Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

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May 10, 2010

Dr. Keith Maruya
Southern California Coastal Water Research Project
3535 Harbor Blvd., Suite 110
Costa Mesa, CA 92626

Via email to: keithm@sccwrp.org

Subject: Comments on April 15, 2010 Draft Report of Science Advisory Panel on Chemicals of Emerging Concern (CECs) in Recycled Water

Dear Dr. Maruya and Panel Members:

Inland Empire Utilities Agency (IEUA) is pleased to submit comments on the April 15, 2010 *Draft Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water: Recommendations of a Science Advisory Panel.* IEUA produces and supplies recycled water for irrigation, groundwater recharge, industrial, and agricultural uses. IEUA's water recycling program is regulated by our NPDES permit (R8-2009-21) and our groundwater recharge permits (R8-2005-0033 (Phase I) and R8-2007-0039 (Phase II)). Annually, we publish a report on the water quality of the IEUA water recycling plants and the additional soil aquifer treatment at the specific recharge facilities, as required by our permits. IEUA has monitored for CECs and that data is included in our monitoring reports. A table summarizing the results of our CEC monitoring is attached. Under permit and as requested by California Department of Public Health, an independent expert advisory panel was convened in 2010 to review our recharge operations. Their report, dated April 14, 2010, is also attached.

Thank you for the opportunity to submit comments on the Panel's draft report. We appreciate the Panel's logical and scientific approach to developing a recommended monitoring strategy for CECs. The recommended step-wise approach to screening and prioritizing CECs for monitoring is conservative, yet practical. It appropriately considers the toxicological relevance of the levels of CECs found in recycled water with regard to human health and distinguishes between landscape irrigation and groundwater recharge projects. The Panel has appropriately designed the framework so that monitoring can be modified if constituents are routinely found not to be present, and has provided a workable response plan based on monitoring results.

We support the recommended framework to guide current and future prioritization of individual CECs for monitoring recycled water quality. We also support the recommended methodology of using surrogate and indicator compounds for tracking water reclamation treatment performance. With some clarification (see below), both the prioritization framework and treatment performance methodology, if adopted by the State Water Resources Control Board, will ensure that CEC monitoring requirements will be consistently applied to water reuse projects.

While we are generally supportive of the overall approach adopted by the Panel, in order to assist the public, State Water Resources Control Board (SWRCB), Department of Public Health (DPH) and water recyclers with how to interpret the report, we recommend that some additional detailed guidance be provided. Specifically, we recommend that the the report be expanded to:

- Provide more guidance on how many and which classes of chemicals to include as performance indicators, assuming that a water recycler has already completed baseline monitoring and has no findings of toxicological significance.

- Clarify if the Panel is recommending to choose a treatment performance indicator chemical or chemicals from each of the Good, Intermediate, and Poor removal categories in order to achieve the goal of representing suites of chemicals with different characteristics.

- Discuss the pros and cons of using BDOC, change in DOC, or TOC as a surrogate performance indicator for soil aquifer treatment. What information needs to be developed to make this decision?

Thank you for considering these comments. If you have any questions, please contact Mr. Chris Berch at (909) 993-1762.

Sincerely,
INLAND EMPIRE UTILITIES AGENCY

Richard W. Atwater
Chief Executive Officer/
General Manager

Attachments:

1. NWRI Independent Advisory Panel Final Report Regarding the Inland Empire Utilities Agency's Groundwater Recharge Permit Amendment (April 14, 2010)
2. Chino Basin Recycled Water Groundwater Recharge Program 2009 Annual Report (May 1, 2010)
3. IEUA GWR Monitoring Data, 2005 to Present, Endocrine Disrupting Chemicals and Pharmaceuticals

Attachment 1

NWRI National Water Research Institute

Jeffrey J. Mosher
Executive Director

E-mail: jmosher@NWRI-USA.org

April 14, 2010

Mr. Patrick Sheilds
Executive Manager of Operations
Inland Empire Utilities Agency
6075 Kimball Ave., Bldg. B
Chino, California 91708

Subject: NWRI Independent Advisory Panel Final Report Regarding the Inland Empire Utilities Agency's Groundwater Recharge Permit Amendment

Dear Mr. Sheilds:

The National Water Research Institute (NWRI) is pleased to submit the final report of the NWRI Independent Advisory Panel for Inland Empire Utilities Agency's Groundwater Recharge Permit Amendment.

The report is based on presentations and discussions that occurred at a meeting held February 8-9, 2010, in Chino, California. All six Panel members attended this meeting and participated in the development of the 17-page final report, which includes findings and recommendations for the following:

- Source Control Program
- Soil Aquifer Treatment
- Recycled Water Management Plan
- Diluent Water
- Calculating Underflow as a Source of Diluent Water
- Extending the RWC to 120 Months

If you have any questions, please do not hesitate to call me at (714) 378-3278 or email jmosher@nwri-usa.org.

Sincerely,

NATIONAL WATER RESEARCH INSTITUTE

Jeffrey J. Mosher
Executive Director

Enclosures
cc: James Crook, Ph.D., P.E., Panel Chair

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<u>NATIONAL WATER RESEARCH INSTITUTE</u>

Final Report

of the February 8-9, 2010, Meeting of the

Independent Advisory Panel

for the

Inland Empire Utilities Agency's Groundwater Recharge Permit Amendment

April 14, 2010
Fountain Valley, California

Disclaimer

This report was prepared by an NWRI Independent Advisory Panel, which is administered by the National Water Research Institute (NWRI). Any opinions, findings, conclusions, or recommendations expressed in this report were prepared by the Panel. This report was published for informational purposes.

Purpose of the Panel

In 2009, the Inland Empire Utilities Agency (IEUA) of Chino, California, received approval from the California Regional Water Quality Board, Santa Ana Region (Regional Board) to increase the Recycled Water Contribution (RWC) averaging period for the Chino Basin Recycled Water Ground Water Recharge Program from its current 60-month averaging period to a 120-month averaging period[1]. The purpose of this change is to address the water supply shortage of imported water from the State Water Project needed as diluent water for IEUA's groundwater recharge basins.

IEUA requested that the National Water Research Institute (NWRI) of Fountain Valley, California, form an Independent Advisory Panel (Panel) in 2009 to monitor, evaluate, and report on IEUA's current groundwater recharge projects and on any possible implications that may result from extending the averaging period for RWC from 60 months to 120 months and from using underflows into the basin as diluent water. This Panel was developed to meet requirement F.22 (Required Notices and Reports) of the amended Regional Board Order No. R8-2009-0057, which stated that IEUA "shall submit a written report based on the findings of a scientific peer reviewed panel."[2]

Specifically, the Panel is charged with:

1. Evaluating the change in the calculation period for a running monthly average RWC from 60 months to an extended RWC compliance period for 120 months (including reporting changes for IEUA's annual "Recycled Water Management Plan").
2. Reviewing the assessment of diluent water contributions, including underflows into the basin, for calculating the RWC.
3. Reviewing the criteria needed to provide an "equivalent level of public health protection" while operating under the amended permit that extends the RWC averaging period and allows for consideration of using underflows into the basin as diluent water.

Panel members include:

- *Chair*: James Crook, Ph.D., P.E., Environmental Engineering Consultant (Boston, MA)
- Richard Bull, Ph.D., MoBull Consulting (Richland, WA)
- Jean-François Debroux, Ph.D., Kennedy/Jenks Consultants (San Francisco, CA)
- Dr.-Ing. Jörg Drewes, Colorado School of Mines (Golden, CO)
- Peter Fox, Ph.D., Arizona State University (Tempe, AZ)
- Dennis Williams, Ph.D., P.G., CHG, GEOSCIENCE Support Services, Inc. (Claremont, CA)

A short biography of each Panel member is included in **Appendix A**.

[1] California Regional Water Quality Control Board, Santa Ana Region. Order No. R8-2009-0057, Amending Order No. R8-2007-0039, Water Recycling Requirements for Inland Empire Utilities Agency and Chino Basin Watermaster, Chino Basin Recycled Water Groundwater Recharge Program Phase 1 and Phase II Projects, San Bernardino County. Adopted October 23, 2009.
[2] Ibid.

Introduction

A two-day meeting of the NWRI Independent Advisory Panel for IEUA's Groundwater Recharge Permit Amendment was held February 8-9, 2010, at IEUA's facilities in Chino, California.

Representatives from IEUA gave presentations during this meeting on the following topics:

- Source Control Program
- Soil Aquifer Treatment (SAT)
- Recycled Water Management Plan Reporting
- Overview of WateReuse Study WRF-06-018 – "Tools to Access & Understand the Relative Risks of Indirect Potable Reuse Projects"
- Diluent Water
- Proposal for Calculating Underflow as a Source of Diluent Water

This meeting also included a site tour of two of IEUA's recharge basin sites: Turner and Eighth Street. The complete meeting agenda is included in **Appendix B.**

A complete list of meeting attendees is included in **Appendix C**.

Findings and Recommendations

The Panel's recommendations are strictly in the context of the IEUA project. These recommendations were made in consideration of the unique aspects of the IEUA system (e.g., the Chino Basin aquifer and associated hydrogeology is well characterized, there is a very deep vadose zone used for SAT, and the bulk of industrial wastewater generated in IEUA's service area is excluded from IEUA's water reclamation system).

1. Source Control Program

a. IEUA owns and operates two independent wastewater collection systems for its service area – a non-reclaimable wastewater system for industries with large industrial wastes and a regional sewer system that primarily serves residential customers, although there is some commercial and industrial input. Wastewater from the non-reclaimable wastewater system is collected and exported to treatment plants outside of its service area for treatment and discharge, while wastewater from the regional sewer system is treated at IEUA facilities. The separation of industrial discharges is a unique situation that minimizes the impact of industrial sources on the recycled water system.

b. Although IEUA's member cities manage their own source control programs, IEUA is the responsible control agency. It is the Panel's finding that IEUA has an efficient pretreatment program in place with appropriate program elements and oversight. There is a low probability that industrial toxic pollutants would be present in the recycled water at levels that would adversely impact the treatment or use of the water for groundwater recharge.

2. Soil Aquifer Treatment

a. Based on data obtained at the recycled water recharge sites (or clusters of sites), the Panel concludes that:
   - The recycled water is amenable to treatment across the entire deep vadose zone (approximately 300 feet).
   - IEUA's current practice of determining the RWC at the compliance lysimeters (which are located between 20 and 35 feet below the top of the vadose zone) is a conservative measure of the total organic carbon (TOC) removal that occurs during SAT; additional TOC removal at deeper depths is likely.
   - Surrogate parameters (such as biodegradable organic carbon [BDOC]) and indicator compounds suitable to assess SAT performance suggest that SAT at the various recharge basins is primarily based on biological processes that indicate sustainable removal of TOC and trace organic chemicals.

b. The ongoing TOC monitoring program needs to be maintained and the results reported in the Recycled Water Groundwater Recharge Annual Report. The monitoring program is very extensive considering the large number of recharge sites operated by IEUA. The method used to determine the RWC provides very consistent results since the basins are flooded continuously and localized saturated flow conditions develop in the vadose zone. The ongoing TOC monitoring program should recognize variations in TOC concentrations as a consequence of basin maintenance, drying, and changes in infiltration rates. All of these factors may affect TOC concentration at an RWC compliance point. However, these variations should not affect TOC levels in the underlying groundwater since there is a deep vadose zone below the currently chosen RWC compliance points. The current Recycled Water Groundwater Recharge Annual Reports do not provide information on basin operations that could be relevant to observed TOC concentrations.

c. The Panel agrees that IEUA needs to utilize a consistent approach regarding operation and performance monitoring for all the recycled water recharge sites (single basin or cluster of basins). The Panel was presented with data from one site. Similar data from each site needs to be collected and reviewed by IEUA to confirm SAT performance.

d. The Panel supports continuing the monitoring program and, if necessary, enhancing it to include monitoring of selected persistent wastewater indicators (intrinsic) tracers to assess the degree of impact of recycled water on production wells. Such monitoring is also needed to validate the groundwater flow model assumptions, which are directly dependent on groundwater elevations. Specifically, groundwater elevations can be obtained from depth to groundwater measurements in the monitoring wells. These groundwater elevations can then be used to construct the limiting flow lines around each recharge basin (see Section 5.b). Monitoring of an intrinsic tracer could benefit IEUA by verifying TOC removal at a mound monitoring point. Verification of hydrological model predictions can also be done by monitoring intrinsic tracer compound concentrations at drinking water wells. This could first be done by estimating the travel time and concentrations that will begin to affect drinking water wells. Existing models can be used to estimate the time at which intrinsic tracer concentrations will reach detection levels. In addition, the models may be used to estimate the maximum percentage of reclaimed water at a drinking water well. Both of these model estimations could be verified by monitoring of intrinsic tracers. Because of the large size of the IEUA groundwater basin, there should be ample time to develop a cost-effective monitoring strategy to verify the model. IEUA currently uses conductivity and major ion chemistry to estimate recycled water content. A carefully developed intrinsic tracer monitoring plan may be used to verify estimates based on conductivity and major ions within the basin. If current estimates using conductivity are verified, intrinsic tracer monitoring may not be necessary indefinitely.

3. Recycled Water Management Plan

a. The Panel concurs that, unless the quantities of recycled water delivered to spreading basins are curtailed, IEUA is likely to exceed the current allowable RWC if credit for dilution is not given to the underflow of the Chino Basin aquifer.

b. The use of the underflow as diluent water is logical for the IEUA project, since the Chino Basin is large and the underflow has been clearly defined. Due to the hydrogeological characteristics of the groundwater basin (i.e., recharge or underflow occurs over a broader area than is captured by the extraction wells), not all of the underflow will contribute to dilution of the recycled water at a potable water extraction well. Even if a conservative approach is taken to determine the mix of recycled water and diluent water that is extracted at potable water wells (i.e., allocating less than 100 percent of the underflow as diluent water), it is the Panel's opinion that the quantity of underflow that mixes with the recycled water provide sufficient diluent water to meet the RWC requirement.

c. One of the Regional Board amendments to Order No. R8-2007-0039 requires IEUA to suspend recycled water deliveries upon reaching the RWC limit on or after month 96 of the 120 month period. In the event this occurs, the Panel is in agreement with the amended Regional Board order that IEUA prepare a plan to achieve compliance with the RWC limit prior to resuming recycled water deliveries. The plan should address the fate of the treated wastewater (e.g., disposal or nonpotable reuse) if it is not delivered to the recharge basins.

d. IEUA should update its RWC Management Plan to address compliance with the maximum RWC by the 120th month at each recharge basin or cluster of basins. IEUA should provide documentation via modeling or other means (e.g., water quality measurements of typical recycled water constituents at key wells hydraulically upgradient, downgradient, and crossgradient of spreading basins may be used to validate the modeling) that any cluster of basins represents a single capture zone for recycled water and underflow. IEUA should describe how the Plan will be updated to reflect estimated diluent water and recycling water contributions for the upcoming year and what steps will be taken to ensure compliance with the maximum RWC and TOC limits for each basin or cluster of basins.

e. There is concern regarding total dissolved solids (TDS) and nitrate concentration levels rising in the basin as the result of decreased recharge of diluent waters. In particular, the lack of State Water Project water from the Metropolitan Water District of Southern California (MWD) to recharge the basin in future years could result in an increase in TDS concentrations in the groundwater. The Panel supports the findings of IEUA's current ambient study conducted to review the impact of TDS and nitrate levels in the basin and recommends that IEUA continue to investigate means to assure that TDS and nitrogen concentrations in the groundwater do not exceed acceptable levels.

f. The use of underflow as diluent water in conjunction with the high degree of TOC removal observed at IEUA recharge sites could allow for a significant increase in the volume of recycled water that may be recharged annually. The Panel recognizes that this potential significant increase in the recharge of recycled water will not endanger public health. Moreover, the potential issues related to TDS would be an overriding factor that may limit any major increase in the volume of recycled water recharged without additional treatment and/or management strategies. IEUA has historically attempted to use recycled water for uses other than groundwater recharge to get the greatest benefit from water recycling. There is no reason to believe IEUA will not continue to employ this strategy, thereby limiting the volume of recycled water available for groundwater recharge.

g. The Panel supports IEUA's conservative approach in not forecasting limited imported water in the RWC Management Plan and relying on the use of underflows in forecasts for meeting the RWC. If IEUA expects to forecast imported water in the RWC running averaging, more definitive information would be required on how the forecast will be determined and how it will be resolved should imported supplies not be available for recharge.

4. Diluent Water

a. There are three main sources which currently qualify as diluent water that can be diverted to recharge basins beside recycled water: imported water (e.g., untreated State Project Water); storm water runoff during rain events and snowmelt from the San Gabriel Mountains; and local runoff from urban areas during rain events and dry weather flows. In addition to these three sources, natural recharge of the Chino Basin occurs by natural infiltration from the San Gabriel Mountains that provides a fourth source of diluent water that is not currently accounted for. This water is referred to as underflow.

b. Quarterly groundwater monitoring data provided by IEUA for the period from April 1 through June 30, 2009, include monitoring results for 33 monitoring wells: one well upgradient of a spreading basin; 3 wells crossgradient of spreading basins; and 29 wells downgradient of spreading basins. With a few exceptions that are considered to be non-representative of the local groundwater, the water quality data indicate that the groundwater met drinking water primary and secondary maximum contaminant levels. Additional data on specific constituents of concern from research conducted on the IEUA groundwater recharge project by consultants indicate that the groundwater does not contain levels of those specific constituents that would be hazardous to health. Although water quality for the underflow alone (without potential mixing with recharged diluent water or recycled water) is sparse, it appears that the underflow conforms to the water quality requirements specified in the most recent California Department of Public Health (CDPH) Groundwater Recharge Reuse Draft Regulation (dated August 5, 2008).

c. The CDPH Groundwater Recharge Reuse Draft Regulation contains nitrogen requirements that can be met in the recycled water or recharge water (recharge water is defined as either recycled municipal wastewater or the combination of recycled municipal wastewater and diluent water that is applied at a groundwater recharge project). The intent is to allow diluent water to be used to meet nitrogen requirements in the mix of the two waters. While the nitrogen levels in the IEUA recycled water after SAT comply with the limits specified in the CDPH Groundwater Recharge Reuse Draft Regulation, the native groundwater has relatively high nitrogen levels in some of the monitoring wells. Thus, if underflow is to be used as diluent water and the mix of the waters exceeds the nitrogen limits specified in the CDPH Groundwater Recharge Reuse Draft Regulation, it is unclear whether CDPH would consider this to be a violation of the draft recharge regulations. It behooves IEUA to consult with CDPH on this matter.

d. The Panel finds that the quantity of underflow from the Chino Basin aquifer is capable of providing sufficient diluent water to meet the required RWC. The amount of underflow available to contribute to the RWC varies at different recharge sites or clusters of recharge sites and should be determined at each site (See Section 5 below).

e. It is unclear from review of the CDPH draft groundwater recharge regulations as to the point of compliance with the RWC limit. The Panel recommends that IEUA contact CDPH to confirm that the RWC can be met at a potable water extraction well if it is proposed to meet the RWC limit at that point.

5. Calculating Underflow as a Source of Diluent Water

a. The Panel recommends that underflow contribution to be credited as diluent water should be based on a Darcian calculation of groundwater flow through the uppermost permeable layer in the vicinity of the basins. The effective area of groundwater recharge in the vicinity of a recharge basin should include the footprint of the site's basin(s), plus an appropriate buffer zone surrounding the basin(s) to account for the lateral spreading of the groundwater mound beneath the basins.

b. The Panel has the following recommendations regarding calculation of the underflow as a source of diluent water:
   - The cross-sectional area of groundwater flow should be based on transects normal to the limiting flow lines. The limiting flow lines represent groundwater flow paths that are not under the influence of the recycled water spreading basin(s).

Groundwater flow lines are normal to the lines of equal groundwater elevations in the specific area of the basin(s) in question (see Section 2.d).

- The transects between the limiting flow lines should be drawn considering both groundwater flow directions in the vicinity of the recharge basins, as well as groundwater flow directions in downgradient extraction wells.
- The hydraulic conductivity for the Darcian underflow calculation should be representative of the uppermost aquifer materials in the vicinity of the transect's cross-sectional area.
- The hydraulic gradient for the Darcian calculation should be representative of the groundwater elevations in the area of the transect.
- The total underflow through the transect's cross sectional area should be calculated from the product of the cross sectional area of the uppermost aquifer layer below the transect, the hydraulic conductivity in the vicinity of the transect, and the hydraulic gradient in the vicinity of the transect.
- If the transect is located hydraulically downgradient from the recharge basin, the recharged water should be subtracted from the total calculated underflow to arrive at the underflow volume to be credited as diluent water.
- If the transect is located hydraulically upgradient from the recharge basin, the transect should be outside of the influence of the recharge mound in order for the calculated underflow to represent diluent water.

c. Use of a Darcian method of estimating groundwater underflow is a conservative and accurate method when used with existing data and parameters from the calibrated Chino Basin groundwater flow model. The recommendation to exclude underflow outside the limiting flow lines and to exclude underflow in deeper aquifers is a conservative approach to identifying the fraction of total groundwater underflow to include as diluent water in the RWC running average.

d. A check on the diluent underflow contribution at downgradient wells that capture recharged water may be made considering well production rate, upstream basin recharge, and respective underflow contribution from the uppermost permeable layer.

6. Extending the RWC to 120 Months

a. The RWC limit is a subjective requirement intended to provide an additional degree of public health protection against chemical constituents of concern (and, perhaps, unidentified health-significant constituents) by reducing their concentration via dilution of the recycled water with diluent water. It may also have some value during early implementation of an SAT project to provide assurance that the recharge of recycled water does not result in the mobilization of contaminants already present in the subsurface or the formation of new contaminants by chemical reactions or other means in the aquifer.

b. From a toxicological/health effects standpoint, dilution required by the RWC has limited objective value in reducing potential health effects resulting from exposure to chemical contaminants. Since guideline values such as MCLs are developed applying substantial factors, the presence of twice the MCL can add little in the way of risk. In cases where a carcinogenic chemical is detected, de minimus risk levels are set so low, typically at one additional cancer case per 10,000 to 1,000,000 population, doubling this risk does not result in a meaningful difference when the background lifetime cancer risk is considered (i.e., between 1-in-3 to 1-in-4 lifetime risk). This is not to argue against the conservative nature of such guidelines, but to point out that a doubling of the risk is not measurable at such levels and is a trivial issue that cannot be reasonably characterized as adding public health benefits. The RWC is not an effective public health strategy; it is more important to ensure that chemicals that present potential health risks do not get to the aquifer. While it is difficult to state with certainty that all such compounds are removed because of analytical limitations, a well-designed and proactive source control program (which IEUA has) is far more important than a RWC consideration. A second effective public health measure is to confirm that specific compounds of varying chemical and physical properties are removed by SAT as well as relying upon general measures of system performance (e.g., TOC). Thus, the complexity and uncertainties associated with attempting to characterize the likely RWC add little value from a public health standpoint. At present, its major value is as a tool to trigger reviews of changes in system operations. On the other hand, if the RWC is eliminated, another trigger should be available for review of projects as they change operations.

c. The original allowable RWC averaging period of 60 months does not require actual mixing of the recycled water and diluent water at the point of recharge. It is intended to result in the RWC being met as an average over 60 months. Given potential drought conditions, agencies should be allowed to recharge recycled water during periods when diluent water is not available as long as the RWC is met at the end of 60 months. The Panel found no data to indicate that the RWC averaging period of 60 months is the maximum time period beyond which health protection would be compromised. Based on data reviewed relating to recycled water quality before and after SAT, diluent water quality, and the Recycled Water Management Plan, the Panel finds that extending the RWC to 120 months would not compromise the current level of public health protection.

d. Using intrinsic tracers to verify the RWC at potable water extraction wells will provide further assurance that extending the RWC averaging period to 120 months is equivalent to current practices. In addition, the use of intrinsic tracers to verify the use of conductivity and/or major ion chemistry for estimating RWC will allow IEUA to confirm RWC estimates throughout the groundwater basin.

APPENDIX A: Panel Biographies

JAMES CROOK, Ph.D., P.E. (Panel Chair)
Environmental Engineering Consultant (Boston, Massachusetts)

Jim Crook is an environmental engineer with more than 37 years of experience in state government and consulting engineering arenas, serving public and private sectors in the U.S. and abroad. He has authored more than 100 publications and is an internationally recognized expert in water reclamation and reuse. He has been involved in numerous projects and research activities involving public health, regulations and permitting, water quality, risk assessment, treatment technology, and all facets of water reuse. Crook spent 15 years directing the California Department of Public Health's water reuse program, during which time he developed California's first comprehensive water reuse criteria. He also spent 15 years with consulting firms overseeing water reuse activities and is now an independent consultant specializing in water reuse. He has served on several advisory panels and committees convened by the National Academy of Sciences, NWRI, and others. Among his honors, he was selected as the American Academy of Environmental Engineers' 2002 Kappe Lecturer and the WateReuse Association's 2005 Person of the Year. Crook received a B.S. in Civil Engineering from the University of Massachusetts and both an M.S. and Ph.D. in Environmental Engineering from the University of Cincinnati. He is a registered professional engineer in California and Florida.

RICHARD BULL, Ph.D.
Consulting Toxicologist
MoBull Consulting (Richland, Washington)

Since 2000, Richard Bull has been a Consulting Toxicologist with MoBull Consulting, where he conducts studies on the chemical problems encountered in water for water utilities, as well as federal, state, and local governments. Bull is a retired Professor of Pharmacology/Toxicology from Washington State University, where he maintains Adjunct Professor appointments in the College of Pharmacy and the Department of Environmental Science. Formerly, he served as a senior staff scientist at DOE's Pacific Northwest National Laboratory, Professor of Pharmacology/Toxicology at Washington State University, and Director of the Toxicology and Microbiology Division in the Cincinnati Laboratories for the U.S. Environmental Protection Agency. Bull has published extensively on research on central nervous system effects of heavy metals, the carcinogenic and toxicological effects of disinfectants and disinfection by-products, halogenated solvents, acrylamide, and other contaminants of drinking water. He has also served on many international scientific committees convened by the National Academy of Sciences, World Health Organization, and International Agency for Research on Cancer regarding various contaminants of drinking water. Bull received a B.S. in Pharmacy from the University of Washington and a Ph.D. in Pharmacology from the University of California, San Francisco.

JEAN-FRANÇOIS DEBROUX, Ph.D.
Director, Advanced Technologies Group
Kennedy/Jenks Consultants (San Francisco, CA)

At Kennedy/Jenks Consultants, Jean Debroux serves as Director of the Advanced Technologies Group, which was formed to solve technologically challenging problems. Part of this effort includes performing pilot and field studies for regulated and emerging contaminants and evaluates the cost impacts of complying with Safe Drinking Water Act regulations. A water quality expert, Debroux has extensive experience and expertise working with water utilities and research organizations in water treatment and water reuse issues, and is an active member of the WateReuse Foundation, where he serves on the Research Advisory Committee. Debroux received a B.S. in Chemical Engineering from the University of South Florida, and both an M.S. in Environmental Engineering and Ph.D. in Civil Engineering from the University of Colorado, Boulder. In addition, he attended the Environmental Management Institute at Tufts University and has served as a Post Doctoral Research Fellow and Lecturer at Stanford University and as a Research Fellow at Université de Poitiers, France.

DR.-ING. JÖRG E. DREWES
Associate Professor
Colorado School of Mines (Golden, CO)

Jörg Drewes has taught courses as in the Environmental Science and Engineering Division at Colorado School of Mines (CSM) since 2001. He also serves as Director of CSM's Advanced Water Technology Center (AQWATEC), which is dedicated to advancing the research and development of novel water treatment processes and hybrid systems to enable sustainable and energy efficient utilization of impaired water sources to provide potable and non-potable water supplies. Drewes is actively involved in research in the areas of water treatment and non-potable and potable water reuse. Current research interests include treatment technologies leading to indirect potable reuse and the fate and transport of persistent organic compounds in these systems. He has published more than 140 journal papers, book contributions, and conference proceedings, and was recently appointed to the National Research Council Committee on Water Reuse as an Approach for Meeting Future Water Supply Needs. Drewes received a Cand. Ing. (B.S.), Dipl. Ing. (M.S.), and Doctorate (Dr.-Ing.) in Environmental Engineering from the Technical University of Berlin in Germany.

PETER FOX, Ph.D.
Professor, School of Sustainable Engineering and the Built Environment
Arizona State University (Tempe, AZ)

Peter Fox is a Professor in the School of Sustainable Engineering and the Built Environment at Arizona State University (ASU) and serves as the coordinator of Environmental Engineering at ASU. He previously served as Director of the National Center for Sustainable Water Supply, which researched indirect potable reuse at numerous field sites in both Arizona and California. His professional interests include water reuse, biological treatment processes, and combined biological/adsorptive systems. For the last 14 years, he has focused his work on natural treatment systems and water reuse; recently, he has begun to expand his expertise on sustainable water systems to include desalination. Fox served as an Associate Editor of the American Society of Civil Engineering *Journal of Environmental Engineering*, and has published over 100 papers and presentations. He has also served on the National Academy of Science ad-hoc committee to assess Sustainable Underground Storage and was an executive committee member for the development of the national roadmap for desalination and water purification. Fox also authored the groundwater recharge chapter of the Metcalf and Eddy textbook, *Water Reuse*. Fox received a B.S. Chemical Engineering and both an M.S. and Ph.D. in Civil and Environmental Engineering from the University of Illinois.

DENNIS E. WILLIAMS, PH.D., P.G., CHG
President
GEOSCIENCE Support Services, Inc. (Claremont, CA)

Dennis Williams is founder and president of GEOSCIENCE Support Services, Inc., which focuses on groundwater supply, development, management, and protection. He has over 35 years of experience in groundwater hydrology, specializing in groundwater planning, development, and management, with specific emphasis on the groundwater basins of Southern California. In particular, he has consulted to most of the major water districts and agencies in the Southern California area, as well as clients in South America, Europe, and the Middle and Far East. The author of numerous publications on groundwater, Williams is also a part-time research professor at the University of Southern California, where he has taught graduate level courses in geohydrology and groundwater modeling since 1980. Williams received a B.S. in Geology from the University of Redlands and both an M.S. and Ph.D. in Groundwater Hydrology from the New Mexico Institute of Mining and Technology. He is a registered California geologist, a certified hydrogeologist with the State of California, and a certified groundwater hydrologist with the American Institute of Hydrology.

APPENDIX B: Meeting Agenda

NATIONAL WATER RESEARCH INSTITUTE

Independent Advisory Panel
Inland Empire Utilities Agency's
Groundwater Recharge Permit Amendment

Meeting Agenda
February 8-9, 2010

Meeting Location
Inland Empire Utilities Agency
Building B, Anza Room
6075 Kimball Ave
Chino, CA 91708

On-Site Contacts:
Jeff Mosher (NWRI)
Cell: (714) 705-3722
Carolyn Echavarria (IEUA)
Office: (909) 993-1855

Background

In 2009, IEUA received provisional approval from the Santa Ana Regional Board to increase the Recycled Water Contribution (RWC) averaging period for the Chino Basin Recycled Water Ground Water Recharge Program from its current 60-month averaging period to a 120-month averaging period. The purpose of this change is to address the water supply shortage of imported water from the State Water Project needed as diluent water the groundwater recharge basins.

Panel Charge and Meeting Objectives

The NWRI Independent Advisory Panel was formed to monitor, evaluate, and report on IEUA's current groundwater recharge projects and on any possible implications that may result from extending the 60-month averaging period for RWC to 120 months. Specifically, the Panel is charged with:

- Evaluating the change in the calculation period for a running monthly average RWC from 60 months to an extended RWC compliance period for 120 months (including reporting changes for IEUA's annual "Recycled Water Management Plan."
- Reviewing the criteria needed to provide an "equivalent level of public health protection" while operating under the proposed extended RWC averaging period.

Monday – February 8, 2010

8:15 am	**Meeting Begins**	**IEUA (Build. B, Anza Room)**
8:30 am	Introductory Remarks and Meeting Overview	Jeff Mosher (NWRI) Jim Crook (Panel Chair)

8:45 am	Panel Charge and Objectives	Patrick Sheilds, IEUA
9:00 am	*Panel Questions and Discussion*	Jim Crook
9:10 am	Source Control Program	Craig Proctor, IEUA
9:30 am	*Panel Questions and Discussion*	Jim Crook
9:45 am	Soil Aquifer Treatment	Andy Campbell, IEUA
10:10 am	*Panel Questions and Discussion*	Jim Crook
10:30 am	**BREAK**	
10:45 am	Recycled Water Management Plan Reporting	Andy Campbell, IEUA
11:30 am	Overview of WateReuse Study WRF06-018	Jeff Soller
12:00 noon	**WORKING LUNCH**	
12:30 pm	Diluent Water	Andy Campbell, IEUA
1:10 pm	Proposal for Calculating Underflow as a Source of Diluent Water	Andy Campbell, IEUA
2:00 pm	*Open Discussion*	Jim Crook
2:30 pm	**BREAK**	
3:45 pm	Panel-Only Deliberations	
5:30 pm	**Day 1 Adjourns**	

Tuesday – February 9, 2010

8:00 am	Depart for Site Tour of Groundwater Recharge Basins (Turner or Brooks Basin)	Andy Campbell
10:00 am	**Arrive at IEUA**	**IEUA (Build. B)**
10:00 am	Panel-Only Deliberations	Jim Crook
12:00 noon	**PANEL WORKING LUNCH**	
2:00 pm	Panel Open Briefing with IEUA	Jim Crook
3:00 pm	**Day 2 Adjourns**	

APPENDIX C – Meeting Attendees

Panel Members

- *Chair*: James Crook, Ph.D., P.E., Environmental Engineering Consultant (Boston, MA)
- Richard Bull, Ph.D., MoBull Consulting (Richland, WA)
- Jean-François Debroux, Ph.D., Kennedy/Jenks Consultants (San Francisco, CA)
- Dr.-Ing. Jörg Drewes, Colorado School of Mines (Golden, CO)
- Peter Fox, Ph.D., Arizona State University (Tempe, AZ)
- Dennis Williams, Ph.D., P.G., CHG, GEOSCIENCE Support Services, Inc. (Claremont, CA)

NWRI Staff

- Jeffrey Mosher, Executive Director
- Gina Melin Vartanian, Outreach and Communications Manager

IEUA Staff

- Chris Berch, P.E., BCEE, Manager of Planning and Environmental Compliance
- Andy Campbell, PG, CHG, Groundwater Recharge Coordinator
- Pari Dezham, P.E., Manager of Pre-Treatment and Source Control
- Bonita Fan, Senior Environmental Compliance Officer
- Nel Groenveld, Manager of Laboratories
- Randy Lee, P.E., Manager of Operations
- Jesse Pompa, P.E., CPP, Environmental Compliance Officer,
- Craig Proctor, Pre-Treatment/Source Control Supervisor
- Patrick Sheilds, Executive Manager of Operations
- Kenneth Tam, Assistant Engineer

IEUA Consultants

- Margaret Nellor, P.E., Nellor Environmental Associates, Inc.
- Mark Wildermuth, WEI for Watermaster
- Jeffrey Soller, Soller Environmental, Inc.

Regional Water Quality Control Board, Santa Ana Region

- Gerald Thibeault, Executive Officer
- Gary Stewart, Chief of Compliance Section

California Department of Public Health

- Brian Bernados, P.E., Recycled Water and Treatment Technology Specialist
- Heather Collins, P.E., Section Chief, Drinking Water Program, Region V (San Bernardino)
- Sean McCarthy, Drinking Water Technical Operations Section, District 13 (San Bernardino)
- Kurt Souza, District Engineer, Drinking Water Program, Region IV (Carpinteria)

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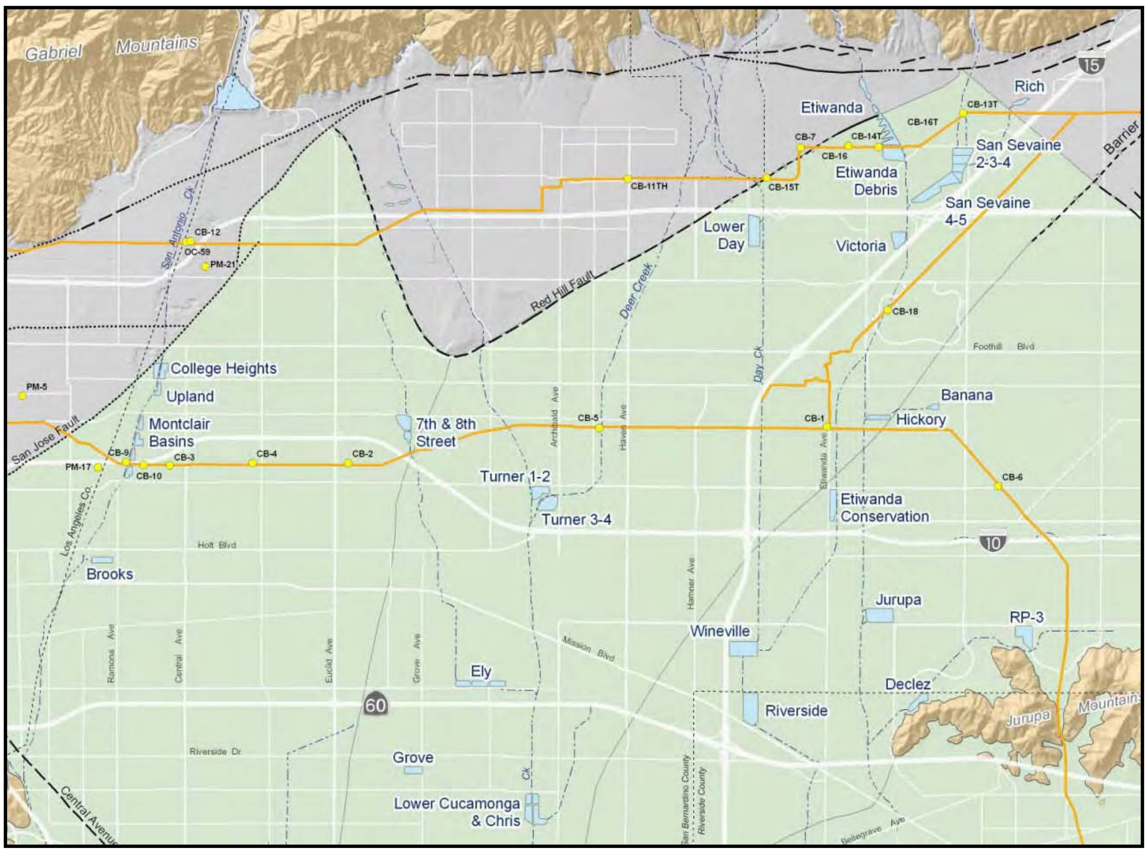
Attachment 2

Chino Basin Recycled Water Groundwater Recharge Program

2009

Annual Report



May 1, 2010

Inland Empire
UTILITIES AGENCY

Patrick O. Sheilds
Executive Manager of Operations

April 29, 2010

Regional Water Quality Control Board, Santa Ana Region
Attention: Mr. Gerard Thibeault
3737 Main Street, Suite 500
Riverside, California 92501-3348

Subject: Transmittal of the Annual Report for 2009
Chino Basin Recycled Water Groundwater Recharge Program

Dear Mr. Thibeault,

The Inland Empire Utilities Agency (IEUA) and the Chino Basin Watermaster (CBWM) hereby submit the *2009 Annual Report* for the *Recycled Water Groundwater Recharge Program* being implemented by IEUA and CBWM. This document is submitted pursuant to requirements in Order No.R8-2007-0039 and Monitoring and Reporting Program No. R8-2007-0039:

- California Regional Water Quality Control Board, Santa Ana Region. Order No. R8-2007-0039. Water Recycling Requirements for Inland Empire Utilities Agency and Chino Basin Watermaster. Chino Basin Recycled Water Groundwater Recharge Program: Phase I and Phase II Projects, San Bernardino County, June 29, 2007.

- California Regional Water Quality Control Board, Santa Ana Region. Monitoring and Reporting Program No. R8-2007-0039 for Inland Empire Utilities Agency and Chino Basin Watermaster. Chino Basin Recycled Water Groundwater Recharge Program: Phase I and Phase II Projects, San Bernardino County, June 29, 2007.

- California Regional Water Quality Control Board, Santa Ana Region. Order No. R8-2009-0057 Amending Order No. R8-2007-0039 for Inland Empire Utilities Agency and Chino Basin Watermaster. Chino Basin Recycled Water Groundwater Recharge Program: Phase I and Phase II Projects, San Bernardino County, October 23, 2009.

ACTIVITIES, FINDINGS, AND CONCLUSIONS

The following bullets summarize the principal activities, findings, and conclusions of the *Recycled Water Groundwater Recharge Program* for 2009:

- At the October 23, 2009 Regional Board meeting Order No. R8-2009-0057 was adopted, which amended the recharge permit by extending the previous 60-month averaging period to 120 months for determining a recharge site's recycled water contribution (RWC). The Order also allowed a fraction of the groundwater underflow of the Chino Basin aquifers to be used as a source of diluent water when calculating the RWC.

- Highlights during the 2009 calendar year include amendment of the recharge permit to extend the RWC averaging period and utilization of groundwater underflow, completion of the RP-3 Basins start-up period, conclusion of the both Brooks Street Basin start-up period and tracer test, and total program recharge of 12,764 acre-feet (AF) including 4,516 AF of recycled water.

- During 2009, recycled water monitoring was conducted in accordance with MRP No. R8-2007-0039. No Turbidity, Coliform, TN, TOC, and DO limits were exceeded during 2009. No regulated and contaminants limits were exceeded during 2009.

- No operational problems were encountered during the 2009 calendar year; therefore no corrective actions were necessary for RP-1, RP-4, recharge operations, and well sampling. No violations or suspensions of recharge operations occurred. No unit process changes occurred during 2009.

- In-aquifer blending of recycled water, diluent water, and native groundwater was evidenced at monitoring wells in the vicinity of 8^{th}, Banana, Hickory, Brooks, Ely, Turner, and RP-3 Basins. For 8^{th}, Banana, and Hickory Basins, blending was observed to be occurring both in the area of the groundwater mound and downgradient. Evidence includes variations in water chemistry, variations in water levels, and recharge ratios of water sources.

- At the end of 2009, the volume-based 120-month running average RWCs (inclusive of groundwater underflow) by basin were: 8th Street - 11%; Banana – 13%; Brooks – 13%; Ely – 6%, Hickory – 11%, Turner Basin Cells 1&2 – 11%; Turner Basin Cells 3&4 – 8%; and RP-3 – 11%. The Banana, Ely, Hickory, Turner Cells 1&2, and Turner Cells 3&4 recharge sites are in compliance with their maximum RWC limits determined during their start-up period. RWC limits for 8^{th}, Brooks, and RP-3 are being evaluated.

- CBWM has certified in the 2009 quarterly reports that there was no reported pumping of groundwater in 2009 for domestic or municipal use from the zones that extend 500 feet and 6 months underground travel time from the 8^{th}, Banana, Brooks, Ely, Hickory, Turner, and RP-3 recharge sites.

- Sufficient data exist to estimate arrival times of recycled water at monitoring wells 8TH-1/1 (660 days) and 8TH-2/2 (402 days) for 8th Street Basin; BRK-1/1 (7 to 14 days) for Brooks Basin; BH-1 (59 – 106 days) for Hickory Basin; California Speedway Infield well (198 days) for Banana Basin; TRN-1 (97 days) and TRN-2 (285 days) for Turner Cell1 and Cell 4, respectively; and RP3-1 (14 days) for RP-3 Basin Cell 1. Other program monitoring wells have yet to indicate arrival of recycled water.

- Comparison of the pre-recharge elevation contours (2003) with the post-program start-up contours (2008) indicates the recharge program has not changed the overall groundwater flow path directions. With the exception of local recharge mounds at basins, 2008 groundwater elevations in the program monitoring wells have changed less than the contour interval (25 feet) used in the 2006 groundwater elevation map. A new groundwater elevation contour map (2010) will be available for the 2011 Biennial State of the Basin Report and will be used to identify potential regional changes in groundwater flow patterns since 2006.

DECLARATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments thereto; and that, based on my inquiry of the individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Executed on the 29th day of April 2010 in the City of Chino.

Patrick O. Sheilds
Executive Manager of Operations

Chino Basin Recycled Water Groundwater Recharge Program

2009
Annual Report

Prepared by:

Inland Empire Utilities Agency

Andrew Campbell

Groundwater Recharge Coordinator

Bonita Fan

Sr. Environmental Compliance Officer

Reviewed and Approved by:

Chris Berch, P.E.

Manager of Planning & Environmental Compliance

Inland Empire Utilities Agency

May 1, 2010

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B	Evidence for Blending: EC, TDS, & Chloride Time-Series Graphs
C	RWC Management Plans
D	Groundwater Elevation Contour Maps
E	Monitoring Well Hydrographs
F	Brooks Basin Tracer Experiment Report
G	Proposed Methodology and Assessment of Groundwater Underflow

1 INTRODUCTION

This document is the Annual Report for Chino Basin Recycled Water Groundwater Recharge Program for the 2009 calendar year. Inland Empire Utilities Agency (IEUA), Chino Basin Watermaster (CBWM), Chino Basin Water Conservation District, and San Bernardino County Flood Control District are partners in the operation and maintenance of the Chino Basin Recycled Water Groundwater Recharge Program. This is a comprehensive water supply program to enhance water supply reliability and improve the groundwater quality in local drinking water wells throughout the Chino Groundwater Basin by increasing the recharge of storm water, imported water and recycled water. The annual report summarizes recycled water quality monitoring and the effects of the recharge program on the groundwater basin. The 2009 recharge operations have previously been summarized in the four 2009 quarterly reports, which documents the recharge activities for the basins having already begun recharge with recycled water, namely 8th Street, Banana, Brooks, Ely, Hickory, RP-3, and Turner Basins. The highlights of the 2009 calendar year included the amendment of the recharge permit to extend the Recharge Water Contribution (RWC) averaging period from 60 to 120 months, and to allow utilization of groundwater underflow in the RWC running average calculation. Additional highlights included the completion of the RP-3 Basins start-up period, conclusion of the both Brooks Street Basin start-up period and introduced tracer test, and total program recharge of 12,764 acre-feet (AF) including 4,516 AF of recycled water.

1.1 Requirements of Order No. R8-2007-0039

This Recycled Water Groundwater Recharge Program is subject to the requirements found in the following documents issued by the California Regional Water Quality Control Board Santa Ana Region:

- Order No. R8-2007-0039 Water Recycling Requirements for Inland Empire Utilities Agency and Chino Basin Watermaster, Chino Basin Recycled Water Groundwater Recharge Program, Phase I and Phase II Projects, San Bernardino County, June 29, 2007;
- Monitoring and Reporting Program No. R8-2007-0039 for Inland Empire Utilities Agency and Chino Basin Watermaster, Chino Basin Recycled Water Groundwater Recharge Program Phase I and Phase II Projects, San Bernardino County, June 29, 2007; and
- Order No. R8-2009-0057 Amending Order No. R8-2007-0039 for Inland Empire Utilities Agency and Chino Basin Watermaster, Chino Basin Recycled Water Groundwater Recharge Program: Phase I and Phase II Projects, San Bernardino County, October 23, 2009.

The Monitoring and Reporting Program (M&RP) describes the requirements for the Annual Reports. The following is an excerpt from Section VI of the MRP:

3. The annual report shall include the following:

a. A list of the analytical methods employed for each test and associated laboratory quality assurance/quality control procedures. The report shall restate, for the record, the laboratories used by the users to monitor compliance with this Order and their status of certification. Upon request by Regional Board staff, the users shall also provide a summary of performance.

b. A mass balance to ensure that blending is occurring in the aquifer at each recharge basin. Recharge water groundwater flow paths shall be determined annually from groundwater elevation contours and compared to the flow and transport model's flow paths, travel of recharge waters, including leading edge of the recharged water plume, any anticipated changes. The flow and transport model shall be updated to match as closely as possible the actual flow patterns observed within the aquifer if the flow paths have significantly changed.

c. A summary of corrective actions taken as a result of violations, suspensions of recharge, detections of monitored constituents and any observed trends, information on the travel of the recycled water (estimated location of the leading edge), description of any changes in operation of any unit processes or facilities, and description of any anticipated changes, including any impacts on other unit processes.

d. A summary of calibration records for equipments, such as pH meters, flow meters, turbidity meters, and lysimeters.

e. All down gradient public drinking water systems. A summary discussion on whether domestic drinking water wells extracted water within the buffer zone defined by the area less than 500 feet and 6 months underground travel time from the recharge basins, including the actions/measures that were undertaken to prevent reoccurrence. If there were none, a statement to that effect shall be written.

f. A summary of the results and recommendations of any tracer testing conducted during the past year.

4. At least one year after the blended recharged water has reached at least one groundwater monitoring well, the users shall submit a report to the CDHS and Regional Board evaluating the compliance with the minimum underground retention time, distance to the nearest point of extraction, blending, and the maximum RWC requirements. The annual report shall include water quality data on turbidity, coliform, total nitrogen, dissolved oxygen, regulated contaminants, TOC, and non-regulated contaminants compliance.

1.2 Organization of the Annual Report

The annual report contains two main sections: Section 2: Recycled Water Quality Monitoring and Section 3: Groundwater Recharge Monitoring. Supporting documents for these sections are included in the 2009 quarterly reports or are provided as appendices to this report. Section 2 discusses compliance with recycled water production specifications and other water quality requirements. Section 3 discusses the blending and movement of recycled water in the groundwater basin.

2 RECYCLED WATER QUALITY MONITORING

2.1 Water Quality Specifications

During 2009, recycled water monitoring was conducted in accordance to the required frequency for all parameters as specified in MRP No. R8-2007-0039. All monitoring and compliance data for the year can be found in the quarterly reports submitted to the Regional Board (IEUA, 2009a, 2009b, & 2009c; and IEUA, 2010).

2.1.1 Detections and Compliance with Turbidity, Coliform, TN, TOC, DO

Recycled Water Specifications A.5 though A.9 are narrative limits in the permit with the exception of that for dissolved oxygen. The 2009 recycled water monitoring data and associated limits for specifications A.5 through A.9 are shown in Table 2-1 and 2-2 of the quarterly monitoring reports. The monitoring and compliance for these parameters is based on the analysis of the two separate recycled water sources, Regional Plant No. 1 (RP-1) and Regional Plant No. 4 (RP-4). Dissolved oxygen has a limit in MRP No. R8-2007-0039 for groundwater monitoring; the limit specifies that if the dissolved oxygen falls below 2 mg/L, or that coliform are present, the users shall notify the CDPH within 48 hours of receiving the results. In accordance with MRP No. R8-2007-0039, the required monitoring frequency for turbidity is continuous, total coliform is daily, total nitrogen and total organic carbon is weekly, and dissolved oxygen for groundwater monitoring wells is quarterly. None of the limits for turbidity, coliform, total nitrogen, total organic carbon, and dissolved oxygen were exceeded during 2009.

2.1.2 Detections and Compliance with Regulated and Non-regulated Contaminants

Recycled Water Specifications A.1 through A.3 (Tables I, II, and III in Order No. R8-2007-0039) specifies limits for constituents with primary maximum contaminant levels (MCLs) and secondary MCLs. The 2009 recycled water monitoring data and associated limits for specifications A.1 through A.3 are shown in Table 2-3 of the quarterly monitoring reports. Compliance determination for these constituents are based on 4-quarter running averages. In accordance with MRP No. R8-2007-0039, the required monitoring frequency for constituents with primary MCLs is quarterly and constituents with secondary MCLs is annually. During 2009, the 4-quarter running average concentrations for constituents with MCLs were not in excess of compliance limits.

The monitoring and compliance for these parameters is based on the analysis of a sample collected at a recycled water sampling point along the distribution pipeline. The sample point is the turnout to RRI Energy (formerly known as Reliant Energy) as it represents a mixture of water from both RP-1 and RP-4. The compliance sampling point for Trihalomethanes (TTHMs) and Total Haloacetic Acids (HAA5) are not at the RRI Energy Turnout. TTHMs and HAA5 compliance sampling is done at the recharge basins because it is more representative of the recycled water prior to reaching the groundwater table. During

2009, compliance sampling for TTHMs and HAA5 was done at lysimeters actively receiving recycled water from basins. Compliance for TTHMs and HAA5 were consistently met throughout 2009 at the selected lysimeters.

Non-regulated contaminants include the remaining priority pollutants, endocrine disrupting chemicals & pharmaceuticals, and unregulated chemicals. These constituents do not have associated limits; however require annual monitoring in accordance with MRP No. R8-2007-0039 (Table II. Recycled Water Monitoring). Recycled water monitoring for unregulated chemicals listed in Table II continues even though the regulations for monitoring were repealed on October 18, 2007.

2.2 Title 22 Results from Nearest Potable Wells

Table 2-1 contains Title 22 drinking water quality data for the nearest potable water supply well located down gradient of recharge sites that have initiated recharge using recycled water. The Title 22 parameters included in this table are the same as those parameters tested for recycled water.

2.3 Laboratory Certifications and Test Methods

The IEUA and MWH Laboratories were utilized for the analytical testing required during the recycled water recharge program. Both of the laboratories are California Department of Public Health Environmental Laboratory Accreditation Program (ELAP) certified, pursuant to the California Environmental Laboratory Improvement Act. The IEUA laboratory certification is valid through October 2010 and the MWH Laboratories laboratory certification is valid through January 2011.

To ensure the quality and reliability of test measurements and results, specific programs and procedures have been developed by both the IEUA and MWH Laboratories. The 2005 Annual Report contained an electronic copy of the QA/QC manual from each laboratory, including analytical methodologies; this information has not changed since last reported. The 2009 Annual Laboratory QA/QC Data Summary Report was also submitted to the Regional Board as an attachment to the RP-1/RP-4 2009 Annual NPDES Report.

2.4 Calibration Summary

Field parameters temperature, pH, conductivity, dissolved oxygen, oxidation/reduction potential were recorded during surface water sampling from recharge basins using a QED MP20 Multiparameter Meter. This instrument utilizes a flow-cell to allow water to flow through the meter chamber without exposure to the atmosphere. Field analytical instruments used throughout this project were maintained and calibrated each day of use. Calibration was conducted according to instructions provided by the instrument manufacturer.

2.5 Violations, Suspensions, and Corrective Actions

No operational problems were encountered during the 2009 calendar year, therefore no corrective actions were necessary for the following: RP-1, RP-4, recharge operations, lysimeter and monitoring well sampling. No violations or suspensions of recharge operations occurred during the 2009 calendar year.

During the fourth quarter of 2009, 1,2-Dibromo-3-chloropropane (DBCP), a soil fumigant banned in 1977, was identified in monitoring well 8TH-2/2 located 2,460 feet downgradient from 8^{th} Street Basin. The DBCP concentration of 3.3 µg/L was found in the November 2009 sample and a 3.2 µg/L was confirmed by a repeat sampling event in December 2009. This legacy occurrence is unrelated to recharge operations and the CDPH was notified of the results in December 2009. Similarly, chromium (above the drinking water standard) was identified in the shallow casing of the two BRK monitoring wells downgradient of Brooks Basin. While chromium has not been found in the recycled water, it is a legacy parameter (below drinking water standards) in nearby (deeper) City of Pomona municipal production wells. Additional sampling and analysis is being conducted to validate the values at BRK-1/1.

Municipal groundwater production wells Ontario Well No. 19 and Pomona Well No. 4 have been taken out of service by their owners for mechanical issues, and were thus not sampled as part of the recharge program list of monitoring wells.

2.6 Unit Process Changes and Anticipated Impact on Water Quality

The San Bernardino Lift Station began operating on June 24, 2009 (initial diversion stage) with approximately 3.2 MGD of flow from Fontana diverted to the station. The final diversion stage occurred on September 14, 2009 which allows approximately 4.6 MGD of flow from Fontana. All flow can be treated at RP-4, thereby increasing average influent flow and increasing the recycled water volume available to the 1299 pressure zone by the same amount. Neither the San Bernardino Lift Station nor the operation of the RP-4 facility at the upgraded capacity (7 MGD to 14 MGD expansion completed in 2008) result in an impact on water quality.

2.7 Summary of Chemical Usage

The summary of treatment chemicals used on a monthly basis at RP-1 and RP-4 during the 2009 calendar year is presented in Table 2-2.

3 GROUNDWATER RECHARGE MONITORING

3.1 Summary of Recharge Operations

Groundwater recharge using recycled water has been initiated in 8th, Banana, Brooks, Ely, Hickory, RP-3 and Turner Basins. During 2009, recycled water recharge totaled 4,516 AF using these seven recharge sites. Of this volume, 61% was recharged in the Brooks and RP-3 Basins with the remaining being recharged in the five other recharge sites already initiated with recycled water recharge. Appendix A of this report contains the monthly groundwater recharge summaries for all sites in the recycled water groundwater recharge program. The Brooks Basin completed its start-up period and tracer test study in 2009. The Brooks Basin Tracer Test Report is contained in Appendix F. The RP-3 Basins completed its start-up period in late 2009 and the start-up report is being prepared in 2010. Recharge volumes, including diluent and recycled water volumes, are presented in the quarterly reports (IEUA, 2009a, 2009b, 2009c, and 2010), but are repeated in this section's discussion of RWC management plans.

3.2 In-Aquifer Blending of Recycled Water

Section IV.B.3.b of the MRP requires the annual report include:

> A mass balance to ensure that blending is occurring in the aquifer at each recharge basin.

In-aquifer blending of recharge using recycled water and diluent water can be shown in two ways. The first is the mass balance of relative volumes of the recharge water sources - recycled water and diluent water, including stormwater / local runoff, underflow, and imported water - presented in the RWC Management Plans. The second is by comparison of relative concentrations of water quality parameters that have distinct concentrations in both the background groundwater and the recycled water used for recharge, such as EC (electrical conductivity), TDS (total dissolved solids), and chloride (Cl).

While these methods are appropriate, they should be used together as evidence of in-aquifer blending. They are appropriate as the horizontal groundwater flow travel velocity away from the recharge site is much slower than the vertical recharge percolation velocity. This velocity difference results in the development of the groundwater mound beneath a recharge site. In-aquifer blending occurs as the accumulating water sources comprising the mound dissipate away from the basin. As discussed in the following subsections, blending is evidenced by concentration changes in the monitoring wells located down gradient from the recharge sites. The volume-based percentage expresses a reasonably anticipated blending as recharge moves towards distant monitoring wells. Actual blending, however, will likely be greater as the recharged water blends with groundwater in storage.

3.2.1 Evidence of Blending Based on Volume

The 2009 recharge volumes by water type are presented in Appendix A and in the historical recharge portion of the RWC Management Plans (Appendix C). Recycled water and diluent water are typically recharged in distinct batches. However, there can be some blending of local runoff with recycled water as it is delivered to the basins, or if storm water enters a basin already containing some recycled water. Variations in the delivery period of diluent water and recycled water batches do support a level of blending. Dilution with a calculated fraction of the groundwater already in storage is accounted for by the utilization of underflow in the running average RWC calculation beginning with the first month of recycled water recharge.

The running average RWC calculation is equal to:

Recycled Water 120-Month Total / (Recycled Water + Diluent Water 120-Month Total)

At the end of December 2009, the (volume-based) running average RWC for basins having initiated recharge using recycled water were as follows:

Basin	120-month Running Average RWC
8th Street	11%
Brooks	13%
Banana	13%
Ely	6%
Hickory	11%
RP-3	11%
Turner 1&2	8%
Turner 3&4	11%

Maximum RWC and the RWC management are discussed in more detail in Section 3.3. The volume-based percentages express reasonably anticipated blending as recharge waters move towards distant monitoring wells.

3.2.2 Evidence of Blending Based on Water Quality

Time series graphs of EC, TDS, and Cl were prepared for monitoring wells adjacent the recharge sites to help identify if blending is occurring within the aquifer. The graphs depicting trends in EC, TDS, and Cl are presented in Appendix B. The graphed data are tabulated in prior quarterly reports. In general, background groundwater concentrations of EC, TDS, and Cl are much lower than recycled water used for recharge. Blending can be gauged based on how rapidly these concentrations change and for how long the concentration changes persist. The degree of blending can be estimated based on the proportional relationship of EC given the general EC of recycled water and the background groundwater EC. For wells having EC increases associated with recycled water recharge, Table 3-1 provides estimates of the maximum percent of recycled water observed at a given well in the past year.

For the 8th Street Basin area, the shallower casing of the monitoring wells at the basin (8TH-1/1) began an upward trend in Cl in July 2009 which could indicate the arrival of recycled water. The deeper casing (8TH-1/2) does not display such a trend. The 8th Street Basin began recharge using recycled water in its northern half of its northernmost basin (8th Street Basin 1) in September 2007 and fairly continuously through 2008 with interrupts for storm water capture. The increase in Cl suggests an approximate 22-month travel time for recharge in the north cell of 8th Street cell 1 to percolate to the water table and travel to MW-8TH-1/1. The deeper casing of MW-8TH-1 has not shown an increase in TDS, EC, or Cl that would indicate arrival of recharged recycled water to the deeper aquifer. The shallower casing of monitoring well 8TH-2 (8TH-2/1), located approximately 2,500 feet farther from 8TH-1 shows seasonal variations in TDS, EC, and Cl that make any possible arrival of recycled water difficult to evaluate. The deeper casing at monitoring well 8TH-2 (8TH-2/2) shows a steady increase in Cl above seasonal fluctuations beginning in approximately February 2009, which with a similar Cl indicator would suggest a 17-month travel time (approximately 5 feet per day) to this location. As this is counter to hydrogeologic expectations, additional monitoring data are required to conclusively identify the arrival of recycled water at the 8th Street Basin monitoring wells.

In the Banana and Hickory Basins area, monitoring well BH-1 casing 2 (BH-1/2) adjacent to Hickory Basin has noticeable variations in EC, TDS, and Cl (100 to 150-mg/L TDS difference) that appear to be attributed to cycles of recycled water and diluent recharge at Hickory Basin. These concentrations return to background levels following the basins' start-up periods during the subsequent period of diluent water recharge, which is an indication of groundwater flow moving the recycled water recharge away from the site. Following the start-up period, recycled water recharge had occur predominately in only the east half of Hickory basin, which produces a more delayed response at the well than from the start-up period.

The California Speedway Infield well south of Banana Basin shows a gradual concentration increase (100-mg/L TDS difference) since the initiation of recycled water recharge, which would be expected with gradual blending as groundwater moves away from the basin (compare with the 150 to 200-mg/L variation at the basin). Cl concentrations at the Speedway Infield show gradual doubling from 10 to 20 mg/L since the initiation of recycled water at Banana Basin. As presented in Table 3-1 based on EC variations, the groundwater mound at BH-1/2 during 2009 reached a high of approximately 42% recycled water and groundwater at the California Speedway Infield well located downgradient of Banana and Hickory reached a high of approximately 34% recycled water. The data show that blending is occurring in the aquifer downgradient of the Banana and Hickory Basins.

For the Brooks Street Basin area, monitoring wells are located at the basin (BRK-1) and downgradient of the basin (BRK-2). Recycled water recharge began in September 2008. EC, TDS, and Cl concentrations at BRK-1/1 were observed, showing seasonal increases and decreases 100 mg/L TDS through 2009. No significant concentration changes were observed in the deeper casing of BRK-1 (BRK-1/2) and well

BRK-2 (BRK-2/2). As presented in Table 3-1 based on EC variations, the groundwater mound at the recharge basin (BRK-1/1) during 2009 reached a high of approximately 70% recycled water. These data show that blending is occurring in the aquifer beneath Brooks Street Basin.

For the Ely Basin area, monitoring wells are located at the basin (Philadelphia well) and downgradient (Walnut well and Riverside well). Recycled water has been recharged at Ely Basin since 1999. TDS of groundwater at the Philadelphia steadily increased 50 mg/L during 2009 while Cl at the Philadelphia well showed a steady increase from 20 towards 50 mg/L from mid 2008 through the end of 2009. As presented in Table 3-1, in 2009 the Ely Basin groundwater mound at the Philadelphia well reached a high of approximately 20% recycled water. The Philadelphia monitoring well water quality data indicate blending is occurring in the aquifer beneath the Ely Basins.

EC, TDS, and Cl at the Walnut monitoring well fluctuate at higher concentrations (TDS just below 600 mg/L), but do not appear to be linked directly to recycled water recharge activities at Ely Basin as the higher TDS values at this location are greater than the TDS of recycled water. Groundwater in the area directly south of Ely Basin (south of the 60 freeway) lies on the northern perimeter of the Chino Basin area having high TDS-high nitrate concentrations. Groundwater in this immediate area has historically had TDS concentrations between 500 and 1,000 mg/L as is typical of lands in the Chino Basin with irrigation history (CBWM, 2003). Further down gradient, the EC, TDS, and Cl of the Riverside well are relatively stable and do not indicate any impacts on these parameters from recycled water recharge.

