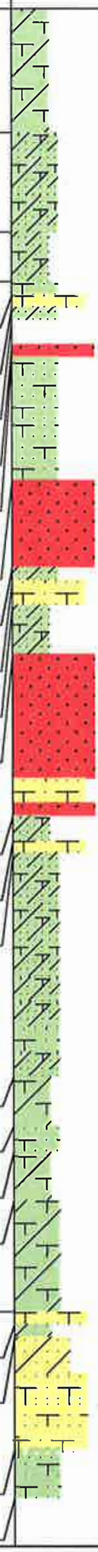
Note on Datum
All depths cited in this summary report are based on grade as it existed at the time of construction.

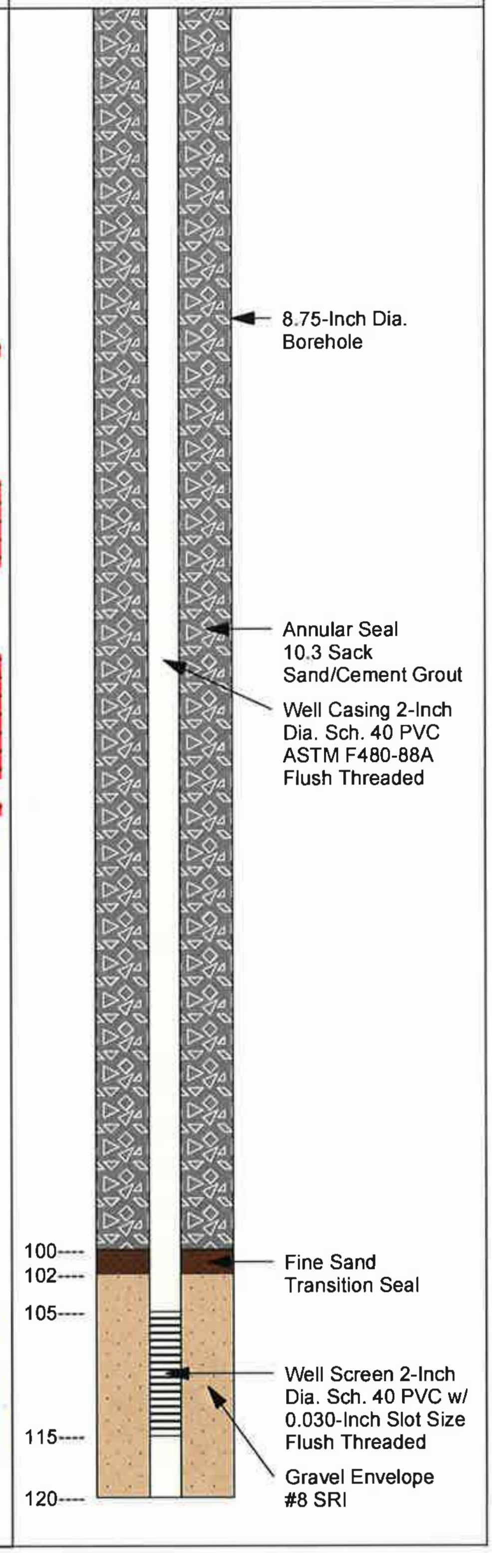
Client:	City of Elk Grove	Lat/Long:	
Project Name:	Strawberry Creek Basin MW-3	GSE (ft-msl)	
LSCE #:	12-1-001	Drill Date:	09/23/2013-09/25/2013
Location:	Mountain Bell Drive	Drilling Method:	Hollow Stem Auger
Geologist:	W. Andrews/C. Jenkins	Driller:	Penecore Drilling

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Lithologic Description | **Strat-Column** | **Well Construction Diagram**

Depth (ft)	Lithologic Description
0	0-10' Silty Clay-reddish brown, medium plastic w/ fine sand, dry
10	10-15' Sandy Clayey Silt- tan mottled yellowish brown, medium plastic, very fine, dry, damp at 13' 15-18' Sandy Clayey Silt- reddish brown, medium plastic, very fine, damp
20	18-22' Sandy Silty Clay- reddish brown, medium plastic, very fine, damp
	22-23' Sandy Silt- tan, very fine, damp
	23-24' Silty Sand- very fine to fine, reddish brown, abundant mica, damp
30	24-25' Sandy Clayey Silt- tan, medium plastic, very fine, damp
	25-27' No sample
	27-28' Sand- tan, very fine to fine, dry
40	28-33' Sandy Silt- tan, very fine, damp 33-38' Sandy Silt- tan mottled reddish brown, very fine to fine, damp
	38-45' Sand- light brown, very fine to medium, damp to moist
50	45-46' Sandy Clayey Silt- reddish brown, medium plastic, very fine, damp
	46-48' Silty Sand- reddish brown, very fine to medium w/ streaks of clay, damp
	48-52' Sandy Silty Clay- brown, medium plastic, very fine to fine, damp
60	52-62' Sand- brown, very fine to medium, moist, wet at 58' 62-64' Silty Sand- light brown, very fine to medium, wet 64-65' Sand- brown, fine to coarse, wet
70	65-67' Sandy Silty Clay- tan mottled reddish brown, medium plastic, fine, moist to wet
	67-68' Silty Sand- light brown, very fine to fine, moist to wet
80	68-78' Sandy Clayey Silt- tan mottled reddish brown, medium plastic, very fine, moist 78-80' Sandy Clayey Silt- light brown mottled reddish brown, medium plastic, very fine, moist 80-82' Sandy Clayey Silt- reddish brown, medium plastic, very fine, moist 82-84' Sandy Silt- reddish brown, very fine to fine, moist 84-86' Sandy Clayey Silt- reddish brown, medium plastic, very fine, moist
90	86-90' Silty Clay- light brown, medium plastic, moist
	90-92' Sandy Silt- tan, very fine to fine, damp
	92-96' Silty Clay- brown mottled reddish brown, medium plastic, moist, wet at 94'
100	96-105' Clayey Silt- tan mottled light brown, medium plastic, wet
	105-106' Silty Sand- reddish brown, very fine to medium, wet
110	106-107' Sandy Clay- tan, medium plastic, very fine to fine, wet
	107-110' Clayey Sand- brown, medium plastic, very fine to medium, wet 110-112' Silty Sand- reddish brown, very fine to medium, sandy silt 111.7 to 112', wet 112-116' Silty Sand- reddish brown, very fine to medium, wet
120	116-120' Sandy Silt- tan mottled reddish brown, very fine, moist to wet





*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190749

Page 1 of 2

Owner's Well Number SC MW-3

Date Work Began 09/23/2013 Date Work Ended 9/25/2013

Local Permit Agency County of Sacramento

Permit Number 53183 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical O Horizontal O Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)
0	10	Silty Clay-reddish brown, medium plastic w/ fine sand, dry
10	15	Sandy Clayey Silt- tan mottled yellowish brown, medium plastic, very fine, dry, damp at 13'
15	18	Sandy Clayey Silt- reddish brown, medium plastic, very fine, damp
18	22	Sandy Silty Clay- reddish brown, medium plastic, very fine, damp
22	23	Sandy Silt- tan, very fine, damp
23	24	Silty Sand- very fine to fine, reddish brown, abundant mica, damp
24	25	Sandy Clayey Silt- tan,med. plastic,very fine,damp
25	27	no sample
27	28	Sand- tan, very fine to fine, dry
28	33	Sandy Silt- tan, very fine, damp
33	38	Sandy Silt- tan mottled reddish brown, very fine to fine, damp
38	45	Sand- light brn,very fine to medium, damp to moist
45	46	Sandy Clayey Silt- reddish brown, medium plastic, very fine, damp
46	48	Silty Sand- reddish brown, very fine to medium w/ streaks of clay, damp
48	52	Sandy Silty Clay- brown, medium plastic, very fine to fine, damp
52	62	Sand- brown,very fine to medium, moist, wet at 58'
62	64	Silty Sand- light brown, very fine to medium, wet
64	65	Sand- brown, fine to coarse, wet
65	67	Sandy Silty Clay- tan mottled reddish brn.,medium plastic, fine, moist to wet
67	68	Silty Sand- light brn., very fine to fine, moist to wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude ____ Deg. ____ Min. ____ Sec. N Longitude ____ Deg. ____ Min. ____ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 115 Page 0150 Parcel 036

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
O Modification/Repair
O Deepen
O Other ____
O Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

O Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
O Cathodic Protection
O Dewatering
O Heat Exchange
O Injection
⦿ Monitoring
O Remediation
O Sparging
O Test Well
O Vapor Extraction
O Other ____

Water Level and Yield of Completed Well

Depth to first water 58 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	105	8.75	Blank	PVC Sch. 40		2		
105	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	100	Cement	10.3 Sack sand/ cement
100	102	Fine Sand	Transition
102	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Venecore Drilling (Person, Firm or Corporation)

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] (C-57 Licensed Water Well Contractor) 11/5/13 (Date Signed) 926899 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190749

Page 2 of 2

Owner's Well Number SC MW-3

Date Work Began 09/23/2013 Date Work Ended 9/25/2013

Local Permit Agency County of Sacramento

Permit Number 53183 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Hollow Stem Auger Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
68	78	Sandy Clayey Silt- tan mottled reddish brown,
		medium plastic, very fine, moist
78	80	Sandy Clayey Silt- light brown mottled reddish
		brown, medium plastic, very fine, moist
80	82	Sandy Clayey Silt- reddish brown, medium plastic,
		very fine, moist
82	84	Sandy Silt- reddish brown, very fine to fine, moist
84	86	Sandy Clayey Silt- reddish brown, medium plastic,
		very fine, moist
86	90	Silty Clay- light brown, medium plastic, moist
90	92	Sandy Silt- tan, very fine to fine, damp
92	96	Silty Clay- brown mottled reddish brown, medium
		plastic, moist, wet at 94'
96	105	Clayey Silt- tan mottled light brn., med. plastic,wet
105	106	Silty Sand- reddish brn., very fine to medium, wet
106	107	Sandy Clay- tan, med. plastic, very fine to fine, wet
107	110	Clayey Sand- brown, medium plastic, very fine to
		medium, wet
110	112	Silty Sand- reddish brown, very fine to medium,
		sandy silt 111.7 to 112', wet
112	116	Silty Sand- reddish brn., very fine to medium, wet
116	120	Sandy Silt- tan mottled reddish brown, very fine,
		moist to wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum Dec. Lat. Dec. Long.

APN Book 115 Page 0150 Parcel 036

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water 58 (Feet below surface)

Depth to Static Water Level (Feet) Date Measured

Estimated Yield * (GPM) Test Type

Test Length (Hours) Total Drawdown (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Penecore Drilling (Person, Firm or Corporation)

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] C-57 Licensed Water Well Contractor 11/5/13 Date Signed 906899 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.

Client:	City of Elk Grove	Lat/Long:	
Project Name:	Strawberry Creek Basin MW-4	GSE (ft-msl)	
LSCE #:	12-1-001	Drill Date:	09/27/2013-09/30/2013
Location:	Mountain Bell Drive	Drilling Method:	Hollow Stem Auger
Geologist:	W. Andrews/C. Jenkins	Driller:	Penecore Drilling

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Lithologic Description | **Strat-Column** | **Well Construction Diagram**

0-5' Silty Clay- reddish brown, medium plastic w/ fine sand, moist

5-9' Sandy Silt- yellowish brown, very fine to fine, moist

9-18' Sandy Silty Clay- tan mottled light brown, medium plastic, very fine, moist

18-19' Sandy Silt- tan, very fine to fine, moist

19-21' Silty Sand- brown, very fine to fine, micaceous, moist

21-23' Sandy Silt- tan mottled light brown, very fine, moist

23-24' Sand- brown, very fine to medium, moist

24-27' Silty Clay- tan, medium plastic, moist

27-33' Sandy Silt- tan, very fine, moist

33-39' Sand- brown, very fine to medium, moist

39-40' Sandy Silt- brown, very fine, moist

41-45' Sandy Silty Clay- brown, medium plastic, very fine, moist

45-48' Sandy Clayey Silt- tan mottled light brown, medium plastic, moist

48-51' Sand- brown, very fine to medium, moist, wet at 49'
51-54' Silty Sand- brown, very fine to fine, micaceous, moist to wet

54-61' Sandy Clayey Silt- tan mottled light brown, medium plastic, very fine, moist

61-63' Silty Clay- brown mottled reddish brown, medium plastic, moist

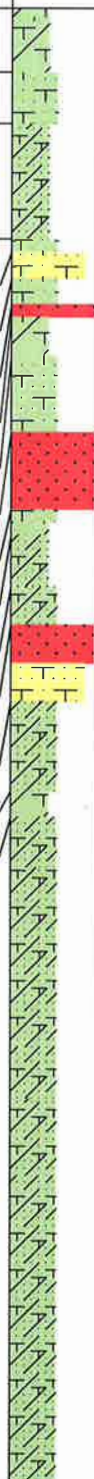
63-67' Sandy Clayey Silt- light brown, medium plastic, moist
67-81' Sandy Clayey Silt- reddish brown, medium plastic, very fine, wet

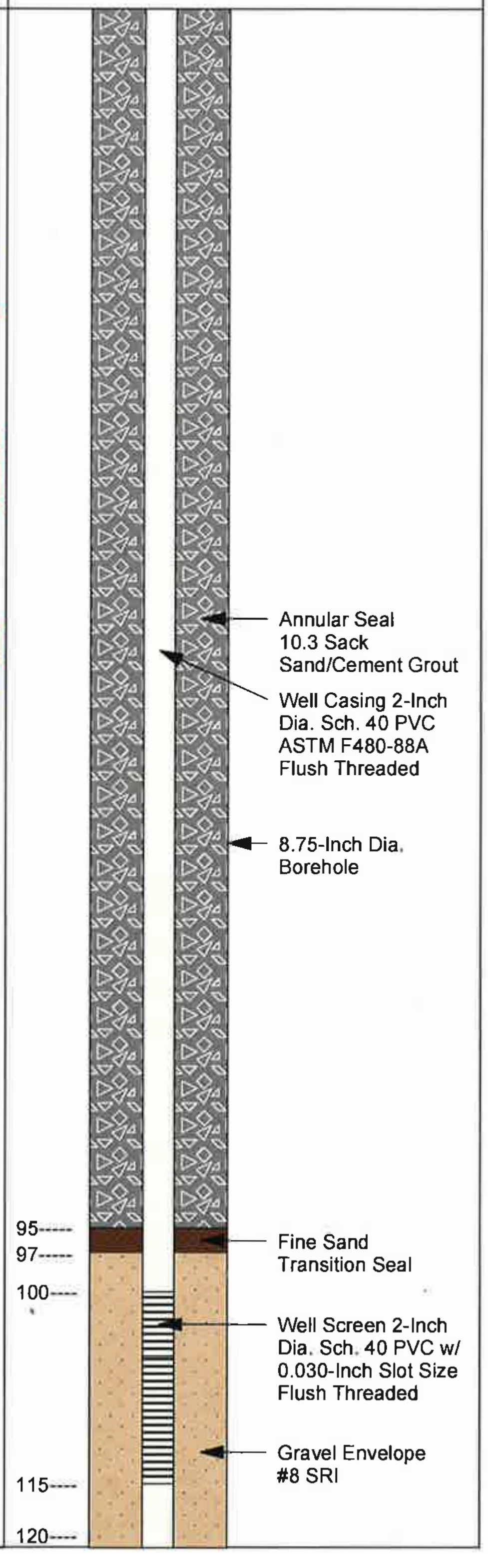
81-85' Sandy Clayey Silt- tan, medium plastic, very fine, wet

85-91' Sandy Clayey Silt- tan, medium plastic, very fine, moist

91-115' Sandy Clayey Silt- tan mottled yellowish brown, medium plastic, fine, moist to wet

115-120' No Samples





*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190749

Page 1 of 1

Owner's Well Number SC MW-4

Date Work Began 09/27/2013 Date Work Ended 9/30/2013

Local Permit Agency County of Sacramento

Permit Number 53184 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)
0	5	Silty Clay- reddish brown, medium plastic w/ fine sand, moist
5	9	Sandy Silt- yellowish brown, very fine to fine, moist
9	18	Sandy Silty Clay- tan mottled light brown, medium plastic, very fine, moist
18	19	Sandy Silt- tan, very fine to fine, moist
19	21	Silty Sand- brown, very fine to fine, mica, moist
21	23	Sandy Silt- tan mottled light brown, very fine, moist
23	24	Sand- brown, very fine to medium, moist
24	27	Silty Clay- tan, medium plastic, moist
27	33	Sandy Silt- tan, very fine, moist
33	39	Sand- brown, very fine to medium, moist
39	40	Sandy Silt- brown, very fine, moist
40	41	Silty Clay- brown, medium plastic, moist
41	45	Sandy Silty Clay- brn., med. plastic, very fine,moist
45	48	Sandy Clayey Silt- tan mottled light brown, medium plastic, moist
48	51	Sand- brn., very fine to medium, moist, wet at 49'
51	54	Silty Sand- brn., very fine to fine, mica,moist to wet
54	61	Sandy Clayey Silt- tan mottled light brn., medium plastic, very fine, moist
61	63	Silty Clay- brown mottled reddish brown, medium plastic, moist
63	67	Sandy Clayey Silt- light brn., med. plastic, moist
67	81	Sandy Clayey Silt- reddish brown, medium plastic very fine, wet
81	85	Sandy Clayey Silt- tan, med. plastic, very fine, wet
85	91	Sandy Clayey Silt- tan,med. plastic,very fine, moist
91	115	Sandy Clayey Silt- tan mottled yellowish brn., med. plastic, fine, moist to wet. No samples 115-120'

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 115 Page 0150 Parcel 036

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well

○ Modification/Repair

○ Deepen

○ Other ____

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

⦿ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other ____

Water Level and Yield of Completed Well

Depth to first water 49 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	100	8.75	Blank	PVC Sch. 40		2		
100	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	95	Cement	10.3 Sack sand/ cement
95	97	Fine Sand	Transition
97	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log

☐ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pene Cove Drilling

Person, Firm or Corporation

220 N. East St. Woodland CA 95776

Address City State Zip

Signed [signature] 11/5/13 906899

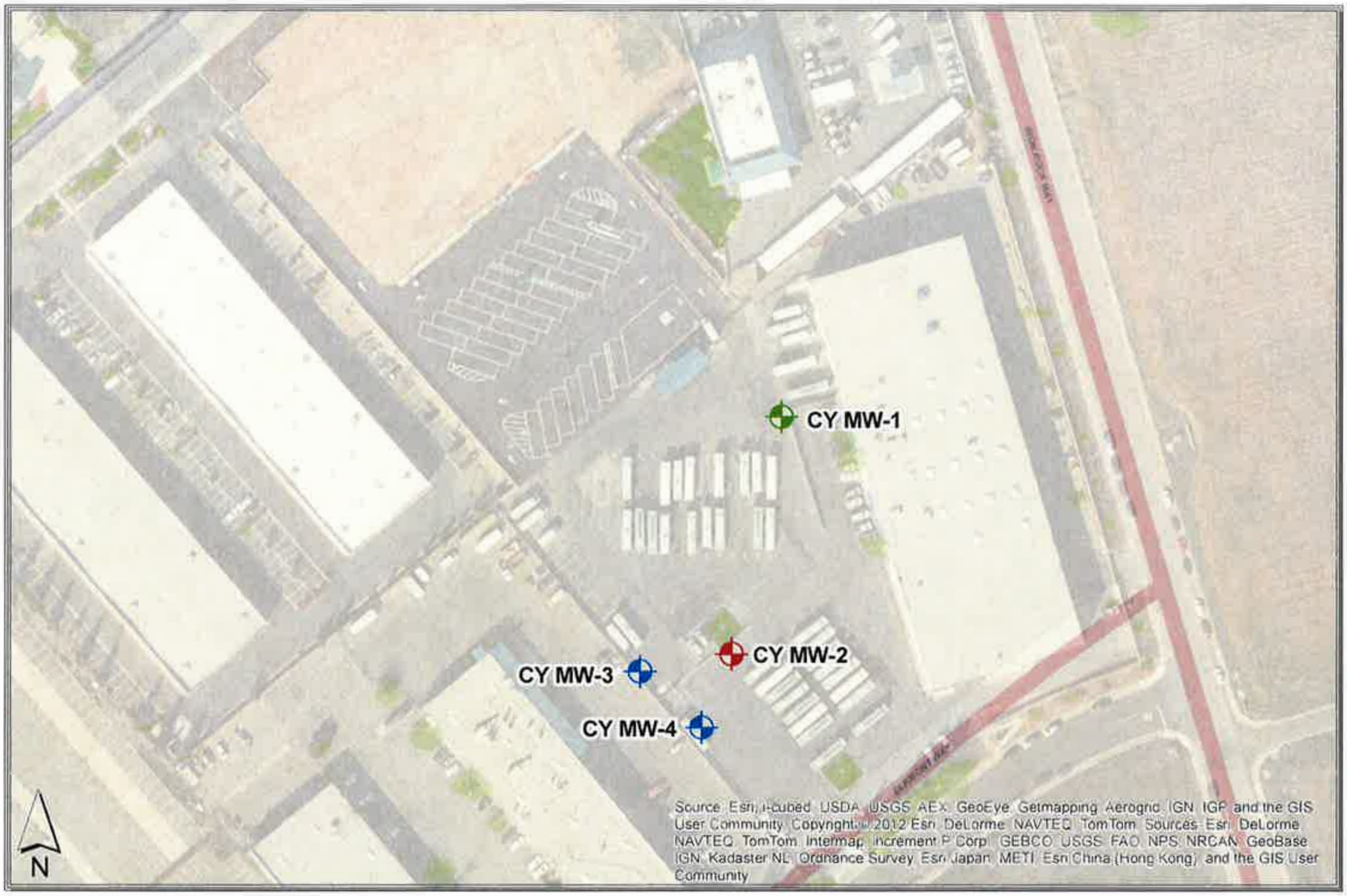
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

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



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LUHDORFF & SCALMANINI
CONSULTING ENGINEERS

Corporation Yard Well Layout

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

EXPEDITED

WELL INSPECTION LINE: (916) 875-8524

IS THIS PERMIT FOR A HAZARDOUS SUBSTANCE INVESTIGATION? ☐ YES ☐ NO

FOR OFFICE USE ONLY — EXPEDITED PROCESSING? ☐ YES ☐ NO

☒ APPROVED ☐ APPROVED W/CONDITIONS (ATTACHED) — PERMIT NUMBER(S): 53187-53190

BY: SBN DATE: 9/20/13 — DATE RECEIVED: 9/20/13 — TOTAL FEE: Ø

INITIAL GROUT BY: ____ DATE: ____ — RECEIPT NO: ____ — DEPTH TO WATER: ____

FINAL INSPECTION BY: ____ DATE: ____ — WELL DEPTH: ____ — GROUT DEPTH: ____

DESTRUCTION BY: ____ DATE: ____ — GPS: N: 38 — W: -121

COMMENTS: See TSCE technical provisions (SBN)

SITE ADDRESS: 10250 Iron Rock Way Elk Grove, CA — CORP YARD

Job Address: — Nearest Major Cross Street: Elk Mont Way

Property Owner: City of Elk Grove — Parcel Number(s): 134-0630-037

Well Contractor: Pene Core Drilling — CA License No: 906899 exp. 11/30/13 OK SBN

Contractor's Address: 220 N. East Street Woodland, CA 95776

Well/Boring Identification Number(s): Deep Water Table Investigation Wells, Vadose Zone Wells.

TYPE OF WORK: (California C-57 License required unless noted otherwise)

☒ Well construction ☐ Vault box repair (General A or B) ☐ Well destruction (SUPPLEMENT REQUIRED)
☐ Pump replacement (or C-61) ☐ Well repair ☐ Exploratory boring (C-57 if water present)
☐ Well Inactivation (Owner only) ☐ Pump repair (or C-61) ☐ Other: ____

INTENDED USE:

☐ Domestic/private ☐ Dewatering ☐ Geotechnical boring
☐ Irrigation/agricultural ☐ Cathodic protection ☐ Environmental boring
☒ Water/vapor monitoring/extraction ☐ Heat exchange ☐ Other: ____
☐ Public water system: ____ (NAME OF WATER PURVEYOR WITH CONTACT NAME AND TELEPHONE NUMBER)

DRILLING METHOD:

☐ Mud rotary ☐ Air Rotary ☐ Cable tool ☒ Auger ☐ Driven ☐ Other: ____

SETBACKS: (Wells only)

Is the well located within 50 feet of a: ☐ sewer line, ☐ stream, ☐ ditch, ☐ drainage course, ☐ pond, or ☐ lake? ☒ No
Is the well located within 100 feet of a: ☐ septic tank, ☐ leach line, ☐ deep trench, or ☐ animal enclosure? ☒ No

SPECIFICATIONS:

BOREHOLE: Diameter: 8.5" Depth: 120' — CASING: Diameter: 2" Depth: 120'
Diameter: 8.5" Depth: 55' — CASING: Diameter: 2" Depth: 55
CONDUCTOR: Diameter: ____ Depth: ~~2~~ — IF STEEL: Gauge: ____ or Thickness: ____
ANNULAR SEAL: Depth: 100' Material: ~~Cement~~ — IF PLASTIC: Type: ____ (Must meet ASTM F-480)
TRANSITION SEAL: 3' Material: ~~Bentonite~~ — MULTIPLE COMPLETION? ☐ Yes (DIAGRAM REQUIRED)
COMMENTS: ~~Ful Sack~~ 10.2 sack Sand Cement

PUMP INSTALLATION/REPAIR:

Contractor: ____ Type of Pump: ____ Horsepower: ____
License Number: ____

I will comply with all Codes, Rules and Regulations of the State and County pertaining to or regulating wells and pumps, call (916) 875-8524 for a grout inspection at least 24 hours prior to the requested appointment time, submit a "Well Completion Report" (if required) within 60 days of the completion of my work so a final inspection can be made, and obtain WPD approval before placing a well in service.

SIGNATURE: [signature] — ☐ Property Owner — OK-SBN
PRINTED NAME: Tuan Nguyen — ☒ Well Contractor
COMPANY: Pene Core Drilling — ☐ Agent (REQUIRES AUTHORIZATION FORM)
MAILING ADDRESS: 220 N. East Street Woodland, CA 95776
PHONE NUMBER: 530 661-3600 — FIELD PHONE: 530 681-3158

A SITE PLAN MUST BE SUBMITTED WITH EACH APPLICATION.
PERMIT EXPIRES ONE (1) YEAR AFTER DATE APPROVED (UNLESS EXTENDED)

8/19/2012 gfb W:\Data\FORMSARCHIVE\WP\WELLS\07 WELL APPLICATION AND PERMIT FORM.doc

Information For Parcel:
134-0630-037-0000

PROPERTY INFORMATION	
APN	13406300370000
Situs Address	10250 IRON ROCK WY
Postal City/St/Zip	ELK GROVE, CA 95624
	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	• CITY OF ELK GROVE
Mailing Address	10250 IRON ROCK WAY ELK GROVE, CA 95624
Transfer Date	2004-08-30
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 Info	View Assessor Data
Building Permits	View Permits
Parcel Notes	No Parcel Notes recorded.
Business Licenses	No Business License Data available.
SHRA Info	View SHRA Data
CUBS Info	View CUBS Data
Refuse Pickup	No Refuse Pickup schedule available.
Water Meters	000000000012118601

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.

Client:	City of Elk Grove	Lat/Long:	
Project Name:	Corp Yard MW-1	GSE (ft-msl)	
LSCE #:	12-1-001	Drill Date:	10/10/2013-10/11/2013
Location:	10250 Iron Rock Way	Drilling Method:	Hollow Stem Auger
Geologist:	W. Andrews/C. Jenkins	Driller:	Penecore Drilling

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Lithologic Description | **Strat-Column** | **Well Construction Diagram**

0-5' Clay- red, hard, trace sand and silt, hardpan

5-7' Clayey Silty Sand- brittle, hard, reddish brown, very fine to fine

7-9' Sandy Clayey Silt- reddish brown, low plastic, very fine to fine

9-15' Silty Sand- very fine to fine, reddish brown, medium plastic, trace clay
15-17' Sand- very fine to fine, tan, loose, slightly moist
17-19' Silty Clayey Sand- very fine to fine, packed, reddish brown, some white clay
19-22' Silty Sand- very fine to medium, tan, packed
22-23' Sand- very fine to fine, well sorted, loose, tan

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

29-30' Sandy Silt- 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, light brown

47-48' Clayey Silt- tan, brittle, hard
48-49' Sandy Silt- very fine to fine, dark tan, brittle

49-50' Silty Sand- very fine to fine, loose, tannish gray

50-52' Sandy Silt- very fine to fine, hard, brown

52-63' Sand- very fine to medium, tan to light brown

63-67' Sandy Silt- very fine to fine, packed, moist, tan
67-71' Clayey Sandy Silt- tan, moist, packed, very fine to fine
71-79' Sandy Silt- very fine to fine, moist, reddish brown

79-81' Silty Sand- fine to medium, wet, sub-rounded, brown
81-82' Sand- fine to medium, wet, brownish red, clean

82-85' Sandy Silt- very fine to fine, hard, brownish red, wet

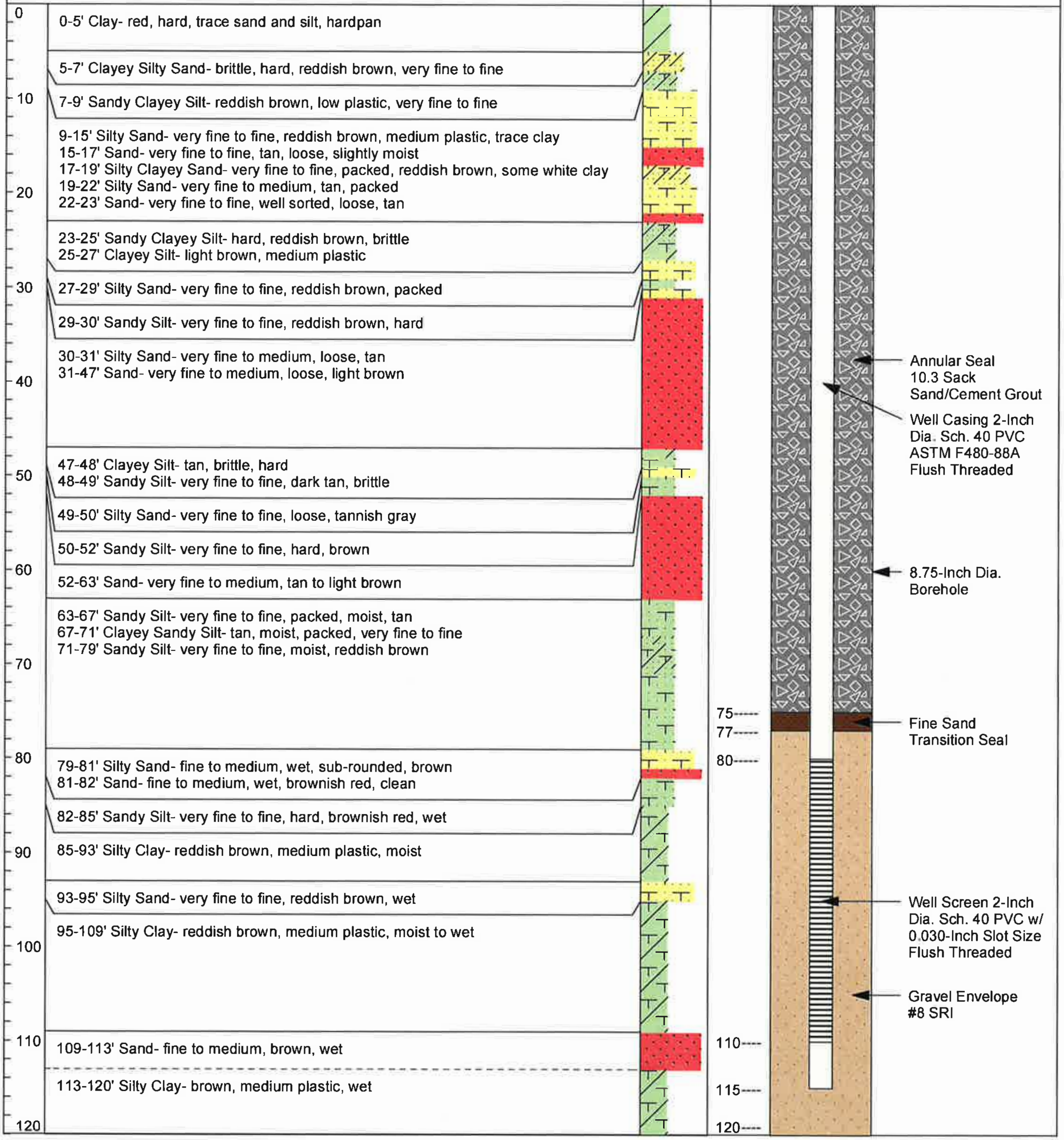
85-93' Silty Clay- reddish brown, medium plastic, moist

93-95' Silty Sand- very fine to fine, reddish brown, wet

95-109' Silty Clay- reddish brown, medium plastic, moist to wet

109-113' Sand- fine to medium, brown, wet

113-120' Silty Clay- brown, medium plastic, wet



*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190455

Page 1 of 2

Owner's Well Number CY MW-1

Date Work Began 10/10/2013   Date Work Ended 10/11/2013

Local Permit Agency County of Sacramento

Permit Number 53187   Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N   Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Hollow Stem Auger   Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	5	Clay- red, hard, trace sand and silt, hardpan
5	7	Clayey Silty Sand- brittle, hard, reddish brown, very fine to fine
7	9	Sandy Clayey Silt- reddish brown, low plastic, very fine to fine
9	15	Silty Sand- very fine to fine, reddish brown, medium plastic, trace clay
15	17	Sand- very fine to fine, tan, loose, slightly moist
17	19	Silty Clayey Sand- very fine to fine, packed, reddish brown, some white clay
19	22	Silty Sand- very fine to medium, tan, packed
22	23	Sand- very fine to fine, well sorted, loose, tan
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
29	30	Sandy Silt- 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, light brown
47	48	Clayey Silt- tan, brittle, hard
48	49	Sandy Silt- very fine to fine, dark tan, brittle
49	50	Silty Sand- very fine to fine, loose, tannish gray
50	52	Sandy Silt- very fine to fine, hard, brown
52	63	Sand- very fine to medium, tan to light brown
63	67	Sandy Silt- very fine to fine, packed, moist, tan
67	71	Clayey Sandy Silt- tan, moist, packed, very fine to fine sand
71	79	Sandy Silt- very fine to fine, moist, reddish brown
79	81	Silty Sand- fine to medium, wet, sub-rounded, brown
81	82	Sand- fine to medium, wet, brownish red, clean

Total Depth of Boring 120 Feet

Total Depth of Completed Well 115 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove   State CA   Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove   County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N   Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ___ Dec. Lat. ___ Dec. Long. ___

APN Book 134   Page 0630   Parcel 037

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North / West / East / South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ___
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ___

Water Level and Yield of Completed Well

Depth to first water 79 (Feet below surface)

Depth to Static Water Level ___ (Feet)   Date Measured ___

Estimated Yield * ___ (GPM)   Test Type ___

Test Length ___ (Hours)   Total Drawdown ___ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	80	8.75	Blank	PVC Sch. 40		2		
80	110	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
110	115	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	75	Cement	10.3 sack sand/ cement
75	77	Fine Sand	Transition
77	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ___

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Penecore Drilling (Person, Firm or Corporation)

220 North east st (Address)   Woodland (City)   CA (State)   95776 (Zip)

Signed [signature] (C-57 Licensed Water Well Contractor)   11/5/13 (Date Signed)   906899 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190455

Page 2 of 2

Owner's Well Number CY MW-1

Date Work Began 10/10/2013 Date Work Ended 10/11/2013

Local Permit Agency County of Sacramento

Permit Number 53187 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Hollow Stem Auger Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
82	85	Sandy Silt- very fine to fine, hard, brownish red, wet
85	93	Silty Clay- reddish brown, medium plastic, moist
93	95	Silty Sand- very fine to fine, reddish brown, wet
95	109	Silty Clay- reddish brown, medium plastic, moist to wet
109	113	Sand- fine to medium, brown, wet
113	120	Silty Clay- brown, medium plastic, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 115 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ___ ___ ___ N (Deg. Min. Sec.) Longitude ___ ___ ___ W (Deg. Min. Sec.)

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
  ○ Deepen
  ○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
  ☐ Domestic ☐ Public
  ☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water 79 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pencore Drilling (Person, Firm or Corporation)

220 North East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] C-57 Licensed Water Well Contractor 11/5/13 Date Signed 906899 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
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.

Client:	City of Elk Grove	Lat/Long:	
Project Name:	Corp Yard MW-2	GSE (ft-msl)	
LSCE #:	12-1-001	Drill Date:	10/04/2013
Location:	10250 Iron Rock Way	Drilling Method:	Hollow Stem Auger
Geologist:	W. Andrews/C. Jenkins	Driller:	Penecore Drilling

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Lithologic Description | **Strat-Column** | **Well Construction Diagram**

0

0- 5' Silty Clay- reddish brown, medium plastic, dry

5-13' Sandy Silt- very fine to fine, reddish brown, dry to damp

10

13-17' Clayey Silty Sand- very fine to medium, reddish brown, damp

17-19' Silty Sand- very fine to medium, reddish brown, damp

19-25' Sand- very fine to medium, light brown, damp

20

25-29' Silty Sand- very fine to medium, light brown, damp

29-30' Sandy Silty Clay- very fine to fine, reddish brown, medium plastic

30

30-31' Gravelly Sand- fine to coarse, gravel up to 1/2", damp, reddish brown

31-33' Sandy Silty Clay- very fine to fine, reddish brown, medium plastic, damp
33-34' Silty Clay- light brown, medium plastic, damp
34-35' Sandy Silty Clay, very fine to fine, medium plastic
35-36' Silty Clay- light brown, medium plastic, light brown
36-37' Sandy Silty Clay- light brown, medium plastic
37-38' Silty Clay- light brown, medium plastic, light brown
38-44' Clay- tan, medium plastic, some black organics

40

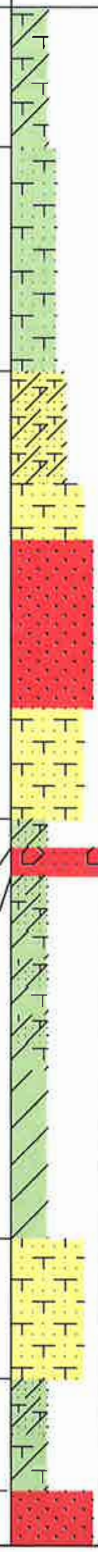
44-49' Silty Sand- very fine to fine, brown, moist

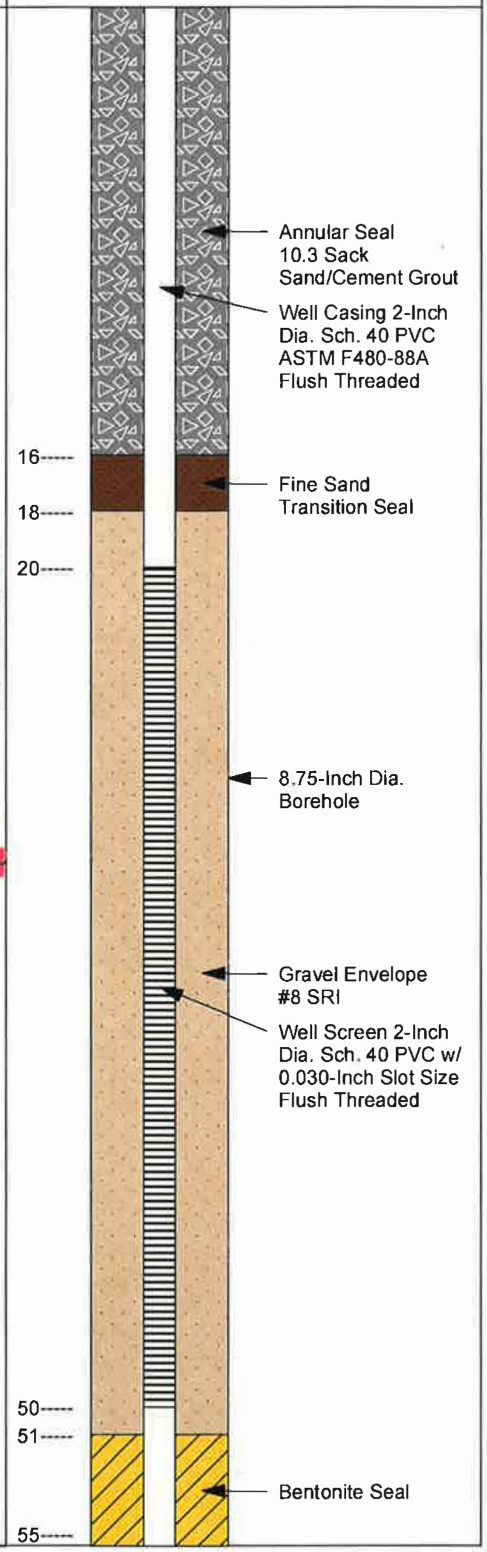
49-51' Sandy Silty Clay- very fine to fine, micaceous, light brn., medium plastic, damp

50

51-53' Silty Clay- tan mottled light brown, medium plastic, moist

53-55' Sand- very fine to medium, light brown, moist





*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190458

Page 1 of 1

Owner's Well Number CY MW-2

Date Work Began 10/04/2013 Date Work Ended 10/4/2013

Local Permit Agency County of Sacramento

Permit Number 53188 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	5	Silty Clay- reddish brown, medium plastic, dry
5	13	Sandy Silt- very fine to fine, reddish brown, dry to damp
13	17	Clayey Silty Sand- very fine to medium, reddish brown, damp
17	19	Silty Sand- very fine to medium, reddish brown, damp
19	25	Sand- very fine to medium, light brown, damp
25	29	Silty Sand- very fine to medium, light brown, damp
29	30	Sandy Silty Clay- very fine to fine, reddish brown, medium plastic
30	31	Gravelly Sand- fine to coarse, gravel up to 1/2", damp, reddish brown
31	33	Sandy Silty Clay- very fine to fine, reddish brown, medium plastic, damp
33	34	Silty Clay- light brown, medium plastic, damp
34	35	Sandy Silty Clay, very fine to fine, medium plastic
35	36	Silty Clay- light brown, medium plastic, light brown
36	37	Sandy Silty Clay- light brown, medium plastic
37	38	Silty Clay- light brown, medium plastic, light brown
38	44	Clay- tan, medium plastic, some black organics
44	49	Silty Sand- very fine to fine, brown, moist
49	51	Sandy Silty Clay- very fine to fine, micaceous, light brown, medium plastic, damp
51	53	Silty Clay- tan mottled light brown, medium plastic, moist
53	55	Sand- very fine to medium, light brown, moist

Total Depth of Boring 55 Feet

Total Depth of Completed Well 55 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ____ Deg. ____ Min. ____ Sec. N Longitude ____ Deg. ____ Min. ____ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well

○ Modification/Repair

○ Deepen

○ Other ____

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

⦿ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other ____

Water Level and Yield of Completed Well

Depth to first water ____ (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	20	8.75	Blank	PVC Sch. 40		2		
20	50	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
50	55	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	16	Cement	10.3 sack sand/ cement
16	18	Fine Sand	Transition
18	51	Filter Pack	SRI #8 Gravel
51	55	Bentonite	

Attachments

☐ Geologic Log

☐ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Penecore Drilling (Person, Firm or Corporation)

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] C-57 Licensed Water Well Contractor 11/5/13 Date Signed 906899 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
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.

