2010 Recharge Master Plan Update

Volume I − Final Report

Prepared for
Chino Basin Watermaster
Chino Basin Water Conservation District
Inland Empire Utilities Agency

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Acronyms, Abbreviations, and Initialisms

ac	acre
acre-ft/yr	acre-feet per year
ACR	Application for Capacity Right
ADC	Azuza-Devil Canyon
ASR	Aquifer Storage and Recovery
Authority	San Bernardino Regional Tertiary & Water Reclamation Authority
B&V	Black & Veatch
BMP	Best Management Practice
BOR	Bureau of Reclamation
CASQA	California Storm Water Quality Association
CBFIP	Chino Basin Facilities Improvement Program
CBWCD	Chino Basin Water Conservation District
CBWL	Chino Basin Wastewater Line
cfs	cubic feet per second
CURO	cumulative unmet replenishment obligation
CRA	Colorado River Aqueduct
CVP	Central Valley Project
CVWD	Cucamonga Valley Water District
Delta	Sacramento-San Joaquin River Delta
DOT	US Department of Transportation
DSOD	CA Department of Water Resources Division of Safety of Dams
DWR	CA Department of Water Resources
EPA	US Environmental Protection Agency
ft	feet
GRCC	Groundwater Recharge Coordinating Committee
IEUA	Inland Empire Utilities Agency
IID	Imperial Irrigation District
IX	ion exchange
JCSD	Jurupa Community Services District
LACSD	Los Angeles County Sanitation District
LMWTP	Lloyd W. Michael Water Treatment Plant
Metropolitan	Metropolitan Water District of Southern California
MS4	Municipal Separate Storm Sewer System

Acronyms, Abbreviations, and Initialisms

msl	mean sea level
MVWD	Monte Vista Water District
MZ1	Management Zone 1
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRW	Non-Reclaimable Waste
O&M	operations and maintenance
OCSD	Orange County Sanitation District
POC	Pollutants of Concern
QSA	Quantification Settlement Agreement
R4	Rainfall, Runoff, Router, and Rootzone Model
RC	Riverside-Corona
RWQCB	Regional Water Quality Control Board
RIX	Rapid Infiltration Extraction Treatment Plant
RMPU	Recharge Master Plan Update
ROM	Chino Basin Recharge Facilities Operations Procedures Manual
RP	Regional Plant
RO	reverse osmosis
SARI	Santa Ana Regional Interceptor
SBCFCD	San Bernardino County Flood Control District
SBMWD	San Bernardino Municipal Water Department
SCADA	supervisory control and data acquisition
SCE	Southern California Edison
SDCWA	San Diego County Water Authority
SGVMWD	San Gabriel Valley Municipal Water District
Stantec	Stantec Consulting Inc.
SWG	Sierra Water Group
SWP	State Water Project
TDS	total dissolved solids
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WBE	Wagner & Bonsignore Consulting Civil Engineers
Watermaster	Chino Basin Watermaster

Acronyms, Abbreviations, and Initialisms

WFA	Water Facilities Authority
WTP	water treatment plant
WEI	Wildermuth Environmental, Inc.
WMWD	Western Municipal Water District
WQMP	Water Quality Management Plan
WRCRWAP	Western Riverside County Regional Wastewater Authority Plant

In September 2000, the Superior Court of the State of California approved the Peace Agreement and authorized the implementation of the Chino Basin Optimum Basin Management Program. The Peace Agreement required the preparation of a recharge master plan update every five years starting in 2000. The Parties to the Peace Agreement started a process in 2005 to revise the Peace Agreement and the Judgment. This revision process was completed in late 2007 (hereafter the Peace II Agreement) and was approved by the Superior Court on December 21, 2007. The Court's approval contained nine conditions subsequent that must be satisfied time certain for the revisions to be effective. Condition Subsequent 8 requires that a recharge master plan update be completed and submitted to the Court by July 1, 2010. This report documents the Chino Basin Watermaster's 2010 Recharge Master Plan Update and fulfills Watermaster's obligation to the Court when filed prior to July 1, 2010.

The scope of work and contents of the 2010 Recharge Master Plan Update (RMPU) are, in part, based on the December 21, 2007 Court Order and the requirements of the Watermaster. Pursuant to Condition Subsequent 5—which reads, "By July 1, 2008 Watermaster shall prepare and submit to the Court a detailed outline and scope and content of its first Recharge master Plan Update, […]"—Watermaster, working with the Chino Basin Water Conservation District, the Inland Empire Utilities Agency and the Judgment parties, developed a detailed report outline for the 2010 RMPU. The Court subsequently approved this outline and Watermaster started developing the RMPU. The outline of the RMPU, as described herein, was changed slightly to reflect how the investigation actually proceeded, but the content has remained faithful to the outline that was submitted to Court. This report includes the following sections:

Section	Title	Description
1	Introduction	
2	Planning Criteria	Describes the investigation requirements and planning assumptions used in the 2010 Chino Basin Recharge Master Plan Update
3	Safe Yield	Describes how safe yield was historically estimated, why it is projected to decline, and what actions can be taken to mitigate the loss of safe yield
4	Integrated Review of Water Supply Plans	Describes the global water supply for water agencies that use the Chino Basin and projected groundwater production in the Chino Basin through 2030
5	Stormwater Recharge Enhancement Opportunities	Describes the existing stormwater recharge capacity and structural opportunities to increase stormwater recharge

Section	Title	Description
6	Supplemental Water Recharge Enhancement Opportunities	Describes the existing supplemental water recharge capacity, sources of supplemental water, the need for additional supplemental water recharge, and recharge capacities
7	Recharge Master Plan Update	Describes the recommended future recharge plan for Watermaster
8	References	

The RMPU was developed through a stakeholder process. Watermaster convened several workshops over the course of developing the RMPU. At these workshops, the important assumptions and interim work products of the RMPU were presented. Two of those workshops were dedicated solely to the *Draft – 2010 Chino Basin Recharge Master Plan Update* (WEI, 2010c). Appendix A lists these workshops and their content. The technical presentations of these workshops were posted on the RMPU website and are available for download (http://rmp.wildermuthenvironmental.com). As part of the stakeholder process, the development of RMPU was open to comments by all, and all comments were responded to and/or addressed. Appendix F contains the comments and responses.

This report was written for managers and decisions makers. The science and engineering support for the RMPU has been provided in recent past reports and reports that were commissioned specifically for the RMPU—the latter have been included as appendices to this report. The final section of this report (Section 8 – References) cites the investigations that were used in preparing the RMPU. Some of the more important investigations have been posted on the RMPU website (http://rmp.wildermuthenvironmental.com).

This report was written and prepared by Wildermuth Environmental, Inc., with the exception of Section 5, and is based on their work and the work of other consultants, including the Black & Veatch Corporation (supplemental water recharge projects), the Sierra Water Group (supplemental water supplies), and Wagner & Bonsignore Consulting Civil Engineers (stormwater recharge). Section 5 was written and prepared by Wagner & Bonsignore; Wildermuth Environmental, Inc. was responsible for the modeling work used in Wagner & Bonsignore's technical analysis. Portions of the work done by Black & Veatch and the Sierra Water Group were incorporated directly into the RMPU. The technical analyses of the Sierra Water Group and Black & Veatch have been included with this report as Appendices D and E, respectively.

The consultant team was supported by staff from the Chino Basin Watermaster (Watermaster), the Chino Basin Water Conservation District (CBWCD), and the Inland empire Utilities Agency (IEUA), and specifically:

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Ben Pak, Senior Project Engineer of the Watermaster

Danni Mauruzio, Senior Engineer of the Watermaster

Eunice Ulloa, General Manager of the CBWCD

Marv Shaw, former Manager of Planning & Water Resources of the IEUA

Chris Berch, Manager of Planning & Water Resources of the IEUA

Andy Campbell, Groundwater Recharge Coordinator for the IEUA

Ryan Shaw, Associate Engineer of the IEUA

2.1 Introduction

This section articulates the investigation requirements and planning assumptions used in the 2010 Chino Basin RMPU. These criteria include those from the Judgment, the Peace Agreement, the Peace II Agreement, the December 21, 2007 Court Order approving the Peace II Agreement, and the facility planning information and assumptions used to evaluate the new recharge projects and alternatives that were investigated and are reported on herein. The Court requires that the RMPU contain recharge estimations and summaries of projected water supply availability as well as the physical means to accomplish those recharge projections. The RMPU reflects an appropriate schedule for planning, design, and physical improvements—as required—to provide the replenishment capability sufficient to meet the reasonable projected replenishment obligations. The investigation requirements and planning criteria were reported to the RMPU stakeholders in a task memorandum in March 2009 (B&V & WEI, 2009). The objective of the task memorandum was to record the criteria and assumptions early in the investigation such that stakeholders would have the opportunity to comment prior to the development and analysis of new recharge projects and recharge alternatives.

The first part of this section discusses the planning criteria and assumptions from the Judgment, the Peace Agreement, the Peace II Agreement, and the December 21, 2007 Court Order approving the Peace II Agreement. This is followed by facility planning, operating, and cost estimating criteria.

2.2 Legal Requirements

2.2.1 Chino Basin Judgment

The Chino Basin Watermaster was established under a Judgment entered in the Superior Court of the State of California for the County of San Bernardino, entitled "Chino Basin Municipal Water District v. City of Chino et al.," (originally Case No. SCV 164327, the file was transferred August 1989 by order of the Court and assigned Case No. RCV 51010). The Honorable Judge Howard B. Wiener signed the Judgment on January 27, 1978. For accounting and operations, the effective date of the Judgment is July 1, 1977.

The Chino Basin Judgment resulted from studies and discussions that began in the early 1970s and continued for several years. Safe yield is defined on page 4 of the Judgment as:

> The long-term average annual quantity of ground water (excluding replenishment or stored water but including return flow to the Basin from the use of replenishment or stored water) which can be produced from the Basin under cultural conditions of a particular year without causing an undesirable result.

On page 6 of the Judgment, the safe yield of the Chino Basin is numerically defined as: "[…]

140,000 acre-ft/yr.” The safe yield is allocated among the three producer pools as follows:

Overlying agricultural pool	82,800 acre-ft/yr
Overlying non-agricultural pool	7,366 acre-ft/yr
Appropriative pool	49,834 acre-ft/yr

A fundamental premise of the Judgment is that it allows all Chino Basin water users to pump sufficient water from the basin to meet their requirements (page 24, paragraph 42). To the extent that pumping exceeds the share of the safe yield, assessments are levied by Watermaster, and Watermaster uses these assessments to purchase supplemental water to replace overproduction.

The Judgment also provides that “Any subsequent change in the safe yield shall be debited or credited to the appropriative pool” (page 25, paragraph 44), meaning that if Watermaster determines that the safe yield has changed at some point in time after the Judgment was entered, the change would be exclusively debited or credited to members of the appropriative pool and the rights allocated to the other pools and their respective parties would remain unchanged. The overlying agricultural pool consists of all overlying producers that produce groundwater for uses other than industrial or commercial and the State of California. The overlying non-agricultural pool consists of overlying producers that produce groundwater for industrial and commercial uses. And, the appropriative pool consists of owners of appropriative rights. All parties were assigned to a pool when the Judgment was entered. The Watermaster maintains a current list of all parties and their pool assignments.

2.2.2 Peace Agreement

Section 5.1 (e) of the Peace Agreement contains Watermaster’s commitments regarding the recharge of supplemental water in the Chino Basin. This analysis focuses on Watermaster’s implementation of Peace Agreement Section 5.1 (e) items (i), (iii), (v), (vii), and (viii), which are stated as follows (see Peace Agreement, pages 20 and 21):

> Watermaster shall exercise Best Efforts to:
>
> (i) protect and enhance the safe yield of the Chino Basin through Replenishment and Recharge; […]
>
> (iii) direct Recharge relative to Production in each area and sub-area of the Basin to achieve long term balance and to promote the goal of equal access to groundwater in all areas and sub-areas of the Chino Basin; […]
>
> (v) establish and periodically update criteria for the use of water from different sources for Replenishment purposes; […]
>
> (vii) recharge the Chino Basin with water in any area where groundwater levels have declined to such an extent that there is an imminent threat of Material Physical Injury to any party to the Judgment;
>
> (viii) maintain long-term hydrologic balance between total Recharge and discharge in all areas and sub-areas; […].

The *OBMP Implementation Plan* (Exhibit B of the Peace Agreement) contains language identical to that in Peace Agreement Section 5.1 (e), but it is mostly silent as to the schedule for implementing the specific commitments listed above (see Exhibit B, paragraph 11 on page 20 and the implementation schedule on pages 22 and 23). Paragraph 9 of page 20 of the Implementation Plan includes additional recharge guidelines that Watermaster must consider regarding recharge:

> 9. When locating and directing physical recharge, Watermaster shall consider the following guidelines:
>
> (i) provide long term hydrologic balance within the areas and sub-areas of the basin
>
> (ii) protect and enhance water quality
>
> (iii) improve water levels
>
> (iv) the cost of recharge water
>
> (v) any other relevant factors

Section 7 of the Rules and Regulations repeats the commitments of Section 5.1 (e) of the Peace Agreement and adds (see Rules and Regulations, page 37, 7.1 [b] [iv]):

> (b) Watermaster shall exercise Best Efforts to: […]
>
> (iv) Make its initial report on the then existing state of Hydrologic Balance by July 1, 2003, including any recommendations on Recharge actions which may be necessary under the OBMP. Thereafter, Watermaster shall make written reports on the long term Balance in the Chino Basin every two years; […].

2.2.3 Peace II Agreement

The Peace II Agreement states that Watermaster will update and obtain Court approval of that update to the Recharge Master Plan to address how the Chino Basin will be managed to secure and maintain hydraulic control and operated at a new equilibrium at the conclusion of the period of reoperation.

This plan must reflect an appropriate schedule for planning, design, and physical improvements—as required—to provide reasonable assurance that, following the full beneficial use of groundwater withdrawn in accordance with basin reoperation and authorized controlled overdraft, sufficient replenishment capability exists to meet the reasonable projections of Desalter Replenishment obligations. With the concurrence of the IEUA and Watermaster, the Recharge Master Plan is to be updated and amended as frequently as necessary with Court approval and not less than every five (5) years.

Peace II Article 8.4 summarizes recharge in Management Zone 1 (MZ1), specifically the 6,500 acre-ft/yr supplemental recharge to MZ1. Moreover, the Parties make the following acknowledgments regarding the 6,500 acre-ft/yr supplemental recharge:

> (a) fundamental premise of the Physical Solution is that all water users dependent upon Chino Basin will be allowed to pump sufficient waters from the Basin to meet their requirements. To promote the goal of equal access to groundwater within all areas and sub-areas of the Chino Basin, Watermaster

has committed to use its best efforts to direct recharge relative to production in each area and subarea of the Basin and to achieve long-term balance between total recharge and discharge. The Parties acknowledge that to assist Watermaster in providing for recharge, the Peace Agreement sets forth a requirement for Appropriative Pool purchase of 6,500 acre-ft/yr of Supplemental Water for recharge in Management Zone 1 (MZ1). The purchases have been credited as an addition to Appropriative Pool storage accounts. The water recharged under this program has not been accounted for as Replenishment water.

(b) Watermaster was required to evaluate the continuance of this requirement in 2005 by taking into account provisions of the Judgment, Peace Agreement and OBMP, among all other relevant factors. It has been determined that other obligations in the Judgment and Peace Agreement, including the requirement of hydrologic balance and projected replenishment obligations, will provide for sufficient wet water recharge to make the separate commitment of Appropriative Pool purchase of 6,500 acre-ft unnecessary. Therefore, because the recharge target as described in the Peace Agreement has been achieved, further purchases under the program will cease and Watermaster will proceed with operations in accordance with the provisions of paragraphs (c), (d) and (e) below.

(c) The parties acknowledge that, regardless of Replenishment obligations, Watermaster will independently determine whether to require wet-water recharge within MZ1 to maintain hydrologic balance and to provide equal access to groundwater in accordance with the provisions of this Section 8.4 and in a manner consistent with the Peace Agreement, OBMP and the Long Term Plan for Subsidence."

Watermaster will conduct its recharge in a manner to provide hydrologic balance within, and will emphasize recharge in MZ1. Accordingly, the Parties acknowledge and agree that each year Watermaster shall continue to be guided in the exercise of its discretion concerning recharge by the principles of hydrologic balance. (d) Consistent with its overall obligations to manage the Chino Basin to ensure hydrologic balance within each management zone, for the duration of the Peace Agreement (until June of 2030), Watermaster will ensure that a minimum of 6,500 acre-ft of wet water recharge occurs within MZ1 on an annual basis. However, to the extent that water is unavailable for recharge or there is no replenishment obligation in any year, the obligation to recharge 6,500 acre-ft will accrue and be satisfied in subsequent years.

1. Watermaster will implement this measure in a coordinated manner so as to facilitate compliance with other agreements among the parties, including but not limited to the Dry-Year Yield Agreements.
2. In preparation of the Recharge Master Plan, Watermaster will consider whether existing groundwater production facilities owned or controlled by producers within MZ1 may be used in connection with an aquifer storage and recovery ("ASR") project so as to enhance recharge in specific locations and to otherwise meet the objectives of the Recharge Master

Plan.

(e) Five years from the effective date of the Peace II Measures, Watermaster will cause an evaluation of the minimum recharge quantity for MZ1. After consideration of the information developed in accordance with the studies conducted pursuant to paragraph 3 below, the observed experiences in complying with the Dry Year Yield Agreements as well as any other pertinent information, Watermaster may increase the minimum requirement for MZ1 to quantities greater than 6,500 acre-ft/yr. In no circumstance will the commitment to recharge 6,500 acre-ft be reduced for the duration of the Peace Agreement.

2.2.4 Special Referee's December 2007 Report, Sections VI (Assurances Regarding Recharge), VII (Declining Safe Yield), and VIII (New Equilibrium)

In the Final Report and Recommendations on Motion for Approval of Peace II Documents, the Special Referee stated that "A key element of the proposed Peace II Measures is that Watermaster must develop recharge capability throughout the Basin Reoperation period, to ensure that sufficient recharge capability exists at the end of the period" (Final Report, page 25, [Schneider, 2007]).

The Special Referee recommended and the Court ultimately ordered that several elements be included within the updated Plan (Motion to Approve Watermaster's Filing in Satisfaction of Condition Subsequent 5; Watermaster Compliance with Condition Subsequent 6, August 21, 2008):

1. Baseline conditions must be clearly defined and supported by technical analysis. The baseline definition should encompass factors such as pumping, demand, recharge capacity, total Basin water demand, and availability of replenishment water.
2. Safe Yield should be estimated annually, though it is recognized that it is not to be formally recalculated until 2011. Watermaster should develop a technically defensible approach to estimating Safe Yield annually.
3. Measures should be evaluated to lessen or stop the projected Safe Yield decline. All practical measures should be evaluated in terms of their potential benefits and feasibility.
4. Evaluations and reporting of the impact of Basin Re-Operation on groundwater storage and water levels should be done on an annual basis.
5. Total demand for groundwater should be forecast for 2015, 2020, 2025, and 2030. The availability of imported water for supply and replenishment, and the availability of recycled water should be forecast on the same schedule. The schedules should be refined in each Recharge Master Plan update. Projections should be supported by thorough technical analysis.
6. The Recharge Master Plan must include a detailed technical comparison of current and projected groundwater recharge capabilities and current and projected demands for groundwater. The Recharge Master Plan should provide guidance as to what should be done if recharge capacity cannot meet

or is projected not to be able to meet replenishment needs. This guidance should detail how Watermaster will provide sufficient recharge capacity or undertake alternative measures so that Basin operation in accordance with the Judgment and the Physical Solution can be resumed at any time.

These recommendations are a reflection of the requirements described in the Peace II Measures. Peace Agreement II section 8.1 and the Amendment to Judgment Exhibit "I" section 2(b)(5) require that the updated Recharge Master Plan must:

7. Address how the Basin will be contemporaneously managed to secure and maintain Hydraulic Control and subsequently operated at a new equilibrium at the conclusion of the period of Re-Operation.
8. Contain recharge estimations and summaries of the projected water supply availability as well as the physical means to accomplish the recharge projections.
9. Reflect an appropriate schedule for planning, design, and physical improvements as may be required to provide reasonable assurance that sufficient Replenishment capacity exists to meet the reasonable projections of Desalter Replenishment obligations following the implementation of Basin Re-Operation.

Peace Agreement II section 8.4(d)(2) further requires that the Recharge Master Plan:

> Consider whether existing groundwater production facilities owned or controlled by producers within MZ1 may be used in connection with an aquifer storage and recovery ("ASR") project so as to further enhance recharge in specific locations and to otherwise meet the objectives of the Recharge Master Plan.

The Outline of the Recharge Master Plan Update report and the scope of work were designed to respond to the Special Referee's report, as ordered by the Court on December 21, 2007. The Court subsequently approved the outline, and the stakeholders reviewed and approved the scope of work.

2.3 Design Criteria for Wells Spreading Basins, Conveyance, and Treatment Facilities

This section presents the planning level design criteria for wells, conveyance, storage, and treatment facilities to enhance recharge opportunities in the Chino Basin. These facilities may be further refined and integrated into future water recharge projects to meet the following groundwater recharge goals: (1) enhance the recharge of stormwater runoff, (2) increase the recharge of recycled water, and (3) develop new facilities to capture supplemental imported water.

2.3.1 New ASR Wells

ASR is a process that consists of injecting treated water down through a well for storage in a confined aquifer system and recovery through reversing operations when groundwater production is needed. Table 2-1 shows the planning level design criteria for an ASR well. Estimates for production and injection capacities are conceptual and presented for initial basin-wide planning purposes only. The equipping of an ASR well shall be based on an above ground vertical turbine type pump with a premium efficiency motor. This type of pump/motor arrangement is commonly found on existing production wells located in the Chino Basin. Each ASR well may include a well enclosure building to accommodate the pump/motor, electric control panels, and other required components.

2.3.2 New Injection Wells

Injection wells enable artificial aquifer recharge by injecting treated surplus water underground to replenish groundwater within the local aquifer. The design criteria for the proposed injection well facilities are provided in Table 2-2.

2.3.3 Recharge Basins

The general design criteria for recharge basin facilities—also referred to as stormwater retention, debris, and conservation basins—are provided in Table 2-3. These criteria were developed based on a typical basin layout, utilizing a conservative percolation design rate (ft/day), as determined by previous programs implemented in the Chino Basin.

2.3.4 Treatment

This section introduces the treatment facilities required to enhance recharge opportunities in the Chino Basin. Treatment concepts were developed for the following source water alternatives: (1) State Water Project (SWP) water, (2) Colorado River Aqueduct (CRA) water, and (3) recycled water sources. The specific treatment opportunities for each water source are described below.

2.3.4.1 SWP Water

SWP water is an imported water supply delivered by the Metropolitan Water District of Southern California (Metropolitan). SWP water is primarily conveyed to the Basin through the Rialto Pipeline, which flows east to west along the northern portion of the Basin; though, opportunities to use a secondary conveyance source, the San Gabriel Valley Municipal Water District (SGVMWD) Azusa-Devil Canyon (ADC) Pipeline, were also evaluated in the RMPU. The SWP water recharge plan would utilize surplus water, when available. This water would be treated at several existing surface water treatment plants, including the CVWD's Lloyd W. Michael Water Treatment Plant (LMWTP), the Water Facilities Authority (WFA) Aqua de Lejos Water Treatment Plant (WTP), and the Fontana Water Company Sandhill WTP. Table 2-4 presents general criteria and information for the Chino Basin WTPs.

The current projected availability of surplus water from Metropolitan has been substantially reduced due to drought and the uncertainty of SWP pumping operations related to protection requirements for the Delta Smelt and other environmental issues. It is assumed that surplus water would be available to Watermaster in three out of every ten years. This assumption will impact the facilities required to handle the surplus supply during replenishment periods.

SWP water replenishment and treatment cost rates are addressed in the cost criteria section of this report (Section 2.4).

2.3.4.2 CRA Water

The CRA is a 242-mile aqueduct that diverts water from the Colorado River at Lake Havasu on the California-Arizona border west across the Mojave and Colorado Deserts to the east side of the Santa Ana Mountains. The CRA terminates at Lake Mathews in western Riverside County, where water is then distributed to Metropolitan's member agencies via the Upper Feeder.

CRA water is essentially no longer used in the Basin due to high total dissolved solids (TDS) concentrations. CRA projected surplus availability may be increasing due to the potential supply available to Metropolitan from the unused portion of California's normal apportionment and existing contracts in place to divert additional surplus water on an annual basis. Treatment obstacles would need to be considered such that the water quality issues associated with CRA water could be managed to maintain the salt balance in the Basin and to meet the maximum benefit based TDS objectives. Two treatment scenarios were evaluated under the CRA imported source water plan: (1) CRA without TDS reduction and (2) CRA with TDS reduction. Each scenario is discussed below.

CRA without TDS Reduction. This scenario is based upon the strategy to maintain an overall salt balance in the Basin. The plan incorporates conventional surface treatment of CRA water without provisions for TDS reduction. To offset the potential for additional salt loading in the Basin, it is likely that the IEUA's regional recycled water facilities would require additional advanced treatment to further reduce the TDS concentration in recycled water. Under this scenario, CRA water could be used for direct recharge if an equivalent salt reduction from recycled water was implemented to maintain compliance under the Basin's maximum benefit objectives.

CRA with TDS Reduction. This scenario includes the advanced treatment of CRA water to reduce its TDS to acceptable levels, as required by the Basin Plan objectives. The treatment process would likely include the following steps: flocculation, sedimentation, gravity filtration, sidestream reverse osmosis, and disinfection. Facilities, such as concrete basins, could be constructed utilizing conventional methods of construction, or there may be opportunities to use a more packaged type of treatment facility.

Rehabilitation of the Galvin WTP was previously identified as an opportunity for using CRA water. During the DYY Expansion, the City of Ontario expressed an interest in rehabilitating and reactivating its Galvin WTP, which was initially designed in 1958 and has been out of service for over ten years. After the CDPH implemented the Surface Water Treatment Rule in June 1993, the existing WTP could not comply with the regulatory criteria, and there was not sufficient space within the existing building for additional processes. The WTP would likely require demolition, expansion, and conversion to membrane filtration. The raw water supply for the Galvin WTP would be provided via the Upper Feeder. This project is likely more than 5 to 10 years out and is part of Ontario's long-term planning. When completed, this project would be capable of treating surplus CRA water to enhance replenishment opportunities in the Basin.

Brine Disposal. The removal of contaminates, such as TDS, via treatment (RO or IX) typically requires facilities for waste brine disposal. Waste brine can be conveyed to the Non-Reclaimable Waste (NRW) System, owned and operated by the IEUA, or to the Chino Basin Wastewater Line (CBWL), operated by the Los Angeles County Sanitation District (LACSD). Depending on the facility's location in the Chino Basin, brine would flow to the NRW System through the Upper Trunk (East Edison and West Edison Lines), the CBWL, or to Santa Ana Regional Interceptor (SARI) via the South System Chino Line. The system conveys industrial wastewater and other salt-laden water to the LACSD and Orange County Sanitation District (OCSD) wastewater plants. Waste could be delivered to the NRW System by connecting a brine line directly to it or by hauling the waste to an NRW System disposal site.

Connecting waste regenerate lines to the NRW System or the CBWL requires the completion of an Application for Capacity Right (ACR) Agreement, the purchase of hydraulic capacity in the NRW System or the CBWL, and the completion of a wastewater discharge permit application.

The availability of NRWS capacity should be determined as this is could be a critical constraint when considering treatment technologies for future projects due to the high volume of waste that is currently being conveyed by the system.

2.3.4.3 Recycled Water

At the IEUA's Regional Plant (RP) sites, advanced recycled water treatment would be used to achieve a target TDS to maintain a salt balance in the Basin; in turn, more imported CRA water could be used to enhance recharge operations in the Basin. The IEUA's facilities, listed in Table 2-5, are the best potential source for advanced treatment and groundwater recharge.

2.4 Cost Methodology and Financial Criteria

This section presents the cost methodology and the planning-level construction, operations and maintenance (O&M), and general financial cost criteria to be used in the development of Basin recharge facility cost opinions.

2.4.1 Cost Methodology

Unit cost criteria and assumptions were developed for construction costs, annual O&M costs, and other general and financing terms. Some of the major unit costs include rolled-up costs as part of the lump sum costs. The following list identifies the components included as part of the rolled-up unit cost criteria:

Source Water

- ASR Wells – drilling, equipping, and well enclosure buildings
- Injection Wells – drilling, equipping, and well enclosure buildings

- Recharge Basins – mass excavation, fine grading, diversion control equipment, instrumentation, and security

Conveyance

- Piping – major material, trenching, and installation
- Pipeline Crossing – bridge, freeway, railroad, and storm channel
- Pump Stations – major equipment, site work, electrical, mechanical, and instrumentation

Treatment

- Conventional Surface Water Treatment – coagulation, flocculation, sedimentation, dual media filtration, and disinfection
- Advanced Surface Water Treatment – coagulation, flocculation, sedimentation, dual media filtration, sidestream reverse osmosis, and disinfection
- Advanced Recycled Water Treatment – sidestream microfiltration and reverse osmosis

2.4.2 Construction Cost Criteria

Table 2-6 summarizes the unit construction cost criteria that were used in the development of the alternative cost estimates.

2.4.3 Annual O&M Cost Criteria

Table 2-7 summarizes the unit annual O&M cost criteria that were used in the development of the alternative cost estimates.

2.4.4 General Financial Criteria

Table 2-8 summarizes the financing and general unit cost criteria that were used in the development of the cost opinions. A 25-percent contingency has been applied to all costs, which is reflective of the planning level of detail. A 15-percent markup has been applied to all costs to account for engineering and administration activities. And, a 7-percent markup has been included to account for construction management. The financing and amortization period and discount rate used to develop the annualized cost are also provided in Table 2-8.

Table 2-1
ASR Well Design Criteria

Facility Component	Design Criteria
Production capacity (varies), gpm	1,100 - 3,400
Assumed injection capacity: low (varies), gpm[1]	550 - 1,700
Assumed injection capacity: high (varies), gpm[2]	1,100 - 3,400
Well Depth	TBD
Pump type	Vertical deep well
Well enclosure building (if used)	Single story structure w/ CMU block wall (or) pre-fab type structure
Required land, sf	2,500 - 5,000

Table 2-2
Injection Well Design Criteria

Facility Component	Design Criteria
Estimated injection capacity (varies), gpm[1]	550 - 3,400
Well enclosure building (if used)	Single story structure w/ CMU block wall (or) pre-fab type structure
Required land, sf	2,500 - 5,000

Table 2-3
Recharge Basin Design Criteria

Facility Component	Design Criteria
Percolation design rate, feet/day	1.0 - 2.0, or per WEI
Total basin usable area (usable perc./total area), %	90, or Site Dependent
Typical basin layout	
Aspect ratio (length : width)	1.5 : 1, or Site Dependent
Basin wall slope (horizontal : vertical)	3:1 Waterside
Basin depth, ft	8-16, per WEI Model or Highwater
Perimeter driveway width, ft	16
Fine grading depth, ft	1
Perimeter fencing	Chain link
Spillway / overflow	Concrete lined or large rock lined
Diversion design	Drop inlet structure, rubber dam, or other
Flow control gates	Gate flow control devise
Instrumentation & control	RTU, radio system, security system

Table 2-4
General Criteria/Information for Chino Basin Water Treatment Plants

Description	LMWTP	WFA WTP	Sandhill WTP
Owner	Cucamonga Valley Water District	Water Facilities Authority	Fontana Water Company
Plant Location	Rancho Cucamonga, California	Upland, California	Rialto, California
Capacity	60 MGD (expanded in yr 2003)	88 MGD	20 MGD (ultimate 30 MGD)
Treatment Process	Conventional surface water treatment	Conventional surface water treatment	Conventional surface water treatment
Water Source	State Water Project, local surface water	State Water Project	State Water Project, local surface water
Source Water Purveyor(s)	Metropolitan Water District	Metropolitan Water District	Metropolitan Water District, San Bernardino Valley Municipal Water District
Distribution Users	CVWD service area (Rancho Cucamonga)	City of Upland, City of Ontario, City of Chino, City of Chino Hills, Monte Vista Water District	Fontana Water Company service area (Fontana, Rialto)

Table 2-5
Potential Sources of Recycled Water

Agency	Facility
LA Sanitation District	Pomona Water Reclamation Plant
IEUA	Regional Plant No. 1
	Regional Plant No. 2
	Regional Plant No. 4
	Regional Plant No. 5
	Carbon Canyon Water Reclamation Plant
California Institute for Men at Chino	CIM Water Reclamation Plant
WMWD	West Riverside Regional

Table 2-6
Summary of Unit Construction Cost Criteria

Item	Unit Cost
Conveyance Facilities	
Pipelines installed, $/in-dia/lf	$ 15
Distribution system booster pump station, $/HP	$ 5,000
Crossings	
Bridge supported, $/lf	$ 900
Freeway crossing (microtunnel), $/lf	$ 1,100
Railroad crossing (auger boring), LS	$ 200,000
Storm channel crossing (auger boring), LS	$ 150,000
Turnouts & Miscellaneous connections	
Transmission pipeline turnout, LS	$ 750,000
Connection to storm channel, LS	$ 100,000
Valve & Metering, LS	$ 25,000
Well Facilities	
New ASR Well, LS	$ 2,800,000
New Injection Well, LS	$ 1,300,000
Well Rehabilitation/ASR Conversion, LS	$ 900,000
Treatment Facilities	
New conventional Surface WTP $/gal	$ 2.50
New Advanced Surface WTP, $/gal	$ 3.00
Advanced Recycled WTP (retrofit), $gal	$ 4.50
Land	
Undeveloped	$ 500,000
Recharge Basin Facilities	
Mass Excavation, $/CY	$ 10
Fine Grading, $/CY	$ 15
Perimeter Fence, $/LF	$ 15
Instrumentation, LS	$ 100,000

Table 2-7
Summary of Unit O&M Cost Criteria

Item	Unit Cost
Conveyance Facilities	
Pipelines - general, $/mile	$ 4,000
Pump Stations - general, % construction cost	2 percent
Well Facilities	
Misc. well maintenance, $/year/well	$ 25,000
Surface Water and Treatment Facilities	
SWP and CRA replenishment rate, $/AF[1]	$ 365
Surface WTP surcharge, $/AF[2]	$ 75
Advanced Surface WTP surcharge, $/AF[3]	$ 100
Advanced recycled WTP surcharge, $/AF[4]	$ 250
Recharge Basin Facilities	
Misc. basin maintenance, $/year/basin	$ 50,000

Notes:

1 -- Metropolitan projected rate effective 1/1/2010. Rates are expected to increase to $398/AF and $438/AF in years 2011 and 2012, respectively.

Table 2-8
Summary of Unit Construction Cost Criteria

Item	Criteria
Contingency, %	25
Engineering, Administration, %	15
Construction Management, %	7
Energy, $/kwh	0.14
Project life (amortization period), years	30
Interest Rate, %	5

3.1 Introduction

Safe yield is a term used in groundwater management to articulate, subject to assumptions and constraints, the amount of groundwater that can be produced on an annual basis without persistent lowering of groundwater levels and without undesirable effects. Safe yield is a sustainable level of groundwater production. This section of the report describes the safe yield of the Chino Basin as developed for the 1978 Judgment, safe yield as a concept and the information needed to compute it, why safe yield was projected to change during the Peace II engineering work in 2007, and the recommended methodology to compute safe yield in the future. This section specifically addresses the RMPU requirements set forth in items 2 and 3 of the November 2007 Special Referee's report to the Court:

2. Safe Yield should be estimated annually, though it is recognized that it is not to be formally recalculated until 2011. Watermaster should develop a technically defensible approach to estimating Safe Yield annually.

3. Measures should be evaluated to lessen or stop the projected Safe Yield decline. All practical measures should be evaluated in terms of their potential benefits and feasibility.

3.2 Safe Yield

The Stipulated Agreement for the Chino Basin defines safe yield as "the long-term average annual quantity of groundwater (excluding replenishment or stored water but including return flow to the basin from the use of replenishment or stored water) which can be produced from the Basin under cultural conditions of a particular year without causing an undesirable result" (Judgment, Section I Introduction, Paragraph 4 Definitions). The definition also ties the safe yield to the cultural conditions of a specific year, presumably a near current year if cultural conditions are changing. The Judgment declares the safe yield to be 140,000 acre-ft (Judgment, Section II Declaration of Rights, Part A Hydrology, Paragraph 6 Safe Yield).

Undesirable results commonly listed in published literature include the depletion of groundwater reserves, intrusion of water of undesirable quality, contravention of existing water rights, excessive increases in production costs, streamflow depletion, and subsidence (Freeze & Cherry, 1979). In the Chino Basin, the depletion of groundwater reserves is the primary undesirable result that limits the safe yield. The groundwater management plans provided in the Judgment and the Optimum Basin Management Program limit the undesirable results listed above through the implementation of localized management programs. The Judgment requires that production in excess of the safe yield be mitigated by replenishment by Watermaster. Watermaster assesses the parties that produce groundwater in excess of their production rights, pursuant to the Judgment, to fund the purchase of replenishment water. The Peace Agreement requires that Watermaster use its discretion when recharging supplemental water to balance recharge and discharge in every area and subarea.

3.2.1 Carroll's Estimate of the Safe Yield of the Chino Basin

The safe yield of the Chino Basin was established in the 1978 Judgment to be 140,000 acre-ft/yr. The basis for this estimate was described by William J. Carroll in his testimony on December 19 and 20, 1977 during the Chino Basin adjudication process. Table 3-1 lists the hydrologic components developed by Carroll to estimate the safe yield of the Chino Basin. These components were developed for the 1965 to 1974 period, a period that Carroll referred to as the base period. The hydrologic components listed in Table 3-1 are described below.

> Deep Percolation of Precipitation and Surface Inflow – consists of the deep percolation of precipitation and streamflow. Carroll developed the estimate of 47,500 acre-ft/yr based on an extrapolation of the early Chino Basin modeling results from the DWR.
>
> Deep Percolation of Artificial Recharge – consists of the percolation of local runoff in spreading basins. Carroll estimated the local runoff recharged in SBCFCD-controlled facilities to be about 2,800 acre-ft/yr during the base period. The Etiwanda Water Company also recharged about 1,000 acre-ft/yr of water to the Chino Basin from Deer and Day Creeks during the base period.
>
> Deep Percolation of Chino Basin Groundwater Used for Irrigation (Domestic and Agricultural) – defined as the fraction of water applied for irrigation that percolates through the soil and recharges underlying groundwater. Carroll estimated that about 15 percent of the water used for domestic irrigation would percolate to groundwater and about 45 percent of the water used for agricultural irrigation would percolate to groundwater. Carroll estimated the volume of percolation of Chino Basin groundwater used for irrigation over the base period to be about 61,700 acre-ft/yr.
>
> Deep Percolation of Imported Water Used for Irrigation (Domestic and Agricultural) – same as deep percolation of Chino Basin groundwater except the water used for irrigation is imported to and used over the Chino Basin. Carroll estimated the volume of percolation of imported water used for irrigation over the base period to be about 7,000 acre-ft/yr.
>
> Recharge of Sewage – defined as the percolation in ponds of wastewater discharged by municipal wastewater treatment plants. This component almost completely ceased during the base period and was known to be eliminated as a recharge source when the safe yield was estimated. The volume of sewage recharge over the base period was about 18,200 acre-ft/yr. The inclusion of sewage recharge as a component of the safe yield was therefore not hydrologically consistent with how the Basin was to be operated post-Judgment.
>
> Subsurface Inflow – defined as the groundwater inflow to the Chino Basin from adjacent groundwater basins and mountain fronts, including:

Subsurface Source	Annual Inflow (acre-ft/yr)
Bloomington Divide	3,500
San Gabriel Mountain Front	2,500
Colton Rialto Basin	500
Cucamonga Basin	100
Claremont and Pomona Basins	100
Jurupa Hills	500
Total	7,200

> Subsurface Outflow – defined as groundwater that rises to the ground surface in the Prado Basin to become Santa Ana River flow. Estimates of subsurface outflow were based on studies by the DWR, United States Geological Survey (USGS), and Carroll. Carroll estimated the subsurface outflow to average about 6,800 acre-ft/yr over the base period.
>
> Extractions – defined as groundwater extractions from the Chino Basin. Carroll estimated groundwater extractions to average about 180,000 acre-ft/yr during the base period.

In addition to these components, Carroll estimated the change in storage over the base period to be about -40,000 acre-ft/yr, which equates to a decline in the volume of groundwater in storage of about 400,000 acre-ft during the base period. Carroll estimated the safe yield to be equal to the average production over the base period plus the average annual change in storage during the base period:

$$\begin{aligned}\text{Safe Yield} &= \text{Production} + \text{Change in Storage}\\ &= 180{,}000 - 40{,}000\\ &= 140{,}000 \text{ acre-ft/yr}\end{aligned}$$

This safe yield estimate is approximately equal to the total average inflow to the basin (145,500 acre-ft/yr) minus non-production outflow (7,200 acre-ft/yr). This 140,000 acre-ft/yr safe yield estimate was incorporated into the Judgment and is the current safe yield used by Watermaster.

3.2.2 Methodology to Compute Safe Yield

Safe yield is estimated one of two ways: it can be established by negotiation among interested parties with little or no science or it can be estimated based on hydrologic principles. The following discussion describes the basic methodology used to estimate safe yield from hydrologic principles.

For the Chino Basin, the safe yield—with deference to the Judgment and the requirements of the Peace Agreement—can be estimated as the average net inflow to the basin excluding the direct recharge of supplemental water. There are two ways to compute safe yield under this concept, both of which can be derived from the continuity equation. The continuity equation is:

$$\text{Change in Storage } (\Delta S) = [\text{Inflow (I)} - \text{Outflow (O)}] * \Delta t \qquad (1)$$

Where:

S^t is the storage at time t,

ΔS is the change in storage calculated as S^{t+1} minus S^t,

I is the total inflow to the basin over the period t to $t+1$ and is equal to the sum of Streambed Recharge (I_{sr}) + Deep Infiltration of Precipitation (I_p) + Subsurface Inflow (I_{ssi}) + Artificial Recharge of Supplemental Water (I_{ar}) + Irrigation Return Flows ($I_{rf.}$),

O is the total outflow from the basin over the period t to $t+1$ and is equal to the sum of Groundwater Pumping (O_p) + Subsurface Outflow (O_{ss}) + Discharge to Surface Water (Q_{rw}) + Evapotranspiration (Q_{et}), and

Δt is the length of the time period used to compute the balance and is equal to the time at $t+1$ minus the time at t.

The inflow and outflow terms listed above have dimensions of L^3/T. If expanded using the hydrologic terms listed above, the continuity equation becomes:

$$\Delta S = [I_{sr} + I_p + I_{ssi} + I_{ar} + I_{rf.} - O_p - O_{ss} - O_{rw} - O_{et}] * \Delta t \qquad (2)$$

For certain idealized conditions, the safe yield can be estimated from:

$$\text{Safe Yield} = [\Sigma I_{sr} + \Sigma I_p + \Sigma I_{ssi} + \Sigma I_{rf.} - \Sigma O_{ss} - \Sigma O_{rw} - \Sigma\ O_e] \,/\, \Delta t \qquad (3)$$

The summation (Σ) in equation 3 for each term covers the contiguous time series over a common base period. Idealized conditions include: the time history of inflow and outflow terms are known for sufficiently long periods of time and under representative hydrologic and cultural conditions, and there exists enough storage capacity in the aquifer to buffer wet periods and dry periods. It is common practice to define a base period that is assumed to be hydrologically representative of long term conditions and to estimate the inflow and outflow terms each year over that base period. The safe yield is then estimated using the base period average of the inflow and outflow terms. Another more pragmatic approach to estimating safe yield is to simplify equation (2), rewriting it as:

$$\text{Safe Yield} = \Delta S/\Delta t + O_p - I_{ar} \qquad (4)$$

Where O_p and I_{ar} are the mean groundwater pumping and the mean supplemental water recharge over the base period. Mathematically, equations 4 and 3 are identical; though, equation 4 is usually easier to solve.

Carroll attempted to apply both approaches when estimating safe yield, using hydrologic methods and data available in the mid 1970s to estimate the inflow and outflow terms and the change in storage. Carroll's testimony and working papers clearly indicate that some of the inflow terms and groundwater production were not well known. In addition, it was not appropriate to include the recharge of recycled water in the safe yield: it is supplemental water and was phased out after 1973. Removing the recycled water recharge reduces Carroll's estimate of safe yield from 140,000 acre-ft/yr to about 122,000 acre-ft/yr. Groundwater level time histories throughout the basin have suggested that the basin is in state of dynamic equilibrium and that the safe yield has been at least 140,000 acre-ft/yr from 1977-78 to the present.

3.2.3 Base Period Considerations

Carroll assumed a ten-year base period. This assumption was made by agreement and has no hydrologic basis. Common practice is to select a base period from precipitation records that span a reasonably long period of time and contain wet periods and dry periods over which the average precipitation equals the long-term average precipitation. The availability of data for estimating the inflow, outflow, and storage terms can also factor into base period selection.

The watershed surface that is tributary to and overlies the groundwater basin and related water management practices have changed dramatically over the last 70 years. The landuse, water management, and drainage conditions that are tributary to and overlie the Basin at a specific time are herein referred to collectively as the cultural condition of the basin at that time. The landuse transition from native or natural conditions to agricultural uses and subsequently to developed urban uses radically changed the amount of recharge to the Basin. Furthermore, irrigation practices change over time in response to agricultural economics (demand for various agricultural products), the availability of water, regulatory requirements, and the cost of water. Urbanization increases the amount of imperviousness—decreasing irrigable area and the permeable area that allows irrigation return flows and precipitation to infiltrate the soil—and increases the amount of stormwater produced on the land surface. Drainage improvements associated with the transition from natural to agricultural and urban uses reduce the recharge of stormwater: channels and streams are lined to move stormwater efficiently through the watershed overlying the groundwater basin. Changes in landuse, water management, and drainage over time produce inflow and outflow time histories that are not stationary; that is, the relationship of the inflow and outflow terms to precipitation and other hydrologic and management drivers change over time. Thus, the selection of a representative base period that satisfies the traditional criteria for a safe yield analysis that is representative of today's cultural conditions is not possible using the actual historical record. The impacts of changes in landuse, water management, and drainage on safe yield over time will be subsequently demonstrated.

Precipitation has long been considered statistically stationary for planning purposes. Analysis of temperature and precipitation records suggests that this may not have been correct. The affects of climate change have clearly been demonstrated: monotonic temperature increases over the last century, receding glaciers, and temporal change in the runoff pattern of the Sierra Nevada Mountains, to name a few (DWR, 2009). Advances in climate change science have produced global climate models that have demonstrated reasonably accurate hindcasting capabilities and subsequent forecasts through the year 2100, based on several future scenarios of economic development and greenhouse gas emissions.

3.2.4 Storage Considerations

The availability of water in storage at the beginning of the base period and the availability of operational storage during the base period must be such that production at the estimated safe yield can be maintained. There must be enough storage space available to store recharge in excess of the safe yield during wet years so that it can be available in years when the recharge is less than the safe yield.

3.2.5 Areal Considerations

The safe yield is determined for a geographically defined groundwater basin. The recharge and discharge of the basin occur within or on the boundaries of the basin. The Chino Basin has two boundaries: the legal boundary, as defined in the Judgment, and the hydrologic boundary, which more accurately reflects the location of physical barriers to groundwater movement and basin recharge. Figure 3-1 shows the location of these boundaries. The primary differences in the boundaries can be observed in the northern part of the basin and its boundary with the Cucamonga Basin. Carroll's estimate, prepared in 1978, was based on the legal boundary. Subsequent estimates by Watermaster have been prepared based on the hydrologically defined boundary.

3.3 Why Has the Safe Yield Changed Over Time?

The Peace II engineering work completed in 2007 (WEI, 2007b) contained a conclusion that the safe yield, as defined using equation 4 above, is projected to decline. This decline is projected to occur due to land use changes and associated changes in water use and stormwater management practices that, when combined, will reduce recharge to the Chino Basin. Below, changes in landuse and stormwater management decisions and their projected impacts on safe yield are discussed.

3.3.1 Landuse Change

Figures 3-2a through 3-2i illustrate landuse in the Chino Basin for 1933, 1949, 1957, 1963, 1975, 1984, 1990, 2000, and 2006 (WEI, 2007b). Years 1933 through 1984 were based on landuse maps that were prepared by the DWR; landuses were aggregated into the categories listed on each figure. Year 2000 landuse information was obtained from SAWPA; these data were aggregated into the same landuse categories developed for the earlier maps. Year 2006 landuse was based on the 2000 landuse map and was updated with information from 2006 air photos. Table 3-2 summarizes landuse from 1933 through 2006. Figure 3-2j shows estimated landuses for build-out conditions, based on the year 2000 landuse map and the general plans of the land use planning agencies in the study area.

Landuse changes result in changes in imperviousness. With few exceptions, as land is converted from natural undeveloped conditions to human uses, it becomes more impervious and produces more stormwater runoff. Historically, when landuse converted from natural or agricultural uses to urban uses, the imperviousness increased from near zero to between 60 and 100 percent, depending on the specific land use. Drainage improvements that were incorporated into the urban landscape were historically designed to convey stormwater rapidly, safely, and efficiently from the land surface through urban developments, and to discharge stormwater away from urbanized areas. There was little or no thought as to value of the stormwater; essentially, it was thrown away.

In an undeveloped state, most of the precipitation from most storms that fell on the watershed tributary to and over the Chino Basin would have been absorbed into the soils overlying the watershed. This water would have either been consumed by native vegetation or lost to evaporation. The overlying soils would have become wet near the surface and completely dry before the next winter. Infrequent large storms would have produced significant runoff, some of which would have recharged the underlying groundwater basin through streambed infiltration.

When precipitation falls on paved urban areas, most of it becomes runoff, which is essentially a new source of water. In the urban landscape, permeable areas are covered with vegetation that is carefully irrigated and cultivated or left unplanted and not irrigated. The soil underlying irrigated vegetation is maintained in a moist state and never completely dries out. The significance being that when soil is continuously moist, some of the irrigation water and precipitation can infiltrate beyond the root zone and recharge the underlying groundwater basin.

Each landuse type has specific water use and drainage characteristics that can change over time. Table 3-3 shows the water use characteristics that were assumed in the 1960 through 2006 calibration period of the 2007 Chino Basin Watermaster Groundwater Model. Table 3-4 shows the approximate changes in basin imperviousness associated with landuse changes. This table shows the impervious area for each landuse, based on the landuse time history listed in Table 3-2 and the total impervious area listed in Table 3-3. Moreover, Table 3-4 shows the total imperviousness as function of aggregated agricultural and urban uses and as a percentage of the total basin surface area. The total imperviousness was about 10 percent in 1949, increased to 24 percent by 1975, and reached about 46 percent by 2006.

Note that the while the groundwater model is calibrated from July 1960 through June 2006, the recharge hydrology is estimated from 1933 through 2006 because of the lag time between the deep infiltration of precipitation and applied water passing through the root zone and reaching the water table. Table 3-5 and Figure 3-3 show the estimated time history of the deep infiltration of precipitation and applied water that was developed for the calibration of the 2007 Watermaster Groundwater Model (WEI, 2007b). During the 1965 through 1974 base period that Carroll used to estimate safe yield, the deep infiltration of precipitation and applied water averaged about 113,000 acre-ft/yr. Carroll's estimate for the same period is 116,000 acre-ft/yr. During the last ten years of the calibration period, 1997 through 2006, the deep infiltration of precipitation and applied water averaged about 87,000 acre-ft/yr, a decline of about 26,000 acre-ft/yr. The increase in the deep infiltration of precipitation and applied water contribution from urban landuse has not offset the decrease in the deep infiltration of precipitation and applied water contribution from agricultural landuse. Due to the lag time associated with recharge leaving the root zone and reaching the water table, some of this decrease in recharge has not been realized in the groundwater system. Figure 3-4 illustrates the time history of the deep infiltration of precipitation and applied water at the root zone and at the water table. Also, note the significance of the deep infiltration of precipitation and applied water contribution from agricultural landuse that occurred in the period before 1957.

3.3.2 Changes in Drainage

Figure 3-5 shows the stream systems that start in the San Gabriel Mountains and flow from the north to the south, crossing the Chino Basin. From about 1957 to present, the drainage areas overlying the valley floor have almost completely converted to urban uses, and all the streams have been converted from unlined to lined channels. The lining of these channels has almost completely eliminated stormwater recharge in the Chino Basin. Prior to the Chino Basin Facilities Improvement Program (CBFIP), there was some incidental recharge in stormwater retention basins. Figure 3-5 also shows the decades in which these stream channels were lined. Figure 3-6 shows the estimated recharge in these channels from 1933 through 2006. These estimates were prepared with the Rainfall, Runoff, Router, and Rootzone (R4) Model[1] (see Appendix C *Summary of the R4 Model for the Chino Basin*) for the development and calibration of the 2007 Chino Basin Watermaster Groundwater Model (WEI, 2007b). The decline in stormwater recharge spanning the period of 1959 through roughly the present correlates to channel lining. Using the 26-year period prior to 1959 as a baseline, the average stormwater recharge declined from about 16,000 acre-ft/yr to zero. Because stormwater recharge is highly concentrated in time and area, it generally reaches the groundwater table within a year. Note that during the base period for the Chino Basin safe yield determination, 1965 through 1974, stormwater recharge averaged about 12,000 acre-ft/yr.

While stormwater recharge declined from the Santa Ana River tributaries that cross the Chino Basin, the recharge of the Santa Ana River to the Chino Basin increased due to the increased stormwater and non-stormwater discharge carried by the River. Analysis of the annual reports of the Santa Ana River Watermaster, engineering working papers for the development of the Santa Ana River Judgment (Albert Web and Associates, 1969; Joint Engineering Committee, 1969) and the recent Santa Ana River White Paper prepared by SAWPA (WEI, 2010a) clearly demonstrates that stormwater and non-stormwater discharge in the reach of the Santa Ana River within the Chino Basin has increased significantly from the late 1970s to the present. This increase is largely due to urbanization, which has generated more stormwater discharge and recycled water discharges to the River. Figure 3-7a shows the time history of Santa Ana River discharge just below the Riverside Narrows at the point where the City of Riverside discharges to the River and the discharge at just below Prado Dam. The estimated recharge in the Santa Ana River is fairly consistent from year to year due to the recycled water discharged to the River with some large recharge years corresponding to large volumes of stormwater runoff (1978, 1980, 1983, 1993, 1998, and 2005). Figure 3-7b shows the projected time history of Santa Ana River recharge for the period of 2007 through 2030. The increase in

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[1] The rainfall, runoff, and router modules of the R4 Model have been reported on in the literature as the Wasteload Allocation Model or WLAM. With the addition of the rootzone module the code was renamed R4.

Santa Ana River recharge is caused by the Chino Desalters and Watermaster's use of reoperation water for desalter replenishment.

3.3.3 Predicted Decline in Safe Yield from the Peace II Engineering Work in 2007

Table 3-6 shows the hydrologic budget and estimated safe yield of the Chino Basin, based on the 2007 Chino Basin Watermaster Model simulation of the Peace II Alternative (WEI, 2009b). The estimated safe yield is shown graphically in Figure 3-8 for the calibration period and the Peace II projection period. The safe yield is estimated to change from about 145,000 acre-ft/yr during Carroll's 1965 through 1974 base period to about 143,000 acre-ft/yr in 1997 through 2006 and to about 131,000 acre-ft/yr in 2030. The future safe yield estimates presented herein are based on the methodology described in the next section.

3.3.4 Mitigation of the Loss of Safe Yield

The analysis of the Peace II Agreement did not take the MS4 permit compliance of various cities and counties into account. The known compliance measures as of June 1, 2009 were compiled in the RMPU process and are listed in Section 5. In 2010, the Regional Water Quality Control Board (RWQCB) issued new MS4 permits to the Santa Ana Watershed parts of the Counties of Riverside and San Bernardino and the cities within the Santa Ana Watershed. These permits contain stormwater management requirements for stormwater that is generated from new development and will increase recharge in the Chino Basin.

Essentially, the new permits require that all stormwater generated from new development from a 24-hour, 85th percentile storm be detained and recharged on site if recharge is feasible; if recharge is not feasible, the stormwater must be detained and treated and subsequently discharged. In the Chino Basin, this roughly corresponds to 1 inch over 24 hours. The specific technologies for detention and recharge are to be developed by the landuse control entities. The landuse control entities are responsible for the inspection and maintenance of these new stormwater management facilities. The recharge facilities could include detention and sedimentation basins, recharge basins, dry wells, and managed swales.

As part of this investigation, projections of new stormwater recharge from the implementation of the 2010 MS4 permits were prepared. The land area that would be subject to the 2010 MS4 permits was estimated by comparing the ultimate land use map (Figure 3-2j) to the 2006 landuse map (Figure 3-2i). The R4 Model was used to estimate the increase in stormwater recharge from new development by applying the stormwater management criteria from the new MS4 permit for two conditions: (1) all of the stormwater managed pursuant to the MS4 permit is recharged and (2) half of the stormwater managed pursuant to the MS4 permit is recharged. No assumptions were made as to the specific new stormwater management facilities used to comply with the permits. Table 3-7 shows the new stormwater recharge that is projected to occur at build-out due to the implementation of the new MS4 permit. The table shows, by landuse control entity, the new recharge for the Chino Basin area watershed and the land overlying the Chino Basin. The new stormwater recharge created through permit compliance is estimated to range from about 6,300 acre-ft/yr if half of the stormwater managed pursuant to the MS4 permit is recharged to about 12,600 acre-ft/yr if all of the stormwater managed pursuant to the MS4 permit is recharged. Implementation of the new MS4 permit will offset some of the lost recharge from landuse and drainage changes.

The R4 Model was also used to estimate the increase in stormwater recharge if the new MS4 permit were applied to the developed parts of the Chino Basin. These results are shown in Table 3-7. If applied to the developed areas, the new stormwater recharge created through permit compliance is estimated to range from about 19,000 acre-ft/yr if half of the stormwater managed pursuant to the MS4 permit is recharged to about 38,000 acre-ft/yr if all of the stormwater managed pursuant to the MS4 permit is recharged.

3.4 Recommended Method to Estimate Safe Yield

There is no period in the last 70 years where there is a hydrology representative of long term hydrologic and cultural conditions. The hydrology and safe yield have changed over time in response to the changes in landuse, drainage, and other water management practices. Therefore, to calculate safe yield, Watermaster needed to create a long-term stationary time series for recharge that is representative of the long-term hydrology as well as present and future cultural conditions. This was accomplished in the Peace II engineering work through the development of an expected value hydrology for year 2006 and year 2030 landuses, drainage, and water management practices. The Peace II engineering procedure consisted of the following steps:

- For each planning year (2006 and 2030), a 57-year (1959 to 2006) daily precipitation time history was used to estimate the deep infiltration of precipitation and applied water, runoff, stormwater recharge in Chino Basin recharge facilities, and recharge in the Santa Ana River.
- The expected or average recharge from each planning year was used for the planning years, and the recharge was linearly interpolated for intervening years.
- The projected groundwater production and supplemental water recharge was assigned to each year from 2006 through 2030 pursuant to planning projections and the replenishment requirements of the Judgment.
- The 2007 Chino Basin Groundwater Model was used to simulate the basin response to expected value hydrology, projected groundwater production, and projected supplemental water recharge.
- The safe yield was estimated using the modified Carroll method of equation 4 and a ten-year base period.

Table 3-6 and Figure 3-8 show the results of this process for the Peace II Alternative planning assumptions, which were originally reported in *2007 CBWM Model Documentation and Evaluation of the Peace II Project Description* (WEI, 2007b) and subsequently revised in *2009 Production Optimization and Evaluation of the Peace II Project Description* (WEI, 2009b). This approach to estimating safe yield can be used by Watermaster to evaluate impacts on safe yield that result from changes in groundwater management strategies, including varying the amount of groundwater production, varying the location of production, varying the magnitude and operating concepts for conjunctive use programs, and varying the location and magnitude of recharge.

Watermaster should also apply equation 4 to historical data as a verification of the modeling approach outlined above. Watermaster already collects groundwater production data and supplemental water recharge estimates. Computing the change in storage can be done based on groundwater elevation maps created at the beginning and end of the base period and comparable ground elevation maps for areas that are undergoing subsidence. Pursuant to Watermaster's Rules and Regulations, Watermaster staff will use this approach in fiscal year 2010-11 to do the first re-computation of safe yield.

3.5 Baseline Stormwater Recharge with Existing Recharge Facilities in 2010

A 2010 estimate of stormwater recharge was developed to compare against the stormwater recharge estimates developed for the CBFIP projects prior to their construction and as a baseline to measure recharge improvements for the projects evaluated in Section 5 of this report. This baseline recharge estimate is the long-term average annual stormwater recharge from existing stormwater management facilities, including the CBFIP facilities constructed as part of the implementation of the OBMP. Recharge estimates were prepared for each recharge facility using the 57-year daily precipitation record that was used in the 2007 Peace II engineering work (WEI, 2007b) and the R4 Model. These estimates are based on the *2006 Chino Basin Recharge Facilities Operation Procedures Manual* (GRCC, 2006) with some operating procedure modifications, provided by the IEUA. The results are summarized in Table 3-8 for current conditions and build-out. The long-term average annual stormwater recharge with the recharge facilities existing in 2009-10 is estimated to be about 13,600 acre-ft/yr, and this recharge will increase slightly over time due to new stormwater generated by development that is not captured in the local recharge facilities required to comply with the 2010 MS4 permit.

Table 3-8 also shows the interrelationship of the new recharge created by compliance with the 2010 MS4 permit and recharge at the regional stormwater recharge facilities. Note that the stormwater recharge created through compliance with the 2010 MS4 permit actually reduces the future stormwater recharge that would otherwise occur at the regional stormwater recharge facilities in the absence of the 2010 MS4 permit, and thus the net new recharge created by the MS4 permit is reduced slightly to about 5,300 acre-ft/yr if half of the stormwater managed pursuant to the MS4 permit is recharged and about 10,500 acre-ft/yr if all of the stormwater managed pursuant to the MS4 permit is recharged.

3.6 Recharge Master Plan Update Implementation Items

3.6.1 Recomputation of the Safe Yield

Watermaster should use the methodology described in Section 3.4 to recompute safe yield in

2010-11 and should apply this method every five years thereafter. The revised safe yield estimates can then be used by the water purveyors in the Chino Basin to prepare UWMPs and by Watermaster to complete Recharge Master Plan updates.

3.6.2 Mitigation of the Projected Loss of Safe Yield

Section 3.3.4 describes the range of new stormwater recharge that could result from implementing the 2010 MS4 permit. Based on the requirements of the permit, the expected new stormwater recharge could range from about 5,300 acre-ft/yr (if 50 percent of the stormwater that is required to be managed by the permit is recharged) to about 10,600 acre-ft/yr (if 100 percent of the stormwater that is required to be managed by the permit is recharged).

Section 3.3.4 also describes the new recharge potential of existing developed areas. Applying the same criteria from the MS4 permit to developed areas yields, on average, between 19,000 acre-ft/yr and 38,000 acre-ft/yr of new recharge. Watermaster, working with the landuse control entities, should encourage development practices that will maximize the capture and recharge of stormwater. New recharge, as used herein, means the net new recharge created by the project.

The following should be implemented by the CBWCD, the IEUA, the Watermaster, and other stakeholders.

1. Watermaster should allocate new yield that is created by new recharge above that required by MS4 permit compliance to the owners of those projects that create new recharge. This will require the development of (a) new agreements involving Watermaster, project owners, and others; and (b) the development of new practices and procedures that can quantify new recharge during project development and subsequently verify that the new recharge is occurring during the project lifetime.
2. Watermaster, working with the Parties, should encourage the construction of local recharge projects in developed areas that will increase the capture and recharge of stormwater. The recommendations for local stormwater recharge projects in developed areas are the same as those for newly developed areas, articulated above.
3. In implementing the above, Watermaster should form a committee—consisting of itself, the landuse control entities, the County Flood Control Districts, the CBWCD, the IEUA, and others—to develop the monitoring, reporting, and accounting practices that will be required to estimate local project stormwater recharge and new yield. This committee should be formed immediately, and the monitoring, reporting, and accounting practices should be developed as soon as possible.

Table 3-1
Components of Safe Yield
Adopted in the Chino Basin Judgment

Hydrologic Component[1]	Annual Average	
	(acre-ft/yr)	(%)
Inflows to the Chino Basin		
Deep Percolation		
Precipitation and Surface Inflow	47,500	33%
Imported Water	7,000	5%
Irrigation		
Domestic	9,800	7%
Agriculture	51,900	36%
Artificial Recharge	3,900	3%
Recharge of Sewage	18,200	13%
Subsurface Inflow	7,200	5%
Total Inflow	145,500	100%
Outflows from the Chino Basin		
Subsurface Outflow	7,200	4%
Extractions	180,000	96%
Total Outflow	187,200	100%
Hydrologic Balance		
Estimated Annual Average Change in Storage 1965-1974	-40,000	
Safe Yield (equal to average annual extraction plus annual average change in storage)	140,000	

Table 3-2
Historical Landuse in the Chino Basin Area
(acres unless indicated otherwise)

Land Use Type	1933	1949	1957	1963	1975	1984	1990	2000	2006
Non-Irrigated Field Crops, Pasture, Fruits and Nuts	39,348	39,347	4,577	769	1,529	1,153	461	445	444
Irrigated Field Crops, Pasture, Fruits and Nuts	37,004	37,004	27,885	27,107	22,062	19,809	19,943	16,069	14,112
Irrigated and Non-Irrigated Citrus	18,206	18,179	9,460	4,562	2,100	2,205	607	706	402
Irrigated Vineyard	2,022	2,022	8,879	21,545	11,422	7,646	3,614	906	1,081
Non-Irrigated Vineyard	109	109	95	0	0	0	180	138	129
Dairies and Feedlots	226	224	4,604	5,097	7,846	8,074	8,523	7,921	7,865
Medium and High Density Urban Residential	7,926	7,930	9,972	19,818	22,544	24,730	30,532	35,272	38,020
Low Density Urban Residential	2,159	2,159	2,471	5,602	5,596	8,057	11,687	11,884	11,717
Commercial	2,072	2,072	3,550	4,728	5,660	6,976	8,790	15,340	15,330
Industrial	2,267	2,267	2,573	2,693	5,832	8,888	8,850	9,940	9,980
Special Impervious	992	992	1,013	1,136	1,208	5,063	5,800	7,480	7,500
Native Vegetation	4,662	4,662	7,381	6,143	6,060	6,018	5,326	5,274	5,290
Undeveloped	20,408	20,435	54,991	38,259	45,613	38,786	33,091	26,022	25,533
Totals	137,402	137,402	137,450	137,459	137,474	137,405	137,403	137,398	137,403
Aggregated by Landuse Group (acres)									
Agricultural	96,915	96,885	55,499	59,081	44,959	38,887	33,328	26,185	24,034
Urban	15,416	15,420	19,579	33,976	40,841	53,714	65,659	79,916	82,547
Undeveloped + Native Vegetation	25,070	25,097	62,372	44,402	51,673	44,804	38,416	31,297	30,822
Total	137,402	137,402	137,450	137,459	137,474	137,405	137,403	137,398	137,403
Aggregated by Landuse Group (percent of total)									
Agricultural	71%	71%	40%	43%	33%	28%	24%	19%	17%
Urban	11%	11%	14%	25%	30%	39%	48%	58%	60%
Undeveloped + Native Vegetation	18%	18%	45%	32%	38%	33%	28%	23%	22%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: *2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description* (WEI, 2007)

Table 3-3
Imperviousness and Irrigation Properties

Land Use Type	Total Imperviousness (%)	Evapotranspiration (ft/yr)	Irrigation Efficiencv[1] (%)			Applied Water (ft/yr)		Irrigation Return (ft/yr)	
Non-Irrigated Field Crops, Pasture, Fruits and Nuts	2	2.38	na			na		na	
Irrigated Field Crops, Pasture, Fruits and Nuts	2	2.38	55	-	75	4.33	3.18	1.95	0.79
Irrigated and Non-Irrigated Citrus	2	2.53	60	-	80	4.22	3.16	1.69	0.63
Irrigated Vineyard	2	2.07	60	-	75	3.45	2.76	1.38	0.69
Non-Irrigated Vineyard	2	1.75	na			na		na	
Dairies and Feedlots	10	na	na			na		na	
Medium and High Density Urban Residential	75	3.06	75	-	75	4.08	4.08	1.02	1.02
Low Density Urban Residential	30	3.06	75	-	75	4.08	4.08	1.02	1.02
Commercial	90	3.50	75	-	75	4.67	4.67	1.17	1.17
Industrial	90	3.06	75	-	75	4.08	4.08	1.02	1.02
Special Impervious	95	na	na			na		na	
Native Vegetation	2	0.74 to 3.50	na			na		na	
Undeveloped	2	1.44	na			na		na	

1. Irrigation efficiency corresponds to the current period for urban uses and to the period of time in which crops were principally grown. For example, citrus was flood irrigated when it was cultivated in the northern part of the Chino Basin area and, thus, has a low irrigation efficiency, whereas modern citrus cultivation utilizes drip irrigation with a much greater irrigation efficiency. Irrigation of turf and ornamental plants is assumed to occur by sprinkler irrigation, which is assumed to have an irrigation efficiency of 75 percent.

Table 3-4
Time History of Total Imperviousness of the Land Surface in the Chino Basin Area
(acres unless indicated otherwise)

Land Use Type	1933	1949	1957	1963	1975	1984	1990	2000	2006
Non-Irrigated Field Crops, Pasture, Fruits and Nuts	787								
Irrigated Field Crops, Pasture, Fruits and Nuts	740	740	558	542	441	396	399	321	282
Irrigated and Non-Irrigated Citrus	364	364	189	91	42	44	12	14	8
Irrigated Vineyard	40	40	178	431	228	153	72	18	22
Non-Irrigated Vineyard	2	2	2	0	0	0	4	3	3
Dairies and Feedlots	23	22	460	510	785	807	852	792	787
Medium and High Density Urban Residential	5,944	5,947	7,479	14,863	16,908	18,547	22,899	26,454	28,515
Low Density Urban Residential	648	648	741	1,681	1,679	2,417	3,506	3,565	3,515
Commercial	1,864	1,864	3,195	4,255	5,094	6,278	7,911	13,806	13,797
Industrial	2,040	2,040	2,316	2,423	5,249	8,000	7,965	8,946	8,982
Special Impervious	943	943	962	1,079	1,148	4,810	5,510	7,106	7,125
Native Vegetation	93	93	148	123	121	120	107	105	106
Undeveloped	408	409	1,100	765	912	776	662	520	511
Totals	13,110	13,113	17,327	26,763	32,608	42,349	49,899	61,652	63,652
Imperviousness as a Percent of Total Basin Surface	10%	10%	13%	19%	24%	31%	36%	45%	46%
Aggregated by Landuse Group (acres)									
Agricultural	1,169	1,169	1,387	1,574	1,496	1,401	1,339	1,148	1,101
Urban	11,440	11,443	14,693	24,301	30,078	40,052	47,791	59,877	61,934
Undeveloped + Native Vegetation	501	502	1,247	888	1,033	896	768	626	616
Total	13,110	13,113	17,327	26,763	32,608	42,349	49,899	61,652	63,652
Aggregated by Landuse Group (percent of total)									
Agricultural	9%	9%	8%	6%	5%	3%	3%	2%	2%
Urban	87%	87%	85%	91%	92%	95%	96%	97%	97%
Undeveloped + Native Vegetation	4%	4%	7%	3%	3%	2%	2%	1%	1%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 3-5
Estimated Deep Infiltration of Precipitation and Applied Water
(acre-ft)

Year	Deep Infiltration of Precipitation and Applied Water				
	Aggregated Agricultural Landuse	Aggregated Urban Landuse	Undeveloped and Native Vegetation	Total Infiltration	Ten-Year Average Total Infiltration
1933	117,144	8,001	4,781	129,926	
1934	129,287	9,842	7,408	146,537	
1935	128,925	11,618	7,294	147,837	
1936	128,717	9,801	8,628	147,147	
1937	162,944	15,995	16,678	195,617	
1938	150,389	13,556	12,084	176,028	
1939	131,628	10,797	8,159	150,584	
1940	126,982	11,067	8,077	146,127	
1941	176,095	18,402	19,006	213,503	
1942	106,491	8,388	3,599	118,478	157,178
1943	154,485	13,991	12,481	180,957	162,281
1944	145,079	12,005	11,873	168,957	164,523
1945	127,084	10,386	8,751	146,221	164,362
1946	121,479	9,066	6,724	137,269	163,374
1947	129,569	9,695	7,926	147,190	158,531
1948	104,957	7,238	2,721	114,916	152,420
1949	108,219	7,472	4,680	120,370	149,399
1950	117,609	9,826	7,150	134,585	148,245
1951	90,174	7,156	2,286	99,616	136,856
1952	139,053	16,756	24,986	180,794	143,088
1953	86,472	9,159	8,163	103,794	135,371
1954	88,183	12,200	13,206	113,589	129,834
1955	74,924	10,527	10,449	95,901	124,802
1956	71,504	11,356	13,399	96,259	120,701
1957	56,528	10,283	11,678	78,489	113,831
1958	100,242	24,918	46,400	171,559	119,496
1959	52,560	11,440	5,603	69,603	114,419
1960	57,724	14,293	7,025	79,042	108,865
1961	49,339	12,530	2,311	64,180	105,321
1962	81,060	25,679	17,794	124,533	99,695
1963	57,112	20,462	6,178	83,752	97,691
1964	61,365	23,304	8,403	93,072	95,639
1965	64,597	22,231	12,001	98,829	95,932
1966	79,112	32,276	20,976	132,365	99,542
1967	83,863	38,984	24,077	146,924	106,386
1968	61,772	25,337	11,778	98,888	99,119
1969	91,340	45,855	38,012	175,207	109,679
1970	53,647	25,005	11,579	90,231	110,798
1971	50,844	23,751	13,293	87,888	113,169
1972	49,420	23,612	13,885	86,917	109,407
1973	62,671	35,562	25,896	124,128	113,445
1974	47,691	28,156	16,558	92,405	113,378
1975	42,203	26,400	14,422	83,025	111,798
1976	40,998	23,263	11,159	75,420	106,103
1977	40,397	30,857	14,933	86,187	100,030
1978	84,107	67,299	55,649	207,055	110,846
1979	58,359	42,953	26,861	128,173	106,143
1980	69,562	62,625	44,325	176,511	114,771
1981	34,850	27,324	8,424	70,598	113,042
1982	45,100	40,825	22,002	107,927	115,143
1983	66,066	65,429	44,809	176,304	120,360
1984	34,799	28,969	11,543	75,312	118,651
1985	37,068	30,539	9,967	77,574	118,106
1986	38,162	38,116	12,165	88,443	119,408
1987	26,752	31,159	3,511	61,422	116,932
1988	30,027	36,504	5,612	72,142	103,441
1989	27,978	34,741	8,365	71,084	97,732
1990	22,737	32,312	4,891	59,940	86,075
1991	26,823	46,120	14,702	87,645	87,779
1992	32,125	55,110	19,053	106,288	87,615
1993	47,846	88,586	33,177	169,609	86,946
1994	20,547	34,926	5,282	60,755	85,490
1995	33,130	70,628	22,814	126,572	90,390
1996	23,147	43,295	9,745	76,187	89,164
1997	28,928	53,399	15,003	97,330	92,755
1998	32,243	75,380	25,374	132,998	98,841
1999	15,064	28,158	1,298	44,521	96,185
2000	21,584	46,147	9,279	77,009	97,892
2001	20,197	47,484	8,614	76,295	96,757
2002	14,236	25,187	352	39,775	90,105
2003	22,185	62,982	13,690	98,857	83,030
2004	17,672	40,750	6,236	64,658	83,420
2005	33,391	102,146	32,483	168,019	87,565
2006	14,843	43,450	10,155	68,448	86791.0994

Table 3-6
Water Budget for Chino North, Chino East, Chino South, and Prado Basin Management Zones
Peace II Alternative
(acre-ft)

	Inflows								Outflows					Change in Storage	Cumulative Change in Storage	Safe Yield
					Artificial Recharge											
	Boundary Inflow	Temescal to PBMZ	Deep Percolation of Precipitation and Applied Water	Stream Recharge	Storm	Imported Water	Recycled Water[1]	Subtotal Inflows	Production	PBMZ to Temescal	ET	Rising Groundwater	Subtotal Outflow			
2006	32,703	6,294	86,301	25,502	11,646	24,759	2,980	190,185	151,206	2,069	14,799	15,663	183,737	6,448	6,448	140,000
2007	32,703	6,355	82,094	28,349	11,646	0	2,340	163,486	174,244	2,058	14,469	14,283	205,053	-41,567	-35,119	140,000
2008	32,703	5,925	83,013	30,165	11,646	0	5,000	168,452	167,173	2,013	14,335	13,868	197,389	-28,937	-64,056	140,000
2009	32,703	5,418	83,671	31,743	11,646	0	5,000	170,181	181,868	1,986	14,132	13,299	211,285	-41,104	-105,160	140,000
2010	32,703	5,566	82,150	33,576	11,646	0	10,000	175,641	188,574	2,235	13,944	12,462	217,216	-41,575	-146,735	140,000
2011	32,703	5,509	81,850	34,952	11,646	0	10,500	177,159	186,659	2,305	13,835	12,006	214,806	-37,647	-184,382	134,127
2012	32,703	5,263	79,177	35,988	11,646	0	11,000	175,776	184,744	2,310	13,720	11,692	212,465	-36,689	-221,072	134,545
2013	32,703	4,987	78,267	36,703	11,646	0	11,500	175,806	182,828	2,304	13,614	11,453	210,198	-34,392	-255,464	134,844
2014	32,703	4,710	77,834	37,934	11,646	12,000	12,000	188,826	187,393	2,297	13,429	10,958	214,076	-25,250	-280,714	135,211
2015	32,703	4,441	77,243	39,030	11,646	77,556	12,500	255,119	185,477	2,289	13,243	10,498	211,507	43,612	-237,102	135,593
2016	32,703	4,181	76,196	39,207	11,646	77,056	13,000	253,989	186,953	2,284	13,148	10,337	212,721	41,268	-195,834	136,418
2017	32,703	3,937	75,761	39,045	11,646	76,556	13,500	253,148	188,429	2,278	13,109	10,312	214,128	39,020	-156,814	137,123
2018	32,703	3,709	74,232	38,761	11,646	76,056	14,000	251,107	189,905	2,273	13,101	10,352	215,631	35,476	-121,338	137,332
2019	32,703	3,499	73,531	38,551	11,646	0	14,500	174,430	191,380	2,268	13,108	10,416	217,172	-42,742	-164,080	137,170
2020	32,703	3,305	71,573	38,807	11,646	0	15,000	173,034	192,856	2,265	13,109	10,407	218,637	-45,603	-209,682	136,695
2021	32,703	3,123	71,111	39,222	11,646	0	15,900	173,705	195,925	2,262	13,090	10,346	221,624	-47,919	-257,601	136,055
2022	32,703	2,953	70,147	39,853	11,646	0	16,800	174,102	198,994	2,260	13,043	10,200	224,497	-50,395	-307,997	135,529
2023	32,703	2,792	68,772	40,458	11,646	72,356	17,700	246,427	202,064	2,257	12,979	10,023	227,323	19,104	-288,893	134,947
2024	32,703	2,643	67,887	40,762	11,646	71,456	18,600	245,696	205,133	2,256	12,926	9,903	230,218	15,478	-273,415	134,188
2025	32,703	2,501	66,934	41,110	11,646	70,556	19,500	244,949	208,202	2,254	12,880	9,797	233,133	11,816	-261,599	133,281
2026	32,703	2,369	66,058	41,464	11,646	69,656	20,400	244,295	210,632	2,247	12,824	9,684	235,387	8,908	-252,690	132,413
2027	32,703	2,243	65,444	41,819	11,646	68,756	21,300	243,911	213,062	2,239	12,765	9,558	237,623	6,288	-246,402	131,603
2028	32,703	2,122	64,550	42,301	11,646	36,000	22,200	211,521	215,492	2,232	12,715	9,440	239,879	-28,358	-274,760	130,964
2029	32,703	2,009	64,037	43,098	11,646	0	23,100	176,594	217,922	2,226	12,654	9,267	242,069	-65,475	-340,236	130,485
2030	32,703	1,906	63,215	43,919	11,646	0	24,000	177,388	220,852	2,221	12,581	9,081	244,735	-67,347	-407,583	130,210
Total	817,567	97,759	1,851,046	942,320	291,150	732,765	352,320	5,084,927	4,827,967	55,686	333,549	275,308	5,492,510	-407,583		
Average	32,703	3,910	74,042	37,693	11,646	29,311	14,093	203,397	193,119	2,227	13,342	11,012	219,700	-16,303		
Maximum	32,703	6,355	86,301	43,919	11,646	77,556	24,000	255,119	220,852	2,310	14,799	15,663	244,735	43,612		
Minimum	32,703	1,906	63,215	25,502	11,646	0	2,340	163,486	151,206	1,986	12,581	9,081	183,737	-67,347		

1 -- These recycled water recharge projections predate the IEUA May 2010 Recycled water recharge estimates.

Table 3-7

Stormwater Recharge from Future Development from Compliance with the 2010 MS4 Permits and Potential New Recharge if the Same Requirements Were Applied to the Current Developed Areas

(acre-ft)

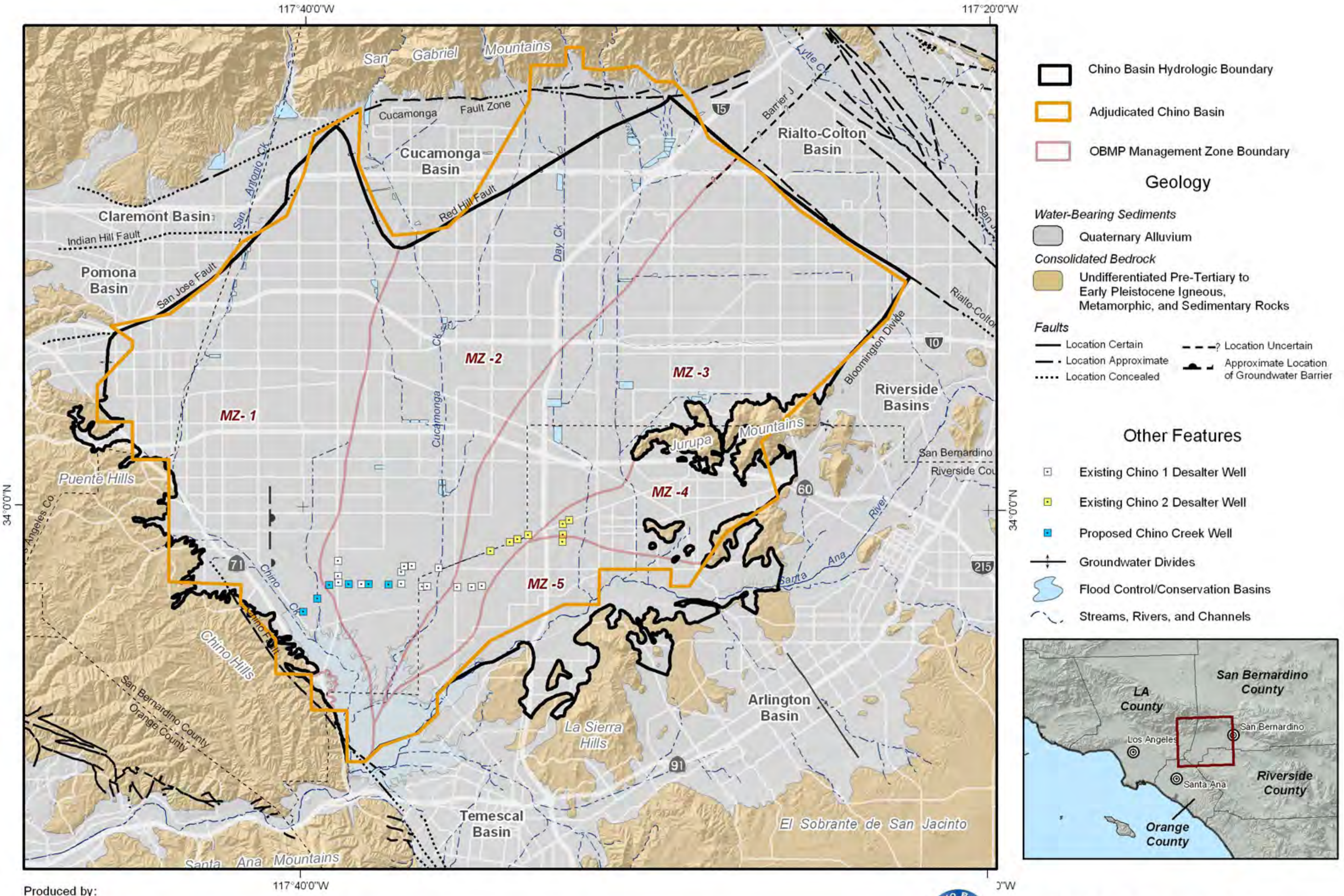
Landuse Control Entity	Undeveloped Area[1]		Developed Area[2]	
	100% Recharge	50% Recharge	100% Recharge	50% Recharge
Claremont	3	2	84	42
Montclair	82	41	1,638	819
Upland	210	105	2,377	1,189
Rancho Cucamonga	1,721	861	6,692	3,346
Fontana	1,616	808	5,018	2,509
Rialto	145	72	862	431
Ontario	3,934	1,967	9,840	4,920
Chino	1,787	893	3,358	1,679
Chino Hills	33	16	223	111
Pomona	38	19	566	283
San Bernardino County	589	294	3,731	1,866
Riverside County	2,423	1,212	3,735	1,867
Others	0	0	0	0
Total	**12,581**	**6,290**	**38,126**	**19,063**

1 -- Represents a range of recharge that is expected to occur through implementation of the 2010 MS4 permit

2 -- Represents a theoretical estimate of what might be possible if the 2010 MS4 permit were applied to all existing developed areas

Table 3-8
Expected Theoretical Stormwater Recharge at CBFIP Facilities

Basins	Recharge with 2006 Land Use Condition (acre-ft)	Average Annual Future Stormwater Recharge at CBFIP Facilities for Buildout Conditions and Varying Amounts of New Runoff Management Pursuant the MS4 Permits		
		No New Recharge (acre-ft)	50% Recharge (acre-ft)	100% Recharge (acre-ft)
Brooks	672	713	697	680
College Heights	0	0	0	0
Montclair #1	290	325	312	300
Montclair #2	118	130	127	125
Montclair #3	274	276	275	274
Montclair #4	341	345	343	342
8th St	785	789	787	785
7th St	438	445	441	438
Upland	479	637	582	528
Ely	1,366	1,411	1,390	1,368
Etiwanda Debris	883	1,617	1,369	1,105
Hickory	213	231	224	213
Lower Day	555	637	603	568
San Sevaine #1	903	1,048	993	935
San Sevaine #2	117	161	149	139
San Sevaine #3	652	747	714	659
San Sevaine #4	68	93	84	73
San Sevaine #5	1,124	1,926	1,683	1,448
Turner 1&2	752	814	784	756
Turner 3&4	733	772	754	735
Victoria	561	937	812	674
Grove	259	268	264	260
Banana	445	483	465	445
Declez	912	995	960	912
RP3	444	466	466	466
Wineville	239	296	274	252
Total	13,625	16,562	15,555	14,480
MS4 Decision Impact on CBFIP Facilities		0	-1,007	-2,081
Estimated Recharge at New MS4 Facilities			6,290	12,581
Net MS4 Recharge Due to Reduction at Existing Facilities			5,283	10,499



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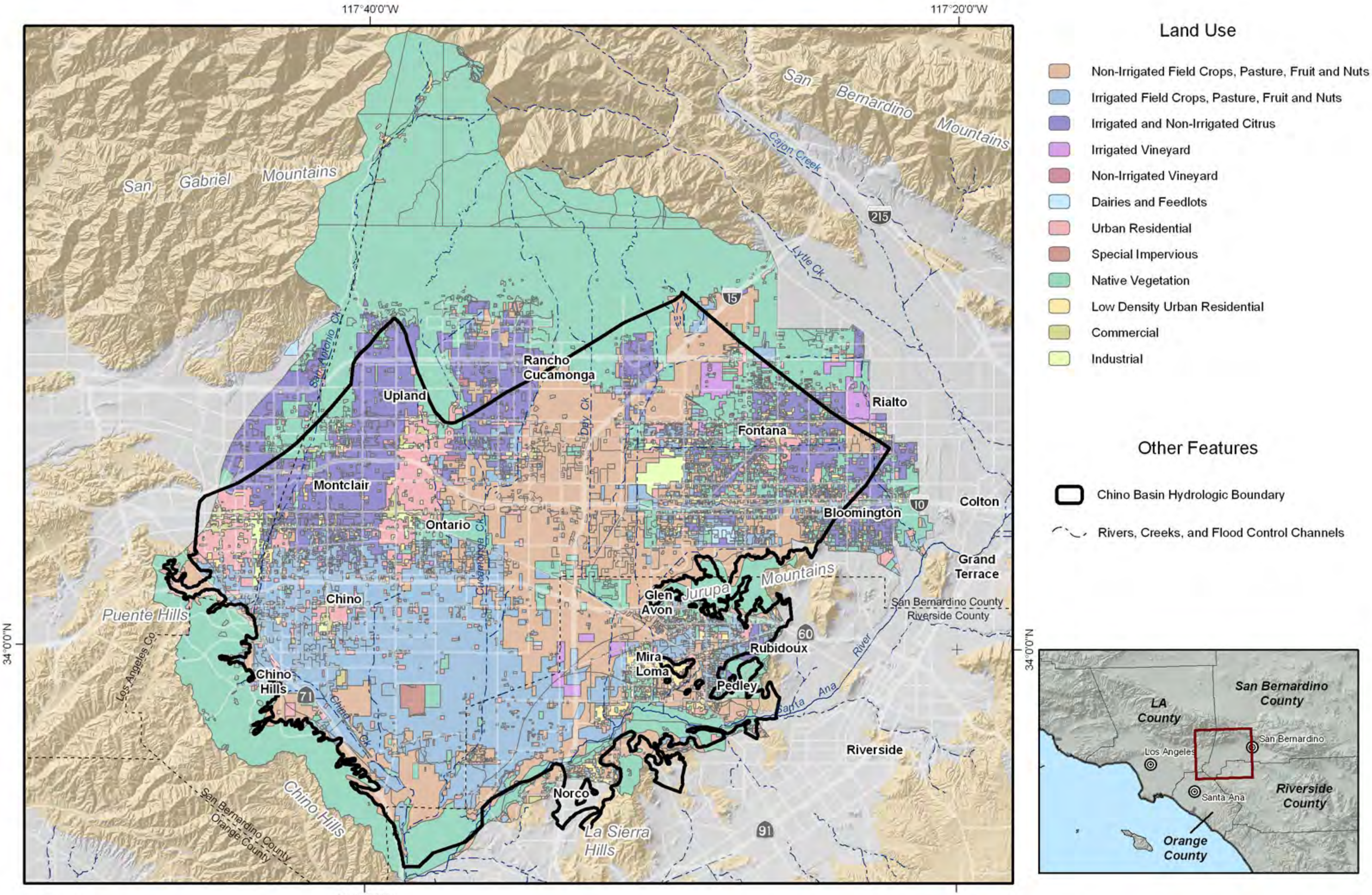
0 4 Miles
0 4 8 KM

2010 Recharge Master Plan Update

Legal and Hydrologic Boundaries of the Chino Basin

Figure 3-1



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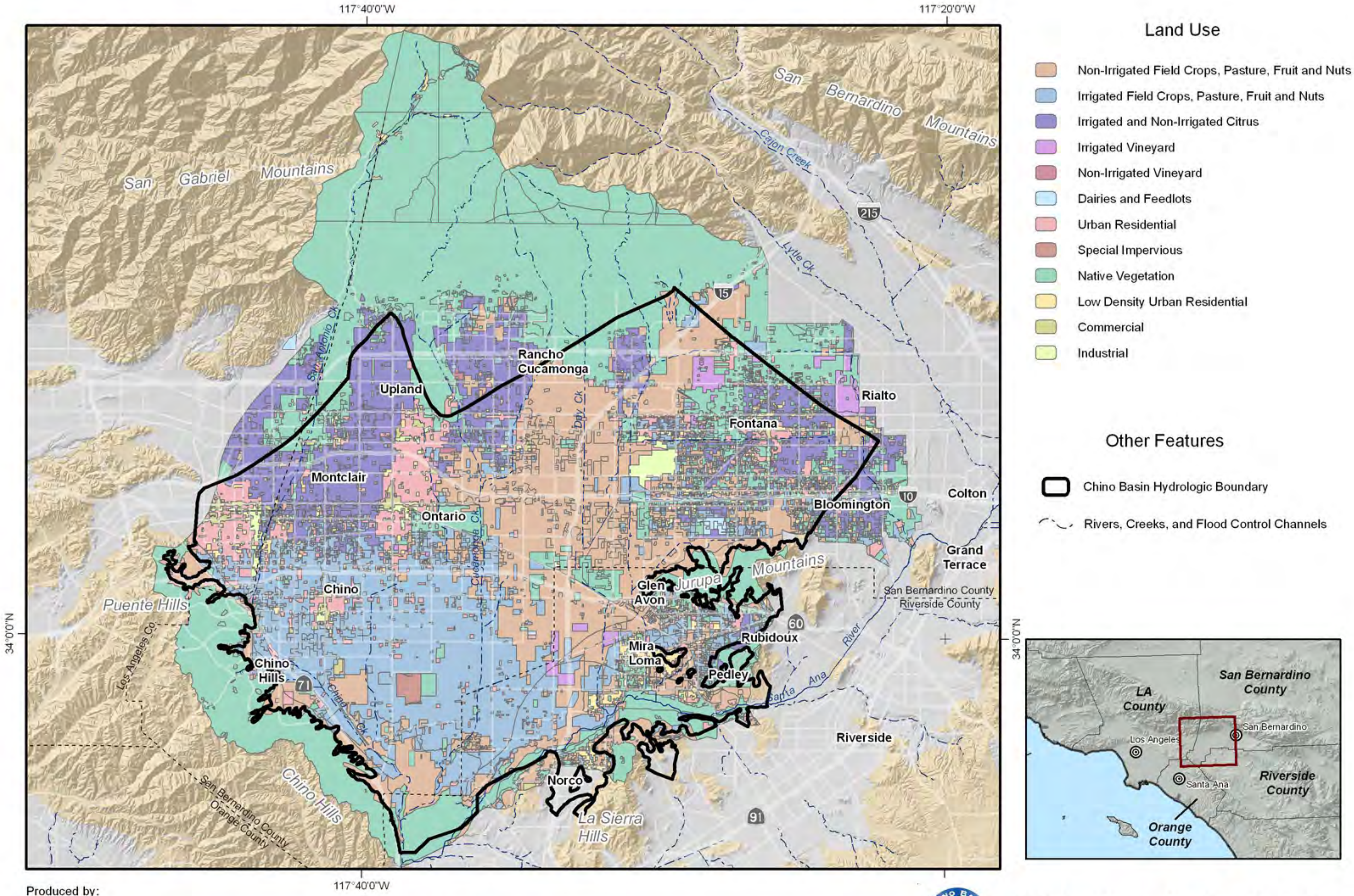
2010 Recharge Master Plan Update

1933 Land Use in the Chino Basin Area

Figure 3-2a



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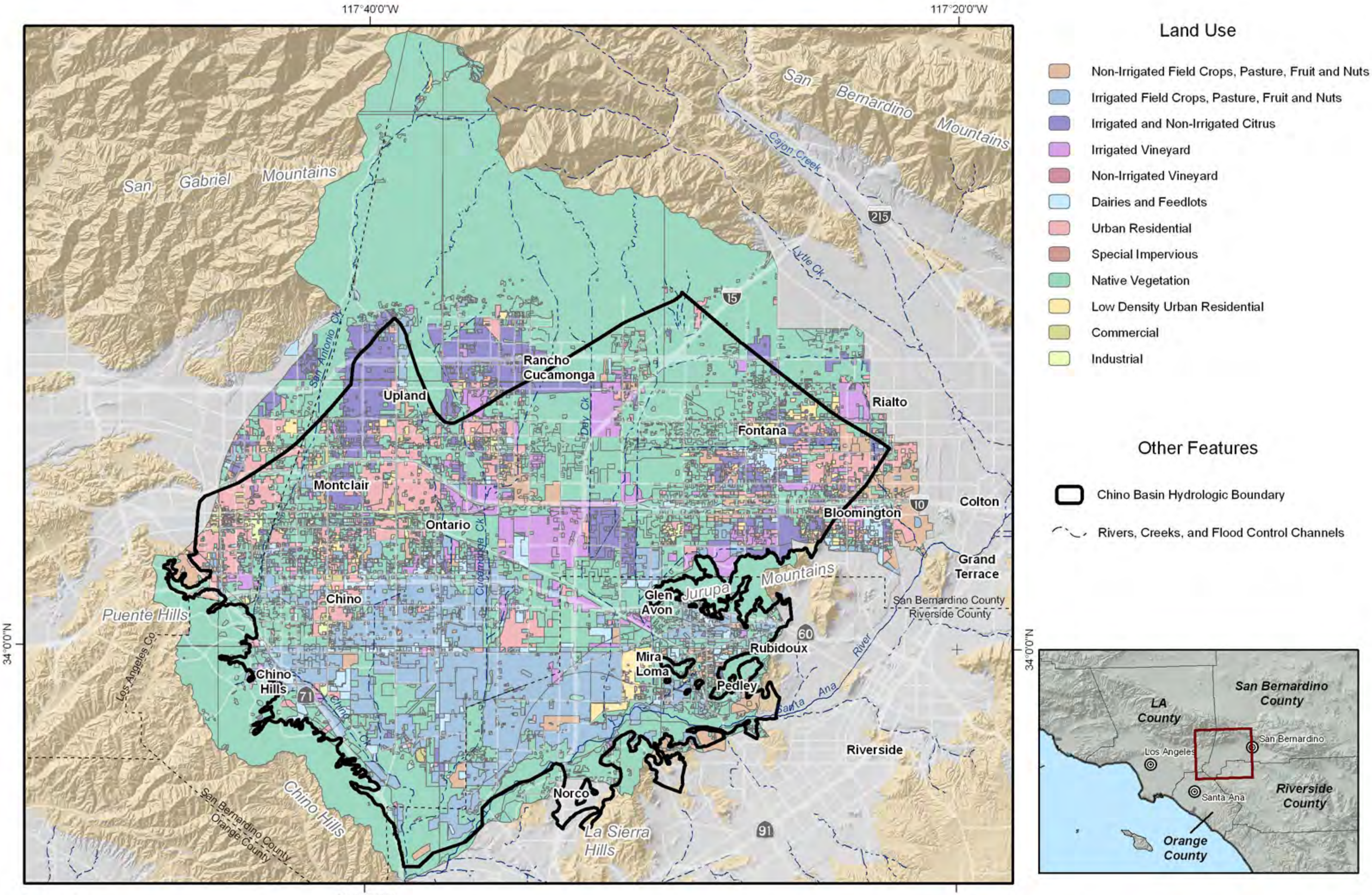
2010 Recharge Master Plan Update

1949 Land Use in the Chino Basin Area

Figure 3-2b



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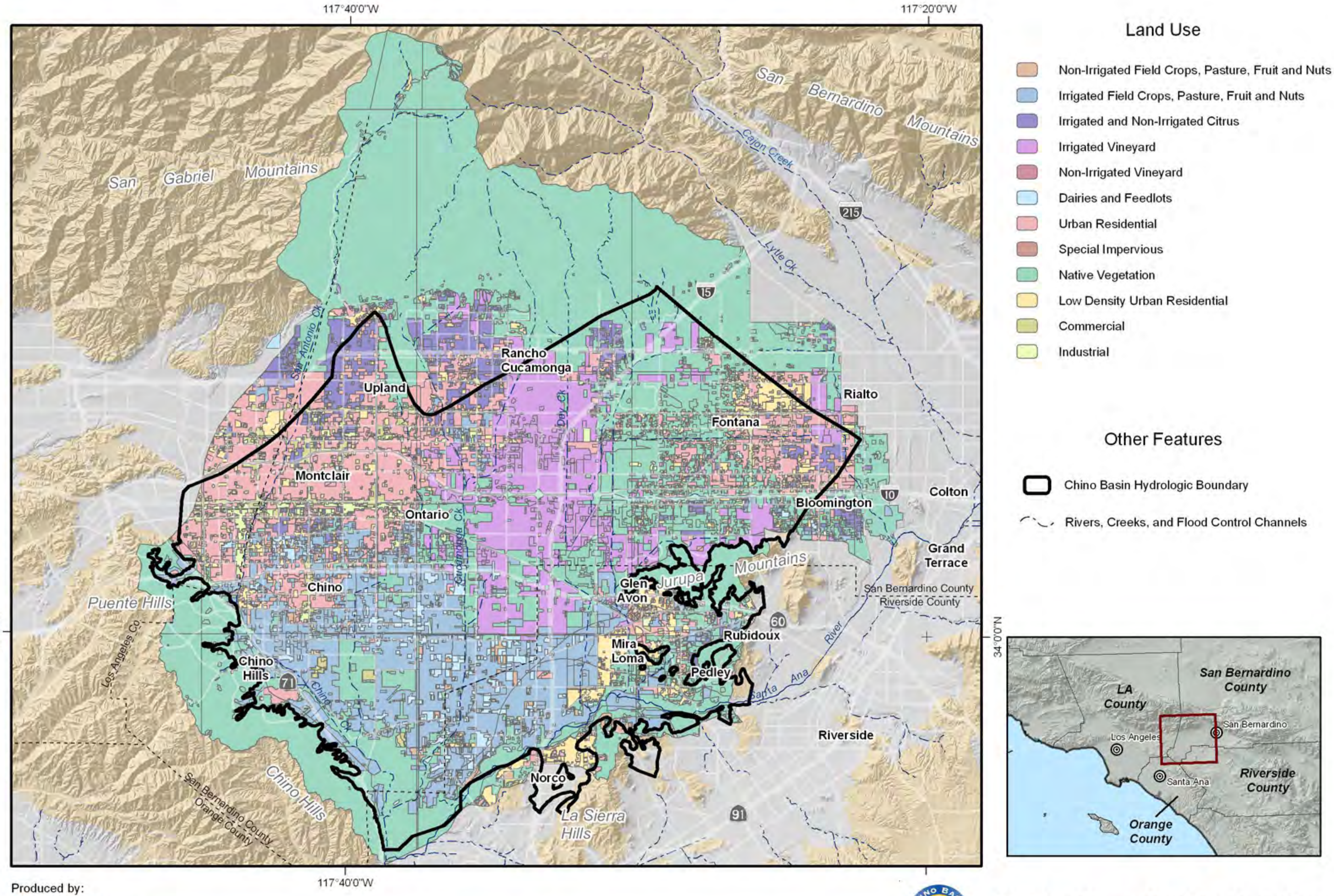
0 2 4 6 Miles
0 4 8 12 KM

2010 Recharge Master Plan Update

1957 Land Use in the Chino Basin Area

Figure 3-2c



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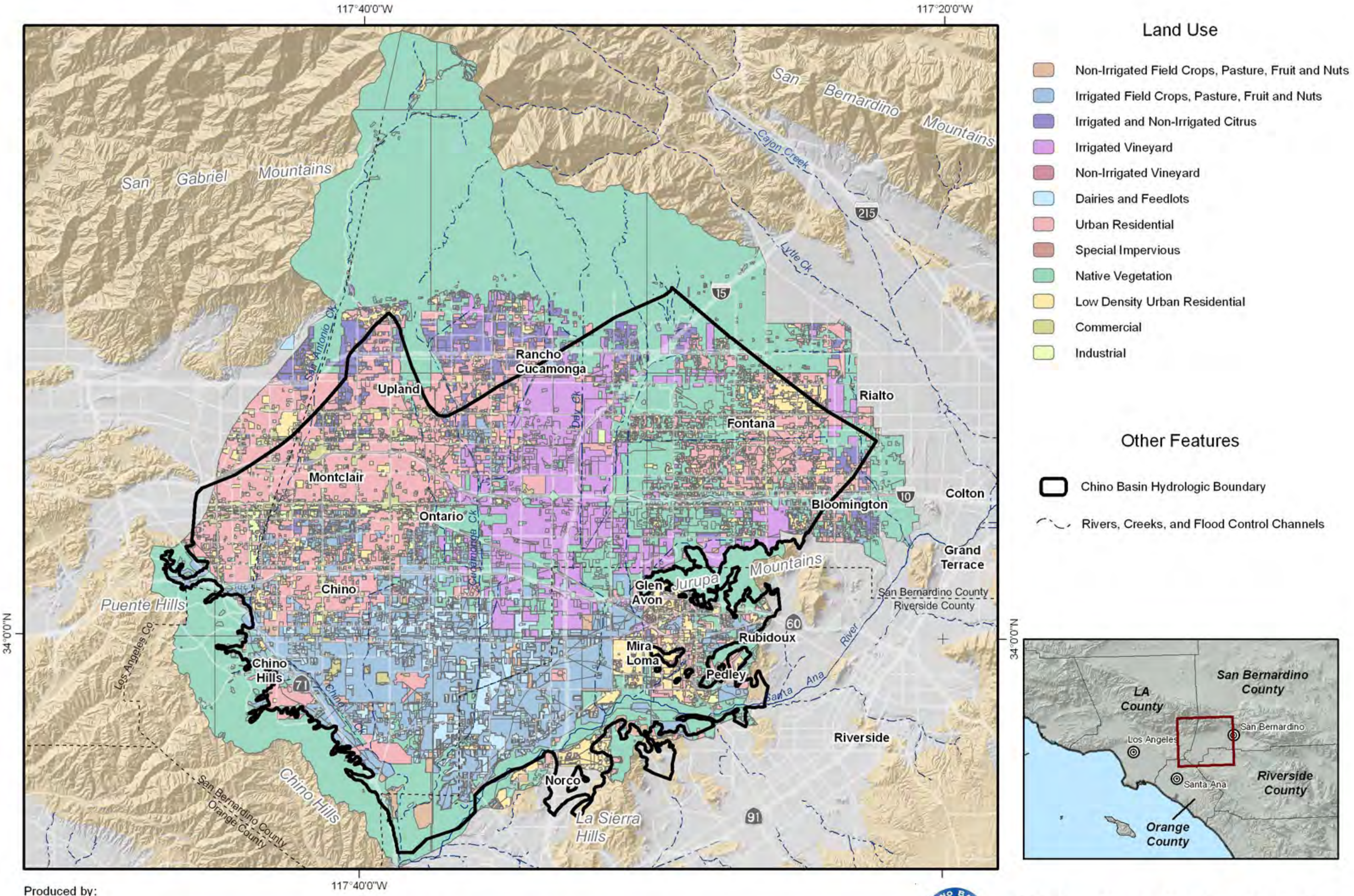
1963 Land Use in the Chino Basin Area

2010 Recharge Master Plan Update

Figure 3-2d



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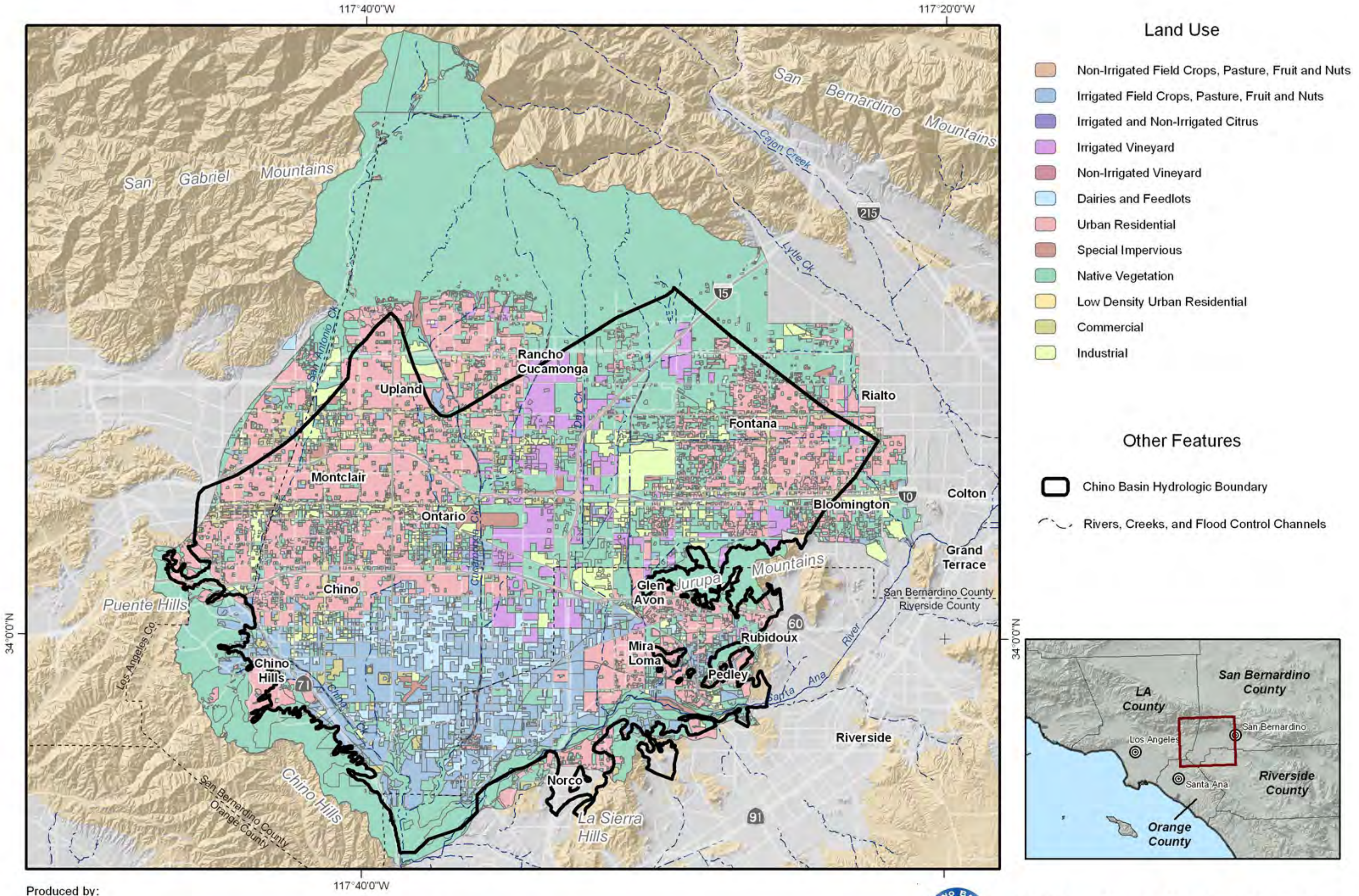
2010 Recharge Master Plan Update

1975 Land Use in the Chino Basin Area

Figure 3-2e



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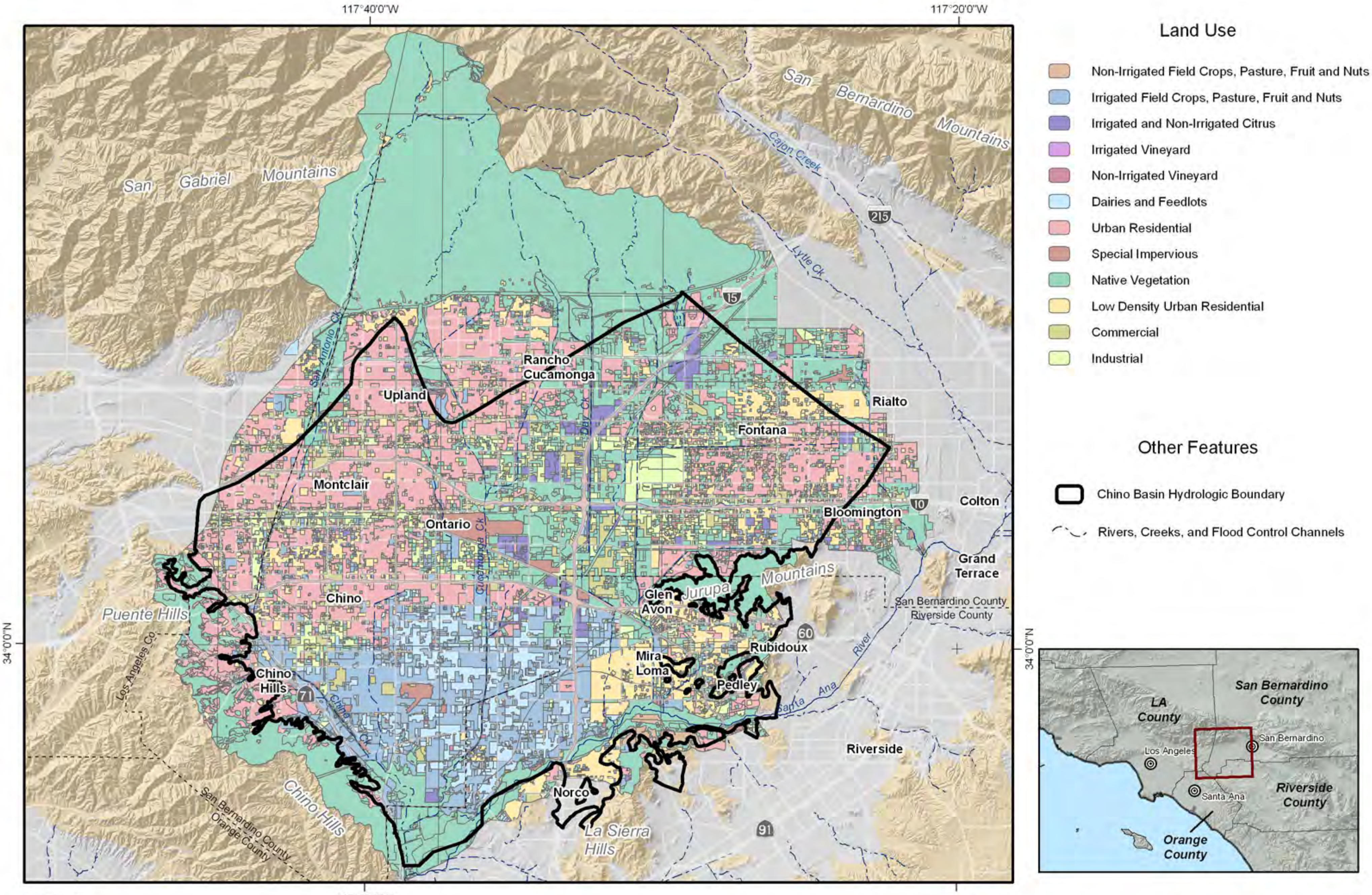
2010 Recharge Master Plan Update