For the Turner Basin area, the monitoring well TRN-1 at the basin (Turner cell 1) has noticeable and relatively temporal variations in EC, TDS, and Cl (100 to 200 mg/L for TDS) that can be attributed to cycles of recycled water recharge. These concentrations decrease towards background levels following periods of recycled water recharge, which indicates groundwater blending and movement away from Turner Basin. Monitoring well TRN-2 (adjacent cell 4) however shows a gradual and steady increase in TDS concentration of about 125 mg/L through 2007, peaking in 2008, and then decreasing in 2009. This slower and more steady trend and smaller relative concentration change at TRN-2 suggests that recharge from cell 4 is more regionally distributed when it reaches the groundwater table. This is consistent with the slower recharge rates observed at cell 4, and supports more immediately aquifer blending occurring beneath Turner cell 4 in comparison to Turner cell 1. As presented in Table 3-1, in 2009 the groundwater mound within the recharge site at monitoring wells TRN-1/2 and TRN-2/2 reached highs of 0% and 29% recycled water, respectively. The data show blending is occurring in the aquifer beneath the Turner Basins. Additional data for future monitoring are required to assess the degree of blending downgradient from Turner Basins. Downgradient City of Ontario Well 25 and Well 29 show no evidence of changes in TDS, Cl, and EC that would correlate with groundwater recharge using recycled water

For the RP-3 Basins area, the data at monitoring well RP3-1 (at cell 1) are inconclusive as to the degree of recharge blending. An anomalous spike in the concentrations of EC, TDS, and Cl occurred at the well several months prior to recharge at RP-3 with recycled water, and were likely due to a purging of the vadose zone with the first use of the RP-3 cell 1 and the Jurupa pump station (used to deliver water to cell 1). Following the initiation of recycled water recharge, the EC, TDS, and Cl concentrations at the well decreased rapidly to background levels. Sediments in this area of the Chino Basin are highly conductive, which may help explain the observed trends in water quality and as discussed later (in Section 3.5.2), the relatively-small recharged-induced water level changes at this location. Water quality changes would be difficult to detect in highly conductive sediments due to the blending influence of groundwater underflow and because the recharge mound never developed to any significant depth to push recharged water down into the screen depth of the monitoring well.

3.3 RWC Management Plan

The RWC Management Plan is a necessary tool to demonstrate how IEUA and CBWM will meet a recharge site's maximum RWC following a site's startup period. In 2009, IEUA and CBWM received a permit amendment from the RWQCB Order No. R8-2009-0057, which allows the RWC averaging period to be 120-months long (previously 60-months long) and allows the inclusion of a fraction of groundwater underflow as a diluent water source. In 2010, the National Water Research Institute (NWRI) convened an independent expert panel to review the amendment and evaluate if the amendment provided an equal level of public protection. The panel supported the proposed Darcian method of quantifying site specific groundwater underflow, but recommended that to be conservative (from a mixing standpoint); the fraction of the underflow used should only include the uppermost aquifer layers of higher hydraulic conductivity. Appendix G is the proposed methodology and assessment of groundwater underflow, and includes recommendations of the expert review panel convened by NWRI in February 2010.

The RWC Management Plans presented in the 2009 Annual Report reflect the allowances of the permit amendment, including a 120-month averaging period and use of a fraction of the basin underflow. Each recharge site's RWC Management Plan is updated through February 2010 to reflect the past year's operations. Appendix C contains the RWC Management Plans for Banana, Ely, Hickory, Turner Basin Cells 1&2, and Turner Basin Cells 3&4. Appendix C does include a RWC history for the 8th Street, Brooks, and RP-3 Basins as the start-up period reports for these basins are in progress. For the basins still being evaluated, the RWC Management Plan conservatively limits the forecast RWC to 20%.

Each basin's plan was developed from historical recharge of diluent water (imported and storm water) and recycled water, and projections of diluent water and recycled water. Stormwater projections are based on the historical averages of diluent recharge for the months January through December. With each subsequent operational year, stormwater projections will be modified by averaging the past year's historical data. To add to the conservative approach of the RWC calculation, imported water forecasts are assumed to be zero and are not used to calculate a recharge site's projected RWC. To be conservative from a mixing standpoint, groundwater underflow in the RWC calculation is started at the same month that recycled water recharge was initiated. By the 120th month of recycled water recharge operations, there will be a full 120 months of underflow in the RWC calculation.

Within these limits of historical recharge, stormwater projections, and groundwater underflow, planned recycled water deliveries are forecasted to maintain the volume-based RWC within the maximum RWC limit. While the plan contains calculations for up to 120 months of historical data, for clarity the graphed RWC management plans (Appendix C) show only the previous 60 months of recharge and projections for the next 120 months. The volume-based RWC is a calculation of the percent recycled water infiltrated based on a 120-month rolling average.

The volume-based RWC at the end of 2009 are listed in the below matrix. These recharge sites are in compliance with maximum RWC limits. Based on future projections of diluent recharge and RWC Management Plans, recycled water deliveries for each basin can be made and continue to be within RWC limit compliance.

Volume-Based RWC Actuals at the End of 2009

Basin	Limit	2008*	2009**
8th Street	TBD	28%	11%
Brooks	TBD	8%	13%
Banana	36%	29%	13%
Ely	29%	17%	6%
Hickory	36%	29%	11%
RP-3	TBD	0%	11%
Turner 1&2	25%	12%	8%
Turner 3&4	45%	20%	11%

* 2008 RWC Actuals are based on 60-months running average and exclusion of groundwater underflow as diluent water.

** 2009 RWC Actuals are based on 120-month running average and inclusion of groundwater underflow as diluent water.

3.4 Buffer Zone/Travel Time Compliance

Section VI.B.3.e of the M&RP requires the annual report to include the following:

> A summary discussion on whether domestic drinking water wells extracted water within the buffer zone defined by the area less than 500 feet and 6 months underground travel time from the recharge basins, including the actions/measures that were undertaken to -prevent reoccurrence. If there were none, a statement to that effect shall be written.

As stated in the cover letters of the 2009 quarterly reports, CBWM has certified that there was no reported pumping of groundwater in 2009 for domestic or municipal use from the zones that extend 500 feet and

6 months underground travel time from the 8th Street, Banana, Brooks, Ely, Hickory, RP-3, and Turner Basins. In fact, there are no production wells within the buffer zones of these recharge sites.

3.4.1 Recharge Water Arrival Times

As documented in this and prior program Annual Reports, sufficient data exist to estimate arrival times of recycled water at monitoring wells: 8TH-1/1 and 8TH-2/2 for 8th Street Basin, BH-1 for Hickory Basin, California Speedway Infield well for Banana Basin, TRN-1 and TRN-2 for Turner cell 1 and cell 4, respectively, and RP3-1/1 and RP3-1/2 for RP-3 Basins. The evaluations of arrival time are based on the water chemistry data presented in Appendix B. Arrival times can be determined from notable increases in EC, TDS, and/or Cl concentration above background that exclude natural seasonal variations.

Travel time from 8th Street Basin through the vadose zone and along groundwater flow paths to monitoring well 8TH-1/1 is estimated by steadily increasing in both EC and Cl concentrations beginning in July 2009 and continuing through 2009. Recharge began at 8th Street Basin on November 7, 2007, thus the travel estimate for 8TH-1/1 is approximately 660 days. Oddly the travel time to the further downgradient monitoring well 8TH-2/2 appears to be more rapid (in a more in a direct flow path), and was preliminarily estimated to be approximately 402 days based on Cl data (IEUA, 2009d). While this difference between wells is not inconceivable, continued observations of EC, TDS, and Cl in 2009 at 8TH-2/2 continue to support this travel time assessment.

Travel time from Hickory Basin through the vadose zone and along groundwater flow paths to monitoring well BH-1 was documented at approximately 59 days (IEUA, 2009d). Travel time from Banana Basin to California Speedway Infield Well was estimated at approximately two years (IEUA, 2009d). An additional year of data collection in 2008 were used to refine this travel time to approximately 2.3 years (848 days) based on a stepped increase in EC, TDS, and Cl concentrations beginning between October 9, 2007 and January 7, 2008 (IEUA, 2009d). The California Speedway Infield Well has demonstrated a small and gradual increase in EC, TDS, and Cl since the initiation of recycled water recharge at Banana Basin in September 2005 through 2009. The more noticeable increases occurred in October 2007, which while not definitive would suggest a general travel time to this well of approximately 750 days. The modeled travel time to the California Infield well was 682 days (CH2MHill, 2003). Other Banana-Hickory monitoring wells have not yet shown definitive variations in EC, TDS, and Cl that would signal arrival of recycled water at these well sites.

Travel time from Brooks Basin through the vadose zone to the shallow casing of mound monitoring well BRK-1/1 located at the basin was observable from EC changes to be approximately 7 days. Recharge began on August 6, 2008 and a 200 µmhos/cm increase was observed in this mound monitoring well by August 13. Recycled water has not been observed at the deeper casing BRK-1/2. At monitoring well BRK-2, variations in EC, TDS, and Cl concentrations prior to recycled water recharge make identification of recycled water difficult. EC of BRK-2/1 suggested arrival in May 2009, but is not supported by a corresponding Cl increase. BRK-2 has higher background Cl than BRK-1 which will reduce the usefulness of Cl as an indicator for recycled water arrival at BRK-2.

Travel time from Turner Basins through the vadose zone to groundwater was documented at 97 days and 285 days to monitoring wells TRN-1 and TRN-2, respectively (IEUA, 2009d). Original modeling (CH2MHill, 2003) for the Turner recharge site predict a 109-day travel time to these two wells. Recycled water continued to be detected at TRN-2 (as elevated EC) through mid 2009 despite the end of the intense start-up recharge in June 2007. This highlights the slow migration of recharge water from Turner Basins 3&4. A decrease in EC, TDS, and Cl concentrations at TRN-1 indicates that recycled water recharged during the start-up period has migrated away from this location since July 2008. Other downgradient Turner Basin monitoring wells (Ontario 25 and 29) have not yet shown variations in EC, TDS, and Cl that could signal arrival of recycled water at these well sites.

Travel time from RP-3 Basin (cell 1) through the vadose zone to the shallower casing of mound monitoring well RP3-1/1 (located at on the west side of cell 1) was observable to be approximately 14 days based on observation of EC changes. Similar travel time is supported by water level changes that correlate with periods of recharge (Appendix D). Recycled water recharge began on June 2, 2005 and a 400 µmhos/cm decrease was observed in this mound monitoring well by June 14. While the background EC prior to recycled water recharge was 1,000 to 1,100 µmhos/cm, initiation of diluent recharge operations at cell 1 appears to have pushed the higher EC water from the vadose zone raising the well water EC to 1,400 µmhos/cm. Subsequent recycled water recharge returned the well water EC to 1,000 µmhos/cm. Recycled water has not been observed at the deeper casing BRK-1/2.

3.4.2 Leading Edge of Recycled Water in Aquifer

The leading edge of groundwater containing a component of recycled water was evaluated using groundwater elevations changes and changes in EC, TDS, and/or Cl concentrations. The occurrence of an EC, TDS, Cl concentration increase that can be traced to recycled water recharge periods can be used to indicate if the leading edge has past a monitoring well location. Then concurrence of an increase in water level in a mound monitoring well supports these determinations. Evaluation of basin specific data indicates recycled water recharge has past the first monitoring wells located downgradient of Banana, Brooks, Hickory, Turner Basins, and RP-3 Basins. Recycled water has also been observed at the downgradient monitoring well 8TH-2/2 associated with 8th Street Basin. Production wells used for monitoring near these basins do not show any increases in EC above the background concentrations that would be associated with recycled water recharge.

3.4.3 Tracer Test Results

The Brooks Basin tracer test was conducted during October 2008 through May 2009 using protocols developed with UC Santa Barbara professor, Dr Jordon Clark, and approved by the CDPH. The tracer test used sulfur hexafluoride and boron stable isotopes to evaluate the travel time for recycled water recharged at the basin to the nearest potable wells located in the City of Pomona, and whether that time was greater than the 6-month minimal travel time requirement of CDPH. Appendix F contains the final report of the Brooks Street Basin Tracer Experiment. The report findings indicate the minimum groundwater travel time requirement of 6 months is met for Brooks Basin recharge and the Pomona wells.

3.5 Groundwater Elevations

Section VI.B.3.b of the M&RP requires the annual report to include a discussion of groundwater elevations and flow paths:

> Recharge water groundwater flow paths shall be determined annually from groundwater elevation contours and compared to the flow and transport model's flow paths, travel of recharge waters, including leading edge of the recharged water plume, any anticipated changes. The flow and transport model shall be updated to match as closely as possible the actual flow patterns observed within the aquifer if the flow paths have significantly changed.

3.5.1 Current Elevation vs. Modeled Elevation

Groundwater elevations from the recharge program monitoring wells and many other wells are used by CBWM to periodically prepare groundwater elevation contours of the Chino groundwater basin. Groundwater Contour maps were prepared for fall 2000, 2003, 2006, and 2008. The maps from the *Biennial State of the Basin Report* are presented in Appendix D. The next scheduled regional contour map will be prepared by CBWM in 2011 for 2010 elevation data. Comparison of the pre-recharge elevation contours with the post-program start-up contours and 2009 monitoring well hydrographs (discussed in the following section) indicate the recharge program (initiated in 2005) has not changed the overall groundwater flow directions. With the exception of local recharge mounds at basins, 2009 groundwater elevations in the program monitoring wells have changed less than the contour interval (25 feet) used in the historical groundwater elevation map. Appendix G (Figure 1) contains modeled groundwater elevation data using 2009 conditions and indicates groundwater flow directions from active recycled water groundwater recharge basins are consistent with flow conditions prior to recycled water groundwater recharge initiation. Additionally, groundwater flow directions have not changed significantly as the recharge program has not reached the maximum annual recharge volumes modeled and not all permitted recharge sites are operational.

3.5.2 Water Level Trends in Monitoring Wells

Appendix E contains hydrographs of groundwater elevations, from Basin start-up through 2009, for wells constructed for the monitoring program. Plotted on the hydrographs is the daily recharge for the nearest recharge site(s). These hydrographs can be used to identify local increases in water elevations and their correlation with local recharge. Generally these wells are mound (near basin monitoring wells) or the next monitoring well downgradient of the recharge site.

The hydrographs for the 8th Street Basin mound monitoring well (8TH-1) and downgradient monitoring well (8TH-2) show about a 10 foot decrease in water levels throughout the year. This is a change from late 2007 when these wells both rose sharply 7 feet with the initiation of recycled water and winter storm recharge, and the fairly stable water levels of 2008. The 2009 water level decreases are likely a combination of reduced recycled water recharge and increased extraction from local production wells. Short duration downward spikes in the 8TH-2 hydrograph are indicative of nearby pumping activities.

The hydrographs for the Brooks Street Basin mound monitoring well (BRK-1) shows variations that can be correlated with recharge in the basin. The delay between recharge and arrival through the vadose zone varies between 7 and 21 days and is likely due to variations in recharge duration and magnitude. The hydrograph of the deeper casing of BRK-1 and the downgradient monitoring well (BRK-2) also show groundwater elevations that correlate with recharge activities but on a much more muted scale and a longer response time (approximately 3 months).

The hydrograph for the mound monitoring well (BH-1/2) in the vicinity of Banana and Hickory Basins shows a generally decreasing water elevation trend of 3 to 5 feet per year with 5 to 7 foot seasonal fluctuations. The 2009 seasonal fluctuations appear to correlate within 2 weeks of recharge activities, where in the prior year they were delayed between 3 and 4 months. Impacts on water elevations due to Banana-Hickory Basins' recharge is more likely muted and delayed due to the over 400-foot depth to the water table at this location. The decreasing water elevations and variations in the correlation of recharge and water level response suggest recharge in this location is less than groundwater extraction.

The hydrographs for the two Turner Basin monitoring wells, TRN-1 and TRN-2, show a 15-foot increase in groundwater elevation with a delay of about 3 months associated with peaks in recharge. The annual low water elevations in September of 2007 to September 2009 show only a slight increase of approximately 3 feet, suggesting recharge and extraction in the immediate vicinity of this well are approximately in balance.

The hydrograph of the RP-3 mound monitoring well shows good correlation with recharge activity at the basin, yet water levels increased only 3 feet despite a nearly continuous recharge of water during the basin's start-up period. Sediments in this area of the Chino Basin are highly conductive, which explain the relatively small recharged-induced water level changes at this location. Travel time to the vadose zone at RP3-1 is approximately 35 days based on correlation of recharge and changes in water levels.

4 REFERENCES

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TABLES

Table 2-1
Title 22 Results for Nearest Potable Well

	Sample Location	Date	TOC (mg/L)	Total Coliform (MPN/100mL)	pH	EC (µmho/cm)	TDS (mg/L)	Al (µg/L)	Color (units)	Cu (µg/L)	Corrosivity Index (SI)	Foaming Agents (mg/L)	Fe (µg/L)	Mn (µg/L)	MTBE (µg/L)	Odor Threshold (TON)	Ag (µg/L)	Thiobencarb (µg/L)	Turbidity (NTU)	Zn (µg/L)	Cl (mg/L)	Hardness (mg $CaCO_3$/L)	Na (mg/L)	SO_4 (mg/L)	NH_3-N (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)	Nitrogen, Total (mg/L)	TKN (mg/L)	Alkalinity (mg $CaCO_3$/L)	Dissolved Oxygen (mg/L)
Banana & Hickory	City of Ontario Well No. 20	1/27/09	0.3	<1.1	7.05	345	218	<25	3	3.1	0.4	0.05	34	<1	<0.5	2	<0.25	<0.2	2.8	3	6	161	14	6	<0.1	<0.01	1.9	1.9	<0.5	166	12.7
		4/21/09	0.2	<1.1	7.42	350	222	<25	<3	4.8	0.4	0.08	<15	<1	<0.5	2	<0.25	<0.2	0.2	7	9	158	15	6	<0.1	<0.01	1.9	1.9	<0.5	164	10.4
		7/20/09	<0.1	<1.1	7.70	350	227	<25	<3	5.9	0.4	0.06	<15	<1	<0.5	1	<0.25	<0.2	0.2	<1	5	154	15	4	<0.1	0.08	1.4	1.5	<0.5	159	7.8
		10/5/09	0.2	<1.1	7.91	345	246	<25	<3	5.5	0.3	<0.05	<15	<1	<0.5	1	<0.25	<0.2	0.5	2	6	148	13	6	<0.1	0.13	2.1	2.3	<0.5	172	7.9
8th St	City of Ontario Well No. 35	1/22/09	0.7	2.2	6.28	345	220	<25	<3	4.7	0.2	0.06	<15	<1	<0.5	2	<0.25	<0.2	0.2	19	8	146	22	20	0.2	0.07	2.4	2.4	<0.5	149	9.1
		4/20/09	0.5	<1.1	7.55	340	216	<25	3	22.7	0.2	0.07	<15	<1	<0.5	1	<0.25	<0.2	0.7	11	7	133	24	22	<0.1	<0.01	2.4	2.4	<0.5	142	6.7
		7/28/09	<0.1	<1.1	7.65	345	268	<25	<3	2.7	0.2	<0.05	<15	<1	<0.5	2	<0.25	<0.2	0.8	2	7	139	25	20	<0.1	0.10	2.3	2.5	<0.5	142	7.6
Turner	City of Ontario Well No. 29	1/27/09	0.4	<1.1	6.04	415	272	<25	3	2.9	0.2	<0.05	<15	<1	<0.5	2	<0.25	<0.2	0.2	1	16	171	22	23	<0.1	<0.01	6.1	6.1	<0.5	148	12.6
		4/21/09	0.3	<1.1	6.19	350	240	<25	<3	8.3	0.2	0.08	<15	<1	<0.5	2	<0.25	<0.2	0.3	2	9	141	23	18	<0.1	<0.01	3.1	3.1	<0.5	153	8.3
		7/20/09	<0.1	<1.1	7.59	375	247	<25	<3	2.3	0.3	<0.05	<15	<1	<0.5	2	<0.25	<0.2	0.1	<1	10	147	22	19	<0.1	0.09	3.4	3.5	<0.5	148	6.9
		10/5/09	0.1	<1.1	7.77	410	256	<25	<3	1.2	0.3	<0.05	<15	<1	<0.5	2	<0.25	<0.2	0.3	1	16	159	22	25	<0.1	0.12	5.5	5.9	<0.5	152	7.8
Ely	Bishop Of San Bernardino Corp.	1/20/09	0.5	<1.1	6.85	765	508	<25	<3	3.8	0.6	<0.05	49	4	<0.5	1	<0.25	<0.2	8.8	9	37	373	24	65	<0.1	<0.01	19.8	20.4	0.6	230	10.9
		4/16/09	0.2	<1.1	6.54	790	466	<25	3	7.1	1.0	0.06	34	2	<0.5	1	<0.25	<0.2	0.9	11	41	374	24	73	<0.1	<0.01	21.7	21.7	<0.5	237	7.2
		7/21/09	0.2	2.2	7.37	800	492	<25	10	102	0.6	<0.05	1330	5	<0.5	1	<0.25	<0.2	5.1	699	38	371	25	68	<0.1	0.09	19.4	19.7	<0.5	219	5.4
		10/21/09	0.2	<1.1	7.50	795	502	<25	<3	6.7	0.5	<0.05	399	8	<0.5	1	<0.25	<0.2	8.4	25	37	372	24	64	<0.1	0.08	19.2	19.3	<0.5	232	2.1
Brooks	Pomona Well No. 10	4/28/09	0.1	<1.1	5.77	525	354	<25	<3	10.0	0.3	<0.05	<15	<1	<0.5	1	<0.25	<0.2	0.2	13	41	252	12	46	<0.1	0.14	10.1	10.3	<0.5	148	9.3
		7/21/09	0.1	<1.1	7.12	600	374	<25	3	11.0	0.4	<0.05	158	7	<0.5	1	<0.25	<0.2	0.8	18	45	285	12	50	<0.1	0.07	8.9	9.0	<0.5	153	5.8
		11/4/09	0.1	<1.1	7.72	570	346	<25	<3	2.6	0.4	<0.05	<15	<1	<0.5	2	<0.25	<0.2	0.1	9	34	278	12	39	<0.1	0.05	8.6	8.9	<0.5	158	3.3
RP-3	Southridge JHS	9/17/09	0.4	<1.1	6.55	1010	648	401	25	1.4	0.2	<0.05	11700	355	<0.5	1	<0.25	<0.2	46.8	7	134	394	60	81	<0.1	<0.01	16.6	17.1	<0.5	190	6.3
		11/11/09	0.5	<1.1	6.35	1020	600	412	15	1.5	0.2	<0.05	23800	733	<0.5	2	<0.25	<0.2	95.4	10	121	387	57	74	<0.1	<0.01	14.2	14.2	<0.5	205	9.3

Table 2-2
Regional Plant No. 1 & No. 4 Chemical Usage Summary

	RP-1 (Flow)								RP-1 (Tertiary)				RP-4					
	Ferric Cloride		HW Polymer		Sodium Hypoclorite-Odor Scrub		Sodium Hydroxide 50%		Aluminum Sulfate		Sodium Hypoclorite		Ferric Cloride		Aluminium Sulfate		Sodium Hypoclorite	
Month	Gal.	lbs.	Gal.	lbs.	Gal.	lbs.	Gal.	lbs.		lbs.	Gal.	lbs.	Gal.	lbs.	Gal.	lbs.	Gal.	lbs.
Jan-09	29,510	143,976	439	3,859	12,745	15,944	75	479		9,192	141,000	176,391	6,319	30,830	663	3,502	12,253	15,329
Feb-09	29,300	142,952	448	3,942	2,390	2,990	680	4,338		5,160	94,650	118,407	500	2,439	183	969	13,994	17,506
Mar-09	29,510	143,976	455	4,002	16,460	20,591	110	702		6,480	118,050	147,681	634	3,093	314	1,657	15,995	20,010
Apr-09	32,300	157,588	398	3,504	13,010	16,276	65	415		7,800	132,750	166,070	1,908	9,309	249	1,314	15,592	19,506
May-09	31,750	154,905	395	3,480	14,555	18,208	40	255		4,680	126,350	158,064	5,570	27,175	1,765	9,327	16,138	20,189
Jun-09	30,500	148,806	371	3,264	15,435	19,309	0	0		9,936	112,200	140,362	9,693	47,291	2,597	13,725	17,986	22,500
Jul-09	31,025	151,368	346	3,040	11,645	14,568	0	0		4,872	123,200	154,123	13,908	67,856	5,704	30,142	26,325	32,933
Aug-09	27,950	136,365	338	2,972	12,625	15,794	5	32		3,120	117,750	147,305	12,136	59,210	3,615	19,102	24,071	30,113
Sep-09	25,000	121,973	224	1,967	21,405	26,778	40	255		2,832	124,600	155,875	12,241	59,723	3,402	17,977	22,339	27,946
Oct-09	21,250	103,677	238	2,092	10,115	12,654	105	670		3,554	108,000	135,108	15,171	74,018	2,189	11,568	21,149	26,457
Nov-09	19,750	96,358	228	2,003	11,955	14,956	50	319		3,343	103,850	129,916	15,754	76,862	158	832	22,796	28,518
Dec-09	19,850	96,846	252	2,225	10,300	12,885	65	414		3,364	122,000	152,622	7,157	34,918	130	689	26,705	33,408
Total	327,695	1,598,791	4,130	36,349	152,640	190,953	1,235	7,879		64,334	1,424,400	1,781,924	100,991	492,725	20,969	110,803	235,343	294,414

Table 3-1
Evidence of Blending Based on Water Quality
Mass Balance based on EC

Basin	Well	Well Position	Recycled Water EC (µmhos/cm)	Groundwater Background EC (µmhos/cm)	Peak EC at Well (µmhos/cm)	Mass-Balance Blend (max) (% Recycled Water)
8th Street	8TH-1/1	Downgradient	750	170	245	13%
	8TH-1/2	Downgradient	No evidence of recycled water			
	8TH-2/1	Downgradient	No evidence of recycled water			
	8TH-2/2	Downgradient	750	580	650	41%
Banana & Hickory	BH-1/2	Mound	750	360	525	42%
	California Speedway Infield	Downgradient	750	400	520	34%
	California Speedway No. 2		No evidence of recycled water			
	Reliant East Well		No evidence of recycled water			
	Fontana Water Co. 37A		No evidence of recycled water			
	Ontario No. 20		No evidence of recycled water			
Brooks	BRK-1/1		750	380	640	70%
	BRK-1/2		No evidence of recycled water			
	BRK-2/1		No evidence of recycled water			
	BRK-2/2		No evidence of recycled water			
Ely	Philadelphia Well	Mound	750	245	345	20%
	Walnut Well	Downgradient	Well impacted by regionally high TDS concentration			
	Riverside Well	Downgradient	No EC fluctuation correlatable with recharge			
Turner	TRN-1/2	Mound	750	390	390	0%
	TRN-2/2	Mound	750	350	465	29%
	Ontario No. 25	Downgradient	No evidence of recycled water			
	Ontario No. 29	Downgradient	No evidence of recycled water			
RP-3	RP3-1/1	Mound	Cannot be determine at this time due to high background EC			
	RP3-1/2	Mound	Cannot be determine at this time due to high background EC			
	Alcoa MW-3	Downgradient	Cannot be determine at this time due to high background EC			
	Alcoa MW-1	Downgradient	No evidence of recycled water			
	IEUA Southridge JHS	Downgradient	No evidence of recycled water			

APPENDIX A

MONTHLY GROUNDWATER RECHARGE SUMMARIES

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS

January 2009

Drainage System	Recharge Volume (AF)*			Management
Basin	SW/LR	MW	RW	Zone Subtotals
San Antonio Channel Drainage System				MZ-1 **343** AF**
College Heights	-	-	N	
Upland	**5**	-	N	
Montclair 1, 2, 3 & 4	**19**	-	N	
Brooks	**25**	-	**277**	
West Cucamonga Channel Drainage System				
8th Street	**27**	X	**-**	
7th Street	**8**	X	**-**	
Ely 1, 2, & 3	**38**	X	**39**	MZ-2 **154** AF**
Minor Drainage				
Grove	**3**	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**29**	-	-	
Turner 3 & 4	**10**	-	-	
Day Creek Channel Drainage System				
Lower Day	**4**	-	X	
Etiwanda Channel Drainage System				
Etiwanda Debris	-	-	X	
Victoria	**15**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	**10**	-	N	
San Sevaine 5	**6**	N	X	
West Fontana Channel System				
Hickory	-	-	-	
Banana	**5**	-	**40**	MZ-3 **83** AF**
Declez Channel Drainage System				
RP3 Cells 1, 3, & 4	**7**	-	**-**	
RP3 Cell 2	**5**	-	**-**	
Declez	**26**	-	-	
Non-Replentishment Recharge**				
Brooks (MVWD) MZ-1	-			
Montclair (MVWD) MZ-1	**(18)**			
Turner (SAWCO) MZ-2	-			
Ely (GE) MZ-2	-			
Month Total = 580 AF	**224**	**0**	**356**	
Fiscal Year to Date Total Since July 1, 2008 = 5,471 AF	**3,781**	**0**	**1,690**	

SW : Storm Water, LR : Local Runoff (and GE, MVWD), MW : MWD Imported Water, RW : Recycled Water

- \- : No stormwater/local runoff, or basin not in use due to maintenance or testing.
- X : Turnouts not available - to be installed during future projects.
- N : No turnout planned for installation.
- * : Data are preliminary based on the data available at the time of this report preparation.
- ** : Management Zone Subtotals have deducted from them any Non-Replenishment Recharge, which is recharge originating from pumped groundwater and is not new water.

Printed: Feb. 13, 09

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS
February 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MW	RW	Management Zone Subtotals
San Antonio Channel Drainage System				
College Heights	-	-	N	MZ-1
Upland	**141**	-	N	**1,148**
Montclair 1, 2, 3 & 4	**321**	-	N	AF**
Brooks	**208**	-	**20**	
West Cucamonga Channel Drainage System				
8th Street	**338**	X	**-**	
7th Street	**120**	X	**-**	
Ely 1, 2, & 3	**399**	X	**9**	
Minor Drainage				
Grove	**213**	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**345**	-	-	
Turner 3 & 4	**68**	-	-	MZ-2
Day Creek Channel Drainage System				**1,392**
Lower Day	**67**	-	X	AF**
Etiwanda Channel Drainage System				
Etiwanda Debris	**13**	-	X	
Victoria	**95**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	**28**	-	N	
San Sevaine 5	**79**	N	X	
West Fontana Channel System				
Hickory	**63**	-	**23**	
Banana	**95**	-	-	
Declez Channel Drainage System				MZ-3
RP3 Cells 1, 3, & 4	**202**	-	**-**	**592**
RP3 Cell 2	**71**	-	**-**	AF**
Declez	**224**	-	-	
Non-Replentishment Recharge**				
Brooks (MVWD) MZ-1	-			
Montclair (MVWD) MZ-1	-			
Turner (SAWCO) MZ-2	-			
Ely (Ontario) MZ-2	**(10)**			
Month Total = 3,132 AF	**3,080**	**0**	**52**	
Fiscal Year to Date Total Since July 1, 2008 = 8,603 AF	**6,861**	**0**	**1,742**	

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Printed: Mar. 24, 09

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS
March 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MW	Recycled	Management Zone Subtotals
San Antonio Channel Drainage System				
College Heights	-	-	N	MZ-1
Upland	**4**	-	N	**206**
Montclair 1, 2, 3 & 4	**13**	-	N	AF**
Brooks	**30**	-	**159**	
West Cucamonga Channel Drainage System				
8th Street	**16**	X	**-**	
7th Street	**5**	X	**-**	
Ely 1, 2, & 3	**32**	X	**-**	
Minor Drainage				
Grove	**7**	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**47**	-	-	
Turner 3 & 4	**10**	-	-	
Day Creek Channel Drainage System				
Lower Day	**13**	-	X	MZ-2
Etiwanda Channel Drainage System				**174**
Etiwanda Debris	**3**	-	X	AF**
Victoria	**13**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	**4**	-	N	
San Sevaine 5	**4**	N	X	
West Fontana Channel System				
Hickory	**31**	-	**23**	
Banana	-	-	-	
Declez Channel Drainage System				MZ-3
RP3 Cells 1, 3, & 4	**45**	-	**-**	**98**
RP3 Cell 2	**2**	-	**-**	AF**
Declez	**51**	-	-	
Non-Replentishment Recharge**				
Brooks (MVWD) MZ-1	**(21)**			
Montclair (MVWD) MZ-1	**-**			
Turner (SAWCO) MZ-2	**-**			
Ely (Ontario) MZ-2	**(13)**			
Month Total = 478 AF	**296**	**0**	**182**	
Fiscal Year to Date Total Since July 1, 2008 = 9,081 AF	**7,157**	**0**	**1,924**	

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N : No turnout planned for installation.

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Printed: Apr. 02, 09

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS
April 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MW	Recycled	Management Zone Subtotals
San Antonio Channel Drainage System				
College Heights	-	-	N	MZ-1
Upland	**3**	-	N	**331**
Montclair 1, 2, 3 & 4	**23**	-	N	AF**
Brooks	**1**	-	**296**	
West Cucamonga Channel Drainage System				
8th Street	**15**	X	**-**	
7th Street	**-**	X	**-**	
Ely 1, 2, & 3	**78**	X	**15**	
Minor Drainage				
Grove	**3**	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**11**	-	-	
Turner 3 & 4	**2**	-	-	MZ-2
Day Creek Channel Drainage System				**63**
Lower Day	-	-	X	AF**
Etiwanda Channel Drainage System				
Etiwanda Debris	-	-	X	
Victoria	**3**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	-	-	N	
San Sevaine 5	-	N	X	
West Fontana Channel System				
Hickory	**8**	-	**-**	
Banana	-	-	**-**	
Declez Channel Drainage System				MZ-3
RP3 Cells 1, 3, & 4	**17**	-	**-**	**31**
RP3 Cell 2	**1**	-	**-**	AF**
Declez	**5**	-	-	
Non-Replentishment Recharge**				
Brooks (MVWD) MZ-1	-			
Montclair (MVWD) MZ-1	**(7)**			
Turner (SAWCO) MZ-2	-			
Ely (GE & Ontario) MZ-2	**(57)**			
Month Total = 417 AF	**106**	**0**	**311**	
Fiscal Year to Date Total Since July 1, 2008 = 9,501 AF	**7,266**	**0**	**2,235**	

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Printed: May. 11, 09

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS
May 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MWD	Recycled	Management Zone Subtotals
San Antonio Channel Drainage System				
College Heights	-	-	N	MZ-1
Upland	-	-	N	**131**
Montclair 1, 2, 3 & 4	**92**	-	N	AF**
Brooks	**17**	-	**115**	
West Cucamonga Channel Drainage System				
8th Street	**16**	X	-	
7th Street	-	X	-	
Ely 1, 2, & 3	**38**	X	**11**	
Minor Drainage				
Grove	**3**	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**18**	-	**30**	
Turner 3 & 4	**1**	-	-	
Day Creek Channel Drainage System				
Lower Day	-	-	X	MZ-2
Etiwanda Channel Drainage System				**92**
Etiwanda Debris	-	-	X	AF**
Victoria	**3**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	-	-	N	
San Sevaine 5	-	N	X	
West Fontana Channel System				
Hickory	**18**	-	-	
Banana	-	-	-	
Declez Channel Drainage System				MZ-3
RP3 Cells 1, 3, & 4	**3**	-	-	**12**
RP3 Cell 2	**3**	-	-	AF**
Declez	**6**	-	-	
Non-Replenishment Recharge**				
Brooks (MVWD) MZ-1	**(17)**			
Montclair (MVWD) MZ-1	**(92)**			
Turner (SAWCO) MZ-2	-			
Ely (GE, Ontario) MZ-2	**(30)**			
Month Total = 235 AF	**79**	**0**	**156**	
Fiscal Year to Date Total Since July 1, 2008 = 9,736 AF	**7,345**	**0**	**2,391**	

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Printed: Jun. 02, 09

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS
June 2009

Drainage System / Basin	Recharge Volume (AF)*			Management Zone Subtotals
	SW/LR	**MWD**	**Recycled**	
San Antonio Channel Drainage System				
College Heights	-	-	N	MZ-1
Upland	-	-	N	**208**
Montclair 1, 2, 3 & 4	**31**	-	N	AF**
Brooks	-	-	**178**	
West Cucamonga Channel Drainage System				
8th Street	**30**	X	**-**	
7th Street	**-**	X	**-**	
Ely 1, 2, & 3	**14**	X	**-**	
Minor Drainage				
Grove	**-**	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**62**	-	**9**	MZ-2
Turner 3 & 4	-	-	-	**92**
Day Creek Channel Drainage System				AF**
Lower Day	**-**	-	X	
Etiwanda Channel Drainage System				
Etiwanda Debris	-	-	X	
Victoria	**-**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	**-**	-	N	
San Sevaine 5	**-**	N	X	
West Fontana Channel System				
Hickory	**11**	-	-	
Banana	-	-	**-**	
Declez Channel Drainage System				MZ-3
RP3 Cells 1, 3, & 4	**16**	-	**106**	**146**
RP3 Cell 2	**4**	-	**-**	AF**
Declez	**20**	-	-	
Non-Replenishment Recharge**				
Brooks (MVWD) MZ-1	**0**			
Montclair (MVWD) MZ-1	**(31)**			
Turner (SAWCO) MZ-2	**0**			
Ely (GE) MZ-2	**(10)**			
Month Total = 446 AF	**153**	**0**	**293**	
Fiscal Year to Date Total Since July 1, 2008 = 10,182 AF	**7,498**	**0**	**2,684**	

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- N : No turnout planned for installation.
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Printed: Aug. 05, 09

SUMMARY OF GROUNDWATER RECHARGE OPERATIONS
July 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MW	Recycled	Management Zone Subtotals
San Antonio Channel Drainage System				MZ-1 **26** AF**
College Heights	-	-	N	
Upland	-	-	N	
Montclair 1, 2, 3 & 4	**5**	-	N	
Brooks	**1**	-	**6**	
West Cucamonga Channel Drainage System				
8th Street	**19**	X	**-**	
7th Street	**-**	X	**-**	
Ely 1, 2, & 3	**-**	X	**-**	MZ-2 **44** AF**
Minor Drainage				
Grove	-	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**32**	-	-	
Turner 3 & 4	**-**	-	-	
Day Creek Channel Drainage System				
Lower Day	**2**	-	X	
Etiwanda Channel Drainage System				
Etiwanda Debris	-	-	X	
Victoria	**1**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	-	-	N	
San Sevaine 5	-	N	X	
West Fontana Channel System				
Hickory	**9**	-	-	
Banana	**-**	-	-	MZ-3 **127** AF**
Declez Channel Drainage System				
RP3 Cells 1,3, & 4	**20**	-	**84**	
RP3 Cell 2	**2**	-	-	
Declez	**21**	-	-	
Non-Replenishment Recharge* **				
Brooks (MVWD) MZ-1	**-**			
Montclair (MVWD) MZ-1	**(5)**			
Turner (SAWCO) MZ-2	**-**			
Ely (GE) MZ-2	**-**			
Month Total = 197 AF	**107**	**0**	**90**	
Fiscal Year to Date Total Since July 1, 2009 = 197 AF	**107**	**0**	**90**	

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- N : No turnout planned for installation.
- * : Data are preliminary based on the data available at the time of this report preparation.
- ** : Management Zone Subtotals have been reduced by Non-Replenishment Recharge
- *** : Non-Replenishment (deduct) is groundwater pumped from Chino Basin and recharged back into the basin.

Printed: Mar. 17, 10

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS
August 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MW	RW	Management Zone Subtotals**
San Antonio Channel Drainage System				
College Heights	-	-	N	MZ-1
Upland	-	-	N	**65**
Montclair 1, 2, 3 & 4	**37**	-	N	AF
Brooks	**-**	-	**8**	
West Cucamonga Channel Drainage System				
8th Street	**33**	X	**24**	
7th Street	**-**	X	**-**	
Ely 1, 2, & 3	**21**	X	-	
Minor Drainage				
Grove	-	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**19**	-	**20**	
Turner 3 & 4	**-**	-	-	MZ-2
Day Creek Channel Drainage System				**53**
Lower Day	**3**	-	X	AF
Etiwanda Channel Drainage System				
Etiwanda Debris	-	-	X	
Victoria	**-**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	-	-	N	
San Sevaine 5	-	N	X	
West Fontana Channel System				
Hickory	**4**	-	-	
Banana	**-**	-	-	
Declez Channel Drainage System				MZ-3
RP-3 Cells 1,3, & 4	**27**	-	**148**	**195**
RP-3 Cell 2	**3**	-	-	AF
Declez	**17**	-	-	
Non-Replenishment Recharge* **				
Brooks (MVWD) MZ-1	-			
Montclair (MVWD) MZ-1	**(37)**			
Turner (SAWCO) MZ-2	-			
Ely (Ontario, GE) MZ-2	**(14)**			
Month Total = 313 AF	**113**	**0**	**200**	
Fiscal Year to Date Total Since July 1, 2009 = 510 AF	**220**	**0**	**290**	

SW : Storm Water, LR : Local Runoff (and GE, MVWD), MW : MWD Imported Water, RW : Recycled Water

- \- : No stormwater/local runoff, or basin not in use due to maintenance or testing.
- X : Turnouts not available - to be installed during future projects.
- N : No turnout planned for installation.
- * : Data are preliminary based on the data available at the time of this report preparation.
- ** : Management Zone Subtotals have been reduced by Non-Repenishment Recharge
- *** : Non-Replenishment (deduct) is groundwater pumped from Chino Basin and recharged back into the basin.

Printed: Mar. 17, 10

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS
September 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MW	RW	Management Zone Subtotals**
San Antonio Channel Drainage System				
College Heights	-	-	N	MZ-1
Upland	-	-	N	**18**
Montclair 1, 2, 3 and 4	**88**	-	N	AF
Brooks	**-**	-	-	
West Cucamonga Channel Drainage System				
8th Street	**18**	X	**-**	
7th Street	**-**	X	**-**	
Ely 1, 2, & 3	**202**	X	**24**	
Minor Drainage				
Grove	-	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**28**	-	**18**	
Turner 3 & 4	**-**	-	-	MZ-2
Day Creek Channel Drainage System				**124**
Lower Day	**-**	-	X	AF
Etiwanda Channel Drainage System				
Etiwanda Debris	-	-	X	
Victoria	**-**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3,& 4	-	-	N	
San Sevaine 5	-	N	X	
West Fontana Channel System				
Hickory	**3**	-	**34**	
Banana	**-**	-	-	
Declez Channel Drainage System				MZ-3
RP3 Cells 1,3, & 4	**27**	-	**220**	
RP3 Cell 2	**9**	-	-	**262**
Declez	**6**	-	-	AF
Non-Replenishment Recharge***				
Brooks (MVWD) MZ-1	-			
Montclair (MVWD) MZ-1	**(88)**			
Turner (SAWCO) MZ-2	-			
Ely (GE & Ontario) MZ-2	**(185)**			
Month Total = 404 AF	**108**	**0**	**296**	
Fiscal Year to Date Total Since July 1, 2009 = 914 AF	**328**	**0**	**586**	

SW : Storm Water, LR : Local Runoff (and GE, MVWD), MW : MWD Imported Water, RW : Recycled Water

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- X : Turnouts not available - to be installed during future projects.
- N : No turnout planned for installation.
- * : Data are preliminary based on the data available at the time of this report preparation.
- ** : Management Zone Subtotals have been reduced by Non-Replenishment Recharge
- *** : Non-Replenishment (deduct) is groundwater pumped from Chino Basin and recharged back into the basin.

Printed: Mar. 17, 10

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS
October 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MW	RW	Management Zone Subtotals
San Antonio Channel Drainage System				MZ-1 **302** AF**
College Heights	-	-	N	
Upland	**12**	-	N	
Montclair 1, 2, 3 and 4	**57**	-	N	
Brooks	**13**	-	**184**	
West Cucamonga Channel Drainage System				
8th Street	**74**	X	-	
7th Street	-	X	-	
Ely 1, 2, & 3	**187**	X	**102**	MZ-2 **654** AF**
Minor Drainage				
Grove	**8**	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**80**	-	-	
Turner 3 & 4	-	-	-	
Day Creek Channel Drainage System				
Lower Day	**8**	-	X	
Etiwanda Channel Drainage System				
Etiwanda Debris	-	**7**	X	
Victoria	**37**	**5**	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	**20**	-	N	
San Sevaine 5	**36**	N	X	
West Fontana Channel System				
Hickory	**24**	**7**	**189**	
Banana	**15**	-	**129**	MZ-3 **488** AF**
Declez Channel Drainage System				
RP3 Cells 1,3, & 4	**91**	**4**	**203**	
RP3 Cell 2	**31**	-	-	
Declez	**15**	-	-	
Non-Replenishment Recharge Deduct **				
Brooks (MVWD) MZ-1	-			
Montclair (MVWD) MZ-1	**(38)**			
Turner (SAWCO) MZ-2	-			
Ely (GE) MZ-2	**(56)**			
Month Total = 1,444 AF	**614**	**23**	**807**	
Fiscal Year to Date Total Since July 1, 2009 = 2,358 AF	**942**	**23**	**1,393**	

SW : Storm Water, LR : Local Runoff (and GE, MVWD), MW : MWD Imported Water, RW : Recycled Water

- : No stormwater/local runoff, or basin not in use due to maintenance or testing.

X : Turnouts not available - to be installed during future projects.

N : No turnout planned for installation.

* : Data are preliminary based on the data available at the time of this report preparation.

** : Management Zone Subtotals have deducted from them any Non-Replenishment Recharge, which is recharge originating from pumped groundwater and is not new water.

Printed: Mar. 17, 10

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS
November 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MW	RW	Management Zone Subtotals
San Antonio Channel Drainage System				MZ-1 **483** AF**
College Heights	-	-	N	
Upland	-	-	N	
Montclair 1, 2, 3 and 4	**7**	-	N	
Brooks	**4**	-	**246**	
West Cucamonga Channel Drainage System				
8th Street	**90**	**3**	**133**	
7th Street	**-**	-	**-**	
Ely 1, 2, & 3	**282**	-	**120**	MZ-2 **612** AF**
Minor Drainage				
Grove	**25**	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**49**	-	-	
Turner 3 & 4	**3**	-	-	
Day Creek Channel Drainage System				
Lower Day	**11**	-	X	
Etiwanda Channel Drainage System				
Etiwanda Debris	**17**	-	X	
Victoria	**19**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	**21**	-	N	
San Sevaine 5	-	-	X	
West Fontana Channel System				
Hickory	**26**	-	**243**	
Banana	-	-	**181**	MZ-3 **607** AF**
Declez Channel Drainage System				
RP3 Cells 1,3, & 4	**69**	-	**287**	
RP3 Cell 2	**31**	-	**-**	
Declez	**39**	-	-	
Non-Replenishment Recharge**				
Brooks (MVWD) MZ-1	-			
Montclair (MVWD) MZ-1	-			
Turner (SAWCO) MZ-2	-			
Ely (GE, Ontario) MZ-2	**(204)**			
Month Total = 1,702 AF	**489**	**3**	**1,210**	
Fiscal Year to Date Total Since July 1, 2009 = 4,060 AF	**1,431**	**26**	**2,603**	

SW : Storm Water, LR : Local Runoff (and GE, MVWD), MW : MWD Imported Water, RW : Recycled Water

- \- : No stormwater/local runoff, or basin not in use due to maintenance or testing.
- X : Turnouts not available - to be installed during future projects.
- N : No turnout planned for installation.
- * : Data are preliminary based on the data available at the time of this report preparation.
- ** : Management Zone Subtotals have deducted from them any Non-Replenishment Recharge, which is recharge originating from pumped groundwater and is not new water.

Printed: Mar. 17, 10

SUMMARY OF CHINO BASIN GROUNDWATER RECHARGE OPERATIONS

December 2009

Drainage System / Basin	Recharge Volume (AF)* SW/LR	MW	RW	Management Zone Subtotals
San Antonio Channel Drainage System				MZ-1 **890** AF**
College Heights	-	-	N	
Upland	**102**	-	N	
Montclair 1, 2, 3 & 4	**162**	-	N	
Brooks	**129**	-	**144**	
West Cucamonga Channel Drainage System				
8th Street	**249**	-	**93**	
7th Street	**54**	-	-	
Ely 1, 2, & 3	**242**	-	**-**	MZ-2 **1,733** AF**
Minor Drainage				
Grove	**127**	N	N	
Cucamonga and Deer Creek Channel Drainage Systems				
Turner 1 & 2	**401**	-	-	
Turner 3 & 4	**98**	-	**63**	
Day Creek Channel Drainage System				
Lower Day	**117**	-	X	
Etiwanda Channel Drainage System				
Etiwanda Debris	**38**	-	X	
Victoria	**89**	-	X	
San Sevaine Channel Drainage System				
San Sevaine 1, 2, 3, & 4	**109**	-	N	
San Sevaine 5	**225**	-	X	
West Fontana Channel System				
Hickory	**158**	-	**93**	
Banana	**75**	-	**67**	MZ-3 **791** AF**
Declez Channel Drainage System				
RP3 Cells 1,3, & 4	**311**	-	**103**	
RP3 Cell 2	**62**	-	**-**	
Declez	**173**	-	-	
Non-Replenishment Recharge**				
Brooks (MVWD) MZ-1	-			
Montclair (MVWD) MZ-1	**(43)**			
Turner (SAWCO) MZ-2	-			
Ely (GE, Ontario) MZ-2	**(27)**			
Month Total = 3,414 AF	**2,851**	**0**	**563**	
Fiscal Year to Date Total Since July 1, 2009 = 7,474 AF	**4,282**	**26**	**3,166**	

SW : Storm Water, LR : Local Runoff (and GE, MVWD), MW : MWD Imported Water, RW : Recycled Water

- : No stormwater/local runoff, or basin not in use due to maintenance or testing.

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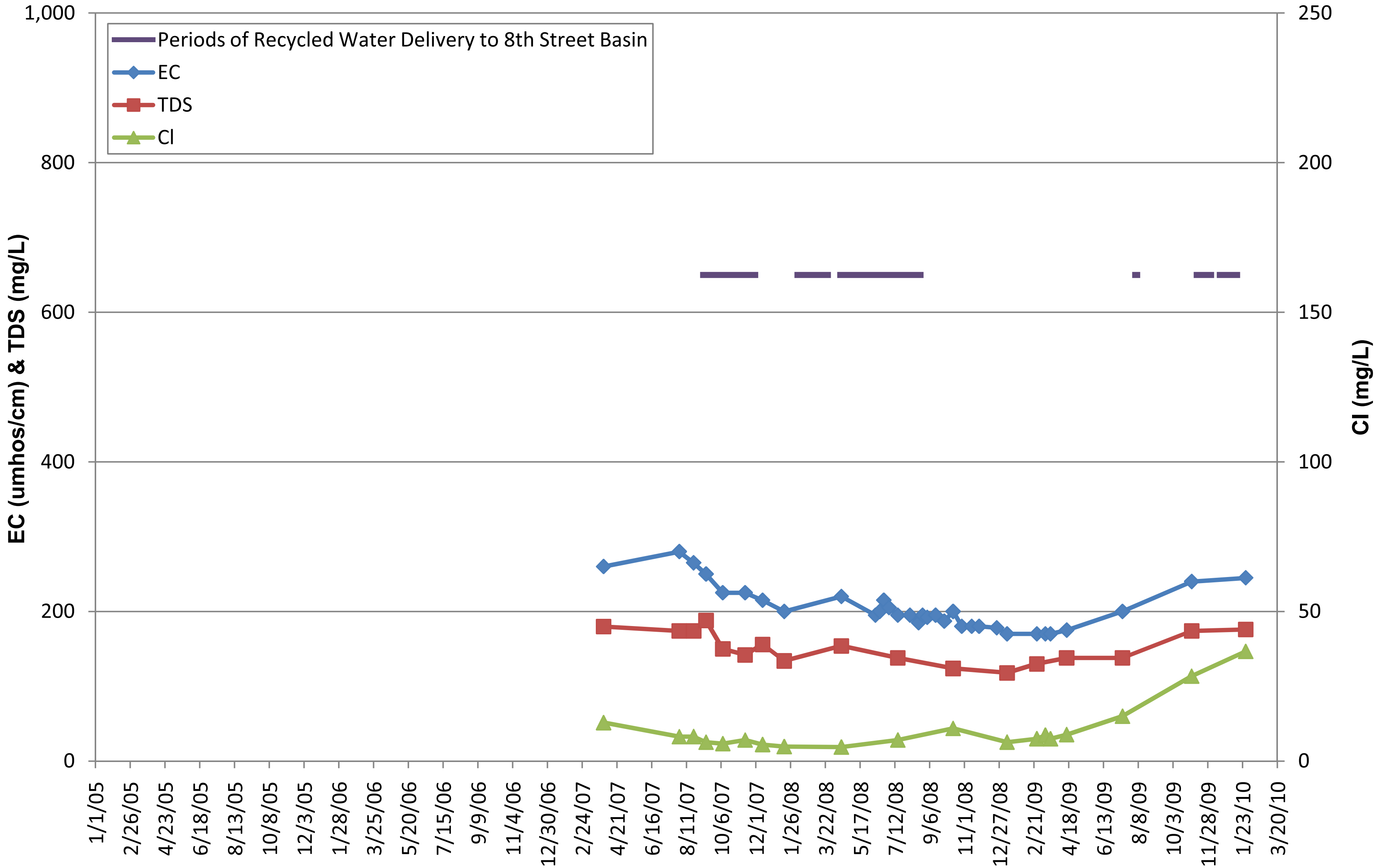
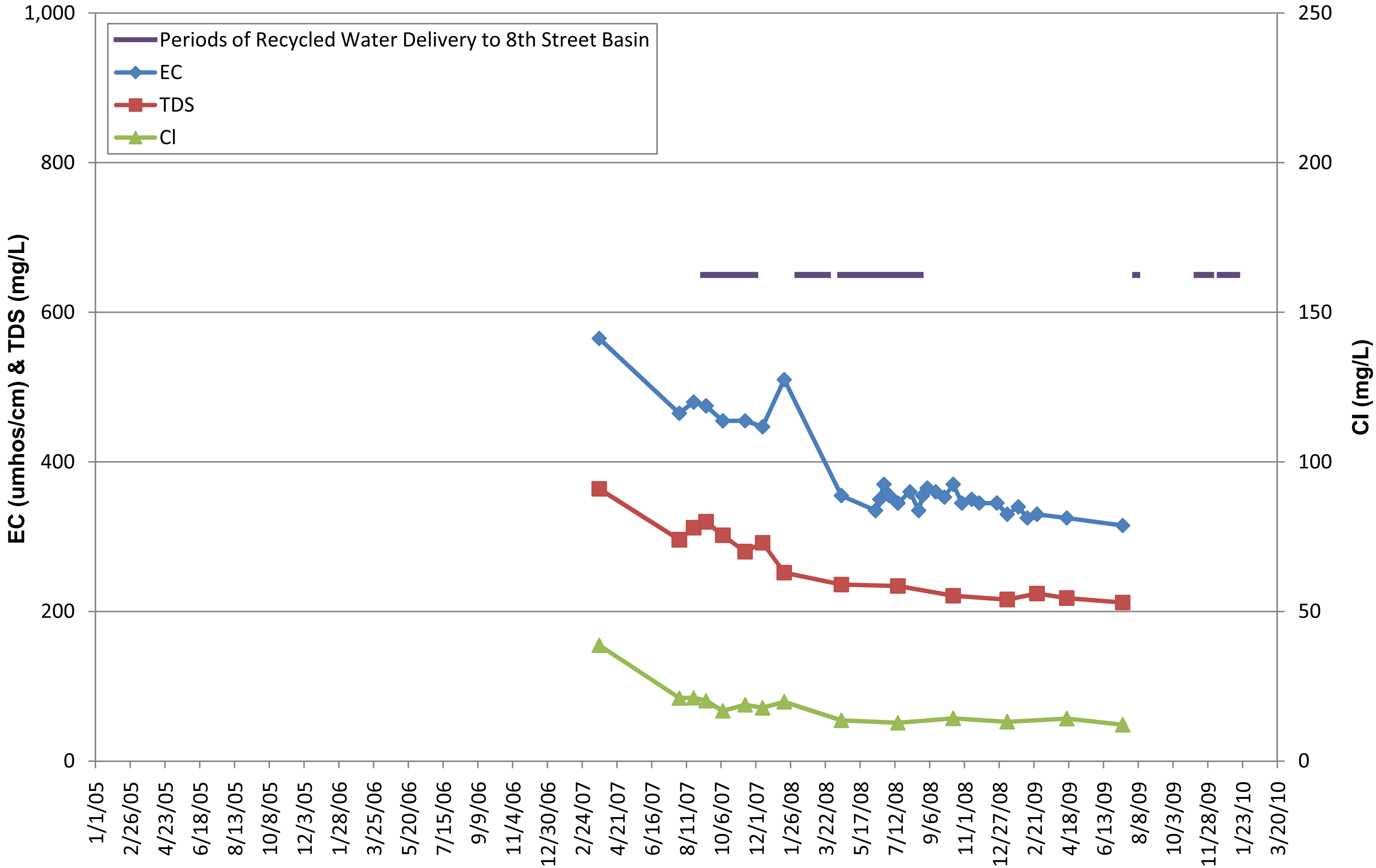
APPENDIX B

EVIDENCE FOR BLENDING:

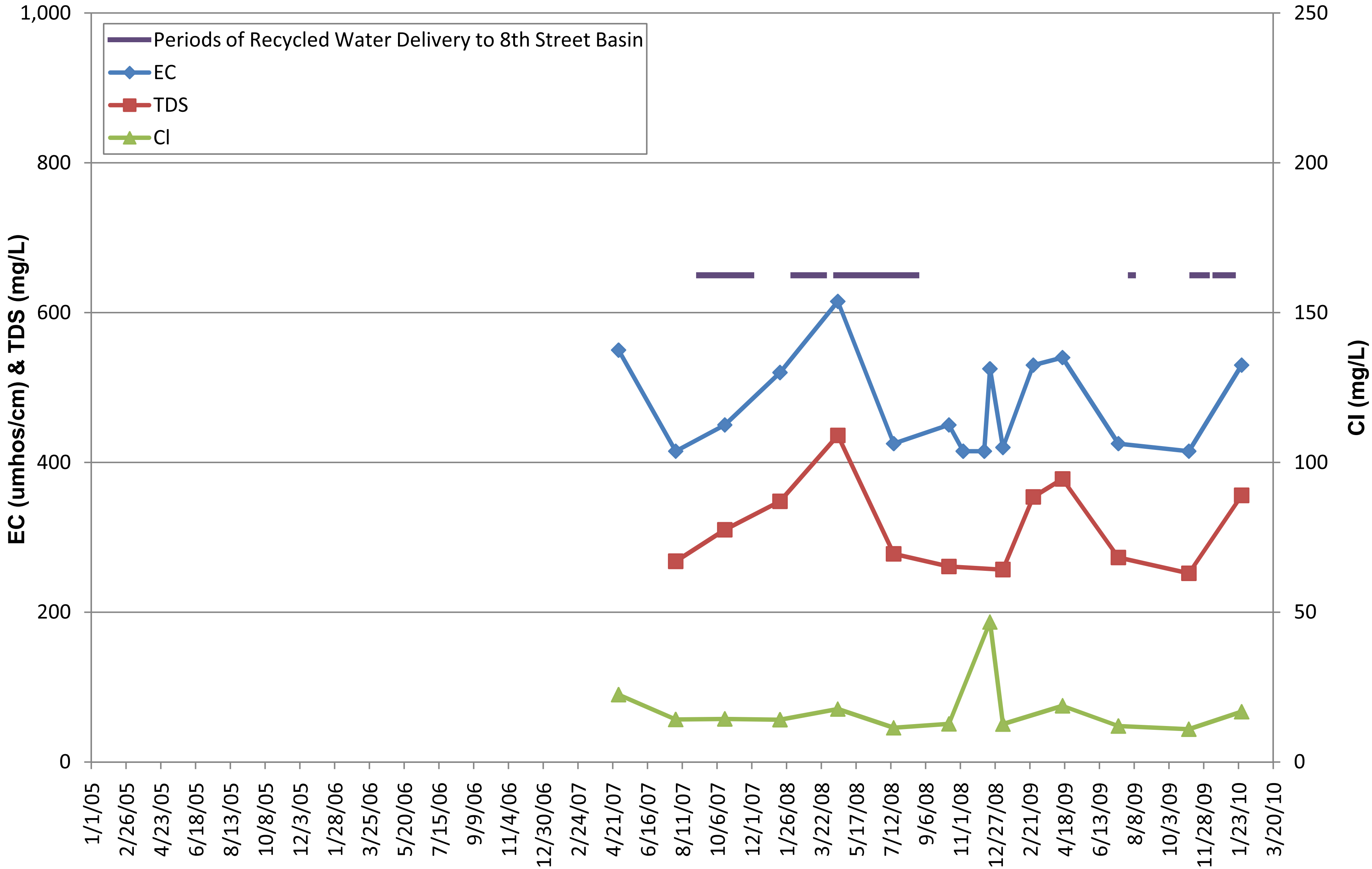
EC, TDS, CHLORIDE TIME-SERIES GRAPHS



EC, TDS, CL TRENDS
8TH STREET BASIN
MW 8TH-1/1



EC, TDS, CL TRENDS
8TH STREET BASIN
MW 8TH-1/2



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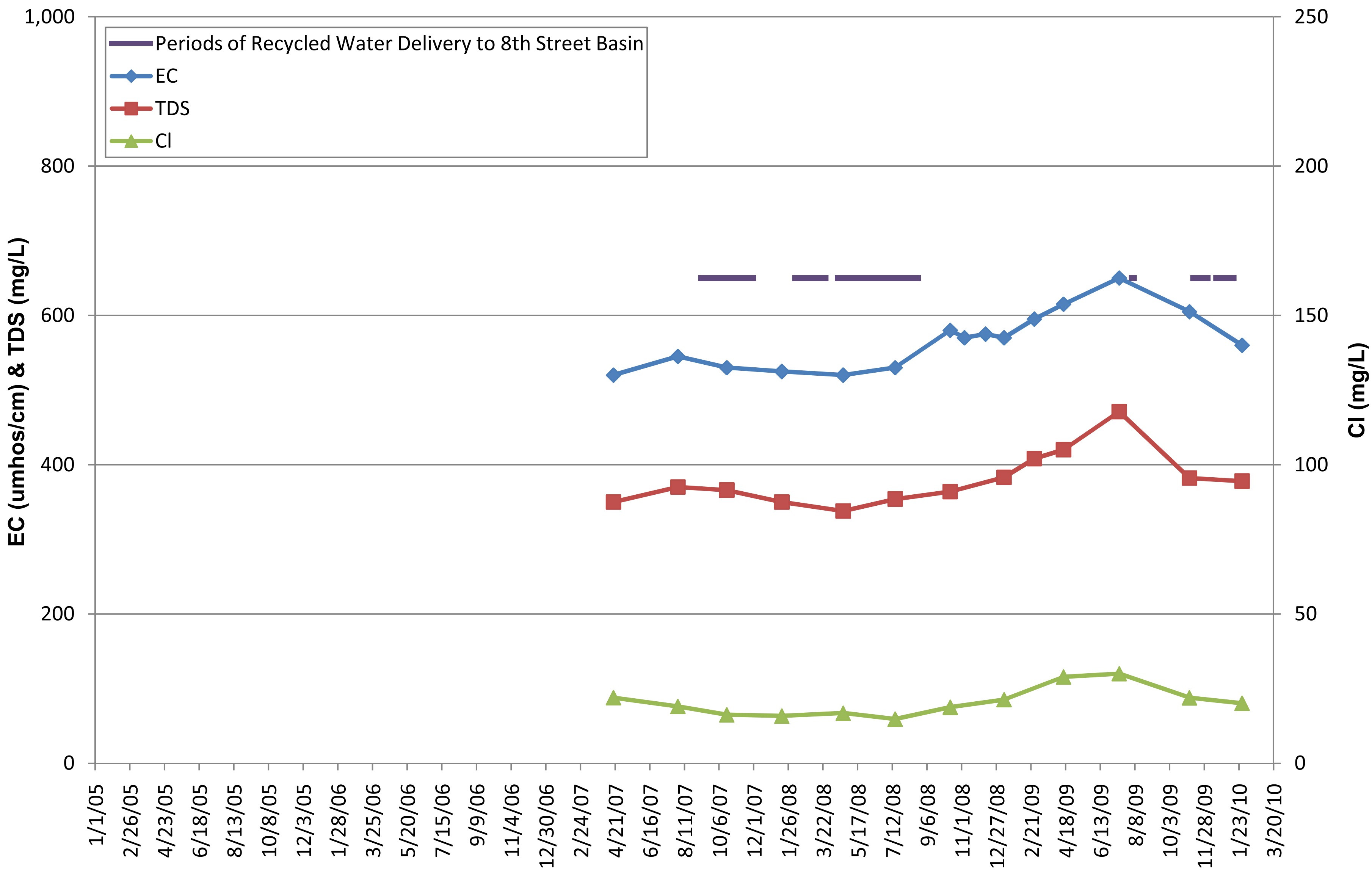
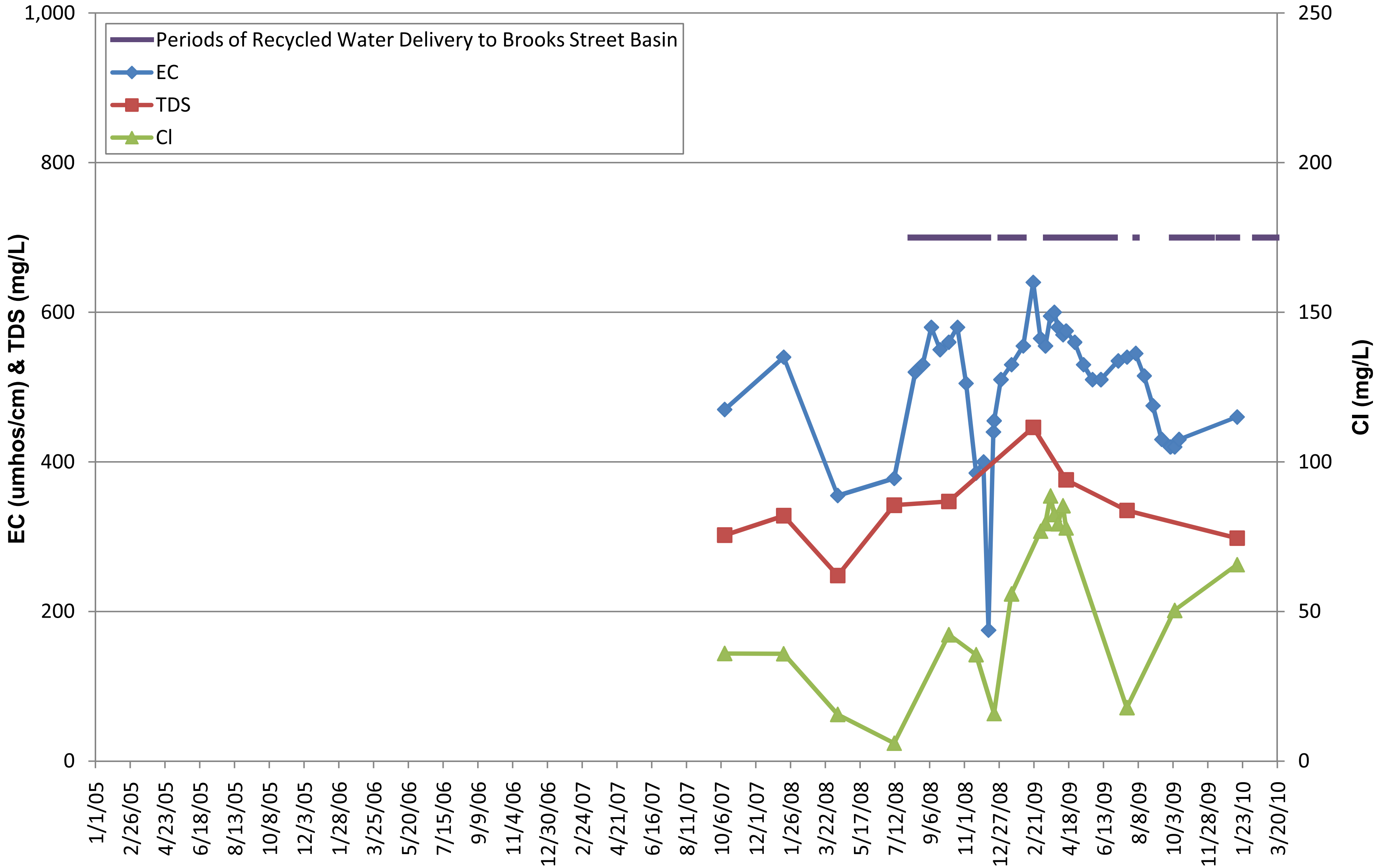
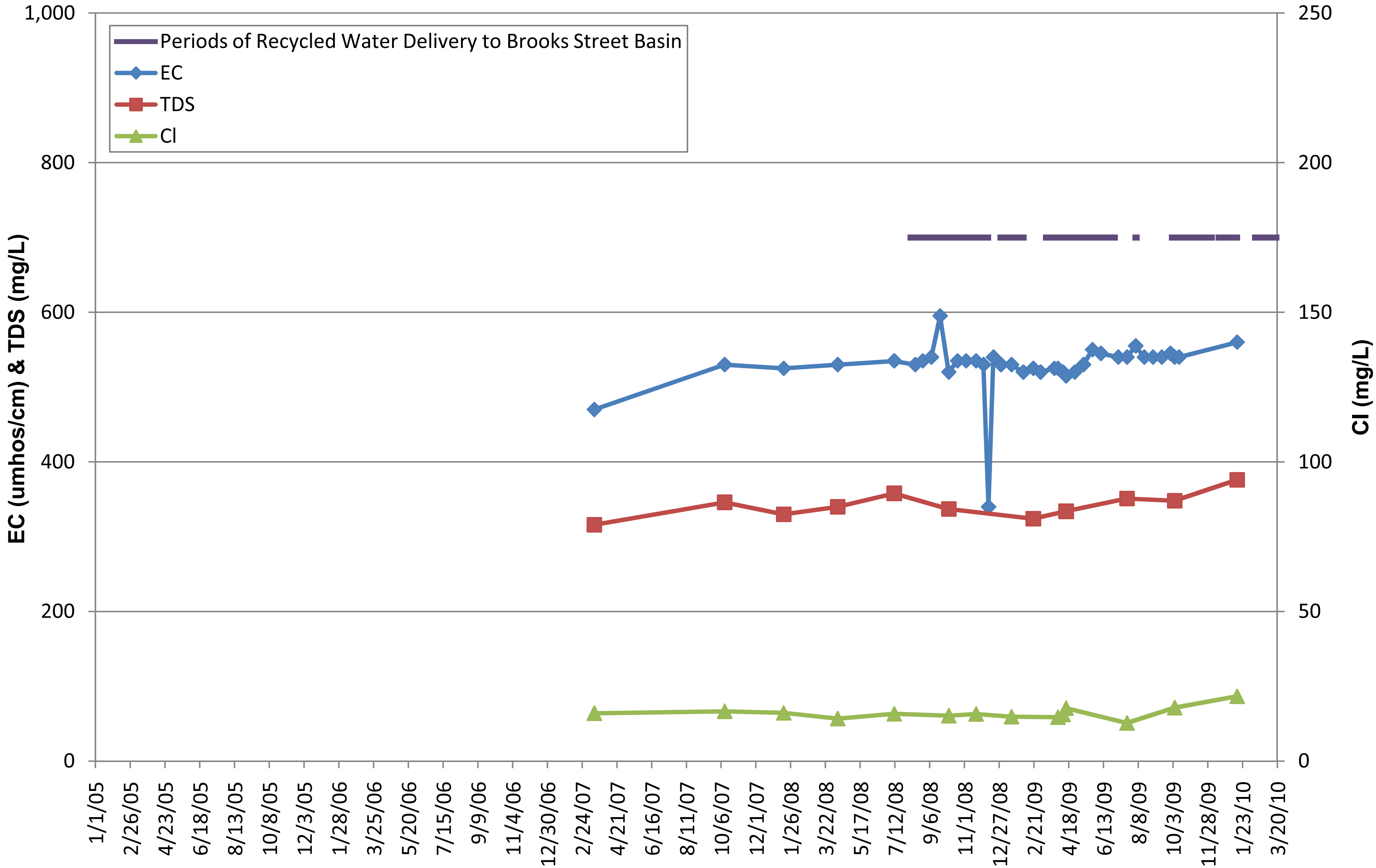
8TH STREET BASIN
MW 8TH-2/1



EC, TDS, CL TRENDS
8TH STREET BASIN
MW 8TH-2/2



EC, TDS, CL TRENDS
BROOKS STREET BASIN
MW BRK-1/1



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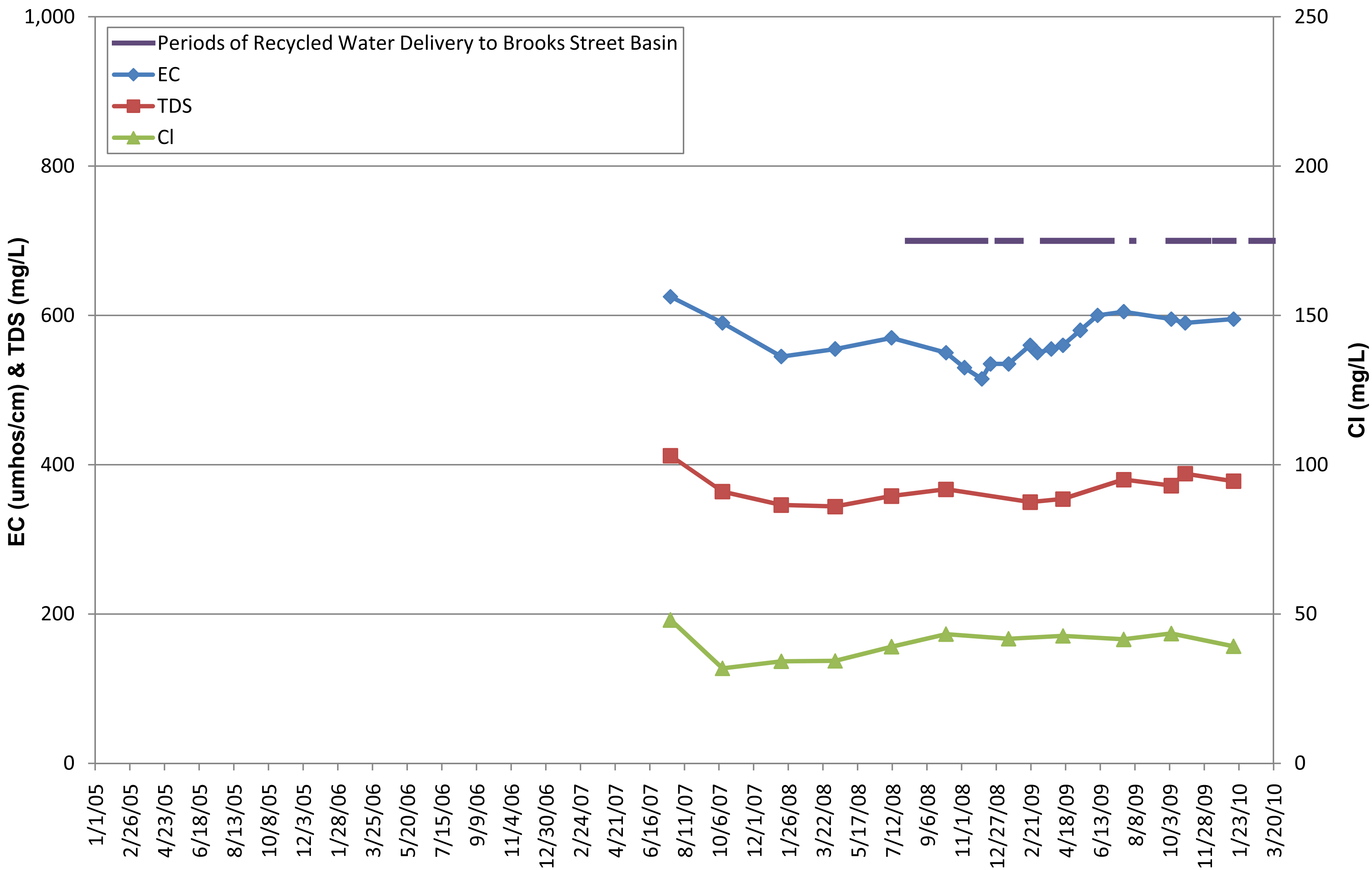
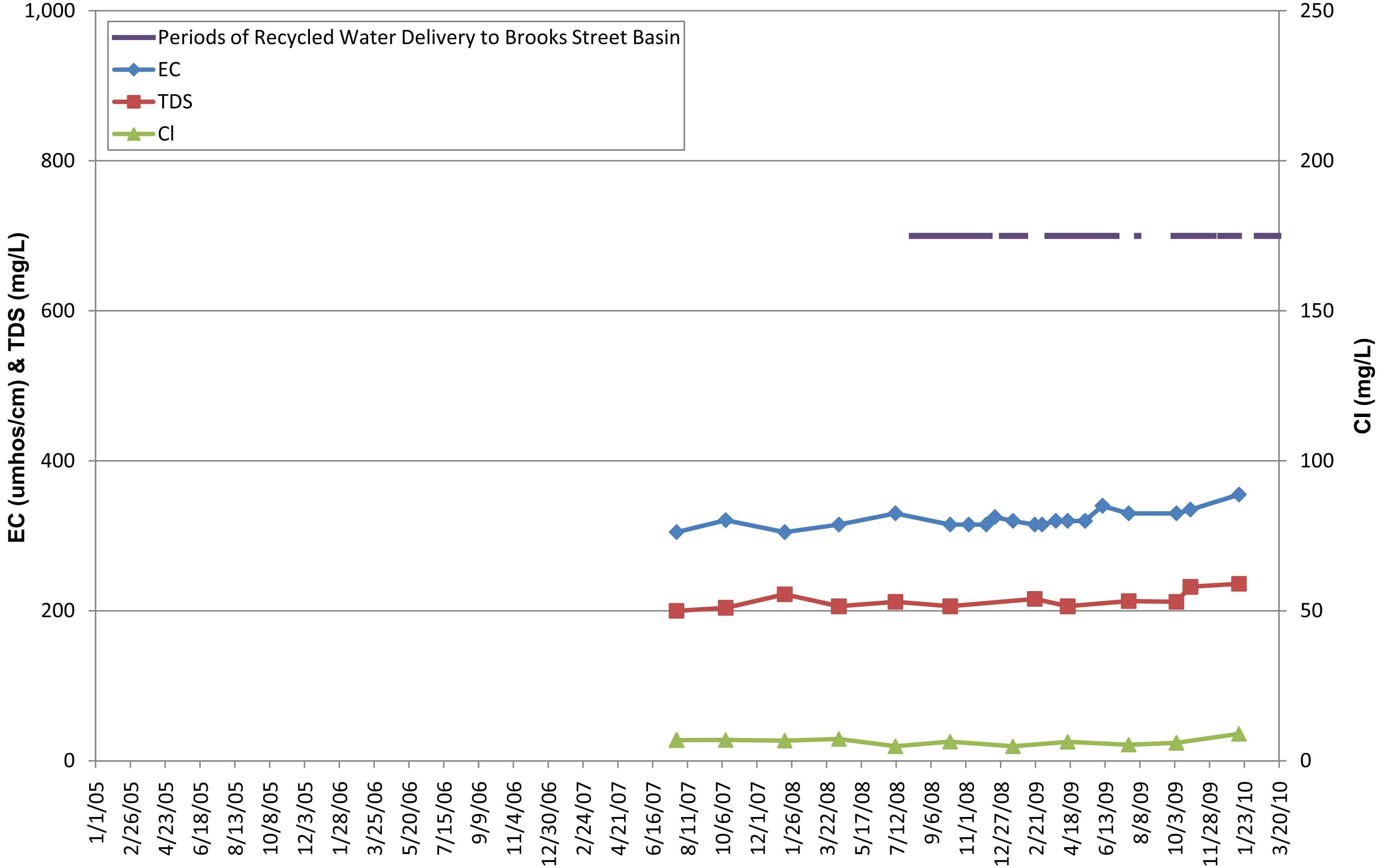
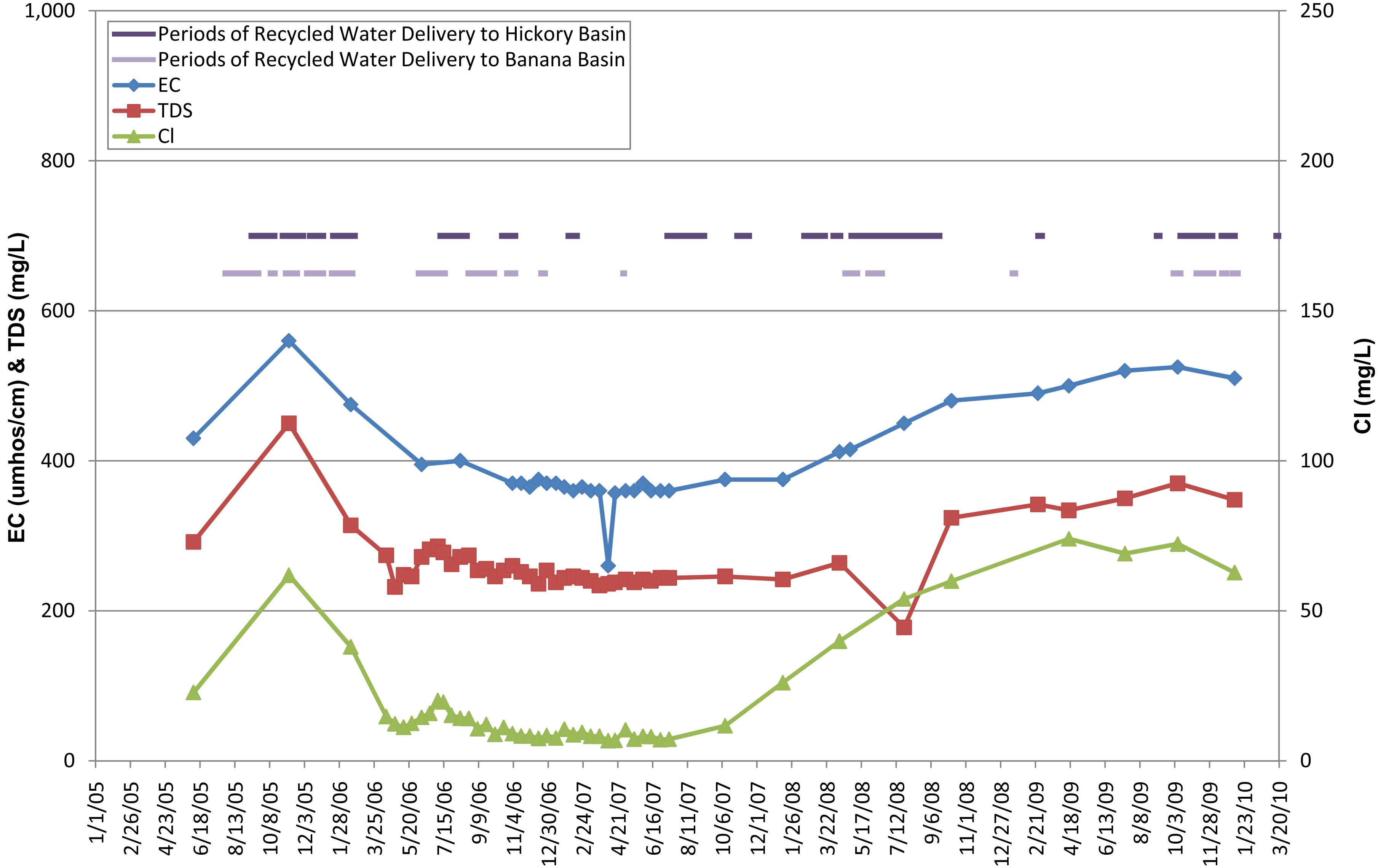
BROOKS STREET BASIN
MW BRK-1/2



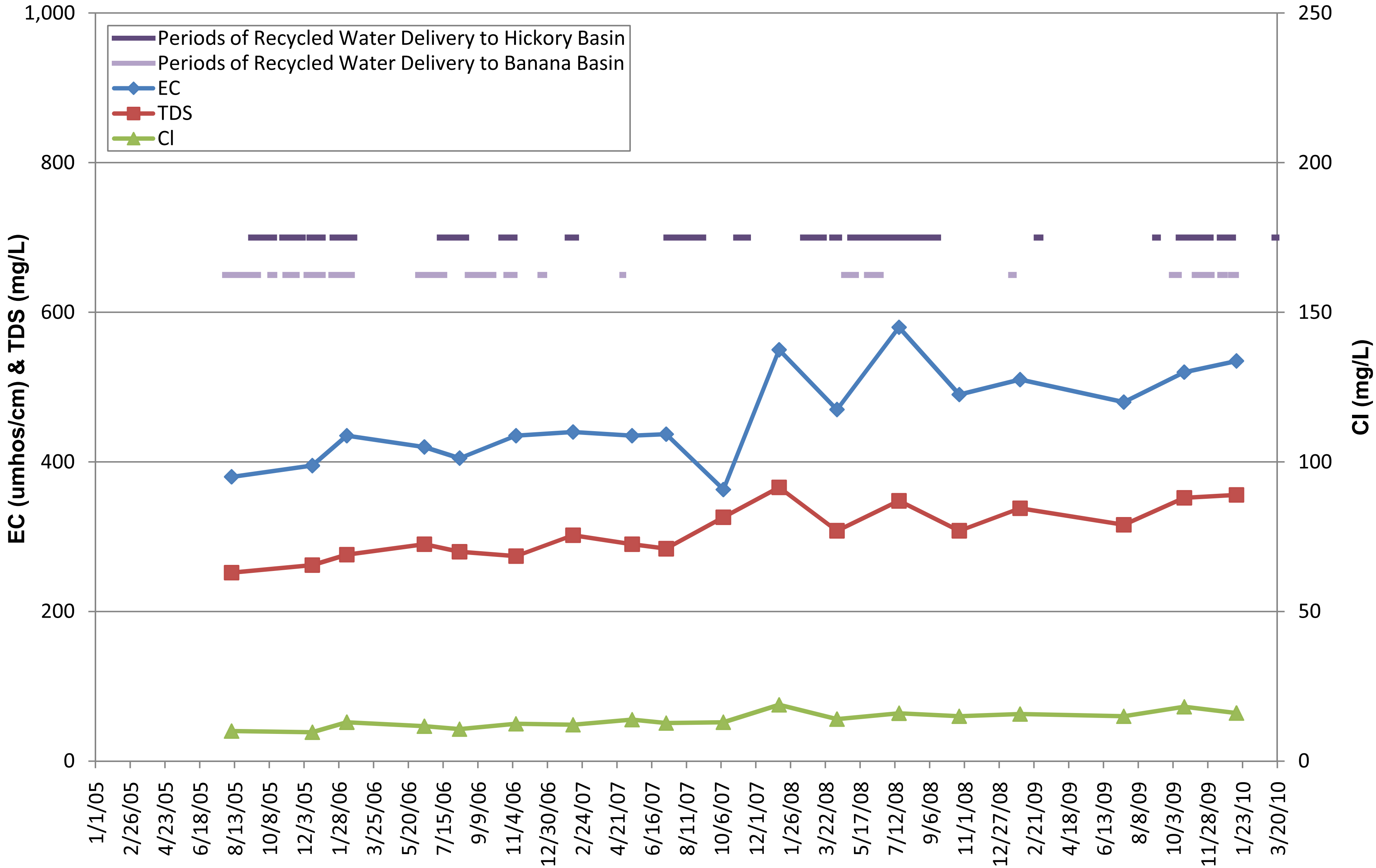
EC, TDS, CL TRENDS
BROOKS STREET BASIN
MW BRK-2/1



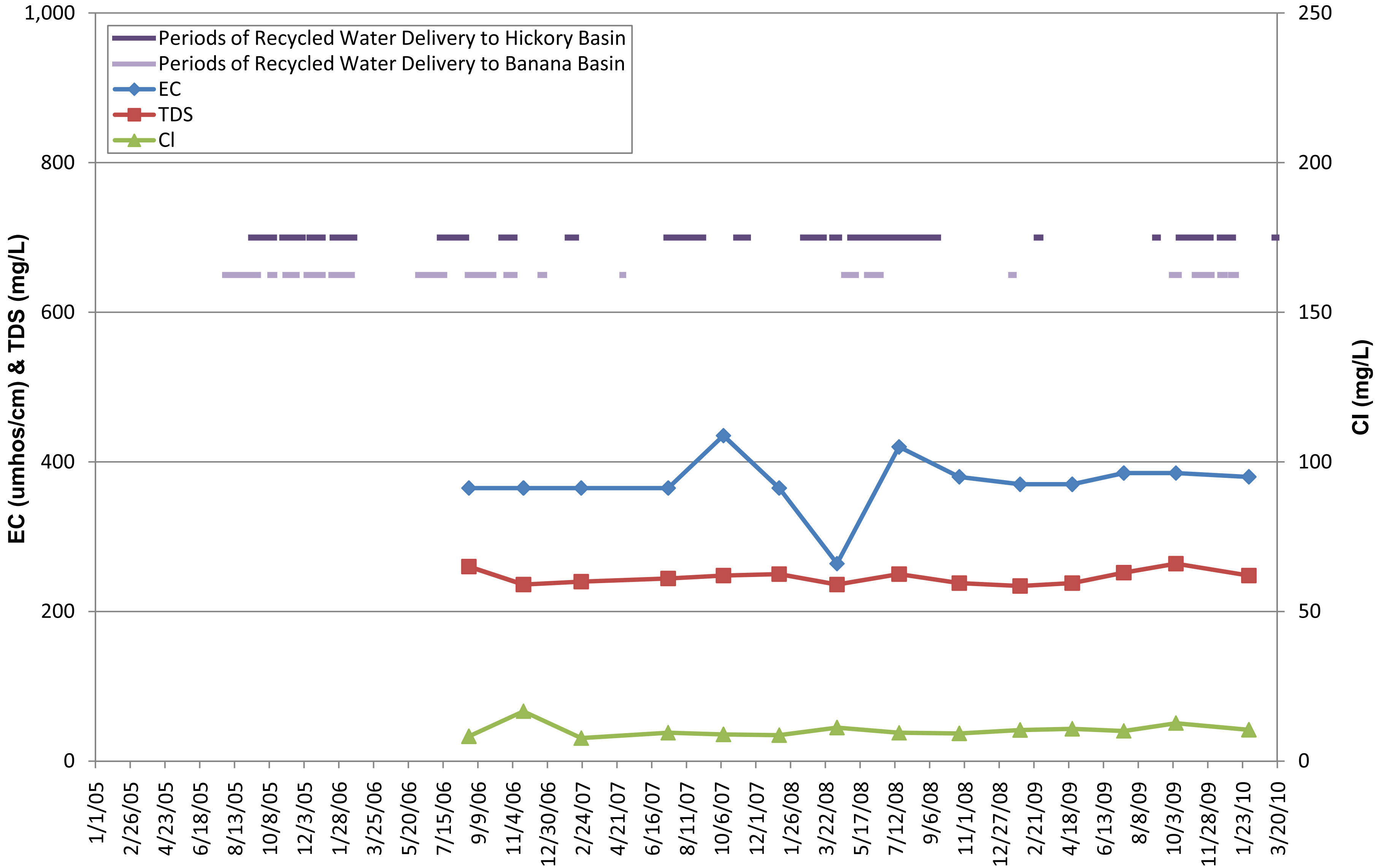
**EC, TDS, CL TRENDS
BROOKS STREET BASIN
MW BRK-2/1**



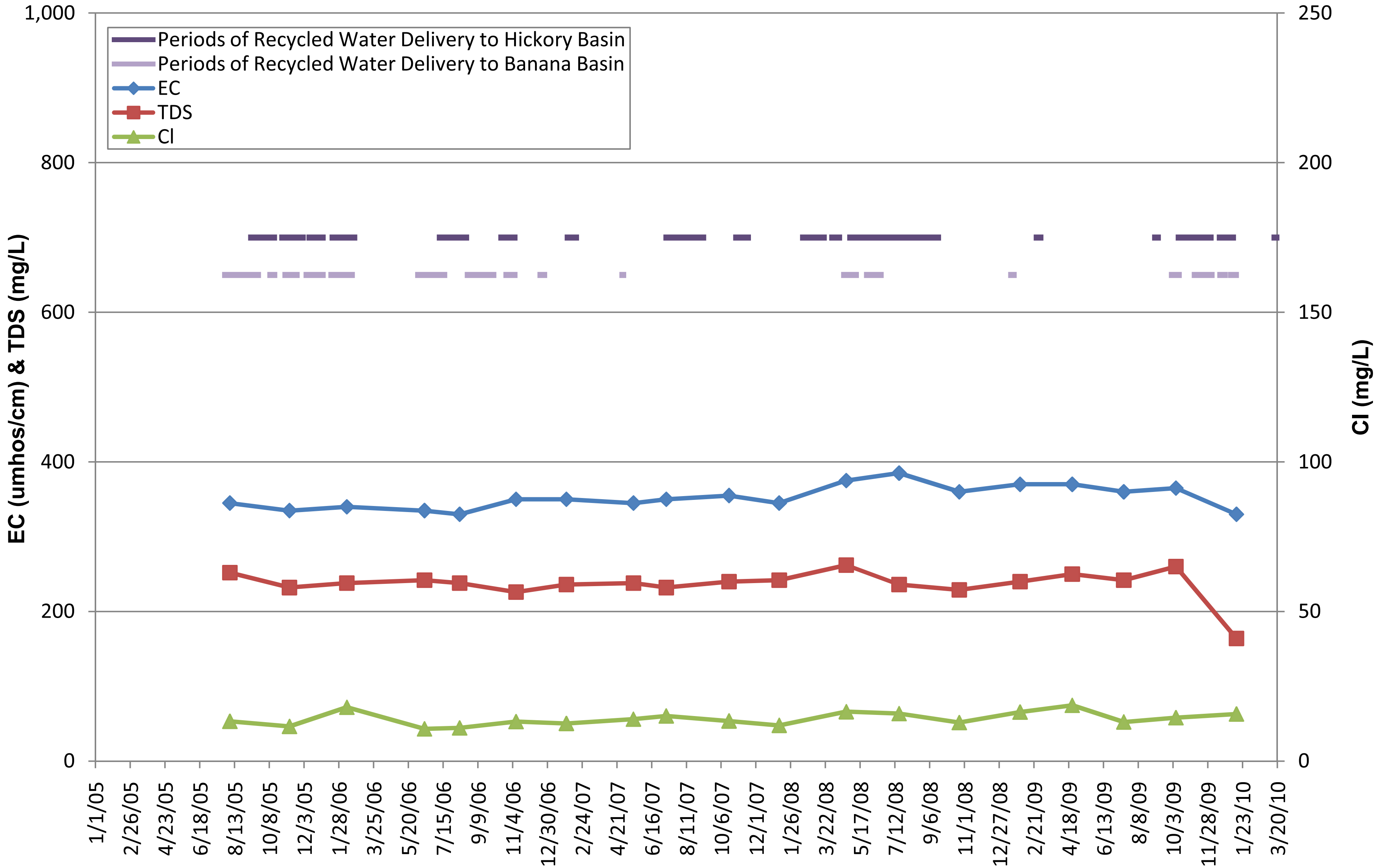
EC, TDS, CL TRENDS
HICKORY BANANA BASINS
MW BH-1/2



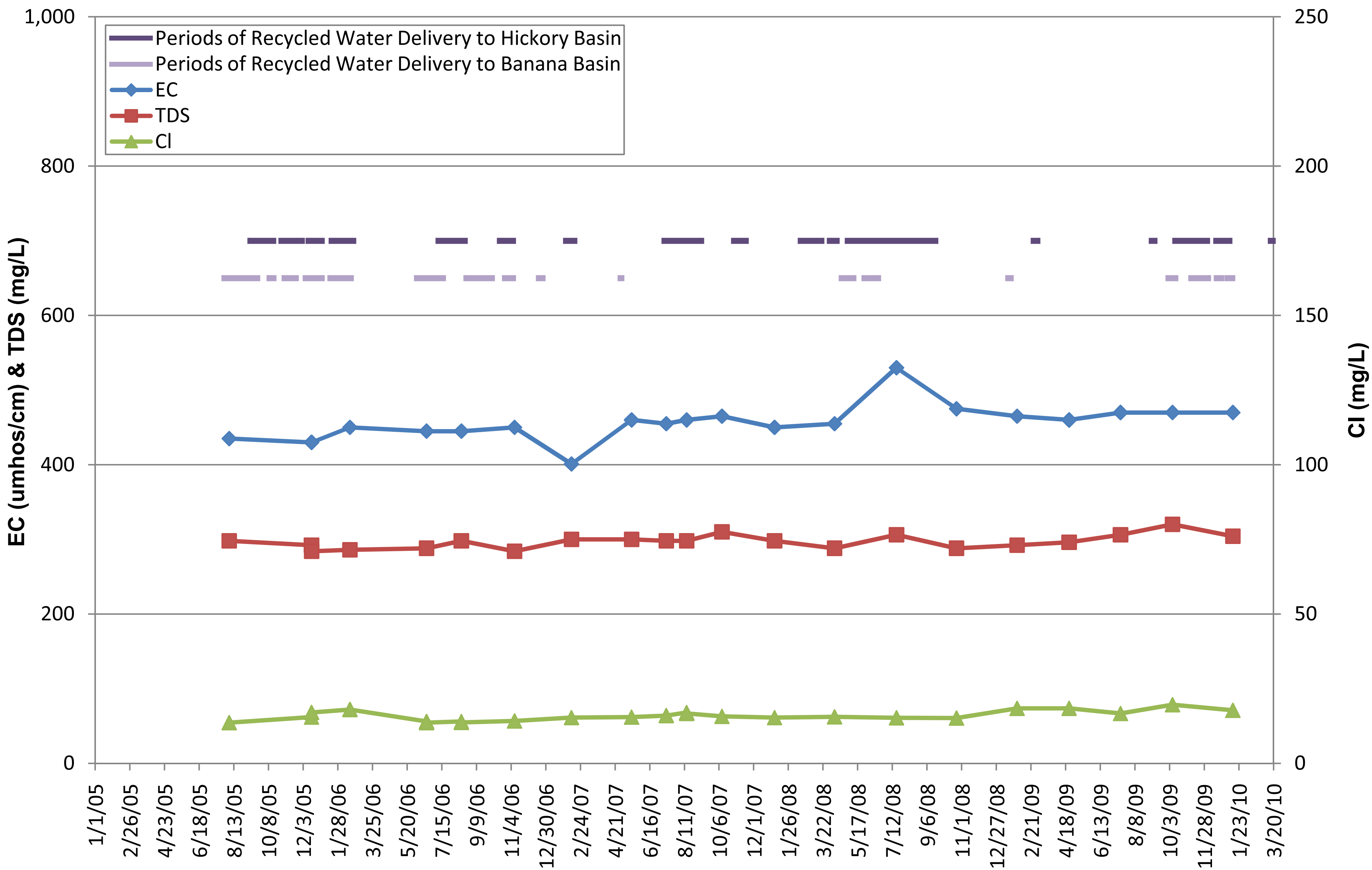
EC, TDS, CL TRENDS
BANANA-HICKORY BASINS
CALIFORNIA SPEEDWAY INFIELD WELL



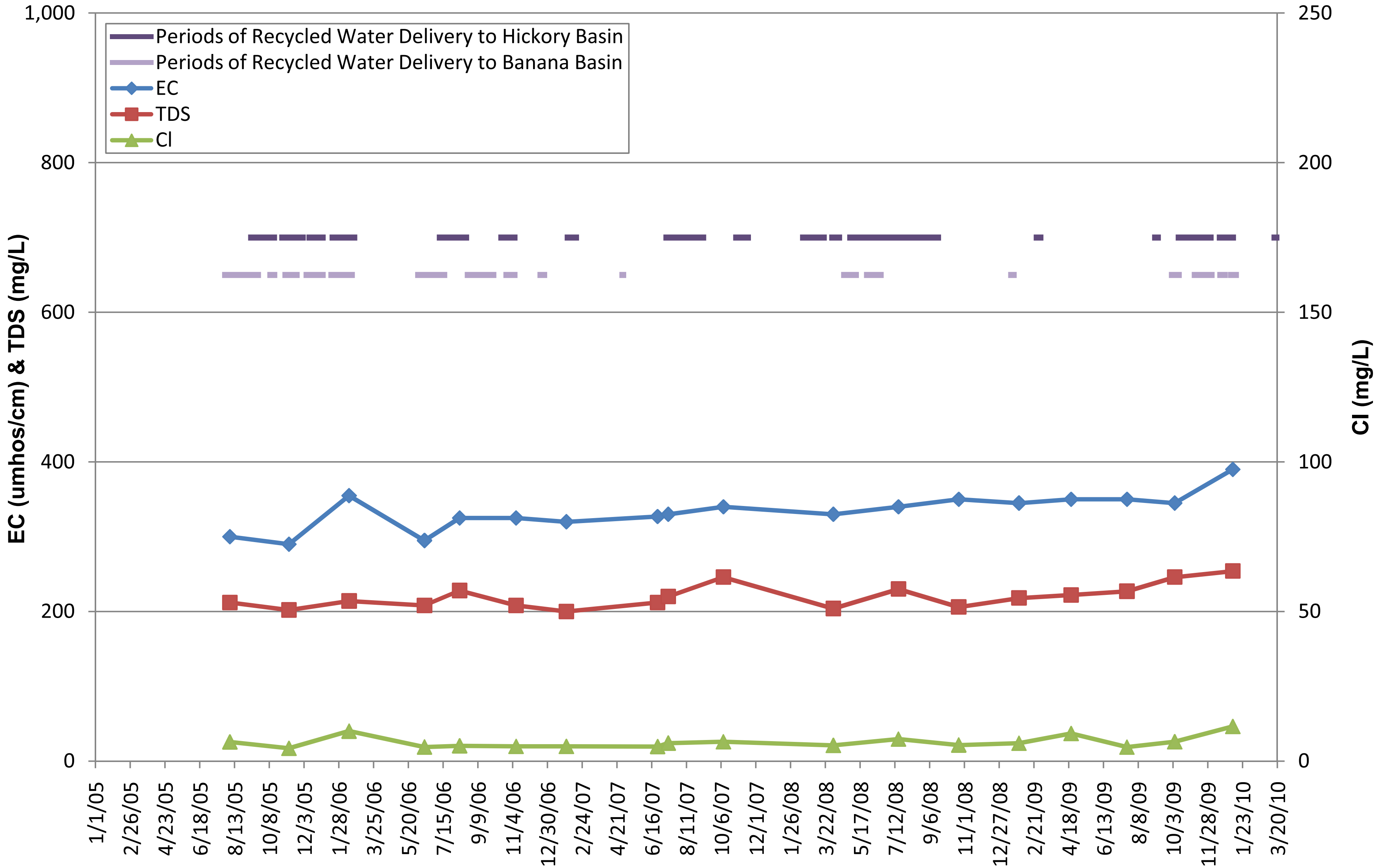
EC, TDS, CL TRENDS
BANANA-HICKORY BASINS
CALIFORNIA SPEEDWAY NO. 2



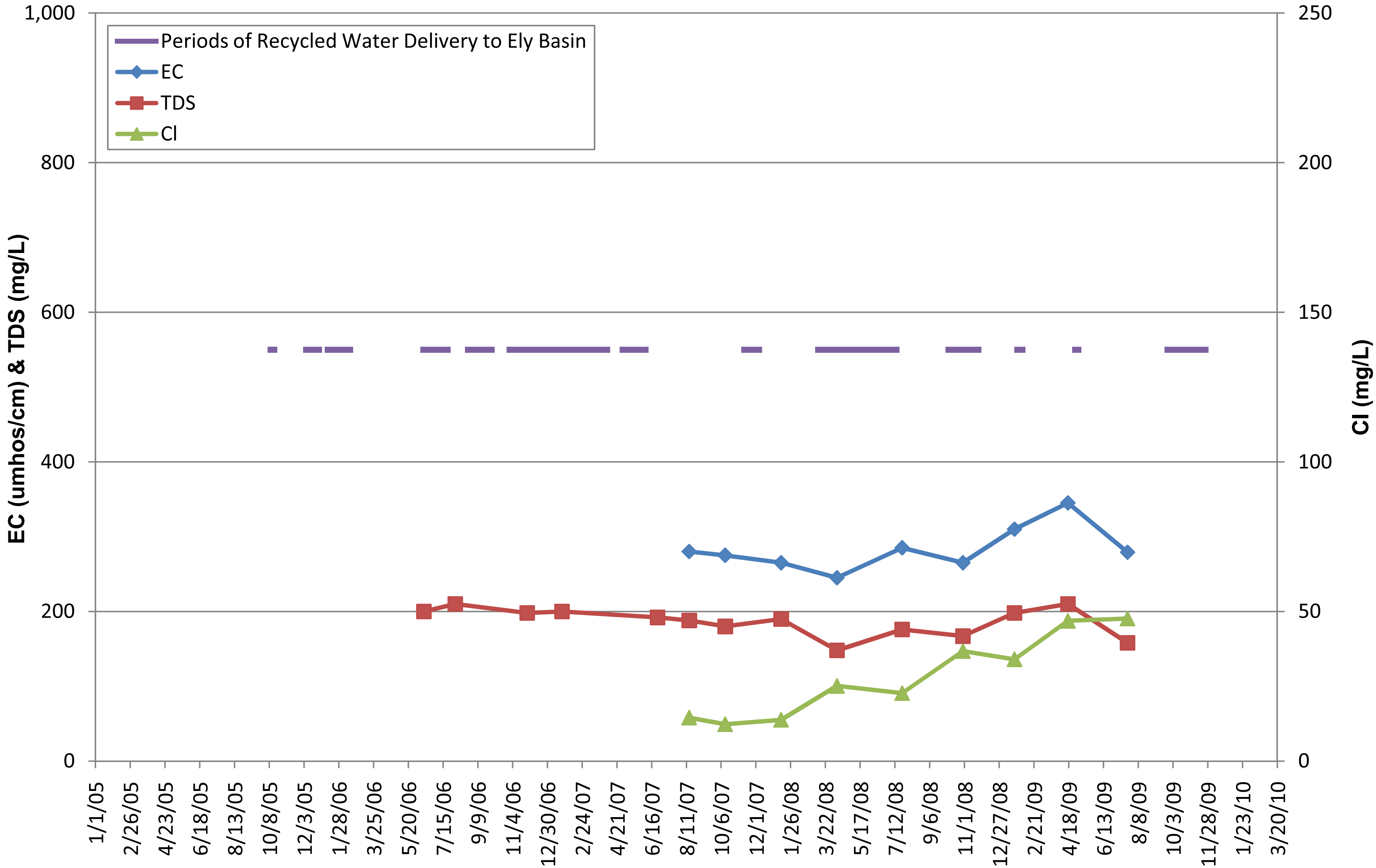
EC, TDS, CL TRENDS
BANANA-HICKORY BASINS
RELIANT EAST WELL



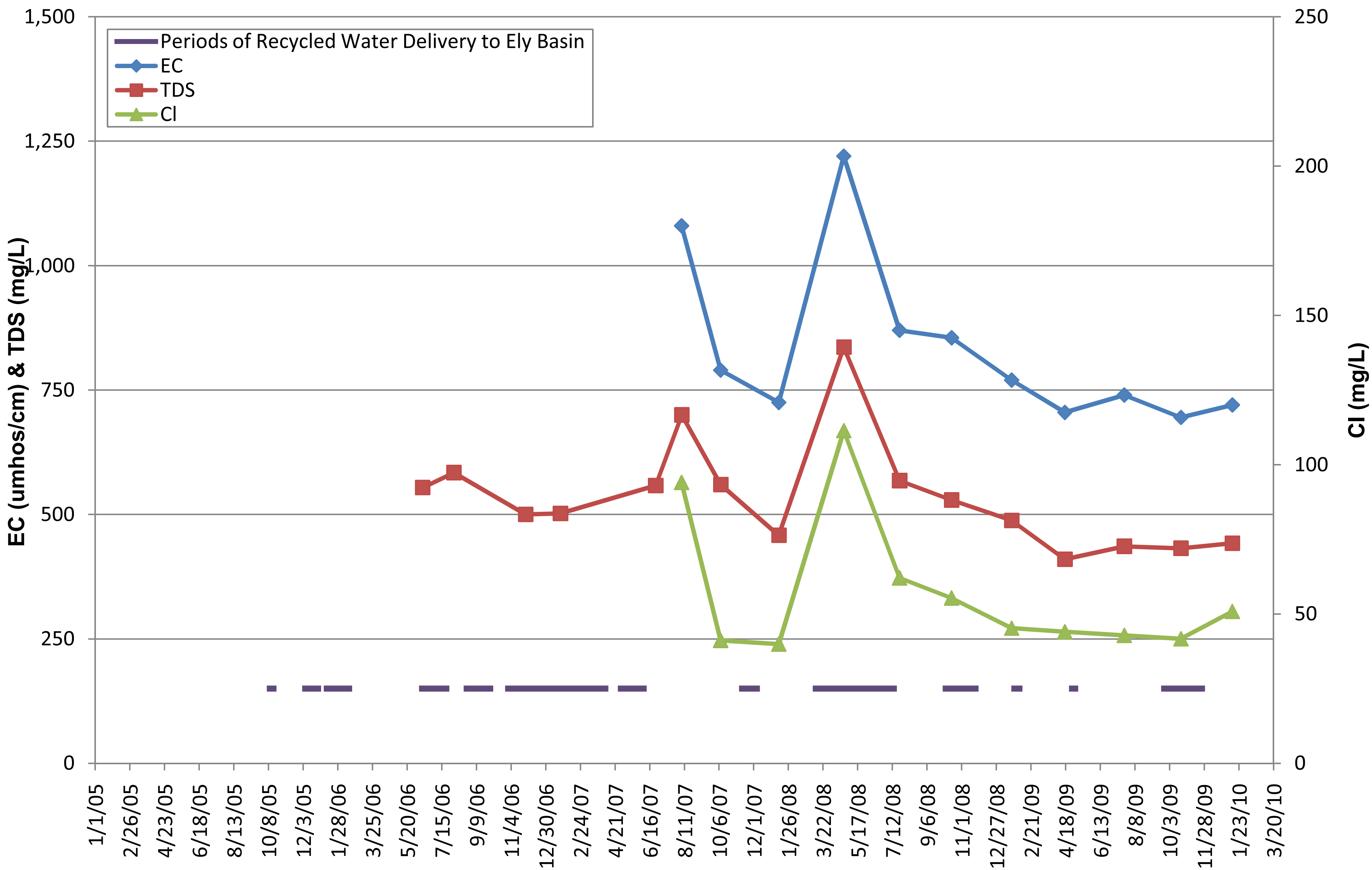
EC, TDS, CL TRENDS
BANANA-HICKORY BASINS
FONTANA WATER CO. 37A



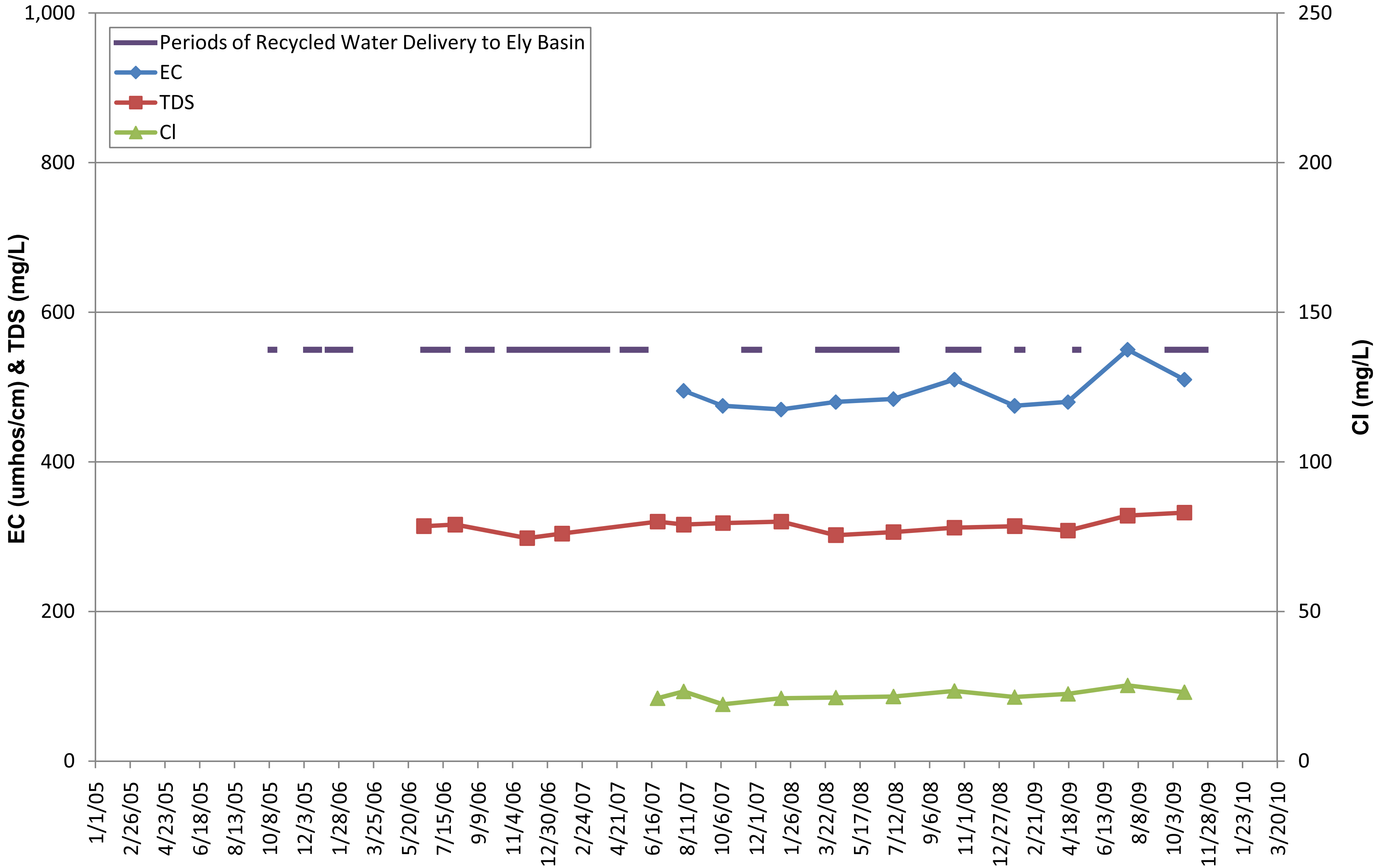
EC, TDS, CL TRENDS
BANANA-HICKORY BASINS
ONTARIO NO. 20



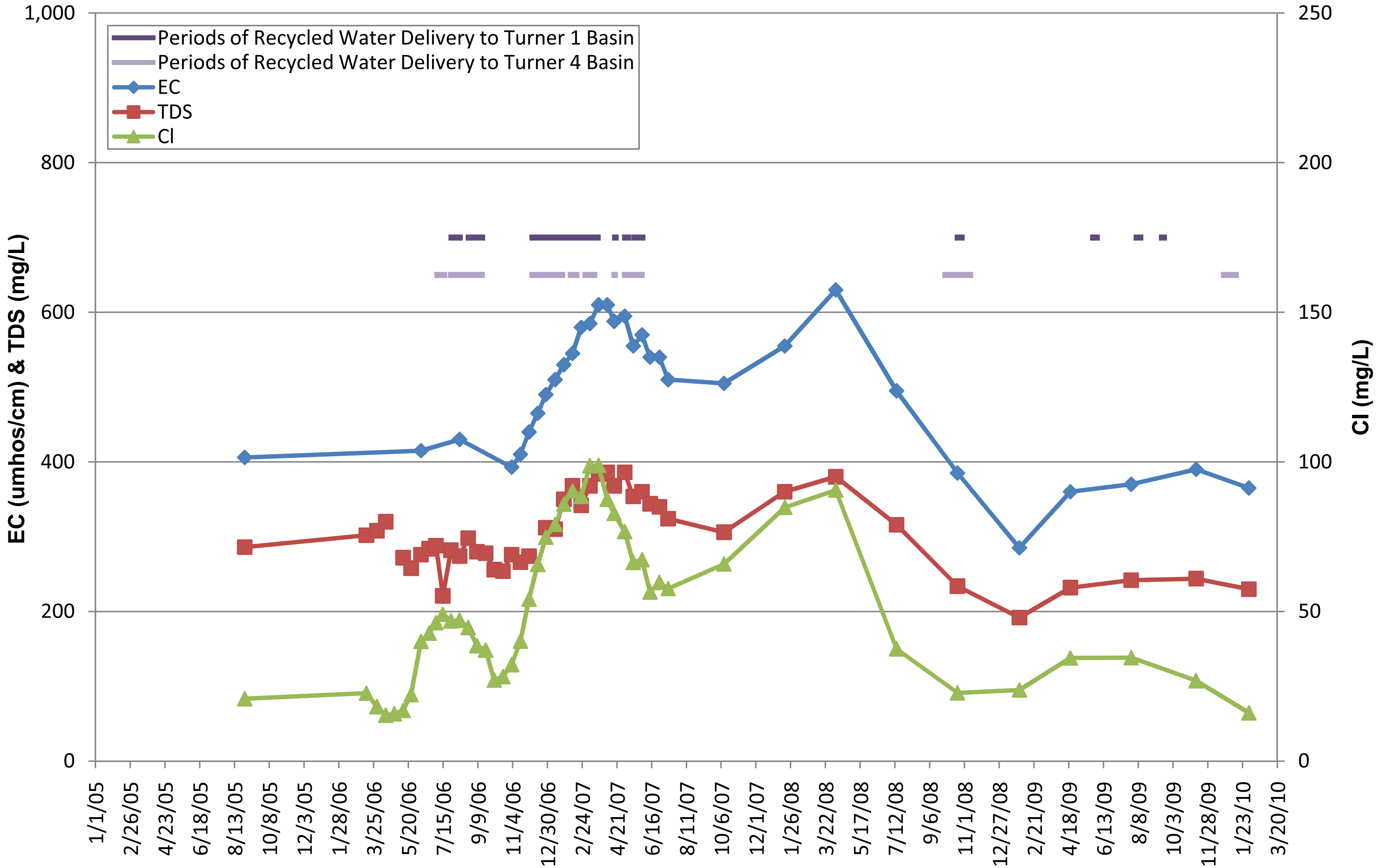
EC, TDS, CL TRENDS
ELY BASIN
PHILADELPHIA WELL



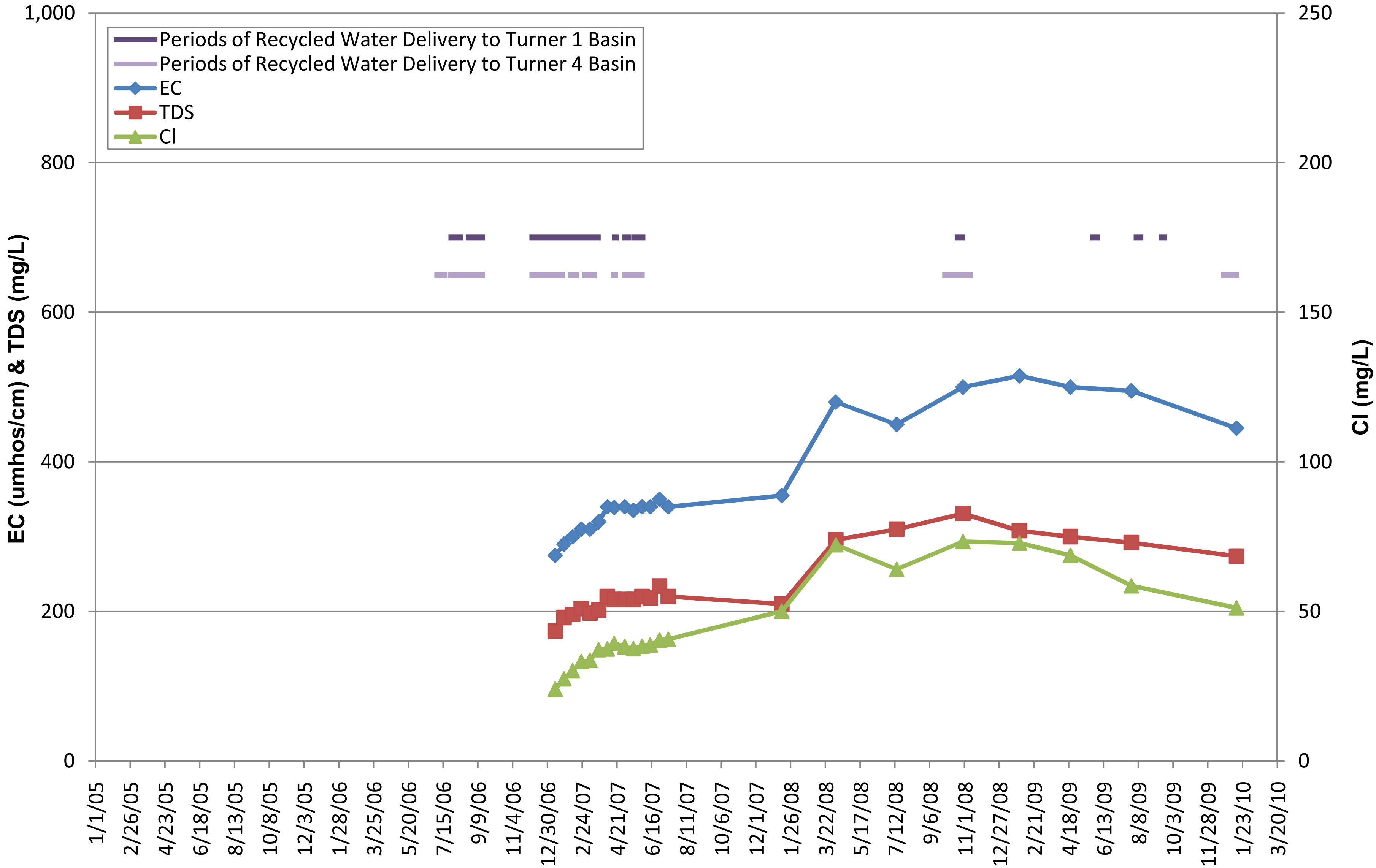
EC, TDS, CL TRENDS
ELY BASIN
WALNUT WELL



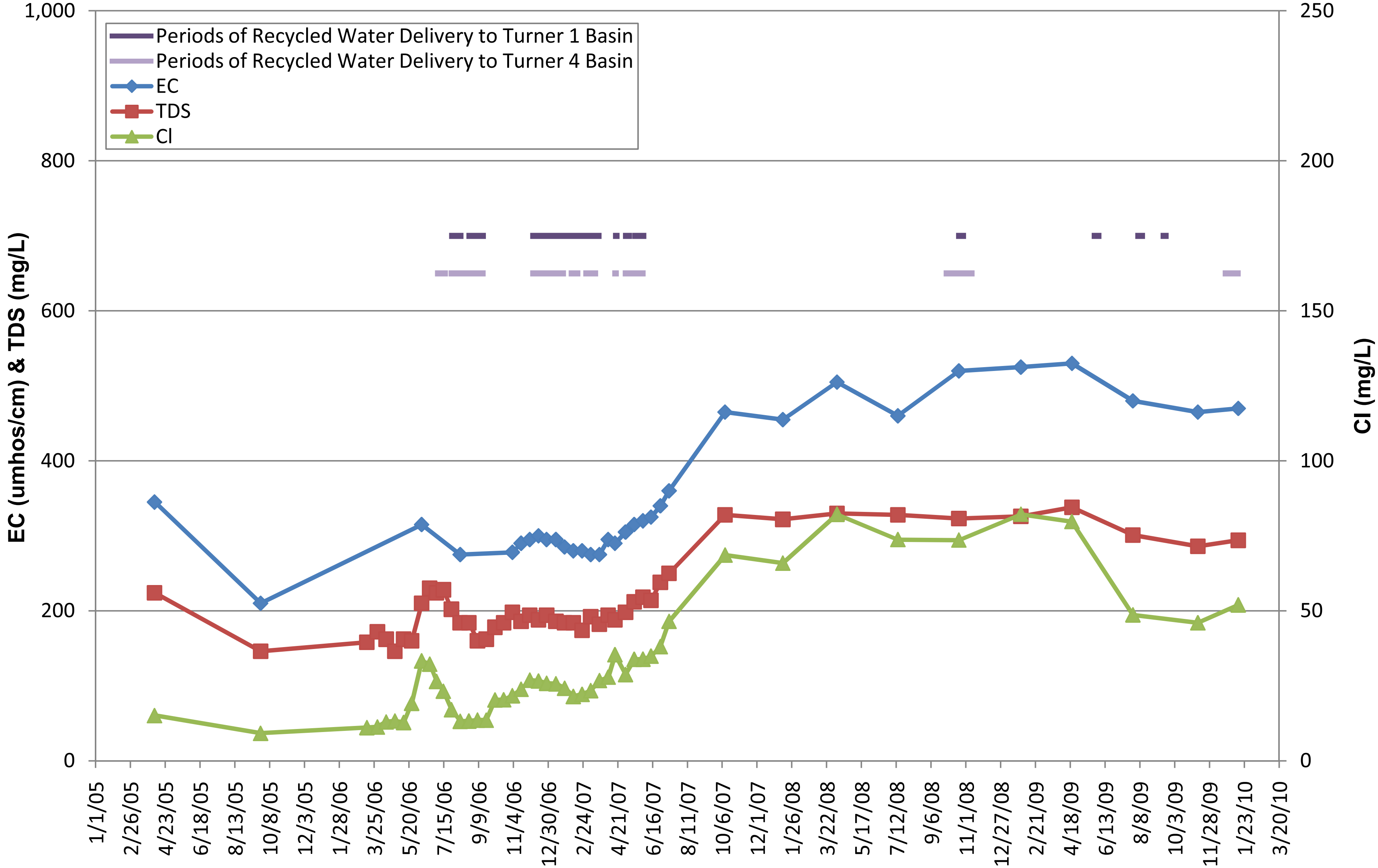
EC, TDS, CL TRENDS
ELY BASIN
RIVERSIDE WELL



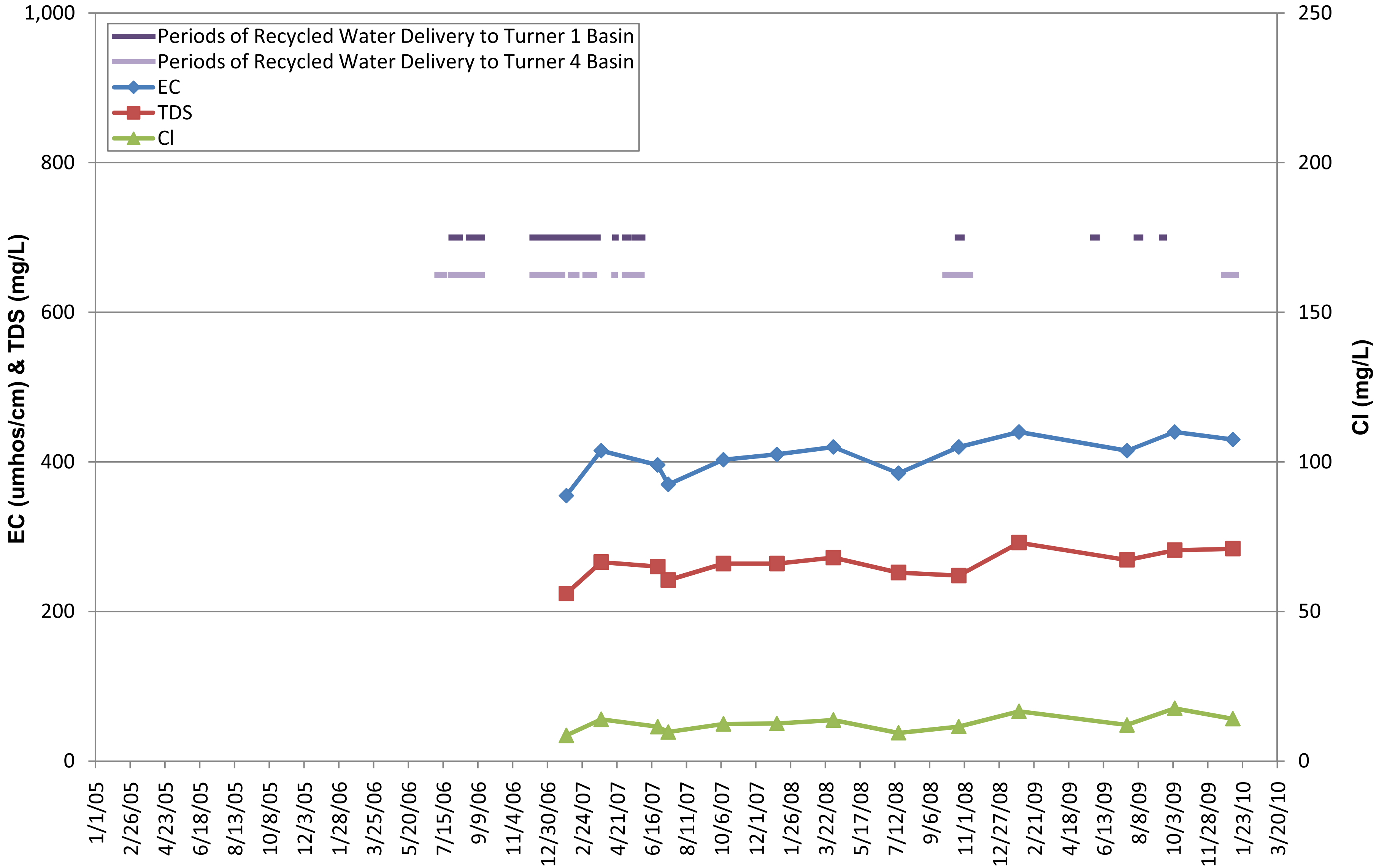
EC, TDS, CL TRENDS
TURNER BASINS
MW TRN-1/2



