

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

Proposition 84 Stormwater Grant Program

Elk Grove, California

Annual Update Summary

Background

This section should include: City and County information; discussion of the watershed; historical uses; problem the project addresses.

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 in the City of Elk Grove (City) in the southern portion of Sacramento County. The project team will design and construct one dry well system, composed of a vegetated pre-treatment feature, sedimentation well for additional pre-treatment, and a groundwater monitoring well network. Two sites with different surrounding land uses have been selected for the study as depicted in Exhibit 1.

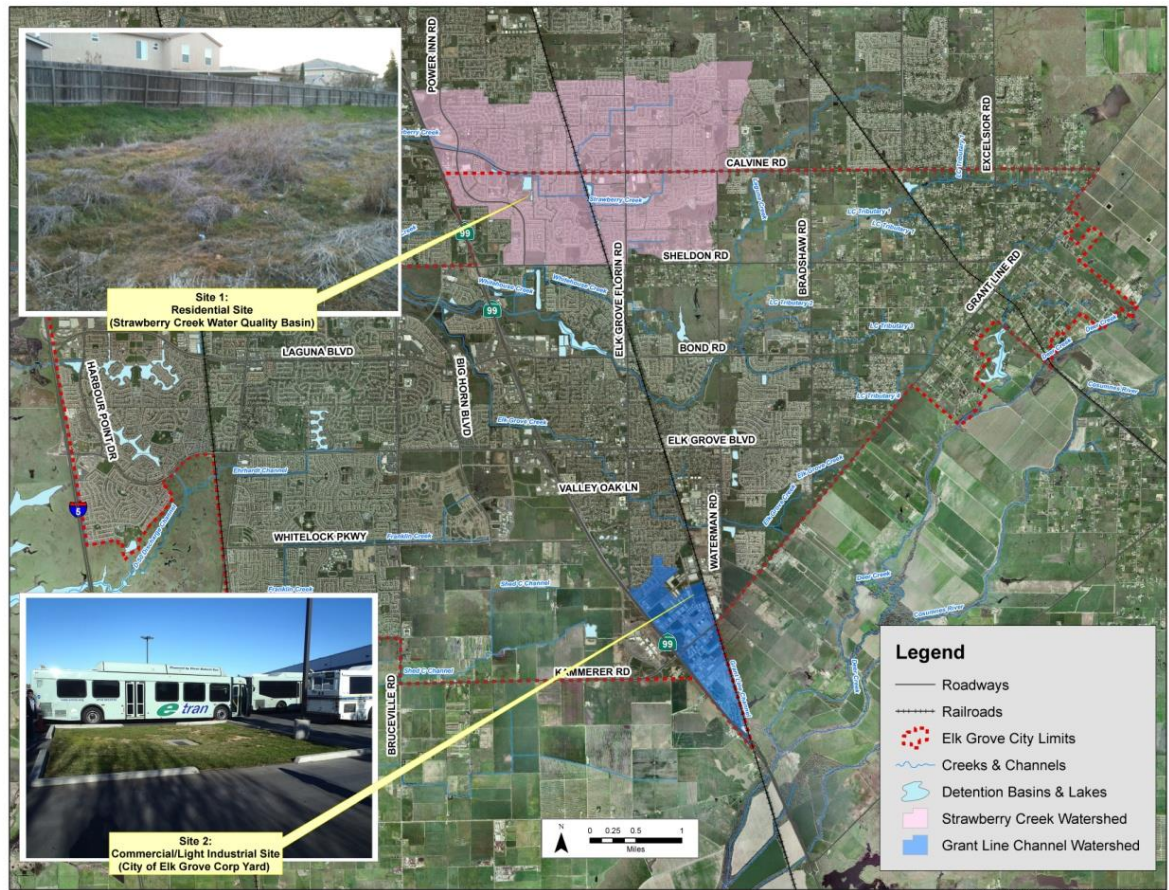


Exhibit 1: Location Map

Site 1 is a residential neighborhood whose stormwater drains into a large water quality basin and Site 2 is a commercial/light industrial area with a large parking lot. Table 1 and 2 provides background information on each site.