1984 Land Use in the Chino Basin Area

Figure 3-2f



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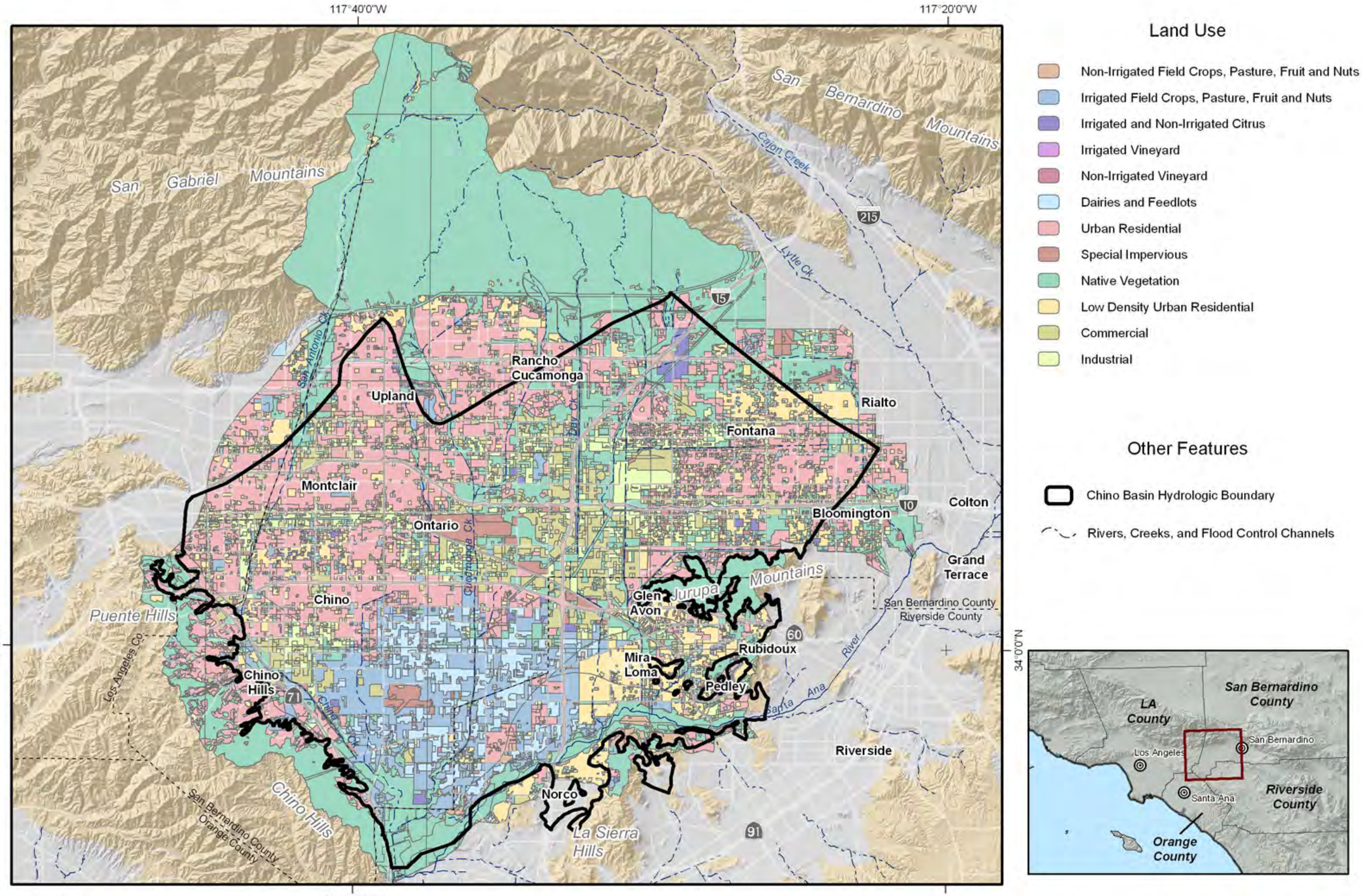
CHINO BASIN WATERMASTER
Partners in Basin Management

2010 Recharge Master Plan Update

1990 Land Use in the Chino Basin Area

Figure 3-2g



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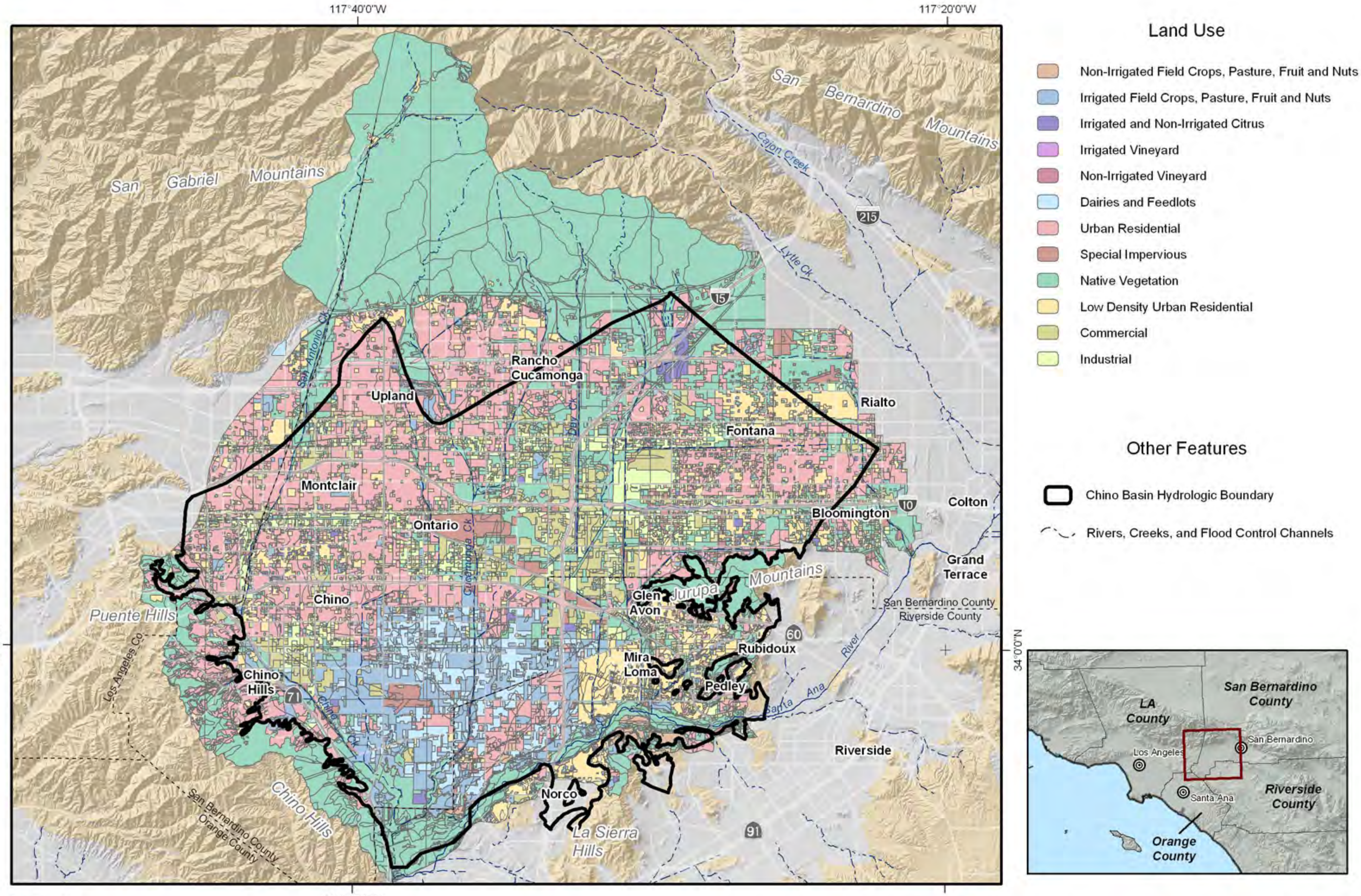
2010 Recharge Master Plan Update

2000 Land Use in the Chino Basin Area

Figure 3-2h



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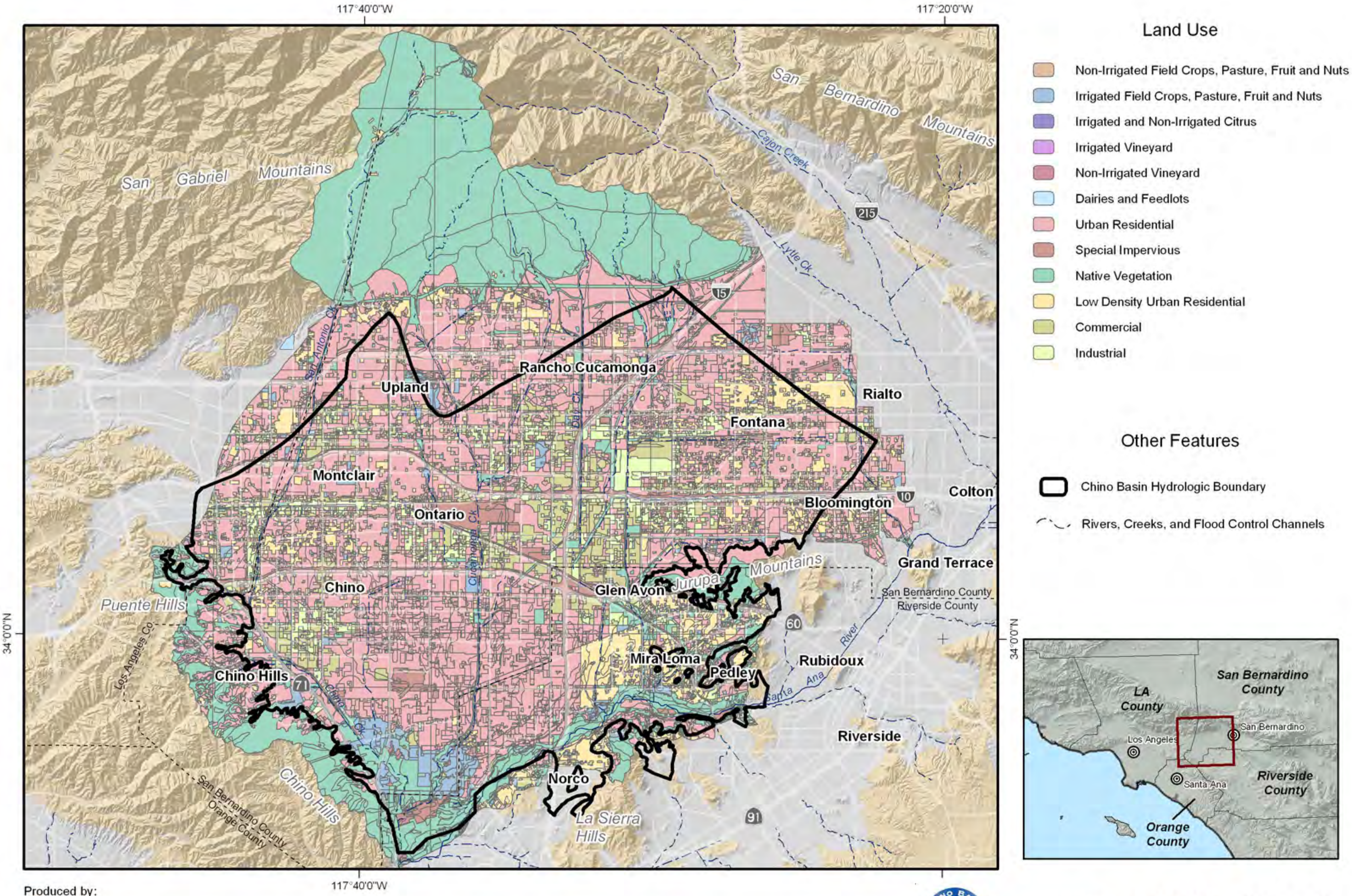
0 2 4 6 Miles
0 4 8 12 KM

2010 Recharge Master Plan Update

2006 Land Use in the Chino Basin Area

Figure 3-2i



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2010 Recharge Master Plan Update

Projected 2025 Land Use in the Chino Basin Area

Figure 3-2j

Figure 3-3

Time History of Deep Infiltration of Precipitation and Applied Water for the Chino Basin

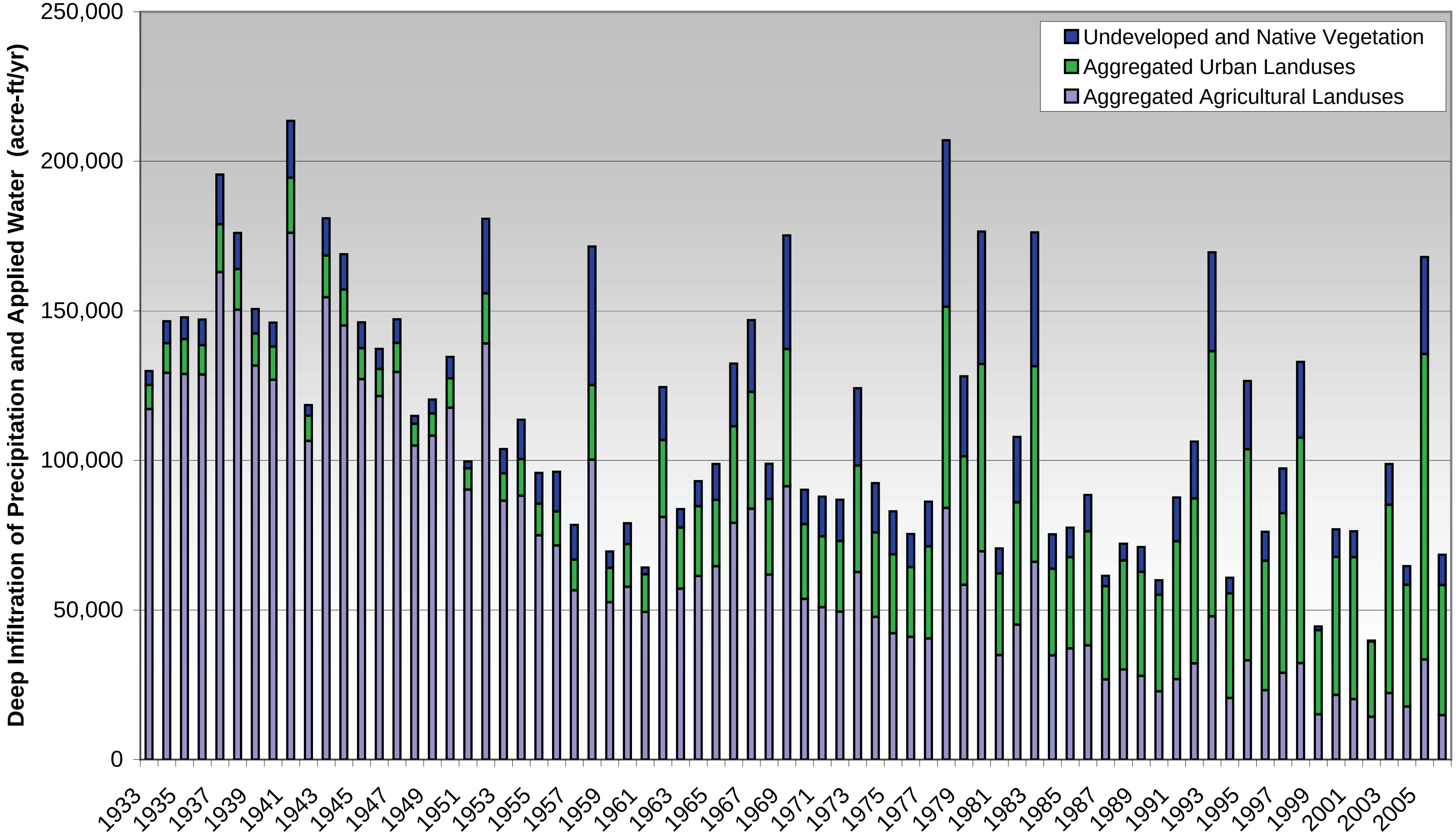
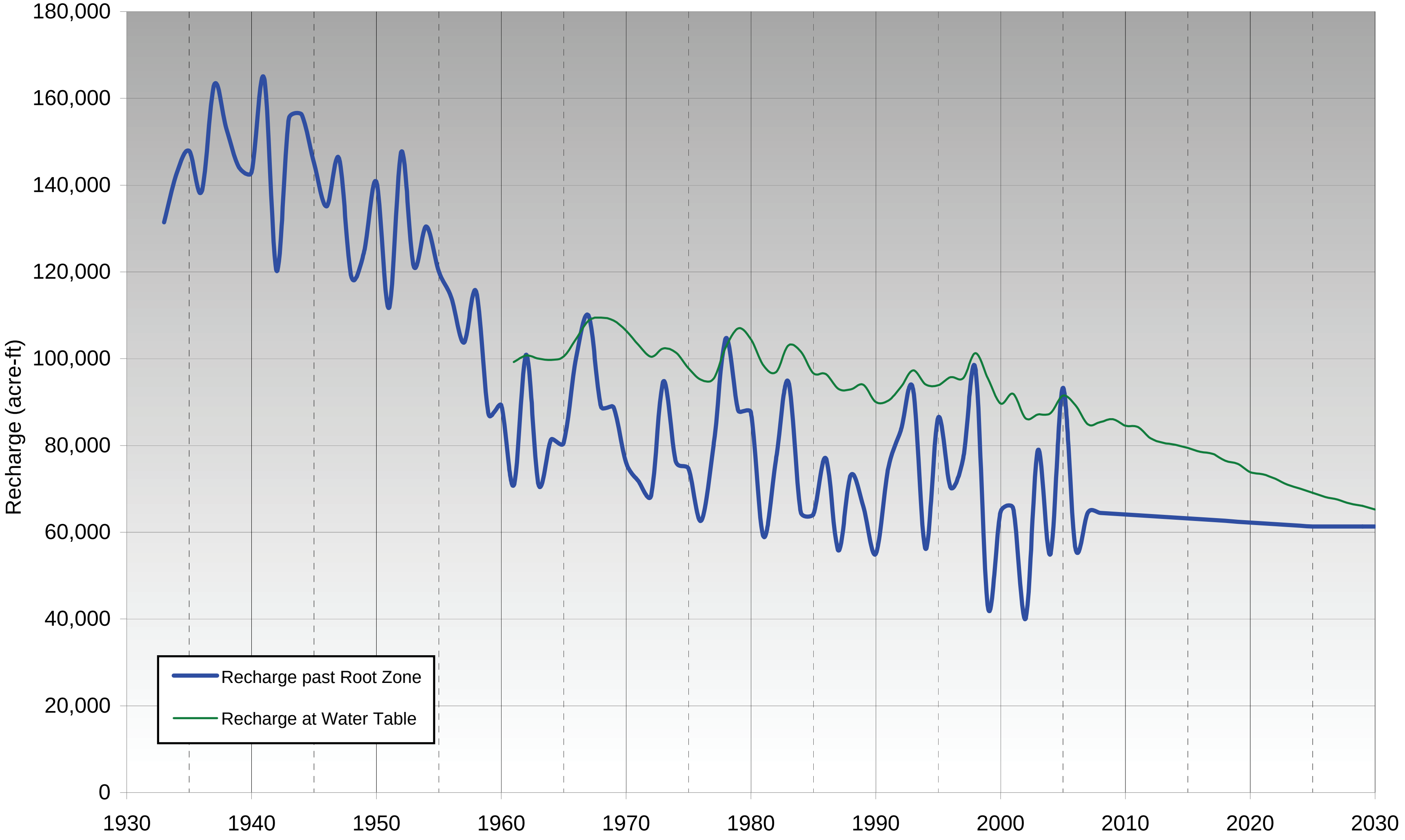
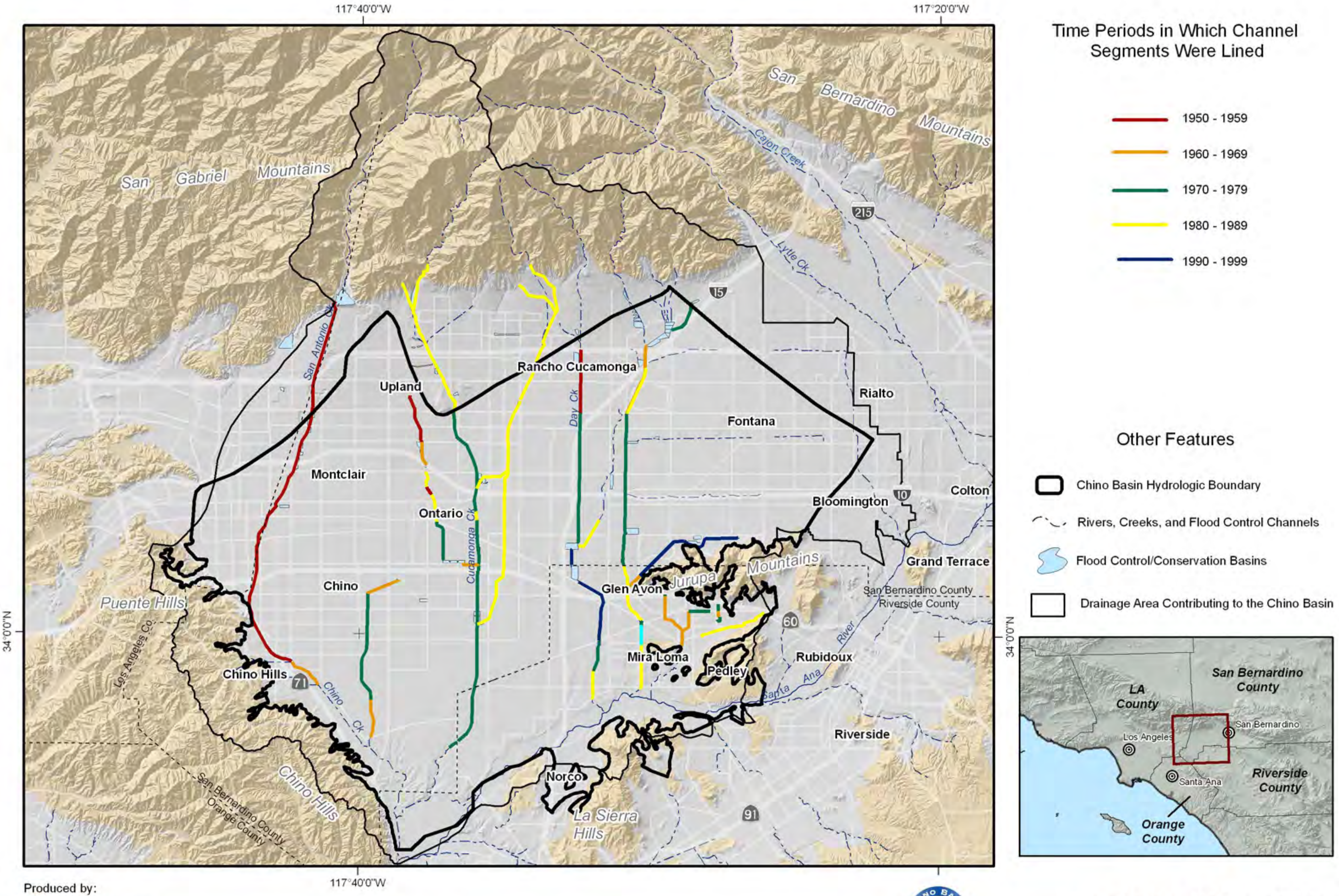


Figure 3-4
Recharge past the Root Zone and Recharge at the Water Table





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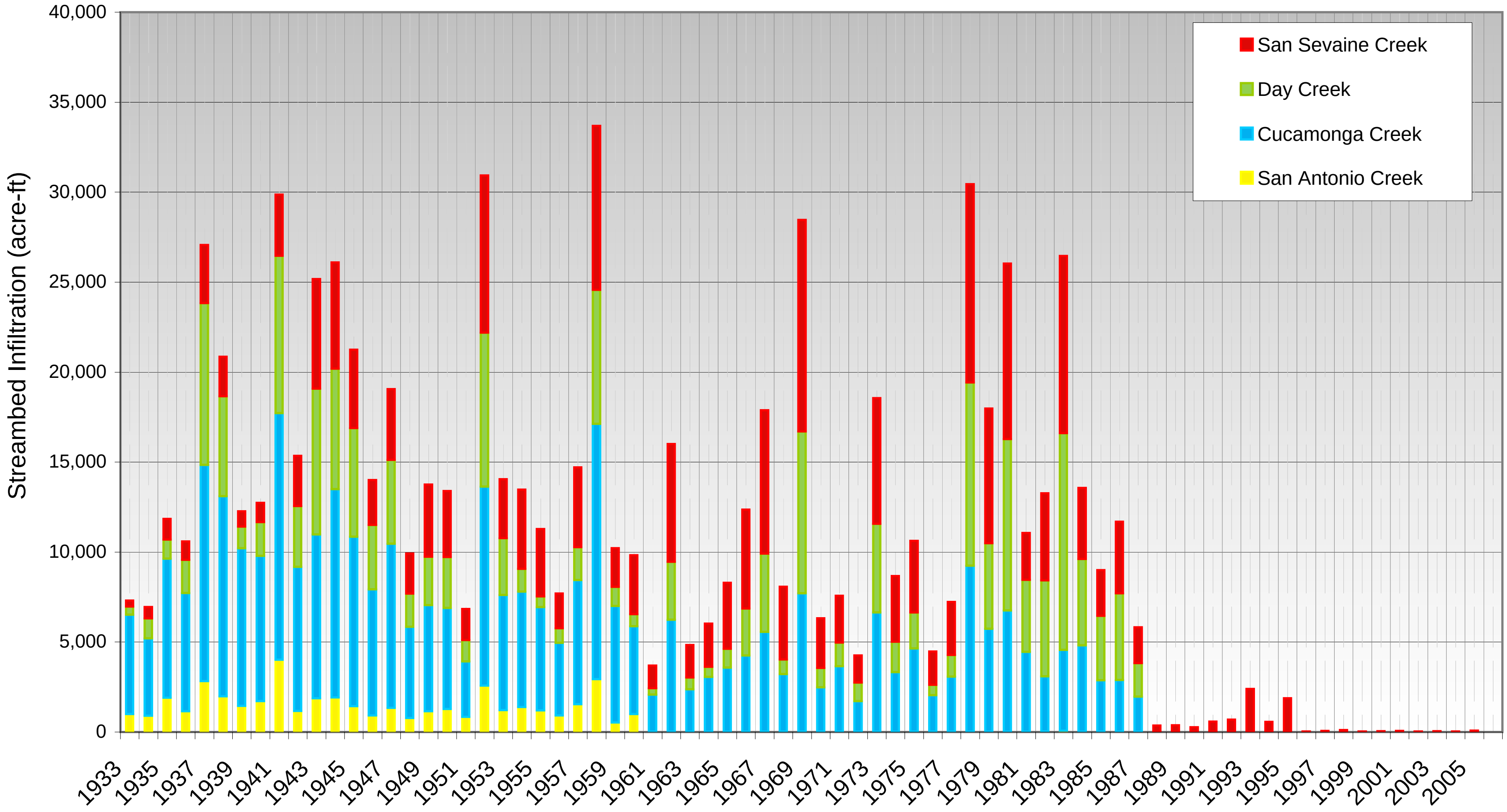
2010 Recharge Master Plan Update

Time History of Channel Lining

Figure 3-5

Figure 3-6
Streambed Infiltration by Creek in the Chino Basin



20100409 Figure 3-6_corrected.xls -- Fig. 3-6 wo SAR
4/13/2010

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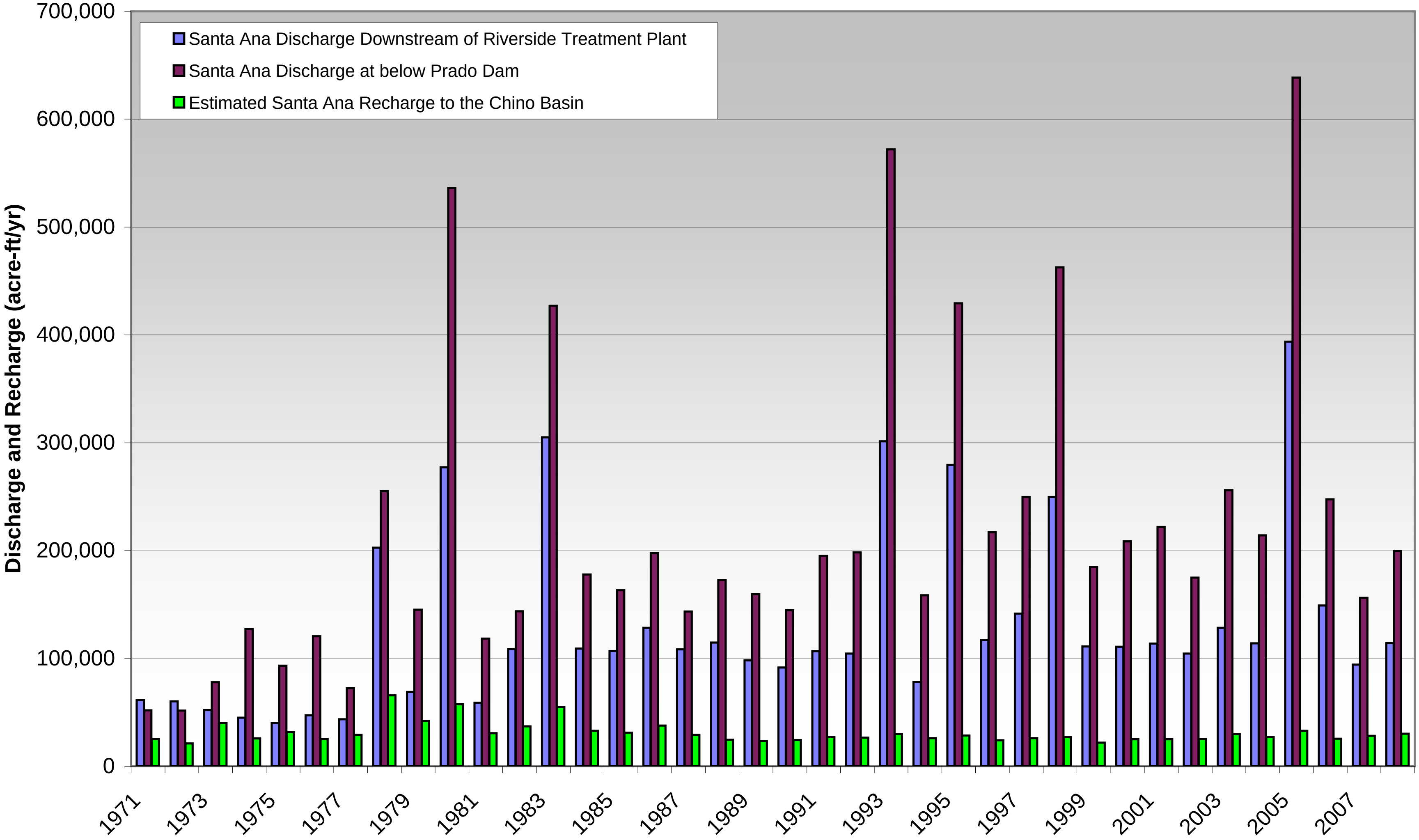
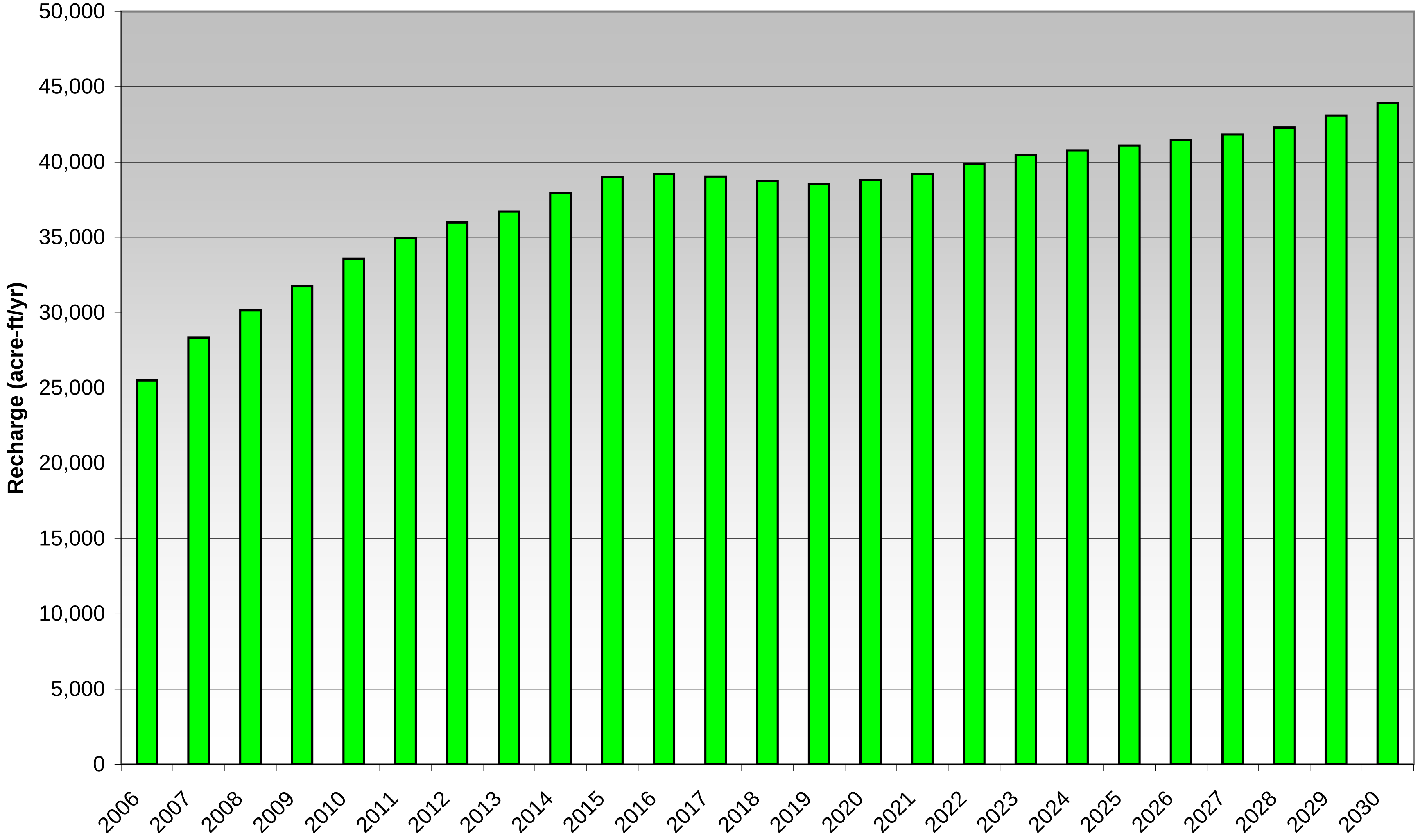
Figure 3-7a
Comparison of Santa Ana River Discharge over the Chino Basin and Santa Ana River Streambed Recharge into the Basin



20100114 SAR discharge tables and charts_v3.xlsFigure 3-7a
4/12/2010

Figure 3-7b
Projected Santa Ana River Streambed Recharge into the Basin



20100114 SAR discharge tables and charts_v3.xlsFigure 3-7b
4/19/2010

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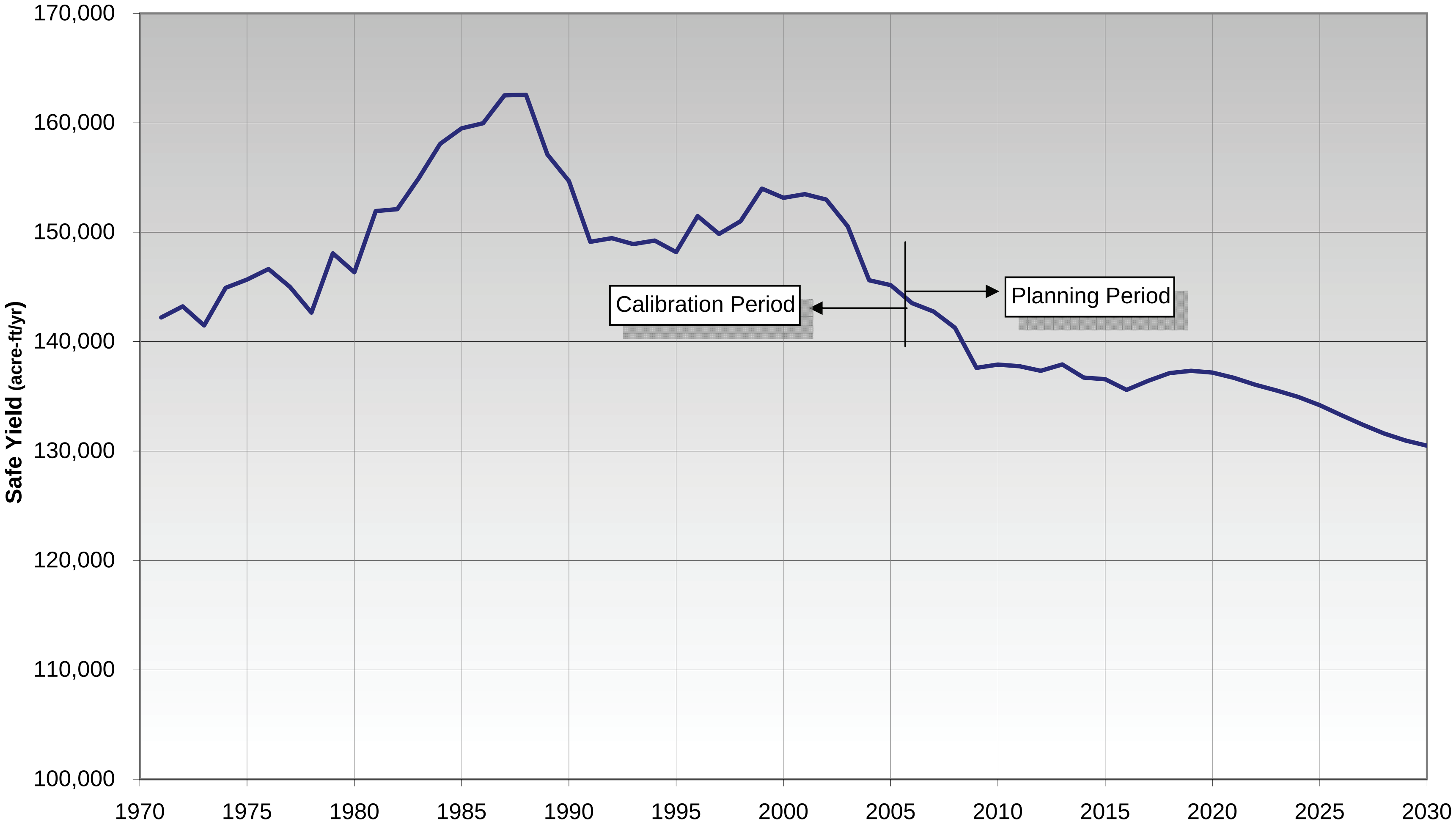
Figure 3-8
Comparison of Safe Yield Estimates for the Calibration and Peace II Periods



Section 4 – Integrated Review of Water Supply Plans

The objectives of the work described herein are to produce future groundwater production projections and associated replenishment requirements for the Chino Basin parties that use the Chino Basin for all or part of their water supply. In the OBMP planning that was conducted in the late 1990s and in the Peace Agreement, which was approved in 2000, it was assumed that the Watermaster parties and others would construct recharge capacity to meet all of Watermaster's replenishment needs through "wet" water recharge. The first step in this process is to develop projected water demand and supply plans for each party. These water demands include aggregated demands as well as individual draws on the various water supplies available to the parties. The annual replenishment requirement is estimated from aggregated Chino Basin production projections, the production rights contained in the Chino Basin Judgment, and amendments thereto. This section specifically addresses the RMPU requirements set forth in items 1 and 5 of the November 2007 Special Referee's report to the Court, which read as follows:

> 1. Baseline conditions must be clearly defined and supported by technical analysis. The baseline definition should encompass factors such as pumping, demand, recharge capacity, total Basin water demand, and availability of replenishment water.
>
> 5. Total demand for groundwater should be forecast for 2015, 2020, 2025, and 2030. The availability of imported water for supply and replenishment, and the availability of recycled water should be forecast on the same schedule. The schedules should be refined in each Recharge Master Plan update. Projections should be supported by thorough technical analysis.

In this section, item 1, with the exception of recharge capacity and the availability of replenishment water, is fully addressed. For item 5, the projected groundwater production (demand), recycled water recharge, and replenishment requirements are developed and discussed. The availability of recycled water and imported water for replenishment is discussed in detail in Section 6.

4.1 Water Supply Plans for All Entities That Use the Chino Basin

Several municipal and private water purveyors and private users in the Chino Basin area depend in part or completely on Chino Basin groundwater. Figure 4-1 shows the service areas of Chino Basin area water purveyors. The IEUA consulted with the major water service purveyors and, in 2008, developed a basin wide water demand and supply plan for all municipal water purveyors that produce Chino Basin groundwater (IEUA, 2008). The IEUA-developed water supply plans and groundwater production plan were vetted through the Watermaster process during the summer of 2008 and accepted by the appropriators in September 2008. Watermaster developed similar projections for smaller groundwater producers. These projections were used by the IEUA in the environmental documentation for the proposed Dry Year Yield program expansion and the environmental documentation for the Peace II Agreement. The table below contains the aggregate water demand and supply projection prepared by the IEUA and Watermaster.

Macro Water Demand and Supply Plan for the Chino Basin
(acre-ft/yr)

Water Sources	2009-10[1]	2014-15	2019-20	2024-25	2029-30
Chino Basin Groundwater	145,811	188,878	192,127	207,864	220,514
Non Chino Groundwater	33,200	33,200	33,200	33,200	33,200
Local Surface Water	16,918	16,490	16,990	17,990	17,990
Imported Water from Metropolitan	84,578	83,449	84,449	84,449	84,449
Recycled Water for Direct Reuse	18,800	33,870	34,520	34,570	34,570
Total Demand	299,307	355,887	361,286	378,073	390,723

Source: 2008 IEUA Water Supply Plan (attached as Appendix B) for large agencies and the *2009 Production Optimization and Evaluation of the Peace II Project Description* (WEI, 2009) for small agencies, small water companies and private well owners

1 -- 2009-10 Chino Basin groundwater production is actual 2009-09 production.

The total water demand is projected to grow about 91,000 acre-ft/yr through the planning period with most of the growth in demand projected to occur in the early part of planning period. With the exception of Chino Basin groundwater production and recycled water, the supply sources—non Chino Basin groundwater, local surface water, and imported water from Metropolitan for direct use—were assumed to be constant over the planning period. Chino Basin groundwater production increases about 75,000 acre-ft/yr over the planning period, resulting in a total increase of about 52 percent. Recycled water for direct reuse increases by about 15,000 acre-ft/yr during the early part of the planning period and then levels off after 2020, resulting in a total increase of about 84 percent.

The IEUA had stated that certain factors in its 2008 water demand and supply projections may reduce future water demands. These factors, updated to 2010, include:

- The continued slowdown of the housing market, which will delay increases in water demand and, thus, the need for additional water supplies;
- Enhanced regional conservation efforts and programs in response to continued statewide dry conditions and environmental restrictions on Sacramento-San Joaquin River Delta (Delta) pumping; and
- The SB-7 requirement for a statewide 10-percent reduction in water use by 2015 and a 20-percent reduction by 2020.

The water demands projected by the IEUA and Watermaster are probably higher than will actually occur. Reductions in water demand from conservation generally reduce the use of the most expensive water supply(s) available to a water purveyor, which has, in the past, been imported water that is served for municipal and industrial uses. Thus, it's possible that even with new conservation efforts, the groundwater production projections used herein could be representative of future conditions. That said, it is also possible that the cost of replenishment may be the most expensive water use in the future due to the scarcity of low cost replenishment water and the cost to recharge.

4.2 Projection of Chino Basin Groundwater Production and Replenishment

Watermaster recharges supplemental water into the Chino Basin pursuant to the Judgment and the Peace Agreement. Total annual replenishment is calculated based on projected groundwater production, recharge facility capacity, and the following assumptions:

- The safe yield is 140,000 acre-ft/yr through 2010 and the 2007 Watermaster Model-calculated safe yield (WEI, 2009b) thereafter.
- The Judgment allows a 5,000 acre-ft/yr controlled overdraft of the Chino Basin through 2017.
- Reoperation water is allocated to the replenishment of CDA desalter production as provided for in the Peace II Agreement and updated in the report prepared to satisfy Condition Subsequent No. 7 (WEI, 2008). Reoperation water is completely used up by 2030.
- The 6,500 acre-ft/yr supplemental water recharge commitment to MZ1 pursuant to the Peace II Agreement.
- Recycled water recharge was assumed to occur pursuant to Watermaster and the IEUA's recharge permit (Order R8-2007-0039) as amended in October 2009 (Order R8-2009-0057) and as projected by the IEUA (IEUA, 2010).
- Post 2010 increase in stormwater recharge due to new development and redevelopment that is captured in existing stormwater recharge facilities and as a result of compliance with the 2010 Municipal Separate Storm Sewer System (MS4) Permit.

Table 4-2 contains the projected groundwater production from Table 4-1, the various components of production rights and total production rights, the projected replenishment obligation, and the cumulative replenishment obligation. Total production rights are about 187,000 acre-ft/yr in 2010 and generally decrease over time to about 159,000 acre-ft/yr through 2035. The decrease is due to the declining yield, the exhaustion of controlled overdraft in 2017, the programmatic decline in reoperation water, the exhaustion of reoperation water in 2030, and an assumed termination of the 6,500 acre-ft/yr supplemental water recharge commitment to MZ1. Watermaster's replenishment obligation was estimated using the following assumptions:

- Water in storage accounts at the start of fiscal year 2009-10 is not used to meet future replenishment obligations. This is a conservative assumption that reserves discretion regarding the use of this water to individual storing parties.
- On a go forward basis, under-producers will transfer un-pumped rights to over-producers each year; that is, there is an efficient market that moves unused production

rights from under-producers to over-producers.

For this investigation, the average annual replenishment obligation was assumed to be equal to the greater of zero and the difference between actual production and production rights. The replenishment obligation for the 2008 IEUA/Watermaster groundwater production scenario is projected to be zero in 2009-10 through 2012-13, jump to about 3,000 acre-ft/yr in 2013-14 as the amount of reoperation water starts to ratchet down to 10,000 acre-ft/yr, increase steadily to about 45,000 acre-ft/yr by 2029-30, jump to 55,000 acre-ft/yr in 2030-31, and increase very slightly thereafter due to a small decline in projected safe yield. This assumes that under-producers will transfer un-used production rights to over-producers each year; as previously stated, there is an efficient market that moves unexercised rights from under-producers to over-producers. This assumption will underestimate the replenishment obligation for some years. Though, over the long term, this assumption is valid because the appropriator parties cannot store unused production rights indefinitely, and the demand for replenishment water will provide financial incentives for unused production rights to be sold to over-producers. Figure 4-2 shows the projected groundwater production for the 2008 IEUA/Watermaster groundwater production projection as a stacked bar chart that consists of the production rights and replenishment obligations for each year in the planning period. The cumulative replenishment obligation is projected to be negative through 2021-22, implying that under-production and the MZ1 recharge mandated by the Peace II Agreement are being stored in appropriator storage accounts and subsequent replenishment obligations are being met from unused production rights via the efficient market assumption. After 2021-22, the cumulative replenishment obligation becomes positive and grows as the unused production rights are not sufficient to meet the replenishment obligation. In theory, this means that Watermaster could go ten years without purchasing imported water for replenishment if an efficient market for unused production rights exists.

4.3 Recharge Master Plan Implementation Items

The December 21, 2007 Court order requires the completion of this RMPU by July 1, 2010 and, at a minimum, every five years thereafter. The RMPU process is very sensitive to projected groundwater production. By statute, groundwater production projections are prepared for UWMPs every five years and in years ending in “0” or “5.” Watermaster, the CBWCD, and the IEUA should review the groundwater production projections from the retail water purveyors’ 2010 UWMPs after their completion in June 2011[2] to update the groundwater production projections included herein and revise the conclusions and recommendations of the 2010 RMPU to comport with the 2010 UWMPs. Conclusions in Section 6 regarding the acquisition of supplemental water for replenishment and new supplemental water recharge facilities should be updated in fiscal 2011-12. Decisions regarding the acquisition of supplemental water for replenishment and new supplemental water recharge facilities should be deferred until that time.

---

[2] The deadline for completing the 2010 UWMPs for retail water agencies was extended by special legislation to June 30, 2010 for the 2010 UWMP. Subsequent UWMPs are required to be submitted to the DWR by December 31 of year due.

The next complete RMPU should be completed no later than December 2016, and subsequent RMPUs should be completed, at a minimum, every five years thereafter. This will ensure that the most up-to-date groundwater production estimates are included in future RMPUs.

Table 4-1

Projected Groundwater Production for the Chino Basin

Based on August 2008 IEUA/Watermaster Estimates[1]

(acre-ft/yr)

Producer	Production Projection					
	2009/10[2]	2014/15	2019/20	2024/25	2029/30	2034/35
Overlying Agricultural Pool						
Combined total Agricultural Pool Production	*32,143*	*18,577*	*5,010*	*5,010*	*5,010*	*5,010*
Overlying Non-Agricultural Pool						
San Bernardino County (Chino Airport)	94	94	94	94	94	94
California Steel Industries Inc	1,126	1,126	563	563	563	563
Swan Lake Mobile Home Park	36	36	36	36	36	36
Vulcan Materials Company	5	5	5	5	5	5
Space Center Mira Loma Inc.	94	94	94	94	94	94
Angelica Textile Service	31	31	31	31	31	31
Sunkist Growers Inc	43	43	43	43	43	43
Praxair Inc	113	113	0	0	0	0
General Electric Company	10	10	10	10	10	10
California Speedway	505	505	505	505	505	505
RRI Etiwanda	536	536	268	268	268	268
Subtotal Overlying Non-Agricultural Pool Production	*2,593*	*2,593*	*1,649*	*1,649*	*1,649*	*1,649*
Appropriative Pool						
Arrowhead Mountain Spring Water Company	350	350	350	350	350	350
Chino Desalter Authority	26,356	39,400	39,400	39,400	39,400	39,400
City of Chino	2,244	10,844	11,811	14,900	14,900	14,900
City of Chino Hills	1,990	4,823	4,823	4,823	4,823	4,823
City of Norco	0	0	0	0	0	0
City of Ontario	13,222	27,211	32,360	37,508	42,658	42,658
City of Pomona	11,731	13,000	13,000	13,000	13,000	13,000
City of Upland	1,021	2,140	2,140	2,140	2,140	2,140
Cucamonga Valley Water District	11,006	21,229	26,729	32,229	37,729	37,729
Fontana Union Water Company	0	0	0	0	0	0
Fontana Water Company	13,202	10,000	11,000	11,500	12,000	12,000
Jurupa Community Services District	17,160	18,123	21,616	21,616	21,616	21,616
Inland Empire Utilities Agency	0	0	0	0	0	0
Marygold Mutual Water Company	142	142	142	142	142	142
Metropolitan Water District of Southern California	0	0	0	0	0	0
Monte Vista Irrigation Company	0	0	0	0	0	0
Monte Vista Water District	9,519	17,000	18,500	20,000	21,500	21,500
Niagara	1,210	1,210	1,210	1,210	1,210	1,210
San Antonio Water Company	992	1,149	1,282	1,282	1,282	1,282
San Bernardino County (Olympic Facility)	22	22	22	22	22	22
Santa Ana River Water Company	160	318	335	335	335	335
Golden State Water Company	748	748	748	748	748	748
West End Consolidated Water Company	0	0	0	0	0	0
West Valley Water District	0	0	0	0	0	0
Subtotal Appropriators	*111,075*	*167,709*	*185,468*	*201,205*	*213,855*	*213,855*
Total Production	145,811	188,878	192,127	207,864	220,514	220,514

1 -- IEUA developed estimates for the Appropriative Pool and Watermaster developed estimates for the other two pools.
2 -- 2009/10 production estimates are based on actual 2008/09 production reported in the FY 2008/09 Watermaster Annual Report and excluding Dry Year Yield Program production

Table 4-2
Projected Groundwater Production and Production Rights
(acre-ft)

Fiscal Year	Projected Groundwater Production 2008 IEUA / Watermaster Projection per Table 4-1	Pre 2010 RMPU Production Rights								Replenishment Obligation[3]	Cumulative Replenishment Obligation
		Safe Yield[1]	Controlled Overdraft	Reoperation Water	6,500 acre-ft/yr Supplemental Water Recharge in MZ1 per Peace II[5]	Mid-Range Recycled Water Recharge[4]	Post 2010 Increase in Stormwater Recharge from Development[2]	Post 2010 Increase in Stormwater Recharge from 2010 MS4 Compliance	Total		
2009 - 2010	145,811	140,000	5,000	28,910	6,500	8,100	0	0	188,510	0	-33,699
2010 - 2011	154,424	134,127	5,000	31,500	6,500	14,100	150	265	191,642	0	-70,916
2011 - 2012	163,038	134,545	5,000	33,740	6,500	16,000	300	530	196,615	0	-104,494
2012 - 2013	171,651	134,844	5,000	11,909	6,500	17,800	450	795	177,298	0	-110,141
2013 - 2014	180,265	135,211	5,000	10,000	6,500	19,100	600	1,060	177,471	2,794	-107,347
2014 - 2015	188,878	135,593	5,000	10,000	6,500	20,000	750	1,325	179,168	9,710	-97,636
2015 - 2016	189,528	136,418	5,000	10,000	6,500	20,700	900	1,590	181,108	8,420	-89,216
2016 - 2017	190,178	137,123	5,000	10,000	6,500	21,000	1,050	1,855	182,528	7,649	-81,567
2017 - 2018	190,827	137,332	0	10,000	6,500	21,000	1,200	2,120	178,152	12,675	-68,892
2018 - 2019	191,477	137,170	0	10,000	6,500	21,000	1,350	2,385	178,405	13,072	-55,820
2019 - 2020	192,127	136,695	0	10,000	6,500	21,000	1,500	2,650	178,345	13,782	-42,038
2020 - 2021	195,274	136,055	0	10,000	6,500	21,000	1,650	2,915	178,120	17,154	-24,884
2021 - 2022	198,421	135,529	0	10,000	6,500	21,000	1,800	3,180	178,009	20,412	-4,472
2022 - 2023	201,569	134,947	0	10,000	6,500	21,000	1,950	3,445	177,842	23,727	19,256
2023 - 2024	204,716	134,188	0	10,000	6,500	21,000	2,100	3,710	177,498	27,218	46,474
2024 - 2025	207,864	133,281	0	10,000	6,500	21,000	2,250	3,975	177,006	30,858	77,332
2025 - 2026	210,394	132,413	0	10,000	6,500	21,000	2,400	4,240	176,553	33,841	111,173
2026 - 2027	212,924	131,603	0	10,000	6,500	21,000	2,550	4,505	176,158	36,766	147,939
2027 - 2028	215,454	130,964	0	10,000	6,500	21,000	2,700	4,770	175,934	39,520	187,459
2028 - 2029	217,984	130,485	0	10,000	6,500	21,000	2,850	5,035	175,870	42,114	229,573
2029 - 2030	220,514	130,210	0	10,000	6,500	21,000	3,000	5,300	176,010	44,504	274,077
2030 - 2031	220,514	130,010	0	0	6,500	21,000	3,000	5,300	165,810	54,704	328,781
2031 - 2032	220,514	129,810	0	0	6,500	21,000	3,000	5,300	165,610	54,904	383,685
2032 - 2033	220,514	129,610	0	0	6,500	21,000	3,000	5,300	165,410	55,104	438,789
2033 - 2034	220,514	129,410	0	0	6,500	21,000	3,000	5,300	165,210	55,304	494,093
2034 - 2035	220,514	129,210	0	0	6,500	21,000	3,000	5,300	165,010	55,504	549,596
Total	5,145,884	3,476,779	40,000	276,058	169,000	514,800	46,500	82,150	4,605,287	659,737	
Average	197,919	133,722	1,538	10,618	6,500	19,800	1,788	3,160	177,126	25,375	

1 -- Safe yield includes stormwater recharge from the CBFIP

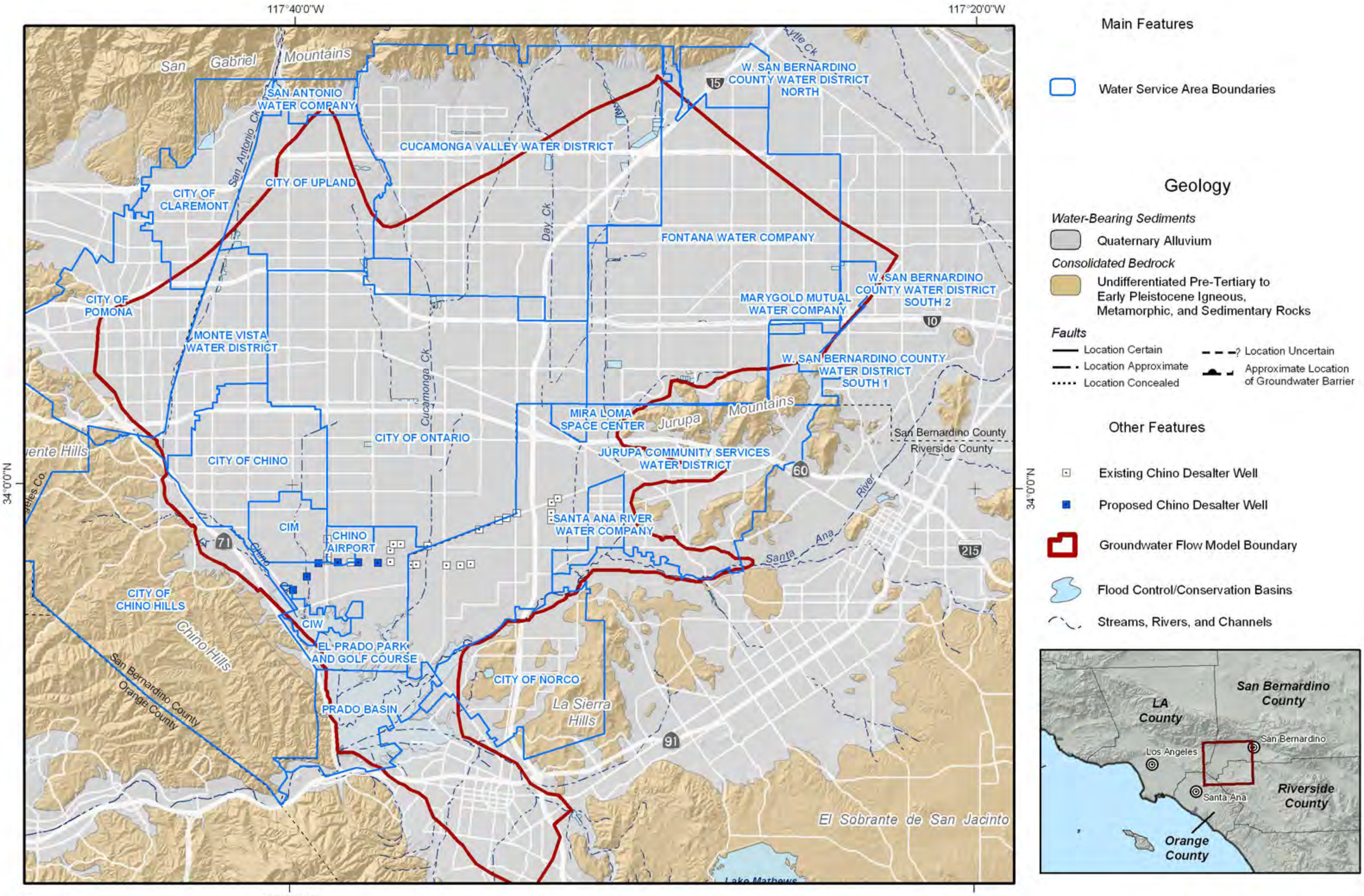
2 -- This is the increase in stormwater recharge that will occur due to increased imperviousness from new development.

3 -- This is the net replenishment obligation based on the assumptions described in the text.

4 -- Mid-range Projection from Table 2 of the IEUA May 4, 2010 *Integrated Review of Water Supply Plans Used for the Chino Basin Recharge Master Plan Update IEUA Tech Memo No. 3* (Appendix B to thi

5 -- Pursuant to the Peace II Agreement.

6 -- Replenishment will be required when the CURO becomes positive.



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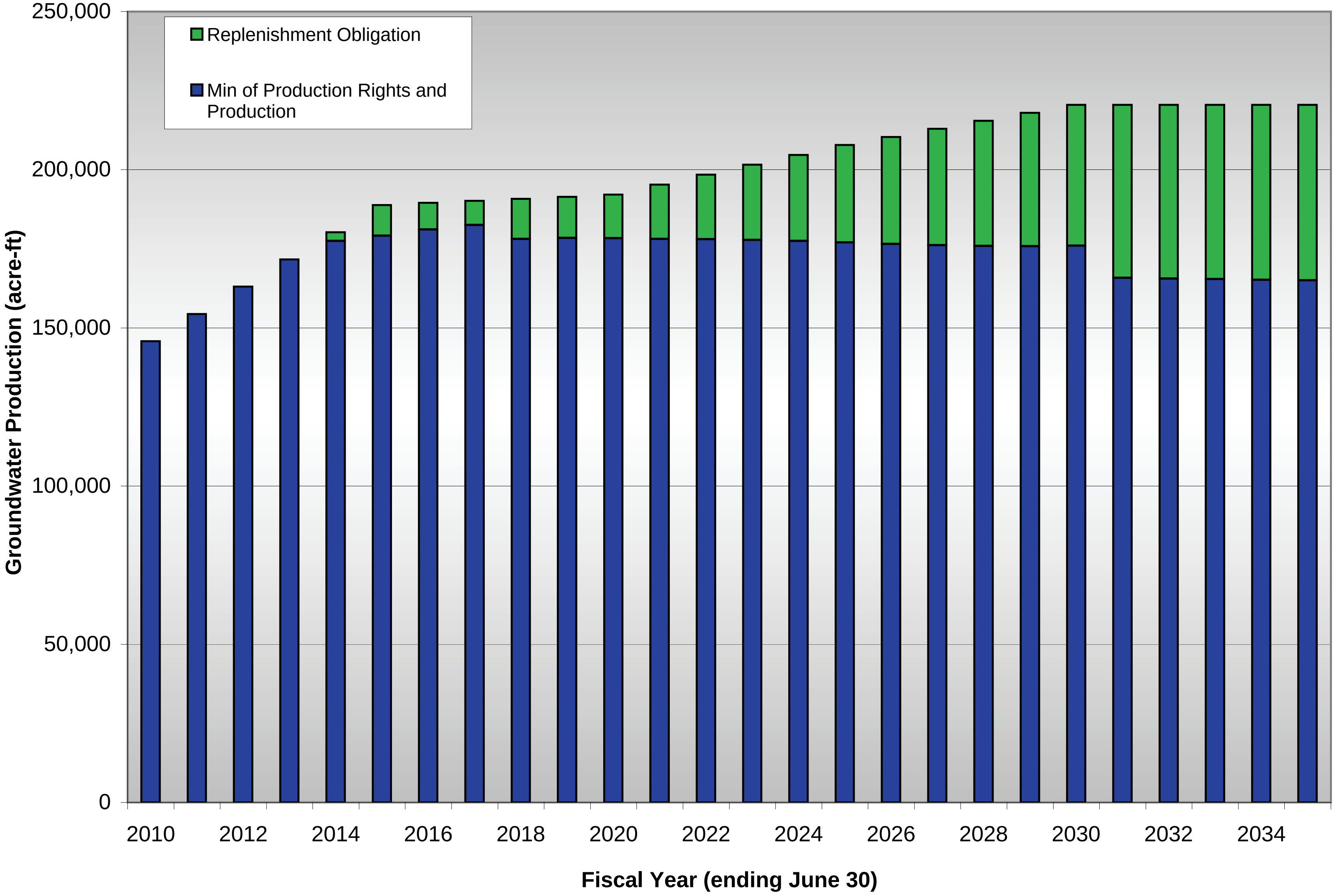
2010 Recharge Master Plan Update

Water Service Areas

Figure 4-1

Figure 4-2
Projected Groundwater Production in the Chino Basin
For the 2008 IEUA/Watermaster Production Projection



20100526 Table 4-2 and Figure 4-2 -- Figure 4-2

Section 5 – Storm Water Recharge Enhancement Opportunities

5.1 Introduction

The CBWCD is a part of the team undertaking the RMPU. The RMPU is being coordinated by Watermaster through its engineer, WEI.

The first task of the CBWCD is in two parts: Part 1 is to identify and comment on current storm water recharge facilities and operations, and evaluate the effectiveness of local storm water facilities and policies intended to improve storm water recharge; Part 2 is to identify and perform preliminary conceptual project evaluations of potential improvements to existing facilities and new facilities located in places where there is uncaptured flow leaving the Chino Basin to determine if projects are potentially viable and warrant further consideration.

This first task analyses will determine if storm water is currently being captured and recharged by local storm water facilities that is unaccounted for in the Chino Basin Surface Water Simulation R4 model developed and operated by WEI and if there is a significant amount of available and obtainable storm water that could be directed to recharge facilities. An increase in storm water recharge in an amount greater than previously accounted for in a base period condition would represent an increase in supply to the Chino Basin, thus augmenting safe yield for the same base period condition. Additional recharge could offset overdraft as well as decrease the amount of supplemental water purchased by Watermaster to maintain hydrologic balance in the basin. The addition of new or previously unaccounted for storm water recharge would lessen the projected decline of the calculated annual safe yield.

The second task of CBWCD is to evaluate the conceptual projects identified in the first phase of project evaluations, and additional project alternatives identified with WEI, develop a regional Recharge Distribution System and estimate its capability to cost effectively improve storm water recharge in the Chino Basin.

The regional Recharge Distribution System developed with WEI is comprised of various improvements, enlargements and reoperations of existing facilities and construction of new diversion and recharge facilities to increase the amount of storm water recharge in the Chino Basin. The improvements would enable existing facilities which currently operated nearly exclusively for flood control purposes to operate in a multipurpose capacity to also divert and regulate storm water flows for transferred to other recharge facilities.

Conceptual project evaluations for alternatives and project components developed by the RMP update team are being performed to develop an economic basis for comparison of projects or project components. This evaluation will enable further discussions of project viability and ultimately lead to decisions of project implementation.

5.2 Existing Storm Water Management and Recharge

There is a long history of storm water recharge in the Chino Basin. The results of some previous analyses suggest that the opportunity to significantly increase recharge is limited, primarily due to the nature of the timing of precipitation and runoff. The flow in creeks and channels is usually less than the inlet capacity of the existing recharge basins, meaning that most of the time all of the flow can be captured with existing facilities. However, in large storm events some recharge basins are unable to divert all available flow because the rate of flow greatly exceeds the capacity of intake structures. Consequently recharge opportunities are lost.

The majority of data regarding current physical and operational parameters of regional basins presently utilized for the analysis of storm water recharge is readily available. The data is available primarily through WEI, San Bernardino County Flood Control District (SBCFCD), and Inland Empire Utilities Agency (IEUA), the operator of the basins. WEI prepared a "Chino Basin Recharge Facilities Operation Procedures" manual (ROM) for the Groundwater Recharge Coordinating Committee in March 2006. This document is the most complete available reference for the regional basins presently utilized for recharge. In some cases data was found in WEI documents prepared prior to the ROM. The information contained herein, discussed in section 5.2.1, is based in part on the information contained in the ROM.

Additional basins are described that were not included in the March 2006 document because they are primarily "flow through" basins that have been concluded to have poor infiltration rates and are accordingly operated for flood control purposes. Current physical and operational parameters for these basins are not as readily available. The physical parameters contained herein for non-recharge basins were primarily obtained from the SBCFCD, where available. The majority of data was gleaned from available construction drawings as well as the SBCFCD Project Systems Inventory Zone 1 Index which was completed in 1976, and personal communication with SBCFCD staff.

Local storm water recharge sites within the Chino Basin are discussed in section 5.2.2. These sites were identified by individual cities in response to a data request letter mailed in March 2009. Collection of local storm water management information proved to be difficult because such sites are largely associated with development projects and are accordingly privately owned and maintained. The cities hadn't previously prepared inventories of such sites and in some cases still do not have the staff or the budget to prepare an inventory for the purposes of this RMP. The majority of the data contained herein was taken from portions of Water Quality Management Plans (WQMP) provided by each contributing entity. Most of the WQMP portions provided contain all relevant data regarding the physical parameters of the storm water retention facilities as well as their tributary drainage areas. Facilities identified by the various cities, that were unaccompanied by provided portions of a WQMP, were mapped using an ArcGIS program. The facility and its tributary drainage area, with contributions from city storm drains, were then delineated using ArcGIS, 2007 aerial imagery, USGS 7.5 minute quadrangles, and city storm drain atlases (when available).

5.2.1 Existing Regional Storm Water Recharge Facilities and Policies Related to Storm Water Management and Recharge

Existing regional recharge basins developed for use in the Chino Basin recharge system (see Figure 5-1) are operated both for peak flood discharge attenuation as well as for the recharge of storm and supplemental water. The majority of the facilities are owned independently by either SBCFCD or CBWCD. The system is operated primarily by IEUA and is managed in order to benefit the flood control interests of SBCFCD, to recharge storm water and supplemental water for CBWCD and Watermaster in Chino Basin.

Recharge basins are served by eight main concrete lined channels and storm drains that collect storm water runoff throughout the Chino Basin. A total of 46 regional basins are classified as recharge basins to the Chino Groundwater Basin, totaling over 3,700 acre-ft of storage volume. The basins are further distinguished as either conservation or multi-purpose basins. There are 27 conservation basins operated to recharge storm water and supplemental water. The 19 multi-purpose basins are operated primarily for peak flood discharge attenuation and secondarily for the recharge of storm and supplemental water. Tables 5-1 and 5-2 identify the available physical and operational parameters for each regional recharge basin. Basins are grouped according to the water supply channel that is the primary source for the basin.

An additional 9 regional basins, with a total storage volume of over 2,600 acre-ft, are identified in Table 5-3 which are within the Chino Basin boundary, but are not operated for groundwater recharge purposes. These basins are not operated for groundwater recharge largely due to poor soil infiltration rates. These basins are primarily flow through basins that attenuate water for flood control purposes. Further study is required to determine if any improvements could be made to these basins in order to increase their recharge capabilities. According to personal communication with IEUA staff, Princeton Basin could potentially infiltrate recharge if properly maintained and operated as a recharge basin. CBWCD found that Lower Cucamonga and Chris Basins were underlain by a thick clay layer. The Wineville Basin was studied and determined to not be viable due to shallow clay lenses, however recent experience with Lower Day Basin indicates the clay lenses may result from gravel mining activity and remediation may be possible. Jurupa Basin was studied and found to percolate poorly. It is essentially used currently for water transfers to RP3 Basins, and is used to some degree as a settling basin prior to pumping to RP3. According to personal communication with SBCFCD staff, Merrill and Linden Basins are being evaluated for potential use as multi-purpose facilities. Currently they are being operated as flood control facilities.

5.2.1.1 General Operations for Recharge Basins

Conservation basins are generally operated according to rule curves which define a target water surface elevation and storage for each basin throughout the year. Basin operation depths vary by season depending on the availability of supplemental and storm water, but are generally maintained at or below a maximum depth. Rule curve designations for conservation basins are shown in columns L through Q on Table 5-1.

Multi-purpose basins are operated based on storm forecasting and the goal of limiting losses of supplemental water. Accordingly, the basins are operated to limit supplemental water losses by limiting storage to the volume of water that can be percolated out of the basin in seven days. If the total volume of a basin can percolate in seven days, the maximum allowable storage is maintained with one foot of freeboard. Rule curve designations for multi-purpose basins are shown in columns I through P on Table 5-2.

The following are current general operational practices for recharge basins:

Conservation Mode

- Monitor depth of water in basins either on site or remotely through SCADA.
- Monitor infiltration rates to determine delivery rate.
- Inspect diversion and inlet structures to maintain functionality.
- Monitor water depth at rubber dams for signs of clogging.
- Unclog inlet structures and rubber dams as needed.
- Reduce flow rate to match infiltration capacity as water level reaches maximum level allowed in rule curve.

Pre-Storm Mode

- Assess basin states and forecast storm intensity using the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service website.
- If a forecast calls for measureable rainfall at 30% chance of rain or greater, 2-3 days before forecasted storm event, determine if expected storm will be significant and what actions are to be taken.
- A significant storm is considered to be 0.3 inches of rainfall per hour or 2.0 inches per 24 hours.
- Pre-Storm mode begins when potentially significant storm has been forecasted to occur within 7 days by NOAA.
- If significant storm is pending:
    - SBCFCD will contact IEUA coordinator.
    - Cease or curtail all supplemental water deliveries.
    - Cease diversions.
    - Open outlet gates at multipurpose basins to drain them and fully restore flood control capacity.

Storm Mode

- Rubber dams to be deflated (depending on when in the season a storm is occurring).
- Basins operated according to separate rules.
- Do not deliver supplemental water.
- When a significant storm is over or nearly over the SBCFCD will authorize transition

from Storm Mode to Conservation Mode:

- First phase
    - Inspect water turbidity for suspended mud (currently a visual observation).
    - Inspect basins, determine water level, and assess available storage.
    - Close outlets and/or open inlets at conservation basins.
- Second phase
    - Re-inflate the rubber dams

Tables 5-1 and 5-2 also include the main control elements for the transfer of water from either the channels to the basins, from basin to basin, or through a configuration of cells within a basin. The operation of each control element varies with a forecasted storm's severity. The typical settings for the first storm, non-significant storm, and significant storm are shown in columns W through Y on Table 5-1 and columns V through X on Table 5-2. Control elements are also operated based on flood control operation alert modes. The alert mode can be green, yellow, or red depending on a storm's severity. In general, the basins are operated in green and yellow alert modes during dry periods and non-significant storms. Basins are operated in red alert mode in the event of a significant storm. The control elements are operated either manually or remotely by the IEUA operator in green mode. In the yellow alert mode the control element settings are basically the same as in green mode, the yellow alert mode is essentially a signal from the IEUA operator to SBCFCD that the operator is aware of a forecasted storm and the proper measures have been taken to prepare the basins for the storm. The red alert mode signals control of the system by SBCFCD and includes a series of automatic system setting changes that are required by SBCFCD for flood control purposes.

IEUA developed automatic control settings (through the SCADA system) that are dependent on water surface elevations in order to maximize recharge during the green and yellow operational alert modes while allowing for proper flood control precautions. These settings would not function in the red alert mode. The flood control valve automation modes are described below in the more detailed descriptions of operations within the various storm channel systems. The automation modes allow automatic inlet gate operation under certain water level conditions. Prior to the development and implementation of the automation modes, the IEUA operator was required to manually change flow control valve positions using the SCADA system.

The five inflatable rubber dams also can be operated according to three mode settings. The rubber dams can be set to either maintain a desired water depth in the channel (level mode), a desired pressure on the dam (pressure mode), or manually inflated or deflated (manual mode). The result is a controlled release over the dam and/or through the inlet of a recharge basin. During a large storm event the rubber dams are set to level mode in order to maintain a desired water level. The dams have a failsafe measure in the form of an auto-deflate float switch that is designed as a control measure to deflate a dam once water overtops the depth of the float trigger. The automatic setting information for each rubber dam is shown in Table 5-

4.

Some of the basins, as indicated below, follow a procedure during particular storm events in order to limit the amount of debris, dust, dirt, and pollutants that can accumulate in channels from urban impervious areas (such as streets and parking lots) entering the recharge basins, thus minimizing maintenance. Such an event is referred to as a first flush opportunity. The rate of accumulation of debris and pollutants can vary depending on the area tributary to each basin. However, the current operating procedure for first flush opportunities is performed only in advance of the first storm event of the season or following a 30 day period lacking rainfall runoff. This is accomplished by closing inlet gates to the recharge basins for the first two hours of such an event.

5.2.1.2 General Operations for Recharge Basins

5.2.1.2.1 San Antonio Creek System

The IEUA Groundwater Recharge Coordinator will be in close contact with the Army Corps of Engineers regarding the discharge of storm water from San Antonio Dam during all operational modes.

First Flush Opportunity

In advance of the first flush opportunity, an IEUA Operator closes the following inlet gates for the San Antonio Creek System:

- SAC-CHW-A to College Heights West.
- SAC-CHE-A to College Heights East.
- SAC-UPL-A to Upland Basin.
- SAC-MT1-A to Montclair No. 1.
- SAC-BRK-A to Brooks Street Basin.

When the IEUA Groundwater Recharge Coordinator determines that the turbidity of the storm water is acceptable (visual observation) and significant inlet clogging debris has passed the site, an IEUA Operator can divert storm water into the College Heights, Upland, Montclair, and Brooks Street Basins. The IEUA Operator will then use the SCADA system to open the aforementioned inlet gates.

Storm Water Capture

College Heights Basins:

- Basins are only used when water is released from San Antonio Dam by Army Corp of Engineers.

Upland Basin:

- Water is conveyed to the basin via City of Upland storm drains.

- Basin is also used for water released from San Antonio Dam by Army Corp of Engineers.

Montclair Basins:

- The inlet gate SAC-MT1-A from San Antonio Channel will generally remain open to divert storm water into Montclair No. 1 (MT1) until the inlet gate is closed when the water surface elevations in all four basins are equal to or greater than their spill elevation to the next basin and open when any of these are lower than its spill elevation to the next basin (Montclair No. 1: elevation 1127.6, Montclair No. 2: elevation 1102.4, Montclair No. 3: elevation 1055.46, Montclair No. 4: elevation 1037.0).

Brooks Basin:

- In auto-mode, inlet gate SAC-BRK-A from San Antonio Channel closes when the Brooks Basin water level sensor (LT-0208) is greater than or equal to elevation 898.5 and opens when water level sensor LT-0208 is greater than or equal to elevation 913.0, about two feet before spilling towards an adjacent property.
- In auto-mode, inlet gate from the West State Street storm drain closes when LT-0208 is greater than or equal to elevation 907.9 (the flow line elevation of the West State St Storm Drain is 907.88) and opens when LT-0208 is less than 907.8, and also opens when LT-0208 is greater than or equal to elevation 913 (allows for outflow if basin is too full from street runoff).

5.2.1.2.2 West Cucamonga Channel System

First Flush Opportunity

Basins in the West Cucamonga Channel System are all multi-use basins (flow through), which require no special provisions for first flush opportunities. A first flush bypass is not applicable.

Storm Water Capture

The following are the procedures to operate the 7th and 8th Street and Ely Basins for the recharge of storm water for a storm that has a non-significant precipitation forecast:

7th and 8th Street Basins:

- Close sluice gate 7TH-WCC-M. This gate should remain closed throughout the storm unless the SBCFCD directs the IEUA Operator to open it during or following the storm.
- In auto-mode, the outlet gate to 7th Street Basin 8SS-7TH-A opens when the 8th Street Basin water level sensor (LT-0501) is greater than or equal to elevation 1139.5 and closes when LT-0501 is less than or equal to elevation 1139.
- The automated outlet gate to the continuation of the West Cucamonga Creek Channel opens when the 7th Street Basin water level sensor (LT-0502) is greater than or equal

to elevation 1134.5 and closes when LT-0502 drops to elevation 1134.0 (Outlet spillway elevation = 1134.0).

Ely Basins:

- Automated outlet gate to the continuation of the West Cucamonga Creek Channel EL3-WCC-A opens when the Ely Basin No. 3 water level sensor (LT-0602) is greater than or equal to elevation 835.5 and closes when LT-0602 is less than or equal to elevation 835.0 (Outlet spillway elevation is 837.0, CBWCD and SBCFCD contract establishes elevation 835.0 as approved water surface elevation for storage and recharge).

The following are the procedures to operate the 7th and 8th Street and Ely Basins for the recharge of storm water for a storm that has a significant precipitation forecast:

7th and 8th Street Basins:

- The 8SS-7TH-A, 7TH-WCC-A, and 8SN-8SS-M gates should be opened 24 hours prior to the storm's arrival and the basins should be fully drained to restore full flood control function before the storm starts.
- Near the end of the significant storm, the IEUA Groundwater Recharge Coordinator can, through coordination with SBCFCD, close sluice gates 8SS-7TH-A and 7TH-WCC-A.

Ely Basins:

- The EL3-WCC-A gate should be opened 24 hours prior to the storm's arrival and the basins should be drained to the elevation of the gate (829 feet msl) in order to restore full flood control function before the storm starts. EL3-WCCA should be closed before the storm begins. Automated sluice gate EL3-WCC-A is programmed to open when the water level in the Ely 3 Basin (EL3) reaches elevation 835 feet msl. The SBCFCD is responsible to ensure that EL3-WCC-A is either closed or open pursuant to SBCFCD storm operations procedures.
- Near the end of the significant storm, the IEUA Groundwater Recharge Coordinator can, through coordination with SBCFCD, close sluice gate EL3-WCC-A.

5.2.1.2.3 Riverside Drive Drain

First Flush Opportunity

There are no special provisions for a first flush opportunity.

Storm Water Capture

Grove Basin:

- The basin spills to the street, accordingly the outlet is kept closed for non-significant storms.
- The outlet flow control gate to Grove Ave. closes when the Basin's water level sensor

(LT-1900) is less than or equal to elevation 747.5 after being at a higher elevation. A CBWCD & SBCFCD contract establishes the bottom 5 feet as approved for storage & recharge; the floor elevation is about 742.5.

- For a significant storm SBCFCD will typically open the outlet about 6% to let the basin drain slowly without flooding the surface street.

5.2.1.2.4 Cucamonga/Deer Creek Channels System

First Flush Opportunity

In advance of a first flush opportunity, the IEUA Operator shall close all inlet gates to the Turner Basins (DRC-TR1-A, DRC-TR4-A, and CCC-TR1-A). When it is determined that the turbidity of the storm water is acceptable and significant inlet clogging debris has passed the site, the IEUA Groundwater Recharge Coordinator will divert storm water into the Turner Basins. The IEUA Operator will then open sluice gates DRC-TR1-A, DRC-TR4-A, and CCC-TR1-A.

Storm Water Capture

Turner Basins:

- Open inlet gate from the Cucamonga Creek Channel CCC-TR1-A. In auto-mode, this gate is automated to close when the Turner Basin No. 1 water level sensor (LT-1100) is greater than or equal to elevation 999.0 (about one foot the below concrete spillway to Turner Basin No. 2).
- Inflate the rubber dam in Cucamonga Creek.
- Open DRC-TR1-A and/or DRC-TR4-A, inlet gates from the Deer Creek Channel, (depending on the storage space available for storm water recharge in Turner Basin 1 and Turner Basins 3 and 4, respectively).
- DRC-TR1-A is automated to close when the Turner Basin No. 1 water level sensor (LT-0208) is greater than or equal to elevation 981.0 (Deer Creek channel floor).
- DRC-TR4-A is automated to close when the Turner Basin No. 4 water level sensor (LT-1200) is greater than or equal to elevation 981.0.
- Automated inlet gate from Turner Basin No. 1 TR1-TR2-A closes when the Turner Basin No. 2 water level sensor (LT-1101) is greater than or equal to elevation 987.5 (the Basin No. 2 spillway elevation).

5.2.1.2.5 Day Creek Channel System

First Flush Opportunity

Prior to the first flush opportunity, Day Creek Channel inlet gate to Lower Day Cell 1 DYC-LD1-A shall be closed and the rubber dam will be deflated. Sluice gate DYC-LD1-A shall remain closed and the rubber dam deflated until the SBCFCD authorizes sluice gate DYC-LD1-A be opened and the rubber dam inflated when it is determined that the turbidity of the storm water is acceptable and significant inlet clogging debris has passed the site. The IEUA Groundwater Recharge Coordinator will then divert storm water into the Lower Day Basin.

Storm Water Capture

The following are the procedures to operate the Lower Day Basin for the recharge of storm water for a storm that has a non-significant precipitation forecast:

- The IEUA Groundwater Recharge Coordinator will open the inlet sluice gate to Lower Day Cell 1 (DYC-LD1-A), open manual sluice gates LD1-LD2-M & LD2-LD3-M, and close Lower Day Cell 3 outlet sluice gate LD3-DYC-M.
- Automated outlet gate from Cell 3 LD3-DYC-A opens when the water level on LT-0902 is greater than or equal to elevation 1386, and closes when elevation is less than or equal to 1386 (top of soffit of uncontrolled outlet). Coincidentally, the inlet flow control gate to Cell 1 should close when LD3-DYC-A opens.

The following are the procedures to operate the Lower Day Basin for a storm that has a significant precipitation forecast:

- Sluice gate LD3-DYC-M should be opened 24 hours prior to the storm's arrival and the basin should be fully drained before the storm starts.
- Sluice gate DYC-LD1-A shall be closed and the rubber dam deflated.

5.2.1.2.6 Etiwanda and San Sevaine Channels System

First Flush Opportunity

The settings for all operable control elements in the Etiwanda and San Sevaine Creeks System are listed in Tables 5-1 and 5-2. The settings for the first flush opportunity were established to bypass debris accumulation in the channels and thus minimize maintenance. The following inlet gate is closed prior to the first storm for this purpose:

- Automated sluice gate SSC-VBN-A, San Sevaine Channel outlet/inlet to Victoria Basin North.

Storm Water Capture

The typical settings for gates and rubber dams within the Etiwanda and San Sevaine Creek Basins for the recharge of storm water for storms that have either a non-significant or significant precipitation forecast are also listed in Tables 5-1 and 5-2. Automated gate controls in the Etiwanda and San Sevaine Creeks System are as follows:

Victoria Basin:

- The outlet flow control gate to the Etiwanda Creek Channel from Victoria Basin VBS-ETI-A opens when Cell 1 water level sensor (LT-1300) is greater than or equal to elevation 1324.5 (15.5 feet deep) and closes when LT-1300 is less than or equal to elevation 1323.9 (outlet spillway elevation is about 1333; Top of SBCFCD spill/box structure is about 1323.9).

5.2.1.2.7 West Fontana Channel System

First Flush Opportunity

The settings for all operable control elements in the West Fontana Channel System are listed in Table 5-1. The following inlet gate is closed prior to the first flush opportunity:

- Automated sluice gate SSC-HKW-A, San Sevaine Channel inlet to Hickory West Cell.

Storm Water Capture

The typical settings for gates and rubber dams within the West Fontana Channel Basins for the recharge of storm water for storms that have either a non-significant or significant precipitation forecast are also listed in Table 5-1. Automated gate controls in the system are as follows:

Banana Basin:

- The outlet flow control gate to the West Fontana Channel from Banana Basin BAN-WFC-A opens when the Banana Basin water level sensor (LT-0100) is greater than or equal to elevation 1143.5 and closes when LT-0100 is less than or equal to elevation 1143.0 (outlet spillway is 1143.0).

Hickory Basin:

- The divider levee flow control gate between the east and west halves of the Hickory Basin HKE-HKW-A opens when the Hickory Basin east water level sensor (LT-0700) is greater than or equal to elevation 1117.5 (7.5 feet) and closes when LT-0700 drops to elevation 1117.0.
- The inlet from San Sevaine Channel gate to Hickory Basin closes when LT-0701 is greater than elevation 1111.5 and opens 6% when is it is less than or equal to elevation 1111.5.

5.2.1.2.8 Declez Channel System

First Flush Opportunity

The settings for all operable control elements in the Declez Channel System are listed in Tables 5-1 and 5-2. The following are the policies for first flush opportunities in the Declez Channel System:

- Automated sluice gate DZC-FC-A, Declez Channel outlet/inlet to Feeder Channel, is closed prior to the first flush opportunity.
- The first flush bypasses the RP3 basin but is allowed to enter Declez Basin Cell No. 1. Cell No. 1 is a habitat area that can receive water with higher turbidity.

Storm Water Capture

The typical settings for gates and rubber dams within the Declez Channel Basins for the recharge of storm water for storms that have either a non-significant or significant precipitation forecast are also listed in Tables 5-1 and 5-2. Gate controls in the system are as follows:

Declez Basin:

- The flow control gate between Declez Basin Cells No. 1 and No. 2 DB1-DB2-A opens when the Basin's Cell No. 1 water level sensor (LT-0402) is greater than or equal to elevation 831.5 and closes when LT-0402 is less than or equal to elevation 831.0.
- The flow control gate between Declez Basin Cells No. 2 and No. 3 DB2-DB3-A opens when the Basin's Cell No. 2 water level sensor (LT-0401) is greater than or equal to elevation 830.0 and closes when LT-0401 is less than or equal to elevation 829.5 (top of the existing levee is 830.0).
- The outlet flow control gate from Declez Basin to the continuation of the Declez channel DB3-DZC-A opens when the Declez cell #3 water level sensor (LT-0400) is greater than or equal to elevation 831.5 and closes when LT-0400 is less than or equal to elevation 831.0.

RP3 Basin:

- Inlet gate DZC-FC-A, Declez Channel outlet/inlet to Feeder Channel will remain open in a storm event.
- Manual gate FC-JS-M, Feeder Channel to RP3 Junction Structure, will typically remain closed in a storm event until Cell No. 1 is full.
- Manual gate FC1-M, Feeder Channel Flow Control, will typically remain closed in a storm event until Cell No. 3 is full.

5.2.2 Local Storm Water Recharge Facilities and Policies Related to Storm Water Management and Recharge

Local storm water management practices and LID identified in the Chino Basin are primarily utilized in conjunction with urban development projects and are accordingly privately owned and maintained facilities. As a result of urbanization, storm water runoff accumulates significant amounts of pollution before returning to a natural water body. The primary function of such facilities is to remove pollutants from runoff. All management practices described herein remove pollutants by utilizing some method of infiltration of runoff through the soil. Accordingly, a secondary function of such facilities is to recharge storm water to the groundwater basin.

The potential amount of water recharged to the groundwater basin as a result of such local storm water management practices may not have been previously modeled and considered in the estimation of the safe yield of the Chino Basin. We evaluated the possibility that water collected in newly constructed local storm water treatment facilities reduces water that would otherwise be captured by existing regional facilities and accordingly has no net effect on previous estimates of storm water recharge. A consequence of storm water retention by local facilities is the potential increase in evaporation. Descriptions of local storm water management practices, contained herein, are based on information collected from individual entities within the Chino Basin.

5.2.2.1 Storm Water Recharge Facilities Identified by Chino Basin Entities

New developments and significant re-developments are required to include facilities to manage storm water runoff commonly referred to as Best Management Practices (BMP). The BMPs are designed according to the Pollutants of Concern (POC) as well as any Hydrologic Conditions of Concern that are specific to each development site. The management of POCs is required by various regulatory decisions such as the federal Clean Water Act 402(p) National Pollutant Discharge Elimination System (NPDES) and the State of California Porter Cologne Act. Developments in the Chino Basin must adhere to the requirements adopted by the Santa Ana Regional Water Board in the NPDES Permit No. CAS618036. Compliance with the permit requires that a WQMP be implemented for such projects. The WQMP template describes steps to be taken for various projects in order to reduce short and long term adverse impacts resulting from the development. The WQMP identifies categories of project types for which a WQMP is required, BMP selection, and operations and maintenance of the BMPs identified.

A total of 260 storm water management project sites were identified by entities within the Chino Basin, utilizing about 569 BMPs (see Figure 5-2). Specific projects are discussed in section 5.2.2.1.2 below. Varying types of BMPs are described in section 5.2.2.1.1 below. The primary sources of information for general descriptions of the effectiveness and maintenance of typical BMPs were the California Storm Water Quality Association (CASQA) BMP Handbooks. We also consulted “Storm Water Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring” prepared by U.S. Department of Transportation (DOT) Federal Highway Administration and Storm Water Technology Fact Sheets prepared by the United States Environmental Protection Agency (EPA).

Each BMP has the potential to recharge storm water to the groundwater basin. However, the recharge effectiveness of a BMP depends not only on the infiltration capacity of its underlying soil matrix but also on regular maintenance. A BMP more prone to failure than others and requires more diligent maintenance might be less effective for recharge, or more expensive.

5.2.2.1.1 Best Management Practices (BMPs)

5.2.2.1.1.1 Infiltration/Detention Basins

There were 133 infiltration basins identified by local Chino Basin entities. An infiltration basin is a shallow impoundment designed to temporarily retain storm water for the purpose of infiltration. New development projects often are designed in conjunction with an infiltration basin in order to capture localized urban storm water runoff, particularly the first flush. The first flush of a storm often times will include higher amounts of pollutants and debris. An advantage of an infiltration basin is that they can serve large drainage areas. DOT suggests infiltration basins serve areas between 5 and 50 acres, though some serve much larger areas. Some basins incorporate a forebay in order to settle out sediment before water is conveyed to the infiltration cells of the basin, limiting maintenance necessary for the majority of the basin. If maintained properly, this practice can have a high efficiency associated with its recharge capabilities, while limiting groundwater contamination.

Effectiveness/Maintenance

In order to perform properly, infiltration basins must be constructed of well drained permeable soils in areas with good geologic/hydraulic conductivity with groundwater, thus limiting the number of potentially efficient sites. Infiltration basins constructed in an area of low permeability may quickly become congested with sediment and debris and require more frequent inspections and maintenance. Conversely, if a site is constructed of more course materials there is a higher risk of groundwater contamination.

According to CASQA, improperly maintained infiltration basins have a high failure rate. To maintain efficient infiltration, facilities require maintenance by scarification or discing. The policy for maintenance of infiltration basins is to scarify when there are performance issues, such as clogging or significant loss of infiltrative capacity, rather than on a routine basis. CASQA suggests a typical basin should maintain an infiltration rate of 72 hours or less to prevent mosquito and other vector habitats. Trash and debris typically has to be removed at the beginning and end of the wet season. Erosion control can also be an issue and the ground must be stabilized.

5.2.2.1.1.2 Vegetated Swale/Bio-swale

Vegetated swales are long, open, shallow channels with vegetation (typically grass) covering the side slopes and bottom. 186 swales were identified as part of a storm water management system by local Chino Basin entities. The majority of the vegetated swales identified in the Chino Basin were constructed adjacent to parking lots. These swales are utilized as an aesthetic alternative to curbs or gutters in the storm water drainage system to collect and convey runoff. Storm water runoff is designed to move slowly through the swale where it is filtered by the vegetation in the channel, through a subsoil matrix, and into underlying soils. Water which does not percolate is conveyed to downstream discharge points, often times to an infiltration basin or infiltration trench.

Effectiveness/Maintenance

As with any storm water treatment practice, swales are susceptible to failure if not properly maintained. According to CASQA, in order to perform properly, a thick vegetative cover (typical grass height of 6 inches) must be maintained. Typical maintenance can require little more than landscape maintenance activities such as irrigation, mowing, reseeding, etc. The accumulation of debris and sediments must be limited for proper infiltration. Proper infiltration requires slow moving flow which can sometimes require the addition of shallow berms or check dams to increase contact time. Accordingly, vegetated swales are rendered ineffective during periods of high flow velocities.

5.2.2.1.1.3 Underground Chamber Vault

DOT states that underground chamber vaults are used to attenuate storm water runoff in urban areas that are very limited in space for other options. Modern chamber vaults are open bottom, perforated, corrugated, polypropylene structures primarily constructed under parking lots for the management of storm water in commercial or municipal sites. Storm drains convey underground to the chambers through inlet pipes. Storm water is attenuated in the chamber vaults and allowed to infiltrate through the open bottoms through surrounding angular aggregate. There were 33 underground chamber vault systems identified by local Chino Basin entities.

Effectiveness/Maintenance

As with any storm water management system reliant on infiltration, the effectiveness of the underground chamber vaults depends on the percolation capacity of the soil. If the chamber vaults are properly maintained they can be effective for very long periods of time. "Stormtech", a commonly used manufacturer of vaults, suggests that systems of underground chamber vaults be constructed with an isolator row wrapped in a filter fabric. The isolator row is intended to capture the first flush of a storm event and remove sediment from runoff before it enters other chambers. The isolator row is typically constructed with an inspection port to visually inspect the chamber. Sediment can also be measured through the inspection port. Excess sediment can be vacuumed from the chamber through access manholes. Proper maintenance of drain inlets and catch basins will also limit debris entering the chamber vaults.

5.2.2.1.1.4 Infiltration Trench

Similar to vegetated swales, infiltration trenches are long and narrow trenches designed to treat small drainage areas. However, unlike vegetated swales, infiltration trenches are filled with rocks and are not meant to convey water and outlet runoff to downstream discharge points. Many of the 71 infiltration trenches identified by local Chino Basin entities are used in conjunction with vegetated swales. Runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix.

Effectiveness/Maintenance

Due to the limitation on drainage area, infiltration trenches are accordingly limited on recharge amount. Infiltration trenches perform well for removal of fine sediment and associated pollutants. However, infiltration trenches typically require some form of pretreatment (such as a vegetative swale) to remove more course sediment. Ineffective pretreatment will lead to frequent clogging of infiltration trenches and once clogged, the infiltration functionality is difficult to restore. According to CASQA, similar to infiltration basins, the trenches should be maintained to sustain an infiltration rate of 72 hours or less to prevent creating mosquito and other vector habitats. Due to the difficulty associated with repairing clogged trenches, most of the maintenance is concentrated on the pretreatment practices upstream of the trench to ensure that the more course sediment does not reach the infiltration trench.

5.2.2.1.1.5 Pervious Pavement

Pervious pavement is a storm water recharge practice that can be incorporated into the design of a typical parking lot or low traffic volume roads. According to CASQA, the pervious pavement system is comprised of two layers of functioning material. The top layer is a porous load bearing surface constructed of a material (porous concrete or porous asphalt) that allows storm water to pass through to the second layer. The underlying second layer is comprised of a material designed for attenuation prior to infiltration for groundwater recharge or, if the soil type isn't suitable for recharge, drainage to a controlled outlet. A total of 16 systems identified by local Chino Basin entities utilize pervious pavement.

Effectiveness/Maintenance

Pervious pavement is an unobtrusive option for storm water treatment and groundwater recharge. Improper maintenance can result in clogging, which can then lead to ponding. However, pervious pavement is relatively simple to clean or replace should failure occur. Routine maintenance can simply include proper care of adjacent landscaping to limit debris or prevent soil from being washed onto the pavement. Regular street sweeping and vacuuming is necessary to clean the surface. If properly maintained, pervious pavement can treat runoff for small drainage areas and are an inexpensive option in confined urban areas in which other treatment options are limited.

5.2.2.1.1.6 Drywell

A total of 124 drywells were identified by the City of Ontario as a BMP for local storm water management. The "MaxWell" drywell system is the most common product used in the storm water management systems incorporated into the development projects identified by Ontario. According to the Torrent Resources, Inc. the MaxWell drywell system is a one or two vertical chamber structure intended to settle out sediment and particulate matter. The drywells utilize infiltration to mitigate surface flows.

Effectiveness/Maintenance

Each chamber has a settling capacity of about 1,000 gallons and has a maximum outflow capacity of 0.25 cfs when installed in drainage soils with optimum permeability. Accordingly, the effectiveness of the drywell is dependent on its underlying soil matrix. A single chamber drywell is intended primarily to serve landscaped retention areas, and works best if the water is passed through some sort of pretreatment before entering the drainage structure. The tributary drainage area that can be accommodated by a drywell is limited; a tributary area that is too large will become clogged quicker. Routine maintenance consists of the cleaning of debris using some sort of truck mounted vacuum. If a drywell is not properly maintained the system will accumulate sediment and clog the void spaces of the drainage pipe gravel pack and may not be repairable.

5.2.2.1.1.7 Roof Well

Particularly in industrial areas, large amounts of precipitation falls directly on roof tops in urbanized areas. Roof downspouts can be directed underground to roof wells for storm water treatment and recharge. A roof well is essentially a hole filled with open graded aggregate. CASQA suggests a roof well be excavated typically 10 feet from the edge of a building. Runoff from the rooftops is conveyed to the roof well from the downspout through an underground connection to fill the voids in the aggregate. Water then infiltrates the soil, consequently recharging the groundwater. Only 6 roof wells were identified by local Chino

Basin entities.

Effectiveness/Maintenance

In poorly drained soils, dry wells have very limited feasibility. However, in appropriate sites, runoff collected from roof tops typically has little sediment, which can result in roof wells being effective for long periods. Roof wells are sized according to the amount of rooftop runoff received. Their drainage areas are limited to the size of the roof top, but the use of roof wells limit the need for larger off-site storm water treatment facilities by treating runoff on-site.

5.2.2.1.2 Identified Recharge Facilities

Our evaluation of local storm water recharge is based on the information provided by local entities within the Chino Basin who responded to a data request letter mailed in March 2009 (see the table below). The responding entities hadn't previously prepared inventories of such sites and accordingly, collection of local storm water management information proved to be very difficult because such sites are largely associated with development projects and are accordingly privately owned and maintained. Representatives from CalTrans were contacted in July 2009 regarding facilities owned and operated by the state of California. CalTrans representatives were in the process of identifying facilities; however this information has not been provided by the date of this report and accordingly not included in our evaluation.

Urban development projects within the last 5-10 years have been required to incorporate a storm water management system that will treat the runoff collecting within the project area. WQMPs and Hydrology Reports for the development projects are submitted to the local entities. Representatives from the various cities provided us with as much information as was readily available regarding local storm water management projects. In many cases, portions of the WQMPs and Hydrology Reports were provided. Most of the WQMP portions provided contain all relevant data regarding the physical parameters of the storm water retention facilities as well as their tributary drainage areas. Facilities identified that were unaccompanied by portions of a WQMP, were mapped using an ArcGIS program as accurately as possible according to information provided. The facility and its tributary drainage area were delineated using ArcGIS, 2007 aerial imagery, San Bernardino County assessor parcel information, USGS 7.5 minute quadrangles, and city storm drain atlases (when available).

Identified Storm Water Management BMPs

Entity	Infiltration/ Detention Basin	Vegetated Swale	Underground Chamber Vault	Infiltration Trench	Pervious Pavement	Drywell	Roof Well	Total
Chino	14	15	2	1	0	0	0	**32**
Chino Hills(1)	2	0	0	0	0	0	0	**2**
Fontana(2)	36	0	0	0	0	0	0	**36**
Montclair	1	3	1	2	0	0	0	**7**
Ontario	63	168	30	68	16	124	6	**475**
Rancho Cucamonga	11	0	0	0	0	0	0	**11**
Upland(3)	6	0	0	0	0	0	0	**6**
Total	**133**	**186**	**33**	**71**	**16**	**124**	**6**	**569**

Notes:

(1) Basins are concrete lined and accordingly do not recharge to the groundwater basin.

(2) Does not include regional basins identified by City of Fontana.

(3) Does not include regional basins identified by City of Upland. All basins identified were assumed to recharge adjacent groundwater basins, not Chino Basin.

5.2.2.1.2.1 City of Chino

Storm water management information for 19 different development projects were provided by the City of Chino. Chino was able to prepare a very complete inventory of storm water management systems within their city limits. Sections of WQMPs containing site descriptions, drainage area delineations, soil investigations, BMP product specifications, plan sheets, etc. were all made available. Parameters of City of Chino storm water management projects are identified in Table 5-5 and approximate site locations are mapped on Figure 5-3. A total of 19 projects, consisting of 32 different storm water management BMPs can store a total of about 280 acre-ft. The projects collect storm water runoff from a tributary area of about 1,555 acres. All storm water management facilities identified by the City of Chino collect storm water runoff that would otherwise drain to Prado Lake and eventually out of the Chino Basin. Accordingly, any recharge estimated by these facilities would represent a positive impact.

5.2.2.1.2.2 City of Chino Hills

Representatives from the City of Chino Hills were able to provide a copy of a storm water management facility maintenance book. This document identified all the publicly maintained storm water facilities including several catch basins, drainage ditches, and two detention basins. The detention basins were found to be concrete lined which negates any possibility of consequent storm water recharge. These basins are primarily utilized for peak flow attenuation, not for treatment or recharge. Privately owned and maintained storm water management systems were not identified by Chino Hills. According to personal communication with Steven Nix, City Engineer of Chino Hills, the underlying soil type for Chino Hills' projects does not allow for significant infiltration. Accordingly, privately owned and maintained facilities only serve to attenuate peak storm flows and not groundwater recharge. Accordingly, storm water management facilities in Chino Hills represent a neutral effect on recharge estimates because runoff will continue to drain to Prado Lake and eventually out of the Chino Basin.

5.2.2.1.2.3 City of Fontana

The City of Fontana provided very detailed electronic copies of their storm drain infrastructure and the locations of storm water management facilities the city utilizes. Fontana identified several regional basins they utilize for storm water management. These basins were evaluated in Section 5.2.1. Unfortunately, Fontana was unable to provide any segments of WQMPs or Hydrology Reports for the locally owned and operated facilities. However, we were able to estimate the surface area and the tributary drainage areas of the identified facilities using ArcGIS, the storm drain atlas provided by Fontana, aerial imagery, USGS 7.5 minute quadrangles, and San Bernardino County assessor parcel information. Parameters of City of Fontana storm water management projects are identified in Table 5-6 and approximate site locations are mapped on Figure 5-4. The 36 basins identified have a total surface area of approximately 46 acres. The basins collect storm water runoff from a tributary area of about 1,445 acres. As described in the notes column in Table 5-5, not all of the facilities identified by the City of Fontana recharge storm water to the Chino Basin. There are 15 facilities that recharge to Chino Basin that would otherwise have drained to regional recharge facilities; these facilities represent a neutral impact to recharge estimates. Seven facilities recharge outside of the Chino Basin but would otherwise drain outside of the Chino Basin, accordingly these sites also represent a neutral impact to recharge estimates. Six facilities recharge storm water to the Chino Basin that would otherwise drain outside of the basin; accordingly this represents a positive impact on recharge estimates. There are eight facilities that capture storm water runoff and recharge outside of the Chino Basin that would otherwise drain to regional recharge basins within the Chino Basin. These sites accordingly represent a negative impact on estimated storm water recharge.

5.2.2.1.2.4 City of Montclair

The City of Montclair identified four local storm water management projects. Complete copies of the WQMPs and the majority of the accompanying construction plan sheets were provided by Montclair. Montclair was also able to provide electronic copies of the existing storm drain infrastructure. Parameters of City of Montclair storm water management projects are identified in Table 5-7 and approximate site locations are mapped on Figure 5-5. The four basins identified have a total surface area of approximately 11,300 sq. ft. and can store a total of about 0.5 acre-ft. The basins collect storm water runoff from a tributary area of about 10 acres. Two facilities capture storm water runoff that would have otherwise have drained to regional recharge basins and represent a neutral impact on estimated recharge to the Chino Basin. The other two sites capture water that would otherwise drain to Prado Lake and outside of the basin and represent a positive impact to estimated recharge.

5.2.2.1.2.5 City of Ontario

Representatives of the City of Ontario identified the largest number of local storm water management facilities. A total of 185 development projects were identified that utilize 475 storm water management BMPs. The projects identified by Ontario are shown in Table 5-8 and the locations are mapped on Figure 5-6. The project site locations were mapped according to the provided assessor parcel number corresponding to the development project. The City of Ontario estimates the total surface area of the BMPs to be about 13 acres, have an approximate storage volume of over 24 acre-ft, and have the ability to collect runoff from a tributary drainage area of about 918 acres. 107 of the BMPs identified by City of Ontario are noted to have minimal infiltration capacity. Facilities such as these are primarily used for peak flow attenuation and accordingly represent a neutral impact on estimated recharge. 123 BMPs capture storm water runoff that would otherwise drain to existing regional recharge basins. Recharge from these facilities also represents a neutral impact to total estimated recharge. The remaining 245 BMPs capture storm water runoff that would otherwise drain to Prado Lake and outside of the Chino Basin. Accordingly, recharge from these BMPs represents a positive impact to estimated recharge.

5.2.2.1.2.6 City of Rancho Cucamonga

Storm water facility construction plans and site location maps featuring aerial imagery and assessor parcel boundaries were provided by representatives of the City of Rancho Cucamonga. Eleven basins were identified that collect storm water runoff primarily from residential areas in Rancho Cucamonga. Parameters of City of Rancho Cucamonga storm water management projects are identified in Table 5-9 and approximate site locations are mapped on Figure 5-7. The 11 basins identified have a total surface area of approximately 26 acres and can capture storm water runoff from a tributary area of about 999 acres. Four of the infiltration basins identified by the City of Rancho Cucamonga capture and recharge runoff outside the Chino Basin that would otherwise be captured by an existing regional recharge basin within the Chino Basin. Accordingly, recharge from these facilities represents a negative impact on estimated recharge to the Chino Basin. The remaining seven infiltration basins capture storm water runoff that would otherwise drain to existing recharge basins. These facilities represent a neutral impact to estimated recharge.

5.2.2.1.2.7 City of Upland

Representatives from the City of Upland did not identify any privately owned and maintained storm water management systems. However, a large amount of information regarding publicly owned and maintained storm water management facilities was provided. Upland storm water runoff is collected by existing storm drain infrastructure and conveyed to a number of large recharge basins. The Upland Basin is the only facility of the seven recharge facilities identified that recharges groundwater to the Chino Basin. The Calmat Basins and the Blue Diamond/Holliday Pit recharge to the College Heights groundwater basin. The Colonies and 15th Street Basins recharge to the Cucamonga Basin. All storm water runoff amounts collected by these regional basins have been estimated in the past. Any new development utilizing privately owned and maintained storm water management facilities in the City of Upland would recharge storm water that would otherwise be collected by the regional basins. Accordingly, estimation of local recharge from development projects would most likely not result in additional recharge to the basin.

5.2.2.2 Evaluation of Local Retention Facilities

In evaluating the recharge capabilities of the facilities identified by local entities within the Chino Basin, the six basins identified by the City of Upland and two basins identified by the City of Chino Hills can be removed from consideration. The local Upland basins recharge to groundwater basins adjacent to the Chino Basin. The Chino Hills basins are concrete lined and accordingly do not recharge. The remaining facilities identified collect storm water runoff from an estimated total tributary area of about 4,927 acres. If each facility were assumed to have equal recharge efficiency, an effective precipitation coefficient can be applied to estimate potential recharge. Previous estimates of discharge to recharge basins in Upland have used a rainfall amount of 11.42 inches/year (Average of last 10 years measured at Upland). If this factor is used, the estimated discharge to the identified local facilities is about 4,690 acre-ft/yr. As discussed in section 5.2.2.1.1, each type of facility has different factors effecting ability to efficiently recharge storm water.

The inclusion of LID elements does not necessarily correlate to an increase of groundwater recharge. The below table displays the potential impact of each of the BMPs identified by the local entities. Each BMP constructed is intercepting runoff that would otherwise drain to another location. If a BMP captures runoff that would otherwise recharge outside of the Chino Basin then it represents a potential positive impact. Conversely, a BMP capturing and recharging water outside of the Chino Basin that would otherwise recharge within the basin represents a potential negative impact (see below).

Number of BMPs According to Source Runoff and Recharge

		Recharges to Chino Basin			Recharges Outside Chino Basin		
BMP	Minimal Infiltration[1]	Would Otherwise Drain to Prado[2]	Would Otherwise Drain to Regional Basin[3]	Would Otherwise Drain Outside Chino Basin[2]	Would Otherwise Drain to Regional Basin[4]	Would Otherwise Drain Outside Chino Basin[3]	Total
Infiltration Basin	2	54	46	6	18	7	133
Vegetated Swale	89	78	19				186
Infiltration Trench	6	47	18				71
Underground Chamber Vault	0	23	10				33
Pervious Pavement	9	3	4				16
Drywell	0	73	51				124
Roof Well	3	2	1				6
Total	**109**	**280**	**149**	**6**	**18**	**7**	**569**

Notes:

(1) Represents little to no impact on estimated recharge.

(2) Represents positive impact on estimated recharge.

(3) Represents neutral impact on estimated recharge.

(4) Represents negative impact on estimated recharge.