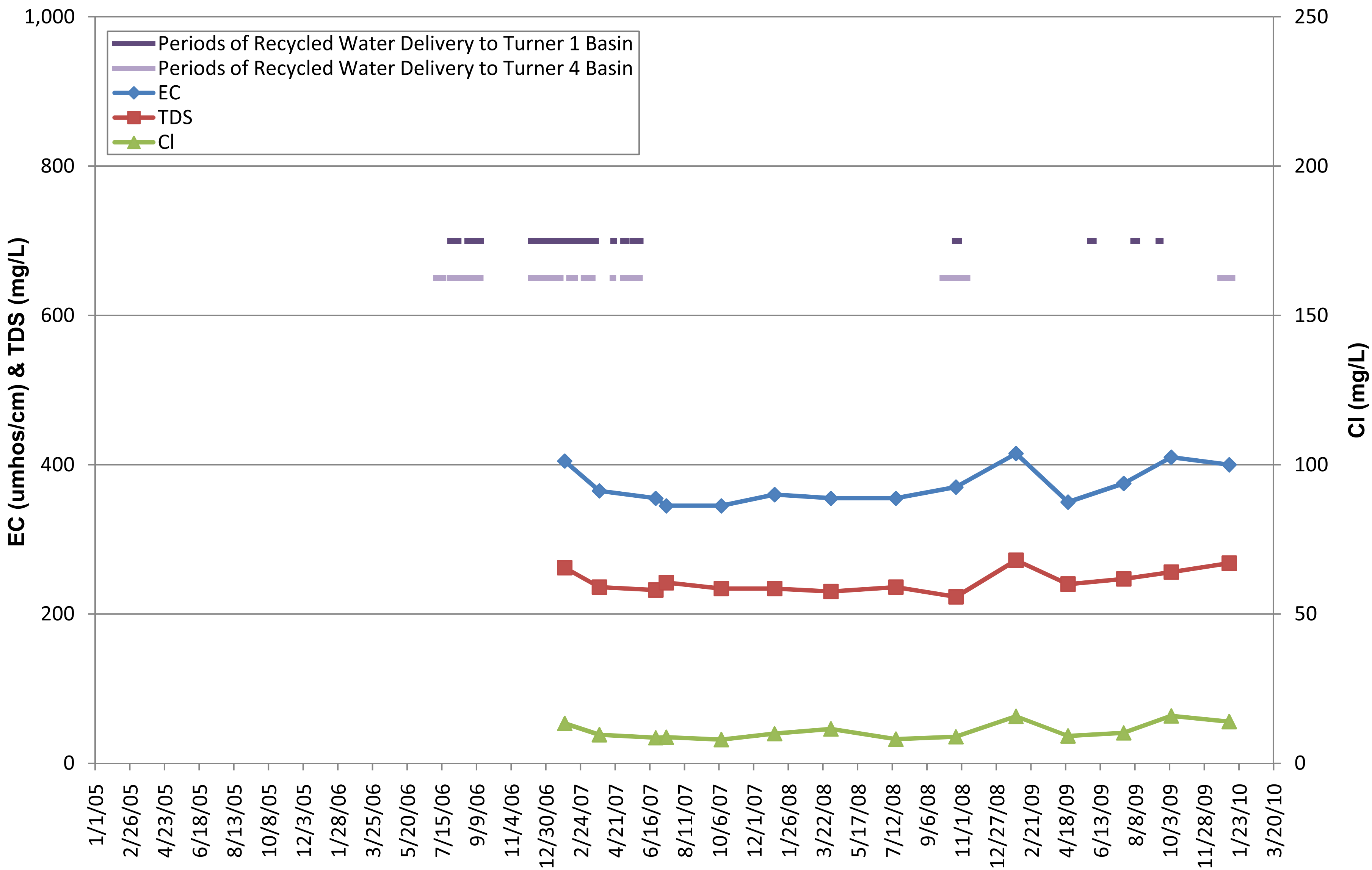
EC, TDS, CL TRENDS
TURNER BASINS
MW TRN-2/1



EC, TDS, CL TRENDS
TURNER BASINS
MW TRN-2/2



EC, TDS, CL TRENDS
TURNER BASINS
ONTARIO NO. 25



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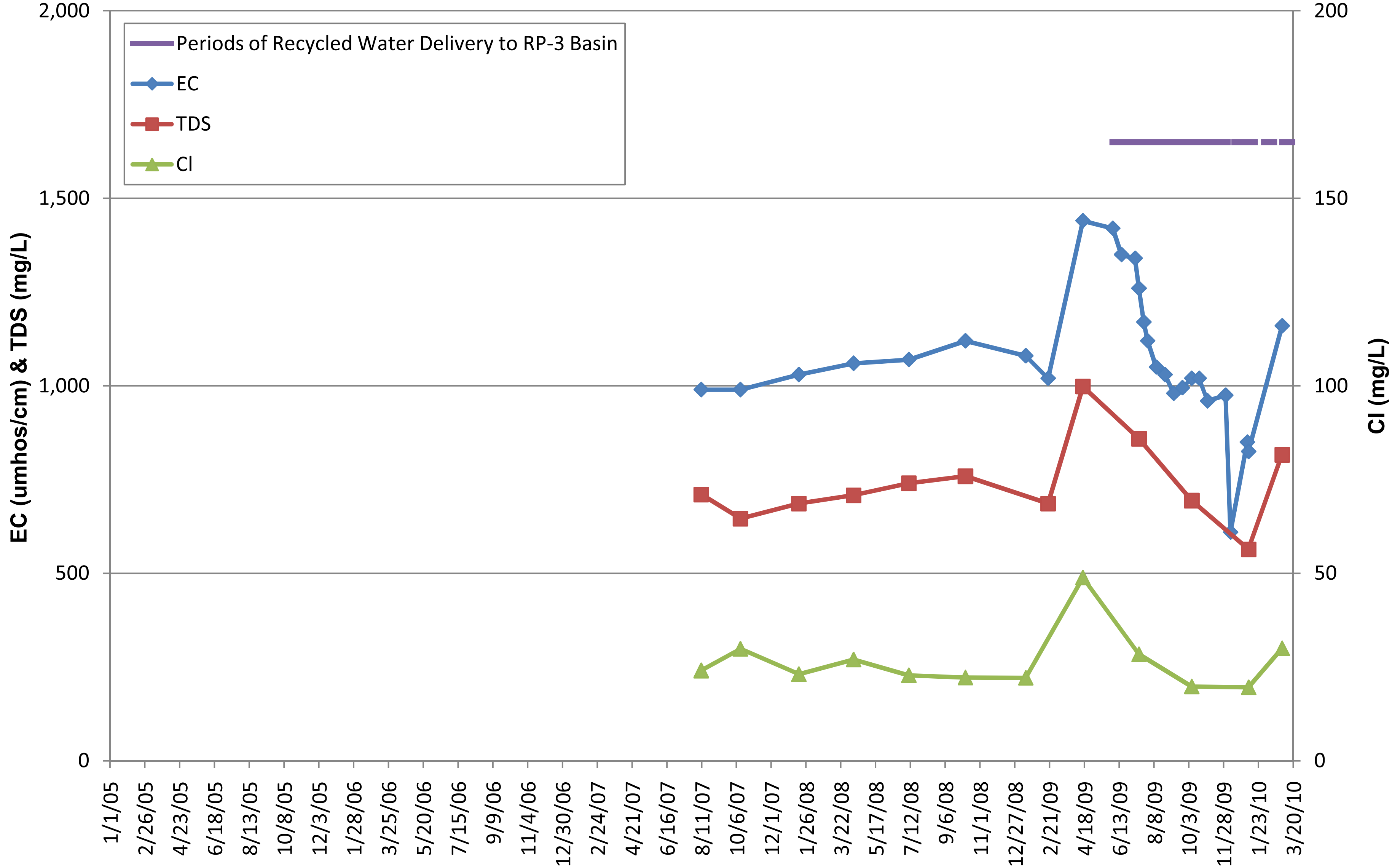
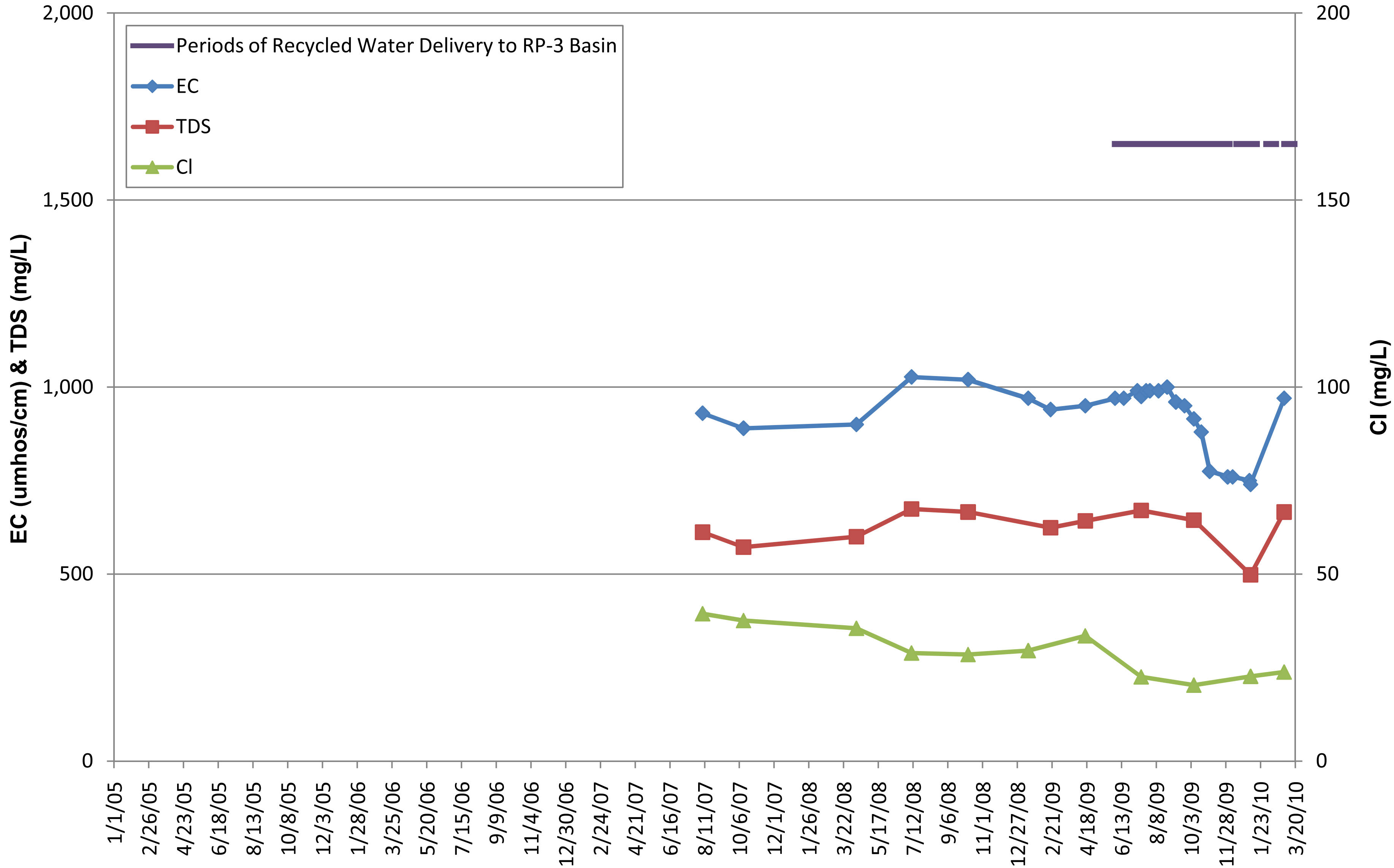
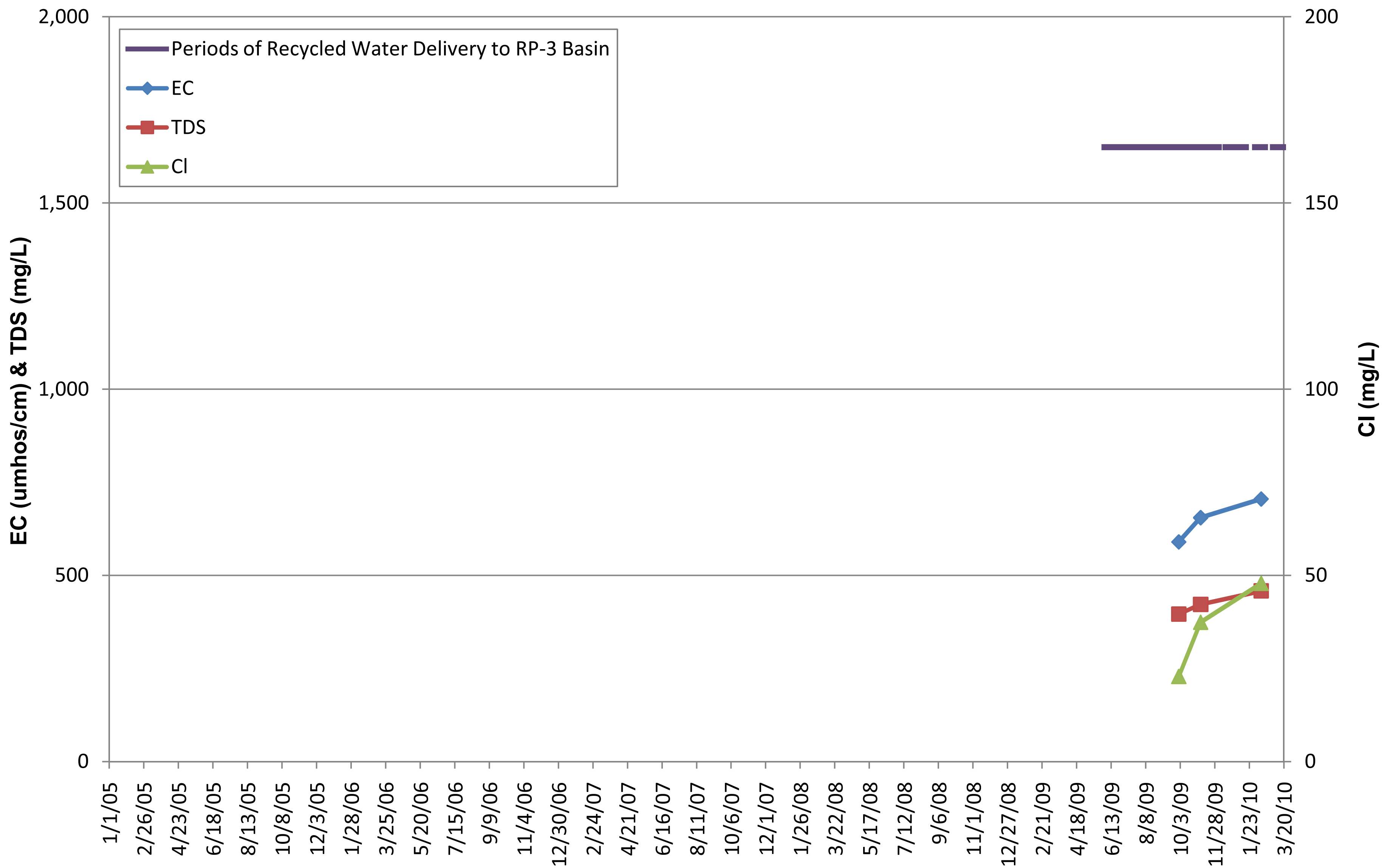
TURNER BASINS
ONTARIO NO. 29



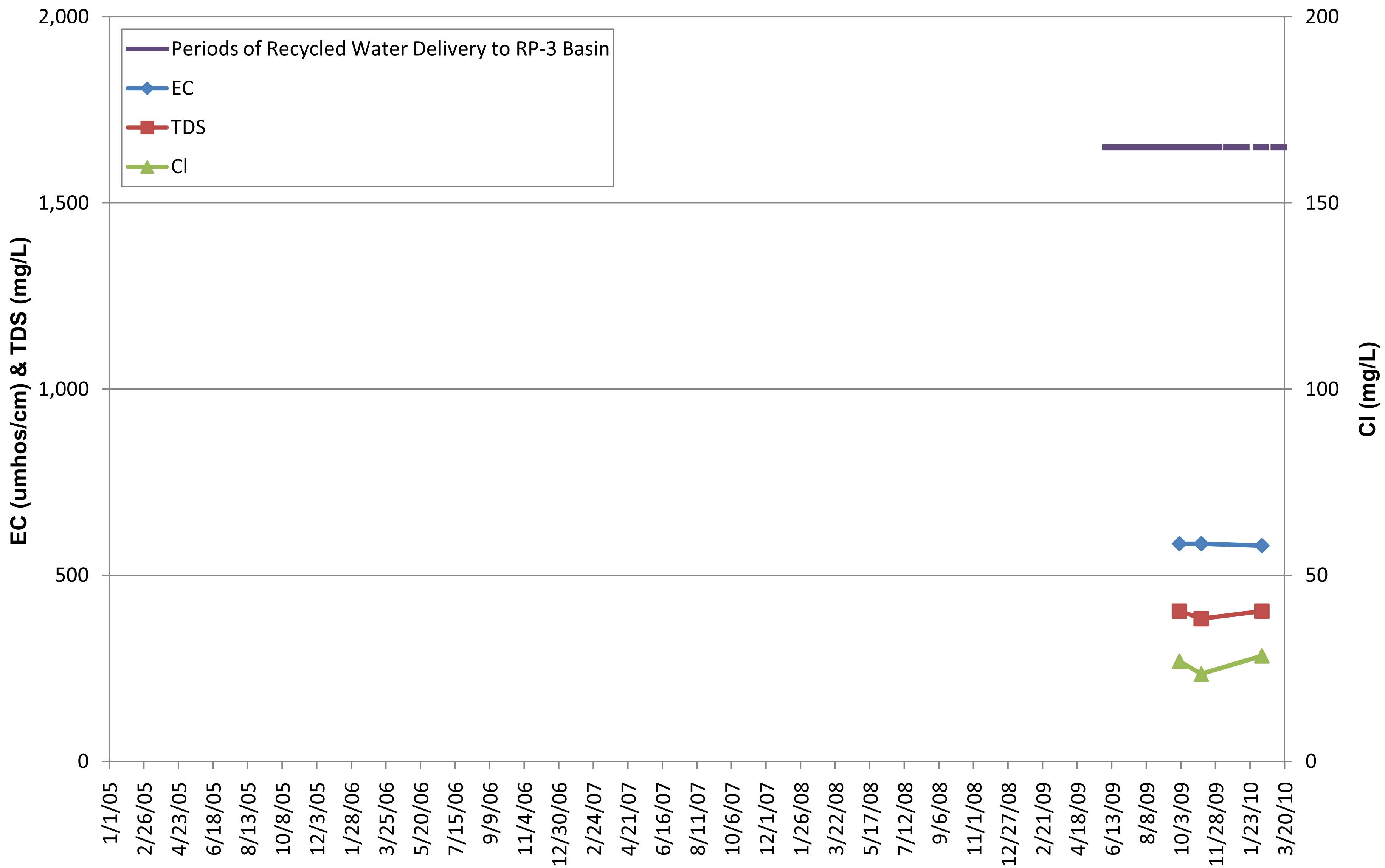
EC, TDS, CL TRENDS
RP-3 BASINS
RP3-1/1



EC, TDS, CL TRENDS
RP-3 BASINS
RP3-1/2



EC, TDS, CL TRENDS
RP-3 BASINS
Alcoa MW-3



EC, TDS, CL TRENDS
RP-3 BASINS
Alcoa MW-1

APPENDIX C

RWC MANAGEMENT PLANS

RWC Management Plan for 8th Street Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2002/03	Jul '02	-61	1.2	0.		1		0.				HISTORICAL MODELED
	Aug '02	-60	0.	0.		0		0.				
	Sep '02	-59	4.9	0.		5		0.				
	Oct '02	-58	11.1	0.		11		0.				
	Nov '02	-57	6.2	0.		6		0.				
	Dec '02	-56	8.7	0.		9		0.				
	Jan '03	-55	11.1	0.		11		0.				
	Feb '03	-54	24.7	0.		25		0.				
	Mar '03	-53	22.3	0.		22		0.				
	Apr '03	-52	19.8	0.		20		0.				
	May '03	-51	6.2	0.		6		0.				
	Jun '03	-50	3.7	0.		4		0.				
2003/04	Jul '03	-49	1.2	0.		1		0.				
	Aug '03	-48	0.	0.		0		0.				
	Sep '03	-47	4.9	0.		5		0.				
	Oct '03	-46	11.1	0.		11		0.				
	Nov '03	-45	6.2	0.		6		0.				
	Dec '03	-44	8.7	0.		9		0.				
	Jan '04	-43	11.1	0.		11		0.				
	Feb '04	-42	24.7	0.		25		0.				
	Mar '04	-41	22.3	0.		22		0.				
	Apr '04	-40	19.8	0.		20		0.				
	May '04	-39	6.2	0.		6		0.				
	Jun '04	-38	3.7	0.		4		0.				
2004/05	Jul '04	-37	1.2	0.		1		0.				
	Aug '04	-36	0.	0.		0		0.				
	Sep '04	-35	4.9	0.		5		0.				
	Oct '04	-34	11.1	0.		11		0.				
	Nov '04	-33	6.2	0.		6		0.				
	Dec '04	-32	8.7	0.		9		0.				
	Jan '05	-31	11.1	0.		11		0.				
	Feb '05	-30	24.7	0.		25		0.				
	Mar '05	-29	22.3	0.		22		0.				
	Apr '05	-28	19.8	0.		20		0.				
	May '05	-27	6.2	0.		6		0.				
	Jun '05	-26	3.7	0.		4		0.				
2005/06	Jul '05	-25	0.	0.		0.		0.				MEASURED
	Aug '05	-24	0.	0.		0.		0.				
	Sep '05	-23	60.	0.		60.		0.				
	Oct '05	-22	132.6	0.		132.6		0.				
	Nov '05	-21	60.	0.		60.		0.				
	Dec '05	-20	60.	0.		60.		0.				
	Jan '06	-19	116.	0.		116.		0.				
	Feb '06	-18	242.4	0.		242.4		0.				
	Mar '06	-17	325.9	0.		325.9		0.				
	Apr '06	-16	229.5	0.		229.5		0.				
	May '06	-15	50.2	0.		50.2		0.				
	Jun '06	-14	15.	0.		15.		0.				
2006/07	Jul '06	-13	11.9	0.		11.9	1,664	0.	0			HISTORICAL
	Aug '06	-12	6.2	0.		6.2	1,670	0.	0			
	Sep '06	-11	22.	0.		22.	1,692	0.	0			
	Oct '06	-10	40.3	0.		40.3	1,732	0.	0			
	Nov '06	-9	42.	0.		42.	1,774	0.	0			
	Dec '06	-8	79.8	0.		79.8	1,854	0.	0			
	Jan '07	-7	58.8	0.		58.8	1,913	0.	0			
	Feb '07	-6	167.4	0.		167.4	2,080	0.	0			
	Mar '07	-5	38.3	0.		38.3	2,118	0.	0			
	Apr '07	-4	89.	0.		89.	2,207	0.	0			
	May '07	-3	42.	0.		42.	2,249	0.	0			
	Jun '07	-2	42.	0.		42.	2,291	0.	0			

RWC Management Plan for 8th Street Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2007/08	Jul '07	-1	16.	0.		16.	2,307	0.	0			
	Aug '07	0	16.	0.		16.	2,323	0.	0	2323	0%	
	Sep '07	1	17.	0.	310.2	327.2	2,651	128.1	128	2779	5%	START - UP
	Oct '07	2	42.	0.	310.2	352.2	3,003	109.	237	3240	7%	
	Nov '07	3	81.	0.	310.2	391.2	3,394	161.	398	3792	10%	
	Dec '07	4	224.	0.	310.2	534.2	3,928	0.	398	4326	9%	
	Jan '08	5	328.	0.	310.2	638.2	4,566	1.	399	4965	8%	
	Feb '08	6	98.	0.	310.2	408.2	4,975	157.	556	5531	10%	
	Mar '08	7	21.	0.	310.2	331.2	5,306	164.	720	6026	12%	
	Apr '08	8	11.	0.	310.2	321.2	5,627	90.	810	6437	13%	
	May '08	9	90.	0.	310.2	400.2	6,027	158.	968	6995	14%	
	Jun '08	10	15.	0.	310.2	325.2	6,352	86.	1,054	7407	14%	
2008/09	Jul '08	11	29.	0.	310.2	339.2	6,692	224.	1,278	7970	16%	HISTORICAL
	Aug '08	12	15.	0.	310.2	325.2	7,017	128.	1,406	8423	17%	
	Sep '08	13	15.	0.	310.2	325.2	7,342	0.	1,406	8748	16%	
	Oct '08	14	16.	0.	310.2	326.2	7,668	0.	1,406	9074	15%	
	Nov '08	15	137.	0.	310.2	447.2	8,115	0.	1,406	9522	15%	
	Dec '08	16	352.	0.	310.2	662.2	8,778	0.	1,406	10184	14%	
	Jan '09	17	35.	0.	310.2	345.2	9,123	0.	1,406	10529	13%	
	Feb '09	18	458.	0.	310.2	768.2	9,891	0.	1,406	11297	12%	
	Mar '09	19	21.	0.	310.2	331.2	10,222	0.	1,406	11628	12%	
	Apr '09	20	15.	0.	310.2	325.2	10,547	0.	1,406	11954	12%	
	May '09	21	16.	0.	310.2	326.2	10,874	0.	1,406	12280	11%	
	Jun '09	22	0.	0.	310.2	310.2	11,184	0.	1,406	12590	11%	
2009/10	Jul '09	23	19.	0.	310.2	329.2	11,513	0.	1,406	12919	11%	
	Aug '09	24	33.	0.	310.2	343.2	11,856	24.	1,430	13286	11%	
	Sep '09	25	18.	0.	310.2	328.2	12,185	0.	1,430	13615	11%	
	Oct '09	26	74.	0.	310.2	384.2	12,569	0.	1,430	13999	10%	
	Nov '09	27	90.	0.	310.2	400.2	12,969	133.	1,563	14532	11%	
	Dec '09	28	7.	0.	310.2	317.2	13,286	93.	1,656	14942	11%	
	Jan '10	29	387.	0.	310.2	697.2	13,983	102.	1,758	15741	11%	
	Feb '10	30	474.	3.	310.2	787.2	14,771	0.	1,758	16529	11%	
	Mar '10	31	102.		310.2	412.2	15,183	100.	1,858	17041	11%	PROJECTED
	Apr '10	32	86.		310.2	396.2	15,579	150.	2,008	17587	11%	
	May '10	33	50.		310.2	360.2	15,939	175.	2,183	18122	12%	
	Jun '10	34	18.		310.2	328.2	16,267	175.	2,358	18626	13%	
2010/11	Jul '10	35	15.		310.2	325.2	16,593	150.	2,508	19101	13%	
	Aug '10	36	14.		310.2	324.2	16,917	0.	2,508	19425	13%	
	Sep '10	37	26.		310.2	336.2	17,253	0.	2,508	19761	13%	
	Oct '10	38	61.		310.2	371.2	17,624	0.	2,508	20132	12%	
	Nov '10	39	82.		310.2	392.2	18,016	125.	2,633	20650	13%	
	Dec '10	40	145.		310.2	455.2	18,472	100.	2,733	21205	13%	
	Jan '11	41	185.		310.2	495.2	18,967	75.	2,808	21775	13%	
	Feb '11	42	288.		310.2	598.2	19,565	50.	2,858	22423	13%	
	Mar '11	43	102.		310.2	412.2	19,977	100.	2,958	22935	13%	
	Apr '11	44	86.		310.2	396.2	20,373	150.	3,108	23482	13%	
	May '11	45	50.		310.2	360.2	20,734	175.	3,283	24017	14%	
	Jun '11	46	18.		310.2	328.2	21,062	175.	3,458	24520	14%	
2011/12	Jul '11	47	15.		310.2	325.2	21,387	150.	3,608	24995	14%	
	Aug '11	48	14.		310.2	324.2	21,711	0.	3,608	25319	14%	
	Sep '11	49	26.		310.2	336.2	22,048	0.	3,608	25656	14%	
	Oct '11	50	61.		310.2	371.2	22,419	0.	3,608	26027	14%	
	Nov '11	51	82.		310.2	392.2	22,811	125.	3,733	26544	14%	
	Dec '11	52	145.		310.2	455.2	23,266	100.	3,833	27099	14%	
	Jan '12	53	185.		310.2	495.2	23,761	75.	3,908	27669	14%	
	Feb '12	54	288.		310.2	598.2	24,360	50.	3,958	28318	14%	
	Mar '12	55	102.		310.2	412.2	24,772	100.	4,058	28830	14%	
	Apr '12	56	86.		310.2	396.2	25,168	150.	4,208	29376	14%	
	May '12	57	50.		310.2	360.2	25,528	175.	4,383	29911	15%	
	Jun '12	58	18.		310.2	328.2	25,856	175.	4,558	30415	15%	

RWC Management Plan for 8th Street Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2012/13	Jul '12	59	15.		310.2	325.2	26,180	150.	4,708	30888	15%	PLANNED
	Aug '12	60	14.		310.2	324.2	26,505	0.	4,708	31213	15%	
	Sep '12	61	26.		310.2	336.2	26,836	0.	4,708	31544	15%	
	Oct '12	62	61.		310.2	371.2	27,196	0.	4,708	31904	15%	
	Nov '12	63	82.		310.2	392.2	27,582	125.	4,833	32415	15%	
	Dec '12	64	145.		310.2	455.2	28,028	100.	4,933	32962	15%	
	Jan '13	65	185.		310.2	495.2	28,513	75.	5,008	33521	15%	
	Feb '13	66	288.		310.2	598.2	29,086	50.	5,058	34144	15%	
	Mar '13	67	102.		310.2	412.2	29,476	100.	5,158	34634	15%	
	Apr '13	68	86.		310.2	396.2	29,852	150.	5,308	35161	15%	
	May '13	69	50.		310.2	360.2	30,206	175.	5,483	35690	15%	
	Jun '13	70	18.		310.2	328.2	30,531	175.	5,658	36189	16%	
2013/14	Jul '13	71	15.		310.2	325.2	30,855	150.	5,808	36663	16%	
	Aug '13	72	14.		310.2	324.2	31,179	0.	5,808	36987	16%	
	Sep '13	73	26.		310.2	336.2	31,510	0.	5,808	37318	16%	
	Oct '13	74	61.		310.2	371.2	31,870	0.	5,808	37679	15%	
	Nov '13	75	82.		310.2	392.2	32,256	125.	5,933	38190	16%	
	Dec '13	76	145.		310.2	455.2	32,703	100.	6,033	38736	16%	
	Jan '14	77	185.		310.2	495.2	33,187	75.	6,108	39295	16%	
	Feb '14	78	288.		310.2	598.2	33,760	50.	6,158	39919	15%	
	Mar '14	79	102.		310.2	412.2	34,150	100.	6,258	40409	15%	
	Apr '14	80	86.		310.2	396.2	34,527	150.	6,408	40935	16%	
	May '14	81	50.		310.2	360.2	34,881	175.	6,583	41464	16%	
	Jun '14	82	18.		310.2	328.2	35,205	175.	6,758	41964	16%	
2014/15	Jul '14	83	15.		310.2	325.2	35,529	150.	6,908	42437	16%	
	Aug '14	84	14.		310.2	324.2	35,854	0.	6,908	42762	16%	
	Sep '14	85	26.		310.2	336.2	36,185	0.	6,908	43093	16%	
	Oct '14	86	61.		310.2	371.2	36,545	0.	6,908	43453	16%	
	Nov '14	87	82.		310.2	392.2	36,931	125.	7,033	43964	16%	
	Dec '14	88	145.		310.2	455.2	37,377	100.	7,133	44511	16%	
	Jan '15	89	185.		310.2	495.2	37,862	75.	7,208	45070	16%	
	Feb '15	90	288.		310.2	598.2	38,435	50.	7,258	45693	16%	
	Mar '15	91	102.		310.2	412.2	38,825	100.	7,358	46183	16%	
	Apr '15	92	86.		310.2	396.2	39,201	150.	7,508	46709	16%	
	May '15	93	50.		310.2	360.2	39,555	175.	7,683	47239	16%	
	Jun '15	94	18.		310.2	328.2	39,880	175.	7,858	47738	16%	
2015/16	Jul '15	95	15.		310.2	325.2	40,205	150.	8,008	48213	17%	
	Aug '15	96	14.		310.2	324.2	40,529	0.	8,008	48537	16%	
	Sep '15	97	26.		310.2	336.2	40,805	0.	8,008	48814	16%	
	Oct '15	98	61.		310.2	371.2	41,044	0.	8,008	49052	16%	
	Nov '15	99	82.		310.2	392.2	41,376	125.	8,133	49509	16%	
	Dec '15	100	145.		310.2	455.2	41,772	100.	8,233	50005	16%	
	Jan '16	101	185.		310.2	495.2	42,151	75.	8,308	50459	16%	
	Feb '16	102	288.		310.2	598.2	42,507	50.	8,358	50865	16%	
	Mar '16	103	102.		310.2	412.2	42,593	100.	8,458	51051	17%	
	Apr '16	104	86.		310.2	396.2	42,760	150.	8,608	51368	17%	
	May '16	105	50.		310.2	360.2	43,070	175.	8,783	51853	17%	
	Jun '16	106	18.		310.2	328.2	43,383	175.	8,958	52341	17%	
2016/17	Jul '16	107	15.		310.2	325.2	43,696	150.	9,108	52804	17%	
	Aug '16	108	14.		310.2	324.2	44,014	0.	9,108	53122	17%	
	Sep '16	109	26.		310.2	336.2	44,328	0.	9,108	53436	17%	
	Oct '16	110	61.		310.2	371.2	44,659	0.	9,108	53767	17%	
	Nov '16	111	82.		310.2	392.2	45,009	125.	9,233	54243	17%	
	Dec '16	112	145.		310.2	455.2	45,385	100.	9,333	54718	17%	
	Jan '17	113	185.		310.2	495.2	45,821	75.	9,408	55229	17%	
	Feb '17	114	288.		310.2	598.2	46,252	50.	9,458	55710	17%	
	Mar '17	115	102.		310.2	412.2	46,626	100.	9,558	56184	17%	
	Apr '17	116	86.		310.2	396.2	46,933	150.	9,708	56641	17%	
	May '17	117	50.		310.2	360.2	47,251	175.	9,883	57135	17%	
	Jun '17	118	18.		310.2	328.2	47,538	175.	10,058	57596	17%	

RWC Management Plan for 8th Street Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2016/17	Jul '17	119	15.		310.2	325.2	47,847	150.	10,208	58055	18%	PLANNED
	Aug '17	120	14.		310.2	324.2	48,155	0.	10,208	58363	17%	
	Sep '17	121	26.		310.2	336.2	48,164	0.	10,080	58244	17%	
	Oct '17	122	61.		310.2	371.2	48,183	0.	9,971	58154	17%	
	Nov '17	123	82.		310.2	392.2	48,184	125.	9,935	58119	17%	
	Dec '17	124	145.		310.2	455.2	48,105	100.	10,035	58140	17%	
	Jan '18	125	185.		310.2	495.2	47,962	75.	10,109	58071	17%	
	Feb '18	126	288.		310.2	598.2	48,152	50.	10,002	58154	17%	
	Mar '18	127	102.		310.2	412.2	48,233	100.	9,938	58171	17%	
	Apr '18	128	86.		310.2	396.2	48,308	150.	9,998	58306	17%	
	May '18	129	50.		310.2	360.2	48,268	175.	10,015	58283	17%	
	Jun '18	130	18.		310.2	328.2	48,271	175.	10,104	58375	17%	
2016/17	Jul '18	131	15.		310.2	325.2	48,257	150.	10,030	58287	17%	
	Aug '18	132	14.		310.2	324.2	48,256	0.	9,902	58158	17%	
	Sep '18	133	26.		310.2	336.2	48,267	0.	9,902	58169	17%	
	Oct '18	134	61.		310.2	371.2	48,312	0.	9,902	58214	17%	
	Nov '18	135	82.		310.2	392.2	48,257	125.	10,027	58284	17%	
	Dec '18	136	145.		310.2	455.2	48,050	100.	10,127	58177	17%	
	Jan '19	137	185.		310.2	495.2	48,200	75.	10,202	58402	17%	
	Feb '19	138	288.		310.2	598.2	48,030	50.	10,252	58282	18%	
	Mar '19	139	102.		310.2	412.2	48,111	100.	10,352	58463	18%	
	Apr '19	140	86.		310.2	396.2	48,182	150.	10,502	58684	18%	
	May '19	141	50.		310.2	360.2	48,216	175.	10,677	58893	18%	
	Jun '19	142	18.		310.2	328.2	48,234	175.	10,852	59086	18%	
2016/17	Jul '19	143	15.		310.2	325.2	48,230	150.	11,002	59232	19%	
	Aug '19	144	14.		310.2	324.2	48,211	0.	10,978	59189	19%	
	Sep '19	145	26.		310.2	336.2	48,219	0.	10,978	59197	19%	
	Oct '19	146	61.		310.2	371.2	48,206	0.	10,978	59184	19%	
	Nov '19	147	82.		310.2	392.2	48,198	125.	10,970	59168	19%	
	Dec '19	148	145.		310.2	455.2	48,336	100.	10,977	59313	19%	
	Jan '20	149	185.		310.2	495.2	48,134	75.	10,950	59084	19%	
	Feb '20	150	288.		310.2	598.2	47,945	50.	11,000	58945	19%	
	Mar '20	151	102.		310.2	412.2	47,945	100.	11,000	58945	19%	
	Apr '20	152	86.		310.2	396.2	47,945	150.	11,000	58945	19%	
	May '20	153	50.		310.2	360.2	47,945	175.	11,000	58945	19%	
	Jun '20	154	18.		310.2	328.2	47,945	175.	11,000	58945	19%	

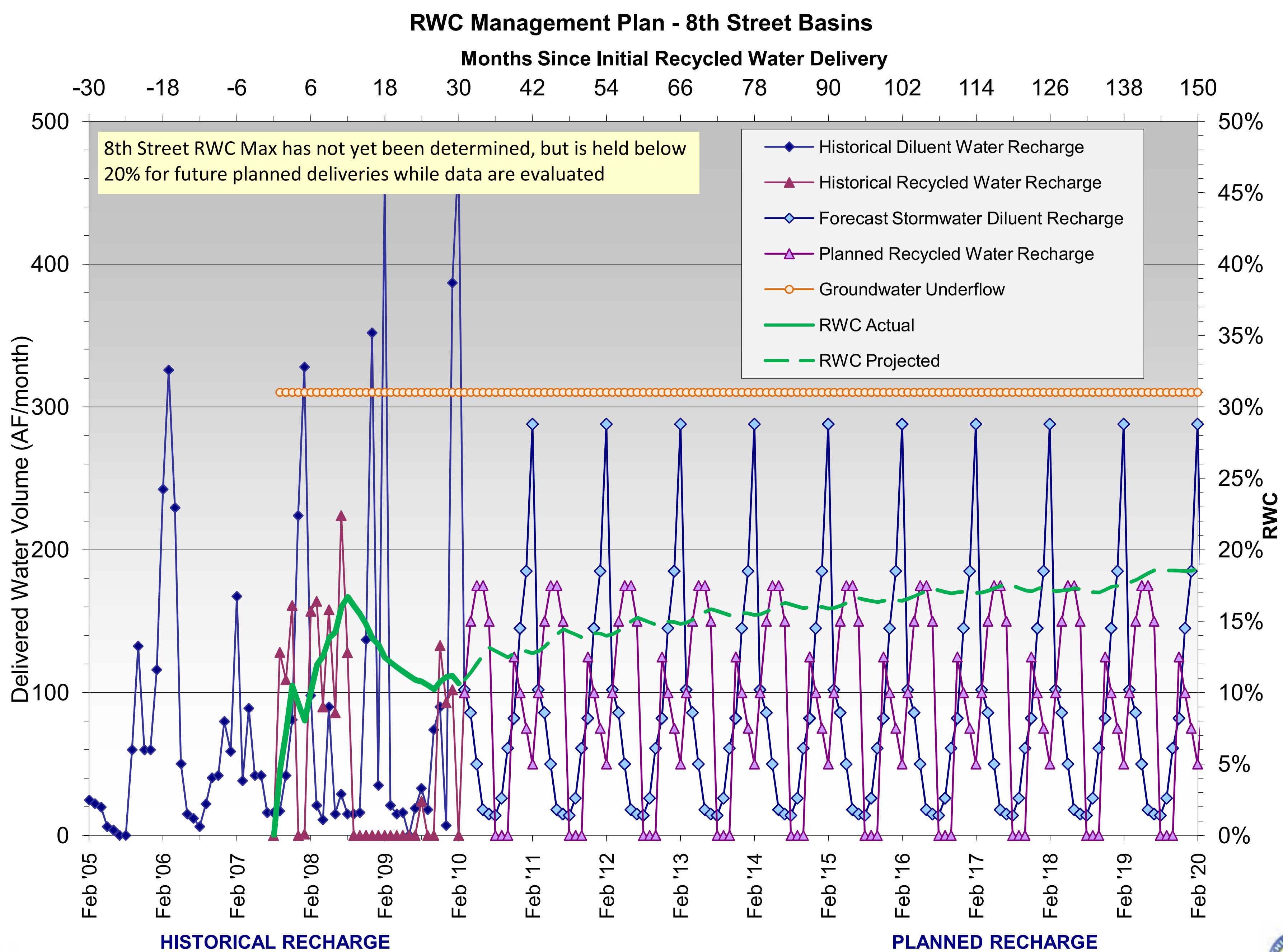
Notes:

DW = Diluent Water; Total DW is the sum of Stormwater & Local Runoff (SW), Imported Water from the State Water Project (MWD), and groundwater underflow.

RW = Recycled Water

RWC = 120-month running total of recycled water / 120-month running total of all diluent and recycled water.

RWC maximum = 0.5 mg/L / the Running Average of Total Organic Carbon (TOC) determined from a recharge site's start-up period



RWC Management Plan - 8th Street Basins
Months Since Initial Recycled Water Delivery
8th Street RWC Max has not yet been determined, but is held below 20% for future planned deliveries while data are evaluated
Historical Diluent Water Recharge
Historical Recycled Water Recharge
Forecast Stormwater Diluent Recharge
Planned Recycled Water Recharge
Groundwater Underflow
RWC Actual
RWC Projected
Delivered Water Volume (AF/month)
RWC
HISTORICAL RECHARGE
PLANNED RECHARGE

RWC Management Plan for Banana Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2001/02	Jul '01	-48	12.2	0		12.2		0.				HISTORICAL (MODELED)
	Aug '01	-47	0.	0		0.		0.				
	Sep '01	-46	0.	0		0.		0.				
	Oct '01	-45	0.	0		0.		0.				
	Nov '01	-44	39.3	0		39.3		0.				
	Dec '01	-43	16.7	0		16.7		0.				
	Jan '02	-42	50.1	0		50.1		0.				
	Feb '02	-41	20.9	0		20.9		0.				
	Mar '02	-40	31.	0		31.		0.				
	Apr '02	-39	13.1	0		13.1		0.				
	May '02	-38	0.8	0		0.8		0.				
	Jun '02	-37	0.	0		0.		0.				
2002/03	Jul '02	-36	0.	0		0.		0.				
	Aug '02	-35	0.	0		0.		0.				
	Sep '02	-34	0.	0		0.		0.				
	Oct '02	-33	0.	0		0.		0.				
	Nov '02	-32	38.9	0		38.9		0.				
	Dec '02	-31	59.3	0		59.3		0.				
	Jan '03	-30	0.	0		0.		0.				
	Feb '03	-29	80.5	0		80.5		0.				
	Mar '03	-28	38.9	0		38.9		0.				
	Apr '03	-27	86.9	0		86.9		0.				
	May '03	-26	61.7	0		61.7		0.				
	Jun '03	-25	0.	0		0.		0.				
2003/04	Jul '03	-24	0.	0		0.		0.				
	Aug '03	-23	0.	0		0.		0.				
	Sep '03	-22	0.	0		0.		0.				
	Oct '03	-21	0.	0		0.		0.				
	Nov '03	-20	34.2	0		34.2		0.				
	Dec '03	-19	37.1	0		37.1		0.				
	Jan '04	-18	4.5	0		4.5		0.				
	Feb '04	-17	83.5	0		83.5		0.				
	Mar '04	-16	28.2	0		28.2		0.				
	Apr '04	-15	0.3	0		0.3		0.				
	May '04	-14	0.	0		0.		0.				
	Jun '04	-13	0.	0		0.		0.				
2004/05	Jul '04	-12	0.	0		0.		0.				
	Aug '04	-11	0.	0		0.		0.				
	Sep '04	-10	0.	0		0.		0.				
	Oct '04	-9	62.8	0		62.8		0.				
	Nov '04	-8	17.	0		17.		0.				
	Dec '04	-7	25.3	0		25.3		0.				
	Jan '05	-6	93.6	0		93.6		0.				
	Feb '05	-5	110.8	0		110.8		0.				
	Mar '05	-4	24.9	0		24.9		0.				
	Apr '05	-3	19.3	0		19.3		0.				
	May '05	-2	14.6	0		14.6		0.				
	Jun '05	-1	0.	0		0.	1,496.1	0.	0.	1496	0%	
2005/06	Jul '05	1	0.	192.3	151	343.6	1,839.7	19.8	19.8	1860	1%	START-UP
	Aug '05	2	0.	0	151	151.3	1,991.	253.9	273.7	2265	12%	
	Sep '05	3	0.	0	151	151.3	2,142.3	128.7	402.4	2545	16%	
	Oct '05	4	28.8	0	151	180.1	2,322.4	25.3	427.7	2750	16%	
	Nov '05	5	0.	0	151	151.3	2,473.7	8.	435.7	2909	15%	
	Dec '05	6	19.	0	151	170.3	2,644.	10.2	445.9	3090	14%	
	Jan '06	7	6.	0	151	157.3	2,801.3	50.3	496.2	3298	15%	
	Feb '06	8	22.3	0	151	173.6	2,974.9	55.2	551.4	3526	16%	
	Mar '06	9	55.1	0	151	206.4	3,181.3	0.	551.4	3733	15%	
	Apr '06	10	35.7	0	151	187.	3,368.3	0.	551.4	3920	14%	
	May '06	11	57.	0	151	208.3	3,576.6	0.	551.4	4128	13%	
	Jun '06	12	0.	0	151	151.3	3,727.9	47.	598.4	4326	14%	

RWC Management Plan for Banana Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2006/07	Jul '06	13	0.	0	151	151.3	3,879.2	64.2	662.6	4542	15%	HISTORICAL
	Aug '06	14	0.	0	151	151.3	4,030.6	85.	747.6	4778	16%	
	Sep '06	15	0.	0	151	151.3	4,181.9	378.3	1,125.8	5308	21%	
	Oct '06	16	74.1	0	151	225.5	4,407.3	49.4	1,175.3	5583	21%	
	Nov '06	17	234.6	0	151	385.9	4,793.2	7.2	1,182.5	5976	20%	
	Dec '06	18	201.2	0	151	352.5	5,145.8	49.6	1,232.1	6378	19%	
	Jan '07	19	331.5	0	151	482.8	5,628.5	0.	1,232.1	6861	18%	
	Feb '07	20	73.7	0	151	225.	5,853.6	0.	1,232.1	7086	17%	
	Mar '07	21	53.1	0	151	204.4	6,057.9	0.	1,232.1	7290	17%	
	Apr '07	22	29.	0	151	180.3	6,238.2	4.	1,236.1	7474	17%	
	May '07	23	37.	0	151	188.3	6,426.5	6.	1,242.1	7669	16%	
	Jun '07	24	0.	0	151	151.3	6,577.8	0.	1,242.1	7820	16%	
2007/08	Jul '07	25	0.	0	151	151.3	6,729.2	0.	1,242.1	7971	16%	
	Aug '07	26	0.	0	151	151.3	6,880.5	0.	1,242.1	8123	15%	
	Sep '07	27	3.	0	151	154.3	7,034.8	0.	1,242.1	8277	15%	
	Oct '07	28	2.	0	151	153.3	7,188.1	0.	1,242.1	8430	15%	
	Nov '07	29	35.	0	151	186.3	7,374.4	0.	1,242.1	8616	14%	
	Dec '07	30	22.	0	151	173.3	7,547.7	0.	1,242.1	8790	14%	
	Jan '08	31	130.	0	151	281.3	7,829.	0.	1,242.1	9071	14%	
	Feb '08	32	75.	0	151	226.3	8,055.3	0.	1,242.1	9297	13%	
	Mar '08	33	0.	0	151	151.3	8,206.6	0.	1,242.1	9449	13%	
	Apr '08	34	0.	0	151	151.3	8,357.9	47.	1,289.1	9647	13%	
	May '08	35	3.	0	151	154.3	8,512.2	38.	1,327.1	9839	13%	
	Jun '08	36	8.	0	151	159.3	8,671.5	72.	1,399.1	10071	14%	
2008/09	Jul '08	37	31.	0	151	182.3	8,853.8	0.	1,399.1	10253	14%	
	Aug '08	38	45.	0	151	196.3	9,050.1	0.	1,399.1	10449	13%	
	Sep '08	39	34.	0	151	185.3	9,235.4	0.	1,399.1	10635	13%	
	Oct '08	40	36.	0	151	187.3	9,422.8	0.	1,399.1	10822	13%	
	Nov '08	41	50.	0	151	201.3	9,624.1	0.	1,399.1	11023	13%	
	Dec '08	42	87.	0	151	238.3	9,862.4	0.	1,399.1	11261	12%	
	Jan '09	43	5.	0	151	156.3	10,018.7	40.	1,439.1	11458	13%	
	Feb '09	44	95.	0	151	246.3	10,265.	0.	1,439.1	11704	12%	
	Mar '09	45	0.	0	151	151.3	10,416.3	0.	1,439.1	11855	12%	
	Apr '09	46	0.	0	151	151.3	10,567.6	0.	1,439.1	12007	12%	
	May '09	47	0.	0	151	151.3	10,718.9	0.	1,439.1	12158	12%	
	Jun '09	48	0.	0	151	151.3	10,870.2	0.	1,439.1	12309	12%	
2009/10	Jul '09	49	0.	0	151	151.3	11,021.5	0.	1,439.1	12461	12%	
	Aug '09	50	0.	0	151	151.3	11,172.8	0.	1,439.1	12612	11%	
	Sep '09	51	0.	0	151	151.3	11,324.1	0.	1,439.1	12763	11%	
	Oct '09	52	15.	0	151	166.3	11,490.4	129.	1,568.1	13059	12%	
	Nov '09	53	0.	0	151	151.3	11,641.7	181.	1,749.1	13391	13%	
	Dec '09	54	75.	0	151	226.3	11,868.	66.7	1,815.8	13684	13%	
	Jan '10	55	100.	0	151	251.3	12,119.4	75.	1,890.8	14010	13%	
	Feb '10	56	143.	0	151	294.3	12,413.7	0.	1,890.8	14304	13%	
	Mar '10	57	29.	0	151	180.3	12,594.	120.	2,010.8	14605	14%	PLANNED
	Apr '10	58	24.	0	151	175.3	12,769.3	120.	2,130.8	14900	14%	
	May '10	59	25.	0	151	176.3	12,945.6	120.	2,250.8	15196	15%	
	Jun '10	60	1.	0	151	152.3	13,097.9	120.	2,370.8	15469	15%	
2010/11	Jul '10	61	4.	0	151	155.3	13,253.2	120	2,490.8	15744	16%	
	Aug '10	62	6.	0	151	157.3	13,410.5	0	2,490.8	15901	16%	
	Sep '10	63	5.	0	151	156.3	13,566.8	60	2,550.8	16118	16%	
	Oct '10	64	27.	0	151	178.3	13,716.8	120	2,670.8	16388	16%	
	Nov '10	65	51.	0	151	202.3	13,906.4	100	2,770.8	16677	17%	
	Dec '10	66	66.	0	151	217.3	14,123.7	90	2,860.8	16984	17%	
	Jan '11	67	84.	0	151	235.3	14,272.1	0	2,860.8	17133	17%	
	Feb '11	68	85.	0	151	236.3	14,386.2	0	2,860.8	17247	17%	
	Mar '11	69	29.	0	151	180.3	14,488.	120	2,980.8	17469	17%	
	Apr '11	70	24.	0	151	175.3	14,602.3	120	3,100.8	17703	18%	
	May '11	71	25.	0	151	176.3	14,778.6	120	3,220.8	17999	18%	
	Jun '11	72	1.	0	151	152.3	14,930.9	120	3,340.8	18272	18%	

RWC Management Plan for Banana Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2011/12	Jul '11	73	4.	0	151	155.3	15,074.	120	3,460.8	18535	19%	PLANNED
	Aug '11	74	6.	0	151	157.3	15,231.3	0	3,460.8	18692	19%	
	Sep '11	75	5.	0	151	156.3	15,387.6	60	3,520.8	18908	19%	
	Oct '11	76	27.	0	151	178.3	15,565.9	120	3,640.8	19207	19%	
	Nov '11	77	51.	0	151	202.3	15,728.9	100	3,740.8	19470	19%	
	Dec '11	78	66.	0	151	217.3	15,929.5	90	3,830.8	19760	19%	
	Jan '12	79	84.	0	151	235.3	16,114.7	0	3,830.8	19945	19%	
	Feb '12	80	85.	0	151	236.3	16,330.1	0	3,830.8	20161	19%	
	Mar '12	81	29.	0	151	180.3	16,479.4	120	3,950.8	20430	19%	
	Apr '12	82	24.	0	151	175.3	16,641.6	120	4,070.8	20712	20%	
	May '12	83	25.	0	151	176.3	16,817.1	120	4,190.8	21008	20%	
	Jun '12	84	1.	0	151	152.3	16,969.4	120	4,310.8	21280	20%	
2012/13	Jul '12	85	4.	0	151	155.3	17,125	120	4,431	21,556	21%	
	Aug '12	86	6.	0	151	157.3	17,282	0	4,431	21,713	20%	
	Sep '12	87	5.	0	151	156.3	17,438	60	4,491	21,929	20%	
	Oct '12	88	27.	0	151	178.3	17,617	120	4,611	22,227	21%	
	Nov '12	89	51.	0	151	202.3	17,780	100	4,711	22,491	21%	
	Dec '12	90	66.	0	151	217.3	17,938	90	4,801	22,739	21%	
	Jan '13	91	84.	0	151	235.3	18,173	0	4,801	22,974	21%	
	Feb '13	92	85.	0	151	236.3	18,329	0	4,801	23,130	21%	
	Mar '13	93	29.	0	151	180.3	18,471	120	4,921	23,391	21%	
	Apr '13	94	24.	0	151	175.3	18,559	120	5,041	23,600	21%	
	May '13	95	25.	0	151	176.3	18,674	120	5,161	23,834	22%	
	Jun '13	96	1.	0	151	152.3	18,826	120	5,281	24,107	22%	
2013/14	Jul '13	97	4.	0	151	155.3	18,981	120	5,401	24,382	22%	
	Aug '13	98	6.	0	151	157.3	19,139	0	5,401	24,539	22%	
	Sep '13	99	5.	0	151	156.3	19,295	60	5,461	24,756	22%	
	Oct '13	100	27.	0	151	178.3	19,473	120	5,581	25,054	22%	
	Nov '13	101	51.	0	151	202.3	19,641	100	5,681	25,322	22%	
	Dec '13	102	66.	0	151	217.3	19,821	90	5,771	25,592	23%	
	Jan '14	103	84.	0	151	235.3	20,052	0	5,771	25,823	22%	
	Feb '14	104	85.	0	151	236.3	20,205	0	5,771	25,976	22%	
	Mar '14	105	29.	0	151	180.3	20,357	120	5,891	26,248	22%	
	Apr '14	106	24.	0	151	175.3	20,532	120	6,011	26,543	23%	
	May '14	107	25.	0	151	176.3	20,709	120	6,131	26,839	23%	
	Jun '14	108	1.	0	151	152.3	20,861	120	6,251	27,112	23%	
2014/15	Jul '14	109	4.	0	151	155.3	21,016.1	120.	6,370.8	27387	23%	
	Aug '14	110	6.	0	151	157.3	21,173.4	0.	6,370.8	27544	23%	
	Sep '14	111	5.	0	151	156.3	21,329.7	60.	6,430.8	27760	23%	
	Oct '14	112	27.	0	151	178.3	21,445.2	120.	6,550.8	27996	23%	
	Nov '14	113	51.	0	151	202.3	21,630.5	100.	6,650.8	28281	24%	
	Dec '14	114	66.	0	151	217.3	21,822.5	90.	6,740.8	28563	24%	
	Jan '15	115	84.	0	151	235.3	21,964.3	0.	6,740.8	28705	23%	
	Feb '15	116	85.	0	151	236.3	22,089.8	0.	6,740.8	28831	23%	
	Mar '15	117	29.	0	151	180.3	22,245.2	120.	6,860.8	29106	24%	
	Apr '15	118	24.	0	151	175.3	22,401.2	120.	6,980.8	29382	24%	
	May '15	119	25.	0	151	176.3	22,562.9	120.	7,100.8	29664	24%	
	Jun '15	120	1.	0	151	152.3	22,715.2	120.	7,220.8	29936	24%	
2015/16	Jul '15	121	4.	0	151	155.3	22,527	120	7,321	29,848	25%	
	Aug '15	122	6.	0	151	157.3	22,533	0	7,067	29,600	24%	
	Sep '15	123	5.	0	151	156.3	22,538	60	6,998	29,536	24%	
	Oct '15	124	27.	0	151	178.3	22,536	120	7,093	29,629	24%	
	Nov '15	125	51.	0	151	202.3	22,587	100	7,185	29,772	24%	
	Dec '15	126	66.	0	151	217.3	22,634	90	7,265	29,899	24%	
	Jan '16	127	84.	0	151	235.3	22,712	0	7,215	29,927	24%	
	Feb '16	128	85.	0	151	236.3	22,775	0	7,159	29,934	24%	
	Mar '16	129	29.	0	151	180.3	22,749	120	7,279	30,028	24%	
	Apr '16	130	24.	0	151	175.3	22,737	120	7,399	30,136	25%	
	May '16	131	25.	0	151	176.3	22,705	120	7,519	30,224	25%	
	Jun '16	132	1.	0	151	152.3	22,706	120	7,592	30,298	25%	

RWC Management Plan for Banana Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2016/2017	Jul '16	133	4.	0	151	155.3	22,710	120	7,648	30,358	25%	PLANNED
	Aug '16	134	6.	0	151	157.3	22,716	0	7,563	30,279	25%	
	Sep '16	135	5.	0	151	156.3	22,721	60	7,245	29,966	24%	
	Oct '16	136	27.	0	151	178.3	22,674	120	7,315	29,989	24%	
	Nov '16	137	51.	0	151	202.3	22,490	100	7,408	29,899	25%	
	Dec '16	138	66.	0	151	217.3	22,355	90	7,449	29,804	25%	
	Jan '17	139	84.	0	151	235.3	22,108	0	7,449	29,556	25%	
	Feb '17	140	85.	0	151	236.3	22,119	0	7,449	29,568	25%	
	Mar '17	141	29.	0	151	180.3	22,095	120	7,569	29,663	26%	
	Apr '17	142	24.	0	151	175.3	22,090	120	7,685	29,774	26%	
	May '17	143	25.	0	151	176.3	22,078	120	7,799	29,876	26%	
	Jun '17	144	1.	0	151	152.3	22,079	120	7,919	29,997	26%	
2017/2018	Jul '17	145	4.	0	151	155.3	22,083	120	8,039	30,121	27%	
	Aug '17	146	6.	0	151	157.3	22,089	0	8,039	30,127	27%	
	Sep '17	147	5.	0	151	156.3	22,091	60	8,099	30,189	27%	
	Oct '17	148	27.	0	151	178.3	22,116	120	8,219	30,334	27%	
	Nov '17	149	51.	0	151	202.3	22,132	100	8,319	30,450	27%	
	Dec '17	150	66.	0	151	217.3	22,176	90	8,409	30,584	27%	
	Jan '18	151	84.	0	151	235.3	22,130	0	8,409	30,538	28%	
	Feb '18	152	85.	0	151	236.3	22,140	0	8,409	30,548	28%	
	Mar '18	153	29.	0	151	180.3	22,169	120	8,529	30,697	28%	
	Apr '18	154	24.	0	151	175.3	22,193	120	8,602	30,794	28%	
	May '18	155	25.	0	151	176.3	22,215	120	8,684	30,898	28%	
	Jun '18	156	1.	0	151	152.3	22,208	120	8,732	30,939	28%	
2018/2019	Jul '18	157	4.	0	151	155.3	22,181	120	8,852	31,032	29%	
	Aug '18	158	6.	0	151	157.3	22,142	0	8,852	30,993	29%	
	Sep '18	159	5.	0	151	156.3	22,113	60	8,912	31,024	29%	
	Oct '18	160	27.	0	151	178.3	22,104	120	9,032	31,135	29%	
	Nov '18	161	51.	0	151	202.3	22,105	100	9,132	31,236	29%	
	Dec '18	162	66.	0	151	217.3	22,084	90	9,222	31,305	29%	
	Jan '19	163	84.	0	151	235.3	22,163	0	9,182	31,344	29%	
	Feb '19	164	85.	0	151	236.3	22,153	0	9,182	31,334	29%	
	Mar '19	165	29.	0	151	180.3	22,182	120	9,302	31,483	30%	
	Apr '19	166	24.	0	151	175.3	22,206	120	9,422	31,627	30%	
	May '19	167	25.	0	151	176.3	22,231	120	9,542	31,772	30%	
	Jun '19	168	1.	0	151	152.3	22,232	120	9,662	31,893	30%	
2019/2020	Jul '19	169	4.	0	151	155.3	22,236	120	9,782	32,017	31%	
	Aug '19	170	6.	0	151	157.3	22,242	0	9,782	32,023	31%	
	Sep '19	171	5.	0	151	156.3	22,247	60	9,842	32,088	31%	
	Oct '19	172	27.	0	151	178.3	22,259	120	9,833	32,091	31%	
	Nov '19	173	51.	0	151	202.3	22,310	100	9,752	32,061	30%	
	Dec '19	174	66.	0	151	217.3	22,301	90	9,775	32,076	30%	
	Jan '20	175	84.	0	151	235.3	22,285	0	9,700	31,985	30%	
	Feb '20	176	85.	0	151	236.3	22,227	0	9,700	31,927	30%	
	Mar '20	177	29.	0	151	180.3	22,227	120	9,700	31,927	30%	
	Apr '20	178	24.	0	151	175.3	22,227	120	9,700	31,927	30%	
	May '20	179	25.	0	151	176.3	22,227	120	9,700	31,927	30%	
	Jun '20	180	1.	0	151	152.3	22,227	120	9,700	31,927	30%	

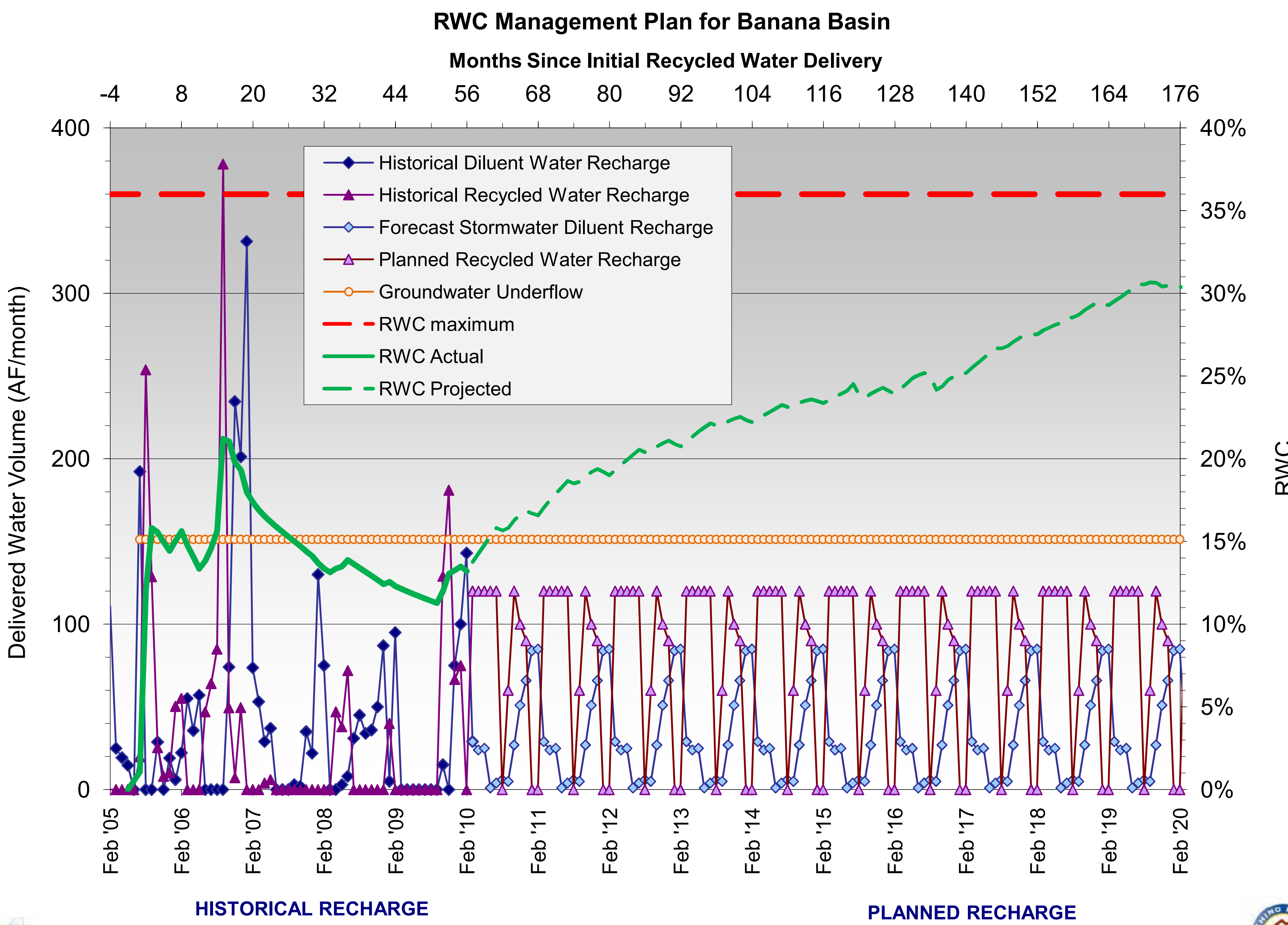
Notes:

DW = Diluent Water; Total DW is the sum of Stormwater & Local Runoff (SW), Imported Water from the State Water Project (MWD), and groundwater underflow.