Table 1. Site 1: Residential Site - Strawberry Creek Water Quality Basin


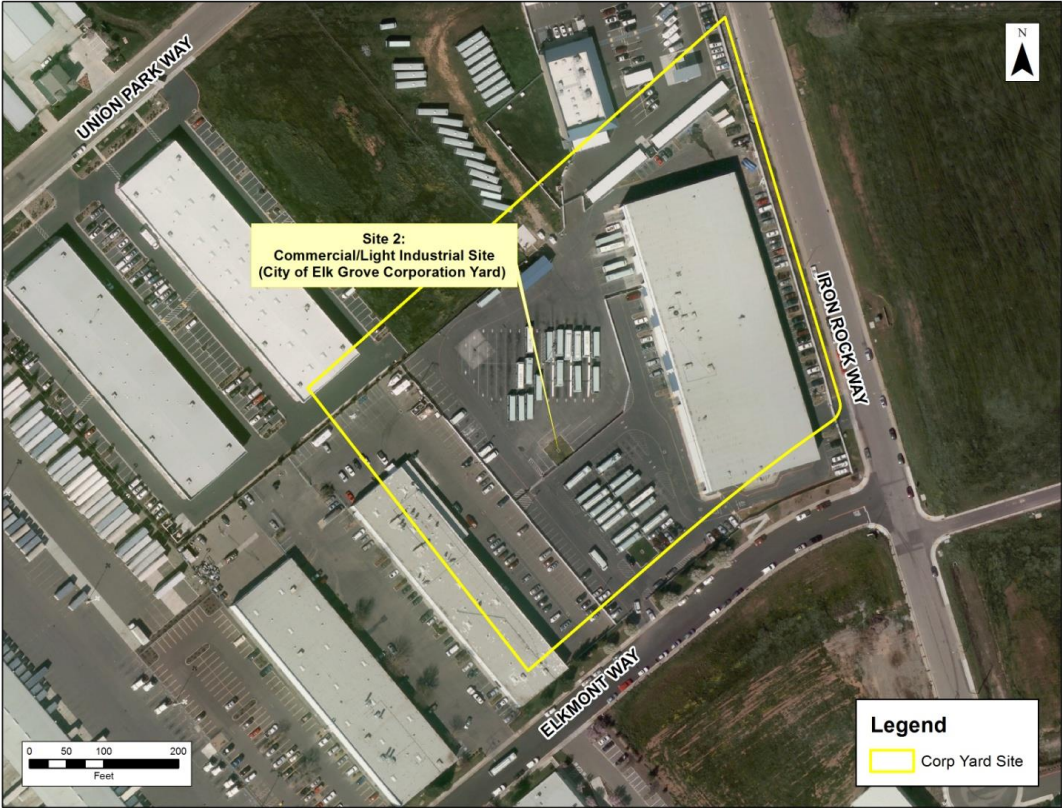
Location	Strawberry Creek detention basin is south of Calvine Road and east of Highway 99.
Watershed	Strawberry Creek Watershed (part of Morrison Creek Watershed).
Land Use	Residential.
Ownership of Study Site	Public. City of Elk Grove.
Soil Type	C and D (assumed).
Depth to Groundwater Type	From boring logs: 58 feet bgs – perched groundwater; 94 feet bgs – water table; Laguna Formation.
Description	<p>This site receives runoff from various surrounding residential subdivisions to the east and south. The drainage catch basin is approximately 168 acres. Stormwater runoff enters the south end of the water quality basin via 2 existing 72" and 30" pipes/culverts. Exhibit 2 depicts an aerial photograph of the Strawberry Creek water Quality Basin.</p> 
<p>Exhibit 2. Site 1: Residential Site - Strawberry Creek Water Quality Basin</p>	

Table 2. Site 2: Commercial/Light Industrial – City of Elk Grove Corporation Yard