The potential negative impact attributable to increased evaporation losses as a result of storm water runoff captured in local management facilities was evaluated. We analyzed only the above ground facilities that capture and recharge storm water runoff that would have otherwise drained to existing regional recharge facilities. A "ball-park" estimate of potential negative impact was calculated in order to see if further study was necessary. An average annual unit evaporation loss was estimated using available daily pan increment evaporation measured at Lake Isabella in Kern County (data available from 1994 through 2009). Storm events reported at the Upland Water Facilities Authority precipitation station during the same period were identified. The evaporation corresponding to each storm event was identified and an average annual unit evaporation of 2.91 inches was calculated. This evaporation applied to the surface area of the facilities evaluated (22.3 acres) corresponds to a potential loss of about 5.4 acre-ft/yr. Considering this value is a gross estimation, this amount is most likely negligible and the effect of these facilities on the total estimated recharge is considered a neutral impact (see table below).

Approximated Annual Reduction in Recharge Resulting from Increased Evaporation(1) From Open-Air BMPs Capturing Runoff Otherwise Captured By Regional Basins

BMP	Quantity	Surface Area(2) (ac)	Estimated Evaporation Loss (af)
Infiltration Basin	46	21.7	5.26
Vegetated Swale	19	0.34	0.08
Infiltration Trench	18	0.25	0.06
Total	**83**	**22.3**	**5.40**

Notes:

(1) Evaporation is estimated using average pan increment evaporation measured at Lake Isabella on days with reported precipitation measured at Upland Water Facilities Authority Station from January 1994 through May 2009.

(2) Surface areas for vegetated swales identified by City of Ontario are largely unavailable.

5.3 Potential Storm Water Recharge Projects

As described in previous sections, the opportunity to significantly increase recharge from storm water with the current system may be limited for many basins, primarily due to the nature of the timing of precipitation and runoff. Storm water runoff draining to creeks and channels is usually less than the inlet capacity of the existing recharge basins, meaning that most of the time all flow can be captured and recharged by facilities. However, in large storm events some recharge basins are unable to divert all available flow because the rate of flow greatly exceeds the capacity of intake structures. Consequently recharge opportunities are lost. Groundwater recharge could potentially be optimized by developing new projects, altering current practices, or both.

Potential storm water recharge projects evaluated in this Section by CBWCD are as follows:

- Potential Storm Water Recharge Projects
  - Potential Recharge Basins – Sites that could potentially be made available for construction of groundwater recharge basins
  - Brooks Basin Enlargement – Expand to utilize vacant area to the south of the existing basin
  - Whispering Lakes Golf Course – Utilize small depression adjacent to Cucamonga Creek Channel
- Potential Local Storm Water Recharge Projects
  - Low Impact Development Best Management Practices – Required as part of future urban development
- Potential Changes in Storm Water Management Policy to Increase Recharge
  - Increase Divertible Runoff – Enlarge diversion inlet and/or storage capacity

- First Flush Bypass Practice – Effect of discontinuing practice

5.3.1 Potential Storm Water Recharge Projects

5.3.1.1 Potential New Recharge Basins

John Van Dyk of Beno, Van Dyk & Owens Land Brokers and Development Consultants investigated the existence of potential sites for new groundwater recharge facilities. Mr. Van Dyk identified a total of 51 sites within the boundary of the CBWCD that were vacant (see Table 5-10). The total approximate surface area of these sites is 576 acres. The approximate maximum tributary drainage area if all sites were constructed is about 7,780 acres. Drainage areas were approximated based on knowledge of existing storm drain systems, evaluation of aerial imagery, and topography. Estimated tributary drainage areas for these sites are preliminary and could potentially be affected by changes in storm drain systems.

As shown on Figure 5-8, the potential recharge sites identified are largely upstream of existing regional recharge basins. Accordingly, significant increase in storm water recharge resulting from the development of these sites is not very likely. As mentioned previously, the majority of storm water runoff in this area is captured and recharged by the existing facilities. New facilities collecting runoff from their local tributary drainage areas would be collecting runoff that would most likely be captured by the existing basins. Accordingly, significant increase in recharge of storm water runoff collected upstream of existing basins is limited. However, runoff collected downstream of the existing basins remains largely un-captured and accordingly does not recharge to the Chino Basin.

Runoff occurring in San Antonio Creek and Cucamonga Creek downstream of existing basins is measured at USGS streamgages 11073300 San Antonio Creek at Riverside Dr. near Chino, CA (Riverside Dr. gage) and 11073495 Cucamonga Creek near Mira Loma, CA (Mira Loma gage). Average water year discharge downstream of the existing basins on San Antonio Creek from 1999 through 2008 is about 6,300 acre-ft (excluding contributions from OC-59 releases) and on Cucamonga Creek from 1986 through 2008 is about 39,200 acre-ft. Facilities could conceivably be constructed to divert runoff contributing to the discharge measured at these gages that could transfer water to some of the potential recharge sites identified (see Sections 5.4 and 5.5). Recharge of storm water could potentially be increased significantly if runoff occurring downstream of existing basins were able to be captured.

5.3.1.2 Brooks Basin Enlargement

Vacant land to the south of Brooks Basin, between the existing basin and the railroad tracks running parallel along West State Street, could potentially be used to expand the basin. We evaluated the potential increase of capacity if the basin were to be expanded 40 feet into the vacant area. Topographic data was digitized from Figure 4-4 of the March 2006 GRCC Chino Basin Recharge Facilities – Operations Procedures manual. Based on a preliminary evaluation using limited resources, expanding Brooks Basin 40 feet to the south would increase the spillway capacity by about 70 acre-ft. This increase in capacity would require the removal of about 112,000 cu. yd. of soil.

5.3.1.3 Whispering Lakes Golf Course

A small site located in the Whispering Lakes Golf Course was investigated to determine if it was viable as an option for recharging storm water. A depression currently exists adjacent to the Cucamonga Creek (downstream from IEUA's RP-1) that has a surface area of about 4 acres. The site is currently being used as a disposal site for waste "fill" material.

According to representatives from the City of Ontario, the pond site originally had a capacity of about 100 acre-ft. However, the amount of replaced waste fill is currently unknown. The replaced fill is tight, compacted, fine grained soil and would require removal in order for the site to be used for recharge. The side slopes however, are loose gravels and sands and may be more permeable. An additional concern with the Whispering Lakes Golf Course site is an underlying plume of volatile organic compound (VOC) immediately below and down gradient of the site. An investigation would need to be undertaken to determine the potential impacts of recharge on the VOC plume. Artificial recharge could potentially mobilize the plume.

An investigation into historical land use would need to be undertaken. Deep and shallow soils would require testing for permeability and contamination. The existence of the VOC plume potentially raises multiple concerns over the viability of the site. Mobilization of the plume could have a potential impact to down gradient wells including the Watermaster's desalter wells. Reported tricholoethene concentrations under the site are 10 to 20 micrograms per liter and exceed US-EPA and California maximum contaminant level of 5 micrograms per liter.

The potential obstacles involved with the Whispering Lakes Golf Course may make the site a more likely candidate for seasonal off-channel storage similar to proposed facilities described in Section 5.4. The site could potentially be used to store water temporarily during the wet season to be transferred to existing facilities for groundwater recharge during the dry season when there would likely be capacity available.

5.3.2 Potential Local Storm Water Recharge Projects

As described in 5.1.2.1, new developments and significant re-developments are required to include BMPs to manage storm water runoff. Developments in the Chino Basin must adhere to the requirements adopted by the Santa Ana Regional Water Board in the NPDES Permit No. CAS618036. Compliance with the permit requires that a WQMP be implemented for such projects. The WQMP template describes steps to be taken for various projects in order to reduce short and long term adverse impacts resulting from the development. The WQMP identifies categories of project types for which a WQMP is required, BMP selection, and operations and maintenance of the BMPs identified. As urban growth continues, the effects of the new LID BMPs on storm water recharge in the Chino Basin will need to be revisited.

5.3.3 Potential Changes in Storm Water Management Policy to

Increase Recharge

5.3.3.1 Increase Divertible Runoff

A method that could potentially be used to maximize recharge opportunities would be to increase the inlet capacities and/or the storage capacities of the basins enough to capture more of the storm water runoff accumulating in each channel. This method would not be optimal if the cost associated with increasing the recharge capacity of the basins is greater than the value of the increased recharge opportunities.

WEI has developed the Chino Basin Surface Water Simulation R4 Model which estimates daily runoff at points of interest. WEI provided model output for San Antonio Creek flow near Upland Basin, and local inflow to Upland and Montclair Basins from water year 1950 through 2006. The Upland and Montclair Basins have an approximate recharge capacity of about 60 cfs. An initial evaluation of recharge opportunity on the San Antonio Creek was completed using the 60 cfs recharge capacity limitation as an indicator of missed recharge opportunity.

According to the modeled amounts, there is zero flow available to recharge at these basins in over 91% of the days modeled. Of the remaining days, when there is modeled flow available for recharge at the basins, the 60 cfs recharge capacity is exceeded only about 14 % of the time. As shown on Figure 5-9, the resulting average annual amount of runoff greater than 60 cfs occurring on days with greater than zero flow is about 630 acre-ft.

This evaluation serves as a preliminary indicator of the relative efficiency with which storm water runoff is captured in this system. In order to recharge the average amount of runoff available, the basins would have to capture every drop of water passing the inlet. This would include capture of peak flows such as the estimated 3,100 cfs occurring in January 1969 at the Montclair inlet.

If the basins were to regularly fill to capacity, the limitation on the capture of storm water would be the storage capacity. However, as a result of the manner in which runoff occurs in the San Antonio Creek Channel, the factor limiting storm water capture for recharge is typically not storage capacity. The relatively high recharge rates quickly create storage capacity following storm events, as is evident by infrequent spilling. As a result, the factor most commonly limiting recharge opportunities is the capacity of the diversion inlets.

Potential runoff available for diversion at the Montclair Basins can also be estimated using flow measurements taken downstream of the basins. USGS measures flow in San Antonio Creek using the aforementioned Riverside Dr. gage. Measurements at this gage are available from December 1998 through the present. Because the gage is downstream of the basins, flow measured at this gage accounts for diversions made by Pomona Valley Protective Association upstream of the basins. The only other streamflow gages on the San Antonio Creek measure runoff upstream of this diversion. The OC-59 turnout in the Rialto Reach of the Foothill Feeder releases state water to San Antonio Creek for use by Orange County Water District and Municipal Water District of Orange County. Historic daily discharge from

OC-59 was provided by the Santa Ana River Watermaster. Data is available through September 2008. Contributions from OC-59 to San Antonio Creek discharge, where available, were excluded from consideration for diversion to recharge basins.

Mr. Campbell has been measuring diversions to recharge basins within the Chino Basin since April 2005. The estimation of average missed recharge opportunity is thus limited to a period of record from April 2005 through the present. The total runoff available between San Antonio Dam and the Riverside Dr. gage was estimated by adding daily diversions made to the recharge basins to the daily flow measured at the Riverside Dr. gage. Runoff available at the Montclair Basins was then estimated by prorating measured flows according to the ratio of the tributary drainage areas of the basins and the gage (about 30%). In order to accurately measure tributary drainage areas in their entirety, runoff collected in storm drains from surface streets and residential areas were taken into account. Tributary drainage areas are shown on Figure 5-10.

As shown on the below table, the estimated average water year discharge available at the Montclair Basins, using the methodology described above, is about 1,174 acre-ft. Diversions to the basins are limited by an inlet capacity of 100 cfs and an approximate recharge capacity of 40 cfs. Applying these limitations to estimated daily flows, an average of about 1,164 acre-ft could potentially be diverted to the Montclair Basins. The difference of 10 acre-ft is representative of potential missed recharge opportunities on the San Antonio Creek, based on the limitations of the inlet capacity of the Montclair Basins, during this period. Estimated flows are illustrated in the water year hydrographs shown in Figures 5-11 through 5-13.

Chino Basin Water Conservation District
Summary of Reported and Calculated Flows in the San Antonio Creek System

Water Year	Reported SAC Near Chino[1] (af)	Actual Measured Total System Diversions[2] (af)	Adjusted SAC Near Chino[3] (af)	Estimated SAC at Montclair Inlet[4] (af)	Estimated Montclair Divertible Discharge[5] (af)	Estimated Uncapturable Discharge[6] (af)
2006	3,414	1,642	5,056	1,518	1,518	0.0
2007	819	834	1,653	496	496	0.0
2008	3,071	1,954	5,025	1,508	1,478	29.8
Total	**7,304**	**4,430**	**11,734**	**3,522**	**3,492**	**30**
Average	**2,435**	**1,477**	**3,911**	**1,174**	**1,164**	**10**

Notes:

(1) USGS 11073300 San Antonio Creek at Riverside Drive near Chino, CA excluding contributions from OC-59 turnout.

(2) Actual daily diversions to regional recharge basins in the San Antonio Creek System (from IEUA). This includes local runoff captured in the basins.

(3) Discharge is adjusted based on actual daily diversions.

(4) Discharge at the Montclair Basin 1 inlet is estimated based on drainage area percentage. (about 30% of the gaged watershed downstream of San Antonio Dam)

(5) Estimated Montclair Divertible Discharge assumes zero diversions upstream of Montclair Basins.

(6) Uncaptured discharge is estimated as discharge exceeding inlet and/or recharge capacity of the Montclair Basins.

The available period of record occurs during a period of lower than average flow. Accordingly, the amount of missed recharge opportunity is most likely higher than the estimated average 10 acre-ft calculated. The data does, however, show that portions of the occasional peak flows during a storm event that will not be captured are infrequent. This occurred only one time in the four year period.

When the evaluation described above is applied to the aforementioned modeled WEI runoff, the results support the conclusion that opportunity to decrease the amount of uncapturable flow is limited. According to the modeled data, the estimated average uncapturable flow per water year, using the current inlet and storage capacity of the Montclair Basins, is about 369 acre-ft. This estimation is conservative because it is calculated assuming that there are no storm water diversions upstream at Upland Basin or downstream at Brooks Basin. This is a potentially significant amount of water that could be recharged if it could be captured. Two potential means of increasing the capturable water at the Montclair Basins are to enlarge the storage capacities and/or the inlet capacity of the existing basins. Unfortunately, as a result of the nature of the runoff occurring during a storm event, these methods will most likely not significantly increase the capturable storm water.

As shown in Figure 5-14, if it were possible to enlarge each Montclair Basin 100 acre-ft (nearly an 80% increase in capacity), the uncapturable runoff would be decreased to 296 acre-ft/yr, an increase of only 73 acre-ft/yr. Doubling the capacity of the inlet to the Montclair Basins from San Antonio Creek from 100 cfs to 200 cfs would only increase the capturable runoff 21 acre-ft/yr. If it were possible to increase both the inlet capacity to 200 cfs and each basin by 100 acre-ft, the resulting increase of capturable runoff over the existing condition would be 132 acre-ft/yr.

Similarly, when the same evaluation is applied to WEI modeled runoff potentially available for diversion to the Turner Basins, it is apparent that the opportunity to significantly decrease uncapturable runoff in the Cucamonga Creek system is also limited. From water year 1949 through 1999 about 7,276 acre-ft per water year is estimated to be available for diversion from Cucamonga and Deer Creeks at the Turner Basin drop inlets.

According to WEI, a drop inlet in the Cucamonga Creek channel has the potential to divert up to 255 cfs to Turner 1. Drop inlets in the Deer Creek channel can divert 183 cfs to Turner 1 and 225 cfs to Turner 4. Combined, the three inlets correspond to a relatively large inlet capacity. However, according to the March 2006 GRCC Chino Basin Recharge Facilities Operation Procedures manual and personal communication with Andy Campbell of IEUA (see Table 5-1), the rule curve guideline for Turner Basin storage from October 16th through April 15th is limited to about 157 acre-ft. Accordingly, the operating storage capacity is the driving factor limiting recharge opportunities in the Turner Basins.

In order to evaluate potential increases in recharge opportunity at the Turner Basins we modeled the effects of increasing inlet capacity and also increasing the operating storage capacity. Increasing the inlet capacity appears to have little to no effect on average annual capturable runoff. However, there is a potential increase in capturable runoff by increasing the operating storage capacity. The basins are operated at a total storage of about 157 acre-ft in the wet season, but the total capacity at the spillways is much greater, about 488 acre-ft total. As shown in Figure 5-15, if the operating storage capacity were increased to 488 acre-ft, the corresponding capturable runoff could potentially be increased 596 acre-ft.

Increasing capturable runoff 596 acre-ft by simply increasing the operating storage capacity could be cost effective. Clearly, avoiding the need to physically enlarge the basins would be an advantage. Increasing the operating storage capacity may require only changes in operational practices and a reconfiguration of diversion inlets. The four Turner Basins have varying spillway elevations which contribute to a lack of flexibility when utilizing the basins. Mr. Campbell of IEUA has suggested that modifying the diversion structures in Deer Creek, adding a bypass structure from Turner 1 to either Turner 3 or 4, and possibly adding a rubber dam in Deer Creek would increase flexibility without the cost of enlarging the basins.

The potential for additional storage at the Turner Basins is also a possibility. There is vacant land owned by SBCFCD east of Turner 4 that could potentially be used to construct an additional recharge basin. Representatives of IEUA are also investigating the possibility of utilizing several existing ponds on the east side of North Archibald Avenue from the Turner Basins in the Guasti Park. This could also potentially be a cost effective way to increase recharge opportunity due to the fact that the ponds as well as some transfer ability already exist.

5.3.3.2 First Flush Bypass

A current operational practice used by the IEUA operator, as discussed in Section 5.2.1.2, is the first flush bypass. This practice was established to in order to limit the amount of debris, dust, dirt, and pollutants that can accumulate in channels and urban impervious areas entering the recharge basins, thus minimizing maintenance. Such an event is referred to as a first flush opportunity. The rate of accumulation of debris and pollutants can vary depending on the area tributary to each basin. According to Andy Campbell of IEUA, this is accomplished by closing inlet gates to the recharge basins for the first two hours of a storm occurring 30 days after any previous storm event. Though this first flush clears excess debris and minimizes the cost of maintenance, it is also a lost recharge opportunity.

Recharge opportunity lost as a result of bypassing the first flush was evaluated by estimating the associated losses that occur in the San Antonio Creek system. This evaluation was based on streamflow measured at the Riverside Dr. gage, excluding contributions from OC-59 releases, as described above (the gage location is also mapped in Figure 5-18). Measurements reported using this gage were used because historic flow measurements taken at 15 minute intervals are readily available from December 1998 through the present. The methodology described above was used to estimate flow available at the Montclair Basins based on flow measured at the Riverside Dr. gage.

The SBCFCD uses the period of October 15th through April 15th to evaluate storm seasons. However, according to Mr. Campbell, if a storm event occurs outside of this period the runoff is still captured for recharge. Accordingly, a first flush opportunity occurring at any point during the year was evaluated. The daily average flows reported at the Riverside Dr. gage were analyzed to identify the events. A total of 32 first flush opportunities were identified at the Riverside Dr. gage from December 1998 through September 2008, as shown in Table 5-11.

However, as described above, the diversion data used to estimate flow available at the Montclair Basins is only available from April 2005 through June 2009 and releases from OC-59 were only available through September 2008. A total of 14 first flush opportunities were identified and evaluated during this period.

For each storm identified, the total flow measured at the Riverside Dr. gage for the first two hours was calculated. The ratio of reported daily and reported 2-hour discharge measured for these events was then used to calculate the potential 2-hour discharge at the Montclair Basins. This amount was then used to estimate the potential recharge opportunity lost by foregoing the first flush. As indicated in Table 5-12 and Figure 5-16, two to four first flush bypass opportunities typically occur each water year.

The estimated average first flush discharge foregone in each water year, estimated based on 2-hour discharge, is about 8.6 acre-ft per event. The corresponding average water year total discharge foregone is about 37.7 acre-ft. The average daily discharge available at the Montclair Basins occurring on the day of a first flush opportunity is about 26.1 acre-ft, with a corresponding average water year total of 106.7 acre-ft (see Figure 5-17).

An evaluation of the aforementioned modeled daily runoff on San Antonio Creek provided by WEI, yields similar results. From water year 1950 through 2006, there was an average of nearly 3 first flush opportunities per year. Each event produced an average of about 20 acre-ft of runoff for the day, with a corresponding average water year total of about 54 acre-ft (Table 5-13). If the first flush is limited to the first 2-hours of each event, the foregone runoff would likely be much less than 20 acre-ft per opportunity.

The first flush bypass practice not only minimizes maintenance of basins by clearing silt, pollutants, and other small debris, but it also helps to clear large debris as well. It is not uncommon to find branches, even shopping carts and appliances, in the channels. An immeasurable amount of recharge opportunity would be lost if such debris were allowed to clog drop inlets. The evaluation suggests that discontinuing the first flush bypass likely will not create a significant enough increase in recharge opportunity to offset the advantages of continuing the practice.

5.4 Reconnaissance Level Evaluation of Improvements to Potential Storm Water Recharge

Potential alternative projects were identified and evaluated where a large amount of storm water runoff is not currently fully captured for recharge. Estimates of annual uncaptured runoff measured on San Antonio Creek at Riverside Dr. near Chino, CA (excluding contributions from OC-59 releases) averages about 6,300 acre-ft for complete water years from 1999 through 2008. Similarly, the gage on Cucamonga Creek near Mira Loma measures an average of nearly 40,000 acre-ft of water that is un-captured each year (water years 1986 through 2008). Flow measured on Cucamonga Creek includes treated effluent from IEUA's

RP-1. See Figure 5-18 for locations of the gages.

Potential projects in the San Antonio, Cucamonga, Day, San Sevaine, and Declez Creek systems were identified for evaluation to determine if the proposed project could capture a greater portion of the currently uncaptured flow. The preliminary project concept involves the diversion and storage of storm water during the wet season and pumping the stored water to existing recharge basins in the dry season. In the San Antonio Creek system, we evaluated the benefit of a hypothetical off-channel storage reservoir that would be located near the Riverside Dr. Gage. In the Cucamonga Creek system we evaluated the possibility of enhancing the Lower Cucamonga and Chris Basins. Similarly, in the Day, San Sevaine, and Declez systems we evaluated the possibility of enhancing the Wineville, Jurupa, and RP3 Basins.

The following are general proposed operations for the enhanced Lower Cucamonga/Chris, Wineville, and Jurupa Basins:

- Divert storm water runoff from channel.
    - Winter - flows diverted and stored in reservoir.
    - Summer - Stored water and real-time Creek flows pumped to existing recharge basins (and potentially to other seasonal storage sites) via new transfer pump stations and pipelines.

5.4.1 Potential Stream System Improvements

5.4.1.1 San Antonio Creek System

On the San Antonio Creek we evaluated options for a potential off-channel seasonal storage reservoir near the location of the USGS gage at Riverside Dr. Runoff from San Antonio Creek would be diverted when available throughout the year and pumped upstream to be recharged in the dry season at Brooks, Montclair, Upland, or College Heights basins. See Figure 5-19 for a conceptual schematic of the off-channel storage reservoir project.

A preliminary evaluation was completed for potential off-channel reservoir capacities of 1,000, 3,000, 5,000, and 10,000 for capturing runoff from San Antonio Creek near the Riverside Dr. gage. For each potential reservoir storage capacity, we evaluated a range of embankment heights above existing ground. Potential embankment heights range from 10 feet to 40 feet above existing ground. Assumptions made for the evaluation of off-channel storage reservoir options are described below.

- Annual un-captured runoff measured at the Riverside Dr. gage on San Antonio Creek (excluding contributions from OC-59 releases) averaged about 6,300 acre-ft for complete water years during the period of 1999 through 2008 (see Figure 5-20).
    - Includes a peak annual runoff of 21,604 acre-ft in 2005.
    - Winter season average = 5,286 acre-ft.

  - Summer season average = 1,034 acre-ft.

- Operational Overview
  - Divert flow from San Antonio Creek near gage site to off-stream storage reservoir.
  - Winter - flows diverted and stored in reservoir.
  - Summer - Stored water and real-time Creek flows pumped to existing recharge basins via new transfer pump station and pipeline.

- Project Facilities
  - Intake and diversion pump station, assume capacity = 200 cfs. This capacity is based on an evaluation of historic daily runoff measured at the gage. A diversion capacity of 200 cfs could potentially capture over 99% of the flow measured at the gage. Pump size varies depending on embankment height.
  - Diversion pipelines (Creek to reservoir) - assume 4 – 42" diameter, length = 200 feet each.
  - Off-stream storage reservoir – evaluated storage capacity options of 1,000, 3,000, 5,000, 7,000, and 10,000 acre-ft. Assumed a simple square shaped design.
  - Transfer pump station size varies depending on runoff stored and pumped to recharge basins. Transfer pump and pipeline sizes are primarily dependent on the maximum real-time summer runoff to be transferred to recharge basins.
  - Transfer pipeline - length = 6 miles, route parallels San Antonio Creek.

5.4.1.2 Cucamonga Creek System

We evaluated the potential enhancement of the existing Lower Cucamonga and Chris Basins in order to potentially operate them to store available runoff from the Cucamonga Creek and recharge the water in a manner similar to the aforementioned proposed operation on San Antonio Creek. The existing basins have poor infiltration. However, these sites have the advantage of already being owned by SBCFCD and CBWCD, and could potentially be enhanced by excavating soil from on-site to construct embankments and increase the storage capacities.

Four potential enhancement configuration options were evaluated. See Figure 5-21 for the layout of each option. For Option 1, the potential basins were combined into East and West Basins, with the Cucamonga Creek Channel running between them. The potential basins attempt to maximize the use of the existing area currently occupied by Lower Cucamonga and Chris Basins. Option 2 consists of the West Basin the same as Option 1; however the East Basin is expanded to include an adjacent property that could potentially be acquired. Option 3 assumes that the East and West Basins as laid out in Option 1 could be combined into one large basin with the Cucamonga Creek flowing through the basin. Lastly, Option 4 assumes that the East and West Basins as laid out in Option 2 could be combined into one large basin.

For simplicity, earthwork calculations were completed assuming the existing ground is flat. Accordingly, calculated cost estimates are conservative. Similar to the evaluation of off-channel storage reservoirs near San Antonio Creek, the potential reservoirs were evaluated based on a range of potential embankment heights. The basin options range from embankment heights of 10 feet to 40 feet when feasible. Details for the evaluation of Lower Cucamonga and Chris enhancement options are described below.

- Annual un-captured runoff measured at the Mira Loma gage on Cucamonga Creek which is located about 2-miles south of the Cucamonga and Chris Basins, averaged about 39,200 acre-ft for water years during the period of 1986 through 2008 (see Figure 5-22).
  - Includes a peak annual runoff of 99,509 acre-ft in 2005.
  - Winter season average = 25,091 acre-ft.
  - Summer season average = 14,146 acre-ft.

Flow measured at the Mira Loma gage includes treated effluent from IEUA's RP-1. Further evaluation may be required to determine if the inclusion of the treated effluent would limit the opportunity to recharge at this location. It is possible that treated effluent may be sufficiently diluted during the wet winter months.

5.4.1.3 Day Creek System

In the Day Creek System we evaluated the possibility of enhancing the Wineville Basin. The enhancement assumes a rectangular shaped configuration attempting to maximize use of the existing property. Similar to the Lower Cucamonga/Chris site, for simplicity, earthwork calculations were completed assuming the existing ground is flat. Potential enhancements were evaluated based on a range of potential embankment heights ranging from 5 to 40 feet above existing ground. Details for the evaluation of Wineville Basin enhancement options are described below.

- Annual estimated runoff available at the Wineville Basin was modeled by WEI (see Figures 5-23 and 5-24).
  - Includes a peak daily runoff of 5,223 cfs.
  - Winter season average = 7,707 acre-ft.
  - Summer season average = 1,145 acre-ft.

5.4.1.4 San Sevaine System

The existing Jurupa Basin is currently about 40 feet deep from the pond bottom to the spillway. We evaluated the potential capacity increase and cost of earthwork if the existing shape at the dam crest were maintained and the basin excavated 25 and 50 feet deeper than current conditions. Details of the evaluation at Jurupa are as follows:

- Annual estimated runoff available at Jurupa Basin was modeled by WEI (see Figures 5-25 and 5-26).
    - Includes a peak daily runoff of 295 cfs.
    - Winter season average = 2,315 acre-ft.
    - Summer season average = 361 acre-ft.

5.4.1.5 Declez Creek System

The existing RP3 Basins are currently two collections of cells separated by a narrow piece of property. We evaluated two separate configuration options for the enhancement project at RP3 (see Figure 5-27). Option 1 enlarges the basins maintaining two separate reservoirs. Option 2 assumes that the piece of property between the cells could be acquired and one large basin could be constructed. For the RP3 Basin enhancements we evaluated the two greatest capacity options allowable by the limitations of the existing dimensions. Details of the evaluation at RP3 are as follows:

- Annual estimated runoff available in the Declez Channel at the RP3 Diversion was modeled by WEI (see Figures 5-28 and 5-29).
    - Includes a peak daily runoff of 489 cfs.
    - Winter season average = 1,108 acre-ft.
    - Summer season average = 74 acre-ft.

5.4.2 Estimated Recharge for Potential Stream System Improvements

5.4.2.1 San Antonio Creek System

For these reconnaissance level evaluations, yield for each choice of reservoir size was estimated based on available runoff measured at the Riverside Dr. gage. During the wet season it was assumed that the entire reported runoff available at the gage from October through March of each year could be captured, with a maximum diversion equal to the capacity of the reservoir. Runoff during this period measuring an amount greater than the capacity of the reservoir is assumed to be foregone. During the dry season it was assumed that runoff being stored from the wet season could be transferred to existing recharge basins upstream at a high enough rate to allow for enough capacity to capture any summer flows. Just as during the wet season, measured runoff accumulating during the dry season (April through September) in excess of the capacity of the reservoir is assumed uncapturable.

Estimated annual yield for each reservoir capacity scenario is assumed to be the total capturable runoff occurring in each year less the estimated evaporation that would occur at three-quarter capacity. The estimated annual yield for each reservoir option is shown the below table.

Estimated Annual Yield for Off-Channel Storage Reservoir Scenarios

Embankment Height (ft)	Estimated Yield (acre-ft/yr)				
	1,000 acre-ft Reservoir	3,000 acre-ft Reservoir	5,000 acre-ft Reservoir	7,000 acre-ft Reservoir	10,000 acre-ft Reservoir
10	1,255	-	-	-	-
15	1,397	3,010	-	-	-
20	1,472	3,226	3,852	-	-
25	1,518	3,355	4,068	4,506	-
30	-	3,446	4,214	4,712	5,052
35	-	3,512	4,323	4,858	5,262
40	-	3,568	4,405	4,972	5,421

5.4.2.2 Cucamonga Creek System

For reconnaissance level evaluation of the potential yield of diversions from Cucamonga Creek to Lower Cucamonga and Chris Basin locations, the yield is assumed to be at least equal to the estimated capacity of the reservoir due to the high rate of runoff measured at the Mira Loma gage. The estimated capacities for enhanced Lower Cucamonga and Chris Basins are shown in the below table.

Estimated Potential Capacity for
Enhanced Lower Cucamonga and Chris Basin Options
(values in acre-ft)

Embankment Height (ft)	Option 1		Option 2		Option 3	Option 4
	West Basin	East Basin	West Basin	East Basin		
10	374	329	374	638	787	1,096
15	554	488	554	950	1,173	1,634
20	734	-	734	1,258	1,552	2,169
25	917	-	917	1,563	1,930	2,698
30	-	-	-	1,865	2,305	3,221
35	-	-	-	2,169	2,681	3,743
40	-	-	-	2,479	3,060	4,262

5.4.2.3 Day Creek System

Similar to the enhancements at the Lower Cucamonga/Chris site, it is assumed that potential yield is most likely at least equal to the estimated capacity of the reservoir. The estimated capacities for enhanced Wineville Basin options are shown in the below table.

Estimated Potential Capacity for
Wineville Basin Enhancement Options

Embankment Height (ft)	Estimated Potential Capacity (acre-ft)
5	352
10	700
15	1,044
20	1,388
25	1,731
30	2,076
35	2,427
40	2,787

5.4.2.4 San Sevaine System

Potential yield for Jurupa Basin enhancements is estimated to be at least equal to the estimated capacity of the reservoir. The estimated capacities for enhanced Jurupa Basin options are shown in the below table.

Estimated Potential Capacity for
Jurupa Basin Enhancement Options

Cut Depth (ft)	Estimated Potential Capacity (acre-ft)
25	3,292
50	4,104

5.4.2.5 Declez Creek System

Potential yield for RP3 Basin enhancements is estimated to be at least equal to the estimated capacity of the reservoir. The estimated capacities for enhanced RP3 Basin options are shown in the below table.

Estimated Potential Capacity for
Enhanced RP3 Basin Options
(values in acre-ft)

Embankment Height (ft)	Option 1		Option 2
	North Basin	South Basin	
15	224	-	-
20	286	-	-
30	-	1,181	-
32	-	1,265	-
35	-	-	2,198
40	-	-	2,519

5.4.3 Implementation Barriers for Potential Stream System Improvements

5.4.3.1 San Antonio Creek System

Construction of such a project would require cooperation between CBWCD, Watermaster, IEUA and SBCFCD. The most obvious obstacle that would have to be overcome in order to construct an off-channel seasonal storage reservoir in the San Antonio Creek system would be the acquisition of the necessary property. Cost of acquiring land could vary greatly. Another barrier could be the availability of the appropriate easements for all related pipelines, pump stations, etc. Once the appropriate land and easements are available, and an actual project is identified an accurate estimate of yield and cost can be made.

5.4.3.2 Cucamonga Creek System

Enhancement of the Lower Cucamonga and Chris Basins would require cooperation between several entities as well. With cooperation from SBCFCD, this project would not have the same land acquisition barriers as the project in the San Antonio Creek System for Options 1 and 3. Options 2 and 4 would require acquisition of land adjacent to the existing basins. Appropriate land and easements would need to be available for the required pipeline alignments, pump stations, etc. necessary to transfer water from the new facility to existing recharge basins upstream for recharge.

Further study of the availability of RP-1 effluent for storage, transfer, and ultimately recharge would be required. Effluent is assumed to be diluted, and more likely available for recharge, during the wet season.

Additional implementation and project barriers for enhancement of the Cucamonga and Chris Basins are identified and discussed in Section 5.6.6.

5.4.3.3 Day and San Sevaine Creek Systems

With cooperation from the IEUA, the Wineville and Jurupa Basin projects would not have any land acquisition barriers. However, the appropriate land and easements would need to be available for the required pipeline alignments, pump stations, etc. necessary to transfer water from the new facility to existing recharge basins for recharge, or the transfer of water between potential seasonal storage facilities.

Additional implementation and project barriers for enhancement of the Wineville and Jurupa Basins are identified and discussed in Sections 5.6.1 & 5.6.3.

5.4.3.4 Declez Creek System

With cooperation from SBCFCD, the enhancement of RP3 Basin would not have land acquisition barriers for Option 1. Option 2 would require acquisition of a narrow strip of land between the north and south basins. Appropriate land and easements would need to be available for the required pipeline alignments, pump stations, etc. necessary to transfer water from the new facility to existing recharge basins upstream for recharge.

Additional implementation and project barriers for enhancement of the RP3 Basin are identified and discussed in Section 5.6.4.

5.4.4 Policy Changes

All proposed seasonal storage facility projects require sufficient capacity to be available in the upstream existing recharge basins. The off-channel seasonal storage facilities and the recharge basins would need to be operated in a way that would maximize recharge opportunity without encroaching on the existing operational rule curve limitations. It is possible that little change in the operation of the existing recharge basins would be required as water would be transferred from the proposed facilities during the dry season.

5.4.5 Review of Preliminary Evaluation of Stream System Improvements

Preliminary evaluation of local recharge facilities, in the form of LID BMPs, and their impact on estimated groundwater recharge is not conclusive. Further hydrologic analysis by WEI with the aid of its model should provide an estimate of recharge attributable to the LID BMPs.

Based on our preliminary conceptual project evaluations of regional facilities, some existing regional groundwater recharge facilities appear to be effective for the recharge of storm water runoff. Physically changing facilities or changing the operation of facilities likely would not efficiently increase storm water recharge opportunity. Such changes could potentially increase groundwater recharge, but likely at an expense that would outweigh the benefit. One exception might be the existing Turner Basins on Cucamonga Creek. It is estimated that a large amount of water is available for diversion at the Turner Basins. By reconfiguring inlets and changing operation in order to utilize more of the existing capacity up to the basin spillway, capturable storm water runoff could potentially be increased nearly 600 acre-ft/yr. These findings are encouraging and warrant further evaluation.

After preliminary evaluations of existing facilities, operations, and hydrology in the Chino Basin, it was determined that further investigation was warranted to identify cost effective projects that capture and recharge the currently uncapturable runoff that is accumulating to the channels downstream of existing recharge facilities. Such further evaluation of facilities that might enhance storm water recharge is provided in Sections 5.5 and 5.6.

5.5 Conceptual Regional Recharge Distribution System

Conceptual project components comprising the Recharge Distribution System were developed by the CBWCD and Watermaster and were presented by WEI on December 17, 2009 at a Watermaster Workshop. Conceptual project designs and cost estimates were prepared by CBWCD and conservation and recharge estimates were determined by WEI for each project components individually and as a system.

The system of conceptual project components involves improvement of existing facilities to enhance operation for recharge and development of new recharge facilities and distribution systems. The system components evaluated for the Recharge Distribution System includes the following:

- Improvements to Wineville Basin including a new gate structure on the discharge spillway.
- A pump station and conveyance pipeline from Wineville Basin to Jurupa Basin.
- Improvements to the Lower Day Basin inlet facilities.
- Improvements to Jurupa Basin including improved inlet facilities and capacity enlargement.
- Upgrades to the Jurupa pump station to increase diversion rates to RP3 Basin
- Improvements to RP3 Basin including improved inlet facilities and enlargement.
- Development of the Vulcan Pit as a storm water recharge facility.
- A new flow-through storm water detention basin, Lower Cucamonga Basin, at the lower portion of Cucamonga Creek.
- A pump station and conveyance pipeline from the new Lower Cucamonga Basin to Wineville Basin.
- Improvements to Declez Basin.
- A pump station and conveyance pipeline from Wineville Basin to regulatory storage tanks at the former Etiwanda Basin.
- A pump station and conveyance pipeline from the former Etiwanda Basin to regulatory storage at Hickory Basin.

- A pump station and conveyance pipeline from Hickory Basin to Victoria Basin for regulation and recharge.
- A pump station and conveyance pipeline from Hickory Basin to recharge storm water in Banana Basin.
- A pump station and conveyance pipeline system from the Victoria Basin to recharge storm water in the San Sevaine, Etiwanda Debris and Lower Day basins.
- A new flow through recharge basin, Lower San Sevaine Basin, on Etiwanda and San Sevaine Creek channels.

5.5.1 Existing Condition

Most existing recharge basins are located to the north, at higher elevations within the Chino Basin, typically where quarry pits existed in the past or where basins were built for peak flow attenuation to protect downstream areas. The lower basins that do exist have not been exploited for recharge because they generally have poor recharge capabilities. Recharge opportunities for many existing facilities are limited because while basins often fill to conservation capacity during storm events, the storm events are generally short in duration and do not afford replenishment of basin capacity. Storm water in excess of the capacity of the basins bypasses the facility and is lost. Similarly storm water collected in channels below the recharge facilities is also lost.

5.5.2 Evaluated Alternative

The regional Recharge Distribution System was conceived and conceptually designed to divert storm water at locations where flow is plentiful and diversion facilities exist and conveyed to recharge facilities when recharge opportunities allow. The system was evaluated at varying capacities, rates and configurations to determine overall net improvement to storm water recharge of Chino Basin.

The Recharge Distribution System has been evaluated to be developed in a series of five phases of system development ranging from improvements to inlets of existing facilities, to implementation of the full diversion, storage, and distribution network. Permutations will all be further optimized as additional project information and constraints are indentified. The five phases of project development are described in the below table and following sections.

Regional Recharge Distribution System
Development Phases

Phase	Description
I	Improvements to Existing Facilities
II	Partial South System Diversion and Distribution System Improvements and Development
III	Total South System Diversion, Distribution System, and Storage Improvements and Development
IV	Northern System Diversion, Distribution and Development
V	Complete System

5.5.3 Phase I Development

Phase I development of the Regional Recharge Distribution System involves improvements to existing facilities. These improvements involve modification of diversion inlets or discharge spillway structures of existing recharge facilities to allow greater diversion and storage of water naturally accruing to the facilities.

Phase I construction includes the installation of a pneumatic gate on the Wineville Basin spillway, improvements to the inlet for Lower Day, Jurupa and RP3 Basins, construction of inlet and discharge facilities into Vulcan Pit and operating the existing Jurupa pump station to transfer storm water to RP3 Basin. Facilities of Phase I development are mapped on Figure 5-30 and shown schematically on Figure 5-31.

5.5.3.1 Potential Recharge Increase

WEI estimated potential recharge, by simulating potential diversions to existing recharge facilities under Phase I development conditions. Results of the simulation are shown on the following table:

Regional Recharge Distribution System

Phase I - Recharge Conditions

(values in acre-ft)

Project	Project Component	Current Recharge	Potential Recharge	Potential Recharge Increase
Wineville Basin	Spillway Gate	346	3,474	3,128
Jurupa Basin	Inlet Improvements	596	200	-396
RP3 Basin	Inlet Improvements	244	2,655	2,411
Vulcan Pit	Inlet Improvements	0	1,077	1,077
Lower Day Basin	Inlet Improvements	601	2,070	1,469
Total		**1,787**	**9,476**	**7,689**

Total recharge of the system for Phase I development is up to 9,476 acre-ft and potential increase in recharge is estimated to be between 6,959 and 7,689 acre-ft depending on simulated recharge rates.

5.5.3.2 Potential Cost

Estimated costs for Phase I development projects are shown on the below table.

Regional Recharge Distribution System
Phase I - Estimated Cost

Project	Project Component	Component Cost
Wineville Basin	Spillway Gate	$5,990,000
Jurupa Basin	Inlet Improvements	$690,000
RP3 Basin	Inlet Improvements	$5,890,000
Vulcan Pit	Inlet Improvements	$2,446,000
Lower Day Basin	Inlet Improvements	$2,130,000
Total		**$17,146,000**

Annualized cost for Phase I development, estimated at 5-percent annual rate of interest for a period of 30 years, is about $1,115,000. This equates to an annual capital cost of $183 per acre-foot.

5.5.4 Phase II Development

Phase II development of the Regional Recharge Distribution System involves improvements to the existing facilities of the Phase I development and the development of a storm water distribution system in the southern area of Chino Basin. The distribution system includes construction of a pump station and about 2 miles of pipeline from Wineville Basin to Jurupa Basin, and upgrading of the pump station at Jurupa Basin to increase its rate of discharge to RP3 Basin.

The new distribution system will allow additional water diverted from Day Creek in Wineville Basin to be recharge in the RP3 and Declez basins where recharge capacities are greater.

The southern basin distribution system and facilities of Phase II development are shown on Figure 5-32. The pipeline alignment from Wineville Basin to Jurupa Basin, depicted on Figure 5-32, is shown for distance and destination purposes only and does not indicate currently known or intended alignments. To the extent possible, the alignment follows Southern California Edison easements, existing roads, and flood control channels. Facilities are shown schematically on Figure 5-33.

5.5.4.1 Potential Recharge Increase

WEI estimated potential recharge, using their model, by simulating potential diversions to existing recharge facilities under Phase II development conditions. Results of the simulation are shown on the following table:

Regional Recharge Distribution System
Phase II - Recharge Conditions
(values in acre-ft)

Project	Project Component	Current Recharge	Potential Recharge	Potential Recharge Increase
Wineville Basin	Spillway Gate	346	2,425	2,079
Jurupa Basin	Inlet Improvements	596	344	-252
RP3 Basin	Inlet Improvements	244	3,926	3,682
Vulcan Pit	Inlet Improvements	0	1,077	1,077
Lower Day Basin	Inlet Improvements	601	2,070	1,469
Phase I Subtotal		**1,787**	**9,842**	**8,055**
Wineville Pump Station & Pipeline to Jurupa	20 cfs Diversion Rate	0	0	0
Jurupa Pump Station to RP3	40 cfs Diversion Rate	0	0	0
Phase II Subtotal		**0**	**0**	**0**[1]
Total		**1,787**	**9,842**	**8,055**

Note: 1) Recharge increase by Phase II project attributed to increase recharge realized at Phase I project basins.

Total recharge of the system for Phase II development is up to 9,842 acre-ft and potential increase in recharge is estimated to be between 7,298 and 8,055 acre-ft, depending on simulated recharge rates.

5.5.4.2 Potential Cost

Estimated costs for Phase II development projects are shown on the below table.

Regional Recharge Distribution System
Phase II - Estimated Cost

Project	Project Component	Component Cost
Wineville Basin	Spillway Gate	$5,990,000
Jurupa Basin	Inlet Improvements	$690,000
RP3 Basin	Inlet Improvements	$5,890,000
Vulcan Pit	Inlet Improvements	$2,446,000
Lower Day Basin	Inlet Improvements	$2,130,000
Phase I Subtotal		**$17,146,000**
Wineville Pump Station & Pipeline to Jurupa	20 cfs Diversion Rate	$9,119,000
Jurupa Pump Station to RP3	40 cfs Diversion Rate	$282,000
Phase II Subtotal		**$9,401,000**
Total		**$26,547,000**

Annualized cost for Phase II development, estimated at 5-percent annual rate of interest for a period of 30 years, is about $1,727,000. This equates to an annual capital cost of $246 per acre-foot.

5.5.5 Phase III Development

Phase III development of the Regional Recharge Distribution System involves improvements to existing facilities of the Phase I and II developments, and also development of additional storage capacity in southern system by constructing Lower Cucamonga Basin; including a pump station and about 5-miles of pipeline to move water to Wineville Basin. The new Lower Cucamonga Basin will enable diversion of storm flow from Cucamonga Creek that would otherwise be lost.

The southern basin distribution system and facilities of Phase III development are shown on Figure 5-34. Pipeline alignments depicted on Figure 5-34 are shown for distance and destination purposes only and do not indicate currently known or intended alignments. To the extent possible, alignments are shown to follow Southern California Edison easements, existing roads, and flood control channels. Facilities are shown schematically on Figure 5-35.

5.5.5.1 Potential Recharge Increase

WEI estimated potential recharge, using their model, by simulating potential diversions to existing recharge facilities under Phase III development conditions. Results of the simulation are shown on the following table:

Regional Recharge Distribution System

Phase III - Recharge Conditions

(values in acre-ft)

Project	Project Component	Current Recharge	Potential Recharge	Potential Recharge Increase
Wineville Basin	Spillway Gate	346	2,425	2,079
Jurupa Basin	Inlet Improvements	596	344	-252
RP3 Basin	Inlet Improvements	244	7,132	6,888
Vulcan Pit	Inlet Improvements	0	1,077	1,077
Lower Day Basin	Inlet Improvements	601	2,070	1,469
Phase I Subtotal		**1,787**	**13,048**	**11,261**
Wineville Pump Station & Pipeline to Jurupa	20 cfs Diversion Rate	0	0	0
Jurupa Pump Station to RP3	40 cfs Diversion Rate	0	0	0
Phase II Subtotal		**0**	**0**	**0**[1]
Lower Cucamonga Basin	Construct Basin	0	0	0
Lower Cucamonga Pump Station & Pipeline to Wineville	20 cfs Diversion Rate	0	0	0
Phase III Subtotal		**0**	**0**	**0**[1]
Total		**1,787**	**13,048**	**11,261**

Note: 1) Recharge increase by Phase II & III projects attributed to increase recharge realized at Phase I project basins.

Total recharge of the system for Phase III development is up to 13,048 acre-ft and potential increase in recharge is estimated to be between 10,504 and 11,261 acre-ft depending on simulated recharge rates.

5.5.5.2 Potential Cost

Estimated costs for Phase III development projects are shown on the below table.

Regional Recharge Distribution System
Phase III - Estimated Cost

Project	Project Component	Component Cost
Wineville Basin	Spillway Gate	$5,990,000
Jurupa Basin	Inlet Improvements	$690,000
RP3 Basin	Inlet Improvements	$5,890,000
Vulcan Pit	Inlet Improvements	$2,446,000
Lower Day Basin	Inlet Improvements	$2,130,000
Phase I Subtotal		**$17,146,000**
Wineville Pump Station & Pipeline to Jurupa	20 cfs Diversion Rate	$9,119,000
Jurupa Pump Station to RP3	40 cfs Diversion Rate	$282,000
Phase II Subtotal		**$9,401,000**
Lower Cucamonga Basin	Construct Basin	$21,060,000
Lower Cucamonga Pump Station & Pipeline to Wineville	20 cfs Diversion Rate	$16,717,000
Phase III Subtotal		**$37,777,000**
Total		**$64,324,000**

Annualized cost for Phase III development, estimated at 5-percent annual rate of interest for a period of 30 years, is about $4,184,000. This equates to an annual capital cost of $519 per acre-foot.

5.5.6 Phase IV Development

Phase IV development of the Regional Recharge Distribution System involves improvements to existing facilities of the Phase I, II and III developments in addition to development of the recharge distribution system to basins in the northern and upper end of Chino Basin. Completion of the distribution system to the north involves construction of four pump stations, two regulatory reservoirs, and about 13-miles of pipeline between Wineville Basin and the existing recharge basins to the north.

The complete recharge distribution system will enable water diverted in Lower Cucamonga Basin to be pumped to Wineville Basin where it will be re-diverted to Jurupa Basin and also up to Victoria Basin for recharge and redistribution to Lower Day, Etiwanda Debris, and San Sevaine basins. Movement of water up to Victoria Basin from Wineville Basin is anticipated to require two intermediate pumping stations and regulatory reservoirs to overcome the approximate 450-feet of elevation gain between Wineville and Victoria basins. These regulatory storage facilities have been preliminarily located at existing or former recharge facilities where either existing basins will be improved or a steel storage tank will be constructed.

Conveyance pipelines between Lower Cucamonga and Victoria Basin are sized to accommodate flow rates modeled by WEI which vary between 10 and 40 cfs. Pipelines from Victoria and Hickory basins to end use recharge facilities are sized in accordance to the maximum recharge rate of the facility.

The complete distribution system is shown on Figure 5-36. The pipeline alignments depicted on Figure 5-36 are shown for distance and destination purposes only and do not indicate currently known or intended alignments. To the extent possible, alignments are shown to follow Southern California Edison easements, existing roads, and flood control channels. Facilities are shown schematically on Figure 5-37.

5.5.6.1 Potential Recharge Increase

WEI estimated potential recharge, using their model, by simulating potential diversions to existing recharge facilities under Phase IV development conditions. Increase in recharge is shown in the below table.

Regional Recharge Distribution System

Phase IV - Recharge Conditions

(values in acre-ft)

Project	Project Component	Current Recharge	Potential Recharge	Potential Recharge Increase
Wineville Basin	Spillway Gate	346	1,875	1,529
Jurupa Basin	Inlet Improvements	596	288	-308
RP3 Basin	Inlet Improvements	244	3,054	2,810
Vulcan Pit	Inlet Improvements	0	1,077	1,077
Lower Day Basin	Inlet Improvements	601	2,070	1,469
Phase I Subtotal		**1,787**	**8,364**	**6,577**
Wineville Pump Station & Pipeline to Jurupa	20 cfs Diversion Rate	0	0	0
Jurupa Pump Station to RP3	40 cfs Diversion Rate	0	0	0
Phase II Subtotal		**0**	**0**	**0**[1]
Lower Cucamonga Basin	Construct Basin	0	0	0
Lower Cucamonga Pump Station & Pipeline to Wineville	20 cfs Diversion Rate	0	0	0
Phase III Subtotal		**0**	**0**	**0**[1]
Wineville Pump Station & Pipeline to Etiwanda	40 cfs Diversion Rate	0	0	0
Etiwanda Pump Station & Pipeline to Hickory	40 cfs Diversion Rate	228	230	2
Hickory Pump Station & Pipeline to Victoria	40 cfs Diversion Rate	739	1,551	812
Hickory Pump Station & Pipeline to Banana	6 cfs Diversion Rate	476	999	523
Victoria Pump Station & Pipeline to Lower Day	8 cfs Diversion Rate	0	259	259
Victoria Pump Station & Pipeline to Etiwanda Debris	7 cfs Diversion Rate	1,409	2,125	716
Victoria Pump Station & Pipeline to San Sevaine 1-4	27 cfs Diversion Rate	1,978	6,089	4,111
Victoria Pump Station & Pipeline to San Sevaine 5	17 cfs Diversion Rate	1,691	2,245	554
Phase IV Subtotal		**6,521**	**13,498**	**6,977**
Total		**8,308**	**21,862**	**13,554**

Note: 1) Recharge increase by Phase II & III projects attributed to increase recharge realized at Phase I and IV project basins.

Total recharge of the system for Phase IV development is up to 21,862 acre-ft and potential increase in recharge is estimated to be between 12,933 and 13,554 acre-ft depending on simulated recharge rates.

5.5.6.2 Potential Cost

Estimated costs for Phase IV development projects are shown on the below table.

Regional Recharge Distribution System
Phase IV - Estimated Cost

Project	Project Component	Component Cost
Wineville Basin	Spillway Gate	$5,990,000
Jurupa Basin	Inlet Improvements	$690,000
RP3 Basin	Inlet Improvements	$5,890,000
Vulcan Pit	Inlet Improvements	$2,446,000
Lower Day Basin	Inlet Improvements	$2,130,000
Phase I Subtotal		**$17,146,000**
Wineville Pump Station & Pipeline to Jurupa	20 cfs Diversion Rate	$9,119,000
Jurupa Pump Station to RP3	40 cfs Diversion Rate	$282,000
Phase II Subtotal		**$9,401,000**
Lower Cucamonga Basin	Construct Basin	$21,060,000
Lower Cucamonga Pump Station & Pipeline to Wineville	20 cfs Diversion Rate	$16,717,000
Phase III Subtotal		**$37,777,000**
Wineville Pump Station & Pipeline to Etiwanda	40 cfs Diversion Rate	$11,900,000
Etiwanda Pump Station & Pipeline to Hickory	40 cfs Diversion Rate	$19,216,000
Hickory Pump Station & Pipeline to Victoria	40 cfs Diversion Rate	$22,208,000
Hickory Pump Station & Pipeline to Banana	6 cfs Diversion Rate	$31,228,000
Victoria Pump Station & Pipeline to Lower Day	8 cfs Diversion Rate	
Victoria Pump Station & Pipeline to Etiwanda Debris	7 cfs Diversion Rate	
Victoria Pump Station & Pipeline to San Sevaine 1-4	27 cfs Diversion Rate	
Victoria Pump Station & Pipeline to San Sevaine 5	17 cfs Diversion Rate	
Phase IV Subtotal		**$84,552,000**
Total		**$148,876,000**

Annualized cost for Phase IV development, estimated at 5-percent annual rate of interest for a period of 30 years, is about $9,685,000. This equates to an annual capital cost of $736 per acre-foot.

5.5.7 Phase V Development

Phase V development of the Regional Recharge Distribution System involves improvements to existing facilities of the Phase I, II, III, and IV developments in addition to development of additional storage capacity in the system. Additional storage capacity is created through enlargement of Jurupa and RP3 basins, as well as the construction of Lower San Sevaine Basin.

Jurupa Basin modifications pursuant to the Option 2 alternative developed by Stantec Consulting Inc. (Stantec) include excavation and pumping station modifications. Modifications of RP3 Basin include and excavation and facility improvements. Additional storage in Jurupa and RP3 Basins will further increase the amount of storm water to be recharge in the RP3 and Declez basins. Construction of the new Lower San Sevaine Basin will develop about 600 acre-ft of storage capacity.

The complete system and facilities of Phase V development are shown on Figure 5-38. Pipeline alignments depicted on Figure 5-38 are shown for distance and destination purposes only and do not indicate currently known or intended alignments. To the extent possible, alignments are shown to follow Southern California Edison easements, existing roads, and flood control channels. Facilities are shown schematically on Figure 5-39.

5.5.7.1 Potential Recharge Increase

WEI estimated potential recharge, using their model, by simulating potential diversions to existing recharge facilities under Phase V development conditions. Increase in recharge is shown in the below table.

Regional Recharge Distribution System
Phase V - Recharge Conditions

(values in acre-ft)

Project	Project Component	Current Recharge	Potential Recharge	Potential Recharge Increase
Wineville Basin	Spillway Gate	346	1,875	1,529
Jurupa Basin	Inlet Improvements	596	169	-427
RP3 Basin	Inlet Improvements	244	3,054	2,810
Vulcan Pit	Inlet Improvements	0	1,077	1,077
Lower Day Basin	Inlet Improvements	601	2,070	1,469
Phase I Subtotal		**1,787**	**8,245**	**6,458**
Wineville Pump Station & Pipeline to Jurupa	20 cfs Diversion Rate	0	0	0
Jurupa Pump Station to RP3	40 cfs Diversion Rate	0	0	0
Phase II Subtotal		**0**	**0**	**0**[1]
Lower Cucamonga Basin	Construct Basin	0	0	0
Lower Cucamonga Pump Station & Pipeline to Wineville	20 cfs Diversion Rate	0	0	0
Phase III Subtotal		**0**	**0**	**0**[1]
Wineville Pump Station & Pipeline to Etiwanda	40 cfs Diversion Rate	0	0	0
Etiwanda Pump Station & Pipeline to Hickory	40 cfs Diversion Rate	228	230	2
Hickory Pump Station & Pipeline to Victoria	40 cfs Diversion Rate	739	1,551	812
Hickory Pump Station & Pipeline to Banana	6 cfs Diversion Rate	476	999	523
Victoria Pump Station & Pipeline to Lower Day	8 cfs Diversion Rate	0	259	259
Victoria Pump Station & Pipeline to Etiwanda Debris	7 cfs Diversion Rate	1,409	2,125	716
Victoria Pump Station & Pipeline to San Sevaine 1-4	27 cfs Diversion Rate	1,978	6,089	4,111
Victoria Pump Station & Pipeline to San Sevaine 5	17 cfs Diversion Rate	1,691	2,245	554
Phase IV Subtotal		**6,521**	**13,498**	**6,977**
Lower San Sevaine Basin	Construct Basin	0	1,679	1,679
RP3 Basin	Basin Enlargement	-	738	738
Jurupa Basin	Basin Enlargement	-	0	0
Phase V Subtotal		**0**	**2,417**	**2,417**
Total		**8,308**	**24,160**	**15,852**

Note: 1) Recharge increase by Phase II & III projects attributed to increase recharge realized at Phase I and IV project basins.

Total recharge of the system for Phase V development is up to 24,160 acre-ft and potential increase in recharge is estimated to be between 14,539 and 15,852 acre-ft depending on simulated recharge rates.

5.5.7.2 Potential Cost

Estimated costs for Phase V development projects are shown on the below table.

Regional Recharge Distribution System
Phase V - Estimated Cost

Project	Project Component	Component Cost
Wineville Basin	Spillway Gate	$5,990,000
Jurupa Basin	Inlet Improvements	$690,000
RP3 Basin	Inlet Improvements	$5,890,000
Vulcan Pit	Inlet Improvements	$2,446,000
Lower Day Basin	Inlet Improvements	$2,130,000
Phase I Subtotal		**$17,146,000**
Wineville Pump Station & Pipeline to Jurupa	20 cfs Diversion Rate	$9,119,000
Jurupa Pump Station to RP3	40 cfs Diversion Rate	$282,000
Phase II Subtotal		**$9,401,000**
Lower Cucamonga Basin	Construct Basin	$21,060,000
Lower Cucamonga Pump Station & Pipeline to Wineville	20 cfs Diversion Rate	$16,717,000
Phase III Subtotal		**$37,777,000**
Wineville Pump Station & Pipeline to Etiwanda	40 cfs Diversion Rate	$11,900,000
Etiwanda Pump Station & Pipeline to Hickory	40 cfs Diversion Rate	$19,216,000
Hickory Pump Station & Pipeline to Victoria	40 cfs Diversion Rate	$22,208,000
Hickory Pump Station & Pipeline to Banana	6 cfs Diversion Rate	$31,228,000
Victoria Pump Station & Pipeline to Lower Day	8 cfs Diversion Rate	
Victoria Pump Station & Pipeline to Etiwanda Debris	7 cfs Diversion Rate	
Victoria Pump Station & Pipeline to San Sevaine 1-4	27 cfs Diversion Rate	
Victoria Pump Station & Pipeline to San Sevaine 5	17 cfs Diversion Rate	
Phase IV Subtotal		**$84,552,000**
Lower San Sevaine Basin	Construct Basin	$30,360,000
RP3 Basin	Basin Enlargement	$16,630,000
Jurupa Basin	Basin Enlargement	$20,270,000
Phase V Subtotal		**$67,260,000**
Total		**$216,136,000**

Annualized cost for Phase V development, estimated at 5-percent annual rate of interest for a period of 30 years, is about $14,060,000. This equates to an annual capital cost of $887 per acre-foot.

Considering the potential for the excavation of the Lower San Sevaine, RP3 and Jurupa Basins could be completed and compensated by lease agreements to surface mining operators, the cost for completing the Phase V work could be significantly reduced. Estimating that the cost could be reduced by about $66-million, the annualized cost for Phase V development is reduced to about $9,737,000 which equates to an annual capital cost of $614 per acre-foot.

5.5.8 Phased Development Discussion

The Recharge Distribution System is proposed and evaluated for development in a series of phases. The phasing of construction of the Recharge Distribution System is proposed for convenience of design and construction without any prioritization or rigorous cost to benefit analysis. The phasing of the system development was established by developing an order of construction with each component or phase building on the previous phase of work.

The following table summarizes the cost and the incremental increase recharge developed in the phase of Recharge Distribution System development.

Regional Recharge Distribution System
Summary of Cost and Recharge by Phase
(values in acre-ft)

Phase	Incremental Total Cost	Incremental Recharge Increase
I	$17,146,000	7,689
II	$9,401,000	366
III	$37,777,000	3,206
IV	$84,552,000	2,293
V	$67,260,000	2,298
Total	$216,136,000	15,852

The increase in cost to progress the development of the Recharge Distribution System from, for example, Phase II to Phase III is an additional $37,777,000 which nets an additional 3,206 acre-ft of recharge to the Chino Basin. The Phase III project could not be completed and obtain the estimated increase in recharge unless the Phase II project components are completed. The Phase II projects components, considering the relatively minimal amount of recharge increase, would probably not be completed unless Phase III project components were planned to be developed.

The increase in recharge developed by each phase is evaluated in the aggregate of all projects within the Chino Basin. The system is proposed and is modeled to move storm water to recharge facilities as capacity is available. Further optimization may improve recharge and reduce incremental costs.

5.5.9 Distribution Power Requirements and Cost

The cost to pump and move water as part of the Regional Recharge Distribution System is estimated based on a rate of $0.14 per kwh as provided in the 2010 Recharge Master Plan Update Technical Memorandum, Task 3 Planning Criteria, prepared by Black & Veatch and WEI dated March 19, 2009. Annual power costs for distributing increased storm water for recharge, determined by estimating the power required to move the storm water at the maximum rate simulated by WEI, are shown in the below table.

Regional Recharge Distribution System
Annual Energy Cost

Phase	Total Horsepower Required	Annual Energy Cost
I	300	$63,000
II	905	$382,000
III	1,700	$769,000
IV	6,850	$4,038,000
V	6,850	$4,038,000

5.5.10 Operation and Maintenance Costs

The cost attributable to annual Operation and Maintenance (O&M) of the Regional Recharge Distribution System has been estimated at a rate of $50 per acre-foot of total recharge. Annual O&M costs for each phase of development are shown in the below table.

Regional Recharge Distribution System
Operation and Maintenance Cost

Phase	Total Recharge	Annual O&M Cost
I	9,476	$473,800
II	9,842	$492,100
III	13,048	$652,400
IV	21,862	$1,093,100
V	24,160	$1,208,000

5.5.11 Total Annualized Cost

The annualized cost of the Regional Recharge Distribution System including project construction, energy and O&M costs is shown in the below table. Phase Vb is provided for discussion proposes to demonstrate the possible effect of removing the cost of excavation, approximately $66-million, for additional storage capacity of RP3, San Sevaine and Jurupa Basins. The concept is that the excavation could be performed as part of a lease agreement with a surface mining operation or similar.

Regional Recharge Distribution System
Total Cost

Phase	Total Recharge Increase	Annual Cost	Cost /AF Recharge
I	7,689	$1,651,800	$215
II	8,055	$2,601,100	$323
III	11,261	$5,605,400	$498
IV	13,554	$14,816,100	$1,093
V	15,852	$19,306,000	$1,218
Vb	15,852	$14,962,000	$944

The range of realized recharge and cost of the Regional Recharge Distribution System (including additional contingencies) will vary depending on basin maintenance and variations in annual costs. To estimate the range of costs for each phase of development we applied a reduction factor of 25 percent to recharge values and a 15 percent increase to annual cost values. Estimated realized costs of recharge developed at each level of development, based on the aforementioned contingency factors, are shown in the below table.

Regional Recharge Distribution System
Range of Realized Recharge and Total Cost

Phase	Realized Recharge Decrease 25%	Realized Annual Cost Increase 15%	Cost /AF Recharge
I	5,767 - 7,689	$1,651,800 - $1,899,600	$215 - $329
II	6,041 - 8,055	$2,601,100 – $2,991,300	$323 - $495
III	8,446 - 11,261	$5,605,400 – $6,446,200	$498 - $763
IV	10,166 - 13,554	$14,816,100 – $17,038,500	$1,093 - $1,676
V	11,889 - 15,852	$19,306,000 – $22,201,900	$1,218 - $1,867
Vb	11,889 - 15,852	$14,962,000 – $17,206,300	$944 - $1,447

5.6 Potential Improvement Projects

5.6.1 Wineville Basin

5.6.1.1 Existing Condition

Wineville Basin is located on Day Creek and is essentially a flow-through flood control basin, designed for peak flood discharge attenuation. Both the primary inlet spillway and outlet spillway are not gated. There are four smaller drain inlets to the basin. The basin is roughly nine feet deep at the outlet spillway (the basin bottom elevation varies). Wineville Basin was evaluated for potential groundwater recharge use in 2000, but determined to not be viable due to shallow clay lenses. However, recent experience with Lower Day Basin revealed that the clay lenses may have resulted from mining activity on Day Creek and remediation may be possible to increase infiltration capacity.

5.6.1.2 Proposed Improvement Alternatives

- Install a pneumatic gate in the spillway of the existing basin. This alternative is described in Section 5.6.1.3.
- Excavate the interior basin to acquire additional storage capacity. Wineville Basin was preliminarily evaluated to increase storage capacity by excavating the interior basin 5, 15 and 25 feet below the original basin bottom elevation. Excavating the interior basin generates additional capacity, but it also requires modification and repairs of the inlet spillway, drain inlet energy dissipation and erosion protection facilities. Excavating the existing basin bottom 25 feet deeper would develop about 895 acre-ft of storage and require the export of over 1.4-million cubic yards of material. Alternatives involving excavation of Wineville Basin are potentially viable, albeit costly; however they have been removed from further evaluation primarily due to the efficiency of storage capacity gained by only adding a gate to the existing spillway and making any necessary changes to the embankment, as described in Section 5.6.1.3.

5.6.1.3 Evaluated Alternatives

The proposed Wineville Basin improvement project will operate as a multi-purpose facility operated for storm water detention, on-site groundwater recharge, and regulatory storage for the re-diversion of storm water to other recharge facilities. The primary element to the Wineville Basin project is construction and installation of a pneumatic gate in the existing spillway of the basin. Installation of a gate structure in the spillway will develop about 510 acre-ft of storage within the existing freeboard of the basin.

A pneumatic gate is a bladder actuated gate system that allows for the automatic level or flow control of water in the reservoir or over the gate structure. The pneumatic gate will monitor and self-adjust to maintain the reservoir water storage level or discharge over the gate structure in accordance with the logic programming that has been set to operate. For the Wineville Basin project, the primary mode of operation for the pneumatic gate will be to maintain a maximum reservoir water surface elevation while inflows into the basin from Day Creek or local storm water flows are occurring. The gate will automatically raise or lower (until the gate is flat with the spillway channel bottom if necessary) to maintain the set channel water surface elevation in the reservoir. The gate can also be manually lowered if necessary to evacuate all storage in the reservoir prior to storm events or other operational requirements. Details of the proposed project are shown in Figures 5-40 and 5-41.

The existing earth embankment structure will be evaluated and reconstructed to meet the requirements of a dam embankment under the jurisdiction of the State of California Department of Water Resources Division of Safety of Dams (DSOD). Embankment fills of height and capacity shown on Figure 5-42 are under the jurisdiction of the State of DSOD. Improvements to the dam structure may include excavation of the existing embankment to expose firm, undisturbed and stable material across the entire width and length of the embankment and excavation of a keyway or cutoff trench that will extend to an underlying impervious material, or to a depth considered adequate to prevent piping or seepage through the embankment. The dam embankment will be constructed at a typical slope of about 3:1 (H:V) on the upstream side and 2:1 (H:V) on the downstream side.

The existing basin bottom will be cleaned and graded to improve the recharge capacity of the basin and to allow the basin to better function as a distribution system for water being pumped to other recharge facilities.

Storm water accruing to Wineville Basin is proposed to be rediverted to Jurupa Basin and/or to other recharge facilities within Chino Basin for recharge. A pump station will be constructed with conveyance pipelines extending from Wineville Basin to Jurupa and/or towards other recharge facilities (see Figure 5-43). This system is described in Section 5.5.

Additional conceptual level investigations and evaluations will be required to verify the project design and determine if or how the project will be required to be modified to address issues that arise. The following is a preliminary list of items that are known at this time that will require further review.

- Evaluate affects of the proposed project to the hydraulics of the existing drain inlets and inlet channels.
- Evaluate operation and maintenance procedures to determine facility requirements for periodic dewatering and cleaning of the basin.
- Review and evaluate project operations during design storm events with SBCFCD.
- Review and evaluate known environmental concerns with SBCFCD.

Review and evaluate project operations and maintenance waste discharge requirements of storm water discharges from MS4 for compliance with Tentative Order No. R8-2009-0036 from the California Regional Water Quality Control Board, Santa Ana Region, NPDES Permit and Waste Discharge Requirements for SBCFCD, et al., Area-Wide Urban Storm Water Runoff Management Program.

5.6.1.3.1 Potential Recharge Increase

Potential recharge at Wineville Basin was modeled by WEI according to varying potential diversion rates and varying potential infiltration rates resulting from basin improvements. Diversions from Wineville could vary from 10 to 30 cfs. Results of the WEI simulation are shown in the below table.

Potential Increased Storm Water Recharge
Wineville Basin

(values in acre-ft)

Alternative	Current Recharge	Potential Recharge	Potential Increase in Recharge
0.25 ft/day Infiltration	176	2,597	2,421
0.50 ft/day Infiltration	346	3,474	3,128

5.6.1.3.2 Potential Cost

The estimated cost for construction of Wineville Basin is shown on the below table. A discussion of the development of project cost items is provided in Section 5.6.11. Cost of basin cleaning and contouring can be significantly reduced or offset if material excavated for the project can be used for other purposes such as in conjunction with another construction project that requires imported borrow material.

Cost Estimate for Conceptual Project Evaluation of Wineville Basin

	Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs					
1	Mobilization @ 3% Other Direct Construction Cost	1	Job	Lump Sum	$127,000
2	Compacted Embankment				
	Foundation Excavation	122,000	Cu. Yds.	$3.00	$366,000
	Compacted Embankment	122,000	Cu. Yds.	$6.00	$732,000
3	Basin Spillway/Discharge Structure				
	Spillway Gate	1	Job	$720,000	$720,000
	Concrete/Building Components	1	Job	$1,038,000	$1,038,000
4	Basin Cleaning and Contouring				
	Basin Excavation	110,000	Cu. Yds.	$12.50	$1,375,000
	Subtotal Direct Construction				**$4,358,000**
	Contingency @ 25%				**$1,089,500**
	Total Construction				**$5,447,500**
Engineering and Administration Costs					
	Engineering, Construction Inspection and Contract Admin. @ 10%				$545,000
	Total Engineering and Administration				**$545,000**
Total Estimated Cost					**$5,992,500**
Total Estimated Cost - Rounded					**$5,990,000**
Annual Cost - 30 Years @ 5% Interest					**$389,800**

5.6.1.3.3 Discussion

Preliminary evaluation of recharge efficiency of the project indicates that the project is efficient in diversion of additional water for recharge and for diversion export to other recharge facilities. At an estimated annual cost of about $390,000, the facility could capture for recharge, and/or diversion, an additional 2,421 to 3,128 acre-ft of water annually. This equates to an annualized cost between $125 and $161 per acre-foot.

5.6.2 Lower Day Basin

5.6.2.1 Existing Condition

Lower Day Basin is located on the western side of the Day Creek channel and is currently operated as a multi-purpose facility serving first as a flood control facility and secondarily for recharge of storm and supplemental water. The basin is divided into three cells and can receive water from the Day Creek channel for recharge during low-flow events by means of an existing rubber dam diversion structure and pipe conduit. The basin also receives inflow from a side channel overflow weir for flood control operation.

5.6.2.2 Proposed Improvement Activities

- Modify the existing diversion intake structure and install pneumatic gates in the channel. This alternative is described in Section 5.6.2.3.
- Enlarge the existing Lower Day Basin by excavating the area currently held by the local storm water detention basin. Excavating the basin would develop about 158 acre-ft of additional storage however, would require removal of over 1.1 million cubic yards of material. Cost of this excavation with the relatively minor amount of storage obtained provided reasonable justification to drop the concept from further evaluation.

5.6.2.3 Evaluated Alternatives

The proposed Lower Day Basin project will function as a modified flow-through basin through modification of the existing diversion and inlet channel structure and installation of pneumatic gates both in the Day Creek channel and the diversion channel. The diversion and inlet channel will be modified by removing the side-channel overflow weir wall and reshaping of the channel bottom to direct low and moderate level flows into the diversion channel and thence into the basin. Gate structures will provide the capability to fully adjust diversion rates through the diversion and Day Creek channels. Details of the proposed project are shown in Figures 5-44 and 5-45.

The pneumatic gate will monitor and self-adjust to maintain a water level or rate of discharge over the gate structure in accordance with logic programming that has been set to operate. For the Lower Day Basin, the gate in the Day Creek channel will function to impede water flowing through the channel so that it can be diverted through the existing diversion channel into Lower Day Basin. Gates will automatically raise or lower (until the gate is flat with the channel bottom if necessary) to maintain the set channel water surface elevation. The gate structure in the diversion channel will function to control the rate of diversion into the basin. If the basin is filled to capacity, the gate will function to allow only enough water into the facility to keep the basin full. Discussions with the gate manufacture and review of test results provided by the gate manufacturer indicate that a pneumatic gate will perform adequately as proposed in the Day Creek channel (see Figure 5-46).

The existing earth embankment structure will be evaluated and reconstructed to meet the requirements of a dam embankment under the jurisdiction of the DSOD. Embankment fills of sufficient height and capacity are under the jurisdiction of DSOD. Improvements to the dam structure may include excavation of the existing embankment to expose firm, undisturbed and stable material across the entire width and length of the embankment and excavation of a keyway or cutoff trench that will extend to an underlying impervious material, or to a depth considered adequate to prevent piping or seepage through the embankment.

The dam embankment will be constructed at a typical slope of about 3:1 (H:V) on the upstream side and 2:1 (H:V) on the downstream side.

Lower Day Basin is also proposed to receive water diverted at other diversion facilities, such as Lower Cucamonga and Wineville Basins for recharge as part of the regional recharge distribution system as was described in Section 5.5.

Additional conceptual level investigations and evaluations will be required to verify the project design and determine if or how the project will be required to be modified to address issues that arise. The following is a preliminary list of items that are known at this time that will require further review.

- SCE should be consulted to discuss the project's encroachment into the existing SCE easement.
- Site specific analysis and modeling of the project to verify hydraulic constraints of existing and proposed facilities.
- Evaluate the existing outlet conduit to determine if modification will be required. (SCADA will most likely be necessary)
- Evaluate operation and maintenance procedures to determine facility requirements for periodic dewatering and cleaning of the basin.
- Review and evaluate project operations during design storm events with SBCFCD.
- Further review and evaluate performance of gate structure in high-energy channel installation with gate manufacturer.
- Review and evaluate project operations and maintenance waste discharge requirements of storm water discharges from MS4 for compliance with Tentative Order No. R8-2009-0036 from the California Regional Water Quality Control Board, Santa Ana Region, NPDES Permit and Waste Discharge Requirements for SBCFCD, et al., Area-Wide Urban Storm Water Runoff Management Program.

5.6.2.3.1 Potential Recharge Increase

The potential increase of storm water recharge resulting from improvements to Lower Day, as estimated by WEI, is as follows:

Potential Increased Storm Water Recharge
Lower Day Basin
(values in acre-ft)

Current Recharge	Potential Recharge with Inlet Improvement	Potential Increase in Recharge with Inlet Improvement
601	2,070	1,469

5.6.2.3.2 Potential Cost

The estimated cost for construction of Lower Day Basin is shown on the below table. A discussion of the development of project cost items is provided in Section 5.6.11.

Cost Estimate for Conceptual Project Evaluation of Lower Day Basin

Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs				
1 Mobilization	1	Job	Lump Sum	$45,000
2 Compacted Embankment				
Foundation Excavation	72,000	Cu. Yds.	$3.00	$216,000
Compacted Embankment	72,000	Cu. Yds.	$6.00	$432,000
3 Day Creek Channel Modification				
Channel Demolition	400	Cu. Yds.	$55.00	$22,000
Gate	1	Job	$144,000	$144,000
Gate Structure	1	Job	$165,000	$165,000
4 Basin Diversion Channel Inlet				
Gate	1	Job	$144,000	$144,000
Gate Structure	1	Job	$378,000	$378,000
Subtotal Direct Construction				**$1,546,000**
Contingency @ 25%				**$386,500**
Total Construction				**$1,932,500**
Engineering and Administration Costs				
Engineering, Construction Inspection and Contract Admin. @ 10%				$193,000
Total Engineering and Administration				**$193,000**
Total Estimated Cost				**$2,125,500**
Total Estimated Cost - Rounded				**$2,130,000**
Annual Cost - 30 Years @ 5% Interest				**$138,300**

5.6.2.3.3 Discussion

Preliminary evaluation of recharge efficiency of the project indicates that the project is relatively efficient in diversion of additional water for recharge. Improvements to the diversion structure as proposed will increase capture about 1,469 acre-ft of water annually at an annualized cost of about $138,300 or about $95 an acre-foot.

5.6.3 Jurupa Basin

5.6.3.1 Existing Condition

Jurupa is a flood control basin adjacent to San Sevaine Creek channel in Fontana, CA. Jurupa is designed for peak flood discharge attenuation. Flows are diverted into the basin through an overflow side channel weir. Imported and recycled water can also be transferred to Jurupa through a low flow diversion culvert. Jurupa has been evaluated and found to have limited groundwater recharge potential as a result of poor infiltration capacity.

5.6.3.2 Proposed Improvement Alternatives

An analysis was conducted by Stantec and preliminary results were reported in their October 28, 2009 draft study. The Stantec study identified conceptual improvements to the San Sevaine Creek channel and Jurupa Basin in order to increase both the rate of water diverted from the creek and the amount of water stored for groundwater recharge in Jurupa. Options Stantec reviewed included the following:

- Construction of a drop inlet in San Sevaine Creek Channel.
- Construction of a rubber dam in San Sevaine Creek Channel.
- Creation of additional conservation storage in Jurupa Basin.

5.6.3.3 Evaluated Alternatives

Evaluated alternatives reported by Stantec are as follows:

Creation of conservation storage within Jurupa Basin is proposed as a feasible approach to meeting storm water capture/storage objectives. Two options have been developed conceptually including:

- Option 1 – Excavate the existing basin about 9 feet with a typical side slope 5:1 (H:V) would add approximately 300 acre-ft of additional storage. Limits of excavation will be offset from existing embankments at least 100-feet except at the north embankment where the existing low-flow delivery channel for the pump station is located and at the existing conservation dike. The minimum basin invert for the water conservation pool is set by the elevation at the inlet to the existing pump station wet well. The pump station is currently capable of lifting approximately 20 cfs corresponding to an approximate drawdown time with no infiltration or inflow of 8 days.
- Option 2 – Excavate the existing basin about 29 feet with a typical side slope 5:1 (H:V). This will add approximately 685 acre-ft of additional conservation storage. Limits of excavation will be offset from existing embankments at least 100-feet except at the north embankment where the existing low-flow delivery channel for the pump station is located and at the existing conservation dike. The proposed basin invert for the water conservation pool will require a lift station in order to deliver water to the existing pump station wet well. The flow rate for the additional lift station is assumed to match the existing pump station (20 cfs) and the approximate drawdown time with no infiltration or inflow is 17 days assuming a pumping rate of 20 cfs.

Conceptual improvements to increase the diversion rates are as follows:

- Drop Inlet – Construct a drop inlet located upstream of the existing low flow diversion turnout in order to take advantage of the elevation difference between the main line channel and adjacent diversion channel. The entire mainline channel and a portion of the diversion channel would be demolished in order to construct the drop inlet.

- Rubber Dam – Construct a rubber dam located downstream of the existing low flow diversion turnout, providing additional headwater at the existing turnout and thus an increased diversion rate. A portion of the easterly mainline channel sidewall and westerly diversion channel sidewall would be demolished in order to construct a new turnout adjacent to the rubber dam.

See Figure 5-47 for evaluated alternative schematic.

In previous analyses CBWCD evaluated the potential increase in storage in Jurupa Basin if the reservoir was excavated 25 or 50 feet deeper. The analyses determined that if the basin was excavated at a 3H:1V slope from the interior toe of the existing basin, about 1,930 acre-ft of additional storage would be developed by the 25 foot depth of excavation, and about 2,730 acre-ft would be developed by excavating 50 feet in depth. Excavation configurations were conceptual in nature however comparison between Stantec and CBWCD configurations show that the CBWCD configuration for the corresponding depth of excavation of 25 feet is 1,245 acre-ft greater in capacity increase than the Stantec configuration. This is due to differences in basin excavation criteria. Stantec included an offset from the interior basin toe of 100 feet, CBWCD had no offset; Stantec estimated excavated basin slopes at 5H:1V, CBWCD evaluated the basin at 3H:1V; Stantec included terracing of the excavation slopes when slope depths exceeded 30 feet per UBC requirements. CBWCD (for simplicity) did not include this constraint in its conceptual evaluation and therefore the estimated volumes maybe slightly overstated, the significant difference however indicates that additional storage capacity may be realized under Stantec options of excavation if the interior toe offset was reduced and excavated basin slopes were excavated at 3H:1V. We note that increasing storage volume at Jurupa Basin may not increase recharge.

5.6.3.3.1 Potential Recharge Increase

WEI simulated potential recharge increases resulting from improvement alternatives at Jurupa Basin based on the evaluation prepared by Stantec. Recharge estimates for Option 1 or Option 2 basin enlargements with only inflow from San Sevaine Creek from an improved inlet were not evaluated. Results of the simulation are shown in the below table.

Potential Increased Storm Water Recharge Jurupa Basin

(values in acre-ft)

Alternative	Current Recharge	Potential Recharge in Basin	Potential Increase in Recharge in Basin
Improved Inlet	596	1,054	458

5.6.3.3.2 Potential Cost

The estimated cost for construction of Jurupa Basin is shown on the below tables. Potential costs for development of project options were estimated utilizing quantities and lump sum costs prepared by Stantec. Unit costs for excavation developed by CBWCD for evaluation of other RMP projects were applied to quantities provided by Stantec. Mobilization for the project was also evaluated with the same methodology as other RMP cost estimates. A discussion of the development of project cost items is provided in Section 5.6.11. The cost for excavation of the basin could be significantly reduced or offset if material excavated for the project can be used for other purposes such as in conjunction with another construction project that requires imported borrow material.

Cost Estimate for Conceptual Project Evaluation of Jurupa Basin

Stantec - Option 1 (Improved Inlet and 15 Foot Excavation)

	Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs					
1	Mobilization	1	Job	Lump Sum	$197,000
2	Reservoir Excavation				
	Excavate & Haul Offsite	485,000	Cu. Yds.	$12.50	$6,062,500
3	Inlet Improvement				
	Rubber Dam and Structure	1	Job	$335,000	$335,000
	Sluice Gate	1	Job	$25,000	$25,000
	Electrical Service	1	Job	$100,000	$100,000
	SCADA Interface	1	Job	$30,000	$30,000
	Subtotal Direct Construction				**$6,749,500**
	Contingency @ 25%				**$1,687,400**
	Total Construction				**$8,436,900**
Engineering and Administration Costs					
	Engineering, Construction Inspection and Contract Admin. @ 10%				$844,000
	Total Engineering and Administration				**$844,000**
Total Estimated Cost					**$9,280,900**
Total Estimated Cost - Rounded					**$9,280,000**
Annual Cost - 30 Years @ 5% Interest					**$603,700**

Cost Estimate for Conceptual Project Evaluation of Jurupa Basin
Stantec - Option 2 (Improved Inlet and 29 Foot Excavation)

	Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs					
1	Mobilization	1	Job	Lump Sum	$444,000
2	Reservoir Excavation				
	Excavate & Haul Offsite	1,105,000	Cu. Yds.	$12.50	$13,812,500
3	Inlet Improvement				
	Rubber Dam and Structure	1	Job	$335,000	$335,000
	Sluice Gate	1	Job	$25,000	$25,000
	Electrical Service	1	Job	$100,000	$100,000
	SCADA Interface	1	Job	$30,000	$30,000
4	Pump Station Modification				
	Lift Station	1	Job	$500,000	$500,000
	Subtotal Direct Construction				**$15,246,500**
	Contingency @ 25%				**$3,811,600**
	Total Construction				**$19,058,100**
Engineering and Administration Costs					
	Engineering, Construction Inspection and Contract Admin. @ 10%				$1,906,000
	Total Engineering and Administration				**$1,906,000**
Total Estimated Cost					**$20,964,100**
Total Estimated Cost - Rounded					**$20,960,000**
Annual Cost - 30 Years @ 5% Interest					**$1,363,700**

Cost Estimate for Conceptual Project Evaluation of Jurupa Basin

Stantec - Inlet Improvement (Drop Inlet)

	Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs					
1	Mobilization	1	Job	Lump Sum	$12,000
2	Inlet Improvement				
	Drop Inlet Structure	1	Job	$330,000	$330,000
	Sluice Gate	1	Job	$25,000	$25,000
	Electrical Service	1	Job	$25,000	$25,000
	SCADA Interface	1	Job	$30,000	$30,000
	Subtotal Direct Construction				**$422,000**
	Contingency @ 25%				**$105,500**
	Total Construction				**$527,500**
Engineering and Administration Costs					
	Engineering, Construction Inspection and Contract Admin. @ 10%				$53,000
	Total Engineering and Administration				**$53,000**
Total Estimated Cost					**$580,500**
Total Estimated Cost - Rounded					**$580,000**
Annual Cost - 30 Years @ 5% Interest					**$37,800**

Cost Estimate for Conceptual Project Evaluation of Jurupa Basin
Stantec - Inlet Improvement (Rubber Dam)

	Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs					
1	Mobilization	1	Job	Lump Sum	$15,000
2	Inlet Improvement				
	Dam and Structure	1	Job	$335,000	$335,000
	Sluice Gate	1	Job	$25,000	$25,000
	Electrical Service	1	Job	$100,000	$100,000
	SCADA Interface	1	Job	$30,000	$30,000
	Subtotal Direct Construction				**$505,000**
	Contingency @ 25%				**$126,300**
	Total Construction				**$631,300**
Engineering and Administration Costs					
	Engineering, Construction Inspection and Contract Admin. @ 10%				$63,000
	Total Engineering and Administration				**$63,000**
Total Estimated Cost					**$694,300**
Total Estimated Cost - Rounded					**$690,000**
Annual Cost - 30 Years @ 5% Interest					**$45,200**

5.6.3.3.3 Discussion

Preliminary evaluation of recharge efficiency of the project without diversions of storm water to other recharge facilities and without excavation of the basin indicates improvements will capture about 458 acre-ft of water annually at an annualized cost of about $45,000 (for the more expensive inlet improvement option evaluated) or about $98 an acre-foot.

5.6.4 RP3 Basin

5.6.4.1 Existing Condition

RP3 is made up of 4 separate cells adjacent to Declez Channel. Water is diverted from Declez channel by inflating a rubber bladder dam in the channel and directing flow into a feeder channel. Cells 1, 3, and 4 divert flow from the feeder channel for recharge. Cell 1 also has the potential to receive water from Jurupa Basin. Recharge cells typically produce relatively high infiltration rates (up to 2.5 ft/day). Some storm water is diverted into Cell 2, though Cell 2 is reserved as a mitigation site in compliance with the Regional Water Quality Board 401

Certification.

5.6.4.2 Proposed Improvement Alternatives

- Construct a new diversion inlet and conveyance between existing cells of the RP3 Basin. Excavate Cells 1, 3 & 4 40-feet to acquire additional storage. These alternatives are described in Section 3.4.3.
- Excavate Cell 2 and move the existing mitigation site.
- Excavate to combine Cells 3 and 4 or Cells 2, 3 & 4 into one basin. Combination of cells 3 and 4 or Cells 2, 3 & 4 would require either or a combination of excavation of material above the proposed storage elevation and construction of a dam for the lower portion of project area.
- Excavate Cells 3 and 4 or Cells 2, 3 & 4 to also include the area currently occupied by the existing diversion intake and distribution canal.
- Excavate Cells to a depth greater or less than the 40-foot depth currently evaluated.

5.6.4.3 Evaluated Alternatives

The RP3 Basin project is proposed to function as a modified flow-through basin for water in Declez Creek channel. A new diversion structure and conduit is proposed to be constructed east of the project at a point higher in elevation than the existing point of diversion. A pneumatic gate will be installed in Declez Channel immediately downstream of the new diversion intake structure. The intake structure will be equipped with an intake gate to control the rate of diversion from the channel. Water will flow from the intake structure through a box culvert channel into Cell 1 of the RP3 Basin. The box culvert is proposed to be sufficiently sized to allow equipment to traverse the culvert for cleaning and maintenance. With the new diversion structure located higher in Declez Channel, water can be diverted and stored to a higher elevation than existing operations allow. The proposed maximum storage elevation for Cell 1 will be equal to the invert of the channel at the point of diversion. A low-level box culvert channel with an automatic flow level-control valve will hydraulically connect Cell 1 to Cells 3 so that the cells will effectively operate as one basin. A similar low-level pipe outlet will connect Cell 3 to Cell 4. Overflow spillways will be constructed for each basin. The overflow conduit for Cell 1 will discharge into the existing diversion channel that can be diverted into Cell 3 & 4 or else outfall to the Declez Channel. Cells 3 & 4 will each have an overflow spillway channel that will discharge into Declez Channel. Details of the proposed project are shown in Figures 5-48 and 5-49.

RP3 Basin, particularly Cells 1, 3 & 4, may be excavated to acquire additional storage capacity. Excavation of cells 40 feet deep would develop about 476 acre-ft of storage.

RP3 Basin, Cell 1 currently receives water pumped from Jurupa Basin. A pipeline is proposed to be added to allow water to discharge directly to Cells 3 and/or 4 independently from Cell 1.

The existing earth embankment structure will be evaluated and reconstructed as necessary to meet requirements of a dam embankment under the jurisdiction of the DSOD. Embankment fills of height and capacity are under the jurisdiction of DSOD. Improvements to the dam structure may include the excavation of the existing embankment to expose firm, undisturbed and stable material across the entire width and length of the embankment and excavation of a keyway or cutoff trench that will extend to an underlying impervious material, or to a depth considered adequate to prevent piping or seepage through the embankment. The dam embankment will be constructed at a typical slope of about 3:1 (H:V) on the upstream side and 2:1 (H:V) on the downstream side.

Additional conceptual level investigations and evaluations will be required to verify the project design and determine if or how the project will be required to be modified to address issues that arise. The following is a preliminary list of items that are known at this time that will require further review.

- SCE should be consulted to discuss the projects encroachment into the existing SCE easement.
- Evaluate operation and maintenance procedures to determine facility requirements for periodic dewatering and cleaning of the basin.
- Review and evaluate project operations during design storm events with SBCFCD.
- Review and evaluate project operations and maintenance waste discharge requirements of storm water discharges from MS4 for compliance with Tentative Order No. R8-2009-0036 from the California Regional Water Quality Control Board, Santa Ana Region, NPDES Permit and Waste Discharge Requirements for SBCFCD, et al., Area-Wide Urban Storm Water Runoff Management Program.

See Figure 5-50 for evaluated alternative schematic.

5.6.4.3.1 Potential Recharge Increase

WEI estimated potential recharge using their model by simulating potential diversions to RP3 transferred from Jurupa and Wineville Basins as discussed in Section 5.5 of this report. Results of the simulation are as follows:

Potential Increased Storm Water Recharge RP3 Basin

(values in acre-ft)

Alternative	Current Recharge	Potential Recharge	Potential Increase in Recharge
Improve Inlet	244	1,048	804
Improve Inlet and Basin Enlargement for Cells 1, 3 & 4	244	1,357	1,113

5.6.4.3.2 Potential Cost

The estimated cost for construction of RP3 Basin is shown on Tables 5-14 and 5-15. A discussion of development of project cost items is provided in Section 5.6.11. The cost for excavation of the basin could be significantly reduced or offset if material excavated for the project can be used for other purposes such as in conjunction with another construction project that requires imported borrow material.

5.6.4.3.3 Discussion

Preliminary evaluation of recharge efficiency of the project indicates that the project is most efficient in diversion of additional water for recharge from Declez Creek without import of water from other facilities when the basin is not enlarged. Improvements to the diversion structure and basin modifications without basin enlargement will capture about 804 acre-ft of water annually at an annualized cost of about $383,000 or about $476 an acre-foot. Improvements to the diversion structure and basin modifications with basin enlargement will capture about 1,113 acre-ft of water annually at an annualized cost of about $1,465,000 or about $1,316 an acre-foot.

5.6.5 Vulcan Pit

5.6.5.1 Existing Condition

Vulcan Pit is located in Fontana, CA adjacent to West Fontana Channel. According to WEI, the site had previously been used as a sand and gravel mine for over 60 years, as well as an asphalt batch plant for 30 years. The site is currently an open pit about 100 feet deep. Above ground structures associated with historic uses have been removed. WEI reported in their 2006 document, "Reconnaissance-Level Feasibility Assessment of Recharge at the Vulcan Pit," that similar aggregate mining practices occurred in pits that later became the Upland and Montclair recharge basins. Vulcan Pit could potentially recharge at a similar rate to these existing facilities (0.5-2.0 ft/day).

5.6.5.2 Proposed Improvement Alternatives

- The preliminary alternative proposed to be evaluated is the installation of pneumatic gates in Lower Fontana Channel and in a new diversion channel and spillway into Vulcan Pit which will allow controlled diversions of water into the basin at times when discharge is available. An outflow spillway will also be constructed from Vulcan Pit to West Fontana Channel. Vulcan Pit is proposed to function as a multi-purpose facility ideally capable of diverting low flows for recharge and conservation and peak storm flows greater than the capacity of West Fontana Channel downstream of the facility. (See Figure 5-51.)

- An additional consideration for the preliminary project evaluation includes utilizing the upper portion of storage as a regulatory reservoir and pumping water out of the basin during and between storm events to Banana or Hickory Basins wherefrom water will be pumped to northern recharge basins for recharge as part of the regional recharge distribution system described in Section 5.5.

5.6.5.3 Evaluated Alternatives

Formal evaluation of alternatives will be completed following consultation with SBCFCD.

5.6.5.3.1 Potential Recharge Increase

Similar to Lower San Sevaine, a new basin at Vulcan Pit was simulated by WEI according to three different assumed operating infiltration rates. Results are shown in the below table.

Potential Increased Storm Water Recharge Vulcan Pit

(values in acre-ft)

Alternative	Current Recharge	Potential Increase in Recharge
0.5 ft/day Infiltration	0	1,054
1.0 ft/day Infiltration	0	1,074
1.5 ft/day Infiltration	0	1,077

5.6.5.3.2 Potential Cost

Evaluation of cost for the project alternative will be completed following consultation with SBCFCD. Cost for reclamation of the existing mining pit into a recharge basin will not be included into the cost evaluation of the project as this is a component to the surface mining reclamation plan required to be completed by the current mining operator.

For preliminary conceptual project evaluation, the estimated cost to develop Vulcan Pit into a flood control and storm water recharge facility was obtained from the "Reconnaissance-Level Construction Cost Opinion Alternative 2 Flood Control Use with Maximum Storm Water Capture" summary and cost update worksheet prepared by WEI. The estimated cost for Watermaster's portion of the project is $2,446,000.

5.6.5.3.3 Discussion

Preliminary evaluation of recharge efficiency of the project indicates that the project is efficient in diversion of additional water for recharge if the project is cost shared with SCBFCD with Watermaster responsible for only the components required for operation as a recharge facility. At an estimated annual cost of about $159,000 the facility could capture for recharge an additional 1,054 to 1,077 acre-ft of water annually. This equates to an annualized cost of about $150 per acre-foot.

5.6.6 Lower Cucamonga Basin

5.6.6.1 Existing Condition

Lower Cucamonga Basin is located on Cucamonga Creek within the City of Ontario. The facility is owned by SBCFCD and the basins are currently not utilized for groundwater recharge as a result of an evaluation by CBWCD which found that the basins have limited infiltration capacity. The basins are underlain by a thick clay layer. Lower Cucamonga consists of four cells, two on each of the east and west sides of Cucamonga Creek. The east and west cells are divided into north and south cells by a Southern California Edison (SCE) high-voltage power line easement. The southeastern cell of the existing Lower Cucamonga Basin is currently a mitigation site for the burrowing owl.

5.6.6.2 Proposed Improvement Alternatives

- Construct a flow-through regulatory storage facility at the site of the existing Lower Cucamonga local storm water detention basins. This alternative is described in Section 5.6.6.3.

- Construct a flow-through regulatory storage basin at the site of the existing Lower Cucamonga local storm water detention basins and extending the new basin across the generally open ground to the east. This alternative was not pursued because the ground surface in this area is generally 10 to 30 feet above the proposed maximum storage elevation of the basin and would require a significant amount of excavation just to get to the point where excavation depth yields an increase in storage capacity. Additionally, this alternative would require an island be constructed around an SCE high voltage power tower and/or movement of the tower, both of which are unattractive options on a cost and project efficiency basis.

- Construct a flow-through regulatory storage basin at the site of the existing Lower Cucamonga local storm water detention basins and extending the new basin to include the existing Chris Basin and inflow from Lower Deer Creek. This alternative was not pursued because the water surface elevation for the proposed Lower Cucamonga Basin would inundate the Lower Deer Creek channel above its discharge into Chris Basin. This inundation would affect the hydraulics and discharge capacity of the Lower Deer Creek channel. In addition, it is presumed that the hydrology of Lower Deer Creek is similar to the hydrology of Cucamonga Creek and will most significantly vary in amount of flow rather than timing. Cucamonga Creek will generate a significantly greater amount of discharge than Lower Deer Creek. It is anticipated that discharge of Cucamonga Creek will be ample to fill the proposed Lower Cucamonga Basin. An inlet to Lower Cucamonga Basin from Chris Basin is included in the evaluated alternative to enable diversion of water during low flow periods.

- Construct a flow-through regulatory storage basin within the same footprint area as the evaluated alternative with depth of excavation varying to yield storage capacities ranging from about 1,000 to 1,800 acre-ft. The number of basin storage capacity options for evaluation was reduced as it became apparent that the proposed project was less dependent on basin storage capacities than the diversion rate to recharge facilities and the capacity of recharge facilities. Final basin capacity will ultimately be optimized to balance storage, diversion rates, recharge facility capacities, project site constraints, and cost.
- A technical memorandum from CDM, who is a consultant to SBCFCD, dated February 24, 2010 to the MSAR Bacterial TMDL Taskforce regarding Dry Weather Runoff Controllability Assessment for Lower Deer Creek Sub-watershed (Chris Basin) describes a bacterial indicator concentration in Lower Deer Creek that exceed water quality objectives. The memorandum discusses two options for control of dry water runoff from Chris Basin. 1) Construct a wetland within Chris Basin or 2) Collaborate with IEUA to develop a project to divert runoff from Lower Deer Creek into the proposed Lower Cucamonga Basin. Further discussion should be coordinated with SBCFCD and IEUA to develop a mutually beneficial project for resolution of IEUA's bacterial problems during dry weather periods that could also be utilized for diversion of Lower Deer Creek flows during wet weather periods for recharge.

5.6.6.3 Evaluated Alternatives

The proposed Lower Cucamonga Basin is a flow-through regulatory storage facility to be constructed at the site of the existing Lower Cucamonga local storm water detention basins. The proposed Lower Cucamonga Basin project will be situated over the footprint of the existing basins, bifurcating the existing Cucamonga Creek channel above and below the basin. Cucamonga Creek will discharge directly into Lower Cucamonga Basin through a new inlet channel and energy dissipation structure. Water in excess of the storage capacity of Lower Cucamonga Basin will return to Cucamonga Creek through a new concrete lined spillway structure that discharges to the channel below the basin. Details of the proposed project are shown in Figures 5-52 and 5-53.

The basin will require construction of an earth embankment structure along the southern portion of the basin which will be constructed of soil and rock materials obtained from excavations within the project area. General construction protocol for a dam embankment requires sub-excavation of the ground surface across the entire width and length of the embankment to expose firm, undisturbed and stable material. Within the embankment foundation area a keyway or cutoff trench will be excavated extending to an underlying impervious material or to a depth considered adequate to prevent piping or seepage through the embankment. Embankment fills of sufficient height and capacity are under the jurisdiction of DSOD. The dam embankment is proposed to be constructed, at a typical slope of about 3:1 (H:V) on the upstream side and 2:1 (H:V) on the downstream side.

Lower Cucamonga Basin has been evaluated at capacity of 1,200 acre-ft. Previous analyses of basins with larger capacities yielded that the amount of water obtainable for re-diversion to other recharge facilities is less dependent on basin storage capacity than rate of pumping and recharge capacity. The basin configuration and grading plan shown on Figure 5-52 is for conceptual evaluation purposes only for general project layout and preliminary earthwork quantity determination. Subsequent project evaluations will include design of basin features including access ramps, benches on slopes, and basin bottom grading features.

Water surface elevation, discharge spillway width, and dam embankment height were determined through a preliminary hydraulic analysis of water surface elevations at a flow rate of 20,000 cfs which corresponds to a freeboard allowance of about 7.5 feet within the channel. This flow rate is larger than the largest instantaneous flow rate measured in Cucamonga Creek in 40 years of record.

An inlet conduit between the proposed Lower Cucamonga Basin and Chris Basin will be constructed to enable diversion of water from Chris Basin and Deer Creek into Lower Cucamonga Basin. The existing inlet from Chris Basin to the southeastern cell of the existing Lower Cucamonga Basin will be removed and replaced.

Storm water accruing to Lower Cucamonga Basin is proposed to be re-diverted to Wineville Basin and thence to other recharge facilities within Chino Basin for recharge. A pump station will be constructed at Lower Cucamonga Basin with a conveyance pipeline extending from Lower Cucamonga Basin to Wineville Basin. This system is described in Section 5.5.

Additional conceptual level investigations and evaluations will be required to verify the project design and determine if or how the project will be required to be modified to address issues that arise. The following is a preliminary list of items that are known at this time that will require further review.

- SCE should be consulted to discuss the project's encroachment into the existing SCE easement and resulting modification to its operations.
- Impact to and relocation of the burrowing owl mitigation site located in the southeastern cell of the existing Lower Cucamonga Basin will need to be evaluated.
- Collaborate with IEUA and SBCFCD on development of a dry weather diversion facility on Deer Creek discharging into the proposed Lower Cucamonga Basin that could also be utilized during wet weather to enhance diversion opportunities from Deer Creek.
- Basin capacity and configuration shall be reviewed for optimization of storage, diversion and cost.
- Localized condition and net reflection of regional groundwater system needs to be reviewed and analyzed to determine its impact to the project.

- The existing drain inlet discharging into the northwestern cell of the existing Lower Cucamonga Basin will need to be evaluated.
- Evaluate operation and maintenance procedures to determine facility requirements for periodic dewatering and cleaning of the basin.
- Review and evaluate the project operations during design storm events with SBCFCD.
- Review and evaluate project operations and maintenance waste discharge requirements of storm water discharges from MS4 for compliance with Tentative Order No. R8-2009-0036 from the California Regional Water Quality Control Board, Santa Ana Region, NPDES Permit and Waste Discharge Requirements for SBCFCD, et al., Area-Wide Urban Storm Water Runoff Management Program.

See Figure 5-54 for evaluated alternative schematic.

5.6.6.3.1 Potential Recharge Increase

A potential increase in groundwater recharge was estimated by WEI using their hydrologic simulation model. Lower Cucamonga Basin, however, is not expected to be a recharge basin because of limited infiltration capacity of underlying soils. Discharge from Cucamonga Creek will be diverted and transferred elsewhere to be recharged. Potential diversions at Lower Cucamonga Basin are shown in the below table.

Potential Increased Storm Water Recharge
Lower Cucamonga Basin
(values in acre-ft)

Alternative	Current Recharge	Potential Recharge	Potential Diversion Export
10 cfs Diversion	0	0	4,020
20 cfs Diversion	0	0	5,551
30 cfs Diversion	0	0	6,483
40 cfs Diversion	0	0	7,160

5.6.6.3.2 Potential Cost

The estimated cost for construction of the Lower Cucamonga Basin is shown on the below table. A discussion of development of the project cost items is provided in Section 5.6.11. Cost for reservoir excavation can be significantly reduced or offset if material excavated for the project can be used for other purposes such as in conjunction with another construction project that requires imported borrow material.

Cost Estimate for Conceptual Project Evaluation of Lower Cucamonga Basin

	Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs					
1	Mobilization	1	Job	Lump Sum	$446,000
2	Compacted Embankment				
	Foundation Excavation	214,000	Cu. Yds.	$3.00	$642,000
	Compacted Embankment	409,000	Cu. Yds.	$6.00	$2,454,000
3	Reservoir Excavation				
	Excavate & Haul Offsite	709,800	Cu. Yds.	$12.50	$8,872,500
4	Existing Channel				
	Channel Demolition	17,300	Cu. Yds.	$24.00	$415,200
5	Basin Discharge Structure				
	Concrete Spillway Structure	1,400	Cu. Yds.	$800	$1,120,000
6	Basin Inlet Structure				
	Concrete Inlet Spillway Structure	1,300	Cu. Yds.	$700	$910,000
7	Basin Outlet to Cucamonga Creek				
	60" Dia. RCP Outlet Conduit	400	Lin. Ft.	$600	$240,000
	Gates and Controls	1	Job	$50,000	$50,000
8	Chris Basin Inlet Structure				
	60" Dia. RCP Outlet Conduit	200	Lin. Ft.	$600	$120,000
	Gates and Controls	1	Job	$50,000	$50,000
	Subtotal Direct Construction				**$15,319,700**
	Contingency @ 25%				**$3,829,900**
	Total Construction				**$19,149,600**
Engineering and Administration Costs					
	Engineering, Construction Inspection and Contract Admin. @ 10%				$1,915,000
	Total Engineering and Administration				**$1,915,000**
Total Estimated Cost					**$21,064,600**
Total Estimated Cost - Rounded					**$21,060,000**
Annual Cost - 30 Years @ 5% Interest					**$1,370,300**

5.6.6.3.3 Discussion

Preliminary evaluation of recharge efficiency of the project indicates that efficiency is limited by the capacity of the recharge facilities. More water is available for diversion than there is a place to put it. Additional destination facilities should be explored. Assuming a destination facility is available for all storm water estimated to be available at the rates shown, between 5,551 and 7,160 acre-ft can be annually captured at an annualized cost of $1,370,000. This equates to a cost between $191 and $247 per acre-foot.

The development of Lower Cucamonga Basin is estimated to be about $21-million and is about 10-percent of the total cost for the entire RMP project; however it generates between

25 and 45-percent of new water to be recharged.

5.6.7 Lower San Sevaine Basin

5.6.7.1 Existing Condition

The proposed Lower San Sevaine Basin is a new facility that would be located in a vacant area downstream of the San Sevaine flood control basins and Victoria Basin, adjacent to Interstate 15 in Etiwanda, CA. The proposed basin was previously referred to in discussions with Watermaster as the Lower Victoria Basin.

5.6.7.2 Proposed Improvement Alternatives

Construct a flow-through recharge basin on Etiwanda and San Sevaine Creek. This alternative is described in Section 5.6.7.3.

Evaluate the potential for enlargement of existing recharge storage basins upstream of the proposed Lower San Sevaine Basin both on the Etiwanda and San Sevaine stream system.

5.6.7.3 Evaluated Alternatives

Lower San Sevaine Basin is a proposed new flow-through basin located on San Sevaine and Etiwanda Creek channels. The basin is proposed to collect flows occurring in San Sevaine and Etiwanda Creeks for recharge. Flows in excess of the basin storage capacity will return to the San Sevaine and Etiwanda channels.

The basin is designed for a maximum reservoir depth of 25 feet and will store about 605 acre-ft of water. The dam embankment crest elevation and freeboard allowance was determined pursuant to preliminary hydraulic analyses performed to estimate surcharge storage capacity to pass the design storm event through the reservoir and spillway structure and into the San Sevaine and Etiwanda Creek channels below the proposed basin. Although inflow into the basin from the San Sevaine and Etiwanda Creek channels will vary in rate and proportion due to the operations of upstream basins, discharge from the is proposed to occur by proportion to design capacity of the channels, (i.e. Etiwanda channel with receive about 63 percent of all discharge and San Sevaine channel will receive the balance, about 37 percent). Low-level outlet conduits will be constructed to release water into the channels below the basin. Details of the proposed project are shown in Figures 5-55 and 5-56.

Earth embankment structures are anticipated to be constructed of soil and rock materials obtained from excavations within the project area. General construction protocol for a dam embankment requires sub-excavation of the ground surface across the entire width and length of the embankment to expose firm, undisturbed and stable material. Within the embankment foundation area a keyway or cutoff trench will be excavated extending to an underlying impervious material or to a depth considered adequate to prevent piping or seepage through the embankment. The dam embankment will be constructed, at a typical slope of about 3:1

(H:V) on the upstream side and 2:1 (H:V) on the downstream side. Embankment fills of sufficient height will be under the jurisdiction of the DSOD.

Lower San Sevaine Basin will also receive water diverted at other diversion facilities, such as Lower Cucamonga and Wineville Basins, for recharge as part of the regional recharge distribution system. This system is described in Section 5.5. See Figure 5-57 for evaluated alternative schematic.

Additional conceptual level investigations and evaluations will be required to verify project design and determine if or how the project will be required to be modified to address issues that arise. The following is a preliminary list of items that are known at this time that will require further review.

- Evaluate operation and maintenance procedures to determine facility requirements for periodic dewatering and cleaning of the basin.
- Evaluate potential for having the basin excavated by a surface mining operator.
- Review and evaluate project operations during design storm events with SBCFCD.

Review and evaluate project operations and maintenance waste discharge requirements of storm water discharges from MS4 for compliance with Tentative Order No. R8-2009-0036 from the California Regional Water Quality Control Board, Santa Ana Region, NPDES Permit and Waste Discharge Requirements for SBCFCD, et al., Area-Wide Urban Storm Water Runoff Management Program.

5.6.7.3.1 Potential Recharge Increase

Lower San Sevaine was simulated by WEI according to three different assumed operating infiltration rates. Results are shown in the below table.

Potential Increased Storm Water Recharge Lower San Sevaine Basin

(values in acre-ft)

Alternative	Current Recharge	Potential Increase in Recharge
0.25 ft/day Infiltration	0	1,157
0.5 ft/day Infiltration	0	1,429
1.0 ft/day Infiltration	0	1,679

5.6.7.3.2 Potential Costs

The estimated cost for construction of Lower San Sevaine Basin is shown on the below table. A discussion of the development of project cost items is provided in Section 5.6.11. Cost can be significantly reduced or offset if material excavated for the project can be used for other purposes such as in conjunction with another construction project that requires imported borrow material. Another consideration to reduce project costs is to lease out land to a mining operator who would construct the basin concurrent with their mining operations.

Cost Estimate for Conceptual Project Evaluation of
Lower San Sevaine Basin

	Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs					
1	Mobilization	1	Job	Lump Sum	$643,000
2	Compacted Embankment				
	Foundation Excavation	30,000	Cu. Yds.	$3.00	$90,000
	Compacted Embankment	46,000	Cu. Yds.	$6.00	$276,000
3	Reservoir Excavation				
	Excavate & Haul Offsite	1,542,000	Cu. Yds.	$12.50	$19,275,000
4	Existing Channel Demolition				
	Channel Demolition	5,800	Cu. Yds.	$24.00	$139,200
5	Basin Outlet to Etiwanda Channel				
	60" Dia. RCP Outlet Conduit	300	Lin. Ft.	$600	$180,000
	Gates and Controls	1	Job	$50,000	$50,000
6	Basin Outlet to San Sevaine Channel				
	60" Dia. RCP Outlet Conduit	300	Lin. Ft.	$600	$180,000
	Gates and Controls	1	Job	$50,000	$50,000
6	Basin Spillway/Discharge Structure				
	Concrete Structure	650	Cu. Yds.	$1,200	$780,000
7	Basin Inlet Structure				
	Concrete Structure	350	Cu. Yds.	$1,200	$420,000
	Subtotal Direct Construction				**$22,083,200**
	Contingency @ 25%				**$5,520,800**
	Total Construction				**$27,604,000**
Engineering and Administration Costs					
	Engineering, Construction Inspection and Contract Admin. @ 10%				$2,760,000
	Total Engineering and Administration				**$2,760,000**
Total Estimated Cost					**$30,364,000**
Total Estimated Cost - Rounded					**$30,360,000**
Annual Cost - 30 Years @ 5% Interest					**$1,975,200**

5.6.7.3.3 Discussion

Preliminary evaluation of recharge efficiency of the project indicates that the project is not efficient in diversion of additional water for recharge. At an estimated annual cost of about $1,975,200 the facility could capture for recharge an additional 1,157 to 1,679 acre-ft of water annually. This equates to an annualized cost between $1,176 and $1,707 per acre-foot. If the cost of constructing the basin was reduced by leasing the land to a mining operator as discussed above to about $1,500,000 (95-percent cost reduction) and with an annualized cost of about $100,000, the cost for recharge the project would be worth pursuing.