RW = Recycled Water

RWC = 120-month running total of recycled water / 120-month running total of all diluent and recycled water.

RWC maximum = 0.5 mg/L / the Running Average of Total Organic Carbon (TOC) determined from a recharge site's start-up period



RWC Management Plan for Banana Basin
Months Since Initial Recycled Water Delivery
Delivered Water Volume (AF/month)
RWC
Historical Diluent Water Recharge
Historical Recycled Water Recharge
Forecast Stormwater Diluent Recharge
Planned Recycled Water Recharge
Groundwater Underflow
RWC maximum
RWC Actual
RWC Projected
-4
8
20
32
44
56
68
80
92
104
116
128
140
152
164
176
400
300
200
100
0
40%
35%
30%
25%
20%
15%
10%
5%
0%
Feb '05
Feb '06
Feb '07
Feb '08
Feb '09
Feb '10
Feb '11
Feb '12
Feb '13
Feb '14
Feb '15
Feb '16
Feb '17
Feb '18
Feb '19
Feb '20
HISTORICAL RECHARGE
PLANNED RECHARGE

RWC Management Plan for Brooks Street Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2001/02	Jul '01	-84				0.						HISTORICAL (MODELED)
	Aug '01	-83				0.						
	Sep '01	-82				0.						
	Oct '01	-81				0.						
	Nov '01	-80				0.						
	Dec '01	-79				0.						
	Jan '02	-78				0.						
	Feb '02	-77				0.						
	Mar '02	-76				0.						
	Apr '02	-75				0.						
	May '02	-74				0.						
	Jun '02	-73				0.						
2002/03	Jul '02	-72				0.						
	Aug '02	-71				0.						
	Sep '02	-70				0.						
	Oct '02	-69				0.						
	Nov '02	-68				0.						
	Dec '02	-67				0.						
	Jan '03	-66				0.						
	Feb '03	-65				0.						
	Mar '03	-64				0.						
	Apr '03	-63				0.						
	May '03	-62				0.						
	Jun '03	-61				0.						
2003/04	Jul '03	-60				0.		0.				
	Aug '03	-59				0.		0.				
	Sep '03	-58				0.		0.				
	Oct '03	-57				0.		0.				
	Nov '03	-56				0.		0.				
	Dec '03	-55				0.		0.				
	Jan '04	-54				0.		0.				
	Feb '04	-53				0.		0.				
	Mar '04	-52				0.		0.				
	Apr '04	-51				0.		0.				
	May '04	-50				0.		0.				
	Jun '04	-49				0.		0.				
2004/05	Jul '04	-48				0.		0.				
	Aug '04	-47				0.		0.				
	Sep '04	-46				0.		0.				
	Oct '04	-45				0.		0.				
	Nov '04	-44				0.		0.				
	Dec '04	-43				0.		0.				
	Jan '05	-42				0.		0.				
	Feb '05	-41				0.		0.				
	Mar '05	-40				0.		0.				
	Apr '05	-39				0.		0.				
	May '05	-38				0.		0.				
	Jun '05	-37				0.		0.				
2005/06	Jul '05	-36	32.7	0.		32.7		0.				MEASURED
	Aug '05	-35	0.	175.3		175.3		0.				
	Sep '05	-34	0.	684.2		684.2		0.				
	Oct '05	-33	5.5	121.9		127.4		0.				
	Nov '05	-32	59.5	330.		389.5		0.				
	Dec '05	-31	31.8	331.2		363.		0.				
	Jan '06	-30	12.	245.1		257.1		0.				
	Feb '06	-29	160.4	232.2		392.6		0.				
	Mar '06	-28	204.9	10.		214.9		0.				
	Apr '06	-27	156.3	105.		261.3		0.				
	May '06	-26	16.6	284.1		300.7		0.				
	Jun '06	-25	0.	371.		371.		0.				

RWC Management Plan for Brooks Street Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2006/07	Jul '06	-24	0.	206.4		206.4	3776	0.	0	3776	0%	MEASURED
	Aug '06	-23	20.	131.		151.	3927	0.	0	3927	0%	
	Sep '06	-22	21.	321.5		342.5	4270	0.	0	4270	0%	
	Oct '06	-21	14.	292.9		306.9	4577	0.	0	4577	0%	
	Nov '06	-20	30.	257.7		287.7	4864	0.	0	4864	0%	
	Dec '06	-19	30.8	231.		261.8	5126	0.	0	5126	0%	
	Jan '07	-18	25.3	87.2		112.5	5239	0.	0	5239	0%	
	Feb '07	-17	62.2	66.9		129.1	5368	0.	0	5368	0%	
	Mar '07	-16	3.5	0.		3.5	5371	0.	0	5371	0%	
	Apr '07	-15	102.	0.		102.	5473	0.	0	5473	0%	
	May '07	-14	4.	0.		4.	5477	0.	0	5477	0%	
	Jun '07	-13	2.	0.		2.	5479	0.	0	5479	0%	
2007/08	Jul '07	-12	0.	0.		0.	5479	0.	0	5479	0%	
	Aug '07	-11	0.	0.		0.	5479	0.	0	5479	0%	
	Sep '07	-10	25.	0.		25.	5504	0.	0	5504	0%	
	Oct '07	-9	35.	0.		35.	5539	0.	0	5539	0%	
	Nov '07	-8	24.	0.		24.	5563	0.	0	5563	0%	
	Dec '07	-7	42.	0.		42.	5605	0.	0	5605	0%	
	Jan '08	-6	282.	0.		282.	5887	0.	0	5887	0%	
	Feb '08	-5	50.	0.		50.	5937	0.	0	5937	0%	
	Mar '08	-4	9.	0.		9.	5946	0.	0	5946	0%	
	Apr '08	-3	4.	0.		4.	5950	0.	0	5950	0%	
	May '08	-2	43.	0.		43.	5993	0.	0	5993	0%	
	Jun '08	-1	3.	0.		3.	5996	0.	0	5996	0%	
2008/09	Jul '08	0	3.	0.		3.	5999	0.	0	5999	0%	START-UP
	Aug '08	1	16.	0.	509.2	525.2	6524	117.	117	6641	2%	
	Sep '08	2	0.	0.	509.2	509.2	7034	86.	203	7237	3%	
	Oct '08	3	0.	0.	509.2	509.2	7543	166.	369	7912	5%	
	Nov '08	4	23.	0.	509.2	532.2	8075	103.	472	8547	6%	
	Dec '08	5	162.	0.	509.2	671.2	8746	88.	560	9306	6%	
	Jan '09	6	25.	0.	509.2	534.2	9281	277.	837	10118	8%	
	Feb '09	7	208.	0.	509.2	717.2	9998	20.	857	10855	8%	
	Mar '09	8	30.	0.	509.2	539.2	10537	159.	1016	11553	9%	HISTORICAL
	Apr '09	9	1.	0.	509.2	510.2	11047	296.	1312	12359	11%	
	May '09	10	17.	0.	509.2	526.2	11573	115.	1427	13000	11%	
	Jun '09	11	0.	0.	509.2	509.2	12083	178.	1605	13688	12%	
2009/10	Jul '09	12	1.	0.	509.2	510.2	12593	6.	1611	14204	11%	
	Aug '09	13	0.	0.	509.2	509.2	13102	8.	1619	14721	11%	
	Sep '09	14	0.	0.	509.2	509.2	13611	0.	1619	15230	11%	
	Oct '09	15	13.	0.	509.2	522.2	14134	184.	1803	15937	11%	
	Nov '09	16	4.	0.	509.2	513.2	14647	246.	2049	16696	12%	
	Dec '09	17	129.	0.	509.2	638.2	15285	144.	2193	17478	13%	
	Jan '10	18	251.	0.	509.2	760.2	16045	74.	2267	18312	12%	
	Feb '10	19	215.	0.	509.2	724.2	16769	54.	2321	19090	12%	
	Mar '10	20	62.		509.2	571.2	17341	120.	2441	19782	12%	PLANNED
	Apr '10	21	66.		509.2	575.2	17916	150.	2591	20507	13%	
	May '10	22	20.		509.2	529.2	18445	250.	2841	21286	13%	
	Jun '10	23	1.		509.2	510.2	18955	250.	3091	22046	14%	
2010/11	Jul '10	24	7.		509.2	516.2	19472	0.	3091	22563	14%	
	Aug '10	25	7.		509.2	516.2	19988	0.	3091	23079	13%	
	Sep '10	26	9.		509.2	518.2	20506	250.	3341	23847	14%	
	Oct '10	27	14.		509.2	523.2	21029	200.	3541	24570	14%	
	Nov '10	28	28.		509.2	537.2	21566	150.	3691	25257	15%	
	Dec '10	29	79.		509.2	588.2	22155	120.	3811	25966	15%	
	Jan '11	30	119.		509.2	628.2	22783	80.	3891	26674	15%	
	Feb '11	31	139.		509.2	648.2	23431	80.	3971	27402	14%	
	Mar '11	32	62.		509.2	571.2	24002	120.	4091	28093	15%	
	Apr '11	33	66.		509.2	575.2	24578	150.	4241	28819	15%	
	May '11	34	20.		509.2	529.2	25107	250.	4491	29598	15%	
	Jun '11	35	1.		509.2	510.2	25617	250.	4741	30358	16%	

RWC Management Plan for Brooks Street Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2011/12	Jul '11	36	7.		509.2	516.2	26133	0.	4741	30874	15%	PLANNED
	Aug '11	37	7.		509.2	516.2	26649	0.	4741	31390	15%	
	Sep '11	38	9.		509.2	518.2	27168	250.	4991	32159	16%	
	Oct '11	39	14.		509.2	523.2	27691	200.	5191	32882	16%	
	Nov '11	40	28.		509.2	537.2	28228	150.	5341	33569	16%	
	Dec '11	41	79.		509.2	588.2	28816	120.	5461	34277	16%	
	Jan '12	42	119.		509.2	628.2	29445	80.	5541	34986	16%	
	Feb '12	43	139.		509.2	648.2	30093	80.	5621	35714	16%	
	Mar '12	44	62.		509.2	571.2	30664	120.	5741	36405	16%	
	Apr '12	45	66.		509.2	575.2	31239	150.	5891	37130	16%	
	May '12	46	20.		509.2	529.2	31769	250.	6141	37910	16%	
	Jun '12	47	1.		509.2	510.2	32279	250.	6391	38670	17%	
2012/13	Jul '12	48	7.		509.2	516.2	32795	0.	6391	39186	16%	
	Aug '12	49	7.		509.2	516.2	33311	0.	6391	39702	16%	
	Sep '12	50	9.		509.2	518.2	33829	250.	6641	40470	16%	
	Oct '12	51	14.		509.2	523.2	34353	200.	6841	41194	17%	
	Nov '12	52	28.		509.2	537.2	34890	150.	6991	41881	17%	
	Dec '12	53	79.		509.2	588.2	35478	120.	7111	42589	17%	
	Jan '13	54	119.		509.2	628.2	36106	80.	7191	43297	17%	
	Feb '13	55	139.		509.2	648.2	36755	80.	7271	44026	17%	
	Mar '13	56	62.		509.2	571.2	37326	120.	7391	44717	17%	
	Apr '13	57	66.		509.2	575.2	37901	150.	7541	45442	17%	
	May '13	58	20.		509.2	529.2	38430	250.	7791	46221	17%	
	Jun '13	59	1.		509.2	510.2	38940	250.	8041	46981	17%	
2013/14	Jul '13	60	7.		509.2	516.2	39457	0.	8041	47498	17%	
	Aug '13	61	7.		509.2	516.2	39973	0.	8041	48014	17%	
	Sep '13	62	9.		509.2	518.2	40491	250.	8291	48782	17%	
	Oct '13	63	14.		509.2	523.2	41014	200.	8491	49505	17%	
	Nov '13	64	28.		509.2	537.2	41552	150.	8641	50193	17%	
	Dec '13	65	79.		509.2	588.2	42140	120.	8761	50901	17%	
	Jan '14	66	119.		509.2	628.2	42768	80.	8841	51609	17%	
	Feb '14	67	139.		509.2	648.2	43416	80.	8921	52337	17%	
	Mar '14	68	62.		509.2	571.2	43987	120.	9041	53028	17%	
	Apr '14	69	66.		509.2	575.2	44563	150.	9191	53754	17%	
	May '14	70	20.		509.2	529.2	45092	250.	9441	54533	17%	
	Jun '14	71	1.		509.2	510.2	45602	250.	9691	55293	18%	
2014/15	Jul '14	72	7.		509.2	516.2	46118	0.	9691	55809	17%	
	Aug '14	73	7.		509.2	516.2	46635	0.	9691	56326	17%	
	Sep '14	74	9.		509.2	518.2	47153	250.	9941	57094	17%	
	Oct '14	75	14.		509.2	523.2	47676	200.	10141	57817	18%	
	Nov '14	76	28.		509.2	537.2	48213	150.	10291	58504	18%	
	Dec '14	77	79.		509.2	588.2	48801	120.	10411	59212	18%	
	Jan '15	78	119.		509.2	628.2	49430	80.	10491	59921	18%	
	Feb '15	79	139.		509.2	648.2	50078	80.	10571	60649	17%	
	Mar '15	80	62.		509.2	571.2	50649	120.	10691	61340	17%	
	Apr '15	81	66.		509.2	575.2	51224	150.	10841	62065	17%	
	May '15	82	20.		509.2	529.2	51754	250.	11091	62845	18%	
	Jun '15	83	1.		509.2	510.2	52264	250.	11341	63605	18%	
2015/16	Jul '15	84	7.		509.2	516.2	52747	0.	11341	64088	18%	
	Aug '15	85	7.		509.2	516.2	53088	0.	11341	64429	18%	
	Sep '15	86	9.		509.2	518.2	52922	250.	11591	64513	18%	
	Oct '15	87	14.		509.2	523.2	53318	200.	11791	65109	18%	
	Nov '15	88	28.		509.2	537.2	53466	150.	11941	65407	18%	
	Dec '15	89	79.		509.2	588.2	53691	120.	12061	65752	18%	
	Jan '16	90	119.		509.2	628.2	54062	80.	12141	66203	18%	
	Feb '16	91	139.		509.2	648.2	54318	80.	12221	66539	18%	
	Mar '16	92	62.		509.2	571.2	54674	120.	12341	67015	18%	
	Apr '16	93	66.		509.2	575.2	54988	150.	12491	67479	19%	
	May '16	94	20.		509.2	529.2	55217	250.	12741	67958	19%	
	Jun '16	95	1.		509.2	510.2	55356	250.	12991	68347	19%	

RWC Management Plan for Brooks Street Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2016/17	Jul '16	96	7.		509.2	516.2	55666	0.	12991	68657	19%	PLANNED
	Aug '16	97	7.		509.2	516.2	56031	0.	12991	69022	19%	
	Sep '16	98	9.		509.2	518.2	56207	250.	13241	69448	19%	
	Oct '16	99	14.		509.2	523.2	56423	200.	13441	69864	19%	
	Nov '16	100	28.		509.2	537.2	56672	150.	13591	70263	19%	
	Dec '16	101	79.		509.2	588.2	56999	120.	13711	70710	19%	
	Jan '17	102	119.		509.2	628.2	57515	80.	13791	71306	19%	
	Feb '17	103	139.		509.2	648.2	58034	80.	13871	71905	19%	
	Mar '17	104	62.		509.2	571.2	58601	120.	13991	72592	19%	
	Apr '17	105	66.		509.2	575.2	59075	150.	14141	73216	19%	
	May '17	106	20.		509.2	529.2	59600	250.	14391	73991	19%	
	Jun '17	107	1.		509.2	510.2	60108	250.	14641	74749	20%	
2017/18	Jul '17	108	7.		509.2	516.2	60624	0.	14641	75265	19%	
	Aug '17	109	7.		509.2	516.2	61141	0.	14641	75782	19%	
	Sep '17	110	9.		509.2	518.2	61634	250.	14891	76525	19%	
	Oct '17	111	14.		509.2	523.2	62122	200.	15091	77213	20%	
	Nov '17	112	28.		509.2	537.2	62635	150.	15241	77876	20%	
	Dec '17	113	79.		509.2	588.2	63181	120.	15361	78542	20%	
	Jan '18	114	119.		509.2	628.2	63528	80.	15441	78969	20%	
	Feb '18	115	139.		509.2	648.2	64126	80.	15521	79647	19%	
	Mar '18	116	62.		509.2	571.2	64688	120.	15641	80329	19%	
	Apr '18	117	66.		509.2	575.2	65259	150.	15791	81050	19%	
	May '18	118	20.		509.2	529.2	65746	250.	16041	81787	20%	
	Jun '18	119	1.		509.2	510.2	66253	250.	16291	82544	20%	
2018/19	Jul '18	120	7.		509.2	516.2	66766	0.	16291	83057	20%	
	Aug '18	121	7.		509.2	516.2	66757	0.	16174	82931	20%	
	Sep '18	122	9.		509.2	518.2	66766	250.	16338	83104	20%	
	Oct '18	123	14.		509.2	523.2	66780	200.	16372	83152	20%	
	Nov '18	124	28.		509.2	537.2	66785	150.	16419	83204	20%	
	Dec '18	125	79.		509.2	588.2	66702	120.	16451	83153	20%	
	Jan '19	126	119.		509.2	628.2	66796	80.	16254	83050	20%	
	Feb '19	127	139.		509.2	648.2	66727	80.	16314	83041	20%	
	Mar '19	128	62.		509.2	571.2	66759	120.	16275	83034	20%	
	Apr '19	129	66.		509.2	575.2	66824	150.	16129	82953	19%	
	May '19	130	20.		509.2	529.2	66827	250.	16264	83091	20%	
	Jun '19	131	1.		509.2	510.2	66828	250.	16336	83164	20%	
2019/20	Jul '19	132	7.		509.2	516.2	66834	0.	16330	83164	20%	
	Aug '19	133	7.		509.2	516.2	66841	0.	16322	83163	20%	
	Sep '19	134	9.		509.2	518.2	66850	250.	16572	83422	20%	
	Oct '19	135	14.		509.2	523.2	66851	200.	16588	83439	20%	
	Nov '19	136	28.		509.2	537.2	66875	150.	16492	83367	20%	
	Dec '19	137	79.		509.2	588.2	66825	120.	16468	83293	20%	
	Jan '20	138	119.		509.2	628.2	66693	80.	16474	83167	20%	
	Feb '20	139	139.		509.2	648.2	66617	80.	16500	83117	20%	
	Mar '20	140	62.		509.2	571.2	66617	120.	16500	83117	20%	
	Apr '20	141	66.		509.2	575.2	66617	150.	16500	83117	20%	
	May '20	142	20.		509.2	529.2	66617	250.	16500	83117	20%	
	Jun '20	143	1.		509.2	510.2	66617	250.	16500	83117	20%	

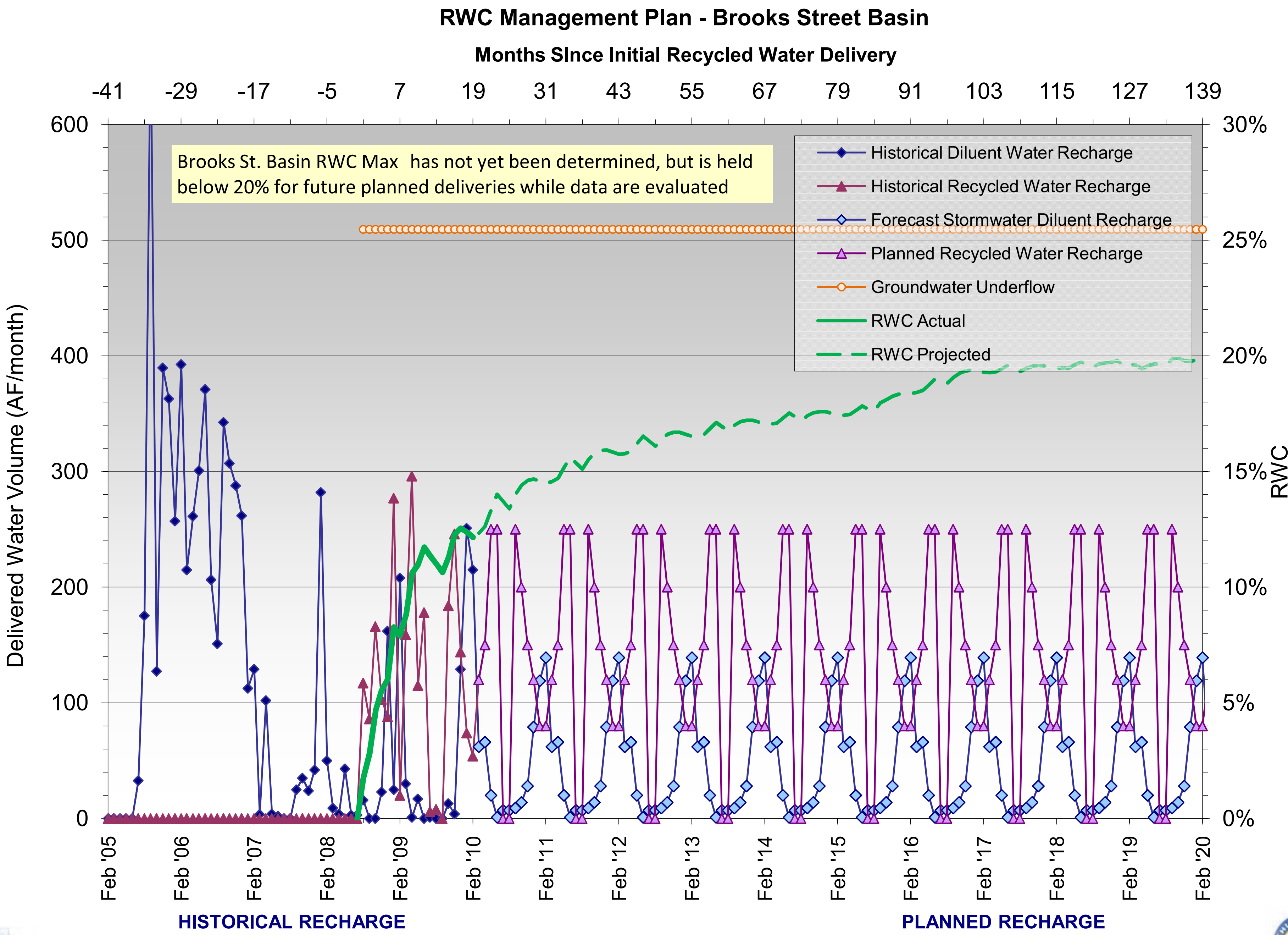
Notes:

DW = Diluent Water; Total DW is the sum of Stormwater & Local Runoff (SW), Imported Water from the State Water Project (MWD), and groundwater underflow.

RW = Recycled Water

RWC = 120-month running total of recycled water / 120-month running total of all diluent and recycled water.

RWC maximum = 0.5 mg/L / the Running Average of Total Organic Carbon (TOC) determined from a recharge site's start-up period


RWC Management Plan - Brooks Street Basin
Months SInce Initial Recycled Water Delivery
Brooks St. Basin RWC Max has not yet been determined, but is held below 20% for future planned deliveries while data are evaluated
Historical Diluent Water Recharge
Historical Recycled Water Recharge
Forecast Stormwater Diluent Recharge
Planned Recycled Water Recharge
Groundwater Underflow
RWC Actual
RWC Projected
Delivered Water Volume (AF/month)
RWC
HISTORICAL RECHARGE
PLANNED RECHARGE

RWC Management Plan for Ely Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2001/2002	Jul '01	23	14	0	286	300	15,571	0	1,007	16,578	6%	
	Aug '01	24	11	0	286	297	15,868	31	1,038	16,906	6%	
	Sep '01	25	26	0	286	312	16,181	178	1,216	17,397	7%	
	Oct '01	26	76	0	286	362	16,543	186	1,402	17,945	8%	
	Nov '01	27	329	0	286	615	17,158	109	1,512	18,669	8%	
	Dec '01	28	113	0	286	399	17,557	0	1,512	19,069	8%	
	Jan '02	29	178	0	286	464	18,021	0	1,512	19,533	8%	
	Feb '02	30	106	0	286	392	18,413	0	1,512	19,925	8%	
	Mar '02	31	219	0	286	505	18,918	0	1,512	20,430	7%	
	Apr '02	32	121	0	286	407	19,325	0	1,512	20,837	7%	
	May '02	33	86	0	286	372	19,698	0	1,512	21,209	7%	
	Jun '02	34	15	0	286	302	19,999	0	1,512	21,511	7%	
2002/2003	Jul '02	35	116	0	286	402	20,401	0	1,512	21,913	7%	HISTORICAL
	Aug '02	36	136	0	286	422	20,823	0	1,512	22,335	7%	
	Sep '02	37	97	0	286	383	21,206	0	1,512	22,718	7%	
	Oct '02	38	179	0	286	466	21,672	0	1,512	23,184	7%	
	Nov '02	39	330	0	286	616	22,288	0	1,512	23,800	6%	
	Dec '02	40	330	0	286	616	22,904	0	1,512	24,416	6%	
	Jan '03	41	176	0	286	463	23,367	0	1,512	24,879	6%	
	Feb '03	42	330	0	286	616	23,983	0	1,512	25,495	6%	
	Mar '03	43	330	0	286	616	24,599	0	1,512	26,111	6%	
	Apr '03	44	330	0	286	616	25,216	0	1,512	26,727	6%	
	May '03	45	330	0	286	616	25,832	30	1,542	27,374	6%	
	Jun '03	46	112	0	286	398	26,230	154	1,696	27,926	6%	
2003/2004	Jul '03	47	105	0	286	391	26,621	0	1,696	28,317	6%	
	Aug '03	48	32	0	286	318	26,939	0	1,696	28,635	6%	
	Sep '03	49	11	0	286	298	27,237	0	1,696	28,933	6%	
	Oct '03	50	11	0	286	297	27,534	0	1,696	29,230	6%	
	Nov '03	51	105	0	286	391	27,924	0	1,696	29,620	6%	
	Dec '03	52	193	0	286	479	28,404	0	1,696	30,100	6%	
	Jan '04	53	33	0	286	319	28,723	0	1,696	30,419	6%	
	Feb '04	54	330	0	286	616	29,339	0	1,696	31,035	5%	
	Mar '04	55	174	0	286	460	29,800	0	1,696	31,496	5%	
	Apr '04	56	69	0	286	355	30,154	0	1,696	31,850	5%	
	May '04	57	17	0	286	303	30,457	5	1,701	32,158	5%	
	Jun '04	58	13	0	286	299	30,757	44	1,745	32,501	5%	
2004/2005	Jul '04	59	14	0	286	300	31,057	46	1,791	32,847	5%	
	Aug '04	60	94	0	286	380	31,437	48	1,839	33,276	6%	
	Sep '04	61	179	0	286	465	31,902	41	1,880	33,781	6%	
	Oct '04	62	330	0	286	616	32,518	23	1,903	34,421	6%	
	Nov '04	63	330	0	286	616	33,134	0	1,903	35,037	5%	
	Dec '04	64	330	0	286	616	33,750	0	1,903	35,653	5%	
	Jan '05	65	330	0	286	616	34,366	0	1,903	36,269	5%	
	Feb '05	66	330	0	286	616	34,983	0	1,903	36,885	5%	
	Mar '05	67	238	0	286	524	35,506	0	1,903	37,409	5%	
	Apr '05	68	176	0	286	462	35,968	0	1,903	37,871	5%	
	May '05	69	140	0	286	426	36,394	0	1,903	38,297	5%	
	Jun '05	70	3	0	286	289	36,683	0	1,903	38,586	5%	
2005/2006	Jul '05	71	0	0	286	286	36,969	0	1,903	38,872	5%	HISTORICAL
	Aug '05	72	0	0	286	286	37,255	0	1,903	39,158	5%	
	Sep '05	73	0	0	286	286	37,541	0	1,903	39,444	5%	
	Oct '05	74	198	0	286	485	38,026	32	1,935	39,961	5%	
	Nov '05	75	15	0	286	301	38,327	0	1,935	40,262	5%	
	Dec '05	76	107	0	286	393	38,721	35	1,970	40,690	5%	
	Jan '06	77	190	0	286	476	39,197	21	1,990	41,187	5%	
	Feb '06	78	268	0	286	554	39,751	74	2,065	41,815	5%	
	Mar '06	79	338	0	286	625	40,375	0	2,065	42,440	5%	
	Apr '06	80	362	0	286	648	41,023	0	2,065	43,088	5%	
	May '06	81	35	0	286	322	41,345	0	2,065	43,410	5%	
	Jun '06	82	26	0	286	312	41,657	26	2,091	43,748	5%	

RWC Management Plan for Ely Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2006/2007	Jul '06	83	33	0	286	320	41,977	41	2,132	44,109	5%	HISTORICAL
	Aug '06	84	10	0	286	296	42,273	6	2,138	44,411	5%	
	Sep '06	85	40	0	286	326	42,599	83	2,221	44,820	5%	
	Oct '06	86	54	0	286	340	42,753	31	2,252	45,006	5%	
	Nov '06	87	63	0	286	349	42,773	50	2,302	45,075	5%	
	Dec '06	88	86	0	286	372	42,815	41	2,344	45,158	5%	
	Jan '07	89	95	0	286	381	42,866	58	2,401	45,267	5%	
	Feb '07	90	150	0	286	436	43,213	23	2,424	45,638	5%	
	Mar '07	91	17	0	286	303	43,435	45	2,469	45,904	5%	
	Apr '07	92	59	0	286	345	43,687	41	2,510	46,197	5%	
	May '07	93	14	0	286	300	43,950	40	2,550	46,500	5%	
	Jun '07	94	18	0	286	304	44,234	7	2,557	46,791	5%	
2007/2008	Jul '07	95	26	0	286	312	44,536	0	2,557	47,093	5%	
	Aug '07	96	29	0	286	315	44,840	0	2,557	47,397	5%	
	Sep '07	97	34	0	286	320	45,030	0	2,557	47,587	5%	
	Oct '07	98	34	0	286	320	45,242	0	2,557	47,799	5%	
	Nov '07	99	166	0	286	452	45,368	87	2,644	48,012	6%	
	Dec '07	100	257	0	286	543	45,581	53	2,697	48,278	6%	
	Jan '08	101	793	0	286	1079	46,330	0	2,697	49,027	6%	
	Feb '08	102	233	0	286	519	46,520	0	2,697	49,217	5%	
	Mar '08	103	20	0	286	306	46,496	116	2,813	49,309	6%	
	Apr '08	104	30	0	286	316	46,515	116	2,929	49,444	6%	
	May '08	105	30	0	286	316	46,502	87	3,016	49,518	6%	
	Jun '08	106	18	0	286	304	46,644	0	3,016	49,660	6%	
2008/2009	Jul '08	107	17	0	286	303	46,797	67	3,083	49,880	6%	
	Aug '08	108	8	0	286	294	46,982	0	3,083	50,065	6%	
	Sep '08	109	5	0	286	291	47,145	0	3,083	50,228	6%	
	Oct '08	110	17	0	286	303	47,387	135	3,218	50,605	6%	
	Nov '08	111	114	0	286	400	47,702	88	3,306	51,008	6%	
	Dec '08	112	287	0	286	573	48,163	0	3,306	51,469	6%	
	Jan '09	113	38	0	286	324	48,276	39	3,345	51,621	6%	
	Feb '09	114	409	0	286	695	48,833	9	3,354	52,187	6%	
	Mar '09	115	48	0	286	334	49,005	0	3,354	52,359	6%	
	Apr '09	116	135	0	286	421	49,111	15	3,369	52,480	6%	
	May '09	117	68	0	286	354	49,367	11	3,380	52,747	6%	
	Jun '09	118	24	0	286	310	49,639	0	3,380	53,019	6%	
2009/2010	Jul '09	119	0	0	286	286	49,912	0	3,380	53,292	6%	
	Aug '09	120	35	0	286	321	50,159	0	3,380	53,539	6%	
	Sep '09	121	387	0	286	673	50,472	24	3,318	53,789	6%	
	Oct '09	122	243	0	286	529	50,651	102	3,255	53,906	6%	
	Nov '09	123	486	0	286	772	51,132	120	3,259	54,391	6%	
	Dec '09	124	269	0	286	555	51,363	0	3,147	54,510	6%	
	Jan '10	125	319	0	286	605	51,563	0	3,119	54,682	6%	
	Feb '10	126	221	0	286	507	51,454	0	3,119	54,573	6%	
	Mar '10	127	192		286	478	51,327	0	3,119	54,446	6%	PLANNED
	Apr '10	128	206		286	492	51,227	0	3,119	54,347	6%	
	May '10	129	115		286	401	51,211	0	3,119	54,330	6%	
	Jun '10	130	46		286	332	51,141	0	3,119	54,260	6%	
2010/2011	Jul '10	131	43		286	329	51,125	60	3,114	54,239	6%	
	Aug '10	132	43		286	329	51,162	60	3,029	54,190	6%	
	Sep '10	133	86		286	372	51,238	140	3,034	54,272	6%	
	Oct '10	134	117		286	403	51,206	120	3,028	54,234	6%	
	Nov '10	135	188		286	474	51,308	100	3,128	54,436	6%	
	Dec '10	136	197		286	483	51,389	0	3,128	54,517	6%	
	Jan '11	137	242		286	528	51,301	0	3,128	54,429	6%	
	Feb '11	138	270		286	556	51,241	0	3,128	54,369	6%	
	Mar '11	139	192		286	478	51,323	0	3,128	54,452	6%	
	Apr '11	140	206		286	492	51,255	0	3,128	54,383	6%	
	May '11	141	115		286	401	51,266	120	3,248	54,515	6%	
	Jun '11	142	46		286	332	51,299	140	3,359	54,658	6%	

RWC Management Plan for Ely Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2011/2012	Jul '11	143	43		286	329	51,328	60	3,419	54,747	6%	PLANNED
	Aug '11	144	43		286	329	51,361	60	3,448	54,809	6%	
	Sep '11	145	86		286	372	51,421	140	3,410	54,831	6%	
	Oct '11	146	117		286	403	51,461	120	3,344	54,805	6%	
	Nov '11	147	188		286	474	51,321	100	3,334	54,655	6%	
	Dec '11	148	197		286	483	51,405	0	3,334	54,739	6%	
	Jan '12	149	242		286	528	51,469	0	3,334	54,803	6%	
	Feb '12	150	270		286	556	51,633	0	3,334	54,967	6%	
	Mar '12	151	192		286	478	51,606	0	3,334	54,940	6%	
	Apr '12	152	206		286	492	51,691	0	3,334	55,026	6%	
	May '12	153	115		286	401	51,720	120	3,454	55,175	6%	
	Jun '12	154	46		286	332	51,751	140	3,594	55,345	6%	
2012/2013	Jul '12	155	43		286	329	51,678	60	3,654	55,332	7%	
	Aug '12	156	43		286	329	51,585	60	3,714	55,299	7%	
	Sep '12	157	86		286	372	51,574	140	3,854	55,428	7%	
	Oct '12	158	117		286	403	51,511	120	3,974	55,486	7%	
	Nov '12	159	188		286	474	51,369	100	4,074	55,444	7%	
	Dec '12	160	197		286	483	51,236	0	4,074	55,311	7%	
	Jan '13	161	242		286	528	51,302	0	4,074	55,376	7%	
	Feb '13	162	270		286	556	51,242	0	4,074	55,316	7%	
	Mar '13	163	192		286	478	51,104	0	4,074	55,178	7%	
	Apr '13	164	206		286	492	50,980	0	4,074	55,054	7%	
	May '13	165	115		286	401	50,765	120	4,164	54,929	8%	
	Jun '13	166	46		286	332	50,699	140	4,150	54,849	8%	
2013/2014	Jul '13	167	43		286	329	50,637	60	4,210	54,847	8%	
	Aug '13	168	43		286	329	50,648	60	4,270	54,918	8%	
	Sep '13	169	86		286	372	50,722	140	4,410	55,132	8%	
	Oct '13	170	117		286	403	50,829	120	4,530	55,359	8%	
	Nov '13	171	188		286	474	50,912	100	4,630	55,542	8%	
	Dec '13	172	197		286	483	50,916	0	4,630	55,546	8%	
	Jan '14	173	242		286	528	51,125	0	4,630	55,755	8%	
	Feb '14	174	270		286	556	51,065	0	4,630	55,695	8%	
	Mar '14	175	192		286	478	51,083	0	4,630	55,713	8%	
	Apr '14	176	206		286	492	51,220	0	4,630	55,850	8%	
	May '14	177	115		286	401	51,318	120	4,745	56,063	8%	
	Jun '14	178	46		286	332	51,351	140	4,841	56,193	9%	
2014/2015	Jul '14	179	43		286	329	51,380	60	4,855	56,236	9%	
	Aug '14	180	43		286	329	51,329	60	4,867	56,196	9%	
	Sep '14	181	86		286	372	51,237	140	4,966	56,203	9%	
	Oct '14	182	117		286	403	51,024	120	5,063	56,087	9%	
	Nov '14	183	188		286	474	50,882	100	5,163	56,045	9%	
	Dec '14	184	197		286	483	50,749	0	5,163	55,912	9%	
	Jan '15	185	242		286	528	50,661	0	5,163	55,824	9%	
	Feb '15	186	270		286	556	50,601	0	5,163	55,764	9%	
	Mar '15	187	192		286	478	50,555	0	5,163	55,718	9%	
	Apr '15	188	206		286	492	50,585	0	5,163	55,749	9%	
	May '15	189	115		286	401	50,561	120	5,283	55,844	9%	
	Jun '15	190	46		286	332	50,604	140	5,423	56,027	10%	
2015/2016	Jul '15	191	43		286	329	50,647	60	5,483	56,130	10%	
	Aug '15	192	43		286	329	50,690	60	5,543	56,233	10%	
	Sep '15	193	86		286	372	50,776	140	5,683	56,459	10%	
	Oct '15	194	117		286	403	50,695	120	5,771	56,466	10%	
	Nov '15	195	188		286	474	50,868	100	5,871	56,739	10%	
	Dec '15	196	197		286	483	50,957	0	5,836	56,793	10%	
	Jan '16	197	242		286	528	51,009	0	5,816	56,825	10%	
	Feb '16	198	270		286	556	51,012	0	5,741	56,753	10%	
	Mar '16	199	192		286	478	50,865	0	5,741	56,607	10%	
	Apr '16	200	206		286	492	50,709	0	5,741	56,451	10%	
	May '16	201	115		286	401	50,789	120	5,861	56,650	10%	
	Jun '16	202	46		286	332	50,809	140	5,975	56,784	11%	

RWC Management Plan for Ely Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2016/2017	Jul '16	203	43		286	329	50,818	60	5,994	56,813	11%	PLANNED
	Aug '16	204	43		286	329	50,852	60	6,048	56,900	11%	
	Sep '16	205	86		286	372	50,898	140	6,105	57,002	11%	
	Oct '16	206	117		286	403	50,960	120	6,194	57,154	11%	
	Nov '16	207	188		286	474	51,085	100	6,244	57,329	11%	
	Dec '16	208	197		286	483	51,196	0	6,202	57,399	11%	
	Jan '17	209	242		286	528	51,344	0	6,145	57,488	11%	
	Feb '17	210	270		286	556	51,464	0	6,122	57,585	11%	
	Mar '17	211	192		286	478	51,639	0	6,077	57,716	11%	
	Apr '17	212	206		286	492	51,786	0	6,036	57,822	10%	
	May '17	213	115		286	401	51,887	120	6,116	58,003	11%	
	Jun '17	214	46		286	332	51,915	140	6,249	58,164	11%	
2017/2018	Jul '17	215	43		286	329	51,932	60	6,309	58,241	11%	
	Aug '17	216	43		286	329	51,946	60	6,369	58,315	11%	
	Sep '17	217	86		286	372	51,998	140	6,509	58,507	11%	
	Oct '17	218	117		286	403	52,081	120	6,629	58,710	11%	
	Nov '17	219	188		286	474	52,103	100	6,642	58,745	11%	
	Dec '17	220	197		286	483	52,043	0	6,589	58,632	11%	
	Jan '18	221	242		286	528	51,492	0	6,589	58,081	11%	
	Feb '18	222	270		286	556	51,529	0	6,589	58,118	11%	
	Mar '18	223	192		286	478	51,701	0	6,473	58,174	11%	
	Apr '18	224	206		286	492	51,877	0	6,357	58,234	11%	
	May '18	225	115		286	401	51,962	120	6,390	58,352	11%	
	Jun '18	226	46		286	332	51,990	140	6,530	58,520	11%	
2018/2019	Jul '18	227	43		286	329	52,016	60	6,523	58,539	11%	
	Aug '18	228	43		286	329	52,051	60	6,583	58,634	11%	
	Sep '18	229	86		286	372	52,132	140	6,723	58,855	11%	
	Oct '18	230	117		286	403	52,232	120	6,708	58,940	11%	
	Nov '18	231	188		286	474	52,306	100	6,720	59,026	11%	
	Dec '18	232	197		286	483	52,216	0	6,720	58,936	11%	
	Jan '19	233	242		286	528	52,420	0	6,681	59,101	11%	
	Feb '19	234	270		286	556	52,281	0	6,672	58,953	11%	
	Mar '19	235	192		286	478	52,425	0	6,672	59,097	11%	
	Apr '19	236	206		286	492	52,496	0	6,657	59,153	11%	
	May '19	237	115		286	401	52,543	120	6,766	59,309	11%	
	Jun '19	238	46		286	332	52,565	140	6,906	59,471	12%	
2019/2020	Jul '19	239	43		286	329	52,608	60	6,966	59,574	12%	
	Aug '19	240	43		286	329	52,616	60	7,026	59,642	12%	
	Sep '19	241	86		286	372	52,315	140	7,142	59,457	12%	
	Oct '19	242	117		286	403	52,189	120	7,160	59,349	12%	
	Nov '19	243	188		286	474	51,891	100	7,140	59,031	12%	
	Dec '19	244	197		286	483	51,819	0	7,140	58,959	12%	
	Jan '20	245	242		286	528	51,742	0	7,140	58,882	12%	
	Feb '20	246	270		286	556	51,791	0	7,140	58,931	12%	
	Mar '20	247	192		286	478	51,791	0	7,140	58,931	12%	
	Apr '20	248	206		286	492	51,791	0	7,140	58,931	12%	
	May '20	249	115		286	401	51,791	120	7,260	59,051	12%	
	Jun '20	250	46		286	332	51,791	140	7,400	59,191	13%	

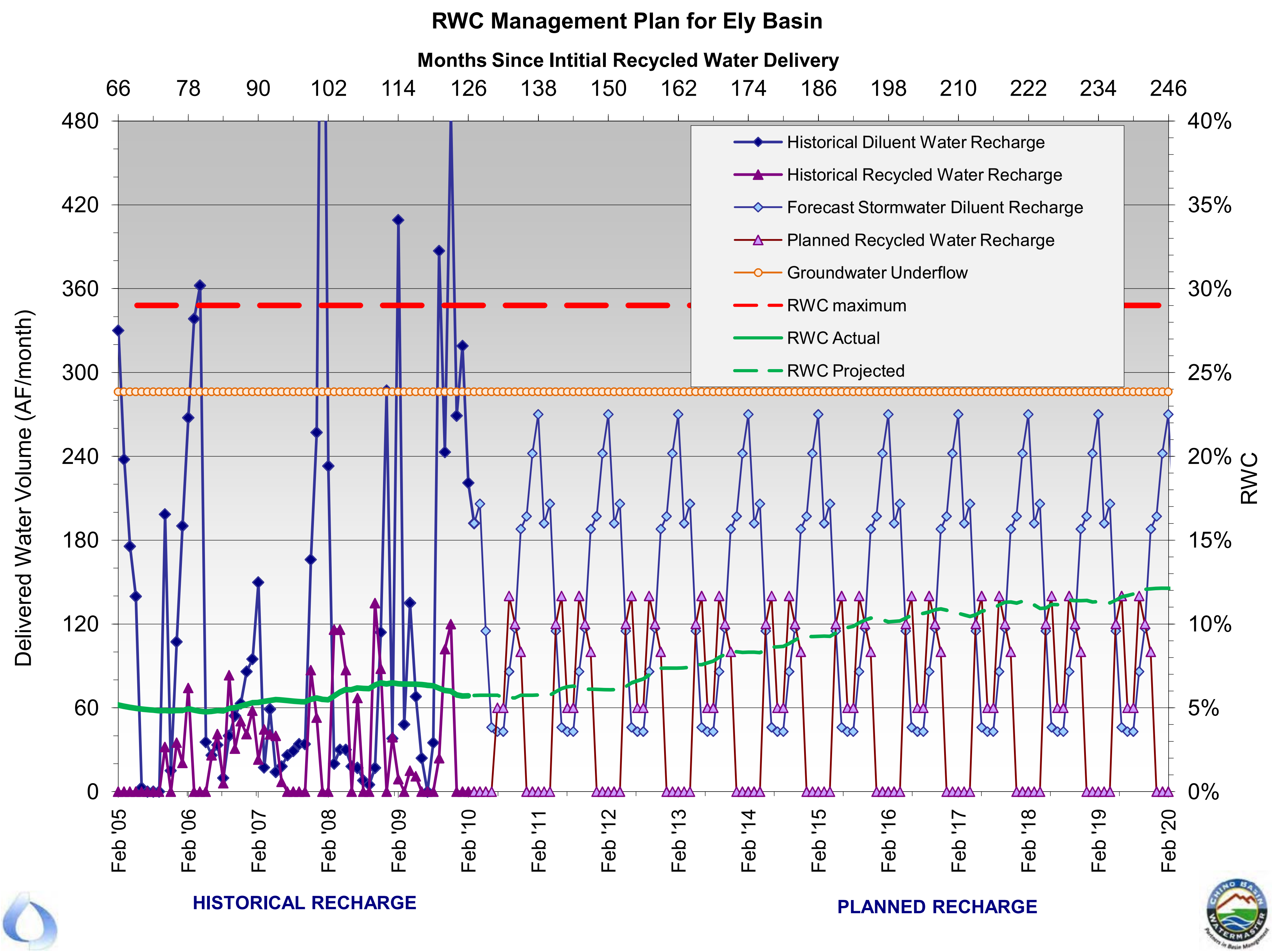
Notes:

DW = Diluent Water; Total DW is the sum of Stormwater & Local Runoff (SW), Imported Water from the State Water Project (MWD), and groundwater underflow.

RW = Recycled Water

RWC = 120-month running total of recycled water / 120-month running total of all diluent and recycled water.

RWC maximum = 0.5 mg/L / the Running Average of Total Organic Carbon (TOC) determined from a recharge site's start-up period


RWC Management Plan for Ely Basin
Months Since Intitial Recycled Water Delivery
66
78
90
102
114
126
138
150
162
174
186
198
210
222
234
246
480
420
360
300
240
180
120
60
0
Delivered Water Volume (AF/month)
40%
35%
30%
25%
20%
15%
10%
5%
0%
RWC
Historical Diluent Water Recharge
Historical Recycled Water Recharge
Forecast Stormwater Diluent Recharge
Planned Recycled Water Recharge
Groundwater Underflow
RWC maximum
RWC Actual
RWC Projected
Feb '05
Feb '06
Feb '07
Feb '08
Feb '09
Feb '10
Feb '11
Feb '12
Feb '13
Feb '14
Feb '15
Feb '16
Feb '17
Feb '18
Feb '19
Feb '20
HISTORICAL RECHARGE
PLANNED RECHARGE

RWC Management Plan for Hickory Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2001/02	Jul '01	-49	1.5	0.		1.5						
	Aug '01	-48	0.	0.		0.						
	Sep '01	-47	0.	0.		0.						
	Oct '01	-46	0.	0.		0.						
	Nov '01	-45	61.	0.		61.						
	Dec '01	-44	2.	0.		2.						
	Jan '02	-43	35.4	0.		35.4						
	Feb '02	-42	0.	0.		0.						
	Mar '02	-41	3.7	0.		3.7						
	Apr '02	-40	1.5	0.		1.5						
	May '02	-39	0.1	0.		0.1						
	Jun '02	-38	0.	0.		0.						
2002/03	Jul '02	-37	0.	0.		0.						
	Aug '02	-36	0.	0.		0.						
	Sep '02	-35	0.	0.		0.						
	Oct '02	-34	0.	0.		0.						
	Nov '02	-33	81.7	0.		81.7						
	Dec '02	-32	121.5	0.		121.5						
	Jan '03	-31	0.	0.		0.						
	Feb '03	-30	146.3	0.		146.3						MODELED
	Mar '03	-29	105.6	0.		105.6						
	Apr '03	-28	89.	0.		89.						
	May '03	-27	7.	0.		7.						
	Jun '03	-26	0.	0.		0.						
2003/04	Jul '03	-25	0.	0.		0.						
	Aug '03	-24	0.	0.		0.						
	Sep '03	-23	0.	0.		0.						
	Oct '03	-22	0.	0.		0.						
	Nov '03	-21	4.5	0.		4.5						MODELED
	Dec '03	-20	35.2	0.		35.2						
	Jan '04	-19	0.5	0.		0.5						
	Feb '04	-18	128.8	0.		128.8						
	Mar '04	-17	54.9	0.		54.9						
	Apr '04	-16	0.	0.		0.						
	May '04	-15	0.	0.		0.						
	Jun '04	-14	0.	0.		0.						
2004/05	Jul '04	-13	0.	0.		0.						
	Aug '04	-12	0.	0.		0.						
	Sep '04	-11	0.	0.		0.						
	Oct '04	-10	117.6	0.		117.6						HISTORICAL
	Nov '04	-9	2.	0.		2.						
	Dec '04	-8	39.	0.		39.						
	Jan '05	-7	149.8	0.		149.8						
	Feb '05	-6	127.5	0.		127.5						
	Mar '05	-5	27.	0.		27.						
	Apr '05	-4	4.1	0.		4.1						
	May '05	-3	19.8	31.9		51.7						MEAS
	Jun '05	-2	59.5	159.5		219.						
2005/06	Jul '05	-1	123.	142.3		265.3						
	Aug '05	0	487.1	0.		487.1	2407	0.	0.	2407	0%	
	Sep '05	1	130.4	0.	266.6	397.1	2804	138.8	138.8	2943	5%	
	Oct '05	2	21.8	0.	266.6	288.4	3093	92.7	231.6	3324	7%	
	Nov '05	3	0.	0.	266.6	266.6	3359	92.2	323.8	3683	9%	
	Dec '05	4	7.8	0.	266.6	274.4	3634	31.6	355.4	3989	9%	START-UP
	Jan '06	5	12.6	0.	266.6	279.2	3913	82.9	438.3	4351	10%	
	Feb '06	6	34.6	0.	266.6	301.2	4214	79.2	517.5	4732	11%	
	Mar '06	7	26.7	0.	266.6	293.3	4507	0.	517.5	5025	10%	
	Apr '06	8	43.5	0.	266.6	310.1	4818	0.	517.5	5335	10%	
	May '06	9	83.2	0.	266.6	349.8	5167	0.	517.5	5685	9%	
	Jun '06	10	30.	0.	266.6	296.6	5464	0.	517.5	5981	9%	

RWC Management Plan for Hickory Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2006/07	Jul '06	11	129.1	0.	266.6	395.7	5860	182.8	700.3	6560	11%	HISTORICAL
	Aug '06	12	47.	0.	266.6	313.6	6173	180.	880.3	7054	12%	
	Sep '06	13	89.	0.	266.6	355.6	6529	0.	880.3	7409	12%	
	Oct '06	14	43.2	0.	266.6	309.8	6839	143.6	1023.9	7863	13%	
	Nov '06	15	58.5	0.	266.6	325.1	7164	35.4	1059.3	8223	13%	
	Dec '06	16	84.4	0.	266.6	351.	7515	0.	1059.3	8574	12%	
	Jan '07	17	16.3	0.	266.6	282.9	7798	0.	1059.3	8857	12%	
	Feb '07	18	40.3	0.	266.6	306.9	8105	42.	1101.3	9206	12%	
	Mar '07	19	34.6	0.	266.6	301.2	8406	0.	1101.3	9507	12%	
	Apr '07	20	50.	0.	266.6	316.6	8722	63.	1164.3	9887	12%	
	May '07	21	58.	0.	266.6	324.6	9047	0.	1164.3	10211	11%	
	Jun '07	22	90.	0.	266.6	356.6	9404	0.	1164.3	10568	11%	
2007/08	Jul '07	23	93.	0.	266.6	359.6	9763	141.	1305.3	11068	12%	
	Aug '07	24	93.	0.	266.6	359.6	10123	78.	1383.3	11506	12%	
	Sep '07	25	92.	0.	266.6	358.6	10481	15.	1398.3	11880	12%	
	Oct '07	26	73.	0.	266.6	339.6	10821	22.8	1421.1	12242	12%	
	Nov '07	27	102.	0.	266.6	368.6	11190	98.	1519.1	12709	12%	
	Dec '07	28	102.	0.	266.6	368.6	11558	0.	1519.1	13077	12%	
	Jan '08	29	126.	0.	266.6	392.6	11951	0.	1519.1	13470	11%	
	Feb '08	30	97.	0.	266.6	363.6	12314	39.	1558.1	13873	11%	
	Mar '08	31	44.	0.	266.6	310.6	12625	80.	1638.1	14263	11%	
	Apr '08	32	64.	0.	266.6	330.6	12956	7.	1645.1	14601	11%	
	May '08	33	39.	0.	266.6	305.6	13261	86.	1731.1	14992	12%	
	Jun '08	34	24.	0.	266.6	290.6	13552	0.	1731.1	15283	11%	
2008/09	Jul '08	35	18.	0.	266.6	284.6	13836	0.	1731.1	15568	11%	
	Aug '08	36	6.	0.	266.6	272.6	14109	0.	1731.1	15840	11%	
	Sep '08	37	3.	0.	266.6	269.6	14379	0.	1731.1	16110	11%	
	Oct '08	38	3.	0.	266.6	269.6	14648	0.	1731.1	16379	11%	
	Nov '08	39	3.	0.	266.6	269.6	14918	0.	1731.1	16649	10%	
	Dec '08	40	35.	0.	266.6	301.6	15219	0.	1731.1	16951	10%	
	Jan '09	41	0.	0.	266.6	266.6	15486	0.	1731.1	17217	10%	
	Feb '09	42	63.	0.	266.6	329.6	15816	23.	1754.1	17570	10%	
	Mar '09	43	31.	0.	266.6	297.6	16113	23.	1777.1	17890	10%	
	Apr '09	44	8.	0.	266.6	274.6	16388	0.	1777.1	18165	10%	
	May '09	45	18.	0.	266.6	284.6	16672	0.	1777.1	18450	10%	
	Jun '09	46	3.	0.	266.6	269.6	16942	0.	1777.1	18719	9%	
2009/10	Jul '09	47	9.	0.	266.6	275.6	17218	0.	1777.1	18995	9%	
	Aug '09	48	4.	0.	266.6	270.6	17488	0.	1777.1	19265	9%	
	Sep '09	49	3.	0.	266.6	269.6	17758	34.	1811.1	19569	9%	
	Oct '09	50	28.	0.	266.6	294.6	18052	189.2	2000.3	20053	10%	
	Nov '09	51	26.	0.	266.6	292.6	18345	243.	2243.3	20588	11%	
	Dec '09	52	0.	0.	266.6	266.6	18612	93.	2336.3	20948	11%	
	Jan '10	53	214.	0.	266.6	480.6	19092	19.	2355.3	21448	11%	
	Feb '10	54	200.	0.	266.6	466.6	19559	0.	2355.3	21914	11%	
	Mar '10	55	46.		266.6	312.6	19872	120.	2475.3	22347	11%	PLANNED
	Apr '10	56	37.		266.6	303.6	20175	120.	2595.3	22770	11%	
	May '10	57	32.		266.6	298.6	20474	0.	2595.3	23069	11%	
	Jun '10	58	30.		266.6	296.6	20770	0.	2595.3	23366	11%	
2010/11	Jul '10	59	47.		266.6	313.6	21084	0.	2595.3	23679	11%	
	Aug '10	60	80.		266.6	346.6	21431	0.	2595.3	24026	11%	
	Sep '10	61	40.		266.6	306.6	21737	120.	2715.3	24452	11%	
	Oct '10	62	36.		266.6	302.6	22038	150.	2865.3	24903	12%	
	Nov '10	63	35.		266.6	301.6	22340	120.	2985.3	25325	12%	
	Dec '10	64	53.		266.6	319.6	22659	90.	3075.3	25735	12%	
	Jan '11	65	65.		266.6	331.6	22980	60.	3135.3	26116	12%	
	Feb '11	66	105.		266.6	371.6	23339	90.	3225.3	26565	12%	
	Mar '11	67	46.		266.6	312.6	23646	120.	3345.3	26991	12%	
	Apr '11	68	37.		266.6	303.6	23943	120.	3465.3	27409	13%	
	May '11	69	32.		266.6	298.6	24242	0.	3465.3	27707	13%	
	Jun '11	70	30.		266.6	296.6	24539	0.	3465.3	28004	12%	

RWC Management Plan for Hickory Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2011/12	Jul '11	71	47.		266.6	313.6	24851	0.	3465.3	28316	12%	
	Aug '11	72	80.		266.6	346.6	25197	0.	3465.3	28663	12%	
	Sep '11	73	40.		266.6	306.6	25504	120.	3585.3	29089	12%	
	Oct '11	74	36.		266.6	302.6	25807	150.	3735.3	29542	13%	
	Nov '11	75	35.		266.6	301.6	26047	120.	3855.3	29903	13%	
	Dec '11	76	53.		266.6	319.6	26365	90.	3945.3	30310	13%	
	Jan '12	77	65.		266.6	331.6	26661	60.	4005.3	30666	13%	
	Feb '12	78	105.		266.6	371.6	27033	90.	4095.3	31128	13%	
	Mar '12	79	46.		266.6	312.6	27342	120.	4215.3	31557	13%	
	Apr '12	80	37.		266.6	303.6	27644	120.	4335.3	31979	14%	
	May '12	81	32.		266.6	298.6	27942	0.	4335.3	32277	13%	
	Jun '12	82	30.		266.6	296.6	28239	0.	4335.3	32574	13%	
2012/13	Jul '12	83	47.		266.6	313.6	28552	0.	4335.3	32888	13%	
	Aug '12	84	80.		266.6	346.6	28899	0.	4335.3	33234	13%	
	Sep '12	85	40.		266.6	306.6	29206	120.	4455.3	33661	13%	
	Oct '12	86	36.		266.6	302.6	29508	150.	4605.3	34113	13%	
	Nov '12	87	35.		266.6	301.6	29728	120.	4725.3	34453	14%	
	Dec '12	88	53.		266.6	319.6	29926	90.	4815.3	34741	14%	
	Jan '13	89	65.		266.6	331.6	30258	60.	4875.3	35133	14%	
	Feb '13	90	105.		266.6	371.6	30483	90.	4965.3	35448	14%	
	Mar '13	91	46.		266.6	312.6	30690	120.	5085.3	35775	14%	
	Apr '13	92	37.		266.6	303.6	30905	120.	5205.3	36110	14%	
	May '13	93	32.		266.6	298.6	31196	0.	5205.3	36402	14%	
	Jun '13	94	30.		266.6	296.6	31493	0.	5205.3	36698	14%	
2013/14	Jul '13	95	47.		266.6	313.6	31807	0.	5205.3	37012	14%	
	Aug '13	96	80.		266.6	346.6	32153	0.	5205.3	37358	14%	
	Sep '13	97	40.		266.6	306.6	32460	120.	5325.3	37785	14%	
	Oct '13	98	36.		266.6	302.6	32762	150.	5475.3	38238	14%	
	Nov '13	99	35.		266.6	301.6	33059	120.	5595.3	38655	14%	
	Dec '13	100	53.		266.6	319.6	33344	90.	5685.3	39029	15%	PLANNED
	Jan '14	101	65.		266.6	331.6	33675	60.	5745.3	39420	15%	
	Feb '14	102	105.		266.6	371.6	33918	90.	5835.3	39753	15%	
	Mar '14	103	46.		266.6	312.6	34175	120.	5955.3	40131	15%	
	Apr '14	104	37.		266.6	303.6	34479	120.	6075.3	40554	15%	
	May '14	105	32.		266.6	298.6	34778	0.	6075.3	40853	15%	
	Jun '14	106	30.		266.6	296.6	35074	0.	6075.3	41150	15%	
2014/15	Jul '14	107	47.		266.6	313.6	35388	0.	6075.3	41463	15%	
	Aug '14	108	80.		266.6	346.6	35734	0.	6075.3	41810	15%	
	Sep '14	109	40.		266.6	306.6	36041	120.	6195.3	42236	15%	
	Oct '14	110	36.		266.6	302.6	36226	150.	6345.3	42571	15%	
	Nov '14	111	35.		266.6	301.6	36526	120.	6465.3	42991	15%	
	Dec '14	112	53.		266.6	319.6	36806	90.	6555.3	43362	15%	
	Jan '15	113	65.		266.6	331.6	36988	60.	6615.3	43603	15%	
	Feb '15	114	105.		266.6	371.6	37232	90.	6705.3	43938	15%	
	Mar '15	115	46.		266.6	312.6	37518	120.	6825.3	44343	15%	
	Apr '15	116	37.		266.6	303.6	37817	120.	6945.3	44763	16%	
	May '15	117	32.		266.6	298.6	38064	0.	6945.3	45010	15%	
	Jun '15	118	30.		266.6	296.6	38142	0.	6945.3	45087	15%	
2015/16	Jul '15	119	47.		266.6	313.6	38190	0.	6945.3	45135	15%	
	Aug '15	120	80.		266.6	346.6	38050	0.	6945.3	44995	15%	
	Sep '15	121	40.		266.6	306.6	37959	120.	6926.5	44886	15%	
	Oct '15	122	36.		266.6	302.6	37973	150.	6983.7	44957	16%	
	Nov '15	123	35.		266.6	301.6	38008	120.	7011.5	45020	16%	
	Dec '15	124	53.		266.6	319.6	38054	90.	7069.9	45123	16%	
	Jan '16	125	65.		266.6	331.6	38106	60.	7047.	45153	16%	
	Feb '16	126	105.		266.6	371.6	38176	90.	7057.8	45234	16%	
	Mar '16	127	46.		266.6	312.6	38196	120.	7177.8	45373	16%	
	Apr '16	128	37.		266.6	303.6	38189	120.	7297.8	45487	16%	
	May '16	129	32.		266.6	298.6	38138	0.	7297.8	45436	16%	
	Jun '16	130	30.		266.6	296.6	38138	0.	7297.8	45436	16%	