Location	10250 Iron Rock Way, Elk Grove, CA 95624
Watershed	Grant Line Channel Watershed (part of Laguna Creek Watershed).
Land Use	Commercial/Light Industrial - receives runoff from Corp Yard facility's parking lot.
Ownership	Public. City of Elk Grove.
Soil Type	C and D.
Depth to Groundwater Type	Estimated from DWR records: 70 feet bgs – water table; Laguna formation.
Description	<p>This site receives runoff from the City's Corporation Yard large parking lot. The catchment size for this site is approximately 0.64 acres. This site houses the City transit buses, police fleet and maintenance equipment/trucks. Transit operations are conducted at the site along with police fleet refueling and City Public Works offices. Exhibit 3 depicts an aerial photograph of the City's Corporation Yard.</p> 
<p>Exhibit 3. Site 2 – Commercial/Light Industrial Site City's Corporation Yard</p>	

Project Description

Project description should include: discussion of the project; how the project will address the problem discussed in Site Description; list the different tasks associated with the project.

The project involves a combination of reviewing existing research on dry wells and their effects on groundwater quality as well as conducting new research at the identified two locations in Elk Grove with different land uses. The project will design and construct one dry well system with a groundwater monitoring well network. The dry well system as depicted in Exhibit 4 is a treatment train of three features: 1) a vegetated pre-treatment area that will infiltrate and/or slow and filter sediment out of stormwater runoff, 2) a structural pre-treatment sedimentation well that permits particles and associated pollutants to settle, and 3) the dry well that will convey stormwater runoff through impermeable layers of clay soil and release it into a geologic layer with high permeability. The dry well will be constructed at a porous layer that is underlain by a layer of clay or other composition with poor permeability. This will facilitate dispersion and attenuation of any contaminants that might remain in the water. Further, within the dry well itself, layers of sand and gravel will provide additional removal of pollutant laden sediments.