5.6.8 Declez Basin

5.6.8.1 Existing Condition

Declez Basin is located downstream of RP3 on Declez Channel. Declez is currently operated as a flow-through multi-purpose basin. The basin is divided into 3 cells with the upper cell utilized as a habitat area. Habitat use in the upper cell currently allows for the sediment and debris flowing into the basin to be filtered to reduce the maintenance of the subsequent cells.

5.6.8.2 Proposed Improvement Alternatives

- Reconstruct existing embankment and install a gate on the existing low level outlet. This alternative is described in Section 5.6.8.3.
- Repair and reconstruct internal berms as required to prevent frequent wash-out and repair.

5.6.8.3 Evaluated Alternatives

Declez Basin is proposed to be improved to a storage reservoir by installation of a gate on the existing low-level conduit and reconstruction of the embankment to function satisfactorily as a dam. A new spillway structure will be constructed at a lower elevation to maintain the storage level at a point where it will not affect the inflow to the basin from Declez Channel upstream. Existing berms which separate the existing basin into cells will be removed. Details of the proposed project are shown in Figure 5-58.

The existing earth embankment structure will be evaluated and reconstructed as necessary to meet requirements of a dam embankment under the jurisdiction of the DSOD. Embankment fills of sufficient height and capacity are under the jurisdiction of DSOD. Improvements to the dam structure may include the excavation of the existing embankment to expose firm, undisturbed and stable material across the entire width and length of the embankment and the excavation of a keyway or cutoff trench that will extend to an underlying impervious material, or to a depth considered adequate to prevent piping or seepage through the embankment. The dam embankment will be constructed at a typical slope of about 3:1 (H:V) on the upstream side and 2:1 (H:V) on the downstream side.

Additional conceptual level investigations and evaluations will be required to verify the project design and determine if or how the project will be required to be modified to address issues that arise. The following is a preliminary list of items that are known at this time that will require further review.

- Hydraulic analysis of the channel and reservoir system will be completed pursuant to receipt of channel design flow information from SBCFCD.

- Evaluate operation and maintenance procedures to determine facility requirements for periodic dewatering and cleaning of the basin.
- Review and evaluate project operations during design storm events with SBCFCD.
- Review and evaluate project operations and maintenance waste discharge requirements of storm water discharges from MS4 for compliance with Tentative Order No. R8-2009-0036 from the California Regional Water Quality Control Board, Santa Ana Region, NPDES Permit and Waste Discharge Requirements for SBCFCD, et al., Area-Wide Urban Storm Water Runoff Management Program.

See Figure 5-59 below for evaluated alternative schematic.

5.6.8.3.1 Potential Recharge Increase

Similar to RP3, WEI estimated potential recharge using their model by simulating potential diversions to Declez transferred from Jurupa and Wineville Basins as discussed in Section 5.5 of this report. Results of the simulation are as follows:

Potential Increased Storm Water Recharge Declez Basin

(values in acre-ft)

Alternative	Current Recharge	Potential Recharge	Potential Increase in Recharge
Enlarged & with Improved Inlet for RP3 Basin	789	827	38
Enlarged & with Improved Inlet and Enlargement of Cells 1, 3 & 4 for RP3 Basin	789	820	31

5.6.8.3.2 Potential Cost

The estimated cost for construction of Declez Basin is shown in the below table. A discussion of the development of project cost items is provided in Section 5.6.11.

Cost Estimate for Conceptual Project Evaluation of Declez Basin

	Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs					
1	Mobilization	1	Job	Lump Sum	$79,000
2	Compacted Embankment				
	Foundation Excavation	70,600	Cu. Yds.	$3.00	$211,800
	Compacted Embankment	70,600	Cu. Yds.	$6.00	$423,600
	Interior Berm Excavation	40,000	Cu. Yds.	$3.00	$120,000
	Interior Berm Compacted Fill	40,000	Cu. Yds.	$6.00	$240,000
3	Existing Spillway Demolition				
	Channel Demolition	1,000	Cu. Yds.	$18.17	$18,170
4	Basin Spillway/Discharge Structure				
	Basin Discharge Concrete Structure	1,000	Cu. Yds.	$1,200	$1,200,000
	Berm Overflow Concrete Structure	300	Cu. Yds.	$1,200	$360,000
5	Outlet Gate				
	Gates and Controls	1	Job	$50,000	$50,000
	Subtotal Direct Construction				**$2,702,600**
	Contingency @ 25%				**$675,700**
	Total Construction				**$3,378,300**
Engineering and Administration Costs					
	Engineering, Construction Inspection and Contract Admin. @ 10%				$338,000
	Total Engineering and Administration				**$338,000**
Total Estimated Cost					**$3,716,300**
Total Estimated Cost - Rounded					**$3,720,000**
Annual Cost - 30 Years @ 5% Interest					**$241,800**

5.6.8.3.3 Discussion

Preliminary evaluation of recharge efficiency of the project indicates that the project is not efficient in diversion of additional water for recharge. At an estimated annual cost of about $242,000 the facility could capture for recharge an additional 31 to 38 acre-ft of water annually. This equates to an annualized cost between $6,370 and $7,800 per acre-foot. In addition, as the recharge facilities are developed upstream of the Declez Basin, less water is available for recharge at Declez Basin which results in a diminishing return on the improvements.

5.6.9 Turner Basin Expansion/Gausti Park

The Turner Basin Guasti Park project includes the Turner 4 basin and the Guasti Park located east and adjacent to the Turner 4 basin. Modifications and enhancements to the existing Turner Basins and Guasti Park have been conceptually developed by IEUA and other stakeholders. The plan is a mixed use project proposed to serve recreational, flood control and groundwater recharge interests. Modifications of the existing facilities include moving the inlet from Deer Creek upstream to enable diversion at a higher elevation and subsequently increasing the storage capacity of the existing basins and construction of additional basins for storage and recharge. Preliminary evaluation of the available water supply by WEI indicates that if the project could be built as shown on the plan, recharge to Chino Basin could be increased by about 1,300 acre-ft/yr.

The plan presented by IEUA is a graphical representation of ideas developed in discussions by IEUA with local agencies and has not undergone preliminary engineering design. A conceptual level project design and evaluation would need to be completed to verify project hydraulics, evaluate proposed basin excavations and estimate material quantities. A preliminary cost estimate for construction of the proposed facility could then be developed based on quantities of materials and work required to complete the project. This project is actively being pursued by the IEUA and other stakeholders and will likely be implemented outside of the RMPU.

5.6.10 Pumping and Conveyance Systems

5.6.10.1 Existing Condition

Existing conveyance systems for the distribution of water for recharge are limited to a single pipeline and pump station between Jurupa and RP3 basins. The pipeline is currently only utilized for the transfer of recycled water to RP3 Basin Cell 1.

5.6.10.2 Proposed Improvement Alternatives

The pumping and distribution system was prepared utilizing the maximum recharge and diversion amounts the recharge basins could receive as simulated by WEI. The distribution system should be reviewed as the system is optimized to maximize recharge.

5.6.10.3 Evaluated Alternatives

The pumping and conveyance system was evaluated to estimate the cost for moving water from one facility to another utilizing the most direct and assessable route as determined by review of available aerial photography. Pipeline alignments were prepared to determine distance to the intended destination and do not indicate currently known or intended alignments. To the extent possible, alignments are shown to follow Southern California

Edison easements, existing roads, and flood control channels.

5.6.10.4 Potential Cost

The estimated cost for construction of the elements of the recharge pumping and conveyance system are shown on the below tables. A discussion of the development of project cost items is provided in Section 5.6.11.

Cost Estimate for Conceptual Conveyance System

Segment	Flowrate (cfs)	Pipe Diameter (in)	Length (ft)	Pipe Cost ($/LF)	Pipeline Cost	Contingency & Engineering	Total Cost Pipeline
Lower Cucamonga to Wineville	20	24	26,900	$294	$8,943,300	$3,130,100	$12,073,400
Wineville to Jurupa	20	24	10,400	$294	$3,315,100	$1,160,300	$4,475,400
Wineville to Etiwanda	40	36	12,000	$383	$5,196,800	$1,818,900	$7,015,600
Etiwanda to Hickory West	40	36	11,000	$383	$4,947,100	$1,731,500	$6,678,500
Hickory West to Victoria	40	36	18,700	$383	$7,163,200	$2,507,100	$9,670,300
Hickory West to Banana	6	18	3,300	$249	$821,700	$6,081,500	$23,457,000
Victoria to Lower Day	8	18	12,000	$249	$3,225,000		
	59	42	2,500	$428	$1,445,300		
Victoria to Etiwanda Debris	7	18	700	$249	$394,400		
	34	30	3,700	$338	$1,252,000		
	51	36	1,600	$383	$946,300		
	59	42	2,500	$428	$1,445,300		
Victoria to San Sevaine #1 (Upper)	27	30	4,000	$338	$1,353,500		
	34	30	3,700	$338	$1,252,000		
	51	36	1,600	$383	$946,300		
	59	42	2,500	$428	$1,445,300		
Victoria to San Sevaine #5 (Lower)	17	24	1,800	$294	$528,600		
	51	36	1,600	$338	$874,800		
	59	42	2,500	$428	$1,445,300		
Total			**123,000**		**$46,941,300**	**$16,429,400**	**$63,370,200**

Note: Pipeline Contingency and Engineering are estimated 25% and 10% of total construction cost, respectively.

Cost Estimate for Conceptual Pumping System

Segment	Hp Req'd	Pump Cost	Structure Cost	Regulatory Tank, 20 MG	Pump Station Cost	Contingency & Engineering	Total Cost Pump Station
Lower Cucamonga to Wineville	794	$240,000	$3,200,000	-	$3,440,000	$1,204,000	$4,644,000
Wineville to Jurupa	305	$240,000	$3,200,000	-	$3,440,000	$1,204,000	$4,644,000
Wineville to Etiwanda	1,147	$418,000	$3,200,000	-	$3,618,000	$1,266,300	$4,884,300
Etiwanda to Hickory West	692	$418,000	$3,200,000	$5,700,000	$9,287,000	$3,250,450	$12,537,450
Hickory West to Victoria Jurupa to RP3	1,382	$418,000	$3,200,000	$5,700,000	$9,287,000	$3,250,450	$12,537,450
Hickory West to Banana	-	$209,000	$0	-	$209,000	$73,150	$282,150
Victoria to Lower Day	179	$120,000					
Victoria to Etiwanda Debris	180	$209,000					
Victoria to San Sevaine #1	329	$120,000					
Victoria to San Sevaine #5	918	$298,000					
Total		**$2,690,000**	**$20,800,000**	**$11,400,000**	**$34,828,000**	**$12,189,800**	**$47,017,800**

Note:

Pump Station Contingency and Engineering are estimated 25% and 10% of total construction cost, respectively.

5.6.10.5 Discussion

Pumping and conveyance elements of the recharge distribution system are integral to the concept of capturing storm water in areas where it is plentiful and moving it to areas where it can be recharged to the Chino Basin. This system is the primary component to the Recharge Master Plan Update project.

5.6.11 Project Evaluation

5.6.11.1 Cost Evaluations

Project cost estimates were developed on a unit cost or per item basis where applicable. The following described components of, or sources to, cost values used for project evaluations.

Mobilization: Mobilizations were estimated at 3-percent of the total of all other direct construction cost items. For projects that require a large number of equipment move-in with a relatively small scope of work, mobilization cost may exceed 3-percent. In some cases this overstates expected cost for a contractor to mobilize, and in other cases it underestimates it. Mobilization is generally expected to cover items such as equipment move-in and move-out, preparation and installation of SWPPP plans and erosion control features, project schedules, traffic control, office facilities and other relatively minor components of the project.

Compacted Embankment: The cost for excavation and construction of soil and rock materials which comprise the structural fill of dam embankment structures were estimated from review of unit cost bids received from previous dam construction projects and by discussion with local contractors. As the scope of proposed projects are preliminary at best and limits of dam foundation and cutoff trench excavation and sources of borrow material suitable for construction of a dam embankment are unknown, unit costs will need to be reviewed and reevaluated.

Reservoir Basin Excavation: The unit cost for reservoir basin excavation was developed by building the cost from equipment production and hourly cost estimates. Equipment production and cost estimates were obtained from discussions with contractors familiar with similar work in the project area. Costs include time and equipment to load and off-haul the material to an unknown location located within a two hour round trip radius of the project site. Grading of the reservoir basin is assumed to occur during excavation. Costs do not include purchase or acquisition of the disposal site or work performed at the disposal site. The cost for basin excavation can potentially be partially offset or reduced by the sale of excavated material to an aggregate supplier or the lease of the project site to an aggregate supplier who would effectively construct the basin in course of its operations.

Concrete Channel Demolition: The unit cost for demolition was developed by building the cost from equipment production and hourly cost estimates. Equipment production and cost estimates were obtained from discussions with contractors familiar with similar work in the project area. Costs include time and equipment to break-up existing concrete and transport it to a temporary stockpile location on-site. Concrete rubble material would then be loaded for off-haul to an unknown location located within a one hour round trip radius of the project site. Cost can be reduced by establishing an on-site crushing plant to develop recycled aggregate road base for sale to other projects or use on the project site.

Concrete Structures: The unit cost for concrete structures such as basin inlet or outlet spillways were estimated on a per cubic yard unit cost basis. Unit costs were obtained from discussions with contractors familiar with similar work. Unit costs were estimated separately for concrete placed on a base slab and concrete placed on wall-type structures.

Basin Inlet/Outlet Conduits: The unit cost for basin inlet/outlet conduits and gate controls was estimated by review and adjustment of unit cost bids received for similar inlet/outlet conduits and by discussion with local contractors.

Pneumatic Gates: The cost for construction and installation of pneumatic gates was estimated from review of project costs for previous pneumatic gate projects. Material costs for gate components were obtained from the gate manufacturer.

Pipeline: The unit cost for pipelines was developed from review and adjustment of pipeline installation bids received for the Chino Basin Facilities Improvement Project – Bid Package No. 3 which involved the construction of about 11,000 feet of 36-inch CML&C steel pipe between the Jurupa and RP3 basins. Review of bid results indicated that about 70 percent of the cost of the project was for construction of the pipeline and required pipeline appurtenances; the remaining 30% was for miscellaneous required elements such as traffic control and road repair. It is assumed that miscellaneous elements would not vary substantially for projects that varied by pipeline diameters. The total project unit cost for the Jurupa pipeline was about $290 per linear foot. This corresponds to a cost for the pipeline portion of this project of about $200 per foot and other costs of about $90 per foot. Unit costs for pipelines of diameters greater or lesser than 36-inches in diameter were determined on a per inch-diameter basis. The miscellaneous portion of the unit cost was applied without adjustment for pipe diameter differences. All unit costs were updated to current cost values by the composite trend index of the Bureau of Reclamation Construction Cost Trend for July of 2003 and 2009 which yields cost increase of about 32 percent. Portions of proposed pipelines will require horizontal directional drilling or micro-tunneling to pass under highways and canals. Unit costs were obtained from a horizontal drilling contractor and are additive to the cost of the general pipeline unit cost.

Pump Station: The cost for pump stations was estimated from review and adjustment of pump station construction bids received for the Chino Basin Facilities Improvement Project – Bid Package No. 4 which involved construction of the Jurupa Basin Pump Station. The pump station construction cost was updated to current cost values by the composite trend index of the Bureau of Reclamation Construction Cost Trend for July of 2003 and 2009 which yields an increase of about 32 percent. The pump station was designed to accommodate diversion of up to 40 cfs from the Jurupa Basin, however only one of the two ultimate pumps was installed. Costs for pumps ranging from 10 cfs to 40 cfs were obtained from a pump supplier and were used to determine an estimate for construction of the pump station structure (building, wet well, intake conduit, control equipment, etc.), separate from the cost of the pumps. For purposes of this cost evaluation study, it is assumed that the pump station structure cost would be essentially the same for each project. The total pump station cost includes the cost for the pump station structure and cost of pumps required to move the water at the desired rate.

Regulatory Storage Tanks: The cost for regulatory storage tanks were obtained from discussions with a tank supplier. The cost assumes that adequate foundation support is readily available and no significant special factors will affect design of the structures. Tanks may be able to be reduced in capacity or eliminated if it is possible to construct a regulatory reservoir, either by excavation or by balanced cut/fill.

Box Culvert Conduit: The unit cost for construction of box culvert conduits was estimated from information provided by and discussions with a box culvert supplier and contractor familiar with construction and installation of RCB conduits.

Other: Miscellaneous unit or per item costs were obtained from review and adjustment of bid received for similar items constructed for the Chino Basin Facilities Improvement Projects and from the County of Los Angeles, Dept. of Public Works, Rio Hondo Coastal Basin Spreading Grounds and Termino Avenue Drain Projects.

5.7 Conclusions and Recommendations

The Recharge Distribution System is estimated to capture and recharge up to 16,000 acre-ft/yr of additional storm water into the Chino Basin at a capital cost of about $216 million, or $800 per acre-foot annualized for 30-years at an interest rate of 5%. When including estimates for energy and operation and maintenance, the annualized cost is about $1,200 per acre-foot.

The estimated cost for the regional Recharge Distribution System and the additional yield of storm water recharge acquired demonstrate that the concept of improving the diversion and storage capacity of existing recharge basins moving the water to existing and proposed basins for recharge could be cost effective compared to the cost of imported water and warrants further evaluation.

The proposed Recharge Distribution System, if developed in total, includes construction of two new diversion and recharge basins, six new major pump station facilities, over 20 miles of conveyance pipeline, excavation of over 4-million cubic yards of material, installation of pneumatic gates in the spillway or flood control channels of four existing basins, and significant modifications to the inlet facilities of two existing basins.

Table 5-1

Existing Regional Conservation Basin Parameters(1)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
								Maximum Conservation Storage(2)			Rule Curves Apr 16 - Oct 15			Rule Curves Oct 16 - Apr 15			Annual Recharge Estimates(3)					Control Element Settings		
Basins	Owner	Bottom Elevation (ft MSL)	Spillway Elevation (ft MSL)	Maximum Intake Capacity from Channel (cfs)	Storage Volume at Spillway Elevation (af)	Typical Percolation Rate (ft/day)	Recharge Capacity (cfs)	Maximum Operation Depth (ft)	Maximum Operating Elevation (ft MSL)	Storage Volume at Maximum Operating Depth (af)	Elevation (ft MSL)	Storage (af)	Percent Full	Elevation (ft MSL)	Storage (af)	Percent Full	Storm Water (af/yr)	Supplemental Water (af/yr)	Recycled Water (af/yr)	Control Element	Operator	First Storm	Non-Significant Storm	Significant Storm
San Antonio Channel - CB59																				San Antonio Channel Rubber Dam	Rubber dam operated from adjacent control building or SCADA	Deflated	Deflated	Deflated
College Heights West (MZ1)	CBWCD	1,224.0	1,243.0	162.3	87.8	2.5	15	10.0	1,234.0	39.4	NA	NA	NA	NA	NA	NA	50	0	0	San Antonio Channel to College Heights West	Automated Sluice Gate	Closed	Closed	Closed(5)
College Heights East (MZ1)	CBWCD	1,224.0	1,243.0	161.4	83.0	2.5		10.0	1,234.0	33.4	NA	NA	NA	NA	NA	NA				San Antonio Channel to College Heights East	Automated Sluice Gate	Closed	Open	Closed(5)
Montclair 1 (MZ1)	CBWCD	1,099.0	1,127.2	100.0	117.0	1.5	40	28.0	1,127.0	117.0	1,127.2	134.0	100%	1,127.2	134.0	100%	340	2,331	668	San Antonio Channel to Montclair 1	Automated Sluice Gate	Closed	Open	Open
Montclair 2 (MZ1)	CBWCD	1,070.0	1,102.0	-	308.0	1.5		28.0	1,098.0	258.0 (4)	1,098.0	258.0	100%	1,087.0	132.0	51%	370	3,682	1,013	Montclair 1 to Montclair 2	Manual Sluice Gate	Open	Open	Open
Montclair 3 (MZ1)	CBWCD	1,034.0	1,054.0	-	33.0	1.5		20.0	1,054.0	33.0	1,054.0	33.0	100%	1,034.0	0.0	0%	160	1,317	369	Montclair 2 to Montclair 3	Manual Sluice Gate	Open	Open	Open
Montclair 4 (MZ1)	CBWCD	1,010.0	1,037.0	-	111.0	1.5		27.0	1,037.0	111.0	1,037.0	111.0	100%	1,010.0	0.0	0%	250	1,697	487	Montclair 3 to Montclair 4 Montclair 4 to San Antonio Creek	Passive Overflow Passive Overflow	NA NA	NA NA	NA NA
Brooks (MZ1)(5)	CBWCD	860.0	923.0	112.1	200.0	1.5	5	29.0	875/893 (6)	185.0 (6)	888.0	180.0	90%	875.0	65.0	13%	1,710	3,724	1,359	San Antonio Channel to Brooks Basin	Automated Sluice Gate	Closed	Open	Varies(7)
West Cucamonga Channel																								
Ely 1 (MZ2)	SBCFCD	823.0	835.0	NA	85.0	0.5	5	5.0	828.0	22.0	828.0	22.0	26%	828.0	22.0	26%	1,570	3,167	1,184	West Cucamonga Channel to Ely 1 Basin	Manual Sluice Gate	Open	Open	Open
Ely 2 (MZ2)	SBCFCD	825.0	835.0	-	96.0	0.5		3.0	828.0	25.0	828.0	25.0	26%	828.0	25.0	26%				Ely 1 Basin to Ely 2 Basin	Manual Sluice Gate	Open	Open	Open
Ely 3 Cells 1 (MZ2)(8)	CBWCD	820.0	835.0	-	136.0	0.5		3.8	823.8	12.0	823.8	11.8	100%	823.8	11.8	100%				Ely 2 Basin to Ely 3 Basin to Cell 1	Manual Sluice Gate	Open	Open	Open
Ely 3 Cells 2 (MZ2)(8)	CBWCD	820.0	835.0	-		0.5		3.8	823.8	9.0	823.8	8.7	100%	823.8	8.7	100%				Ely 2 Basin to Ely 3 Basin to Cell 2	Manual Sluice Gate	Open	Open	Open
Ely 3 Cells 3 (MZ2)(8)	CBWCD	820.0	835.0	-		0.5		3.8	823.8	9.0	823.8	9.1	100%	823.8	9.1	100%				Ely 2 Basin to Ely 3 Basin to Cell 3 Ely 3 to West Cucamonga Channel	Manual Sluice Gate Automated Sluice Gate	Open Closed	Open Closed	Open Open
Riverside Drive Drain																								
Grove (MZ2)	CBWCD	742.5	767.3	NA	305.5	0.25	NA	5.0	747.5	52.0	742.9	0.0	0%	747.5	52.0	100%	NA	NA	NA	Grove Basin to Grove Ave.	Automated Sluice Gate	Closed	Closed	Open
Cucamonga/Deer Cr Channels - CB11																				Cucamonga Channel Rubber Dam	Rubber dam operated from adjacent control building or SCADA	Deflated	Inflated	Deflated
Turner 1 (MZ2)	CBWCD	965.0	1,000.0	255.0 182.7	266.0	0.5	6	13.0	978.0	56.0	981.0	80.0	30%	978.0	56.0	21%	1,240	1,098	584	Cucamonga Channel Inlet to Turner Basin 1 Deer Creek Channel Drop Inlet (48" pipe) to Turner Basin 1	Automated Sluice Gate Automated Sluice Gate	Closed Closed	Open Closed	Open Closed
Turner 2 (MZ2)	SBCFCD	968.0	990.0	-	52.0	0.5		10.0	978.0	16.0	978.0	16.0	31%	978.0	16.0	31%				Turner Basin 1 to Turner Basin 2 (42" pipe)	Manual Sluice Gate	Closed(9)	Closed(9)	Open
Turner 3 (MZ2)	SBCFCD	966.0	986.5	-	120.0	0.5		12.0	978.0	60.0	978.0	59.6	50%	978.0	59.6	39%	640	937	394	Turner Basin 4 to Turner Basin 3 (42" pipe)	Manual Sluice Gate	Open	Open	Closed
Turner 4 (MZ2)	SBCFCD	961.0	987.0 (10)	224.9	50.0	0.5		17.0	978.0	25.0	978.0	25.0	39%	978.0	25.0	50%				Deer Creek Drop Inlet (48" pipe) to Turner Basin 4	Automated Sluice Gate	Closed	Open	Closed
Etiwanda Channel - CB14																								
Victoria North (MZ2)	SBCFCD	1,313.0	1,318.0	100.0	28.5	1.5	6	3.0	1,316.0	19.0	1,317.5	23.7	67%	1,317.5	23.7	67%	2,090	2,365	1,114	San Sevaine Channel Outlet/Inlet to Victoria Basin North	Automated Sluice Gate	Closed	Open	Closed
Victoria South (MZ2)(11)	SBCFCD	1,309.0	1,318.0	-	47.1	1.5		7.0	1,316.0	31.8	1,317.5	43.2	84%	1,317.5	43.2	84%				Victoria Basin North to Victoria Basin South Victoria Basin South to San Sevaine Channel	Manual Sluice Gate Automated Sluice Gate	Open Closed	Open Closed	Open Closed
Etiwanda Conservation Ponds (MZ3)	SBCFCD	1,010.0	1,048.0	NA	120.0	1.0	NA	11.0	1,048.0	120.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DeClez Channel																				DeClez Channel Rubber Dam DeClez Channel Outlet/Inlet to Feeder Channel(13) Feeder Channel to RP3 Junction Structure Feeder Channel Flow Control Feeder Channel Outlet to DeClez Channel	Rubber dam operated from adjacent control building or SCADA Automated Sluice Gate Manual Sluice Gate Manual Sluice Gate Manual Sluice Gate	Deflated Closed Closed(14) Closed(15) Closed	Inflated Open Closed(14) Closed(15) Closed	Deflated Open Closed(14) Closed(15) Closed
RP3 Cell 1a (MZ3)	IEUA	948.0	952.0	-	20.0	2.5	7	2.0	950.0	10.0	952.0	20.0	100%	952.0	20.0	100%	1,330	6,562	1,973	Jurupa Basin to RP3 Cell 1a RP3 Cell 1a to Junction Structure	Automated Valve Manual Sluice Gate	NA Open	NA Open	NA Open
RP3 Cell 1b (MZ3)	IEUA	948.0	952.0	-	13.2	2.5		2.0	950.0	6.3	952.0	13.2	100%	952.0	13.2	100%				RP3 Cell 1b to Junction Structure	Manual Sluice Gate	Open	Open	Open
RP3 Cell 2 (MZ3)	IEUA	949.0	955.0	-	48.1	2.5		4.0	953.0	31.4	949.0	0.0	0%	955.0	48.1	100%				Feeder Channel to RP3 Cell 2	Manual Sluice Gate	Open	Open	Open
RP3 Cell 3a (MZ3)	IEUA	941.0	946.0	-	12.9	2.5		3.0	944.0	7.4	945.0	10.3	80%	945.0	10.3	80%				Feeder Channel to RP3 Cell 3a	Manual Sluice Gate	Open	Open	Open
RP3 Cell 3b (MZ3)	IEUA	941.0	946.0	-	13.2	2.5		3.0	944.0	6.3	945.0	10.6	80%	945.0	10.6	80%				Feeder Channel to RP3 Cell 3b	Manual Sluice Gate	Open	Open	Open
RP3 Cell 4a (MZ3)	IEUA	937.0	942.0	-	13.1	2.5		3.0	940.0	9.6	941.0	10.5	80%	941.0	10.5	80%				Feeder Channel to RP3 Cell 4a	Manual Sluice Gate	Open	Closed	Closed
RP3 Cell 4b (MZ3)	IEUA	937.0	942.0	-	15.1	2.5		3.0	940.0	7.3	941.0	12.1	80%	941.0	12.1	80%				Feeder Channel to RP3 Cell 4b	Manual Sluice Gate	Open	Closed	Closed

Notes:

(1) Recharge Basin Operating Parameters represent the most recent available data reported in either the March 2006 Chino Basin Recharge Facilities Operation Procedures prepared for the Groundwater Recharge Coordinating Committee by WEI, the August 2001 Recharge Master Plan Phase II Report prepared for Chino Basin Watermaster by WEI and Black & Veatch, the January 1998 Chino Basin Recharge Master Plan prepared for CBWCD and Chino Basin Watermaster by WEI, SBCFCD Facility Drawings, or SBCFCD Zone 1 Project Systems Inventory.

(2) Water level and storage generally associated with the maximum storage with one foot of freeboard.

(3) Recharge estimates post Chino Basin Facilities Improvement Project.

(4) Open when San Antonio Dam releases and water quality is acceptable.

(5) Exception to the rule for 7-day perc out due to basin geometry. Maximum Inlet Capacity from West State Street is 96.24 cfs.

(6) Brooks Street Basin has a desired maximum operation elevation of 893 feet MSL. Groundwater monitoring is being done in piezometers adjacent this basin to determine slope stability. Pending evaluation of this monitoring data, 875 feet MSL will be the maximum operating water surface elevation for supplemental recharge operations. Storm water can be retained in Brooks Street Basin in excess of 875 feet MSL provided that no additional supplemental water will be discharged into the basin until the water surface elevation falls below 875 feet MSL.

(7) Generally, gate should be open to capture storm water from San Antonio Creek. Gate SAC-BRK-A must be closed if water surface elevation in Brooks Street is greater than the inlet elevation.

(8) The storage shown for Ely 3 Maximum Conservation Storage and Rule Curves is based on the storage at the top of internal berms, minus 1.0 foot.

(9) Closed until Turner 1 is full.

(10) Only possible if Deer Creek gate DRC-TR4-A is shut and local flow fills basins.

(11) Maximum Inlet Capacity from Etiwanda Channel is 156.2 cfs.

(12) Open if Banana Basin is full.

(13) Maximum Intake Capacity from Declez Channel to RP3 Diversion is 192.0 cfs.

(14) Changed from March 2006 document per personal communication from Andy Campbell. Adjusted Rule Curve elevations based on capacity curves in March 2006 document.

(15) Closed until Cell 3 is full.

Table 5-2

Existing Regional Multi-Purpose Basin Parameters(1)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
								7-Day Perc Out(2)			Maximum Conservation Storage(3)			Operating Range for Water Surface Elevation		Annual Recharge Estimates(4)					Control Element Settings		
Basins	Owner	Bottom Elevation (ft MSL)	Spillway Elevation (ft MSL)	Maximum Intake Capacity from Channel (cfs)	Storage Volume at Spillway Elevation (af)	Typical Percolation Rate (ft/day)	Recharge Capacity (cfs)	Water Surface Elevation (ft MSL)	Depth (ft)	Volume (af)	Maximum Operation Depth (ft)	Maximum Operating Elevation (ft MSL)	Storage Volume at Maximum Operating Depth (af)	Min (ft MSL)	Max (ft MSL)	Storm Water (af/yr)	Supplemental Water (af/yr)	Recycled Water (af/yr)	Control Element	Operator	First Storm	Non-Significant Storm	Significant Storm
San Antonio Channel - CB59																			San Antonio Channel Rubber Dam	Rubber dam operated from adjacent control building or SCADA	Deflated	Deflated	Deflated
Upland (MZ1)	City of Upland	1,145.0	1,225.7	80.7	1,236.0	2.0	20	1,174.0	29.0	278.0	70.0	1,215.0	960.0	1,174.0	1,215.0	580	0	0	San Antonio Channel to Upland	Automated Sluice Gate	Closed	Closed	Closed
West Cucamonga Channel																							
8th Street North (MZ1)	SBCFCD	1,134.0	1,151.7	-	NA	0.5	5	1,137.5	3.5	24.0	5.0	1,139.0	36.0	1,137.5	1,139.0	1,020	2,196	804	8th St. North to 8th St. South	Manual Sluice Gate	Closed	Closed	Open
8th Street South (MZ1)	SBCFCD	1,127.0	1,151.7	-	NA	0.5		1,135.0	8.0	7.0	12.0	1,139.0	26.0	1,135.0	1,139.0				8th St. South to 7th St. Basin	Automated Sluice Gate	Closed	Closed	Open
7th Street (MZ1)	SBCFCD	1,124.0	1,134.0	-	48.0	0.5		1,127.5	3.5	11.0	9.0	1,133.0	42.0	1,127.5	1,133.0				7th St. Basin to West Cucamonga Channel	Automated Sluice Gate	Closed	Closed	Open
Day Creek Channel - CB15																			Day Creek Channel Rubber Dam	Rubber dam operated from adjacent control building or SCADA	Deflated	Inflated	Deflated
Lower Days Cell 1 (MZ2)	SBCFCD	1,370.0	1,395.0	62.3	502.0	1.5	9	1,377.0	8.0	23.0	8.0	1,378.0	26.0	1,377.0	1,377.0	2,180	2,027	1,052	Day Creek Channel to Lower Day Basin 1	Automated Sluice Gate	Closed	Open	Open
Lower Days Cell 2 (MZ2)	SBCFCD	1,365.0	1,395.0	-		1.5		1,372.0	8.0	27.0	8.0	1,373.0	31.0	1,372.0	1,372.0				Lower Day 1 to Lower Day 2	Manual Sluice Gate	Open	Open	Open
Lower Days Cell 3 (MZ2)	SBCFCD	1,362.0	1,395.0	-		1.5		1,372.0	10.0	49.0	8.0	1,373.0	31.0	1,372.0	1,372.0				Lower Day 2 to Lower Day 3 Lower Day 3 to Day Creek Channel	Manual Sluice Gate Manual Sluice Gate	Open Closed	Open Closed	Open Closed(5)
Etiwanda Channel - CB14																							
Etiwanda Debris Basin (MZ2)	Under Construction	TBD	TBD	TBD	TBD	TBD	7	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
San Sevaine Channel - CB13																			San Sevaine Channel Rubber Dam	Rubber dam operated from adjacent control building or SCADA	Deflated	Inflated	Deflated
San Sevaine #1 (MZ2)	SBCFCD	1,487.0	1,493.0	-	22.0	1.0	50	1,494.0	7.0	22.0	4.0	1,494.0	22.0	1,494.0	1,494.0	930	8,310	2,310	NA	NA	NA	NA	NA
San Sevaine #2 (MZ2)	SBCFCD	1,471.0	1,477.0	-	20.0	1.0		1,477.0	6.0	20.0	6.0	1,477.0	20.0	1,477.0	1,477.0	110	1,723	458	NA	NA	NA	NA	NA
San Sevaine #3 (MZ2)	SBCFCD	1,457.0	1,462.0	-	17.0	1.0		1,462.0	5.0	17.0	5.0	1,462.0	17.0	1,462.0	1,462.0	770	3,673	1,111	NA	NA	NA	NA	NA
San Sevaine #4 (MZ2)	SBCFCD	1,440.0	1,447.0	-	13.0	1.0		1,447.0	7.0	13.0	7.0	1,447.0	13.0	1,447.0	1,447.0	630	4,771	1,350	NA	NA	NA	NA	NA
San Sevaine #5 (MZ2)	SBCFCD	1,382.0	1,400.0	121.0	35.0	0.5		1,385.5	3.5	NA	3.5	1,385.5	NA	1,385.5	1,385.5				NA	NA	NA	NA	NA
West Fontana Channel - CB18																							
Banana (MZ3)	SBCFCD	1,133.0	1,146.0	NA	76.0	0.5	5	1,142.0	9.0	35.0	11.0	1,144.0	60.0	1,142.0	1,142.0	410	2,196	651	Whittram Regional Pipeline Outlet to Banana Basin Banana Basin Outlet to West Fontana Channel	Automated Valve Automated Sluice Gate	Closed Closed	Closed Closed	Closed Open
Hickory East (MZ2)	SBCFCD	1,110.0	1,115.0	-	18.0	0.5	5	1,116.0	6.0	21.9	3.0	1,113.0	10.0	1,116.0	1,116.0	780	4,395	1,294	Whittram Regional Pipeline Outlet to Hickory East Ce	Automated Valve	Closed	Closed	Closed
Hickory West (MZ2)	SBCFCD	1,101.0	1,115.0	108.9	43.0	0.5		1,110.0	9.0	11.1	12.0	1,113.0	30.0	1,110.0	1,110.0				San Sevaine Channel Inlet to Hickory West Cell Hickory East Cell to Hickory West Cell Hickory West Cell to Hickory Basin Afterbay	Automated Sluice Gate Automated Sluice Gate Manual Sluice Gate	Closed Open Closed	Open(12) Open Closed	Closed Open Open
DeClez Channel																			DeClez Channel Rubber Dam DeClez Channel Outlet/Inlet to Feeder Channel Feeder Channel to RP3 Junction Structure Feeder Channel Flow Control Feeder Channel Outlet to DeClez Channel	Rubber dam operated from adjacent control building or SCADA Automated Sluice Gate Manual Sluice Gate Manual Sluice Gate Manual Sluice Gate	Deflated Closed Closed(6) Closed(7) Closed	Inflated Open Closed(6) Closed(7) Closed	Deflated Open Closed(6) Closed(7) Closed
DeClez Cell 1 (MZ3)	SBCFCD	825.0	832.0	-	42.7	0.7	6	831.0	6.0	36.0	5.0	830.0	29.3	831.0	831.0	80	3,547	907	DeClez Basin 1 to DeClez Basin 2	Automated Sluice Gate	Closed	Closed	Open
DeClez Cell 2 (MZ3)	SBCFCD	823.0	830.0	-	29.1	0.7		829.0	6.0	25.0	5.0	828.0	20.1	829.0	829.0				DeClez Basin 2 to DeClez Basin 3	Automated Sluice Gate	Closed	Closed	Open
DeClez Cell 3 (MZ3)	SBCFCD	821.0	829.0	-	30.0	0.7		828.0	7.0	26.0	6.0	827.0	21.8	828.0	828.0				DeClez Basin 3 to DeClez Channel	Automated Sluice Gate	Closed	Closed	Open

Notes:

(1) Recharge Basin Operating Parameters represent the most recent available data reported in either the March 2006 Chino Basin Recharge Facilities Operation Procedures prepared for the Groundwater Recharge Coordinating Committee by WEI, the August 2001 Recharge Master Plan Phase II Report prepared for Chino Basin Watermaster by WEI and Black & Veatch, the January 1998 Chino Basin Recharge Master Plan prepared for CBWCD and Chino Basin Watermaster by WEI, SBCFCD Facility Drawings, or SBCFCD Zone 1 Project Systems Inventory.

(2) The lesser of the volume of water that can be percolated out of the basin in seven days or the maximum allowable storage with one foot of freeboard.

(3) Water level and storage generally associated with the maximum storage with one foot of freeboard.

(4) Recharge estimates post Chino Basin Facilities Improvement Project.

(5) Closed until the water surface elevation equals the midlevel height of the outlet invert.

(6) Closed until Cell 1 is full.

(7) Closed until Cell 3 is full.

Table 5-3

Existing Regional Flood Control Basin Parameters[1]

Basins	Owner	Bottom Elevation (ft MSL)	Spillway Elevation (ft MSL)	Maximum Intake Capacity from Channel (cfs)	Storage Volume at Spillway Elevation (af)	Typical Percolation Rate (ft/day)
West Cucamonga Channel						
Princeton (MZ1)	SBCFCD	1,070.0	1,077.0	NA	6.4	0.5
Cucamonga/Deer Cr Channels - CB11						
Lower Cucamonga Spreading Grounds (MZ2)	SBCFCD	714.0	730.0	NA	Varies (70 ac)	0.1
Chris (MZ2)	CBWCD	715.0	720.0	NA	NA	0.1
Day Creek Channel - CB15						
Wineville (MZ3)	SBCFCD	864.0	869.0	NA	95.0	0.5
Riverside (MZ3)		780.0	813.0	NA	840.0	0.5
San Sevaine Channel - CB13						
Rich (MZ2)	SBCFCD			NA	87.0	1.0
Jurupa (MZ3)	SBCFCD	885.0	927.0	23.2	1,365.0	0.5
East Fontana Storm Drain						
Linden (MZ3)	SBCFCD	1,195.0	1,201.7	NA	146.6	2.0
Merrill (MZ3)	SBCFCD	1,201.0	1,214.0	NA	79.1	2.0

Notes:

(1) Recharge Basin Operating Parameters represent the most recent available data reported in either the March 2006 Chino Basin Recharge Facilities Operation Procedures prepared for the Groundwater Recharge Coordinating Committee by WEI, the August 2001 Recharge Master Plan Phase II Report prepared for Chino Basin Watermaster by WEI and Black & Veatch, the January 1998 Chino Basin Recharge Master Plan prepared for CBWCD and Chino Basin Watermaster by WEI, or 1976 SBCFCD Project Systems Inventory for zone 1.

Table 5-4

Information on Rubber Dam Automation Within the Chino Basin Boundary

Dam Location (Basin/Creek)	Channel Elevation (feet msl)	Dam Height (feet)	Top of Dam Elevation (feet msl)	Plus Depth to Auto Deflate (inches)	Auto-Deflation Elev. (feet msl)	Max Pressure Setpoint (feet of water)	Max WL Setpoint (feet)
College Heights /San Antonio	1,242	4.0	1,246	9-5/8"	1,247	4.8	4.0
Hickory/San Sevaine	1,114	5.0	1,119	12"	1,120	4.8	4.0
Lower Day/ Day Crk	1,460	3.3	1,463	7-7/8"	1,464	3.9	3.3
RP3 / Declez Crk	947	5.0	952	12"	953	6.8	7.5
Turner Basin #1 / Cucamonga Crk	996	4.5	1,000	10-3/4"	1,001	5.4	4.5

Table 5-5
City of Chino Storm Water Recharge

Map ID	Project Name	Project No.	Stormwater BMP	Approximate Surface Area (ac)	Length (ft)	Storage Volume (af)	Typical Percolation Rate (ft/day)	Tributary Drainage Area (ac)	Notes
1	Watson Commerce Center (Nature's Best)	SA 05-35	Vegetated Swale	-		-	3.0-6.0	22	Discharges to Detention Basin. (LOCATION UNCERTAIN)
			Detention Basin	0.21	-	2.2	3.0-6.0		
			Underground Retention Chamber	-	-	0.23	3.0-6.0		Stormtech SC-740, 216 units, 12 rows x 18 units long
2	Watson Industrial Building (816)	SA 05-36	Vegetated Swale (Swale A)	0.02	224	0.09	2.0	14	6 inch underdrain pipe conveys low flows from one swale to the next, and discharging to the basin. Overflow drains directly to existing storm drains.
			Vegetated Swale (Swale B)	0.06	616	0.26	2.0		
			Vegetated Swale (Swale C)	0.03	296	0.22	2.0		
			Detention Basin	0.07	-	0.79	5.0		
3	Euclid Plaza (Stater Bros. Market)	SA 05-30	Vegetated Swale (Swale B1)	0.01	170	0.0119	2.5	15	
			Vegetated Swale (Swale B3)	0.01	156	0.0119	2.5		
			Vegetated Swale (Swale B4)	0.01	201	0.0147	2.5		
			Vegetated Swale (Swale B5)	0.01	146	0.0141	2.5		
4	Victory Outreach Church	SA 05-38	Underground Retention Chamber	0.61	-	1.44	2.0	1.2	Cultec Recharger 330HD, 840 units, 60 rows x 14 units long
5	Carson Companies Industrial Buildings	SA 05-03	Detention Basin	6.58	-	72.75	0.2	92	Cypress Channel Diversion. Designed for 100 yr Event .
6	Yoshimura	PM-15166	Vegetated Swale	0.07		-	0.04-2.0	1.5	
7	Brehm Communities (The Preserve)	TM-17055	Detention Basin	0.44	-	2.6	0.2	31	
8		Tract 16419	Wetlands/Detention Basin	2.75	-	10.0	0.18	269	Bickmore Basin (Forebay is 2.2 af) (5 ac of basin floor covered by liner)
			Wetlands/Detention Basin Forebay	4.53	-	10.40	0.18	390	Kimball Basin: 7.5 ac of basin floors covered by liner
			Wetlands/Detention Basin Cell 1	5.51	-	43.78	0.18		
			Wetlands/Detention Basin Cell 2	5.49	-	44.56	0.18		
			Wetlands/Detention Basin Cell 3	5.77	-	44.71	0.18		
9		Tracts 17635, 17057, & 17572	Detention Basin	0.37	-	1.16	0.18	21	Northern Basin 1 (LOCATION UNCERTAIN)
			Detention Basin	0.28	-	0.9	0.18	22	Southern Basin 2 (LOCATION UNCERTAIN)
10		Tract 17571	Detention Basin	1.43	-	9.6	0.18	65	
11		Tract 16419 (Phase 2)	Temporary Detention Basin	1.18	-	3.5	-	305	"Hellman Basin"
12	Rancho Del Chino (Panattoni Retail)	TM -17819	Detention Basin	0.30	-	1.26	0.8	24	
13	College Park Phase 1	Tr 16837	Detention Basin	5.21	-	27.0	2.5-3.0	164	An estimated 50 ac drains directly to the swales, which discharge to existing storm drains.
			Vegetated Swale	0.16	1,295	0.05	2.5-3.0		
14	Chino Business Center	SA 05-10	Vegetated Swale	0.71	-	-	-	0.0	
15	Watson Industrial Buildings (818 & 819)	SA 05-34	Vegetated Swale A	0.08	820	0.53	3.0	28	(TRUE LENGTH AND VOLUME UNCERTAIN)
			Vegetated Swale B	0.06	420	0.79	3.0		(TRUE LENGTH AND VOLUME UNCERTAIN)
			Vegetated Swale C	0.06	425	0.38	3.0		(TRUE LENGTH AND VOLUME UNCERTAIN)
16	Larry Biggs Parking Lot	SCUP 05-35	Infiltration Trench	0.07		0.04	4.0	0.8	
17	Canyon Ridge Hospital	SCUP 558	Detention Basin	0.05		0.04	0.3	1	(ACTUAL CONSTRUCTION DIFFERS FROM PLAN)
18	Don Lugo High School	-	Detention Basin	0.96		0.71	-	47	
19	Ayala Park Expansion	-	Vegetated Swale	NA	2,222	-	3.0-14.1	38	13 different Swales
Total				**43.1**		**280**		**1,555**	

Table 5-6

City of Fontana Storm Water Recharge

Map ID	Project Name	Approximate Surface Area (ac)	Tributary Drainage Area (ac)	Notes
1	NA	0.36	14.9	Would otherwise drain to Banana or Hickory Basins
2	NA	0.86	19.6	Would otherwise drain to Banana or Hickory Basins
3	NA	0.53	11	Would otherwise drain to Banana or Hickory Basins
4	NA	0.86	17.2	Would otherwise drain to Banana or Hickory Basins
5	NA	4.75	85.2	Would otherwise drain to Banana or Hickory Basins
6	NA	2.34	81	Would likely otherwise drain outside of Chino Basin.
7	NA	0.16	8.2	Would likely otherwise drain outside of Chino Basin.
8	NA	0.37	15.7	Would likely otherwise drain outside of Chino Basin.
9	NA	0.29	9.9	Would likely otherwise drain outside of Chino Basin.
10	NA	0.83	8.6	Would likely otherwise drain outside of Chino Basin.
11	NA	0.27	7.2	Outside of Chino Basin. Would likely otherwise drain outside of Chino Basin.
12	NA	0.27	5.5	Would likely otherwise drain outside of Chino Basin.
13	NA	0.21	34.7	Outside of Chino Basin. Would likely otherwise drain outside of Chino Basin.
14	NA	0.45	18.9	Outside of Chino Basin. Would likely otherwise drain outside of Chino Basin.
15	NA	0.55	6.4	Outside of Chino Basin. Would likely otherwise drain outside of Chino Basin.
16	NA	0.79	30.7	Outside of Chino Basin. Would likely otherwise drain outside of Chino Basin.
17	NA	0.59	32.4	Outside of Chino Basin. Would likely otherwise drain outside of Chino Basin.
18	NA	0.46	12	Outside of Chino Basin. Would likely otherwise drain outside of Chino Basin.
19	NA	0.73	21.7	Would otherwise drain to Banana or Hickory Basins
20	NA	0.20	16.4	Would otherwise drain to Banana or Hickory Basins
21	NA	0.17	30.8	Would otherwise drain to Banana or Hickory Basins
22	NA	0.33	19	Would otherwise drain to Banana or Hickory Basins
23	NA	0.37	4.4	Would otherwise drain to Banana or Hickory Basins
24	NA	4.12	167.9	Would otherwise drain to Banana or Hickory Basins
25	NA	0.69	14.2	Would otherwise drain to Banana or Hickory Basins
26	NA	0.38	19.2	Would otherwise drain to Banana or Hickory Basins
27	NA	0.97	47.5	Would otherwise drain to Banana or Hickory Basins
28	NA	4.78	338.7	Would otherwise drain to RP3 Basins
32	NA	0.70	18.1	Outside of Chino Basin. Would likely otherwise drain to San Sevaine Basins.
33	NA	2.25	37.4	Outside of Chino Basin. Would likely otherwise drain to San Sevaine Basins.
41	Sierra Lakes Golf Club	0.50	115.4	Outside of Chino Basin. Would likely otherwise drain to Victoria Basins.
42	Sierra Lakes Golf Club	0.20	28.4	Outside of Chino Basin. Would likely otherwise drain to Victoria Basins.
43	Sierra Lakes Golf Club	0.35	14.6	Outside of Chino Basin. Would likely otherwise drain to Victoria Basins.
44	Sierra Lakes Golf Club	0.16	44.3	Outside of Chino Basin. Would likely otherwise drain to Victoria Basins.
45	Sierra Lakes Golf Club	0.15	14.5	Outside of Chino Basin. Would likely otherwise drain to Victoria Basins.
46	Sierra Lakes Golf Club	0.18	73.5	Outside of Chino Basin. Would likely otherwise drain to Victoria Basins.
Total		**46.1**	**1,445**	

Table 5-7

City of Montclair Storm Water Recharge

Map ID	Basin Name	BMP	Approximate Surface Area (ac)	Storage Volume (af)	Typical Percolation Rate (ft/day)	Tributary Drainage Area (ac)	Notes
1	4855 Mission Blvd	Underground Chamber Vault	0.09	0.17	17.1	1.5	
2	Chaffey West Community Day School	Infiltration Trench and Vegetated Swale	NA	0.13	NA	5.0	Would otherwise drain to Brooks Basin
3	Montclair Retail Center	Infiltration Trench and Vegetated Swale	0.11	0.06	1.8	0.6	
4	Storage Specialists LLC	Infiltration Basin and Vegetated Swale	0.06	0.09	15.0	2.5	Would otherwise drain to Montclair Basins
Total			**0.26**	**0.45**		**9.6**	

Table 5-8

City of Ontario Storm Water Recharge

Map No.	Project No.	Name of Project	APN	Project Acres	Structural BMP	Status	Approximate Surface Area (ac)	Storage Volume (af)	Tributary Drainage Area (ac)	Infiltration Capacity (ft/day)	Vegetated Swale	Infiltration/ Detention Basin	Drywell	Infiltration Trench	Underground Chamber Vault	Pervious Pavement	Roof Well	Notes
1	99-048-S	Belmont Business Park	1049-401-03,04 to 09	7.02	Detention Basin+SunTree Filters	Complete	0.03	0.19	7.02	2		1						Would otherwise drain to Ely Basins
2	99-068-S	Walgreens	0218-041-29	1.68	2 - Pervious Turf Filter channels	Complete					2							Minimal infiltration capacity
3	PDEV00-030	Milliken Francis LLC	0238-152-01, 03	5.96	Veg.Swale+1-MaxWell Plus+SunTree Filter	Complete			5.96	688	1		1					
4	PDEV00-047	Empire Towers, Bldg IV	0210-205-16	2.88	4 shallow infiltration trenches+ 4 SunTree filters	C-10/12/04								4				Infilt trenches located between parking spaces. Minimal infiltration capacity
5	PDEV00-052	ACCO Airport Center	0211-263-37	3.98	5 - Turf Swales/2-pervious natural channels	Complete					5							Minimal infiltration capacity
6	PDEV00-057	Access Mini Storage	1050-181-17	2.81	Detention Basin + 2-SunTree filters	C-10/24/04	0.02	0.05	3.35	2		1						Would otherwise drain to Ely Basins
7	PDEV00-059	Bldg NWC Pointe/Philadel	0211-275-24	1.00	Underground retention/infiltration chambers (4)	C- 1/4/06	0.01	0.01	1.00	2					4			
8	PDEV00-064	AAA Self Storage	1011-192-04	2.74	1-Detention Basin	Complete	0.01	0.00	2.74	2		1						
9	PDEV00-076	West Locust Court	0113-395-45,46,41	6.24	6-Perv Channels, 4-Filters,3 roof wells	Complete	0.00	0.00	8.05	2	6			4				
10	PDEV00-077	Ontar Gateway West, II	0113-401-06	17.89	2-MaxWell Plus + 1-Drainage Channel	Complete			17.89	688	1		2					Would otherwise drain to Ely Basins
11	PDEV01-005	Vogel Engineers, Inc.	0238-133-44, 43	5.76	2-10'x3' Porous Channels+2 roof wells	Complete					2						2	Minimal infiltration capacity
12	PDEV01-011	Kobold Indust Pk, Phase 2	1011-211-14,15 to 21	5.23	2-4'x80' ADS Leach Lines+SunTree Filt	Complete	0.02	0.08	5.23	2								
13	PDEV01-012	Guasti Ontario	0238-042-25	6.12	1 - 6' x 75' underground retention/infiltration trench	Complete	0.01	0.07	6.12	2		1						
14	PDEV01-013	Vogel Engineers, Inc.	0238-132-04, 05	6.40	2 - Drainage Swales + 2 Fossil Filters	Complete					2							Minimal infiltration capacity
15	PDEV01-029	Grove Ave Business Pk.	1050-481-30 1050-491-17	0.77	2- CSR Stormceptors + 2 Rock Swales	Complete					2							Minimal infiltration capacity. Would otherwise drain to Grove Basin.
16	PDEV01-030	Pat & Oscar's Restaur	0238-014-45	1.37	1- 2'x6' Filter Drain Channel	Complete					1							Minimal infiltration capacity
17	PDEV01-039	Nissin Cap Inc.	1050-451-04	4.67	2 - MaxWell IV Drainage Systems	Complete			4.67	688			2					Would otherwise drain to Grove Basin
18	PDEV01-042	Tom's Burger #1	0211-263-34	0.94	2 - Grassy Swales+ Trash Enc drain	C- 7/20/04					2							Minimal infiltration capacity
19	PDEV01-047	Haven Bldg G	0211-275-46	0.99	1 -Grassy Swale + Fossil Filter insert	Complete					1							Minimal infiltration capacity
20	PDEV01-048	Crown Lexus	0238-251-13	4.75	1-MaxWell IV + 1- Drain-Pac filter insert	Complete			4.75	688			1					
21	PDEV01-050	Campus Self-Storage	1050-211-03	3.08	1-MaxWell IV + 1-Drain-Pac Filter insert	C-7/10/06			3.08	688			1					Would otherwise drain to Ely Basins
22	PDEV01-053	Panattoni Development	0211-222-70	9.51	1-Swale + 1-MaxWell IV + 4 Fossil Filter inserts	Complete			9.51	688	1		1					
23	PDEV01-058	Calif Manufacturing Corp	1050-521-01	1.12	1-Grassy Swale/Basin	Complete	0.02	0.06	1.12	2	1							Would otherwise drain to Grove Basin
24	PDEV01-062	Airport Drive Industrial	0238-044-24	1.13	1- Stormgate Separator + 1-vegetated swale	C- 11/8/05					1							Minimal infiltration capacity
25	PDEV01-064	The Village/Ontario Ctr	0210-204-29	8.06	1-underground retention/infiltration pipe/trench 5'x260'	Complete	0.04	0.12	12.79	2				1				
26	PDEV02-001	47 Jurupa Partnership	0238-132-23	7.38	1- MaxWell IV Drywell + Retention Basin	Complete	0.06	0.03	7.38	10			1					
27	PDEV02-002	Cedar St Industrial	0113-461-33	3.79	1-Grass Swale + HydroCartridge Filter	Complete					1							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
28	PDEV02-003	Waxie - Ontario	0238-021-66	11.76	Grass Swales + SunTree Filter	Complete					2							Minimal infiltration capacity
29	PDEV02-005	Vineyard Townhomes	0110-441-15,16 to 47 0110-441-49,50 to 87 0110-441-91	6.32	2-MaxWell Plus, 3300+1200 cu ft Ret/Inf Chambers	C-12/10/04	0.01	0.10	6.32	86			2	1				Would otherwise drain to Turner Basins
30	PDEV02-006	Burgundy/Philadelphia	0238-152-22	3.26	1-Large Grass Swale, 1 - curb drain filter	Complete					1							Minimal infiltration capacity
31	PDEV02-009	Ontario Towne Center	1011-141-10	6.27	3-Vegetated Swales	C-12/22/04					3							Minimal infiltration capacity. Would otherwise drain to Brooks Basin.
32	PDEV02-014	MBK Homes	0110-531-01,02 to 71 0110-531-86,87	15.00	1-Detention Basin	C-10/26/04	0.13	0.13	15.00	2		1						
33	PDEV02-015	Richard Dick & Assoc	0238-121-63	3.83	1-Grass Swale, 2-BioClean Filters+ 1-CDS PMSU20_20	Complete					1							Minimal infiltration capacity
34	PDEV02-025	RiverArch Shopping Ctr	0218-041-36	2.30	1-Vortsentry Sep + 2-underground 36" retention/infiltration pipes	C- 7/10/05	0.04	0.13	2.30	2				1				
35	PDEV02-026	Washingtom Mutual	0218-041-30	1.09	1- BioClean filter insert + 1-underground 36" retention/infiltration pipe	C- 1/31/05	0.02	0.08	1.09	2				1				
36	PDEV02-027	Campus Court LLC	1050-441-63,64 to 72	8.62	2-Bioswales + 4-Maxwell IV drywells	C-5/13/05			8.62	688	2		4					Would otherwise drain to Grove Basin
37	PDEV02-029	Richard Dick & Assoc	0238-121-62	2.01	Grass Swale, 1-SunTree Filter	Complete					1							Minimal infiltration capacity
38	PDEV02-034	Hampton Inn & Suites	0238-014-15	1.82	1 MaxWell drywell,1 Fossil Filter, 1-grass swale	C-12/21/04			1.82	688	1		1					
39	PDEV02-036	CSI Ontario Senior House	0110-254-77,78	6.17	2 Large Grass Swales, 2 SunTree Filters	C-1/31/05					2							Minimal infiltration capacity
40	PDEV02-044	Concours Plaza	0210-182-70	1.67	Grass Swale, 1-MaxWell Plus drain sys	Complete			4.67	688	1		1					
41	PDEV02-045	Ontario Spectrum Bus Ctr	0211-232-53	1.31	SunTree Filters, 1-MaxWell Plus System	Complete			1.31	688			1					

Table 5-8

City of Ontario Storm Water Recharge

Map No.	Project No.	Name of Project	APN	Project Acres	Structural BMP	Status	Approximate Surface Area (ac)	Storage Volume (af)	Tributary Drainage Area (ac)	Infiltration Capacity (ft/day)	Vegetated Swale	Infiltration/ Detention Basin	Drywell	Infiltration Trench	Underground Chamber Vault	Pervious Pavement	Roof Well	Notes
42	PDEV02-050	PC Indust.Distribution Fac	0113-343-30	3.13	1- Large Vegetated Retention/Infiltration Basin	C-6/28/05	0.28	0.76	3.13	2		1						Would otherwise drain to Ely Basins
43	PDEV02-051	Legacy I	0211-242-24	5.88	2-CDS Units+2-MaxWell Plus drywells	C-1/10/08			5.88	688			2					
44	PDEV02-052	Euclid Garden Apts.	1050-591-17	1.75	1-Retention Basin + 1-MaxWell Plus Drywell	C-8/21/06	0.03	0.08	1.75	17		1	1					
45	PDEV02-062	Shilpark Paint	0218-051-76	0.00	1-Infilt Basin+2-Drainpac filters+1-MaxWell Plus	C- 6/10/05	0.06	0.57	0.00	10		1	1					
46	PDEV02-065	MLRCE Warehouse Bldg	0211-301-18	3.81	1 MaxWell IV, Large landscape swale	C- 7/27/04			4.90		1		1					
47	PDEV02-069	Ontario Christian Parking	1050-391-33	9.91	2-Vegetated Swales + 1 Drainpac filter insert	C-1/30/06	0.02	0.04	9.91	2	2							
48	PDEV02-072	Bedford Property Phase3	0211-281-54	1.42	2-Kristar Flogard drain inserts + 2 infiltration swales	C-11/12/04					2							Minimal infiltration capacity
49	PDEV02-073	Airport Wineville Project	0238-081-87	1.00	9-infiltration trenches+4 swales+ 3-1000 & 1-3000 Vortechs Separators	C-6/20/06	0.17	0.18	8.20	2	4			9				
50	PDEV02-074	Rockefeller CommerceCtr	0238-201-16	9.84	1-MaxWell IV drywell + 6 SunTree Filters	Complete			9.84	688			1					
51	PDEV02-076	Housing Tract #14266	1014-091-35,36 to 54 1014-091-62,63 to 72	13.36	1- MaxWell IV drywell	Complete			13.36	688			1					
52	PDEV02-079	Indigo Hotel	0210-182-71,11	2.95	1-Vortechs Model 1000 + StormTech Underground Chambers	Active	0.02	0.00	2.95	2					1			
53	PDEV02-080	Fazoli's Restaurant	0210-204-33	0.82	1-Vegetated Swale	Complete					1							Minimal infiltration capacity
54	PDEV02-081	Parkside Manor Condos	0210-425-02, 03 to 13	0.92	Pervious pavement + 1-MaxWell IV Drywell	C-6/10/08			0.92	688			1			1		
55	PDEV02-082	Wendy's Restaurant	0110-261-12	0.78	1-Grass swale, SunTree Filter	Complete					2							Minimal infiltration capacity
56	M-324	Woodcrest Junior High	1051-381-07	1.79	State Controlled project, 1- MaxWell drywell	Complete			9.50	688			1					Would otherwise drain to Grove Basin
57	PDEV03-001	Hudson Ave Indust Bldg	0238-121-28	1.49	1-Grass Swale,1-retention/infiltration trench	C-12/8/04	0.02	0.08	1.49	2	1			1				
58	PDEV03-003	Christensen Airport Ind Bl	0238-081-86	3.56	1-MaxWell drywell+ 1-CDS PMSU20_15 +Ret Basin	C-2/22/06	0.01	0.02	3.56	67			1	1				
59	PDEV03-004	SW Council Carpenters	0210-193-20	14.54	7-BioClean Inlet Filters + 1 Veg Swale + 1 Ret Basin	C-2/23/07	0.53	0.78	14.54	2	1	1						
60	PDEV03-007	Bridgestone Phase II	0218-081-22	49.04	1-earthen bottomed detention/retention basin	Complete	0.88	0.88	49.04	2		1						
61	PDEV03-008	Art Damos Warehouse	0113-381-27	0.46	1-Vegetated Swale+Pervious Concrete Pavement	Complete					2					1		Minimal infiltration capacity. Would otherwise drain to Ely Basins.
62	PDEV03-009	Mag Inst., Bldg A & B	0113-414-42, 43, 44	4.50	2-CDS Clarifiers + Grassy Swale	C-8/27/04					1							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
63	PDEV03-011	Ponderosa Industrial	0210-212-39	0.86	Vegetated Swales + Kristar Flo-gard drain inserts	Complete					2							Minimal infiltration capacity
64	PDEV03-014	Carillo Privado Indust Park	0113-395-02	6.33	1-MaxWell IV/ 1 Flo-Gard Filter, porous channels	C-3/10/06			6.33	688	1		1					
65	PDEV03-017	Grove Ave Business Ctr	0113-361-54	1.00	3 Vortechnic Units, Swales	C- 6/17/05					2							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
66	PDEV03-019	Lakeview Ctr, Bldg A & B	0210-551-17	2.54	3-MaxWell Plus Drywells, 4- SunTree Tech filters	C - 7/8/05			6.00	688			3					
67	PDEV03-022	Concours Plaza, Phase 2	0210-521-01,02 to 09	5.02	Numerous landscaped swales + perforated landscaping drain lines+infiltration pockets	C-2/25/05					4							Minimal infiltration capacity
68	PDEV03-024	Haven Gateway No. 7	0218-071-60	2.41	3- Large grass swales + 7 Flo-Gard Plus+filters	C-5/16/05					3							Minimal infiltration capacity
69	PDEV03-025	Used Car Sales OfficeLot	1049-101-40	0.40	1- small gravel swale	C - 1/18/05					1							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
70	PDEV03-026	Del Rio Develop Partners	0210-311-02	1.22	1-Kristar Inlet filter + 2 Vegetated Swales	C-1/13/05					2							Minimal infiltration capacity. Would otherwise drain to Turner Basins.
71	PDEV03-029	ACCO Airport Ctr - II	0211-263-32	6.89	Vegetated Swales						2							Minimal infiltration capacity
72	PDEV03-031	Chick-Fil-A Restaurant	0238-041-18	1.31	Grass Swale/Rest Trash Enclosur/2 drain filters	C- 5/25/04					1							Minimal infiltration capacity
73	PDEV03-032	Ontario Dialysis Clinic	1008-471-38	1.02	2-vegetated/rock swales+ pervious concrete pavement	C-10/31/06					2					1		Minimal infiltration capacity. Would otherwise drain to Brooks Basin.
74	PDEV03-033	Retail ShopsforRosenblum	1048-563-07	0.20	1-Infiltration Trench	C-9/5/07	0.00	0.00	0.10	2	1			1				Minimal infiltration capacity
75	PDEV03-036	Haven Gateway Bldg 9	0211-281-45	2.61	Grassy Swale + 1 BioClean Filter insert	C - 5/6/05					1							Minimal infiltration capacity
76	PDEV03-040	CarMax	0210-211-46	14.00	Grass Swales/Vortechnics Clarifier	C-3/2/05					2							Minimal infiltration capacity
77	PDEV03-043	Trio Glen TM 16582	0110-021-04,05 to 29 0110-021-31,32 to 54 0110-261-18,19 to 39 0110-261-41,42 to 58 0110-261-60,62 to 80	16.00	2-110'Lx48"+1-70'x36" Infilt Pipes + 3-Vortechs Model 1000 separators + 3-Drainpac filters	C-3/24/06	0.06	0.13	10.30	2					2			

Table 5-8

City of Ontario Storm Water Recharge

Map No.	Project No.	Name of Project	APN	Project Acres	Structural BMP	Status	Approximate Surface Area (ac)	Storage Volume (af)	Tributary Drainage Area (ac)	Infiltration Capacity (ft/day)	Vegetated Swale	Infiltration/ Detention Basin	Drywell	Infiltration Trench	Underground Chamber Vault	Pervious Pavement	Roof Well	Notes
78	PDEV03-044	1175 E. D St Condos	1048-451-53, 54 to 58	0.14	Grass Swale + Underground Stormchamber Unit	C-9/27/07	0.00	0.00	0.14	2	1				1			Would otherwise drain to Ely Basins
79	PDEV03-045	La Galleria Retail Center	0238-014-49	1.98	Grass Swale+1-SunTree Filter+1-PMSU20_15 CDS Unit	C - 8/22/05					1							Minimal infiltration capacity
80	PDEV03-046	University Plaza Off Bldg	0210-551-10	6.54	PL Infiltration strips + C.B. filter inserts	C - 1/20/05												Minimal infiltration capacity
81	PDEV03-048	Andy's Burgers	1049-065-09	0.87	2-catch basin filters, Rest Trash enclos, swales	C-4/15/06					2							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
82	PDEV03-049	Inland Empire Office	0210-191-28	0.53	Stormfilter Cartridge Vault + 2-Drywells	C - 3/1/06		0.04	1.40	688		1	2					
83	PDEV03-050	Lockaway Self Storage	0108-501-50	4.48	1-MaxWell drywell, Percolation Pipe System, Swale	C-10/1/06	0.07	0.10	4.48	9	1	1	1		1			Would otherwise drain to Turner Basins
84	PDEV03-051	Warehouse/Office Bldg	1050-501-13	0.58	2- Infiltration Trenches + Pervious Concrete	Active	0.01	0.07	0.55	2		4		3		1		Would otherwise drain to Grove Basin
85	PDEV03-053	Tract # 16362	1011-562-11,12 to 23	2.52	1-Vegetated Swale + Infiltration Trench	C-11/22/04	0.05	0.07	3.20	2	1			1				
86	PDEV03-054	Kellogg Garden Prod	0216-313-05	23.03	Self Containment Basin	C - 9/20/05	0.28	0.99	23.03	2		1						
87	PDEV03-055	Sequoia Industrial Bldg	0210-212-42	0.87	2-Vegetated Swales + 1-Kristar Trash filter	C - 9/20/05					2							Minimal infiltration capacity
88	PDEV03-056	Sunkist Campus Ind Park	1049-354-08,09 to 12	5.02	Multiple Vegetated Swales	C-5/11/05					4							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
89	PDEV03-057	Bombay Partners LP- V	0218-061-59	2.67	Multiple Vegetated Swales + infiltration trenches	C-12/20/04	0.19	0.19	2.67	2	4							
90	PDEV03-060	Airport Corporate Center	0210-551-24,25 to 28 0210-551-38	18.00	9-BioClean Filter insert, Multiple Infilt Trenches	C - 1/5/06	0.06	0.02	18.00	2	4			4				
91	PDEV03-061	Empire Center	0210-541-01,02 to 06	3.39	12-Drainpac Filter Inserts + 3 Infiltration Trenches	C - 9/19/05	0.00	0.01	3.39	2				3				
92	PDEV03-062	Food Distribution Facility	1049-371-07	0.45	1- continuous vegetated swale around project	C-1/23/07					1							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
93	PDEV03-063	Acacia Grove Bus Park	0113-351-16	1.74	3-Stormgate Separators+Veg Swales+ Perv Concrete	C-8/1/06					2					1		Minimal infiltration capacity. Would otherwise drain to Ely Basins.
94	M-392	H BIZCTR/Ontario	0113-631-01,02 to 09	5.34	4-Infiltration trenches+roof drain swales	C - 9/10/05	0.04	0.02	5.34	2	4			4				Would otherwise drain to Ely Basins
95	PDEV04-002	IH Campus Business	1050-111-14,15 to 24	4.39	12-BioClean Inlet filters + 470'x36" diam perf infilt pipe	C - 9/20/05	0.08	0.14	4.39	2	1			2				Would otherwise drain to Ely Basins
96	PDEV04-003	BCI Campus, LLC	1050-111-11	4.85	6-BioClean Inlet filters + 508'x36" diam perf infilt pipe	C - 9/20/05	0.11	0.19	4.85	2				1				Would otherwise drain to Ely Basins
97	PDEV04-005	Archibald Shop Bldg 1&2	0110-311-44,43	1.06	2-Stormfilter Cartridge Units+45 LF Stormtech SC-740	C - 5/17/05	0.02	0.03	1.06	2					1			
98	PDEV04-006	Shelby Office Pk, Phase1	0210-571-14,15 to 20 0210-571-23 & 24	3.47	2 -Stormgate SCS 610 + 4 infiltration basins	C -1/15/06	0.07	0.20	2.90	2		4						
99	PDEV04-006	Shelby Office Pk, Phase2	0210-571-01,02 to 14 0210-571-22	6.52	Grass Swale/Retention Basin/Vortechnics	C-11/15/06	0.45	0.18	6.52	2	1	1						
100	PDEV04-008	Amrep Inc.	1050-161-01	9.23	1-Vortechs Model 5000 + Vegetated Swales	C - 5/10/05					2							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
101	PDEV04-010	Akram Auto Electric	1011-121-21	1.06	1-BioClean Trench filter + 2 Veg Swales	C-11/20/07					1							Minimal infiltration capacity. Would otherwise drain to Brooks Basin.
102	PDEV04-015	Pacific Collision Center	0113-481-09	1.00	1-MaxWell Drywell + Vegetated Swale	C-11/15/05			1.00	688	1		1					Would otherwise drain to Ely Basins
103	PDEV04-017	Grove Lumber StorageYd	1049-482-02,03	8.84	2-StormTreat Units+Perforated Infiltration Pipe Trench+Pervious Pavement+2-Veg Swales	C-8/29/08	0.03	0.06	8.84	2	1					1		Would otherwise drain to Ely Basins
104	PDEV04-018	Jack Jones Trucking	1049-401-10	11.23	1-CDS PMSU20_25+ Kristar Filter +1-Lg Veg Swale	C-1/15/06					2							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
105	PDEV04-020	Xtreme Image Off Road	1011-361-08	0.42	1-Veg Swale+Rainstore Infilt Unit+Perv Pavement	Active	0.02	0.04	0.42	2	1				1	1		
106	PDEV04-021	Haven Airport Centre	0211-263-41	3.26	numerous vegetated swales + Rainstore 3	C-8/1/06	0.02	0.11	3.26	4	4				1			
107	PDEV04-022	Holiday Inn Hotel	0110-321-58	2.57	Stormfilter Media Cartridge Vault + Roof runoff controls	C-2/1/08												Minimal infiltration capacity
108	PDEV04-023	Archibald/Philad Ind Cmplx	0218-021-71	0.68	2-Vortechs Units+ 2- StormTech galleries	C-11/13/06	0.11	0.31	7.40	2					2			
109	PDEV04-025	Eastside Water Facility	1053-111-01,03	13.44	Retention/Infiltration Basins	Plan Check			13.44			2						Files missing-City of Chino has copies
110	PDEV04-026	Vintage Apartments	0210-531-02	11.13	2-Stormgate-SGS 610 + 2-MaxWell Plus + 2-Veg Swale	C-3/21/07			11.13	688	2		2					
111	PDEV04-028	Phase 2 Mtn View Senior	1010-461-08,09 & 11	0.64	1-MaxWell Plus Drywell + Vegetated Swale	C-3/28/07			0.64	688	1		1					Would otherwise drain to Brooks Basin
112	PDEV04-032	WarmingtonHomesTM16901	0210-601-02,03 to 57	9.25	2-CDS Media Cartridge Vaults + 3-MaxWell Plus Drywells	Active			9.25	688			3					Would otherwise drain to Turner Basins
113	PDEV04-033	Crossroads Bus Pk Bldg 6	0238-021-74	12.25	1-Vortechs 7000+Veg Swale+2-MaxWells+ 57 LF StormTech740 underground chambers	C-9/06	0.13	0.07	12.25	10	1		2					

Table 5-8

City of Ontario Storm Water Recharge

Map No.	Project No.	Name of Project	APN	Project Acres	Structural BMP	Status	Approximate Surface Area (ac)	Storage Volume (af)	Tributary Drainage Area (ac)	Infiltration Capacity (ft/day)	Vegetated Swale	Infiltration/ Detention Basin	Drywell	Infiltration Trench	Underground Chamber Vault	Pervious Pavement	Roof Well	Notes
114	PDEV04-034	Cedar Business Park	1050-451-08 1050-511-07,08,09	6.12	3-Vortechs 1000+1-2000 VortUnits + 4 Cultec Chamber Syst.	C-4/14/08	0.63	1.36	4.60	2					4			Would otherwise drain to Grove Basin
115	PDEV04-035	Mag Inst., Corporate Ctr	0113-491-82	29.39	1-Vortechs Model 7000 + 1-MaxWell Drywell+7-Drainpac filters	C-3/30/05			29.39	688			1					
116	PDEV04-036	Hudson Industrial Bldg II	0238-121-29	1.49	2 Vegetated swales + 1-MaxWell IV	C- 8/19/05	0.03	0.06	1.49	18	2		1					
117	PDEV04-039	Cedar Oaks, TM16804	1014-571-42,43 to 51	4.39	Driveway drains to NDS Flo-Well units	Complete											1	Minimal infiltration capacity
118	PDEV04-041	Gateway Mountain Village	1008-272-02,03 to 09	8.00	Driveway drains to NDS Flo-Well units	C-7/30/06	0.10	0.20	6.83	2					1		1	Would otherwise drain to Brooks Basin
119	PDEV04-043	Corinthian Colleges	0211-272-12	4.60	2-Detention Basins+Infiltration Strips+ 1-CBSF-2S media cart filt.	C-4/24/06	0.05	0.07	3.05	2		2						
120	PDEV04-044	GSC Corporation	0211-275-05	4.41	Perv concrete parkng stalls +1-Vortechs 3000+ 1-MaxWell Plus	C-10/30/07			4.41				1			1		
121	PDEV04-045	Francis Rochstr Ind,Phas1	0238-152-32	19.78	Retention/Infiltration Basins	C-6/12/06	1.05	0.77	19.78	2		2						
122	PDEV04-046	Ontario Mills & Vintage	0238-051-34	6.57	4-CDS Units + drainage swale/retention basin	C-2/7/07					1							Minimal infiltration capacity
123	PDEV04-050	Yokin Business Center	0113-463-34,35,36	1.12	2-Contech CBSF-3SF media cart filt + 2-MaxWell Plus Drywells	C-8/31/07			1.12	69			2					Would otherwise drain to Grove Basin
124	PDEV04-051	H' Street Town Homes	1048-271-14	0.55	Pervious concrete park stalls + Vegetated swale	Active					1					1		Minimal infiltration capacity. Would otherwise drain to Ely Basins.
125	PDEV04-059	Diamante Terrace	1048-581-07	0.55	Vegetated Swales	Plan Check					1							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
126	PDEV04-060	San George Auto Sales	1011-131-17	0.63	Vegetated Swale+Pervious pavers	C-10/19/06					1					1		Minimal infiltration capacity
127	PDEV04-061	Inland Community Bank	0210-205-14	1.14	1-Stormfilter Cartridge Vault, Pervious Pave+ Roof runoff control	C-3/10/06					1					1		Minimal infiltration capacity
128	PDEV04-064	Francis/Rochester,Phas2	0238-152-31	9.82	StormTech SC-740 sys+Inf Basin+3-MaxWell IV+1-2000 Vortechs	C-2/02/06	0.03	0.08	9.82	53		1	3		1			
129	PDEV04-066	Patton's Warehouse	1049-181-01	3.04	1-Vegetated swale + 7-roof drain drywells	C-4/20/07			3.04	688	1		7					Would otherwise drain to Ely Basins
130	PDEV05-001	Marketplace On Grove	1051-151-07	12.44	2-Vortechs 5000 + 1-Large Retention Basin+ 6-MaxWell drywells	C-11/14/06	0.37	1.65	17.58	10		1	6					Would otherwise drain to Grove Basin
131	PDEV05-004	West Ontario Indust. Park	1011-201-14,15 to 25	10.50	5 Vortechs Units + 8 Infiltration pits + 5 Grate Inlet skimmers	C-11/30/06	0.13	0.67	10.50	2				5				
132	PDEV05-008	Rexxons Plaza	1049-268-11	0.48	1-MaxWell(on site)+1 Maxwell(off-site) + 1 Vegetated swale	Active			0.48	688	1		2					
133	PDEV05-009	Lot 42, Greystone Dr	0218-091-42	1.62	1-Grass Swale+ 1-MaxWell IV + pervious conc park stalls	C - 2/17/06			1.62	688	1		1					
134	PDEV05-019	Crown Business Center	0110-091-07,08 to 29 0110-091-34,35 to 40 0110-091-44,45	14.57	1-Vortechs 5000 + Pervious Paved parking stalls	Active										1		Minimal infiltration capacity
135	PDEV05-020	American Career College	0210-193-27	2.79	1-Vegetated swale + 2-retention basins + 8 drywells	C-8/25/08	0.52	0.39	7.00	9	1	1	8					
136	PDEV05-021	Legacy II	0211-275-51	2.78	1-CDS PMSU20_25 + 1-MaxWell Plus Drywell	C-12/20/07			2.78	688			1					
137	PDEV05-022	Office Depot	0216-081-21	1.49	2-CDS PMSU20_15 units + pervious swale	C-8/15/06					1							Minimal infiltration capacity. Would otherwise drain to Grove Basin.
138	PDEV05-024	Ontario Carwash	1011-131-02	0.30	1-BioClean filter+8-SC-740 Storm Tech Chambers	Active	0.01	0.02	0.30	2					1			Would otherwise drain to Brooks Basin
139	PDEV05-028	Majestic Milliken Bldg1&2	0238-152-34,33	8.05	1-Vortechs 3000 + 1-Detention Basin + Perc Pipe	C-3/16/07	0.25	0.05	8.05	2		1		1				
140	PDEV05-029	Ontario Center, Phase 2	0210-501-31,32,33	5.31	2-MaxWells + 1-Stormceptor STC 4800 Vault	C-1/7/08			5.31	1,375			2					
141	PDEV05-034	BNP Church	1052-141-03	9.20	1-Vortechs 1000 Unit + Pervious Pavement+ Infilt. Strips	C-1/25/07								1		1		Minimal infiltration capacity
142	B200503873	Citizens Business Bank	0210-212-30	1.02	1-underground percolation pit	C-3/30/06	0.02	0.06	1.02	2	2	2		1				
143	PDEV05-036	Ontario Pines	0210-212-53	0.59	Veg Swale + BioClean Stormtreat Unit	C-5/1/07	0.01	0.02	0.59	2	2	2						
144	PDEV05-039	Riverarch Center	0218-041-15,16,23,29 to 32 0218-041-35,36	2.48	1-Stormfilter Cartridge Vault + Infiltration System	C-9/06	0.13	0.12	2.48	2				1				
145	PCUP05-039	Budget Rental Expansion	0110-131-08,09,13	3.43	3-Filter Cartridge Catch Basins+3 Swales	C-2008					3							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
146	PDEV05-044	Empire Towers Building V	0210-205-17	2.97	Numerous Infiltration Trenches + 1-1000 Vortechs Unit	C-2/22/07	0.01	0.09	4.13	2				9				
147	PDEV05-047	Emporia Development	1049-141-26	0.48	1-Retention Basin	C-3/16/07	0.06	0.02	0.48	2		3						Would otherwise drain to Ely Basins
148	PDEV05-048	HMC World Headqtrs	0210-204-05	3.96	1-MaxWell + 2 Vegetated swales	C-1/31/07			3.96	688	2		1					
149	PDEV05-049	H Street Townhomes	1048-271-14	0.55	Pervious concrete + Vegetated swale	Active					1					1		Minimal infiltration capacity
150	PDEV05-052	Defoe Furniture 4 Kids	1049-384-13,17 to 35	8.29	1-CDS PMSU20_20 + 2-Veg Swales + 1 Ret/Infilt Pit	C-3/29/07	0.04	0.04	7.05	2	2	1						Would otherwise drain to Ely Basins
151	PDEV05-062	Oak Hill Drive residential	0218-971-02,03 to 37	2.81	2-BioClean filters + Infiltration Trench	C-6/10/08	0.05	0.01	2.81	2				1				
152	PDEV05-066	Sterling Center	0210-551-40,41 to 49	19.12	3-Vortechs Units + 5 D-Raintank Systems+Inf Trench	C-9/16/08	0.13	0.19	9.36	2				1	5			

Table 5-8

City of Ontario Storm Water Recharge

Map No.	Project No.	Name of Project	APN	Project Acres	Structural BMP	Status	Approximate Surface Area (ac)	Storage Volume (af)	Tributary Drainage Area (ac)	Infiltration Capacity (ft/day)	Vegetated Swale	Infiltration/ Detention Basin	Drywell	Infiltration Trench	Underground Chamber Vault	Pervious Pavement	Roof Well	Notes
153	PDEV05-071	Tech Packaging Expansion	0211-232-24	3.78	Vegetated Swale	C -					1							Minimal infiltration capacity
154	PDEV06-001	Ont Airport Towers Phs1	0210-192-13	1.45	1- 2000 + 1- 7000 Vortechs+NSBB10-14-20+CultecRecharger	C-8/4/08	0.36	1.11	12.00	2					2			
155	PDEV06-006	Ontario HolidayInnExpress	0218-061-56	2.72	1-MaxWell Plus, 2-Contech Cartridge Vaults	C-6/4/08			2.72	688			1					
156	PDEV06-007	B & G Plaza Improvements	1049-065-10	0.31	1-PMSU20_15 CDS Unit + Veg Swale	C-6/30/08					1							Minimal infiltration capacity. Would otherwise drain to Ely Basins.
157	M-425	Ontario Town Ctr A3/A4	1048-547-04,05 to 27 1048-547-29,30 to 53	6.52	5 - 4-6.5-72 NSBB Clarifiers+5 Infiltration trenches	Complete	0.00	0.00	5.42	2				5				Would otherwise drain to Ely Basins
158	PDEV06-011	Archibald Business Ctr	0211-275-52	11.13	1-Vortechs 5000 + Retention Basin	C-10/24/07	0.10	0.17	11.13	0		1						
159	PDEV06-015	Marketplace/Grove Condos	1051-151-04	10.84	2-CDS PMSU 30_30+2 Stormtech galleries+1-MaxWell	Active		0.49	10.84	860			1		2			Would otherwise drain to Grove Basin
160	PDEV06-023	Home Depot Center	1051-511-16	10.64	1-CDS Unit + 2-MaxWell Plus Drywells+1 Veg Swale	C-12/17/08			10.64	688	1		2					
161	PDEV06-024	Oakmont Greystone	0218-091-44	9.29	3 Retention Basins	C-12/17/07	0.21	2.03	18.54	3		3						
162	PDEV06-028	Kaiser Hospital Expansion	0113-285-13	30.00	3-CDS Units + 4 Retention Basins	Active	2.07	1.76	20.28	2		4						
163	PDEV06-032	Hofer Ranch, Phase 1	0211-261-13	28.47	1-Retention Basin+2-NSBBs+Vegetated Swale	C-2/22/08	0.05	1.22	28.47	49	1	1						
164	PDEV06-040	Ontario Airport Plaza	0110-092-15,16,17	4.19	1-MaxWell, 2-Vortechs Units + Swales	C-2/12/09	0.42	0.04	4.19	1	2		1					
165	PDEV06-041	Ontario/Pacific Indust Park	1050-151-17	4.67	2-Retention Basins + 1-MaxWell Plus Drywell	Active	0.18	0.25	4.67	5		2	1					Would otherwise drain to Ely Basins
166	PDEV06-045	Haven Business Center	0211-301-02	1.98	Vegetated Swales, Infiltration Basins+Stormchambers	C-12/5/07	0.16	0.18	1.98	2	2	2						
167	PDEV06-049	Big Yards Industrial Park	1049-181-12	4.50	4-Vortechs Units + 4 Retention/Infiltration Pits	C-10/24/07	0.09	0.14	4.50	64		4	12					Would otherwise drain to Ely Basins
168	PDEV06-055	Apex Constuction Co, Ph 2	0113-383-08	2.24	Retention/Infiltration Basin + MaxWell Drywell unit	Active	0.13	0.08	3.12	6		1	1					Would otherwise drain to Ely Basins
169	PDEV06-065	Chablis Warehouse	0238-133-46	3.34	1-Vortechs 2000 + 2-24" roof runoff infiltration pipes	Active	0.10	0.22	3.34	2							2	
170	PDEV06-066	Calif Commerce Center, IV	0211-281-57,58,59	96.22	Mult Vortechs units, 9 MaxWells, Basins and swales	Complete	0.75	0.60	94.76	8	5	1	9					
171	PDEV06-071	Event Ctr Overflow Parking	0210-204-08	11.86	2-Vortechs 4000 + 4 MaxWell Drywells	C-10/6/08			11.86	688			4					
172	PDEV07-003	Taco Bell T-50	1010-201-14	0.51	Pervious Pavement- parking stalls +1-Infiltration Basin	C-1/20/09	0.01	0.02	0.51	2		1				1		Would otherwise drain to Brooks Basin
173	PDEV07-012	Commercial Building	0110-301-07	8.24	1-Infiltration Trench + Pervious Pavement-Park stalls	C-12/23/08	0.01	0.02	8.24	2				1		1		Would otherwise drain to Turner Basins
174	PDEV07-017	Phase 2 CSI Senior Housing	0110-254-78	0.00	2-MaxWell Drywells + Swales	Active			0.00	688	2		2					
175	PDEV07-032	24-Hour Fitness Center	0218-021-64	2.75	1-STC 2400 Stormceptor+ 3-MaxWell Drywells	Active			2.75	688			3					
176	B200701603	Valley Power Systems	1050-211-09	2.33	1-MaxWell IV Drywell + 1-Fossil Filter at drywell inlet	C-3/17/08			2.33	688			1					Would otherwise drain to Ely Basins
177	PDEV07-050	The Colonies Marketplace	1051-081-02	4.11	1-Lg Underground Ret/Infilt Basin + CDS Clarifier	Active	0.21	0.59	4.11	2		1						
178			1050-181-03	9.07	1 Infiltration Basin		0.05	0.30	9.07	2		1						Would otherwise drain to Ely Basins
179			1050-451-06	20.01	1 Infiltration Basin		0.19	1.79	20.01	2		1						Would otherwise drain to Grove Basin
180			1048-131-01	0.18	1 Dry Well					688			1					Would otherwise drain to Ely Basins
181			1048-241-18	4.44	1 Dry Well					688			1					Would otherwise drain to Ely Basins
182			1050-615-15	0.21	1 Dry Well					688			1					
183			1014-551-17	0.50	1 Dry Well					688			1					
184			1011-581-17	0.38	1 Dry Well					688			1					
185			0218-161-06	36.97	1 Dry Well					688			1					
Total							**13.0**	**24.3**	**918**		**168**	**63**	**124**	**68**	**30**	**16**	**6**	

Table 5-9

City of Rancho Cucamonga Storm Water Recharge

Map ID	Basin Name	Approximate Surface Area (ac)	Storage Volume (af)	Typical Percolation Rate (ft/day)	Tributary Drainage Area (ac)	Notes
1	Dry Creek MS	3.00	NA	1.0	18	Perc rate assumed to equal TR 13527. Outside of Chino Basin. Would likely otherwise drain to Victoria Basin.
2	City Basin DRWG 1357-D	1.00	NA	1.6	61	Perc rate assumed to equal TR 16776. Would otherwise drain to Hickory Basin.
3	Grapeland Elementary School	0.71	NA	1.6	22	Perc rate assumed to equal TR 16776. Would otherwise drain to Hickory Basin.
4	TR 13527	4.35	10.4	1.0	174	Elev from 1708-1714 for debris storage. Outside of Chino Basin. Would likely otherwise drain to Victoria Basin.
5	TR 14139 Lots 1-5	1.38	NA	1.0	49	Perc rate assumed to equal TR 13527. Outside of Chino Basin. Would likely otherwise drain to Victoria Basin.
6	TR 15711 & TR 15711-1	5.26	NA	NA	147	Would otherwise drain to Hickory Basin.
7	TR 15912 LOT A	1.91	12	1.6	253	Would otherwise drain to Hickory Basin.
8	TR 16114 Lot 13	0.87	1	NA	14	Would otherwise drain to Victoria Basin
9	TR 16227-1	5.27	18.5	1.8	129	Volume is Q_{10} first flush design. Outside of Chino Basin. Would likely otherwise drain to Victoria Basin.
10	TR 16279 Lots 78-79	1.34	5.5	1.1	73	Perc rate based on max loss rate. Would otherwise drain to Hickory Basin.
11	TR 16776 Lots 56-59	1.05	3.2	1.6	58	Would otherwise drain to Hickory Basin.
Total		**26.13**			**999**	

Table 5-10

Potential Recharge Basins

Site No.	Map ID	Approximate Surface Area (ac)	Approximate Tributary Drainage Area (ac)	Notes
1	1.A	7.5	240	
2	1.B	7.6		
3	2.A	15.1	200	
4	3.A	4.3	18	DA is within DA for 3.C
5	3.B	-	-	Blue Diamond/Holliday Pit
6	3.C	11.3	112	DA does not include 3.C DA
7	3.D	6.5	167	
8	3.E	44.9		
9	4.A	4.3	702	
10	4.B	6.8		
11	4.C	5.7	102	
12	4.D	2.1	63	
13	4.E	2.2	32	
14	5.A	14.1	30	
15	5.B	4.9	34	
16	5.C	2.8	17	
17	5.D	6.1	180	DA combined with 5.F
18	5.E	5.9	17	
19	5.F	15.1	-	DA combined with 5.D
20	5.G	3.7	109	
21	5.H	9.5	104	
22	5.I	5.1	24	
23	5.J	10.8	111	
24	5.K	4.4	16	
25	5.L	5.3	25	
26	5.M	10.0	53	
27	5.N	45.6	141	
28	5.O	8.5	78	
29	6.A	9.3	1,062	DA does not include 6.A & B DA
30	6.B	6.3		
31	6.C	5.0	77	DA is within DA for 6.A & B
32	7.1.A	18.6	100	
33	7.1.B	13.1	156	
34	7.1.C	9.0	100	
35	7.1.D	13.7	139	
36	7.A	10.1	124	
37	7.B	7.6	632	
38	7.C	14.0	152	
39	7.D	15.8	295	
40	7.E	5.4	195	
41	7.F	7.2		
42	7.G	20.7	147	
43	8.A	17.7	152	
44	8.B	17.8	268	
45	8.C	5.5	43	
46	8.D	13.5	294	
47	9.1.A	4.9	521	
48	9.1.B	6.7		
49	9.1.C	7.9	184	
50	9.1.D	4.9	159	
51	9.RC	70.7	403	
Total		**576**	**7,780**	

Note:
Sites identified by John Van Dyk of Beno, Van Dyk & Owens.
(DA) = Drainage Area

Table 5-11

First Flush Opportunities Based on Reported Discharge Measured at USGS 11073300 San Antonio Creek at Riverside Drive near Chino, CA Excluding Contributions from the OC-59 Turnout

Water Year	First Flush Opportunity[1]	Daily Discharge (af)	Water Year Total of Daily Discharge	2-Hour Discharge (af)	Water Year Total of 2-Hour Discharge
1999	1/4/1999	5.0	46.6	0.9	0.9
	6/2/1999	41.7		NA	
2000	10/14/1999	19.8	247.9	NA	NA
	4/17/2000	228.1		NA	
2001	10/22/2000	6.0	54.5	NA	42.5
	1/8/2001	6.9		3.7	
	7/5/2001	41.7		38.8	
2002	11/12/2001	25.8	42.6	21.6	27.9
	4/24/2002	8.9		6.3	
	8/1/2002	7.9		NA	
2003	11/8/2002	184.5	325.3	12.9	25.3
	2/11/2003	130.9		12.5	
	8/16/2003	9.9		NA	
2004	10/6/2003	7.9	353.1	NA	42.2
	12/25/2003	277.7		7.5	
	4/1/2004	41.7		34.7	
	5/21/2004	11.9		NA	
	9/1/2004	13.9		NA	
2005	4/28/2005	146.8	152.1	23.7	24.5
	9/15/2005	5.4		0.8	
2006	12/9/2005	12.7	105.5	5.0	53.4
	2/17/2006	27.8		22.7	
	5/22/2006	57.5		18.9	
	8/1/2006	7.5		6.8	
2007	10/14/2006	5.6	164.8	3.0	38.3
	11/27/2006	12.5		9.0	
	4/20/2007	99.2		20.6	
	9/22/2007	47.6		5.7	
2008	11/30/2007	355.0	422.1	107.7	127.8
	5/22/2008	47.6		3.7	
	7/12/2008	15.5		15.6	
	8/29/2008	4.0		0.8	
Average		**59.8**	**191.5**	**16.6**	**42.5**

Notes:

(1) A first flush opportunity refers to the first storm event of the season or a storm following a 30 day period lacking rainfall runoff.

Table 5-12

Estimated San Antonio Creek Discharge at Montclair Basin Inlet During First Flush Opportunities
Based on Reported Discharge Measured at USGS 11073300 San Antonio Creek at Riverside Drive near Chino, CA
Excluding Contributions from the OC-59 Turnout

		Reported Discharge at Chino Gage(2)			Adjusted Discharge at Chino Gage(3)		Estimated Discharge at Montclair Inlet(4)			
Water Year	First Flush Opportunity(1)	Daily Discharge (af)	2-Hour Discharge (af)	2-Hour/ Daily Ratio	Daily Discharge (af)	2-Hour Discharge (af)	Daily Discharge (af)	Water Year Total of Daily Discharge (af)	2-Hour Discharge Foregone (af)	Water Year Total 2-Hour Discharge Foregone (af)
2005	4/28/2005	146.8	23.7	0.2	146.8	23.7	44.1	45.7	7.1	7.4
	9/15/2005	5.4	0.8	0.1	5.4	0.8	1.6		0.2	
2006	12/9/2005	12.7	5.0	0.4	15.7	6.2	4.7	78.4	1.8	45.1
	2/17/2006	27.8	22.7	0.8	120.8	98.7	36.3		29.6	
	5/22/2006	57.5	18.9	0.3	117.1	38.5	35.2		11.6	
	8/1/2006	7.5	6.8	0.9	7.5	6.8	2.3		2.0	
2007	10/14/2006	5.6	3.0	0.5	5.6	3.0	1.7	84.5	0.9	19.3
	11/27/2006	12.5	9.0	0.7	16.9	12.2	5.1		3.7	
	4/20/2007	99.2	20.6	0.2	203.6	42.3	61.1		12.7	
	9/22/2007	47.6	5.7	0.1	55.6	6.7	16.7		2.0	
2008	11/30/2007	355.0	107.7	0.3	451.0	136.9	135.4	157.3	41.1	48.9
	5/22/2008	47.6	3.7	0.1	47.6	3.7	14.3		1.1	
	7/12/2008	15.5	15.6	1.0	21.4	21.6	6.4		6.5	
	8/29/2008	4.0	0.8	0.2	4.0	0.8	1.2		0.2	
Average(5)							**26.1**	**106.7**	**8.6**	**37.7**

Notes:

(1) A first flush opportunity refers to the first storm event of the season or a storm following a 30 day period lacking rainfall runoff.

(2) USGS 11073300 San Antonio Creek at Riverside Drive near Chino, CA without contributions from OC-59 turnout.

(3) Discharge is adjusted based on actual daily diversions to regional recharge basins in the San Antonio Creek System.

(4) Discharge at the Montclair Basin 1 inlet is estimated based on drainage area percentage. (about 30% of the gaged watershed downstream of San Antonio Dam)

(5) Water year averages include only water years 2006 through 2008.

Table 5-13

Estimated San Antonio Creek Discharge at Montclair Basin Inlet During First Flush Opporunities Based on Wildermuth Environmental, Inc. Modeled Discharge

Water Year	First Flush Opportunity[(1)]	Daily Discharge (af)	Water Year Total of Daily Discharge (af)
1950	11/9/1949	10.1	72.2
	3/24/1950	62.1	
1951	10/27/1950	2.2	33.9
	1/10/1951	10.7	
	4/4/1951	5.0	
	9/28/1951	16.1	
1952	9/19/1952	6.9	6.9
1953	11/8/1952	14.7	190.4
	2/23/1953	38.7	
	4/28/1953	137.1	
1954	10/22/1953	0.6	38.3
	1/12/1954	37.7	
1955	11/11/1954	109.3	141.0
	4/22/1955	31.7	
1956	11/14/1955	35.5	45.8
	4/1/1956	0.6	
	7/25/1956	9.7	
1957	10/4/1956	2.2	5.8
	12/5/1956	2.4	
	4/17/1957	1.2	
1958	10/11/1957	43.8	141.2
	12/5/1957	77.6	
	5/12/1958	6.9	
	8/15/1958	5.0	
	9/24/1958	7.9	
1959	1/6/1959	184.7	265.2
	2/8/1959	36.1	
	4/26/1959	44.4	
1960	11/2/1959	0.2	26.2
	12/21/1959	26.0	
1961	10/9/1960	6.9	18.8
	1/25/1961	11.9	
1962	11/20/1961	38.5	43.0
	5/14/1962	4.6	
1963	10/18/1962	1.4	19.4
	12/24/1962	0.8	
	9/4/1963	17.3	
1964	1/18/1964	0.4	1.0
	6/9/1964	0.6	
1965	10/29/1964	8.5	13.9
	12/20/1964	2.0	
	7/30/1965	3.4	

Table 5-13

Estimated San Antonio Creek Discharge at Montclair Basin Inlet During First Flush Opporunities Based on Wildermuth Environmental, Inc. Modeled Discharge

Water Year	First Flush Opportunity$^{(1)}$	Daily Discharge (af)	Water Year Total of Daily Discharge (af)
1966	11/14/1965	8.1	12.1
	3/24/1966	3.6	
	5/11/1966	0.4	
1967	11/6/1966	2.8	3.6
	9/28/1967	0.8	
1968	11/19/1967	163.6	171.6
	7/29/1968	7.9	
1969	10/2/1968	0.2	1.2
	7/11/1969	1.0	
1970	11/6/1969	92.6	93.2
	12/8/1969	0.4	
	6/10/1970	0.2	
1971	11/6/1970	1.2	12.3
	2/16/1971	9.5	
	4/14/1971	1.6	
1972	10/17/1971	1.6	7.7
	4/18/1972	3.2	
	8/12/1972	3.0	
1973	10/18/1972	2.0	2.0
1974	11/17/1973	4.2	4.6
	2/28/1974	0.2	
	5/16/1974	0.2	
1975	10/8/1974	0.2	0.2
1976	10/12/1975	0.8	9.9
	2/4/1976	6.5	
	4/3/1976	1.6	
	9/3/1976	1.0	
1977	10/23/1976	3.6	110.9
	12/30/1976	46.4	
	5/8/1977	27.4	
	8/17/1977	33.5	
1978	11/5/1977	11.5	23.4
	12/16/1977	0.2	
	8/5/1978	0.6	
	9/5/1978	11.1	
1979	10/20/1978	0.2	0.4
	5/1/1979	0.2	
1980	12/21/1979	3.8	3.8
1981	10/17/1980	0.8	49.0
	12/4/1980	9.5	
	1/11/1981	2.2	
	9/27/1981	36.5	

Table 5-13

Estimated San Antonio Creek Discharge at Montclair Basin Inlet During First Flush Opporunities Based on Wildermuth Environmental, Inc. Modeled Discharge

Water Year	First Flush Opportunity(1)	Daily Discharge (af)	Water Year Total of Daily Discharge (af)
1982	12/30/1981	16.5	18.4
	8/26/1982	2.0	
1983	8/9/1983	0.6	0.6
1984	11/12/1983	38.9	43.2
	3/13/1984	0.8	
	7/27/1984	0.8	
	9/17/1984	2.8	
1985	6/3/1985	0.4	1.8
	9/4/1985	1.4	
1986	10/7/1985	2.4	161.3
	1/13/1986	6.1	
	9/24/1986	152.7	
1987	11/17/1986	5.8	6.0
	7/17/1987	0.2	
1988	10/12/1987	1.4	171.4
	4/15/1988	54.5	
	6/30/1988	115.2	
	8/24/1988	0.2	
1989	11/13/1988	14.5	23.8
	4/26/1989	5.6	
	9/17/1989	3.8	
1990	10/22/1989	7.1	24.2
	11/26/1989	16.9	
	12/28/1989	0.2	
1991	11/19/1990	6.3	246.3
	1/3/1991	49.4	
	2/27/1991	190.4	
	8/11/1991	0.2	
1992	10/26/1991	26.0	32.7
	12/19/1991	5.4	
	7/6/1992	1.4	
1993	10/23/1992	8.1	84.5
	12/4/1992	5.4	
	6/5/1993	71.0	
1994	11/11/1993	6.3	15.9
	1/24/1994	5.2	
	4/25/1994	4.4	
1995	10/4/1994	4.6	123.8
	11/10/1994	12.5	
	6/16/1995	106.7	
1996	1/30/1996	14.5	14.5

Table 5-13

Estimated San Antonio Creek Discharge at Montclair Basin Inlet During First Flush Opporunities Based on Wildermuth Environmental, Inc. Modeled Discharge

Water Year	First Flush Opportunity(1)	Daily Discharge (af)	Water Year Total of Daily Discharge (af)
1997	10/28/1996	1.0	1.2
	9/15/1997	0.2	
1998	11/10/1997	12.1	30.7
	8/31/1998	18.6	
1999	11/8/1998	27.0	54.7
	1/20/1999	13.3	
	3/15/1999	4.6	
	6/2/1999	9.9	
2000	11/8/1999	0.8	49.6
	12/31/1999	4.4	
	4/17/2000	42.6	
	9/22/2000	1.8	
2001	10/26/2000	1.6	7.1
	1/8/2001	0.8	
	7/5/2001	1.2	
	9/25/2001	3.6	
2002	11/6/2001	23.0	43.0
	12/14/2001	11.9	
	4/24/2002	8.1	
2003	11/8/2002	110.1	175.1
	2/11/2003	64.9	
	7/28/2003	0.2	
2004	11/1/2003	12.5	12.5
2005	10/17/2004	104.1	123.6
	4/24/2005	2.4	
	9/20/2005	17.1	
2006	12/9/2005	1.0	34.5
	2/17/2006	2.4	
	5/22/2006	26.6	
	11/27/2006	4.6	
Average		**19.8**	**53.8**

Notes:

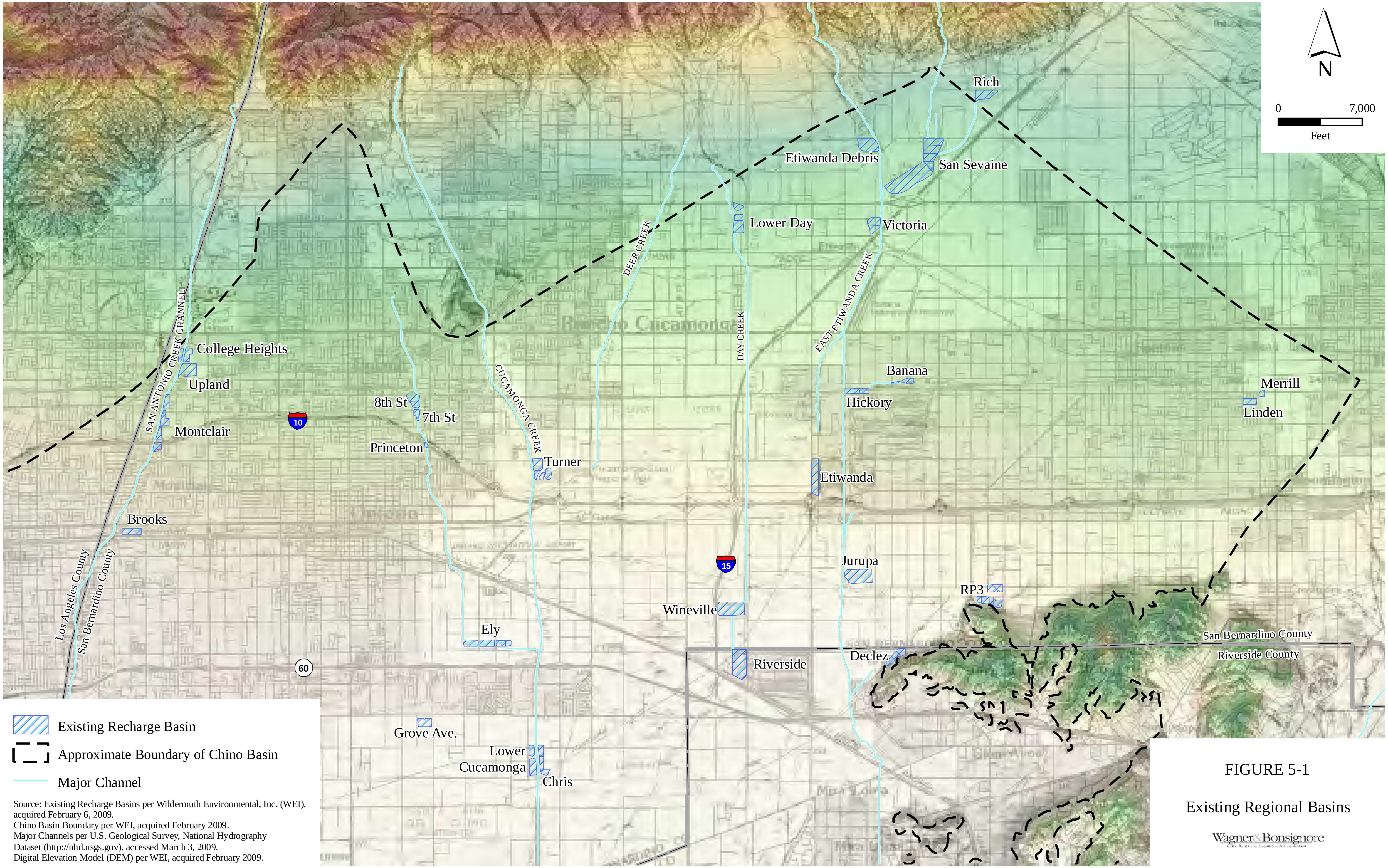
(1) A first flush opportunity refers to the first storm event of the season or a storm following a 30 day period lacking rainfall runoff.

Table 5-14
Cost Estimate for Conceptual Project Evaluation of RP3 Basin (No Excavation)

Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs				
1 Mobilization	1	Job	Lump Sum	$125,000
2 Channel Modification				
Modify Channel for Conduit Inlet	35	Cu. Yds.	$1,200	$42,000
Modify Channel for Pneumatic Gate	1	Job	$380,500	$380,500
Pneumatic Gate	1	Job	$140,000	$140,000
3 Conduit to Cell 1				
Excavation	22,200	Cu. Yds.	$5.00	$111,000
Replace Compacted Fill	8,300	Cu. Yds.	$15.00	$124,500
8' x 10' RCB	950	Lin. Ft.	$830	$788,500
Coarse Drain Material	550	Ton	$23	$12,650
Automated Gate	1	Job	$130,000	$130,000
Concrete Inlet Structure	1	Job	$24,000	$24,000
Energy Dissipation Structure	1	Job	$48,000	$48,000
Road Demolition & Replacement	1	Job	$25,000	$25,000
4 Conduit to Cell 3				
Excavation	1,720	Cu. Yds.	$5.00	$8,600
Replace Compacted Fill	1,720	Cu. Yds.	$15.00	$25,800
8' x 10' RCB	820	Lin. Ft.	$830	$680,600
Coarse Drain Material	460	Ton	$23	$10,580
Automated Gate	1	Job	$162,500	$162,500
Concrete Inlet Structure	1	Job	$48,000	$48,000
Energy Dissipation Structure	1	Job	$48,000	$48,000
Channel Demolition & Replacement	1	Job	$17,800	$17,800
5 Conduit to Cell 4				
Excavation	720	Cu. Yds.	$5.00	$3,600
Replace Compacted Fill	720	Cu. Yds.	$15.00	$10,800
48" Dia. RCP	360	Lin. Ft.	$335	$120,600
Automated Gate	1	Job	$30,000	$30,000
Concrete Inlet Structure	1	Job	$23,500	$23,500
Energy Dissipation Structure	1	Job	$23,500	$23,500
6 Spillway from Cell 1				
48" Dia. RCP	360	Lin. Ft.	$335	$120,600
Concrete Inlet Structure	1	Job	$23,500	$23,500
Energy Dissipation Structure	1	Job	$1,400	$1,400
7 Spillway from Cell 3				
Excavate & Haul Offsite	300	Cu. Yds.	$12.50	$3,750
Concrete Channel & Weir	125	Cu. Yds.	$500	$62,500
Energy Dissipation Structure	1	Job	$17,000	$17,000
8 Spillway from Cell 4				
Excavate & Haul Offsite	200	Cu. Yds.	$12.50	$2,500
Concrete Channel & Weir	105	Cu. Yds.	$500	$52,500
Energy Dissipation Structure	1	Job	$17,000	$17,000
9 Tie-In to Jurupa Pipeline				
36" Dia. RCP	2,300	Lin. Ft.	$270	$621,000
Butterfly Valve	3	Job	$19,700	$59,100
Energy Dissipation Structure	3	Job	$46,200	$138,600
Subtotal Direct Construction				**$4,284,500**
Contingency @ 25%				**$1,071,100**
Total Construction				**$5,355,600**
Engineering and Administration Costs				
Engineering, Construction Inspection and Contract Admin. @ 10%				$536,000
Total Engineering and Administration				**$536,000**
Total Estimated Cost				**$5,891,600**
Total Estimated Cost - Rounded				**$5,890,000**
Annual Cost - 30 Years @ 5% Interest				**$383,300**

Table 5-15
Cost Estimate for Conceptual Project Evaluation of RP3 Basin (With Excavation)

	Description	Quantity	Unit	Unit Cost	Total Cost
Direct Construction Costs					
1	Mobilization	1	Job	Lump Sum	$477,000
2	Reservoir Excavation				
	Excavate & Haul Offsite	762,000	Cu. Yds.	$12.50	$9,525,000
3	Channel Modification				
	Modify Channel for Conduit Inlet	35	Cu. Yds.	$1,200	$42,000
	Modify Channel for Pneumatic Gate	1	Job	$380,500	$380,500
	Pneumatic Gate	1	Job	$140,000	$140,000
4	Conduit to Cell 1				
	Excavation	22,200	Cu. Yds.	$5.00	$111,000
	Replace Compacted Fill	8,300	Cu. Yds.	$15.00	$124,500
	8' x 10' RCB	950	Lin. Ft.	$830	$788,500
	Coarse Drain Material	550	Ton	$23	$12,650
	Automated Gate	1	Job	$130,000	$130,000
	Concrete Inlet Structure	1	Job	$24,000	$24,000
	Energy Dissipation Structure	1	Job	$226,800	$226,800
	Road Demolition & Replacement	1	Job	$66,000	$66,000
5	Conduit to Cell 3				
	Excavation	66,500	Cu. Yds.	$5.00	$332,500
	Replace Compacted Fill	66,500	Cu. Yds.	$15.00	$997,500
	8' x 10' RCB	820	Lin. Ft.	$830	$680,600
	Coarse Drain Material	460	Ton	$23	$10,580
	Automated Gate	1	Job	$162,500	$162,500
	Concrete Inlet Structure	1	Job	$48,000	$48,000
	Energy Dissipation Structure	1	Job	$48,000	$48,000
	Channel Demolition & Replacement	1	Job	$218,000	$218,000
6	Conduit to Cell 4				
	Excavation	23,400	Cu. Yds.	$5.00	$117,000
	Replace Compacted Fill	23,400	Cu. Yds.	$15.00	$351,000
	48" Dia. RCP	420	Lin. Ft.	$335	$140,700
	Automated Gate	1	Job	$30,000	$30,000
	Concrete Inlet Structure	1	Job	$23,500	$23,500
	Energy Dissipation Structure	1	Job	$23,500	$23,500
7	Spillway from Cell 1				
	48" Dia. RCP	440	Lin. Ft.	$335	$147,400
	Concrete Inlet Structure	1	Job	$23,500	$23,500
	Energy Dissipation Structure	1	Job	$1,400	$1,400
8	Spillway from Cell 3				
	Excavate & Haul Offsite	300	Cu. Yds.	$12.50	$3,750
	Concrete Channel & Weir	125	Cu. Yds.	$500	$62,500
	Energy Dissipation Structure	1	Job	$17,000	$17,000
9	Spillway from Cell 4				
	Excavate & Haul Offsite	200	Cu. Yds.	$12.50	$2,500
	Concrete Channel & Weir	105	Cu. Yds.	$500	$52,500
	Energy Dissipation Structure	1	Job	$17,000	$17,000
9	Tie-In to Jurupa Pipeline				
	36" Dia. RCP	2,300	Lin. Ft.	$270	$621,000
	Butterfly Valve	3	Job	$19,700	$59,100
	Energy Dissipation Structure	3	Job	$46,200	$138,600
	Subtotal Direct Construction				**$16,377,600**
	Contingency @ 25%				**$4,094,400**
	Total Construction				**$20,472,000**
Engineering and Administration Costs					
	Engineering, Construction Inspection and Contract Admin. @ 10%				$2,047,000
	Total Engineering and Administration				**$2,047,000**
Total Estimated Cost					**$22,519,000**
Total Estimated Cost - Rounded					**$22,520,000**
Annual Cost - 30 Years @ 5% Interest					**$1,464,900**



Source: Existing Recharge Basins per Wildermuth Environmental, Inc. (WEI), acquired February 6, 2009.
Chino Basin Boundary per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 3, 2009.
Digital Elevation Model (DEM) per WEI, acquired February 2009.