RWC Management Plan for Hickory Basin

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2016/2017	Jul '16	131	47.		266.6	313.6	38056	0.	7115.	45171	16%	PLANNED
	Aug '16	132	80.		266.6	346.6	38089	0.	6935.	45024	15%	
	Sep '16	133	40.		266.6	306.6	38040	120.	7055.	45095	16%	
	Oct '16	134	36.		266.6	302.6	38033	150.	7061.4	45094	16%	
	Nov '16	135	35.		266.6	301.6	38009	120.	7146.	45155	16%	
	Dec '16	136	53.		266.6	319.6	37978	90.	7236.	45214	16%	
	Jan '17	137	65.		266.6	331.6	38026	60.	7296.	45322	16%	
	Feb '17	138	105.		266.6	371.6	38091	90.	7344.	45435	16%	
	Mar '17	139	46.		266.6	312.6	38103	120.	7464.	45567	16%	
	Apr '17	140	37.		266.6	303.6	38090	120.	7521.	45611	16%	
	May '17	141	32.		266.6	298.6	38064	0.	7521.	45585	16%	
	Jun '17	142	30.		266.6	296.6	38004	0.	7521.	45525	17%	
2017/2018	Jul '17	143	47.		266.6	313.6	37958	0.	7380.	45338	16%	
	Aug '17	144	80.		266.6	346.6	37945	0.	7302.	45247	16%	
	Sep '17	145	40.		266.6	306.6	37893	120.	7407.	45300	16%	
	Oct '17	146	36.		266.6	302.6	37856	150.	7534.2	45390	17%	
	Nov '17	147	35.		266.6	301.6	37789	120.	7556.2	45345	17%	
	Dec '17	148	53.		266.6	319.6	37740	90.	7646.2	45386	17%	
	Jan '18	149	65.		266.6	331.6	37679	60.	7706.2	45385	17%	
	Feb '18	150	105.		266.6	371.6	37687	90.	7757.2	45444	17%	
	Mar '18	151	46.		266.6	312.6	37689	120.	7797.2	45486	17%	
	Apr '18	152	37.		266.6	303.6	37662	120.	7910.2	45572	17%	
	May '18	153	32.		266.6	298.6	37655	0.	7824.2	45479	17%	
	Jun '18	154	30.		266.6	296.6	37661	0.	7824.2	45485	17%	
2018/2019	Jul '18	155	47.		266.6	313.6	37690	0.	7824.2	45514	17%	
	Aug '18	156	80.		266.6	346.6	37764	0.	7824.2	45588	17%	
	Sep '18	157	40.		266.6	306.6	37801	120.	7944.2	45745	17%	
	Oct '18	158	36.		266.6	302.6	37834	150.	8094.2	45928	18%	
	Nov '18	159	35.		266.6	301.6	37866	120.	8214.2	46080	18%	
	Dec '18	160	53.		266.6	319.6	37884	90.	8304.2	46188	18%	
	Jan '19	161	65.		266.6	331.6	37949	60.	8364.2	46313	18%	
	Feb '19	162	105.		266.6	371.6	37991	90.	8431.2	46422	18%	
	Mar '19	163	46.		266.6	312.6	38006	120.	8528.2	46534	18%	
	Apr '19	164	37.		266.6	303.6	38035	120.	8648.2	46683	19%	
	May '19	165	32.		266.6	298.6	38049	0.	8648.2	46697	19%	
	Jun '19	166	30.		266.6	296.6	38076	0.	8648.2	46724	19%	
2019/2020	Jul '19	167	47.		266.6	313.6	38114	0.	8648.2	46762	18%	
	Aug '19	168	80.		266.6	346.6	38190	0.	8648.2	46838	18%	
	Sep '19	169	40.		266.6	306.6	38227	120.	8734.2	46961	19%	
	Oct '19	170	36.		266.6	302.6	38235	150.	8695.	46930	19%	
	Nov '19	171	35.		266.6	301.6	38244	120.	8572.	46816	18%	
	Dec '19	172	53.		266.6	319.6	38297	90.	8569.	46866	18%	
	Jan '20	173	65.		266.6	331.6	38148	60.	8610.	46758	18%	
	Feb '20	174	105.		266.6	371.6	38053	90.	8700.	46753	19%	
	Mar '20	175	46.		266.6	312.6	38053	120.	8700.	46753	19%	
	Apr '20	176	37.		266.6	303.6	38053	120.	8700.	46753	19%	
	May '20	177	32.		266.6	298.6	38053	0.	8700.	46753	19%	
	Jun '20	178	30.		266.6	296.6	38053	0.	8700.	46753	19%	

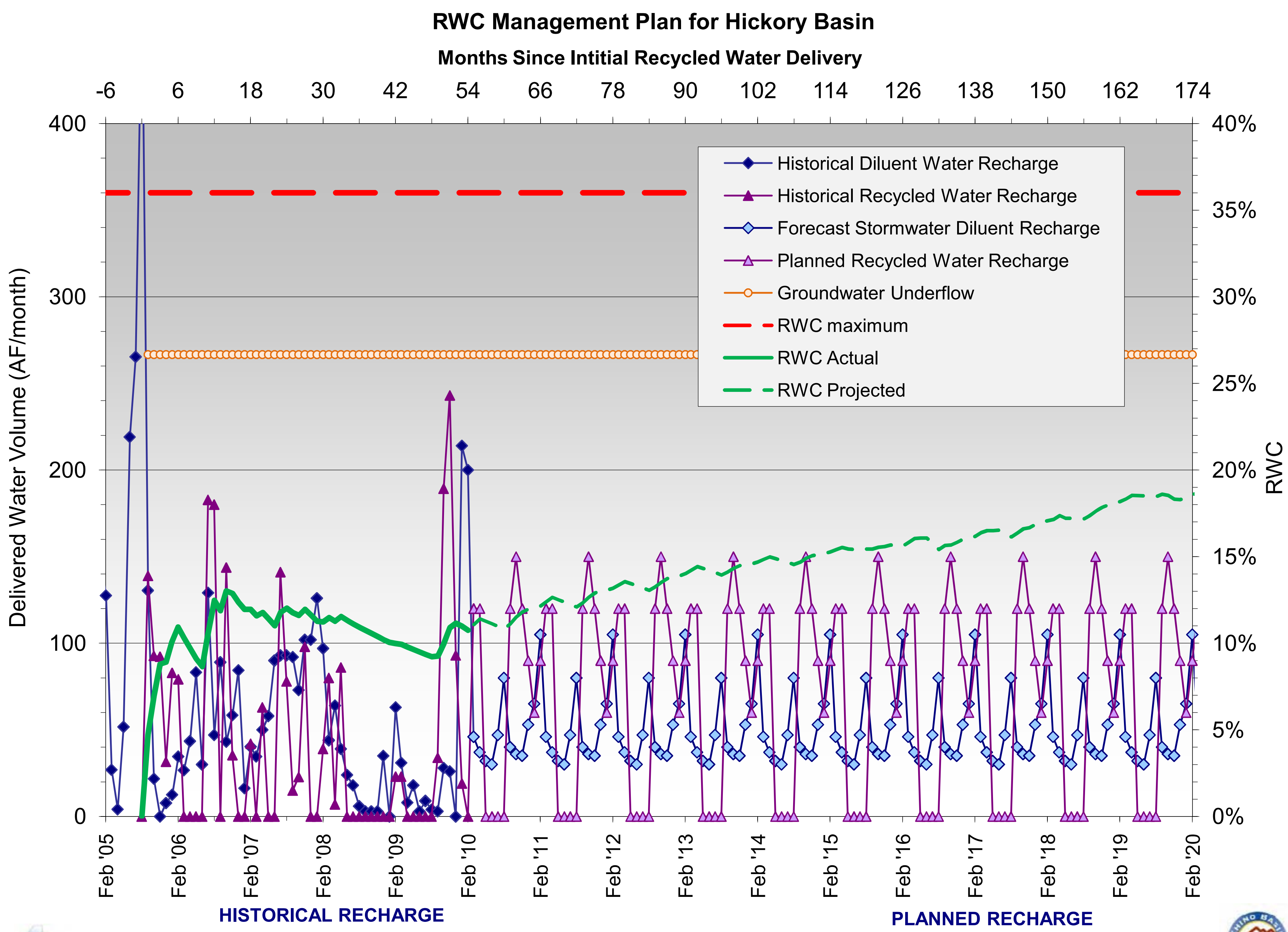
Notes:

DW = Diluent Water; Total DW is the sum of Stormwater & Local Runoff (SW), Imported Water from the State Water Project (MWD), and groundwater underflow.

RW = Recycled Water

RWC = 120-month running total of recycled water / 120-month running total of all diluent and recycled water.

RWC maximum = 0.5 mg/L / the Running Average of Total Organic Carbon (TOC) determined from a recharge site's start-up period


RWC Management Plan for Hickory Basin
Months Since Intitial Recycled Water Delivery
-6
6
18
30
42
54
66
78
90
102
114
126
138
150
162
174
400
300
200
100
0
Delivered Water Volume (AF/month)
40%
35%
30%
25%
20%
15%
10%
5%
0%
RWC
Historical Diluent Water Recharge
Historical Recycled Water Recharge
Forecast Stormwater Diluent Recharge
Planned Recycled Water Recharge
Groundwater Underflow
RWC maximum
RWC Actual
RWC Projected
Feb '05
Feb '06
Feb '07
Feb '08
Feb '09
Feb '10
Feb '11
Feb '12
Feb '13
Feb '14
Feb '15
Feb '16
Feb '17
Feb '18
Feb '19
Feb '20
HISTORICAL RECHARGE
PLANNED RECHARGE

RWC Management Plan for RP3 Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2001/02	Jul '01	-94	0.	0.								
	Aug '01	-93	0.	0.								
	Sep '01	-92	0.	0.								
	Oct '01	-91	0.	0.								
	Nov '01	-90	0.	0.								
	Dec '01	-89	0.	0.								
	Jan '02	-88	0.	0.								
	Feb '02	-87	0.	0.								
	Mar '02	-86	0.	0.								
	Apr '02	-85	0.	0.								
	May '02	-84	0.	0.								
	Jun '02	-83	0.	0.								
2002/03	Jul '02	-82	0.	0.								
	Aug '02	-81	0.	0.								
	Sep '02	-80	0.	0.								
	Oct '02	-79	0.	0.								
	Nov '02	-78	0.	0.								
	Dec '02	-77	0.	0.								
	Jan '03	-76	0.	0.								
	Feb '03	-75	0.	0.								
	Mar '03	-74	0.	0.								
	Apr '03	-73	0.	0.								
	May '03	-72	0.	0.								
	Jun '03	-71	0.	0.								
2003/04	Jul '03	-70	0.	0.								
	Aug '03	-69	0.	0.								
	Sep '03	-68	0.	0.								
	Oct '03	-67	0.	0.								
	Nov '03	-66	0.	0.								
	Dec '03	-65	0.	0.								
	Jan '04	-64	0.	0.								
	Feb '04	-63	0.	0.								
	Mar '04	-62	0.	0.								
	Apr '04	-61	0.	0.								
	May '04	-60	0.	0.								
	Jun '04	-59	0.	0.								
2004/05	Jul '04	-58	0.	0.								
	Aug '04	-57	0.	0.								
	Sep '04	-56	0.	0.								
	Oct '04	-55	0.	0.								
	Nov '04	-54	0.	0.								
	Dec '04	-53	0.	0.								
	Jan '05	-52	0.	0.								
	Feb '05	-51	0.	0.								
	Mar '05	-50	0.	0.								
	Apr '05	-49	0.	0.								
	May '05	-48	0.	0.								
	Jun '05	-47	0.	0.								
2005/06	Jul '05	-46	31.	0.		31.	31.0	0.	0.0	31.0	0%	HISTORICAL
	Aug '05	-45	31.	0.		31.	62.0	0.	0.0	62.0	0%	
	Sep '05	-44	60.	0.		60.	122.0	0.	0.0	122.0	0%	
	Oct '05	-43	78.	0.		78.	200.0	0.	0.0	200.0	0%	
	Nov '05	-42	60.	0.		60.	260.0	0.	0.0	260.0	0%	
	Dec '05	-41	60.	0.		60.	320.0	0.	0.0	320.0	0%	
	Jan '06	-40	32.5	0.		32.5	352.5	0.	0.0	352.5	0%	
	Feb '06	-39	64.4	0.		64.4	416.9	0.	0.0	416.9	0%	
	Mar '06	-38	160.7	0.		160.7	577.6	0.	0.0	577.6	0%	
	Apr '06	-37	126.9	0.		126.9	704.5	0.	0.0	704.5	0%	
	May '06	-36	37.	0.		37.	741.5	0.	0.0	741.5	0%	
	Jun '06	-35	25.	0.		25.	766.5	0.	0.0	766.5	0%	

RWC Management Plan for RP3 Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2006/07	Jul '06	-34	15.	0.		15.	781.5	0.	0.0	781.5	0%	
	Aug '06	-33	36.	0.		36.	817.5	0.	0.0	817.5	0%	
	Sep '06	-32	35.	0.		35.	852.5	0.	0.0	852.5	0%	
	Oct '06	-31	33.1	0.		33.1	885.6	0.	0.0	885.6	0%	
	Nov '06	-30	36.	0.		36.	921.6	0.	0.0	921.6	0%	
	Dec '06	-29	25.6	0.		25.6	947.2	0.	0.0	947.2	0%	
	Jan '07	-28	22.1	0.		22.1	969.3	0.	0.0	969.3	0%	
	Feb '07	-27	19.	0.		19.	988.3	0.	0.0	988.3	0%	
	Mar '07	-26	7.4	0.		7.4	995.7	0.	0.0	995.7	0%	
	Apr '07	-25	4.	0.		4.	999.7	0.	0.0	999.7	0%	
	May '07	-24	2.	0.		2.	1,001.7	0.	0.0	1,001.7	0%	
	Jun '07	-23	2.	0.		2.	1,003.7	0.	0.0	1,003.7	0%	
2007/08	Jul '07	-22	0.	0.		0.	1,003.7	0.	0.0	1,003.7	0%	
	Aug '07	-21	3.	0.		3.	1,006.7	0.	0.0	1,006.7	0%	
	Sep '07	-20	3.	0.		3.	1,009.7	0.	0.0	1,009.7	0%	
	Oct '07	-19	9.	0.		9.	1,018.7	0.	0.0	1,018.7	0%	
	Nov '07	-18	47.	0.		47.	1,065.7	0.	0.0	1,065.7	0%	
	Dec '07	-17	108.	0.		108.	1,173.7	0.	0.0	1,173.7	0%	
	Jan '08	-16	165.	0.		165.	1,338.7	0.	0.0	1,338.7	0%	
	Feb '08	-15	130.	0.		130.	1,468.7	0.	0.0	1,468.7	0%	
	Mar '08	-14	5.	0.		5.	1,473.7	0.	0.0	1,473.7	0%	
	Apr '08	-13	3.	0.		3.	1,476.7	0.	0.0	1,476.7	0%	
	May '08	-12	34.	0.		34.	1,510.7	0.	0.0	1,510.7	0%	
	Jun '08	-11	4.	0.		4.	1,514.7	0.	0.0	1,514.7	0%	
2008/09	Jul '08	-10	0.	0.		0.	1,514.7	0.	0.0	1,514.7	0%	
	Aug '08	-9	16.	0.		16.	1,530.7	0.	0.0	1,530.7	0%	
	Sep '08	-8	16.	0.		16.	1,546.7	0.	0.0	1,546.7	0%	
	Oct '08	-7	13.	0.		13.	1,559.7	0.	0.0	1,559.7	0%	
	Nov '08	-6	27.	0.		27.	1,586.7	0.	0.0	1,586.7	0%	
	Dec '08	-5	156.	0.		156.	1,742.7	0.	0.0	1,742.7	0%	
	Jan '09	-4	12.	0.		12.	1,754.7	0.	0.0	1,754.7	0%	
	Feb '09	-3	273.	0.		273.	2,027.7	0.	0.0	2,027.7	0%	
	Mar '09	-2	47.	0.		47.	2,074.7	0.	0.0	2,074.7	0%	
	Apr '09	-1	18.	0.		18.	2,092.7	0.	0.0	2,092.7	0%	
	May '09	0	6.	0.		6.	2,098.7	0.	0.0	2,098.7	0%	START-UP
	Jun '09	1	0.	0.	903.8	903.8	3,002.4	106.	106.0	3,108.4	3%	
2009/10	Jul '09	2	22.	0.	903.8	925.8	3,928.2	84.	190.0	4,118.2	5%	
	Aug '09	3	30.	0.	903.8	933.8	4,861.9	148.	338.0	5,199.9	7%	
	Sep '09	4	36.	0.	903.8	939.8	5,801.7	220.	558.0	6,359.7	9%	
	Oct '09	5	122.	0.	903.8	1025.8	6,827.4	203.	761.0	7,588.4	10%	
	Nov '09	6	100.	0.	903.8	1003.8	7,831.2	287.	1,048.0	8,879.2	12%	
	Dec '09	7	373.	0.	903.8	1276.8	9,107.9	103.	1,151.0	10,258.9	11%	
	Jan '10	8	526.	0.	903.8	1429.8	10,537.7	76.	1,227.0	11,764.7	10%	
	Feb '10	9	370.	0.	903.8	1273.8	11,811.5	113.	1,340.0	13,151.5	10%	
	Mar '10	10	55.		903.8	958.8	12,770.2	175.	1,515.0	14,285.2	11%	
	Apr '10	11	38.		903.8	941.8	13,712.0	200.	1,715.0	15,427.0	11%	
	May '10	12	20.		903.8	923.8	14,635.7	200.	1,915.0	16,550.7	12%	
	Jun '10	13	8.		903.8	911.8	15,547.5	0.	1,915.0	17,462.5	11%	
2010/11	Jul '10	14	14.		903.8	917.8	16,465.2	0.	1,915.0	18,380.2	10%	
	Aug '10	15	23.		903.8	926.8	17,392.0	250.	2,165.0	19,557.0	11%	
	Sep '10	16	30.		903.8	933.8	18,325.7	200.	2,365.0	20,690.7	11%	
	Oct '10	17	51.		903.8	954.8	19,280.5	200.	2,565.0	21,845.5	12%	PLANNED
	Nov '10	18	54.		903.8	957.8	20,238.3	175.	2,740.0	22,978.3	12%	
	Dec '10	19	145.		903.8	1048.8	21,287.0	150.	2,890.0	24,177.0	12%	
	Jan '11	20	152.		903.8	1055.8	22,342.8	150.	3,040.0	25,382.8	12%	
	Feb '11	21	171.		903.8	1074.8	23,417.5	150.	3,190.0	26,607.5	12%	
	Mar '11	22	55.		903.8	958.8	24,376.3	175.	3,365.0	27,741.3	12%	
	Apr '11	23	38.		903.8	941.8	25,318.0	200.	3,565.0	28,883.0	12%	
	May '11	24	20.		903.8	923.8	26,241.8	200.	3,765.0	30,006.8	13%	
	Jun '11	25	8.		903.8	911.8	27,153.5	0.	3,765.0	30,918.5	12%	

RWC Management Plan for RP3 Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2011/12	Jul '11	26	14.		903.8	917.8	28,071.3	0.	3,765.0	31,836.3	12%	PLANNED
	Aug '11	27	23.		903.8	926.8	28,998.0	250.	4,015.0	33,013.0	12%	
	Sep '11	28	30.		903.8	933.8	29,931.8	200.	4,215.0	34,146.8	12%	
	Oct '11	29	51.		903.8	954.8	30,886.6	200.	4,415.0	35,301.6	13%	
	Nov '11	30	54.		903.8	957.8	31,844.3	175.	4,590.0	36,434.3	13%	
	Dec '11	31	145.		903.8	1048.8	32,893.1	150.	4,740.0	37,633.1	13%	
	Jan '12	32	152.		903.8	1055.8	33,948.8	150.	4,890.0	38,838.8	13%	
	Feb '12	33	171.		903.8	1074.8	35,023.6	150.	5,040.0	40,063.6	13%	
	Mar '12	34	55.		903.8	958.8	35,982.3	175.	5,215.0	41,197.3	13%	
	Apr '12	35	38.		903.8	941.8	36,924.1	200.	5,415.0	42,339.1	13%	
	May '12	36	20.		903.8	923.8	37,847.8	200.	5,615.0	43,462.8	13%	
	Jun '12	37	8.		903.8	911.8	38,759.6	0.	5,615.0	44,374.6	13%	
2012/13	Jul '12	38	14.		903.8	917.8	39,677.4	0.	5,615.0	45,292.4	12%	
	Aug '12	39	23.		903.8	926.8	40,604.1	250.	5,865.0	46,469.1	13%	
	Sep '12	40	30.		903.8	933.8	41,537.9	200.	6,065.0	47,602.9	13%	
	Oct '12	41	51.		903.8	954.8	42,492.6	200.	6,265.0	48,757.6	13%	
	Nov '12	42	54.		903.8	957.8	43,450.4	175.	6,440.0	49,890.4	13%	
	Dec '12	43	145.		903.8	1048.8	44,499.1	150.	6,590.0	51,089.1	13%	
	Jan '13	44	152.		903.8	1055.8	45,554.9	150.	6,740.0	52,294.9	13%	
	Feb '13	45	171.		903.8	1074.8	46,629.6	150.	6,890.0	53,519.6	13%	
	Mar '13	46	55.		903.8	958.8	47,588.4	175.	7,065.0	54,653.4	13%	
	Apr '13	47	38.		903.8	941.8	48,530.1	200.	7,265.0	55,795.1	13%	
	May '13	48	20.		903.8	923.8	49,453.9	200.	7,465.0	56,918.9	13%	
	Jun '13	49	8.		903.8	911.8	50,365.7	0.	7,465.0	57,830.7	13%	
2013/14	Jul '13	50	14.		903.8	917.8	51,283.4	0.	7,465.0	58,748.4	13%	
	Aug '13	51	23.		903.8	926.8	52,210.2	250.	7,715.0	59,925.2	13%	
	Sep '13	52	30.		903.8	933.8	53,143.9	200.	7,915.0	61,058.9	13%	
	Oct '13	53	51.		903.8	954.8	54,098.7	200.	8,115.0	62,213.7	13%	
	Nov '13	54	54.		903.8	957.8	55,056.4	175.	8,290.0	63,346.4	13%	
	Dec '13	55	145.		903.8	1048.8	56,105.2	150.	8,440.0	64,545.2	13%	
	Jan '14	56	152.		903.8	1055.8	57,160.9	150.	8,590.0	65,750.9	13%	
	Feb '14	57	171.		903.8	1074.8	58,235.7	150.	8,740.0	66,975.7	13%	
	Mar '14	58	55.		903.8	958.8	59,194.5	175.	8,915.0	68,109.5	13%	
	Apr '14	59	38.		903.8	941.8	60,136.2	200.	9,115.0	69,251.2	13%	
	May '14	60	20.		903.8	923.8	61,060.0	200.	9,315.0	70,375.0	13%	
	Jun '14	61	8.		903.8	911.8	61,971.7	0.	9,315.0	71,286.7	13%	
2014/15	Jul '14	62	14.		903.8	917.8	62,889.5	0.	9,315.0	72,204.5	13%	
	Aug '14	63	23.		903.8	926.8	63,816.2	250.	9,565.0	73,381.2	13%	
	Sep '14	64	30.		903.8	933.8	64,750.0	200.	9,765.0	74,515.0	13%	
	Oct '14	65	51.		903.8	954.8	65,704.7	200.	9,965.0	75,669.7	13%	
	Nov '14	66	54.		903.8	957.8	66,662.5	175.	10,140.0	76,802.5	13%	
	Dec '14	67	145.		903.8	1048.8	67,711.2	150.	10,290.0	78,001.2	13%	
	Jan '15	68	152.		903.8	1055.8	68,767.0	150.	10,440.0	79,207.0	13%	
	Feb '15	69	171.		903.8	1074.8	69,841.8	150.	10,590.0	80,431.8	13%	
	Mar '15	70	55.		903.8	958.8	70,800.5	175.	10,765.0	81,565.5	13%	
	Apr '15	71	38.		903.8	941.8	71,742.3	200.	10,965.0	82,707.3	13%	
	May '15	72	20.		903.8	923.8	72,666.0	200.	11,165.0	83,831.0	13%	
	Jun '15	73	8.		903.8	911.8	73,577.8	0.	11,165.0	84,742.8	13%	
2015/16	Jul '15	74	14.		903.8	917.8	74,464.5	0.	11,165.0	85,629.5	13%	
	Aug '15	75	23.		903.8	926.8	75,360.3	250.	11,415.0	86,775.3	13%	
	Sep '15	76	30.		903.8	933.8	76,234.0	200.	11,615.0	87,849.0	13%	
	Oct '15	77	51.		903.8	954.8	77,110.8	200.	11,815.0	88,925.8	13%	
	Nov '15	78	54.		903.8	957.8	78,008.6	175.	11,990.0	89,998.6	13%	
	Dec '15	79	145.		903.8	1048.8	78,997.3	150.	12,140.0	91,137.3	13%	
	Jan '16	80	152.		903.8	1055.8	80,020.6	150.	12,290.0	92,310.6	13%	
	Feb '16	81	171.		903.8	1074.8	81,030.9	150.	12,440.0	93,470.9	13%	
	Mar '16	82	55.		903.8	958.8	81,829.0	175.	12,615.0	94,444.0	13%	
	Apr '16	83	38.		903.8	941.8	82,643.8	200.	12,815.0	95,458.8	13%	
	May '16	84	20.		903.8	923.8	83,530.6	200.	13,015.0	96,545.6	13%	
	Jun '16	85	8.		903.8	911.8	84,417.3	0.	13,015.0	97,432.3	13%	

RWC Management Plan for RP3 Basins

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2016/17	Jul '16	86	14.		903.8	917.8	85,320.1	0.	13,015.0	98,335.1	13%	PLANNED
	Aug '16	87	23.		903.8	926.8	86,210.8	250.	13,265.0	99,475.8	13%	
	Sep '16	88	30.		903.8	933.8	87,109.6	200.	13,465.0	100,574.6	13%	
	Oct '16	89	51.		903.8	954.8	88,031.3	200.	13,665.0	101,696.3	13%	
	Nov '16	90	54.		903.8	957.8	88,953.0	175.	13,840.0	102,793.0	13%	
	Dec '16	91	145.		903.8	1048.8	89,976.2	150.	13,990.0	103,966.2	13%	
	Jan '17	92	152.		903.8	1055.8	91,009.9	150.	14,140.0	105,149.9	13%	
	Feb '17	93	171.		903.8	1074.8	92,065.6	150.	14,290.0	106,355.6	13%	
	Mar '17	94	55.		903.8	958.8	93,017.0	175.	14,465.0	107,482.0	13%	
	Apr '17	95	38.		903.8	941.8	93,954.7	200.	14,665.0	108,619.7	14%	
	May '17	96	20.		903.8	923.8	94,876.5	200.	14,865.0	109,741.5	14%	
	Jun '17	97	8.		903.8	911.8	95,786.2	0.	14,865.0	110,651.2	13%	
2016/17	Jul '17	98	14.		903.8	917.8	96,704.0	0.	14,865.0	111,569.0	13%	
	Aug '17	99	23.		903.8	926.8	97,627.7	250.	15,115.0	112,742.7	13%	
	Sep '17	100	30.		903.8	933.8	98,558.5	200.	15,315.0	113,873.5	13%	
	Oct '17	101	51.		903.8	954.8	99,504.3	200.	15,515.0	115,019.3	13%	
	Nov '17	102	54.		903.8	957.8	100,415.0	175.	15,690.0	116,105.0	14%	
	Dec '17	103	145.		903.8	1048.8	101,355.8	150.	15,840.0	117,195.8	14%	
	Jan '18	104	152.		903.8	1055.8	102,246.5	150.	15,990.0	118,236.5	14%	
	Feb '18	105	171.		903.8	1074.8	103,191.3	150.	16,140.0	119,331.3	14%	
	Mar '18	106	55.		903.8	958.8	104,145.0	175.	16,315.0	120,460.0	14%	
	Apr '18	107	38.		903.8	941.8	105,083.8	200.	16,515.0	121,598.8	14%	
	May '18	108	20.		903.8	923.8	105,973.5	200.	16,715.0	122,688.5	14%	
	Jun '18	109	8.		903.8	911.8	106,881.3	0.	16,715.0	123,596.3	14%	
2016/17	Jul '18	110	14.		903.8	917.8	107,799.0	0.	16,715.0	124,514.0	13%	
	Aug '18	111	23.		903.8	926.8	108,709.8	250.	16,965.0	125,674.8	13%	
	Sep '18	112	30.		903.8	933.8	109,627.6	200.	17,165.0	126,792.6	14%	
	Oct '18	113	51.		903.8	954.8	110,569.3	200.	17,365.0	127,934.3	14%	
	Nov '18	114	54.		903.8	957.8	111,500.1	175.	17,540.0	129,040.1	14%	
	Dec '18	115	145.		903.8	1048.8	112,392.8	150.	17,690.0	130,082.8	14%	
	Jan '19	116	152.		903.8	1055.8	113,436.6	150.	17,840.0	131,276.6	14%	
	Feb '19	117	171.		903.8	1074.8	114,238.3	150.	17,990.0	132,228.3	14%	
	Mar '19	118	55.		903.8	958.8	115,150.1	175.	18,165.0	133,315.1	14%	
	Apr '19	119	38.		903.8	941.8	116,073.8	200.	18,365.0	134,438.8	14%	
	May '19	120	20.		903.8	923.8	116,991.6	200.	18,565.0	135,556.6	14%	
	Jun '19	121	8.		903.8	911.8	116,999.6	0.	18,459.0	135,458.6	14%	
2016/17	Jul '19	122	14.		903.8	917.8	116,991.6	0.	18,375.0	135,366.6	14%	
	Aug '19	123	23.		903.8	926.8	116,984.6	250.	18,477.0	135,461.6	14%	
	Sep '19	124	30.		903.8	933.8	116,978.6	200.	18,457.0	135,435.6	14%	
	Oct '19	125	51.		903.8	954.8	116,907.6	200.	18,454.0	135,361.6	14%	
	Nov '19	126	54.		903.8	957.8	116,861.6	175.	18,342.0	135,203.6	14%	
	Dec '19	127	145.		903.8	1048.8	116,633.6	150.	18,389.0	135,022.6	14%	
	Jan '20	128	152.		903.8	1055.8	116,259.6	150.	18,463.0	134,722.6	14%	
	Feb '20	129	171.		903.8	1074.8	116,060.6	150.	18,500.0	134,560.6	14%	
	Mar '20	130	55.		903.8	958.8	116,060.6	175.	18,500.0	134,560.6	14%	
	Apr '20	131	38.		903.8	941.8	116,060.6	200.	18,500.0	134,560.6	14%	
	May '20	132	20.		903.8	923.8	116,060.6	200.	18,500.0	134,560.6	14%	
	Jun '20	133	8.		903.8	911.8	116,060.6	0.	18,500.0	134,560.6	14%	

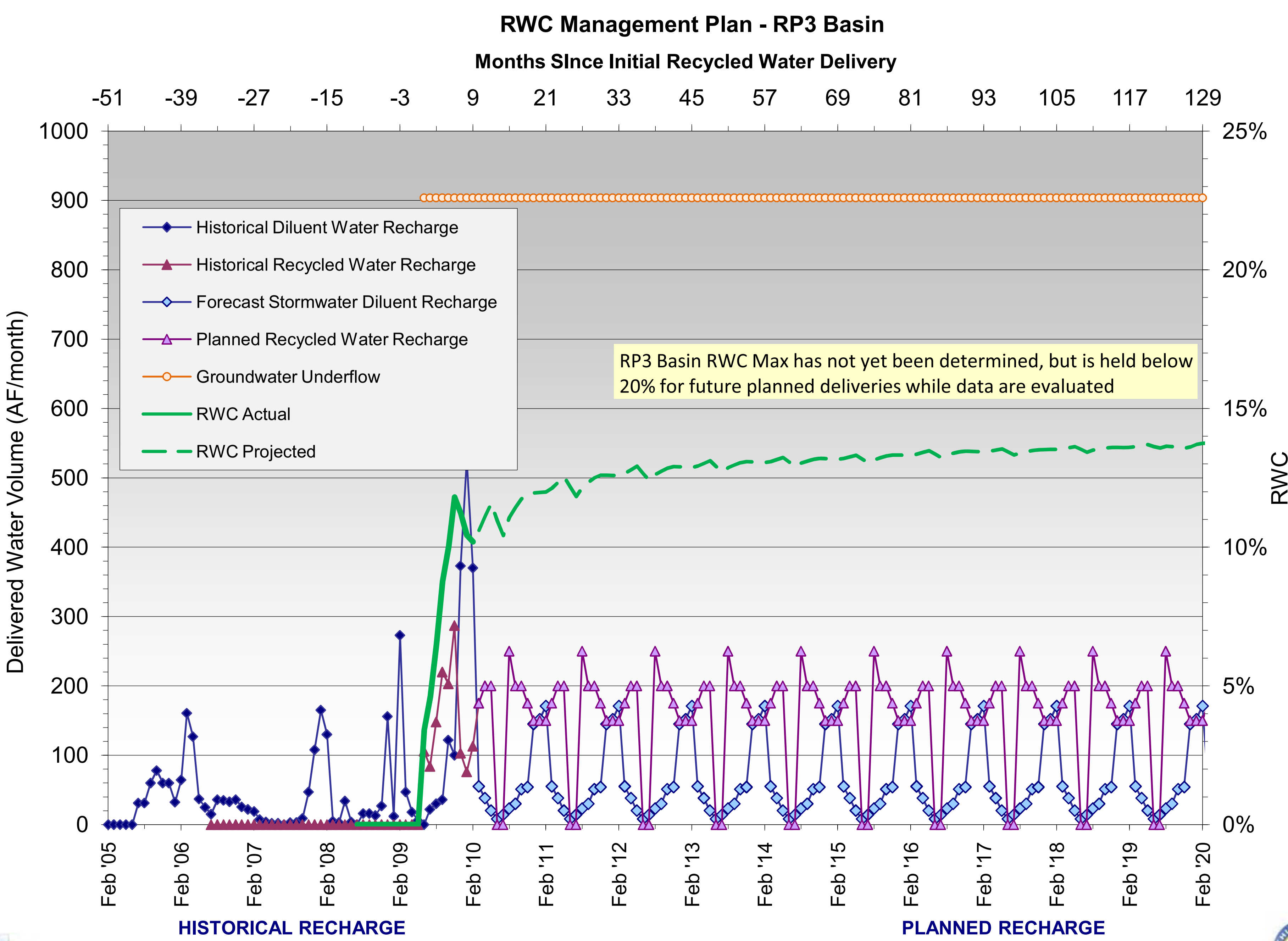
Notes:

DW = Diluent Water; Total DW is the sum of Stormwater & Local Runoff (SW), Imported Water from the State Water Project (MWD), and groundwater underflow.

RW = Recycled Water

RWC = 120-month running total of recycled water / 120-month running total of all diluent and recycled water.

RWC maximum = 0.5 mg/L / the Running Average of Total Organic Carbon (TOC) determined from a recharge site's start-up period


RWC Management Plan - RP3 Basin
Months SInce Initial Recycled Water Delivery
-51 -39 -27 -15 -3 9 21 33 45 57 69 81 93 105 117 129
Delivered Water Volume (AF/month)
1000 900 800 700 600 500 400 300 200 100 0
RWC
25% 20% 15% 10% 5% 0%
Historical Diluent Water Recharge
Historical Recycled Water Recharge
Forecast Stormwater Diluent Recharge
Planned Recycled Water Recharge
Groundwater Underflow
RWC Actual
RWC Projected
RP3 Basin RWC Max has not yet been determined, but is held below 20% for future planned deliveries while data are evaluated
Feb '05 Feb '06 Feb '07 Feb '08 Feb '09 Feb '10 Feb '11 Feb '12 Feb '13 Feb '14 Feb '15 Feb '16 Feb '17 Feb '18 Feb '19 Feb '20
HISTORICAL RECHARGE
PLANNED RECHARGE

RWC Management Plan for Turner Basin Cells 1 & 2

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2001/02	Jul '01	-59	0.	0.		0.						(M O D E L E D)
	Aug '01	-58	0.	0.		0.						
	Sep '01	-57	0.	0.		0.						
	Oct '01	-56	0.	0.		0.						
	Nov '01	-55	19.9	0.		19.9						
	Dec '01	-54	18.7	0.		18.7						
	Jan '02	-53	19.6	0.		19.6						
	Feb '02	-52	24.1	0.		24.1						
	Mar '02	-51	13.1	0.		13.1						
	Apr '02	-50	3.	0.		3.						
	May '02	-49	1.6	0.		1.6						
	Jun '02	-48	0.	0.		0.						
2002/03	Jul '02	-47	0.	0.		0.						
	Aug '02	-46	0.	0.		0.						
	Sep '02	-45	0.	0.		0.						
	Oct '02	-44	0.	0.		0.						
	Nov '02	-43	10.	0.		10.						
	Dec '02	-42	30.6	0.		30.6						
	Jan '03	-41	0.	0.		0.						
	Feb '03	-40	29.4	0.		29.4						
	Mar '03	-39	32.2	0.		32.2						
	Apr '03	-38	37.7	0.		37.7						
	May '03	-37	52.3	0.		52.3						
	Jun '03	-36	0.	0.		0.						
2003/04	Jul '03	-35	0.	0.		0.						H I S T O R I C A L
	Aug '03	-34	0.	0.		0.						
	Sep '03	-33	0.	0.		0.						
	Oct '03	-32	0.	0.		0.						
	Nov '03	-31	0.	0.		0.						
	Dec '03	-30	0.	0.		0.						
	Jan '04	-29	0.	0.		0.						
	Feb '04	-28	0.	0.		0.						
	Mar '04	-27	0.	0.		0.						
	Apr '04	-26	0.	0.		0.						
	May '04	-25	0.	0.		0.						
	Jun '04	-24	0.	0.		0.						
2004/05	Jul '04	-23	0.	0.		0.						
	Aug '04	-22	0.	0.		0.						
	Sep '04	-21	0.	0.		0.						
	Oct '04	-20	60.5	0.		60.5						
	Nov '04	-19	131.	0.		131.						
	Dec '04	-18	165.5	0.		165.5						
	Jan '05	-17	96.4	0.		96.4						
	Feb '05	-16	87.7	0.		87.7						
	Mar '05	-15	65.5	0.		65.5						
	Apr '05	-14	0.	0.		0.						
	May '05	-13	0.5	0.		0.5						
	Jun '05	-12	0.	0.		0.						
2005/06	Jul '05	-11	0.	0.		0.						
	Aug '05	-10	0.	0.		0.						
	Sep '05	-9	89.3	0.		89.3						
	Oct '05	-8	95.2	0.		95.2						
	Nov '05	-7	178.5	0.		178.5						
	Dec '05	-6	238.	121.		359.						
	Jan '06	-5	192.4	69.5		261.9						
	Feb '06	-4	152.	0.		152.						
	Mar '06	-3	426.5	0.		426.5						
	Apr '06	-2	389.8	0.		389.8						
	May '06	-1	97.1	0.		97.1						
	Jun '06	0	11.	0.		11.	2960	0.	0	0	0%	

RWC Management Plan for Turner Basin Cells 1 & 2

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2006/07	Jul '06	1	2.7	60.	67.3	129.9	3090	22.3	22	3112	1%	START-UP
	Aug '06	2	20.8	0.	67.3	88.1	3178	113.	135	3313	4%	
	Sep '06	3	51.	55.3	67.3	173.6	3351	114.4	250	3601	7%	
	Oct '06	4	36.6	127.9	67.3	231.7	3583	0.	250	3833	7%	
	Nov '06	5	29.	0.	67.3	96.3	3679	0.	250	3929	6%	
	Dec '06	6	30.3	0.	67.3	97.5	3777	103.2	353	4130	9%	
	Jan '07	7	27.1	0.	67.3	94.4	3871	70.6	424	4295	10%	
	Feb '07	8	11.7	0.	67.3	79.	3950	44.	468	4418	11%	
	Mar '07	9	25.7	0.	67.3	93.	4043	56.8	524	4567	11%	
	Apr '07	10	5.	0.	67.3	72.3	4115	14.	538	4654	12%	
	May '07	11	12.	0.	67.3	79.3	4195	79.	617	4812	13%	
	Jun '07	12	1.	0.	67.3	68.3	4263	3.	620	4883	13%	
2007/08	Jul '07	13	4.	0.	67.3	71.3	4334	0.	620	4955	13%	HISTORICAL
	Aug '07	14	38.	0.	67.3	105.3	4440	0.	620	5060	12%	
	Sep '07	15	4.	0.	67.3	71.3	4511	0.	620	5131	12%	
	Oct '07	16	62.	0.	67.3	129.3	4640	0.	620	5260	12%	
	Nov '07	17	96.	0.	67.3	163.3	4803	0.	620	5424	11%	
	Dec '07	18	215.	0.	67.3	282.3	5086	0.	620	5706	11%	
	Jan '08	19	311.	0.	67.3	378.3	5464	0.	620	6084	10%	
	Feb '08	20	251.	0.	67.3	318.3	5782	0.	620	6402	10%	
	Mar '08	21	17.	0.	67.3	84.3	5866	0.	620	6487	10%	
	Apr '08	22	14.	0.	67.3	81.3	5948	0.	620	6568	9%	
	May '08	23	143.	0.	67.3	210.3	6158	0.	620	6778	9%	
	Jun '08	24	11.	0.	67.3	78.3	6236	0.	620	6857	9%	
2008/09	Jul '08	25	7.	0.	67.3	74.3	6311	0.	620	6931	9%	
	Aug '08	26	3.	0.	67.3	70.3	6381	0.	620	7001	9%	
	Sep '08	27	127.	0.	67.3	194.3	6575	0.	620	7195	9%	
	Oct '08	28	80.	0.	67.3	147.3	6722	28.	648	7371	9%	
	Nov '08	29	81.	0.	67.3	148.3	6871	30.	678	7549	9%	
	Dec '08	30	344.	0.	67.3	411.3	7282	0.	678	7960	9%	
	Jan '09	31	29.	0.	67.3	96.3	7378	0.	678	8057	8%	
	Feb '09	32	345.	0.	67.3	412.3	7791	0.	678	8469	8%	
	Mar '09	33	47.	0.	67.3	114.3	7905	0.	678	8583	8%	
	Apr '09	34	11.	0.	67.3	78.3	7983	0.	678	8661	8%	
	May '09	35	18.	0.	67.3	85.3	8068	30.	708	8777	8%	
	Jun '09	36	77.	0.	67.3	144.3	8213	9.	717	8930	8%	
2009/10	Jul '09	37	32.	0.	67.3	99.3	8312	0.	717	9029	8%	
	Aug '09	38	19.	0.	67.3	86.3	8398	20.	737	9135	8%	
	Sep '09	39	28.	0.	67.3	95.3	8493	18.	755	9249	8%	
	Oct '09	40	80.	0.	67.3	147.3	8641	0.	755	9396	8%	
	Nov '09	41	49.	0.	67.3	116.3	8757	0.	755	9512	8%	
	Dec '09	42	0.	0.	67.3	67.3	8824	0.	755	9580	8%	
	Jan '10	43	294.	0.	67.3	361.3	9186	0.	755	9941	8%	
	Feb '10	44	330.	0.	67.3	397.3	9583	0.	755	10338	7%	
	Mar '10	45	78.		67.3	145.3	9728	0.	755	10483	7%	PLANNED
	Apr '10	46	58.		67.3	125.3	9853	0.	755	10609	7%	
	May '10	47	41.		67.3	108.3	9962	40.	795	10757	7%	
	Jun '10	48	13.		67.3	80.3	10042	80.	875	10917	8%	
2010/11	Jul '10	49	5.		67.3	72.3	10114	80.	955	11069	9%	
	Aug '10	50	9.		67.3	76.3	10190	80.	1035	11226	9%	
	Sep '10	51	33.		67.3	100.3	10291	80.	1115	11406	10%	
	Oct '10	52	46.		67.3	113.3	10404	40.	1155	11559	10%	
	Nov '10	53	66.		67.3	133.3	10537	0.	1155	11693	10%	
	Dec '10	54	116.		67.3	183.3	10721	0.	1155	11876	10%	
	Jan '11	55	108.		67.3	175.3	10896	0.	1155	12051	10%	
	Feb '11	56	137.		67.3	204.3	11100	0.	1155	12255	9%	
	Mar '11	57	78.		67.3	145.3	11245	0.	1155	12401	9%	
	Apr '11	58	58.		67.3	125.3	11371	0.	1155	12526	9%	
	May '11	59	41.		67.3	108.3	11479	40.	1195	12674	9%	
	Jun '11	60	13.		67.3	80.3	11559	80.	1275	12835	10%	

RWC Management Plan for Turner Basin Cells 1 & 2

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2011/12	Jul '11	61	5.		67.3	72.3	11632	100.	1375	13007	11%	PLANNED
	Aug '11	62	9.		67.3	76.3	11708	80.	1455	13163	11%	
	Sep '11	63	33.		67.3	100.3	11808	90.	1545	13353	12%	
	Oct '11	64	46.		67.3	113.3	11921	80.	1625	13547	12%	
	Nov '11	65	66.		67.3	133.3	12035	0.	1625	13660	12%	
	Dec '11	66	116.		67.3	183.3	12199	0.	1625	13825	12%	
	Jan '12	67	108.		67.3	175.3	12355	0.	1625	13980	12%	
	Feb '12	68	137.		67.3	204.3	12535	0.	1625	14160	11%	
	Mar '12	69	78.		67.3	145.3	12667	0.	1625	14293	11%	
	Apr '12	70	58.		67.3	125.3	12790	0.	1625	14415	11%	
	May '12	71	41.		67.3	108.3	12896	40.	1665	14562	11%	
	Jun '12	72	13.		67.3	80.3	12977	80.	1745	14722	12%	
2012/13	Jul '12	73	5.		67.3	72.3	13049	100.	1845	14894	12%	
	Aug '12	74	9.		67.3	76.3	13125	80.	1925	15050	13%	
	Sep '12	75	33.		67.3	100.3	13225	90.	2015	15241	13%	
	Oct '12	76	46.		67.3	113.3	13339	80.	2095	15434	14%	
	Nov '12	77	66.		67.3	133.3	13462	0.	2095	15557	13%	
	Dec '12	78	116.		67.3	183.3	13615	0.	2095	15710	13%	
	Jan '13	79	108.		67.3	175.3	13790	0.	2095	15885	13%	
	Feb '13	80	137.		67.3	204.3	13965	0.	2095	16060	13%	
	Mar '13	81	78.		67.3	145.3	14078	0.	2095	16173	13%	
	Apr '13	82	58.		67.3	125.3	14165	0.	2095	16261	13%	
	May '13	83	41.		67.3	108.3	14221	40.	2135	16357	13%	
	Jun '13	84	13.		67.3	80.3	14302	80.	2215	16517	13%	
2013/14	Jul '13	85	5.		67.3	72.3	14374	100.	2315	16689	14%	
	Aug '13	86	9.		67.3	76.3	14450	80.	2395	16845	14%	
	Sep '13	87	33.		67.3	100.3	14550	90.	2485	17036	15%	
	Oct '13	88	46.		67.3	113.3	14664	80.	2565	17229	15%	
	Nov '13	89	66.		67.3	133.3	14797	0.	2565	17362	15%	
	Dec '13	90	116.		67.3	183.3	14980	0.	2565	17546	15%	
	Jan '14	91	108.		67.3	175.3	15156	0.	2565	17721	14%	
	Feb '14	92	137.		67.3	204.3	15360	0.	2565	17925	14%	
	Mar '14	93	78.		67.3	145.3	15505	0.	2565	18070	14%	
	Apr '14	94	58.		67.3	125.3	15630	0.	2565	18196	14%	
	May '14	95	41.		67.3	108.3	15739	40.	2605	18344	14%	
	Jun '14	96	13.		67.3	80.3	15819	80.	2685	18504	15%	
2014/15	Jul '14	97	5.		67.3	72.3	15891	100.	2785	18677	15%	
	Aug '14	98	9.		67.3	76.3	15968	80.	2865	18833	15%	
	Sep '14	99	33.		67.3	100.3	16068	90.	2955	19023	16%	
	Oct '14	100	46.		67.3	113.3	16121	80.	3035	19156	16%	
	Nov '14	101	66.		67.3	133.3	16123	0.	3035	19158	16%	
	Dec '14	102	116.		67.3	183.3	16141	0.	3035	19176	16%	
	Jan '15	103	108.		67.3	175.3	16220	0.	3035	19255	16%	
	Feb '15	104	137.		67.3	204.3	16336	0.	3035	19371	16%	
	Mar '15	105	78.		67.3	145.3	16416	0.	3035	19451	16%	
	Apr '15	106	58.		67.3	125.3	16541	0.	3035	19576	16%	
	May '15	107	41.		67.3	108.3	16649	40.	3075	19724	16%	
	Jun '15	108	13.		67.3	80.3	16729	80.	3155	19884	16%	
2015/16	Jul '15	109	5.		67.3	72.3	16801	100.	3255	20057	16%	
	Aug '15	110	9.		67.3	76.3	16878	80.	3335	20213	17%	
	Sep '15	111	33.		67.3	100.3	16889	90.	3425	20314	17%	
	Oct '15	112	46.		67.3	113.3	16907	80.	3505	20412	17%	
	Nov '15	113	66.		67.3	133.3	16862	0.	3505	20367	17%	
	Dec '15	114	116.		67.3	183.3	16686	0.	3505	20191	17%	
	Jan '16	115	108.		67.3	175.3	16599	0.	3505	20104	17%	
	Feb '16	116	137.		67.3	204.3	16651	0.	3505	20157	17%	
	Mar '16	117	78.		67.3	145.3	16370	0.	3505	19876	18%	
	Apr '16	118	58.		67.3	125.3	16106	0.	3505	19611	18%	
	May '16	119	41.		67.3	108.3	16117	40.	3545	19662	18%	
	Jun '16	120	13.		67.3	80.3	16186	80.	3625	19811	18%	

RWC Management Plan for Turner Basin Cells 1 & 2

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2016/17	Jul '16	121	5.		67.3	72.3	16128	100.	3703	19831	19%	PLANNED
	Aug '16	122	9.		67.3	76.3	16117	80.	3670	19787	19%	
	Sep '16	123	33.		67.3	100.3	16043	90.	3646	19689	19%	
	Oct '16	124	46.		67.3	113.3	15925	80.	3726	19650	19%	
	Nov '16	125	66.		67.3	133.3	15962	0.	3726	19687	19%	
	Dec '16	126	116.		67.3	183.3	16048	0.	3622	19670	18%	
	Jan '17	127	108.		67.3	175.3	16129	0.	3552	19680	18%	
	Feb '17	128	137.		67.3	204.3	16254	0.	3508	19762	18%	
	Mar '17	129	78.		67.3	145.3	16306	0.	3451	19757	17%	
	Apr '17	130	58.		67.3	125.3	16359	0.	3437	19796	17%	
	May '17	131	41.		67.3	108.3	16388	40.	3398	19786	17%	
	Jun '17	132	13.		67.3	80.3	16400	80.	3475	19875	17%	
2017/18	Jul '17	133	5.		67.3	72.3	16401	100.	3575	19976	18%	
	Aug '17	134	9.		67.3	76.3	16372	80.	3655	20027	18%	
	Sep '17	135	33.		67.3	100.3	16401	90.	3745	20146	19%	
	Oct '17	136	46.		67.3	113.3	16385	80.	3825	20210	19%	
	Nov '17	137	66.		67.3	133.3	16355	0.	3825	20180	19%	
	Dec '17	138	116.		67.3	183.3	16256	0.	3825	20081	19%	
	Jan '18	139	108.		67.3	175.3	16053	0.	3825	19878	19%	
	Feb '18	140	137.		67.3	204.3	15939	0.	3825	19764	19%	
	Mar '18	141	78.		67.3	145.3	16000	0.	3825	19825	19%	
	Apr '18	142	58.		67.3	125.3	16044	0.	3825	19869	19%	
	May '18	143	41.		67.3	108.3	15942	40.	3865	19807	20%	
	Jun '18	144	13.		67.3	80.3	15944	80.	3945	19889	20%	
2018/19	Jul '18	145	5.		67.3	72.3	15942	100.	4045	19987	20%	
	Aug '18	146	9.		67.3	76.3	15948	80.	4125	20073	21%	
	Sep '18	147	33.		67.3	100.3	15854	90.	4215	20069	21%	
	Oct '18	148	46.		67.3	113.3	15820	80.	4267	20087	21%	
	Nov '18	149	66.		67.3	133.3	15805	0.	4237	20042	21%	
	Dec '18	150	116.		67.3	183.3	15577	0.	4237	19814	21%	
	Jan '19	151	108.		67.3	175.3	15656	0.	4237	19893	21%	
	Feb '19	152	137.		67.3	204.3	15448	0.	4237	19685	22%	
	Mar '19	153	78.		67.3	145.3	15479	0.	4237	19716	21%	
	Apr '19	154	58.		67.3	125.3	15526	0.	4237	19763	21%	
	May '19	155	41.		67.3	108.3	15549	40.	4247	19796	21%	
	Jun '19	156	13.		67.3	80.3	15485	80.	4318	19803	22%	
2019/20	Jul '19	157	5.		67.3	72.3	15458	100.	4418	19876	22%	
	Aug '19	158	9.		67.3	76.3	15448	80.	4478	19926	22%	
	Sep '19	159	33.		67.3	100.3	15453	90.	4550	20003	23%	
	Oct '19	160	46.		67.3	113.3	15419	80.	4630	20049	23%	
	Nov '19	161	66.		67.3	133.3	15436	0.	4630	20066	23%	
	Dec '19	162	116.		67.3	183.3	15552	0.	4630	20182	23%	
	Jan '20	163	108.		67.3	175.3	15366	0.	4630	19996	23%	
	Feb '20	164	137.		67.3	204.3	15173	0.	4630	19803	23%	
	Mar '20	165	78.		67.3	145.3	15173	0.	4630	19803	23%	
	Apr '20	166	58.		67.3	125.3	15173	0.	4630	19803	23%	
	May '20	167	41.		67.3	108.3	15173	40.	4630	19803	23%	
	Jun '20	168	13.		67.3	80.3	15173	80.	4630	19803	23%	

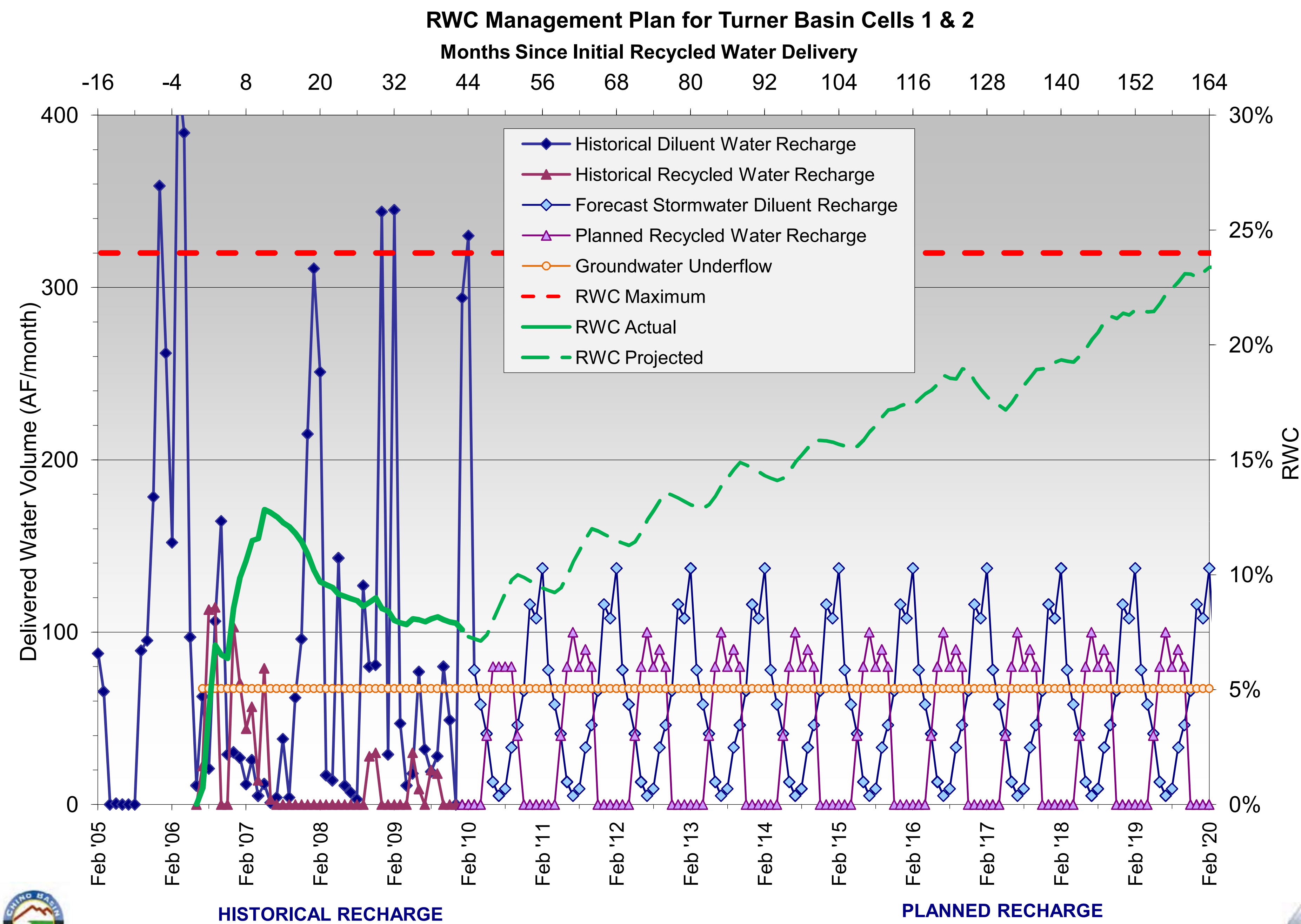
Notes:

DW = Diluent Water; Total DW is the sum of Stormwater & Local Runoff (SW), Imported Water from the State Water Project (MWD), and groundwater underflow.

RW = Recycled Water

RWC = 120-month running total of recycled water / 120-month running total of all diluent and recycled water.