Client:	City of Elk Grove	Lat/Long:	
Project Name:	Corp Yard MW-3	GSE (ft-msl)	
LSCE #:	12-1-001	Drill Date:	10/09/2013
Location:	10250 Iron Rock Way	Drilling Method:	Hollow Stem Auger
Geologist:	W. Andrews/C. Jenkins	Driller:	Penecore Drilling

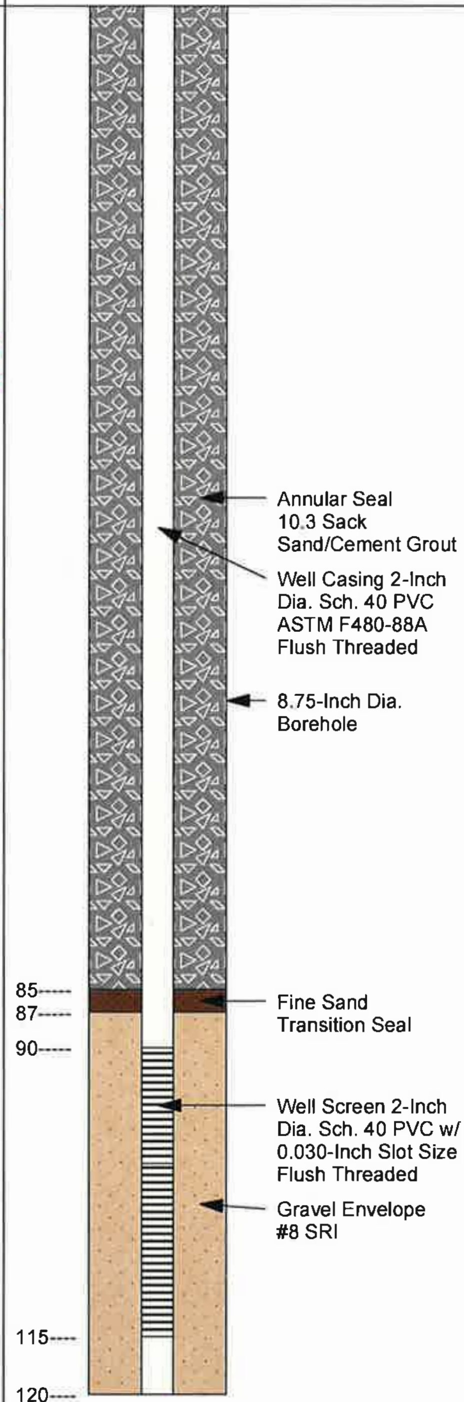
LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Lithologic Description

Depth (ft)	Lithologic Description
0	0-4' Clay- dark brown, medium plastic, damp
	4-17' Sandy Silty Clay- very fine to fine, reddish brown, medium plasticity, dry
10	
20	17-19' Sand- very fine to medium, brown, damp, some silt, moderately sorted
	19-25' Sandy Clayey Silt- very fine, reddish brown, damp, medium plastic
	25-29' Silty Sand- very fine to fine, light brown, damp 29-33' Sand- very fine to coarse, trace gravel, damp
30	
	33-39' Sandy Silty Clay- light brown/reddish brown, medium plastic, damp
40	39-51' Sandy Clayey Silt- very fine, tan, black organics
50	51-53' Silty Sand- very fine to fine, tan, damp
	53-55' Sandy Clayey Silt- very fine to fine, tan, damp
60	55-57' Silty Sand- very fine to fine, tan, damp
	57-61' Sandy Silt- very fine, tan, damp
	61-63' Silty Sand- very fine to fine, tan, moist, well sorted
70	63-65' Sandy Silt- very fine, tan, damp 65-69' Sandy Clayey Silt- very fine, light brown mottled reddish brown, damp 69-81' Sandy Silt- very fine, tan to reddish brown, damp to moist
80	81-89' Sandy Clayey Silt- very fine, reddish brown, moist
90	89-90' Silty Clay- brown, medium plastic, moist
	90-91' Sandy Clayey Silt- very fine, reddish brown, moist
100	91-94' Clay- brown mottled reddish brown, medium plastic, moist
	94-97' Sandy Silt- very fine, reddish brown, moist to wet
	97-99' Silty Clay- reddish brown, medium plastic, wet
110	99-101' Clayey Silt- reddish brown, wet
	101-103' Silty Clay- light brown mottled reddish brown, medium plastic, wet
120	103-105' Sandy Clayey Silt- very fine to medium, reddish brown, wet
	105-115' Clay- reddish brown/brown, medium plastic, wet
	115-117' Sandy Clayey Silt- very fine, tan mottled brown,wet
130	117-120' Silty Clay- brown, medium plastic, wet

Strat-Column

Well Construction Diagram



*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190459

Page 1 of 2

Owner's Well Number CY MW-3

Date Work Began 10/09/2013 Date Work Ended 10/9/2013

Local Permit Agency County of Sacramento

Permit Number 53189 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	4	Clay- dark brown, medium plastic, damp
4	17	Sandy Silty Clay- very fine to fine, reddish brown,
		medium plasticity, dry
17	19	Sand- very fine to medium, brown, damp, some
		silt, moderately sorted
19	25	Sandy Clayey Silt- very fine, reddish brown, damp,
		medium plastic
25	29	Silty Sand- very fine to fine, light brown, damp
29	33	Sand- very fine to coarse, trace gravel, damp
33	39	Sandy Silty Clay- light brown/reddish brown,
		medium plastic, damp
39	51	Sandy Clayey Silt- very fine, tan, black organics
51	53	Silty Sand- very fine to fine, tan, damp
53	55	Sandy Clayey Silt- very fine to fine, tan, damp
55	57	Silty Sand- very fine to fine, tan, damp
57	61	Sandy Silt- very fine, tan, damp
61	63	Silty Sand- very fine to fine, tan, moist, well sorted
63	65	Sandy Silt- very fine, tan, damp
65	69	Sandy Clayey Silt- very fine, light brown mottled
		reddish brown, damp
69	81	Sandy Silt- very fine, tan to reddish brown, damp
		to moist
81	89	Sandy Clayey Silt- very fine, reddish brown,moist
89	90	Silty Clay- brown, medium plastic, moist
90	91	Sandy Clayey Silt- very fine, reddish brown, moist
91	94	Clay- brown mottled reddish brown, medium
		plastic, moist
94	97	Sandy Silt- very fine, reddish brown, moist to wet
97	99	Silty Clay- reddish brown, medium plastic, wet
99	101	Clayey Silt- reddish brown, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ____ Deg. ____ Min. ____ Sec. N Longitude ____ Deg. ____ Min. ____ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 94 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size If Any (Inches)
0	90	8.75	Blank	PVC Sch. 40		2		
90	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	85	Cement	10.3 sack sand/
			cement
85	87	Fine Sand	Transition
87	120	Filter Pack	#8 SRI Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pene Core Drilling (Person, Firm or Corporation)

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] (C-57 Licensed Water Well Contractor) 11/5/13 (Date Signed) 906899 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190459

Page 2 of 2

Owner's Well Number CY MW-3

Date Work Began 10/04/2013 Date Work Ended 10/4/2013

Local Permit Agency County of Sacramento

Permit Number 53189 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
101	103	Silty Clay- light brown mottled reddish brown, medium plastic, wet
103	105	Sandy Clayey Silt- very fine to medium, reddish brown, wet
105	115	Clay- reddish brown/brown, medium plastic, wet
115	117	Sandy Clayey Silt- very fine, tan mottled brown,wet
117	120	Silty Clay- brown, medium plastic, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 94 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Penecore Drilling
Person, Firm or Corporation

220 N. East St. Woodland CA 95776
Address City State Zip

Signed [signature] 11/5/13 906899
C-57 Licensed Water 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
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.

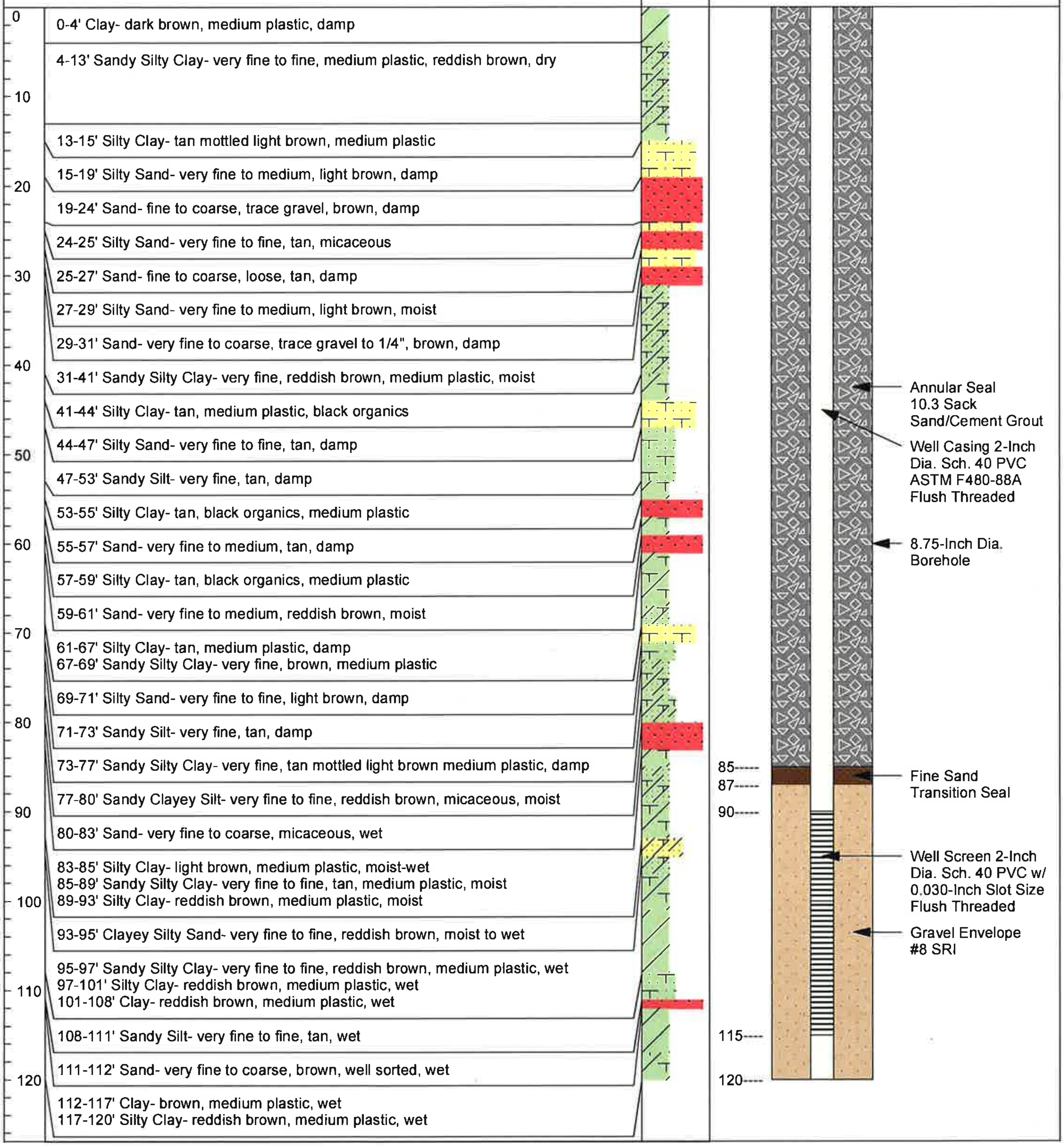
Note on Datum
All depths cited in this summary report are based on grade as it existed at the time of construction.

Client:	City of Elk Grove	Lat/Long:	
Project Name:	Corp Yard MW-4	GSE (ft-msl)	
LSCE #:	12-1-001	Drill Date:	10/07/2013
Location:	10250 Iron Rock Way	Drilling Method:	Hollow Stem Auger
Geologist:	W. Andrews/C. Jenkins	Driller:	Penecore Drilling

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

Lithologic Description	Strat-Column	Well Construction Diagram

- 0-4' Clay- dark brown, medium plastic, damp
- 4-13' Sandy Silty Clay- very fine to fine, medium plastic, reddish brown, dry
- 13-15' Silty Clay- tan mottled light brown, medium plastic
- 15-19' Silty Sand- very fine to medium, light brown, damp
- 19-24' Sand- fine to coarse, trace gravel, brown, damp
- 24-25' Silty Sand- very fine to fine, tan, micaceous
- 25-27' Sand- fine to coarse, loose, tan, damp
- 27-29' Silty Sand- very fine to medium, light brown, moist
- 29-31' Sand- very fine to coarse, trace gravel to 1/4", brown, damp
- 31-41' Sandy Silty Clay- very fine, reddish brown, medium plastic, moist
- 41-44' Silty Clay- tan, medium plastic, black organics
- 44-47' Silty Sand- very fine to fine, tan, damp
- 47-53' Sandy Silt- very fine, tan, damp
- 53-55' Silty Clay- tan, black organics, medium plastic
- 55-57' Sand- very fine to medium, tan, damp
- 57-59' Silty Clay- tan, black organics, medium plastic
- 59-61' Sand- very fine to medium, reddish brown, moist
- 61-67' Silty Clay- tan, medium plastic, damp
- 67-69' Sandy Silty Clay- very fine, brown, medium plastic
- 69-71' Silty Sand- very fine to fine, light brown, damp
- 71-73' Sandy Silt- very fine, tan, damp
- 73-77' Sandy Silty Clay- very fine, tan mottled light brown medium plastic, damp
- 77-80' Sandy Clayey Silt- very fine to fine, reddish brown, micaceous, moist
- 80-83' Sand- very fine to coarse, micaceous, wet
- 83-85' Silty Clay- light brown, medium plastic, moist-wet
- 85-89' Sandy Silty Clay- very fine to fine, tan, medium plastic, moist
- 89-93' Silty Clay- reddish brown, medium plastic, moist
- 93-95' Clayey Silty Sand- very fine to fine, reddish brown, moist to wet
- 95-97' Sandy Silty Clay- very fine to fine, reddish brown, medium plastic, wet
- 97-101' Silty Clay- reddish brown, medium plastic, wet
- 101-108' Clay- reddish brown, medium plastic, wet
- 108-111' Sandy Silt- very fine to fine, tan, wet
- 111-112' Sand- very fine to coarse, brown, well sorted, wet
- 112-117' Clay- brown, medium plastic, wet
- 117-120' Silty Clay- reddish brown, medium plastic, wet



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Well Completion Report

Refer to Instruction Pamphlet

No. e0190478

Page 1 of 2

Owner's Well Number CY MW-4

Date Work Began 10/07/2013 Date Work Ended 10/7/2013

Local Permit Agency County of Sacramento

Permit Number 53190 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N Latitude W Longitude

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	4	Clay- dark brown, medium plastic, damp
4	13	Sandy Silty Clay- very fine to fine, medium plastic, reddish brown, dry
13	15	Silty Clay- tan mottled light brown, medium plastic
15	19	Silty Sand- very fine to medium, light brown, damp
19	24	Sand- fine to coarse, trace gravel, brown, damp
24	25	Silty Sand- very fine to fine, tan, micaceous
25	27	Sand- fine to coarse, loose, tan, damp
27	29	Silty Sand- very fine to medium, light brown, moist
29	31	Sand- very fine to coarse, trace gravel to 1/4", brown, damp
31	41	Sandy Silty Clay- very fine, reddish brown, medium plastic, moist
41	44	Silty Clay- tan, medium plastic, black organics
44	47	Silty Sand- very fine to fine, tan, damp
47	53	Sandy Silt- very fine, tan, damp
53	55	Silty Clay- tan, black organics, medium plastic
55	57	Sand- very fine to medium, tan, damp
57	59	Silty Clay- tan, black organics, medium plastic
59	61	Sand- very fine to medium, reddish brown, moist
61	67	Silty Clay- tan, medium plastic, damp
67	69	Sandy Silty Clay- very fine, brown, medium plastic
69	71	Silty Sand- very fine to fine, light brown, damp
71	73	Sandy Silt- very fine, tan, damp
73	77	Sandy Silty Clay- very fine, tan mottled light brown medium plastic, damp
77	80	Sandy Clayey Silt- very fine to fine, reddish brown, micaceous
80	83	Sand- very fine to coarse, micaceous, wet
83	85	Silty Clay- light brown, medium plastic, moist-wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ____ Deg. Min. Sec. N Longitude ____ Deg. Min. Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 93 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size If Any (Inches)
0	90	8.75	Blank	PVC Sch. 40		2		
90	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	85	Cement	10.3 sack sand/ cement
85	87	Fine Sand	Transition
87	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pene Core Drilling
Person, Firm or Corporation

220 N. East St. Woodland CA 95776
Address City State Zip

Signed [signature] 11/5/13 906899
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190478

DWR Use Only – Do Not Fill In: State Well Number/Site Number; Latitude N; Longitude W; APN/TRS/Other

Page 2 of 2

Owner's Well Number CY MW-4

Date Work Began 10/07/2013 Date Work Ended 10/7/2013

Local Permit Agency County of Sacramento

Permit Number 53190 Permit Date 9/20/13

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
85	89	Sandy Silty Clay- very fine to fine, tan, medium plastic, moist
89	93	Silty Clay- reddish brown, medium plastic, moist
93	95	Clayey Silty Sand- very fine to fine, reddish brown, moist to wet
95	97	Sandy Silty Clay- very fine to fine, reddish brown, medium plasticity, wet
97	101	Silty Clay- reddish brown, medium plastic, wet
101	108	Clay- reddish brown, medium plastic, wet
108	111	Sandy Silt- very fine to fine, tan, wet
111	112	Sand- very fine to coarse, brown, well sorted, wet
112	117	Clay- brown, medium plastic, wet
117	120	Silty Clay- reddish brown, medium plastic, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North / West / East / South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy (Describe procedures and materials under "GEOLOGIC LOG")

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 93 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Penecore Drilling (Person, Firm or Corporation)

220 N. East St (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] (C-57 Licensed Water Well Contractor) 11/5/13 (Date Signed) 906899 (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

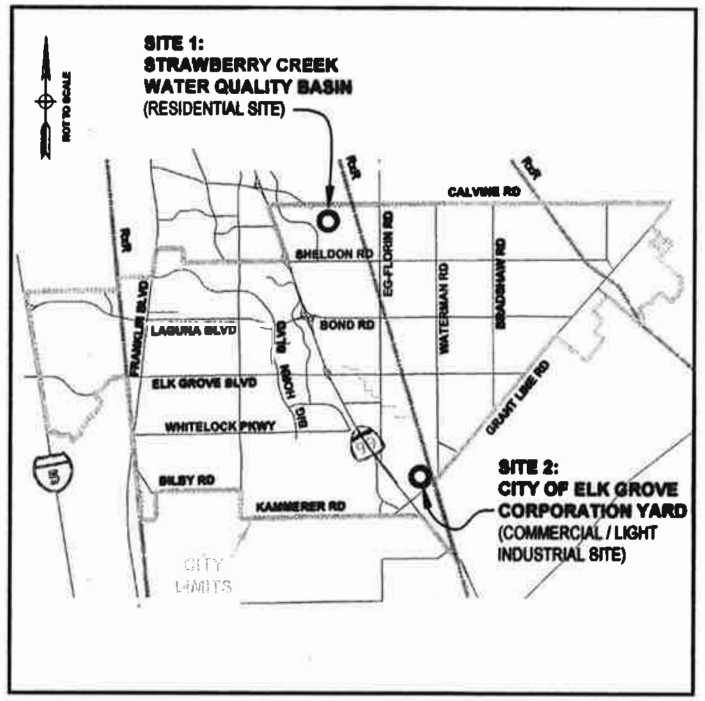
Table1. Well Heads Survey and Construction Summary
Corporation Yard and Strawberry Creek Water Quality Basin

FIELD_PT_NAME	Easting	Northing	XY_DATUM	XY_SURVEY_ORG	XY_SURVEY_DESC	ELEV_SURVEY_DATE	EFF_DATE	ELEVATION	ELEV_DATUM	ELEV_SURVEY_ORG	ELEV_DESC	TD_bgs	TOS_bgs	BOS_bgs	Scrn_Int_bgs	Alt_FIELD_PT_NAME
CY-DW1	6745024.43	1902922.04	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/22/2014	47.67	NAVD88	cbec Ecoengineers	Top of Stilling Pipe	45	7	45		CY-DW1
CY-MW1	6745078.19	1903106.46	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/11/2013	50.14	NAVD88	cbec Ecoengineers	Top of Casing	115	80	110	80-110	CY-MW1
CY-MW2	6745026.65	1902905.48	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/4/2013	48.37	NAVD88	cbec Ecoengineers	Top of Casing	55	20	50	20-50	CY-MW2
CY-MW3	6744955.59	1902888.11	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/9/2013	49.11	NAVD88	cbec Ecoengineers	Top of Casing	120	90	115	90-115	CY-MW3
CY-MW4	6744989.93	1902844.55	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/7/2013	49.30	NAVD88	cbec Ecoengineers	Top of Casing	120	90	115	90-115	CY-MW4
SDB-DW1	6736132.27	1925708.15	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/22/2014	29.54	NAVD88	cbec Ecoengineers	Top of Stilling Pipe	40	7	40		SDB-DW1
SDB-MW1	6736452.15	1925768.21	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	10/2/2013	35.17	NAVD88	cbec Ecoengineers	Top of Casing	120	100	115	100-115	SC-MW1
SDB-MW2	6736129.29	1925733.17	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	9/26/2013	28.82	NAVD88	cbec Ecoengineers	Top of Casing	58	22.5	52.5	22.5-52.5	SC-MW2
SDB-MW3	6736100.98	1925659.18	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	9/25/2013	35.31	NAVD88	cbec Ecoengineers	Top of Casing	120	105	115	105-115	SC-MW3
SDB-MW4	6736125.01	1925752.48	NAD_1983_StatePlane_California_II_FIPS_0402_Feet	cbec Ecoengineers	GPS	11/19/2014	9/30/2013	28.72	NAVD88	cbec Ecoengineers	Top of Casing	120	100	115	100-115	SC-MW4

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



PROJECT LOCATIONS
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

SHEET INDEX:

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	SHEILA WOLCOTT	916-405-7100
GAS	PG&E	MIKE WILLIAMS	916-386-5013
PARKS & RECREATION	COSUMNES COMMUNITY SERVICES DISTRICT	STEVE SIMS	916-947-1631
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
TRANSIT	e-TRAN	JEAN FOLETTA	916-687-3030
WATER	ELK GROVE WATER SERVICE	BRUCE KAMILOS	916-585-9385
WATER	SACRAMENTO COUNTY WATER AGENCY	IMELDA TABBADA	916-874-4261
U.S.A.	UNDERGROUND SERVICE ALERT	811 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

811
Know what's below.
Call before you dig.

APPROVED BY:

[signature] 6-18-14
RICHARD R. CARTER, P.E. - #C55382
CAPITAL PROGRAM MANAGER
DATE

SUBMITTED BY:

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JENNIFER MAXWELL, P.E. - #C54366
CIP SERVICE MANAGER
DATE

REVIEWED BY:

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JOHN R. SCOTT
CONTRACT MANAGER, MAINTENANCE & OPERATIONS
DATE

PREPARED BY:

[signature] 6-18-14
FERNANDO DUENAS, P.E. - #C64070
DESIGN ENGINEER
DATE

NO.	REVISION	BY	DATE

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DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT

TITLE SHEET

DATE: JUNE 2014
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019
SHEET: 1 OF 9

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3 4

WDR019 - UNDERGROUND INJECTION CONTROLS AS LOW IMPACT DEVELOPMENT

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.
2. 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.

CITY OF ELK GROVE DRAINAGE NOTES:

1. 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.
3. THE CONTRACTOR SHALL PLACE THE PROPER STRENGTH PIPE IF TRENCH CONDITIONS ENCOUNTERED DIFFER FROM THE DESIGN TRENCH.
4. 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).
   - 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.
6. 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.
8. ALL DRAINAGE INLETS IN THE PUBLIC ROW AND DRAINAGE EASEMENTS SHALL HAVE A PERMANENT STORM DRAIN MESSAGE "NO DUMPING - FLOW TO CREEK" OR 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.
6. SENSITIVE AREAS AND AREAS WHERE EXISTING VEGETATION IS BEING PRESERVED SHALL BE PROTECTED WITH CONSTRUCTION FENCING. SEDIMENT CONTROL BMPs 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.
8. THE FOLLOWING AREAS ON ALL PROJECTS ARE TO RECEIVE HYDROSEEDING OR OTHER EROSION 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 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.

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
O.C. - on center
PVC - polyvinyl chloride
RC- reinforced concrete pipe
SD - storm drain
(Typ) - typical
w/ - with

NO.	REVISION	BY	DATE

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9281 Office Park Circle ~ Suite 100
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DESIGNED:
DRAWN:
CHECKED:

REGISTERED PROFESSIONAL ENGINEER · JENNIFER MAXWELL · No. C54386 · CIVIL · STATE OF CALIFORNIA

CITY OF ELK GROVE
DEPARTMENT OF PUBLIC WORKS
8401 LAGUNA PALMS WAY
ELK GROVE, CALIFORNIA 95758
916.683.7111

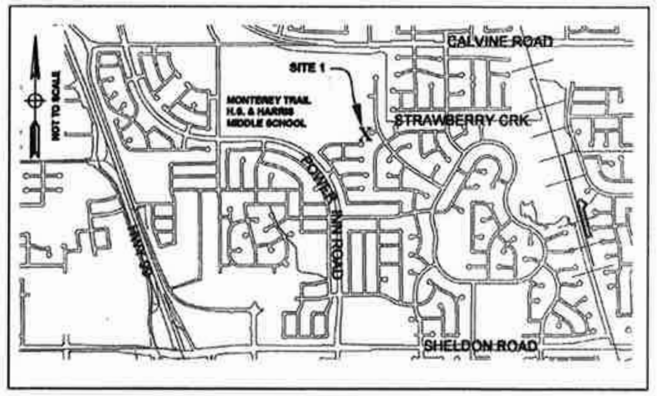
CITY OF ELK GROVE · CALIFORNIA

DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT

ABBREVIATIONS LIST & GENERAL NOTES

DATE: JUNE 2014
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3 4

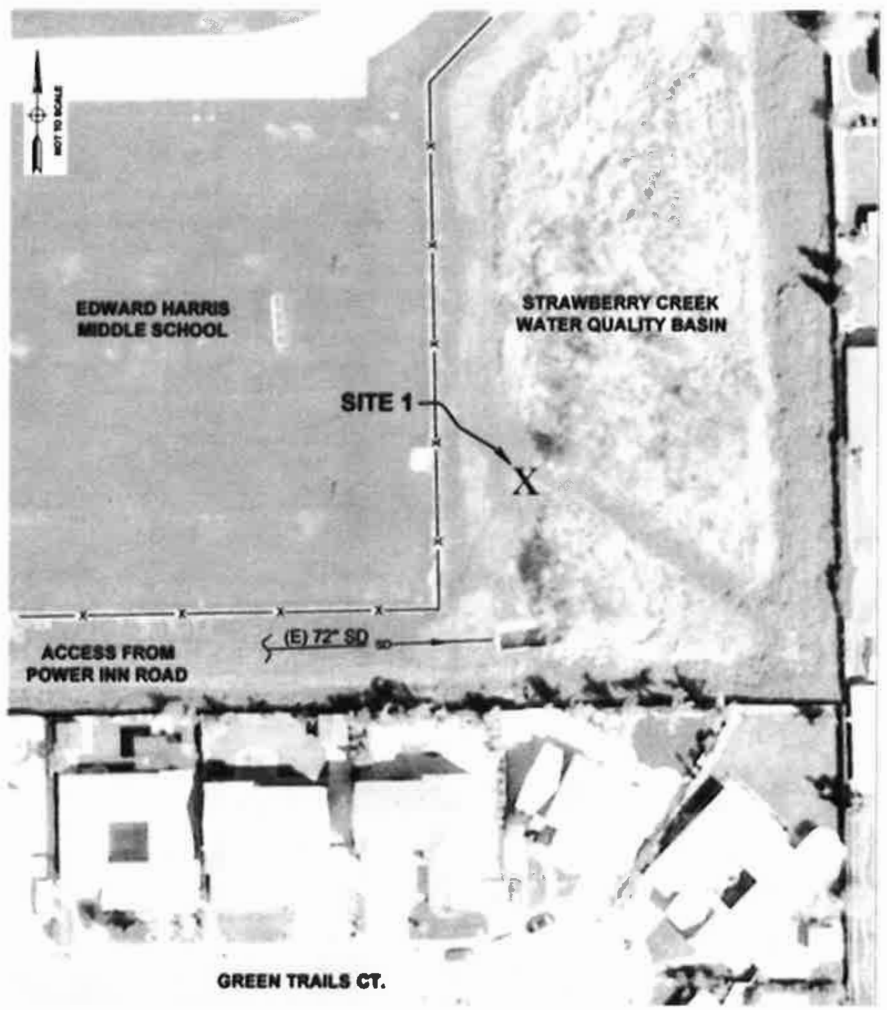


SITE 1 - VICINITY MAP

STRAWBERRY CREEK WATER QUALITY BASIN

NOTES:

1. CONTRACTOR TO VERIFY EXISTING UTILITIES PRIOR TO COMMENCEMENT OF WORK.
2. CONTACT DESIGN ENGINEER TO DETERMINE EXACT LOCATION OF DRY WELL AND SEDIMENTATION WELL PRIOR TO CONSTRUCTION.
3. STAGING AREA TO BE DETERMINED DURING PRE-CONSTRUCTION MEETING.
4. ACCESS WATER QUALITY BASIN THROUGH DRAINAGE EASEMENT FROM POWER INN ROAD.



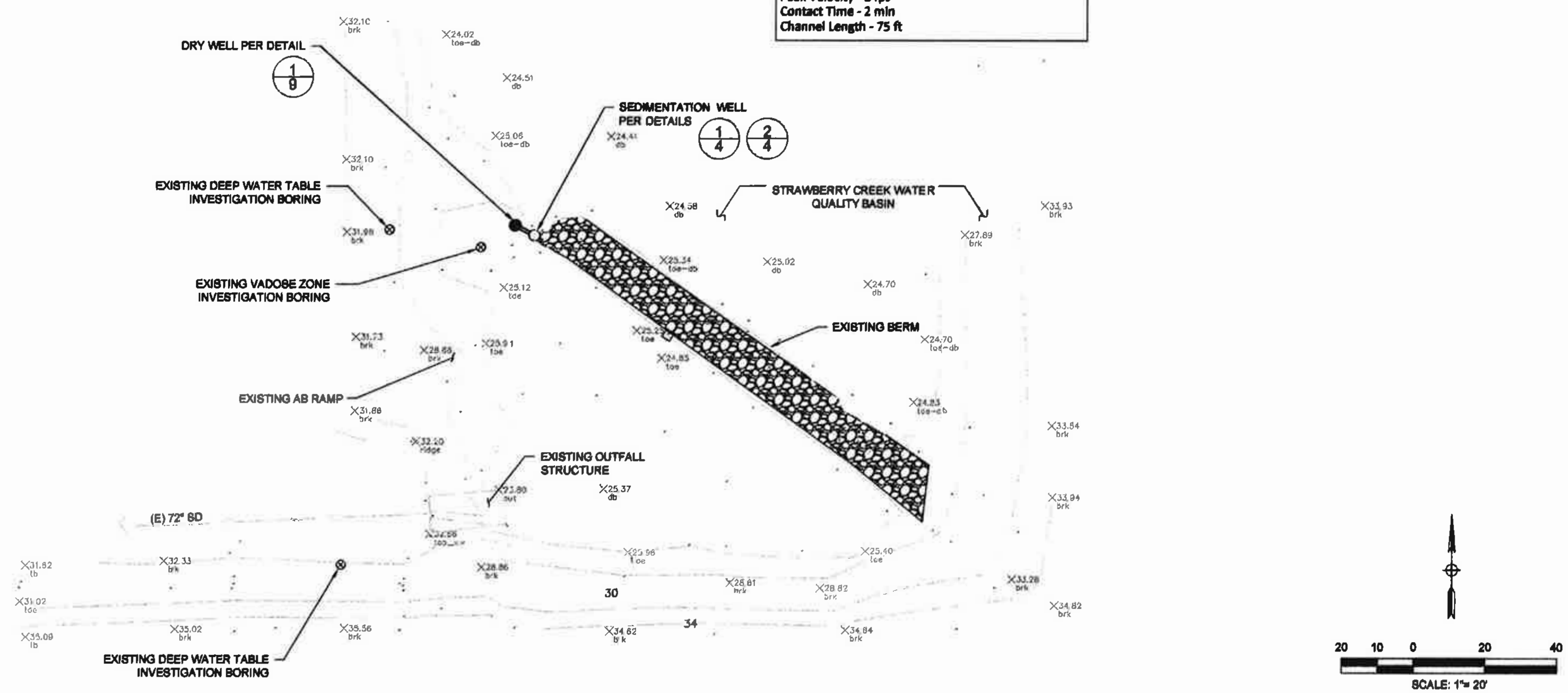
SITE 1 - AERIAL VIEW

STRAWBERRY CREEK WATER QUALITY BASIN

STORMWATER HYDROLOGY INFORMATION

Watershed Size - 168 ac
Design Flow - 15 cfs
Peak Flow - 90 cfs
Average Depth - 1 ft
Peak Flow Depth - 2 ft
Average Velocity - 0.7 fps
Peak Velocity - 2 fps
Contact Time - 2 min
Channel Length - 75 ft

EXISTING UPGRADIENT DEEP WATER TABLE INVESTIGATION BORING



SITE 1 - LAYOUT PLAN

STRAWBERRY CREEK WATER QUALITY BASIN

NO.	REVISION	BY	DATE

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Elk Grove, CA 95758 916.478.6002

DESIGNED:
DRAWN:
CHECKED:

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DEPARTMENT OF PUBLIC WORKS
8401 LAGUNA PALMS WAY
ELK GROVE, CALIFORNIA 95758
916.683.7111

DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT
SITE 1: STRAWBERRY CREEK WATER QUALITY BASIN
VICINITY MAP, AERIAL VIEW & SITE LAYOUT PLAN

DATE: JUNE 2014
SCALE: HORIZ: 1"= 20' VERT: N/A
PROJECT No.: WDR019

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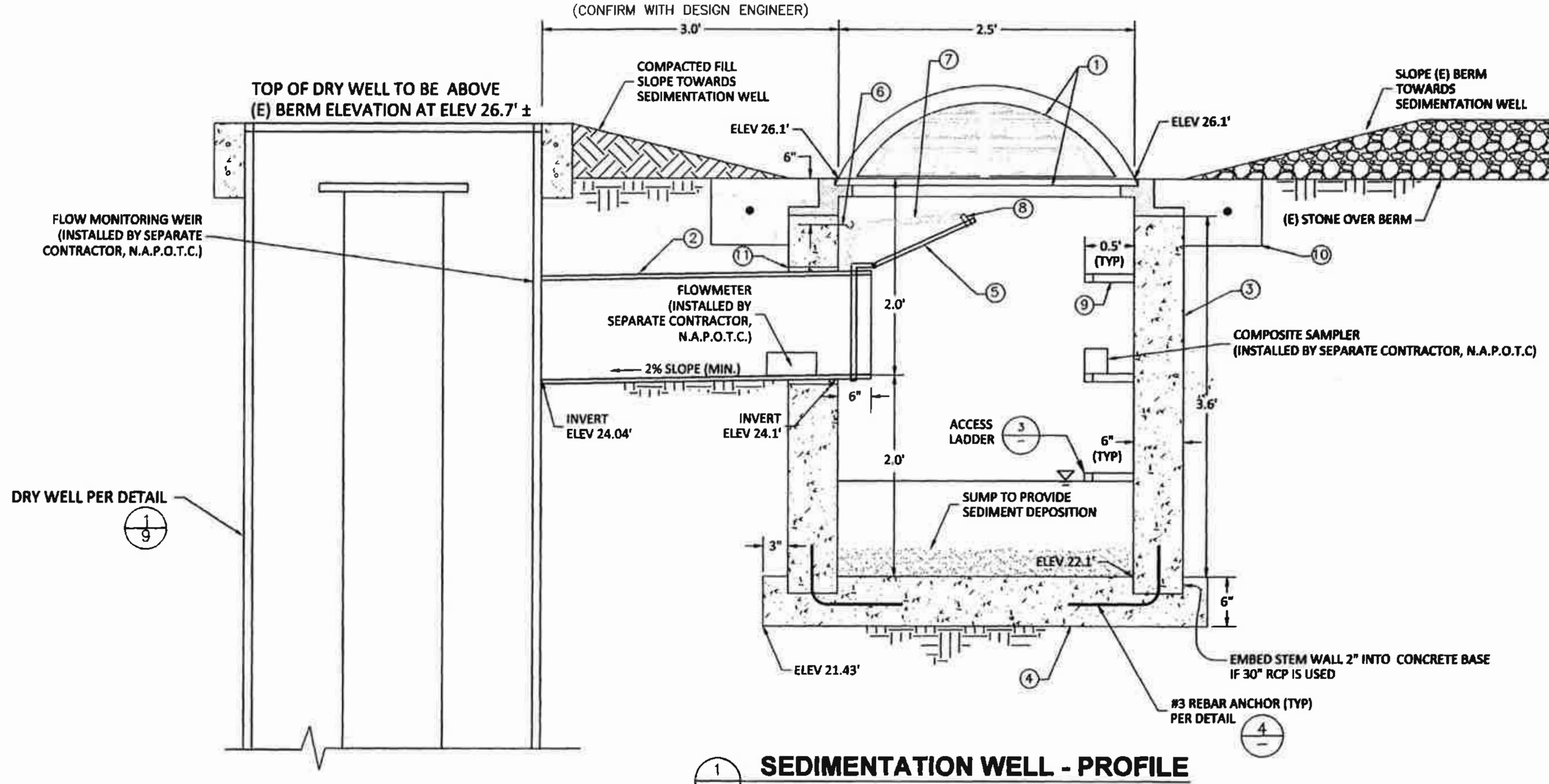
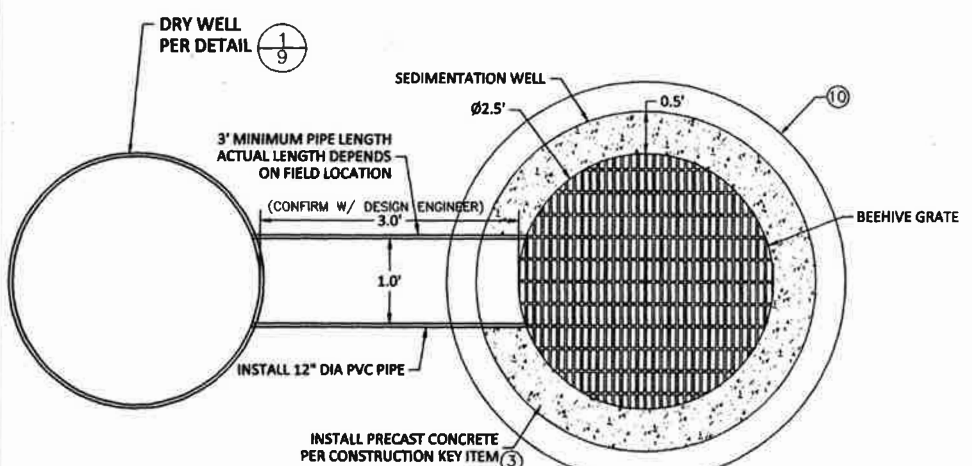


SEDIMENTATION WELL - PROFILE

NOT TO SCALE

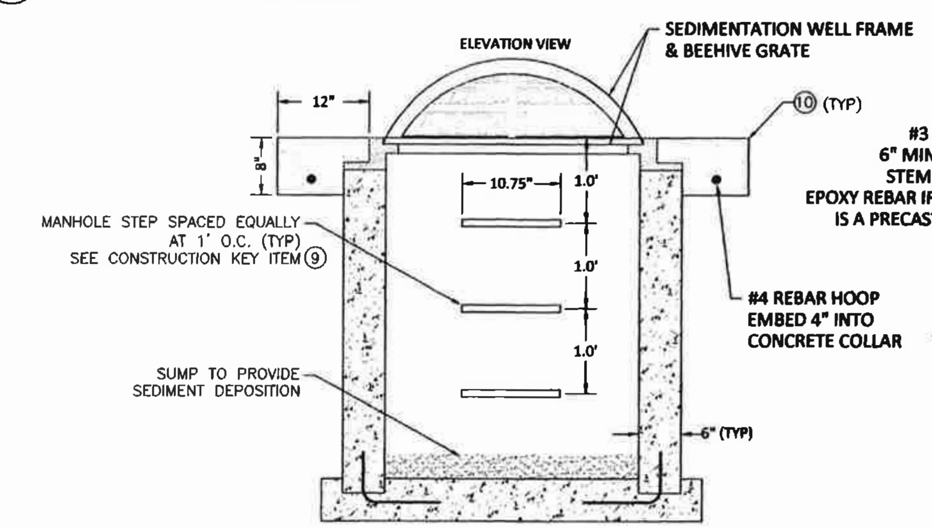
CONSTRUCTION KEY:

1. SEDIMENTATION WELL FRAME & BEEHIVE GRATE
2. 12" SDR-35 PVC PIPE – EXTEND 6" INTO SEDIMENTATION WELL TO ALLOW FOR FLAP GATE INSTALLATION
3. 30" REINFORCED CONCRETE PIPE OR CAST-IN-PLACE CONCRETE
4. CAST-IN-PLACE CONCRETE BASE
5. FLAP GATE SHALL BE A 12" HEAVY DUTY FLAP GATE WITH ATTACHING COLLAR
6. EPOXY 4-7/8" STAINLESS STEEL SCREW "J" HOOK BOLT INTO STILLING WELL
7. #2/0 LINK CHAIN W/ STAINLESS STEEL WELDED LINKS LENGTH OF CHAIN TO BE 10' MINIMUM AND CUT TO FIT IN FIELD
8. ATTACH CHAIN TO FLAP GATE PLATE WITH U-BOLT SCREW AND 3/8" SPRING LINK
9. MANHOLE STEP
10. CAST-IN-PLACE CONCRETE COLLAR
11. PIPE CONNECTION SHALL CONFORM TO ASTM C-923. PRECAST UNIT SHALL BE BOOT TYPE OR COMPRESSION GASKET. CAST-IN-PLACE UNIT SHALL INCLUDE A WATER STOP.



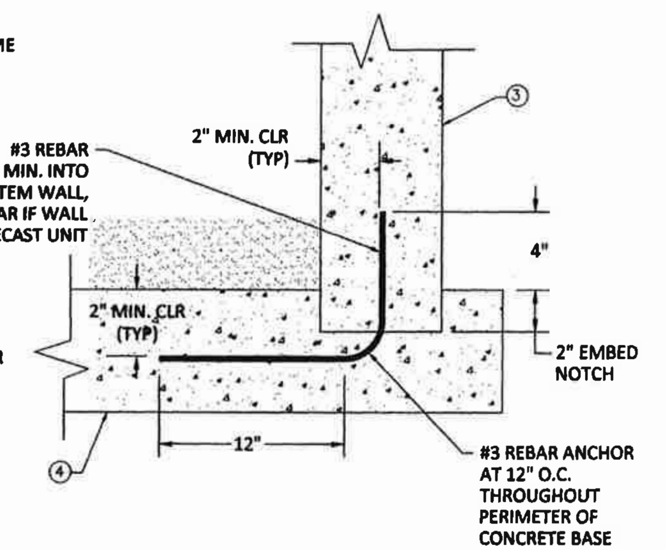
SEDIMENTATION WELL PLAN VIEW

NOT TO SCALE



ACCESS LADDER

NOT TO SCALE



ANCHOR DETAIL

NOT TO SCALE

NO.	REVISION	BY	DATE

cbec, inc. eco engineering
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West Sacramento, CA 95691

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DRAWN:
CHECKED:

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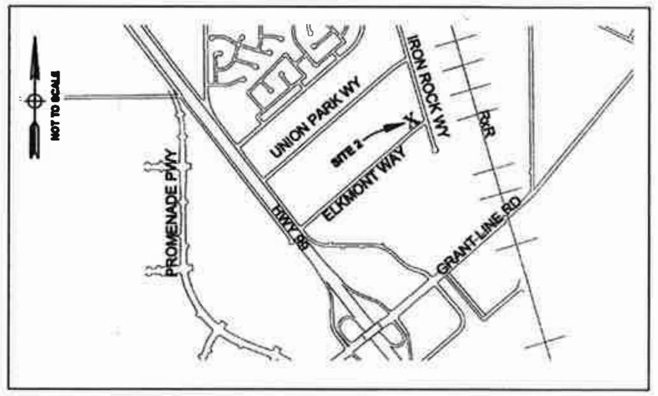
DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT
SITE 1: STRAWBERRY CREEK WATER QUALITY BASIN
SURFACE FLOW & WATER QUALITY PLAN, ELEVATION & DETAILS

DATE: JUNE 2014
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

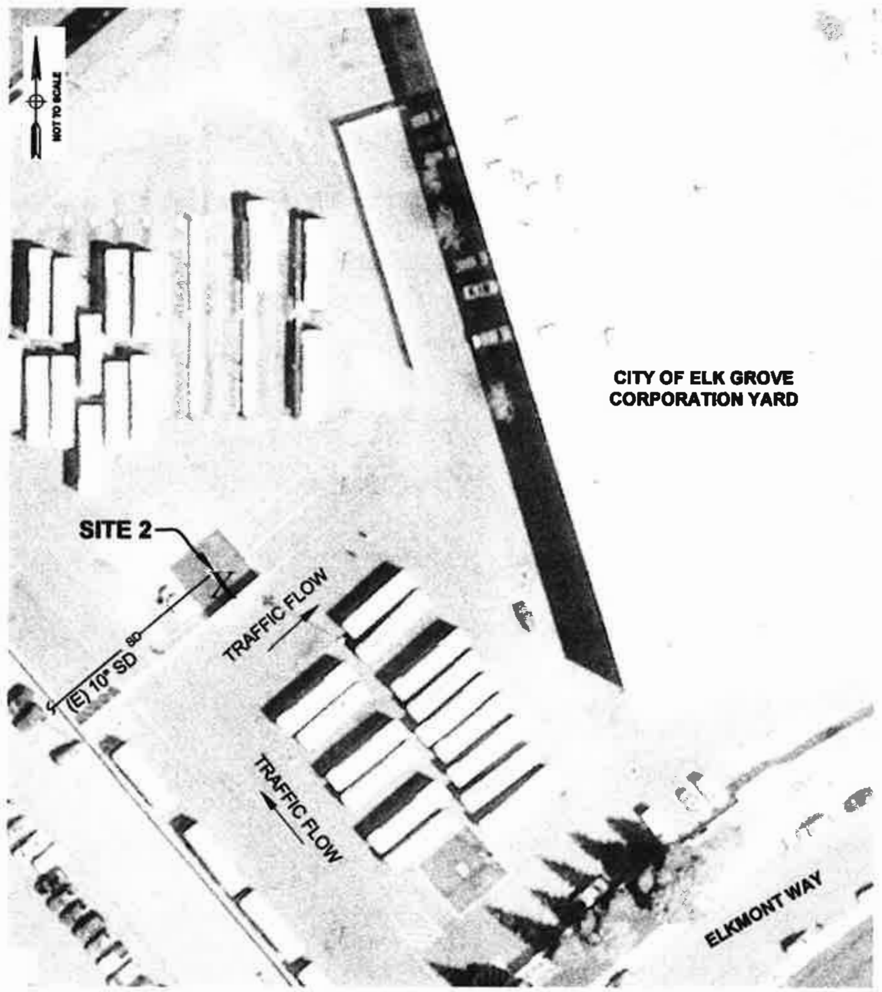


SITE 2 - VICINITY MAP

10250 IRON ROCK WAY

NOTES:

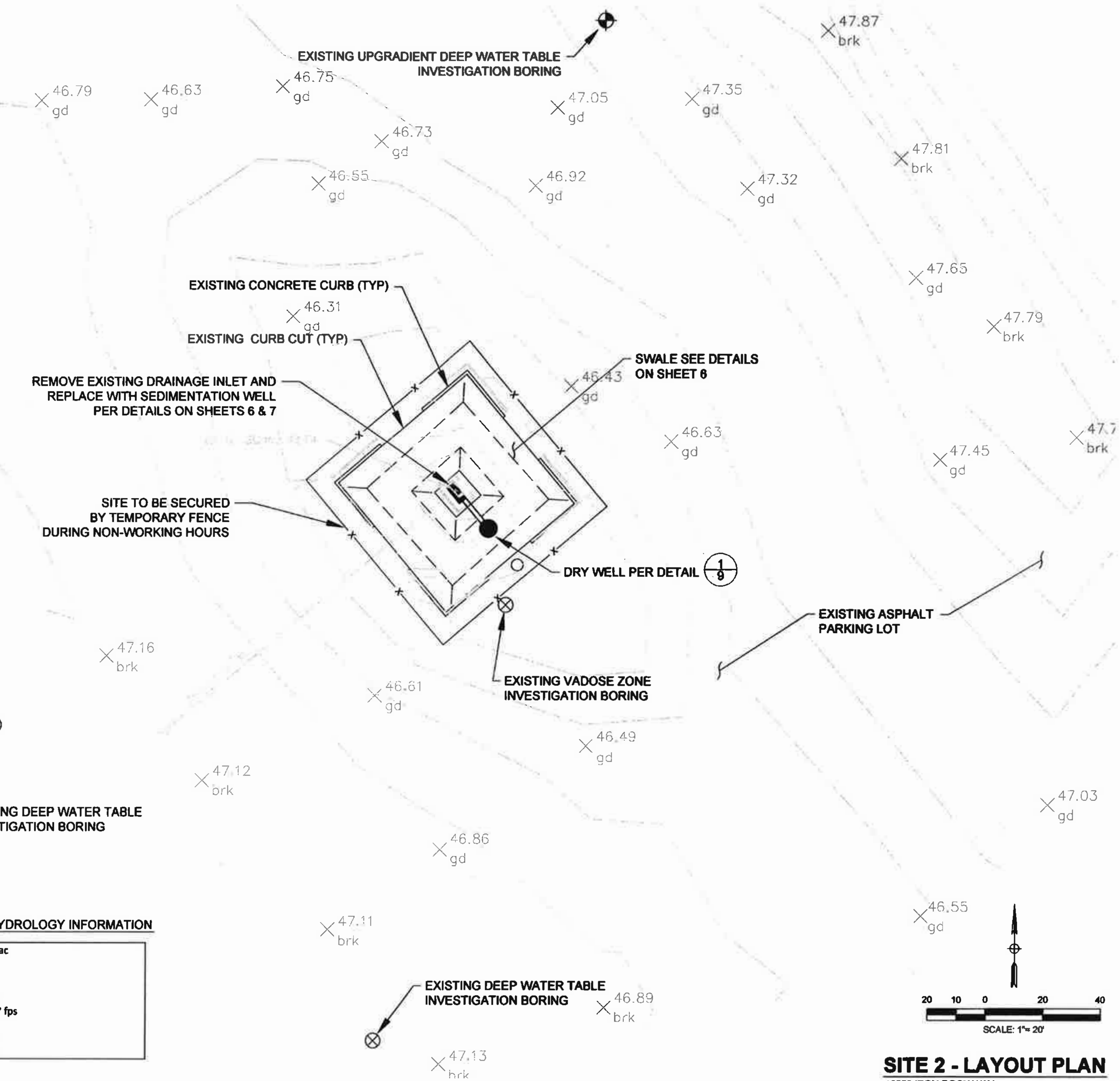
1. CONTRACTOR TO VERIFY EXISTING UTILITIES PRIOR TO COMMENCEMENT OF WORK.
2. CONTACT DESIGN ENGINEER TO DETERMINE EXACT LOCATION OF DRY WELL AND SEDIMENTATION WELL PRIOR TO CONSTRUCTION.
3. PROTECT EXISTING IRRIGATION SYSTEM IN PLACE.
4. STAGING AREA & WORK ZONE TO BE DETERMINED DURING PRE-CONSTRUCTION MEETING.