FIGURE 5-1

Existing Regional Basins

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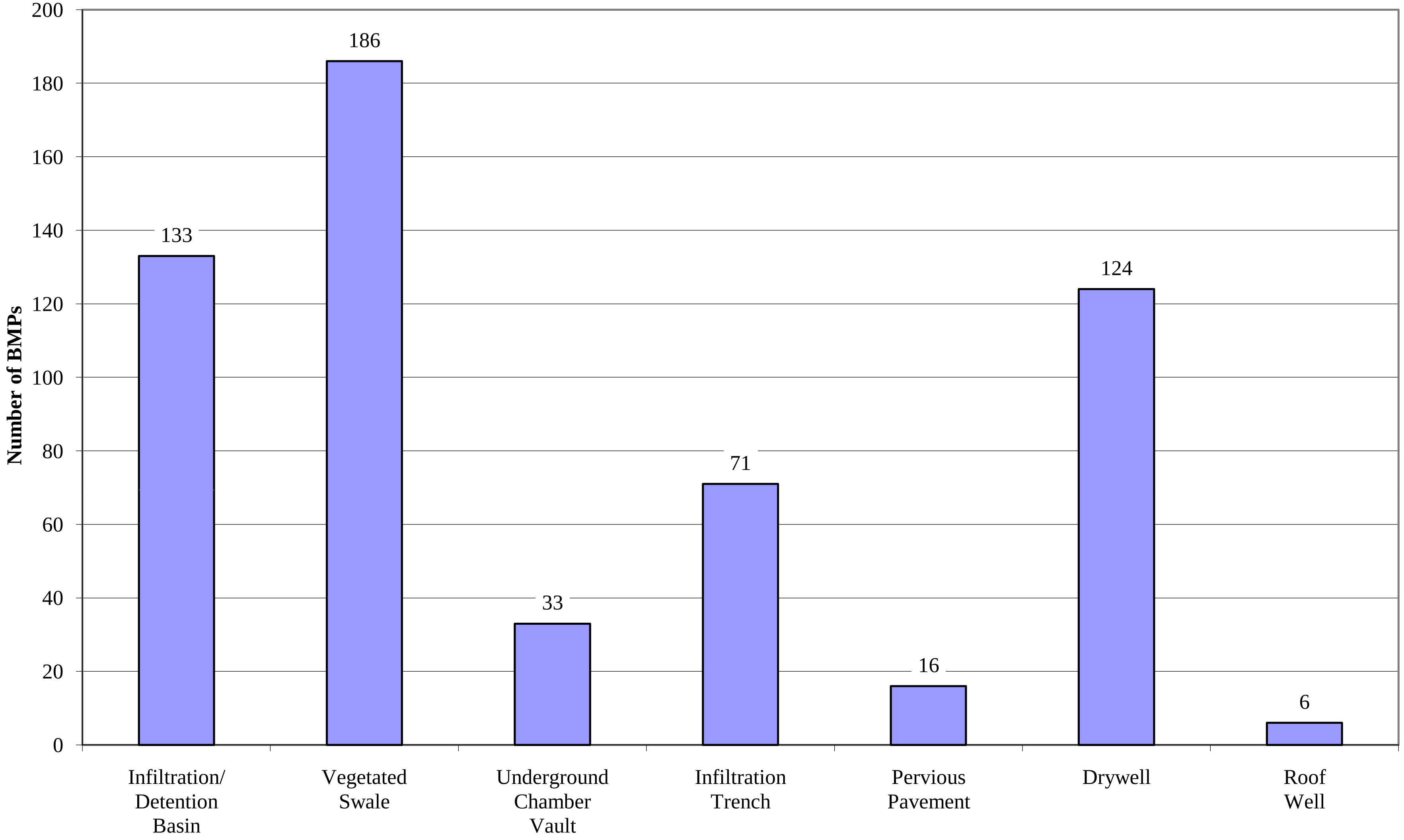
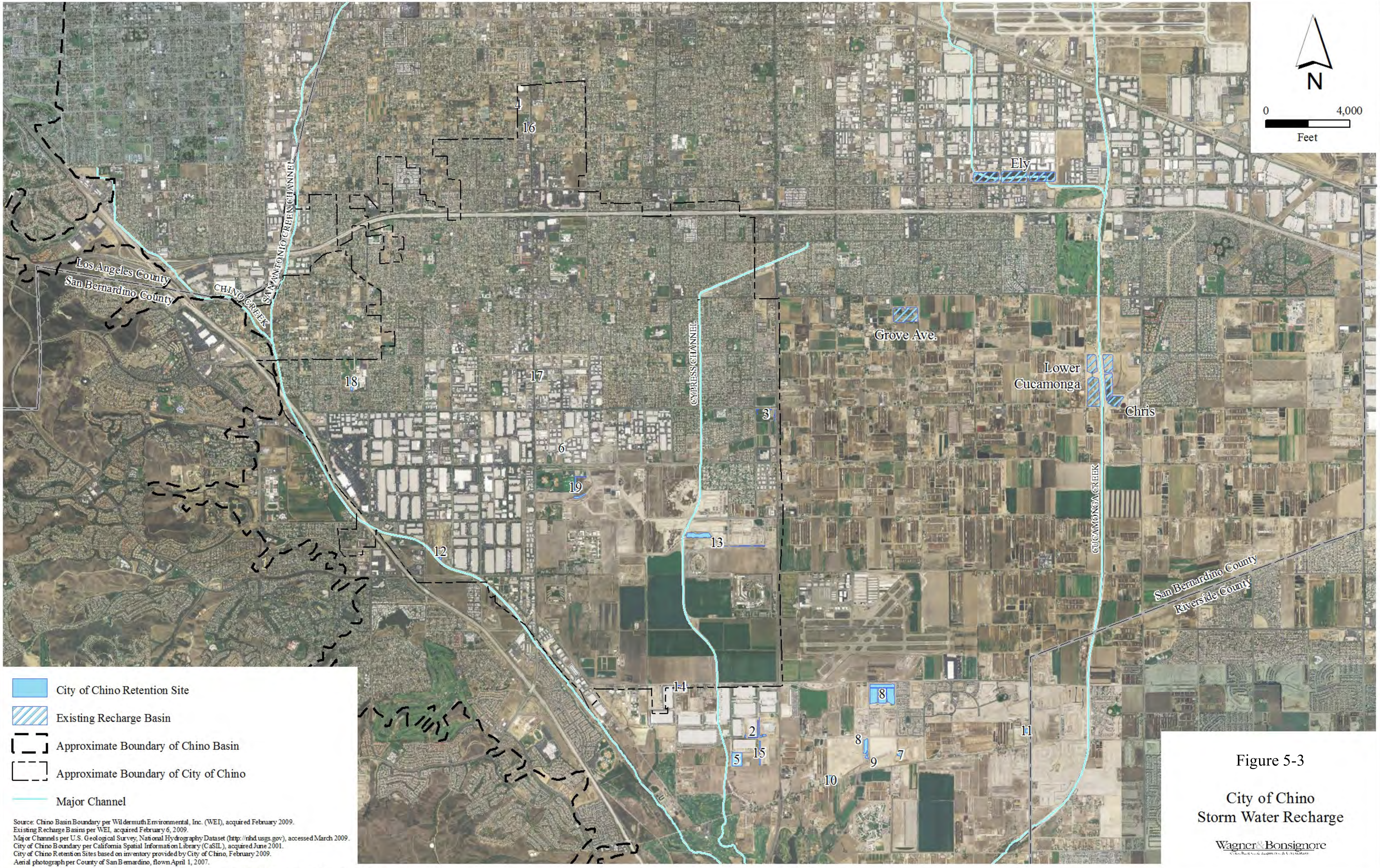
Q:\Drawings\Chino Basin Water Conservation District\Recharge Master Plan\GIS\FIGURE 5.1.1-1 - Existing Regional Recharge Sites.mxd

Figure 5-2

Identified Storm Water Management BMPs





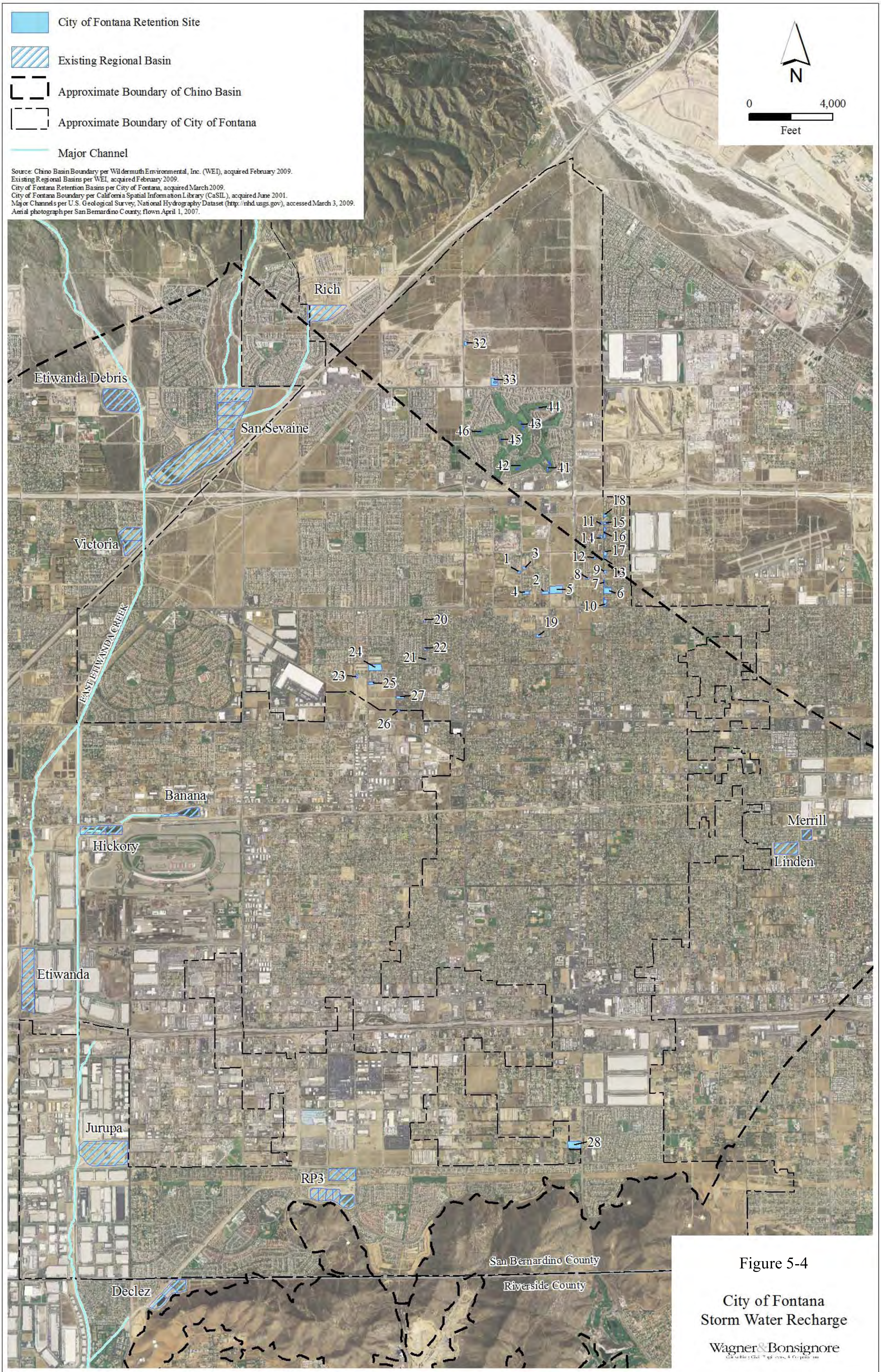
Source: Chino Basin Boundary per Wildermuth Environmental, Inc. (WEI), acquired February 2009.
Existing Recharge Basins per WEI, acquired February 6, 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 2009.
City of Chino Boundary per California Spatial Information Library (CaSIL), acquired June 2001.
City of Chino Retention Sites based on inventory provided by City of Chino, February 2009.
Aerial photograph per County of San Bernardino, flown April 1, 2007.

Q:\Drawings\Chino Basin Water Conservation District\Recharge Master Plan\GIS\FIGURE 6.1.2-2 - City of Chino Stormwater Retention Overview.mxd

Figure 5-3

City of Chino
Storm Water Recharge

Wagner & Bonsignore



Source: Chino Basin Boundary per Wildermuth Environmental, Inc. (WEI), acquired February 2009.
Existing Regional Basins per WEI, acquired February 2009.
City of Fontana Retention Basins per City of Fontana, acquired March 2009.
City of Fontana Boundary per California Spatial Information Library (CaSIL), acquired June 2001.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 3, 2009.
Aerial photograph per San Bernardino County, flown April 1, 2007.

Figure 5-4

City of Fontana
Storm Water Recharge

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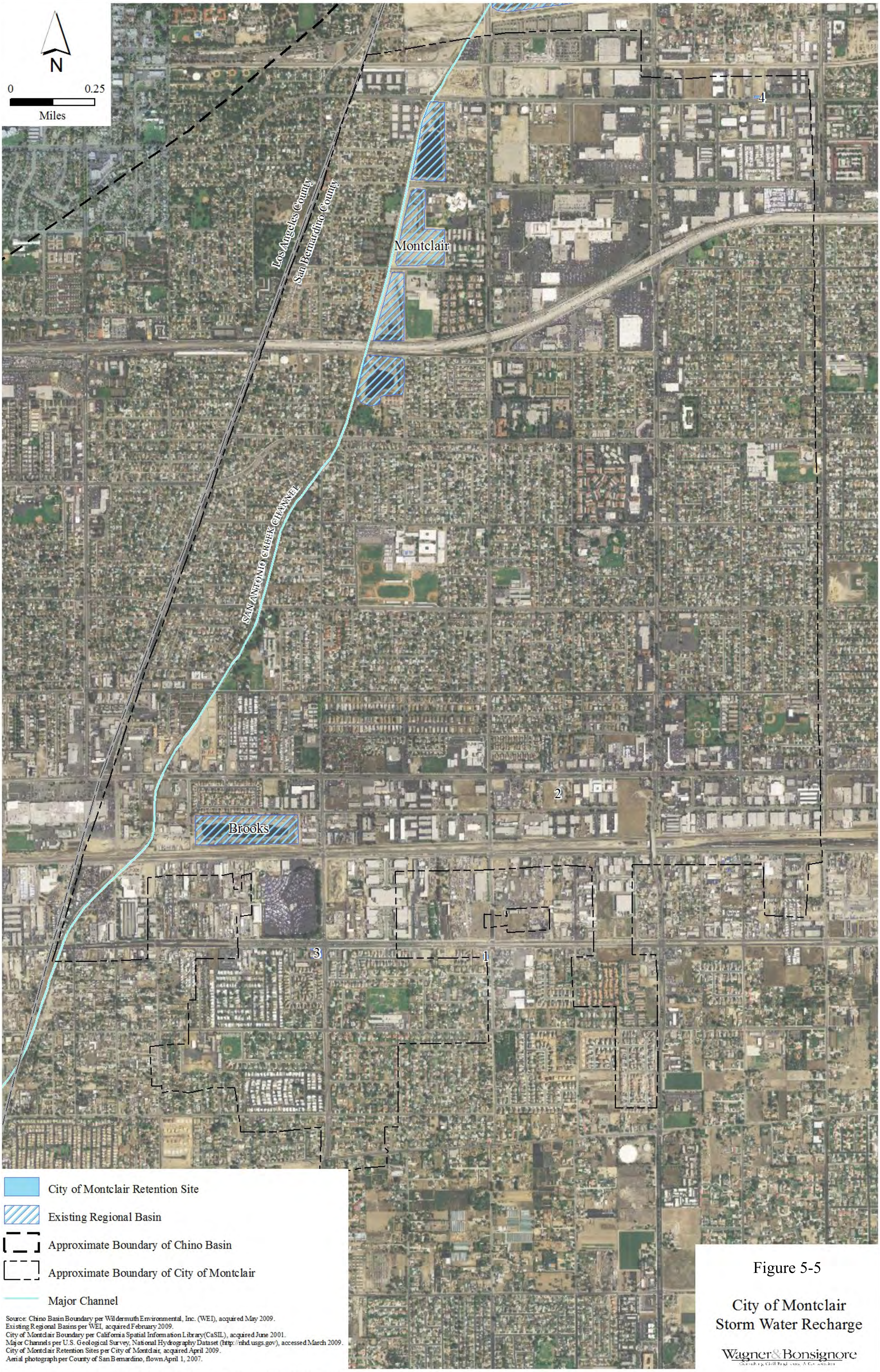
Q:\Drawings\Chino Basin Water Conservation District\Recharge Master Plan\GIS\FIGURE 6.1.2-3 - COF Detention Basins Overview.mxd



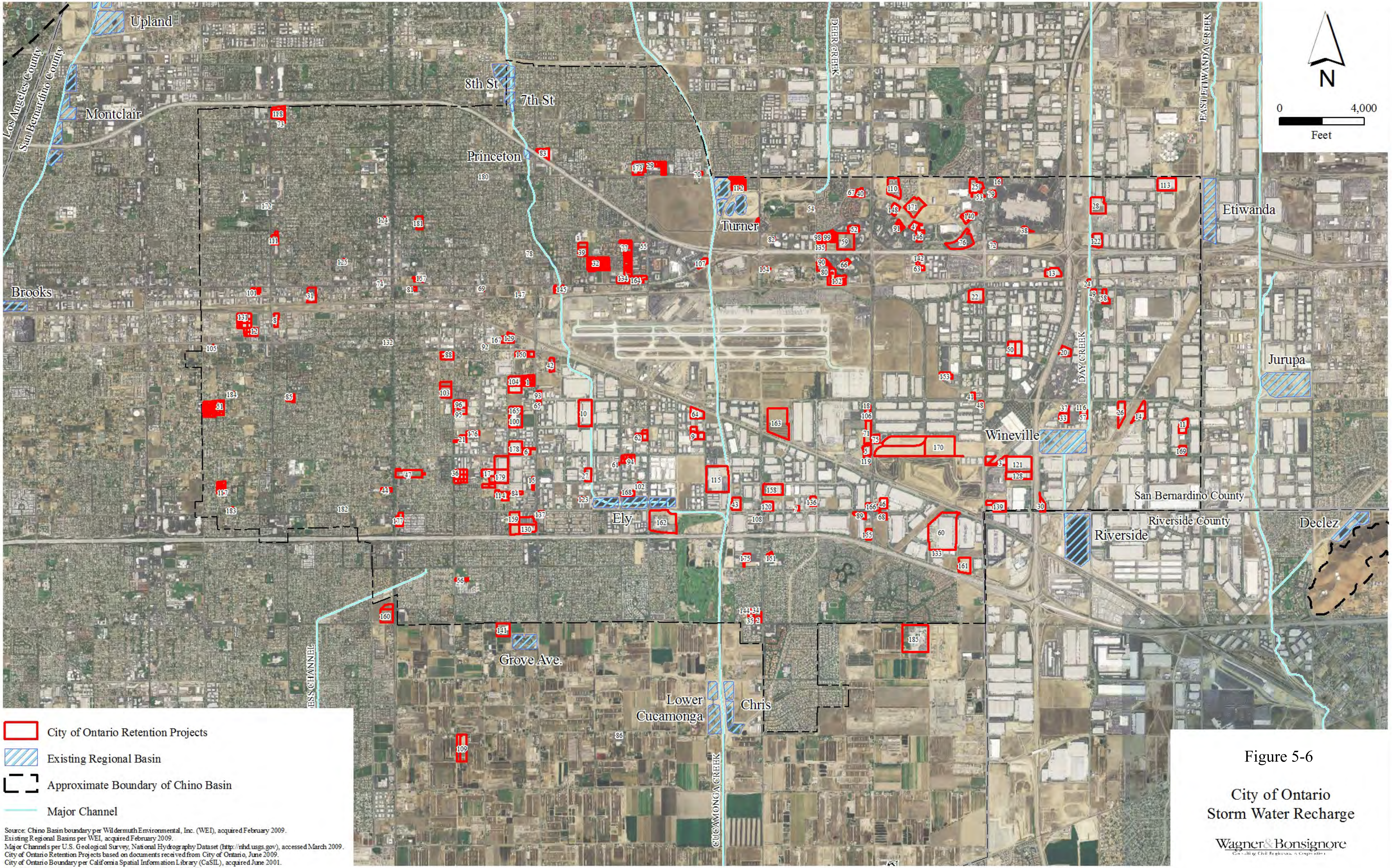
Source: Chino Basin Boundary per Wildermuth Environmental, Inc. (WEI), acquired May 2009.
Existing Regional Basins per WEI, acquired February 2009.
City of Montclair Boundary per California Spatial Information Library(CaSIL), acquired June 2001.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 2009.
City of Montclair Retention Sites per City of Montclair, acquired April 2009.
Aerial photograph per County of San Bernardino, flown April 1, 2007.

Figure 5-5

City of Montclair
Storm Water Recharge

Wagner&Bonsignore

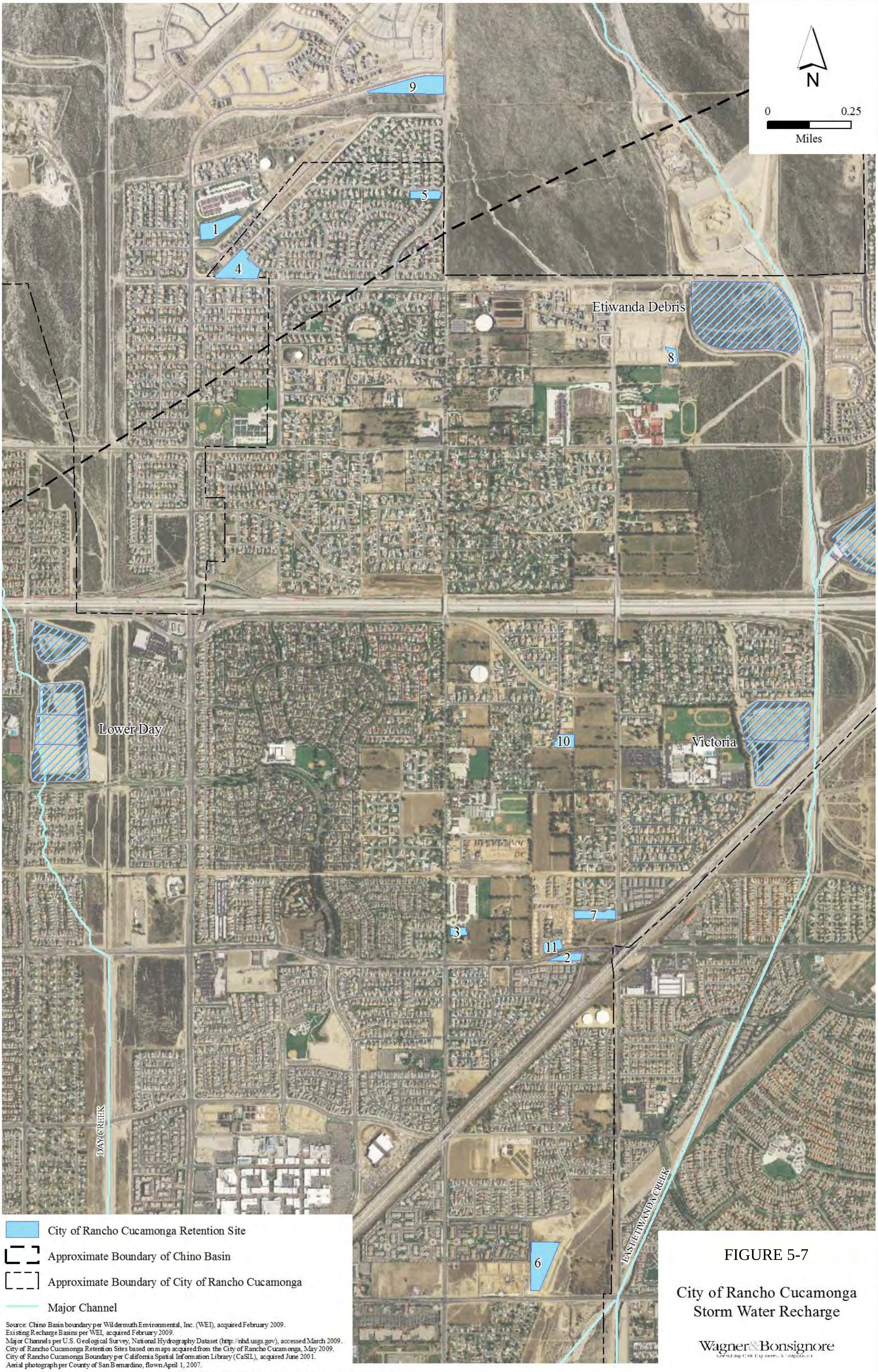
Q:\Drawings\Chino Basin Water Conservation District\Recharge Master Plan\GIS\FIGURE 6.1.2-4 - Montclair Detention Basins Overview.mxd



Source: Chino Basin boundary per Wildermuth Environmental, Inc. (WEI), acquired February 2009.
Existing Regional Basins per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 2009.
City of Ontario Retention Projects based on documents received from City of Ontario, June 2009.
City of Ontario Boundary per California Spatial Information Library (CaSIL), acquired June 2001.
Aerial photograph per County of San Bernardino, flown April 1, 2007.
Q:\Drawings\Chino Basin Water Conservation District\Recharge Master Plan\GIS\FIGURE 6.1.2-5 - City of Ontario Stormwater Retention Overview.mxd

Figure 5-6

City of Ontario
Storm Water Recharge



Source: Chino Basin boundary per Wildermuth Environmental, Inc. (WEI), acquired February 2009.
Existing Recharge Basins per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 2009.
City of Rancho Cucamonga Retention Sites based on maps acquired from the City of Rancho Cucamonga, May 2009.
City of Rancho Cucamonga Boundary per California Spatial Information Library (CaSIL), acquired June 2001.
Aerial photograph per County of San Bernardino, flown April 1, 2007.

Q:\Drawings\Chino Basin Water Conservation District\Recharge Master Plan\GIS\FIGURE 6.1.2-6 - City of Rancho Cucamonga Stormwater Retention Overview.mxd

FIGURE 5-7

City of Rancho Cucamonga
Storm Water Recharge

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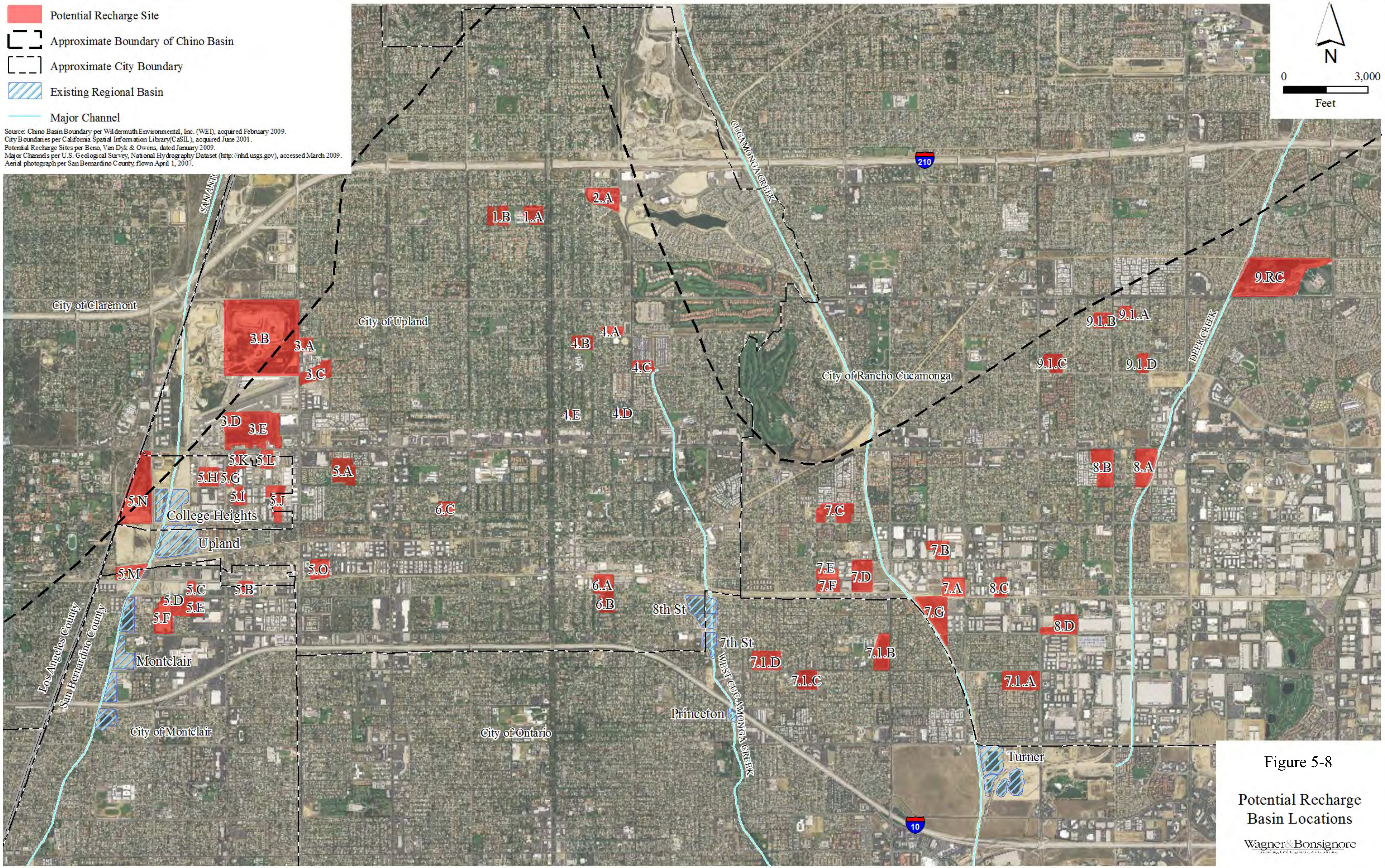


Source: Chino Basin Boundary per Wildermuth Environmental, Inc. (WEI), acquired February 2009.
City Boundaries per California Spatial Information Library(CaSIL), acquired June 2001.
Potential Recharge Sites per Beno, Van Dyk & Owens, dated January 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 2009.
Aerial photograph per San Bernardino County, flown April 1, 2007.

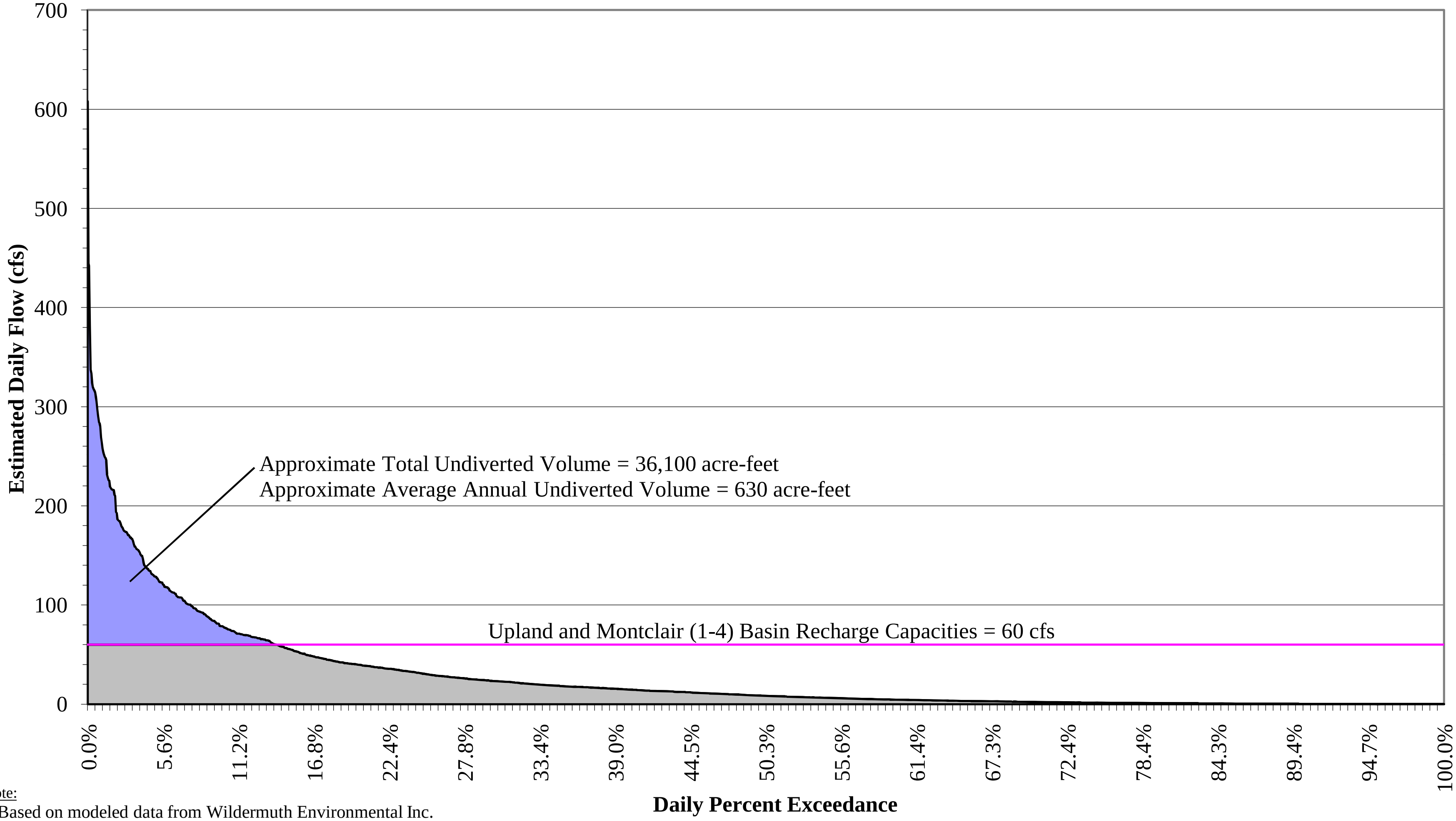
Figure 5-8

Potential Recharge Basin Locations

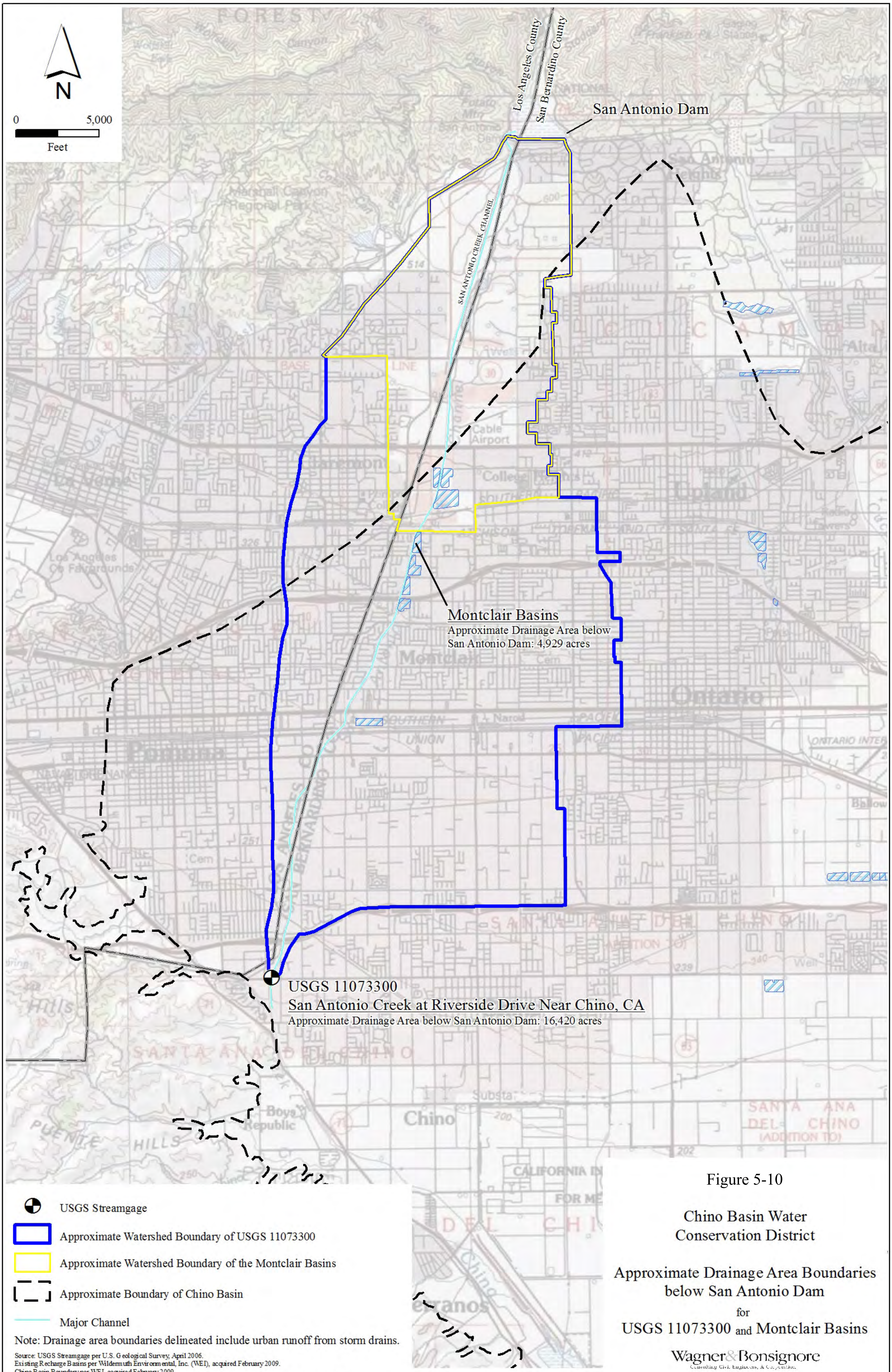
Q:\Drawings\Chino Basin Water Conservation District\Recharge Master Plan\GIS\FIGURE 6.2.1-1 - Potential Sites Overview.mxd

Figure 5-9

Upland and Montclair (1-4) Basin Positive Flow by Percentile
October 1949 Through December 2006



Note:
(1) Based on modeled data from Wildermuth Environmental Inc.
(2) Flows shown according to percentile of non-zero flows, 91.3% of the estimated daily flows for the period of record equal 0 cfs.



Note: Drainage area boundaries delineated include urban runoff from storm drains.

Source: USGS Streamgage per U.S. Geological Survey, April 2006.
Existing Recharge Basins per Wildermuth Environmental, Inc. (WEI), acquired February 2009.
Chino Basin Boundary per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 2009.
Q:\Drawings\Chino Basin Water Conservation District\Recharge Master Plan\GIS\FIGURE 6.2.3-2 - SAC at Riverside and Montclair.mxd

Figure 5-10

Chino Basin Water
Conservation District

Approximate Drainage Area Boundaries
below San Antonio Dam
for
USGS 11073300 and Montclair Basins

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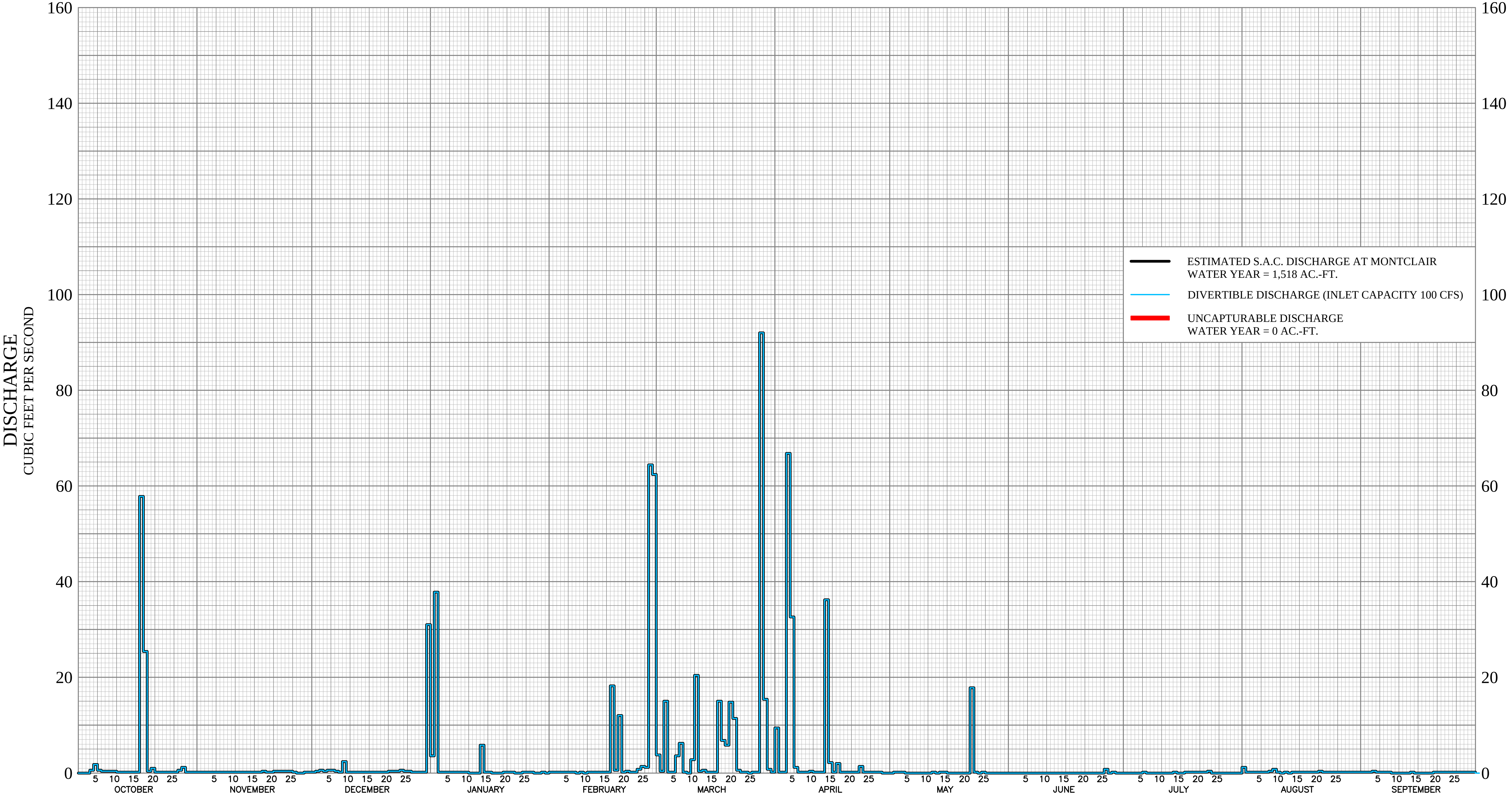
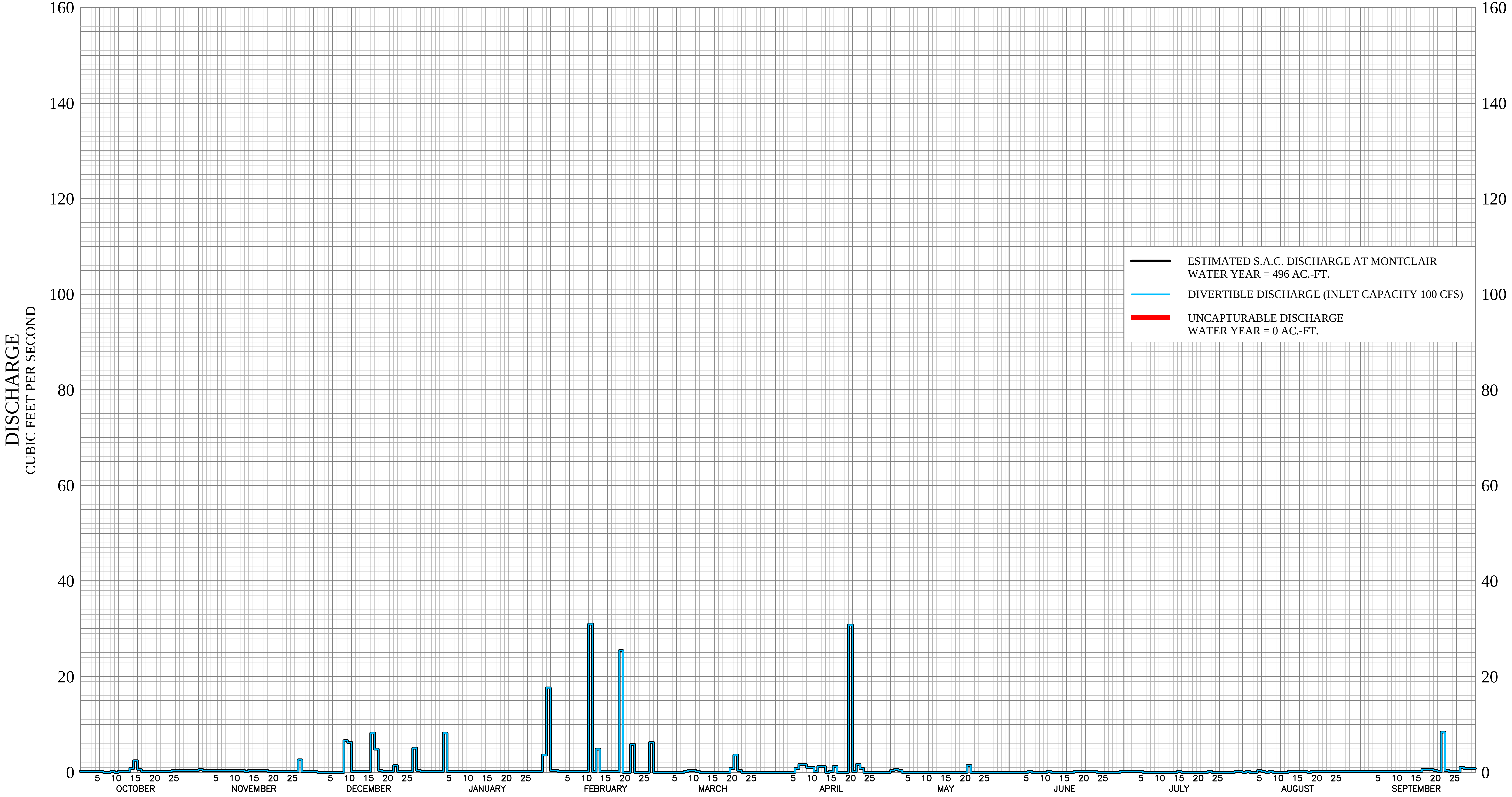
Consulting Civil Engineers, A Corporation

FIGURE 5-11



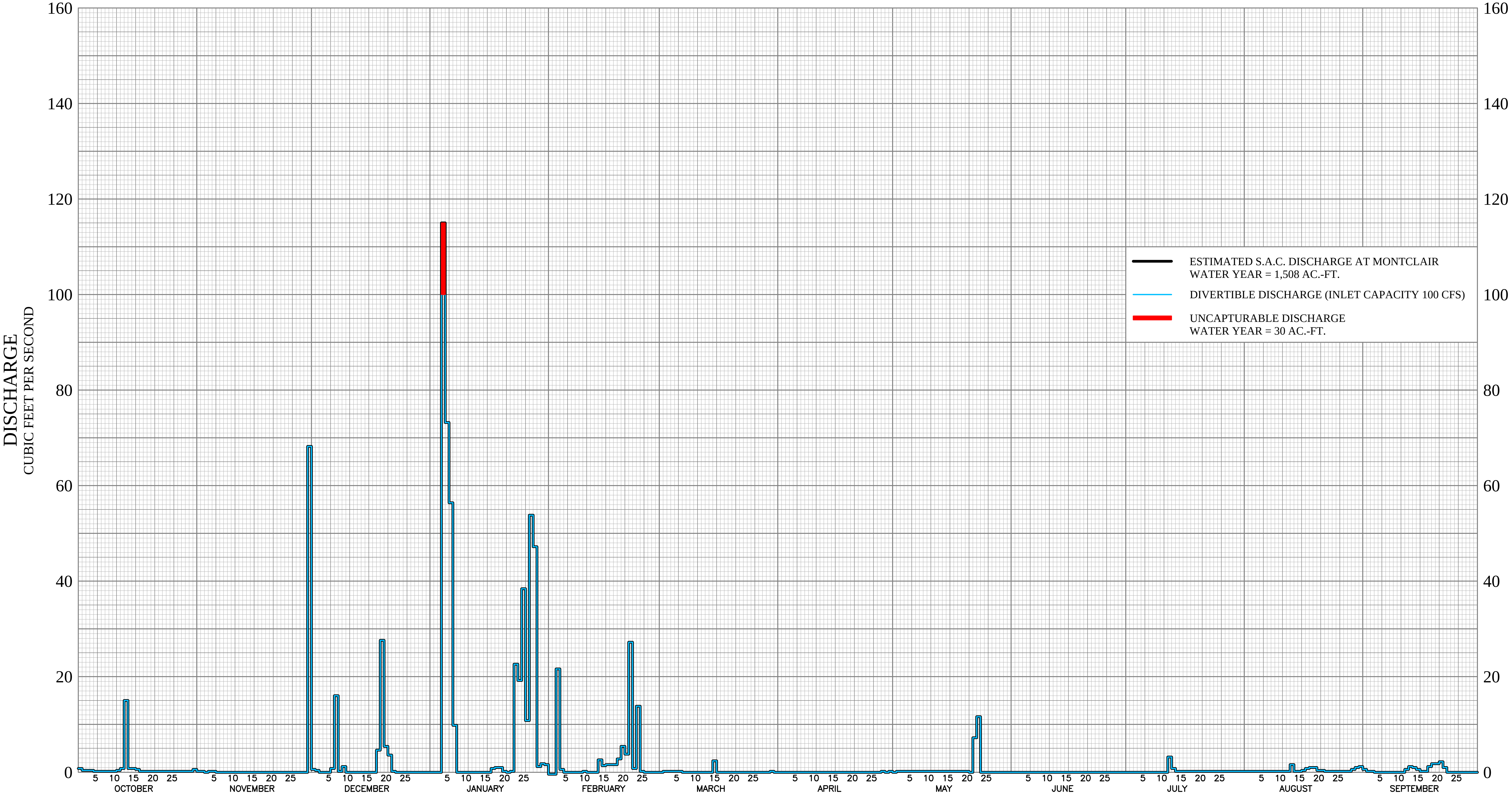
ESTIMATED DISCHARGE OF SAN ANTONIO CREEK AT MONTCLAIR BASINS AND
POTENTIAL MONTCLAIR BASIN DIVERSIONS
WATER YEAR 2006

FIGURE 5-12



ESTIMATED DISCHARGE OF SAN ANTONIO CREEK AT MONTCLAIR BASINS AND
POTENTIAL MONTCLAIR BASIN DIVERSIONS
WATER YEAR 2007

FIGURE 5-13



ESTIMATED DISCHARGE OF SAN ANTONIO CREEK AT MONTCLAIR BASINS AND POTENTIAL MONTCLAIR BASIN DIVERSIONS
WATER YEAR 2008

Figure 5-14

Increase in Capturable Runoff Resulting from Increased Inlet Capacity and/or Storage Capacity
Montclair Basins 1 through 4
Based on Data Modeled by Wildermuth Environmental, Inc.

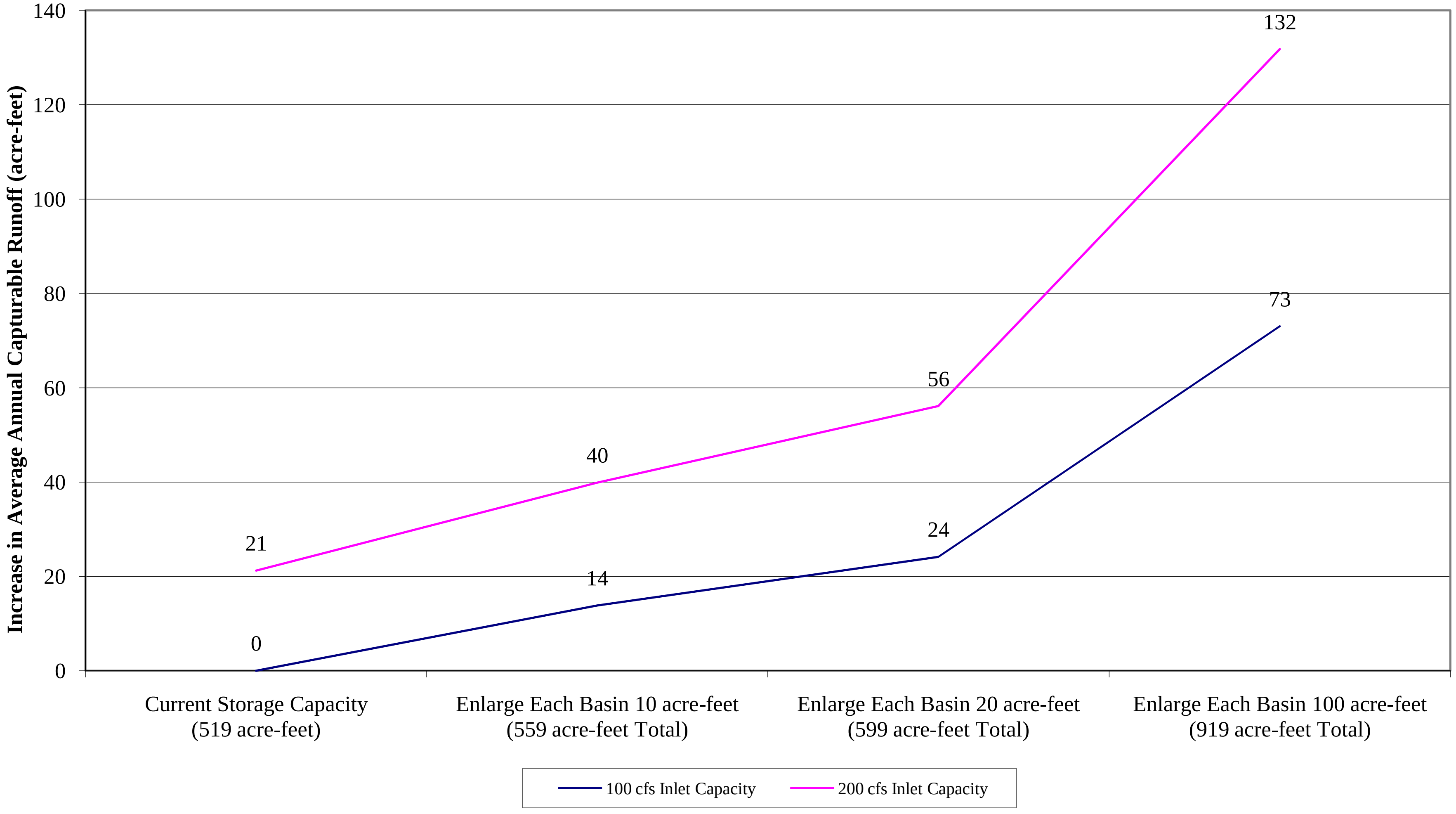


Figure 5-15

Increase in Capturable Runoff Resulting from Increased Storage Capacity
Turner Basins 1 through 4
Based on Daily Cucamonga Creek Runoff at Turner 1 Modeled by Wildermuth Environmental, Inc.

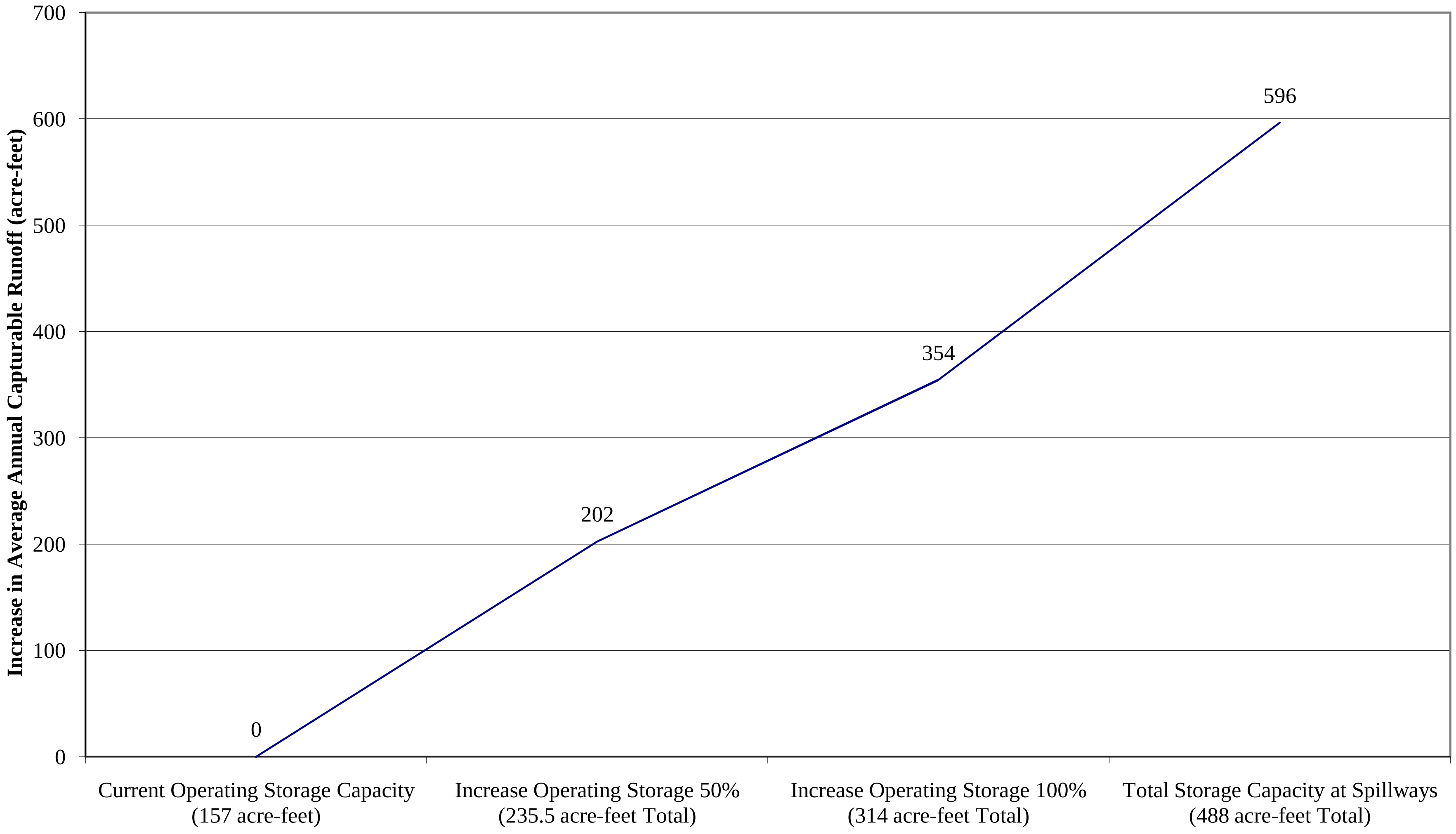


Figure 5-16

Estimated Discharge Potentially Foregone in San Antonio Creek System for Each First Flush Opportunity from April 2005 through September 2008 Based on San Antonio Creek Flow Estimated at the Montclair Basin Inlet

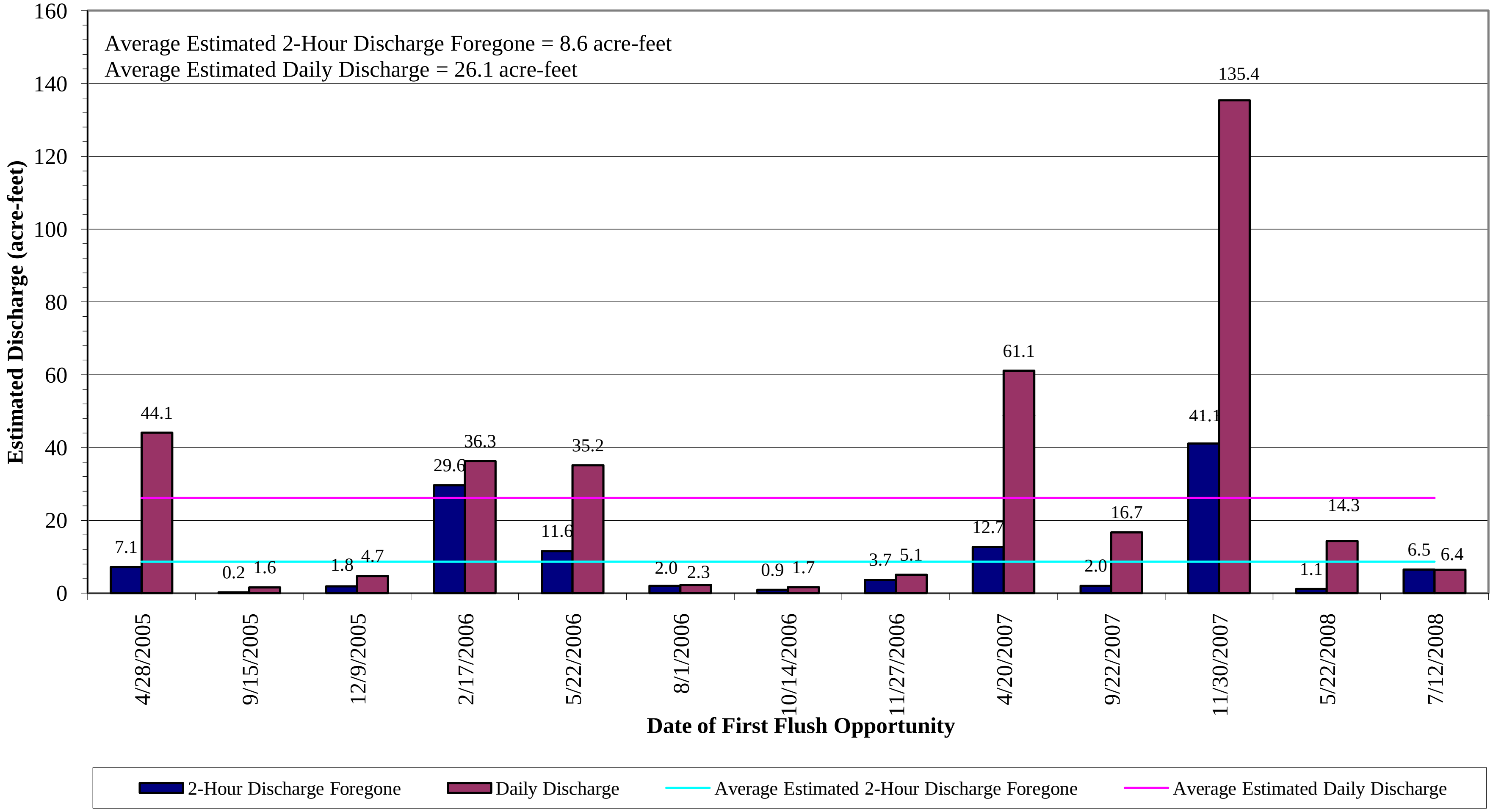
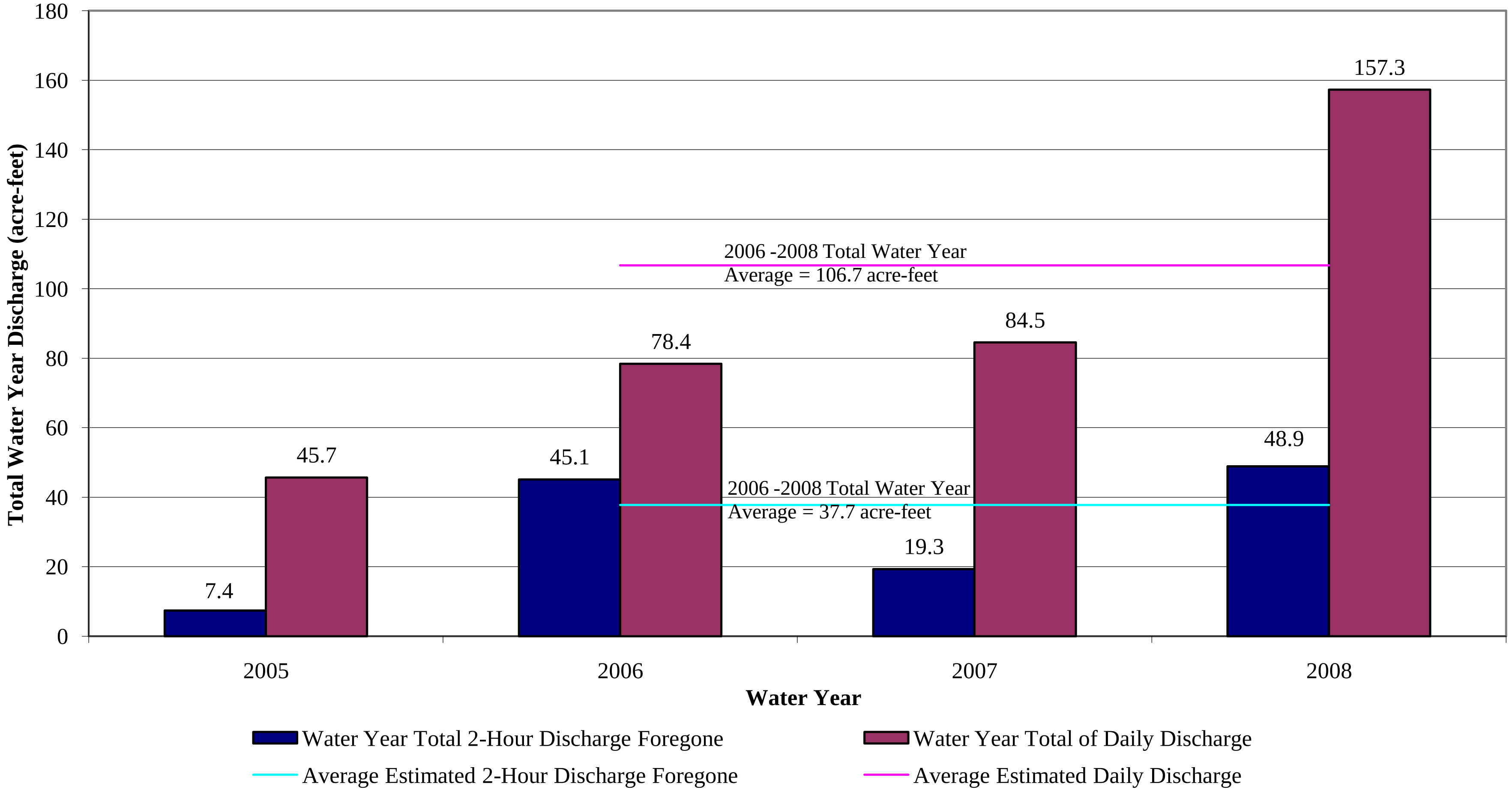
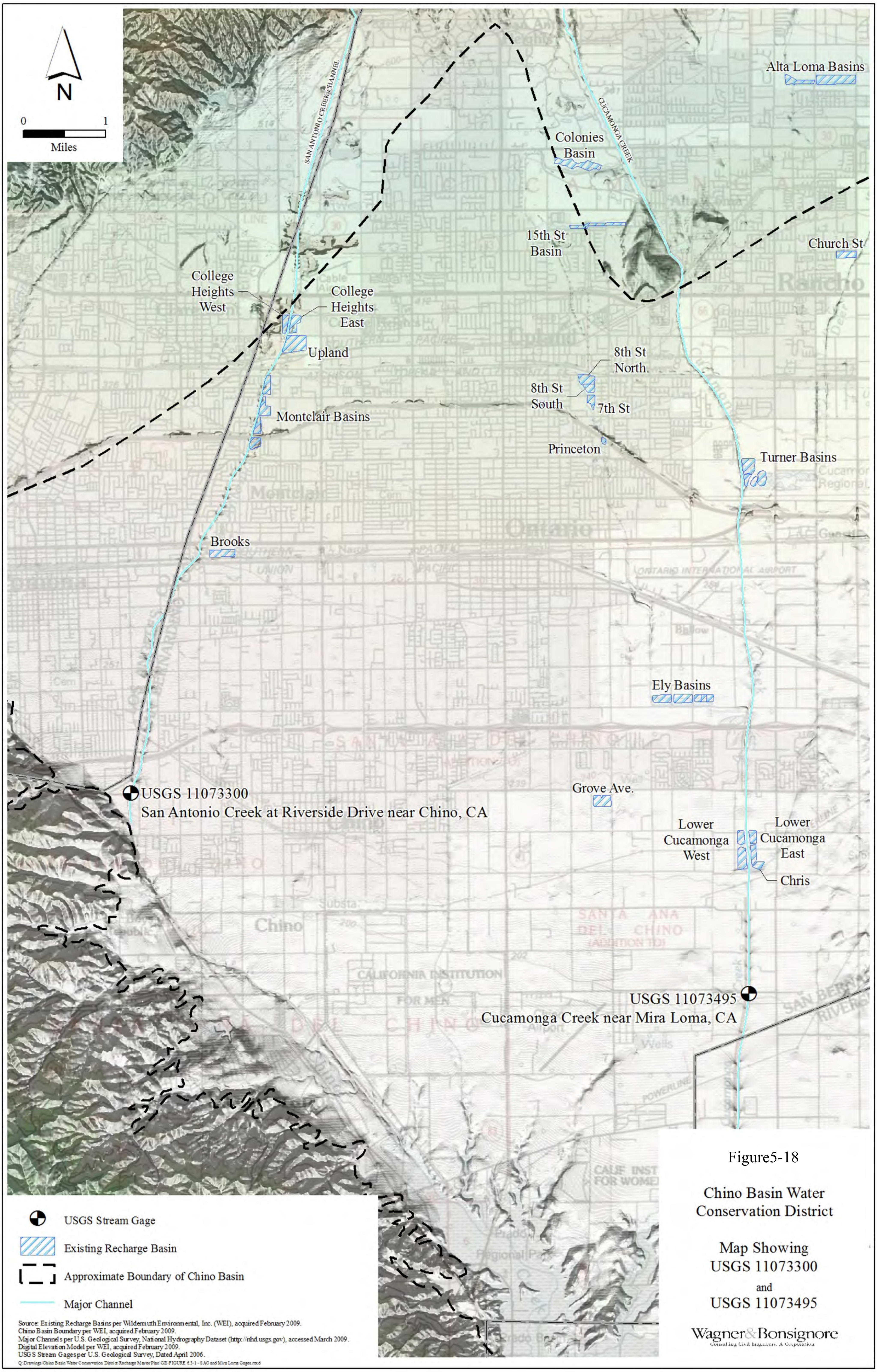


Figure 5-17

Estimated Total Water Year Discharge of Storm Events Occurring on Days Corresponding to First Flush Opportunities Based on San Antonio Creek Flow Estimated at the Montclair Basin Inlet



* Data available April 2005 through September 2008.



Source: Existing Recharge Basins per Wildermuth Environmental, Inc. (WEI), acquired February 2009.
Chino Basin Boundary per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 2009.
Digital Elevation Model per WEI, acquired February 2009.
USGS Stream Gages per U.S. Geological Survey, Dated April 2006.
Q:\Drawings\Chino Basin Water Conservation District\Recharge Master Plan\GIS\FIGURE 6.3-1 - SAC and Mira Loma Gages.mxd

Figure5-18

Chino Basin Water
Conservation District

Map Showing
USGS 11073300
and
USGS 11073495

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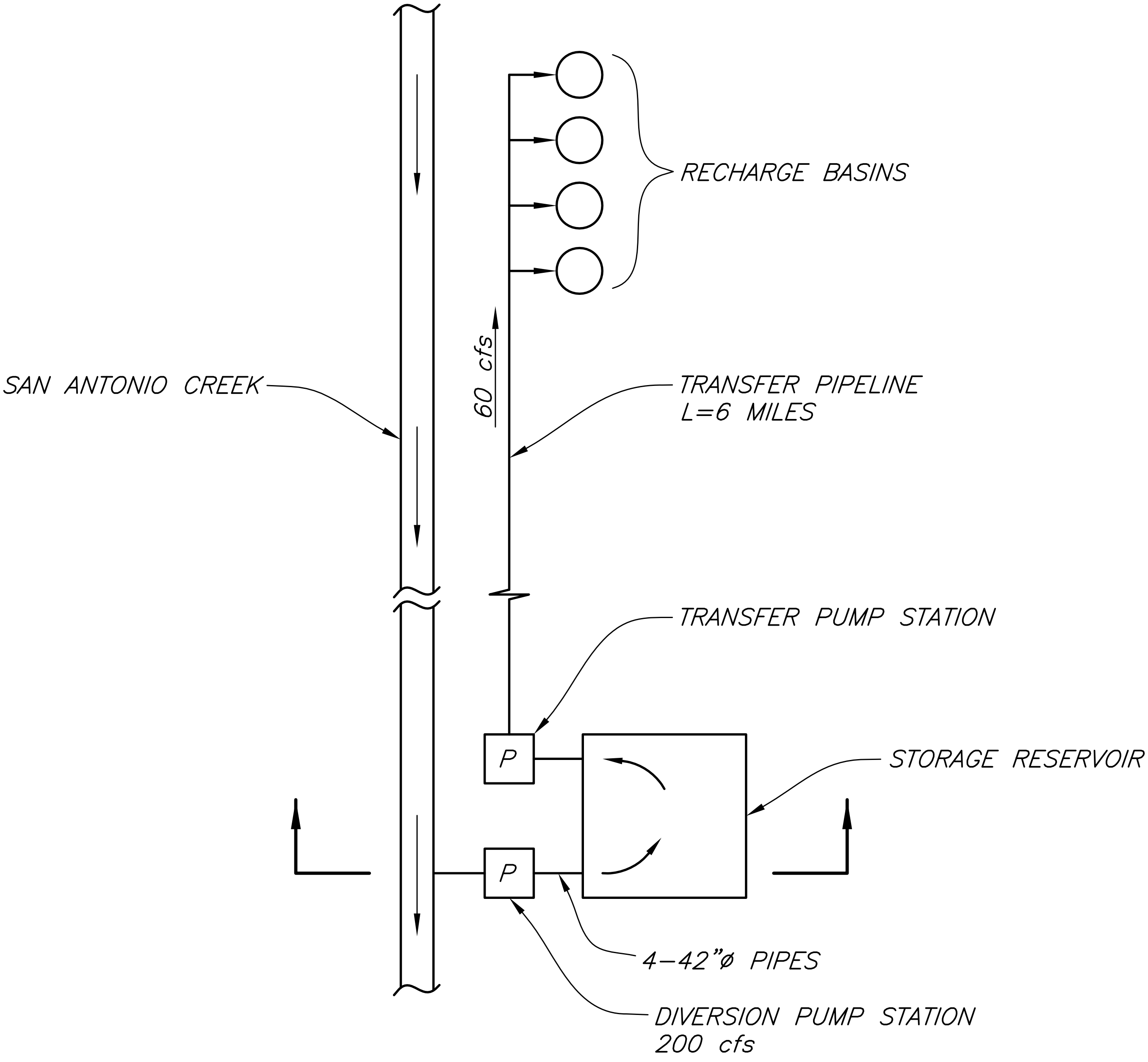
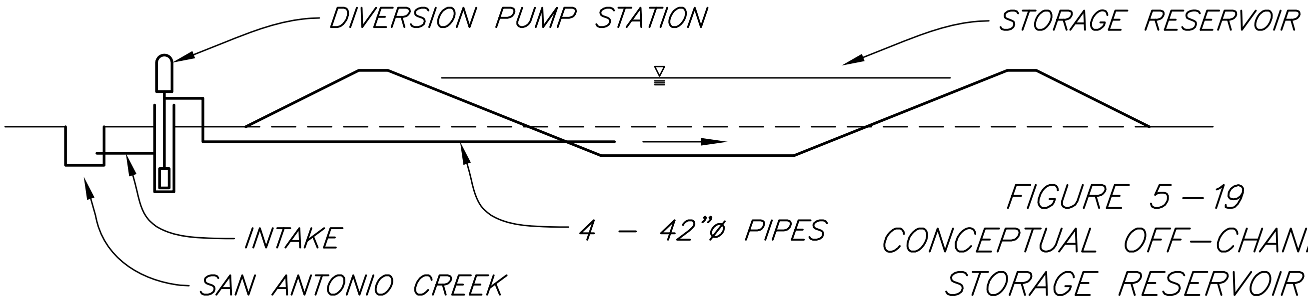


PLAN VIEW



SECTION

FIGURE 5 – 19
CONCEPTUAL OFF–CHANNEL
STORAGE RESERVOIR
PROJECT SCHEMATIC

CHINO BASIN WATER
CONSERVATION DISTRICT

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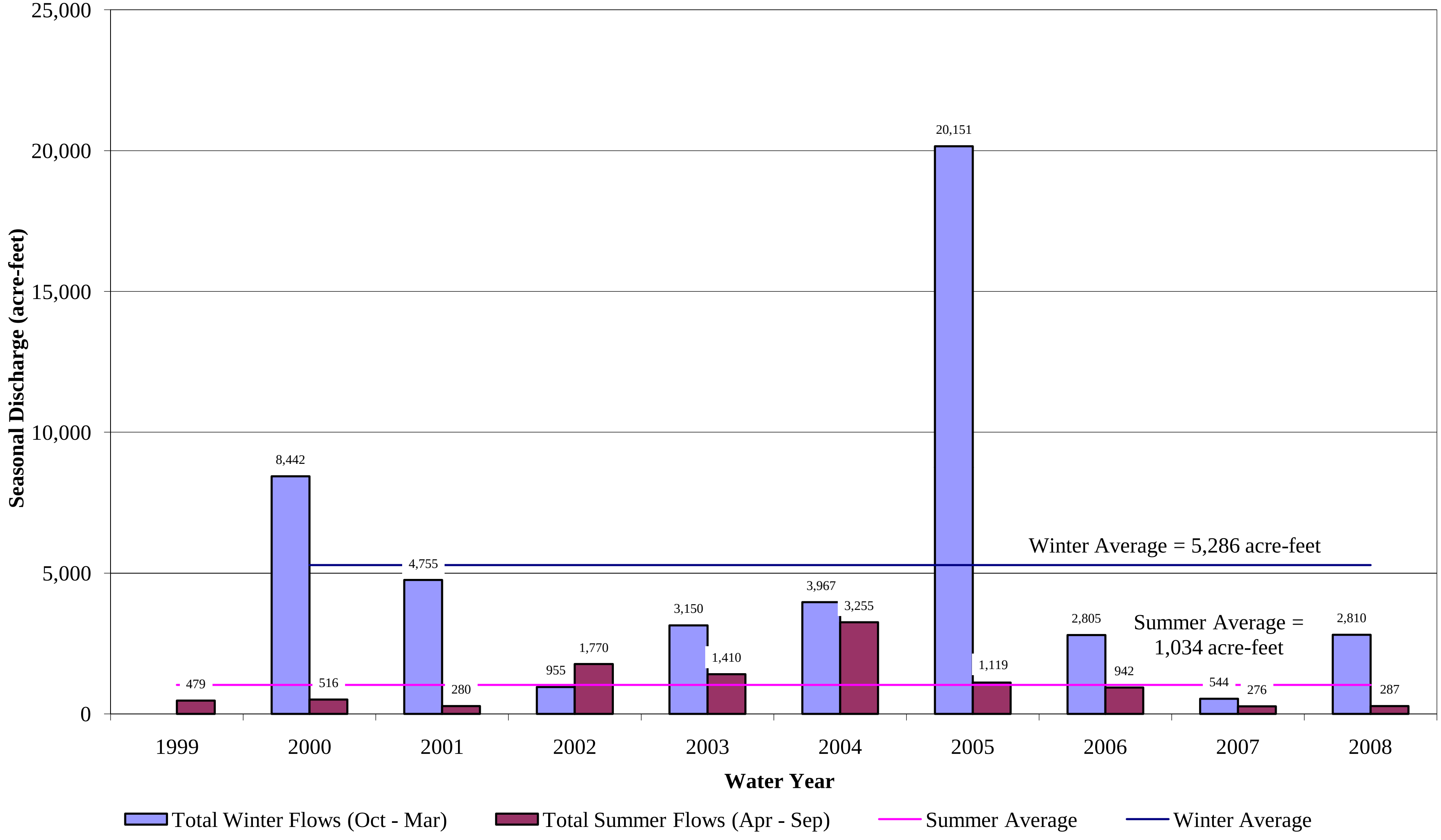
Consulting Civil Engineers, A Corporation

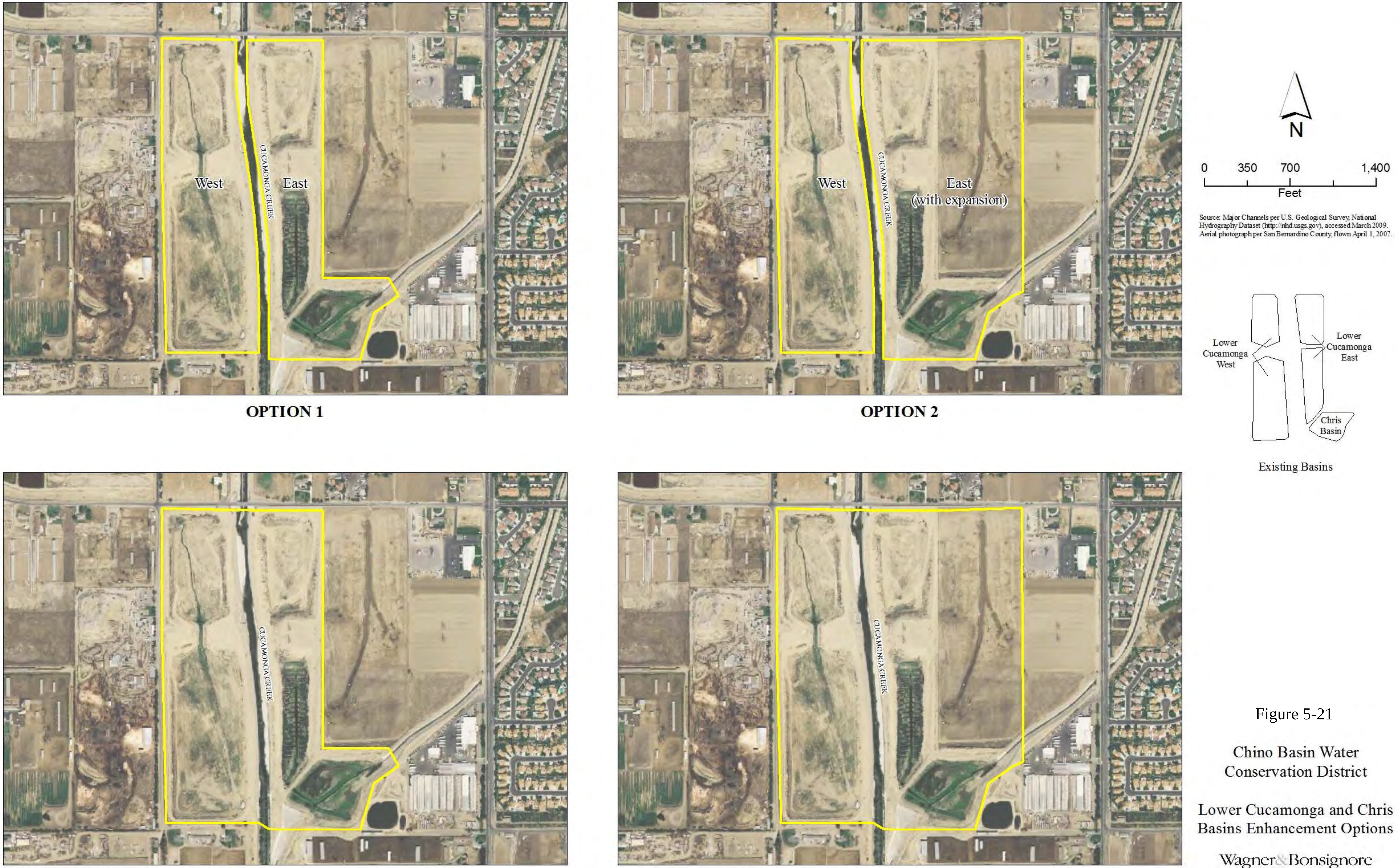
Q:\Drawings\Chino Basin Water Conservation District\CAD\dwg\Concenptual Recharge Project Schematic.dwg

Figure 5-20

Measured Seasonal Discharge USGS 11073300 San Antonio Creek at Riverside Dr., near Chino, CA Excluding Contributions from OC-59 Releases

(only complete seasons shown)





OPTION 1

OPTION 2

OPTION 3

OPTION 4

Existing Basins

Source: Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), accessed March 2009. Aerial photograph per San Bernardino County, flown April 1, 2007.

Figure 5-21

Chino Basin Water Conservation District

Lower Cucamonga and Chris Basins Enhancement Options

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Q:Drawings Chino Basin Water Conservation District Recharge Master Plan GIS FIGURE 6.3.1-3 - Lower Cucamonga and Chris Basin Enhancement.mxd

Figure 5-22

Measured Seasonal Discharge

USGS 11073495 Cucamonga Creek near Mira Loma, CA

(only complete seasons shown)

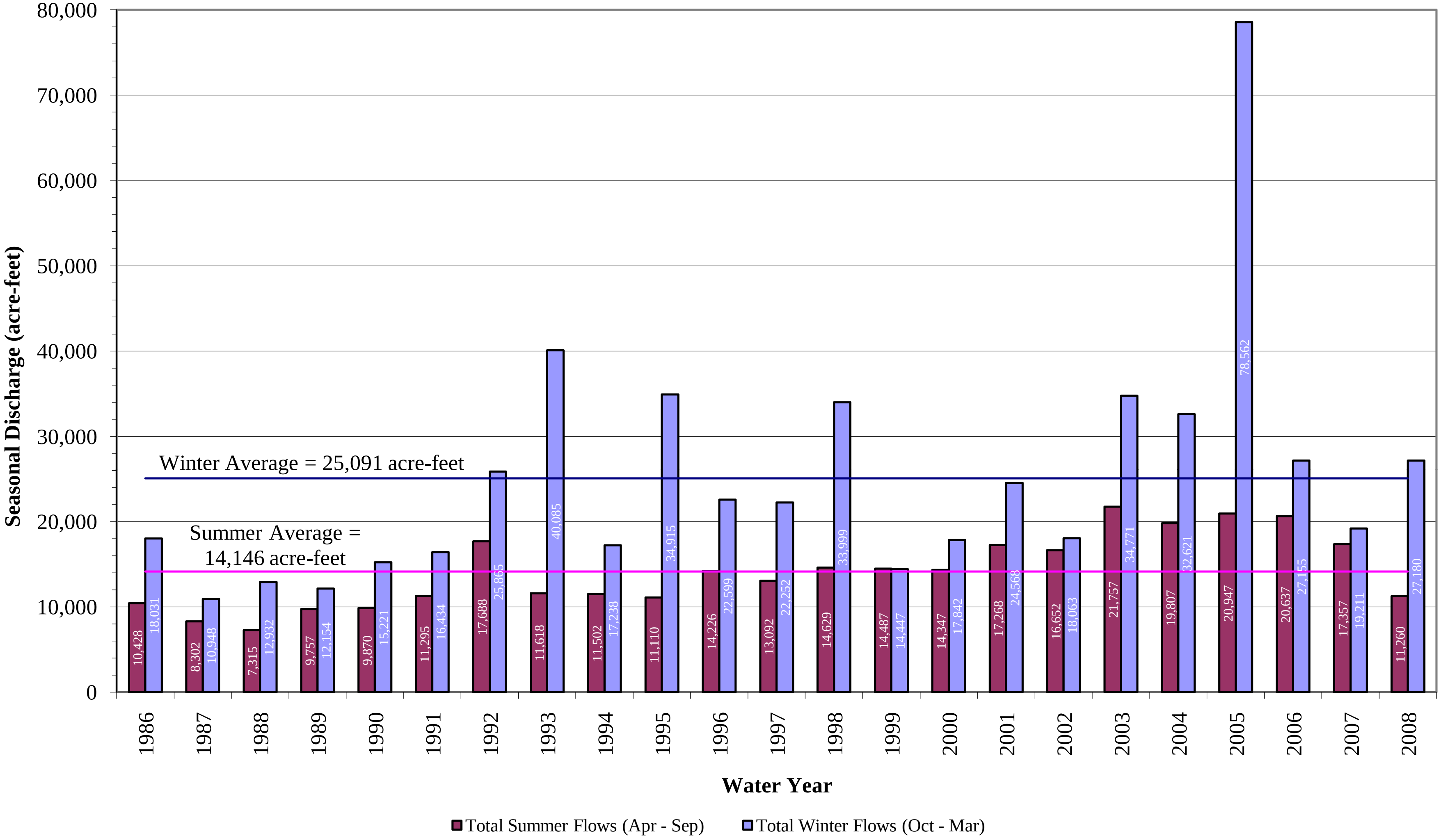
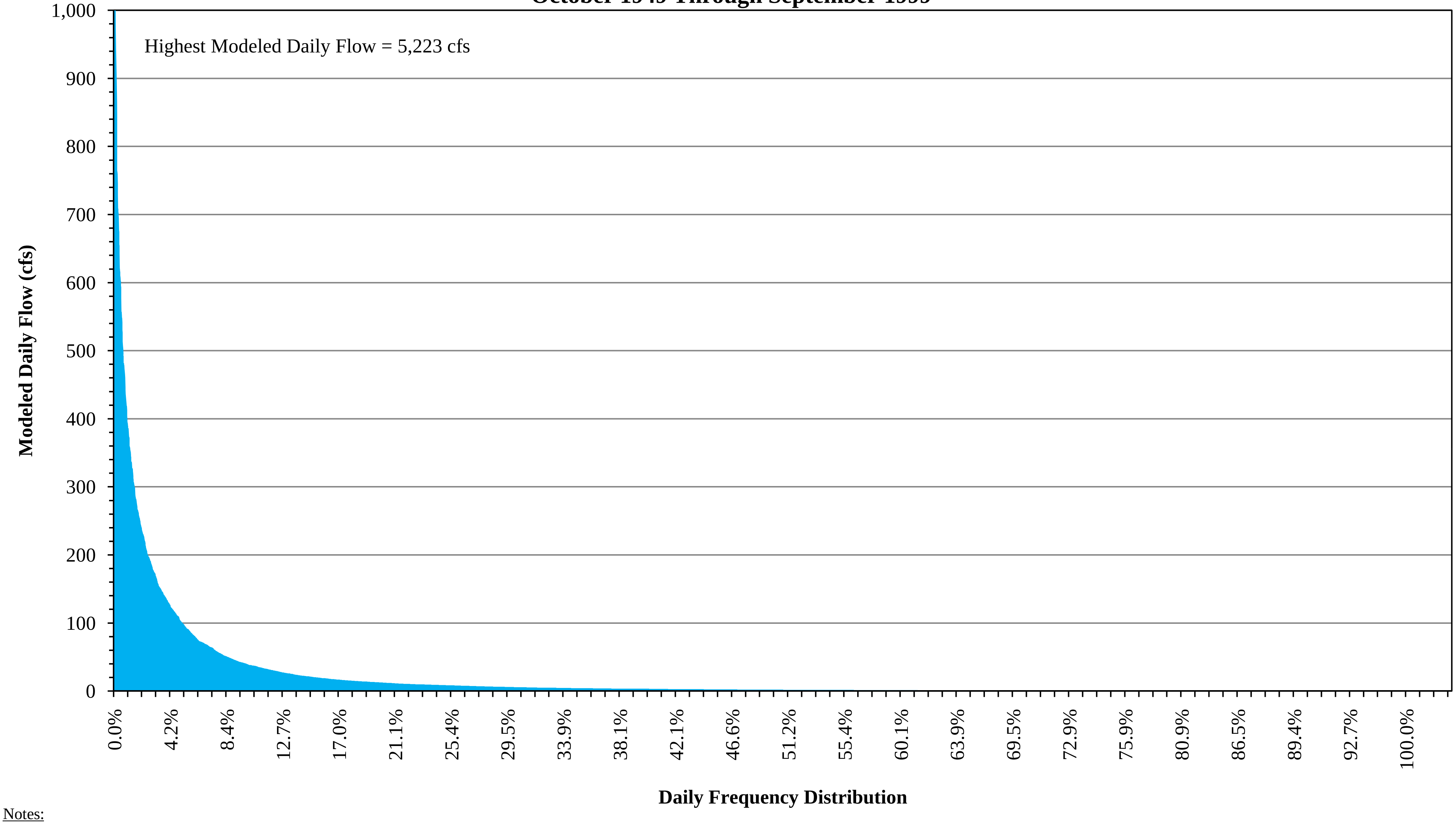


Figure 5-23

Total Inflow to Wineville Basin (NDY13)
Positive Flow Daily Frequency Distribution
October 1949 Through September 1999



Highest Modeled Daily Flow = 5,223 cfs

Notes:

(1) Based on modeled data from Wildermuth Environmental Inc.

(2) Flows shown according to percentile of non-zero flows, 47.8% of the estimated daily flows for the period of record equal 0 cfs.

Figure 5-24

Seasonal Wineville Basin Inflow
Based on Runoff Modeled by Wildermuth Environmental, Inc.

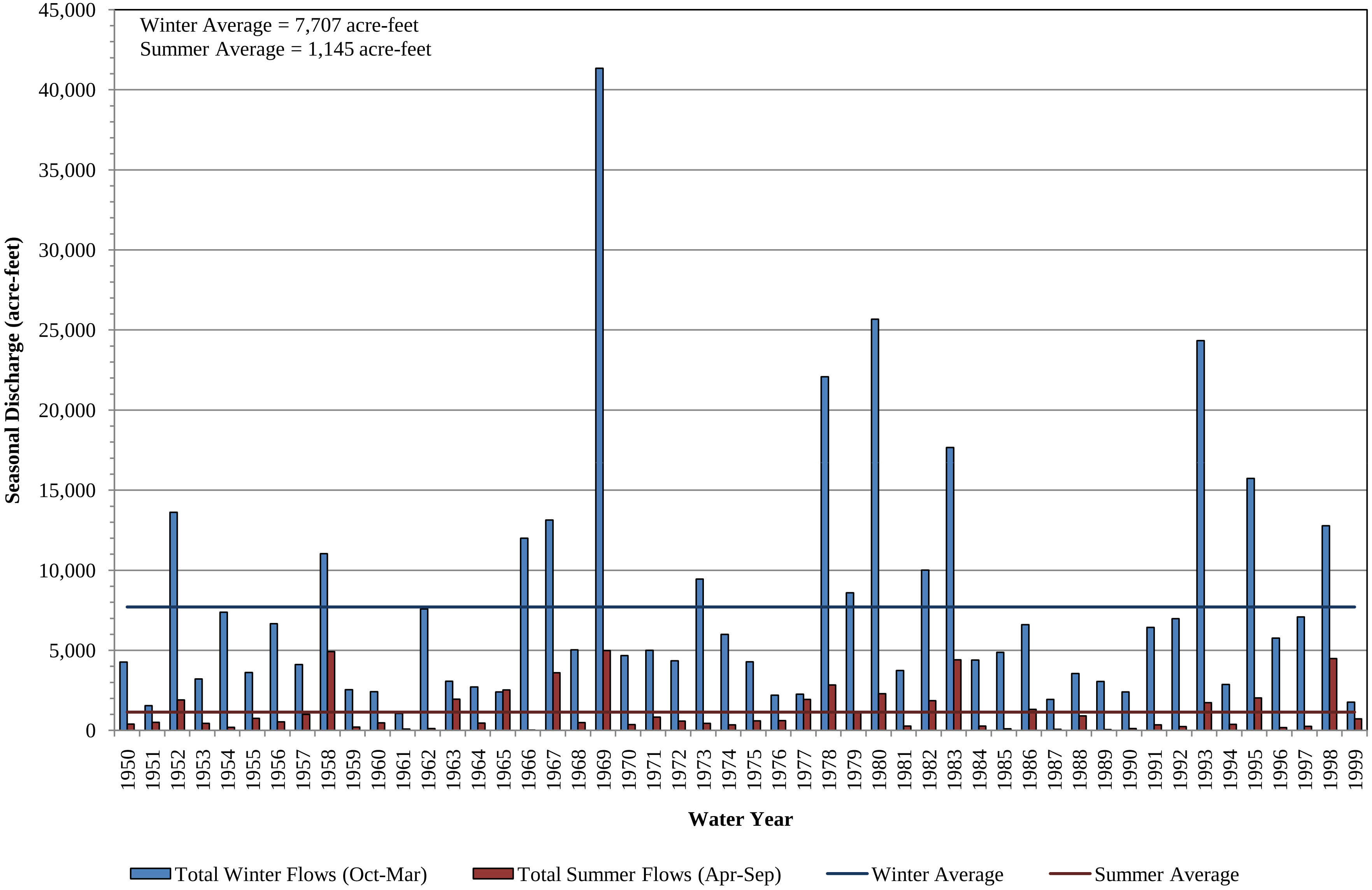
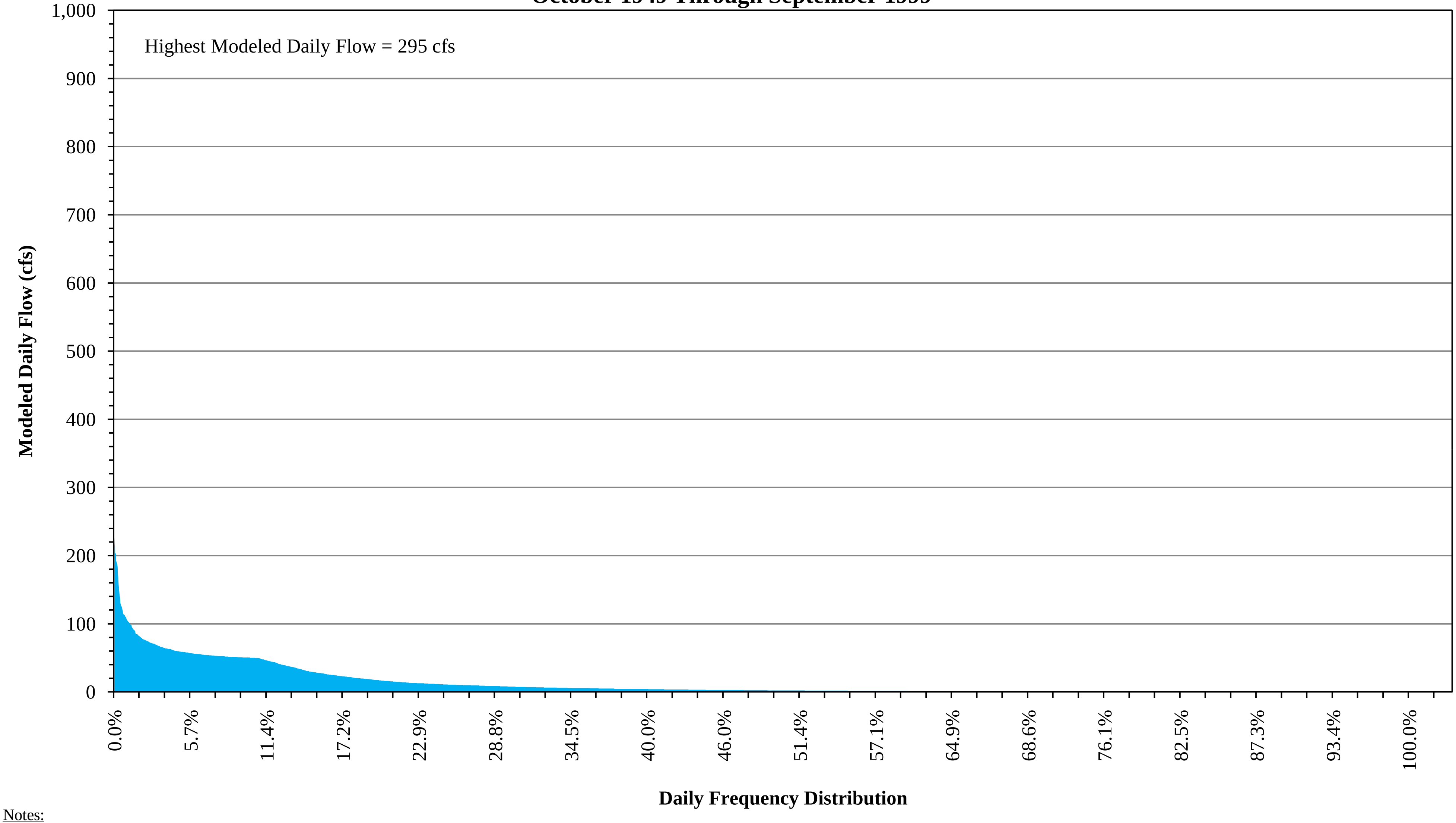


Figure 5-25

Inflow to Jurupa Basin (NSS72)
Positive Flow Daily Frequency Distribution
October 1949 Through September 1999



Notes:

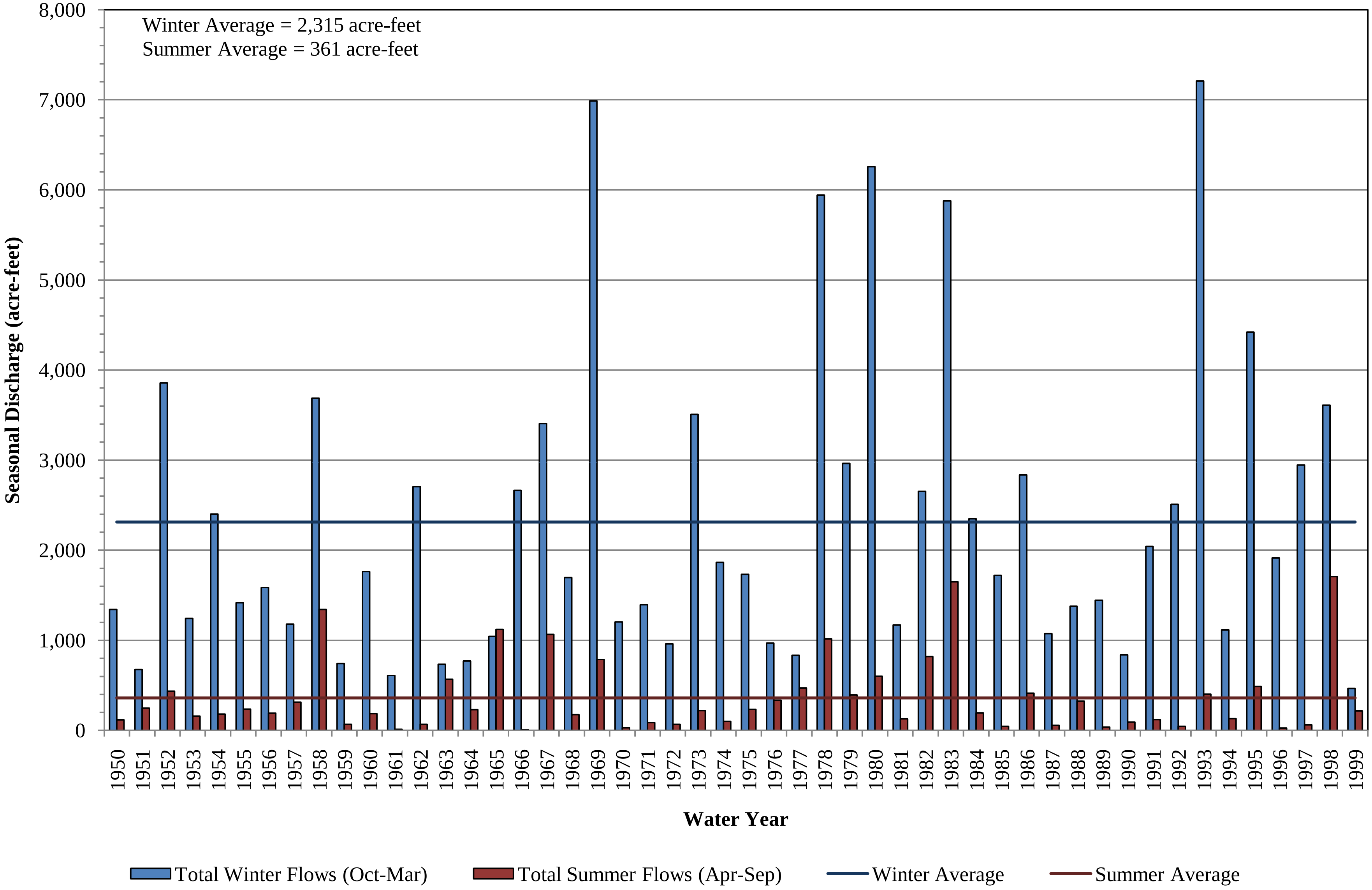
(1) Based on modeled data from Wildermuth Environmental Inc.

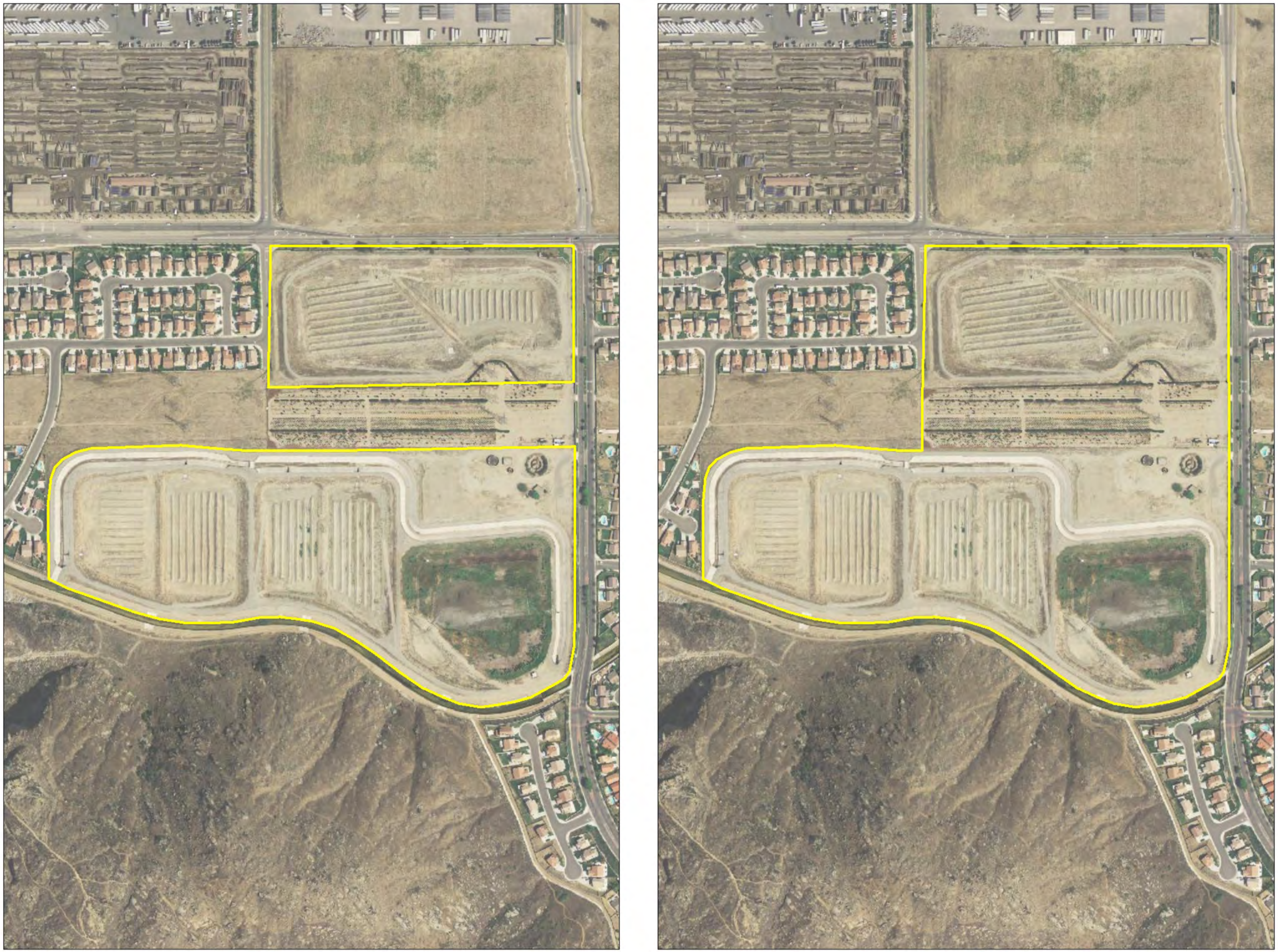
(2) Flows shown according to percentile of non-zero flows, 71.1% of the estimated daily flows for the period of record equal 0 cfs.

Figure 5-26

Seasonal Jurupa Basin Inflow

Based on Runoff Modeled by Wildermuth Environmental, Inc.





Aerial photograph per San Bernardino County, flown April 1, 2007.