RWC maximum = 0.5 mg/L / the Running Average of Total Organic Carbon (TOC) determined from a recharge site's start-up period



RWC Management Plan for Turner Basin Cells 1 & 2
Months Since Initial Recycled Water Delivery
-16
-4
8
20
32
44
56
68
80
92
104
116
128
140
152
164
400
300
200
100
0
Delivered Water Volume (AF/month)
30%
25%
20%
15%
10%
5%
0%
RWC
Historical Diluent Water Recharge
Historical Recycled Water Recharge
Forecast Stormwater Diluent Recharge
Planned Recycled Water Recharge
Groundwater Underflow
RWC Maximum
RWC Actual
RWC Projected
Feb '05
Feb '06
Feb '07
Feb '08
Feb '09
Feb '10
Feb '11
Feb '12
Feb '13
Feb '14
Feb '15
Feb '16
Feb '17
Feb '18
Feb '19
Feb '20
HISTORICAL RECHARGE
PLANNED RECHARGE

RWC Management Plan for Turner Basin Cells 3 & 4

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2001/02	Jul '01	-59	0.	0.		0.						
	Aug '01	-58	0.	0.		0.						
	Sep '01	-57	0.	0.		0.						
	Oct '01	-56	0.	0.		0.						
	Nov '01	-55	0.	0.		0.						
	Dec '01	-54	0.	0.		0.						
	Jan '02	-53	0.	0.		0.						
	Feb '02	-52	0.	0.		0.						
	Mar '02	-51	0.	0.		0.						
	Apr '02	-50	0.	0.		0.						
	May '02	-49	0.	0.		0.						
	Jun '02	-48	0.	0.		0.						
2002/03	Jul '02	-47	0.	0.		0.						
	Aug '02	-46	0.	0.		0.						
	Sep '02	-45	0.	0.		0.						
	Oct '02	-44	0.	0.		0.						
	Nov '02	-43	0.	0.		0.						
	Dec '02	-42	0.	0.		0.						
	Jan '03	-41	0.	0.		0.						
	Feb '03	-40	0.	0.		0.						
	Mar '03	-39	0.	0.		0.						
	Apr '03	-38	0.	0.		0.						
	May '03	-37	0.	0.		0.						
	Jun '03	-36	0.	0.		0.						
2003/04	Jul '03	-35	0.	0.		0.						
	Aug '03	-34	0.	0.		0.						
	Sep '03	-33	0.	0.		0.						
	Oct '03	-32	0.	0.		0.						
	Nov '03	-31	0.	0.		0.						
	Dec '03	-30	0.	0.		0.						
	Jan '04	-29	0.	0.		0.						
	Feb '04	-28	0.	0.		0.						
	Mar '04	-27	0.	0.		0.						
	Apr '04	-26	0.	0.		0.						
	May '04	-25	0.	0.		0.						
	Jun '04	-24	0.	0.		0.						
2004/05	Jul '04	-23	0.	0.		0.						
	Aug '04	-22	0.	0.		0.						
	Sep '04	-21	0.	0.		0.						
	Oct '04	-20	120.8	0.		120.8						HISTORICAL
	Nov '04	-19	128.2	0.		128.2						
	Dec '04	-18	217.9	0.		217.9						
	Jan '05	-17	257.4	0.		257.4						
	Feb '05	-16	232.	0.		232.						
	Mar '05	-15	174.4	0.		174.4						
	Apr '05	-14	0.	0.		0.						
	May '05	-13	0.5	0.		0.5						
	Jun '05	-12	0.	0.		0.						
2005/06	Jul '05	-11	0.	0.		0.						
	Aug '05	-10	0.	0.		0.						
	Sep '05	-9	0.	0.		0.						
	Oct '05	-8	0.	0.		0.						
	Nov '05	-7	0.	0.		0.						
	Dec '05	-6	33.8	90.2		124.						
	Jan '06	-5	35.9	39.1		74.9						
	Feb '06	-4	71.	0.		71.						
	Mar '06	-3	171.3	0.		171.3						
	Apr '06	-2	260.4	0.		260.4						
	May '06	-1	72.1	0.		72.1						
	Jun '06	0	61.	26.		87.	1992	0.	0	0	0%	

RWC Management Plan for Turner Basin Cells 3 & 4

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2006/07	Jul '06	1	30.3	0.	59.7	90.1	2082	138.1	138	2220	6%	START-UP
	Aug '06	2	33.4	0.	59.7	93.2	2175	235.	373	2548	15%	
	Sep '06	3	9.	13.4	59.7	82.1	2257	39.8	413	2670	15%	
	Oct '06	4	10.1	54.8	59.7	124.6	2382	0.	413	2795	15%	
	Nov '06	5	16.	0.	59.7	75.7	2458	0.	413	2870	14%	
	Dec '06	6	13.6	0.	59.7	73.3	2531	65.8	479	3010	16%	
	Jan '07	7	10.	0.	59.7	69.7	2601	31.	510	3110	16%	
	Feb '07	8	9.	0.	59.7	68.7	2669	21.	531	3200	17%	
	Mar '07	9	4.	0.	59.7	63.7	2733	16.	547	3280	17%	
	Apr '07	10	3.	0.	59.7	62.7	2796	8.	555	3351	17%	
	May '07	11	7.9	0.	59.7	67.6	2863	56.9	612	3475	18%	
	Jun '07	12	10.	0.	59.7	69.7	2933	0.	612	3545	17%	
2007/08	Jul '07	13	1.	0.	59.7	60.7	2994	0.	612	3606	17%	HISTORICAL
	Aug '07	14	10.	0.	59.7	69.7	3064	0.	612	3675	17%	
	Sep '07	15	12.	0.	59.7	71.7	3135	0.	612	3747	16%	
	Oct '07	16	3.	0.	59.7	62.7	3198	0.	612	3810	16%	
	Nov '07	17	66.	0.	59.7	125.7	3324	0.	612	3936	16%	
	Dec '07	18	62.	0.	59.7	121.7	3446	0.	612	4057	15%	
	Jan '08	19	143.	0.	59.7	202.7	3648	0.	612	4260	14%	
	Feb '08	20	9.	0.	59.7	68.7	3717	0.	612	4329	14%	
	Mar '08	21	0.	0.	59.7	59.7	3777	0.	612	4389	14%	
	Apr '08	22	4.	0.	59.7	63.7	3841	0.	612	4452	14%	
	May '08	23	38.	0.	59.7	97.7	3938	0.	612	4550	13%	
	Jun '08	24	28.	0.	59.7	87.7	4026	0.	612	4638	13%	
2008/09	Jul '08	25	4.	0.	59.7	63.7	4090	0.	612	4702	13%	
	Aug '08	26	5.	0.	59.7	64.7	4155	0.	612	4766	13%	
	Sep '08	27	14.	0.	59.7	73.7	4228	0.	612	4840	13%	
	Oct '08	28	37.	0.	59.7	96.7	4325	66.	678	5003	14%	
	Nov '08	29	36.	0.	59.7	95.7	4421	8.	686	5107	13%	
	Dec '08	30	50.	0.	59.7	109.7	4531	0.	686	5216	13%	
	Jan '09	31	10.	0.	59.7	69.7	4600	0.	686	5286	13%	
	Feb '09	32	68.	0.	59.7	127.7	4728	0.	686	5414	13%	
	Mar '09	33	10.	0.	59.7	69.7	4798	0.	686	5484	13%	
	Apr '09	34	2.	0.	59.7	61.7	4860	0.	686	5545	12%	
	May '09	35	1.	0.	59.7	60.7	4920	0.	686	5606	12%	
	Jun '09	36	8.	0.	59.7	67.7	4988	0.	686	5674	12%	
2009/10	Jul '09	37	32.	0.	59.7	91.7	5080	0.	686	5766	12%	
	Aug '09	38	19.	0.	59.7	78.7	5159	0.	686	5844	12%	
	Sep '09	39	28.	0.	59.7	87.7	5246	0.	686	5932	12%	
	Oct '09	40	80.	0.	59.7	139.7	5386	0.	686	6072	11%	
	Nov '09	41	49.	0.	59.7	108.7	5495	0.	686	6181	11%	
	Dec '09	42	401.	0.	59.7	460.7	5956	63.	749	6704	11%	
	Jan '10	43	294.	0.	59.7	353.7	6309	127.	876	7185	12%	
	Feb '10	44	330.	0.	59.7	389.7	6699	0.	876	7575	12%	
	Mar '10	45	87.		59.7	146.7	6846	40.	916	7762	12%	PLANNED
	Apr '10	46	67.		59.7	126.7	6973	60.	976	7948	12%	
	May '10	47	30.		59.7	89.7	7062	80.	1056	8118	13%	
	Jun '10	48	25.		59.7	84.7	7147	100.	1156	8303	14%	
2010/11	Jul '10	49	8.		59.7	67.7	7215	100.	1256	8471	15%	
	Aug '10	50	11.		59.7	70.7	7286	100.	1356	8641	16%	
	Sep '10	51	5.		59.7	64.7	7350	80.	1436	8786	16%	
	Oct '10	52	33.		59.7	92.7	7443	60.	1496	8939	17%	
	Nov '10	53	53.		59.7	112.7	7556	40.	1536	9091	17%	
	Dec '10	54	82.		59.7	141.7	7698	20.	1556	9253	17%	
	Jan '11	55	112.		59.7	171.7	7869	0.	1556	9425	17%	
	Feb '11	56	80.		59.7	139.7	8009	0.	1556	9565	16%	
	Mar '11	57	87.		59.7	146.7	8156	40.	1596	9751	16%	
	Apr '11	58	67.		59.7	126.7	8283	60.	1656	9938	17%	
	May '11	59	30.		59.7	89.7	8372	80.	1736	10108	17%	
	Jun '11	60	25.		59.7	84.7	8457	100.	1836	10293	18%	

RWC Management Plan for Turner Basin Cells 3 & 4

(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2011/12	Jul '11	61	8.		59.7	67.7	8525	100.	1936	10460	19%	PLANNED
	Aug '11	62	11.		59.7	70.7	8596	100.	2036	10631	19%	
	Sep '11	63	5.		59.7	64.7	8660	80.	2116	10776	20%	
	Oct '11	64	33.		59.7	92.7	8753	60.	2176	10929	20%	
	Nov '11	65	53.		59.7	112.7	8866	40.	2216	11081	20%	
	Dec '11	66	82.		59.7	141.7	9008	20.	2236	11243	20%	
	Jan '12	67	112.		59.7	171.7	9179	0.	2236	11415	20%	
	Feb '12	68	80.		59.7	139.7	9319	0.	2236	11555	19%	
	Mar '12	69	87.		59.7	146.7	9466	40.	2276	11741	19%	
	Apr '12	70	67.		59.7	126.7	9593	60.	2336	11928	20%	
	May '12	71	30.		59.7	89.7	9682	80.	2416	12098	20%	
	Jun '12	72	25.		59.7	84.7	9767	100.	2516	12283	20%	
2012/13	Jul '12	73	8.		59.7	67.7	9835	100.	2616	12450	21%	
	Aug '12	74	11.		59.7	70.7	9906	100.	2716	12621	22%	
	Sep '12	75	5.		59.7	64.7	9970	80.	2796	12766	22%	
	Oct '12	76	33.		59.7	92.7	10063	60.	2856	12919	22%	
	Nov '12	77	53.		59.7	112.7	10176	40.	2896	13071	22%	
	Dec '12	78	82.		59.7	141.7	10318	20.	2916	13233	22%	
	Jan '13	79	112.		59.7	171.7	10489	0.	2916	13405	22%	
	Feb '13	80	80.		59.7	139.7	10629	0.	2916	13545	22%	
	Mar '13	81	87.		59.7	146.7	10776	40.	2956	13731	22%	
	Apr '13	82	67.		59.7	126.7	10903	60.	3016	13918	22%	
	May '13	83	30.		59.7	89.7	10992	80.	3096	14088	22%	
	Jun '13	84	25.		59.7	84.7	11077	100.	3196	14273	22%	
2013/14	Jul '13	85	8.		59.7	67.7	11145	100.	3296	14440	23%	
	Aug '13	86	11.		59.7	70.7	11216	100.	3396	14611	23%	
	Sep '13	87	5.		59.7	64.7	11280	80.	3476	14756	24%	
	Oct '13	88	33.		59.7	92.7	11373	60.	3536	14909	24%	
	Nov '13	89	53.		59.7	112.7	11486	40.	3576	15061	24%	
	Dec '13	90	82.		59.7	141.7	11628	20.	3596	15223	24%	
	Jan '14	91	112.		59.7	171.7	11799	0.	3596	15395	23%	
	Feb '14	92	80.		59.7	139.7	11939	0.	3596	15535	23%	
	Mar '14	93	87.		59.7	146.7	12086	40.	3636	15721	23%	
	Apr '14	94	67.		59.7	126.7	12213	60.	3696	15908	23%	
	May '14	95	30.		59.7	89.7	12302	80.	3776	16078	23%	
	Jun '14	96	25.		59.7	84.7	12387	100.	3876	16263	24%	
2014/15	Jul '14	97	8.		59.7	67.7	12455	100.	3976	16430	24%	
	Aug '14	98	11.		59.7	70.7	12526	100.	4076	16601	25%	
	Sep '14	99	5.		59.7	64.7	12590	80.	4156	16746	25%	
	Oct '14	100	33.		59.7	92.7	12562	60.	4216	16778	25%	
	Nov '14	101	53.		59.7	112.7	12547	40.	4256	16802	25%	
	Dec '14	102	82.		59.7	141.7	12471	20.	4276	16746	26%	
	Jan '15	103	112.		59.7	171.7	12385	0.	4276	16661	26%	
	Feb '15	104	80.		59.7	139.7	12293	0.	4276	16568	26%	
	Mar '15	105	87.		59.7	146.7	12265	40.	4316	16581	26%	
	Apr '15	106	67.		59.7	126.7	12392	60.	4376	16768	26%	
	May '15	107	30.		59.7	89.7	12481	80.	4456	16937	26%	
	Jun '15	108	25.		59.7	84.7	12566	100.	4556	17122	27%	
2015/16	Jul '15	109	8.		59.7	67.7	12634	100.	4656	17289	27%	
	Aug '15	110	11.		59.7	70.7	12704	100.	4756	17460	27%	
	Sep '15	111	5.		59.7	64.7	12769	80.	4836	17605	27%	
	Oct '15	112	33.		59.7	92.7	12862	60.	4896	17758	28%	
	Nov '15	113	53.		59.7	112.7	12975	40.	4936	17910	28%	
	Dec '15	114	82.		59.7	141.7	12992	20.	4956	17948	28%	
	Jan '16	115	112.		59.7	171.7	13089	0.	4956	18045	27%	
	Feb '16	116	80.		59.7	139.7	13158	0.	4956	18114	27%	
	Mar '16	117	87.		59.7	146.7	13133	40.	4996	18129	28%	
	Apr '16	118	67.		59.7	126.7	13000	60.	5056	18055	28%	
	May '16	119	30.		59.7	89.7	13017	80.	5136	18153	28%	
	Jun '16	120	25.		59.7	84.7	13015	100.	5236	18251	29%	

RWC Management Plan for Turner Basin Cells 3 & 4

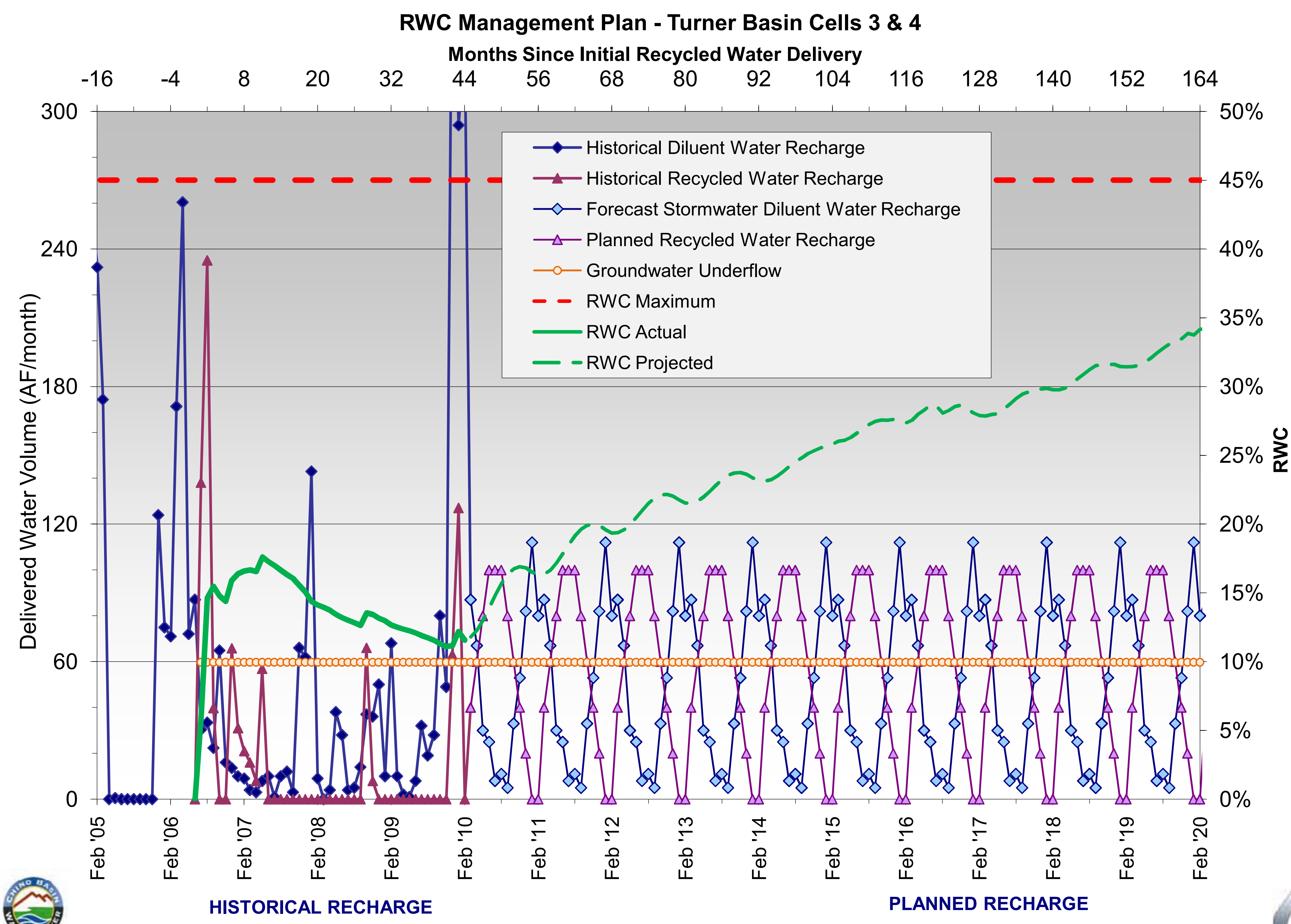
(120-month averaging period)

Calculation of Recycled Water Contribution (RWC) from Historical Diluent Water (DW) and Recycled Water (RW) Deliveries

Date		No. Mos. Since Initial RW Delivery	SW (AF)	MWD (AF)	Underflow (AF)	DW Total (AF)	DW 120-Month Total (AF)	RW (AF)	RW 120-Month Total (AF)	DW + RW 120-Month Total (AF)	RWC	Source
2016/17	Jul '16	121	8.		59.7	67.7	12993	100.	5198	18190	29%	PLANNED
	Aug '16	122	11.		59.7	70.7	12970	100.	5063	18033	28%	
	Sep '16	123	5.		59.7	64.7	12953	80.	5103	18056	28%	
	Oct '16	124	33.		59.7	92.7	12921	60.	5163	18084	29%	
	Nov '16	125	53.		59.7	112.7	12958	40.	5203	18161	29%	
	Dec '16	126	82.		59.7	141.7	13027	20.	5157	18184	28%	
	Jan '17	127	112.		59.7	171.7	13129	0.	5126	18255	28%	
	Feb '17	128	80.		59.7	139.7	13200	0.	5105	18305	28%	
	Mar '17	129	87.		59.7	146.7	13283	40.	5129	18412	28%	
	Apr '17	130	67.		59.7	126.7	13347	60.	5181	18528	28%	
	May '17	131	30.		59.7	89.7	13369	80.	5204	18573	28%	
	Jun '17	132	25.		59.7	84.7	13384	100.	5304	18688	28%	
2017/18	Jul '17	133	8.		59.7	67.7	13391	100.	5404	18795	29%	
	Aug '17	134	11.		59.7	70.7	13392	100.	5504	18896	29%	
	Sep '17	135	5.		59.7	64.7	13385	80.	5584	18969	29%	
	Oct '17	136	33.		59.7	92.7	13415	60.	5644	19059	30%	
	Nov '17	137	53.		59.7	112.7	13402	40.	5684	19086	30%	
	Dec '17	138	82.		59.7	141.7	13422	20.	5704	19126	30%	
	Jan '18	139	112.		59.7	171.7	13391	0.	5704	19095	30%	
	Feb '18	140	80.		59.7	139.7	13462	0.	5704	19166	30%	
	Mar '18	141	87.		59.7	146.7	13549	40.	5744	19293	30%	
	Apr '18	142	67.		59.7	126.7	13612	60.	5804	19416	30%	
	May '18	143	30.		59.7	89.7	13604	80.	5884	19488	30%	
	Jun '18	144	25.		59.7	84.7	13601	100.	5984	19585	31%	
2018/19	Jul '18	145	8.		59.7	67.7	13605	100.	6084	19689	31%	
	Aug '18	146	11.		59.7	70.7	13611	100.	6184	19795	31%	
	Sep '18	147	5.		59.7	64.7	13602	80.	6264	19866	32%	
	Oct '18	148	33.		59.7	92.7	13598	60.	6258	19856	32%	
	Nov '18	149	53.		59.7	112.7	13615	40.	6290	19905	32%	
	Dec '18	150	82.		59.7	141.7	13647	20.	6310	19957	32%	
	Jan '19	151	112.		59.7	171.7	13749	0.	6310	20059	31%	
	Feb '19	152	80.		59.7	139.7	13761	0.	6310	20071	31%	
	Mar '19	153	87.		59.7	146.7	13838	40.	6350	20188	31%	
	Apr '19	154	67.		59.7	126.7	13903	60.	6410	20313	32%	
	May '19	155	30.		59.7	89.7	13932	80.	6490	20422	32%	
	Jun '19	156	25.		59.7	84.7	13949	100.	6590	20539	32%	
2019/2020	Jul '19	157	8.		59.7	67.7	13925	100.	6690	20615	32%	
	Aug '19	158	11.		59.7	70.7	13917	100.	6790	20707	33%	
	Sep '19	159	5.		59.7	64.7	13894	80.	6870	20764	33%	
	Oct '19	160	33.		59.7	92.7	13847	60.	6930	20777	33%	
	Nov '19	161	53.		59.7	112.7	13851	40.	6970	20821	33%	
	Dec '19	162	82.		59.7	141.7	13532	20.	6927	20459	34%	
	Jan '20	163	112.		59.7	171.7	13350	0.	6800	20150	34%	
	Feb '20	164	80.		59.7	139.7	13100	0.	6800	19900	34%	
	Mar '20	165	87.		59.7	146.7	13100	40.	6800	19900	34%	
	Apr '20	166	67.		59.7	126.7	13100	60.	6800	19900	34%	
	May '20	167	30.		59.7	89.7	13100	80.	6800	19900	34%	
	Jun '20	168	25.		59.7	84.7	13100	100.	6800	19900	34%	

Notes:

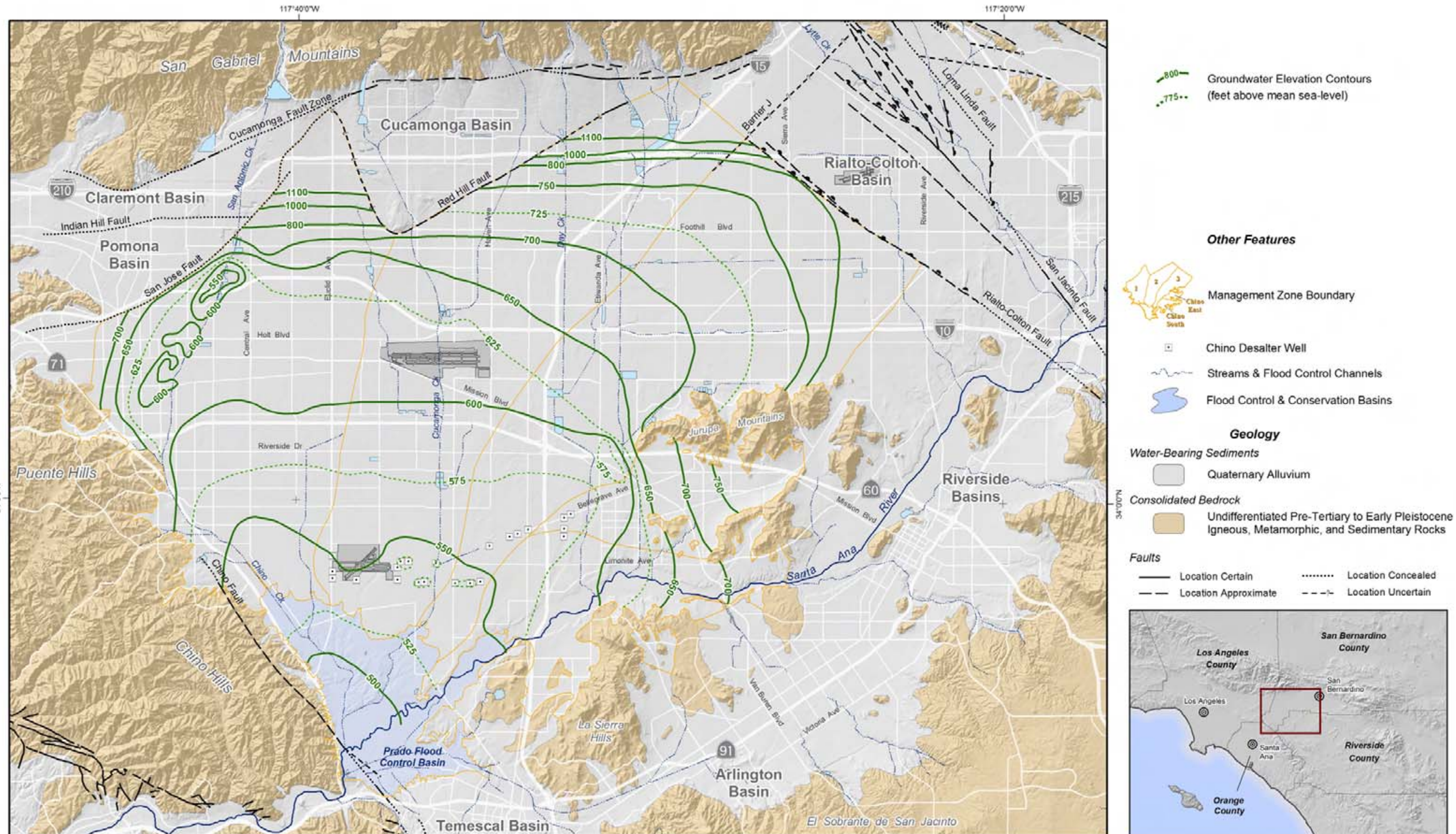
DW = Diluent Water; Total DW is the sum of Stormwater & Local Runoff (SW), Imported Water from the State Water Project (MWD), and groundwater underflow.
RW = Recycled Water
RWC = 120-month running total of recycled water / 120-month running total of all diluent and recycled water.
RWC maximum = 0.5 mg/L / the Running Average of Total Organic Carbon (TOC) determined from a recharge site's start-up period



RWC Management Plan - Turner Basin Cells 3 & 4
Months Since Initial Recycled Water Delivery
-16
-4
8
20
32
44
56
68
80
92
104
116
128
140
152
164
Delivered Water Volume (AF/month)
300
240
180
120
60
0
RWC
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
Historical Diluent Water Recharge
Historical Recycled Water Recharge
Forecast Stormwater Diluent Water Recharge
Planned Recycled Water Recharge
Groundwater Underflow
RWC Maximum
RWC Actual
RWC Projected
Feb '05
Feb '06
Feb '07
Feb '08
Feb '09
Feb '10
Feb '11
Feb '12
Feb '13
Feb '14
Feb '15
Feb '16
Feb '17
Feb '18
Feb '19
Feb '20
HISTORICAL RECHARGE
PLANNED RECHARGE

APPENDIX D

GROUNDWATER ELEVATION CONTOUR MAPS



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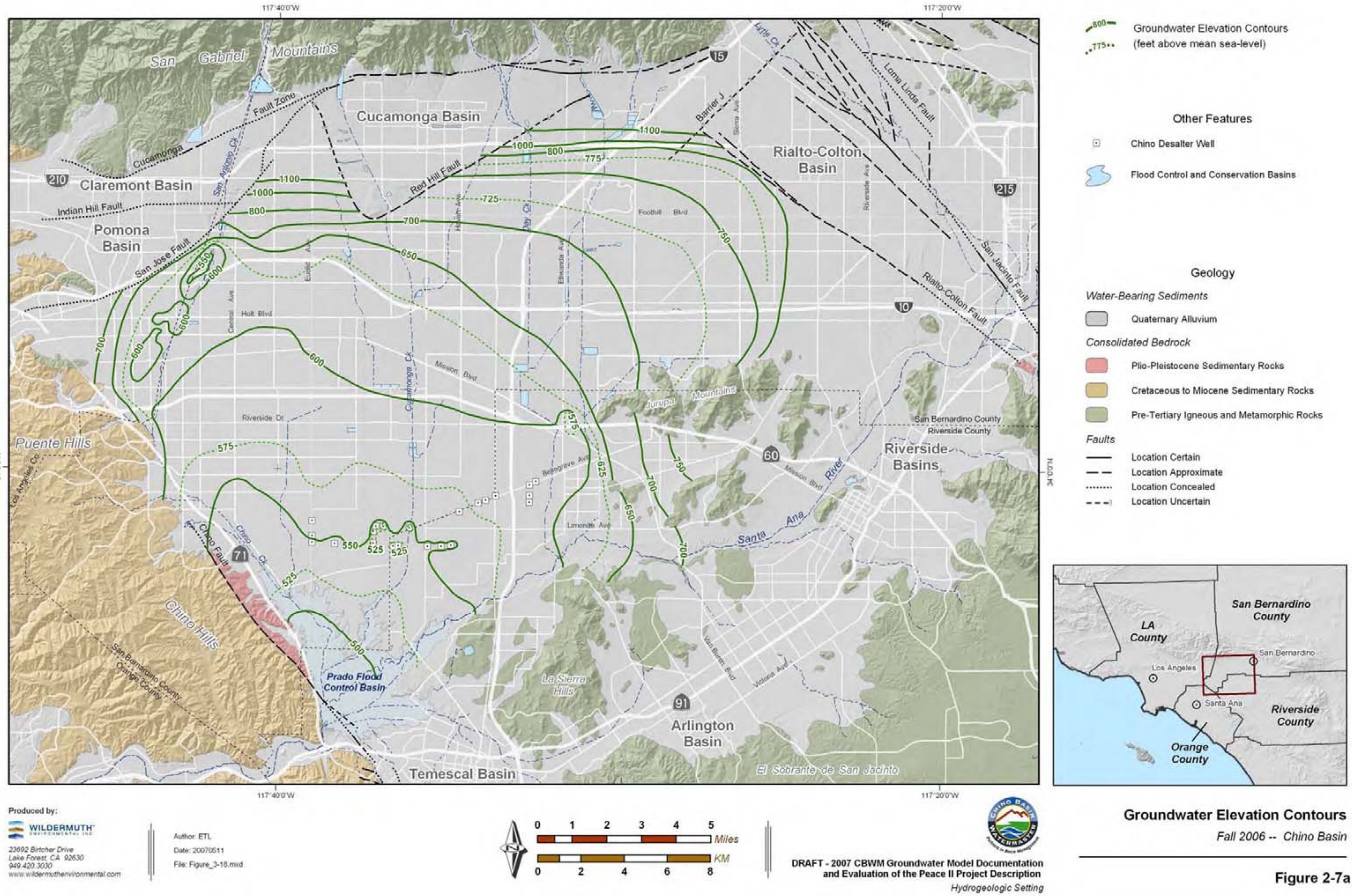
Date: 20090401
File: Figure_3-19.mxd

2008 State of the Basin Report
Groundwater Levels

Groundwater Elevation Contours
Fall 2008 -- Chino Basin

Figure 3-19



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DRAFT - 2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description

Hydrogeologic Setting

Groundwater Elevation Contours

Fall 2006 -- Chino Basin

Figure 2-7a

Main Features

800 Groundwater Elevation Contours

Attachment 3

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

IEUA GWR Monitoring Data
2005 to Present

Chemicals with State Notification Levels	Units	State NL	Method	Lab RDL	Lab	2/14/05		7/5/05		9/27/05	10/11/05	1/18/06	6/7/06 *	8/29/06*	10/6/06*	11/6/06*	2/6/07	4/12/07*	7/17/07*	9/27/07	10/10/07	1/16/08*	2/5/08	4/24/08	8/20/08*	11/25/08	12/2/08	1/6/09*	4/7/09*	5/21/09	8/25/09*	Min	Max	Avg
Frequency Required: Annual						RP1 Effluent	RP4 Effluent	RP1 Effluent	RP4 Effluent	Blend of RP1 & RP4																								
						2005						2006					2007					2008						2009						
Boron	mg/L	1	EPA 200.7	0.1	IEUA					0.3	0.3	0.3	0.2	0.3		0.3	0.3	0.3	0.3		0.2	0.3		0.4	0.4	0.4		0.2	0.2		0.3	0.2	0.4	0.3
n-Butylbenzene	µg/L	260	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	µg/L	260	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	µg/L	260	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	µg/L	160	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5						<0.5						<0.5	<0.5						<0.5		<0.5	<0.5	<0.5
Chlorate	µg/L	800	EPA 300.0	10	MWH			440	870				1150							669			198	204						432		198	1150	566
2-Chlorotoluene	µg/L	140	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chlorotoluene	µg/L	140	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	µg/L		EPA 507	0.5	MWH			<0.5	<0.5				<0.1							<0.1			<0.1							<0.1		<0.1	<0.1	<0.1
Dichlorodifluoromethane (Freon 12)	µg/L	1000	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dioxane	µg/L	3	SW 8270 mod	2	MWH			<2	<2	<2	<2	<2	<2	<2		<2	<2	<2	<2	<2		<2	<2	<2	<2	<2		<2	<2	<2	<2	<2	<2	<2
Ethylene glycol	mg/L	14																																
Formaldehyde	µg/L	100	SM 6252	5	MWH			54	141											<5			<5							32		<5	141	45
HMX	mg/L	0.35																																
Isopropylbenzene	µg/L	770	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5				<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Manganese	µg/L	500	EPA 200.8	1	IEUA					11	5	6	6	3		5	8	7	7		1	9		19	5	1		7	4		11	1	19	7
Methyl isobutyl ketone (MIBK)	µg/L	120	EPA 524.2	2*	IEUA	<2	<2			<2	<2		<5		<5	<5	<2	<5	<5			<5	<2	<2	<5		<2	<5	<5	<2	<5	<2	<5	<4
Naphthalene	µg/L	17	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
N-Nitrosodiethylamine (NDEA)	ng/L	10	EPA 521	2	MWH			<2	<2				<4							<2			<2		<2					<2		<2	<4	<3
N-Nitrosodimethylamine (NDMA)	ng/L	10	See NDMA table																															
N-Nitrosodi-n-propylamine (NDPA)	ng/L	10	EPA 521	2	MWH								<4							<2			<2		<2					<2		<2	<4	<3
Propachlor	µg/L	90	EPA 525.2	0.05	MWH								<0.05							<0.05			<0.05							<0.05		<0.05	<0.05	<0.05
n-Propylbenzene	µg/L	260	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
RDX	mg/L	0.0003																																
tert-Butyl alcohol (TBA)	µg/L	12	EPA 524.2	2	IEUA					<2	<2		<2	<2		4	<2	<2	<2			<2	<2	<2	<2		<2	<2	<2	2.4	2.3	<2	4	<2
1,2,3-Trichloropropane (1,2,3-TCP)	µg/L	0.005	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	µg/L	330	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	µg/L	330	EPA 524.2	0.5	IEUA	<0.5	<0.5			<0.5	<0.5		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5			<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-Trinitrotoluene (TNT)	mg/L	0.001																																
Vanadium	µg/L	50	EPA 200.8	1	IEUA						4	4	5	4		3	3	4	4		4	3		1	5	3		3	7		4	1	7	4

*524.2 MWH, RDLs are the same as IEUA lab with the exception of MIBK, MWH lab is 5 µg/L

Diazinon was removed from the NL list in December 2007

Compounds highlighted in yellow were added to the NL list in December 2007

MWH: Montgomery Watson Harza Laboratories, Monrovia CA

CAS: Columbia Analytical Services Inc., Kelso WA

May 21, 2010

Dr. Keith Mayura
Southern California Coastal Water Research Project
3535 Harbor Blvd., Suite 110
Costa Mesa, CA 92626

RE: Comments on Draft Monitoring Strategies for Chemicals of Emerging Concern in Recycled Water

Dear Dr. Mayura*:*

Thank you for the opportunity to review and comment on the Science Advisory Panel's draft report and recommendations. We apologize for not being able to submit our review comments on the Panel's draft report earlier and our hopeful that they can still be included for the Panel's consideration. The following comments and suggestions were prepared at the request of and on behalf of the Santa Ana Watershed Project Authority's (SAWPA) Emerging Constituents (EC) Program Task Force which met yesterday, May 18, 2010 and formally approved these comments for submittal. The Task Force is comprised of 20 water and wastewater agencies located in the Santa Ana region. A list of the Task Force members is provided at the end of this letter.

For the last two years, representatives from these agencies have been meeting monthly with staff from the Regional Water Quality Control Board (Regional Board) and the California Department of Public Health (CDPH) to develop an appropriate EC monitoring program for the watershed. Early results of this effort were previously presented to the Blue Ribbon Panel at their kick-off meeting held in April, 2009. In December of 2009, the Regional Board approved the EC Program work group's proposed study plan for 2010-11 (copy attached as Appendix A). Our recent experience preparing this work plan forms much of the basis for our comments on the Blue Ribbon Panel's draft report. Some of the Panel members were also instrumental in helping the Task Force develop our regional approach to EC monitoring.

The Science Advisory Panel's draft document is very high quality and reflects an extraordinary level of effort on behalf of the Blue Ribbon Panel and SCCWRP's staff. In particular, the Santa Ana EC Task Force was impressed with the detailed explanation of how state and federal authorities set priorities for investigating and managing new chemical pollutants. The Panel's summary of the current process should help reinforce that there is already a strong system in place to protect public health.

The Task Force endorses the Blue Ribbon Panel's approach to estimating toxicological risk based on the best available scientific information. And, that the Panel did much of the heavy lifting by doing those estimates themselves rather than simply suggesting a general procedure for others to follow. This greatly improved our understanding of the Panel's recommendations and will undoubtedly accelerate the implementation process.

Finally, the Santa Ana EC Task Force strongly supports the Panel's incremental and cautionary approach to this issue. The draft document made clear that the science of EC risk assessment is still in its infancy and, as such, it would be premature to rely on such data for regulatory compliance purposes at this time. To improve effectiveness, the system needs more information on the fate and transport of ECs and more research evaluating the toxicological relevance of the resulting data. To this end, the members of the Santa Ana EC Task Force have committed themselves to a large-scale monitoring program designed to characterize the presence and persistence of ECs in our region. It is our sincere wish that this new water quality data will help all of us continue to protect public health and the environment.

Comments

1) The Panel's report recommends against using CEC monitoring data for establishing drinking water criteria or surface water objectives (pg. 32). The Panel also warns against using CEC data for "compliance purposes" (pg. 66). However, in several places throughout the document, it appears that the Panel is suggesting precisely the opposite. For example:

   a) The Panel's reference to "problematic CECs" (pg. 6 & 65) may be misconstrued to imply water quality or beneficial use impairments. And, the phrase "chronic exceedances" (also on pg. 6) is normally used to describe violations of water quality standards in California.

   b) The Panel recommends that the application of reclaimed water be stopped and corrective actions to "repair" the plant be initiated when the MEC/MTL ratio is greater than 1000-to-1 (pg. 66). Such a recommendation is clearly regulatory and implies that the CECs pose an unacceptable human health threat at the aforementioned levels. The Panel should explain why such action is necessary to protect public health for the specific CECs proposed for monitoring (caffeine, tricolsan and 17beta-estradiol, pg. 62). In addition, the draft text leaves open the possibility that the application of recycled water must cease even if only a single data point exceeds the recommended threshold. Does the Panel truly intend such a strict standard?

   c) Section 7.3 sets forth "Requirements for Compliance Monitoring" (pg. 56). Section 7.4 is entitled "Compliance Monitoring for CECs using Commercially Available Methods" (pg. 57). And, Appendix M includes "Example Requirements for Compliance Monitoring" (pg. 171). It appears that the Panel only intended to suggest that there be some required monitoring for CECs not that the resulting data should be used to assess compliance with narrative or numeric water quality standards. But, such phrasing must be revised to avoid any future confusion regarding the regulatory purpose for the Panel's recommended CEC monitoring program.

2) By recommending that the application of reclaimed water be restricted when one or more CECs are detected above certain concentrations, the Panel has proposed de

facto water quality objectives with serious regulatory consequences. For example, the Panel refers to the ratio between the MEC and MTL as a "Screening Level" (pg. 33). In California, similar "unofficial" data screening levels have been interpreted as implied impairment thresholds in the 303(d) listing process even where the authors recommended against this practice.[1] In fact, the state guidance strongly encourages the use of such screening levels where a 304(a) criteria, water quality objective or MCL has yet to be established.[2]

Primary responsibility for establishing water quality standards to protect human health falls to California's Office of Environmental Health Hazard Assessment (OEHHA) and to U.S. EPA. Thereafter, it is up to the state's Department of Public Health and the Regional Water Quality Control Boards to enact regulations and implement permits designed to meet the recommended standards. The Panel has short-circuited the normal regulatory process by suggesting to the State Board that the application of recycled water should be restricted when CEC concentrations reach certain levels.

The Panel's conclusion appears to be inconsistent with similar analyses performed by others. For example, the USGS's Groundwater Ambient Monitoring Assessment (GAMA) program found that those drinking coffee or cola consumed approximately 100,000,000 ng (100 mg) of caffeine.[3] The Panel's report indicates that the highest measured concentration of caffeine in recycled water was only 2,700 ng/L (pg. 154). A separate analysis prepared by InterTox on behalf of the Orange County Water District reached a similar conclusion.[4] (See Appendix B for a copy of the InterTox report).

Given the Panel's estimate that the MTLs include safety factors "4 to 8 orders of magnitude" (pg.60), it is unclear why such a drastic response is recommended. This is especially true for compounds such as caffeine which are regularly consumed at concentrations many times higher than the Panel's recommended trigger threshold. Elsewhere, the Panel acknowledges that the Federal regulatory paradigm is based on imposing additional controls only where doing so would "provide a meaningful opportunity to reduce public health risk" (pg. 87). On what basis does the Panel conclude that the proposed CEC monitoring program provides a meaningful public health benefit?

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[1] Broderberg, Dr. Robert K. and Gerald A. Pollock, PhD. Prevalence of selected target chemical contaminants in sport fish from two California lakes: public health designed screening study. Final Project Report. Pesticide and Environmental Toxicology Section, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. June, 1999. Pg. 4

[2] [2] SWRCB. Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. September, 2004.

[3] Kent, Robert and Kenneth Belitz. Unites States Geological Survey (USGS). Ground-Water Quality Data in the Upper Santa Ana Watershed Study Unit, November 2006 - March 2007: Results from the California GAMA Program. Data Series 404. November, 2009.

[4] InterTox, Inc. Comparison of Analytical Results for Trace Organics in the Santa Ana River at the Imperial Highway to Health Risk-Based Screening Levels. June 25, 2009.

3) The Panel's report incorrectly states that CDPH's draft Groundwater Recharge/Reuse Regulation "requires regular monitoring of specific wastewater-derived chemical contaminants including...pharmaceuticals and personal care products for which action levels have not been established" (pg. 106). In fact, the draft regulation recommends but does not require monitoring for CECs.[5] Moreover, the draft regulation was first proposed nearly 20 years ago and has never been finalized.

It should be noted that CDPH only suggested CEC monitoring because the state agency is "interested in collecting information that relates to the presence of...[CECs]...in recycled municipal wastewater." CDPH recently revised Endnote 5 in the draft regulation to eliminate any unintended implication that CECs present a known threat to human health. This was necessary because permit writers throughout the state had mistaken CDPH's draft list of suggested CECs as potential water quality impairment thresholds necessitating routine monitoring. The Panel should take heed of how its recommendations may be misconstrued and misapplied within the regulatory context.

4) The Panel's report suggests that current state regulation and guidance do not adequately employ quantitative reliability assessments to monitor and assess process control performance (pg. 30). However, as indicated in Table 3-2 of the Report (pg. 27), Title-22 sets forth minimum performance standards expected to assure the safety of recycled water. Reliability is assessed through the use of effluent limits governing the concentration of NTUs, coliform, total organic carbon and specifying minimum disinfection levels and contact time. Daily measurements of these and other metrics provide a very high level of quantitative process control designed to ensure that the recycled water is pathogen-free. The Panel offers no evidence to indicate that routine evaluation of CEC's would provide unique new insight into the on-going efficacy of treatment plant operations.

5) In several places, the draft report uses vague qualifiers when discussing the potential risks associated with recycled water; for example:

> "...<u>predominantly</u> negative findings..." (pg. 31)
>
> "...<u>essentially</u> no adverse health outcomes..." (pg. 31 & 124)
>
> "...<u>little</u> or no <u>potential</u> to pose an <u>unacceptable potential</u> risk..." (pg. 32)

It is not clear whether the few adverse health outcomes that have been observed are related to CECs or, as is more likely, to human pathogens. The Panel should revise the report to state unequivocally that there is no scientific data to indicate that CEC's pose a known risk to human health at the concentrations routinely measured in recycled water. In addition, when the Panel recommends increased monitoring for

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[5] California Department of Public Health. Groundwater Reuse Recharge Draft Regulation. Aug. 5, 2008; pg31

those CEC "with potential to pose human health concerns" (pg. 32), it should endeavor to define what constitutes a potential to pose such a concern. Merely dividing the therapeutic dose by 3,000 or the No-Observed-Acute Effect-Level (NOAEL) by 1,000 (pg. 34) is arbitrary and lacks scientific foundation.

6) Table 3.3 (pg. 29) in the Report focuses exclusively on direct efforts at wastewater treatment and omits any reference to other significant regulatory requirements aimed primarily at prevention, including: watershed protection programs, pretreatment regulations, groundwater plume management, stormwater BMPs, etc. The multi-barrier approach to pollution control begins well before the sewage collection system and extends well beyond the point where recycled water is discharged from a POTW.

7) The conversion of non-detects to the detection limit creates misleading estimates of the maximum expected concentration (see, for example, the data for Musk ketone on pg. 161 or p-hydroxy atorvastatin on pg. 164). Where a CEC has not been detected, the tables and graphs should so state. This is particularly important where a compound has not been detected by laboratories using different detection levels as the MDL conversion process will artificially inflate the variance of the data.

8) Based on past experience, we are concerned that the Monitoring Trigger Levels may become part of a regulatory program that applies them to receiving waters as regulatory limits. Please be more clear about what are inappropriate uses of the data in a regulatory context, given the developmental status of the analytical methods. At various places in the draft Report, the Panel identifies scientific uncertainty factors and intrinsic analytical variability. Please draw together these various discussions and talk about the implications for using, or not using, EC monitoring data in a regulatory context.

9) The importance of having a detailed QA/QC program as part of any routine monitoring program cannot be over-stated. This is especially true since the resulting EC data may be used for regulatory compliance purposes despite the Panel’s strong recommendations to the contrary. Wherever possible, the Report should re-emphasize this point. In addition, it would be helpful if the Panel could provide detailed Data Quality Objectives (DQOs) that describe the appropriate and intended uses of EC data versus the inappropriate and unintended uses of such data. As an example, a copy of the Quality Assurance Project Plan developed by the Santa Ana EC Task Force has been attached as Appendix C.

10) As noted earlier, the report provides an excellent description of U.S. EPA's existing CCL process and notes that the agency reviews existing MCLs every six years to determine if modifications are required based on new data or technological advancements (pg. 85). However, the report also recommends that California reapply the CEC prioritization process at least every three years and recommends that the state establish an independent panel to provide periodic review of the proposed approach (pg. 72).

The report does not explain why California should establish a separate panel to perform tasks and make decisions already assigned to OEHHA, CDPH, EPA, and the State/Regional Boards. Nor does the report provide any justification for suggesting that the State undertake a comprehensive review every three years instead of the every six years as EPA does.

The primary purpose of a CEC monitoring program is to provide supplemental water quality data to characterize the presence and persistence of common household chemicals in the environment. Such data is useful to the federal and state regulatory agencies charged with deciding which compounds may merit further investigation or should be prioritized for consideration to establish new water quality criteria. In essence, the CEC monitoring program should fit within the existing regulatory structure rather than operating independently of that system.

11) In the workshops that launched the Panel's effort, there was widespread agreement that an appropriate public communications program was essential to implement a successful CEC monitoring program. The draft report makes no mention of this expectation and offers little to guide state authorities or the regulated community as they seek to implement the Panel's recommendations.

The recent stir caused by reports of "drugs in the drinking water" were the direct result of media misunderstanding and misinterpretation of data collected as part of previous CEC monitoring programs. There is grave concern that the very program designed to reassure people that their drinking water is safe may actually undermine public confidence for reasons unrelated to the true toxicological risk.

It would be helpful if the Panel were to amend the Executive Summary to emphasize the fact that there is no evidence whatsoever of any adverse human health effects from CECs at the levels detected in numerous scientific studies. The Executive Summary should translate the MTLs into common English to facilitate public understanding. This may take the form of the number of gallons one must drink to consume the equivalent of one Tylenol capsule or the number of years required (at 2 liters/day) to receive a dose of caffeine equivalent to one can Pepsi. Dr. Snyder's testimony to Congress in the spring of 2008 provides an excellent illustration of this approach. The USGS's GAMA report for the Santa Ana region and the recent CEC study published by the National Water Research Institute (NWRI) offer similar examples.

12) Based on its human health risk analysis, the Panel has recommended that caffeine, tricolsan and 17Beta-Estradiol are the only three CECs that should be monitored. Therefore, it would be very helpful if the final version of their report included a detailed description of how the MEC and MTL were calculated for each of these three specific compounds. In addition, a more explicit explanation of how and where the various safety factors are applied within this analysis would also be much appreciated.

13) Finally, it would also be helpful if the Blue Ribbon Panel provide some insight into when and where stakeholders should be monitoring for the ECs identified in the report? Is it best to analyze reclaimed water where it leaves the wastewater treatment plant or better to do the testing after soil aquifer treatment has occurred, or when the groundwater is withdrawn from the aquifer, of after the finished drinking water is sent to the municipal distribution system?

The Santa Ana EC Task Force wishes to emphasize that none of the above comments should be taken to suggest that the draft report is somehow deficient or defective. On the contrary, it far exceeded our highest expectations. We merely want to ensure that the final recommendations are implemented as the Panel intended.

Thank you again for the opportunity to review and comment upon the draft document.

Respectfully submitted,

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Submitted on behalf of the Emerging Constituents Program Task Force consisting of the following agencies:

- Eastern Municipal Water District
- Inland Empire Utilities Agency
- Orange County Water District
- San Bernardino Valley Muni Water District
- Western Municipal Water District
- Elsinore Valley Municipal Water District
- Irvine Ranch Water District
- Jurupa Community Services District
- Lee Lake Water District
- Metropolitan Water District of Southern California
- San Gorgonio Pass Water Agency
- Yucaipa Valley Water District
- City of Beaumont
- City of Corona
- City of Redlands
- City of Rialto
- City of Riverside
- Chino Basin Watermaster
- Colton/San Bernardino Regional Tertiary Treatment and Wastewater Reclamation Authority
- Western Riverside County Regional Wastewater Authority

Appendix A

Proposed Work Plan for Santa Ana Watershed Project Authority's Emerging Constituents Workgroup in 2010-2011

1.0 Introduction

Water quality is routinely sampled at tens of thousands of locations across the U.S. Samples are collected from rain water, storm water runoff, freshwater streams, lakes and reservoirs, groundwater wells and tap water to characterize the quality of various supply sources. Additional samples from the sewage systems are analyzed to ensure pollution prevention programs and wastewater treatment plants are meeting all federal and state water quality standards.

Most sampling programs focus on a few hundred of the most common chemical constituents to assess overall water quality. These chemicals were selected from the larger universe of known chemicals because there is sufficient scientific evidence to indicate they may pose an increased risk to humans, plants or animals (including aquatic organisms) when they occur at elevated concentrations.

Several different regulatory agencies share responsibility for determining the acceptable concentration of potential pollutants. This is a formidable task as there are tens of thousands of chemical compounds in common use. Consequently, state and federal authorities rely on sales/usage information and monitoring data to establish appropriate research priorities for setting new water quality standards through a sophisticated and thorough regulatory review process.[1]

Improvements in analytical technology over the last decade have dramatically increased the number of chemicals we can detect and greatly decreased the concentration at which we can detect them.[2] Today, we are able to identify and quantify some potential pollutants in the range of one part-per-trillion (ppt) or less.[3] For perspective, 1 ppt is approximately equal to a plot of land the size of a postage stamp in an area the size of Orange County.

This new ability to detect infinitesimally small chemical concentrations has fundamentally altered our understanding of what's in the water. Trace levels (approx. 1-100 ppt) of many different man-made chemicals, particularly pesticides, pharmaceuticals and personal care products, have been found in waters across the United States. Collectively, these compounds are referred to as "Emerging Constituents" (ECs) because their presence is just starting to be revealed by rapid advances in analytical technology.[4]

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1 See, for example, U.S. EPA's process for identifying Candidate Contaminant List (CCL).

2 Vanderford, B.J., et al. "Analysis of Endocrine Disrupters and Personal Care Products in Water Using Liquid Chromatography and Tandem Mass Spectrometry." Analytical Chemistry. 2003 (75:6265-6274)

3 Vanderford, B.J. and Shane Snyder. "Analysis of Pharmaceuticals in Water by Isotope Dilution Liquid Chromatography/Tandem Mass Spectrometry." Environmental Science and Technology. 2006 (p. 7312-7320).

4 Emerging Constituents is one of several similar phrases used to describe the same phenomena. Synonyms include: emerging contaminants of concern, chemicals of emerging concern (CEC), micro-constituents, micro-pollutants, trace organics, etc. Such phrases may mistakenly imply that it is the concern that is emerging rather than the knowledge that certain chemicals may be present in a water sample. Similarly, referring to such compounds as Emerging Pollutants or Emerging Contaminants may mistakenly imply that the levels detected

Once new chemicals are detected, the question naturally arises as to what effect, if any, these compounds have on the municipal drinking water supplies. As part of the Recycled Water Policy adopted in early 2009, the California State Water Resources Control Board ("State Board") recently convened a Blue Ribbon Panel of Experts to address this concern.[5] The Panel's mission is to recommend appropriate water quality monitoring strategies for ECs based on the best available pharmacological and toxicological information taking into consideration the fate and transport of such chemicals through advanced treatments systems and the natural environment. The Panel is expected to publish its final recommendations in mid-2010.

2.0 Regulatory Context

In general, chemical compounds can be divided into two categories: regulated and unregulated. Regulated chemicals include those where a formal water quality standard or a state notification level has been established.[6] State and federal authorities may issue orders governing the release of such compounds into the environment. These regulations may range from relatively simple monitoring and reporting requirements to strict discharge prohibitions.

Unregulated chemicals are those for which no water quality standard or state notification level have been established. By definition, ECs are usually considered unregulated chemicals. However, that status may change as new information is developed. To that end, additional data are needed to characterize the presence and persistence of ECs throughout the water supply system. This information, along with epidemiological and toxicological data, may be used to set priorities for developing new water quality criteria, Maximum Contaminant Levels (MCLs), state notification levels and future water quality monitoring requirements.

Because the analytical techniques used to support EC characterization studies are still in the earliest stages of development, great care must be exercised when using the results of those studies. The data generated from the non-standard methods employed during the preliminary characterization studies are not sufficiently accurate for regulatory purposes such as: 303(d) listing decisions, antidegradation analyses, or translating narrative criteria into numeric effluent limits. These legal determinations depend on detailed risk assessments that are not yet available. However, the data from such studies is useful for determining which ECs, if any, should be prioritized for additional method development in order to determine whether more formal regulatory assessments may be needed in the future.

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pose a known hazard to people or the environment. The Emerging Constituents Workgroup in the Santa Ana region has chosen to use the phrase “emerging constituents” to describe a large group of chemicals that may or may not pose a risk to human health and the environment. The California Office of Environmental Health Hazard Assessment and U.S. EPA have primary legal responsibility for making the necessary risk assessments and publishing appropriate water quality standards for all chemicals including Emerging Constituents.

5 SWRCB. Recycled Water Policy. Resolution No. 2009-0011 (adopted 2/3/09). A summary of the Blue Ribbon Panel's work-in-progress is available at www.sccwrp.org

6 Concentrations of concern may be expressed as Maximum Contaminant Levels (MCLs), Public Health Goals (PHGs), State Notification Levels, 304(a) Criteria, Basin Plan objectives, TMDL targets, wasteload allocations, or receiving water limitations. Some of these also serve as formal regulatory thresholds.

Pending development of additional water quality standards, the California Department of Public Health ("DPH") previously suggested that periodic monitoring for trace organic chemicals may serve as a useful indicator of groundwater quality downgradient of recycled water projects.[7] Such data may also be used to corroborate the effectiveness of soil-aquifer treatment and the multi-barrier approach to preventing pathogen pollution. Therefore, as part of the proposed Groundwater Recharge Reuse Regulations, DPH prepared a draft list of ECs to guide planning and permitting efforts for recycled water projects.[8]

Acting on DPH's draft recommendations, Regional Boards began adding EC monitoring requirements to the permits for recycled water projects. As the use of recycled water has increased, so have the number of permits containing such provisions.[9] By 2006, some form of EC monitoring, often based on DPH's preliminary suggestions, was rapidly becoming a permit condition for all direct and indirect recharge of recycled water.[10]

Recognizing that the draft monitoring list for ECs was being misunderstood, DPH subsequently revised the draft Groundwater Recharge Reuse Regulation to clarify its original intent. DPH eliminated the list of specific chemicals and instead proposed that recycled water projects analyze for representative compounds within broad chemical categories (hormones, pharmaceuticals, personal care products, industrial chemicals, pesticides, etc.). The specific choice of chemical would be left to the project proponent and the permitting authorities.[11]

The SWRCB adopted the Recycled Water Policy and convened the aforementioned Blue Ribbon Panel of Experts to review the available science and make appropriate recommendations for future EC monitoring. California's Blue Ribbon Panel is only one of many different groups undertaking similar efforts. Recent news articles and a number of scientific papers and technical reports increased public awareness of the issue and provided impetus for additional EC investigations around the country.[12]

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7 DPH serves several different regulatory roles with respect to groundwater recharge projects. DPH is responsible, under statute, for establishing water quality criteria for groundwater recharge projects. DPH also acts as a consultant to the Regional Boards on the permit requirements for specific groundwater recharge projects. And, DPH has a co-equal role with the Regional Boards in establishing permit requirements for groundwater recharge projects that rely on direct injection rather than surface percolation.

8 http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Recharge/DraftRechargeReg2008.pdf (see Endnote 5). See also http://www.cdph.ca.gov/certlic/drinkingwater/Pages/EmergingContaminants.aspx

9 See, for example, Monitoring and Reporting Program for Regional Board Order No. R8-2005-0033 for Phase I of the Chino Basin Recycled Water Groundwater Recharge Project.

10 See, for example, the NPDES permit issued to Donald C. Tillman Water Reclamation Plant (NPDES No. CA0056227) and the proposed draft NPDES Permit for the Henry N. Wochholz Regional Water Recycling Facility operated by the Yucaipa Valley Water District (NPDES No. CA0105619). Attachment K: List of Unregulated Chemicals: Endocrine Disrupting Chemicals & Pharmaceuticals and Other Chemicals (2007).

11 A more detailed discussion of the history of EC monitoring as it relates to NPDES permitting requirements in California is provided in the Phase-I Report of the Emerging Constituents Task Force. Santa Ana Watershed Project Authority. April, 2009. Available for download at: http://www.sawpa.org

12 Jeff Donn, Martha Mendoza and Justin Pritchard, Associated Press. "AP Probe Finds Drugs in Drinking Water." March 10, 2008.

3.0 Current Studies to Characterize Emerging Constituents

Recently, several large-scale water quality characterization studies began testing for select ECs. The U.S. Geological Survey's National Ambient Water Quality Assessment (NAWQA) and Groundwater Ambient Monitoring Assessment (GAMA) are probably the largest and best known of these research efforts. Results from samples collected throughout the nation indicate that ECs have been detected at trace levels in some surface and groundwater samples.

Subsequent investigations have detected the presence of similar chemicals in both source waters and tap waters.[13] And, follow-on studies found trace amounts of some ECs in highly treated recycled waters.[14] The concentration of trace organic compounds fluctuates greatly from location to location and from day to day. New research is underway to determine if additional treatment can reduce or eliminate ECs cost-effectively.[15]

Given these findings, and the significant role recycled water plays in Southern California, a coordinated effort to characterize the presence of ECs in the Santa Ana River watershed was recently initiated. In 2007-8, the USGS collected and analyzed local groundwater samples as part of the GAMA program. Results of this effort were published in November, 2009 and the EC data are summarized in Table 1.

TABLE 1: EC Characterization for Select Ground Waters in the Santa Ana Region

Compound	Use	# Detections	Detection %	LRL*
Acetaminophen	Analgesic	3 of 89 wells	3%	25 ng/L
Caffeine	Stimulant	3 of 89 wells	3%	15 ng/L
Carbamazepine	Anti-convulsant	5 of 89 wells	6%	30 ng/L
Sulfamethoxazole	Antibiotic	0 of 89 wells	0%	10 ng/L

*LRL = Laboratory Reporting Level

Other pharmaceutical compounds evaluated included: Codeine (narcotic), Continine (nicotine metabolite), Dehydronifedipine (anti-angina metabolite), Diltiaem (anti-angina), Diphenhydramine (antihistamine), Salbutamol (bronchodilator), Thiabendazole (anthelmintic), Trimethoprim (antibacterial), Warfarin (anti-coagulant).

13 Benotti, M.J., R.A. Trenholm, B.J. Vanderford, J.C. Holady, B.D. Stanford and S. A. Snyder. "Pharmaceuticals and endocrine disrupting compounds in U.S. drinking water." Environmental Science and Technology. 2009

14 Snyder, Shane. Southern Nevada Water Authority – Applied R&D Center. Testimony before the Senate Subcommittee on Transportation Safety, Infrastructure Security and Water Quality on Pharmaceuticals in the Nation's Water: Assessing Potential Risks and Actions to Address the Issue. April 15, 2008.

15 See, for example, Dickenson, E.R., J.E. Drewes, D.L. Sedlak, E.C. Wert and S.A. Snyder. "Applying surrogates and indicators to assess removal efficiency of trace organic chemicals during chemical oxidation of wastewaters." Environmental Science and Technology. 2009.

The GAMA study also analyzed for nine other pharmaceutical compounds (listed above). None of these other chemicals were detected in any of the groundwater samples. USGS concluded that:

> *"No pharmaceutical compound was detected in more than five wells, and all of the concentrations were low. Health-based thresholds do not exist for concentrations of pharmaceuticals in drinking water. However, to reach concentrations of the two detected medications (acetaminophen and carbamazepine) equal to dosages typically recommended or prescribed would, in all cases, require consuming more than one million liters of the sampled water. The sampled concentrations of caffeine were, in all cases, less than one-millionth of the concentration of caffeine in regular coffee."[16] (pg. 13)*

In addition, three water agencies undertook a focused sampling program to characterize EC concentrations in surface waters including water imported to the region from the State Water Project and the Colorado River. The agencies also evaluated samples collected from the Santa Ana River, its tributaries, and select wastewater discharges to these streams.[17] Consistent with previous studies performed elsewhere, preliminary data from the Santa Ana investigation detected the presence of some ECs in surface waters throughout the region (see Table 2).

TABLE 2: Partial EC Characterization for Surface Waters in Santa Ana River (n=32)[18]

Compound	Use	Minimum	Median	Maximum
Caffeine	Stimulant	9 ng/L	47 ng/L	1620 ng/L
Carbamazepine	Anti-convulsant	49 ng/L	135 ng/L	267 ng/L
Gemfibrozil	Anti-cholesterol	<5 ng/L	48 ng/L	590 ng/L
Primidone	Anti-convulsant	41 ng/L	90 ng/L	146 ng/L
Sulfamethoxazole	Antibiotic	4 ng/L	160 ng/L	721 ng/L

This finding is not surprising considering that recycled water often comprises more than 90% of the flow in the Santa Ana River and trace levels of some ECs were also detected in the treated municipal wastewater discharged to the river (see Table 3).

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16 Kent, Robert and Kenneth Belitz. Unites States Geological Survey (USGS). Ground-Water Quality Data in the Upper Santa Ana Watershed Study Unit, November 2006 - March 2007: Results from the California GAMA Program. Data Series 404. November, 2009.

17 Guo, Y.C. et al, "Occurrence, Fate and Transport of PPCPs in Three California Watersheds." AWWA Water Quality Technology Conference, November, 2009. Seattle, WA (Research co-sponsored by Metropolitan Water District of Southern California, Orange County Water District, and National Water Research Institute).

18 Eight stream sites were each sampled four times between April, 2008 and April, 2009.

TABLE 3: Partial EC Characterization for Municipal Effluents (n=16)[19]

Compound	Use	Minimum	Median	Maximum
Caffeine	Stimulant	<5 ng/L	14 ng/L	1883 ng/L
Carbamazepine	Anti-convulsant	123 ng/L	208 ng/L	331 ng/L
Gemfibrozil	Anti-cholesterol	<5 ng/L	22 ng/L	1178 ng/L
Primidone	Anti-convulsant	84 ng/L	146 ng/L	171 ng/L
Sulfamethoxazole	Antibiotic	4 ng/L	417 ng/L	1593 ng/L

Finally, trace concentrations of some ECs were identified in water imported to the Santa Ana Region from the State Project (see Table 4) and the Colorado River (see Table 5).

TABLE 4: Partial EC Characterization for State Project Water (n=8)[20]

Compound	Use	Minimum	Median	Maximum
Caffeine	Stimulant	<5 ng/L	7 ng/L	37 ng/L
Carbamazepine	Anti-convulsant	<1 ng/L	2 ng/L	4 ng/L
Gemfibrozil	Anti-cholesterol	<5 ng/L	<5 ng/L	5 ng/L
Primidone	Anti-convulsant	< 2 ng/L	2 ng/L	10 ng/L
Sulfamethoxazole	Antibiotic	5 ng/L	10 ng/L	11 ng/L

TABLE 5: Partial EC Characterization for Colorado River Water (n=4)[21]

Compound	Use	Minimum	Median	Maximum
Caffeine	Stimulant	<5 ng/L	<5 ng/L	<5 ng/L
Carbamazepine	Anti-convulsant	<1 ng/L	<1 ng/L	2 ng/L
Gemfibrozil	Anti-cholesterol	<5 ng/L	<5 ng/L	<5 ng/L
Primidone	Anti-convulsant	<2 ng/L	2 ng/L	3 ng/L
Sulfamethoxazole	Antibiotic	<1 ng/L	<1 ng/L	1 ng/L

19 Four wastewater treatment plans were each sampled four times between April, 2008 and April, 2009. The four plants include three that discharge to the Santa Ana river system and one that discharges to the Colorado River in Nevada.

20 Two samples locations, representing the east and west branches of the State Project Water in Southern California, were sampled four times each between April, 2008 and April, 2009.

21 Four samples were collected from Lake Mathews, the terminal reservoir for Colorado River imported to Southern California, between April 2008 and April 2009.

After confirming that ECs were present, water and wastewater agencies throughout the Santa Ana region elected to continue their characterization studies and to coordinate those efforts with one another. This voluntary program is intended to supplement the existing knowledge base pending recommendations from the Blue Ribbon Panel of Experts and potential new policy guidance from DPH and/or the State Board. At this time, it is not known what those recommendations will be or what actions DPH and the State Board will take based on those recommendations.

4.0 Purpose

The water and wastewater agencies serving the Santa Ana region are committed to develop an EC investigation program that addresses the public's desire to know more about what chemicals may be in their water supplies. Such efforts are essential to increase public acceptance and encourage greater use of recycled water.

The rationale for this voluntary program was recently described in a report entitled: “Managing Contaminants of Emerging Concern in California.” The report summarizes results and recommendations from a forum of regulatory and scientific experts convened to assist the State Board in developing a scope-of-work for the Blue Ribbon Panel. Workshop participants found that more data characterizing the presence and persistence of ECs will: 1) establish a baseline to evaluate fate and transport mechanisms and potential trends in water quality which is essential to develop a risk-based approach to understanding and managing exposure to ECs; 2) aid federal and state authorities as they set priorities for and determine whether to develop new water quality criteria; and 3) be useful for evaluating the effectiveness of pollution prevention and source control programs.