CITY OF ELK GROVE CORPORATION YARD

SITE 2 - AERIAL VIEW

10250 IRON ROCK WAY



STORMWATER HYDROLOGY INFORMATION

Watershed Size - 0.64 ac
Design Flow - 0.1 cfs
Peak Flow - 0.5 cfs
Average Depth - 1.5 in
Peak Flow Depth - 2 in
Average Velocity - 0.17 fps
Peak Velocity - 0.5 fps
Contact Time - 6.4 min
Channel Length - 64 ft

SITE 2 - LAYOUT PLAN

10250 IRON ROCK WAY

NO.	REVISION	BY	DATE

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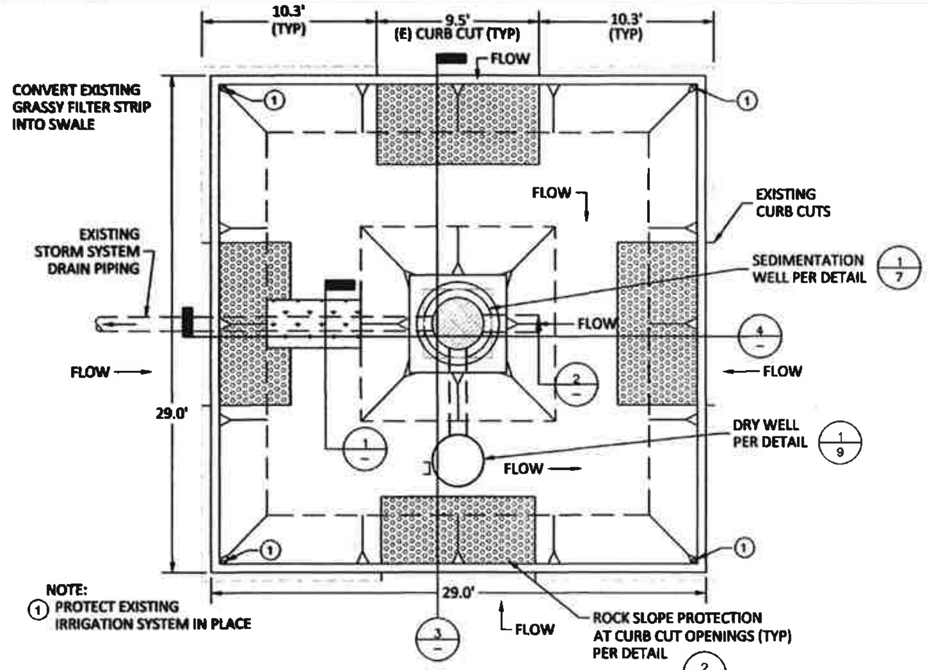
CITY OF ELK GROVE CALIFORNIA

DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT

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

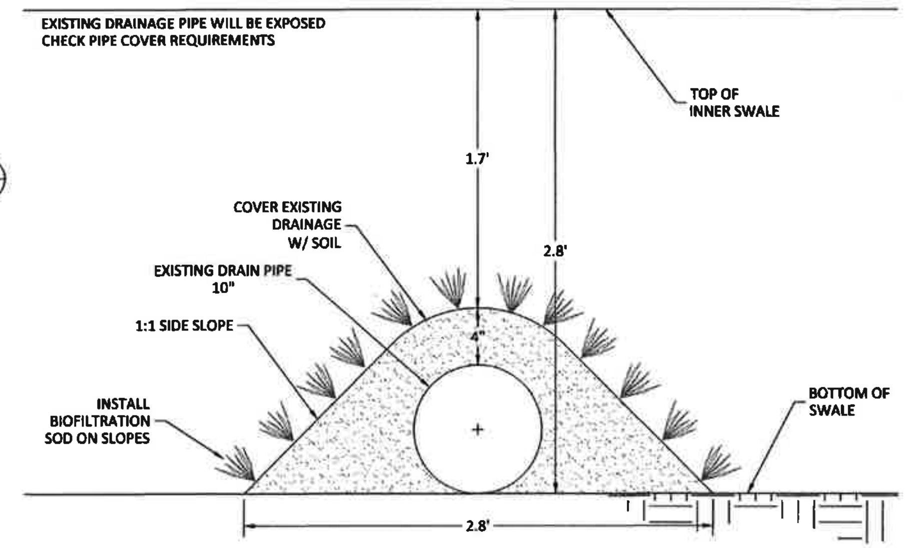
DATE: JUNE 2014
SCALE: HORIZ: 1"=20' VERT: N/A
PROJECT No.: WDR019

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3 4



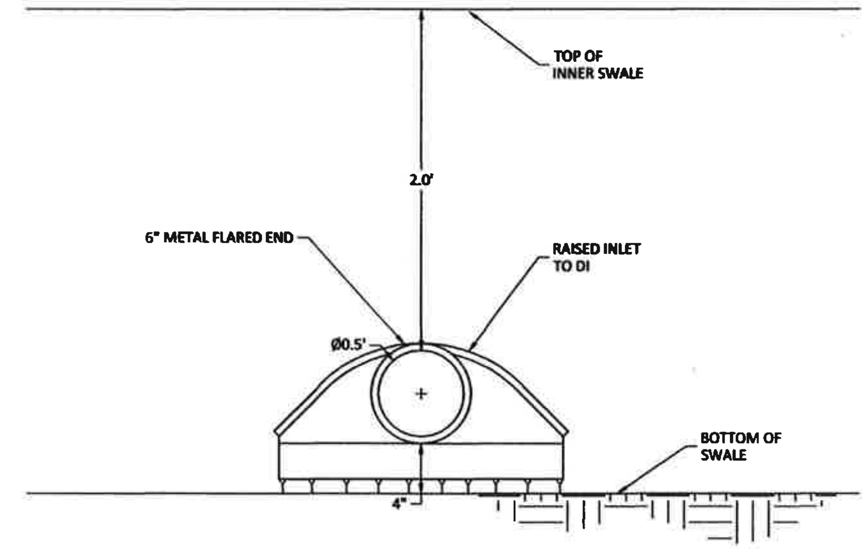
SWALE AREA PLAN VIEW

NOT TO SCALE



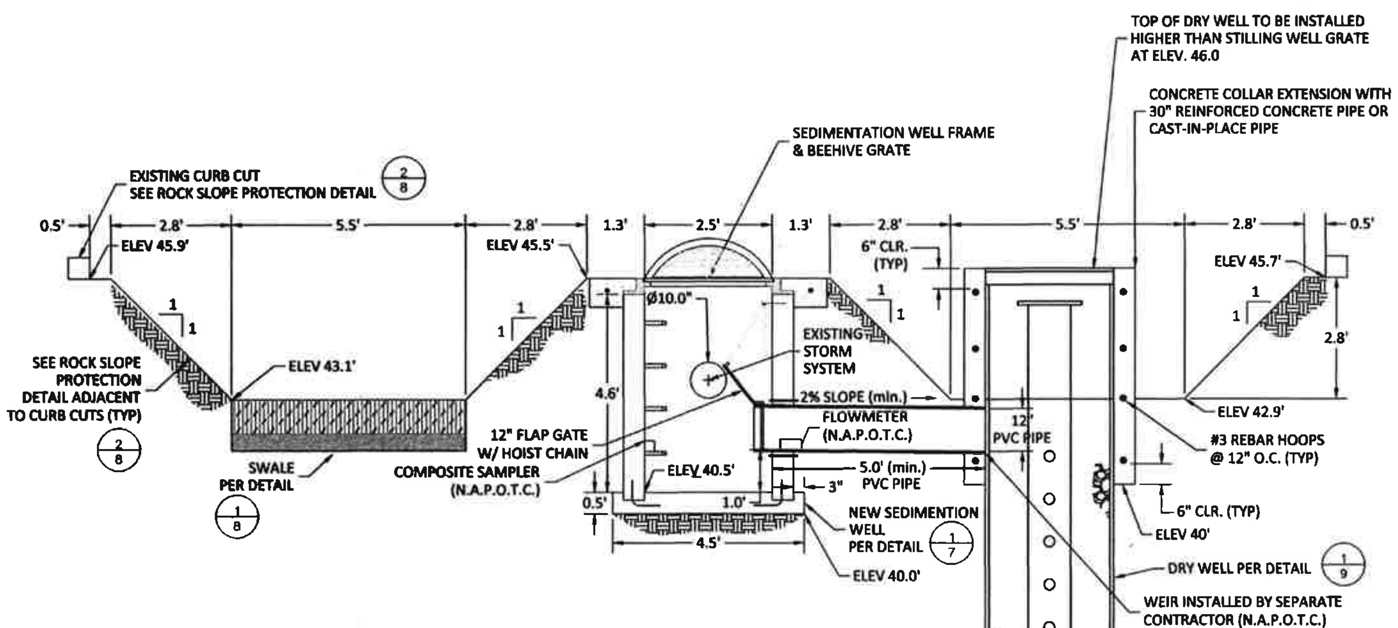
1 BERM AT EXISTING DRAIN PIPE

NOT TO SCALE



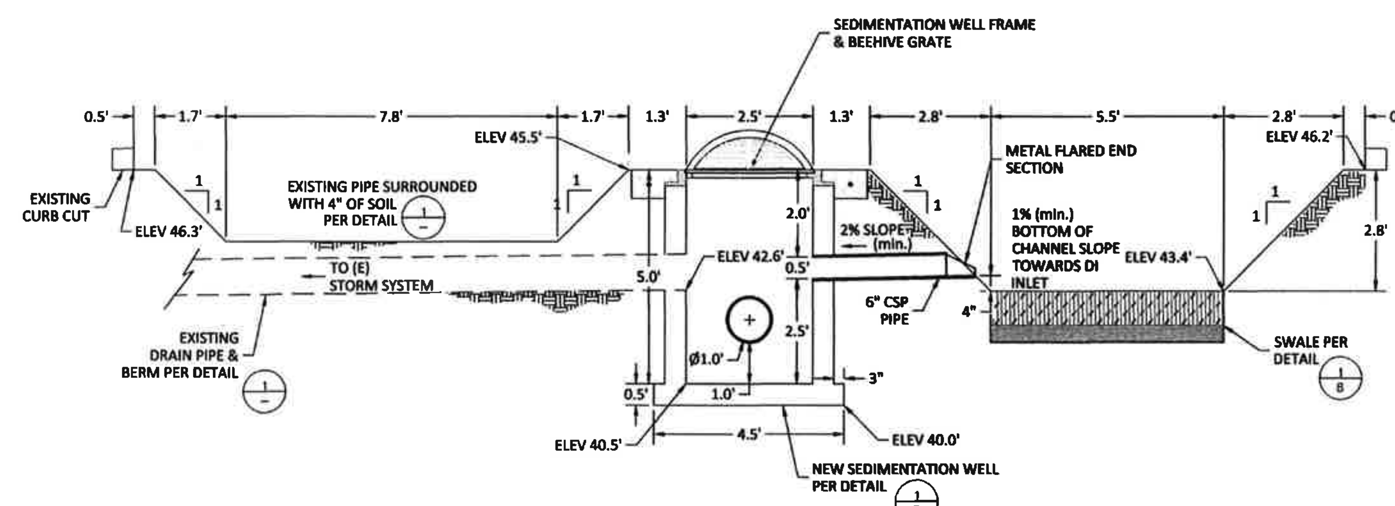
2 SWALE - ELEVATION SEDIMENTATION WELL INLET

NOT TO SCALE



3 SWALE - ELEVATION SOUTHWESTERN VIEW

NOT TO SCALE



4 SWALE - ELEVATION NORTHWESTERN VIEW

NOT TO SCALE

NO.	REVISION	BY	DATE

cbec eco engineering

cbec, inc. eco engineering
2544 Industrial Blvd.
West Sacramento, CA 95691

DESIGNED:
DRAWN:
CHECKED:

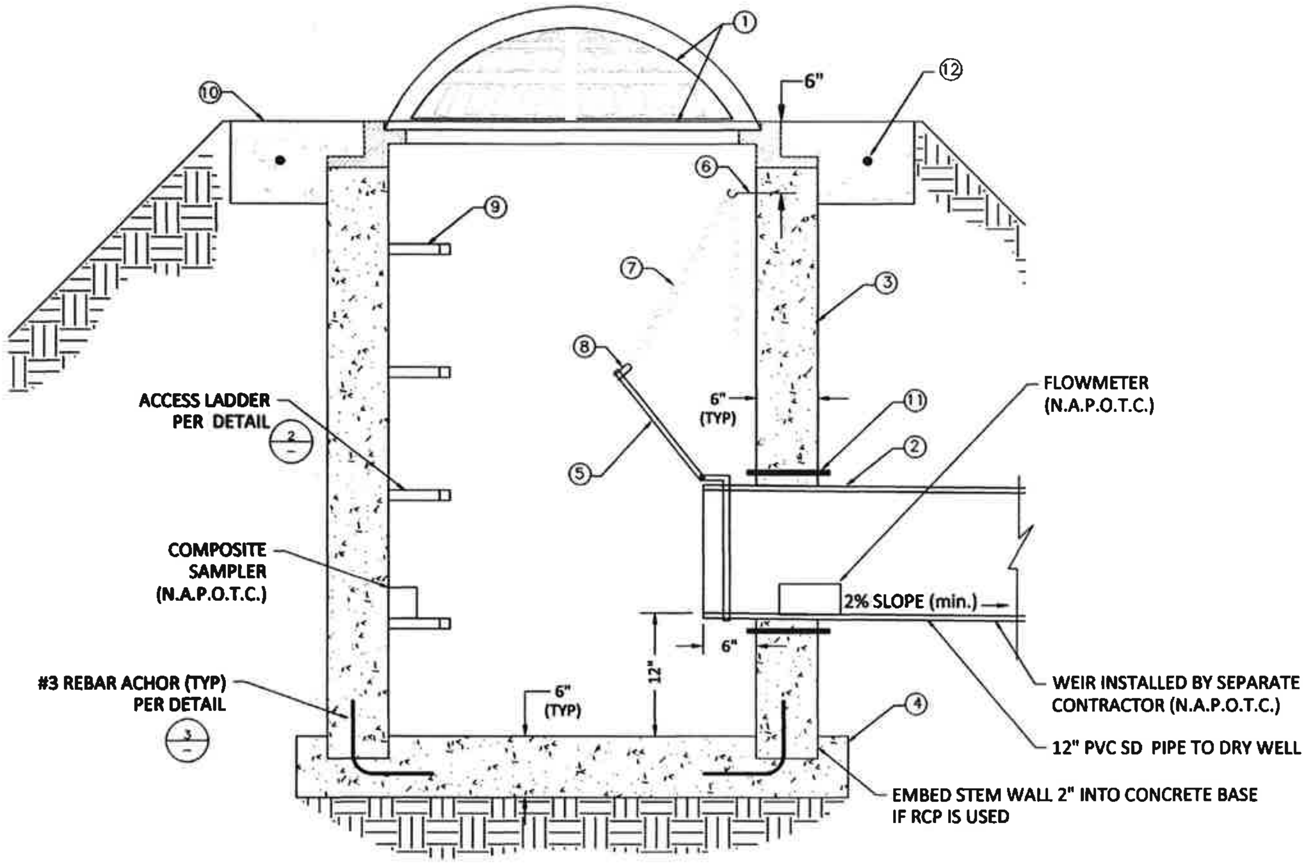
CITY OF ELK GROVE
DEPARTMENT OF PUBLIC WORKS
8401 LAGUNA PALMS WAY
ELK GROVE, CALIFORNIA 95758
916.683.7111

SITE 2: CITY OF ELK GROVE CORPORATION YARD
SURFACE FLOW & WATER QUALITY PLAN, ELEVATION & DETAILS

DATE: JUNE 2014
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019

SHEET: 6 OF 9

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

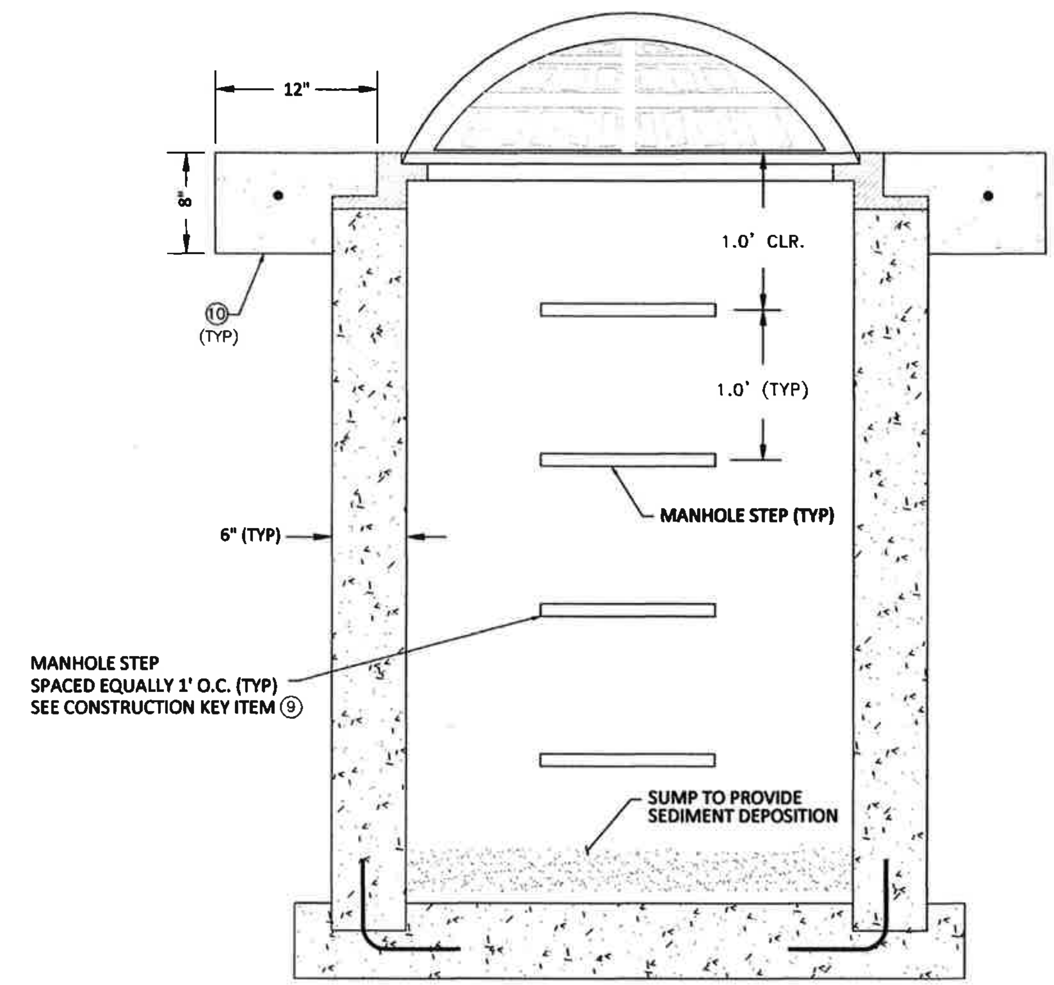


1 SEDIMENTATION WELL - PROFILE

NOT TO SCALE

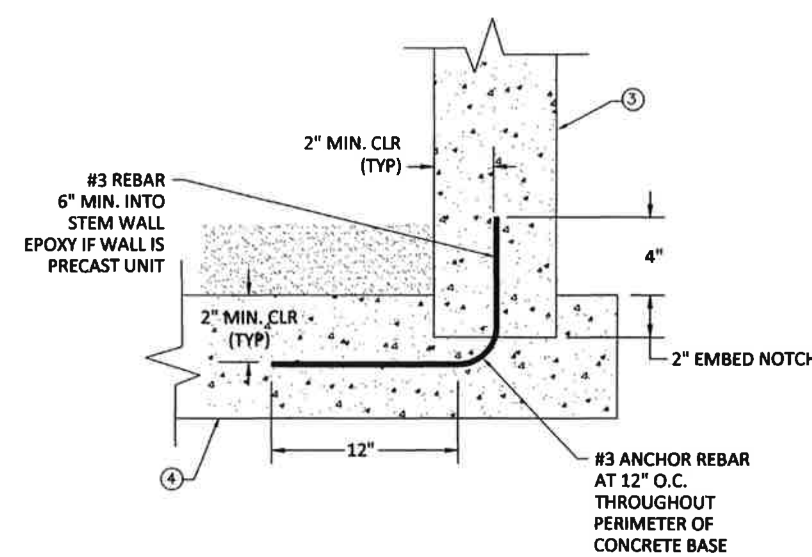
CONSTRUCTION KEY:

1. SEDIMENTATION WELL FRAME & BEEHIVE GRATE
2. 12" PVC PIPE – EXTEND 6" INTO SEDIMENTATION WELL TO ALLOW FOR FLAP GATE INSTALLATION
3. 30" REINFORCED CONCRETE PIPE OR CAST–IN–PLACE CONCRETE
4. CAST–IN–PLACE CONCRETE BASE
5. FLAP GATE SHALL BE A 12" HEAVY DUTY FLAP GATE WITH ATTACHING COLLAR
6. EPOXY 4–7/8" STAINLESS STEEL SCREW "J" HOOK BOLT INTO STILLING WELL
7. #2/0 LINK CHAIN W/ STAINLESS STEEL WELDED LINKS LENGTH OF CHAIN TO BE 10' MINIMUM AND CUT TO FIT IN FIELD
8. ATTACH CHAIN TO FLAP GATE PLATE WITH U–BOLT SCREW AND 3/8" SPRING LINK
9. MANHOLE STEP
10. CAST–IN–PLACE CONCRETE COLLAR
11. PIPE CONNECTION SHALL CONFORM TO ASTM C–923. PRECAST UNITS SHALL BE BOOT TYPE OR COMPRESSION GASKET. CAST–IN–PLACE UNITS SHALL INCLUDE A WATER STOP
12. #4 REBAR HOOP (TYP)



2 ACCESS LADDER

NOT TO SCALE



3 ANCHOR DETAIL

NOT TO SCALE

WDR019 - UNDERGROUND INJECTION CONTROLS AS LOW IMPACT DEVELOPMENT

NO.	REVISION	BY	DATE

cbec eco engineering

cbec, inc. eco engineering
2544 Industrial Blvd.
West Sacramento, CA 95691

DESIGNED:
DRAWN:
CHECKED:

CITY OF ELK GROVE
DEPARTMENT OF PUBLIC WORKS
8401 LAGUNA PALMS WAY
ELK GROVE, CALIFORNIA 95758
916.683.7111

SITE 2: CITY OF ELK GROVE CORPORATION YARD
DRAINAGE INLET DETAIL

DATE: JUNE 2014
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019

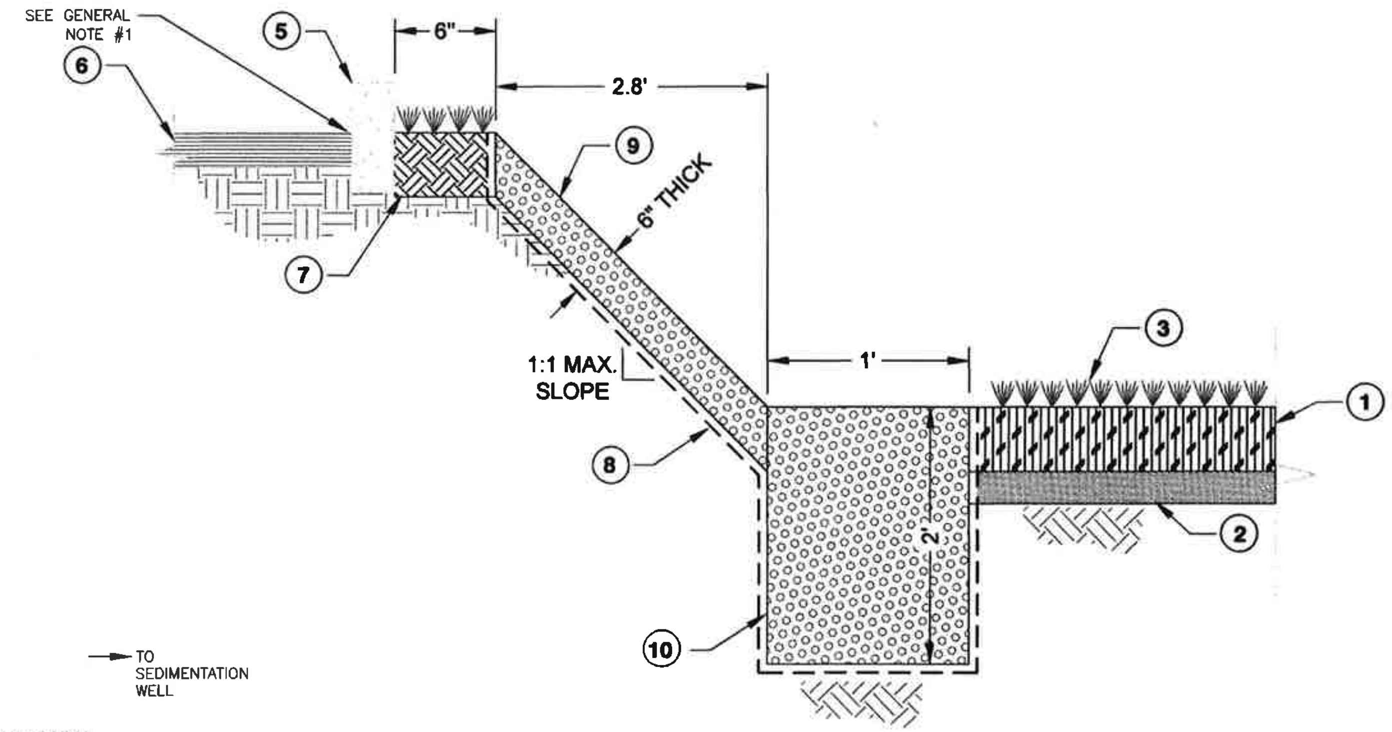
SHEET: 7 OF 9

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3 4

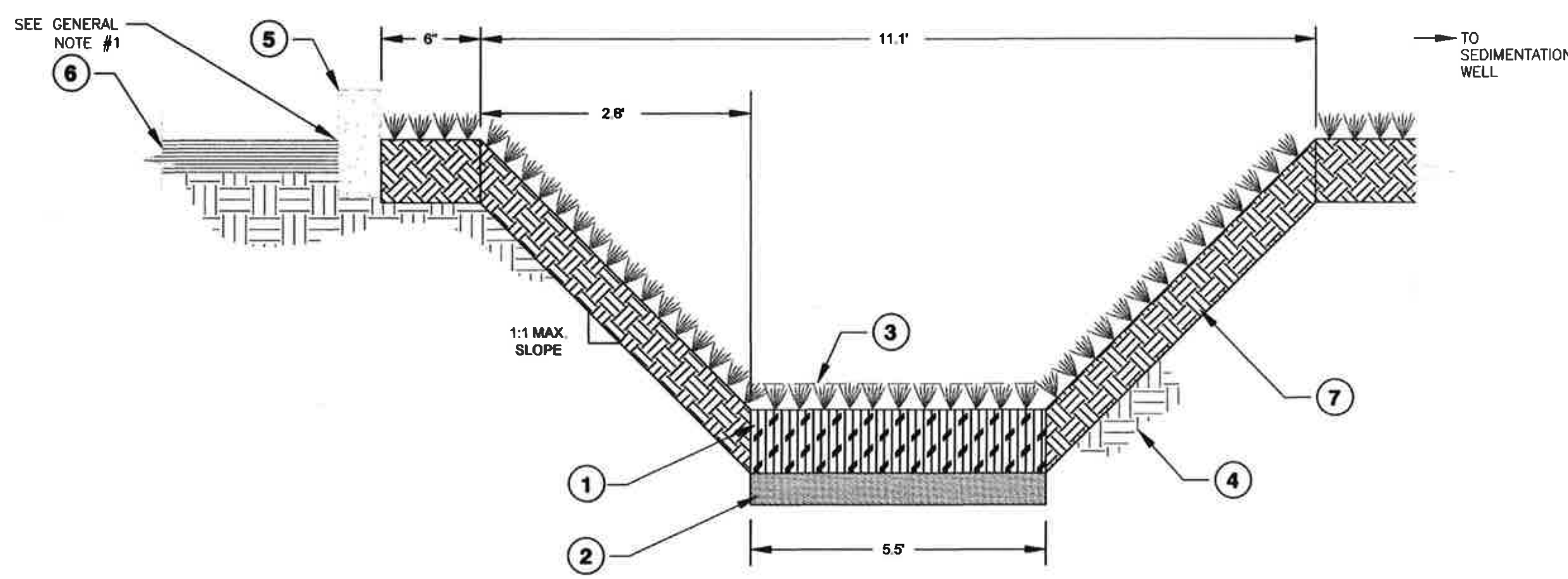
WDR019 - UNDERGROUND INJECTION CONTROLS AS LOW IMPACT DEVELOPMENT

CONSTRUCTION KEY:

1. 12" SANDY LOAM TOPSOIL
2. 6" SAND
3. BIOFILTRATION SOD
   USE SOD STAPLES TO SECURE SOD TO SLOPES
4. UNDISTURBED AND UNCOMPACTED IN-SITU SOIL
5. EXISTING CURB CUT OPENING AT PARKING LOT (EXISTING CONCRETE CURB BEYOND)
6. EXISTING AC PARKING LOT
7. 6" DEEP AMENDED / CONDITIONED SOIL
8. NON-WOVEN GEOTEXTILE FABRIC
9. ROCK SLOPE PROTECTION SHALL BE 75% 6" TO 8" AND 25% 2" COBBLESTONES
10. 1' x 2' COBBLESTONE DIAPHRAGM LEVEL SPREADER DECREASE DEPTH OF LEVEL SPREADER OVER EXISTING 10" STORM DRAIN



2 ROCK SLOPE PROTECTION AT CURB CUT
NOT TO SCALE



1 TYPICAL SWALE DETAIL CROSS-SECTION
NOT TO SCALE

GENERAL NOTES:

1. FLOW ENTERS THROUGH CURB CUT/ OPENING FROM THE PARKING LOT.
2. ACTUAL CONDITIONS MAY VARY. ADJUST IN FIELD.
3. REFER TO COMMERCIAL / LIGHT INDUSTRIAL SITE PLAN FOR DRAINAGE INLET DETAILS PER SHEET 5.

NO.	REVISION	BY	DATE

cbec eco engineering
cbec, inc. eco engineering
2544 Industrial Blvd.
West Sacramento, CA 95691

DESIGNED:
DRAWN:
CHECKED:

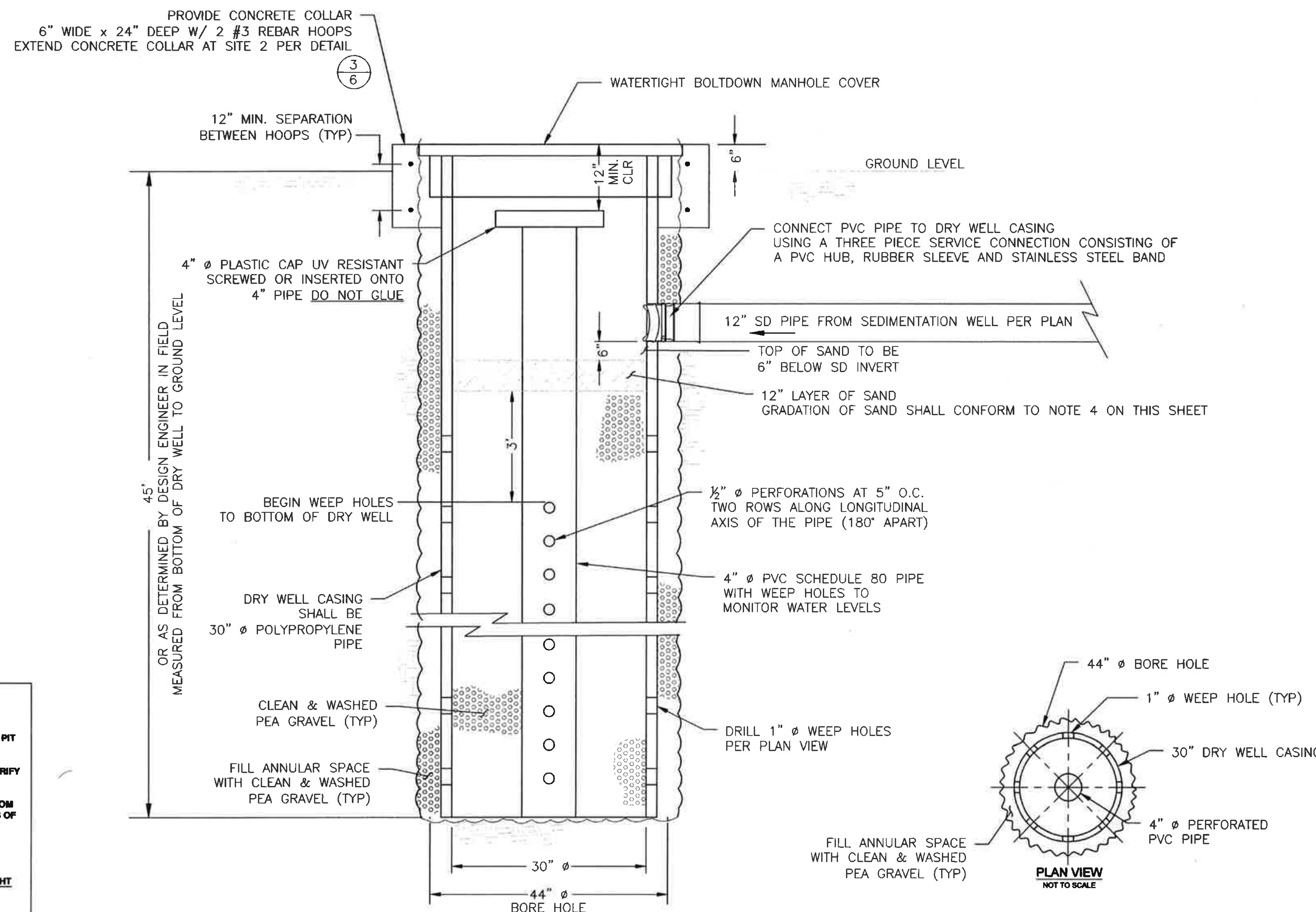
CITY OF ELK GROVE
DEPARTMENT OF PUBLIC WORKS
8401 LAGUNA PALMS WAY
ELK GROVE, CALIFORNIA 95758
916.683.7111

DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT
SITE 2: CITY OF ELK GROVE CORPORATION YARD
SWALE DETAIL

DATE: JUNE 2014
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019

SHEET: 8 OF 9

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3 4



NOTES:

1. ROCK MUST COME FROM CLEAN SOURCES AND MUST BE THOROUGHLY WASHED BEFORE PLACEMENT.
2. GRAVEL PURCHASED FROM A SUPPLIER MUST BE WASHED AT THE PIT OR PLANT PRIOR TO DELIVERY TO THE DRY WELL SITE.
3. BEFORE PLACEMENT OF ROCK CONTACT DESIGN ENGINEER TO VERIFY WASHED ROCK CONDITION.
4. DRY WELL SAND SHALL CONSIST OF SILICA SAND AND BE FREE FROM VEGETABLE MATTER, LUMPS, BALLS OF CLAY OR ADHERENT FILMS OF CLAY.

   THE PERCENTAGE COMPOSITION BY WEIGHT OF DRY WELL SAND SHALL CONFORM TO THE FOLLOWING GRADATIONS:

SIEVE SIZE	PERCENTAGE PASSING BY WEIGHT
0.1319 INCHES (#6)	90-100
0.0929 INCHES (#8)	4-35
0.0787 INCHES (#10)	0-10

1/– DRY WELL DETAIL

NOT TO SCALE

NO.	REVISION	BY	DATE

WILLDAN Engineering
9281 Office Park Circle ~ Suite 100
Elk Grove, CA 95758 916.478.6002

DESIGNED:
DRAWN:
CHECKED:

REGISTERED PROFESSIONAL ENGINEER
JENNIFER MAXWELL
No. C54309
CIVIL
STATE OF CALIFORNIA

CITY OF ELK GROVE
DEPARTMENT OF PUBLIC WORKS
8401 LAGUNA PALMS WAY
ELK GROVE, CALIFORNIA 95758
916.683.7111

CITY OF ELK GROVE CALIFORNIA

DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT

DRY WELL DETAIL

DATE: JUNE 2014
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WDR019

SHEET: 9 OF 9

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES
0 1 2 3 4

Appendix 4.1

Dry Well Permits

AR0067878

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? ☐ YES ☒ NO

FOR OFFICE USE ONLY — EXPEDITED PROCESSING? ☐ YES ☐ NO

☐ APPROVED ☒ APPROVED W/CONDITIONS (ATTACHED) — PERMIT NUMBER(S): 54847

BY: [signature] DATE: 9/30/14 — DATE RECEIVED: 9/26/14 — TOTAL FEE: $853.00
INITIAL GROUT BY: ______ DATE: ______ — RECEIPT NO: IN0363229 — DEPTH TO WATER: ______
FINAL INSPECTION BY: ______ DATE: ______ — WELL DEPTH: ______ — GROUT DEPTH: ______
DESTRUCTION BY: ______ DATE: ______ — GPS: N: 38 — W: -121
COMMENTS: ______

DS 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 Elk Grove	Parcel Number(s): 115-0150-036-0000
Well Contractor: Fox Loomis, Inc.	CA License No.: 372314 (Expiration Date: 9/30/2015) exp. 9/30/15
Contractor's Address: 6901 McComber Street, Sacramento, CA 95828	WC exp. 10/1/15 OK 8/SN
Well/Boring Identification Number(s): Site 1	

TYPE OF WORK: (California C-57 License required unless noted otherwise)
☒ Well construction ☐ Vault box repair (General A or B) ☐ Well destruction (SUPPLEMENT REQUIRED)
☐ Pump replacement (or C-61) ☐ Well repair ☐ Exploratory boring (C-57 if water present)
☐ Well inactivation (Owner only) ☐ Pump repair (or C-61) ☒ Other: Dry Well

INTENDED USE:
☐ Domestic/private ☐ Dewatering ☐ Geotechnical boring
☐ Irrigation/agricultural ☐ Cathodic protection ☐ Environmental boring
☐ Water/vapor monitoring/extraction ☐ Heat exchange ☒ Other: Dry Well STORMWATER INJECTION
☐ Public water system: ______
(NAME OF WATER PURVEYOR WITH CONTACT NAME AND TELEPHONE NUMBER)

DRILLING METHOD:
☐ Mud rotary ☐ Air Rotary ☐ Cable tool ☐ Auger ☐ Driven ☒ Other: BUCKET AUGER

SETBACKS: (Wells only)
Is the well located within 50 feet of a: ☐ sewer line, ☐ stream, ☐ ditch, ☒ drainage course, ☐ pond, or ☐ lake? No
Is the well located within 100 feet of a: ☐ septic tank, ☐ leach line, ☐ deep trench, or ☐ animal enclosure? ☒ No

SPECIFICATIONS:
BOREHOLE: Diameter: 44" Depth: 45' — CASING: Diameter: 30" Depth: 45'
Diameter: ______ Depth: ______ — CASING: Diameter: ______ Depth: ______
CONDUCTOR: Diameter: 30" Depth: 45' — IF STEEL: Gauge: ______ or Thickness: ______
ANNULAR SEAL: Depth: None Material: ______ — IF PLASTIC: Type: Polypropylene (Must meet ASTM F-480)
TRANSITION SEAL: Material: None — MULTIPLE COMPLETION? ☐ Yes (DIAGRAM REQUIRED)
COMMENTS: Dry Well 2' Collar

PUMP INSTALLATION/REPAIR:
Contractor: ______
License Number: ______ Type of Pump: ______ Horsepower: ______

I will comply with all Codes, Rules and Regulations of the State and County pertaining to or regulating wells and pumps, call **(916) 875-8524 for a grout inspection at least 24 hours prior to the requested appointment time**, submit a "Well Completion Report" (if required) within 60 days of the completion of my work so a final inspection can be made, and obtain WPD approval before placing a well in service.

SIGNATURE: [signature] — ☒ Property Owner (City of Elk Grove) OK SN
PRINTED NAME: Richard Shepard, Public Works Director — ☐ Well Contractor
COMPANY: City of Elk Grove — ☐ Agent **(REQUIRES AUTHORIZATION FORM)**
MAILING ADDRESS: 8401 Laguna Palms Way, Elk Grove, CA 95758
PHONE NUMBER: (916) 478-2256 — FIELD PHONE: ______

A SITE PLAN MUST BE SUBMITTED WITH EACH APPLICATION.
PERMIT EXPIRES ONE (1) YEAR AFTER DATE APPROVED (UNLESS EXTENDED)

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 http://www.epa.gov/region9/water/groundwater/uic-classv.html.
- 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 (Attention: 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.

By: ______________________ **Date:** **September 30, 2014**

Susan B. Williams, M.S.
Permitting & Enforcement

W:\DATA\WILLIAMSS\WELLPERMITATTACHMENTS\CITYOFELKGROVE_54847-54848.DOC

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

SITE 1

STREET ADDRESS: O - CALVINE RD. DATE: 9-16-14

OR PARCEL NUMBER: 115-0150-036-0000 AND STREET NAME: ______

CENSUS TRACT: ______ CONTRACTOR: FOX LOOMIS INC PERMIT #: 54847

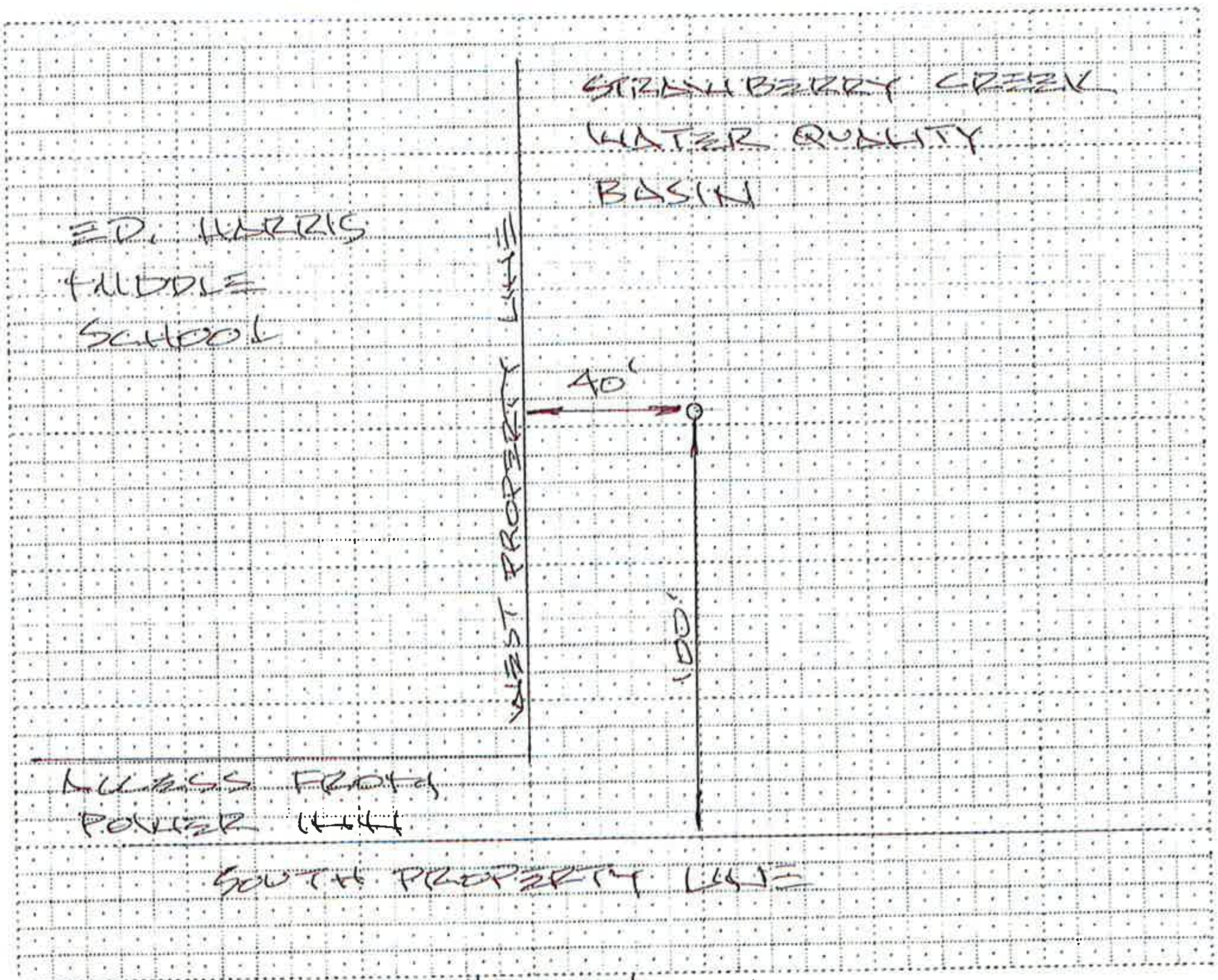
SHOW PARCEL DIMENSIONS, STREETS, STRUCTURES, CONTOURS, LOCATION OF WELLS AND SEPTIC SYSTEMS (SHOW LAYOUT OF SEPTIC SYSTEM). SHOW DISTANCE (IN FEET) FROM SEPTIC AND/OR WELL TO: WATER COURSES, SEPTIC TANKS, LEACHING AREAS, PROPERTY LINES, SEWER LINES AND WATER WELLS (ALSO WELLS AND SEPTIC SYSTEMS WITHIN SETBACK DISTANCES ON ADJACENT PROPERTY). SITE PLAN MUST BE ACCURATE TO ALLOW SYSTEM OR WELL TO BE LOCATED AT A FUTURE DATE.