OPTION 1

OPTION 2

Figure 5-27

Chino Basin Water
Conservation District

RP3 Basin Enhancement Options

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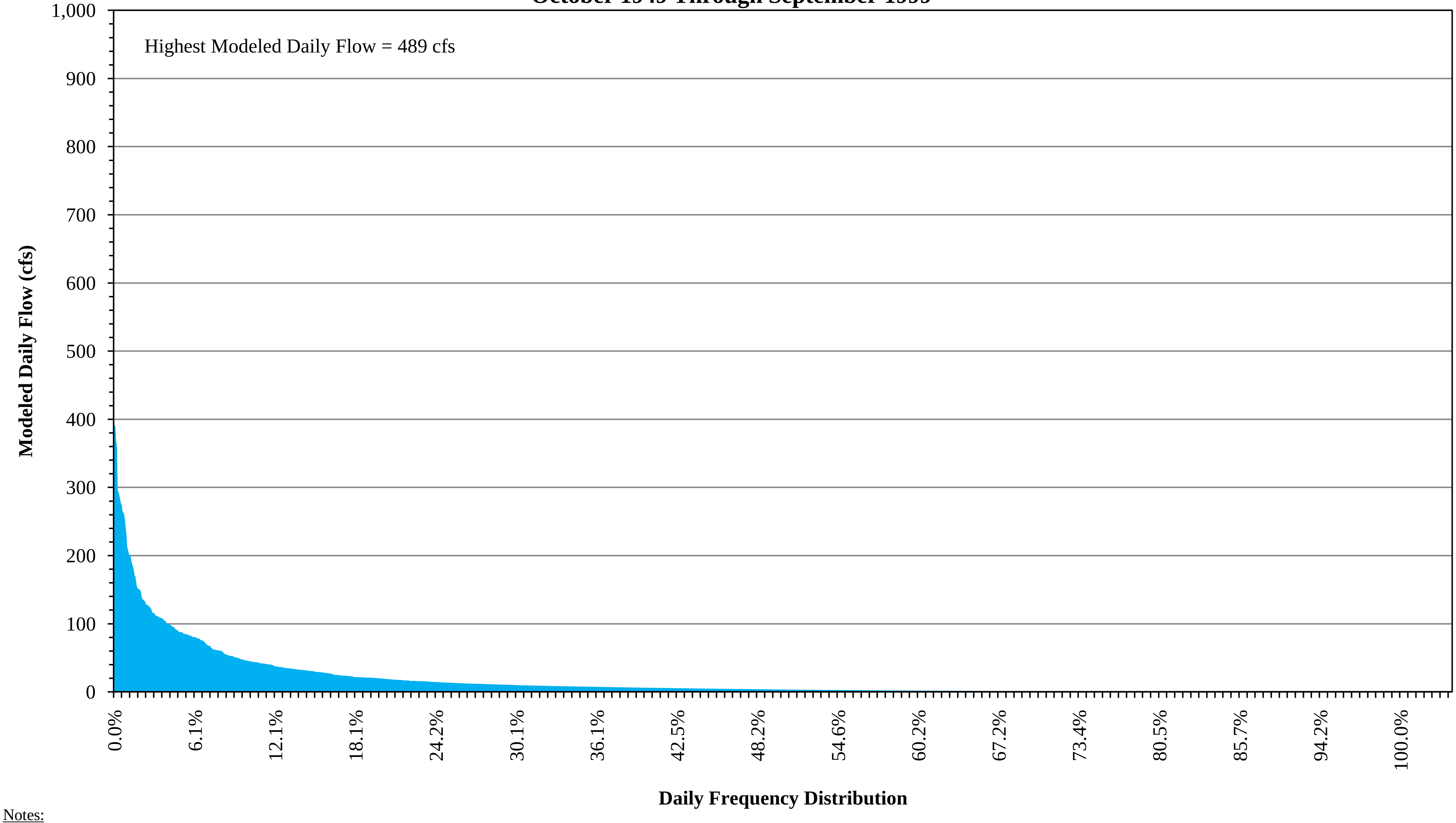
Consulting Civil Engineers. A Corporation

FIGURE 6.3.1-9 - RP3 Basin Enhancement.mxd

Figure 5-28

Declez Channel at Diversion to RP3 Basin (NSS82)
Positive Flow Daily Frequency Distribution
October 1949 Through September 1999



Notes:

[1] Based on modeled data from Wildermuth Environmental Inc.

[2] Flows shown according to percentile of non-zero flows, 90.8% of the estimated daily flows for the period of record equal 0 cfs.

Figure 5-29

Seasonal Flow in Declez Channel at RP3 Diversion
Based on Runoff Modeled by Wildermuth Environmental, Inc.

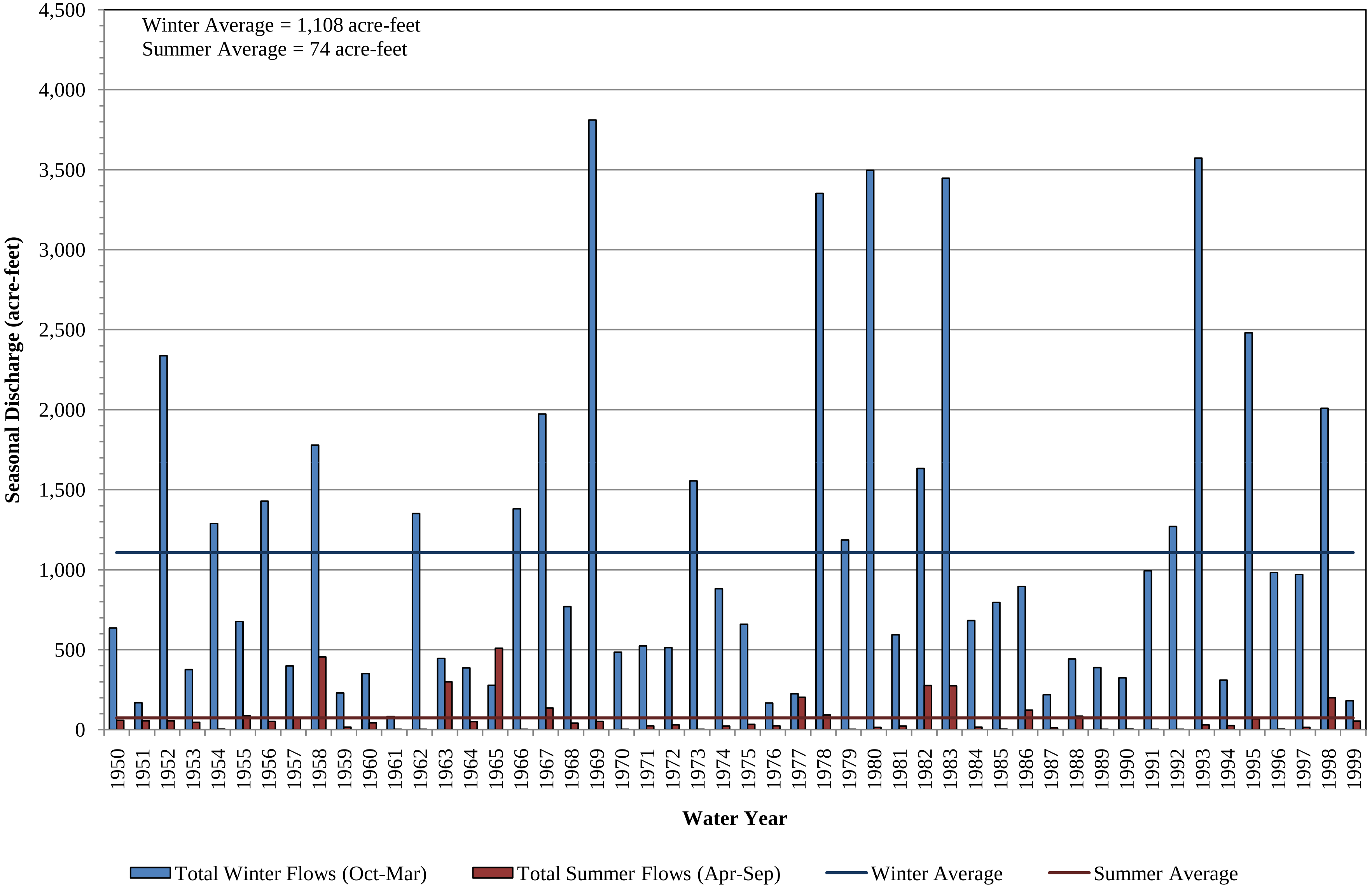
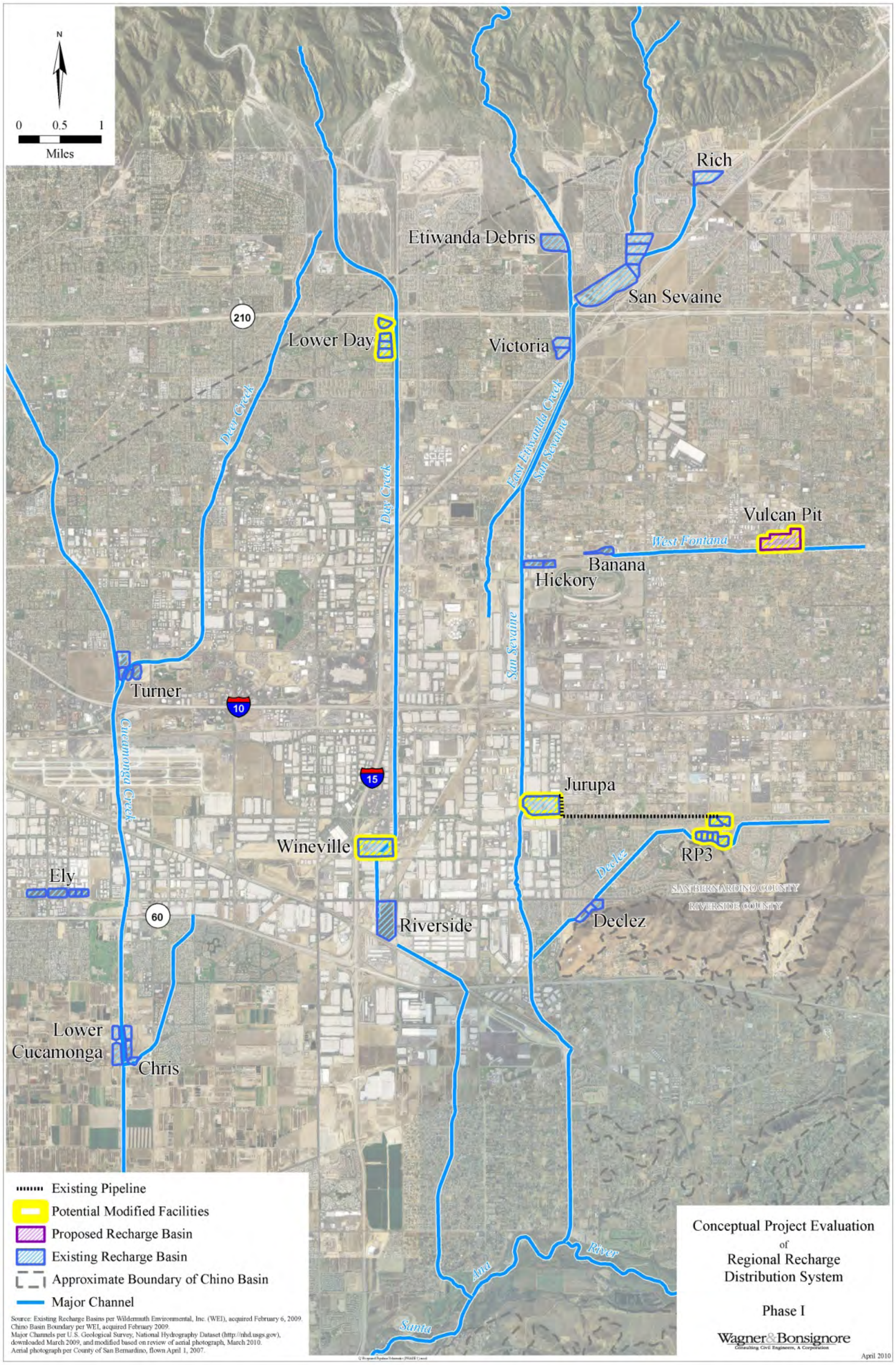
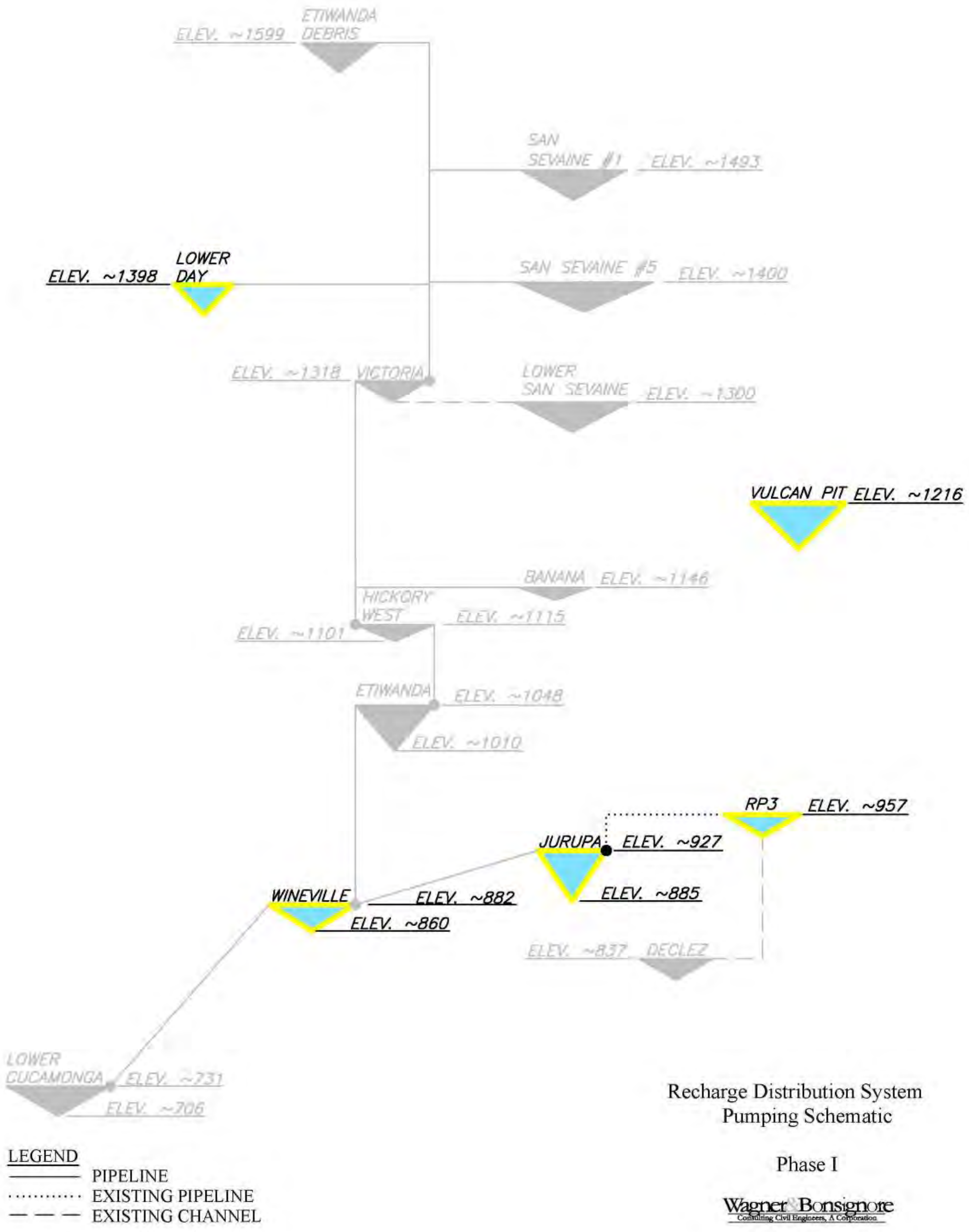


Figure 5-30



Source: Existing Recharge Basins per Wildermuth Environmental, Inc. (WEI), acquired February 6, 2009.
Chino Basin Boundary per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), downloaded March 2009, and modified based on review of aerial photograph, March 2010.
Aerial photograph per County of San Bernardino, flown April 1, 2007.

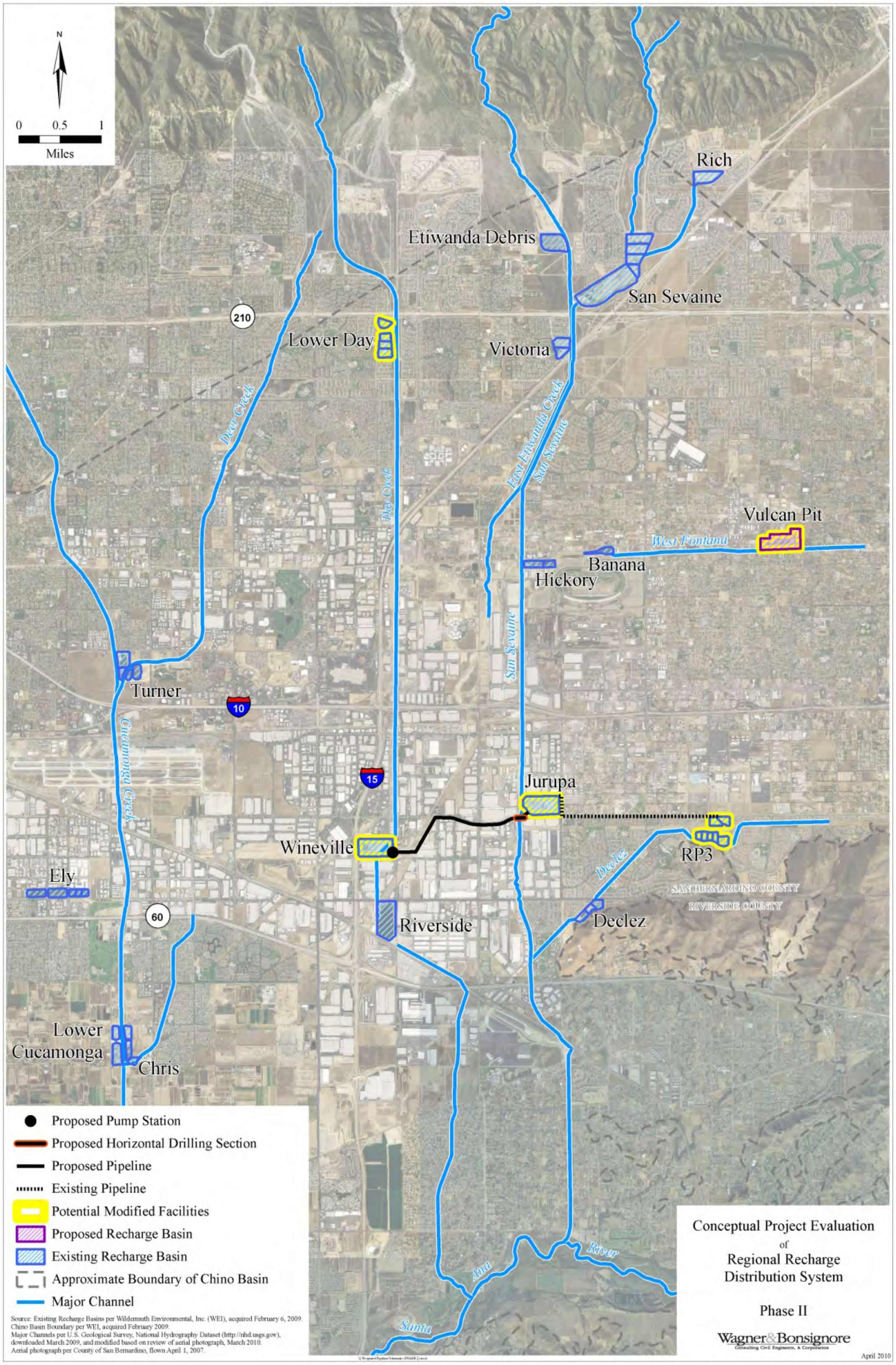
Figure 5-31



Recharge Distribution System
Pumping Schematic

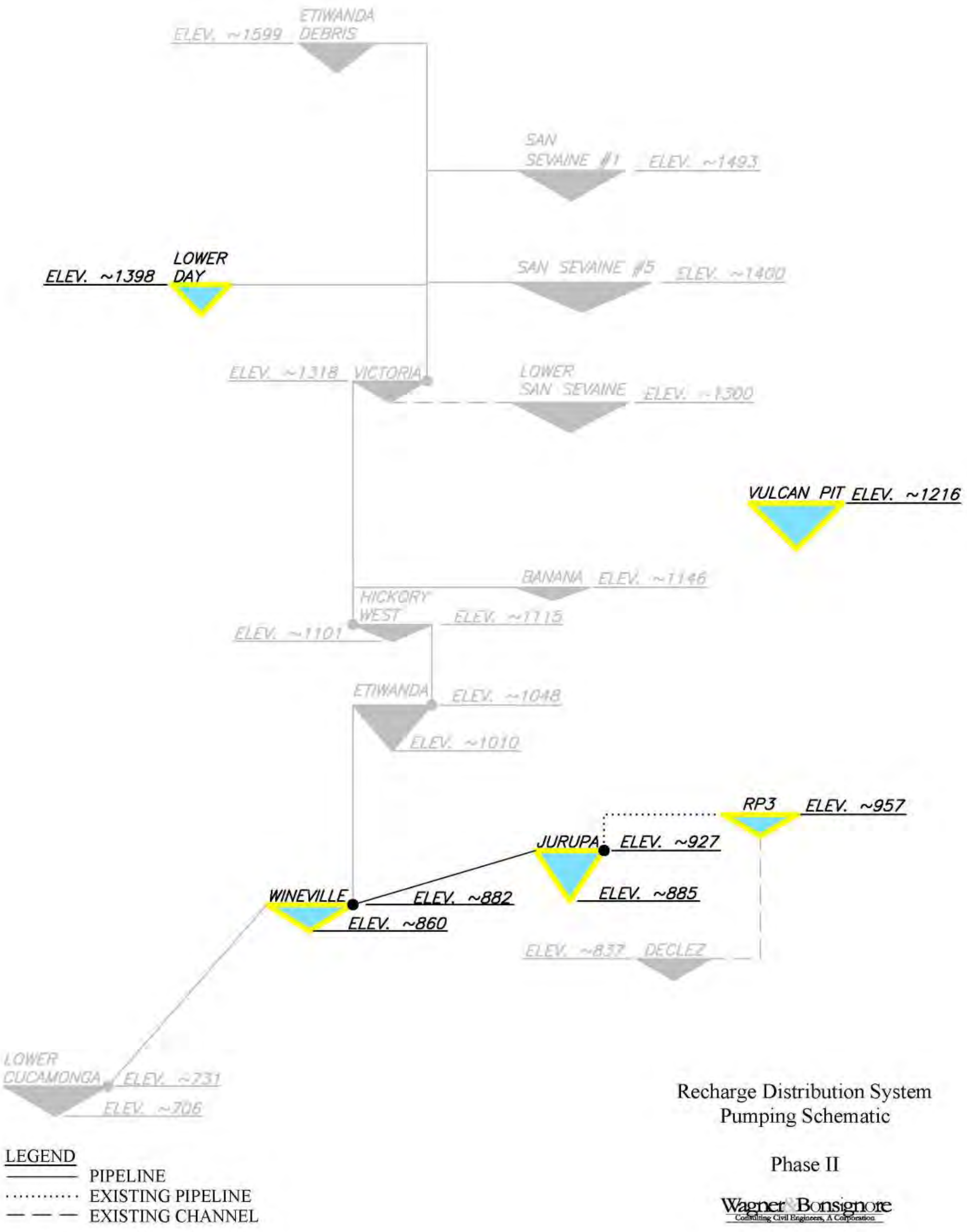
Phase I

Figure 5-32



Source: Existing Recharge Basins per Wildermuth Environmental, Inc. (WEI), acquired February 6, 2009.
Chino Basin Boundary per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), downloaded March 2009, and modified based on review of aerial photograph, March 2010.
Aerial photograph per County of San Bernardino, flown April 1, 2007.

Figure 5-33

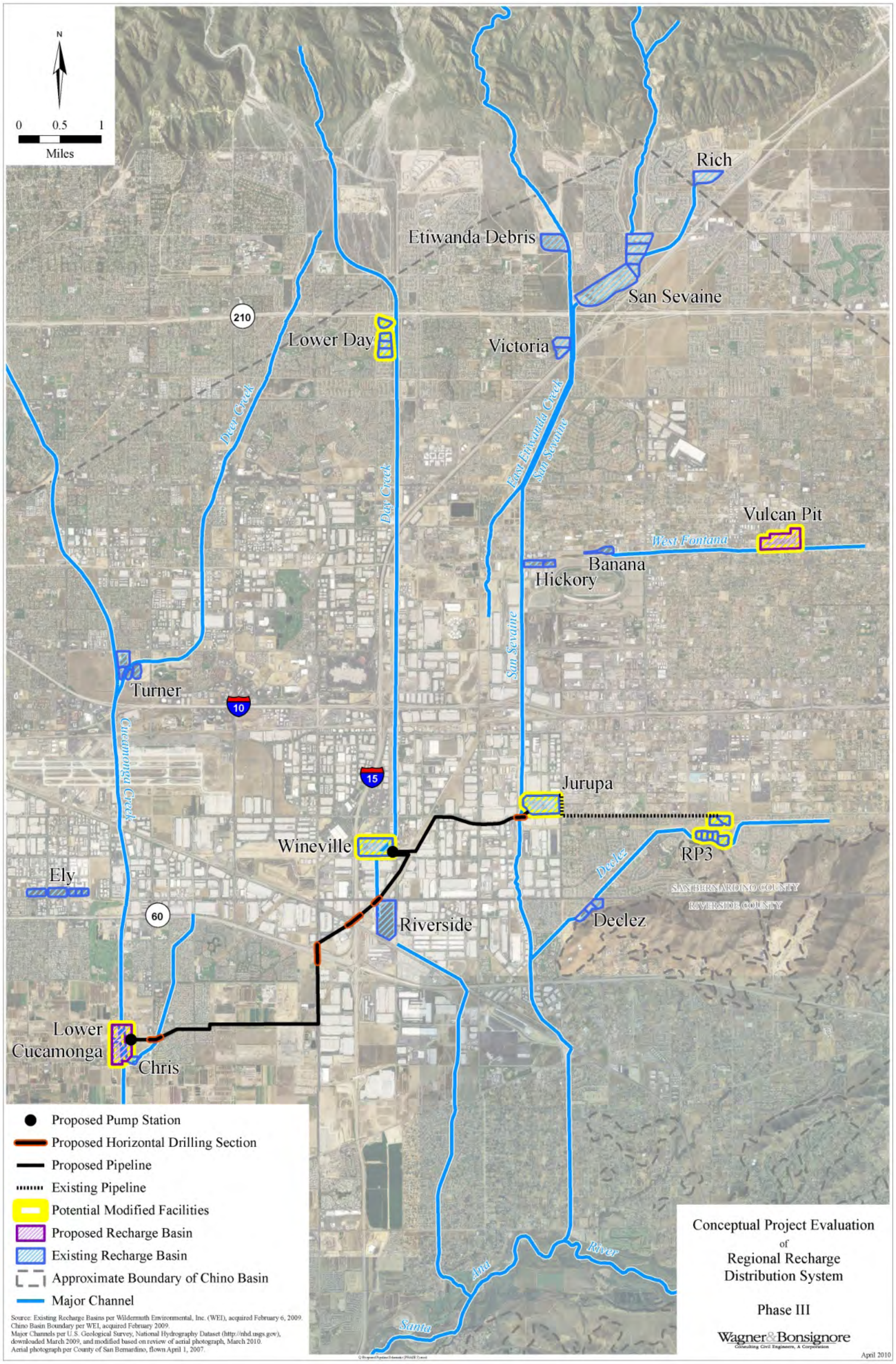


Recharge Distribution System
Pumping Schematic

Phase II

Wagner Bonsignore
Consulting Civil Engineers, A Corporation

Figure 5-34



Source: Existing Recharge Basins per Wildermuth Environmental, Inc. (WEI), acquired February 6, 2009.
Chino Basin Boundary per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), downloaded March 2009, and modified based on review of aerial photograph, March 2010.
Aerial photograph per County of San Bernardino, flown April 1, 2007.

Conceptual Project Evaluation
of
Regional Recharge
Distribution System

Phase III

April 2010

Figure 5-35

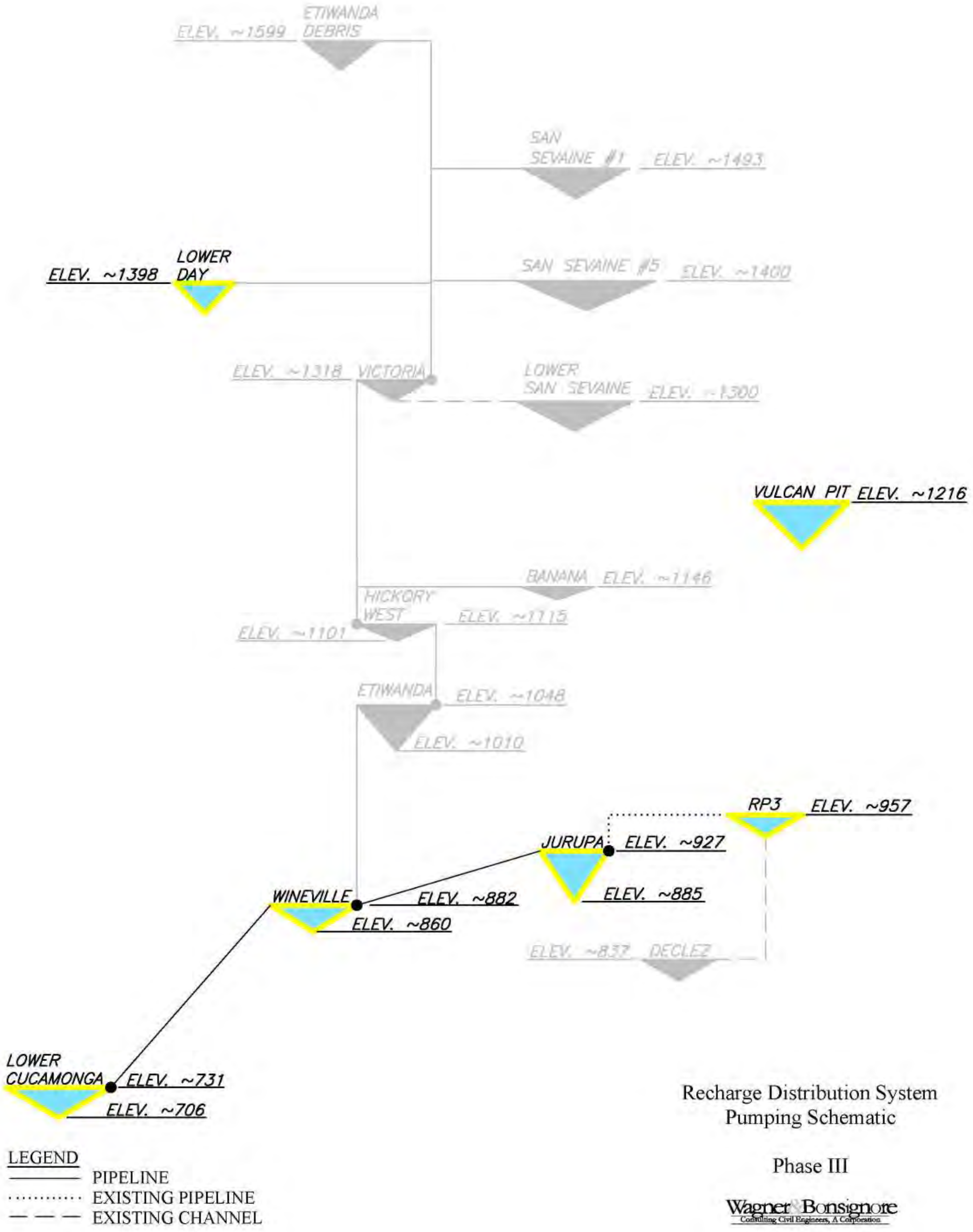
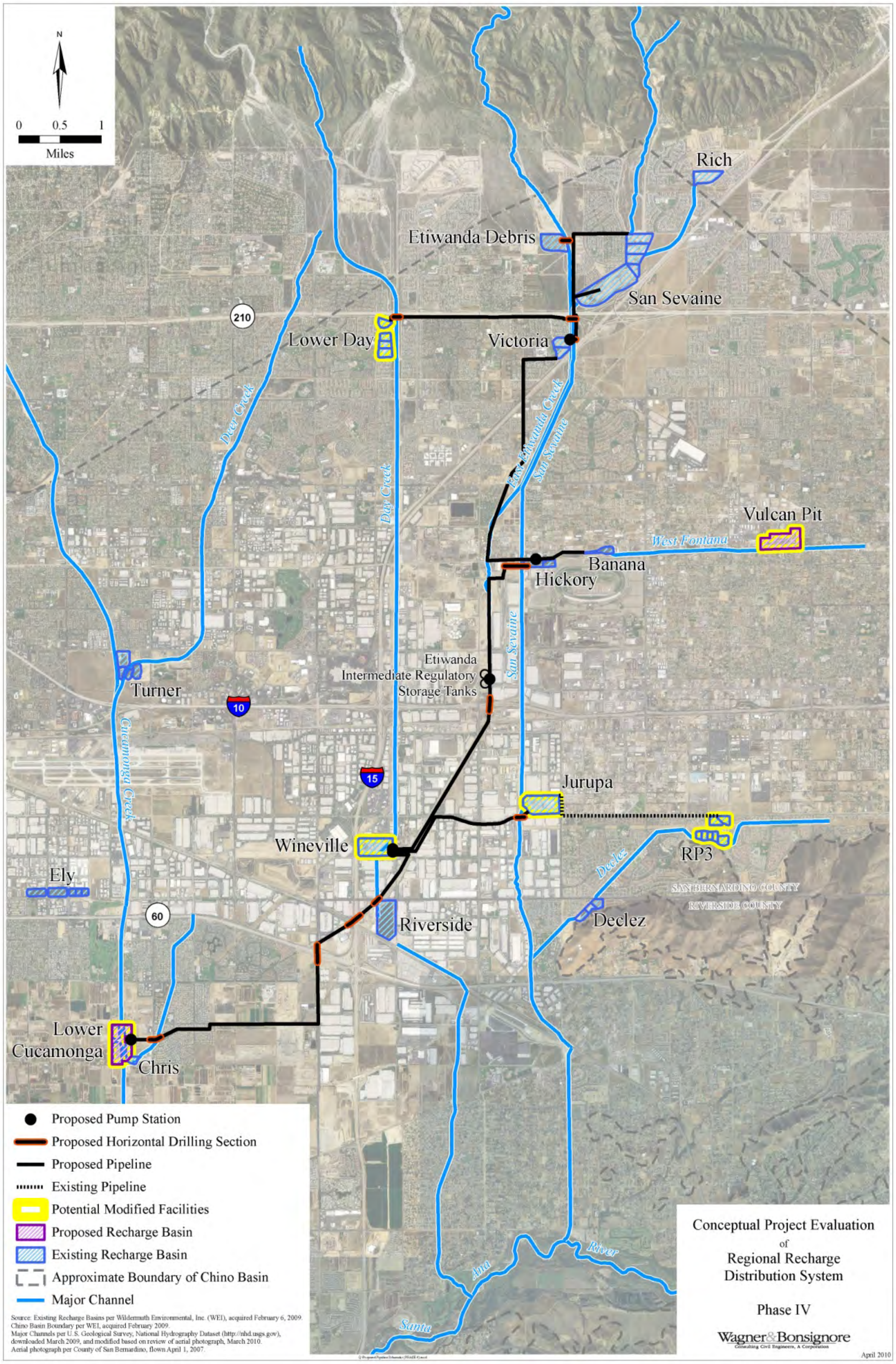
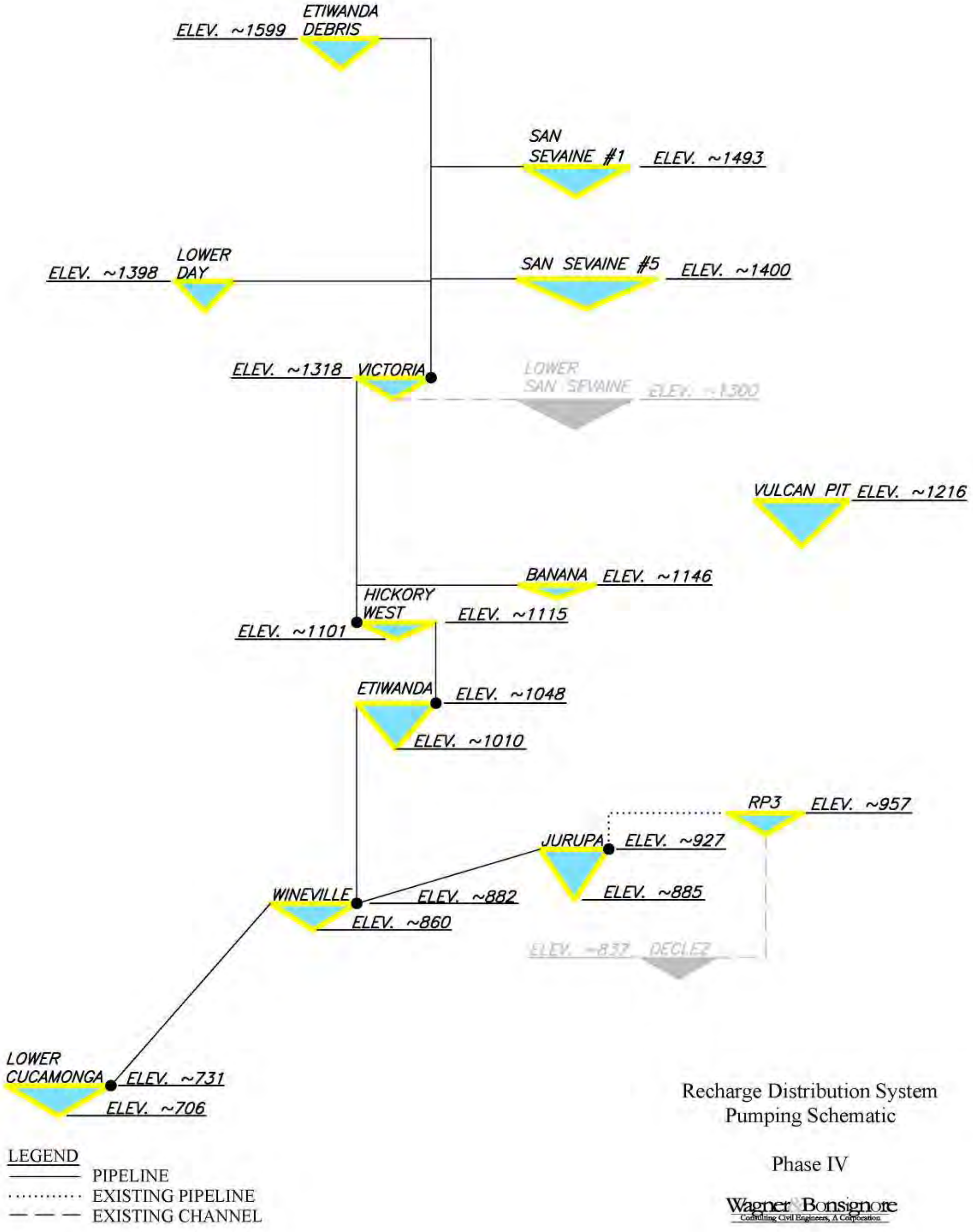

ETIWANDA DEBRIS
ELEV. ~1599
SAN SEVAINE #1
ELEV. ~1493
LOWER DAY
ELEV. ~1398
SAN SEVAINE #5
ELEV. ~1400
ELEV. ~1318
VICTORIA
LOWER SAN SEVAINE
ELEV. ~1300
VULCAN PIT
ELEV. ~1216
BANANA
ELEV. ~1146
HICKORY WEST
ELEV. ~1101
ELEV. ~1115
ETIWANDA
ELEV. ~1048
ELEV. ~1010
RP3
ELEV. ~957
JURUPA
ELEV. ~927
ELEV. ~885
WINEVILLE
ELEV. ~882
ELEV. ~860
ELEV. ~837
DECLEZ
LOWER CUCAMONGA
ELEV. ~731
ELEV. ~706
LEGEND
PIPELINE
EXISTING PIPELINE
EXISTING CHANNEL
Recharge Distribution System
Pumping Schematic
Phase III
Wagner Bonsignore
Consulting Civil Engineers, A Corporation

Figure 5-36



Source: Existing Recharge Basins per Wildermuth Environmental, Inc. (WEI), acquired February 6, 2009.
Chino Basin Boundary per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), downloaded March 2009, and modified based on review of aerial photograph, March 2010.
Aerial photograph per County of San Bernardino, flown April 1, 2007.

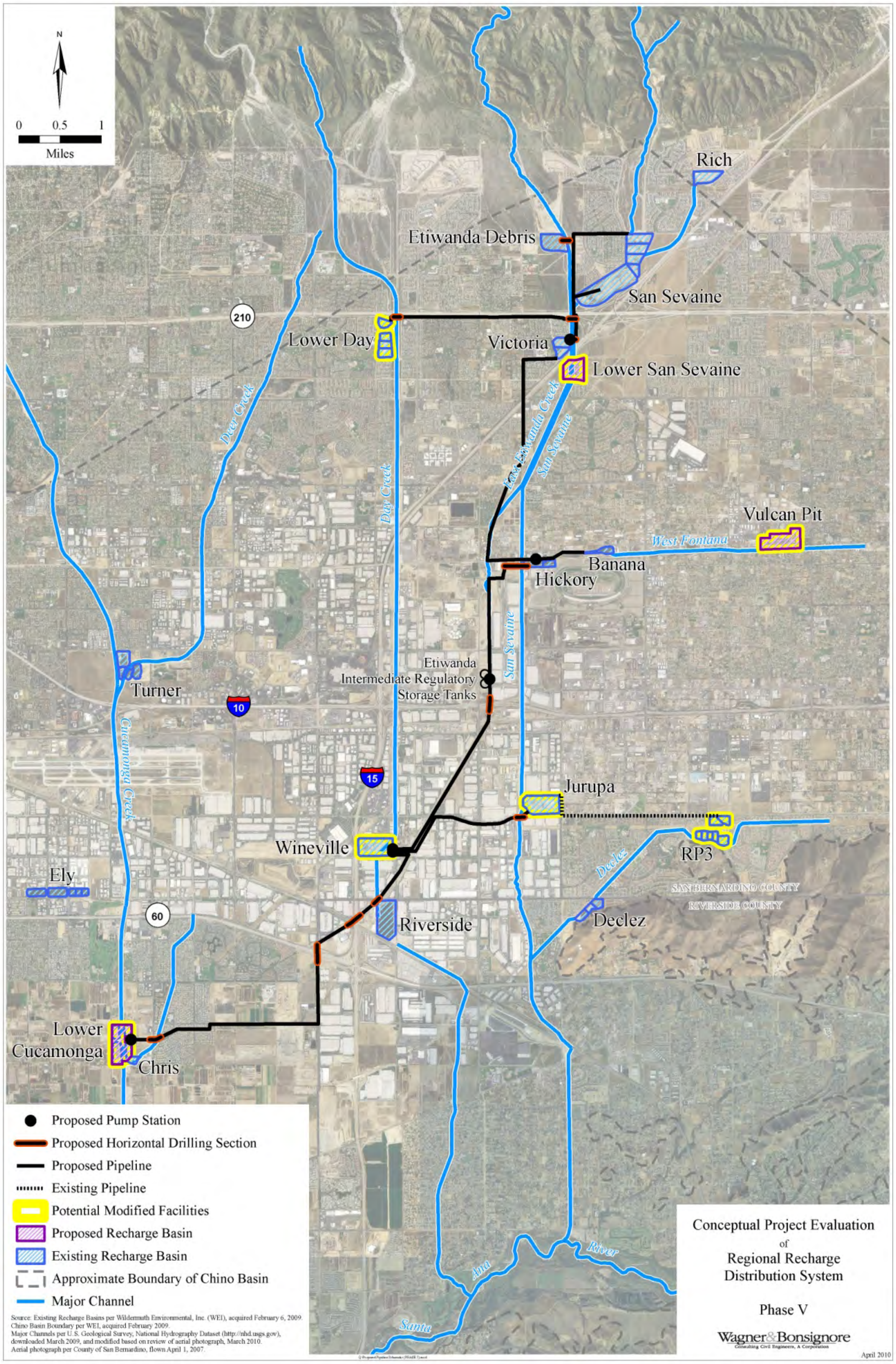
Figure 5-37



Recharge Distribution System
Pumping Schematic

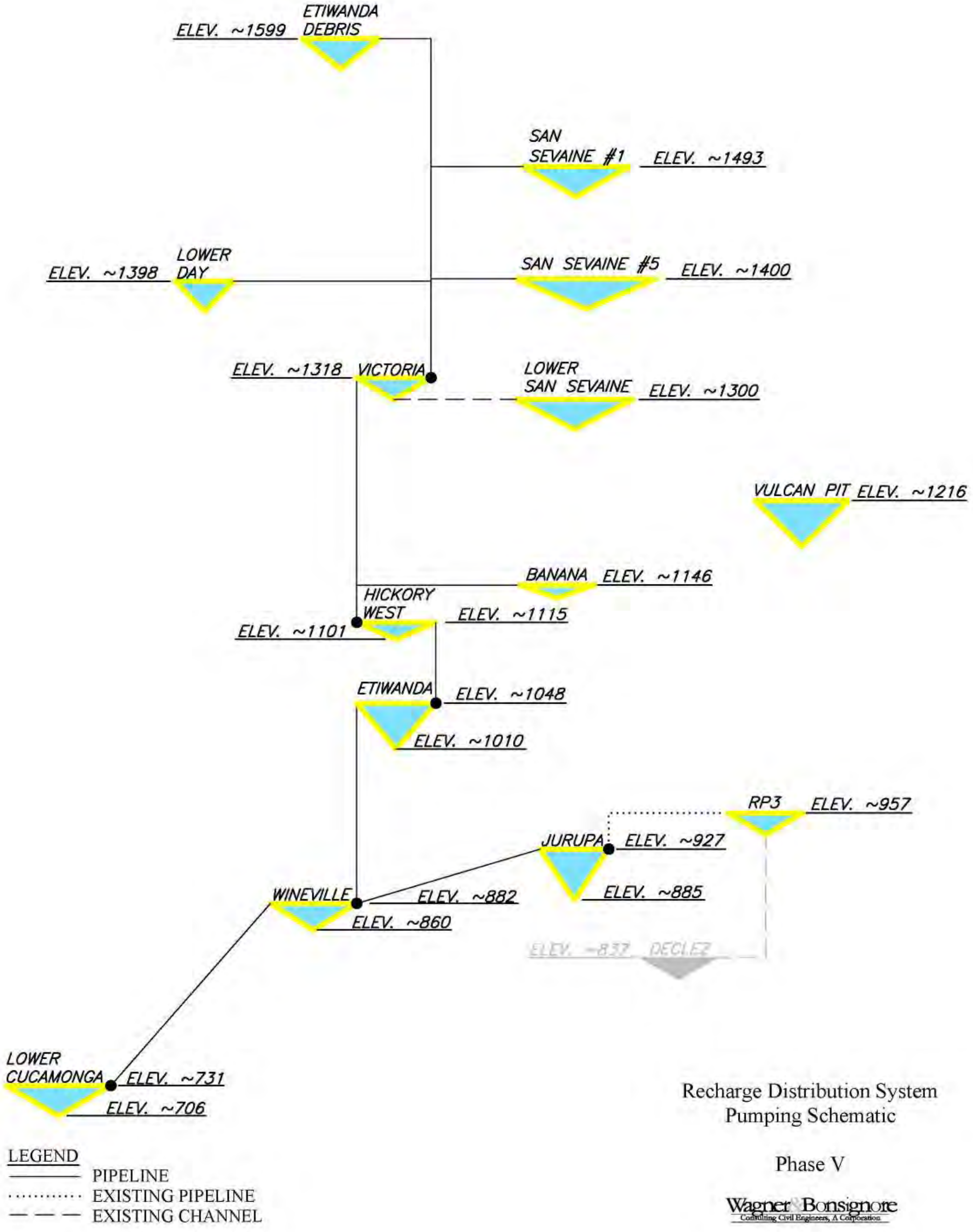
Phase IV

Figure 5-38



Source: Existing Recharge Basins per Wildermuth Environmental, Inc. (WEI), acquired February 6, 2009.
Chino Basin Boundary per WEI, acquired February 2009.
Major Channels per U.S. Geological Survey, National Hydrography Dataset (http://nhd.usgs.gov), downloaded March 2009, and modified based on review of aerial photograph, March 2010.
Aerial photograph per County of San Bernardino, flown April 1, 2007.

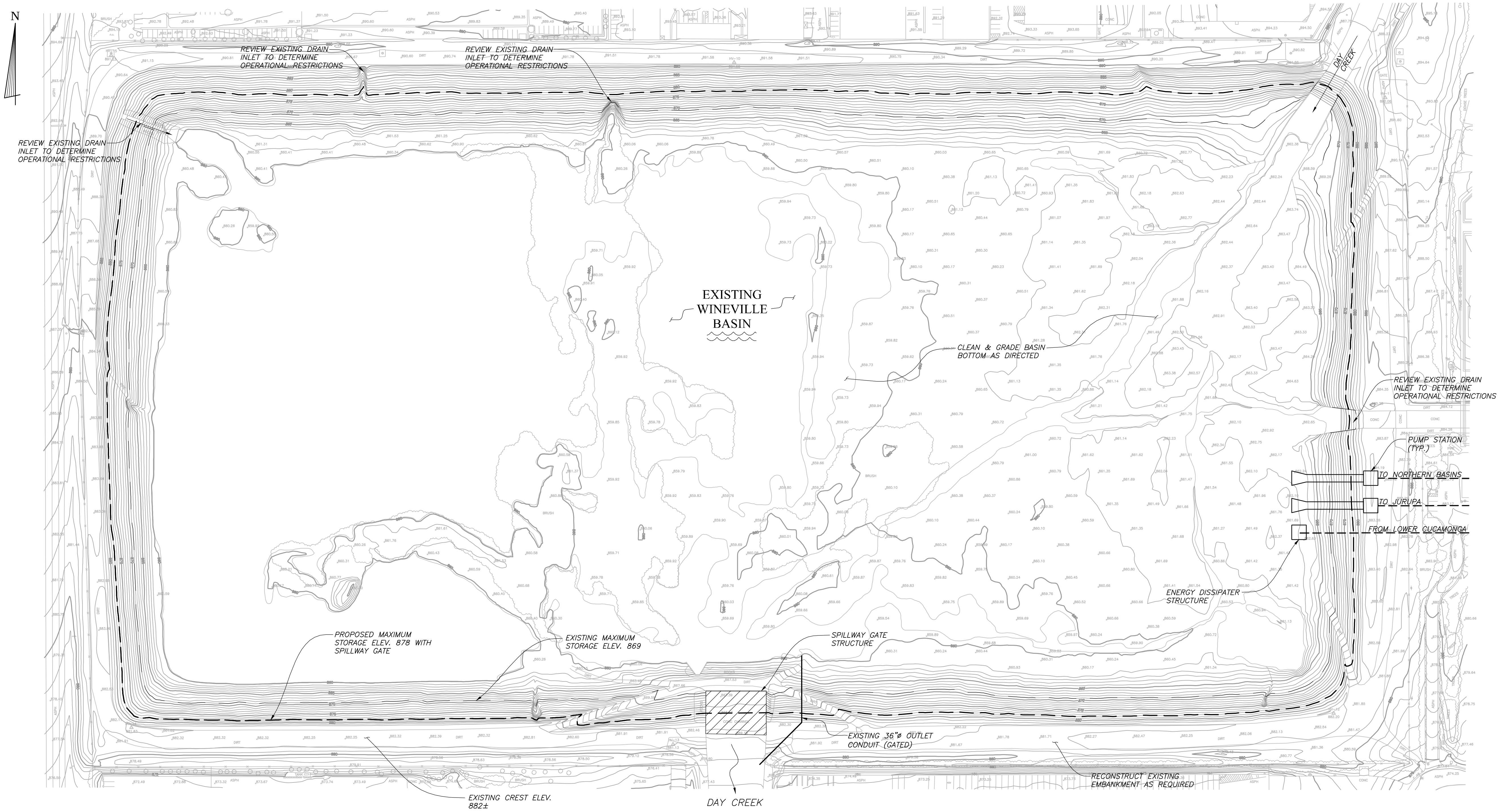
Figure 5-39



Recharge Distribution System
Pumping Schematic

Phase V

Wagner Bonsignore
Consulting Civil Engineers, A Corporation



PLAN

0' 50' 100' 200'

NOTE:

TOPOGRAPHY PROVIDED BY WILDERMUTH ENVIRONMENTAL INC., NOVEMBER 2009.

File Name Preliminary Wineville Basin Enlargement Rev2.dwg
Scale Factor 1
Plot Date 04-21-2010

PRELIMINARY
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AND
SUBJECT TO REVISION

REVISIONS

REF.	DESCRIPTION	APVD.	DATE

DRAFT

Designed By D.P. LOUNSBURY
Drawn By J. HERBERT/ P. INTHARATH
Checked By R.C. WAGNER
Approved By

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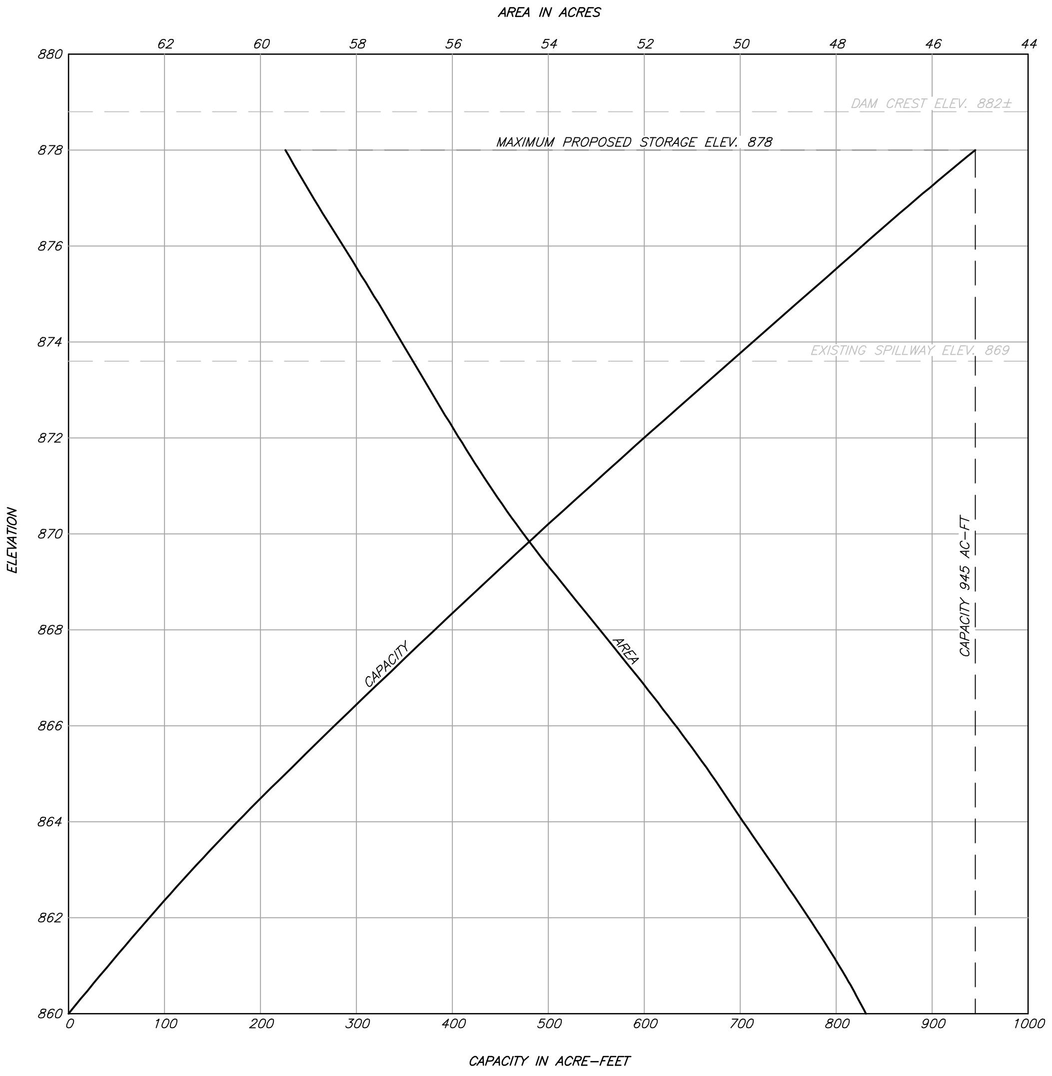
CHINO BASIN WATER CONSERVATION DISTRICT

CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION FOR

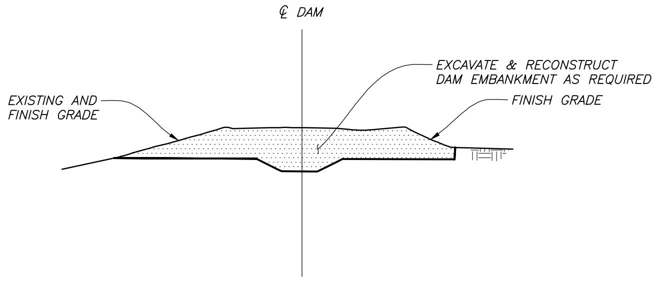
WINEVILLE BASIN

SHEET 1 OF 2 SHEETS

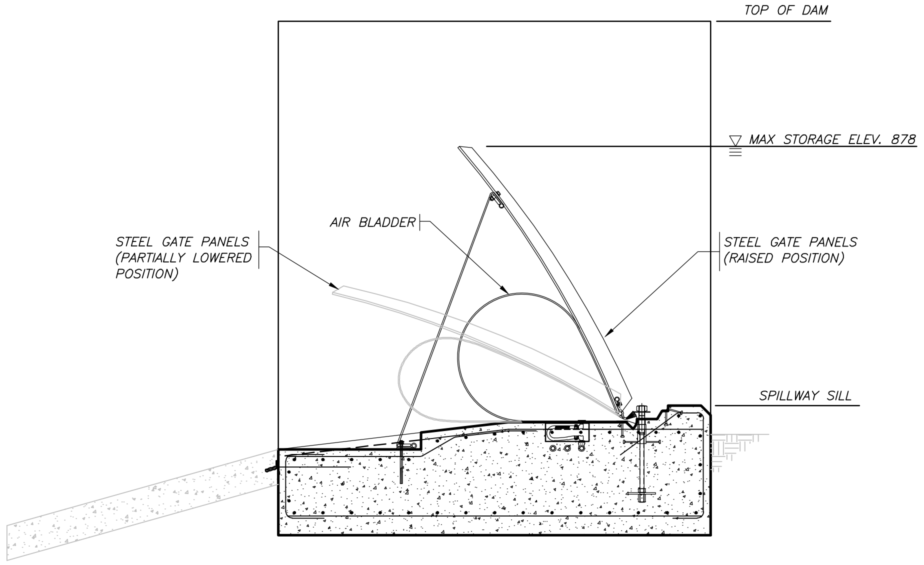
FIGURE 5-40



AREA/CAPACITY CURVE



TYPICAL EMBANKMENT RECONSTRUCTION SECTION



CONCEPTUAL SPILLWAY GATE SECTION
NOT TO SCALE

File Name Preliminary Wineville Basin Enlargement Rev2.dwg
Scale Factor 1
Plot Date 04-21-2010

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CHINO BASIN WATER CONSERVATION DISTRICT

CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION FOR

WINEVILLE BASIN

SHEET 2 OF 2 SHEETS

FIGURE 5-41

Figure 5-42
DSOD – Dam Jurisdictional Size Chart

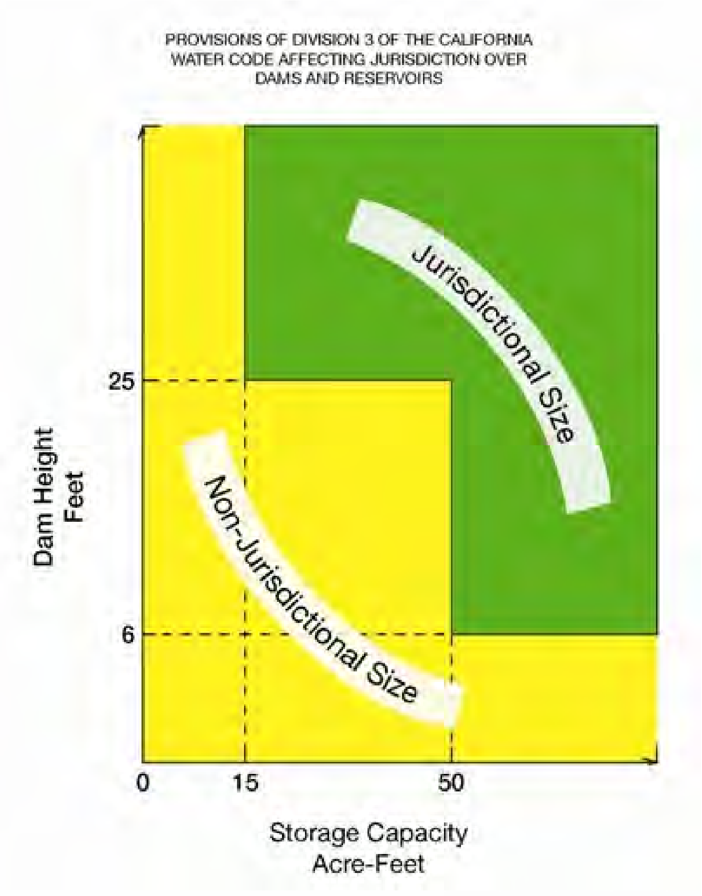
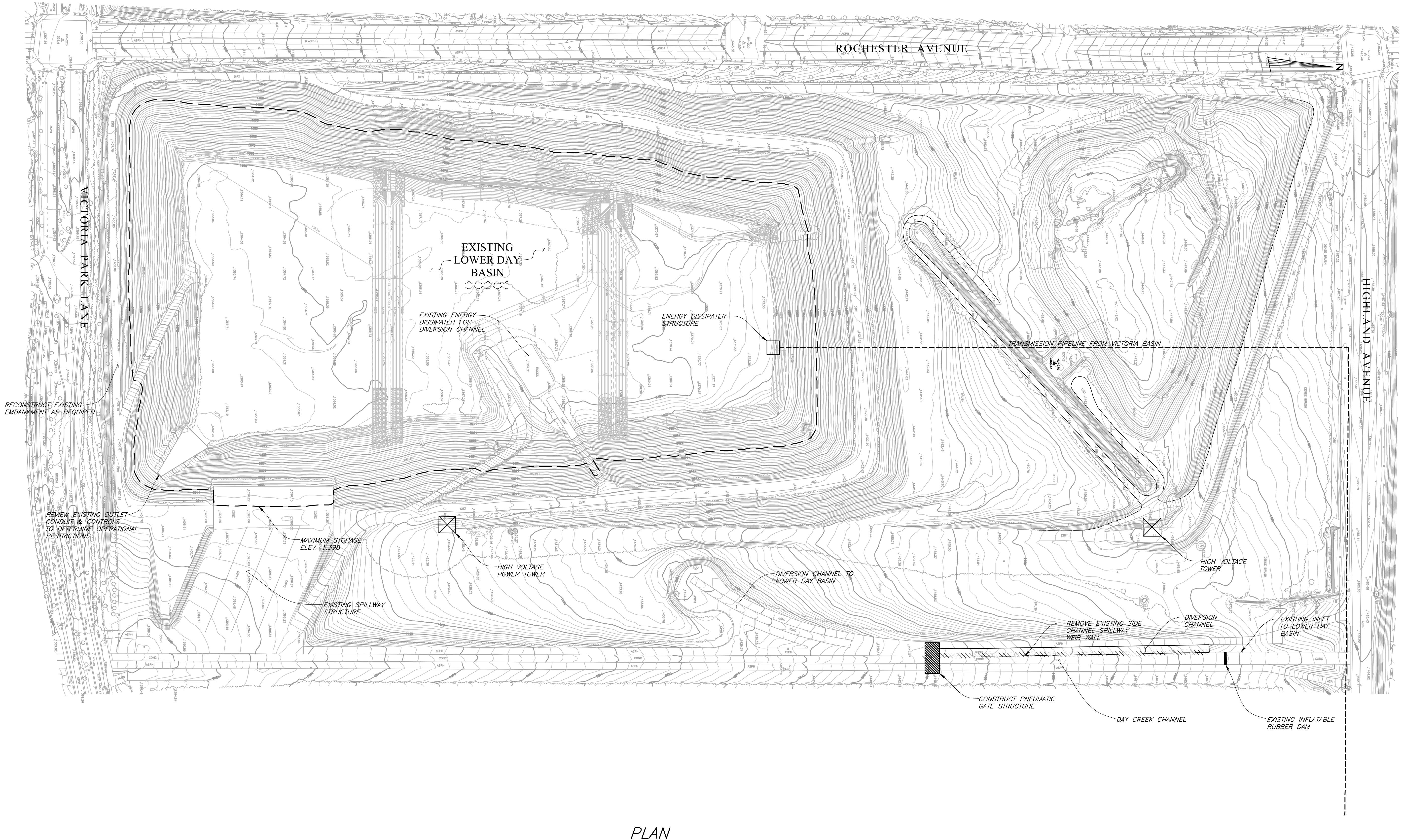


Figure 5-43
Wineville Basin Evaluated Alternative Schematic



NOTE:

TOPOGRAPHY PROVIDED BY WILDERMUTH
ENVIRONMENTAL, INC., NOVEMBER 2009.

PLAN

0' 50' 100' 200'

File Name Preliminary Lower Day Basin Enhancement Rev4.dwg
Scale Factor 1
Plot Date 05-21-2010

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AND
SUBJECT TO REVISION

REVISIONS

REF.	DESCRIPTION	APVD.	DATE

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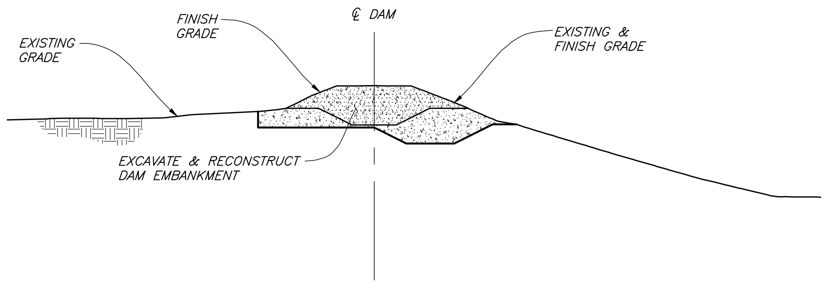
CHINO BASIN WATER CONSERVATION DISTRICT

CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION

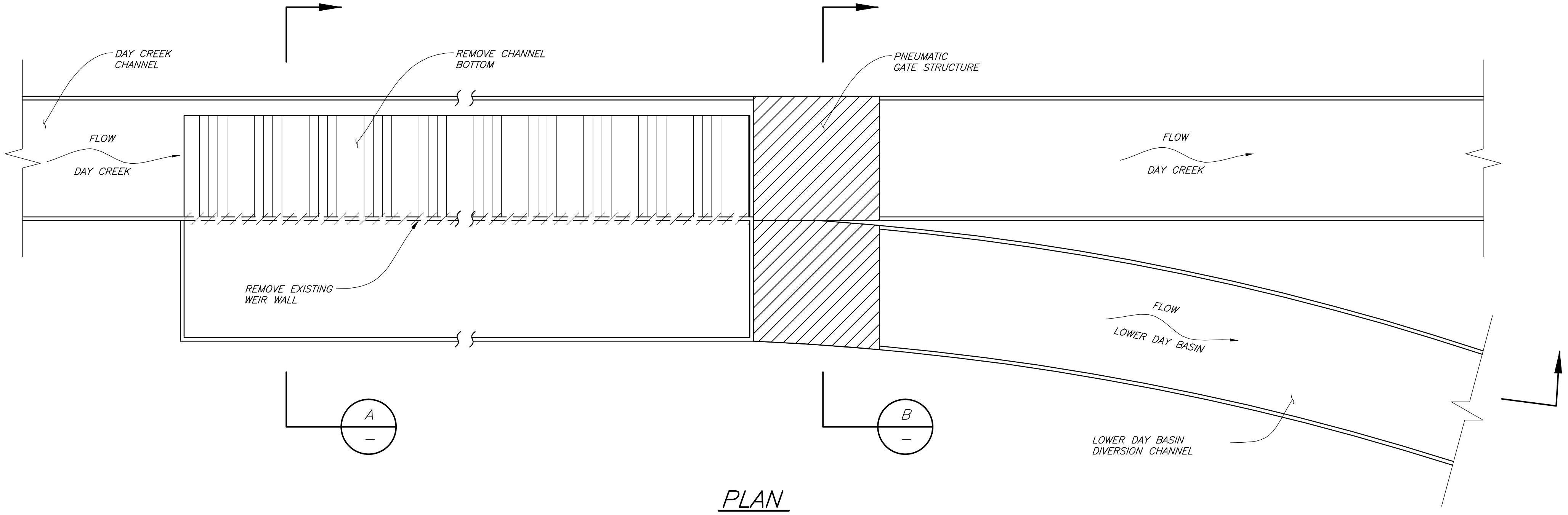
LOWER DAY BASIN

SHEET 1 OF 2 SHEETS

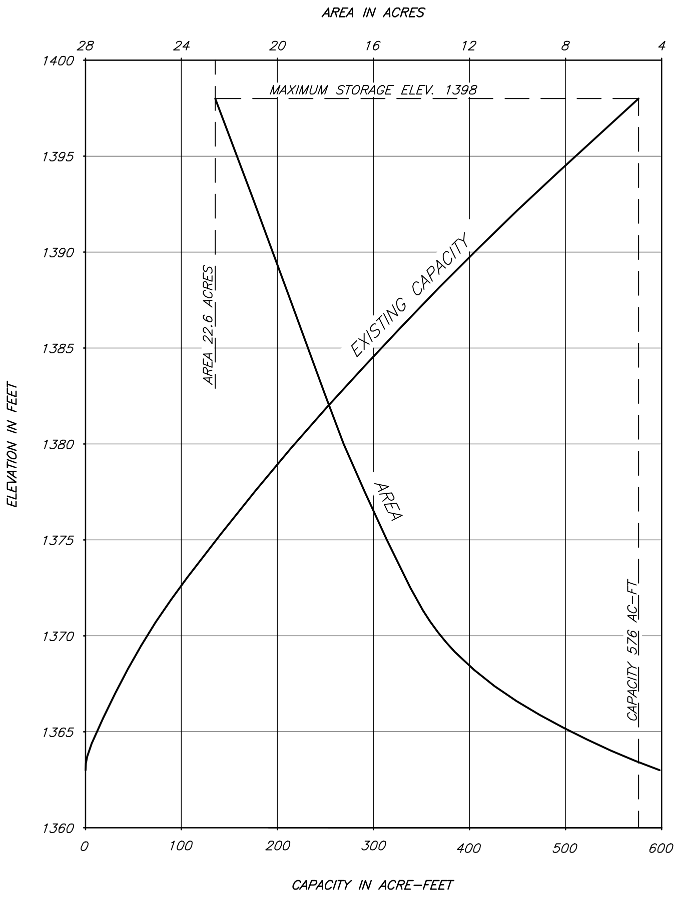
FIGURE 5-44



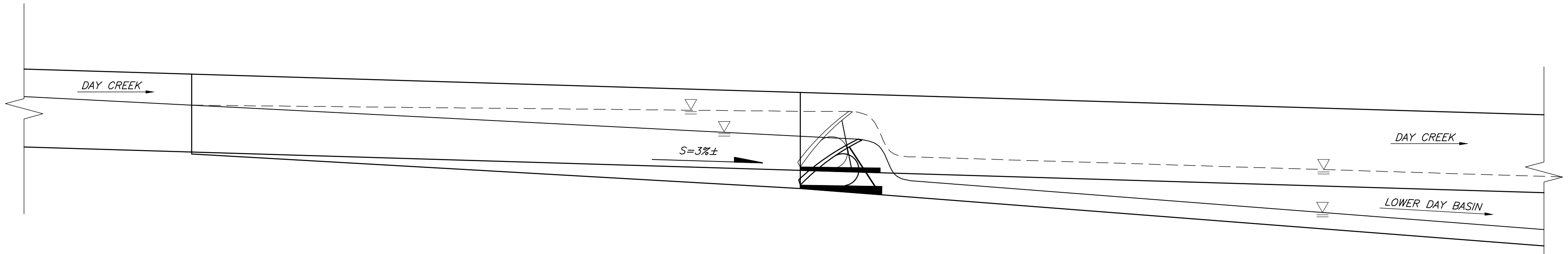
TYPICAL EMBANKMENT RECONSTRUCTION SECTION



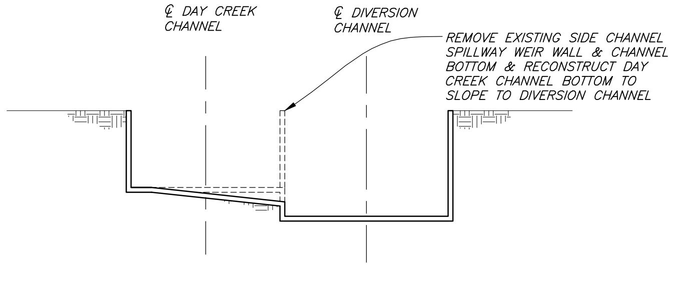
PLAN



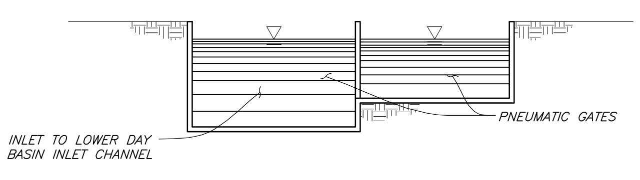
AREA/CAPACITY CURVES



PROFILE



SECTION A
–



SECTION B
–

DIVERSION CHANNEL IMPROVEMENTS

0' 10' 20' 40'

File Name Preliminary Lower Day Basin Enhancement Rev4.dwg
Scale Factor 1
Plot Date 05-21-2010

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CHINO BASIN WATER CONSERVATION DISTRICT

CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION

LOWER DAY BASIN

SHEET
2
OF
2
SHEETS

FIGURE 5-45

Figure 5-46
Lower Day Basin Evaluated Alternative Schematic

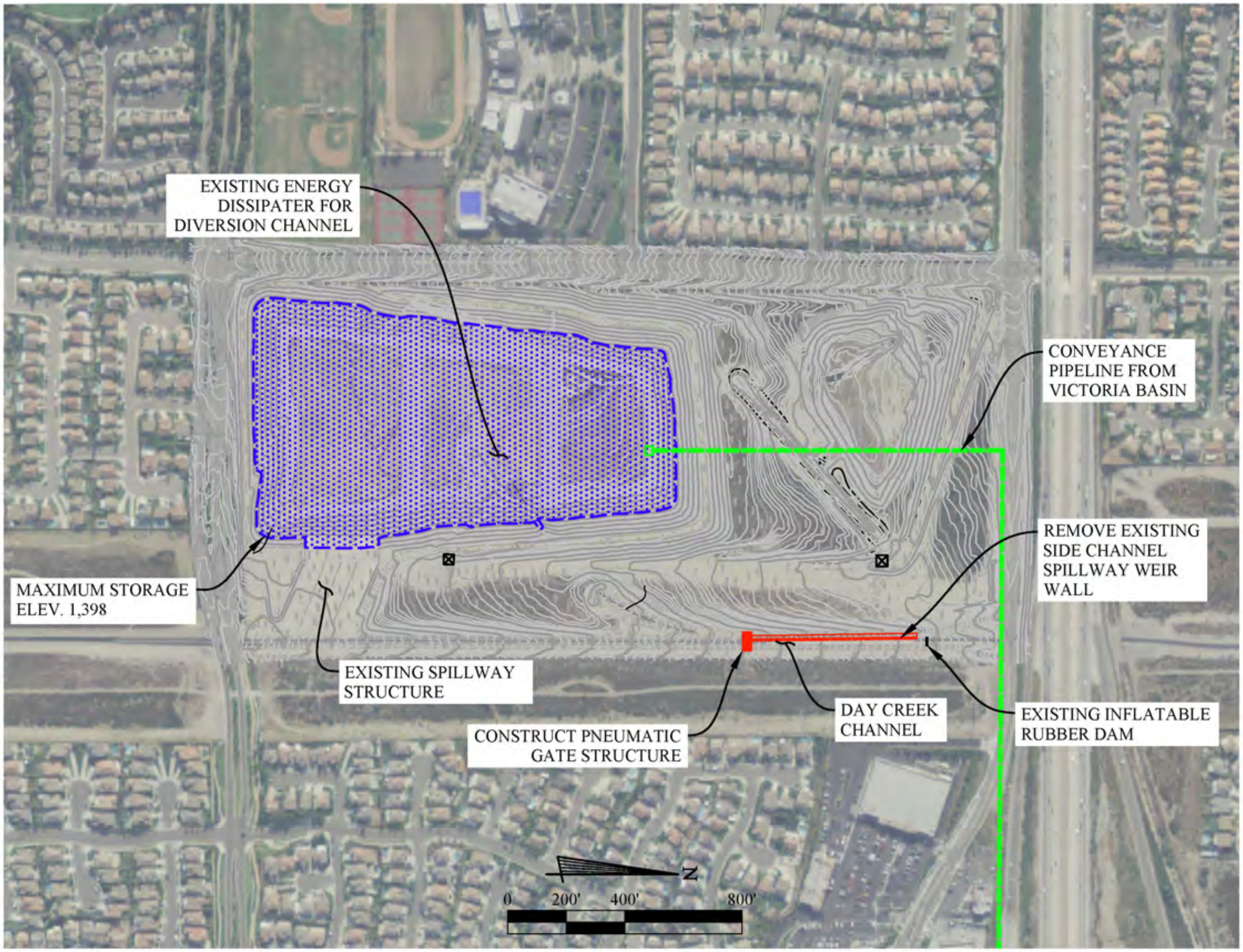
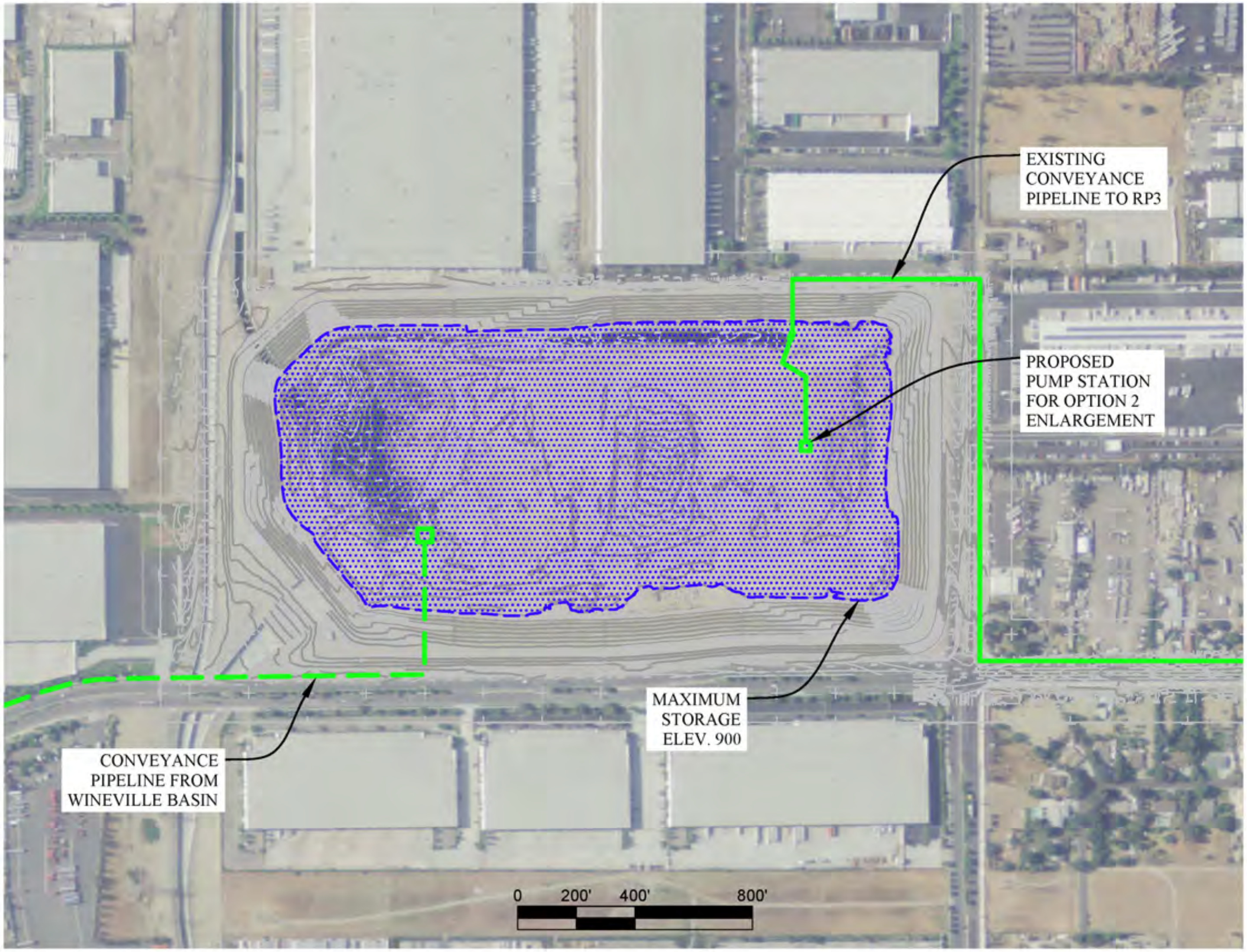
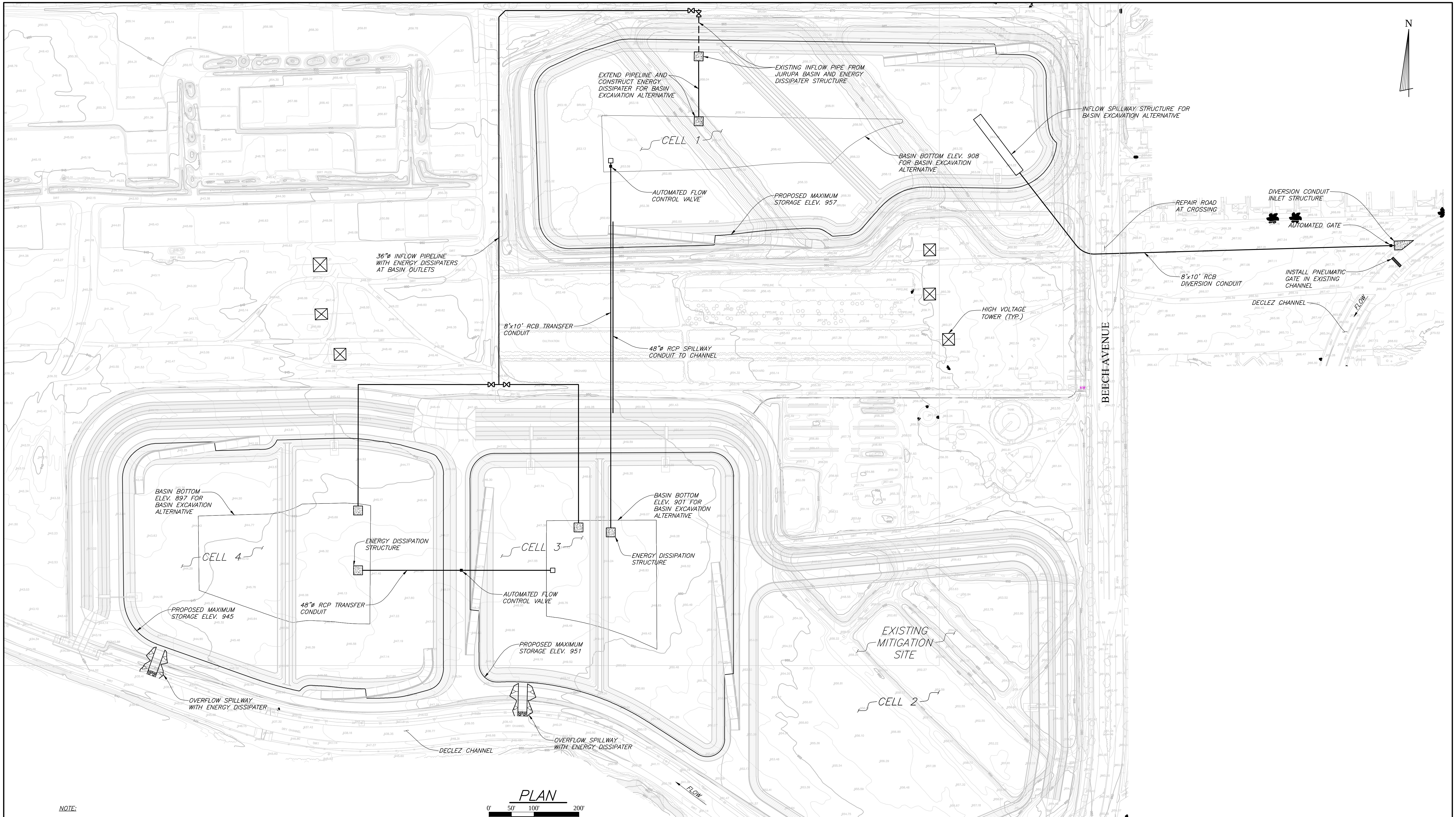


Figure 5-47
Jurupa Basin Evaluated Alternative Schematic





NOTE:

TOPOGRAPHY PROVIDED BY WILDERMUTH ENVIRONMENTAL INC., NOVEMBER 2009.

File Name RP3 Design Rev3.dwg
Scale Factor 1
Plot Date 04-21-2010

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AND
SUBJECT TO REVISION

REVISIONS

REF.	DESCRIPTION	APVD.	DATE

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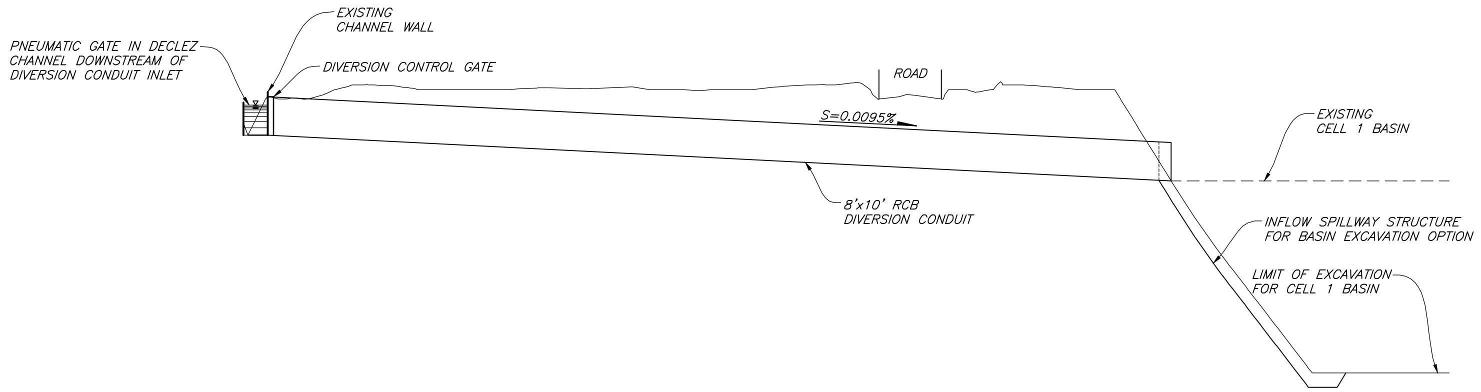
CHINO BASIN WATER CONSERVATION DISTRICT

CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION

RP3 BASIN

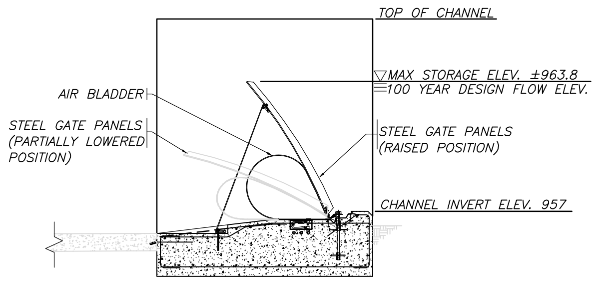
SHEET 1 OF 2 SHEETS

FIGURE 5-48



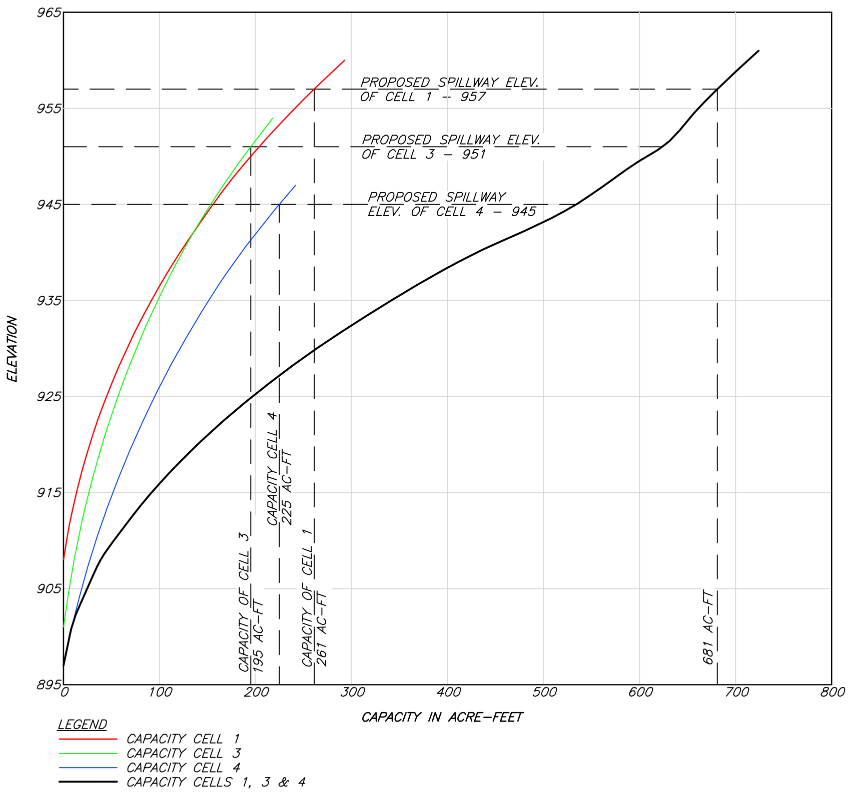
PROFILE OF DECLEZ CREEK DIVERSION CONDUIT

NOT TO SCALE

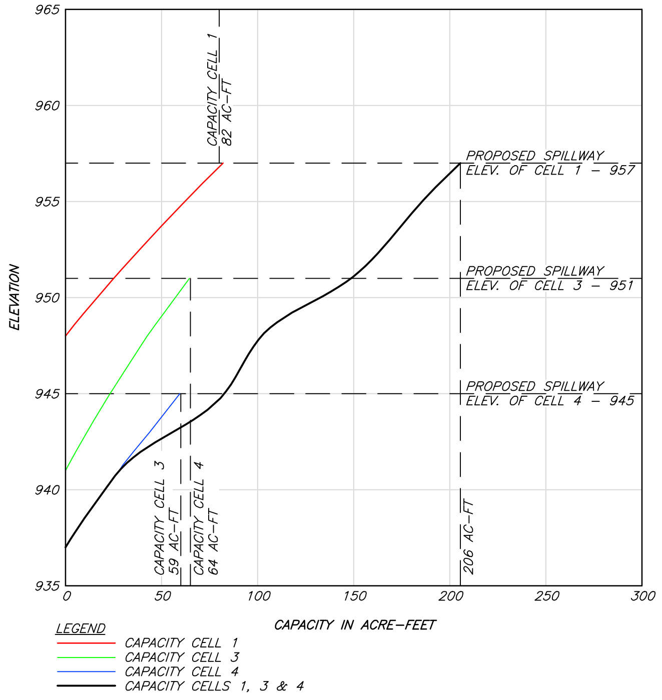


CONCEPTUAL DECLEZ CHANNEL GATE SECTION

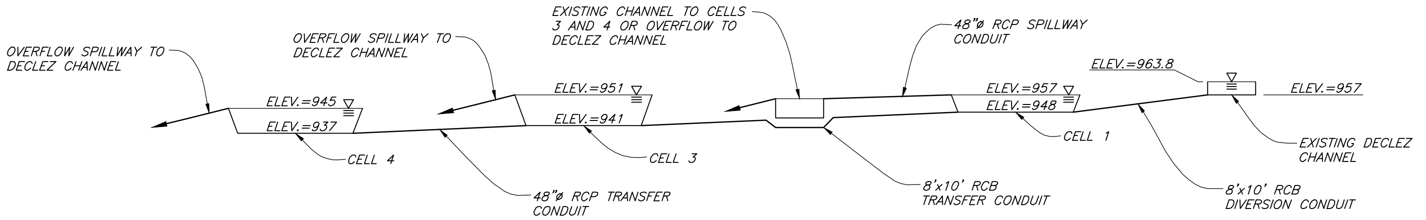
NOT TO SCALE



CAPACITY CURVES (WITH BASIN EXCAVATION)

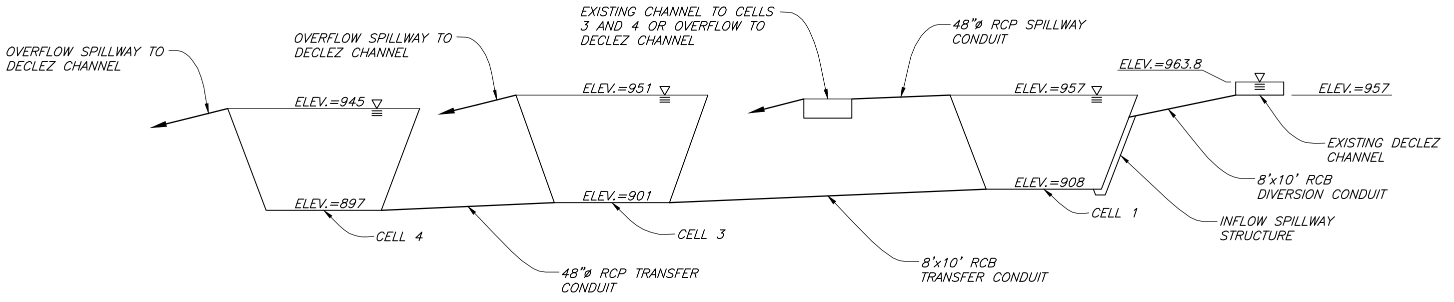


CAPACITY CURVES (NO BASIN EXCAVATION)



CONVEYANCE SYSTEM SCHEMATIC – NO EXCAVATION

NOT TO SCALE



CONVEYANCE SYSTEM SCHEMATIC – WITH EXCAVATION

NOT TO SCALE

File Name RP3 Design Rev3.dwg
Scale Factor 1
Plot Date 04-21-2010

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AND
SUBJECT TO REVISION

REVISIONS

REF.	DESCRIPTION	APVD.	DATE

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CHINO BASIN WATER CONSERVATION DISTRICT

CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION

RP3 BASIN

SHEET
2
OF
2
SHEETS

FIGURE 5-49

Figure 5-50
RP3 Basin Evaluated Alternative Schematic

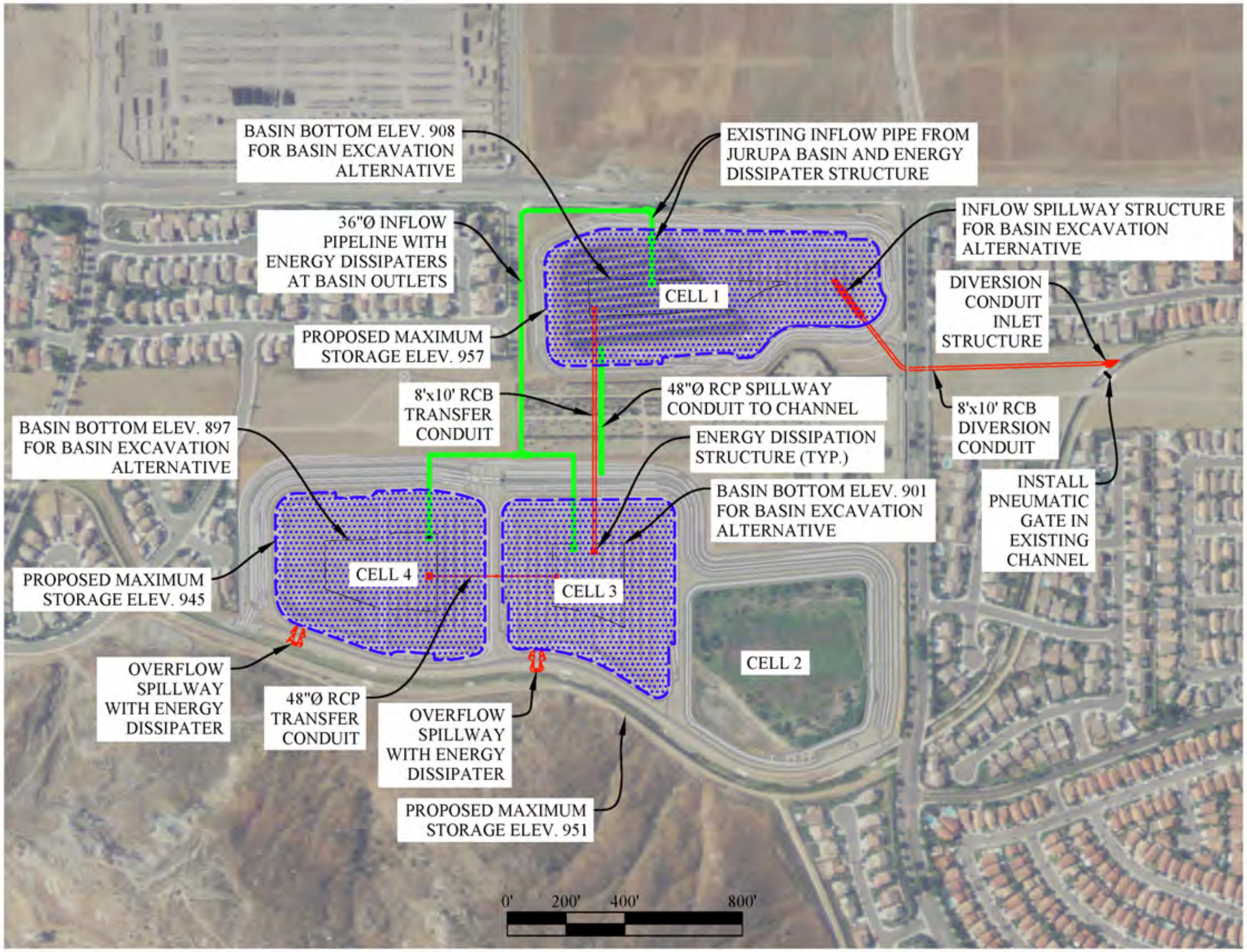
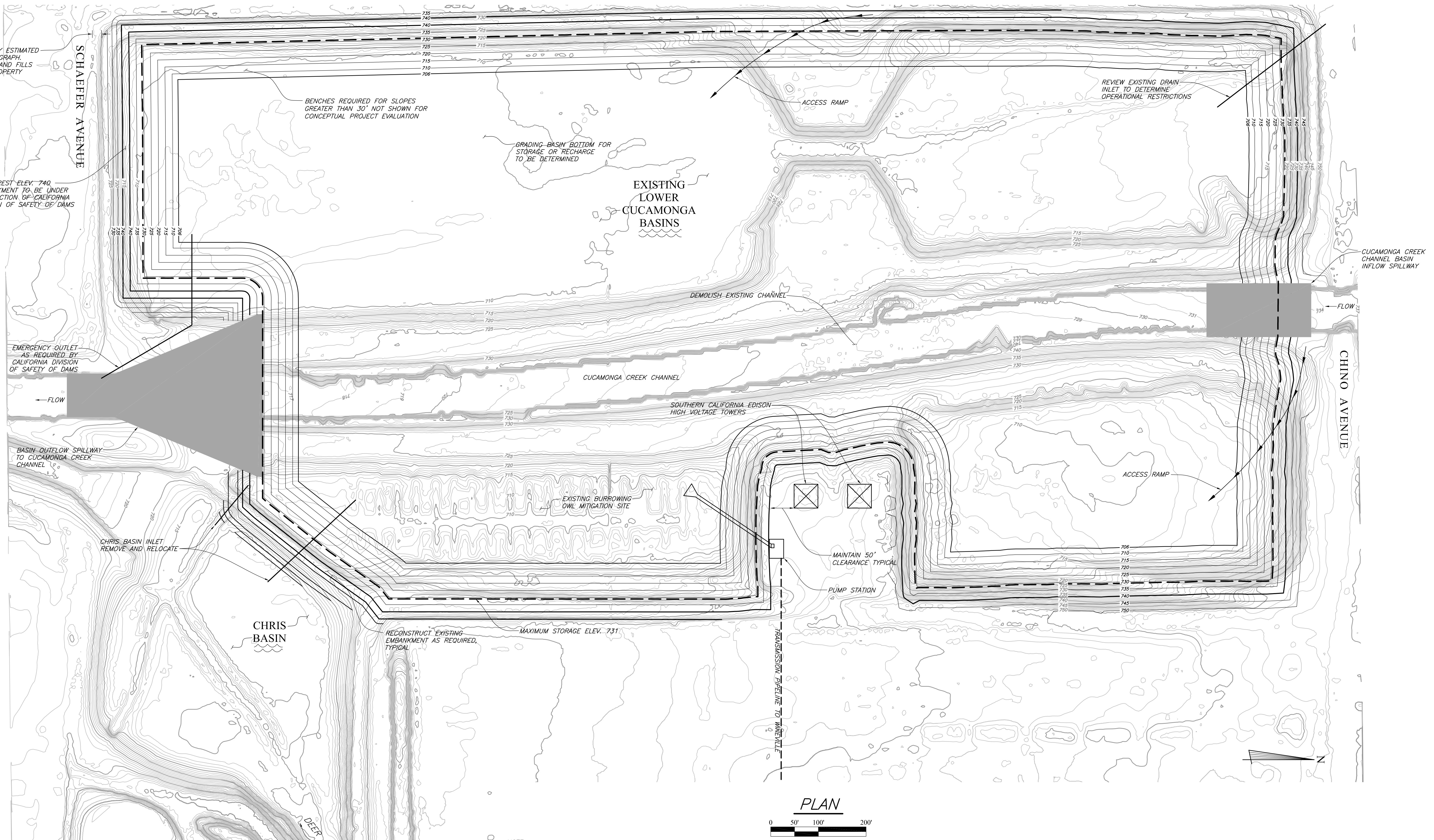


Figure 5-51
Vulcan Pit Evaluated Alternative Schematic



NOTE:

TOPOGRAPHY BASED ON DIGITAL ELEVATION MODEL OBTAINED FROM WILDERMUTH ENVIRONMENTAL, INC., NOVEMBER 2009.

File Name	LC Conceptual Basin Enhancement Option 1 (FINAL-PLOT).dwg
Scale Factor	1
Plot Date	05-21-2010

PRELIMINARY
NOT FOR CONSTRUCTION
AND
SUBJECT TO REVISION

REVISIONS

REF.	DESCRIPTION	APVD.	DATE

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Designed By	D.P. LOUNSBURY
Drawn By	J. HERBERT/ P. INTHARATH
Checked By	R.C. WAGNER
Approved By	

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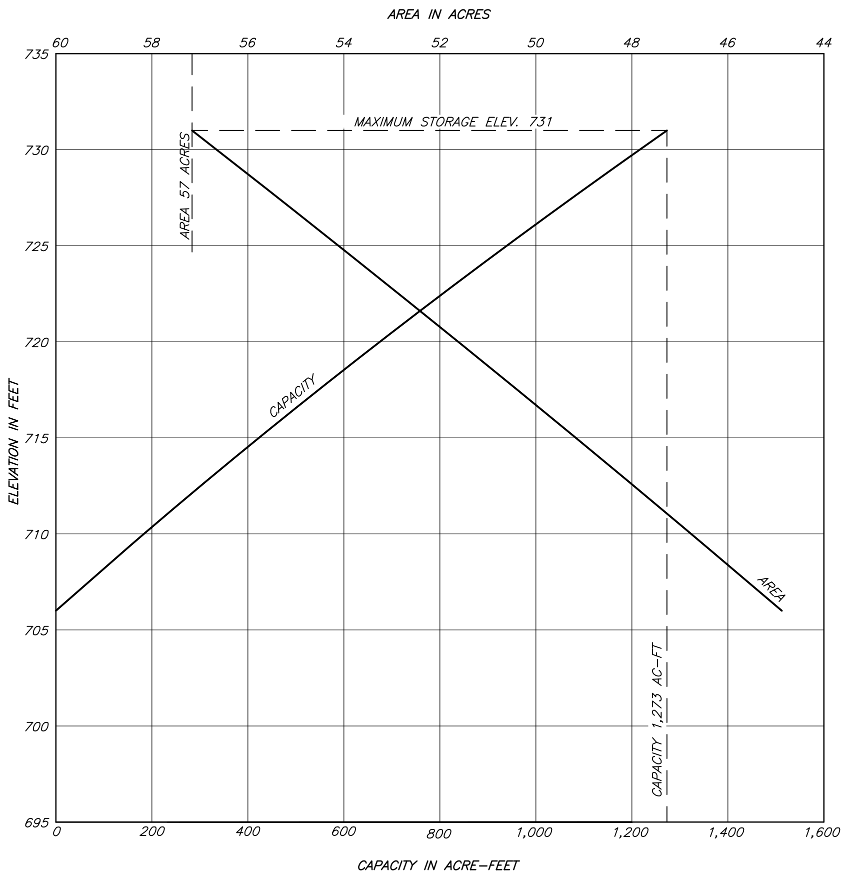
CHINO BASIN WATER CONSERVATION DISTRICT

CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION

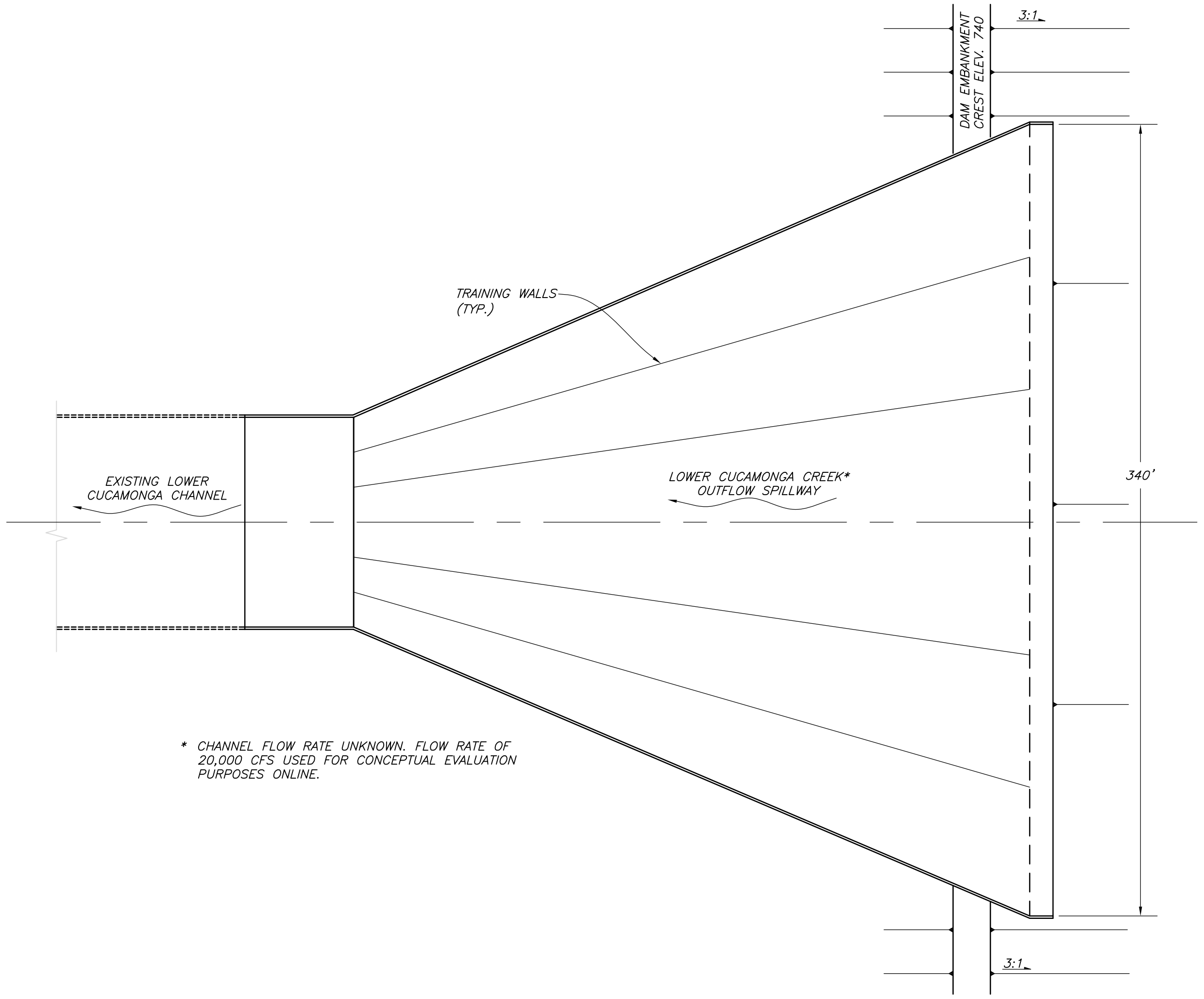
LOWER CUCAMONGA BASIN

SHEET 1 OF 2 SHEETS

FIGURE 5-52

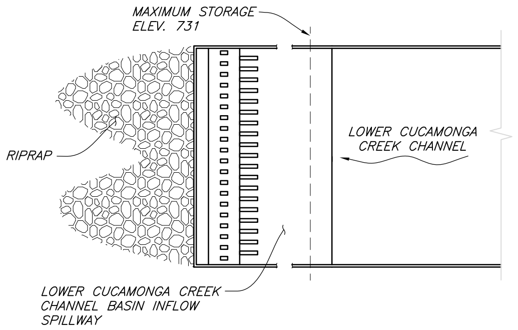


AREA/CAPACITY CURVES

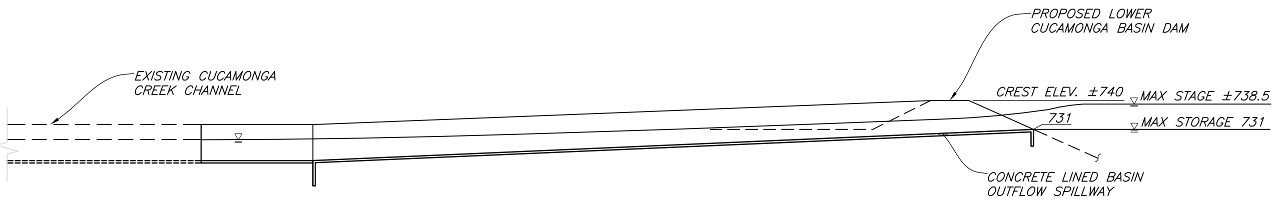


* CHANNEL FLOW RATE UNKNOWN. FLOW RATE OF 20,000 CFS USED FOR CONCEPTUAL EVALUATION PURPOSES ONLINE.