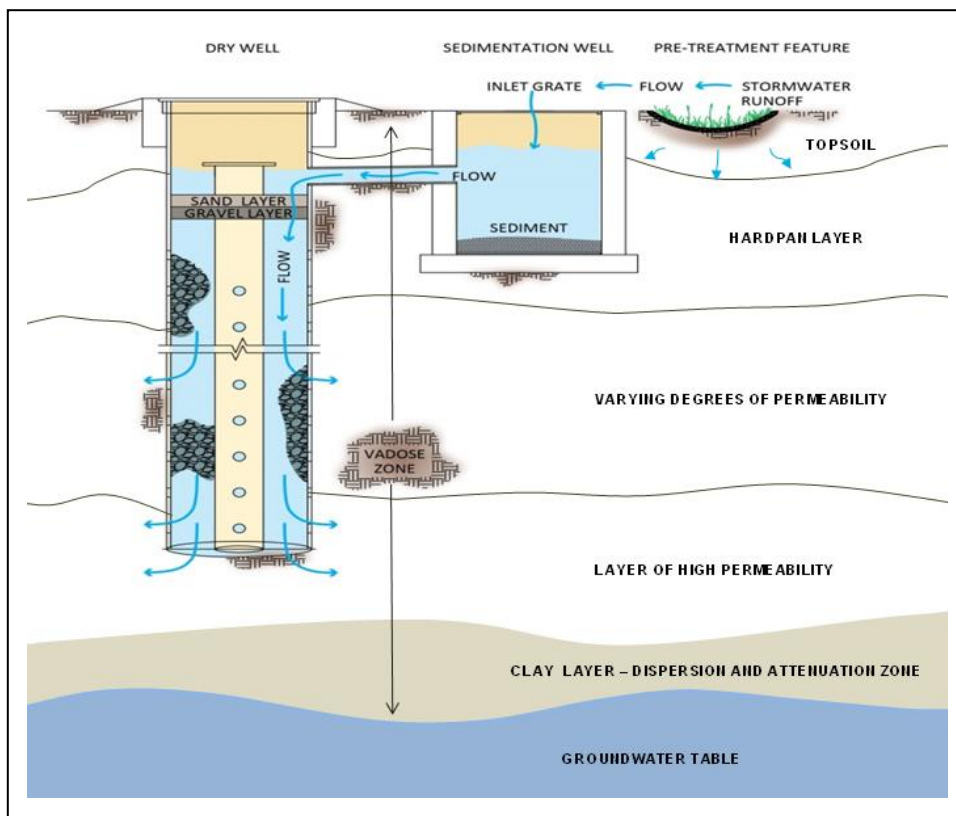


Exhibit 4. Diagram of Dry Well and Pre-treatment Features

At each site, three groundwater monitoring wells will be installed: one up-gradient and two down-gradient of the dry well system to facilitate the assessment of the introduction of contaminants through the dry well. The upgradient well will provide information on the baseline water quality while the two downgradient wells will assess the affects, if any, of the dry well on downgradient groundwater quality. One downgradient vadose zone well will also be installed within 20 feet downgradient of the dry well as an aide to trace the movement of contaminants that pass through the dry well. Exhibit 5 and 6 show the locations of the dry well and monitoring well network system at each site.



Exhibit 5. Diagram of Location of Dry Well and Monitoring Well Network at the Site 1: Residential Site -I Strawberry Creek Water Quality Basin



Exhibit 6. Diagram of Location of Dry Well and Monitoring Well Network at the Site 2: Commercial/Light Industrial Site - City of Elk Grove Corporation Yard

Monitoring of total suspended sediment and pyrethroid concentrations will be measured at the entrance to the vegetated area and just prior to entering the dry well in order to determine the effectiveness of the pre-treatment features at reducing two common urban contaminants: excess sediment and pyrethroids. Stormwater and groundwater samples will be analyzed for organic and inorganic contaminants commonly found in stormwater, including pesticides, metals, and volatile/semi-volatile organics. Samples from both wet and dry seasons will be compared to assess changes in groundwater quality.

Results from the project will be posted on a project's website, along with progress reports, a literature review of scientific and government reports, presentations, factsheets, a lessons learned document, a draft scientific paper, and other information relevant to the project. In addition to posting information on the project's website, this information will be widely distributed through education and outreach efforts at local and regional conferences and meetings of stakeholders' organizations. Outreach efforts will be targeted to interested stakeholders with the goal of sustaining the monitoring effort beyond the term of the grant.

The project will provide valuable information which can be used by local, regional, and state agencies to help fill the gaps in the knowledge and understanding about the appropriate use of dry wells in urban watersheds. It will also assess the potential for the use of dry wells as a stormwater management tool for future improvement projects in Elk Grove.

Project Status

Include what has been completed to date. Discuss what needs to be completed. Discuss issues that arose, how those issues were addressed, and if any deviations from the original scope of work were required. Discuss cost estimate, actual cost, and remaining budget (is the budget more than expected, are you receiving change orders, etc.). This section should include a discussion of the schedule and whether those critical dates and estimated dates in the grant agreement are being met. If they are not, what is occurring to get the project back on track?

The project status is described below:

Tasks Completed

During the nine months of the project, significant strides were made to address logistical issues essential for the implementation of the project. Highlighted below are tasks that were completed in this timeframe:

- Execution of State Water Board agreement, task orders and agreements for subconsultant and Memorandum of Understanding (MOU) with project team organizations.
- Adoption of project through City's City Council.
- Completion of CEQA and NEPA requirements (NOD and NOE).
- Project set-up and administration.
- Convening a Technical Advisory Committee (TAC) and establishing their roles and responsibilities.
- Selection of project sites.
- Presentations of the project background, proposed study design and proposed monitoring efforts at two meetings.
- Meetings and emails to plan and organize the project with project team and TAC.
- Development of 100% design and specifications for pre-treatment features, dry wells, and investigation borings/monitoring wells.
- Development of 100% design for hydrologic and water quality monitoring.
- Design plans vetted through TAC and approved.
- Development and submittal of PAEP, MP and QAPP for review and comment.
- Submittal of 1st invoice and progress report.
- Submittal of deviation form and 1-year extension.