WILL SYSTEM OR WELL BE INSTALLED IN 100 YEAR FLOODPLAIN? YES ☑ NO ☐

N

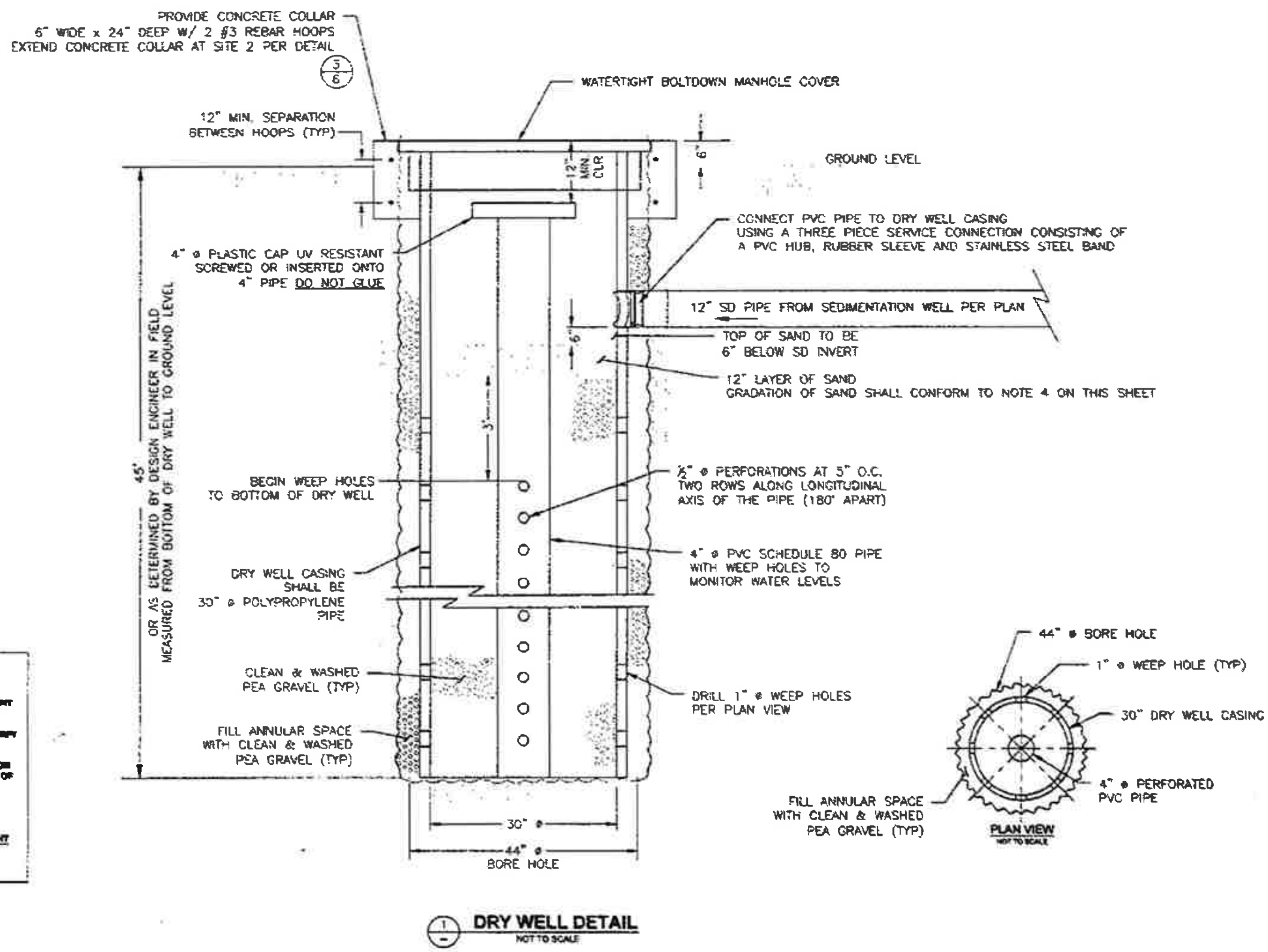
W

E



SCALE 1" = 40'-0"

S



NOTES:

1. ROCK MUST COME FROM CLEAN SOURCES AND MUST BE THOROUGHLY WASHED BEFORE PLACEMENT.
2. GRAVEL PURCHASED FROM A SUPPLIER MUST BE WASHED AT THE PIT OR PLANT PRIOR TO DELIVERY TO THE DRY WELL SITE.
3. BEFORE PLACEMENT OF ROCK CONTACT DESIGN ENGINEER TO VERIFY WASHED ROCK CONDITION.
4. DRY WELL SAND SHALL CONSIST OF SILICA SAND AND BE FREE FROM VEGETABLE MATTER, LUMPS, BALLS OF CLAY OR ADHERENT FILMS OF CLAY.

   THE PERCENTAGE COMPOSITION BY WEIGHT OF DRY WELL SAND SHALL CONFORM TO THE FOLLOWING GRADATIONS:

SIEVE SIZE	PERCENTAGE PASSING BY WEIGHT
[illegible] INCHES (#4)	90-100
[illegible] INCHES ([illegible])	4-[illegible]
[illegible] INCHES (#10)	0-10

DRY WELL DETAIL

1/–
NOT TO SCALE

NO	REVISION	BY	DATE

WILLDAN Engineering
9281 Office Park Circle ~ Suite 100
Elk Grove, CA 95758 916.478.6002

DESIGNED:
DRAWN:
CHECKED:

CITY OF ELK GROVE
DEPARTMENT OF PUBLIC WORKS
8401 LAGUNA PALMS WAY
ELK GROVE, CALIFORNIA 95758
916.683.7111

DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT

DRY WELL DETAIL

DATE: JUNE 2014
SCALE: HORIZ: N/A VERT: N/A
PROJECT NO.: WDR019

SHEET: 9 OF 9

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

Parcel Viewer

SACRAMENTO COUNTY

Rivers

Ortho - Street Names

Freeways

Other/Unknown

Inactivation

County Boundary Lines

Major Streets

EMD Abandoned Wells

- Hand-dug
- Open casing
- Open piping
- Inoperable

Deleted Parcels

Parcel Boundaries

2010 Census Tracts

Information For Parcel:
115-0150-036-0000

PROPERTY INFORMATION

APN	11501500360000
Situs Address	0 CALVINE RD
Postal City/St/Zip	ELK GROVE, CA 95624
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 Address	8380 LAGUNA PALMS WAY 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 Info	View Assessor Data
Building Permits	No Permit record available.
Parcel Notes	View Parcel Notes
Business Licenses	No Business License Data available.
SHRA Info	View SHRA Data
CUBS Info	No CUBS data available.
Refuse Pickup	No Refuse Pickup schedule available.
Water Meters	No Water Meter Data available.
Easements	View Easements Data
Planning Parcel Page	View Planning 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

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

Workers' Compensation History

OK See attached certification

Miscellaneous Information

09/15/1993 - LICENSE REISSUED TO ANOTHER ENTITY

Personnel List

279265

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 09/29/2014

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME: Cheri Greco
John O. Bronson Co. / #0425149 3636 American River Drive Suite 200 Sacramento, CA 95864 916-974-7800	PHONE (A/C, No, Ext): 916-480-4153 FAX (A/C, No): 916-993-7258 E-MAIL ADDRESS: cgreco@johnobronson.com
	INSURER(S) AFFORDING COVERAGE / NAIC #
	INSURER A : National Fire Insurance of Hartford
INSURED Fox Loomis Inc. 6901 Mc Comber Street Sacramento, CA 95828	INSURER B : Continental Casualty
	INSURER C : Oak River Insurance Company
	INSURER D :
	INSURER E :
	INSURER F :

COVERAGES **CERTIFICATE NUMBER:** 19746 **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	GENERAL LIABILITY X COMMERCIAL GENERAL LIABILITY CLAIMS-MADE X OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: POLICY X PRO-JECT LOC			4016889746 Per Project Aggregate Applies When Required By Written Contract	10/01/14	10/01/15	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 1,000,000 $ 100,000 $ 5,000 $ 1,000,000 $ 2,000,000 $ 2,000,000 $
A	AUTOMOBILE LIABILITY X ANY AUTO ALL OWNED AUTOS / SCHEDULED AUTOS HIRED AUTOS / NON-OWNED AUTOS			4016889777	10/01/14	10/01/15	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 1,000,000 $ $ $ $
B	X UMBRELLA LIAB X OCCUR EXCESS LIAB CLAIMS-MADE DED X RETENTION $ 10,000			4016889763	10/01/14	10/01/15	EACH OCCURRENCE AGGREGATE	$ 3,000,000 $ 3,000,000 $
C	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) Y/N If yes, describe under DESCRIPTION OF OPERATIONS below	N/A		2200054068	10/01/14	10/01/15	X WC STATU-TORY LIMITS OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	 $ 1,000,000 $ 1,000,000 $ 1,000,000
A	Limited Pollution Liability			4016889476	10/01/14	10/01/15	$1,000,000 Each Incident $2,000,000 Aggregate Limit	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

RE: License # 372314

Add'l Interests:

Forms:

CERTIFICATE HOLDER	CANCELLATION
CONTRACTORS STATE LICENSE BOARD WORKERS COMPENSATION UNIT PO BOX 26000 SACRAMENTO, CA 95826	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS. AUTHORIZED REPRESENTATIVE Paul F Bystrowski

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

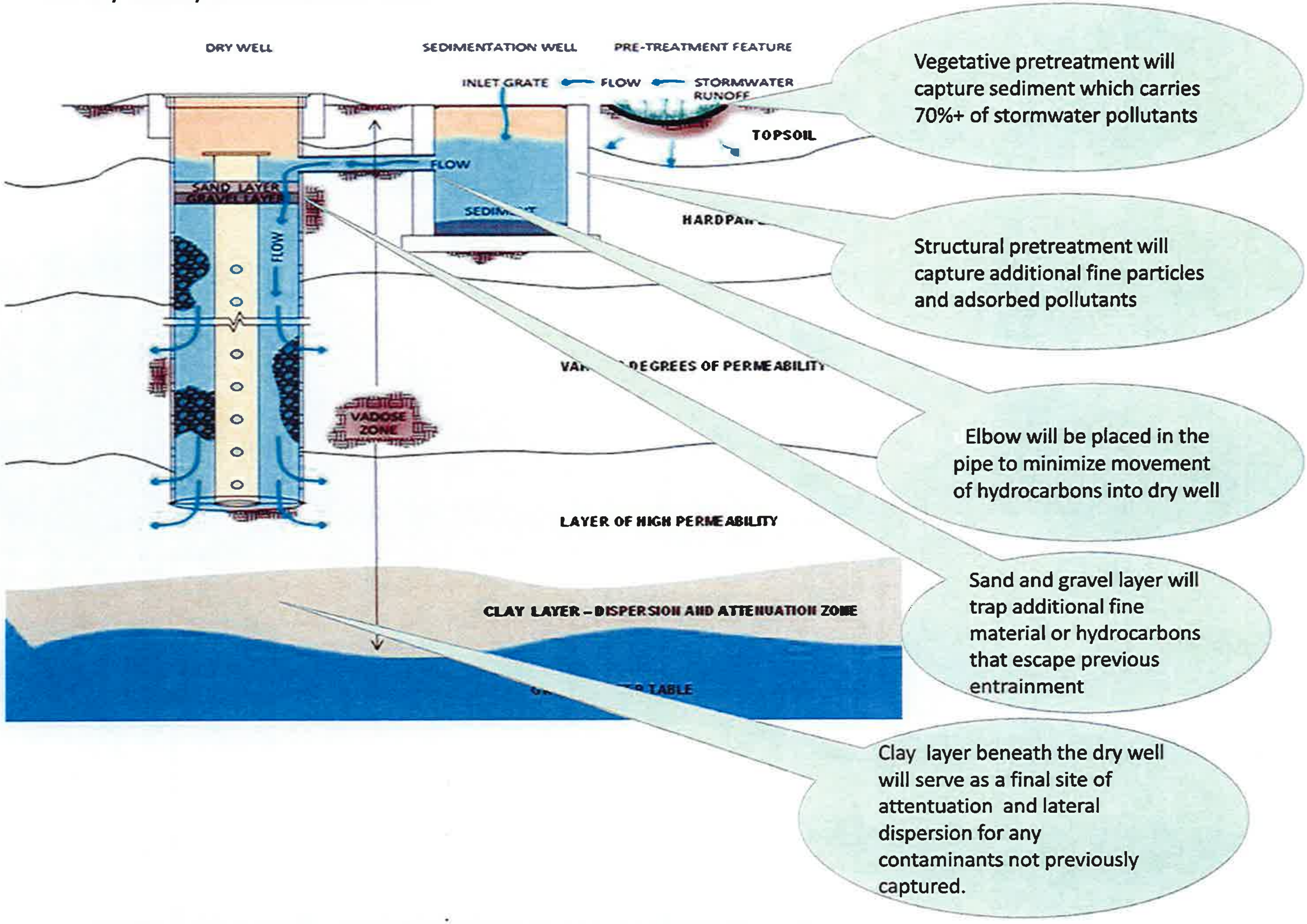
Personnel Currently Associated with License

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.

The Dry Well System Treatment Train



JAL0058876

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? ☐ YES ☒ NO

FOR OFFICE USE ONLY
☐ APPROVED ☐ APPROVED W/CONDITIONS (ATTACHED)
BY: ______ DATE: ______
INITIAL GROUT BY: ______ DATE: ______
FINAL INSPECTION BY: ______ DATE: ______
DESTRUCTION BY: ______ DATE: ______
COMMENTS: ______

EXPEDITED PROCESSING? ☒ YES ☒ NO
PERMIT NUMBER(S): 54847
DATE RECEIVED: 9/17/14 TOTAL FEE: $863.00
RECEIPT NO.: IN0563229 DEPTH TO WATER: ______
WELL DEPTH: ______ GROUT DEPTH: ______
GPS: N: 38 W: -121

SITE ADDRESS: 0 – LAGUNE RD., ELK GROVE 95624
Job Address: S.G., H.G., B., 310, 3D, HARRIS ... MIDDLE SCHOOL, 3D, POWER ... | Nearest Major Cross Street: POWER LINE
Property Owner: CITY OF ELK GROVE | Parcel Number(s): 115-0150-036-0000
Well Contractor: FOX LOOMIS, INC. | CA License No.: 372314 Exp 9-30-15
Contractor's Address: 6901 ... ST, SACRAMENTO CA 95828
Well/Boring Identification Number(s): SITE 1

05
EG
93.22
OK
RBC

CANCELLED

TRANSFERRED TO CITY OF ELK GROVE 9/26/14 (RW)

TYPE OF WORK: (California C-57 ... ise)
☒ Well construction
☐ Pump replacement (or C-61)
☐ Well inactivation (Owner only)
☐ Well destruction **(SUPPLEMENT REQUIRED)**
☐ Exploratory boring (C-57 if water present)
☒ Other: DRY WELL

INTENDED USE:
☐ Domestic/private
☐ Irrigation/agricultural
☐ Water/vapor monitoring/extractio...
☐ Public water system: ______
☐ Geotechnical boring
☐ Environmental boring
☒ Other: DRY WELL
(NAME ... TACT NAME AND TELEPHONE NUMBER)

DRILLING METHOD:
☐ Mud rotary ☐ Air Rotary ... ☐ Driven ☐ Other: ______

SETBACKS: (Wells only)
Is the well located within 50 feet of a: ☐ sewer line, ☐ stream, ☐ ditch, ☒ drainage course, ☐ pond, or ☐ lake? ☐ No
Is the well located within 100 feet of a: ☐ septic tank, ☐ leach line, ☐ deep trench, or ☐ animal enclosure? ☒ No

SPECIFICATIONS:
BOREHOLE: Diameter: 44" Depth: 45'
Diameter: ______ Depth: ______
CONDUCTOR: Diameter: 30" Depth: 45'
ANNULAR SEAL: Depth: NONE Material: ______
TRANSITION SEAL: Material: NONE
COMMENTS: DRY WELL, 25' ...

CASING: Diameter: 30" Depth: 45'
CASING: Diameter: ______ Depth: ______
IF STEEL: Gauge: ______ or Thickness: ______
IF PLASTIC: Type: POLYPROPYL (Must meet ASTM F-480)
MULTIPLE COMPLETION? ☐ Yes **(DIAGRAM REQUIRED)**

PUMP INSTALLATION/REPAIR:
Contractor: ______
License Number: ______ Type of Pump: ______ Horsepower: ______

I will comply with all Codes, Rules and Regulations of the State and County pertaining to or regulating wells and pumps, **call (916) 875-8524 for a grout inspection at least 24 hours prior to the requested appointment time**, submit a "Well Completion Report" (if required) within 60 days of the completion of my work so a final inspection can be made, and obtain WPD approval before placing a well in service.

SIGNATURE: [signature]
PRINTED NAME: SAM FOX
COMPANY: FOX LOOMIS INC.
MAILING ADDRESS: 6901 ... ST., SACRAMENTO, CA 95828
PHONE NUMBER: 916-383-2140

☐ Property Owner
☒ Well Contractor OK RBC
☐ Agent **(REQUIRES AUTHORIZATION FORM)**
FIELD PHONE: 916-826-4781

A SITE PLAN MUST BE SUBMITTED WITH EACH APPLICATION.
PERMIT EXPIRES ONE (1) YEAR AFTER DATE APPROVED (UNLESS EXTENDED)

WELL PERMIT TIME LOG SHEET

FIRST PERMIT: WP0054847	SITE ADDRESS: 0 Calvine Rd.
PAID TIME: 4 hours	CITY OF ELK GROVE - 1 Injection Well

Date	Specialist	Activity	Hours	Time Remaining	Envision Updated
9/17/14	LBC	Permit processing /scheduling	0.5	3.5	x
9/29/14	SBW	Preliminary review, e-mails and phone calls	1.0	2.5	
9/30/14	SBW	Conditional approval	2.0	0.5	X

AR0067878

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? ☐ YES ☒ NO

FOR OFFICE USE ONLY	**EXPEDITED PROCESSING?** ☐ YES ☐ NO
☐ APPROVED ☒ APPROVED W/CONDITIONS (ATTACHED)	PERMIT NUMBER(S): 54848
BY: SBN DATE: 9/30/14	DATE RECEIVED: 9/26/14 TOTAL FEE: $853.00
INITIAL GROUT BY: ____ DATE: ____	RECEIPT NO: IN0363227 DEPTH TO WATER: ____
FINAL INSPECTION BY: ____ DATE: ____	WELL DEPTH: ____ GROUT DEPTH: ____
DESTRUCTION BY: ____ DATE: ____	GPS: N: 38 W: -121
COMMENTS:	

D5 EG CT 93.10

SITE ADDRESS: 10250 Iron Rock Way, Elk Grove, CA 95624 (City Corporation Yard)	
Job Address: Same	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 95828	Exp. 9/30/15
Well/Boring Identification Number(s): Site 2	WC exp. 10/1/15 OK SBN

TYPE OF WORK: (California C-57 License required unless noted otherwise)

☒ Well construction ☐ Vault box repair (General A or B) ☐ Well destruction **(SUPPLEMENT REQUIRED)**
☐ Pump replacement (or C-61) ☐ Well repair ☐ Exploratory boring (C-57 if water present)
☐ Well inactivation (Owner only) ☐ Pump repair (or C-61) ☒ Other: Dry Well

INTENDED USE:

☐ Domestic/private ☐ Dewatering ☐ Geotechnical boring
☐ Irrigation/agricultural ☐ Cathodic protection ☐ Environmental boring
☐ Water/vapor monitoring/extraction ☐ Heat exchange ☒ Other: Dry Well STORMWATER INJECTION
☐ Public water system: ____
(NAME OF WATER PURVEYOR WITH CONTACT NAME AND TELEPHONE NUMBER)

DRILLING METHOD:

☐ Mud rotary ☐ Air Rotary ☐ Cable tool ☐ Auger ☐ Driven ☒ Other: BUCKET AUGER

SETBACKS: (Wells only)

Is the well located within 50 feet of a: ☐ sewer line, ☐ stream, ☒ ditch, ☐ drainage course, ☐ pond, or ☐ lake? ☐ No
Is the well located within 100 feet of a: ☐ septic tank, ☐ leach line, ☐ deep trench, or ☐ animal enclosure? ☒ No

SPECIFICATIONS:

BOREHOLE: Diameter: 44" Depth: 45' CASING: Diameter: 30" Depth: 45'
Diameter: ____ Depth: ____ CASING: Diameter: ____ Depth: ____
CONDUCTOR: Diameter: 30" Depth: 45' IF STEEL: Gauge: ____ or Thickness: ____
ANNULAR SEAL: Depth: 6' Material: Concrete IF PLASTIC: Type: Polypropylene (Must meet ASTM F-480)
TRANSITION SEAL: Material: Collar MULTIPLE COMPLETION? ☐ Yes **(DIAGRAM REQUIRED)**
COMMENTS: Dry Well - 6.0' Concrete Collar

PUMP INSTALLATION/REPAIR:

Contractor: ____
License Number: ____ Type of Pump: ____ Horsepower: ____

I will comply with all Codes, Rules and Regulations of the State and County pertaining to or regulating wells and pumps, call **(916) 875-8524 for a grout inspection at least 24 hours prior to the requested appointment time**, submit a "Well Completion Report" (if required) within 60 days of the completion of my work so a final inspection can be made, and obtain WPD approval before placing a well in service.

SIGNATURE: [signature] ☒ Property Owner (City of Elk Grove)
PRINTED NAME: Richard Shepard, Public Works Director ☐ Well Contractor
COMPANY: City of Elk Grove ☐ Agent **(REQUIRES AUTHORIZATION FORM)**
MAILING ADDRESS: 8401 Laguna Palms Way, Elk Grove, CA 95758
PHONE NUMBER: (916) 478-2256 FIELD PHONE: ____

OK - SBN

A SITE PLAN MUST BE SUBMITTED WITH EACH APPLICATION.
PERMIT EXPIRES ONE (1) YEAR AFTER DATE APPROVED (UNLESS EXTENDED)

SE 04/09/2009 W:\Data\FORMSARCHIVE\WP NEW\WELLS\WELL 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 http://www.epa.gov/region9/water/groundwater/uic-classv.html.
- 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 (Attention: Cheryl Hawkins, Supervising Environmental Specialist).

10590 Armstrong Ave. Suite A • Mather, CA 95655 • phone (916) 875-8550 • fax (916) 875-8513 • www.saccounty.net

- 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.

By: Susan B. Williams **Date:** **September 30, 2014**

Susan B. Williams, M.S.
Permitting & Enforcement

W:\DATA\WILLIAMSS\WELLPERMITATTACHMENTS\CITYOFELKGROVE_54847-54848.DOC

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

SITE 2

STREET ADDRESS: 10250 IRON ROCK WAY ELK GROVE DATE: 9-16-14

OR PARCEL NUMBER: 134-0630-031-0000 AND STREET NAME:

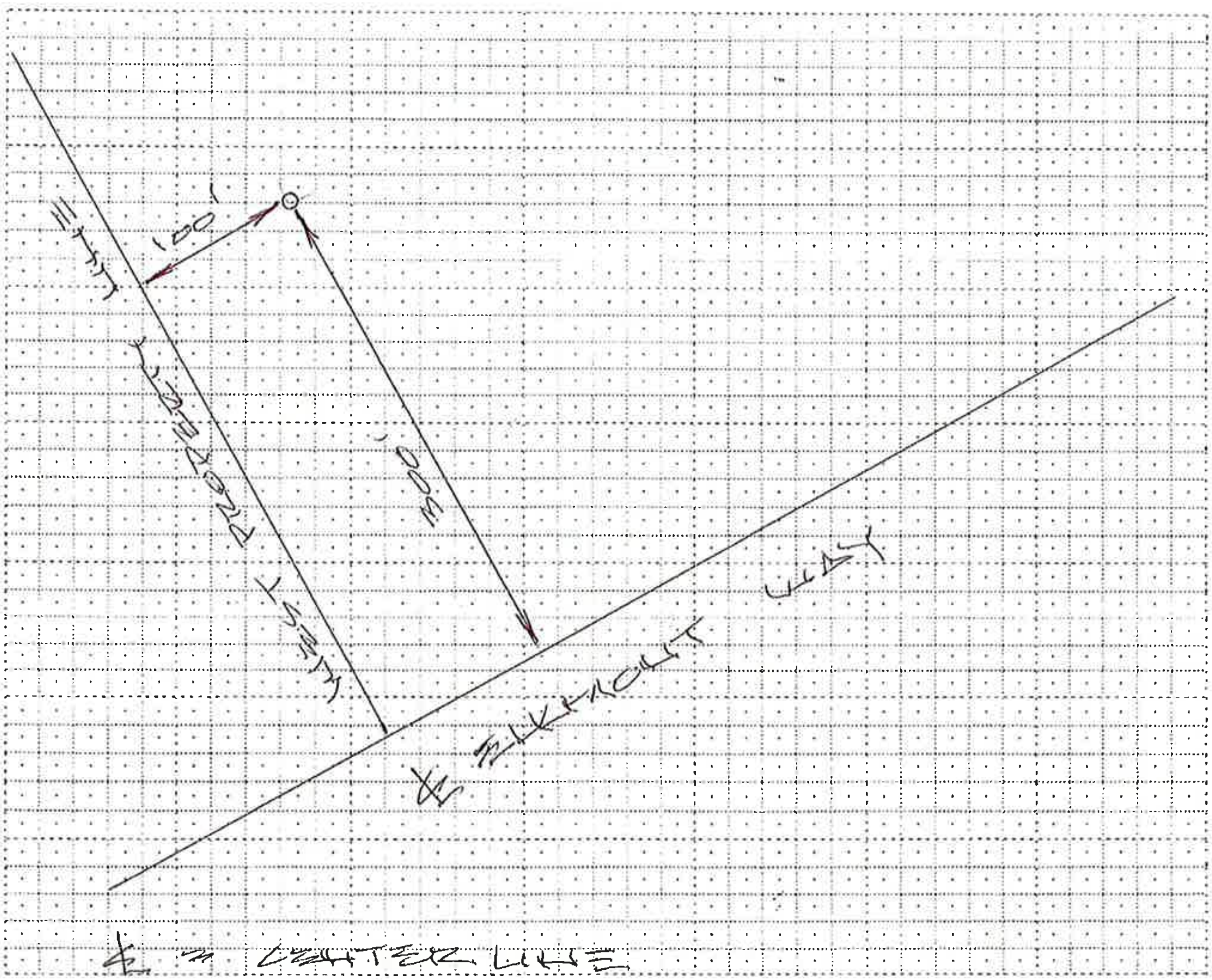
CENSUS TRACT: ________ CONTRACTOR: FOOTHILLS, INC. PERMIT #: 54848

SHOW PARCEL DIMENSIONS, STREETS, STRUCTURES, CONTOURS, LOCATION OF WELLS AND SEPTIC SYSTEMS (SHOW LAYOUT OF SEPTIC SYSTEM). SHOW DISTANCE (IN FEET) FROM SEPTIC AND/OR WELL TO: WATER COURSES, SEPTIC TANKS, LEACHING AREAS, PROPERTY LINES, SEWER LINES AND WATER WELLS (ALSO WELLS AND SEPTIC SYSTEMS WITHIN SETBACK DISTANCES ON ADJACENT PROPERTY). SITE PLAN MUST BE ACCURATE TO ALLOW SYSTEM OR WELL TO BE LOCATED AT A FUTURE DATE.

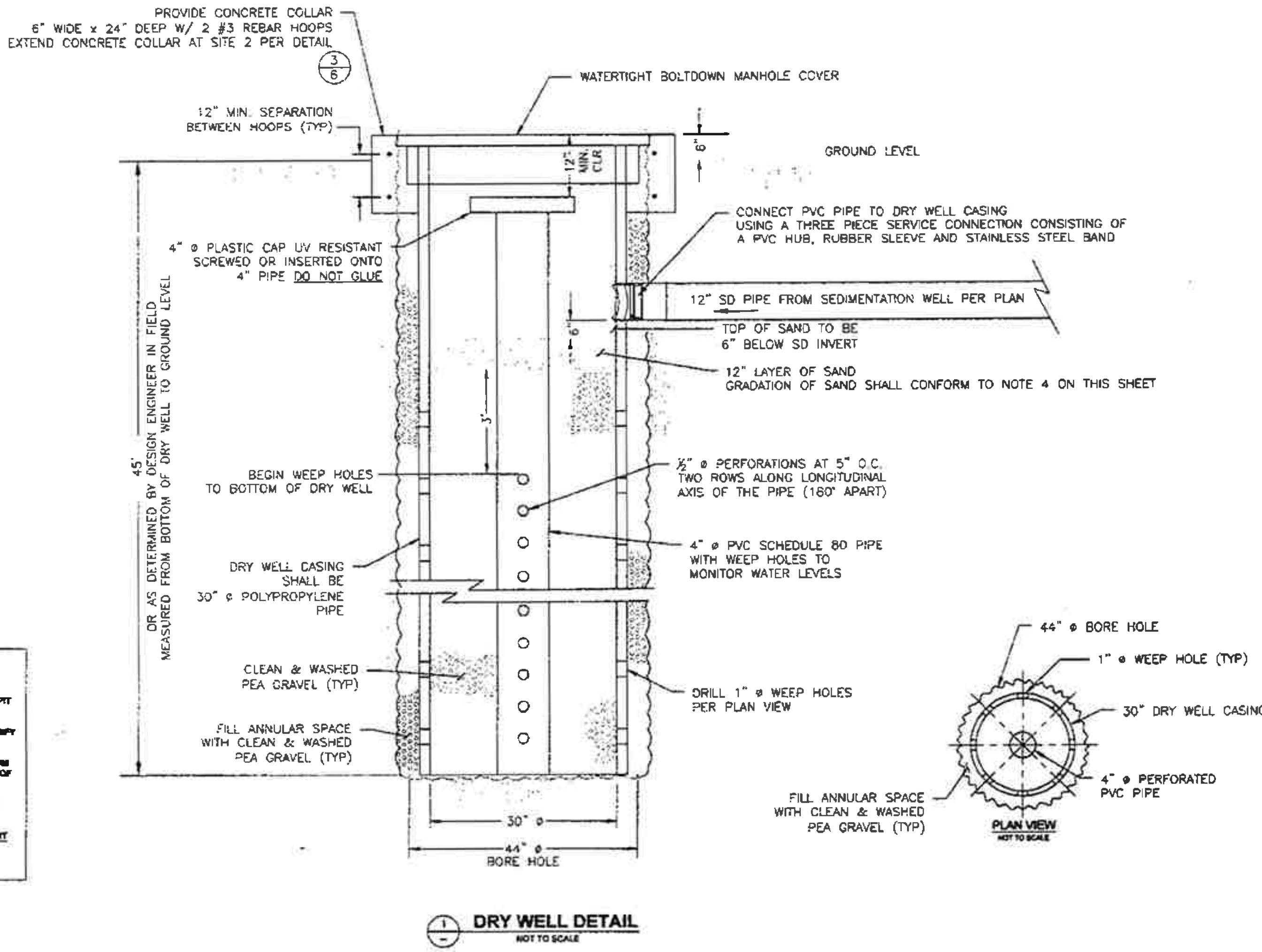
WILL SYSTEM OR WELL BE INSTALLED IN 100 YEAR FLOODPLAIN? YES ☐ NO ☒

N

W E



SCALE 1" = 100'-0" S



1 DRY WELL DETAIL
NOT TO SCALE

NOTES:

1. ROCK MUST COME FROM CLEAN SOURCES AND MUST BE THOROUGHLY WASHED BEFORE PLACEMENT.
2. GRAVEL PURCHASED FROM A SUPPLIER MUST BE WASHED AT THE PIT OR PLANT PRIOR TO DELIVERY TO THE DRY WELL SITE.
3. BEFORE PLACEMENT OF ROCK CONTACT DESIGN ENGINEER TO VERIFY WASHED ROCK CONDITION.
4. DRY WELL SAND SHALL CONSIST OF SILICA SAND AND BE FREE FROM VEGETABLE MATTER, LUMPS, BALLS OF CLAY OR ADHERENT FILMS OF CLAY.

THE PERCENTAGE COMPOSITION BY WEIGHT OF DRY WELL SAND SHALL CONFORM TO THE FOLLOWING GRADATIONS:

SIEVE SIZE	PERCENTAGE PASSING BY WEIGHT
0.1319 INCHES (#6)	90-100
0.0929 INCHES (#8)	4-35
0.0787 INCHES (#10)	0-10

NO	REVISION	BY	DATE

WILLDAN Engineering
9281 Office Park Circle ~ Suite 100
Elk Grove, CA 95758 916.478.6002

DESIGNED:
DRAWN:
CHECKED:

CITY OF ELK GROVE
DEPARTMENT OF PUBLIC WORKS
8401 LAGUNA PALMS WAY
ELK GROVE, CALIFORNIA 95758
916.683.7111

DRY WELLS AS LOW IMPACT DEVELOPMENT IMPROVEMENTS PROJECT

DRY WELL DETAIL

DATE: JUNE 2014
SCALE: HORIZ: N/A VERT: N/A
PROJECT No.: WOR019
SHEET: 9 OF 9

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES


Parcel Viewer
SACRAMENTO COUNTY
134-0640-037
HAMPTON OAK DR.
UNION PARK WAY
IRON ROCK WAY
ELKMONT WAY
9310
134-0630-029
134-0620-082
134-0620-028
134-0620-029
134-0630-024
134-0630-020
134-0620-002
134-0600-047
342'

Information For Parcel:
134-0630-037-0000

PROPERTY INFORMATION	
APN	13406300370000
Situs Address	10250 IRON ROCK WY
Postal City/St/Zip	ELK GROVE, CA 95624
	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
OWNERSHIP INFORMATION	
Owner	• CITY OF ELK GROVE
Mailing Address	10250 IRON ROCK WAY ELK GROVE, CA 95624
Transfer Date	2004-08-30
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 Info	View Assessor Data
Building Permits	No Permit record available.
Parcel Notes	View Parcel Notes
Business Licenses	No Business License Data available.
SHRA Info	View SHRA Data
CUBS Info	View CUBS Data
Refuse Pickup	No Refuse Pickup schedule available.
Water Meters	000000000012118601
Easements	View Easements Data
Planning Parcel Page	View Planning 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

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

Workers' Compensation History

OK - See attached certificate SBW

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.

ACORD CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 09/29/2014

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER John O. Bronson Co. / #0425149 3636 American River Drive Suite 200 Sacramento, CA 95864 916-974-7800	CONTACT NAME: Cheri Greco PHONE (A/C, No, Ext): 916-480-4153 FAX (A/C, No): 916-993-7258 E-MAIL ADDRESS: cgreco@johnobronson.com

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : National Fire Insurance of Hartford	
INSURER B : Continental Casualty	
INSURER C : Oak River Insurance Company	
INSURER D :	
INSURER E :	
INSURER F :	

INSURED Fox Loomis Inc.
6901 Mc Comber Street
Sacramento, CA 95828

COVERAGES CERTIFICATE NUMBER: 19746 REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	GENERAL LIABILITY X COMMERCIAL GENERAL LIABILITY CLAIMS-MADE X OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: POLICY X PRO-JECT LOC			4016889746 Per Project Aggregate Applies When Required By Written Contract	10/01/14	10/01/15	EACH OCCURRENCE	$ 1,000,000
							DAMAGE TO RENTED PREMISES (Ea occurrence)	$ 100,000
							MED EXP (Any one person)	$ 5,000
							PERSONAL & ADV INJURY	$ 1,000,000
							GENERAL AGGREGATE	$ 2,000,000
							PRODUCTS - COMP/OP AGG	$ 2,000,000
								$
A	AUTOMOBILE LIABILITY X ANY AUTO ALL OWNED AUTOS SCHEDULED AUTOS HIRED AUTOS NON-OWNED AUTOS			4016889777	10/01/14	10/01/15	COMBINED SINGLE LIMIT (Ea accident)	$ 1,000,000
							BODILY INJURY (Per person)	$
							BODILY INJURY (Per accident)	$
							PROPERTY DAMAGE (Per accident)	$
								$
B	X UMBRELLA LIAB X OCCUR EXCESS LIAB CLAIMS-MADE DED X RETENTION $ 10,000			4016889763	10/01/14	10/01/15	EACH OCCURRENCE	$ 3,000,000
							AGGREGATE	$ 3,000,000
								$
C	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y/N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	N/A		2200054068	10/01/14	10/01/15	X WC STATU-TORY LIMITS OTH-ER	
							E.L. EACH ACCIDENT	$ 1,000,000
							E.L. DISEASE - EA EMPLOYEE	$ 1,000,000
							E.L. DISEASE - POLICY LIMIT	$ 1,000,000
A	Limited Pollution Liability			4016889476	10/01/14	10/01/15	$1,000,000 Each Incident $2,000,000 Aggregate Limit	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

RE: License # 372314

Add'l Interests:

Forms:

CERTIFICATE HOLDER

CONTRACTORS STATE LICENSE BOARD
WORKERS COMPENSATION UNIT
PO BOX 26000
SACRAMENTO, CA 95826

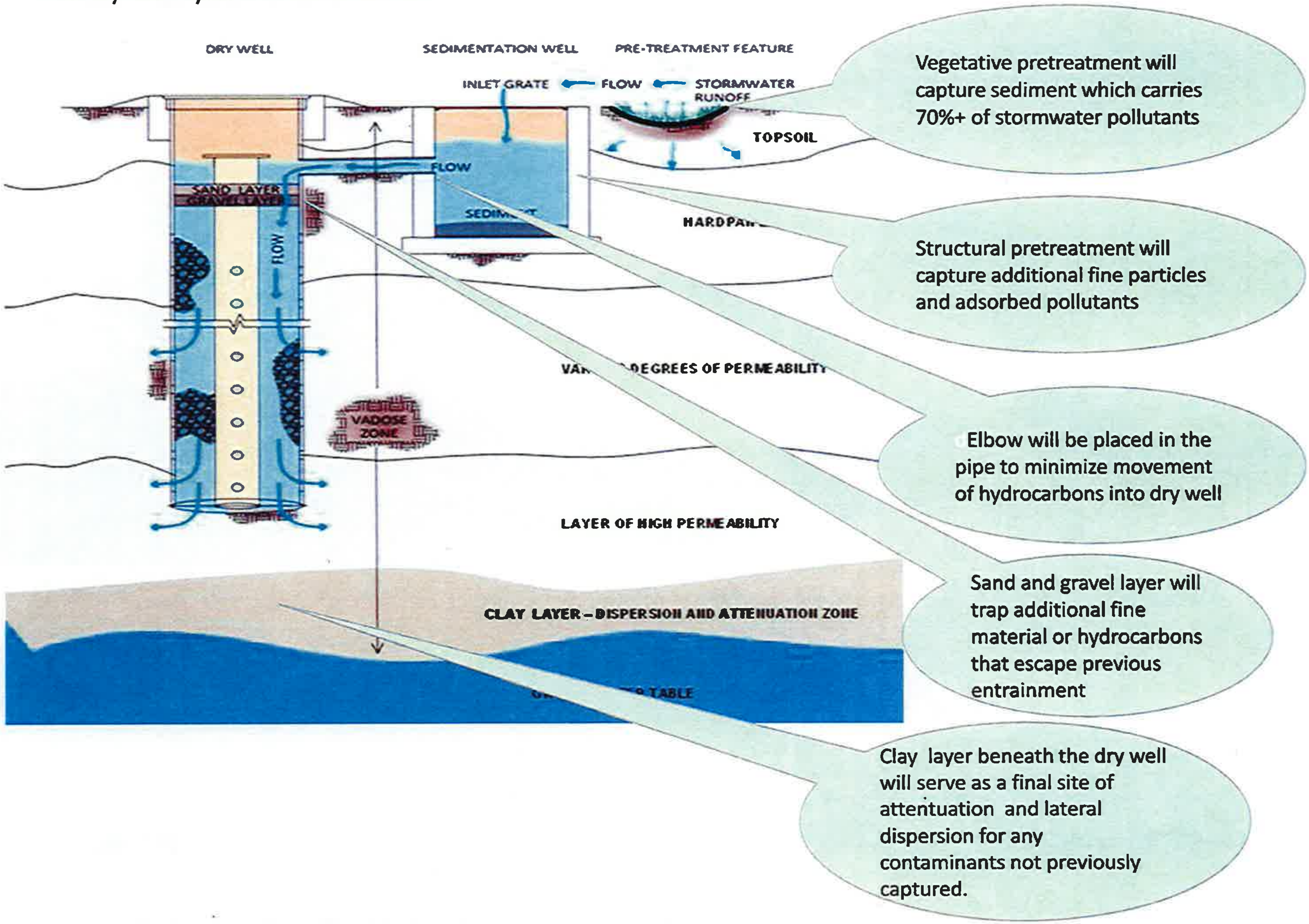
CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

Paul F Bystrowski

The Dry Well System Treatment Train



.. AL0058876

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? ☐ YES ☑ NO

FOR OFFICE USE ONLY

☐ APPROVED ☐ APPROVED W/CONDITIONS (ATTACHED)

EXPEDITED PROCESSING? ☐ YES ☒ NO

PERMIT NUMBER(S): 54848

BY: ______ DATE: ______
INITIAL GROUT BY: ______ DATE: ______
FINAL INSPECTION BY: ______ DATE: ______
DESTRUCTION BY: ______ DATE: ______

DATE RECEIVED: 9/17/14
RECEIPT NO: IN 036 8228
WELL DEPTH: ______
GPS: N: 38

TOTAL FEE: $853 (used credit of $532.50)
DEPTH TO WATER: ______
GROUT DEPTH: ______
W: -121

COMMENTS: ______

CITY CORP. YARD

SITE ADDRESS: 10250 IRON ROCK WAY, ELK GROVE 95624 — 05 EG

Job Address: SAME

Nearest Major Cross Street: 99 & GRANT LINE RD

Property Owner: CITY OF ELK GROVE

Parcel Number(s): 134-0630-037-0000

Well Contractor: FOX LOOTAHS, INC

CA License No.: 372314 Exp 9-30-15 OK JBC

Contractor's Address: 6901 HACKEMBER ST. SACRAMENTO CA 95828

Well/Boring Identification Number(s): SITE 2

CANCELLED

TRANSFERRED TO CITY OF ELK GROVE 9/26/14 (SRM)

TYPE OF WORK: (California C-57 License required unless noted otherwise)

☑ Well construction
☐ Pump replacement (or C-61)
☐ Well inactivation (Owner only)
☐ Vault box repair (General A or B)
☐ Well repair
☐ Well destruction **(SUPPLEMENT REQUIRED)**
☐ Exploratory boring (C-57 if water present)
☑ Other: DRY WELL

INTENDED USE:

☐ Domestic/private
☐ Irrigation/agricultural
☐ Water/vapor monitoring/extracti…
☐ Public water system: ______
(NAME … NTACT NAME AND TELEPHONE NUMBER)
☐ Geotechnical boring
☐ Environmental boring
☑ Other: DRY WELL

DRILLING METHOD:

☐ Mud rotary ☐ Air Rotary … ☐ Driven ☐ Other: ______

SETBACKS: (Wells only)

Is the well located within 50 feet of … ditch, ☐ drainage course, ☐ pond, or ☐ lake? ☐ No
Is the well located within 100 feet … ☐ deep trench, or ☐ animal enclosure? ☑ No

SPECIFICATIONS:

BOREHOLE: Diameter: 44" Depth: 45'
Diameter: ______ Depth: ______
CONDUCTOR: Diameter: 30" Depth: 45'
ANNULAR SEAL: Depth: 6' Material: CONCRETE
TRANSITION SEAL: Material: COLLAR
COMMENTS: DRY WELL – 6.0' CONCRETE COLLAR

CASING: Diameter: 30" Depth: 45'
CASING: Diameter: ______ Depth: ______
IF STEEL: Gauge: ______ or Thickness: ______
IF PLASTIC: Type: POLYPROPYLENE (Must meet ASTM F-480)
MULTIPLE COMPLETION? ☐ Yes **(DIAGRAM REQUIRED)**

PUMP INSTALLATION/REPAIR:

Contractor: ______
License Number: ______ Type of Pump: ______ Horsepower: ______

I will comply with all Codes, Rules and Regulations of the State and County pertaining to or regulating wells and pumps, **call (916) 875-8524 for a grout inspection at least 24 hours prior to the requested appointment time**, submit a "Well Completion Report" (if required) within 60 days of the completion of my work so a final inspection can be made, and obtain WPD approval before placing a well in service.