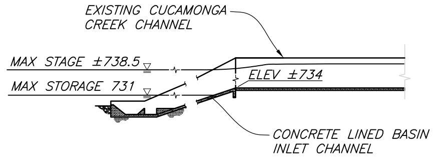
PLAN OF OUTFLOW SPILLWAY



PLAN OF INFLOW SPILLWAY



OUTFLOW SPILLWAY HYDRAULIC SCHEMATIC



INFLOW SPILLWAY HYDRAULIC SCHEMATIC

File Name LC Conceptual Basin Enhancement Option 1 (FINAL–PLOT).dwg
Scale Factor 1
Plot Date 05–21–2010

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AND
SUBJECT TO REVISION

REVISIONS

REF.	DESCRIPTION	APVD.	DATE

DRAFT

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CHINO BASIN WATER CONSERVATION DISTRICT

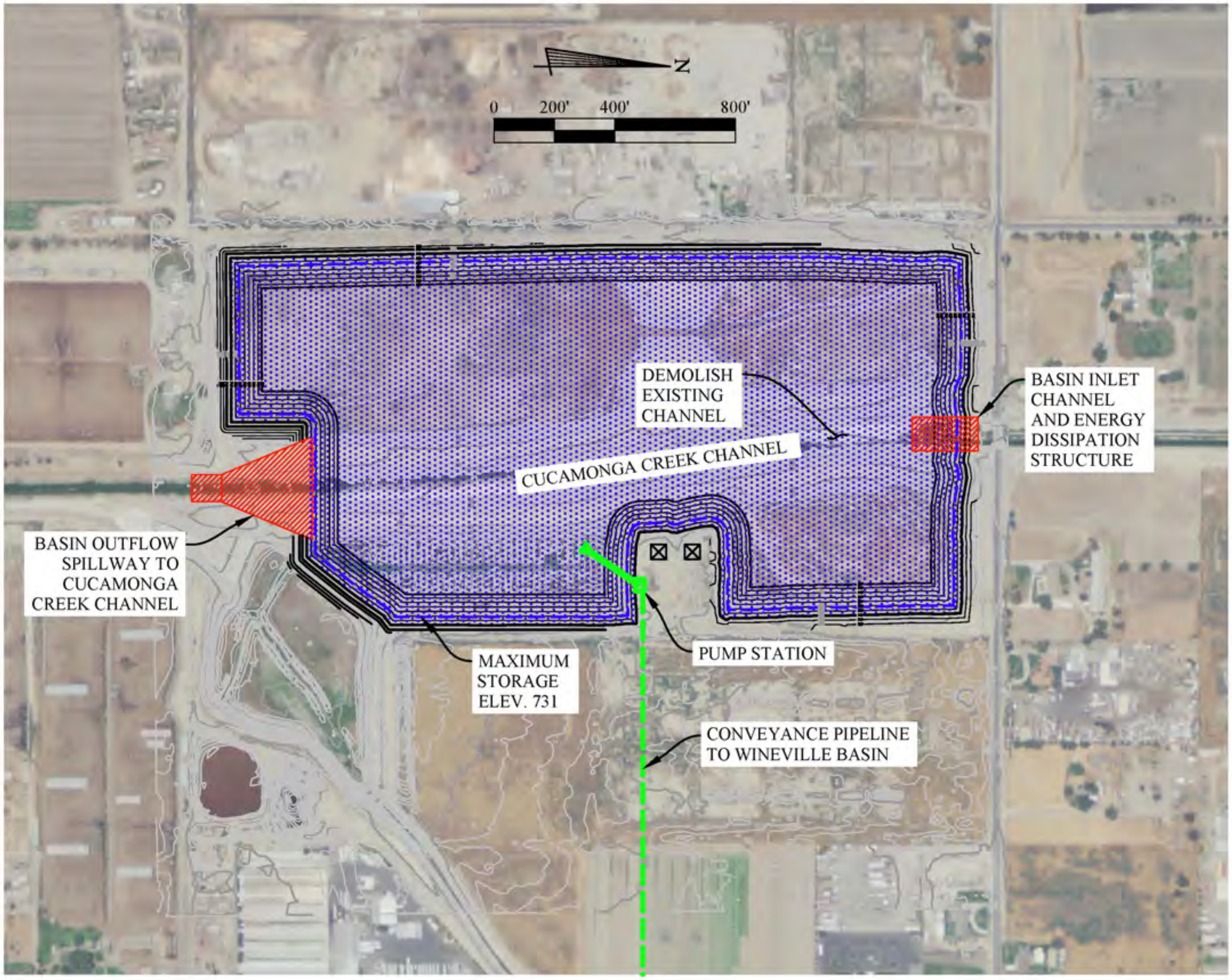
CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION

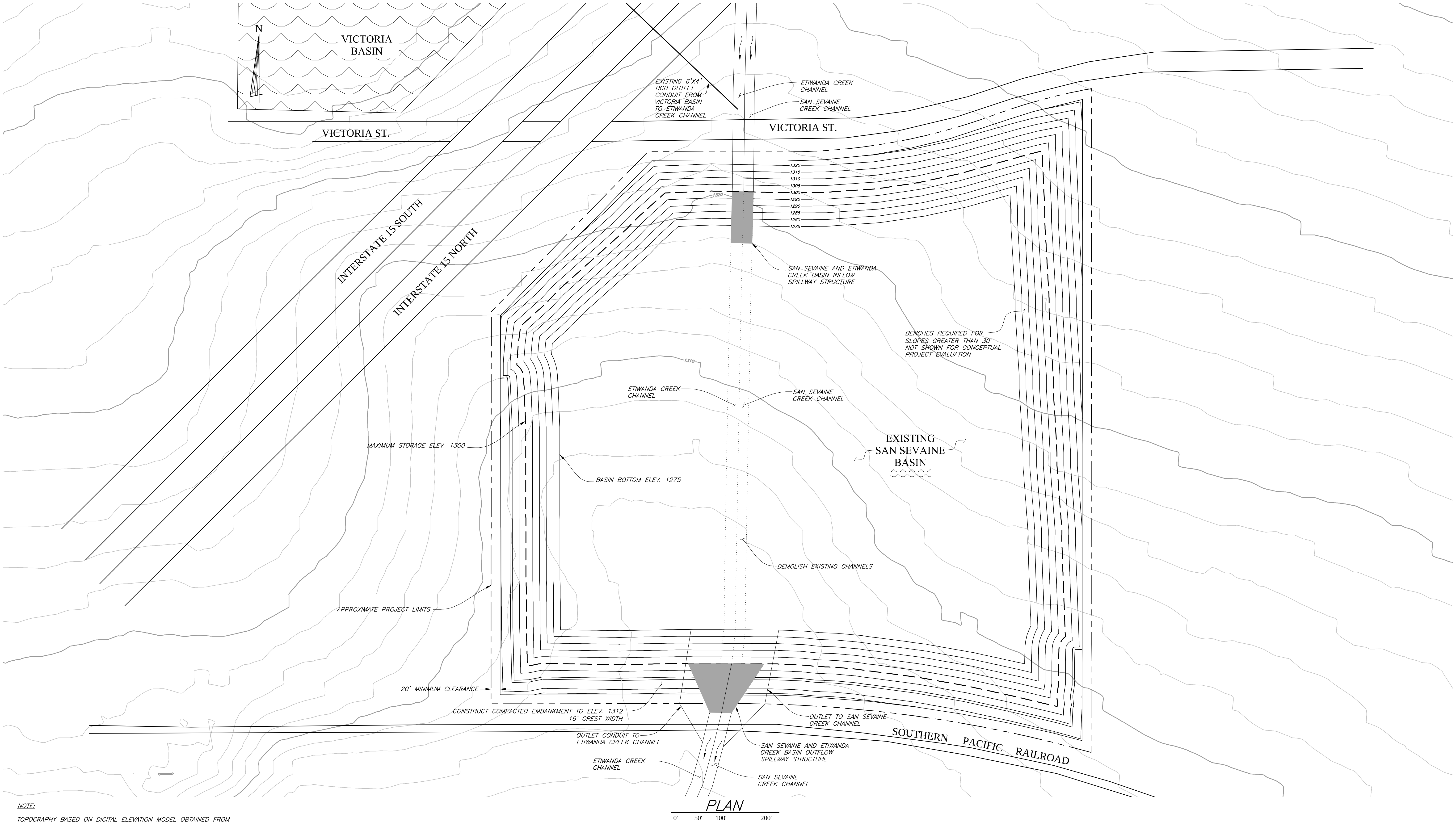
LOWER CUCAMONGA BASIN

SHEET 2 OF 2 SHEETS

FIGURE 5-53

Figure 5-54
Lower Cucamonga Basin Evaluated Alternative Schematic





PLAN

NOTE:

TOPOGRAPHY BASED ON DIGITAL ELEVATION MODEL OBTAINED FROM WILDERMUTH ENVIRONMENTAL, INC., NOVEMBER 2009.

File Name Proposed San Sevaine Channel Basin Rev3.dwg
Scale Factor 1
Plot Date 04-21-2010

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AND
SUBJECT TO REVISION

REVISIONS

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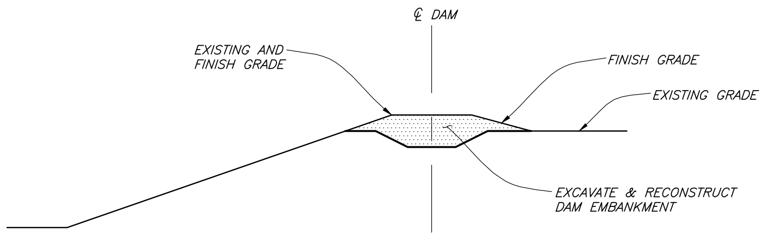
CHINO BASIN WATER CONSERVATION DISTRICT

CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION

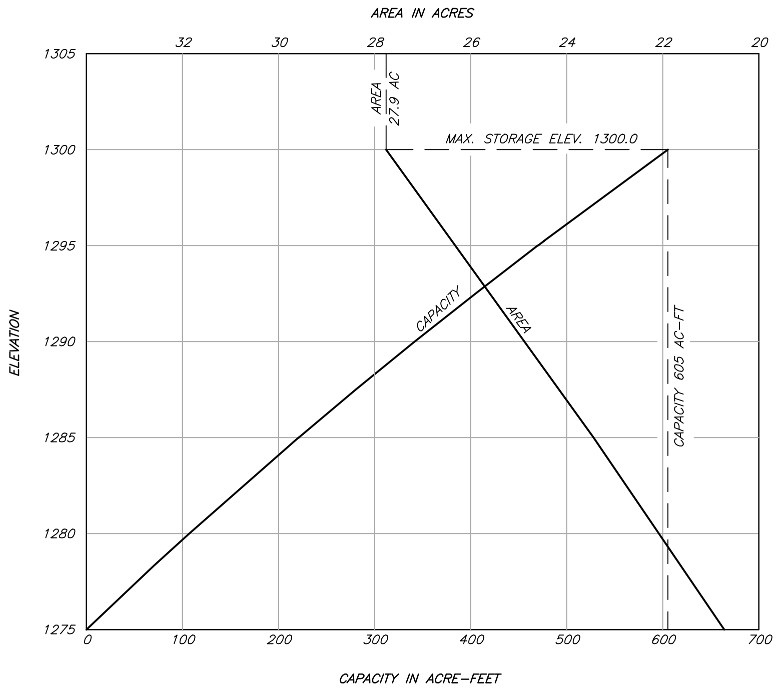
LOWER SAN SEVAINE BASIN

SHEET 1 OF 2 SHEETS

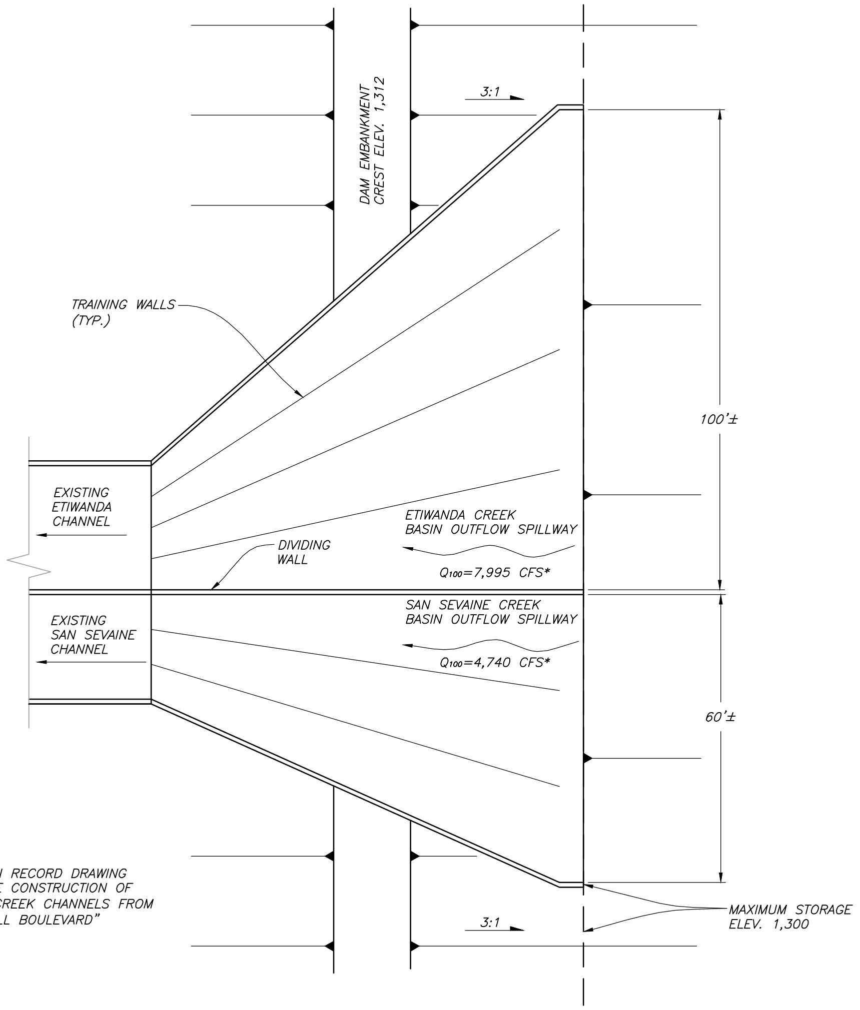
FIGURE 5-55



TYPICAL SECTION

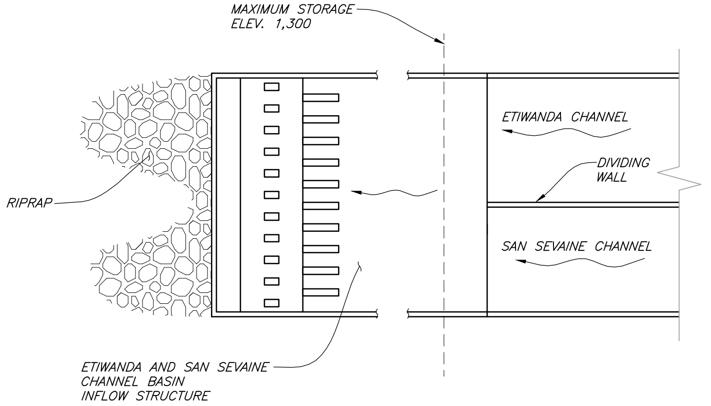


AREA/CAPACITY CURVES

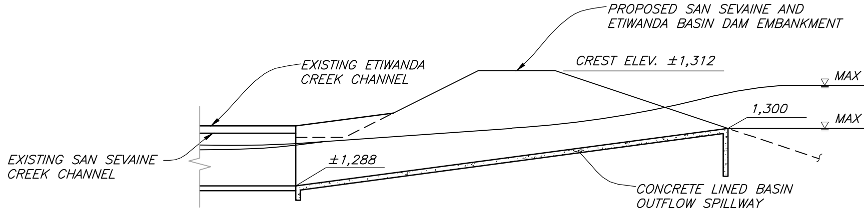


* FLOW VALUES AS SHOWN ON RECORD DRAWING OF SBCFCD, PLANS FOR THE CONSTRUCTION OF
* "SAN SEVAINE & ETIWANDA CREEK CHANNELS FROM VICTORIA AVENUE TO FOOTHILL BOULEVARD"

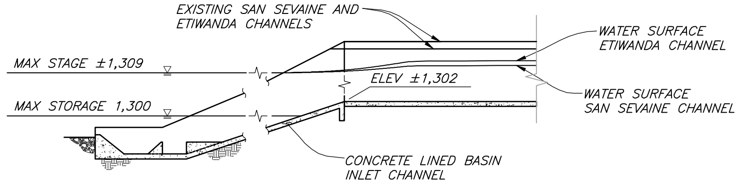
PLAN OF BASIN OUTFLOW SPILLWAY



PLAN OF BASIN INLET CHANNEL ENERGY DISSIPATION STRUCTURE



BASIN OUTFLOW SPILLWAY HYDRAULIC SCHEMATIC



BASIN INLET CHANNEL HYDRAULIC SCHEMATIC

File Name Proposed San Sevaine Channel Basin Rev3.dwg
Scale Factor 1
Plot Date 04-21-2010

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CHINO BASIN WATER CONSERVATION DISTRICT

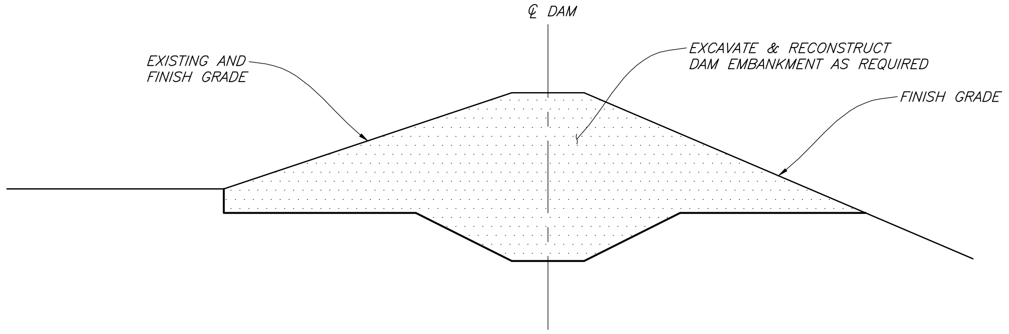
CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION

LOWER SAN SEVAINE BASIN

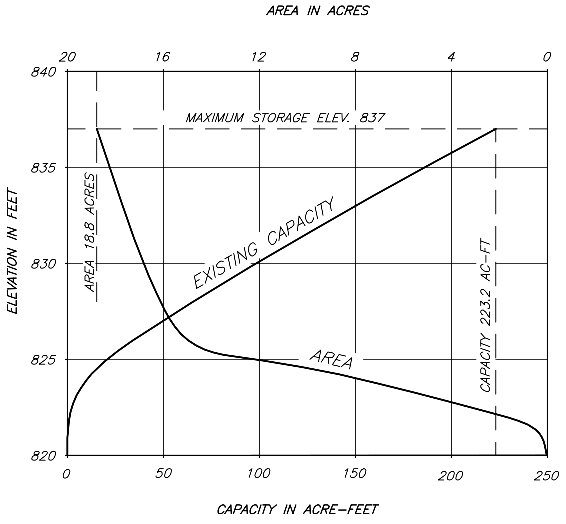
SHEET 2 OF 2 SHEETS

FIGURE 5-56

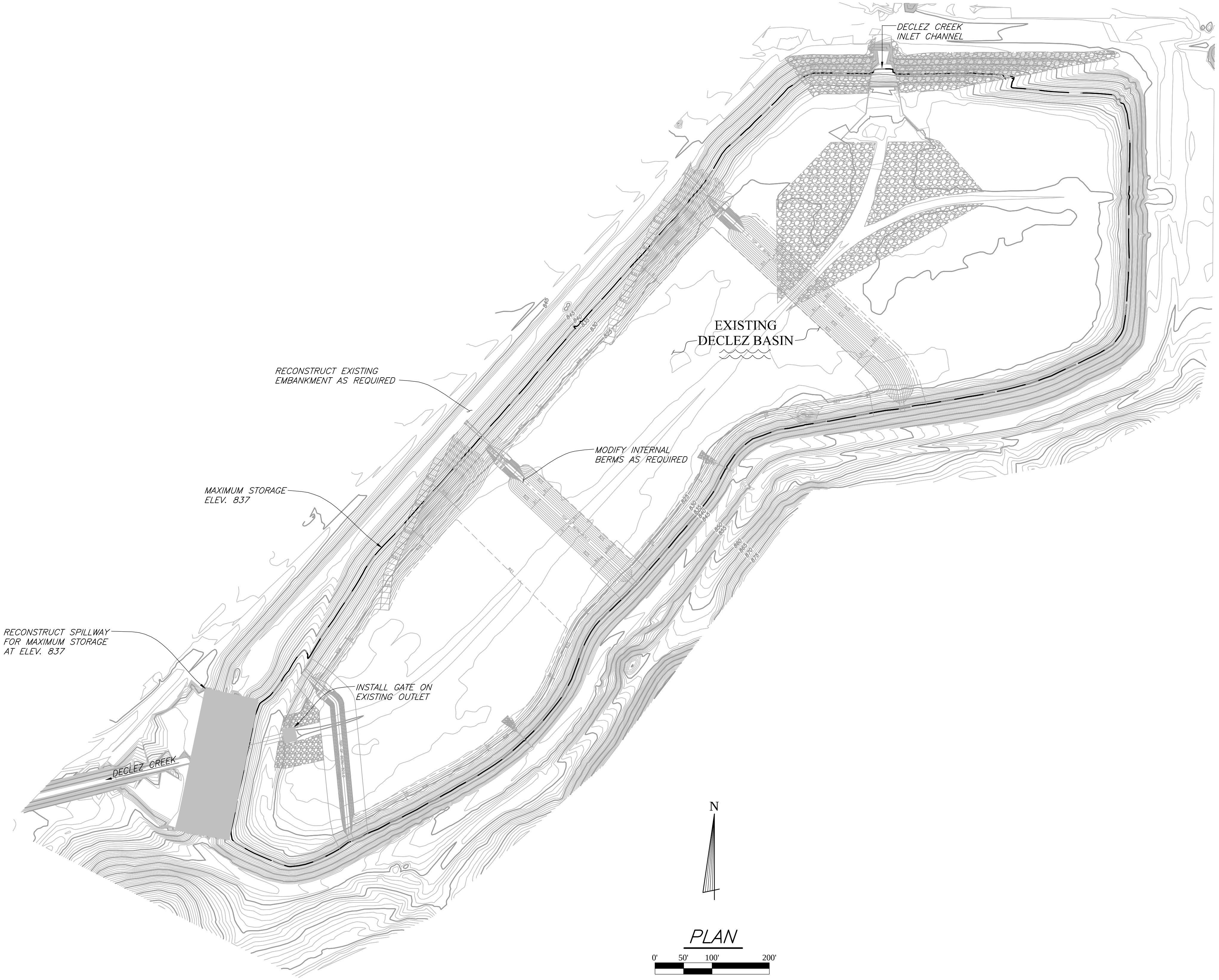
Figure 5-57
Lower San Sevaine Basin Evaluated Alternative Schematic



TYPICAL EMBANKMENT RECONSTRUCTION SECTION



AREA/CAPACITY CURVES



PLAN

File Name Declez.dwg
Scale Factor 1
Plot Date 04-21-2010

REVISIONS			
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CHINO BASIN WATER CONSERVATION DISTRICT

CHINO BASIN RECHARGE MASTER PLAN UPDATE
CONCEPTUAL PROJECT EVALUATION FOR

DECLEZ BASIN

SHEET 1 OF 1 SHEETS

FIGURE 5-58

Figure 5-59
Declez Basin Evaluated Alternative Schematic

Section 6 – Supplemental Water Recharge Enhancement Opportunities

6.1 Introduction

This section describes the existing supplemental water recharge conditions, challenges to meeting future replenishment obligations, and ways to meet future replenishment obligations that are consistent with the Judgment and the Peace Agreement. This section specifically addresses the RMPU requirements set forth in items 1, 5, 6, 8 and 9 of the November 2007 Special Referee's report to the Court:

1. Baseline conditions must be clearly defined and supported by technical analysis. The baseline definition should encompass factors such as pumping, demand, recharge capacity, total Basin water demand, and availability of replenishment water.
5. Total demand for groundwater should be forecast for 2015, 2020, 2025, and 2030. The availability of imported water for supply and replenishment, and the availability of recycled water should be forecast on the same schedule. The schedules should be refined in each Recharge Master Plan update. Projections should be supported by thorough technical analysis.
6. The Recharge Master Plan must include a detailed technical comparison of current and projected groundwater recharge capabilities and current and projected demands for groundwater. The Recharge Master Plan should provide guidance as to what should be done if recharge capacity cannot meet or is projected not to be able to meet replenishment needs. This guidance should detail how Watermaster will provide sufficient recharge capacity or undertake alternative measures so that Basin operation in accordance with the Judgment and the Physical Solution can be resumed at any time.
8. Contain recharge estimations and summaries of the projected water supply availability as well as the physical means to accomplish the recharge projections.
9. Reflect an appropriate schedule for planning, design, and physical improvements as may be required to provide reasonable assurance that sufficient Replenishment capacity exists to meet the reasonable projections of Desalter Replenishment obligations following the implementation of Basin Re-Operation.

For item 1, all issues except recharge capacity and the availability of replenishment water were discussed in Section 4. The recharge capacity of existing recharge basins and ASR wells and the availability of replenishment water are discussed in this section. For item 5, the demand for groundwater was presented in Section 4. The availability of recycled and imported water is discussed in this section. Items 6, 8, and 9 are addressed completely in this section.

6.2 Replenishment Requirement

Watermaster purchases replenishment water when one or more of the parties overproduces. Watermaster has traditionally met its replenishment obligations by purchasing imported water from Metropolitan (replenishment water service) and unproduced groundwater from the appropriators. In the recent past, Metropolitan was typically able to supply all of the replenishment needs in its service area with replenishment water service, which was estimated to be available seven out of ten years.[3] Recent court rulings regarding endangered species and the drought have severely limited the ability of Metropolitan and other SWP contractors to obtain SWP water. In 2008, Metropolitan provided a revised replenishment water service forecast, projecting that replenishment water would be available three out of ten years.[4] In response to the current drought and environmental limitations on Delta exports, Metropolitan has depleted the water stored in its various storage programs, and it is likely that when surplus water is available, some or all of it will be used to refill Metropolitan's storage assets prior to being used for groundwater replenishment.[5] The Chino Basin and the other major groundwater basins that depend on replenishment water service within Metropolitan's service area may become seriously overdrafted in the next ten to twenty years unless other replenishment supplies are acquired, groundwater production is reduced, or both. Watermaster has an unbounded obligation to acquire replenishment water (literal reading of the Judgment, confirmed at the Watermaster 2006 and 2009 Strategic Planning Meetings) to satisfy replenishment obligations. Because of the projected shortfall in replenishment water service from Metropolitan, Watermaster will have to acquire new non-traditional supplemental water supplies for replenishment. These non-traditional supplemental water supplies could consist of Metropolitan Tier 1 and Tier 2 service waters, non-IEUA recycled water, and other imported supplies from the Central Valley, the Colorado River, and other areas.

The following assumptions were made regarding the availability of non-traditional supplemental water supplies:

- Non-traditional imported supplemental water supplies will be conveyed to the Chino Basin through Metropolitan infrastructure and the ADC Pipeline.
- Non-traditional imported supplemental water supplies from the Central Valley and the Colorado River will be available six out of ten years, corresponding to years when State Water Project allocation is less than or equal to 75 percent.
- Deliveries to the Chino Basin through Metropolitan infrastructure and the ADC Pipeline will be limited to a part of the facilities unused capacity.
- New non-traditional imported supplemental water supplies will not be available until 2013 to allow adequate time for planning and acquisition.

Traditionally, Watermaster has purchased replenishment water in arrears to satisfy its replenishment obligation. That is, Watermaster determines the replenishment obligation after

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[3] Based on Metropolitan's IRPSIM analysis using the SWP Delivery Reliability Report, 2005 (DWR, 2005).

[4] Based on Metropolitan's IRPSIM analysis using the SWP Delivery Reliability Report, 2007 (DWR, 2008).

[5] See Appendix E.

the conclusion of a fiscal year and purchases replenishment water to cover this obligation in the subsequent year. Given the current and expected future constraints on the availability of supplemental water for replenishment, it is possible that a large cumulative unmet replenishment obligation (CURO) will occur and could grow so large that Watermaster may not be able to catch up. This possibility was first predicted in the original engineering work for the Peace II process and reported in *2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description* (WEI, 2007b). Furthermore, it was discussed at Watermaster's 2009 Strategic Planning Meeting, and the consensus opinion of the Watermaster parties at that meeting was that Watermaster would do whatever it takes to ensure that projected groundwater production could be sustained with acquisitions of supplemental water for replenishment. In implementation, this means that Watermaster will have to purchase and recharge supplemental water when available and in advance of replenishment obligations, referred to herein as "preemptive replenishment." This will require Watermaster to use some of the available storage space in the Chino Basin to store supplemental water in advance of overproduction.

Table 6-1 shows the projected MZ1 recharge requirement and replenishment obligation from Table 4-2 and an assumed recharge schedule based on imported water being available six out of ten years and the CURO. Watermaster will have to acquire about 710,000 acre-ft of imported water for recharge between 2010 and 2035 to meet its projected recharge obligations. Figure 6-1 shows an example of recharge water deliveries to the Chino Basin, using the assumptions described above. The recharge water delivery pattern illustrated in Figure 6-1 is not an adopted recharge plan of the Watermaster; it is an illustration that demonstrates the concept of recharging when water is available and in quantities that can manage the CURO to a sustainable level.

Figure 6-2 shows the projected recharge time series and the corresponding CURO. A positive CURO indicates an outstanding replenishment obligation, and a negative CURO indicates that Watermaster has recharged more supplemental water than required to meet the annual replenishment obligation and that this water is in storage in the Chino Basin. The replenishment delivery scheme shown in Table 6-1 and Figure 6-1 was designed to avoid a significantly positive CURO. Minimizing the CURO ensures sustainability and minimizes impacts on producers from excessive drawdown during dry periods.

6.3 Existing Supplemental Recharge Capacity

6.3.1 Spreading Basins

Figure 6-3 shows the locations of the recharge facilities used by Watermaster, the CBWCD, and the IEUA for storm and supplemental water recharge. At most of these recharge facilities, supplemental water can only be recharged during non-storm periods. At dedicated conservation basins, supplemental water may be recharged during storm periods, but there is a risk that it may be lost due to overflow. Precipitation records were reviewed to determine the availability of recharge facilities for the recharge of supplemental water. The operating rules regarding supplemental water recharge for each basin were assumed as follows:

- One day prior to a forecasted precipitation event, the delivery of supplemental water to a recharge basin would cease.
- No supplemental deliveries to a recharge basin would occur during a precipitation event.
- Supplemental water deliveries would resume the next day, following a precipitation event.

Long precipitation time histories of four areas in the Chino Basin—Claremont, Ontario, Fontana, and Chino—were evaluated to determine the number and duration of precipitation events. The longest record, 1900 through 2008, was developed by combining data from two precipitation stations located in the Claremont area. This record was evaluated to develop statistics to characterize when the recharge facilities would be operated in flood control management/stormwater recharge mode and, thus, unavailable for supplemental water recharge. Table 6-2 summarizes this analysis. A precipitation event was assumed to occur when measureable precipitation equaled or exceeded 0.04 inches. The duration of an event is the number of contiguous days with measurable precipitation. Table 6-2 provides, by month and year, statistics for the number of days with precipitation, the number of precipitation events, the mean duration of events, precipitation, and the mean facility availability for supplemental water recharge. Using the mean number and duration of precipitation events per month, the mean availability of the recharge facilities for supplemental water recharge can be calculated as:

Mean Availability = [Number of Days in Month - Days Reserved for Flood Control] / Number of Days in Month

The average availability of the existing recharge facilities for supplemental water recharge varies from a low of about 71 percent of the time in January and February to a high of about 94 percent of the time in July and August. The mean availability is about 87 percent. All basins were assumed to be out of service for two months in the summer for maintenance purposes.

Table 6-3 lists the spreading basins, their operational availability for supplemental water recharge, their supplemental water recharge capacities, and the theoretical maximum recharge capacities for supplemental water recharge. The table is organized as follows:

- The first column lists the recharge facilities and aggregates them by OBMP management zone.
- The next twelve columns (columns 2 through 13) show the estimated availability of the recharge facilities by month, based on the mean availability of the recharge facilities in consideration of the number of storm events each month (see Table 6-2). Availability in any one year is dependent upon operation and maintenance schedules as well as actual and forecasted precipitation.
- Column 14 contains the average recharge rate for each recharge facility or group of facilities. These rates were provided by the IEUA and are based on recent operational

performance.

- Column 15 lists the supplemental water recharge capacity.
- Column 16 indicates which Metropolitan turnout is tributary to each basin.
- Columns 17 and 18 provide the turnouts' maximum and useful discharge rates to the recharge facilities. The useful discharge rate is the discharge rate that doesn't adversely impact the Rialto pipeline's hydraulics.
- Column 19 indicates whether a turnout's capacity limits the recharge capacity of a facility; a "no" value means that the capacity of the turnout exceeds the recharge capacity of the facility, and a "yes" value means that the recharge capacity is limited by turnout capacity.
- Column 20 shows the annual theoretical imported water recharge capacity constrained by turnout capacity, which is estimated as the sum of the products of operational availability for each month times the number of days in each month times the average recharge rate of a given basin or the useful discharge rate for a given basin. As the table shows, CB13 and CB18 are the only turnouts that limit recharge capacity.

The last five columns summarize the theoretical maximum supplemental water recharge capacity per year and per quarter. The total maximum supplemental water recharge capacity of the recharge basins available to Watermaster is about 99,000 acre-ft/yr. The total maximum supplemental water recharge capacity for the Chino Basin, constrained by turnout capacity, is about 83,100 acre-ft/yr.

6.3.2 Aquifer Storage and Recovery Wells

The Monte Vista Water District (MVWD) has five ASR wells with an estimated injection capacity of about 5,600 acre-ft/yr. Figure 6-4 shows the locations of these ASR wells. At present, there is no formal agreement that would allow Watermaster to use the MVWD's ASR wells for replenishment.

6.3.3 In-Lieu Recharge Capacity

In lieu recharge occurs when a water purveyor with production rights in the Chino Basin elects to use supplemental water in lieu of its production rights. The un-produced production rights are reclassified as supplemental water pursuant to the Judgment and can be used to satisfy a replenishment obligation by an equal amount. The current in-lieu recharge capacity ranges from about 25,000 to 40,000 acre-ft/yr (B&V, 2008).

6.3.4 Supplemental Water Recharge Capacity Requirements

The supplemental water recharge capacity of the spreading basins available to Watermaster and the existing ASR wells is about 88,700 acre-ft/yr. With in-lieu recharge, the supplemental water recharge capacity ranges from 113,700 to 128,700 acre-ft/yr. Pursuant to the Peace Agreement, Watermaster needs to have enough wet-water recharge capacity to meet its replenishment needs and reserves in-lieu recharge capacity for other recharge programs. Watermaster may use in-lieu recharge for replenishment, but it must also have the ability to do wet-water recharge exclusively. Watermaster prepared a report entitled *2009 Production Optimization and Evaluation of the Peace II Project Description* (WEI, 2009b) that evaluated, among other things, the supplemental water recharge capacity of the Chino Basin and the ability to meet Watermaster's replenishment obligations through 2030. The report:

- Concluded that Watermaster could meet its replenishment obligations with existing spreading basins and existing and planned ASR wells, provided that Watermaster was able to acquire supplemental water for replenishment and that Watermaster used preemptive replenishment to manage the CURO to about 100,000 acre-ft;
- Assumed that replenishment would occur in about six out ten years and that the required supplemental water recharge capacity ranged between 78,000 acre-ft/yr to 86,000 acre-ft/yr, which is within the supplemental water recharge capacity currently available to Watermaster;
- And did not include new stormwater recharge created by compliance with the 2010 MS4 permit and future development or other new stormwater recharge projects.

6.4 Existing Supplemental Water Sources

6.4.1 Metropolitan Water District of Southern California

Metropolitan is a consortium of 26 cities and water districts that provides drinking water to about 19 million people in parts of Los Angeles, Orange, Riverside, San Bernardino, and Ventura Counties—a service area of about 5,200 square miles. Metropolitan currently delivers about 2 million acre-ft/yr of imported water to its service area from the State Water Project and the Colorado River[6] and conveys this water across the Chino Basin. Figure 6-3 shows Metropolitan's pipelines, turnouts, and existing recharge basins in the Chino Basin area.

6.4.1.1 State Water Project

The SWP is owned by the State of California and operated by the Department of Water Resources. The SWP transports Feather River water stored in and released from Lake Oroville and unregulated flows diverted directly from the Delta south via the California Aqueduct to the Metropolitan service area (Metropolitan, 2009). In Antelope Valley, the California Aqueduct divides into the East and West Branches. The East Branch carries water to Silverwood Lake and Lake Perris (DWR, 2009). From Silverwood Lake, SWP water is conveyed to the San Bernardino area at the Devil Canyon Afterbay. Metropolitan supplies SWP water to the Chino Basin area from its Rialto Pipeline, which starts at the Devil Canyon Afterbay and traverses westward across the northern part of the Chino Basin towards Los Angeles. In a 100-percent allocation year, Metropolitan's SWP contract with the DWR will

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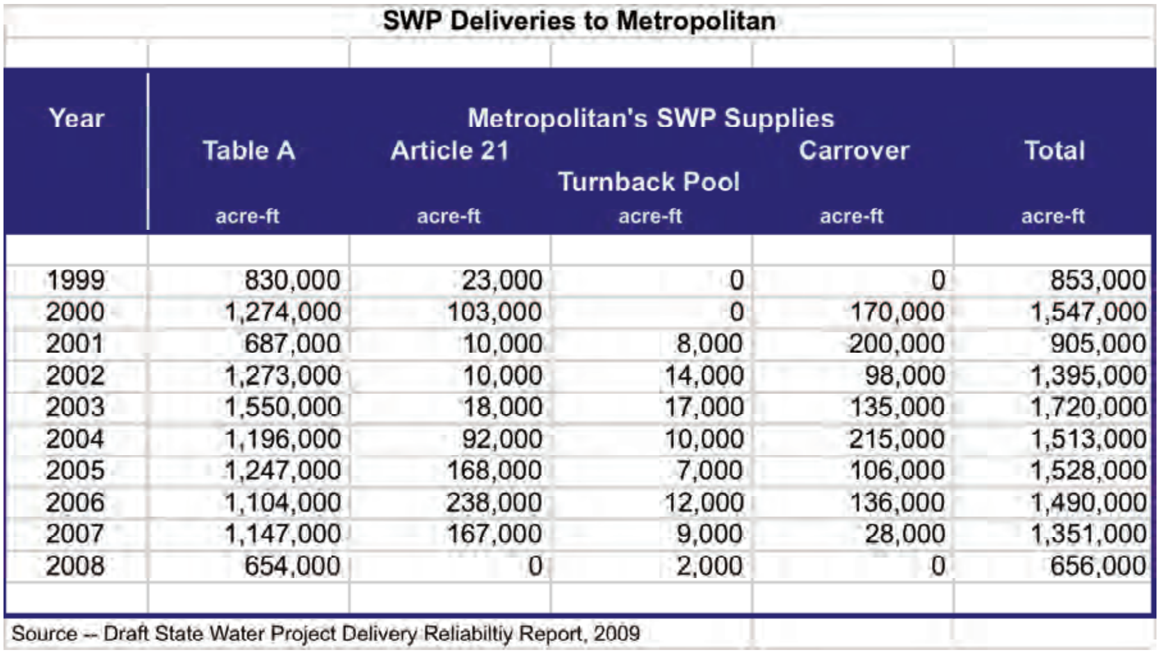
[6] http://www.mwdh2o.com/mwdh2o/pages/about/about01.html

provide Metropolitan with 1,911,500 acre-ft of water (Table A amount). SWP deliveries to Metropolitan, pursuant to Metropolitan's SWP contract, for the last ten years are listed below.



SWP Deliveries to Metropolitan

Year	Metropolitan's SWP Supplies				
	Table A	Article 21	Turnback Pool	Carrover	Total
	acre-ft	acre-ft	acre-ft	acre-ft	acre-ft
1999	830,000	23,000	0	0	853,000
2000	1,274,000	103,000	0	170,000	1,547,000
2001	687,000	10,000	8,000	200,000	905,000
2002	1,273,000	10,000	14,000	98,000	1,395,000
2003	1,550,000	18,000	17,000	135,000	1,720,000
2004	1,196,000	92,000	10,000	215,000	1,513,000
2005	1,247,000	168,000	7,000	106,000	1,528,000
2006	1,104,000	238,000	12,000	136,000	1,490,000
2007	1,147,000	167,000	9,000	28,000	1,351,000
2008	654,000	0	2,000	0	656,000

Source -- Draft State Water Project Delivery Reliabiltiy Report, 2009

SWP contracts define several classifications of water available to contractors under specific circumstances, as described below. All classifications are considered "project" water.

- Table A Water. Each SWP contract's "Table A" is the amount of water, in acre-ft, that is used to determine the portion of available supply to be delivered to the contractor. Table A water is water delivered according this apportionment methodology and is given first priority for delivery.
- Article 21 Water. Article 21 of the SWP contract permits the delivery of water in excess of Table A deliveries and some other water types to those contractors requesting it. This water is available under specific conditions:
    - Water is available only when it does not interfere with SWP Table A allocations and SWP operations.
    - Water is available only when excess water is available in the Delta.
    - Water is available only when capacity is not being used for SWP purposes or scheduled SWP deliveries.
    - The water cannot be stored in the SWP system. In other words, the contractors must be able to use Article 21 water directly or be able to store it in their own systems.
- Turnback Pool Water. Contractors may choose to offer their allocated Table A water in excess of their needs to other contractors through two pools in February and March.
- Carryover Water. Pursuant to the long-term water supply contracts, contractors have the opportunity to carry over a portion of their allocated water approved for delivery

in the current year for delivery during the next year. Normally, carryover water is water that has been exported from the Delta but is not delivered to the contractor that year; instead, this water is stored in the SWP's share of the San Luis Reservoir for delivery the following year.

6.4.1.2 SWP Delivery Reliability

In January 2010, the DWR published the *Draft State Water Project Delivery Reliability Report* (DWR, 2009). This report updates the DWR's estimate of current (2009) and future (2029) SWP water delivery reliability. The report is produced every two years as part of a settlement agreement that was signed in 2003. The 2009 report shows that future SWP deliveries will be impacted by two significant factors: 1) a significant restriction on the SWP and Central Valley Project (CVP) Delta pumping, as required by the biological opinions issued by the U.S. Fish and Wildlife Service (December 2008) and the National Marine Fisheries Service (June 2009); and 2) climate change, which is altering hydrologic conditions in the state.

The report represents the state of affairs if no Delta improvements are made. It shows the continued erosion of SWP water delivery reliability under the current method of moving water through the Delta. In the 2007 report, the average Table A delivery was about 63 percent for 2007 conditions and about 66 to 69 percent for 2027 conditions. In the 2009 report, the average Table A delivery is about 60 percent for 2009 conditions and about 60 percent for 2029 conditions. Most of the reduced reliability is caused by the export limitations resulting from the two biological opinions—the first factor discussed above. Figure 6-5a shows the SWP delivery reliability from the 2005, 2007, and 2009 SWP Delivery Reliability Reports (DWR, 2005; 2008; & 2010 [respectively]). As the figure shows, the delivery probability curve for 2007 drops completely below the 2005 delivery probability curve, showing a drop in average current reliability from 72 percent to 63 percent; and the delivery probability curve for 2009 drops significantly below the 2007 delivery probability curve 68 percent of the time for higher allocations and climbs above the 2007 delivery probability curve 32 percent of the time, corresponding to lower allocations. The significance of the most recent projected delivery reliability is that there is a relative decrease in deliveries during wetter (higher allocation) years and a slight increase in deliveries during dry years. Metropolitan will have less SWP water available in wet years to refill its storage assets and for groundwater replenishment and slightly more water in dry years to meet its firm demand. In response to the *2007 State Water Project Delivery Reliability Report*, Metropolitan reduced its forecast of replenishment service water, as noted earlier in this section, from seven out of ten years to three out of ten years. With the further erosion of SWP reliability projected in the draft *2009 SWP Delivery Reliability Report*, the availability of replenishment water service from Metropolitan is seemingly more limited in the current period than was thought just two years ago.

Figure 6-5b compares the predicted reliability for 2025, 2027, and 2029.[7] The projected future change in SWP delivery reliability is even more restrictive in wet years, indicating that, in the

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[7] Figure 6-5b is not a straight apples to apples comparison due to changes in modeling capabilities and the assumptions associated with climate change in the out years. That said, the conclusion reached from examining the reliability projection is still valid.

future, Metropolitan will receive less SWP water during wet periods than projected in the past. The eroding SWP reliability has major implications: replenishment water service will not be available from Metropolitan in the future, and Watermaster will have to purchase Tier 1 and Tier 2 water if available and possibly other imported water. In the latter case, Watermaster will need to have those waters wheeled through Metropolitan and the IEUA.

6.4.1.3 Colorado River Aqueduct (CRA)

The CRA is owned and operated by Metropolitan. The CRA transports water from the Colorado River approximately 242 miles to its terminus at Lake Mathews in Riverside County. The Colorado River was the initial imported water supply for Metropolitan. Metropolitan acquires Colorado River water from the Bureau of Reclamation (BOR) and is limited to the capacity of the CRA, which is approximately 1.2 million acre-ft/yr. The BOR supplies water to Metropolitan based on a priority system that was created in 1931. Colorado River water is provided under a permanent service contract and an interstate compact. For California, the allocation is as follows:

Priorities Under the 1931 California Seven Party Agreement

Priority 1	Palo Verde Irrigation District	3,850,000
Priority 2	Imperial Irrigation District	(included above)
Priority 3	Coachella Valley Water District	(included above)
Priority 4	Metropolitan Water District	550,000
California Basic Apportionment		**4,400,000**
Priority 5(a)	Metropolitan Water District	550,000
Priority 5(b)	Metropolitan Water District	112,000
Priority 6(a)	Imperial Irrigation District	300,000
Priority 6(b)	Palo Verde Irrigation District	(included above)
Total Surplus Allocation		**962,000**
Total		**5,362,000**
Priority 7	Agricultural Use in the Colorado River Basin	Remaining Surplus

For Metropolitan, only Priority 4 is part of the basic apportionment of the 4.4 million acre-ft of Colorado River water for California. Metropolitan can only divert Priorities 5(a) and (b) if there is surplus water and apportioned but unused water within the Colorado River system (surplus to Priorities 1, 2, and 3). Metropolitan has stated that it was able to take delivery of 1.2 million acre-ft of the Colorado River water through 2002 and that it averaged 762,000 acre-ft/yr from 2003 through 2008. This is due to the drought on the Colorado River system and the increase in water diversions by Nevada and Arizona.[8]

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[8] Metropolitan Water District of Southern California Waterworks General Obligation Refunding Bonds, 2009 Series, dated December 1, 2009, Appendix A, page A-13

The amount of Colorado River water available to Metropolitan's service area was augmented with the long-term transfer agreement between the Imperial Irrigation District (IID) and the San Diego County Water Authority (SDCWA). The transfer agreement provides up to 200,000 acre-ft of water per year for a seventy-five year term. The transfer agreement is dependent upon the Quantification Settlement Agreement (QSA), which was invalidated on January 14, 2010 when a Sacramento Superior Judge issued a final ruling.[9] If the ruling survives an appeal, the IID-SDCWA transfer agreement may have to be revised and renegotiated.

Small amounts of CRA water were used to recharge the Chino Basin prior to the implementation of the Chino Basin Judgment and the 1975 Basin Plan. The TDS concentration of CRA water far exceeds the TDS concentration objectives for the Chino Basin Management Zones. Also, as Figure 6-3 shows, very few recharge basins in the Chino Basin are located such that CRA water could be used for recharge without the construction of pump stations and pipelines. The 2004 Basin Plan contains a requirement that states Watermaster and the IEUA must "[…] optimize the recharge of imported water in the Chino Basin based on the goal of maximizing recharge of SWP water when the TDS of that water is lowest."[10] The use of CRA water for replenishment would likely require a Basin Plan amendment and a demonstration that the increased TDS loading from using CRA water for replenishment could be offset.

6.4.1.4 Metropolitan as a Source of Water for Replenishment

Metropolitan will most likely not be able to supply replenishment service water to the Watermaster in the future. The projected growth in Watermaster replenishment demands has not been considered a firm supply in Metropolitan's planning, and therefore the use of Tier 1 and Tier 2 service water for replenishment is problematic. Watermaster will likely be purchasing Tier 1 and Tier 2 service water for replenishment when it is available and may be required to look outside of Metropolitan for supplemental water for replenishment. The current and projected costs ($/acre-ft) of water purchased from Metropolitan are shown below.

	Effective 1/1//2010	Effective 1/1/2011	Effective 1/1/2012
Replenishment Rate	$366	$409	$442
Tier 1 Rate	$484	$527	$560
Tier 2 Rate	$594	$652	$686
Wheeling Rate	$314	$372	$396

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[9] Superior Court of California, County of Sacramento, Judge Roland L. Candee, Case No.: JC4353, QSA Coordinated Cases, issued January 14, 2010

[10] Santa Ana Regional Water Quality Control Board resolution amending the Basin Plan (R8-2004-0001) http://www.waterboards.ca.gov/santaana/board_decisions/adopted_orders/orders/2004_orders.shtml

Analysis of Metropolitan's historical water rates indicates that Metropolitan's rates have increased at a compounded rate of about 6 percent per year. By comparison, the increase from January 2010 to January 2012 is about 10 percent for the replenishment rate and about 7.5 percent for the Tier 1 and Tier 2 rates.

6.4.2 IEUA Recycled Water

The IEUA initiated an aggressive recycled water reuse program for its service area. Under this program, most of the recycled water produced in the IEUA's service area will be reused. Moreover, the IEUA plans to recharge recycled water at selected spreading basins. Historical and projected recycled water recharge in the Chino Basin is shown below.

Historical[1] and Projected Recycled Water Recharge

(acre-ft)

Year	Recycled Water Recharge		
	Low Range	Mid Range	High Range
2005 - 2006	1,304	1,304	1,304
2006 - 2007	2,989	2,989	2,989
2007 - 2008	2,237	2,237	2,237
2008 - 2009	2,684	2,684	2,684
2009 - 2010	8,056	8,056	8,056
2010 - 2011	12,505	14,090	20,431
2011 - 2012	12,500	15,960	23,142
2012 - 2013	12,500	17,835	24,000
2013 - 2014	12,500	10,985	24,000
2014 - 2015	12,500	20,048	24,000
2015 - 2016	12,500	20,689	24,000
2016 - 2017	12,500	21,000	24,000
2017 - 2018	12,500	21,000	24,000
2018 - 2019	12,500	21,000	24,000
2019 - 2020	12,500	21,000	24,000
2020 - 2021	12,500	21,000	24,000
2021 - 2022	12,500	21,000	24,000
2022 - 2023	12,500	21,000	24,000
2023 - 2024	12,500	21,000	24,000
2024 - 2025	12,500	21,000	24,000
2025 - 2026	12,500	21,000	24,000
2026 - 2027	12,500	21,000	24,000
2027 - 2028	12,500	21,000	24,000
2028 - 2029	12,500	21,000	24,000
2029 - 2030	12,500	21,000	24,000

Source: IEUA May 2010

1 –Historical values in italics

Recycled water recharge is not used to satisfy replenishment obligations. Instead, it is recharged into the basin and subsequently assigned to certain appropriator parties, thereby increasing the appropriators' production rights and reducing their future replenishment liabilities. The recharge of recycled water has the important effect of reducing current and future replenishment obligations. For planning purposes, the mid-range projection was used in Section 4 to determine future replenishment obligations, as it is most consistent with the planning assumptions in this investigation. The assumptions embedded in the IEUA mid-range projection include:

- Recycled water recharge is at 90 percent of the spreading basin capacity from April 16th to October 14th.
- Recycled water recharge is at 60 percent of the spreading basin capacity from October 15th to April 15th.
- Recycled water turnout capacity limitations were considered.
- Spreading basin maintenance is assumed to provide at least 50 percent of the post-cleaning infiltration at all times.
- Recycled water conveyance enhancements to the RP-3 Basins, Turner Basin, and the Banana/Hickory Basins will be complete by 2012-13.
- Although permitted, the Lower Day Basin, the Etiwanda Debris Basin, and the Etiwanda Conservation Basin are not included in the mid-range projection.
- Imported water supply (for recharge and replenishment purposes) is assumed to be 708,000 acre-ft, distributed throughout the Chin Basin between 2015 to 2030, which is consistent with the projections in the draft 2010 Recharge Master Plan Update (WEI, 2010c).

6.5 Other Supplemental Water

6.5.1 Imported Water

Imported water, as discussed herein, means water that does not originate in the Chino Basin or from watersheds that historically contribute recharge to the Chino Basin. Sources of imported water, other than Metropolitan, that may potentially be available to Watermaster include:

- groundwater and surface water supplies from the Central Valley, conveyed to the Chino Basin through SWP and Metropolitan facilities;
- groundwater from the Antelope Valley, conveyed to the Chino Basin through SWP and Metropolitan facilities;
- groundwater and surface water supplies from the Colorado River Basin, conveyed to the Chino Basin through Metropolitan facilities;
- groundwater and surface water supplies in the Santa Ana Watershed that can be

supplied to the Chino Basin directly or by exchange;

- recycled water from the Rapid Infiltration Extraction Treatment Plant (RIX) in Colton, from the City of Riverside, and from others.

The use of these supplies is not limited to replenishment: these supplies could be used in lieu of Chino Basin groundwater, thereby reducing Watermaster's replenishment obligation. Each source is summarized below.

Groundwater and Surface Water from the Central Valley. There is, at times, surplus[11] groundwater and surface water in the Sacramento Valley north of the Delta and in the San Joaquin Valley south of the Delta. Watermaster could acquire water from these sources and have it wheeled to the Chino Basin. Watermaster would provide the acquired water to Metropolitan for conveyance to the Chino Basin within its SWP capacity and subsequently its Rialto pipeline for delivery to spreading basins. In addition to acquisition costs, Watermaster would pay the current Metropolitan wheeling cost and IEUA administrative costs. Appendix E, prepared by the Sierra Water Group, explains this type of transaction in detail. As an alternative to spreading the water, Watermaster could have the replenishment supply delivered directly to treatment plants in the Chino Basin for subsequent injection or in-lieu replenishment.

Groundwater from the Antelope Valley. Antelope Valley water users are currently involved in groundwater rights litigation. It may be possible to acquire groundwater from right holders in the Antelope Valley when this dispute is resolved and to have that water conveyed to the Chino Basin through the East Branch of the SWP. Watermaster would provide the acquired water to Metropolitan for conveyance to the Chino Basin within its SWP capacity and subsequently its Rialto pipeline for delivery to spreading basins. In addition to acquisition costs, Watermaster would pay the current Metropolitan wheeling cost and IEUA administrative costs. As an alternative to spreading the water, Watermaster could have the replenishment supply delivered directly to treatment plants in the Chino Basin for subsequent injection or in-lieu replenishment.

Groundwater and Surface Water from the Colorado River Basin. There is, at times, surplus surface water in the Colorado River Basin. Watermaster could acquire water from this source and have it wheeled to the Chino Basin. Watermaster would provide the acquired water to Metropolitan for conveyance to Southern California in the CRA. Metropolitan would then deliver this water directly to the Chino Basin through its Upper Feeder Pipeline or provide an equal amount of SWP water through the Rialto Pipeline, the latter being the preferred approach for the Chino Basin. In addition to acquisition costs, Watermaster would pay the current Metropolitan wheeling cost and IEUA administrative costs. Appendix E explains this type of water transaction in detail. As an alternative to spreading the water, Watermaster could have the replenishment supply delivered directly to treatment plants in the Chino Basin for subsequent injection or in-lieu replenishment.

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[11] The surplus occurs because local and other supplies are greater than the current need or because the price of water is great enough to encourage transfers.

Groundwater and Surface Water from the Non-Chino Basin Parts of the Upper Santa Ana Watershed. Virtually all of the groundwater and surface water sources in the upper Santa Ana Watershed are being used, and the various parties' rights to use those waters have been established. The exceptions to this statement are infrequent and seasonal stormwater discharges and some recycled water. With the exception of recycled water, it is unlikely that these supplies could be obtained by Watermaster for replenishment. These sources are not considered further in this RMPU.

Recycled Water from the Rapid Infiltration Extraction Treatment Plant (RIX) in Colton. The City of San Bernardino manages the RIX facility for itself and the City of Colton. The City of San Bernardino has expressed an interest in marketing some of its recycled water and completed a program EIR for this marketing program in 2002 (Tom Dodson and Associates, 2005). One of the projects evaluated in the program EIR was the sale of recycled water to water purveyors in the Chino Basin for direct use and recharge. This supply is evaluated later in this section.

Recycled Water from the City of Riverside. The City of Riverside currently produces about 35,000 acre-ft/yr of effluent and may have surplus recycled water that can be conveyed to the Chino Basin. Obtaining water from this source is similar in concept to obtaining water from RIX. Because of its elevation and TDS concentration, this source is not considered further in this RMPU.

6.5.2 Other Water Sources

Two other water sources were evaluated in this update: recycled water produced at the Western Riverside County Regional Wastewater Authority Plant (WRCRWAP) and a surface water diversion from the Santa Ana River located between the Riverside Narrows and the upstream limits of the Prado Reservoir.

Recycled Water from the WRCRWAP. Currently, the WRCRWAP produces about 4,500 acre-ft/yr of recycled water and discharges it to the Santa Ana River. The WRCRWAP is planned to produce about 16,000 acre-ft/yr by 2020. Some or all of this water could be reused in the Chino Basin, reducing Watermaster's replenishment obligation. This supply is evaluated later in this section. Currently, the JCSD is investigating recycled water produced at the WRCRWAP for direct use. The project evaluated herein would use recycled water produced at the WRCRWAP that is surplus to JCSD needs.

Diversion of Santa Ana River Water between the Riverside Narrows and the Upstream Limits of the Prado Reservoir. The discharge in the Santa Ana River below the City of Riverside's point of discharge averages about 158 cfs (115,000 acre-ft/yr) and will likely remain at this level through 2020, based on the recent projections of the Basin Monitoring Task Force (WEI, 2010b). The TDS concentration in this reach of the Santa Ana River is comparable to CRA water and is currently too high for recharge in the Chino Basin without a Basin Plan amendment. Santa Ana River water is not considered further in this RMPU.

6.6 Replenishment Water Supply Portfolio

Table 4-2 contains the current best estimate of the future Watermaster recharge requirements, including the 6,500 acre-ft/yr requirement for MZ 1 and replenishment obligations. This projection assumes future development will create new stormwater recharge and that the IEUA will recharge recycled water per its mid-range projection, discussed in its May 2010 Technical Memo (IEUA, 2010). For the planning purposes of the RMPU, it has been assumed herein that Watermaster will acquire supplemental water for recharge when it is available and in a manner that will limit the CURO to no more than 100,000 acre-ft. Watermaster will maximize its purchase of water from Metropolitan prior to looking at other imported water sources from outside the Santa Ana River Watershed. Watermaster will attempt to develop local projects—including stormwater recharge and, potentially, the acquisition of non-IEUA recycled water—to minimize the purchase of highly variable and unreliable imported supplies.

6.7 New Supplemental Water Recharge Improvement Projects

Black & Veatch (B&V) completed an investigation of *Supplemental Water Recharge Concept Development* (B&V, 2010), which is included with this report as Appendix F. The B&V report describes the development of an initial palette of projects that could be used either to increase supplemental water recharge capacity or to develop more supplemental water supply. B&V developed screening criteria and applied these criteria to the initial palette of projects, reducing the number of projects to only those that were most promising. As a result of this process, five concepts were selected. Section 3 of the B&V report summarizes the initial project palette, the screening process, and the results of the screening process.

Following the pre-screening process, two additional concepts were developed that had not previously been considered, including (1) a new recycled water supply via a connection from the RIX Facility to the IEUA's recycled water distribution system and (2) a new recycled water supply via a connection from the WRCRWAP to the IEUA's recycled water distribution system.

In total, seven projects were carried forward into conceptual design. The table below summarizes the project concepts, estimated recharge capacities, cost opinions, and specific contributions to the recharge master plan.

Concept	Potential Recharge Capacity (acre-ft)/yr	Estimated Capital Cost	Estimated Annual Cost	Unit Water Cost ($/acre-ft) [1]	Contribution to Recharge Master Plan
Delivery of Recycled Water from RIX to IEUA (3)	4,400	$52,604,000	$4,123,000	$937	New supplemental water supply
	10,000		$4,715,000	$472	
Delivery of Recycled Water from WRCRWAP to IEUA(3)	2,000	$11,619,000	$999,000	$495	New supplemental water supply
	4,500		$1,193,000	$265	
CVWD ASR Wells	6,433	$25,844,000	$1,857,000	$289	Improves winter time recharge capacity and groundwater levels
JCSD ASR Wells(2)	3,228	$32,200,000	$2,222,000	$688	Improves winter time recharge capacity and groundwater levels
Ontario ASR Wells	5,020	$27,636,000	$1,949,000	$388	Improves winter time recharge capacity and groundwater levels
Turnout to San Sevaine Basin No. 1 from Azusa Devil Canyon (ADC) Pipeline	10,000	$7,112,000	$507,000	$51	Improves capacity to move imported water into the Chino Basin
Turnout to San Antonio Channel from ADC Pipeline	10,000	$2,636,000	$172,000	$17	Improves capacity to move imported water into the Chino Basin

Notes:

(1) These unit costs do not include the cost of the water supply.

(2) This estimated cost includes a 36,000-foot conveyance pipeline in addition to the wells.

(3) This estimated cost includes conveyance facilities to connect to the IEUA's system only and does not include an evaluation of the system compatibility or modifications to the treatment plants. A more detailed analysis of the treatment processes is recommended.

6.7.1 New Local Supplemental Water Sources

Two new sources of supplemental water were identified that could be used to reduce Watermaster's replenishment obligation and for replenishment supply. These two supplies include recycled water from the RIX Facility in Colton and from the WRCRWAP, which is located in the southern part of the Chino Basin. The project descriptions and the costs to connect these supplies to existing recycled water infrastructure are described below.

6.7.1.1 RIX Facility Connection to the IEUA's Recycled Water Distribution System

This concept includes the construction of a new connection from the RIX facility to the IEUA's recycled water distribution system in the vicinity of the RP3 Spreading Basins. The San Bernardino Regional Tertiary & Water Reclamation Authority (Authority) owns and operates the 40-mgd RIX facility, which is located on Agua Mansa Road within the City of Colton. The RIX plant treats secondary effluent from the Cities of San Bernardino and Colton to tertiary standards, using rapid infiltration followed by well extraction and disinfection, and ultimately discharges the treated effluent to the Santa Ana River. Based on discussions with San Bernardino Municipal Water Department (SBMWD) staff during the development of the RMPU, the SBMWD could sell up to 10,000 acre-ft/yr of recycled water for use in the Chino Basin. After review of the April 2010 B&V draft Technical Memorandum, the IEUA commented that they could not take 10,000 acre-ft/yr into their non-potable system due to physical and operational limitations; therefore, B&V reduced the capacity of this project to 4,400 acre-ft/yr. Should the IEUA's recycled water supply become insufficient in the out years or should additional capacity become available, the B&V proposed conveyance capacity would allow delivery of up to 10,000 acre-ft/yr.

A new pipeline and booster pump station would be constructed to connect the RIX facility to the IEUA recycled water distribution system. The pipeline would be approximately nine miles long and 24 inches in diameter. The connection would include a flowmeter, a check valve to prevent backflow, and isolation valves. A 1,500 horsepower booster pump station would also be required to overcome elevation changes and pipeline losses and to meet the hydraulics within the IEUA distribution system. The facilities are shown on Figure 6-6. The estimated capital cost to construct the facilities is about $52,604,000, and the annual cost[12] will range from about $4,123,000 with a delivery of 4,400 acre-ft/yr to about $4,715,000 with a delivery of 10,000 acre-ft/yr. The unit cost of building and operating this facility would range from about $937/acre-ft with a delivery of 4,400 acre-ft/yr to about $472/acre-ft with a delivery of 10,000 acre-ft/yr.

Coordination with the IEUA and the RWQCB will be necessary to develop new recycling and discharge permits and to develop and operate the project. A water sales agreement between the SBMWD, the IEUA, and perhaps other Chino Basin entities will have to be developed and executed.

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[12] Annual cost, as used herein, includes amortized capital (30-year term at 5 percent) plus annual O&M.

This project provides a completely new supplemental water supply to the Chino Basin. And, this water supply could be provided in constant amounts each year, thus reducing the impacts of highly variable imported water supplies from outside of the basin. Furthermore, the cost of this supply may be more predictable over time and may therefore contribute to more stable replenishment assessments.

6.7.1.2 WRCRWAP Connection to the IEUA's Recycled Water Distribution System

This concept includes the construction of a new connection from the WRCRWAP to the IEUA's recycled water distribution system. The Western Municipal Water District (WMWD) owns and operates the 8-mgd WRCRWAP, which is located on River Road within the City of Corona. Recent planning information suggests that the WRCRWAP capacity will be expanded to 16 mgd by 2020. The WRCRWAP treats secondary effluent from the City of Norco, the Jurupa Community Services District, and the Home Gardens Sanitary District to tertiary standards, and ultimately discharges the treated effluent to the Santa Ana River. This concept would provide up to 4,500 acre-ft/yr of recycled water to supplement the IEUA's supply for direct use and groundwater recharge. A new pipeline and booster pump station would be constructed to connect the WRCRWAP to the IEUA's recycled water distribution system. The pipeline would be approximately three miles long and 16 inches in diameter. The facilities would include metering and flow control, a check valve to prevent backflow, and isolation valves. A 500-horsepower booster pump station would be required to overcome elevation changes and pipeline losses and to meet the hydraulics within the IEUA distribution system. The facilities are shown in Figure 6-7.

Coordination with the IEUA and the RWQCB will be necessary to develop new recycling and discharge permits and to develop and operate the project. A water sales agreement between the WRCRWAP, the IEUA, and perhaps other Chino Basin entities will have to be developed and executed.

This project provides a completely new supplemental water supply to the Chino Basin. And, this supply could be provided in constant amounts each year, thus reducing the impacts of highly variable imported water supplies from outside of the Chino Basin. Furthermore, the cost of this supply may be more predictable over time and may therefore contribute to more stable replenishment assessments.

The estimated capital cost to construct the facilities is about $11,619,000, and the annual cost will range from about $999,000 with a delivery of 2,000 acre-ft/yr to about $1,193,000 with a delivery of 4,500 acre-ft/yr. The unit cost of building and operating this facility will range from about $495/acre-ft with a delivery of 2,000 acre-ft/yr to about $265/acre-ft with a delivery of 4,500 acre-ft/yr. Water acquisition costs are not included.

6.7.2 Increase in Supplemental Recharge Capacity

B&V identified three new ASR projects that could be used to increase the supplemental water recharge capacity of the Chino Basin, to provide Watermaster additional recharge capacity during the rainy season, and to provide Watermaster with another tool to balance recharge and discharge pursuant to the Peace Agreement. The project descriptions and costs for these ASR projects are described below.

6.7.2.1 Cucamonga Valley Water District (CVWD) Aquifer Storage and Recovery (ASR) Wells

This concept includes the construction and operation of several ASR wells within the CVWD service area. These facilities would be owned by the CVWD. This project fills two roles in the RMPU: it increases the supplemental water recharge capacity of the Chino Basin, and it reduces the groundwater level impacts of reoperation in the CVWD service area. In addition, it provides Watermaster with more wintertime recharge capacity when its recharge basins are being used to recharge stormwater.

To accomplish basin recharge, imported SWP water deliveries via Metropolitan's Rialto Pipeline to the CVWD's LMWTP would be increased when Watermaster takes water for replenishment. The additional treated water from the LMWTP would be conveyed through the CVWD service area, using existing CVWD infrastructure, to the ASR wells. This concept would require the conversion of up to three existing extraction wells to ASR wells and the construction of up to four new ASR wells. The new recharge capacity of this project is about 6,400 acre-ft/yr. The following table provides the proposed ASR well locations and assumed injection rates. The well locations are shown in Figure 6-8.

Well (1)	Location	Project Type	Assumed Injection Rate, gpm	Assumed Injection Capacity, acre-ft/yr(2)
CB-38	Southeast corner of Acacia Street and Archibald Avenue	ASR Conversion	750	605
CB-39	North of Woochase Court, west of East Avenue, and east of Interstate 15	ASR Conversion	1,275	1,028
CB-46	Utica Avenue, south of 7th Street	ASR Conversion	1,700	1,371
ASR 1	West of Day Creek, south of Foothill Boulevard, and east of Rochester Avenue	New ASR Well	1,250	1,008
ASR 2	West of Day Creek, south of Foothill Boulevard, and east of Rochester Avenue	New ASR Well	1,000	807
ASR 3 (48)	West Liberty Parkway and Miller Avenue	New ASR Well	1,000	807
ASR 4 (47)	East of Etiwanda between Highland Avenue and Carnesi Drive	New ASR Well	1,000	807
		TOTAL	**7,975**	**6,433**

Notes:
(1) Well locations determined via conversations between WEI and CVWD staff.
(2) Assumes injection over a six-month period.

The estimated capital cost to construct the facilities is about $25,844,000, and the annual cost is about $999,000/yr. The unit cost of building and operating this facility is estimated to be about $289/acre-ft with a recharge capacity of 6,400 acre-ft/yr. Water acquisition costs are not included in the above cost.

6.7.2.2 Jurupa Community Services District (JCSD) Aquifer Storage and Recovery (ASR) Wells

This concept includes the use of several ASR wells owned and operated by the JCSD. Treated water from WMWD's future Riverside-Corona (RC) Feeder Central Reach would be conveyed to the ASR wells for injection into the Chino Basin. This project fills two roles in the Recharge Master Plan: it increases the supplemental water recharge capacity of the basin, and it reduces the groundwater level impacts of reoperation in the JCSD service area. In addition, it provides Watermaster with more wintertime recharge capacity when its recharge basins are being used to recharge stormwater.

This concept includes the conversion of up to four extraction wells to ASR wells and the construction of a new pipeline connecting the RC Feeder to the ASR wells or the use of these facilities if constructed by others. As of the time this report was drafted, the extraction wells had not been constructed; it has been assumed that they will be constructed and available for ASR well conversion in the future. The wells would be located within the JCSD's service area near the intersection of Interstate 15 and State Route 60. This project could recharge about 3,200 acre-ft/yr. The following table provides the ASR well locations and assumed injection rates. The well locations are shown in Figure 6-9.

Well[(1)]	**Location**	**Project Type**	**Assumed Injection Rate, gpm**	**Assumed Injection Capacity, acre-ft/yr[(2)]**
IDI-3A	Wineville Avenue 2,000 feet south of Riverside Drive	ASR Conversion	1,000	807
IDI-5A	Northeast corner of Interstate 15 and Cantu-Galleano Ranch Road	ASR Conversion	1,000	807
Oda	Northwest corner of Riverside Drive and 280 feet west of Wineville Avenue	ASR Conversion	1,000	807
Galleano	2,700 feet west of the intersection of Etiwanda Avenue and San Sevaine Way	ASR Conversion	1,000	807
		TOTAL	**4,000**	**3,228**

Notes:
(1) Well locations determined via conversations between WEI and JCSD staff.
(2) Assumes injection over a six-month period.

The new pipeline would be approximately 36,000 feet long and 30 inches in diameter and would include a metering and flow control facility at its connection to the RC Feeder. The turnout vault would contain a flowmeter, isolation valves, and a check valve to prevent backflow.

The estimated capital cost to construct the facilities is about $32,200,000, and the annual cost is about $2,222,000/yr. The unit cost of building and operating this facility is estimated to be about $688/acre-ft with a recharge capacity of 3,200 acre-ft/yr. Water acquisition costs are not included in the above cost.

6.7.2.3 City of Ontario Aquifer Storage and Recovery (ASR) Wells

This concept includes construction of up to five new ASR wells and the conversion of one existing extraction well to an ASR well. These facilities would be owned and operated by the City of Ontario. This project fills two roles in the Recharge Master Plan: it increases the supplemental water recharge capacity of the Basin, and it reduces the groundwater level impacts of reoperation in the City of Ontario service area. In addition, it provides Watermaster with more wintertime recharge capacity when its recharge basins are being used to recharge stormwater.

Imported water is currently conveyed to the Ontario distribution system via the WFA Agua de Lejos WTP, which currently serves the Cities of Ontario, Upland, Chino, and Chino Hills, and the Monte Vista Water District. The WTP, which is located on Benson Avenue in the City of Upland, has unused capacity during the winter months and could be used to treat surplus imported water for distribution throughout the Ontario service area, thereby allowing injection at the ASR wells. Another source for treated imported water would be the CVWD's Lloyd Michael WTP, which is located on Etiwanda Avenue in Rancho Cucamonga. This variant would be dependent on the construction of a connection between the Ontario distribution system and the CVWD's existing 30-inch transmission main that runs along Rochester Avenue.

For this project, it was assumed that one of the above options would be feasible and that only the construction of ASR wells would be required. The following table provides the ASR well locations and assumed injection rates. The well locations are shown in Figure 6-10.

Well (1)	Location	Project Type	Assumed Injection Rate, gpm	Assumed Injection Capacity, acre-ft/yr(2)
No. 27	South of Jurupa Street and east of Milliken Avenue	ASR Conversion	550	444
No. 51	West of Carnegie Avenue and Santa Ana Street	New ASR Well	800	645
No. 106	Southwest corner of Milliken Avenue and Chino Avenue	New ASR Well	1,250	1,008
No. 109	South of East G Street and west of Corona Avenue	New ASR Well	1,250	1,008
No. 119	South of East State Street and west of South Grove Avenue	New ASR Well	1,250	1,008
No. 138	North of 8th Street and east of Campus Avenue	New ASR Well	1,125	907
		TOTAL	**6,225**	**5,020**

Notes:
(1) Well locations determined via conversation between WEI and City of Ontario staff.
(2) Assumes injection over a six-month period.

The estimated capital cost to construct the facilities is about $27,636,000, and the annual cost is about $1,949,000/yr. The unit cost of building and operating this facility is estimated to be about $388/acre-ft with a recharge capacity of 5,000 acre-ft/yr. Water acquisition costs are not included in the above cost.

6.7.2.4 Current Need for ASR Wells for Replenishment

In the recent *2009 Production Optimization and Evaluation of the Peace II Project Description* (WEI, 2009b), the CVWD's and the City of Ontario's proposed ASR wells were not included in the groundwater simulations of the Peace II project description because their production was projected to be sustainable through 2030. The JCSD ASR wells have been included in the RMPU due to the projected need for supplemental water recharge in the JCSD well field area to sustain production. It would be substantially more cost-effective for the JCSD and Watermaster to conduct in-lieu recharge in the JCSD area than it would be to construct ASR facilities: the same magnitude of recharge could occur with in-lieu as with ASR wells. Watermaster could conduct in-lieu recharge with the CVWD and the City of Ontario to increase groundwater levels in their service areas instead of spreading imported water in the existing basins.

6.7.3 Increase in Supplemental Water Delivery Capacity

B&V also investigated the potential to increase the delivery capacity of supplemental water to the Chino Basin through new spreading basin turnouts. Recall that there is a turnout capacity limitation for the San Sevaine spreading grounds and that there may be times during the summer when the Rialto Pipeline is full, making firm water deliveries, and not available for delivering water to Watermaster for replenishment purposes. The project descriptions and costs for these new turnout projects are described below.

6.7.3.1 Turnout to San Sevaine Basin No. 1 via the Azusa Devil Canyon (ADC) or Etiwanda Pipelines

This concept includes the construction of a new turnout on either the ADC pipeline or the Etiwanda pipeline. The SGVMWD and Metropolitan own and operate the ADC and Etiwanda pipelines, respectively. Both pipelines convey SWP water from Silverwood Lake to the Districts' respective service areas. Water from either the ADC pipeline or the Etiwanda pipeline would be diverted north to San Sevaine Recharge Basin No. 1 through a turnout, metering structure, and conveyance pipeline. The proposed facilities are shown in Figure 6-11. A new pipeline would be constructed, connecting the selected supply pipeline near the intersection of Cherry Avenue and South Highland Avenue to San Sevaine Basin No. 1. At this location, the ADC and Etiwanda pipelines run parallel in close proximity to each other, and connection to either pipeline would require approximately the same length of new pipe. The pipeline would be approximately 6,000 feet long and 36 inches in diameter and would include a flow control and air gap structure at the connection to San Sevaine Basin No. 1. The turnout vault would contain a flowmeter to accurately measure flow to the basin, a fixed orifice sleeve to reduce pressure head, and a check valve to prevent backflow.

The ADC pipeline has a capacity of 55 cfs (39,800 AFY), which would only be available during three winter months when the SGVMWD has met the delivery requirements of its service area. Therefore, the maximum assumed capacity of this concept, for the purposes of the RMPU, would be approximately 10,000 AFY (assuming a delivery of 55 cfs for three months, uninterrupted). Selection of the supply pipeline (ADC or Etiwanda pipeline) would be determined by the available capacity during the design phase of the project.

The project would recharge Management Zone 2 and would benefit the southern CVWD service area, the northeastern Ontario service area, and the western end of the Fontana Water Company service area. This project fills two roles in the Recharge Master Plan: it increases the delivery capacity of imported water to the spreading basins on San Sevaine Creek where the recharge capacity is limited by the existing turnouts, CB-13 and CB-18, and it provides a redundant means to deliver water to the spreading basins on San Sevaine Creek. This project increases supplemental water recharge capacity by 10,000 acre-ft/yr and improves the reliability of this part of the recharge system.

The estimated capital cost to construct the facilities is about $7,712,000, and the annual cost is about $507,000/yr. The unit cost of building and operating this facility is estimated to be about $51/acre-ft with a recharge capacity of 10,000 acre-ft/yr. Water acquisition costs are not included in the above cost.

6.7.3.2 Turnout to San Antonio Channel via the Azusa Devil Canyon (ADC) Pipeline

This concept includes the construction of a new turnout along the ADC pipeline. The SGVMWD owns and operates the ADC pipeline, which conveys SWP water from Silverwood Lake to its retail agencies. Water from the ADC pipeline would be diverted to the San Antonio Channel through a turnout and metering structure and flow south to several Chino Basin recharge facilities, including the College Heights, Upland, Montclair, and Brooks Basins. The proposed facilities are shown in Figure 6-12. The project would recharge MZ1 and would benefit the service areas of the MVWD, the San Antonio Water Company, and the Cities of Upland, Ontario, Chino, and Chino Hills. A new pipeline would be constructed, connecting the ADC pipeline on West 16th Street to the San Antonio Channel. The pipeline would be approximately 800 feet long and 36 inches in diameter and would include a flow control and air gap structure at its connection to the channel. The turnout vault would contain a flowmeter, a fixed orifice sleeve to reduce pressure head, and a check valve to prevent backflow. The water would then enter an air gap structure to ensure that stormwater from the channel would not enter into the turnout vault during high flow events and to maintain a constant discharge head from the turnout. From this structure, a connection would be made to the San Antonio Channel and a flap gate would be installed to further prevent backflow and to protect the conveyance facility from debris. Within the channel, energy dissipation head walls may be constructed instead of the fixed sleeve as a barrier from high velocity streams exiting the structure. Coordination with the Army Corps of Engineers would be necessary to ensure compliance with all codes and standards.

The ADC pipeline has a capacity of 55 cfs (39,000 acre-ft/yr) and would only be available during the winter months after the SGVMWD has met the delivery requirements of its service area. The assumed capacity of this concept for the purposes of the RMPU is approximately 10,000 acre-ft/yr.

This project fills two roles in the RMPU: it increases the delivery capacity of imported water to the spreading basins on San Antonio Creek, and it provides a redundant means to deliver water to spreading basins on San Antonio Creek. Moreover, this project increases the supplemental water recharge capacity and improves the reliability of this part of the recharge system. The estimated capital cost to construct the facilities summarized herein is about $2,636,000, and the annual cost, including O&M, is about $172,000.

6.8 Master Plan Implementation Items

Section 6.2 presented Watermaster's replenishment and recharge requirements over the period of 2010 to 2035. Watermaster is projected to require about 710,000 acre-ft of imported water to meet its replenishment and recharge obligations over this period. Most of the replenishment requirement will occur in the second half of this period. Preemptive replenishment will be required to control the CURO. At the September 2009 Watermaster Strategic Planning meeting, the Watermaster parties agreed to support preemptive replenishment and to purchase enough imported water to meet its recharge and replenishment obligations.

Section 6.3 presented a rigorous analysis of the supplemental water recharge capacity in the Chino Basin. The supplemental water recharge capacity of the existing spreading basins is about 99,000 acre-ft/yr but is limited to about 83,100 acre-ft/yr due to turnout limitations on the Rialto Pipeline. Existing ASR capacity for supplemental water recharge is about 5,600 acre-ft/yr. The total wet-water recharge capacity is 88,700 acre-ft yr. With preemptive replenishment, Watermaster has enough wet-water recharge capacity to meet its projected recharge and replenishment obligations. In-lieu recharge capacity ranges from about 25,000 to 40,000 acre-ft/yr. In-lieu recharge can be used to improve the balance of recharge and discharge in the basin. The total supplemental water recharge capacity ranges from 113,700 to 128,700 acre-ft yr.

Section 6.4 describes the existing or traditional sources of supplemental water available to the Watermaster for recharge, including imported water from Metropolitan and recycled water from the IEUA. CRA water from Metropolitan is not used for recharge in the Chino Basin due to its high TDS. In fact, the 2004 Basin Plan amendment requires that Watermaster and the IEUA recharge SWP water when its TDS is lowest. SWP water from Metropolitan has become less reliable and more expensive. Due to recent Federal Court rulings, Article 21 water has essentially disappeared, which is the type of SWP water that Metropolitan has traditionally used for replenishment service. Other issues, such as drought and Delta levee reliability, exacerbate the reliability challenge. On the positive side, the IEUA has been very successful in its recycled water recharge program. The recharge of recycled water increases the production rights of several of the appropriator parties and reduces the demand for supplemental water for replenishment.

Section 6.5 discusses other supplemental water supplies that Watermaster could use in addition to Metropolitan and IEUA supplies. These nontraditional supplies include groundwater and surface water supplies from the Central Valley, groundwater from the Antelope Valley, groundwater and surface water supplies from the Colorado River Basin, and groundwater and surface water supplies in the Santa Ana Watershed, including a surface water diversion from the Santa Ana River located between the Riverside Narrows and the upstream limits of the Prado Reservoir. The issues related to acquiring these supplies is described in this Section and in more detail in Appendix D. Section 6.5 also discusses recycled water from RIX in Colton, from the City of Riverside, and from the WRCRWAP.

Section 6.6 contains recommendations regarding future supplemental supplies to meet Watermaster's recharge obligation: Watermaster will acquire supplemental water for recharge when it is available and in a manner that will limit the CURO to no more than 100,000 acre-ft. Watermaster will maximize its purchase of water from Metropolitan prior to looking at other imported water sources from outside the Santa Ana River Watershed. Watermaster will attempt to develop local projects—including stormwater recharge and potentially the acquisition of non-IEUA recycled water—to minimize the purchase of highly variable and unreliable imported supplies.

Section 6.7 contains descriptions of the three types of projects that either increase supplemental recharge capacity or supply, including improvements to turnouts from the Rialto or ADC pipelines (increase recharge capacity and reliability); the expansion of ASR capacity in the CVWD, JCSD, and Ontario service areas (increase recharge capacity, reliability, and improve the balance of recharge and discharge); and the importation of recycled water into the Chino Basin for direct recharge and to replace groundwater production (increase supplemental water supply and reliability). Given the groundwater production projections described in Section 4, there is no pressing need as of 2010 for the CBWCD, Watermaster, or the IEUA to implement any of the projects described in this section.

The conclusions and recommendations developed from this analysis are provided below.

1. Watermaster needs to acquire supplemental water to meet its replenishment and Peace Agreement obligations and the dilution requirements for the recharge of recycled water. These sources will include unused production rights from members of the Appropriative Pool, imported water from Metropolitan, and, if necessary, other non-Metropolitan imported water.

2. Because of the environmental and legal challenges involved in importing water from the Sacramento and San Joaquin Delta and the Colorado River, Watermaster should consider preemptive replenishment. Preemptive replenishment would limit the CURO to a sustainable level. Under such a scheme, Watermaster would estimate replenishment obligations for some future period, purchase supplemental water when available in advance of a replenishment obligation, bank that water in

the Chino Basin, and use that water for subsequent replenishment. Watermaster would revise the replenishment projection every year based on planning information provided by the parties and actual overproduction and replenishment. Watermaster should set an upper limit on the CURO and use this limit with the replenishment projections to guide its water acquisition activities.

3. Watermaster, upon reviewing the 2010 UWMPs and supply projections from Metropolitan, should make a determination of the need for non-Metropolitan imported water. This review should take place between July 2011 and December 2011, and this RMPU should be updated in January 2012.

4. If a need for non-Metropolitan imported water is determined, Watermaster should take action to acquire that water. Watermaster should go through this process at the conclusion of each UWMP report period or more frequently if statewide water supply conditions change significantly from those assumed in the then current RMPU. Potential sources of non-Metropolitan imported water are summarized in Section 6.5 of this RMPU and include: groundwater and surface water supplies from the Central Valley, conveyed to the Chino Basin through SWP and Metropolitan facilities; groundwater from the Antelope Valley, conveyed to the Chino Basin through SWP and Metropolitan facilities; groundwater and surface water supplies from the Colorado River Basin, conveyed to the Chino Basin through Metropolitan facilities; groundwater and surface water supplies in the Santa Ana Watershed that can be supplied to the Chino Basin directly or by exchange; and recycled water from RIX and the WRCRWAP. The importation of non-Metropolitan water is a very complex and expensive proposition—the planning of which is beyond the scope of this RMPU. The process to acquire and move imported water from the Central Valley is described in Appendix D, *Sierra Water Group Task Report for Supplemental Water Sources* (SWG, 2010).

5. Under the 2008 IEUA/Watermaster groundwater production projection, Watermaster will need to begin preemptive replenishment to manage the CURO to less than 100,000 acre-ft and to meet the MZ1 6,500 acre-ft/yr requirement. Significant replenishment water acquisition will be necessary after 2014/15—about five years from now.

6. No new recharge facilities will be required to meet Watermaster's replenishment obligations through the planning period, provided that the Riverside Corona Feeder is completed within the next ten years. The Riverside Corona Feeder could supply treated SWP water to the JCSD in lieu of groundwater production, which would achieve replenishment and improve the balance of recharge and discharge in the JCSD area. Watermaster should monitor the progress of the Riverside Corona Feeder and adjust future RMPUs to reflect its efficacy.

7. Provided that the Parties construct ASR wells for their own use, Watermaster should consider the use of these wells for replenishment purposes to achieve an improved balance of recharge and discharge in the specific areas identified in the

2009 Production Optimization and Evaluation of the Peace II Project Description (WEI, 2009b). Specifically, this ASR replenishment should be targeted in the Pomona-MVWD production depression area and the Ontario-CVWD production depression area. Currently, the MVWD has four ASR wells that could be used for this purpose, and the CVWD and Ontario have plans to eventually construct ASR wells.

8. Watermaster should use in-lieu recharge to achieve an improved balance of recharge and discharge in the specific areas identified in the *2009 Production Optimization and Evaluation of the Peace II Project Description* (WEI, 2009b), including the MZ1 managed area, the Pomona-MVWD production depression area, the JCSD well field area, and the Ontario-CVWD production depression area.

Table 6-1

Projected Watermaster Recharge Obligation and an Example of Meeting the Recharge Obligation with Temporally Variable Supplemental Water Supplies and Preemptive Replenishment[1]

(acre-ft)

Year	Watermaster Recharge Requirements				Example Watermaster Recharge Plan					Cumulative Unmet Replenishment Obligation[2]
	MZ1 Recharge Requirement	Net Replenishment Obligation	Total Recharge Obligation	Cumulative Recharge Obligation	Unproduced Production Rights	MZ1 Recharge[3]	Replenishment Obligation	Total Recharge	Cumulative Recharge	
2009 - 2010	6,500	0	6,500	6,500	36,199	5,000	0	41,199	41,199	-24,699
2010 - 2011	6,500	0	6,500	13,000	30,717	0	0	30,717	71,916	-48,916
2011 - 2012	6,500	0	6,500	19,500	27,077	0	0	27,077	98,994	-69,494
2012 - 2013	6,500	0	6,500	26,000	0	12,070	0	12,070	111,064	-75,064
2013 - 2014	6,500	2,794	9,294	35,294	0	12,070	0	12,070	123,134	-77,840
2014 - 2015	6,500	9,710	16,210	51,504	0	12,070	0	12,070	135,204	-73,699
2015 - 2016	6,500	8,420	14,920	66,424	0	12,070	0	12,070	147,274	-70,849
2016 - 2017	6,500	7,649	14,149	80,574	0	12,070	0	12,070	159,344	-68,770
2017 - 2018	6,500	12,675	19,175	99,748	0	12,070	0	12,070	171,414	-61,665
2018 - 2019	6,500	13,072	19,572	119,321	0	0	0	0	171,414	-42,093
2019 - 2020	6,500	13,782	20,282	139,602	0	0	0	0	171,414	-21,812
2020 - 2021	6,500	17,154	23,654	163,257	0	0	0	0	171,414	1,843
2021 - 2022	6,500	20,412	26,912	190,169	0	0	0	0	171,414	28,755
2022 - 2023	6,500	23,727	30,227	220,396	0	12,070	42,000	54,070	225,484	4,913
2023 - 2024	6,500	27,218	33,718	254,115	0	12,070	42,000	54,070	279,554	-15,439
2024 - 2025	6,500	30,858	37,358	291,473	0	12,070	42,000	54,070	333,624	-32,151
2025 - 2026	6,500	33,841	40,341	331,813	0	12,070	42,000	54,070	387,694	-45,880
2026 - 2027	6,500	36,766	43,266	375,079	0	12,070	42,000	54,070	441,764	-56,684
2027 - 2028	6,500	39,520	46,020	421,099	0	12,070	42,000	54,070	495,834	-64,734
2028 - 2029	6,500	42,114	48,614	469,713	0	0	0	0	495,834	-16,120
2029 - 2030	6,500	44,504	51,004	520,717	0	0	0	0	495,834	34,884
2030 - 2031	6,500	54,704	61,204	581,921	0	0	0	0	495,834	96,088
2031 - 2032	6,500	54,904	61,404	643,325	0	6,500	70,000	76,500	572,334	80,991
2032 - 2033	6,500	55,104	61,604	704,929	0	6,500	70,000	76,500	648,834	66,095
2033 - 2034	6,500	55,304	61,804	766,733	0	6,500	70,000	76,500	725,334	51,399
2034 - 2035	6,500	55,504	62,004	828,737	0	6,500	70,000	76,500	801,834	36,903
Totals	169,000	659,737	828,737		93,994	175,840	532,000	801,834		

1 -- Recharge requirements from Table 4-2

2 -- Assumes starting CURO is +10,000 acre-ft. Assumes unproduced appropriator rights are banked and eventually used to offset Watermaster's replenishment obligation.

3 -- Projected actual delivery for 2009-10.

Table 6-2
Calculation of the Availability of Spreading Basins for Supplemental Water Recharge
Based on Precipitation Records at the Montclair/Claremont Gage Composite (1034 and 1137)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Days with Precipitation													
Mean	5.06	4.91	5.02	3.02	1.27	0.32	0.17	0.19	0.59	1.51	2.50	3.68	28.23
Standard Deviation	3.71	3.33	3.54	2.37	1.45	0.58	0.40	0.48	1.06	1.50	2.04	2.69	9.35
Mean+Standard Deviation	8.77	8.24	8.56	5.39	2.72	0.90	0.57	0.68	1.65	3.01	4.54	6.37	37.58
Coefficient of Variation	73%	68%	71%	79%	114%	178%	239%	248%	179%	99%	82%	73%	33%
Skew	0.83	0.31	0.60	0.91	1.76	1.91	2.26	2.51	2.13	1.27	0.83	0.72	0.48
Number of Precipitation Events													
Mean	2.85	2.54	2.95	2.10	0.94	0.31	0.17	0.19	0.45	1.14	1.76	2.44	17.83
Standard Deviation	1.74	1.49	1.72	1.50	0.92	0.52	0.40	0.48	0.75	1.04	1.26	1.55	4.68
Mean+Standard Deviation	4.59	4.03	4.67	3.60	1.86	0.83	0.57	0.66	1.21	2.18	3.02	4.00	22.52
Coefficient of Variation	61%	59%	58%	71%	98%	170%	239%	257%	166%	91%	72%	64%	26%
Skew	0.42	0.29	0.29	0.69	0.79	1.45	2.26	2.62	1.83	1.00	0.55	0.23	0.33
Number of Days per Event													
Mean	1.77	1.93	1.70	1.44	1.36	1.06	1.00	1.05	1.31	1.33	1.42	1.50	1.58
Mean+Standard Deviation	1.91	2.04	1.83	1.50	1.47	1.09	1.00	1.02	1.37	1.38	1.50	1.59	1.67
Precipitation per Month (in inches)													
Mean	3.70	3.77	3.22	1.40	0.48	0.11	0.03	0.08	0.30	0.67	1.52	2.53	17.80
Standard Deviation	3.60	3.54	2.95	1.46	0.88	0.35	0.07	0.29	0.77	1.10	1.81	2.45	7.69
Mean+Standard Deviation	7.30	7.31	6.17	2.86	1.36	0.46	0.09	0.37	1.07	1.77	3.32	4.98	25.49
Coefficient of Variation	97%	94%	92%	104%	184%	323%	260%	358%	262%	163%	119%	97%	43%
Skew	1.44	1.16	1.22	1.96	3.06	6.42	3.69	5.79	3.92	3.75	2.29	1.16	0.57
Basin Availability													
Mean (days)													
Drawdown	3	3	3	3	1	1	1	1	1	2	2	3	18
Event	6	5	6	4	2	1	1	1	1	2	3	4	29
Total	9	8	9	7	3	2	2	2	2	4	5	7	47
Availability (fraction of the month)	0.71	0.71	0.71	0.77	0.90	0.93	0.94	0.94	0.93	0.87	0.83	0.77	0.87
Mean+Standard Deviation (days)													
Drawdown	5	5	5	4	2	1	1	1	2	3	4	4	23
Event	9	9	9	6	3	1	1	1	2	4	5	7	38
Total	14	14	14	10	5	2	2	2	4	7	9	11	61
Availability (fraction of the Month)	0.55	0.50	0.55	0.67	0.84	0.93	0.94	0.94	0.87	0.77	0.70	0.65	0.83

Table 6-3
Supplemental Water Recharge Capacity Estimates[1]

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	Supplemental Water Recharge																						
Basin	Operational Availability for Supplemental Water Recharge												Average Recharge Rate[2]	Supplemental Water Recharge Capacity	Turn Out Capacity				Theoretical Maximum Imported Water Recharge Capacity				
	Quarter 3			Quarter 4			Quarter 1			Quarter 2					Turn Out Name	Max Discharge Rate	Useful Discharge Rate	Turn Out Limited[3]?	Annual	Q3	Q4	Q1	Q2
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(cfs)	(acre-ft/yr)		(cfs)	(cfs)		(acre-ft/Qtr)				
Brooks Street Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474	OC59	300	300	No	2,474	652	794	281	746
College Heights Basins	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	15	7,421				No	7,421	1,957	2,383	843	2,238
Montclair Basin 1	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	40	19,789				No	19,789	5,219	6,355	2,247	5,968
Montclair Basin 2	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
Montclair Basin 3	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
Montclair Basin 4	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
Seventh and Eighth Street Basins	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474	CB20	30	*30*	No	2,474	652	794	281	746
Upland Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	20	9,895	OC59	80	80	No	9,895	2,610	3,177	1,124	2,984
Subtotal Management Zone 1														***42,052***					***42,052***	***11,091***	***13,504***	***4,775***	***12,682***
Ely Basins	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474	CB20	30	*30*	No	2,474	652	794	281	746
Etiwanda Spreading Area (Joint Use of Etiwanda Debris Basin)	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	7	3,463	CB14	30	*30*	No	3,463	913	1,112	393	1,044
Hickory Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474	CB18	30	30	Yes	2,061	544	662	234	622
Lower Day Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	9	4,453	CB15	30	20	No	4,453	1,174	1,430	506	1,343
San Sevaine No. 1	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	50	24,736	CB13	30	23	Yes	11,379	3,001	3,654	1,292	3,432
San Sevaine No. 2	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
San Sevaine No. 3	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
San Sevaine Nos. 4 and 5	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
Turner Basins Nos. 1 and 2	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	3	1,484	CB11	40	9	No	1,484	391	477	169	448
Turner Basins Nos. 3 and 4	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77											
Victoria Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	6	2,968	CB14	30	*30*	No	2,968	783	953	337	895
Subtotal Management Zone 2														***42,052***					***28,282***	***7,459***	***9,082***	***3,211***	***8,529***
Banana Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	2,474	CB18	30	30	Yes	2,061	544	662	234	622
Declez Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	6	2,968					2,474	652	794	281	746
IEUA RP3 Ponds	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	20	9,895					8,245	2,175	2,648	936	2,487
Subtotal Management Zone 3														***15,337***					***12,780***	***3,371***	***4,104***	***1,451***	***3,854***
Total														**99,440**					**83,114**	**21,920**	**26,690**	**9,438**	**25,066**

1 -- Historical recharge estimates provided by IEUA. Recharge basins not optimized for storm water recharge; actual recharge performance could be improved.
2 -- Per Andy Campbell of IEUA, August 2007
3 -- Turn Out Capacity for the San Sevaine Basins is 30 cfs but is limited to 23 cfs due to operational considerations on the Rialto Feeder; 23 cfs assumed.

Figure 6-1
Projected Recharge Obligation Pursuant to the Judgment and the Peace Agreement

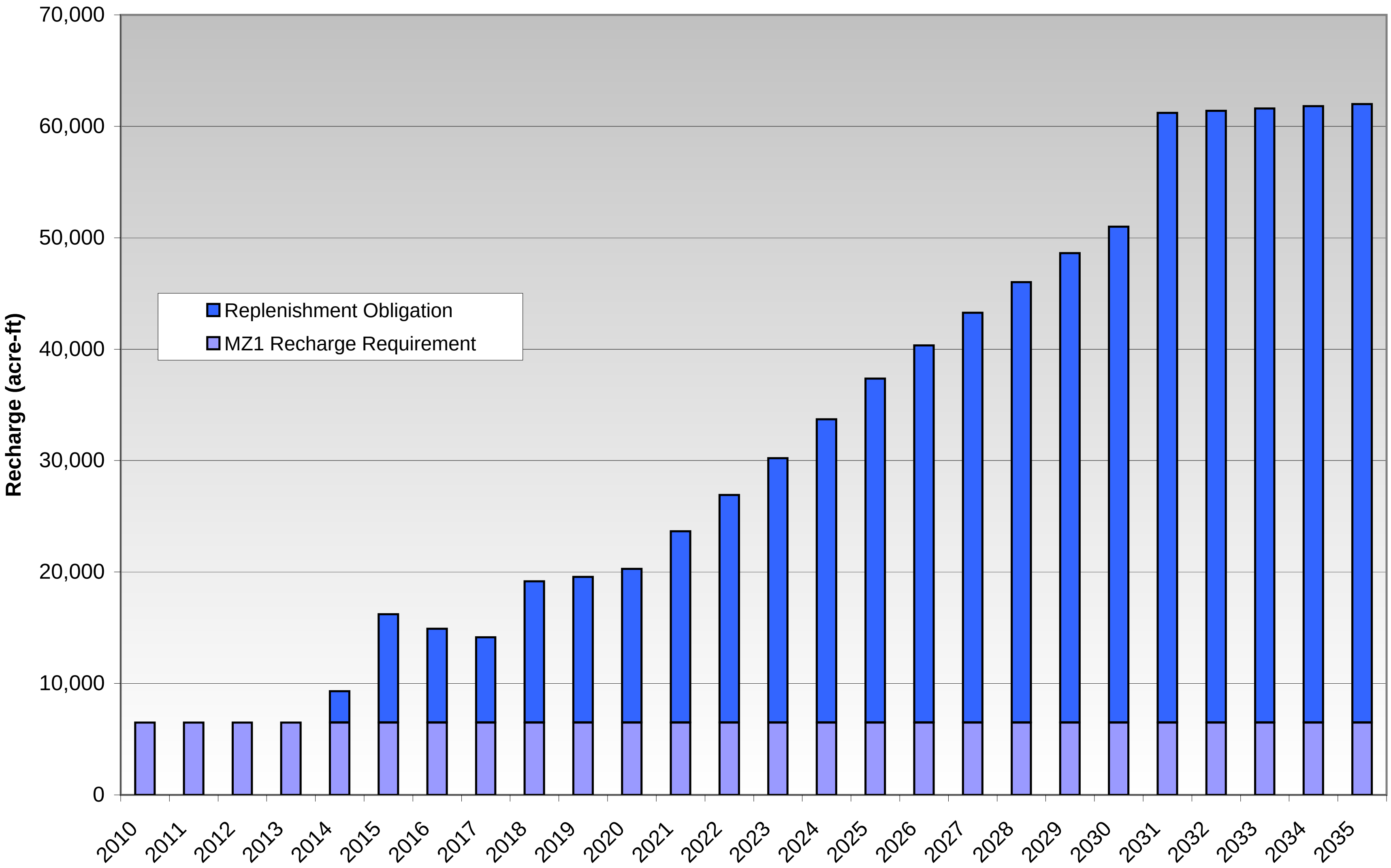
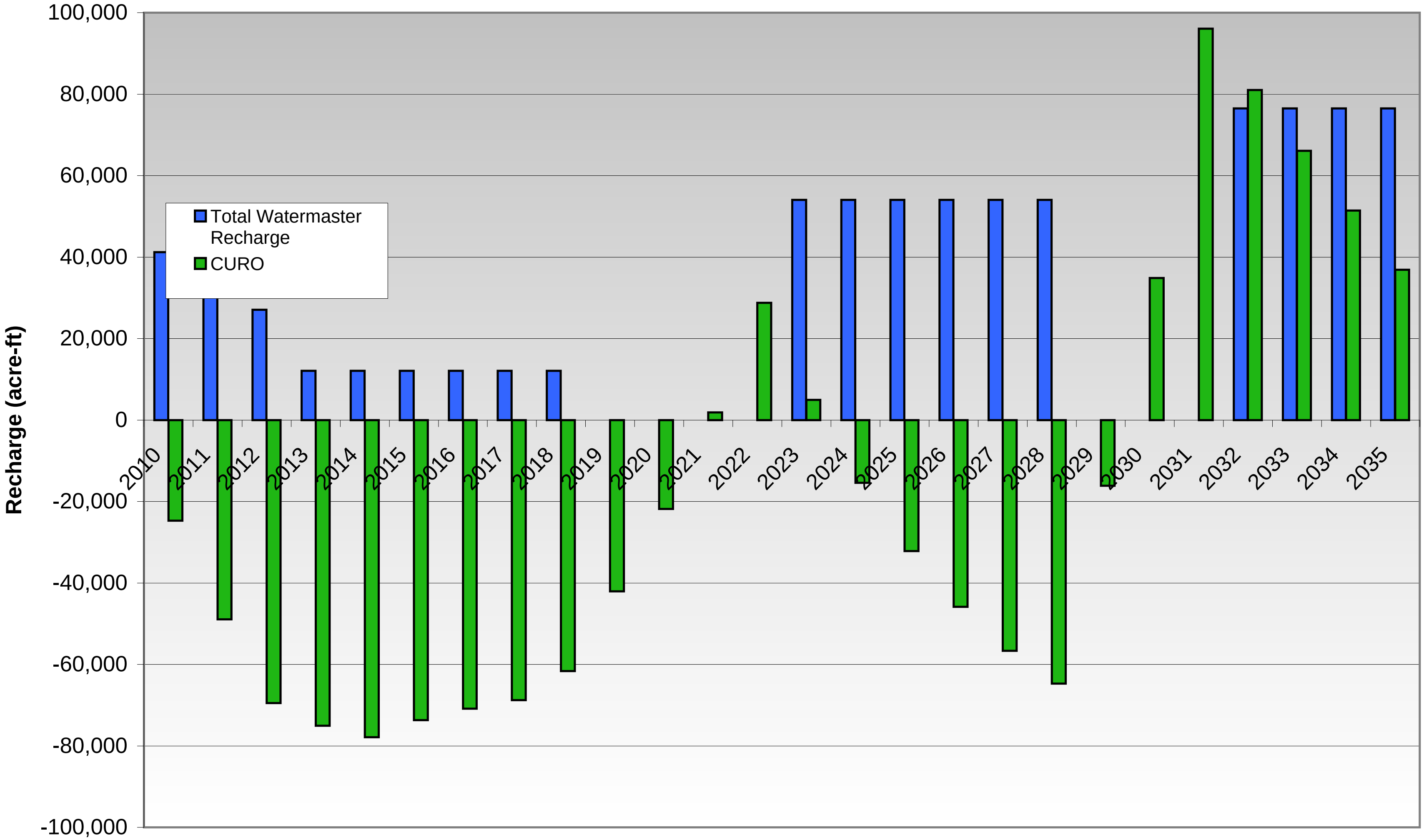
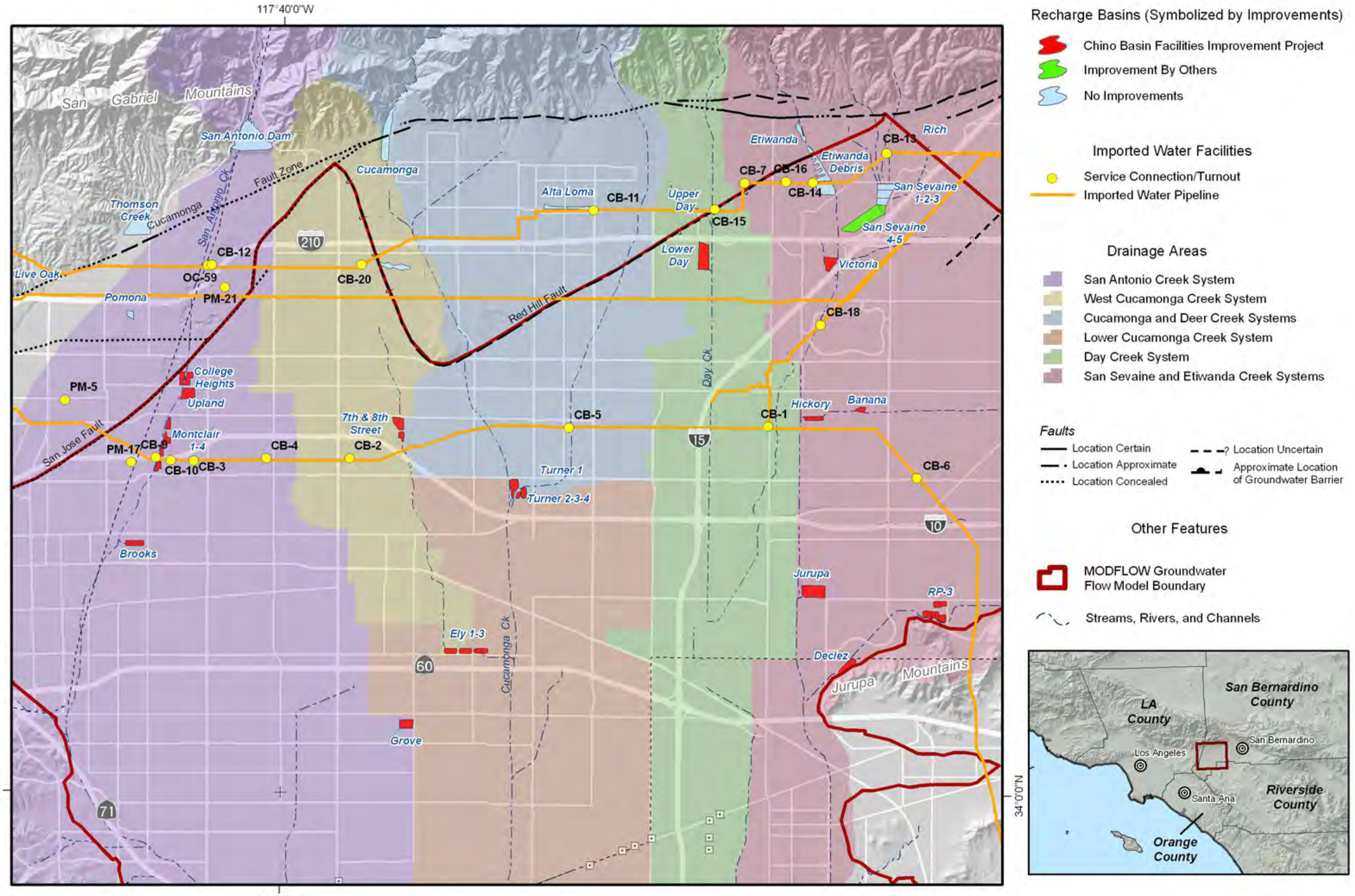


Figure 6-2

Example of a Future Watermaster Recharge Scenario with Temporally Variable Supplemental Water Supplies and Preemptive Replenishment





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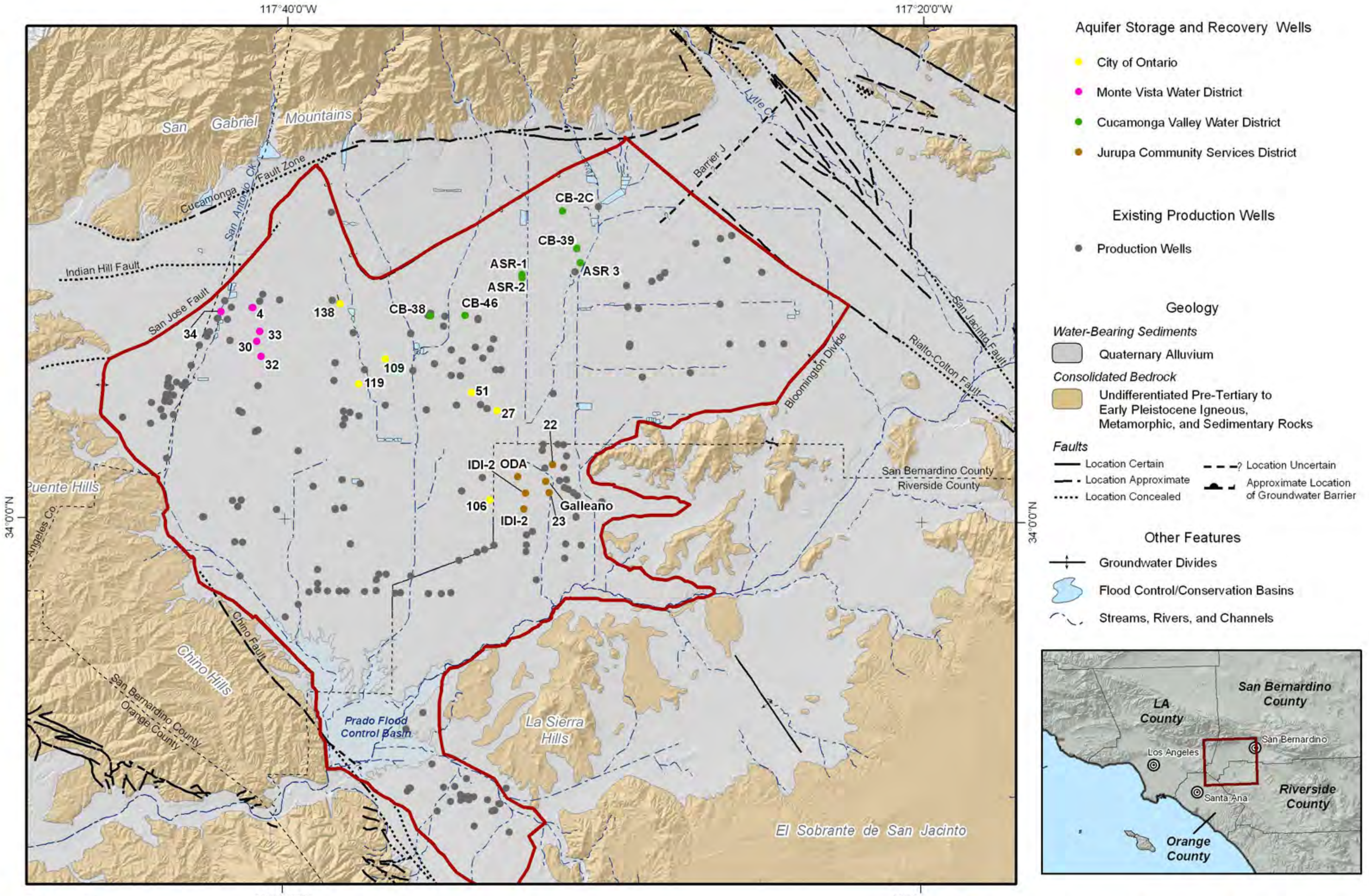
0 1 2 Miles
0 2 4 KM

2010 Recharge Master Plan Update

Groundwater Recharge and Imported Water Facilities

Figure 6-3



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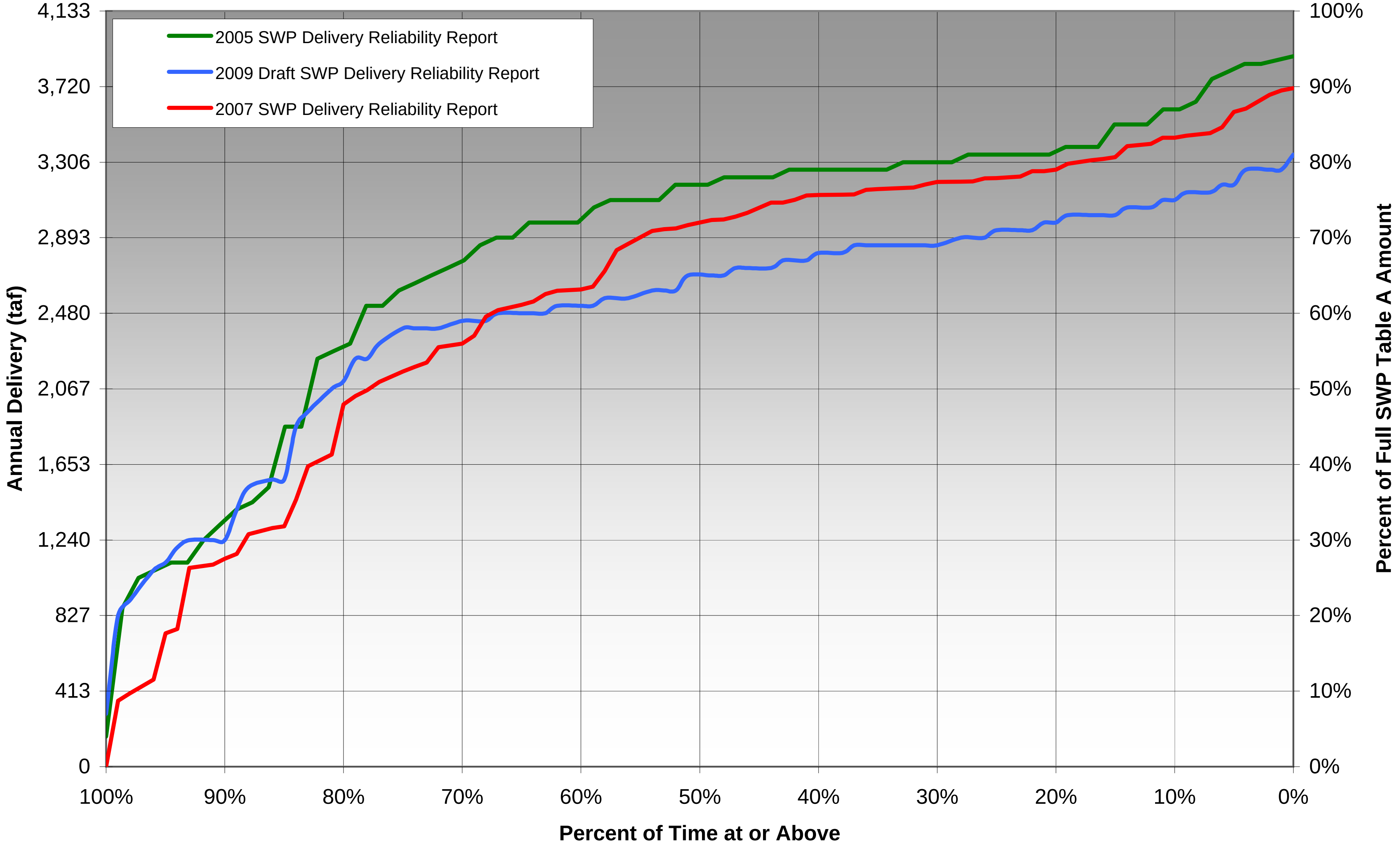
2010 Recharge Master Plan Update