- Implementation of contacts and construction of investigation borings/monitoring wells.
- Development and submittal of GPS coordinates.
- Submittal of budget projections.
- Submittal of various 10-day notifications for meetings and presentations.

In addition, below is Table 3 which summarizes tasks completed to date per the projects scope of work.

Table 3. Summary of Work Completed to Date per Scope of Work

Items Completed	Status	Date Submitted
A.1 GPS Information for project site and monitoring locations	Completed	September 25, 2013
A.2. Project Assessment and Evaluation Plan (PAEP)	Completed Addressing Comments	April 11, 2013
A.3. Monitoring Plan(s) (MP)	Completed Addressing Comments	July 12, 2013
A.4. Quality Assurance Project Plan (QAPP)	Completed Addressing Comments	July 12, 2013
A.6. Copy of final CEQA/NEPA Documentation – Notice of Exemption Environmental Impact Report/Notice of Determination	Completed	January 17, 2013 April 17, 2013
A.7. Public Agency Approvals, Entitlements, or Permits	As Needed Encroachment Permits for Investigation Boring/MW	September 20, 2013
B.1.2. 10-Day Notification of Upcoming Meetings, Workshops, and Training	As-needed	Various Dates
B.2.2. Final List of TAC Members, Their Roles and Responsibilities, and Commitment Letters	Completed	May 15, 2013
B.3.2. Dry Well Designs	Completed As-builts will be submitted after construction	July 12, 2013
B.3.3. Pre-treatment Designs	Completed As-builts will be submitted after construction	July 12, 2013
B.3.4. Hydrologic and Water Quality Monitoring Designs and Specifications	Completed As-builts will be submitted after construction	July 12, 2013
B.3.5. Groundwater Quality Monitoring Design Plans and Specifications	Completed As-builts will be submitted after construction	June 30, 2013
Invoice	Submitted first quarters progress report	Quarterly
G.1. Progress Reports	Submitted first quarters progress report	Quarterly
G.2. Annual Progress Summaries and PAEP Status Update	Submitted annual progress report and PEAP update	Annually September 30th

Tasks in Progress

The following tasks that are currently in progress are described below:

- Construction of investigation borings/monitoring wells and logging soil samples (Exhibits 7 and 8).
- Development of project's website.
- Preparation of factsheets.
- Development of literature review.
- Revising PAEP and QAPP, in response to comments.
- Amendments to subconsultant contracts for additional work associated with 1-year extension.
- Preparation for presentations and outreach efforts.
- TAC updates and milestones.
- Preparation for recording groundwater levels in winter 2013.
- Preparation for and completing selected baseline sampling.
- Preparation of bid package for dry wells.
- Development of monitoring and dry well closure/abandonment plan.
- Development of Operations & Maintenance manual.
- Construction of dry wells and pre-treatment features spring 2014.
- Project administration, including quarterly invoices and progress reports.



Exhibit 7. Site 1: Residential Site - Strawberry Creek Water Quality Basin
Drilling of Investigation Borings/Monitoring Wells

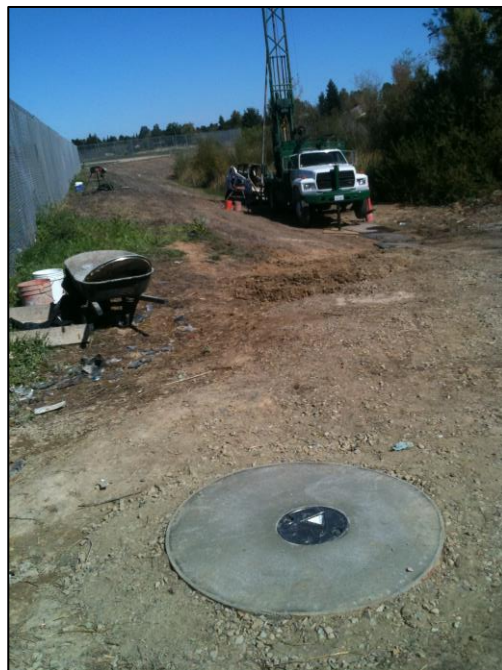


Exhibit 8. Site 1: Residential Site - Strawberry Creek Water Quality Basin
First Monitoring Well and Drilling of Third Investigation Borings/Monitoring Wells

In addition, below is Table 4 which summarizes tasks currently in progress per the projects scope of work.