SIGNATURE: [signature]
PRINTED NAME: SAM FOX
COMPANY: FOX LOOTAHS, INC.
MAILING ADDRESS: 6901 HACKEMBER ST, SACRAMENTO, CA 95828
PHONE NUMBER: 916-383-2140

☐ Property Owner
☑ Well Contractor OK JBC
☐ Agent **(REQUIRES AUTHORIZATION FORM)**
FIELD PHONE: 916-383-8021

A SITE PLAN MUST BE SUBMITTED WITH EACH APPLICATION.
PERMIT EXPIRES ONE (1) YEAR AFTER DATE APPROVED (UNLESS EXTENDED)

WELL PERMIT TIME LOG SHEET

FIRST PERMIT: WP0054848 PAID TIME: 4 hours	SITE ADDRESS: 10250 Iron Rock Wy. CITY OF ELK GROVE - 1 Injection Well

Date	Specialist	Activity	Hours	Time Remaining	Envision Updated
9/17/14	LBC	Permit processing /scheduling	0.5	3.5	x
9/30/14	SBW	Conditional approval	2.0	1.5	X

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

Appendix 4.2

Well Completion Logs

*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190455

Page 1 of 2

Owner's Well Number CY MW-1

Date Work Began 10/10/2013 Date Work Ended 10/11/2013

Local Permit Agency County of Sacramento

Permit Number 53187 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N W

Latitude Longitude

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	5	Clay- red, hard, trace sand and silt, hardpan
5	7	Clayey Silty Sand- brittle, hard, reddish brown,
		very fine to fine
7	9	Sandy Clayey Silt- reddish brown, low plastic,
		very fine to fine
9	15	Silty Sand- very fine to fine, reddish brown,
		medium plastic, trace clay
15	17	Sand- very fine to fine, tan, loose, slightly moist
17	19	Silty Clayey Sand- very fine to fine, packed,
		reddish brown, some white clay
19	22	Silty Sand- very fine to medium, tan, packed
22	23	Sand- very fine to fine, well sorted, loose, tan
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
29	30	Sandy Silt- 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, light brown
47	48	Clayey Silt- tan, brittle, hard
48	49	Sandy Silt- very fine to fine, dark tan, brittle
49	50	Silty Sand- very fine to fine, loose, tannish gray
50	52	Sandy Silt- very fine to fine, hard, brown
52	63	Sand- very fine to medium, tan to light brown
63	67	Sandy Silt- very fine to fine, packed, moist, tan
67	71	Clayey Sandy Silt- tan, moist, packed, very fine
		to fine sand
71	79	Sandy Silt- very fine to fine, moist, reddish brown
79	81	Silty Sand- fine to medium, wet, sub-rounded,
		brown
81	82	Sand- fine to medium, wet, brownish red, clean

Total Depth of Boring 120 Feet

Total Depth of Completed Well 115 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ____ Deg. ____ Min. ____ Sec. N Longitude ____ Deg. ____ Min. ____ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 79 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	80	8.75	Blank	PVC Sch. 40		2		
80	110	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
110	115	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	75	Cement	10.3 sack sand/ cement
75	77	Fine Sand	Transition
77	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Venecore Drilling
Person, Firm or Corporation

220 North east st Woodland CA 95776
Address City State Zip

Signed ____ C-57 Licensed Water Well Contractor 11/5/13 Date Signed 904999 C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190455

Owner's Well Number CY MW-1

Date Work Began 10/10/2013 Date Work Ended 10/11/2013

Local Permit Agency County of Sacramento

Permit Number 53187 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Hollow Stem Auger Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
82	85	Sandy Silt- very fine to fine, hard, brownish red, wet
85	93	Silty Clay- reddish brown, medium plastic, moist
93	95	Silty Sand- very fine to fine, reddish brown, wet
95	109	Silty Clay- reddish brown, medium plastic, moist to wet
109	113	Sand- fine to medium, brown, wet
113	120	Silty Clay- brown, medium plastic, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 115 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ___ Dec. Lat. ___ Dec. Long. ___

APN Book 134 Page 0630 Parcel 037

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ___
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ___

Water Level and Yield of Completed Well

Depth to first water 79 (Feet below surface)

Depth to Static Water Level ___ (Feet) Date Measured ___

Estimated Yield * ___ (GPM) Test Type ___

Test Length ___ (Hours) Total Drawdown ___ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ___

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Penecore Drilling
(Person, Firm or Corporation)

220 North East St. Woodland CA 95776
(Address) (City) (State) (Zip)

Signed [signature] C-57 Licensed Water Well Contractor

Date Signed 11/5/13 C-57 License Number 906899

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190458

Page 1 of 1

Owner's Well Number CY MW-2

Date Work Began 10/04/2013 Date Work Ended 10/4/2013

Local Permit Agency County of Sacramento

Permit Number 53188 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Hollow Stem Auger Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	5	Silty Clay- reddish brown, medium plastic, dry
5	13	Sandy Silt- very fine to fine, reddish brown, dry to
		damp
13	17	Clayey Silty Sand- very fine to medium, reddish
		brown, damp
17	19	Silty Sand- very fine to medium, reddish brown,
		damp
19	25	Sand- very fine to medium, light brown, damp
25	29	Silty Sand- very fine to medium, light brown, damp
29	30	Sandy Silty Clay- very fine to fine, reddish brown,
		medium plastic
30	31	Gravelly Sand- fine to coarse, gravel up to 1/2",
		damp, reddish brown
31	33	Sandy Silty Clay- very fine to fine, reddish brown,
		medium plastic, damp
33	34	Silty Clay- light brown, medium plastic, damp
34	35	Sandy Silty Clay, very fine to fine, medium plastic
35	36	Silty Clay- light brown, medium plastic, light brown
36	37	Sandy Silty Clay- light brown, medium plastic
37	38	Silty Clay- light brown, medium plastic, light brown
38	44	Clay- tan, medium plastic, some black organics
44	49	Silty Sand- very fine to fine, brown, moist
49	51	Sandy Silty Clay- very fine to fine, micaceous,
		light brown, medium plastic, damp
51	53	Silty Clay- tan mottled light brown, medium plastic,
		moist
53	55	Sand- very fine to medium, light brown, moist

Total Depth of Boring 55 Feet

Total Depth of Completed Well 55 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ___ Dec. Lat. ___ Dec. Long. ___

APN Book 134 Page 0630 Parcel 037

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water ___ (Feet below surface)

Depth to Static Water Level ___ (Feet) Date Measured ___

Estimated Yield * ___ (GPM) Test Type ___

Test Length ___ (Hours) Total Drawdown ___ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	20	8.75	Blank	PVC Sch. 40		2		
20	50	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
50	55	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	16	Cement	10.3 sack sand/
			cement
16	18	Fine Sand	Transition
18	51	Filter Pack	SRI #8 Gravel
51	55	Bentonite	

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Denlore Drilling (Person, Firm or Corporation)

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] (C-57 Licensed Water Well Contractor) 11/5/13 (Date Signed) 906899 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190459

Page 1 of 2

Owner's Well Number CY MW-3

Date Work Began 10/09/2013 Date Work Ended 10/9/2013

Local Permit Agency County of Sacramento

Permit Number 53189 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	4	Clay- dark brown, medium plastic, damp
4	17	Sandy Silty Clay- very fine to fine, reddish brown,
		medium plasticity, dry
17	19	Sand- very fine to medium, brown, damp, some
		silt, moderately sorted
19	25	Sandy Clayey Silt- very fine, reddish brown, damp,
		medium plastic
25	29	Silty Sand- very fine to fine, light brown, damp
29	33	Sand- very fine to coarse, trace gravel, damp
33	39	Sandy Silty Clay- light brown/reddish brown,
		medium plastic, damp
39	51	Sandy Clayey Silt- very fine, tan, black organics
51	53	Silty Sand- very fine to fine, tan, damp
53	55	Sandy Clayey Silt- very fine to fine, tan, damp
55	57	Silty Sand- very fine to fine, tan, damp
57	61	Sandy Silt- very fine, tan, damp
61	63	Silty Sand- very fine to fine, tan, moist, well sorted
63	65	Sandy Silt- very fine, tan, damp
65	69	Sandy Clayey Silt- very fine, light brown mottled
		reddish brown, damp
69	81	Sandy Silt- very fine, tan to reddish brown, damp
		to moist
81	89	Sandy Clayey Silt- very fine, reddish brown,moist
89	90	Silty Clay- brown, medium plastic, moist
90	91	Sandy Clayey Silt- very fine, reddish brown, moist
91	94	Clay- brown mottled reddish brown, medium
		plastic, moist
94	97	Sandy Silt- very fine, reddish brown, moist to wet
97	99	Silty Clay- reddish brown, medium plastic, wet
99	101	Clayey Silt- reddish brown, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 94 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	90	8.75	Blank	PVC Sch. 40		2		
90	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	85	Cement	10.3 sack sand/ cement
85	87	Fine Sand	Transition
87	120	Filter Pack	#8 SRI Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Penecore Drilling (Person, Firm or Corporation)

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] (C-57 Licensed Water Well Contractor) 11/5/13 (Date Signed) 906899 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

Page 2 of 2

Owner's Well Number CY MW-3

Date Work Began 10/04/2013 Date Work Ended 10/4/2013

Local Permit Agency County of Sacramento

Permit Number 53189 Permit Date 9/20/13

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190459

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
101	103	Silty Clay- light brown mottled reddish brown, medium plastic, wet
103	105	Sandy Clayey Silt- very fine to medium, reddish brown, wet
105	115	Clay- reddish brown/brown, medium plastic, wet
115	117	Sandy Clayey Silt- very fine, tan mottled brown,wet
117	120	Silty Clay- brown, medium plastic, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ____ Deg. ____ Min. ____ Sec. N Longitude ____ Deg. ____ Min. ____ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 94 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pénécore Drilling
Person, Firm or Corporation

220 N. East St. Woodland CA 95776
Address City State Zip

Signed [signature] 11/5/13 906899
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190478

Page 1 of 2

Owner's Well Number CY MW-4

Date Work Began 10/07/2013 Date Work Ended 10/7/2013

Local Permit Agency County of Sacramento

Permit Number 53190 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	4	Clay- dark brown, medium plastic, damp
4	13	Sandy Silty Clay- very fine to fine, medium plastic,
		reddish brown, dry
13	15	Silty Clay- tan mottled light brown, medium plastic
15	19	Silty Sand- very fine to medium, light brown, damp
19	24	Sand- fine to coarse, trace gravel, brown, damp
24	25	Silty Sand- very fine to fine, tan, micaceous
25	27	Sand- fine to coarse, loose, tan, damp
27	29	Silty Sand- very fine to medium, light brown, moist
29	31	Sand- very fine to coarse, trace gravel to 1/4",
		brown, damp
31	41	Sandy Silty Clay- very fine, reddish brown,
		medium plastic, moist
41	44	Silty Clay- tan, medium plastic, black organics
44	47	Silty Sand- very fine to fine, tan, damp
47	53	Sandy Silt- very fine, tan, damp
53	55	Silty Clay- tan, black organics, medium plastic
55	57	Sand- very fine to medium, tan, damp
57	59	Silty Clay- tan, black organics, medium plastic
59	61	Sand- very fine to medium, reddish brown, moist
61	67	Silty Clay- tan, medium plastic, damp
67	69	Sandy Silty Clay- very fine, brown, medium plastic
69	71	Silty Sand- very fine to fine, light brown, damp
71	73	Sandy Silt- very fine, tan, damp
73	77	Sandy Silty Clay- very fine, tan mottled light brown
		medium plastic, damp
77	80	Sandy Clayey Silt- very fine to fine, reddish brown,
		micaceous
80	83	Sand- very fine to coarse, micaceous, wet
83	85	Silty Clay- light brown, medium plastic, moist-wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 93 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	90	8.75	Blank	PVC Sch. 40		2		
90	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	85	Cement	10.3 sack sand/
			cement
85	87	Fine Sand	Transition
87	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pene core Drilling
Person, Firm or Corporation

220 N. east St. woodland CA 95776
Address City State Zip

Signed ____ 11/5/13 906859
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190478

Page 2 of 2

Owner's Well Number CY MW-4

Date Work Began 10/07/2013 Date Work Ended 10/7/2013

Local Permit Agency County of Sacramento

Permit Number 53190 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
85	89	Sandy Silty Clay- very fine to fine, tan, medium plastic, moist
89	93	Silty Clay- reddish brown, medium plastic, moist
93	95	Clayey Silty Sand- very fine to fine, reddish brown, moist to wet
95	97	Sandy Silty Clay- very fine to fine, reddish brown, medium plasticity, wet
97	101	Silty Clay- reddish brown, medium plastic, wet
101	108	Clay- reddish brown, medium plastic, wet
108	111	Sandy Silt- very fine to fine, tan, wet
111	112	Sand- very fine to coarse, brown, well sorted, wet
112	117	Clay- brown, medium plastic, wet
117	120	Silty Clay- reddish brown, medium plastic, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address 10250 Iron Rock Way

City Elk Grove County Sacramento

Latitude ____ Deg. ____ Min. ____ Sec. N Longitude ____ Deg. ____ Min. ____ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 134 Page 0630 Parcel 037

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well

○ Modification/Repair

○ Deepen

○ Other ____

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

⦿ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other ____

Water Level and Yield of Completed Well

Depth to first water 93 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log

☐ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Penecore Drilling (Person, Firm or Corporation)

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] C-57 Licensed Water Well Contractor 11/5/13 Date Signed 906899 C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190505

Page 1 of 1

Owner's Well Number SC MW-1

Date Work Began 10/01/2013 Date Work Ended 10/2/2013

Local Permit Agency County of Sacramento

Permit Number 53186 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N Latitude W Longitude

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Hollow Stem Auger Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	2	Fill- road base sand and gravel, dry
2	5	Clay- brown, medium plasticity, dry
5	15	Sandy Silt-very fine, light brown mottled tan, damp
15	21	Sandy Silt- very fine to fine, tan, damp
21	25	Sandy Silt- very fine, light brown mottled tan, damp
25	32	Sandy Silt- very fine to fine, tan, damp
32	35	Sand- very fine to medium, well sorted, light brown
		moist
35	37	Sand- very fine to medium, brown, lenses of sandy
		silt, moist
37	47	Sand- very fine to medium, well sorted, light brown
		moist
47	53	Sandy Clayey Silt- very fine to fine, light brown,
		moist
53	57	Sandy Silt- very fine to fine, light brown mottled tan
		moist
57	59	Silty Sand- very fine to fine, brown, micaceous,
		wet
59	67	Sandy Silt- very fine to fine, light brown mottled
		brown, wet
67	109	Clay- brown, medium plastic, trace fine sand, wet
109	111	Sandy Clay- fine to medium, tan mottled reddish
		brown, 3" sand lense at 110'
111	120	Sandy Clay- very fine to fine, reddish brown,
		medium plastic, wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ___ Dec. Lat. ___ Dec. Long. ___

APN Book 115 Page 0150 Parcel 036

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other

Water Level and Yield of Completed Well

Depth to first water 57 (Feet below surface)

Depth to Static Water Level ___ (Feet) Date Measured ___

Estimated Yield * ___ (GPM) Test Type ___

Test Length ___ (Hours) Total Drawdown ___ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	100	8.75	Blank	PVC Sch. 40		2		
100	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	95	Cement	10.3 Sack sand/ cement
95	97	Fine Sand	Transition
97	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ___

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pene Cove Drilling (Person, Firm or Corporation)

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed ___ (C-57 Licensed Water Well Contractor) 11/5/13 (Date Signed) 906899 (C-57 License Number)

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190516

Page 1 of 1

Owner's Well Number SC MW-2

Date Work Began 09/26/2013 Date Work Ended 9/26/2013

Local Permit Agency County of Sacramento

Permit Number 53182 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number: ____ N ____ W

Latitude / Longitude

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	5	Silty Clay- reddish brown, medium plastic, trace very fine sand
5	7	Sandy Silt- very fine to fine, reddish brown, moist
7	11	Silty Clay- tan mottled light brown, medium plastic, moist
11	14	Sandy Silty Clay- very fine to fine, tan mottled light brown, moist
14	18	Silty Clay- tan, medium plastic, some white clay lenses
18	20	Sandy Silt- very fine to fine, tan, moist
20	22	Sand- very fine to medium, well sorted, moist, brown
22	23	Silty Clay- tan, medium plastic, micaceous, moist
23	29	Sandy Silt- very fine, tan micaceous, moist
29	35	Sand- very fine to medium, well sorted, micaceous damp, brown
35	38	Sandy Silt- very fine to fine, tan, micaceous, moist
38	45	Sandy Silty Clay- very fine, medium plastic, reddish brown, micaceous, moist
45	52	Sand- very fine to medium, well sorted, loose with some hard lenses, brown, moist to wet
52	57.5	Silty Clay- tan mottled light brown, medium plastic, moist
		Note: This is version 2, a depth correction was made. The same Well Completion Report number was used.

Total Depth of Boring 57.5 Feet

Total Depth of Completed Well 57.5 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude ____ Deg. ____ Min. ____ Sec. N Longitude ____ Deg. ____ Min. ____ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 115 Page 0150 Parcel 036

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 45 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size If Any (Inches)
0	23	8.75	Blank	PVC Sch. 40		2		
23	53	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
53	57.5	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	18	Cement	10.3 Sack sand/ cement
18	20	Fine Sand	Transition
20	57.5	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pene Core Drilling
Person, Firm or Corporation

220 N. East St. Woodland CA 95776
Address City State Zip

Signed ____ 1/16/14 906899
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190749

DWR Use Only – Do Not Fill In
State Well Number/Site Number
Latitude N / Longitude W
APN/TRS/Other

Page 1 of 2

Owner's Well Number SC MW-3

Date Work Began 09/23/2013   Date Work Ended 9/25/2013

Local Permit Agency County of Sacramento

Permit Number 53183   Permit Date 9/20/13

Geologic Log

Orientation ◉ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method Hollow Stem Auger   Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	10	Silty Clay-reddish brown, medium plastic w/ fine sand, dry
10	15	Sandy Clayey Silt- tan mottled yellowish brown, medium plastic, very fine, dry, damp at 13'
15	18	Sandy Clayey Silt- reddish brown, medium plastic, very fine, damp
18	22	Sandy Silty Clay- reddish brown, medium plastic, very fine, damp
22	23	Sandy Silt- tan, very fine, damp
23	24	Silty Sand- very fine to fine, reddish brown, abundant mica, damp
24	25	Sandy Clayey Silt- tan,med. plastic,very fine,damp
25	27	no sample
27	28	Sand- tan, very fine to fine, dry
28	33	Sandy Silt- tan, very fine, damp
33	38	Sandy Silt- tan mottled reddish brown, very fine to fine, damp
38	45	Sand- light brn,very fine to medium, damp to moist
45	46	Sandy Clayey Silt- reddish brown, medium plastic, very fine, damp
46	48	Silty Sand- reddish brown, very fine to medium w/ streaks of clay, damp
48	52	Sandy Silty Clay- brown, medium plastic, very fine to fine, damp
52	62	Sand- brown,very fine to medium, moist, wet at 58'
62	64	Silty Sand- light brown, very fine to medium, wet
64	65	Sand- brown, fine to coarse, wet
65	67	Sandy Silty Clay- tan mottled reddish brn.,medium plastic, fine, moist to wet
67	68	Silty Sand- light brn., very fine to fine, moist to wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude ____ Deg. ____ Min. ____ Sec. N Longitude ____ Deg. ____ Min. ____ Sec. W

Datum ____ Dec. Lat. ____ Dec. Long. ____

APN Book 115 Page 0150 Parcel 036

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

◉ New Well
○ Modification/Repair
○ Deepen
○ Other ____
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
◉ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ____

Water Level and Yield of Completed Well

Depth to first water 58 (Feet below surface)

Depth to Static Water Level ____ (Feet) Date Measured ____

Estimated Yield * ____ (GPM) Test Type ____

Test Length ____ (Hours) Total Drawdown ____ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	105	8.75	Blank	PVC Sch. 40		2		
105	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	100	Cement	10.3 Sack sand/ cement
100	102	Fine Sand	Transition
102	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pencore Drilling
Person, Firm or Corporation

220 N. East St. (Address) Woodland (City) CA (State) 95776 (Zip)

Signed [signature] C-57 Licensed Water Well Contractor   11/5/13 Date Signed   726899 C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190749

Page 2 of 2

Owner's Well Number SC MW-3

Date Work Began 09/23/2013 Date Work Ended 9/25/2013

Local Permit Agency County of Sacramento

Permit Number 53183 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Hollow Stem Auger Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
68	78	Sandy Clayey Silt- tan mottled reddish brown, medium plastic, very fine, moist
78	80	Sandy Clayey Silt- light brown mottled reddish brown, medium plastic, very fine, moist
80	82	Sandy Clayey Silt- reddish brown, medium plastic, very fine, moist
82	84	Sandy Silt- reddish brown, very fine to fine, moist
84	86	Sandy Clayey Silt- reddish brown, medium plastic, very fine, moist
86	90	Silty Clay- light brown, medium plastic, moist
90	92	Sandy Silt- tan, very fine to fine, damp
92	96	Silty Clay- brown mottled reddish brown, medium plastic, moist, wet at 94'
96	105	Clayey Silt- tan mottled light brn., med. plastic,wet
105	106	Silty Sand- reddish brn., very fine to medium, wet
106	107	Sandy Clay- tan, med. plastic, very fine to fine, wet
107	110	Clayey Sand- brown, medium plastic, very fine to medium, wet
110	112	Silty Sand- reddish brown, very fine to medium, sandy silt 111.7 to 112', wet
112	116	Silty Sand- reddish brn., very fine to medium, wet
116	120	Sandy Silt- tan mottled reddish brown, very fine, moist to wet

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ___ Dec. Lat. ___ Dec. Long. ___

APN Book 115 Page 0150 Parcel 036

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well

○ Modification/Repair

○ Deepen

○ Other ___

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply

☐ Domestic ☐ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

⦿ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other ___

Water Level and Yield of Completed Well

Depth to first water 58 (Feet below surface)

Depth to Static Water Level ___ (Feet) Date Measured ___

Estimated Yield * ___ (GPM) Test Type ___

Test Length ___ (Hours) Total Drawdown ___ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size If Any (Inches)

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log

☐ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other ___

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Penecore Drilling

Person, Firm or Corporation

220 N. East St. Woodland CA 95776

Address City State Zip

Signed [signature] 11/5/13 906899

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

*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 Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e0190749

Page 1 of 1

Owner's Well Number SC MW-4

Date Work Began 09/27/2013 Date Work Ended 9/30/2013

Local Permit Agency County of Sacramento

Permit Number 53184 Permit Date 9/20/13

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Hollow Stem Auger Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)
0	5	Silty Clay- reddish brown, medium plastic w/ fine sand, moist
5	9	Sandy Silt- yellowish brown, very fine to fine, moist
9	18	Sandy Silty Clay- tan mottled light brown, medium plastic, very fine, moist
18	19	Sandy Silt- tan, very fine to fine, moist
19	21	Silty Sand- brown, very fine to fine, mica, moist
21	23	Sandy Silt- tan mottled light brown, very fine, moist
23	24	Sand- brown, very fine to medium, moist
24	27	Silty Clay- tan, medium plastic, moist
27	33	Sandy Silt- tan, very fine, moist
33	39	Sand- brown, very fine to medium, moist
39	40	Sandy Silt- brown, very fine, moist
40	41	Silty Clay- brown, medium plastic, moist
41	45	Sandy Silty Clay- brn., med. plastic, very fine,moist
45	48	Sandy Clayey Silt- tan mottled light brown, medium plastic, moist
48	51	Sand- brn., very fine to medium, moist, wet at 49'
51	54	Silty Sand- brn., very fine to fine, mica,moist to wet
54	61	Sandy Clayey Silt- tan mottled light brn., medium plastic, very fine, moist
61	63	Silty Clay- brown mottled reddish brown, medium plastic, moist
63	67	Sandy Clayey Silt- light brn., med. plastic, moist
67	81	Sandy Clayey Silt- reddish brown, medium plastic very fine, wet
81	85	Sandy Clayey Silt- tan, med. plastic, very fine, wet
85	91	Sandy Clayey Silt- tan,med. plastic,very fine, moist
91	115	Sandy Clayey Silt- tan mottled yellowish brn., med. plastic, fine, moist to wet. No samples 115-120'

Total Depth of Boring 120 Feet

Total Depth of Completed Well 120 Feet

Well Owner

Name City of Elk Grove

Mailing Address 8401 Laguna Palms Way

City Elk Grove State CA Zip 95758

Well Location

Address Mountain Bell Drive (Strawberry Creek Detention Basin)

City Elk Grove County Sacramento

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ___ Dec. Lat. ___ Dec. Long. ___

APN Book 115 Page 0150 Parcel 036

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

⦿ New Well
○ Modification/Repair
○ Deepen
○ Other ___
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

○ Water Supply
☐ Domestic ☐ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
⦿ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ___

Water Level and Yield of Completed Well

Depth to first water 49 (Feet below surface)

Depth to Static Water Level ___ (Feet) Date Measured ___

Estimated Yield * ___ (GPM) Test Type ___

Test Length ___ (Hours) Total Drawdown ___ (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	100	8.75	Blank	PVC Sch. 40		2		
100	115	8.75	Screen	PVC Sch. 40		2	Milled Slots	0.030
115	120	8.75	Blank	PVC Sch. 40		2		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	95	Cement	10.3 Sack sand/ cement
95	97	Fine Sand	Transition
97	120	Filter Pack	SRI #8 Gravel

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ___

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Pene Cove Drilling
(Person, Firm or Corporation)

220 N. East St. Woodland CA 95776
(Address) (City) (State) (Zip)

Signed [signature] 11/5/13 906899
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

TRIPLICATE
Owner's Copy

Page 1 of 1

Owner's Well No. SITE 1

Date Work Began 10-7-14, Ended 10-22-14

Local Permit Agency COUNTY OF SACRAMENTO EMD

Permit No. 54847 Permit Date 9-30-14

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 0955287

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE | LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD BUCKET AUGER FLUID [illegible]

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	5	SILTY CLAY, REDDISH BROWN
5	7	SANDY SILT, FINE, REDDISH BROWN
7	11	SILTY CLAY, LIGHT BROWN
11	14	SANDY SILTY CLAY, LIGHT BROWN
14	18	SILTY CLAY, TAN
18	20	SANDY SILT, TAN
20	22	SAND, FINE TO MEDIUM, BROWN
22	23	SILTY CLAY, TAN
23	29	SANDY SILT, TAN
29	35	SAND, FINE TO MEDIUM, BROWN
35	38	SANDY SILT, FINE, TAN
38	45	SANDY SILTY CLAY, REDDISH BROWN

TOTAL DEPTH OF BORING 45 (Feet)

TOTAL DEPTH OF COMPLETED WELL 40 (Feet)

WELL OWNER

Name CITY OF ELK GROVE

Mailing Address 8401 LAGUNA PALMS WAY

ELK GROVE (CITY) CA (STATE) 95758 (ZIP)

WELL LOCATION

Address STRAWBERRY CREEK W.S. BASIN

City 8950 E. HARRIS ?/MIDDLE SCHOOL ... ELK GROVE

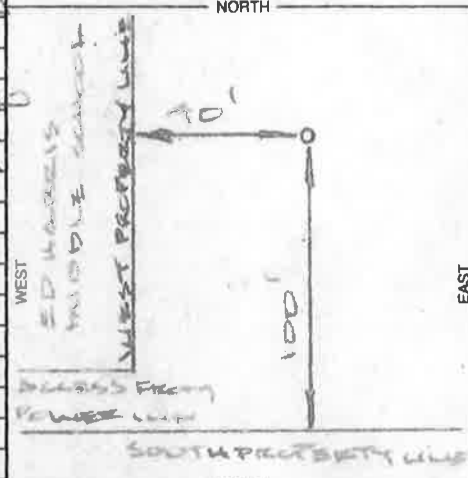
County SACRAMENTO

APN Book 115 Page 0150 Parcel 036-0000

Township ___ Range ___ Section ___

Lat ___ DEG. MIN. SEC. N   Long ___ DEG. MIN. SEC. W

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- ___ Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ✓ DRY WELL [illegible]

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE DRY

DEPTH OF STATIC WATER LEVEL DRY (Ft.) & DATE MEASURED ___

ESTIMATED YIELD * ___ (GPM) & TEST TYPE ___

TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)

** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	7	44	✓				POLYPROPYLENE	30"	3IN WALL SEWER PIPE	—
7	40	44		✓			POLY-PROPYLENE	30"	3IN WALL SEWER PIPE	1/4 HOLES

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	2	✓			6 SACK CONCRETE
2	45			✓	3/16" PEA GRAVEL

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analyses
- ___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME FOX LOOMIS INC. (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

6901 ALDERBEE ST, SACRAMENTO, CA 95828
ADDRESS CITY STATE ZIP

Signed [signature] C-57 LICENSED WATER WELL CONTRACTOR

10-23-14 DATE SIGNED   372314 C-57 LICENSE NUMBER

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

TRIPLICATE
Owner's Copy

Page 1 of 1

Owner's Well No. SITE 2

Date Work Began 10-6-14, Ended 10-22-14

Local Permit Agency COUNTY OF SACRAMENTO EMD

Permit No. 54848 Permit Date 9-30-14

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 0955288

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE / LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD ______ FLUID ______

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	5	SILTY CLAY, REDDISH BROWN
5	13	SANDY SILT, REDDISH BROWN
13	17	CLAYEY SILTY SAND, VERY FINE TO MEDIUM, REDDISH BROWN
17	19	SILTY SAND, VERY FINE TO MEDIUM, BROWN
19	25	SAND, VERY FINE TO MEDIUM, LIGHT BROWN
25	29	SILTY SAND, VERY FINE TO MEDIUM, LIGHT BROWN
29	30	SANDY SILTY CLAY, REDDISH BROWN
30	31	GRAVELLY SAND, FINE TO COARSE TO 3/4", REDDISH BROWN
31	33	SANDY SILTY CLAY, REDDISH BROWN
33	34	SILTY CLAY, LIGHT BROWN
34	35	SANDY SILTY CLAY,
35	36	SILTY CLAY, LIGHT BROWN
36	37	SANDY SILTY CLAY, LIGHT BROWN
37	38	SILTY CLAY, LIGHT BROWN
38	45	CLAY, TAN - SOME BLACK STAINING

TOTAL DEPTH OF BORING ______ (Feet)

TOTAL DEPTH OF COMPLETED WELL ______ (Feet)

WELL OWNER

Name CITY OF ELK GROVE

Mailing Address 8401 LAGUNA PALMS WAY

ELK GROVE CITY CA STATE 95758 ZIP

WELL LOCATION

Address 10250 [illegible] WAY

City ELK GROVE

County SACRAMENTO

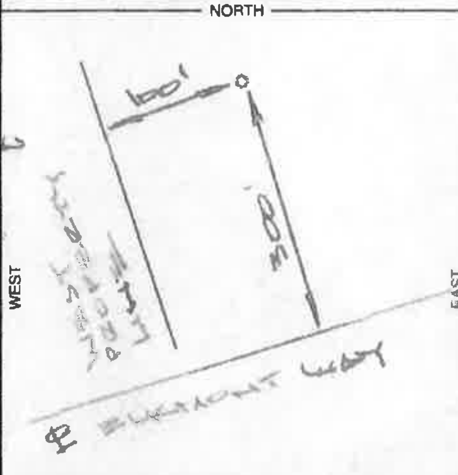
APN Book 134 Page 0630 Parcel 027-0000

Township ______ Range ______ Section ______

Lat ___ ___ ___ N (DEG. MIN. SEC.) Long ___ ___ ___ W (DEG. MIN. SEC.)

LOCATION SKETCH

NORTH



SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

✓ NEW WELL

MODIFICATION/REPAIR

___ Deepen

___ Other (Specify)

___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

USES (✓)

WATER SUPPLY

___ Domestic ___ Public

___ Irrigation ___ Industrial

MONITORING ___

TEST WELL ___

CATHODIC PROTECTION ___

HEAT EXCHANGE ___

DIRECT PUSH ___

INJECTION ___

VAPOR EXTRACTION ___

SPARGING ___

REMEDIATION ___

OTHER (SPECIFY) ✓ DRY WELL STORMWATER

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ______ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL ______ (Ft.) & DATE MEASURED ______

ESTIMATED YIELD * ______ (GPM) & TEST TYPE ______

TEST LENGTH ______ (Hrs.) TOTAL DRAWDOWN ______ (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	7	44	✓				POLYPROPYLENE	30"	3 WALL [illegible]	—
7	45	44		✓			POLYPROPYLENE	30"	3 WALL [illegible] PIPE	1" HOLES

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	6	✓			6 SACK CONCRETE
6	4			✓	3/8" PEA GRAVEL

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ______

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME [illegible] (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

[illegible] ADDRESS [illegible] CITY CA STATE 95[illegible] ZIP

Signed [signature] C-57 LICENSED WATER WELL CONTRACTOR 10-16-14 DATE SIGNED 37[illegible] C-57 LICENSE NUMBER

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

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 7th 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[1] 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[2]). **Table 1** presents the calculated saturated hydraulic conductivity values for each dry well.

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

Site	Ks (in/hr)
SBD	0.72
CY	0.55

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

[1] 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.

[2] 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.

Table 2. Infiltration rates through the sand layer

Site	ft^3/sec	gpm
SDB	0.05	24
CY	0.22	97

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.

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

Site	Values Derived from the April 7, 2015 Falling Head Tests		Anticipated Values Based on Site-Specific Lithology	
	Ks (in/hr)	Infiltration Rate (gpm)	Ks (in/hr)	Infiltration Rate (gpm)
SBD	0.723	11.77	1.72	28.05
CY	0.545	14.78	0.770	20.88

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 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 7th, 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 24th 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 29th, 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 4_24_15	All contaminants and conventional parameters measured in the groundwater by the California Laboratory Services (CLS). This includes volatiles, semi-volatiles, PAHs, herbicides, metals, and general physical/mineral parameters.
CLS SW combo 4_24_15	Same contaminants measured in groundwater by CLS, but using stormwater samples.
WPCL GW pry 4_24_15	Analysis of pyrethroids in groundwater, performed by the Water Pollution Control Lab (WPCL).
WPCL SW combo 4_24_15	Analysis of pyrethroids and total suspended solids in stormwater performed 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 24th, 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 24th. 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.

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.

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
	CY	-	-	-	-	-	n/a
April 24, 2015	**SDB**	2.2	5.0	ND	ND	ND	n/a
	CY	4.0	ND	ND	ND	ND	n/a

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 µg/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 µg/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.

Table 5. Summary of metals in stormwater and groundwater at the City of Elk Grove Corporation Yard.

Metal	Stormwater	Vadose Zone	Downgradient WT wells (MW 3 and 4)	Upgradient WT well (MW1)	MCL or advisory level
Al	ND	n/a	MW3: **1100** 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: **10**	Cr6: 10
Fe	**700**	n/a	MW3: **1100** MW4: 130	**1700**	300
Mn	23	n/a	ND	37	50
Va	4.6	n/a	MW3: 25 MW4: 22	22	50

The concentration of all metals analyzed in the stormwater and groundwater for the April 24th 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. " - " = no analysis 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
NO_3 (mg/L)	CY	-	ND	n/a	MW3: 18 MS4: 18	**64**	45
	SDB	ND	-	n/a	ND	ND	45
TSS (mg/L)	CY	28.7	25.5	-	-	-	n/a
	SDB	32.5	10.8	-	-	-	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_3 in stormwater exceeded the hold time at the laboratory by a few hours. Values returned for NO_3 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 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.

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

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[1]). 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.

1 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[2]. 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

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[2] Posted at: http://www.cityofsacramento.org/utilities/media-room/documents/SWQ_DesignManual_May07_062107.pdf

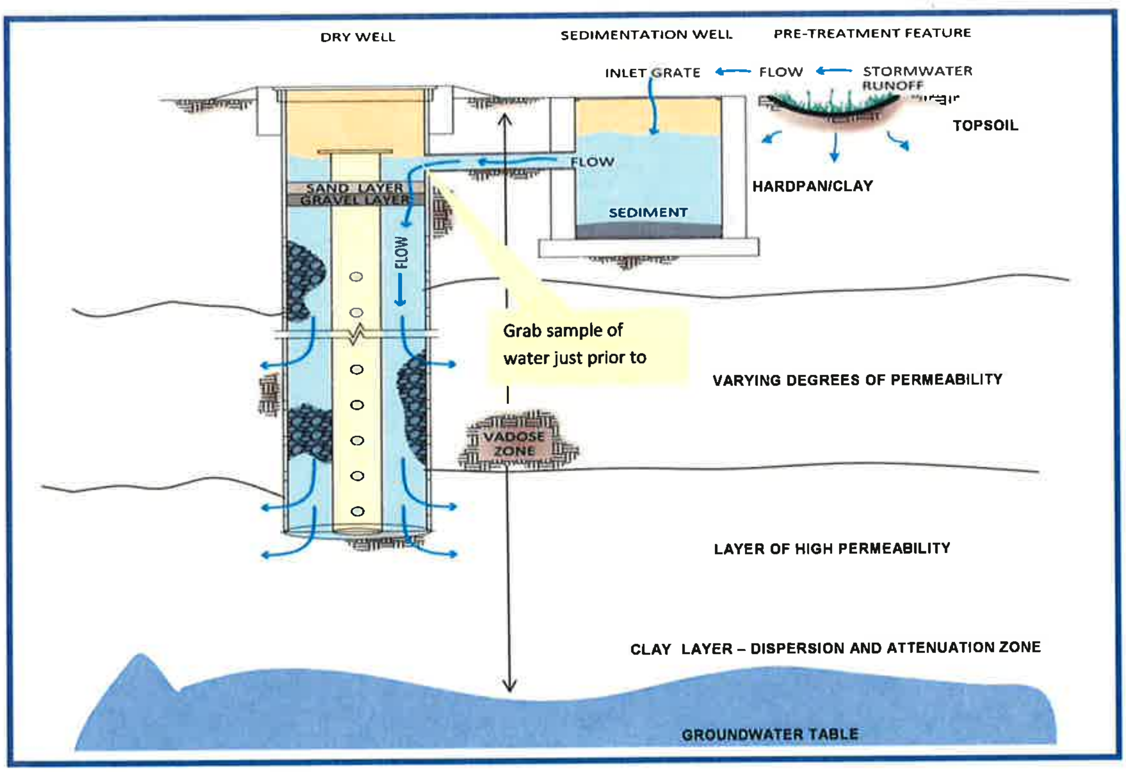
dry well contains a shallow layer of coarse sand at the top of the dry well to help filter out any debris and fine particles not captured by the sedimentation well.

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.

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

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	Type	Timing	Sample type
Yearly	Wet Weather (Stormwater)	1. Beginning of rainy season 2. End of rainy season	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

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March 2017

Submitted to
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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 remove 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.

Table 2. Schedule of stormwater monitoring

Water Year	Stormwater Monitoring Events	Date	Monitoring Activities	Endpoints
Year 1	1st wet weather SDB (first flush)	February. 6-7, 2015	SDB: Flow weighted composite and grab samples	Tier 1[a] 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)
	1st wet weather CY (not first flush)	April 24, 2015	CY: Grab samples only	Tier 1 suite of analytes
Year 2	2nd 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
	3rd wet weather	January 5, 2016	SDB & CY: Flow weighted composites (2) influent and effluent	Tier 2[b] suite of analytes
	4th wet weather	March 4, 2016	SDB & CY: Flow weighted composites and grab samples	Tier 2[b] suite of analytes
	5th wet weather	April 22, 2016	SDB & CY: Flow weighted composites (2) influent & effluent	Modified Tier 2[c] suite of analytes

Table 3. Schedule for groundwater monitoring

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

[a]Tier 1: Includes volatile and semi-volatile organic compounds, pyrogenic PAHs (combustion by-products), chlorophenoxy herbicides, pyrethroids, drinking water metals, general physical and mineral.
[b]Tier 2: a reduced number of contaminants; chlorophenoxy herbicides and PAHs were eliminated.
[c] 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

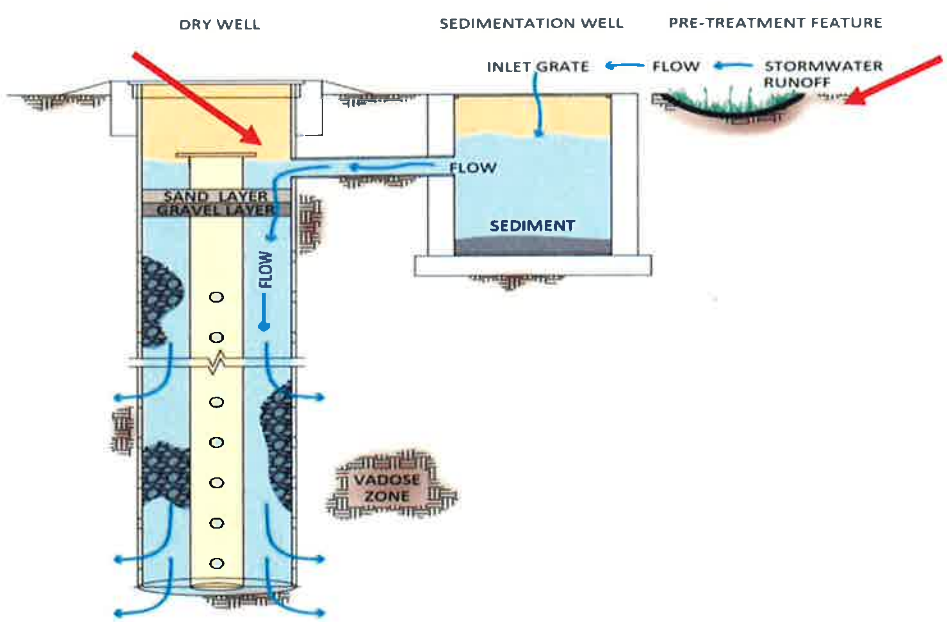
Groundwater samples were collected from three groundwater monitoring wells and a vadose zone well at each site after each stormwater monitoring event was performed. Dry-weather groundwater samples were also collected for post construction and baseline monitoring. In addition, groundwater levels were 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

o 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 $p \leq 0.05$ 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.

- **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_d = 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:

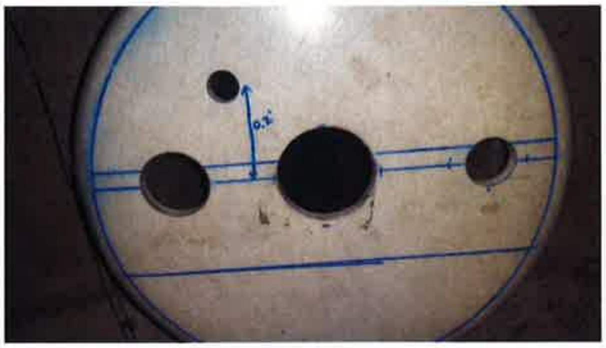


Figure 2. Orifice drilled in the cap of the pipe connecting the sedimentation well to the dry well. By removing the plug (not shown) of the appropriate orifice, runoff flowed into the dry well at a pre-determined rate that was designed to maintain constant, steady flow into the dry well.

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

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.

- **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 (tert-butyl 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 ($t_{½}$), 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 µg/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.

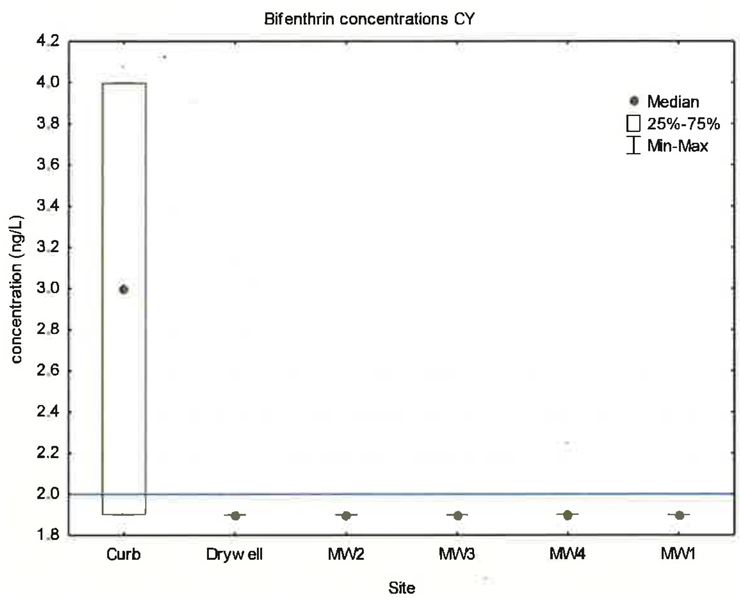
Glyphosate was measured once during the project, at the April 22, 2016 rain event. It was detected at 11 µg/L, below the MCL, as stormwater entering the dry well at SDB. None was detected at CY or in any groundwater samples.

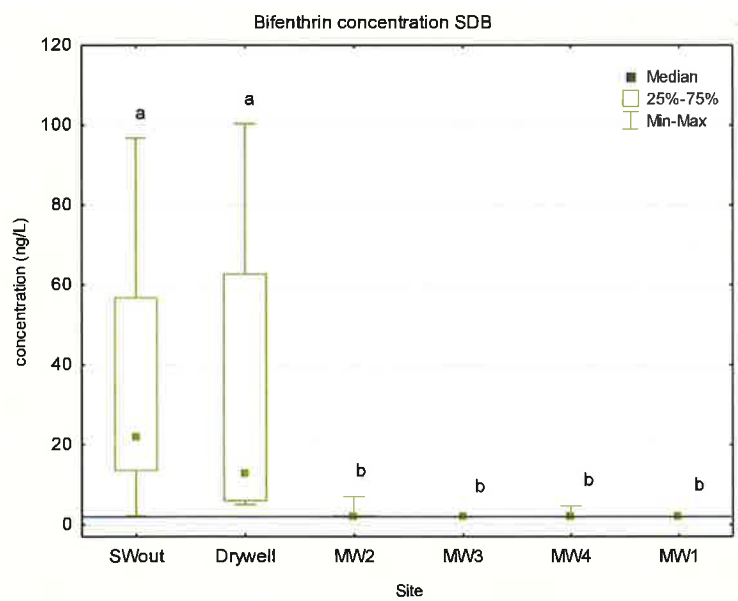
- **Pyrethroids**

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 25th and 75th 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.

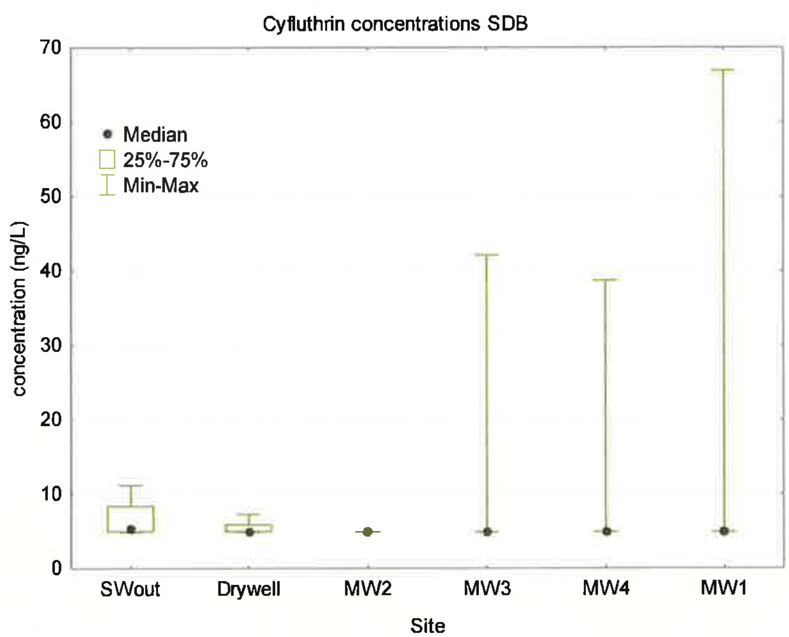


Figure 4. Cyfluthrin concentrations at SDB. Notations are as for previous figures. No significant differences were found between sites.

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.