The report also identified three steps that should be taken as agencies collaborate to characterize and understand the effects of ECs on public health and the environment.   The first step will be filling data gaps through investigative monitoring and targeted research. The second step will be identifying, developing and testing accurate and reliable methods for detecting ECs at very low levels. The third step will be to incorporate the measurement of ECs into on-going water quality studies, such as those that have been undertaken by Inland Empire Utilities Agency, the Metropolitan Water District of Southern California, National Water Research Institute and Orange County Water District. The workshop participants stressed that:

> *"In lieu of regulations or compliance monitoring…investigative chemical monitoring should be used as the first step towards development of a management strategy in California."* [A key element] *"of this process will be our ability to adapt the strategy as new information becomes available. Since relatively little is known about CECs at this time, new information and technology will undoubtedly affect our ability to monitor and establish thresholds for CECs. Preliminary CEC monitoring lists will be subject to trial and error."*[22]

As noted earlier, the draft DPH Groundwater Recharge and Reuse regulations do not identify the specific ECs that must be monitored. Rather, DPH states that this determination must be made on a project-by-project basis and will vary based on a number of considerations including the source of the recharge water, the type of treatments applied to the recycled water and the nature of soil conditions in the area and other factors that may affect the fate, transport and degradation of ECs in the environment. DPH also acknowledges that, for some projects, other chemicals (such as the relative amounts of inorganic tracers or total organic carbon) may provide a better indication of the sources influencing groundwater quality than the specific concentration of various trace organic compounds. It is the responsibility of the project proponents to recommend and justify an appropriate monitoring strategy to the state permitting authorities.

Because analytical technology is constantly improving and our knowledge of which chemicals may pose an unacceptable risk to people and the environment is always growing, it is agreed that any EC investigation program must be updated regularly. Therefore, it is likely that the list of chemicals recommended for future characterization studies will change over time. The water and wastewater agencies proposing to undertake this investigation are committed to a process of adaptive management to ensure the EC characterization program fulfills its stated purpose using the best available science.

To facilitate early implementation of these recommendations, stakeholders in the Santa Ana region propose to undertake a water quality characterization study in 2010-11 to fill some of the aforementioned data gaps. Samples collected from select surface water streams, imported water sources and wastewater treatment plants will be analyzed for a representative group of ECs using the best analytical technology presently available.

The EC Workgroup will prepare a written Sampling and Analysis Plan (SAP) describing the specific data quality objectives, sampling locations, sampling protocols, sampling frequency, analytical methods, QA/QC procedures, database management and reporting requirements. The plan will also discuss the appropriate and inappropriate uses of the data given the various method limitations. The SAP will be submitted to the Regional Board staff by March 15, 2010 for review and comment. The general specifications for the 2010-2011 EC Characterization Study are described in Section 5.

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22 "Managing Contaminants of Emerging Concern in California." California CEC Workshop. Co-sponsored by the Southern California Coastal Water Research Project (SCCWRP), California Ocean Protection Council, California Ocean Science Trust, National Water Research Institute, San Francisco Estuary Institute and the Urban Water Research Center at the University of California-Irvine. Held: April 28-29, 2009. Report published in Sept., 2009 and is available at: ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/600_CEC_wkshp2009.pdf

5) 2010-11 Characterization Study

A) Proposed Analytes

Table 6 identifies the trace organic compounds that the stakeholders propose to assess during the 2010 characterization period. The list may be revised for the 2011 characterization period based on recommendations from the Blue Ribbon Panel of Experts or new guidance from the State Board.

Table 6: ECs to be Analyzed

Chemical	Category	Common Use	Notes
Acetaminophen (aka "Tylenol")	Pharmaceutical	Over-the Counter Analgesic	3,4,5,8
Bisphenol-A (BPA)	Industrial	Plastic Manufacturing	7
Caffeine (coffee, tea, soft drinks)	Food Additive	Non-Prescription Stimulant	3,5,6,8
Carbamazepine	Pharmaceutical	Prescription Anti-Convulsant	1,2,3,4, 5,6,8
DEET (aka "Off")	Pesticide	Household Insect Repellent	1,2,6
Diuron	Herbicide	Weed Control	6
Ethynylestradiol/Ethinylestradiol	Hormone	Prescription	1,2,4,6
Gemfibrozil	Pharmaceutical	Prescription Anti-Cholesterol	1,2,3,4,5,6
Ibuprofen (aka "Advil")	Pharmaceutical	Over-the-Counter Analgesic	3,4,5
Sulfamethoxazole	Pharmaceutical	Prescription Antibiotic	1,2,3,5,6,8
TCEP	Industrial	Flame Retardant	1,2,3,6

<u>Selection Criteria Notes</u>:

1) Commonly detected in national studies of water supply sources.
2) Commonly detected in national studies of finished drinking water.
3) Detected in SAR surface waters and/or effluents in MWDSC/NWRI/OCWD study.
4) Detected in Inland Empire Utility Agency's existing EC monitoring program.
5) Detected in previous USGS studies of the Tualatin River system in Oregon.
6) Recommended by expert panel assembled to review an advanced reclamation project proposed for the West Basin.
7) Recently added to U.S. EPA's Candidate Contaminant List (CCL)
8) Detected by the USGS GAMA program in Santa Ana groundwater samples.

B) Proposed Sampling

Table 7: Sampling Locations, Frequency, Type & Responsibilities

Sampling Site	Sampling Frequency	Sample Type	Responsible Agency[23]
Final Effluent from All Wastewater Treatment Plants[24]	Annually	24-hour Composite	Permitted Operator
State Project Water @ Devil Canyon	Annually	Representative Grab	MWDSC
Colorado River @ San Jacinto West Portal	Annually	Representative Grab	MWDSC
Santa Ana River near MWD Crossing	2x/year	Representative Grab	OCWD
Santa Ana River near Prado Dam	2x/year	Representative Grab	OCWD

Water samples will be collected by June of each year. Second samples, when needed, will be collected by September of each year. Due to the time required to analyze samples, review QA/QC and summarize results, data from the summer collection period will be included in the next year's report.[25]

C) Proposed Methods

At present, there are no standardized or certified methods for analyzing most ECs.[26] Until EPA approves such methods, the EC Workgroup is committed to using the best analytical technology commercially available: LC-MS-MS with isotope dilution. In general, this technique is capable of detecting select ECs in de-ionized laboratory water at concentrations of 1 to 10 ng/L. However, the specific reporting detection level (RDL) will vary over time and between laboratories in more complex water matrices. Therefore, more detailed data quality objectives and QA/QC requirements will be specified in the Sampling and Analysis Plan submitted to the Regional Board.

23 Pending approval and funding authorization from each agency.
24 Includes all wastewater treatment plants operating under a valid NPDES permit or Waste Discharge Requirement (WDR) issued by the California Regional Water Quality Control Board – Santa Ana Region and/or U.S. EPA regardless of whether the discharge is to waters of the U.S. or waters of the state.
25 Therefore, the report submitted in November, 2010 will include only the results for samples collected in May, 2010. The report submitted in November, 2011 will include the results for samples collected in August, 2010 and May, 2011.
26 U.S. EPA approves analytical methods pursuant to 40 CFR Part 136.

D) Proposed Reporting

Participating stakeholders will submit copies of all sampling documents (field notes and chain of custody forms) and laboratory reports to the Santa Ana Watershed Project Authority (SAWPA). SAWPA will input the data to the SAWDMS database and prepare an annual report summarizing results of the EC characterization program. A draft copy of the EC report will be distributed for review and comment and SAWPA will convene a stakeholder meeting shortly thereafter to discuss suggested revisions to the draft document. The final report will be submitted to the Regional Board, on behalf of the stakeholders, by December 31st of each year.

The annual report will include a detailed description of the chemical analytes, sampling locations, sampling dates and protocols, analytical methods, QA/QC procedures and relevant results. Where appropriate, the report will also include any recommended changes to future EC sampling efforts (including revised analytes or sampling locations).

Finally, to facilitate public understanding of the new information, the report will describe the toxicological relevance of the measured EC concentrations. The purpose of this discussion is to provide, where possible, a scientific context for evaluating the relative health risks of these trace organic compounds.[27]

E) Proposed Schedule for 2010-11 Study Period

Task	Description	Deadline
1	Prepare and Submit EC Sampling and Analysis Plan	Mar. 15, 2010
2	Collect and Analyze Initial Samples from All Locations in Table 7	June 30, 2010
3	Submit Initial Sample Results and Related Documentation to SAWPA	July 31, 2010
4	ECW Meeting to Review and Discuss Initial Sample Results	Aug. 31, 2010
5	Collect and Analyze Second Surface Water Samples	Sept. 30, 2010
6	Distribute Draft Annual Report to Emerging Constituents Workgroup	Oct. 31, 2010
7	ECW Meeting to Review and Finalize Annual Report	Nov. 30, 2010
8	Submit First Annual Report to Regional Board	Dec. 31, 2010
9	Submit Second Surface Water Sample Results from 2010 to SAWPA	Jan. 31, 2011

27 See, for example, "Toxicological Relevance of Endocrine Disrupting Chemicals and Pharmaceuticals in Water" American Water Works Association Research Foundation Report No. 3085/WRF 04-003.

E) Emerging Constituents Workgroup

SAWPA will periodically coordinate meetings of the Emerging Constituents Workgroup (ECW) to organize the next phase of the EC characterization study. This includes reviewing new water quality data, preparing the annual EC report, and integrating new EC policies enacted by the State Board and DPH.

During 2010, and after reviewing the final published results from the GAMA study and the MWDSC/NWRI/OCWD study, the ECW will determine whether it is useful and appropriate to expand the investigation effort to include storm water samples and select groundwater locations in 2011.

Appendix B

COMPARISON OF ANALYTICAL RESULTS FOR TRACE ORGANICS IN THE SANTA ANA RIVER AT THE IMPERIAL HIGHWAY TO HEALTH RISK-BASED SCREENING LEVELS

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APPENDICES

APPENDIX A: Methods Used By Intertox to Derive Acceptable Daily Intakes (ADIs) for Pharmaceuticals and Personal Care Products, Endocrine Disrupting Compounds, and Other Compounds of Emerging Interest

1.0 INTRODUCTION

A study underway by the National Water Research Institute—Metropolitan Water District—Orange County Water District (NWRI–MWD–OCWD) is assessing the presence of contaminants of emerging concern in Santa Ana River (SAR), Colorado River, and California State Water Project water. Intertox was asked by OCWD to review and statistically summarize the data from the trace organics analytical program collected on the SAR at the Imperial Highway, and to determine the potential significance of detected concentrations to human health by comparing concentrations to health risk-based screening levels. Specifically, we compared detected concentrations to acceptable daily intakes (ADIs) and drinking water equivalent levels (DWELs) developed by Intertox as part of the Water Research Foundation 3085/WateReuse Foundation (WRF)-04-003 "Toxicological Relevance of Endocrine Disruptors and Pharmaceuticals in Drinking Water" study, the WRF-06-018 "Development and Application of Tools to Assess and Understand the Relative Risks of Drugs and Other Chemicals in Indirect Potable Reuse Water" study and other work we have conducted, and to health risk-based screening levels published by other agencies.

We presented the findings summarized in this report at a meeting on May 28, 2009, in Orange County, organized by NWRI and attended by the NWRI SAR Science Advisory Panel, NWRI Groundwater Replenishment System (GWRS) Independent Advisory Subcommittee Panel, and other agencies, including OCWD and MWD.

The methods and results of the analysis are summarized below.

2.0 DATA ANALYSIS AND STATISTICAL SUMMARY

The OCWD provided Intertox with a summary of analytical data for quarterly water samples collected at 13 locations within the SAR watershed and analyzed by the OCWD and MWD laboratories. Samples were collected on May 22, 2008; August 19, 2008; November 5, 2008; and February 25, 2009, and analyzed for a total of 49 compounds. Intertox was asked to compare concentrations measured at the Imperial Highway location to health risk-based screening levels. For each analyte, a total of four sample measurements were available at the Imperial Highway location. Intertox was not requested to review or verify the laboratory QA/QC data for the analytical program, and we assumed the analytical results we were presented with were valid.

Intertox examined the data to determine whether any seasonal pattern in minimum or maximum concentrations of the various compounds was apparent. No clear trend was evident. Of the 16 detected compounds, the maximum detected concentration was detected on May 22, 2008 for five compounds; August 19, 2008 for four compounds; November 5, 2008 for six compounds; and February 25, 2009 for two compounds (for one compound, the same maximum concentration was detected in two different quarters).

In general, per U.S. EPA guidance, the exposure point concentration (EPC) used in risk assessments should represent "a reasonable estimate of the concentration likely to be contacted over time"—in other words, an average concentration (U.S. EPA, 1989; U.S. EPA, 2002). However, since only four data points were available for each analyte at the Imperial Highway location, we compared the maximum detected concentrations to health risk-based screening levels. Using the maximum detected concentration is consistent with U.S. EPA recommendations when sample sizes are small (e.g., <5 samples) (U.S. EPA, 2002). However, U.S. EPA cautions that "defaulting to the maximum observed concentration may not be protective when sample sizes are very small because the observed maximum may be smaller than the population mean" (U.S. EPA, 2002). In other words, collected samples may not reflect the true mean for the exposure area if sampling episodes were not representative of typical conditions.

Per U.S. EPA (2007), for datasets where most (e.g., > %95) of the observations for a contaminant lie below the detection limit(s), the sample median (rather than a sample average which cannot be computed accurately) should be used as an estimate for the EPC term. In the current evaluation, since only four data points were available for a given compound, when all samples were nondetect, the minimum reporting limit (MRL) for a given compound was compared to the DWEL associated with a health risk-based screening level.

For each compound at the Imperial Highway location, Table 1 summarizes the MRL, frequency of detection, and range of detected concentrations.

3.0 COMPARISON OF SAMPLING RESULTS TO HEALTH RISK-BASED SCREENING LEVELS

In order to assess the potential human health risks associated with exposure to the trace organics detected in SAR water, the maximum detected concentrations at the Imperial Highway location were compared to health risk-based screening levels. These included ADIs developed by Intertox as part of past work addressing the potential human health risks of pharmaceuticals and personal care products (PPCPs) or endocrine disrupting compounds (EDCs) in drinking water or water intended for indirect nonpotable reuse, or various types of health risk-based screening levels developed and published by other agencies.

Health risk-based screening levels, known by such names as ADIs, tolerable daily intakes (TDIs), or reference doses (RfDs), are commonly defined as the amount of a chemical to which a person, including members of sensitive subpopulations, can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect (U.S. EPA, 1993a). Appendix A describes the methods Intertox applied to develop ADIs for PPCPs and EDCs. The various screening levels are typically presented in terms of dose per unit of body weight per day (e.g., micrograms per kilogram body weight per day, or µg/kg-d), or as equivalent water concentrations calculated based on assumptions about the amount of water a person consumes per day and their body weight.

Screening levels in µg/kg-d were converted to drinking water equivalent level (DWELs) in µg/L by multiplying the screening level by an assumed body weight (e.g., 70 kg, the U.S. EPA default adult body weight) and dividing by an average daily drinking water ingestion rate (e.g., 2 liters per day, the U.S. EPA default adult drinking water ingestion rate) (U.S. EPA, 2006):

$$\text{DWEL } (\mu g / L) = \frac{\text{Health risk} - \text{based screening level } (\mu g / kg - d) \times 70 \text{ kg}}{2 \text{ L} / \text{d}}$$

A body weight of 70 kg, or about 150 pounds, is approximately equal to the mean body weight for adults (U.S. EPA, 1997), while a daily drinking water consumption rate of 2 L/day corresponds to about the 84th percentile of the average daily intake distribution for adults; the mean is about 1.4 L/day (U.S. EPA, 1997).

Often, when setting toxicity-based standards for contaminants in surface water systems, regulatory agencies incorporate additional factors into the above equations. One factor, known as a relative source contribution or RSC, accounts for the possibility that, on any given day, a person could be exposed to the substance through some other source than drinking water ingestion (e.g., consumption in food, exposure through other environmental media). RSCs typically range in value from 20 to 80% based on knowledge about likely alternative sources of exposure to the chemical (U.S. EPA, 2000; CDPH, 2007; U.S. EPA, 2006). Thus, if this approach is used, the resulting DWEL would correspond to a dose that is 20 to 80% of the ADI. In addition, in deriving Maximum Contaminant Levels (MCLs), U.S. EPA typically considers best available treatment technologies and costs. Thus, DWELs calculated from ADIs based on assumptions about the average body weight and drinking water consumption rate should not be interpreted as regulatory limits—rather, they represent a concentration below which adverse health effects over a lifetime of exposure are considered unlikely (for noncarcinogens) or are within a *de minimis* risk level (for carcinogens).

For the 49 analytes in SAR water, we determined the availability of health risk-based screening levels from the following sources:

- *ADIs and DWELs developed by Intertox in Water Research Foundation 3085/ WRF-04-003: "Toxicological Relevance of Endocrine Disruptors and Pharmaceuticals in Drinking Water" (Snyder et al., 2008).* This project developed ADIs for 16 PPCPs and 13 EDCs and applied them to assess the potential risk associated with drinking water exposure concentrations measured in water samples submitted by utilities across the United States. The final report has been published.
- *ADIs and DWELs developed by Intertox in WRF-06-018 "Development and Application of Tools to Assess and Understand the Relative Risks of Drugs and Other Chemicals in Indirect Potable Reuse Water" (Bruce et al., 2009).* This project developed ADIs for a total of 43 PPCPs, EDCs, and other emerging compounds of interest potentially present in water intended for indirect potable reuse. The project report is in final draft and will be published by the WateReuse Foundation this year.
- *ADIs and DWELs developed by Intertox in WRF-05-005 "Identifying Pharmaceuticals / Personal Care Products of Most Health Concern and Persistence through Water Treatments Used for Potable Reuse."* This project focused on developing and conducting a workshop attended by an expert panel of regulators and scientists to discuss alternative methods to efficiently develop human health risk-based screening levels for PPCPs and EDCs in potable water. Screening levels were identified for a total of 42 PPCPs, EDCs, and other emerging compounds of interest in water. The workshop was held in November 2008, and a final draft consensus report from the workshop has been developed. Although the objective of this project was not to develop final ADIs, but rather to explore the utility of various approaches for developing ADIs, the methods used are consistent with other programs (see those above); for purposes of the current project, we selected the lowest (most conservative) screening values developed in WRF-05-005 as ADIs. Because the report has not been finalized, ADIs and DWELs from that report are listed herein as *draft* values.

- *Schwab et al. (2005) ADIs for pharmaceuticals*. Schwab et al. (2005) developed screening levels for 16 pharmaceuticals by dividing the lowest therapeutic dose by uncertainty factors ranging from 10.2 to 150.
- *California Environmental Protection Agency Public Health Goals (PHGs) for contaminants in drinking water.* A PHG is a level of contaminant in drinking water (in units of µg/L) that would pose no significant health risk to individuals consuming the water on a daily basis over a lifetime (CA EPA, 2009). PHGs typically incorporate a RSC of 20 to 80% based on knowledge about likely alternative sources of exposure to the chemical (CDPH, 2007).
- *U.S. EPA Reference Doses (RfDs) (in units of µg/kg-d) and Maximum Contaminant Limits (MCLs, in units of µg/L) for various compounds, including pesticides.* A reference dose is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime (U.S. EPA, 2009b). An MCL is the maximum permissible level of a contaminant in water which is delivered to any user of a public water system, and takes into account best available treatment technologies and costs. The MCL is set as close to the Maximum Contaminant Level Goal (MCLG) as feasible. For noncarcinogens, the MCLG is the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, allowing for an adequate margin of safety (U.S. EPA, 2006), and is typically calculated from the DWEL (computed by multiplying an RfD by a body weight of 70 kg and dividing by an average water ingestion rate of 2 L/day) multiplied by an RSC (often 20%) (U.S. EPA, 2006). For carcinogens, the MCLG is set as zero.
- *U.S. EPA slope factors for carcinogenic compounds, in units of $(mg/kg\text{-}d)^{-1}$.* A slope factor is the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a dose of 1 mg/kg-d (U.S. EPA, 2009b). The slope factor is converted to an ADI by dividing an assumed *de minimis* lifetime acceptable cancer risk rate of one in one million (10^{-6}) by the slope factor. The ADI is in turn converted to a DWEL by multiplying it by an average adult body weight of 70 kg and dividing by a drinking water ingestion rate of 2 L/d.

The ADIs and DWELs identified for the 49 compounds are listed in Table 1.

The sections below compare concentrations of trace analytes detected at the Imperial Highway location to health risk-based screening levels presented as DWELs, estimate the amount of water with the maximum-detected concentration of each detected compound that a person would have to consume per day to reach a dose equal to the screening level, and summarize the findings.

3.1 Comparison of Water Concentrations at the Imperial Highway to Health Risk-Based DWELs

Table 2 compares maximum detected concentrations at the Imperial Highway location to health risk-based DWELs, if available, for each of the 16 detected compounds. The potential significance of the 33 nondetected compounds is also assessed by comparing MRLs to DWELs, if available.

3.1.1 Comparison of Maximum Detected Concentrations to Health Risk-Based DWELs

Health risk-based screening levels were identified for all of the detected compounds (Table 2). As shown, maximum detected concentrations of all compounds are below the respective health risk-based DWELs.

3.1.2 Comparison of MRLs for Nondetected Compounds to Health Risk-Based DWELs

Thirty three of the 49 compounds were not detected in any samples at the Imperial Highway location at concentrations above their MRLs. For these compounds, we compared the MRLs to health risk-based DWELs, if available. Health risk-based DWELs were identified for 18 of the nondetected compounds. The MRLs for all of these compounds were below their DWELs with the exception of two, benzo(a)pyrene and pentachlorophenol.

The MRL for benzo(a)pyrene, a polycyclic aromatic hydrocarbon (PAH) that can form when organic materials (e.g., gasoline, garbage, or any animal or plant materials) burn incompletely, was 0.025 µg/L. This concentration is above the California EPA PHG for benzo(a)pyrene of 0.004 µg/L (CA EPA, 1997). The PHG is based on evidence of gastric tumors in mice administered benzo(a)pyrene in the diet, and an assumed acceptable lifetime excess cancer incidence due to exposure to benzo(a)pyrene of 1 in 1,000,000 (i.e., 10^{-6}). The U.S. EPA MCL for benzo(a)pyrene in drinking water is 0.2 µg/L.

The MRL for pentachlorophenol, a pesticide and wood preservative, was 1.0 µg/L. This concentration is above the California EPA PHG for pentachlorophenol of 0.3 µg/L (CA EPA, 2009). The PHG is based on evidence of carcinogenicity (primarily liver tumors) in mice administered pentachlorophenol in the diet, and an assumed acceptable lifetime excess cancer incidence due to exposure to pentachlorophenol of 1 in 1,000,000 (i.e., 10^{-6}). The U.S. EPA MCL for pentachlorophenol in drinking water is 1.0 µg/L.

3.2 Daily Water Consumption Required to Equal Health Risk-Based Screening Levels

To put the health risk-based screening levels into understandable terms to support risk communication, the amount of water with the maximum-detected concentration that a person would have to consume, in liters per day, to reach a dose equal to the health risk-based screening level was calculated. The calculation used to compute these values is as follows:

$$\text{Required water consumption (L/day)} = \frac{\text{Health Risk-Based DWEL } (\mu\text{g/L}) \times 2 \text{ L/d}}{\text{Maximum water concentration } (\mu\text{g/L})}$$

The equivalent amount of water in eight ounce glasses of water per day was computed by multiplying the amount in L/day by 4.23. These calculations assume exposure only through drinking water; if a person is likely to be exposed to the compound through other sources, the required water consumption volume would be lower. However, it is unlikely that a person would directly consume water from this source, day after day, and average concentrations in finished drinking water would likely be much lower than the maximum concentrations assumed here. Therefore, these computations are expected to be reasonably to very conservative, and result in required water consumption estimates to equal health risk-based screening levels that are much lower than would be expected for drinking water. The results of the water consumption calculations are presented in Table 3.

Based on the data shown in Table 3 and the assumptions described above, estimated amounts of water that must be consumed to equal the health risk-based screening level for all detected compounds range from 19 L/day for primidone (about 82 8-oz. glasses per day) to 580,000 L/day for triclosan (about 2,400,000 8-oz. glasses per day). All of the compounds had an estimated water consumption value that significantly exceeded the assumed default daily water consumption rate of 2 L/day.

4.0 SUMMARY AND CONCLUSIONS

As discussed above, maximum detected concentrations of all 16 compounds detected in the SAR at the Imperial Highway location were below their health risk-based DWELs. Exceedance of a health risk-based screening level does not mean that adverse health effects are likely or will occur. Health risk-based screening levels incorporate numerous sources of conservatism, and do not represent thresholds at or above which adverse health effects are likely; rather, they represent levels below which adverse health effects are extremely unlikely to occur. Exceedance of a health risk-based screening level suggests that further examination of detected concentrations and their significance relative to exposure levels associated with adverse health effects is warranted.

For 15 of the 33 analytes that were not detected at the Imperial Highway location, health risk-based screening levels were not identified. Of the 18 nondetected compounds with DWELs, two had MRLs that were slightly above their DWELs. These were benzo(a)pyrene, which had an MRL of 0.025 μg/L and a California EPA PHG of 0.004 μg/L, and pentachlorophenol, which had an MRL of 1.0 μg/L and a California EPA PHG of 0.3 μg/L. While these compounds could theoretically be present at concentrations slightly above the PHG but below the MRL, they were detected very infrequently in the SAR watershed (benzo(a)pyrene was detected in only four of 52 samples at the 13 sample locations, and pentachlorophenol was not detected in any of the 52 samples) suggesting low potential for either of these compounds to be present in water at the Imperial Highway location at levels that present a human health concern.

It is unlikely that a person would drink untreated water from the Santa Ana River. However, based on our review of the water data collected at the Imperial Highway on May 22, 2008, August 19, 2008, November 5, 2008, and February 25, 2009, even if someone routinely consumed untreated drinking water from this source, no adverse health effects would be expected for any of the 49 analyzed compounds.

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TABLE 1. Basis of Health Risk-Based Screening Levels

Compound	Group	ADI (µg/kg-d)	DWEL (µg/L)	Source of ADI	Basis of ADI
Acetaminophen	Drug (antibiotic)	340	12,000	Schwab et al. (2005) ADI[a]	Therapeutic dose & 27 UF
Anthracene	Polycyclic aromatic hydrocarbon	300	11,000	U.S. EPA (1993b) RfD	Noncancer toxicity data (no effect level for systemic effects in mice)
Atrazine	Triazine herbicide	ND [b]	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG	Systemic effects in rats (reduced body weight); mammary tumors in rats
Atrazine-Desethyl	Metabolite and degradate of triazine herbicides	ND [b]	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG [c]	Atrazine MCL and PHG
Atrazine-Desisopropyl	Metabolite and degradate of triazine herbicides	ND [b]	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG [c]	Atrazine MCL and PHG
Azithromycin	Drug (antibiotic) (Zithromax®)	NA	NA	NA	NA
Benzo(a)pyrene	Polycyclic aromatic hydrocarbon	ND [b]	0.004	CA EPA (1997) PHG	Gastric tumors in mice
Bisphenol A	Intermediate in production of resins	50	1,800	U.S. EPA (1993c) RfD; Snyder et al. (2008) ADI	Systemic effects in mice (reduced body weight)
Butylparaben	Preservative in personal care products	NA	NA	NA	NA
Caffeine	Food additive/ natural ingredient	2,500	87,500	Health Canada (2007)	Recommended maximum consumption for children ≤ 12 years based on potential for increased anxiety
Carbamazepine	Drug (anticonvulsant) (Tegretol)®	0.34	12	Snyder et al. (2008) ADI	Liver tumors in rats
Ciprofloxacin	Drug (antibiotic)	0.60	21	WRF-06-018 ADI (Draft value)	Minimum inhibitory concentration for GI flora
Cyanazine	Triazine herbicide	ND [b]	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG [c]	Atrazine MCL and PHG
Cyprazine	Triazine herbicide	ND [b]	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG [c]	Atrazine MCL and PHG
o,p-DDD	Drug (treatment of Cushings disease) (Mitotaine®)	0.0042	0.15	U.S. EPA (1988b) cancer slope factor for p,p-DDD (0.24 $(mg/kg\text{-}d)^{-1}$)	Liver tumors in mice
DEET	Insect repellent	2.3	81	WRF-06-018 ADI	Neurological effects in rats
Diclofenac	Drug (NSAID analgesic)	67	2,300	Snyder et al. (2008) ADI	Developmental effects in mice
Diethylstilbestrol	Drug (synthetic estrogen for miscarriage prevention); no longer approved	NA	NA	NA	NA
Dilantin (Phenytoin)	Drug (anticonvulsant)	0.19	6.7	Snyder et al. (2008) ADI	Liver tumors in mice

TABLE 1 (cont). Basis of Health Risk-Based Screening Levels

Compound	Group	ADI (µg/kg-d)	DWEL (µg/L)	Source of ADI	Basis of ADI
Diuron	Herbicide	2.0	70	U.S. EPA (1988a) RfD	Hematological effects in dogs
Epitestosterone	Endogenous hormone	NA	NA	NA	NA
17a-Estradiol	Endogenous hormone	NA	NA	NA	NA
17b-Estradiol	Endogenous hormone	0.017	1.8	Snyder et al. (2008) ADI	Minimum dose for therapeutic effect in human & 100 UF
Estriol	Endogenous hormone	NA	NA	NA	NA
Estrone	Endogenous hormone	0.050	0.46	Snyder et al. (2008) ADI	No effect on endocrine measurements in humans
Ethylparaben	Preservative in personal care products	NA	NA	NA	NA
Ethynylestradiol	Drug (oral contraception)	NA	NA	NA	NA
Gemfibrozil	Drug (antilipidemic) (Lopid®)	1.3	46	Snyder et al. (2008) ADI	Testicular tumors in rats
Ibuprofen	Drug (NSAID analgesic)	0.97	34	WRF-06-018 ADI (Draft value)	Therapeutic dose & 3000 UF
Lindane	Organochlorine insecticide	ND [b]	0.032	CA EPA (2005) PHG	Liver tumors in mice
Linuron	Substituted urea herbicide	2.0	70	U.S. EPA (1990) RfD; Synder et al. (2008) ADI	Hematological effects in dogs
Methoxychlor	Organochlorine insecticide	0.020	0.70	Snyder et al. (2008) ADI	Developmental effects in mice (EPA MCL = 40 ug/L; CA EPA PHG = 30 ug/L)
Methylparaben	Preservative in personal care products	NA	NA	NA	NA
4-n- and 4-t-Octylphenol	Surfactant	0.50	18	WRF-05-005 ADI (Draft value)	Noncancer toxicity data (developmental, rat)
4-n-Nonylphenol	Surfactant	50	1,800	Snyder et al. (2008) ADI	Developmental effects in rats
Nonylphenol ethoxylates (total)	Surfactant	NA	NA	NA	NA
Pentachlorophenol	Pesticide, wood preservative	ND [b]	0.3	CA EPA (2009) PHG	Liver tumors in mice
4-Phenylphenol	Chemical intermediate	NA	NA	NA	NA
Primidone	Drug (anticonvulsant) (Mysoline®)	0.024	0.84	WRF-06-018 ADI	Liver tumors in mice
Progesterone	Endogenous hormone	NA	NA	NA	NA
Propazine	Triazine herbicide	ND [b]	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG [c]	Atrazine MCL and PHG
Propylparaben	Preservative in personal care products	NA	NA	NA	NA

TABLE 1 (cont). Basis of Health Risk-Based Screening Levels

Compound	Group	ADI (µg/kg-d)	DWEL (µg/L)	Source of ADI	Basis of ADI
Simazine	Triazine herbicide	ND [b]	4	U.S. EPA (2009a) MCL; CA EPA (2001) PHG	Reduced body weight in rats
Sulfamethoxazole	Drug (antibiotic) (Generic)	510	18,000	Snyder et al. (2008) ADI	Developmental effects in rats
TCEP	Reducing agent	0.12	4.2	WRF-06-018 ADI	Virtually safe dose for nongenotoxic carcinogenicity
Testosterone	Endogenous hormone	NA	NA	NA	NA
Tetrabromobisphenol A	Brominated flame retardant	NA	NA	NA	NA
2,4,6-Trichlorophenol	Pesticide, preservative	0.091	3.2	U.S. EPA (1994) slope factor (0.011 $(mg/kg\text{-}d)^{-1}$)	Leukemia in mice
Triclosan	Drug (antibacterial/ antimicrobial) (Generic)	75	2,600	Snyder et al. (2008) ADI	No effect on systemic endpoints in hamsters

ADI– Acceptable daily intake; DEET– N,N-Diethyl-meta-toluamide; PHG– Public Health Goal; NA–Value not available; RfD– Reference dose; TCEP– tris(2-carboxyethyl)phosphine

a. Schwab et al. (2005) calculated an ADI for acetaminophen from a therapeutic dose of 650 mg/day, or 9.3 mg/kg-d assuming exposure to a 70 kg adult. However, Schwab et al. applied a combined UF of 27, whereas more recent work by Intertox, including the results of the expert panel convened in WRF-05-005, concluded that application of a default UF of 3,000 to minimum therapeutic doses is appropriate. Application of a UF of 3,000 to 9.3 mg/kg-d would yield an ADI of 3.1 µg/kg-d.

b. The DWELs for these compounds were set equivalent to published U.S. EPA MCLs or California EPA PHGs. Because MCLs and PHGs incorporate additional factors into calculation of acceptable water concentrations from ADIs (e.g., relative source contributions for both MCLs and PHGs, and best available technologies and costs for MCLs), ADIs were not backcalculated from these values.

c. The DWELs for atrazine-desethyl, atrazine-desisopropyl, cyanazine, cyprazine, and propazine are assumed to be the same as the DWEL for atrazine-desisopropyl atrazine proposed in WRF-06-018, which is equivalent to the U.S. EPA MCL for atrazine. Per U.S. EPA,the chlorotriazine herbicides and their metabolites are assumed to share the same neuroendocrine mechanism of toxicity and to be "toxicologically equivalent (equipotent) to atrazine" (U.S. EPA-OPPTS, 2006).

TABLE 2. Statistical Summary of Sampling Data for Trace Organics in the Santa Ana River at the Imperial Highway and Comparison to Health Risk-Based DWELs

Compound	Lab	MRL (µg/L)	Freq. of Detect	Concentration (µg/L)			Source of DWEL	Max (or MRL) > DWEL? [a]
				Min. Detect	Max.	Health Risk-Based DWEL		
Detected Compounds								
Acetaminophen	OCWD	0.001-0.020	3/4	0.0037	0.430	12,000	Schwab et al. (2005) ADI	No
Atrazine	MWD	0.001	3/4	0.0022	0.0029	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG	No
Caffeine	MWD & OCWD	0.005	4/4	0.035	1.255	87,500	Health Canada (2007)	No
Carbamazepine	MWD & OCWD	0.001	4/4	0.052	0.120	12	Snyder et al. (2008) ADI	No
Ciprofloxacin	OCWD	0.010-0.1	1/4	0.022	0.022	21	WRF-06-018 ADI (Draft value)	No
DEET	MWD & OCWD	0.020	4/4	0.020	0.156	81	WRF-06-018 ADI (Draft value)	No
Diclofenac	MWD	0.005	1/4	0.015	0.015	2,300	Snyder et al. (2008) ADI	No
Dilantin (Phenytoin)	MWD	0.005	4/4	0.035	0.143	6.7	Snyder et al. (2008) ADI	No
Diuron	MWD	0.005	4/4	0.053	0.954	70	U.S. EPA (1988a) RfD	No
Gemfibrozil	MWD & OCWD	0.005	4/4	0.0069	0.023	46	Snyder et al. (2008) ADI	No
Ibuprofen	MWD & OCWD	0.010	3/4	0.042	0.309	34	WRF-06-018 ADI (Draft value)	No
Primidone	MWD & OCWD	0.002	4/4	0.041	0.087	0.84	WRF-06-018 ADI (Draft value)	No
Simazine	MWD	0.020	3/4	0.024	0.060	4	U.S. EPA (2009a) MCL; CA EPA (2001) PHG	No
Sulfamethox-azole	MWD & OCWD	0.001	4/4	0.041	0.084	18,000	Snyder et al. (2008) ADI	No
TCEP	MWD	0.005	4/4	0.111	0.217	4.2	WRF-06-018 ADI (Draft value)	No
Triclosan	MWD & OCWD	0.005	1/4	0.009	0.009	2,600	Snyder et al. (2008) ADI	No
Non-Detected Compounds								
Anthracene	MWD	0.010	0/4	ND	ND	11,000	U.S. EPA (1993b) RfD	No
Atrazine-Desethyl	MWD	0.020	0/4	ND	ND	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG	No
Atrazine-Desisopropyl	MWD	0.020	0/4	ND	ND	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG	No
Azithromycin	OCWD	0.001-0.005	0/4	ND	ND	NA	NA	NA

TABLE 2 (cont). Statistical Summary of Sampling Data for Trace Organics in the Santa Ana River at the Imperial Highway and Comparison to Health Risk-Based DWELs

Compound	Lab	MRL (µg/L)	Freq. of Detect	Concentration (µg/L) Min. Detect	Max.	Health Risk-Based DWEL	Source of DWEL	Max (or MRL) > DWEL? [a]
Benzo(a)pyrene	MWD	0.025	0/4	ND	ND	0.004	CA EPA (1997) PHG	Yes
Bisphenol A	MWD & OCWD	1.0	0/4	ND	ND	1,800	U.S. EPA (1993c) RfD; Snyder et al. (2008) ADI	No
Butylparaben	MWD	0.020	0/4	ND	ND	NA	NA	NA
Cyanazine	MWD	0.020	0/4	ND	ND	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG	No
Cyprazine	MWD	0.020	0/4	ND	ND	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG	No
o,p-DDD	MWD	0.020	0/4	ND	ND	0.15	U.S. EPA (1988b) cancer slope factor for p,p-DDD	No
Diethylstilbestrol	OCWD	0.010	0/4	ND	ND	NA	NA	NA
Epitestosterone	OCWD	0.010	0/4	ND	ND	NA	NA	NA
17a-Estradiol	OCWD	0.010	0/4	ND	ND	NA	NA	NA
17b-Estradiol	OCWD	0.010	0/4	ND	ND	1.8	Snyder et al. (2008) ADI	No
Estriol	OCWD	0.010	0/4	ND	ND	NA	NA	NA
Estrone	OCWD	0.010	0/4	ND	ND	0.46	Snyder et al. (2008) ADI	No
Ethylparaben	MWD	0.020	0/4	ND	ND	NA	NA	NA
Ethynylestradiol	MWD & OCWD	0.010	0/4	ND	ND	NA	NA	NA
Lindane	MWD	0.010	0/4	ND	ND	0.032	CA EPA (2005) PHG	No
Linuron	MWD	0.005	0/4	ND	ND	70	U.S. EPA (1990) RfD; Synder et al. (2008) ADI	No
Methoxychlor	MWD	0.020	0/4	ND	ND	0.70	Snyder et al. (2008) ADI	No
Methylparaben	MWD	0.020	0/4	ND	ND	NA	NA	NA
4-n-Nonylphenol	MWD & OCWD	1.0	0/4	ND	ND	1,800	Snyder et al. (2008) ADI	No
Nonylphenol ethoxylates (total)	OCWD	10	0/4	ND	ND	NA	NA	NA
4-n- and 4-t-Octylphenol	MWD & OCWD	1.0	0/4	ND	ND	18	WRF-05-005 ADI (Draft value)	No
Penta-chlorophenol	OCWD	1.0	0/4	ND	ND	0.3	CA EPA (2009) PHG	Yes
4-Phenylphenol	OCWD	1.0	0/4	ND	ND	NA	NA	NA

TABLE 2 (cont). Statistical Summary of Sampling Data for Trace Organics in the Santa Ana River at the Imperial Highway and Comparison to Health Risk-Based DWELs

Compound	Lab	MRL (µg/L)	Freq. of Detect	Concentration (µg/L)			Source of DWEL	Max (or MRL) > DWEL? [a]
				Min. Detect	Max.	Health Risk-Based DWEL		
Progesterone	OCWD	0.010	0/4	ND	ND	NA	NA	NA
Propazine	MWD	0.020	0/4	ND	ND	3; 0.15	U.S. EPA MCL (U.S. EPA-OPPT, 2006); CA EPA (1999) PHG	No
Propylparaben	MWD	0.020	0/4	ND	ND	NA	NA	NA
Testosterone	OCWD	0.010	0/4	ND	ND	NA	NA	NA
Tetrabromo-bisphenol A	OCWD	1.0	0/4	ND	ND	NA	NA	NA
2,4,6-Trichloro-phenol	OCWD	1.0	0/4	ND	ND	3.2	U.S. EPA (1994) slope factor	No

ADI– Acceptable daily intake; DEET– N,N-Diethyl-meta-toluamide; MRL–Minimum Reporting Limit; MWD–Metropolitan Water District; OCWD–Orange County Water District; PHG– Public Health Goal; NA–Value not available; ND–Not detected; RfD– Reference dose; TCEP– tris(2-carboxyethyl)phosphine

a. For non-detected compounds, the MRL is compared to the health risk-based DWEL.

TABLE 3. Daily Water Consumption Required to Equal Health Risk-Based Screening Levels.
Required consumption rates are the amount of water with the reported concentration that a person would have to consume each day to ingest a dose equal to the health risk-based screening level. The source of the health risk-based DWEL is indicated in Table 1. The calculation method is summarized in Section 3.2.

Compound	Maximum Conc. (μg/L)	Health Risk-Based DWEL (μg/L)	Consumption Rate Required to Equal Health Risk-Based Screening Level (L/day)	Consumption Rate Required to Equal Health Risk-Based Screening Level (8-oz glasses/day)
Acetaminophen	0.430	12,000	56,000	240,000
Atrazine	0.0029	0.15	100	440
Caffeine	1.255	87,500	140,000	590,000
Carbamazepine	0.120	12	200	850
Ciprofloxacin	0.022	21	1,900	8,100
DEET	0.156	81	1,000	4,400
Diclofenac	0.015	2,300	310,000	1,300,000
Dilantin (Phenytoin)	0.143	6.7	94	400
Diuron	0.954	70	150	620
Gemfibrozil	0.023	46	4,000	17,000
Ibuprofen	0.309	34	220	930
Primidone	0.087	0.84	19	82
Simazine	0.060	4	130	560
Sulfamethoxazole	0.084	18,000	430,000	1,800,000
TCEP	0.217	4.2	39	160
Triclosan	0.009	2,600	580,000	2,400,000

ADI– acceptable daily intake; DEET– N,N-Diethyl-meta-toluamide; DWEL– drinking water equivalent level; NA–Value not available; TCEP– tris(2 carboxyethyl)phosphin

APPENDIX A

METHODS USED BY INTERTOX TO DERIVE ACCEPTABLE DAILY INTAKES (ADIS) FOR PHARMACEUTICALS AND PERSONAL CARE PRODUCTS, ENDOCRINE DISRUPTING COMPOUNDS, AND OTHER COMPOUNDS OF EMERGING INTEREST

As part of Water Research Foundation 3085/WRF-04-003, "Toxicological Relevance of Endocrine Disruptors and Pharmaceuticals in Drinking Water" study, the WRF-06-018 "Development and Application of Tools to Assess and Understand the Relative Risks of Drugs and Other Chemicals in Indirect Potable Reuse Water" study, and other work we have conducted, Intertox developed screening level ADIs for pharmaceuticals and personal care products (PPCPs), endocrine disrupting compounds (EDCs), and other compounds of emerging interest in drinking water or source water.

For compounds of interest, Intertox developed screening levels using several different methods that considered the potential for both noncancer and cancer effects, and selected the screening level corresponding to the lowest (most health protective) value as the ADI. For EDCs, ADIs also considered observations of adverse effects assumed to be mediated through alterations of the endocrine system.

Although no specific regulatory guidance exists prescribing how to assess human health risks of exposure to PPCPs or EDCs in drinking water, standard methods exist for determining exposure levels to environmental contaminants that are not likely to be associated with adverse health effects (WHO, 1994; U.S. EPA, 2000a; ATSDR, 2008). To develop ADIs, Intertox reviewed animal toxicology data and data from human clinical studies, for effects other than carcinogenicity, identified a point of departure upon which to base the ADI. This was typically the highest dose at which an effect was not seen (the no observed adverse effect level, or NOAEL) or the lowest dose at which an effect was seen (the lowest observed adverse effect level, or LOAEL). Below this dose, there is no evidence of a statistically or biologically significant increase in adverse effects, although some changes may occur that are not considered adverse (e.g., changes in certain enzyme levels). The point of departure was then divided by uncertainty factors (UFs) to derive an ADI considered protective to broader population groups, including sensitive populations, such as children or people with immune compromised systems, as follows:

$$\text{ADI } (\mu\text{g/kg-d}) = \frac{\text{NOAEL or LOAEL (mg/kg-d)}}{\text{UFs}} \times \frac{1000\ \mu\text{g}}{\text{mg}}$$

UFs individually ranged in value from 3 to 10 with each factor representing a specific area of uncertainty in the available data. For example, if the point of departure is based on an animal study, a factor of 10 was applied to account for possible differences in responsiveness between animals and humans. A second factor of 10 was used to account for variation in susceptibility among humans. Other factors account for database deficiencies, such as when no or minimal information exists on reproductive effects or longer-term exposures. When high-quality toxicity data are available, combined UFs typically ranged from 1,000 to 10,000.

For compounds with evidence of carcinogenicity occurring through genotoxic mechanisms and available tumor incidence data, Intertox derived ADIs using an extrapolation model that assumes a linear relationship between tumor incidence and exposure at low doses (U. S. EPA, 2005; U.S. EPA, 2000b), and the generally accepted *de minimis* cancer risk of one additional cancer per one million exposed people. For compounds with evidence of carcinogenicity in animals occurring through genotoxic mechanisms but no available tumor incidence data, a "virtually safe dose" corresponding to a lifetime cancer risk of one in a million was estimated by dividing the chemical's maximum tolerated dose from 90-day studies in rodents by 740,000 (Gaylor and Gold, 1998). The maximum tolerated dose is the highest dose predicted to produce minimal systemic toxicity over the course of a study. For compounds with evidence of carcinogenicity in animals occurring through nongenotoxic mechanisms (e.g., assumed to be a threshold response), a virtually safe dose was estimated by dividing the chemical's maximum tolerated dose from 90-day studies in rodents by 7,000 (Gaylor and Gold, 1998).

In addition, Intertox developed ADIs for pharmaceuticals based on the lowest therapeutic dose divided by uncertainty factors to account for uncertainties in the data and to protect sensitive populations, as follows:

$$\text{ADI } (\mu\text{g/kg-d}) = \frac{\text{Lowest therapeutic dose } (\mu\text{g/kg-d})}{\text{UFs}}$$

To apply to the therapeutic dose, a combined uncertainty factor of 3,000 was used, to account for extrapolation from the lowest therapeutic dose to a NOAEL (10), variations in susceptibility between different members of the population (10), extrapolation from subchronic to chronic exposure durations (10), and gaps in the dataset (3).

For ciprofloxacin, Intertox developed an ADI based on the minimum inhibitory concentration (MIC) to 50% of strains of the most sensitive relevant human gastrointestional flora, that is, the concentration of ciprofloxacin that will inhibit the visible growth of the microorganism by 50% (WHO, 1997; WHO, 2006). While this response is not explicitly toxic to human cells, it should be considered adverse because of the potential adverse impact on human gastrointestinal health.

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Appendix C

Proposed Sampling and Laboratory Analysis Plan (SLAP) for the

2010-11 Emerging Constituents Characterization Study in the Santa Ana Watershed

The Santa Ana Watershed Project Authority's (SAWPA) Emerging Constituents (EC) Workgroup submitted a water quality investigation workplan to the Santa Ana Regional Water Quality Control Board (RWQCB) to characterize selected ECs in surface waters and imported waters for calendar year 2010[1]. The selected ECs include pharmaceuticals & personal care products (PPCPs), pesticides, herbicides, and industrial indicators of wastewater origin. The analytical laboratories supporting this effort will be able to follow the criteria presented within this Sampling and Laboratory Analysis Plan (SLAP), which is a required element of the workplan.

1. Sample Collection, Preservation, Storage and Holding Times

Sampling and laboratory analysis will be scheduled to meet the deadlines specified in Section 5E of the workplan described in the Phase-II report. Specifically, the results from all POTW (publicly owned treatment works) effluent samples, the State Water Project (SWP) and Colorado River samples from Metropolitan Water District of Southern California (MWDSC), and the first SAR sampling event (two sites) conducted by Orange County Water District (OCWD) are due to SAWPA by July 31st, 2010. These data will be included in the Annual Report that is due to the RWQCB by December 31, 2010. The second set of SAR samples are to be collected and analyzed by OCWD by September 30th, 2010, with these data to be included in the subsequent 2011 Annual Report.

Each designated lab will provide their own sample bottles (pre-cleaned amber glass) preserved with ascorbic acid (50 mg/L) and sodium azide (1 g/L) added to sample bottles before shipment to the sites. Samples bottles can be pre-labeled with site information, and will include date, sampling time, sampler, site location, and required testing. Bottles should include a label with the method's chemical preservatives.

Samplers and laboratory staff will be warned of low-level detection of ECs and potential background sources caused by the sampling process. These personnel should be aware of the potential for interference from the use of target compounds monitored within this investigation (prescription drugs, coffee, ibuprofen, acetaminophen, etc.). Specifically, they will be requested not to consume any caffeinated drinks while at the sample site, nor during the time of sample collection or laboratory analysis. Each designated agency will insure that these sampling guidelines are followed, and that qualified sampling staff are assigned to this investigation. Samplers will wear clean nitrile gloves at each site, and will follow the standard operating procedures outlined within their sampling programs.

[1] Phase-II Report of the Emerging Constituents Workgroup, approved by the Santa Ana Regional Water Quality Control Board on December 10th, 2009

Field Blanks will be taken at each site where a similar sample volume of laboratory reagent water is transferred into a labeled FIELD BLANK sample bottle (preserved). Each laboratory will provide the laboratory reagent water for their field blanks, and any other additional quality control samples required within their laboratory's analysis.

At least one site within each matrix group will be sampled as a duplicate, and noted within the chain of custody (COC) form. Field parameters will be measured and noted onto the COC – electrical conductivity, pH, temperature, dissolved oxygen, etc. Also, enough samples will be taken to ensure that matrix spike and matrix spike duplicates (25-200 ng/L) can be performed on at least 10% of the total samples collected.

Sample extraction holding time is 14 days and the extract analysis holding time 14 days. The laboratory should try and extract and process the EC method as soon as possible after delivery. Samples should be transported in ice (bagged or blue ice) and delivered to the lab at <10°C. Samples are to be kept refrigerated until ready to be extracted (<6°C).

One site location will be identified as a "split sample" and processed by all participating labs. We recommend the *SAR at Prado Dam* site for the split sample. This will represent the matrix split sample within the study. OCWD will collect, split, and distribute this sample to all participating laboratories.

2. Target Analytes

The SAWPA's EC team developed a listing of eleven target compounds to be monitored within this study (see Table 1). The selection criteria are based on detection within previous national studies and recommendations as surrogates for wastewater indicators.

All labs have different EC target lists, and therefore will generate specific information on the samples analyzed. Targets lists will continue to evolve and the reportable levels can also vary. For the purposes of this study, each lab will report to SAWPA the results and related QA/QC data for the eleven target compounds.

All targets will be analyzed using the isotope dilution technique, with the exception of TCEP, as its required labeled standard is cost-prohibitive at the present time.

Table 1: Chemicals to be Analyzed in 2010-11 EC Characterization Study

Analyte	CAS#	Category
Acetaminophen	103-90-2	Pharmaceutical
Diuron	330-54-1	Herbicide
Bisphenol-A	80-05-7	Industrial
Caffeine	58-08-2	Food Additive
Carbamazepine	298-46-4	Pharmaceutical
DEET	134-62-3	Pesticide
17α Ethynylestradiol	57-63-6	Pharmaceutical
Gemfibrozil	25812-30-0	Pharmaceutical
Ibuprofen	15687-27-1	Pharmaceutical
Sulfamethoxazole	723-46-6	Pharmaceutical
TCEP	115-96-8	Industrial

3. QA/QC Procedures

Each lab will operate their method according to their Standard Operating Procedure (SOP), and therefore have associated Quality Assurance/Quality Control (QA/QC) samples analyzed within their procedure to help confirm the reported values. However, general data quality objectives can be developed within this investigation. All laboratories should be able to meet the criteria listed below. In an effort to facilitate the comparison of data produced by multiple laboratories and to minimize the effects of sample interference, the study's minimum reporting level (S-MRL) will be set at 10 ng/L. SAWPA's EC study report will use the S-MRL for final reporting purposes. Each lab will provide their most recent method detection limit (MDL) value for each target reported.

Two "Blind QA Samples" prepared by Environmental Resource Associates (ERA) will be sent directly to each participating lab. The first blind sample will be a mid-level check, where each target compound from SAWPA's target list spiked between 25-200 ng/L in a clean water matrix. The second blind sample will be a low-level check S-MRL Verification, where seven or eight of the eleven target compounds are spiked at a 10-15 ng/L level. These QA samples will be processed along with all received study sites by each laboratory.

Table 2: Method Performance Checks for EC Characterization Study

Sample Description	Specification & Frequency	Acceptance Criteria	Remedial Action
Low-Level CCC at the MRL (RDL)	Each Analysis Run	50-150% target recovery	Instrument Maintenance and Check Standards
Mid-Level CCC	Each Analysis Run	70-130% target recovery	Instrument Maintenance and Check Standards
"RB" Reagent Blank	Each Extraction Set	All targets must be less than 1/3 of the MRL (RDL)	Isolate Source of Contamination and Re-Extract
Low LFB Spiked Reagent Water at the MRL	Each Analysis Run	50-150% target recovery	Check SPE Cartridge Lots Verify Extraction Procedures and Re-extract
LFB – mid level	Each Analysis Run	70-130% target recovery	Check SPE Cartridge Lots Verify Extraction Procedures and Re-extract
Matrix Spikes Matrix Spike Duplicates Spike/Spike Dup (e.g. 200 ng/L - SARMON)	Each Analysis Run 10% minimum of total sample load	60-140% recovery <30%RPD If MS/MSD spike level is <50% of the ambient concentration acceptance limits are not relevant	Investigate Matrix Issues Check Standards and Re-Extract
Field Sample	Run Analysis	Check Internal (Isotope) Recovery (compound independent)	Investigate Matrix Issues Check Standards and Re-Extract
Back Standards	Each Analysis Run Every 10 samples must be bracketed with a CCC std	70-130% target recovery	Instrument Maintenance and Check Standards
Initial Calibration	Started Before Each Analysis Run	Must use at least a 5-point calibration curve Lowest Standard must be at or below reportable detection level (RDL) Calib. Curve <20% RSD	Check Standard Lots and QC Re-shoot or Open New Standards Instrument Maintenance
SAWPA Project Sample Duplicates	Each Analysis Run 10% minimum of total sample load	<30%RPD	Results Reported Re-Extract to confirm if possible
MDLs	Each New SPE Lot or Major Instrument Maintenance	The goal is for the calculated MDL to be 1/3 the RDL. The MDL must be lower than the RDL.	Instrument Maintenance, Extraction Procedures and Check Standards

4. Data Assessment and Reporting

Data will be reviewed by each laboratory's procedure and potential re-extractions or analysis conducted. Any samples that fail specific QA/QC criteria, which require a re-sampling request, will be done and evaluated at each participating lab. A detailed description of the cause(s) of the request will be reviewed.

Laboratories will provide a copy of their detailed SOP within the support of this investigation. Final reports will provide all QA/QC information including spike recovery information, LFB recoveries, blanks, calibration check information, MDLs, and applied method techniques. Blanks and MRL criteria referenced in Table 3 will be followed by all laboratories.

Table 3: Blanks and MRL Criteria for Preliminary EC Characterization Study

Batch QC	QC result	Secondary check	Reporting qualifiers
Method Blank	<MRL		OK to report - not clear that 1/3 MRL is always feasible (e.g. caffeine)
	>MRL	Samples ND	OK to report
	>MRL	Samples positive	Reprocess all positive samples
MRL - Check	<50%		Reprocess entire batch
	50-150%		Proceed
	>150%		Report if samples ND & note qualifier
LCS (spike must be <10x the MRL and should be representative of samples)	<70%		Reprocess entire batch
	70-130%		Proceed
	>130%		Report if samples ND & note qualifier

Field QC	QC result	Secondary check	Reporting qualifiers
Field Blank	< MRL		Proceed
	1-2x MRL		
	1-2x MRL	Samples ND	Report
	1-2x MRL	samples >2x field blank	Report value with flag (field blank contains target analyte but sample >2X field blank level)
	1-2x MRL	samples <2x field blank	Report ND with flag (field blank contains similar levels to sample)
	>2x MRL		
	>2x MRL	samples <10x Field Blank	Field Contamination (Resample required)
	>2x MRL	samples>10x field blank	Report value with flag (field blank contains target analyte but sample >10X field blank level)

5. Data Interpretation and Application

Because the analytical techniques used to support EC characterization studies are still in the early stages of development, great care must be exercised when using the results of such studies. To ensure that water quality monitoring data is used appropriately, EPA has established formal Data Quality Assurance requirements:

> *"EPA has developed a mandatory Agency-wide Quality System (or QA program) that requires all organizations performing work for EPA to assure that: environmental data collected are of the appropriate type and quality for their intended use...."*[2]

> *"Data Quality Objectives (DQOs) are statements of the level of uncertainty that a decision maker is willing to accept in results derived from environmental data, when the results are going to be used in a regulatory or programmatic decision (e.g., setting or revising a standard, or determining compliance). They are a tool that the permit writer may use to ensure that resources are being expended in the most efficient way, and that data collected are sufficient to support the decision making process and not extraneous to that process. To be complete, these quantitative DQOs must be accompanied by clear statements of: decisions to be made; why environmental data are needed and how they will be used; time and resource constraints on data collection; descriptions of the environmental data to be collected; specifications regarding the domain of the decision; calculations, statistical or otherwise, that will be performed on the data in order to arrive at a result. Without first developing DQOs, a QA program can only be used to document the quality of obtained data, rather than to ensure that the data quality obtained will be sufficient to support a permitting decision."*[3]

The most common use of water quality monitoring data is to evaluate compliance with relevant water quality standards. Therefore, DQOs are usually established in order to ensure that the resulting information is suitable for that intended regulatory purpose. The data quality criteria established in conjunction with California's 303(d) listing guidance is an example of such DQOs.[4]

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[2] U.S. EPA. EPA Requirements for Quality Management Plans; EPA QA/R-2; Nov., 1999.
[3] U.S. EPA. NPDES Permit Writer's Guide to Data Quality Objectives; Nov., 1990; p. 1-4 & 1-5.
[4] State Water Resources Control Board. Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. Sept. 30, 2005; Section 6.1 @ pgs. 17-26. See also Final Functional Equivalent Document for Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. Sept., 2004. Pgs. 232-235.

However, since there are no federal or state water quality standards for the ECs analyzed during this characterization study, it is not possible to establish appropriate DQOs for evaluating compliance with such standards.[5] Therefore, until EPA approves standard analytical methods, the data collected as part of this preliminary EC characterization study should be considered "provisional."[6] This is consistent with EPA's guidance:

> *…methods which will be used extensively for regulatory purposes or where significant decision must be based on the quality of the analytical data normally require more extensive validation and standardization than methods developed to collect preliminary baseline data.*[7]

The data quality objectives established in this Sampling and Analysis Plan are suitable for supporting an early effort to characterize EC concentrations in the Santa Ana watershed. However, a more rigorous data quality review will be necessary before the new information can be deemed suitable to support some regulatory applications, such as: 303(d) listing decisions, antidegradation analyses or translating narrative criteria into numeric TMDL targets or effluent limits. This issue is best addressed by the State Board, through the normal public hearing process, after the Blue Ribbon Panel on Emerging Constituents submits its recommendations.

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[5] EPA publishes recommended federal water quality criteria pursuant to Section 304(a) of the Clean Water Act. State water quality standards are normally documented in the Water Quality Control Plan (aka "Basin Plan") adopted by each of the California Regional Water Quality Control Boards.

[6] EPA's criteria for certifying a new standard method, pursuant to 40 CFR Part 136, requires a thorough demonstration of accuracy, precision, method detection levels, representativeness, ruggedness, comparability and availability for the proposed analytical procedure. See U.S. EPA. Availability, Adequacy, and Comparability of Testing Procedures for the Analysis of Pollutants Established Under Section 304(h) of the Federal Water Pollution Control Act - Report to Congress; EPA/600/9-87/030; September, 1988 for a more detailed discussion.

[7] U.S. EPA. Availability, Adequacy, and Comparability of Testing Procedures for the Analysis of Pollutants Established Under Section 304(h) of the Federal Water Pollution Control Act - Report to Congress; EPA/600/9-87/030; September, 1988; pg.3-5S

6. Definitions

Blind QA Samples – An unknown quality assurance sample, which is spiked with the study's target compounds in a reagent water matrix. QA samples are provided by a method Performance Evaluation (PE) vendor – Environmental Resource Associates (ERA). Two QA samples are provided within this study – a mid level calibration check (25-200 ng/L) and an S-MRL check (10-15 ng/L). QA samples are sent directly to participating labs by the PE vendor for analysis.

CCC – Continuous Calibration Check – a method required standard to verify the calibration curve – most labs will run verification at the mid-level of the calibration – and at the reportable detection level - RDL (minimum reporting level – MRL).

COC - Chain of Custody – document that provides field and site information and conditions. COC information is transferred into the lab's database, includes basic field parameters. This is a legally required lab document.

Field Blank – A quality control sample used to monitor/verify sampling conditions at the site. The field blank is processed by pouring laboratory reagent water into a preserved sample container for the required method. The process mimics the sampling techniques for the site sample; tested to insure that none of the targets determined within the sample are coming from the process of sampling.

LFB/LCS (low/high) -Laboratory Fortified Blank/Laboratory Control Sample – is a laboratory reagent water sample, which is spiked with the method targets, and extracted within each method batch of samples. Processed just like a sample. This quality control sample insures that the method is generating acceptable data. Labs may run both an MRL/RDL level LFB (low) as well as a mid-level LFB (high).

MBLK / BLK/ RB – Method Blank/ Blank / Reagent Blank – is a method quality control sample consisting of laboratory reagent water and extracted and analyzed identically to all samples within each analytical batch. It monitors the laboratory method and techniques for any sources of contamination or interference.

MDLs – Method Detection Levels – are a statistical calculated value for each target analyzed by the laboratory's method. MDLs are performed by processing seven or more spiked replicates samples at a low-level, and analyzed over a three or more day period under method conditions. MDLs represent the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDLs goal is to be 3x lower than the laboratory established RDL/MRL.

MRL/RDL – Minimum Reporting Limit/ Reportable Detection Level - Represents the minimum quantifiable concentration level for a target analyte within the method. It usually represents the lowest calibration level within the standard curve. The MRL/RDL must be higher than the statistically calculated MDL.

MS/MSD - Matrix Spike / Matrix Spike Duplicate – are quality control samples processed within each analytical batch. They represent field samples that have been spiked with a known concentration of target analytes and processed within the entire method along with all samples. These QC samples are used to monitor the impact of sample matrix on the accuracy and precision of the results.

RPD – Relative Percent Difference – is a quality control value calculated from the MS/MSD samples (as well as other QC duplicates) as a measure of the precision of the method. $RPD = ((X1-X2) / ((X1+X2)/2))*100$

S-MRL – Study's Minimum Reporting Limit – The lowest concentration level at which each target within this study will be quantified and reported – 10 ng/L.

SOP – Standard Operating Procedure – the laboratory document that provides detailed directions as to the steps and procedures within the method of analysis. Procedure followed by laboratory technicians and chemists so as to produce consistent reliable results. SOPs are also used by field staff.

SPE – Solid Phase Extraction – analytical technique used within the lab to extract and process samples. Disks and cartridges are used to retain the targets of interest during the extraction process – eluted with appropriate solvents and then concentrated for final analysis.

Split Sample – Split Sample – is a quality assurance control, which is an actual field sample that is sent to multiple labs for analysis. The split samples provide a comparison of quality analysis between different labs.