Table 4. Summary of Work in Progress per the Scope of Work

Items in Progress	% Of Work Complete	Status/Date Submitted
A.2. PAEP	85%	Addressing comments/ July 12, 2013
A.3. MP	85%	Addressing comments/ July 12, 2013
A.4. QAPP	85%	Addressing comments/ July 12, 2013
A.7. Public Agency Approvals, Entitlements, or Permits	20%	On-going
B.1.2. 10-Day Notification of Upcoming Meetings, Workshops, and Training	40%	On-going
B.2. TAC	20%	On-going
B.4.1.1. A Copy of Bid Summary and Proof of Advertising for Dry Wells	20%	On-going/ August 2014
B.4.2. Well Completion Logs for Monitoring Wells and Dry Wells	15%	On-going/ October 2014
B.5.1. Stormwater Monitoring Reports and Proposed Edited Sampling Protocol Revisions	90 Days Following Each Sampling Season	On-going
B.6.1. Groundwater Monitoring Reports and Proof of Submittal to GAMA	90 Days Following Each Sampling Season	On-going
B.8.1. Meeting Materials	40%	On-going/ December 2016
B.8.2. Fact Sheets	60%	On-going/December 2016/June 2016
B.8.3. Literature Review	60%	On-going/ December 2014
B.8.6. Monitoring and Dry Well Closure/Abandonment Plan and O & M Plan	10%	On-going/ December 2016
Invoicing	5%	On-going/Quarterly
G.1. Progress Reports	5%	On-going/Quarterly
G.2. Annual Progress Summaries and PAEP Status Update	20%	On-going/Annually September 30

Tasks Outstanding

Table 5 addresses the items that have not been undertaken per the project's scope of work:

Table 5. Summary of Work in Progress per the Scope of Work

Item	Description	Due Date
A.5.	Proof of Water Quality Data Submission to CEDEN	Before Final Invoice
B.7.3	Project Team and TAC Report of Results and Interpretations	December 2016
B.8.4	Draft Scientific Paper and Summary of TAC Peer Review Comments	January 1, 2017
B.8.5	Guidance Document	February 1, 2017
B.9.1	Project Assessment and Reporting Results	December 2016
G.3.	Natural Resource Projects Inventory (NRPI) Survey Form	Before Final Invoice
G.4.	Draft Project Report	November 1, 2016
G.5.	Final Project Report	February 1, 2017
G.6.	Final Project Summary	Before Final Invoice

Project Issues

A number of obstacles were also encountered and solutions were identified. These include:

- *Misinterpretation of timing of some deliverables:* Resolution involved increased contact between State Water Board and City with meetings to clarify goals and issues.
- *Complex administrative issues and an aggressive schedule that required numerous exceptions to standard protocols to meet deadlines:* Resolution deviation request and 1-year extension to permitted slower and more careful steps to ensure successful implementation of the project.
- *Selection of appropriate classes of contaminants for analysis:* Project budget does not permit analysis of all contaminants of interest. Resolution involved adding certain classes of analytes and removing one class; tiering analytes and applying an adaptive management strategy as data is produced and analyzed.
- *Logistical problems with the Grant Line roadway site:* Resolution was to identify alternative sites and ultimately the decision was made to eliminate the roadway site due to budget constraints.
- *Extensive modifications to the simple dry well design to ensure minimal clogging of dry well and reduction of contaminants entering dry well:* Resolution involved intense review of literature and practices around the world to ultimately arrive at current three (3) part design system.
- *Access issues with Strawberry Creek Detention Water Quality Basin:* Resolution was a right-to-enter granted from Elk Grove Unified School District and a 50' drainage easement is being dedicated to the City.
- *Timing issue with public bid process for construction and MP and QAPP approval:* Resolution deviation request, 1-year extension, moving investigation borings/monitoring wells to the Planning, Design, Engineering/Environmental task from the Construction/Implementation task, and increasing matching funds.