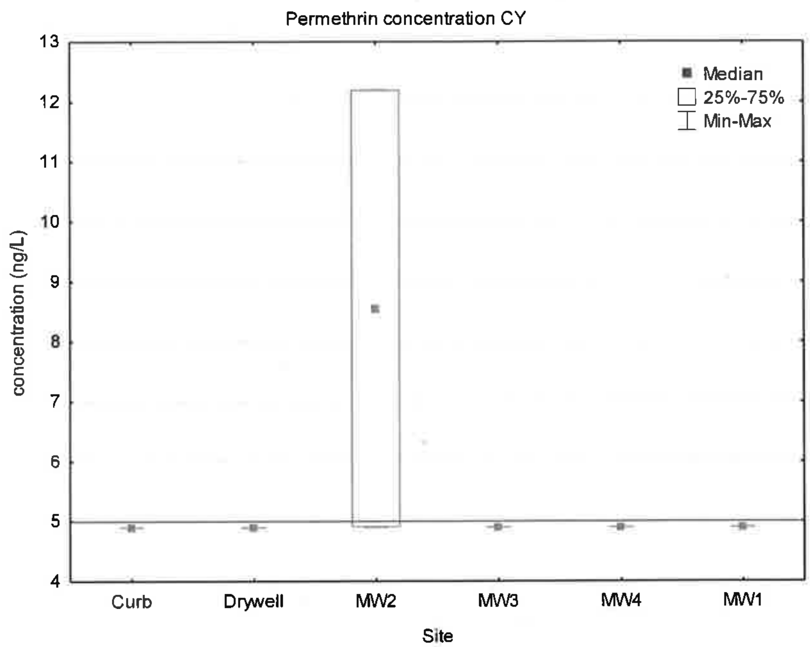


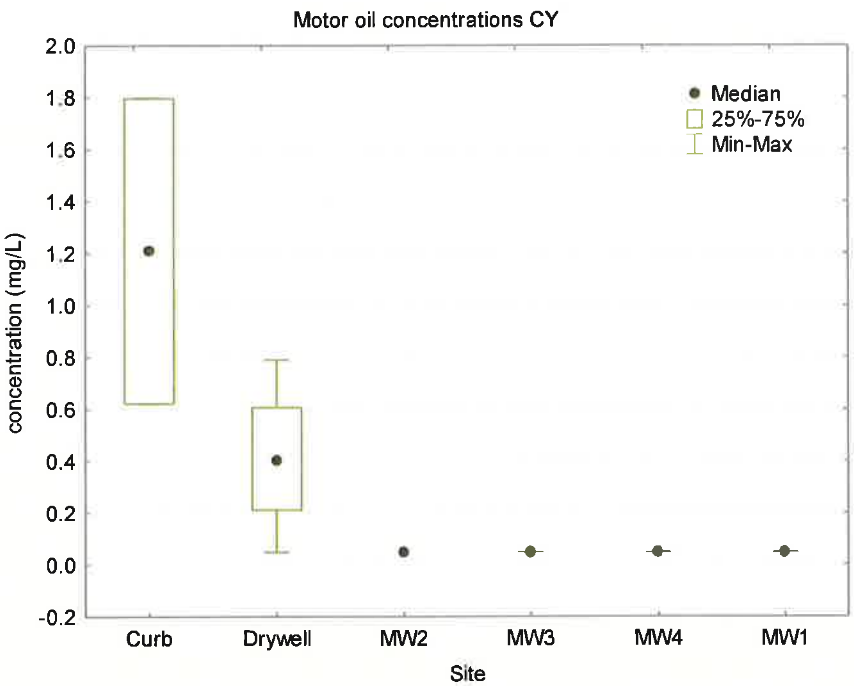
Figure 5. Permethrin concentrations at the CY. All notations are the same as for previous graphs.

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.

- **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).



- **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 (Al) 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 µg/L) the water table within the modeling timeframe of 3000 years.

At SDB, the groundwater samples with detectable concentrations of Al 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 Al 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 Al were too low to reach the water table as a result of infiltration through the dry well.

On a few occasions, the concentration of Al 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 Al 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, Al monitoring and modeling results do not suggest stormwater would pose a risk to groundwater quality.

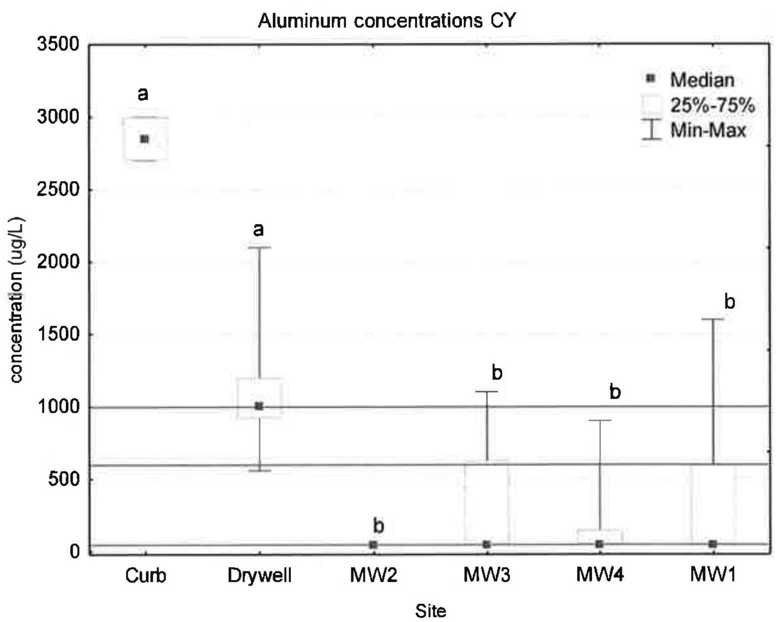


Figure 7a. Aluminum concentrations in stormwater and groundwater at the CY. Notations are as described in Figure 2. Units of concentration are µg/L. In addition, the red line indicates the MCL; teal blue line is the PHG.

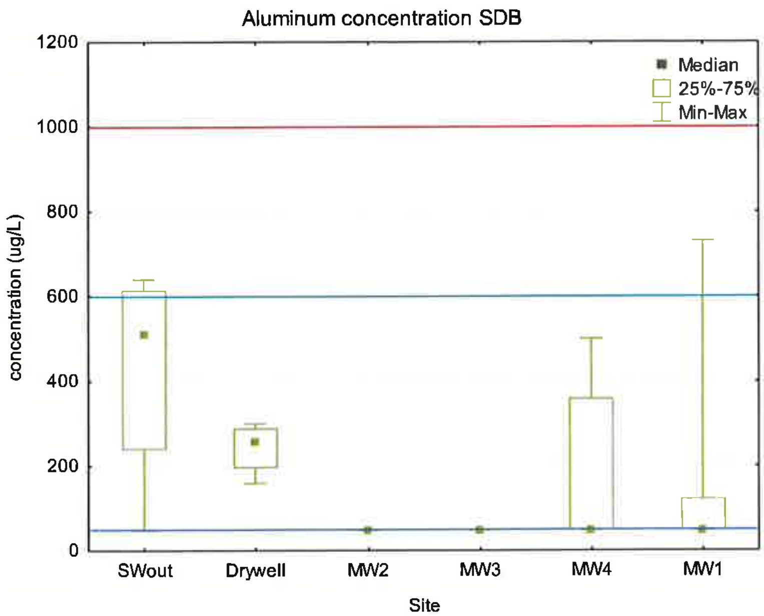
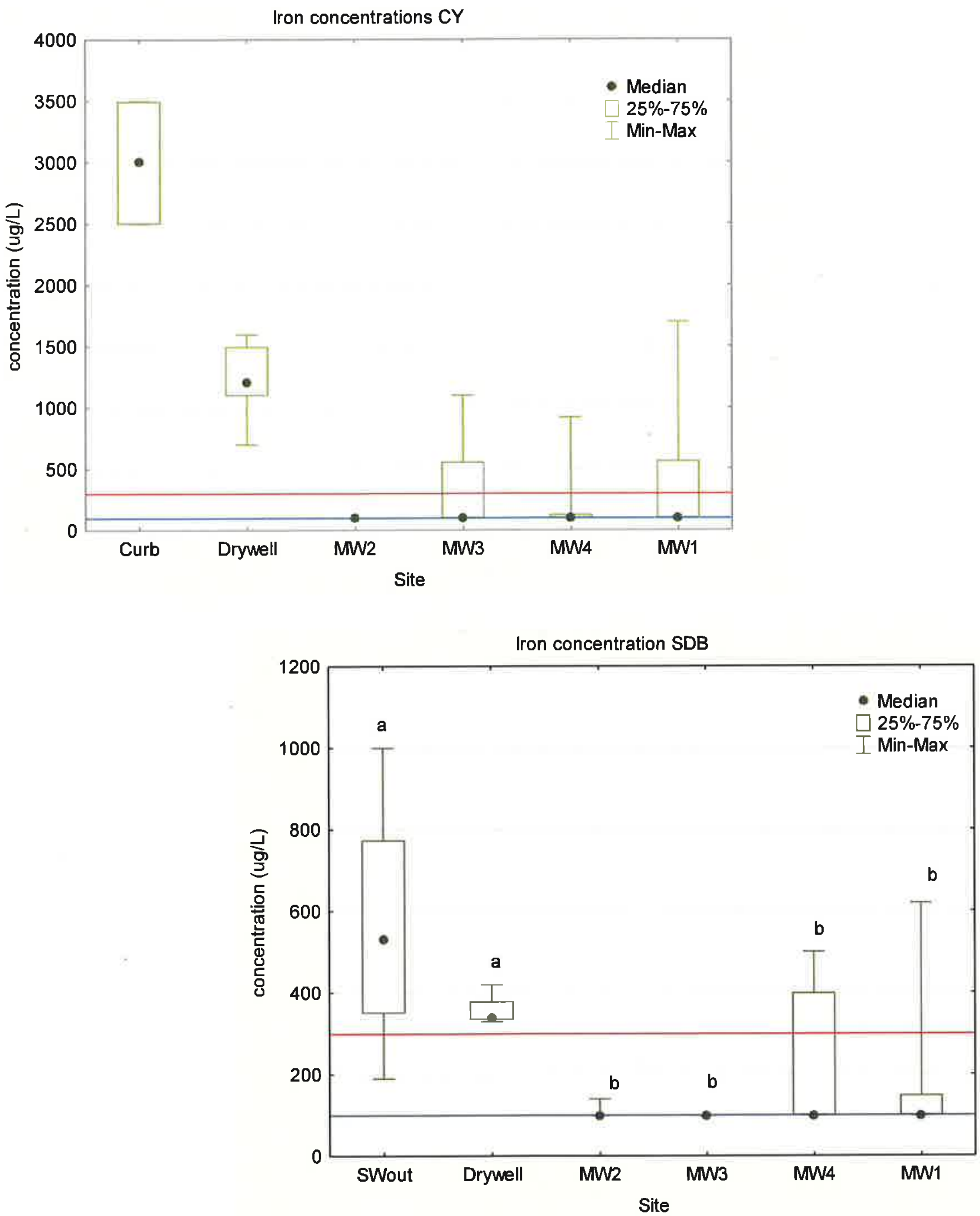


Figure 7b. Aluminum concentrations in stormwater and groundwater at the SDB. Notations are as described in Figure 3. Units of concentration are µg/L. In addition, the red line indicates the MCL; teal blue line is the PHG.

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).

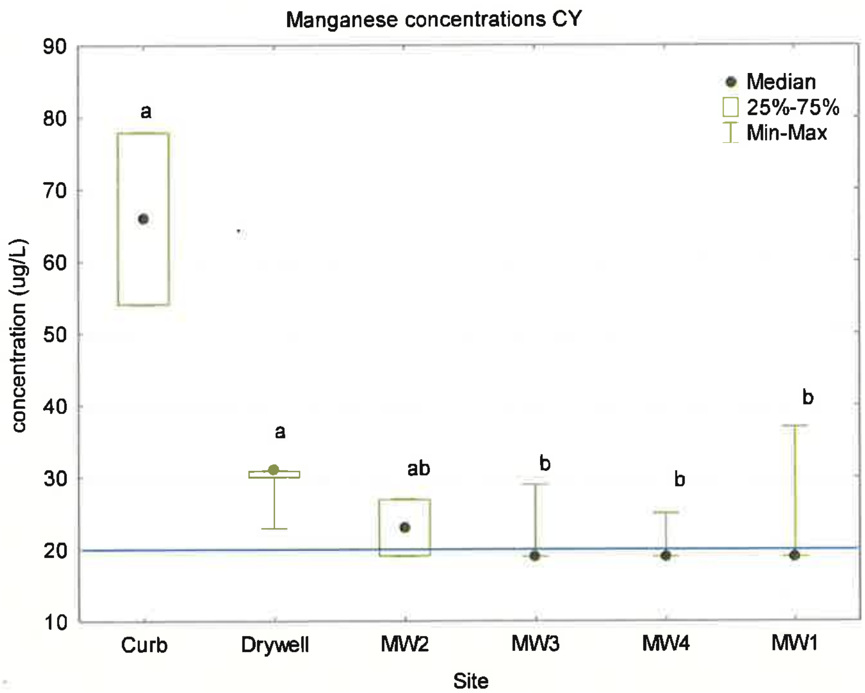
Notable as well is the role of pretreatment on iron concentrations in stormwater. Like aluminum, at the CY the concentration of iron was reduced by about 65% as a result of adsorption and settling in the grassy swale. Also similar to aluminum, about 35% of iron was removed from stormwater at SDB. These 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 µg/L while it was below the reporting limit at SDB (Figure 9; data for SDB not shown).

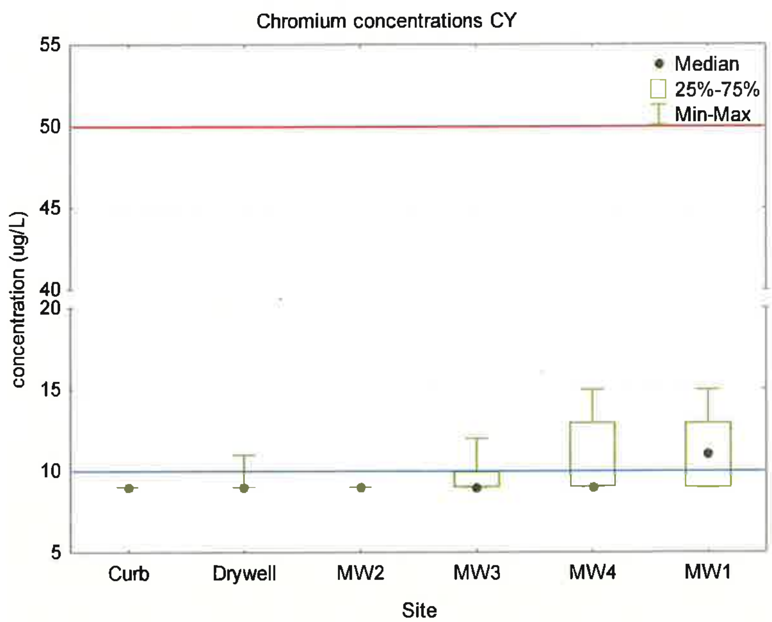
Figure 9. Concentrations of manganese at the CY. Notations are as for other figures. Significant differences in concentration were seen between stormwater and groundwater



The pattern of elevated concentrations of metals (Al, 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 µg/L in groundwater, the MCL for hexavalent chromium (Figure 10). Because the ratio of hexavalent: trivalent chromium can be as great as 95:5, 10 µg/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.



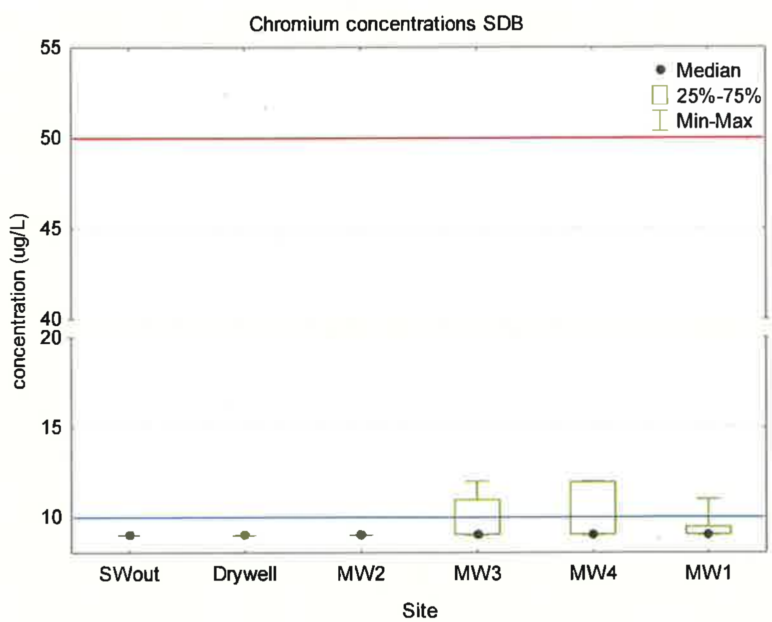
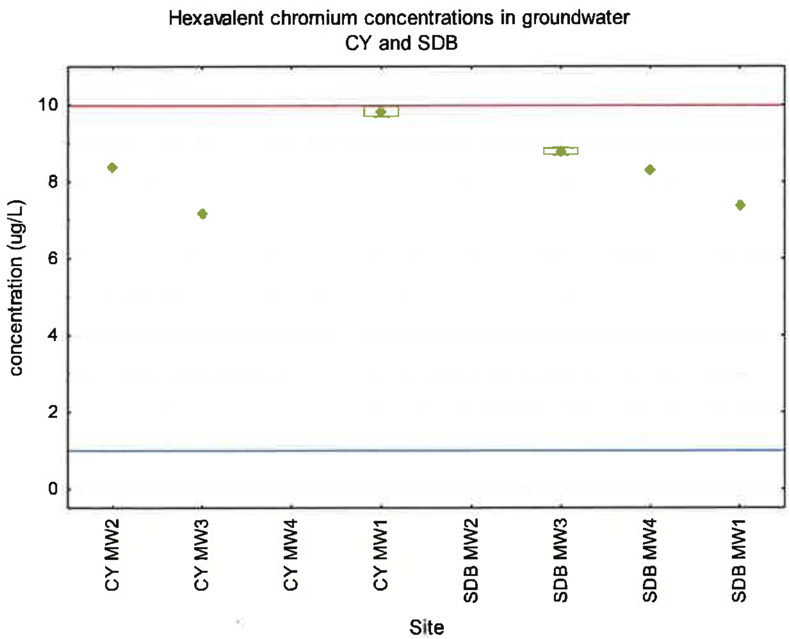


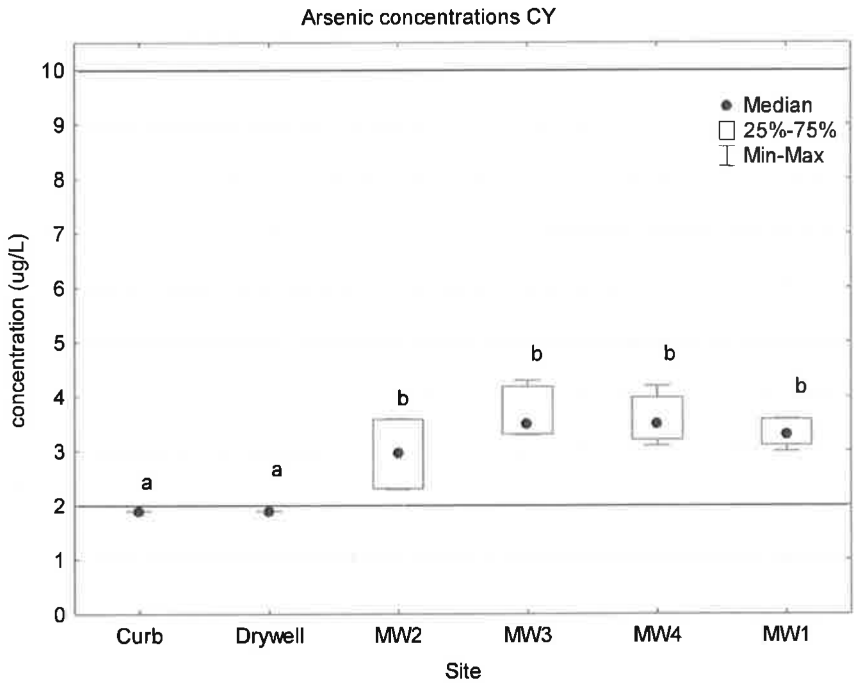
Figure 11. Hexavalent chromium concentrations in groundwater at both sites. Notations are as for other figures. The blue line represents the reporting limit and PHG (they are the same number); the dark red line represents the MCL. The highest concentration, 10 ug/L, was measured on a single occasion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

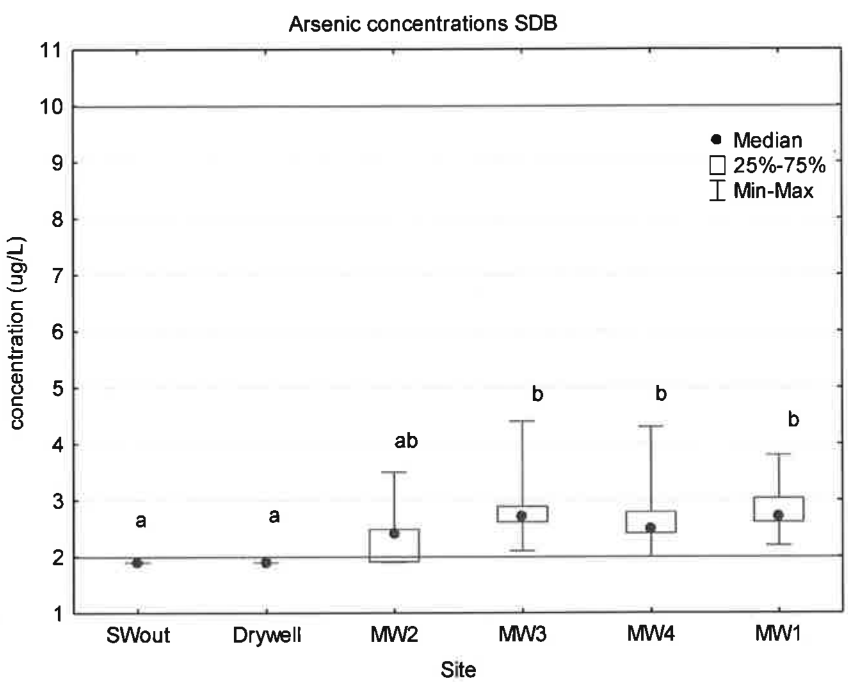


The pattern of arsenic (As) concentrations in runoff and groundwater followed that of chromium; it was significantly higher in groundwater than stormwater (Figure 12). In general, deeper wells (MW 3, 4, and 1) had significantly higher concentrations of arsenic than stormwater, as one would expect for 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 µg/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 µg/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.

Figure 12. Arsenic concentrations in stormwater and groundwater at the CY (top) and SDB (bottom). Notations are as for previous figures.



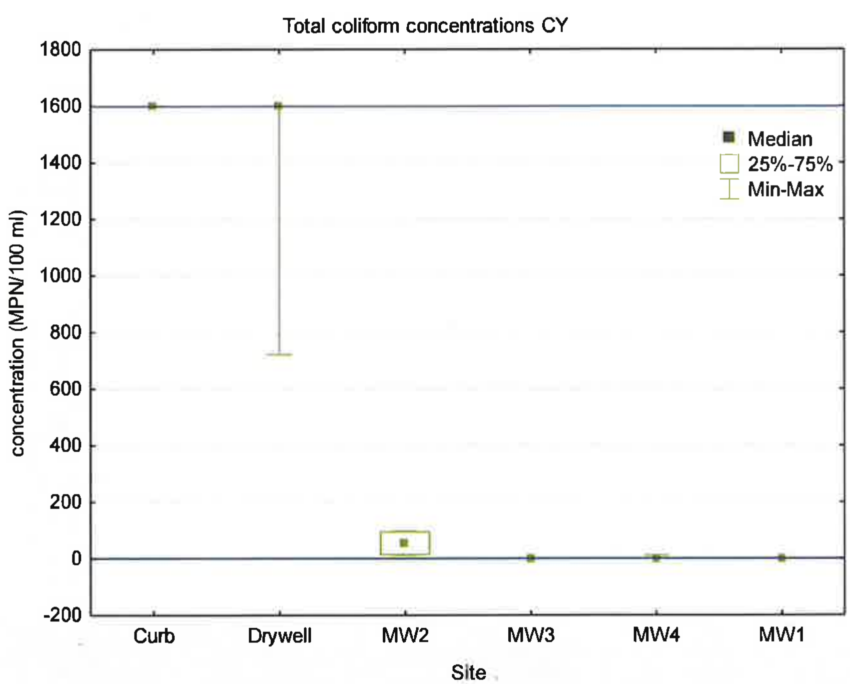


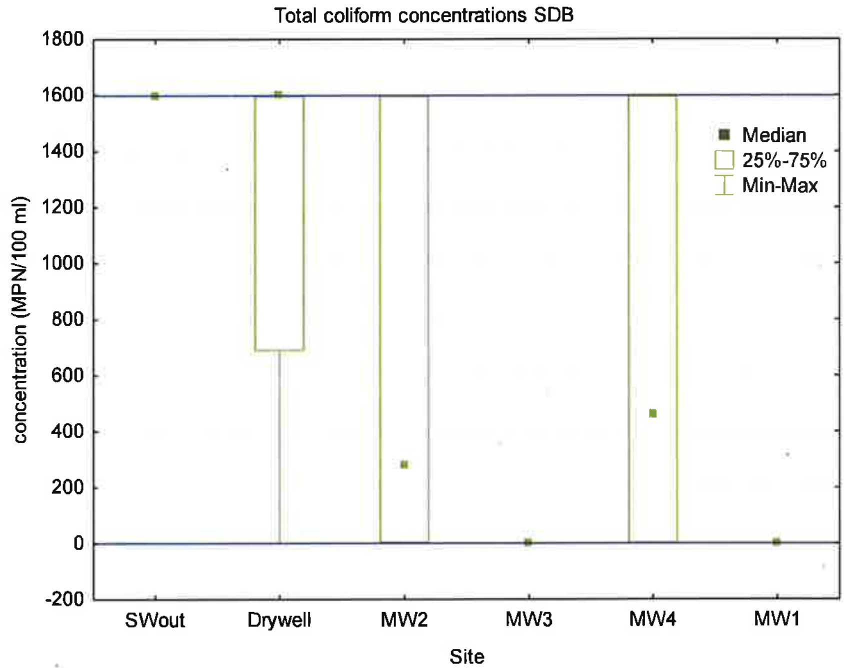
In summary, there is no evidence that, during the period of this project, metals posed a risk to groundwater quality. Further, modeled simulations extended for up to 3,000 years suggested that metals of various valence states will not reach the water table at concentrations sufficient to measure (i.e., 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.

Figure 13. Total coliform concentrations at the Corporation Yard (top) **and Strawberry Detention Basin** (bottom)**.** Notations are the same as for other figures.





- **Nitrate**

Median nitrate-nitrogen (NO_3-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_3-N to be 13 mg/L (n=2) in MW1, a water table well. This demonstrates that the elevated NO_3-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_3 associated with historic agricultural activities in the Elk Grove area. It has been well established that NO_3 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_3 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_3 found in MW1 suggest that stormwater infiltration might have actually diluted and reduced the NO_3 profile in groundwater while NO_3

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.

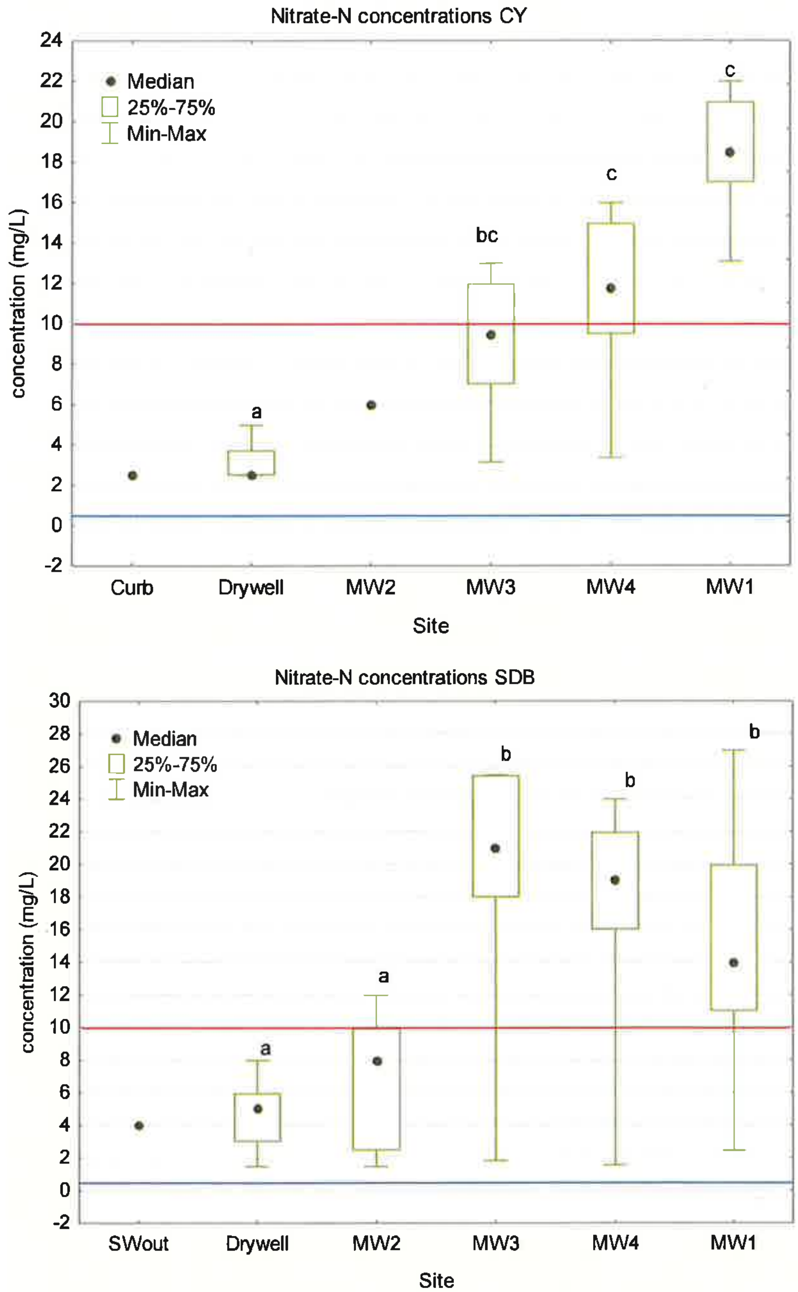


Figure 14. Nitrate (as N) concentration in stormwater and groundwater at the CY (top) and SDB (bottom). Notations are as for other figures.

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 µg/L total chromium; at SDB, n=5) making differences between the 3 groups difficult to discern.

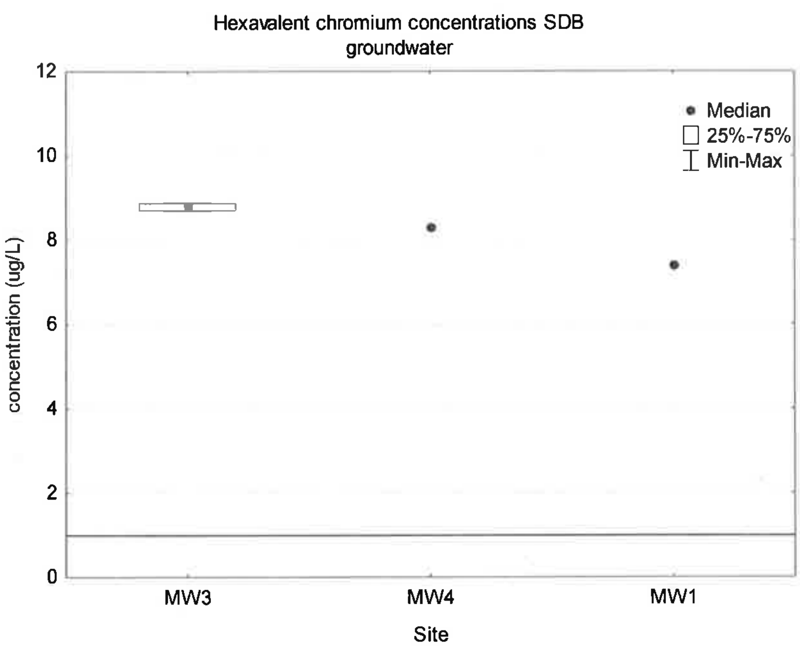


Figure 15. Hexavalent chromium concentrations in upgradient (MW1) and downgradient (MW 3 and 4) wells at the SDB. The blue line is the reporting limit. No significant differences were found. The MCL for total chromium is 50 µg/L.

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 ($p \leq 0.06$) 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).

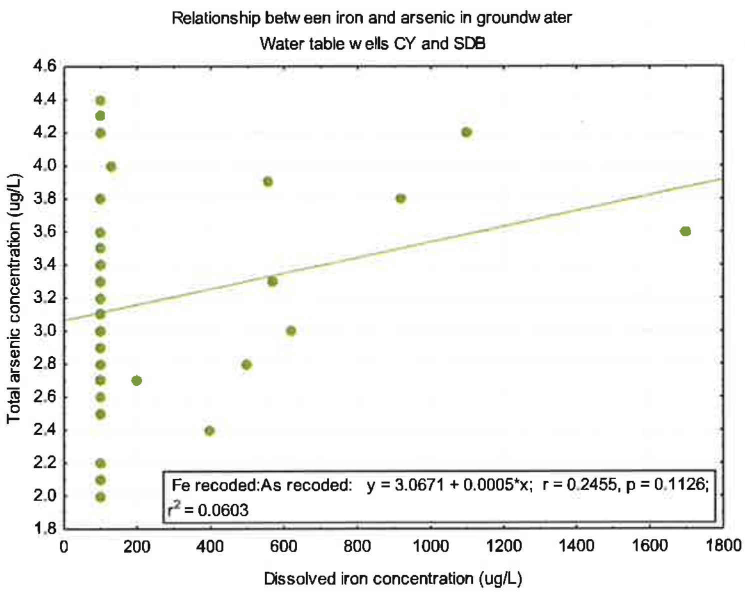
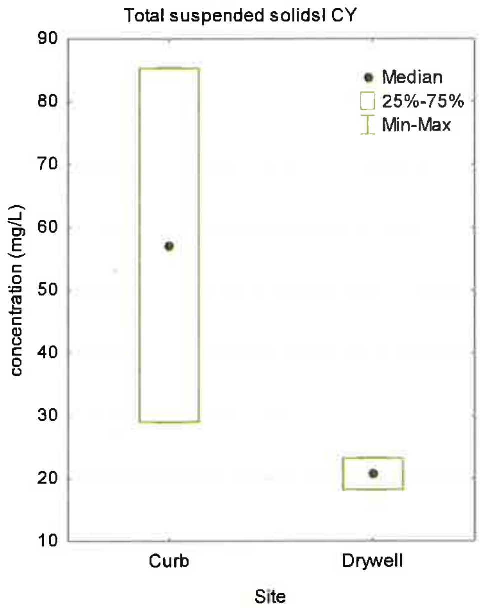


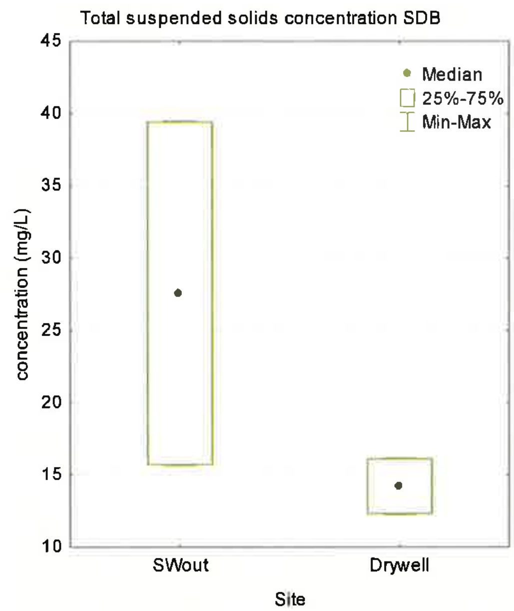
Figure 16. Relationship between dissolved iron and total arsenic in samples collected from water table wells at the Corporation Yard and Strawberry Detention Basin. A weak correlation was detected, strongly influenced by a few data points.

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*	
	CY	SDB
Aluminum	65	50
Bifenthrin	100	42
Manganese	53	- 44
NO_3-N	0	-25
Motor oil	67	55
TSS	63	50

Table 4. Percent reduction in contaminants by the vegetated pretreatment at the CY and SDB. Sample size = 2. Calculations were based solely on flow-weighted composites collected from influent stormwater and at the dry well during two storm events (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).

Event Date	Corporation Yard			Strawberry Detention Basin		
	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. Ψ = 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			
Al 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			
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).

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

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		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
NO_3-N	CY	61,235	2	580
	SDB	216,900	4	3,285

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[1] 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

[1] 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 anti-degradation 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 quality 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. Aquifer 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. These results suggest that either a) stormwater entering the dry 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).

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

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_3	Negative

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_3 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[2], 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,

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[2] 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.

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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:

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

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

β - contaminant does not reach water table within a 1,000 year time period

ε - 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.

Results for CY numerical modeling analysis

Aluminum

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
	-	-*	-	-	-	-
	10.0	1500	114 [φ]	811 (0.04177 mg/L)	φ	0.04144
	-	-	-	-	-	-
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
	-	-	-	-	-	-

*Only one 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

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	ε	1.736
	6.0	0.001	6 [φ]	27	ε	1.722
	10.0	0.01	53 [φ]	290	ε	1.733
	10.0	0.001	6 [φ]	27	ε	1.725

12.2	6.0	0.01	52 [166]	282	ε	8.823
	6.0	0.001	6 [17]	110	ε	8.770
	10.0	0.01	52 [164]	285	ε	8.810
	10.0	0.001	5 [17]	95	ε	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	-**	-	-	-
	10.0	0.01	4 [10]	17	12	17.99
	10.0	0.001	-	-	-	-

**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	ε	0.4678
	6.0	0.001	56 days [134 days]	2	ε	0.4729
	10.0	0.01	3 yrs [6 yrs]	18	ε	0.4681
	10.0	0.001	55 days [133 days]	2	ε	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
	6.0	0.001	7 [17]	36	ε	0.8545
	10.0	0.01	28 [83]	183	ε	0.8545
	10.0	0.001	5 [16]	36	ε	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
	-	-*	-	-	-	-
	15.0	1500	11 [φ]	126	φ	0.005996
	-	-	-	-	-	-
0.3	1.7	1500	87 [251]	1000 (0.2881 mg/L)	φ	0.1076
	-	-	-	-	-	-
	15.0	1500	10 [29]	140	φ	0.2989
	-	-	-	-	-	-

*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)	ε	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	ε	10.85
100	1.7	0.01	117 [372]	912 [88.13 ng/L]	ε	26.90
	1.7	0.001	12 [38]	127	ε	91.61
	15.0	0.01	14 [43]	130	ε	98.66
	15.0	0.001	2 [5]	28	ε	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)	Kd (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 Concentration (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	-	-	-	-

**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	ε	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	ε	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	ε	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	ε	3.5E-9
100		42 yrs [107 yrs]	352	ε	91.15
9	worst case	14 days [69 days]	2	ε	8.992
100		13 days [51 days]	2	ε	99.91

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	ε	0.2102
0.5	worst case	1 day [2 days]	6 days	ε	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	ε	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

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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:

$$[dis] = [tot](lit.\ ratio) \qquad \text{(Eq. 1)}$$

$$[dis] = [tot]/(1+ K_{oc}[POC] + K_{doc}[DOC]) \qquad \text{(Eq. 2)}$$

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_{oc} is the organic carbon-water partitioning coefficient in L/kg, [POC] is the concentration of particulate organic carbon in stormwater in kg/L, K_{doc} 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_d (L/kg) and [TSS] (mg/L) in place of K_{oc}, [POC], K_{doc}, 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). K_{doc} values were taken from literature and calculated using equation 3a and b:

$$K_{doc} = 0.08K_{ow} \qquad \text{(Eq. 3a)}$$

$$K_{doc} = 0.11K_{ow} \qquad \text{(Eq. 3b)}$$

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.

Table 1. Calculated dissolved concentrations for CY organics.

Contaminant	[total](ng/L)	Koc (L/kg)	DOC (kg/L)	POC (kg/L)	Kdoc (kg/L)	[dissolved] (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
TBA	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	18999.9
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	899.7
					0.407	899.7
			1.63E-5	1.03E-6	0.296	899.7
					0.407	899.7
			8.10E-6	1.10E-6	0.296	899.7
					0.407	899.9

Table 2. Calculated dissolved concentrations for CY metals.

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 3. Calculated dissolved concentrations for SDB organics

Contaminant	[total](ng/L)	Koc (L/kg)	DOC (kg/L)	POC (kg/L)	Kdoc (kg/L)	[dissolved] (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
TBA	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
			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 (kg/L)	POC (kg/L)	Kdoc (kg/L)	[dissolved] (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

Appendix B

HYDRUS 1D site sediment profiles

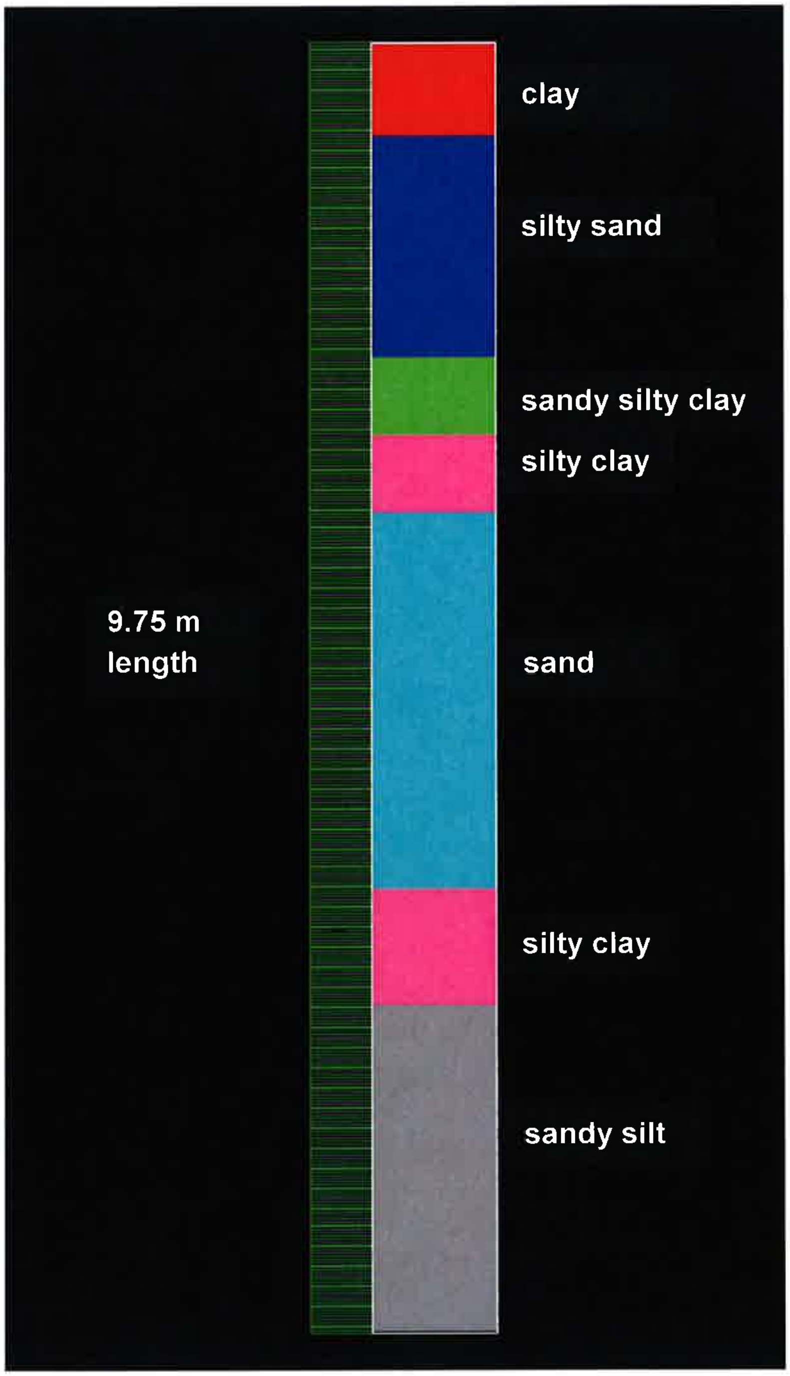


Figure 1. HYDRUS 1D sediment profile for the Corporate Yard drywell site.

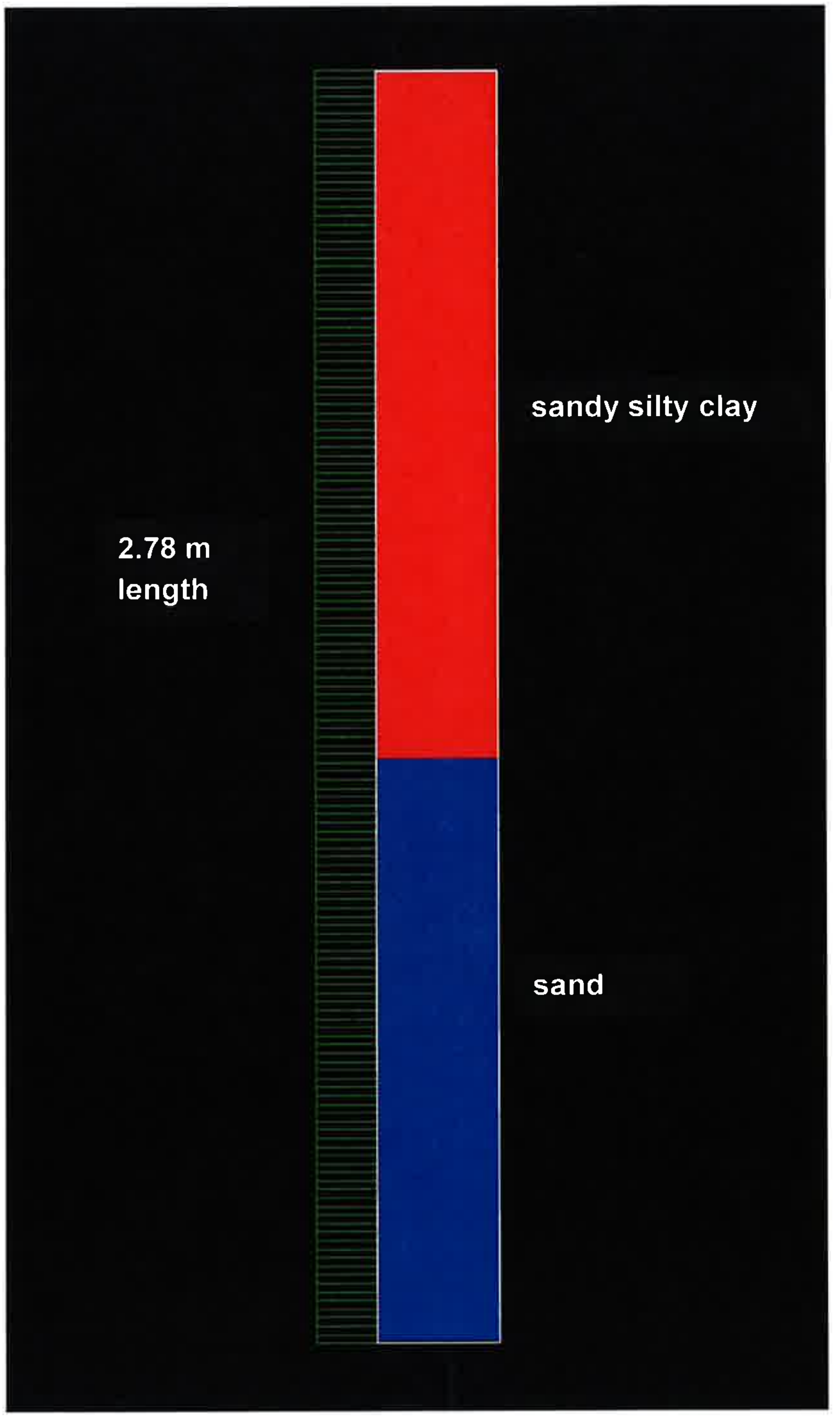


Figure 2. HYDRUS 1D sediment profile for the Strawberry Detention Basin drywell site.

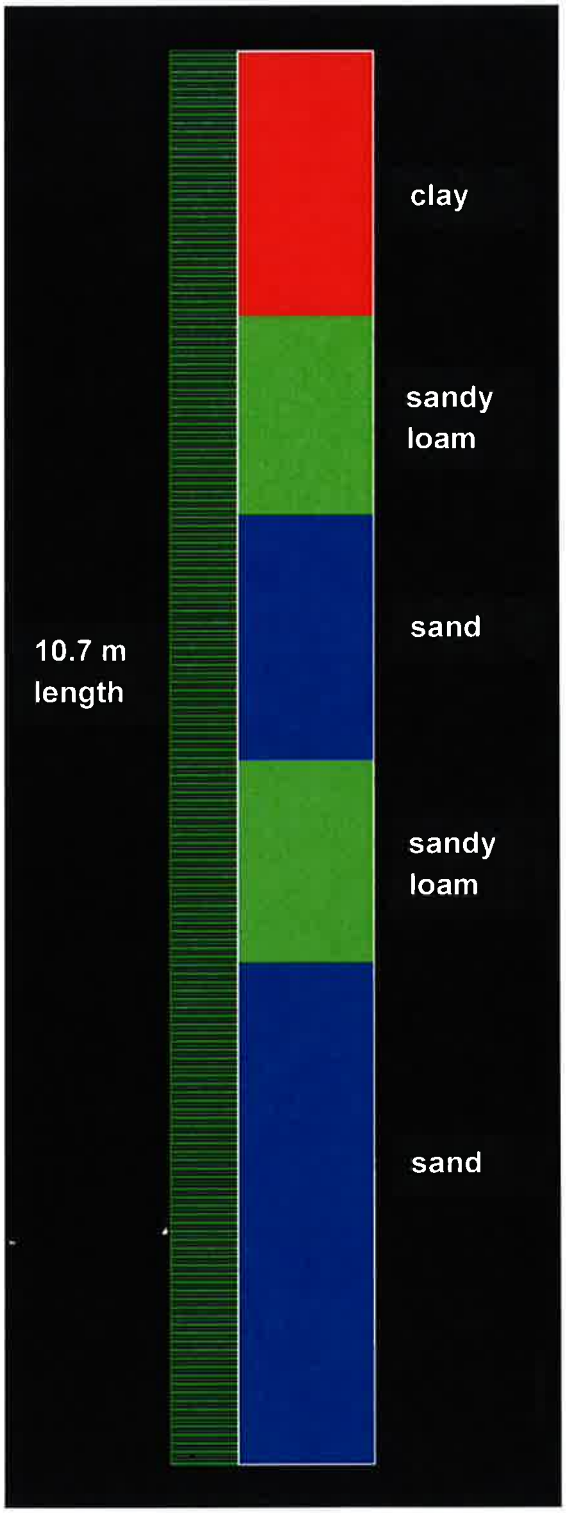


Figure 3. HYDRUS 1D sediment profile for the Los Angeles theoretical average case drywell site.

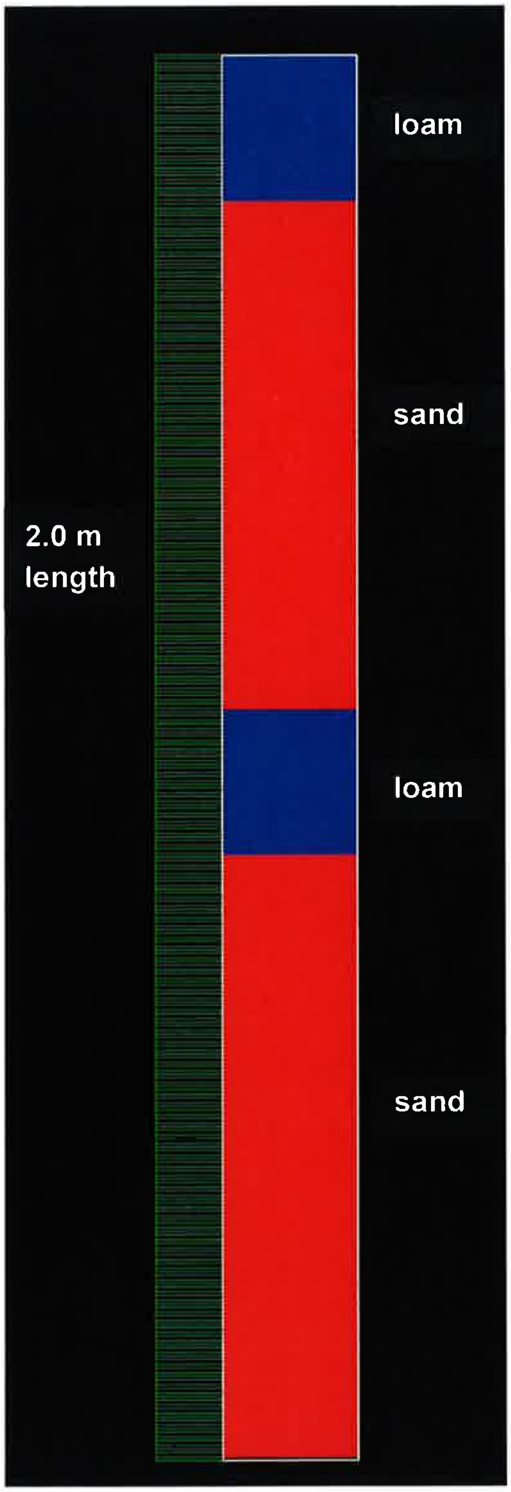


Figure 4. HYDRUS 1D sediment profile for the Los Angeles theoretical worst case drywell site.

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.

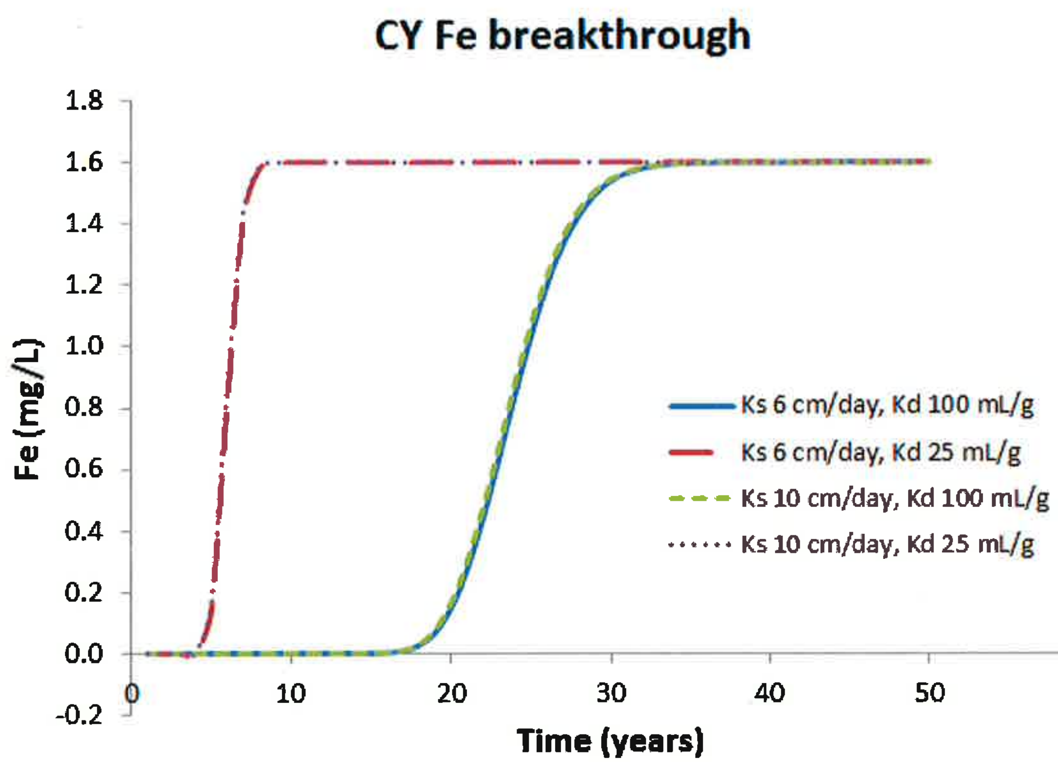


Figure 1. The concentration of iron at the Corporation Yard water table over time. The input concentration is the total concentration measured in stormwater. Because iron is a metal degradation was not taken into account in the modeling, and so the highest concentration reached at the water table remains 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.

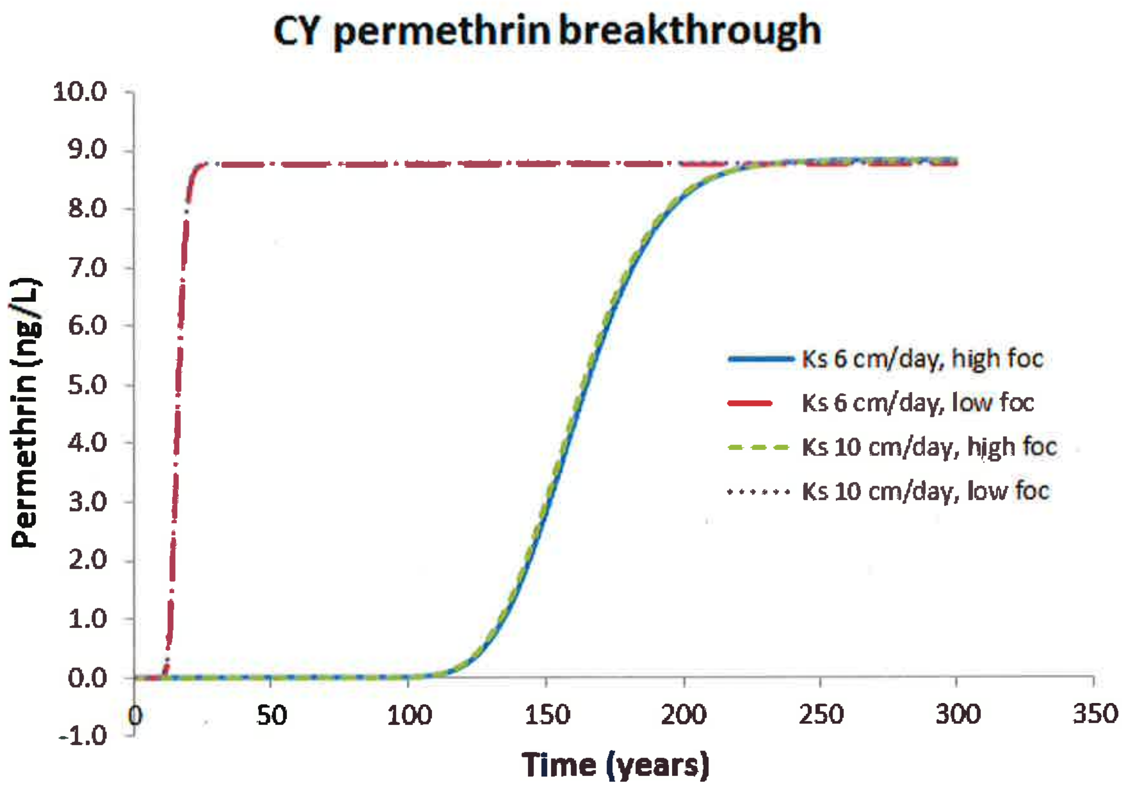


Figure 2. The concentration of permethrin at the Corporation Yard water table over time. The input concentration is the total concentration measured in stormwater. Although permethrin was assumed to degrade in the subsurface, oscillations in concentration at the water table are not seen because the contaminant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

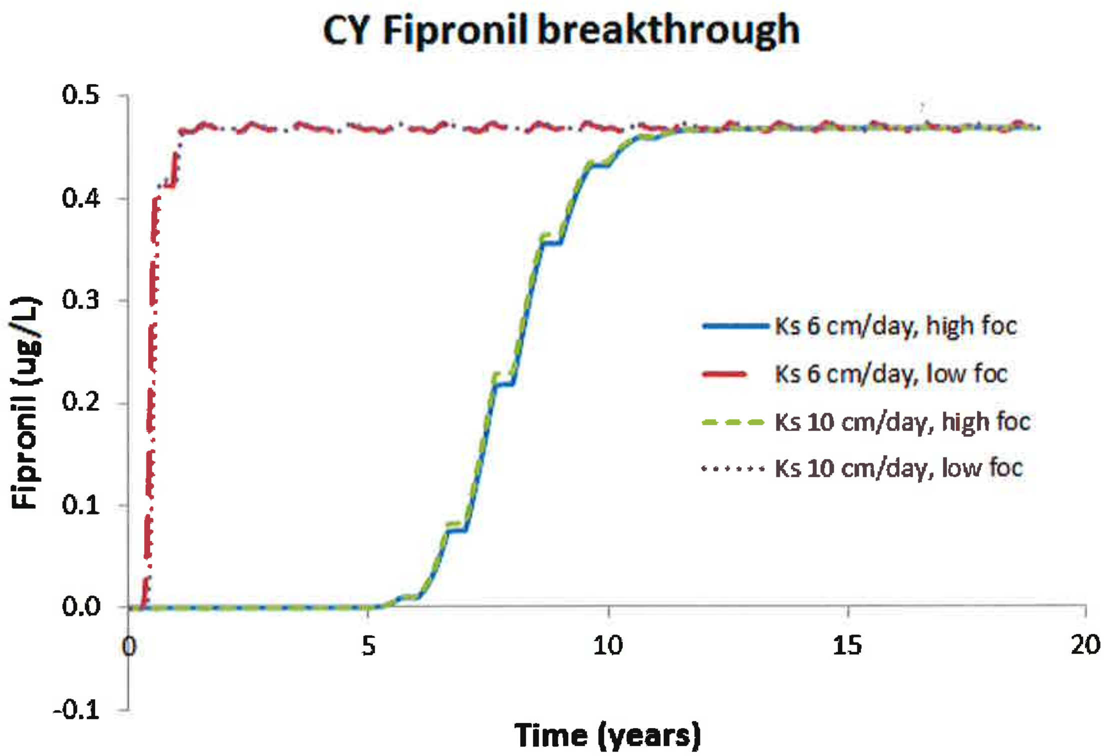


Figure 3. The concentration of fipronil at the Corporation Yard water table over time. The oscillations in the breakthrough curve show the degradation that fipronil undergoes during the dry season. While water containing fipronil is arriving at the water table, the concentration increases, and during 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.

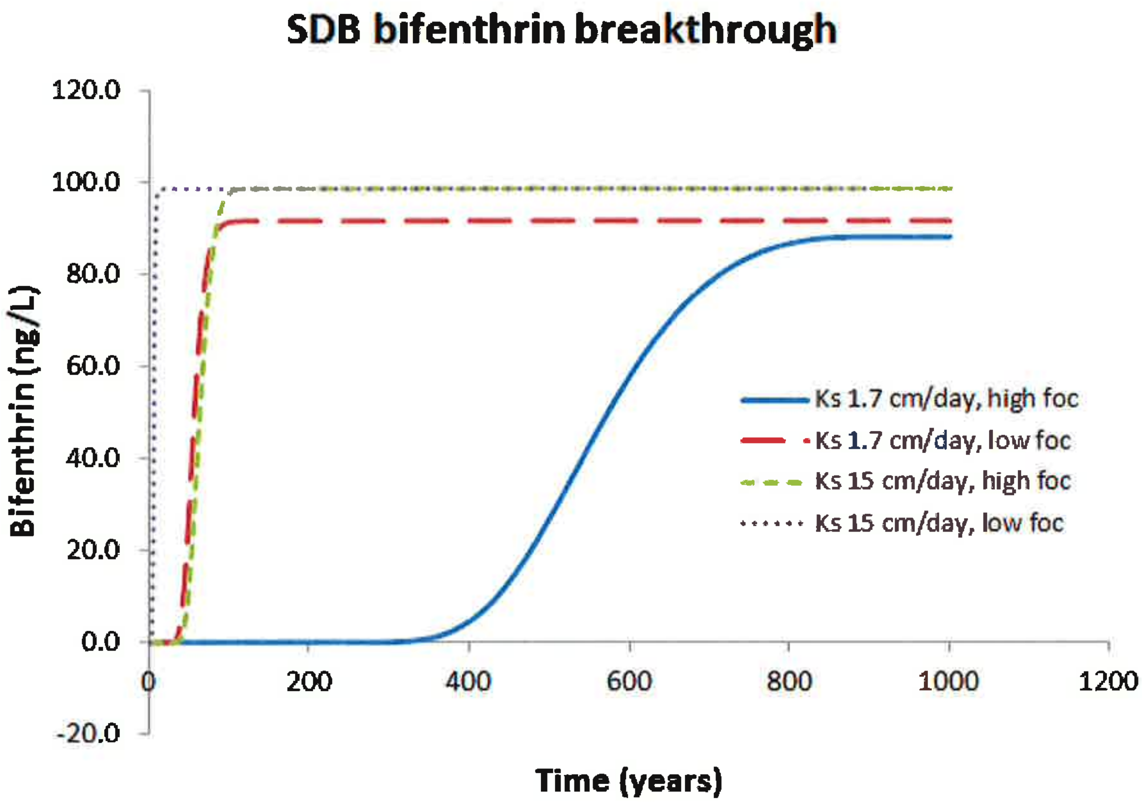


Figure 4. The concentration of bifenthrin at the Strawberry Detention Basin water table over time. The input concentration is the total concentration measured in stormwater. Although bifenthrin was assumed to degrade in the subsurface, oscillations in concentration at the water table are not seen because 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.

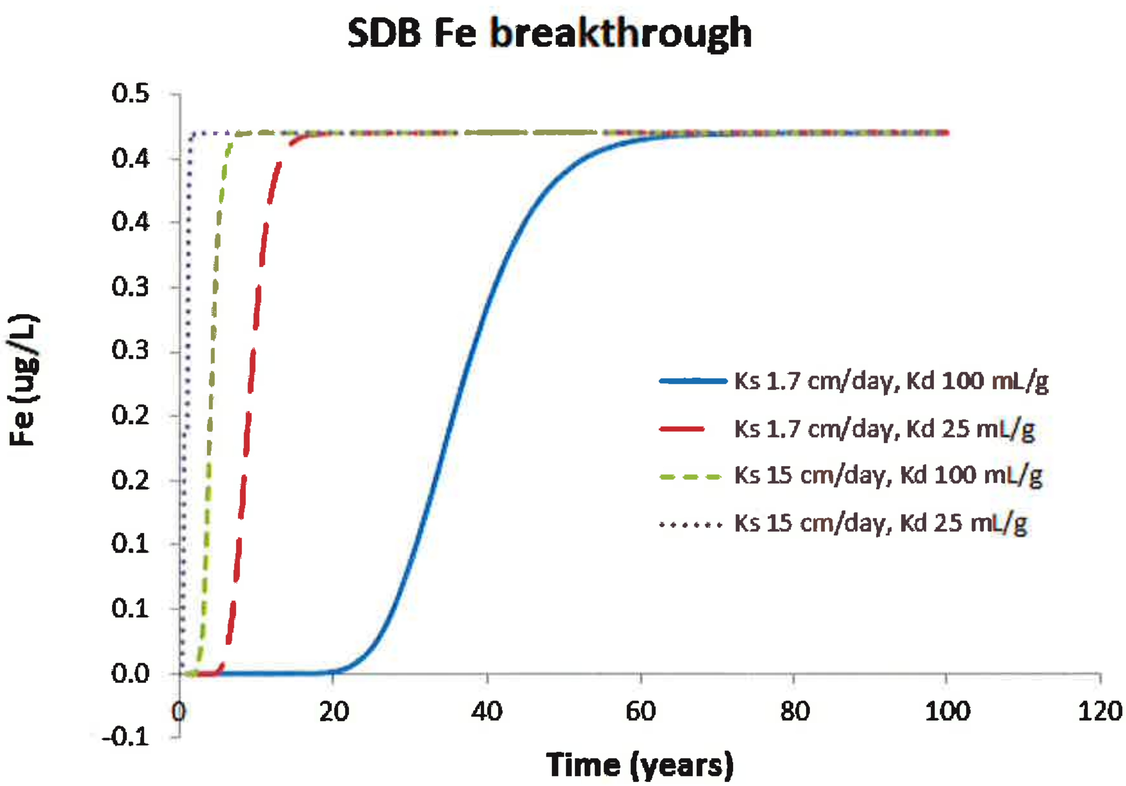


Figure 5. The concentration of iron at the Strawberry Detention Basin water table over time. The input concentration is the total concentration measured in stormwater. Because iron is a metal degradation was not taken into account in the modeling, and so the highest concentration reached at the water table remains constant over time. Both Kd 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.

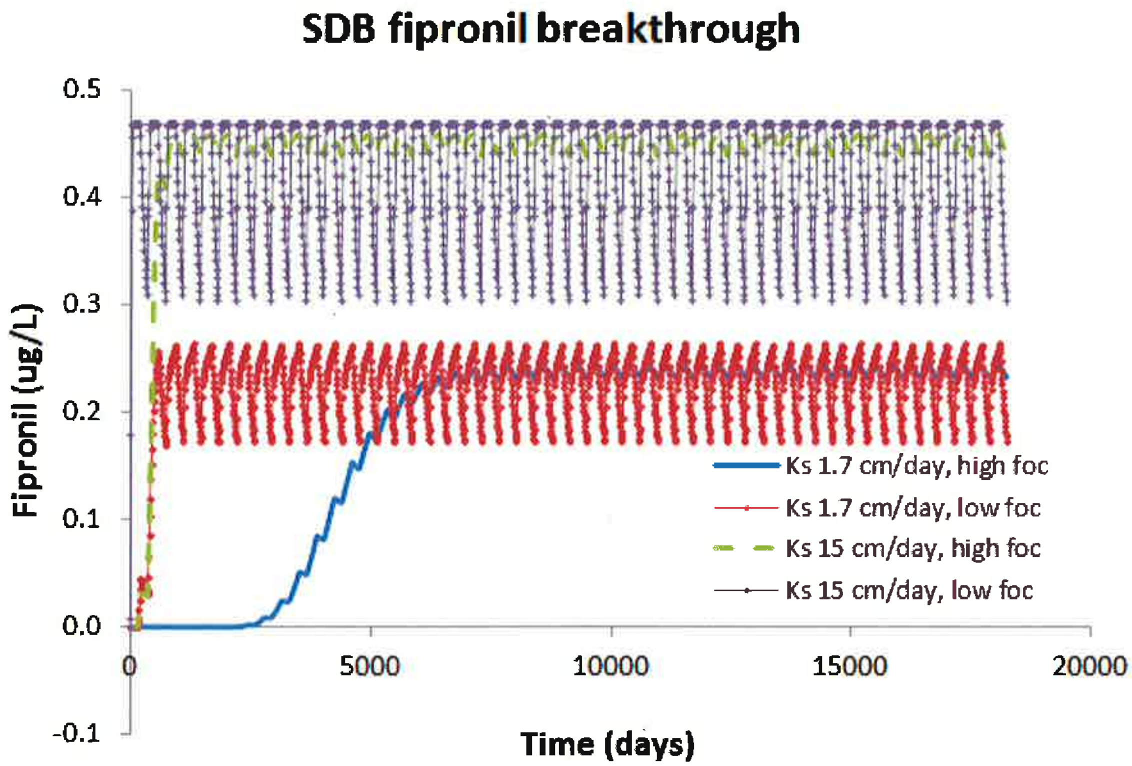


Figure 6. The concentration of fipronil at the Strawberry Detention Basin water table over time. The oscillations in the breakthrough curve show the degradation that fipronil undergoes during the dry season. While water containing fipronil is arriving at the water table, the concentration increases, 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.

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

		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	*84.39*	0.000702	0.000932	0.000898	0.00051	0.000113

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 µS/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.

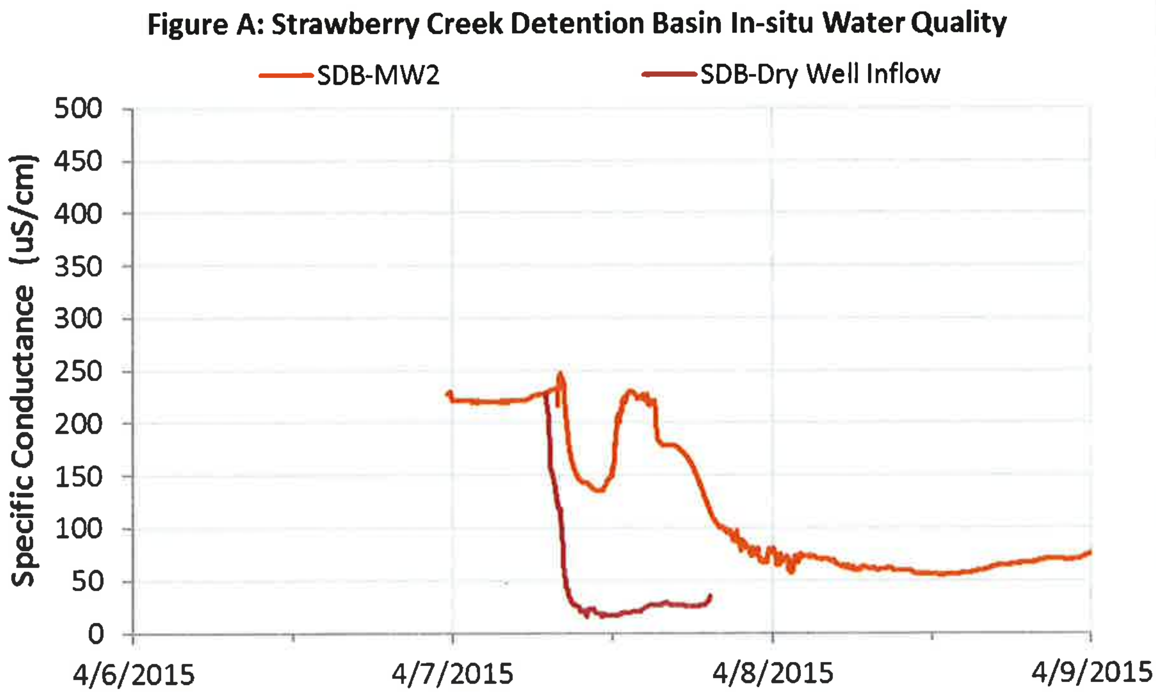
Summary

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.

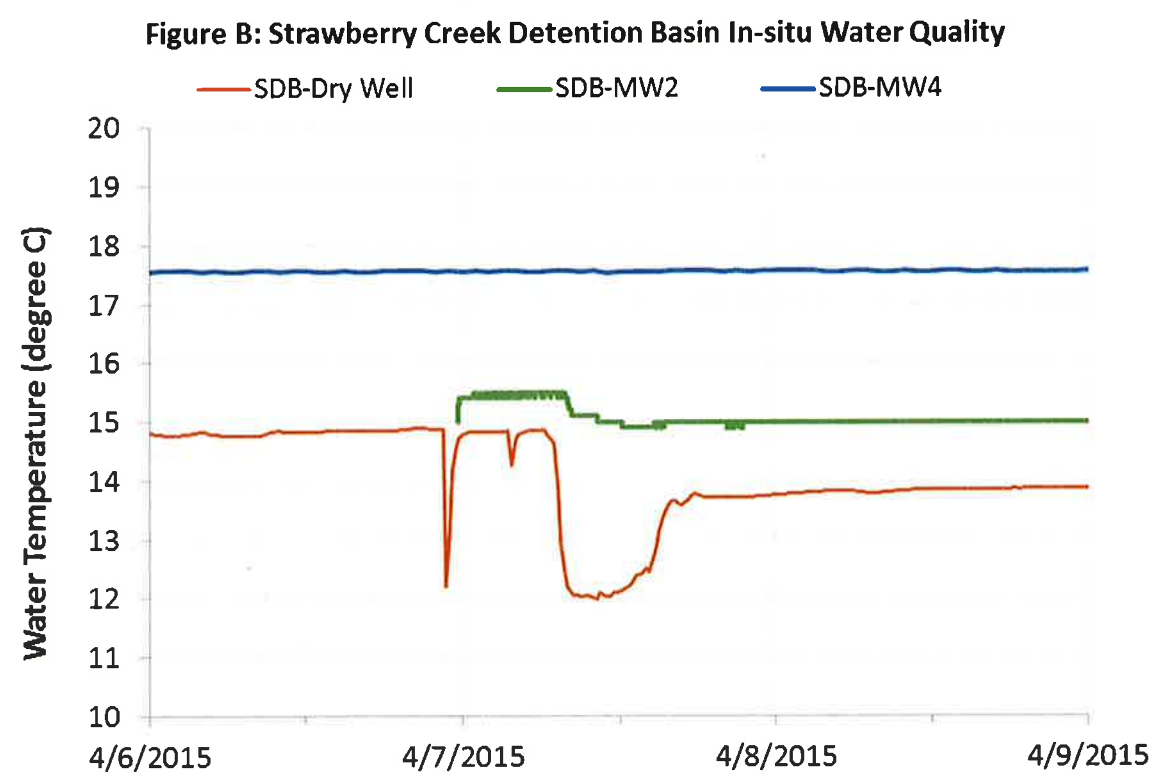
Estimates of the time of travel for a conservative water quality constituent in stormwater infiltrated at the dry well at each site were separately developed assuming vertical, saturated flow through the layered lithologic beds encountered between the bottom of the dry well at each site and highest seasonal 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.

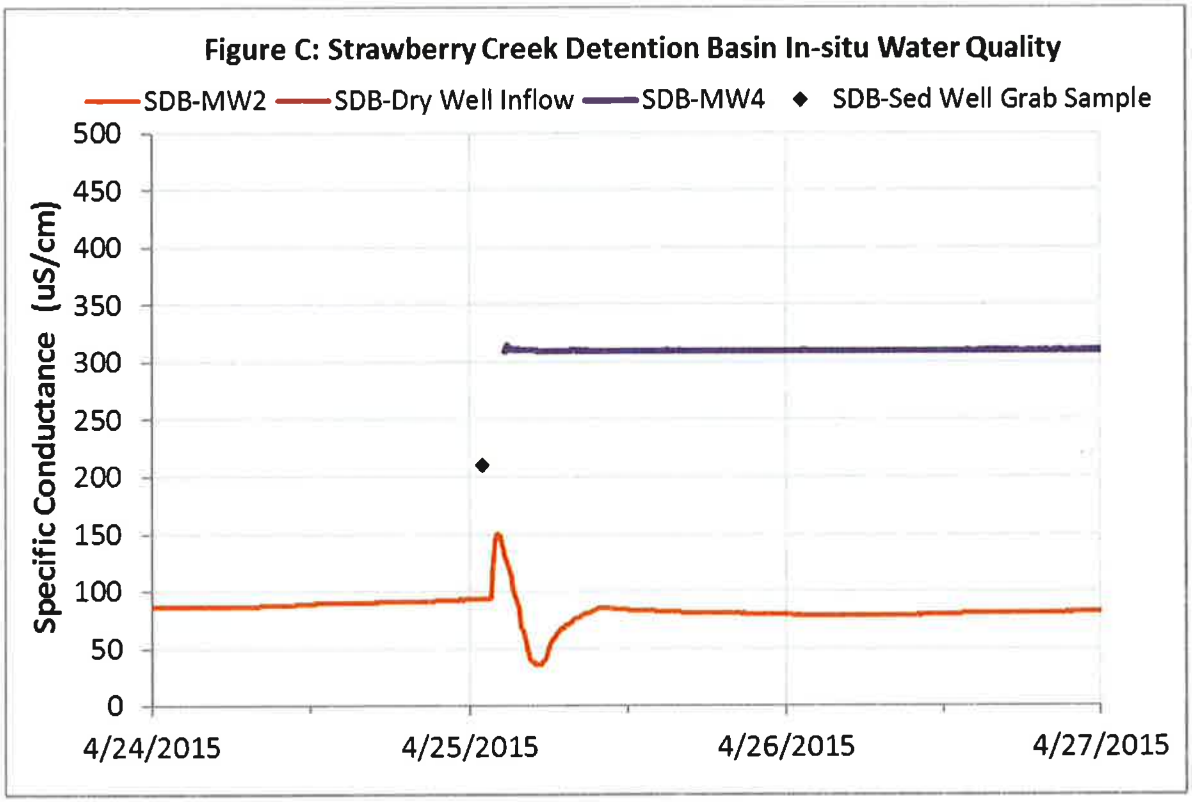


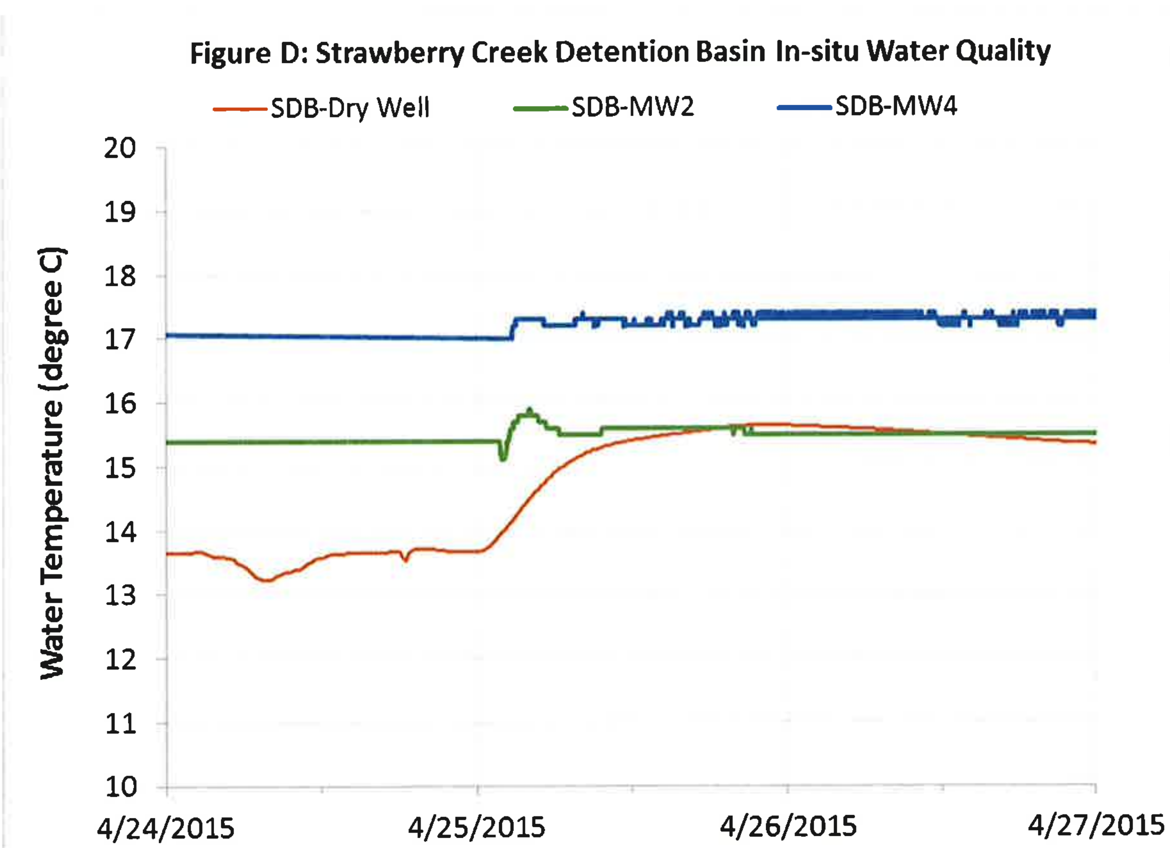
Note: Data from the dry well for these dates is from a transducer placed at the dry well inflow. An additional transducer placed in the dry well stilling pipe malfunctioned while deployed.



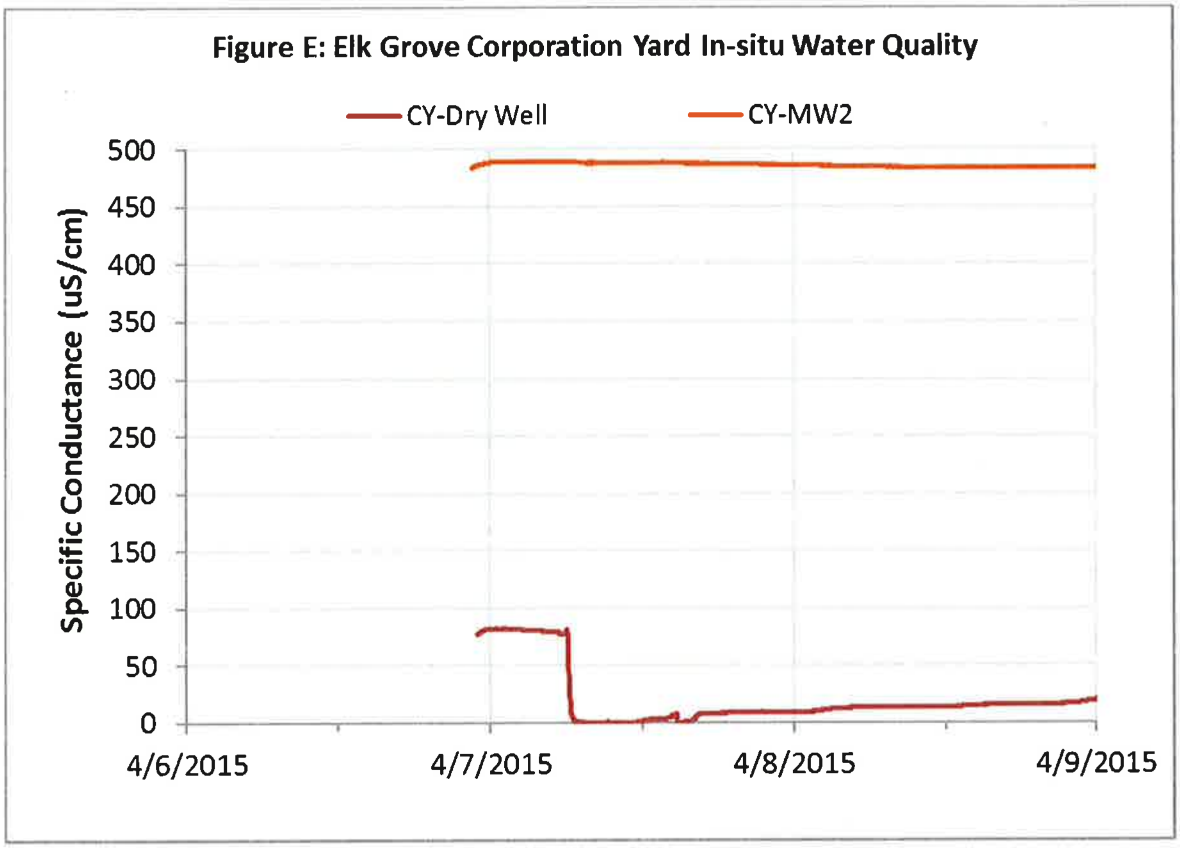
Note: Data from the dry well for these dates is from a transducer placed at the dry well inflow. An additional transducer placed in the dry well stilling pipe malfunctioned while deployed.

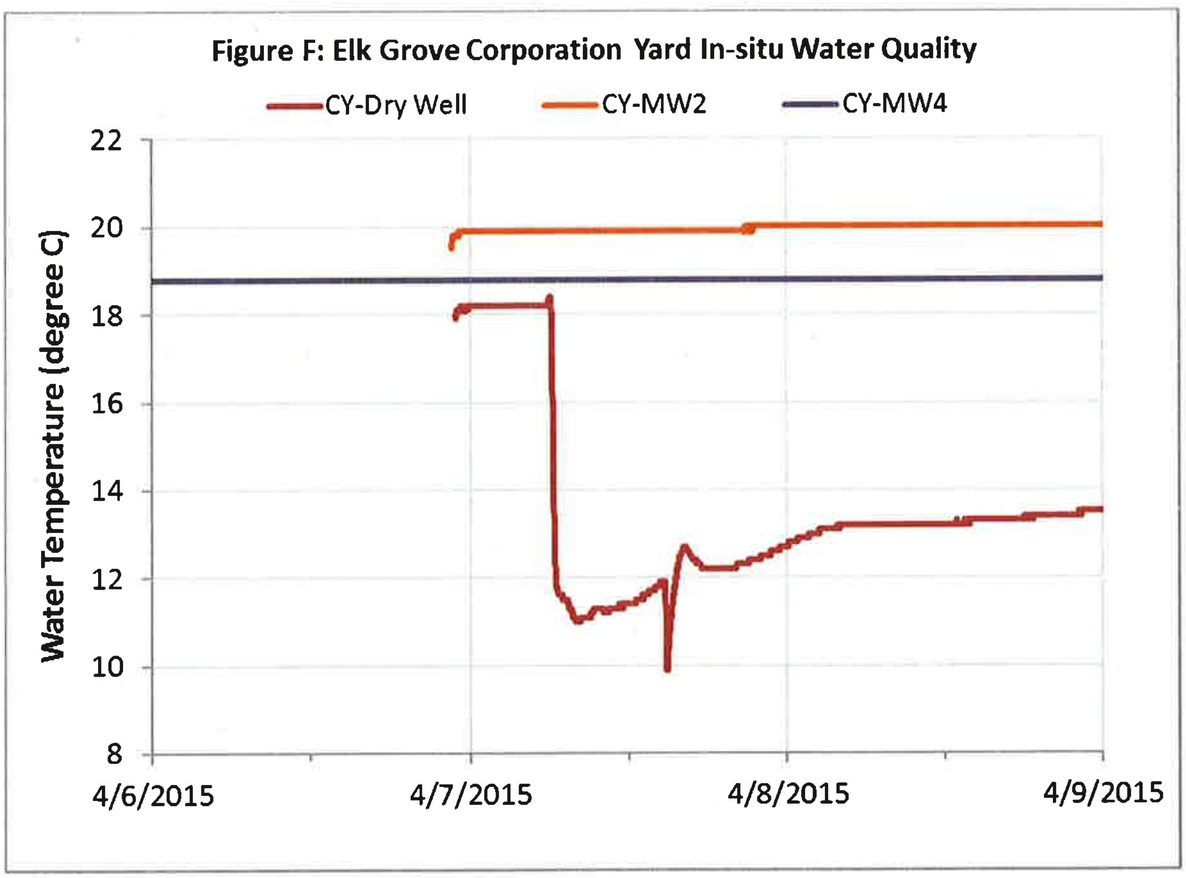
Revised 11/15/2015



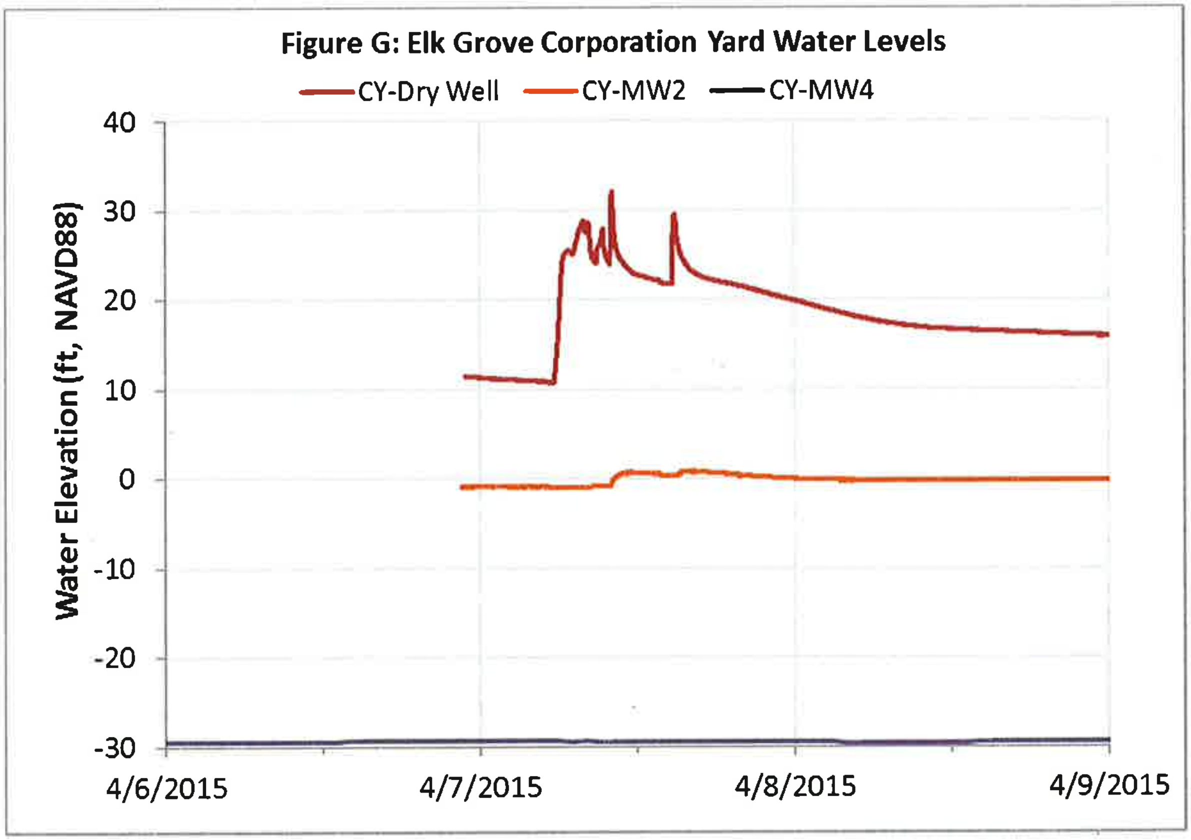


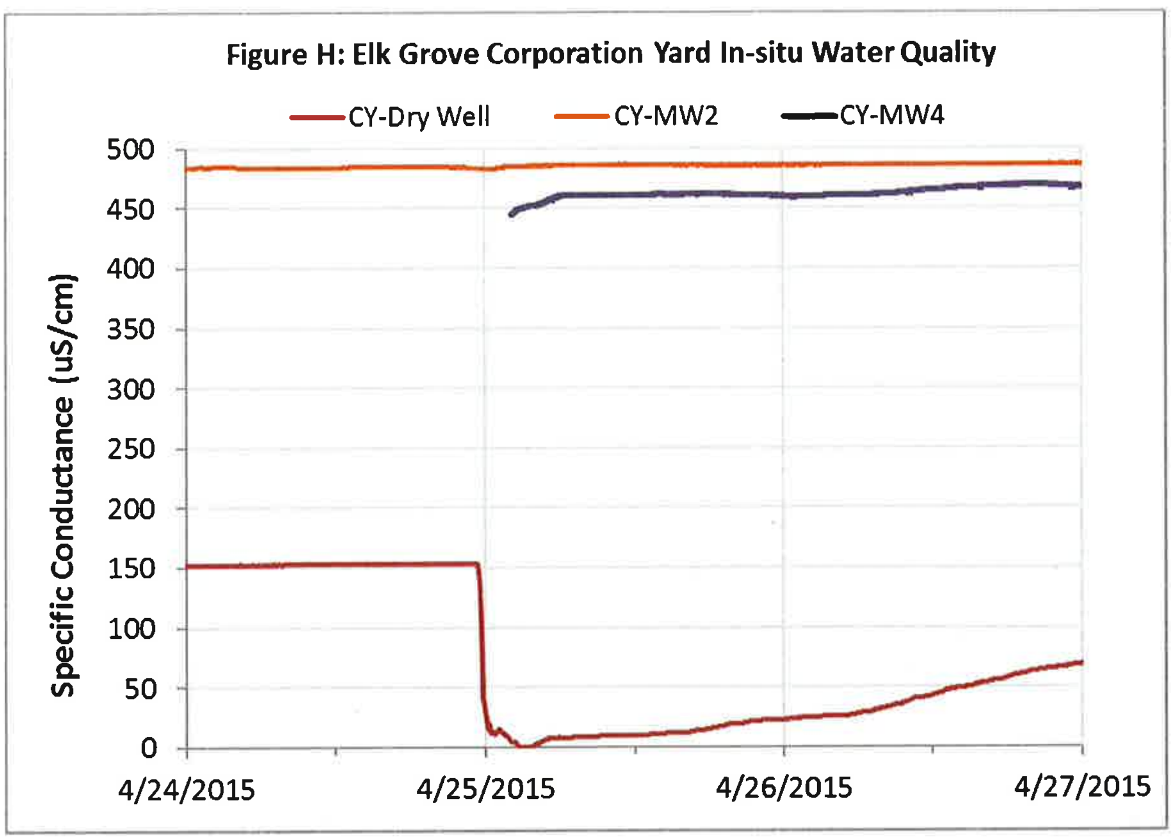
Revised 11/15/2015





Revised 11/15/2015





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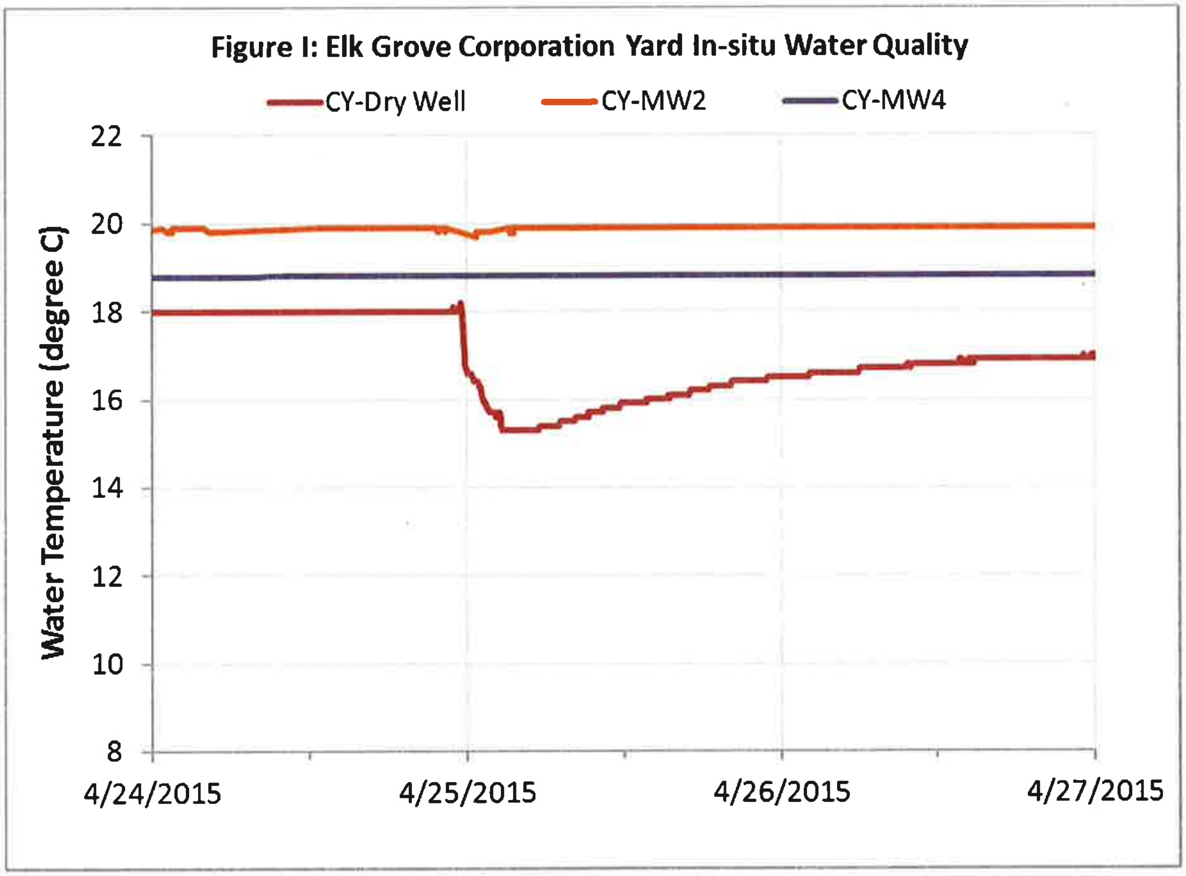