Deviation from Scope of Work, Budget and Schedule

The City requested a deviation and 1-year time extension for the project as recommended by the State Water Board and Technical Advisory Committee. The City amended the scope of work to accommodate recommended investigation boring/monitoring layout design changes, additional sampling of contaminants to produce better project results, schedule changes to come into compliance with deliverable dates, 1-year extension to approve design, MP and QAPP, changed timing for groundwater baseline monitoring efforts, and additional time to go through public bid process to construct project following design and MP/QAPP approval.

In addition, the budget changed due to refined cost estimates for investigation borings/ monitoring wells and dry wells, the addition of two sedimentation wells to the design for pre-treatment features, the additional costs for monitoring efforts, and the additional project costs for a 1-year extension. The increase in budget will be matching funds from the City.

The deviation request to revise the project's agreement and schedule to accommodate the revised project scope and 1-year extension will meet the original intent of project and ensure the project remains on schedule and within budget.

Project Assessment and Evaluation Plan Update

This section should include a discussion on whether the targets listed in the PAEP will be met. Is the project staying on task? Provide a list of the targets in the approved PAEP and discuss each of them separately. If an update to the PAEP is required, the revised PAEP should be included with the Annual Update Summary.

The City's PAEP has not been approved and is being submitted with the Annual Progress Report for approval. The PAEP has been revised to reflect the current scope of work of the project and comments

have been addressed regarding the title page, signature page, removal of percent's for targets, and Core Outcome Indicators.

The targets of the PAEP are identified in Table 6 with a brief summary of their status.

Table 6. PAEP Targets Summary
Planning, Research, Monitoring, and Assessment

Project Goals	Targets	Target Status
<p>1. Assess the potential for contamination of groundwater associated with the use of dry wells with pre-treatment features for infiltrating stormwater runoff from different land uses.</p>	<p>1. Concentrations of contaminants in the aquifer will remain below the California Maximum Contaminant Levels for all anthropogenic contaminants. 2. There will be no statistically significant difference in the groundwater quality in the upgradient and downgradient monitoring wells (using Mann-Kendall test).</p>	<p>Sampling has not begun. These targets remain the same. Adjustments may occur after the first year of sampling.</p>
<p>2. Assess the ability of the various pre-treatment features to remove suspended solids and contaminants from stormwater</p>	<p>1. Statistically significant reduction in TSS and pyrethroids in stormwater by the pre-treatment features (using Mann Whitney U test). 2. Sedimentation well and dry well and/or cleaning to remove sediment less than one time per year.</p>	<p>Sampling has not begun. These targets remain the same. Adjustments may occur after the first year of sampling.</p>

Education, Outreach and Capacity Building

Project Goals	Targets	Target Status/Summary
<p>1. Provide education and outreach on the use, benefits and limitations of dry wells with pre-treatment features</p>	<ol style="list-style-type: none"> 1. 1,000 visits to project website. 2. 500 copies of each factsheet distributed and/or downloaded. 3. 500 downloads of literature review. 4. 500 downloads of lessons learned document. 5. List of > 100 interested stakeholders on project. 6. Presentations given to a minimum of 500 people in target audience (scientists, engineers, and stormwater/ groundwater managers). 7. One or more meetings with the stakeholders' working group. 8. One or more guidance documents on dry well design/use that are produced by local, regional, or state regulatory agencies. 	<ol style="list-style-type: none"> 1. No change. City is in the process of developing project website and OEHHA has set up a temporary webpage. 2. No change. Factsheets are being developed. 3. No change. Literature review is being performed and developed. 4. No change. Lessons Learned document is not currently in progress. 5. No change. To date, approximately 50 interested stakeholders is on the project's distribution list. 6. No change. Presentations have been given to approximately 200 people as September, 2013. 7. No change. Completed one TAC meeting. 8. No change. Guidance documents are not currently in progress.