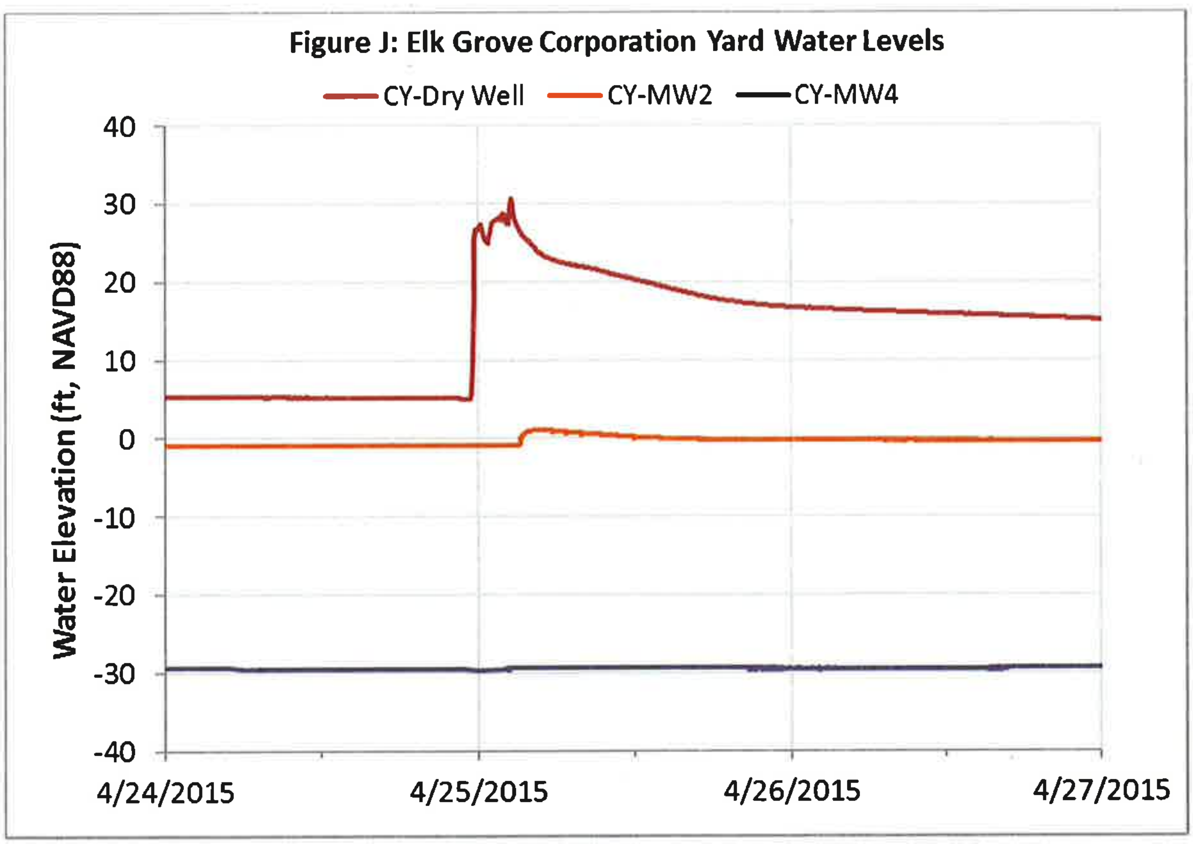

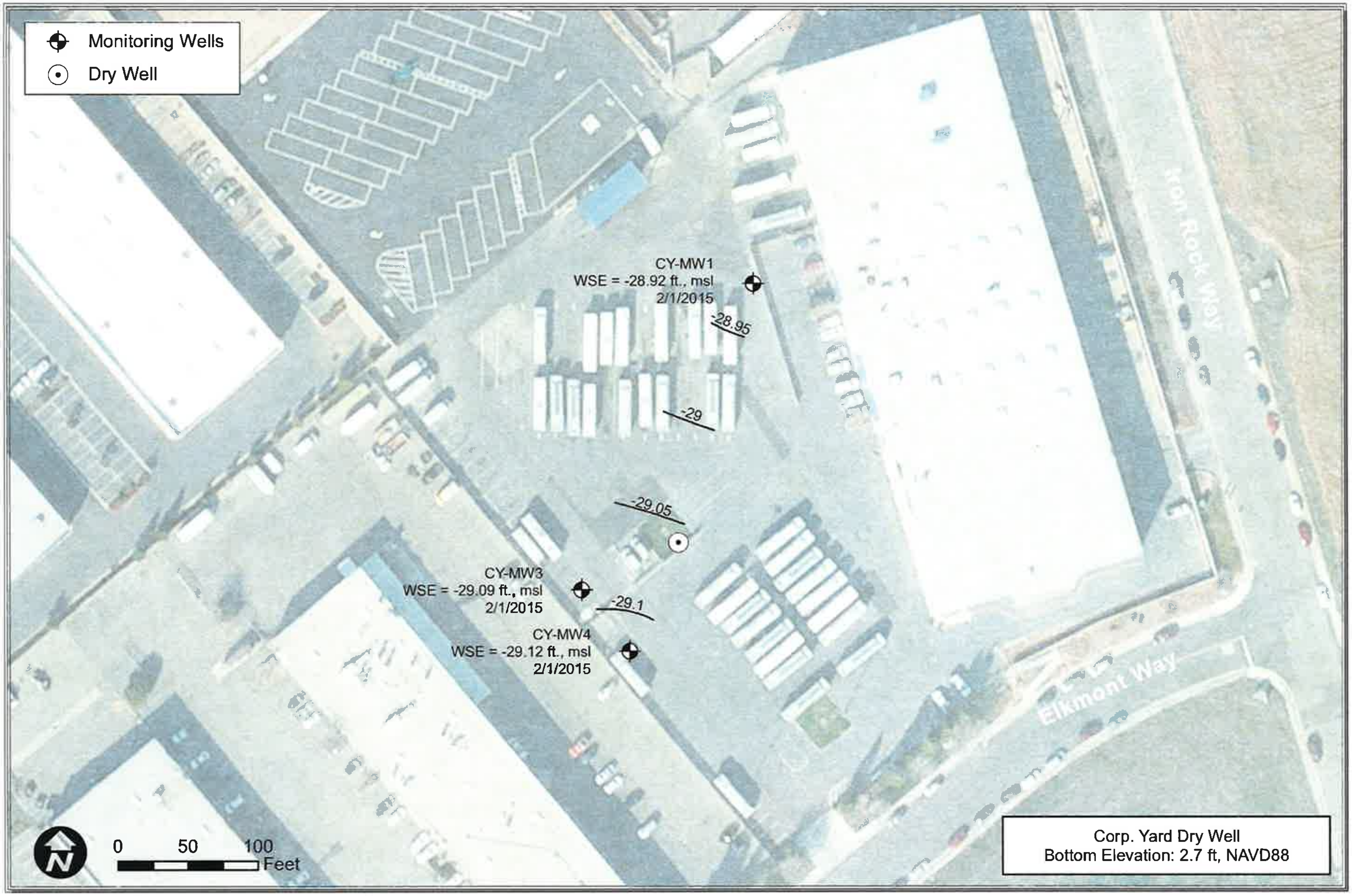

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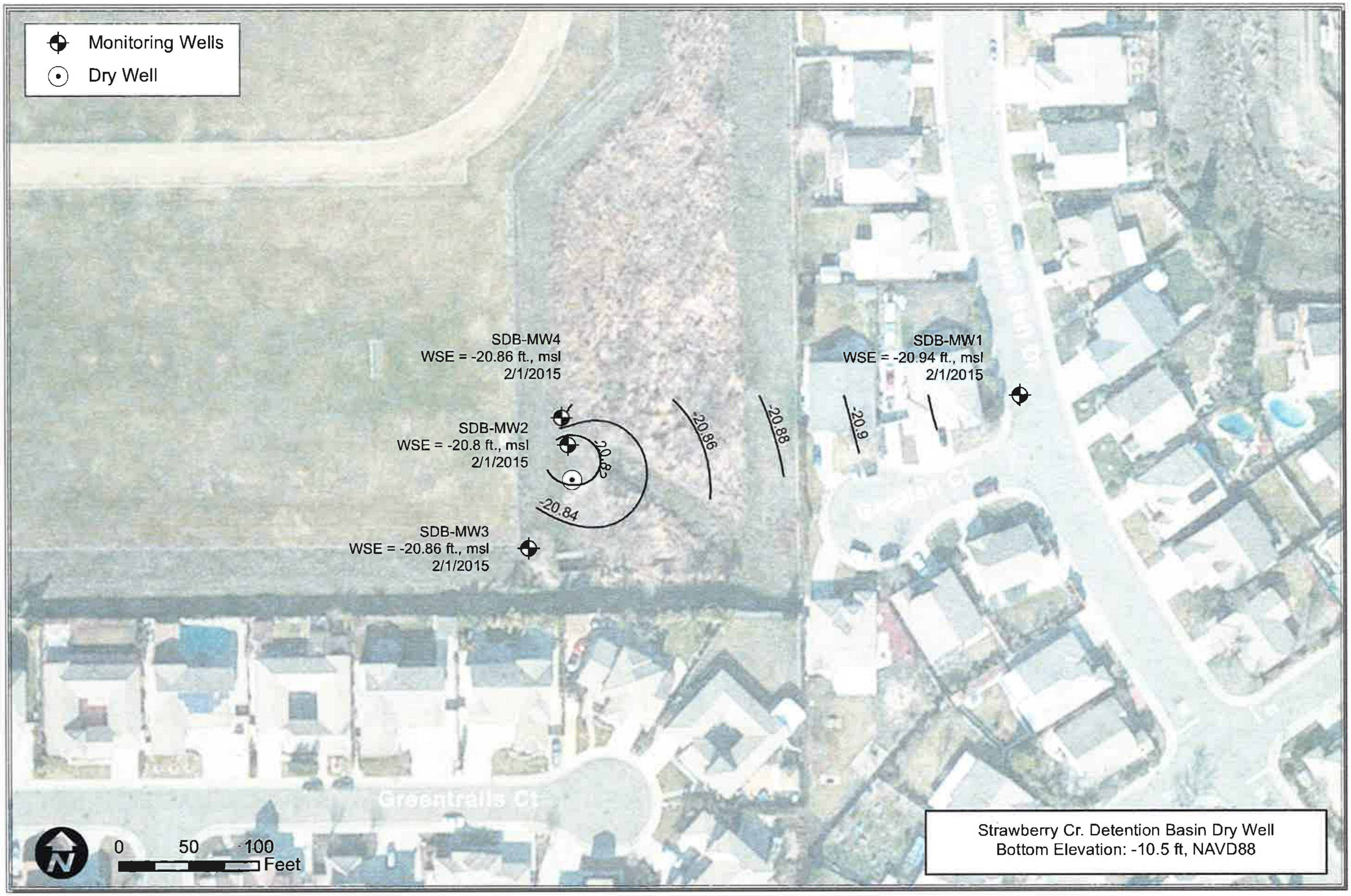
Note: Groundwater elevations are reported in feet relative to the North American Vertical Datum of 1988.

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

February 2015 Groundwater Elevation Contours
Elk Grove Dry Well Project - Elk Grove Corporation Yard



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

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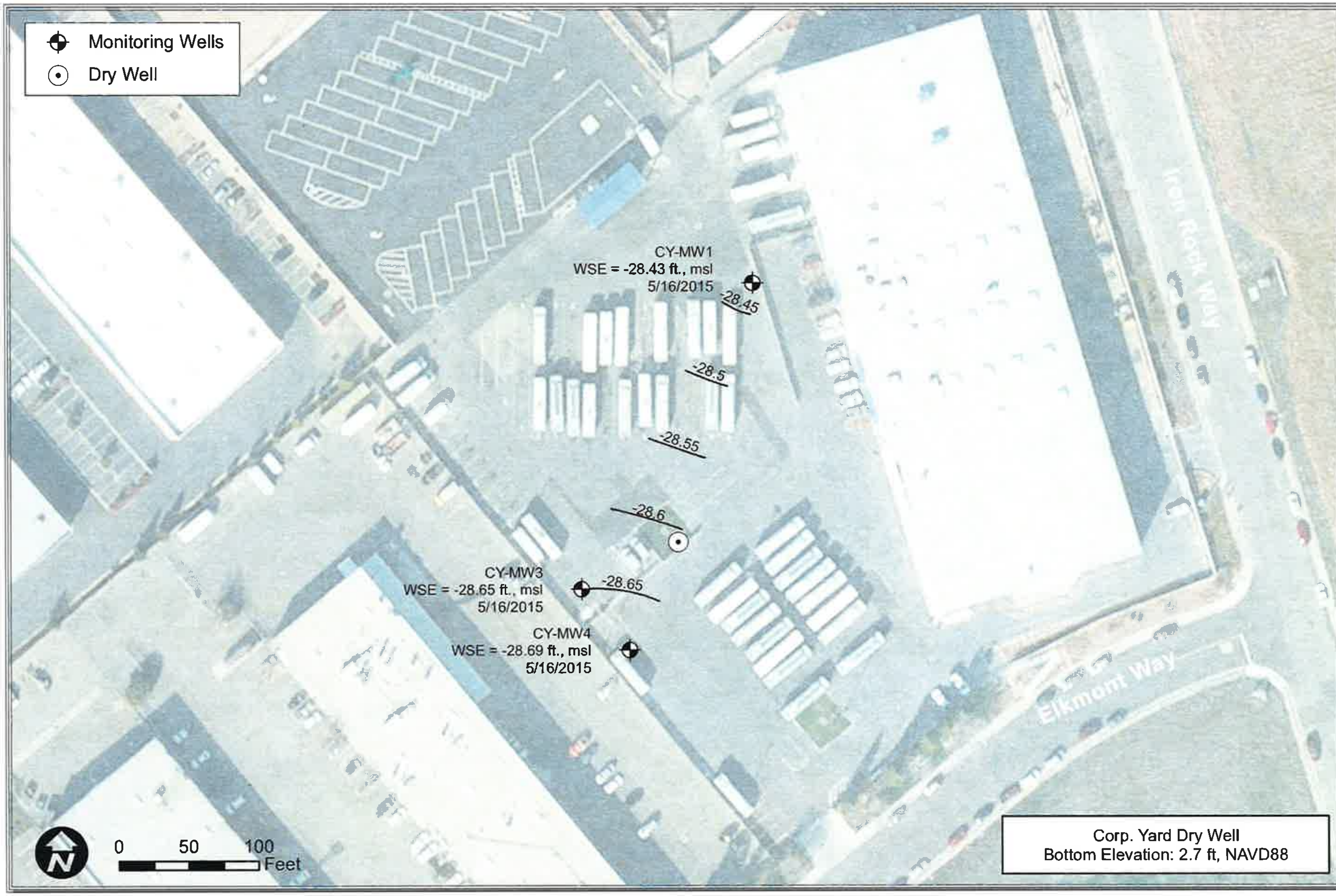
February 2015 Groundwater Elevation Contours
Elk Grove Dry Well Project - Strawberry Creek Detention Basin



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

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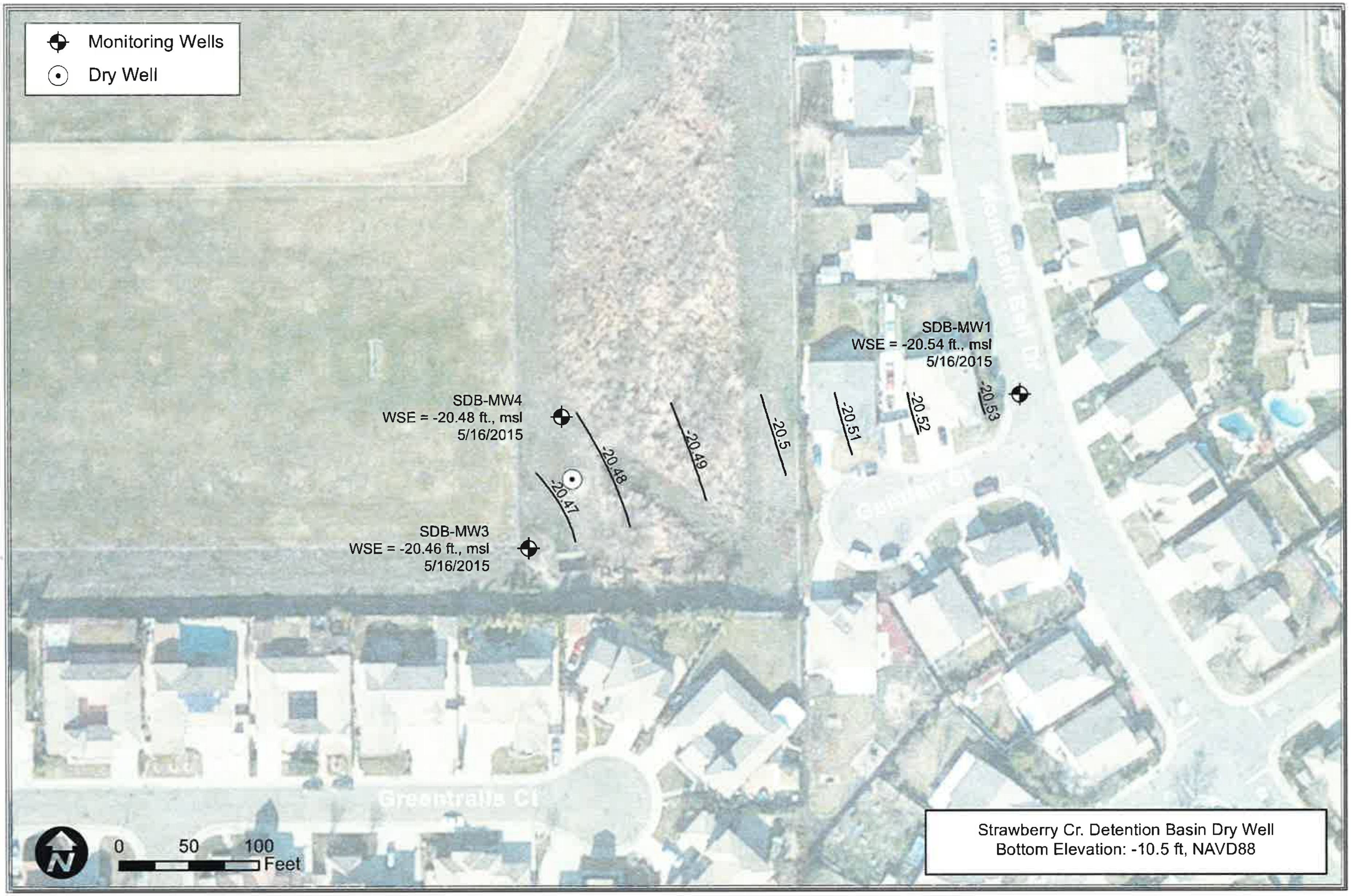
May 2015 Groundwater Elevation Contours
Elk Grove Dry Well Project - Elk Grove Corporation Yard



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

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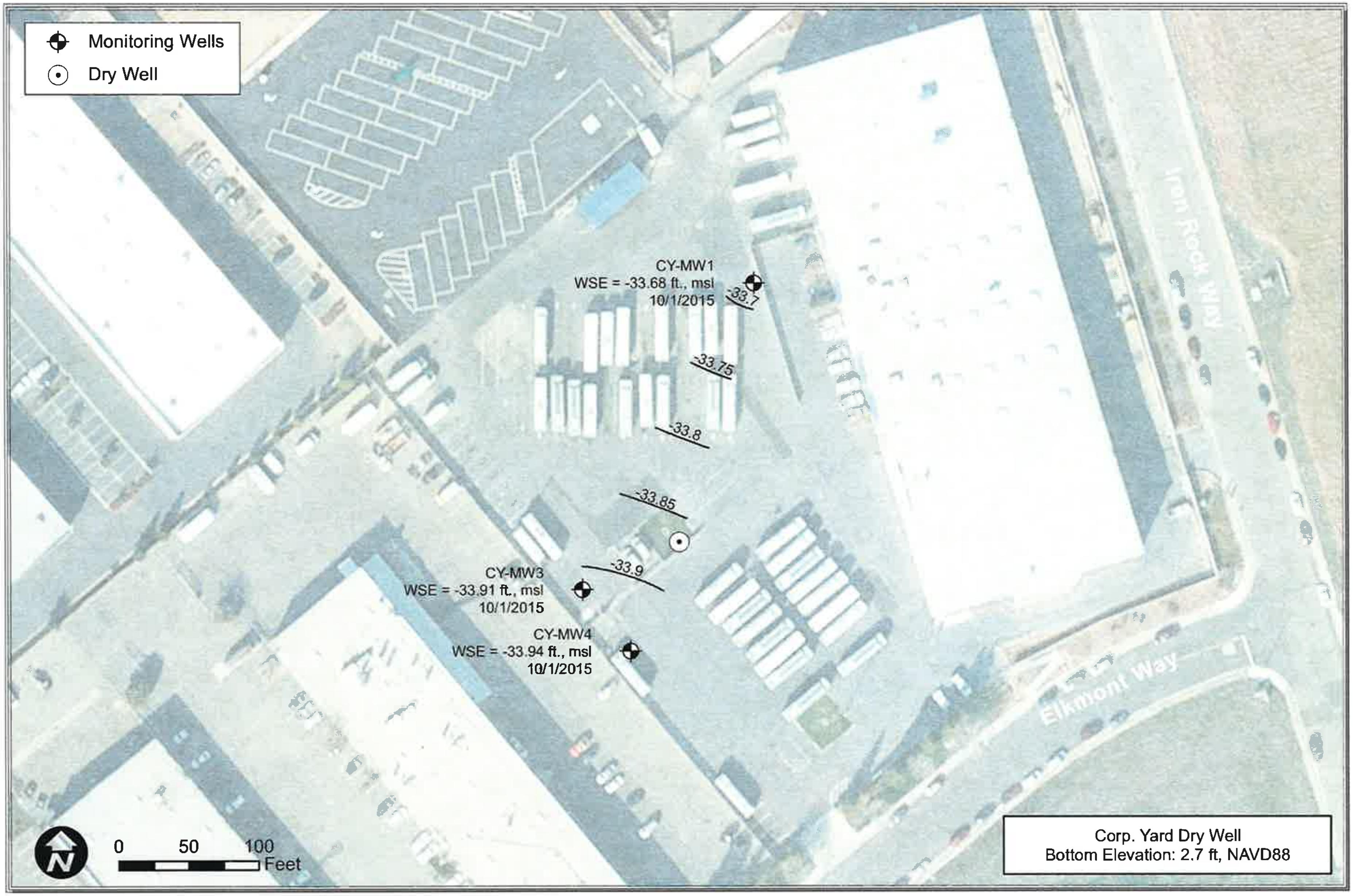
May 2015 Groundwater Elevation Contours
Elk Grove Dry Well Project - Strawberry Creek Detention Basin



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

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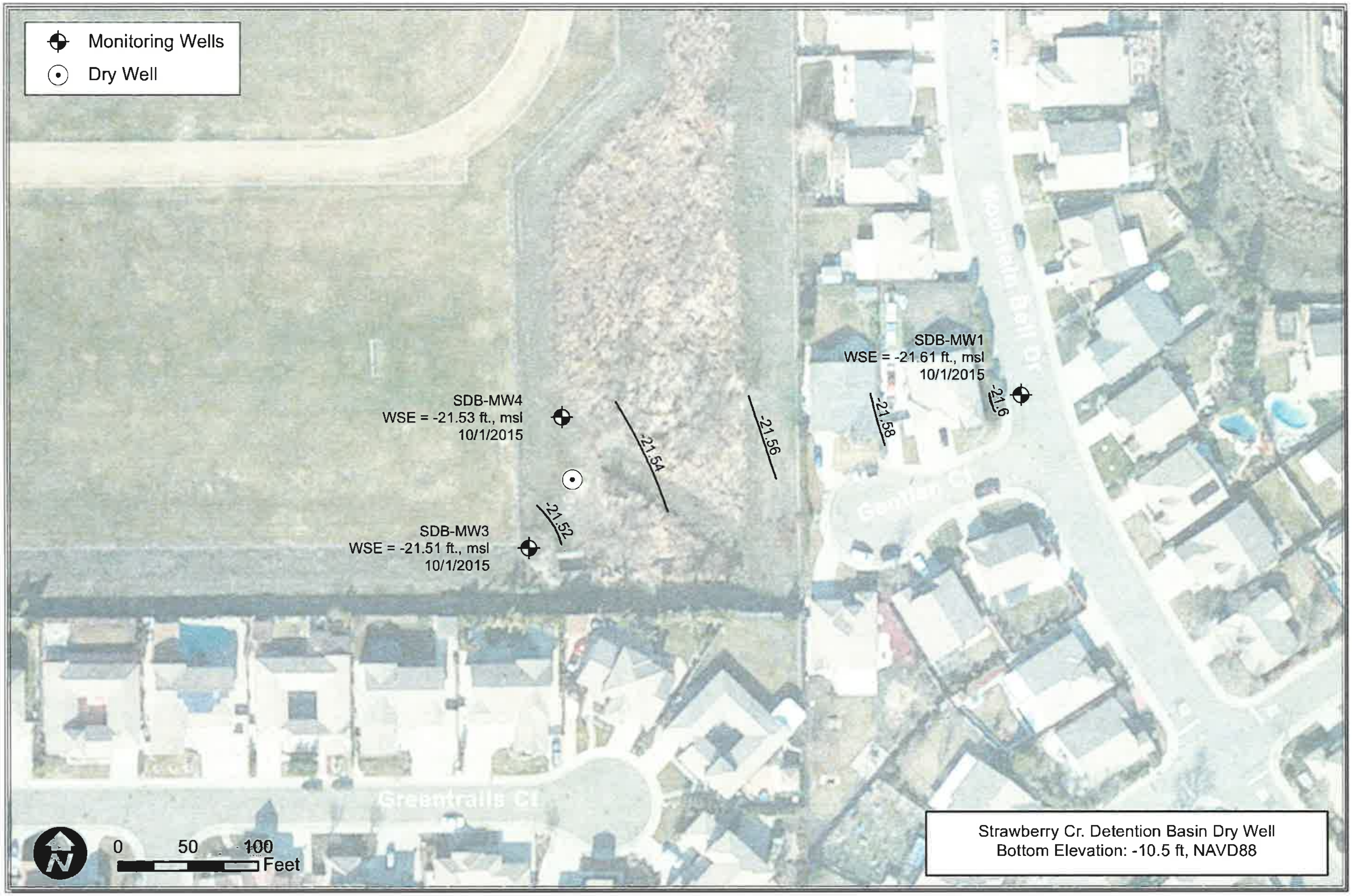
October 2015 Groundwater Elevation Contours
Elk Grove Dry Well Project - Elk Grove Corporation Yard



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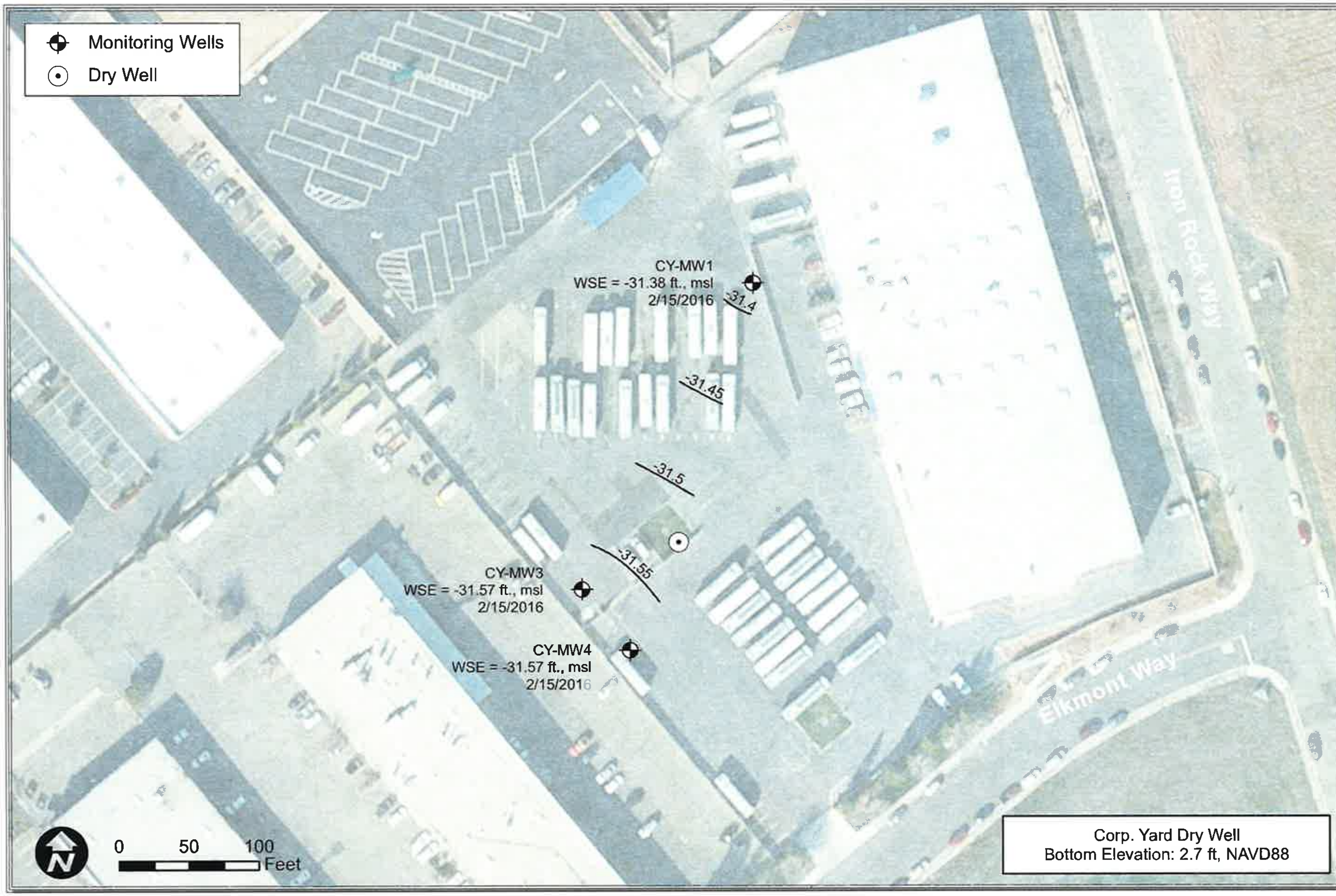
Note: Groundwater elevations are reported in feet relative to the North American Vertical Datum of 1988.

LUHDORFF & SCALMANINI CONSULTING ENGINEERS

October 2015 Groundwater Elevation Contours
Elk Grove Dry Well Project - Strawberry Creek Detention Basin



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

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

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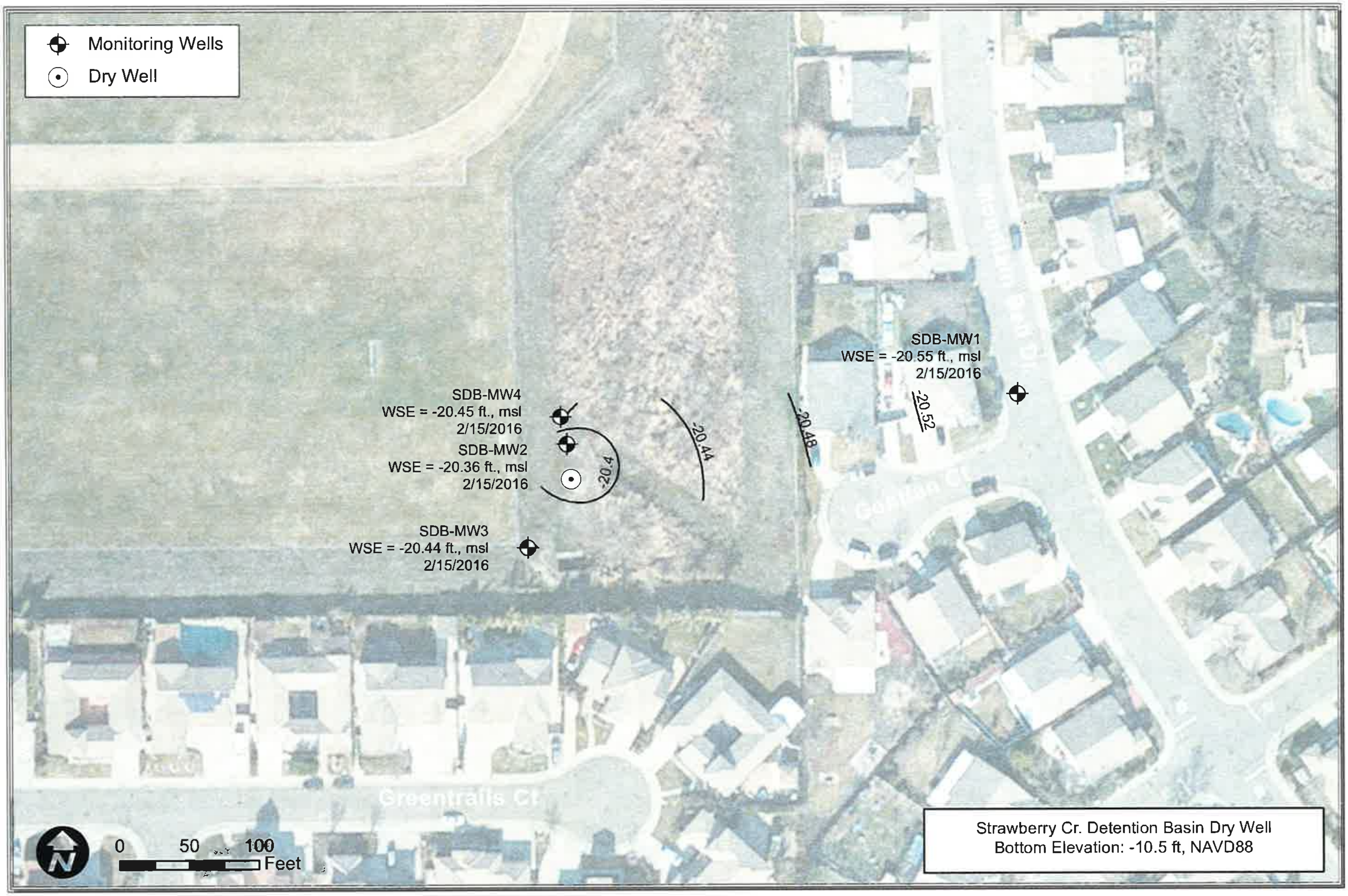
February 2016 Groundwater Elevation Contours
Elk Grove Dry Well Project - Elk Grove Corporation Yard



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

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

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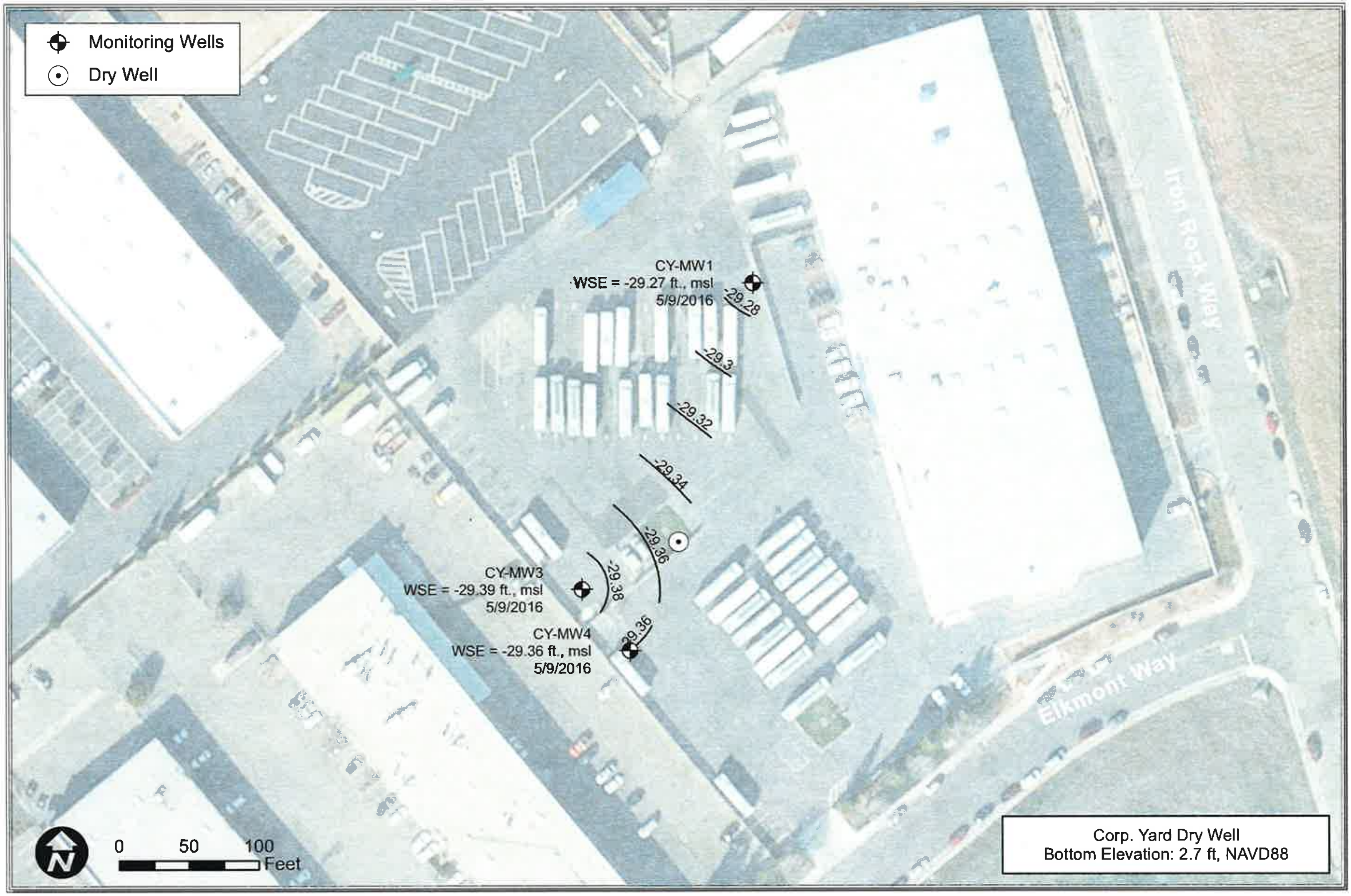
February 2016 Groundwater Elevation Contours
Elk Grove Dry Well Project - Strawberry Creek Detention Basin



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

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

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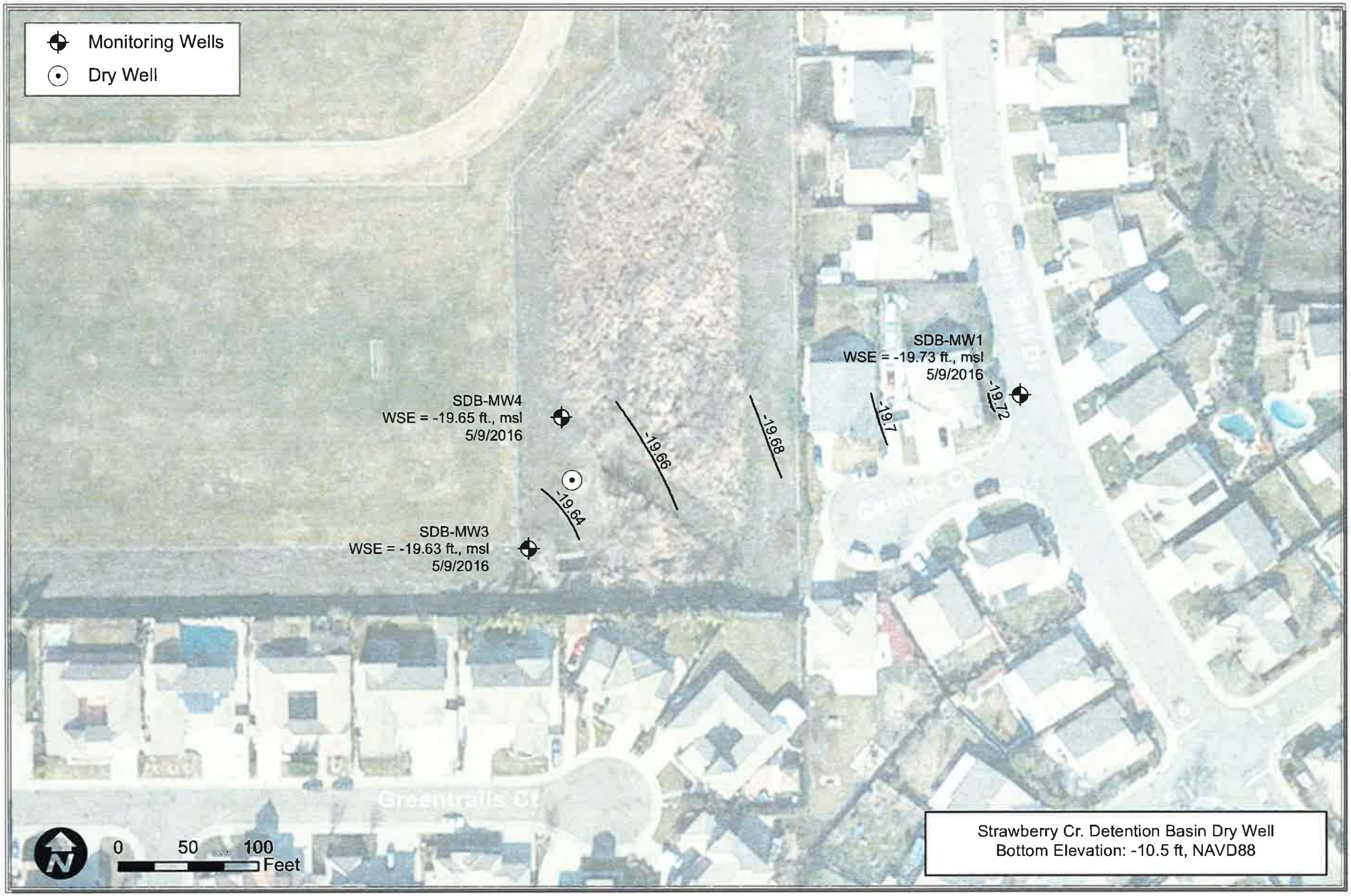
May 2016 Groundwater Elevation Contours
Elk Grove Dry Well Project - Elk Grove Corporation Yard



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

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

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May 2016 Groundwater Elevation Contours
Elk Grove Dry Well Project - Strawberry Creek Detention Basin