Existing and Proposed Aquifer Storage and Recovery Wells

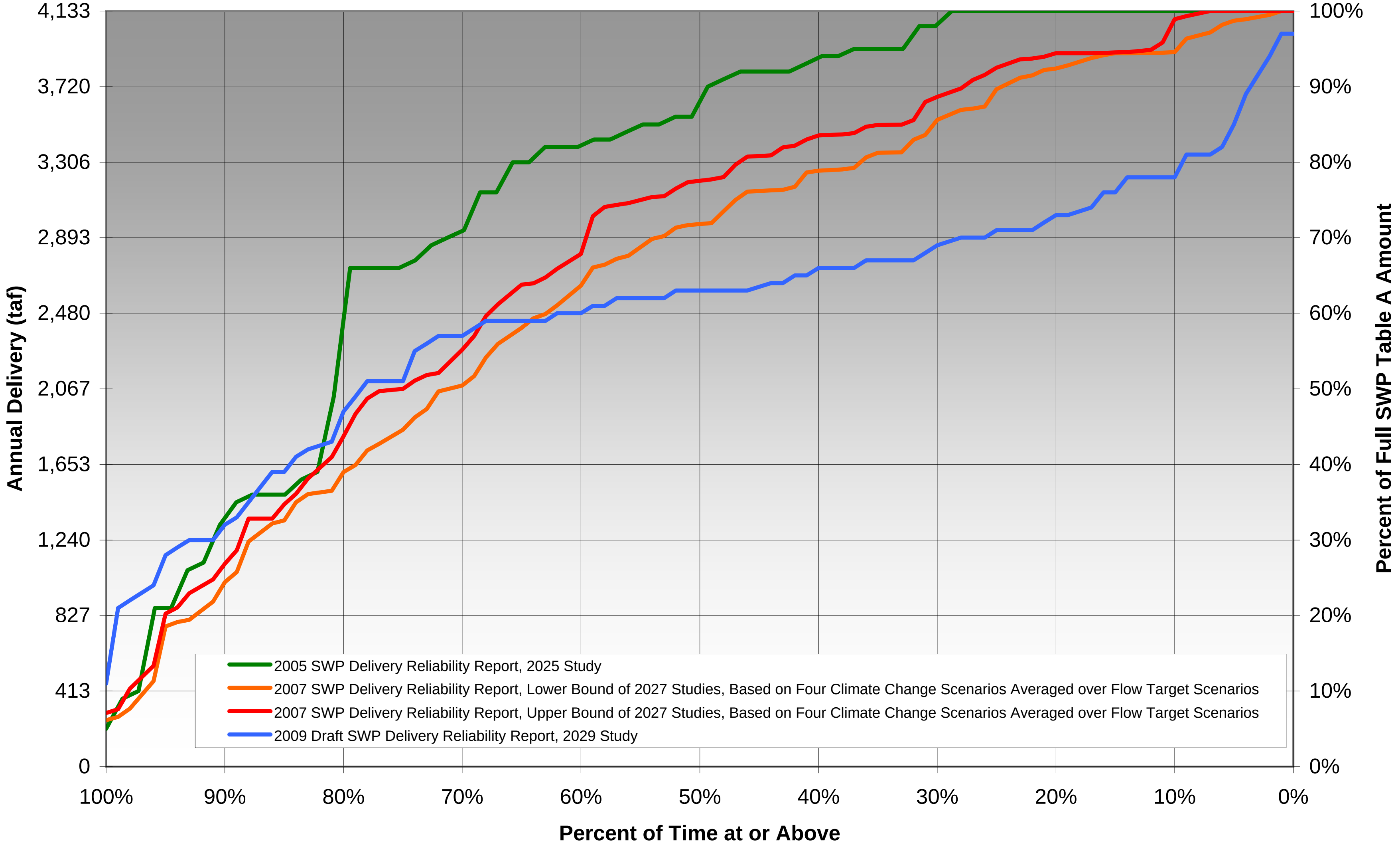
Figure 6-4

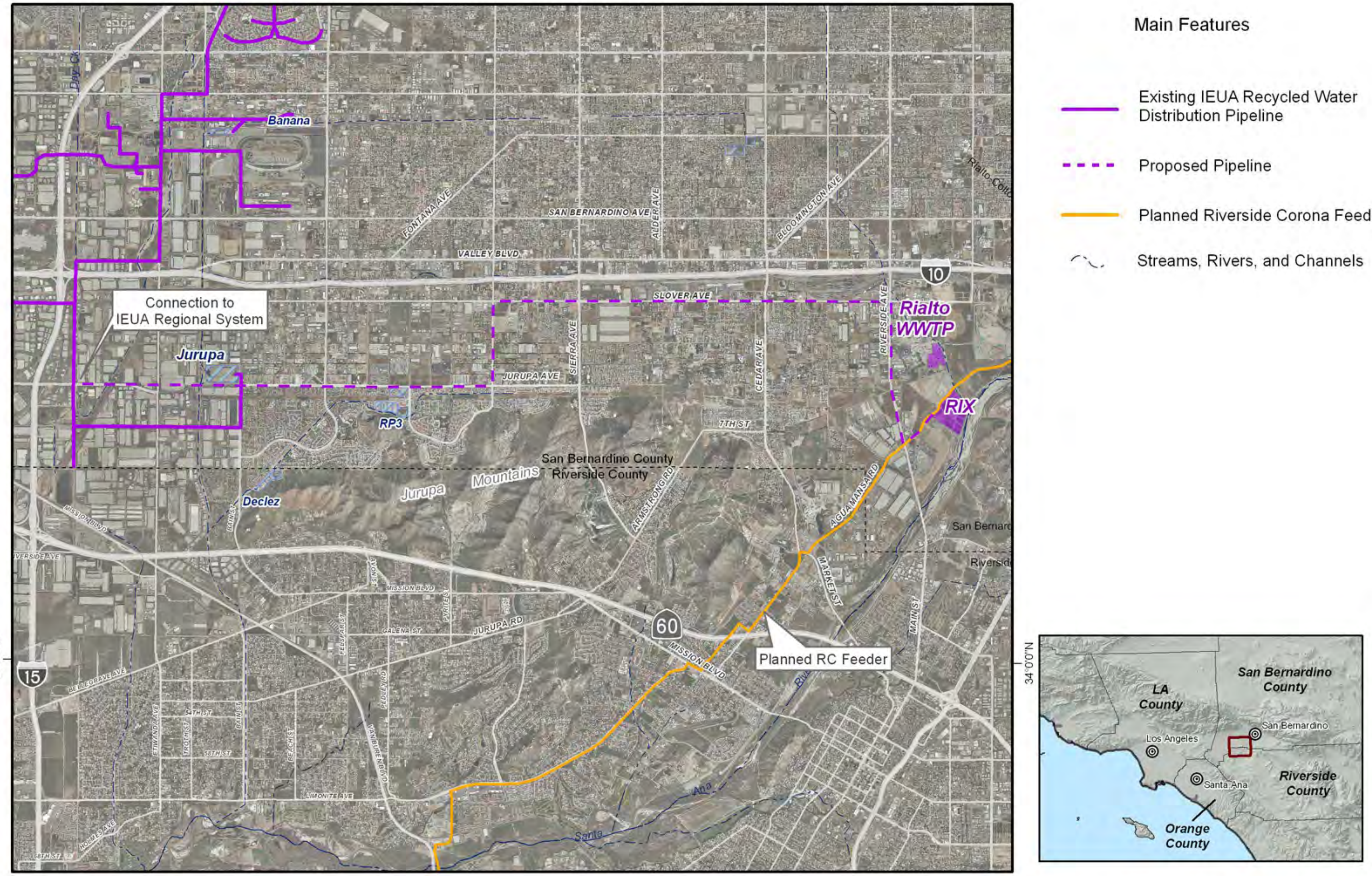
Figure 6-5a
SWP Table A Delivery Probability under Current Conditions



20100409 Figure 6-5a-bSWP Table A Deliver_v2

Figure 6-5b
SWP Table A Delivery Probability under Future Conditions





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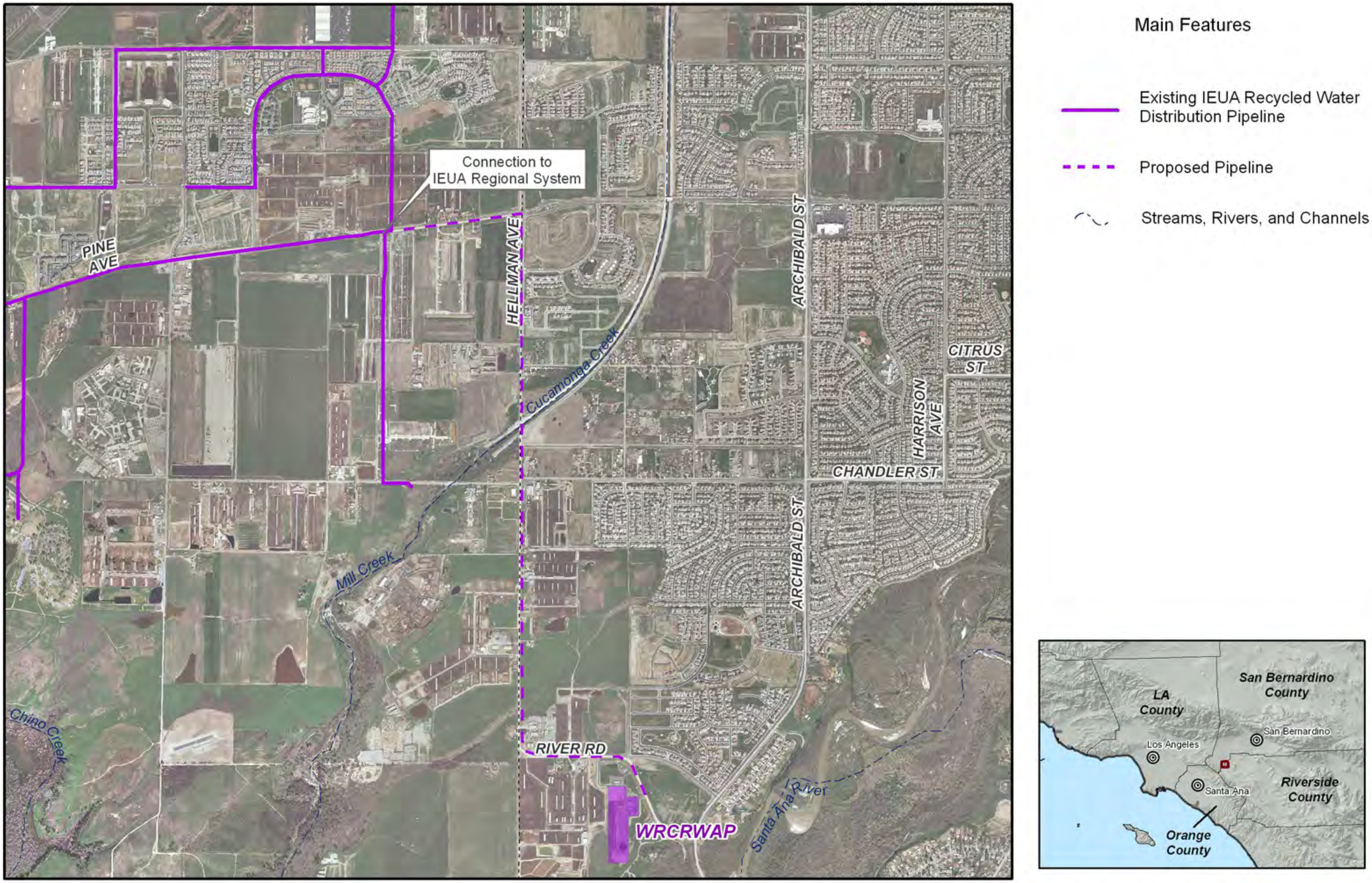
2010 Recharge Master Plan Update

RIX Recycled Water Connection to the IEUA Distribution System

Figure 6-6



WRCRWAP Recycled Water Connection to the IEUA Distribution System

Figure 6-7

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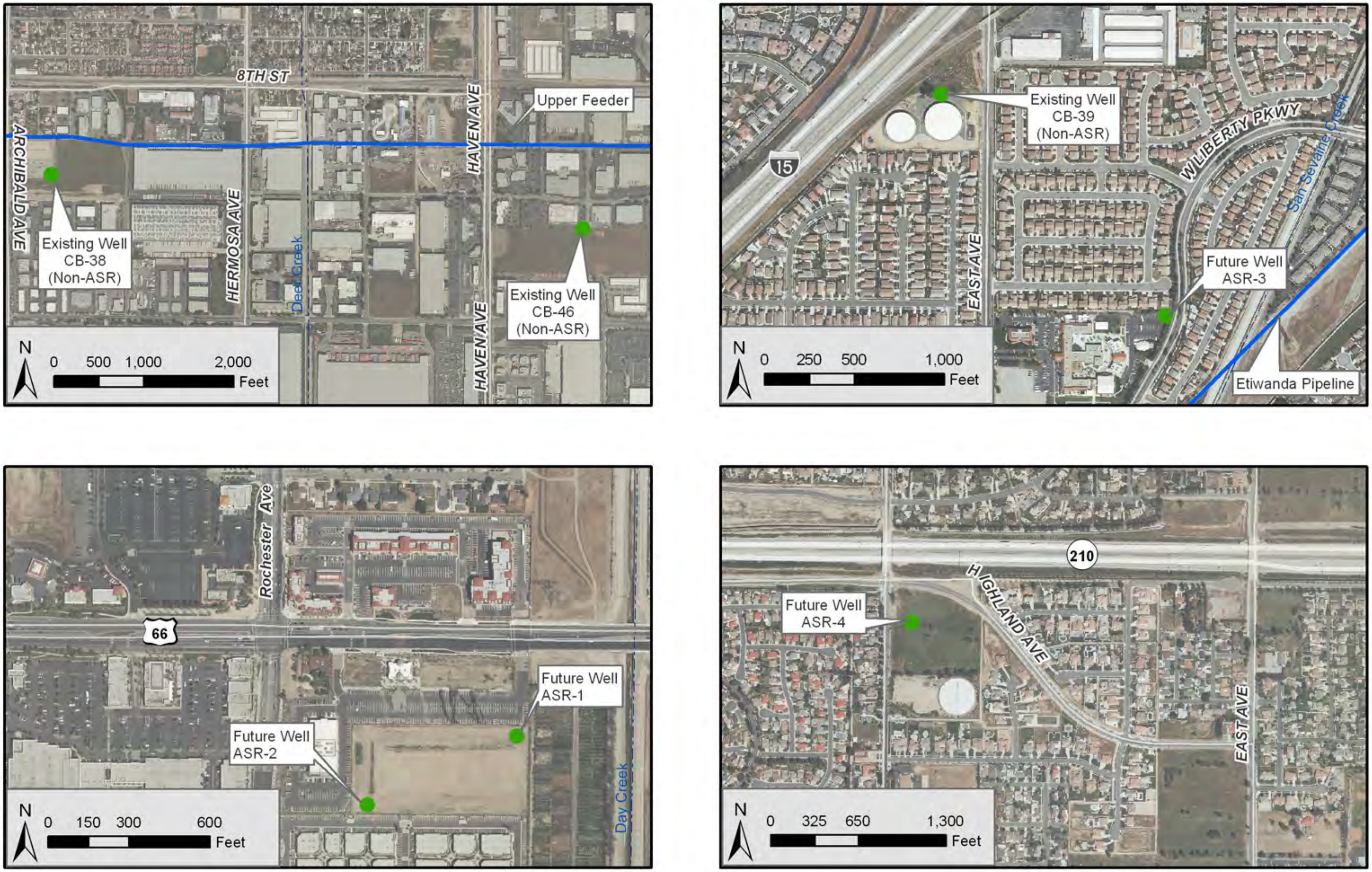

Author: MJC Date: 20100409 File: Figure 6-8.mxd

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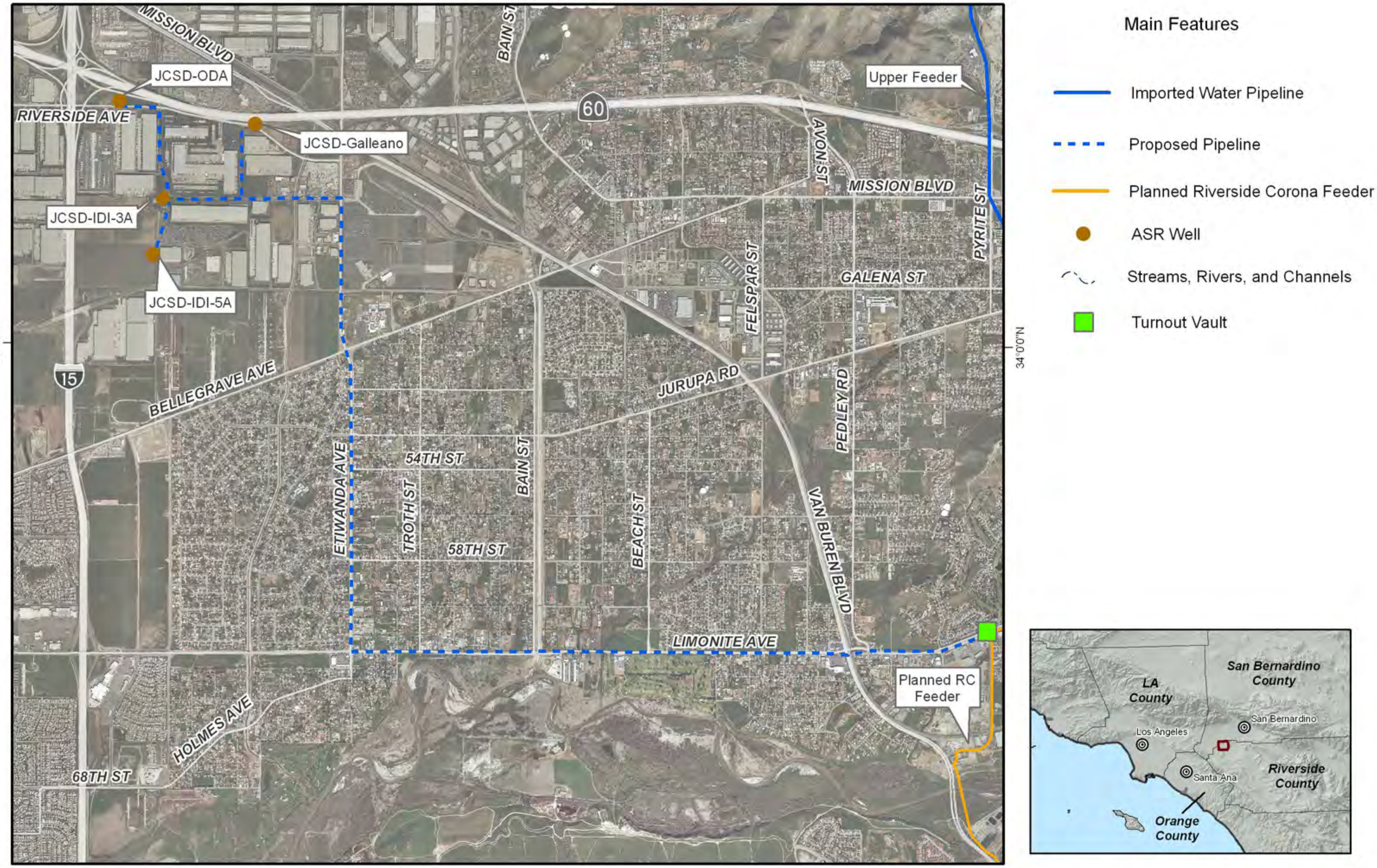
● ASR Well

— Imported Water Pipeline

Cucamonga Valley Water District ASR Wells

2010 Recharge Master Plan Update

Figure 6-8



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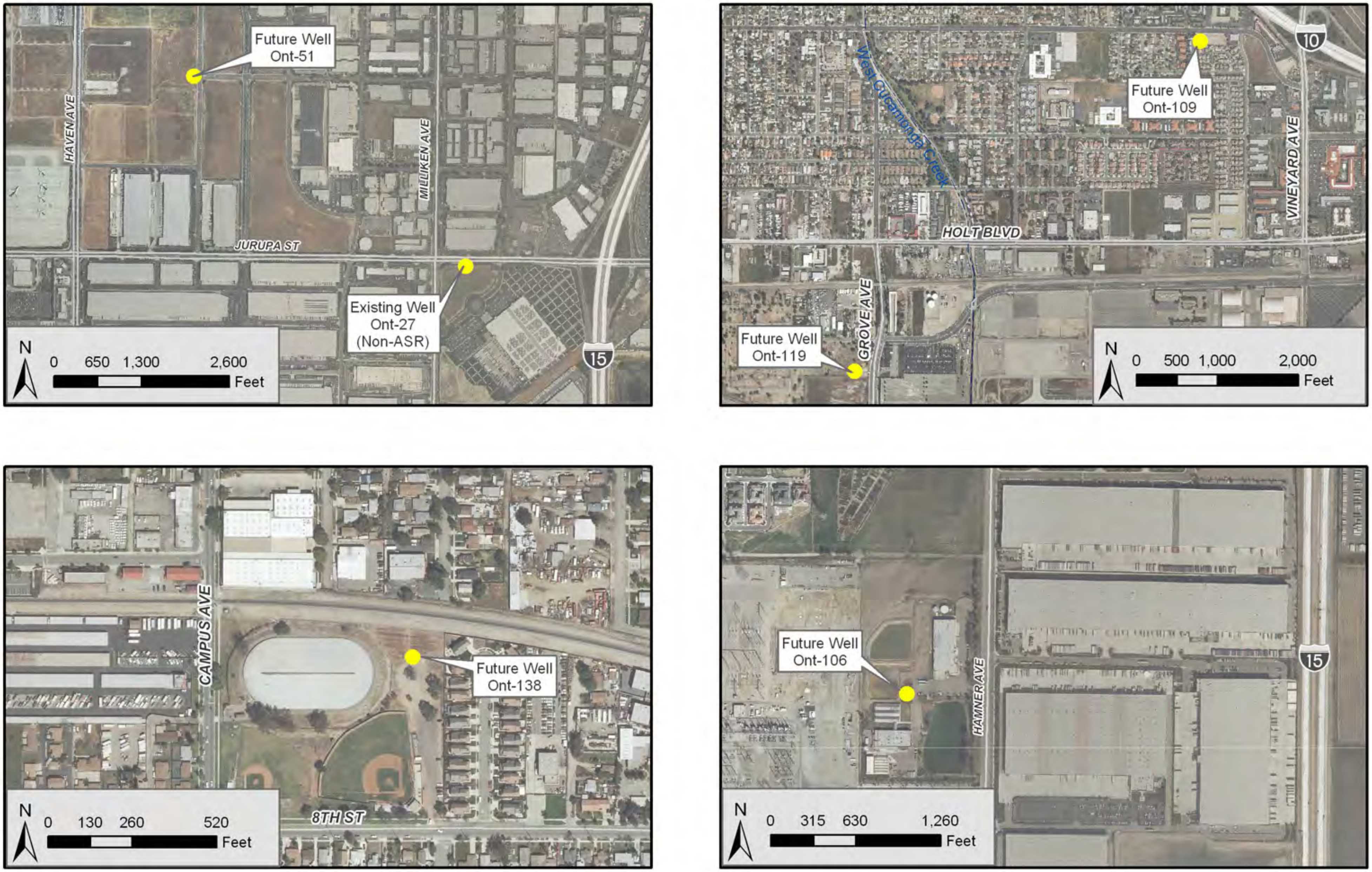
0 2,500 5,000 7,500 Feet
0 1,000 2,000 Meters

CHINO BASIN WATERMASTER Partners in Basin Management

2010 Recharge Master Plan Update

Jurupa Community Services District
ASR Wells

Figure 6-9



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● ASR Well

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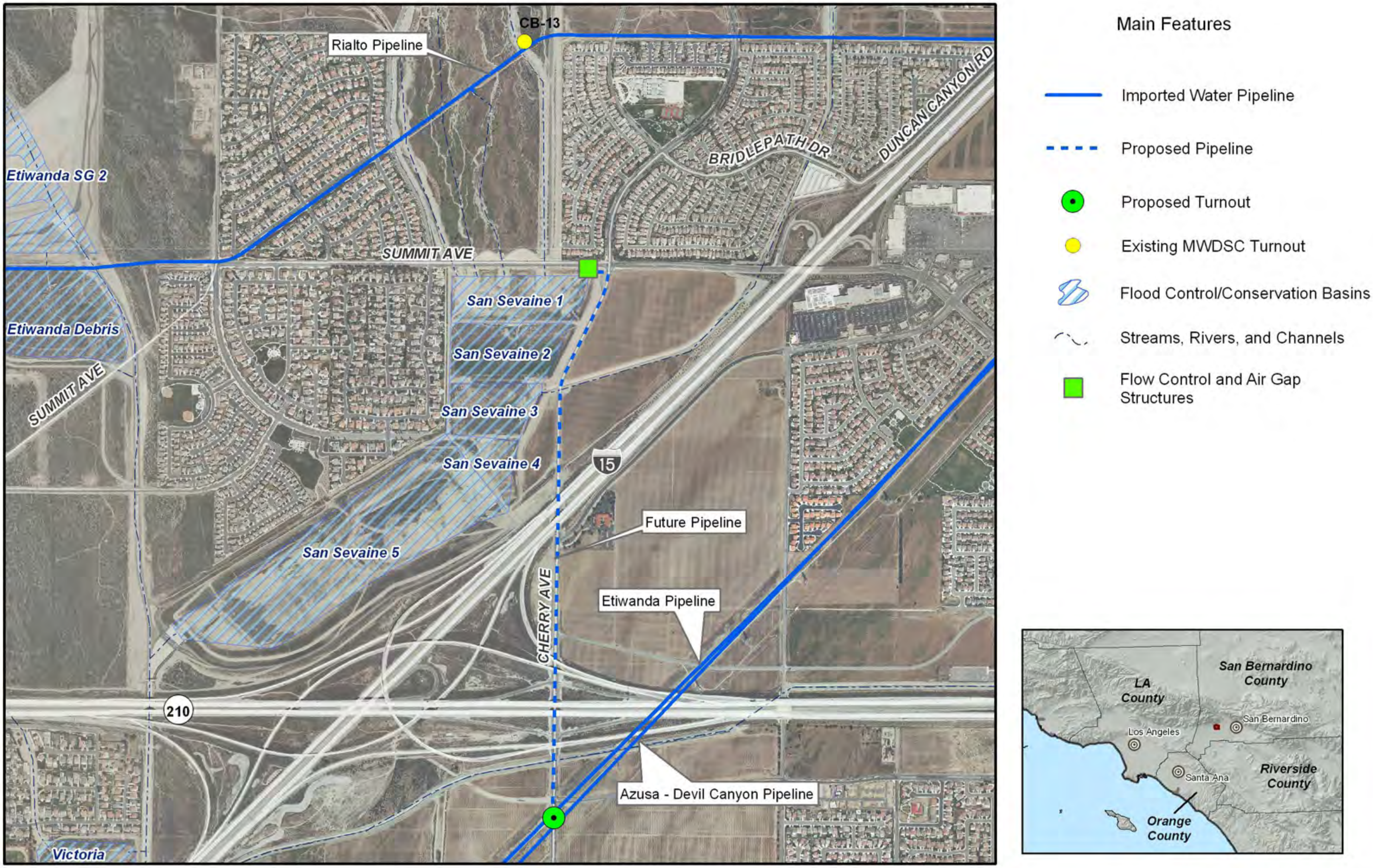
2010 Recharge Master Plan Update

City of Ontario ASR Wells

Figure 6-10



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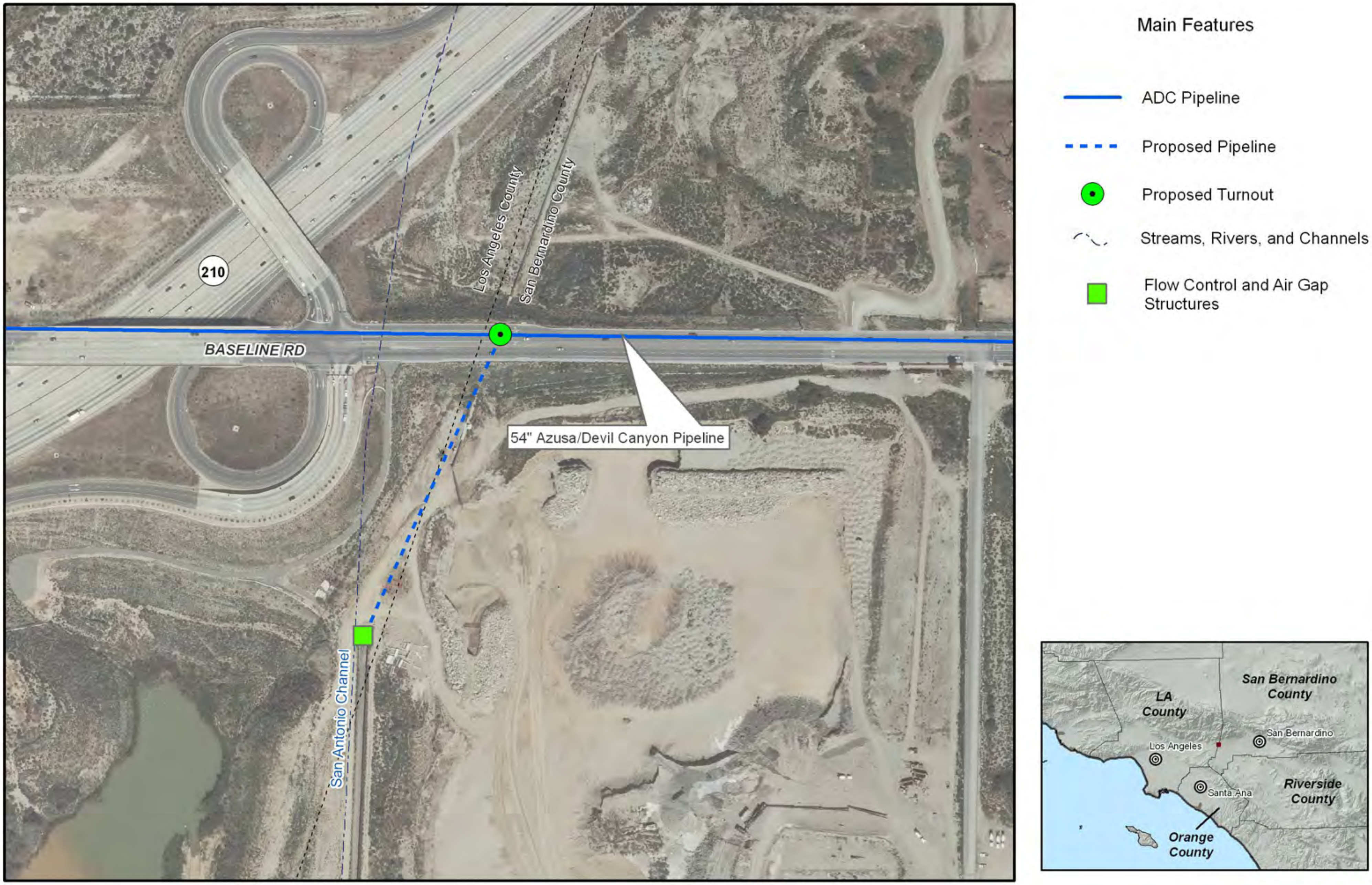
2010 Recharge Master Plan Update

Turnout to San Sevaine Basin No.1 via ADC or Etiwanda Pipelines

Figure 6-11



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Date: 20100409
File: Figure_6-12.mxd

0 500 *Feet*

0 100 200 *Meters*

2010 Recharge Master Plan Update

Turnout to San Antonio Channel via ADC

Figure 6-12

This section contains the conclusions and recommendations of the RMPU. These conclusions and recommendations are grouped under the following subsections: Stormwater Management, Regional Stormwater Recharge Facilities, Supplemental Water for Replenishment, Supplemental Water Recharge Facilities, and Future RMPU Process. The nexus between the Court's Requirement for the RMPU and the information presented in this report is summarized in Table 7-1.

7.1 Local Stormwater Management and Mitigation of the Loss of Safe Yield

Section 3 describes the range of new stormwater recharge that could result from implementing the 2010 MS4 permit. Based on the requirements of the permit, the expected new stormwater recharge could range from about 5,300 acre-ft/yr (if 50 percent of the stormwater required to be managed by the permit is recharged) to about 10,500 acre-ft/yr (if 100 percent of the stormwater required to be managed by the permit is recharged).

Section 3 also describes the new recharge potential of existing developed areas. Applying the same criteria from the MS4 permit to the developed areas yields, on average, between 19,000 acre-ft/yr and 38,000 acre-ft/yr of new recharge. Watermaster, working with the landuse control entities, should encourage development practices that will maximize the capture and recharge of stormwater. New recharge, as used herein, means the net new recharge created by the project. The following should be implemented by the CBWCD, the IEUA, Watermaster, and other stakeholders.

1. Watermaster should allocate new yield that is created by new recharge above that required by MS4 permit compliance to the owners of those projects that create new recharge. This will require the development of (a) new agreements involving the Watermaster, project owners, and others, and (b) the development of new practices and procedures that can quantify new recharge during project development and subsequently verify that the new recharge is occurring during the project lifetime.
2. Watermaster, working with the Parties, should encourage the construction of local recharge projects in developed areas that will increase the capture and recharge of stormwater. The recommendations for local stormwater recharge projects in developed areas are the same as those for newly developed areas, articulated above.
3. In implementing the above, Watermaster should form a committee—consisting of itself, the landuse control entities, the County Flood Control Districts, the CBWCD, the IEUA, and others—to develop the monitoring, reporting, and accounting practices that will be required to estimate local project stormwater recharge and new yield. This committee should be formed immediately, and the monitoring, reporting, and accounting practices should be developed as soon as possible.

7.2 Regional Stormwater Recharge Facilities

Section 3 describes the existing long-term average stormwater recharge from existing stormwater management facilities, including the CBFIP facilities constructed as part of the implementation of the OBMP. The long-term average annual stormwater recharge with the recharge facilities existing in 2009-10 is estimated to be about 13,600 acre-ft/yr, and this recharge will increase slightly over time with new development (See Table 3-8). This estimate is based on the *2006 Chino Basin Recharge Facilities Operation Procedures Manual* (GRCC, 2006) with some operating procedure modifications, provided by the IEUA. Section 5 describes the existing and potential stormwater management facilities and demonstrates that more new stormwater recharge is possible; although, the cost for some future recharge projects will be significant. WBE, the firm that authored Section 5, developed and analyzed several individual new and enhanced projects and project configurations. The embedded table in Section 5.5.8 summarizes the recharge performance and associated costs of the proposed new stormwater projects. WBE grouped these projects and configurations into five phases with the total recharge and unit cost of new stormwater recharge increasing with each phase. The recharge and unit cost of recharge for each phase is summarized below.

Phase	Range of Recharge		Range of Annual Cost		Range of Unit Cost	
	75% of Theoretical (ac-ft/yr)	Theoretical (ac-ft/yr)	WBE Cost Opinion	WBE Cost Opinion + 15%	Min ($/ac-ft)	Max ($/ac-ft)
I	5,800	7,700	$1,652,000	$1,900,000	$215	$328
II	6,000	8,100	$2,601,000	$2,991,000	$321	$499
III	8,400	11,300	$5,605,000	$6,446,000	$496	$767
IV	10,200	13,600	$14,800,000	$17,039,000	$1,088	$1,670
Va	11,900	15,900	$19,306,000	$22,202,000	$1,214	$1,866
Vb	11,900	15,900	$14,692,000	$17,206,000	$924	$1,446

Through the RMPU workshop process, the stakeholder's expressed interest in pursuing Phases I through III as the unit cost of new stormwater recharge is comparable to the cost of imported supplies and new stormwater recharge will be more reliable than imported water. The implementation of Phases IV and V will be deferred until a future time as the projects in these phases are significantly more expensive.

Based on the most current information, the recharge projects described in Phases I through III are estimated to produce a long-term average annual stormwater recharge increase of 8,400 acre-ft/yr to 11,300 acre-ft/yr at cost of about $500 to $800 per acre-ft. The new yield from these projects will reduce the future replenishment obligation by the amount of new yield.

Several issues will need to be resolved to refine, design, and implement these projects. Substantial planning work will be required to implement the Phase I through III projects to ensure that the recharge potential of the projects can be realized. In addition to environmental documentation, this planning work will involve the development of a financing plan, engineering investigations, and the development of an agreement with the SBCFCD regarding the modification and operation of stormwater facilities. The CBWCD, IEUA, and

Watermaster should conduct further analyses of the Phase I through III projects to refine the projects, to develop a financing plan, and to develop an implementation plan. This planning work should begin as soon as practical and could be accomplished within three years. The schedule to implement the Phase I through III projects would be developed during the proposed planning work, and the construction of these projects could completed within five years of completing the proposed planning work.

During the preparation of the RMPU, an independent effort to develop a new multipurpose stormwater management and recreation facility East of Archibald Avenue and south of Deer Creek commenced. Herein, this project is referred to as the Turner Basins/Guasti Park project. The specifics of this project are still unknown. However, hydrologic simulations were conducted, based on a project description that was received in April 2010 using the same model and procedure (see Appendix C, *Summary of the R4 Model for the Chino Basin*) that was used to analyze the potential new stormwater recharge projects described in Section 5. Based on the April 2010 project concept drawings, the potential new stormwater recharge was estimated to be about 1,300 acre-ft/yr. This basin could also be used to recharge supplemental water. A cost opinion to construct and operate this proposed project is not available. Recharge in this location will help manage groundwater levels in the Ontario-CVWD production depression area.

7.3 Supplemental Water for Replenishment

The RMPU must be submitted to the Court by July 1, 2010, which is one year earlier than when retail water agency UWMPs are due and six months earlier than when wholesale water agency UWMPs are due. In lieu of having updated groundwater projections from the 2010 UWMPs, two groundwater production projections were developed in the RMPU to bound the possible groundwater production projections. These production projections are discussed in Section 4 of this report and are shown in Tables 4-1 through 4-2. The means to satisfy these estimated replenishment projections are described in Section 6. Section 6 also discusses the availability and reliability of the traditional water supplies used for replenishment and the possibility of new supplemental water sources. The conclusions and recommendations developed from this analysis are described below.

1. Watermaster needs to acquire supplemental water to meet its replenishment and Peace Agreement obligations and the dilution requirements for the recharge of recycled water. These sources will include unused production rights from members of the Appropriative Pool, imported water from Metropolitan, and, if necessary, other non-Metropolitan imported water.
2. Because of the environmental and legal challenges involved in importing water from the Sacramento and San Joaquin Delta and the Colorado River, Watermaster should consider preemptive replenishment. Preemptive replenishment would limit the CURO to a sustainable level. Under such a scheme, Watermaster would estimate replenishment obligations for some future period, purchase supplemental water when available in advance of a replenishment obligation, bank that water in the Chino Basin, and use that water for subsequent replenishment. Watermaster

would revise the replenishment projection every year based on planning information provided by the parties and actual overproduction and replenishment. Watermaster should set an upper limit on the CURO and use this limit with the replenishment projections to guide its water acquisition activities.

3. Watermaster, upon reviewing the 2010 UWMPs and supply projections from Metropolitan, should make a determination of the need for non-Metropolitan imported water. This review should take place between July 2011 and December 2011, and this RMPU should be updated in January 2012.

4. If a need for non-Metropolitan imported water is determined, Watermaster should take action to acquire that water. Watermaster should go through this process at the conclusion of each UWMP report period or more frequently if statewide water supply conditions change significantly from those assumed in the then current RMPU. Potential sources of non-Metropolitan imported water are summarized in Section 6 of this RMPU and include: groundwater and surface water supplies from the Central Valley, conveyed to the Chino Basin through SWP and Metropolitan facilities; groundwater from the Antelope Valley, conveyed to the Chino Basin through SWP and Metropolitan facilities; groundwater and surface water supplies from the Colorado River Basin, conveyed to the Chino Basin through Metropolitan facilities; groundwater and surface water supplies in the Santa Ana Watershed that can be supplied to the Chino Basin directly or by exchange; and recycled water from RIX and the WRCRWAP. The importation of non-Metropolitan water is a very complex and expensive proposition—the planning of which is beyond the scope of this RMPU. The process to acquire and move imported water from the Central Valley is described in Appendix D, *Sierra Water Group Task Report for Supplemental Water Sources* (SWG, 2010).

5. Under the 2008 IEUA/Watermaster groundwater production projection, Watermaster will need to begin preemptive replenishment to manage the CURO to less than 100,000 acre-ft and to meet the MZ1 6,500 acre-ft/yr requirement. Significant replenishment water acquisition will be necessary after 2014/15—about five years from now.

7.4 Supplemental Water Recharge Facilities

1. No new recharge facilities will be required to meet Watermaster's replenishment obligations through the planning period, provided that the Riverside Corona Feeder is completed within the next ten years. The Riverside Corona Feeder could supply treated SWP water to the JCSD in lieu of groundwater production, which would achieve replenishment and improve the balance of recharge and discharge in the JCSD area. Watermaster should monitor the progress of the Riverside Corona Feeder and adjust future RMPUs to reflect its efficacy.

2. Provided that the Parties construct ASR wells for their own use, Watermaster should consider the use of these wells for replenishment purposes to achieve an improved balance of recharge and discharge in the specific areas identified in the

2009 Production Optimization and Evaluation of the Peace II Project Description (WEI, 2009b). Specifically, this ASR replenishment should be targeted in the Pomona-MVWD production depression area and the Ontario-CVWD production depression area. Currently, the MVWD has four ASR wells that could be used for this purpose, and the CVWD and Ontario have plans to eventually construct ASR wells.

3. Watermaster should use in-lieu recharge to achieve an improved balance of recharge and discharge in the specific areas identified in the *2009 Production Optimization and Evaluation of the Peace II Project Description* (WEI, 2009b), including the MZ1 managed area, the Pomona-MVWD production depression area, the JCSD well field area, and the Ontario-CVWD production depression area.

7.5 Future RMPU Process

The December 21, 2007 Court order requires the completion of this RMPU by July 1, 2010 and, at a minimum, every five years thereafter. The RMPU process is very sensitive to projected groundwater production. By statute, groundwater production projections are prepared for UWMPs every five years and in years ending in "0" or "5." Watermaster, the CBWCD, and the IEUA should review the groundwater production projections from the retail water purveyors' 2010 UWMPs after their completion in June 2011[13] to update the groundwater production projections included herein and revise the conclusions and recommendations of the 2010 RMPU to comport with the 2010 UWMPs. The conclusions in Section 6 regarding the acquisition of supplemental water for replenishment and new supplemental water recharge facilities should be updated in fiscal 2011-12. Decisions regarding the acquisition of supplemental water for replenishment and new supplemental water recharge facilities should be deferred until that time.

The next RMPU should be completed no later than December 2016, and subsequent RMPUs should be completed, at a minimum, every five years thereafter. This will ensure that the most up-to-date groundwater production estimates are included in future RMPUs.

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[13] The deadline for completing the 2010 UWMPs for retail water agencies was extended by special legislation to June 30, 2011 for the 2010 UWMP. Subsequent UWMPs are required to be submitted to the DWR by December 31st of the year due.

Table 7-1
Comparison of the Court's RMPU Requirements and How Those Requirements are Addressed in the RMPU

	Requirement	How Requirement is Met in the RMPU	
		Where in RMPU	Specific Actions
1	Baseline conditions must be clearly defined and supported by technical analysis. The baseline definition should encompass factors such as pumping, demand, recharge capacity, total Basin water demand, and availability of replenishment water.	Sections 4, 6, and 7	Section 4 describes total projected water demand and the associated water supply plans based on projections by the IEUA and Watermaster. Section 6 describes the supplemental water recharge capacity and the availability of supplemental water for replenishment and, in particular, reviews the ability to acquire water for replenishment from Metropolitan. Section 7 contains specific recommendations for the acquisition of supplemental water through the next recharge master plan update.
2	Safe Yield should be estimated annually, though it is recognized that it is not to be formally recalculated until 2011. Watermaster should develop a technically defensible approach to estimating Safe Yield annually.	Section 3	Section 3 describes the computation of safe yield and presents a recommended method to compute safe yield during 2010-11 and subsequent years. Watermaster will likely use its discretion to determine when to recompute safe yield after 2010-11.
3	Measures should be evaluated to lessen or stop the projected Safe Yield decline. All practical measures should be evaluated in terms of their potential benefits and feasibility.	Sections 3, 5, and 7	Section 3 describes the causes of a declining safe yield and suggests that the safe yield could drop from the current value of 140,000 acre-ft/yr to 129,000 acre-ft/yr by 2030. Section 3 also describes the expected increase in safe yield of 5,300 acre-ft/yr to 10,500 acre-ft/yr due to compliance with the 2010 MS4 permits. Section 5 includes descriptions of new stormwater recharge projects that could yield between 10,000 to 15,000 acre-ft/yr. Most of the projects described in Section 5 will require more detailed planning and new agreements with the Counties to determine their ultimate feasibility. Section 7 summarizes the recommended next steps in estimating and crediting the new recharge from the implementation of MS4 and in the implementation of the proposed new stormwater recharge projects.
4	Evaluations and reporting of the impact of Basin Re-Operation on groundwater storage and water levels should be done on an annual basis.		Strictly speaking, this is not an RMPU issue and is not covered in the 2010 RMPU. Watermaster analyzes the impact of Basin Re-Operation on groundwater storage and water levels in the southern part of the Basin annually and basin wide every two years. The data and results of these analyses are published in the Hydraulic Control Monitoring Report each year (on or before April 15) and the State of the Basin Report every two years.
5	Total demand for groundwater should be forecast for 2015, 2020, 2025, and 2030. The availability of imported water for supply and replenishment, and the availability of recycled water should be forecast on the same schedule. The schedules should be refined in each Recharge Master Plan update. Projections should be supported by thorough technical analysis.	Sections 4 and 6	Section 4 contains the demand for groundwater forecasted for 2010, 2015, 2020, 2025, 2030, and 2035. Section 6 describes the availability of imported water for supply and replenishment as forecasted through 2030, based on the draft *2009 SWP Delivery Reliability Report* (DWR, 2010). Section 6 also describes the current and future recycled water recharge projections from the IEUA.
6	The Recharge Master Plan must include a detailed technical comparison of current and projected groundwater recharge capabilities and current and projected demands for groundwater. The Recharge Master Plan should provide guidance as to what should be done if recharge capacity cannot meet or is projected not to be able to meet replenishment needs. This guidance should detail how Watermaster will provide sufficient recharge capacity or undertake alternative measures so that Basin operation in accordance with the Judgment and the Physical Solution can be resumed at any time.	Section 6	Section 6 describes the recharge capacity of existing spreading basins, existing ASR wells, future ASR wells, and existing in-lieu recharge capacity. Section 6 concludes that Watermaster, given present knowledge and agreements, will not be replenishment constrained by recharge capacity. That is, Watermaster has enough installed recharge capacity to meet current and future replenishment obligations through 2030.
7	Address how the Basin will be contemporaneously managed to secure and maintain Hydraulic Control and subsequently operated at a new equilibrium at the conclusion of the period of Re-Operation.		The technical work to make this demonstration was done in 2009 and is reported separately in *2009 Production Optimization and Evaluation of the Peace II Project Description* (WEI, 2009), which has been posted to the RMPU website rmp.wildermuthenvironmental.com.
8	Contain recharge estimations and summaries of the projected water supply availability as well as the physical means to accomplish the recharge projections.	Sections 3, 4, 5, and 6	Section 3 contains recharge projections for stormwater for existing facilities and new recharge from the 2010 MS4 permit. Section 4 contains a schedule of the future recharge requirements for Watermaster to meet its replenishment obligations. Section 5 contains descriptions of new recharge projects, recharge performance, and cost and implementation issues. Section 6 describes the supplemental water supplies available to Watermaster to meet is replenishment obligation and new supplemental water recharge projects that could be implemented to provide Watermaster with additional recharge capacity and supplemental water, and flexibility in meeting its replenishment obligation.
9	Reflect an appropriate schedule for planning, design, and physical improvements as may be required to provide reasonable assurance that sufficient Replenishment capacity exists to meet the reasonable projections of Desalter Replenishment obligations following the implementation of Basin Re-Operation.	Section 7	Section 7 describes the recommended recharge master plan. This section describes the means to stop the projected loss of safe yield, increase stormwater recharge, and acquire supplemental water for replenishment purposes. No new recharge facilities are required to meet replenishment obligations. Detailed scheduling of new stormwater recharge facilities should be deferred until additional planning information is developed to refine these projects. The decision to acquire new supplemental water sources should be deferred until updated groundwater production projections become available in late 2011-12. The RMPU should be updated in the second half of 2011-12 and subsequent years ending in "1" and "6."

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2010 Recharge Master Plan Update

Volume II – Appendices

Prepared for
Chino Basin Watermaster
Chino Basin Water Conservation District
Inland Empire Utilities Agency

Prepared by
Wildermuth Environmental, Inc.
Black & Veatch Corporation
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Sierra Water Group

June 2010

Appendix A

Public Outreach and Process

Appendix A
Public Outreach and Process

The design of the 2010 Recharge Master Plan Update started in January 2008 with the development of a straw-man RMPU report outline that contained the content required by the December 21, 2007 Court Order and met the requirements of the Peace II Agreement and the Peace Agreement. The outline was also suggestive of the process that was to be used to complete the 2010 RMPU. That process specifically provided for input from the stakeholders. This outline was discussed at stakeholder meetings through the spring of 2008 and revised several times to respond to stakeholder input. The final report outline was submitted to the Court for their review and approval in late June 2008. In August 2008, the Court approved the 2010 RMPU report outline. In September 2008 Watermaster convened its second annual strategic planning meeting—the focus of which was the scoping of the 2010 RMPU. This strategic planning meeting served as the kickoff for the development of the 2010 RMPU.

The Chino Basin Watermaster planned and convened several workshops during the course of RMPU development. The purposes of these workshops were generally to present the results of the technical work to the stakeholders and to obtain input from the stakeholders. Each workshop had a specific technical theme. The workshops and their technical themes are listed below:

1. March 26, 2009 *Replenishment Projections and Supplemental Recharge Capacity* and *Design and Cost Development Criteria*
2. April 23, 2009 Stormwater Recharge Optimization: Potential Local Recharge Facilities (960 MB)
3. July 23, 2009 *Production and Replenishment Optimization and 2009 Peace II CEQA Analysis* and *Supplemental Water Recharge for Replenishment*
4. August 27, 2009 *Supplemental Water Alternatives*
5. October 22, 2009 *Stormwater Recharge Update*
6. January 28, 2010 *Storm Water Recharge Update*
7. March 25, 2010 *Replenishment Projections and Recharge Master Plan Update Recommendations* and *Storm Water Recharge Improvement Opportunities*
8. April 21, 2010 *Draft 2010 RMPU Report Workshop* and *Storm Water Recharge Improvement Opportunities*
9. May 19, 2010 *Draft 2010 RMPU Report Workshop #2*

A website was created to post the schedule of workshops and workshop presentations. This website was substantially upgraded in April of 2010 to include draft sections of the 2010 RMPU and again in June 2010 to include the final 2010 RMPU report. The final report, draft report, workshops, and other relevant documents can be accessed via the RMPU website at http://rmp.wildermuthenvironmental.com/.

Appendix B

IEUA Technical Memoranda Regarding the Water Demand and Supply Plan for the Chino Basin Area

Inland Empire
UTILITIES AGENCY

Date: May 4, 2010

To: Ken Manning, CBWM

From: Richard Atwater, IEUA

Subject: Integrated Review of Water Supply Plans Used for the Chino Basin Recharge Master Plan Update – Technical Memo #3

Background

In the spring of 2008, IEUA revised and updated water demand projections for the purposes of the Dry Year Yield (DYY) Expansion Program, Urban Water Management Plans (UWMP) and the Chino Basin Recharge Master Plan Update. IEUA also prepared two tech memos for Chino Basin Watermaster outlining the importance of understanding current water use trends and future near-term water demands and its impact on the need for future replenishment requirements.

This memo updates and is a supplement to the September 25, 2008 Technical Memo #2, *Final Water Demand and Supply Forecasts for Chino Basin Dry Year Yield Expansion Program CEQA Analysis* and the April 16, 2008 Technical Memo #1, *Net Groundwater Replenishment Obligations through 2015 Based upon Projected Water Demands and Available Supplies to the Chino Basin,* which analyzed current water use trends, future water demands, replenishment requirements, available supplies and Chino Basin groundwater pumping scenarios to assess the need for additional replenishment capacity (See Attached). These new updated water demand projections are based upon actual water use trends for the last two years, ongoing economic recession, new laws (SB X7-7) and regulations (MS4 Permit) and the ongoing Metropolitan Water Supply Allocation Plan (WSAP) impacts.

Current Water Demand Trends in the Chino Basin

The Chino Basin Groundwater Recharge Master Plan Update modeling, performed by Wildermuth Environmental Inc., results are largely driven by water demand projections, specifically Chino Basin groundwater pumping projections; which reinforces the need for accurate water demand and supply projections being updated every five years (more often if significant new trends develop or critical assumptions need to be revised).

Urban growth projections and the water demand projections should be developed carefully based on current economic trends and the ongoing efforts within the Chino Basin to reduce potable demand, which is consistent with SB X7-7 and Metropolitan's regional water use efficiency programs. This will ensure that the Chino Basin Recharge Master Plan Update is consistent with the Metropolitan Integrated Resource Plan (IRP) update, IEUA's UWMP and annual Ten-Year Capital Improvement Plan (TYCIP) projected growth and water demand projections.

IEUA staff, as a part of the Chino Basin DYY performance requirements and the Metropolitan Water Supply Allocation Plan (WSAP), has documented all water use within the IEUA service area (plus the City of Pomona and Jurupa Community Services District). Attached is the monthly production data that each of the retail agencies submits to IEUA on a monthly basis.

Below is a summary of the current conditions that have caused more than a 10% (25,000 AF) decrease in overall demand in the IEUA region since FY 2006/07 (the City of Pomona, Jurupa Community Services District and all of Southern California have experienced similar decreases in demand).

- In FY 2006/07 the highest water demand recorded in the IEUA region occurred;
    - It was the hottest/driest year on record;
    - It was the last year there was substantial growth in the Chino Basin;
    - Judge Wanger's Delta decision had not taken effect yet; and
    - It was the year before IEUA's Recycled Water Three Year Business plan was developed and adopted (2007), which resulted in the rapid conversion of potable landscape demands to recycled water landscape demands.
- Since 2007, the economic recession has dramatically caused a slowdown of the housing market which is causing delays in projected new water connections, thus delaying the need for additional water supplies;
- Increased direct reuse of recycled water have reduced demands on "potable supplies" about 10%;
    - Direct reuse of recycled water has increased by almost 6,000 AF since 2007;
- Since 2007, the water use efficiency programs being developed and implemented in response to the continued dry conditions have amassed over 4,500 AF of lifetime savings to date, as well as helped reduce current demand;
- Judge Wanger's Delta decision and its impact on Metropolitan imported supplies;
    - Metropolitan has implemented three consecutive calls on the DYY Program, which will result in the total withdrawal of all water in the DYY storage account (expected to withdraw the remaining 17,200 AF over the summer of 2010);
    - Metropolitan has implemented two consecutive years of the Water Supply Allocation Plan;
- The Governor's call for a 20% statewide reduction in water use by 2020 has caused;
    - Enhanced conservation messaging, statewide;
    - Lead to the development and implementation of increased water use efficiency programs, such as the Department of Water Resources 20% by 2020 water use efficiency initiative, the State Water Resources Control Boards consideration of regulatory conservation programs and legislation such as SB X7-7;

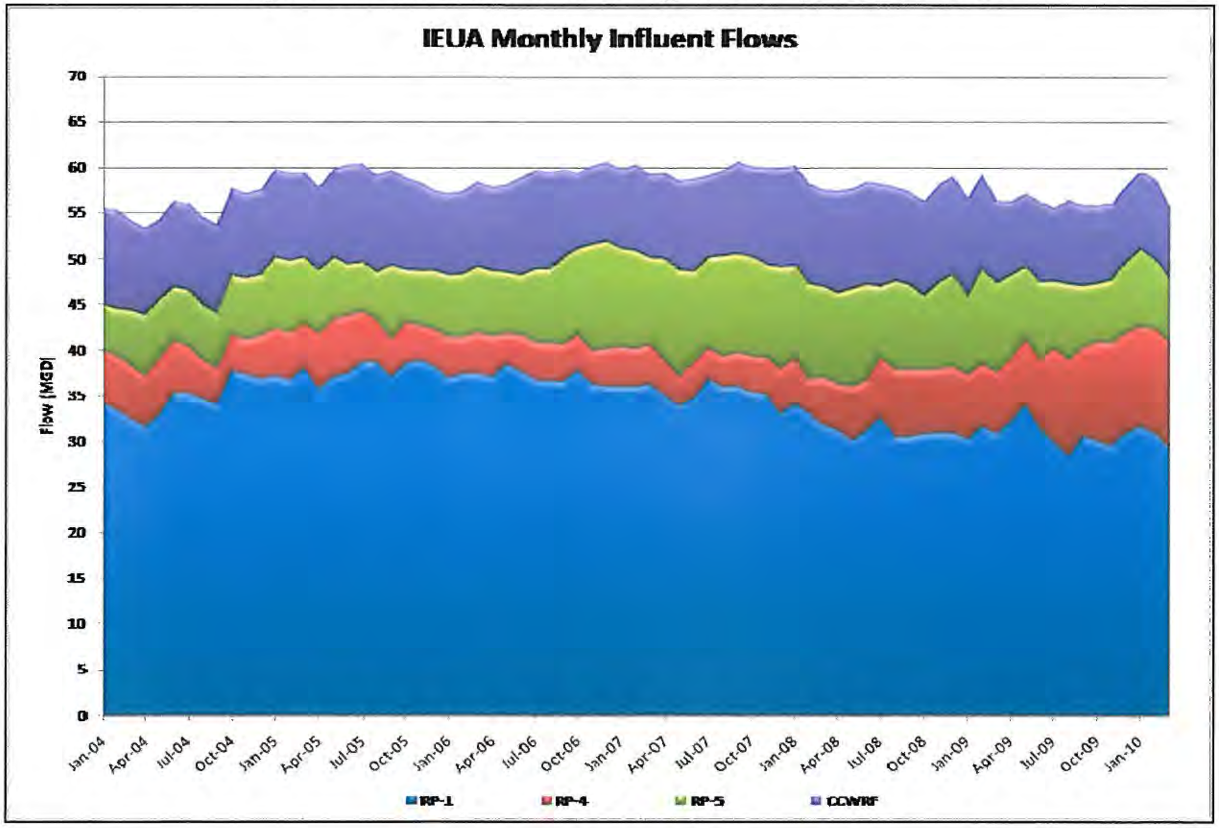
- Lead to the development and implementation of drought and landscape ordinances;

Overall water use is down throughout Southern California. In general, retail agencies are reporting that water demand has been reduced during the past few years between 10-20% (Note: LADWP reports that its water use is the lowest in over 31 years, even though it has added over 1 million new residents). Most water utilities attribute reduced demand to three key factors: economic recession, the active implementation water use efficiency programs and the drought message to the public.

One other key data trend that clearly demonstrates lowering retail potable water demands are influent wastewater flows to IEUA's treatment plants (identified in IEUA's FY 2010/11 TYCIP), which indicates that indoor potable water demands are trending down, not up, when you consider the addition of new development. This data has corroborated with a survey of other wastewater agencies (EMWD, OCSD, LACSD). Effectiveness in recent conservation efforts can be seen on regional wastewater flow trends. In the Chino Basin, IEUA has experienced a reduction in overall wastewater flows, effectively reducing the average daily flow at all the facilities (Figure 1).

Other Southern California agencies have observed similar trends in wastewater treatment influent flows. Los Angeles County and Orange County, which are built-out areas, are actually experiencing declines in wastewater flows (See Attached Exhibits I-III).

Figure 1. IEUA's Historical Average Monthly Influent Flows



Alternative Near-Term Demand Projections in the Chino Basin

When IEUA compared the current demand trends (as summarized above), today's actual demand and the demand projections used in the Chino Basin Groundwater Recharge Master Plan Update modeling effort, it was clear that the data used in the modeling was inconsistent with the observed and expected trends. Trying to connect the demand line from FY 2006/07 demand (255,000 AF) to today's 2010 demand (230,000 AF) to just the 2011 modeled demand (260,000 AF), resulted in a 30,000 AF difference and appeared unrealistic given the current demand trends.

Realizing this disparity between the current demands and the demand projections used in the Chino Basin Groundwater Recharge Master Plan Update, IEUA prepared alternative near-term demand projections to be considered for inclusion in the Chino Basin Groundwater Recharge Master Plan Update (Table 1).

Figure 2 shows the actual demands within the IEUA service area over the past five years and alternative near-term demand projections for the next five years based upon current demand trends.

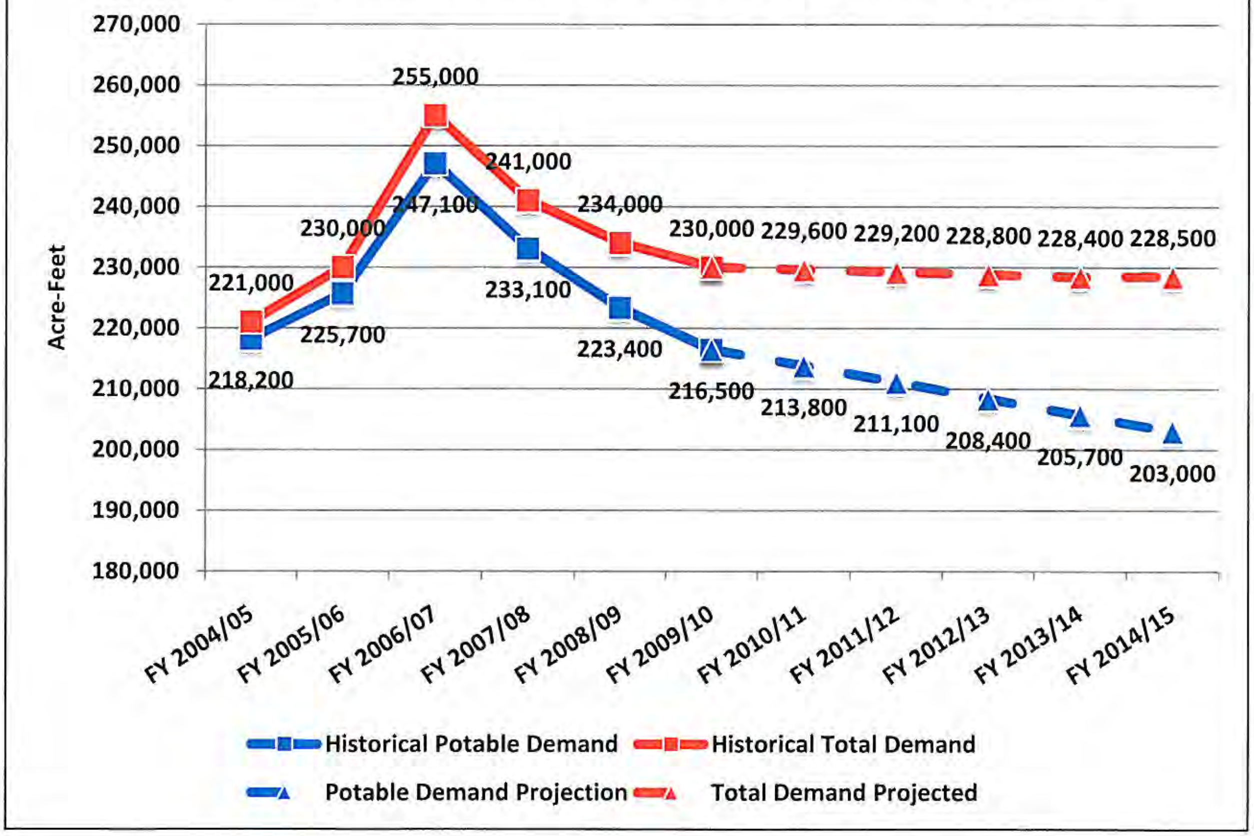


Figure 2. Historical Demands & Alternative Demand Projections

The alternative near-term demand projections, in Figure 2 and Table 1, show overall water demands "flat-lining" over the next five years. However, potable demands are shown to be decreasing over the next five years by 6-7% due to the increase in recycled water and the current trends mentioned previously. The alternative near-term demand projections are based on the following assumptions:

- Desalter water remains constant at 15,000 AFY, with an increase of 3,500 AFY in 2014 for the City of Ontario from the CDA Phase II Expansion;
- Surface water purchases/pumping remains constant at 30,100 AF;
- Other groundwater basin pumping remains constant at 31,700 AF;
- Recycled water direct reuse increases from 13,500 AF to 25,500 AF (this doesn't include recycled water delivered to Reliant (1,000 AF), San Bernardino County (1,500 AF) or IEUA (3,500 AF) giving a total of approximately 31,000 AF of direct reuse in 2015)
- Imported water purchases are essentially flat-lined due to Metropolitan's implemented Water Supply Allocation Plan (Level 2), which means we can expect approximately 68,000 AF of purchases each year as retail agencies don't want to "leave any water on the table" due to the uncertain future of imported water availability; and
- As a result of the above assumptions, Chino Basin groundwater pumping decreases from 77,000 AF to 60,000 AF.

The key drivers that support the assumptions listed above are as follows:

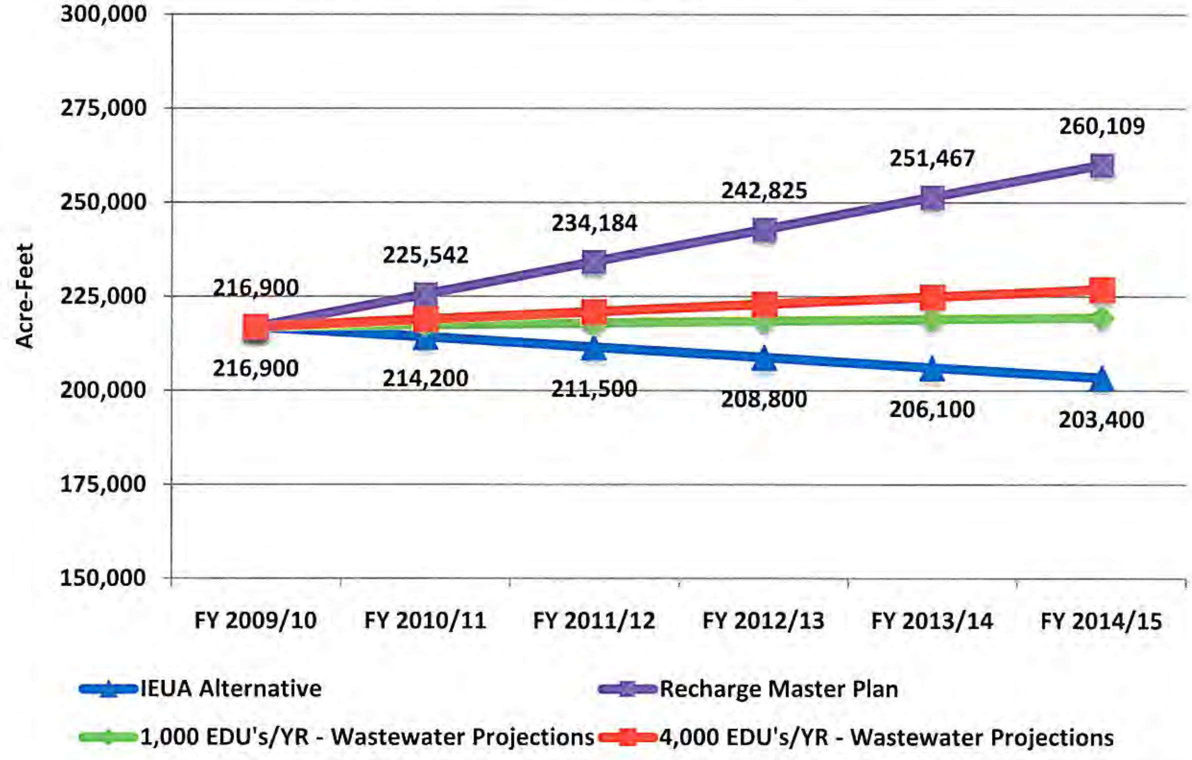
- The projections provided by the retail agencies are planned on being used for various purposes, such as their 2010 UWMP's and General Plans. These Plans have very distinct and different purposes and may not align appropriately with the purpose of the Chino Basin Groundwater Recharge Master Plan Update;
- The projections provided by the retail agencies do not appear to take into account the current demand trends;
- There are no signs that the economic recession will result in significant new residential or commercial development in the next few years (references: John Husing, Building Industry Association, IEUA's Retail Agencies);
- MWD rate increases will cause a decrease in demand;
- Direct reuse of recycled water is expected to reach 30,000 – 40,000 AF in the next five years;
- State Water Project supplies will be restricted and continue to be uncertain over the next decade;
- Metropolitan's implementation of the Water Supply Allocation Plan will occur often until a solution in the Delta is developed;
- SB X7-7 is law and will require retail agencies to reduce demands by 10% by 2015 and by 20% by 2020;
- IEUA and the retail agencies recently completed a Long-Term Water Use Efficiency Plan, which recommends numerous indoor and outdoor programs that will further decrease demands (approximately 1,000 AFY);
- IEUA and retail agencies have adopted Landscape Ordinances that will further decrease demands;

Understanding that these alternative near-term projections are based on assumptions, a sensitivity analysis was also done to estimate a range of possible demand projections. The goal of this sensitivity analysis is to give decision makers a broader range of realistic demand projections to help aid in making expensive decisions on the capital improvement projects that are being recommended in the Chino Basin Groundwater Recharge Master Plan. This analysis will also be included in IEUA's 2010 Urban Water Management Plan.

The sensitivity analysis developed included four demand projections, as shown in Figure 3. The first demand projection is the alternative near-term demand projections, previously discussed (blue). The second demand projection is the projections used in the WEI modeling effort for the Chino Basin Groundwater Recharge Master Plan, also previously discussed (purple). The third and fourth demand projections are based on the wastewater projections developed by IEUA and the retail agencies (green and red respectively). These wastewater projections represent the range of projected growth that IEUA and the retail agencies believe will occur in the next five years.

These projections were chosen for this sensitivity analysis because: they reflect the current economic and growth trends; they are included in the IEUA FY 2010/11 TYCIP (which is approved and adopted by the IEUA Board and the Regional Tech Committee); and most importantly these projections are done on an annual basis and is a key component to help accurately identify when wastewater capital improvement projects are needed.

Figure 3. Alternative Near-Term Projected Potable Demand Sensitivity Analysis



Evaluation of the Cumulative Unmet Replenishment Obligation (CURO)

Currently the recharge components in the Chino Basin include: the safe yield; the controlled overdraft; replenishment with wet water and by exchange; recharge for cyclic storage and other conjunctive use programs with wet water and by exchange; 6,500 AFY MZ1 recharge program; new yield from new storm water recharge; and desalter replenishment from new Santa Ana River recharge.

Under the assumptions of a decreasing or "flat-lining" near-term potable retail demands, plus increasing development of local supplies, there is no need for additional recharge facilities within the next five years. The following is a summary of existing Chino Basin management strategies that would prevent any significant CURO from occurring in the next five to ten years.

- According to the Chino Basin Watermaster 32nd Annual Report, as of June 30, 2009, there is over 215,000 AF in combined storage accounts. These stored pumping rights are going up in value and it is expected that these will continue to be marketed over the next five to ten years.

- The Chino Basin Judgement "market" allows under producers to transfer/lease pumping rights to over producers. For example, generally the Cities of Chino and Upland would be expected to continue to transfer/lease pumping rights to over producers such as Fontana Water Company and Jurupa Community Services District and thus reduce the need for wet CURO water replenishment.

- According to the Chino Basin Watermaster's last three Annual Reports, there has been a significant under production (compared to pumping rights) in the Chino Basin. Under the assumptions of a decreasing or "flat-lining" near-term demand, it can be expected that this trend of under production (compared to pumping rights) would continue and expand due to the recycled water recharge pumping credits.

    - Chino Basin Watermaster 30th Annual Report (FY 2006/07, hottest year on record and highest demand on record), there was approximately 45,000 AF of under production in the Chino Basin.
    - Chino Basin Watermaster 31st Annual Report, there was approximately 75,000 AF of under production in the Chino Basin.
    - Chino Basin Watermaster 32nd Annual Report, there was approximately 71,000 AF of under production in the Chino Basin.

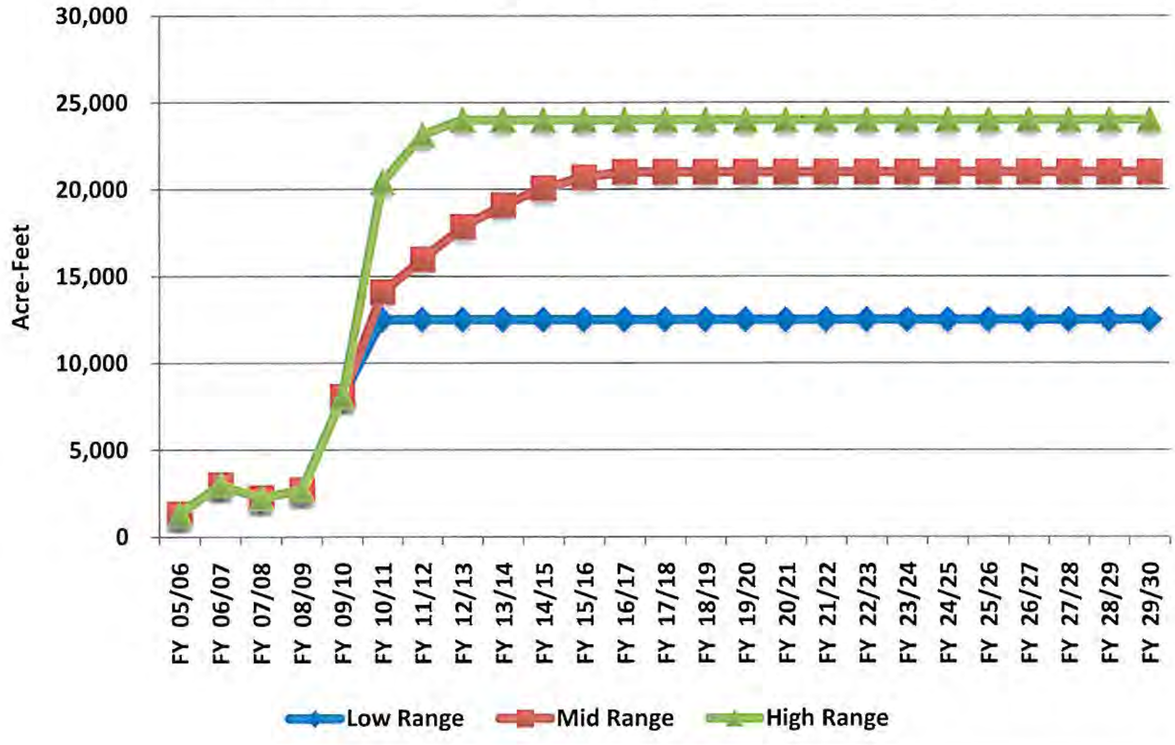
- Recharge of recycled water (see Figure 4 and Table 2) is expected to increase to approximately 20,000 AFY by 2015. This is credited back to the retail agencies as Chino Basin pumping rights, which will reduce the need for wet water replenishment other than recycled water.

    - Mid Range Recycled Water Recharge Assumptions
        1. Recycled water recharge is @ 90% of basin capacity April – October (summer).

2. Recycled water recharge is @ 60% of basin capacity October – April (winter).
3. Recycled water turnout capacity limitations were considered.
4. Basin maintenance is assumed to provide at least 50% of post cleaning infiltration at all times.
5. Recycled water conveyance enhancements to RP-3, Turner and Banana/Hickory to be complete by FY 2012/13.
6. Although permitted, Lower Day, Etiwanda Debris Basin and Etiwanda Conservation Basin are not included in these projections.
7. Imported water supply (for replenishment purposes) is assumed to be 708,000 AF distributed throughout Chino Basin between 2015 – 2030, which is consistent with the Draft Chino Basin Groundwater Recharge Master Plan Update Table 3-6.

- Low Range Recycled Water Recharge Assumptions, same as Mid Range except:
  1. Winter recycled water recharge is reduced to a minimum of 12,500 AFY due to increased storm water recharge.
  2. No imported water available.
- High Range Assumptions, same as Mid Range except:
  1. Winter recycled water recharge is increased to a maximum of 24,000 AFY due to limited storm water recharge.

Figure 4. IEUA Historical & Projected Recycled Water Recharge



- Purchasing imported water in-lieu of pumping groundwater is a widely used and effective way to replenish groundwater basins as demonstrated at OCWD and WRD for over 30 years. In years of surplus, Chino Basin has the ability to purchase imported water in-lieu of pumping and purchase replenishment water (if needed). For some retail agencies, it may be more cost-effective to purchase imported water before over producing, when considering the expected replenishment rate increases.
- Continued conversion of water rights, as mentioned in the 2008 State of the Basin Report, from the Non-Agricultural and Agricultural Pools to the Appropriative Pool would also continue to reduce overall groundwater pumping in the Chino Basin. For example, the Non-Ag Pool could potentially shift 5,000 AF to the Appropriative Pool by converting large industries like California Steel Inc. and the Raceway to recycled water. The Ag Pool could shift 10,000 – 20,000 AF to the Appropriative Pool by converting Chino's Institute for Men (CIM) and other agricultural pumping to recycled water. There is no additional recharge required for any of these conversions.

Conclusion

The current trends in the Chino Basin suggest that retail urban water demands will decrease or "flat-line" over the next five to ten years in the Chino Basin. Fiscal Year 2006/07 was the driest year on record, thus the highest water demand recorded in the Chino Basin. The Chino Basin Judgment "market," continued conservation efforts and water use efficiency programs combined with the reduction in State Water Project water availability and the Governor's call for a 20% reduction, will keep the demand lower than what was projected in the Chino Basin Groundwater Recharge Master Plan Update modeling efforts.

Table 1. Alternative Near-Term Total Demand Projections

Source	Chino		Chino Hills/ MVWD		Ontario		Upland		CVWD		FWC		SAWCO		TOTAL	
	2010	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**
Imported	3,000	3,000	13,000	13,000	10,000	10,500	3,000	2,500	33,000	29,000	1,000	10,000	-	-	63,000	68,000
Chino GW	8,000	7,000	15,000	14,000	25,000	24,000	3,500	3,500	8,000	3,500	16,000	5,000	1,600	1,600	77,100	58,600
Other GW	-	-	-	-	-	-	1,300	1,300	6,000	6,000	19,000	19,000	5,400	5,400	31,700	31,700
Desalter	5,000	5,000	5,000	5,000	5,000	5,000	-	-	-	-	-	-	-	-	15,000	15,000
Surface	-	-	-	-	-	-	12,000	12,000	3,500	3,500	8,000	8,000	6,600	6,600	30,100	30,100
Subtotal	***16,000***	***15,000***	***33,000***	***32,000***	***40,000***	***39,500***	***19,800***	***19,300***	***50,500***	***42,000***	***44,000***	***42,000***	***13,600***	***13,600***	***216,900***	***203,400***
Recycled	7,000	8,000	1,500	2,500	4,000	4,500	-	500	1,000	6,000	-	4,000	-	-	13,500	25,500
TOTAL	**23,000**	**23,000**	**34,500**	**34,500**	**44,000**	**44,000**	**19,800**	**19,800**	**51,500**	**48,000**	**44,000**	**46,000**	**13,600**	**13,600**	**230,400**	**228,900**

- 2010 imported water purchases include DYY certifications.
- Surface water includes the City of Upland purchases from SAWCO/West End.
- Surface water presented under SAWCO may be double counted under City of Upland surface water.

Table 2. Recycled Water Recharge Projections

YEAR	Low Range	Mid Range	High Range
FY 05/06	1304	1304	1304
FY 06/07	2989	2989	2989
FY 07/08	2237	2237	2237
FY 08/09	2684	2684	2684
FY 09/10	8056	8056	8056
FY 10/11	12505	14090	20431
FY 11/12	12500	15960	23142
FY 12/13	12500	17835	24000
FY 13/14	12500	19085	24000
FY 14/15	12500	20048	24000
FY 15/16	12500	20689	24000
FY 16/17	12500	21000	24000
FY 17/18	12500	21000	24000
FY 18/19	12500	21000	24000
FY 19/20	12500	21000	24000
FY 20/21	12500	21000	24000
FY 21/22	12500	21000	24000
FY 22/23	12500	21000	24000
FY 23/24	12500	21000	24000
FY 24/25	12500	21000	24000
FY 25/26	12500	21000	24000
FY 26/27	12500	21000	24000
FY 27/28	12500	21000	24000
FY 28/29	12500	21000	24000
FY 29/30	12500	21000	24000

Inland Empire
UTILITIES AGENCY

Date:	September 2, 2008
Prepared By:	Inland Empire Utilities Agency
Reviewed By:	Black & Veatch and Wildermuth Environmental Inc.
Subject:	Final Water Demand and Supply Forecasts for Chino Basin Dry Year Yield Expansion Program CEQA Analysis – Technical Memo #2

Supplement to the April 16, 2008 IEUA Tech Memo #1 –
Net Groundwater Replenishment Obligations through 2015 Based upon
Projected Water Demands and Available Supplies to the Chino Basin

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Background

Inland Empire Utilities Agency (IEUA), Chino Basin Watermaster (CBWM), Black & Veatch (B&V), Wildermuth Environmental Inc. (WEI) and Tom Dodson & Associates (TDA) are working together to complete the Chino Basin Dry Year Yield (DYY) Expansion Program CEQA documentation process by December 31, 2008. The purpose of this memo is to update the collaborative process for updating the projected individual retail water demands and supplies for the Chino Basin and that will be used for the DYY Program CEQA modeling process.

This memo updates and is a supplement to the April 16, 2008 Technical Memo #1, *Net Groundwater Replenishment Obligations through 2015 Based upon Projected Water Demands and Available Supplies to the Chino Basin,* which analyzed current water use trends, future water demands, replenishment requirements, available supplies and Chino Basin groundwater pumping scenarios to assess the need for additional replenishment capacity (See Appendix C).

Projected Retail Water Demand and Supplies in the Chino Basin

The Chino Basin groundwater modeling performed by WEI is largely driven by the water demand projections and projected groundwater data that are entered into the model, reinforcing the need for up-to-date water demand and supply forecasts. In early 2008, B&V gathered initial demand forecast data for the purposes of the Dry Year Yield Expansion Program. In July and August, IEUA staff met with each IEUA retail agency to review current water supply and growth conditions, update future water demand and supply trends and identify possible future replenishment obligations.[1]

Current conditions that were discussed that may impact near term demand trends include:

- Fiscal Year 2006/07 was the driest year on record, and is thus likely to be the highest water demand recorded in the Chino Basin for the near future;
- Continued slowdown of the housing market which will delay increases in water demand and thus delay the need for additional water supplies;
- Enhanced regional conservation efforts and programs to respond to the continued statewide dry conditions, reduced MWD imported supplies and the potential mandatory reduction in MWD imported supplies; and
- The Governor's call for a 20% statewide reduction in water use by 2020 is leading to the development and implementation of increased conservation programs statewide, including DWR's 20x20x20 conservation initiative, SWRCB's consideration of regulatory conservation programs, and legislation such as AB 2175.

Since April and during this summer discussions with the retail agencies also addressed the implementation of programs that are increasing local water supplies including the recycled water program (consistent with the expedited scheduled under the 3 Year Business Plan) and the expansion of the Chino Desalter production.

Appendix A contains the updated water demand and supply projections that were reviewed by the IEUA retail agencies. These projections will be used in the WEI modeling to complete the DYY CEQA process by December 31, 2008. The projections will also be used in the modeling analysis for the update of the Chino Basin Groundwater Recharge Master Plan (July 2010).

Conclusion

Total projected water demands and supplies for the IEUA service area over the next seven years are expected to range from 244,000 AFY to 260,000 AFY (increasing to 300,000 AFY by 2035). Overall, these updated forecasts still appear to be high when considering all of the current conditions facing the Chino Basin. In particular, the stronger, more aggressive conservation message that is being delivered by the Governor, State Water Resources Control Board, the California Department of Water Resources and MWD will reinforce local water efficiency programs and enhance the near and long term effectiveness of these efforts.

It is important to note that Chino Basin groundwater pumping by DYY participating agencies is projected to remain steady through 2015, at approximately 140,000 AFY, and then increase to approximately 175,000 AFY in 2035. This projection through 2015 reflects, in large part, the planned increase in other local water supplies (such as the growth in the direct use of recycled water from 12,000 AFY to 35,000 AFY) and lower overall water demands (due to increased

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[1] City of Pomona and Jurupa Community Services District initial demand forecasts were used for this analysis.

conservation) that will reduce the need for additional groundwater pumping. In the summer discussions, none of the IEUA retail agencies indicated that they expected to increase their respective Chino Basin groundwater replenishment obligations as a result of their groundwater pumping plans over the next ten years.

Chino Basin DYY participants projected groundwater use is lower (140,000 AFY in 2015 to 175,000 AFY in 2035) as compared to the initial forecasts of 180,000 AFY in 2015 to 200,000 AFY in 2035. Thus overall replenishment needs for MWD spreading supplies is significantly lower than previously projected. And opportunities exist to enhance storing supplemental supplies in the Chino Basin. For example, with a current recharge capacity for Chino Basin facilities at approximately 110,000 AFY with all the phase 1 and 2 improvements, the future replenishment of recycled water (20,000 AFY - 35,000 AFY by 2012 with a five year moving average) along with increased storm water capture will allow significant operating flexibility to use MWD supplies from the SWP when available (about 30-40 percent of the time) to achieve the Judgment requirements for replenishment. The additional combination of new in-lieu replenishment programs (30,000 AFY - 40,000 AFY) and aquifer storage and recovery (ASR) wells (10,000 – 15,000 AFY) can increase the Basin's annual "put" into storage capacity, producing a potential total of 150,000 AFY – 165,000 AFY of recharge capacity (assumes that in-lieu water is appropriately priced and ASR wells can be constructed under an expanded DYY program).

Current & Additional Chino Basin Recharge Capacities	
Basins	110,000 AFY
In-Lieu	30,000 – 40,000 AFY
ASR Wells	10,000 – 15,000 AFY
TOTAL	**150,000 – 165,000 AFY**

Recharge Capacity Sources: 1. Basins – Appendix B; 2. In-Lieu – historical data; and 3. ASR Wells – DYY Expansion

Appendix A

Chino Basin Updated Water Demand Supply Projections

Fontana Water Company - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	14,500.00	13,500.00	12,500.00	11,000.00	10,000.00	10,000.00	10,000.00	11,000.00	11,500.00	12,000.00	12,500.00
Other Basin Groundwater	16,500.00	14,000.00	13,000.00	12,000.00	11,000.00	11,000.00	11,000.00	12,000.00	13,000.00	13,500.00	14,000.00
Imported Water	10,000.00	12,000.00	14,000.00	16,000.00	18,000.00	18,000.00	18,000.00	18,000.00	18,000.00	18,000.00	18,000.00
Surface Water	4,500.00	4,500.00	4,500.00	4,500.00	4,500.00	4,500.00	4,500.00	5,000.00	6,000.00	6,000.00	6,000.00
Recycled Water	1,000.00	2,500.00	3,500.00	5,000.00	5,500.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00
Desalter Water	-	-	-	-	-	-	-	-	-	-	-
TOTAL	46,500.00	46,500.00	47,500.00	48,500.00	49,000.00	49,500.00	49,500.00	52,000.00	54,500.00	55,500.00	56,500.00

Cucamonga Valley Water District - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	16,598.00	16,598.00	18,787.00	18,787.00	21,229.00	21,229.00	21,229.00	26,729.00	32,229.00	37,729.00	37,729.00
Other Basin Groundwater	5,400.00	5,400.00	5,400.00	5,400.00	5,400.00	5,400.00	5,400.00	5,400.00	5,400.00	5,400.00	5,400.00
Imported Water	35,202.00	33,000.00	30,811.00	30,811.00	28,369.00	28,369.00	28,369.00	28,369.00	28,369.00	28,369.00	28,369.00
Surface Water	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00
Recycled Water	1,000.00	3,300.00	3,940.00	4,580.00	5,220.00	5,860.00	6,500.00	6,500.00	6,500.00	6,500.00	6,500.00
Desalter Water	-	-	-	-	-	-	-	-	-	-	-
TOTAL	60,700.00	60,798.00	61,438.00	62,078.00	62,718.00	63,358.00	63,998.00	69,498.00	74,998.00	80,498.00	80,498.00

Monte Vista Water District - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	20,000.00	16,000.00	16,000.00	16,000.00	16,000.00	16,000.00	17,000.00	18,500.00	20,000.00	21,500.00	21,500.00
Other Basin Groundwater	-	-	-	-	-	-	-	-	-	-	-
Imported Water	6,000.00	11,000.00	11,000.00	11,000.00	11,000.00	11,000.00	11,000.00	11,000.00	11,000.00	11,000.00	11,000.00
Surface Water	-	-	-	-	-	-	-	-	-	-	-
Recycled Water	150.00	300.00	400.00	400.00	400.00	400.00	400.00	450.00	500.00	500.00	500.00
Desalter Water	-	-	-	-	-	-	-	-	-	-	-
TOTAL	26,150.00	27,300.00	27,400.00	27,400.00	27,400.00	27,400.00	28,400.00	29,950.00	31,500.00	33,000.00	33,000.00

City of Upland- Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	1,433.00	1,284.00	1,284.00	2,140.00	2,140.00	2,140.00	2,140.00	2,140.00	2,140.00	2,140.00	2,140.00
Other Basin Groundwater	6,810.00	6,420.00	6,420.00	6,420.00	6,420.00	6,420.00	6,420.00	6,420.00	6,420.00	6,420.00	6,420.00
Imported Water	6,345.00	5,778.00	5,564.00	4,494.00	4,494.00	4,494.00	4,280.00	4,280.00	4,280.00	4,280.00	4,280.00
Purchased Water (SAWCO)	8,895.00	7,918.00	7,918.00	7,918.00	7,704.00	7,490.00	7,490.00	7,490.00	7,490.00	7,490.00	7,490.00
Recycled Water	-	-	214.00	428.00	642.00	856.00	1,070.00	1,070.00	1,070.00	1,070.00	1,070.00
Desalter Water	-	-	-	-	-	-	-	-	-	-	-
TOTAL	23,483.00	21,400.00	21,400.00	21,400.00	21,400.00	21,400.00	21,400.00	21,400.00	21,400.00	21,400.00	21,400.00

City of Ontario - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	26,000.00	25,000.00	24,000.00	23,000.00	23,000.00	23,000.00	23,000.00	26,000.00	28,000.00	30,000.00	30,000.00
Other Basin Groundwater	-	-	-	-	-	-	-	-	-	-	-
Imported Water	12,000.00	12,000.00	12,000.00	12,000.00	11,500.00	11,000.00	11,000.00	12,000.00	12,000.00	12,000.00	12,000.00
Surface Water	-	-	-	-	-	-	-	-	-	-	-
Recycled Water	4,000.00	5,000.00	6,000.00	7,000.00	8,000.00	9,000.00	9,000.00	9,000.00	9,000.00	9,000.00	9,000.00
Desalter Water	5,000.00	5,000.00	5,500.00	5,500.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00
TOTAL	47,000.00	47,000.00	47,500.00	47,500.00	48,500.00	49,000.00	49,000.00	53,000.00	55,000.00	57,000.00	57,000.00

Appendix A

Chino Basin Updated Water Demand Supply Projections

City of Chino - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	9,971.00	9,971.00	10,145.60	10,320.20	10,494.80	10,669.40	10,844.00	11,811.00	12,777.00	12,963.00	12,963.00
Other Basin Groundwater	-	-	-	-	-	-	-	-	-	-	-
Imported Water	3,600.00	3,600.00	3,600.00	3,600.00	3,600.00	3,600.00	3,600.00	3,600.00	3,600.00	3,600.00	3,600.00
Surface Water	-	-	-	-	-	-	-	-	-	-	-
Recycled Water	2,000.00	3,000.00	4,000.00	5,000.00	5,500.00	5,500.00	5,500.00	6,000.00	6,000.00	6,000.00	6,000.00
Desalter Water	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00
TOTAL	20,571.00	21,571.00	22,745.60	23,920.20	24,594.80	24,769.40	24,944.00	26,411.00	27,377.00	27,563.00	27,563.00

City of Chino Hills - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	12,500.00	14,200.00	14,500.00	14,800.00	15,100.00	15,400.00	15,400.00	16,000.00	16,000.00	16,000.00	16,000.00
Other Basin Groundwater	-	-	-	-	-	-	-	-	-	-	-
Imported Water	1,500.00	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00
Surface Water	-	-	-	-	-	-	-	-	-	-	-
Recycled Water	1,685.00	1,700.00	1,875.00	2,050.00	2,225.00	2,400.00	2,400.00	2,500.00	2,500.00	2,500.00	2,500.00
Desalter Water	4,200.00	4,200.00	4,200.00	4,200.00	4,200.00	4,200.00	4,200.00	4,200.00	4,200.00	4,200.00	4,200.00
TOTAL	19,885.00	21,300.00	21,775.00	22,250.00	22,725.00	23,200.00	23,200.00	23,900.00	23,900.00	23,900.00	23,900.00

Jurupa Community Services District - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	23,000.00	25,000.00	26,000.00	27,000.00	28,000.00	29,000.00	29,711.00	30,009.00	30,009.00	30,009.00	30,009.00
Other Basin Groundwater											
Imported Water											
Surface Water											
Recycled Water											
Desalter Water	8,700.00	8,700.00	8,700.00	8,700.00	8,700.00	8,700.00	8,700.00	8,700.00	8,700.00	8,700.00	8,700.00
TOTAL	31,700.00	33,700.00	34,700.00	35,700.00	36,700.00	37,700.00	38,411.00	38,709.00	38,709.00	38,709.00	38,709.00

City of Pomona - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	13,000.00	13,000.00	13,000.00	13,000.00	13,000.00	13,000.00	13,000.00	13,000.00	13,000.00	13,000.00	13,000.00
Other Basin Groundwater	7,500.00	7,500.00	7,500.00	7,500.00	7,500.00	7,500.00	7,500.00	7,500.00	7,500.00	7,500.00	7,500.00
Imported Water	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00	6,000.00
Surface Water	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00
Recycled Water	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00
Desalter Water	-	-	-	-	-	-	-	-	-	-	-
TOTAL	31,500.00	31,500.00	31,500.00	31,500.00	31,500.00	31,500.00	31,500.00	31,500.00	31,500.00	31,500.00	31,500.00

TOTAL IEUA Participants - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	101,002.00	96,553.00	97,216.60	96,047.20	97,963.80	98,438.40	99,613.00	112,180.00	122,646.00	132,332.00	132,832.00
Other Basin Groundwater	28,710.00	25,820.00	24,820.00	23,820.00	22,820.00	22,820.00	22,820.00	23,820.00	24,820.00	25,320.00	25,820.00
Imported Water	74,647.00	78,578.00	78,175.00	79,105.00	78,163.00	77,663.00	77,449.00	78,449.00	78,449.00	78,449.00	78,449.00
Surface Water	15,895.00	14,918.00	14,918.00	14,918.00	14,704.00	14,490.00	14,490.00	14,990.00	15,990.00	15,990.00	15,990.00
Recycled Water	9,835.00	15,800.00	19,929.00	24,458.00	27,487.00	30,016.00	30,870.00	31,520.00	31,570.00	31,570.00	31,570.00
Desalter Water	14,200.00	14,200.00	14,700.00	14,700.00	15,200.00	15,200.00	15,200.00	15,200.00	15,200.00	15,200.00	15,200.00
TOTAL	244,289.00	245,869.00	249,758.60	253,048.20	256,337.80	258,627.40	260,442.00	276,159.00	288,675.00	298,861.00	299,861.00

TOTAL DYY Participants - Water Demand & Supply Projections

Source of Water Use	2009	2010	2011	2012	2013	2014	2015	2020	2025	2030	2035
Chino Basin Groundwater	137,002.00	134,553.00	136,216.60	136,047.20	138,963.80	140,438.40	142,324.00	155,189.00	165,655.00	175,341.00	175,841.00
Other Basin Groundwater	36,210.00	33,320.00	32,320.00	31,320.00	30,320.00	30,320.00	30,320.00	31,320.00	32,320.00	32,820.00	33,320.00
Imported Water	80,647.00	84,578.00	84,175.00	85,105.00	84,163.00	83,663.00	83,449.00	84,449.00	84,449.00	84,449.00	84,449.00
Surface Water	17,895.00	16,918.00	16,918.00	16,918.00	16,704.00	16,490.00	16,490.00	16,990.00	17,990.00	17,990.00	17,990.00
Recycled Water	12,835.00	18,800.00	22,929.00	27,458.00	30,487.00	33,016.00	33,870.00	34,520.00	34,570.00	34,570.00	34,570.00
Desalter Water	22,900.00	22,900.00	23,400.00	23,400.00	23,900.00	23,900.00	23,900.00	23,900.00	23,900.00	23,900.00	23,900.00
TOTAL	307,489.00	311,069.00	315,958.60	320,248.20	324,537.80	327,827.40	330,353.00	346,368.00	358,884.00	369,070.00	370,070.00

Prepared by IEUA
8/28/08

DRAFT - Appendix B

Chino Basins Recharge Capacity & Recharge Sources: Recycled Water, Storm Water, Imported Water

Basin	Recharge Capacity cfs	Recharge Capacity AF per day	Total Capacity (80% Usage)	Recycled Water (20%) Title 22 Report	Recycled Water (20%) (AF)	Recycled Water (30%) (AF)	Recycled Water (50%) (AF)	Storm Water (30%) (AF)	Imported Water (50%) For basins with no RW then (70%) (AF)	Imported Water (40%) For basins with no RW then (70%) (AF)	Imported Water (20%) For basins with no RW then (70%) (AF)
Banana Basin	5	9.9	2,900	1,000	580	870	1,450	870	1,450	1,160	580
Declez Basins	6	11.9	3,500	500	690	1,040	1,730	1,040	1,730	1,390	690
Etiwanda Cons. Ponds	Not Developed			1,600							
Hickory Basin	5	9.9	2,900	1,300	580	870	1,450	870	1,450	1,160	580
Jurupa Basin	0	0.0	0	0	0	0	0	0	0	0	0
RP-3 Basins	7	13.9	4,000	2,400	810	1,210	2,020	1,210	2,020	1,620	810
Turner Basins	6	11.9	3,500	1,900	690	1,040	1,730	1,040	1,730	1,390	690
7th & 8th Street Basins	5	9.9	2,900	1,100	580	870	1,450	870	1,450	1,160	580
Etiwanda Debris Basin	7	13.9	4,000	2,400	810	1,210	2,020	1,210	2,020	1,620	810
Lower Day Basin	9	17.8	5,200	1,000	1,040	1,560	2,600	1,560	2,600	2,080	1,040
Brooks Street Basins	5	9.9	2,900	1,400	580	870	1,450	870	1,450	1,160	580
College Heights Basins	15	29.7	8,700	0	0	0	0	2,600	6,070	6,070	6,070
Montclair Basins	40	79.2	23,100	0	0	0	0	6,940	16,190	16,190	16,190
Upland Basin	20	39.6	11,600	0	0	0	0	3,470	8,090	8,090	8,090
San Sevaine Basins	50	99.0	28,900	4,100	5,780	8,670	14,450	8,670	14,450	11,560	5,780
Victoria Basin	6	11.9	3,500	1,400	690	1,040	1,730	1,040	1,730	1,390	690
Ely Basins	5	9.9	2,900	660	580	870	1,450	870	1,450	1,160	580
Subtotal			110,500	20,760	13,410	20,120	33,530	33,130	63,880	57,200	43,760

NOTES:

1. Recycled Water Recharge Capacity By Basin using Operations Data from FY2005/06 (assumes diluent water is available from stormwater or imported water)

2. In previous years, MWD replenishment water was thought to be available 7 out of 10 years. Under current conditions it is thought to be available only 3 out of 10 years. This is the assumption that is going into Wildermuth Environmental Inc. modeling efforts.

Inland Empire
UTILITIES AGENCY

Date: April 16, 2008

Prepared By: IEUA - Ryan Shaw, Kathy Tiegs, Martha Davis and Richard Atwater

Subject: Recharge Master Plan – Technical Memo (UWMP Scenarios)

Net Groundwater Replenishment Obligations through 2015 Based Upon Projected Water Demands and Available Supplies to the Chino Basin

Background

Chino Basin Watermaster and Inland Empire Utilities Agency (IEUA) are working together to update the 2002 Recharge Master Plan. The purpose of this memo is to analyze the current water use trends, water demands, replenishment, available supplies and in particular Chino groundwater pumping scenarios to eliminate the need for replenishment capacity.

In July 2007, Wildermuth Environmental Inc. (WEI) published the Optimum Basin Management Plan (OBMP) that described the "state" of the Chino Basin. ("State of the Basin – 2006," July 2007) As part of the OBMP, Watermaster conducted hydrogeologic investigations and collected new hydrogeologic data and is currently updating their hydrogeologic conceptual model of the Chino Basin.

The safe yield for Chino Basin is based primarily on accurate estimations of groundwater production, artificial recharge, and basin storage changes over time. Watermaster has been expanding its monitoring program extensively in order to get a better understanding for the current and future trends in groundwater production. The following are general trends in groundwater production:

- There was a basin wide increase in the number of wells producing over 1,000 AFY between 1978 and 2006. This is consistent with (1) the land use transition from agricultural to urban, (2) the trend of increasing imported water costs, and (3) the use of desalters.
- Since the implementation of the OBMP in 2000, the number of active production wells has decreased. This is consistent with the conversion of land use from agriculture to urban.
- Since the implementation of the OBMP in 2000, desalter pumping has commenced and has progressively increased to 16,542 AF in 2005/06.
- Since the implementation of the OBMP in 2000, groundwater production has decreased west of Euclid Avenue. This is consistent with (1) the MZ-1 Interim Management Plan, and (2) reduced the pumping in the City of Pomona, Monte Vista Water District and the City of Chino Hill, as these agencies have been participating in the Dry Year Yield Program.

- In accordance with the hypothesis that urbanization is the cause of decreased agricultural production, Appropriative Pool production tends to increase at approximately the same rate that Agricultural Pool production decreases.

In November 2007, Wildermuth Environmental Inc. (WEI) published a report for Chino Basin Watermaster, modeling and evaluating outcomes of the Peace II agreements. In March 2008, the Peace II agreements were approved. These agreements recognize that Hydraulic Control is an essential goal of the Watermaster and critical to the implementation of the Basin Plan for the Chino Basin. To accomplish this, Watermaster parties must pump 400,000 AF of water from the southern end of the basin creating a capture zone that prevents any measurable amount of low quality water from escaping into Prado Reservoir and eventually making its way into the Orange County aquifer. This controlled overdraft is a cornerstone to the plan approved by the court. By creating Hydraulic Control, the region will be allowed the continued use of recycled water for direct use on parks, golf courses and other non-potable demands, and also will be allowed the regulated use of recycled water for recharge into the Chino Ground Water Basin. The important question that came out of the Peace II agreements and WEI's report was whether there a need for additional groundwater recharge facilities in order to meet future replenishment obligations.

The Peace Agreement and the OBMP Implementation Plan both require Watermaster to develop a Recharge Master Plan. Program Element 2 of the OBMP set forth specific expectations and requirements for the development and implementation of specific recharge improvements.

With the adoption of the Peace II Measures, the parties to the Judgment assumed additional responsibilities to elevate the extent of their collective recharge efforts to address conditions arising from Basin Re-Operation and the effort to secure Hydraulic Control. (See e.g. Peace Agreement II Section 8.2.)

Watermaster committed to submitting an updated Recharge Master Plan to the Court for approval by July 10, 2010. In approving the Peace II Measures, the Court also added several procedural deadlines to ensure that the parties continued to make progress towards that end. Specifically, Watermaster must submit a detailed outline of the scope and content of the Recharge Master Plan to the Court for approval by July 1, 2008, and then make further progress reports on January 1, 2009 and July 1, 2009.

These commitments were restated to some degree and amplified in the Report of the Special Referee. These commitments that are inclusions for the Report are summarized as follows:

- A representation of baseline conditions that are clearly defined and supported by technical analysis. The "baseline condition" includes pumping demand, recharge capacity, total Basin water demand, and availability of replenishment water.

- An annual estimate of Safe Yield. The approach must be technically defensible.

- An evaluation of measures that can be taken to lessen or stop the projected Safe Yield decline. If a measure is practicable it should be evaluated in terms of potential benefits and feasibility.

- Annual evaluations and reporting on impacts on groundwater storage and water levels.

- Demand and imported water forecasts, supported by technical analysis for 2015, 2020, 2025 and 2030.

To address the finite character of the Basin resource, the Plan must include a detailed technical comparison of current and projected groundwater recharge capability and current and projected demand for groundwater.

This technical memorandum will review the baseline, future water demand and water supply projections, over the next fiver years and evaluate replenishment obligation in the Chino Basin.

Future Water Demand Projections

This section will discuss IEUA's Urban Water Management Plan, the retail agencies Urban Water Management Plan and Black & Veatch's future water demand projections, offer other future water demand projections that take into account recent events that are impacting water demands and supplies within the Chino Basin.

The adopted plan for future water demand and supply is the 2005 Urban Water Management Plan (UWMP). The UWMP is a public statement of the goals, objectives and strategies needed to maintain a reliable water supply for the IEUA service area. It is intended to be consistent with and to support the implementation of the Chino Basin Watermaster's OBMP.

Current Water Demand Projection Scenarios

IEUA completed its UWMP in November 2005, after receiving population, water supply and water demand projections from each of its retail agencies. The projections were based on an expected growth rate through 2025 that continued slightly lower through 2030. The UWMP forecasts water demands to increase from 255, 280 AF to 316,825 AF by 2015, approximately a 25% increase *without considering conservation efforts*. The UWMP forecasts water demand to increase from 255,280 AF to 373,374 AF by 2030, approximately a 45% increase *without considering conservation efforts*. (See Appendix A) IEUA estimates that the regional conservation programs will reduce the above demands by at least 10%. (2005 UWMP, Appendix Z) (Note: Jurupa Community Service District, Chino Desalter Authority's UWMP and the City of Pomona projections are not included in the IEUA UWMP, and they do include San Antonio Water Company as it is part of the IEUA service area.)

Over the past 4 months, Black and Veatch gathered projections for future water supplies in the Chino Basin for the Metropolitan Water District's Dry Year Yield expansion feasibility study. It is assumed that this data was developed based off of Fiscal Year 2006/07 actual water production. These forecasts show an increase from 266,298 AF to 342,484 AF by 2015, approximately a 30% increase. These forecasts show an increase from 266,298 AF to 383,339 AF by 2030, approximately a 45% increase. (See Appendix A) (Note: In order to compare these projections to IEUA's UWMP, Jurupa Community Services District and the City of Pomona data was not included. However these projections do include San Antonio Water Company as it is a part of the IEUA service area.)

The UWMP and Black & Veatch's water demand projections do not take into account recent events that are expected to reduce water demands in the near future. These events include the following:

Conservation efforts over the past two years have exceeded expectations. Southern California experienced a record dry year, last year, which has led to more intensive regional investments in indoor and outdoor conservation. These programs will continue to grow over the next five years in response to recent legal decisions that have reduced imported water supplies available to Southern California by 35%. In addition, on February 28, 2008 Governor Schwarzenegger called on a 20% reduction of daily water use by 2020.

The current recession facing California has already had significant economic impacts on the Inland Empire region. The housing market has dropped significantly and last year foreclosures were at the highest ever, in the San Bernardino and Riverside counties. These directly affect the projected growth in the Chino Basin, and therefore reduce the water demands.

Effectiveness in recent conservation efforts are can be seen on regional wastewater flow trends. In the Chino Basin, IEUA has experienced no growth in overall wastewater flows, effectively "flat-lining" the average daily flow. (Figure 1)

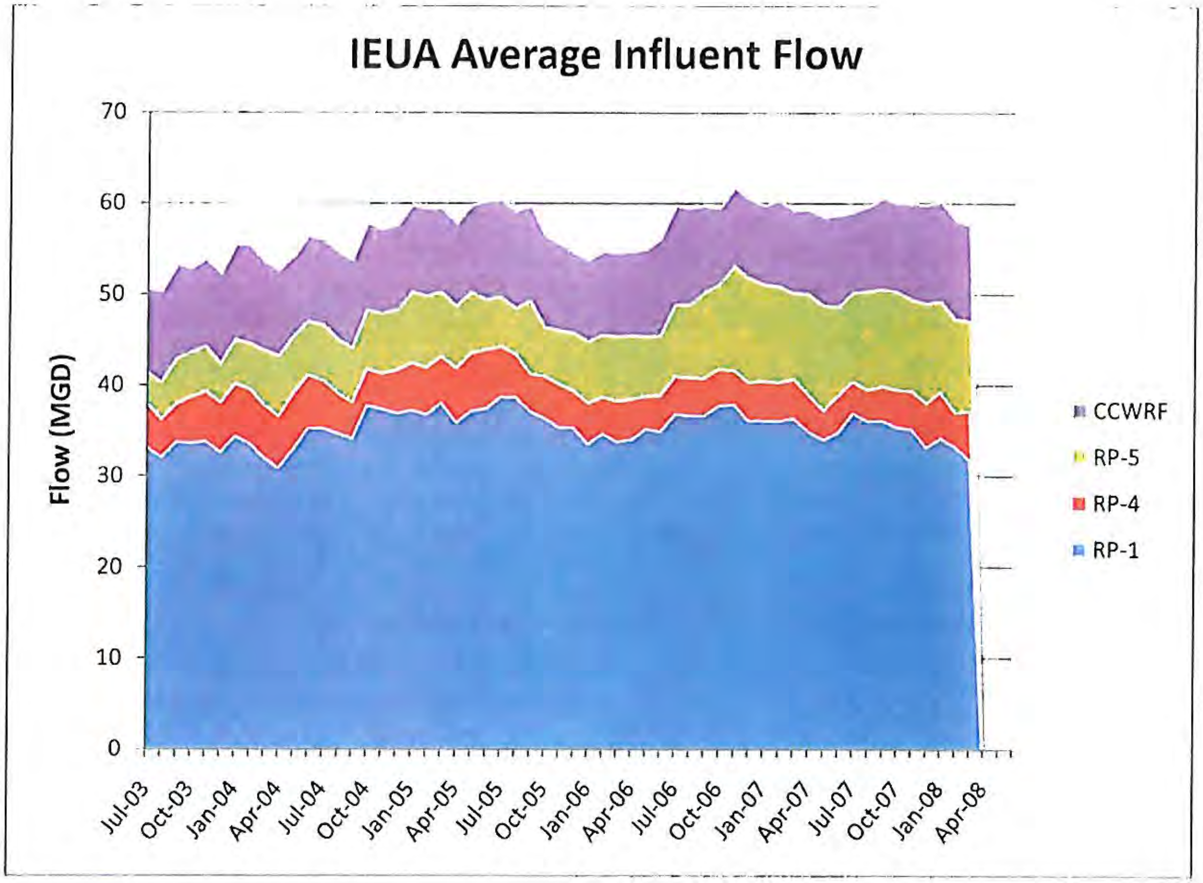


Figure 1 – Shows IEUA's average wastewater influent flow from 2003 to 2008.

Other Southern California agencies have observed similar trends in wastewater treatment. Los Angeles County and Orange County, which are built-out areas, are actually experiencing declines in wastewater flows. (See Exhibits 1 thru 3.)

Alternative Water Demand Projection Scenarios

Given the impacts of recent events on water demand, the following scenarios incorporate these factors below.

The first scenario comes from MWD's January 2008 "Drought Allocation Plan," in which IEUA's growth rate is set at 2.5%. (MWD's Drought Allocation Plan, 2008) Using MWD's growth rate, water demand projections are expected to increase from 255,280 AF to 268,204 AF by 2015, approximately a 5% increase. Using MWD's growth rate, water demand projections are expected to increase from 255,280 AF to 288,826 AF by 2030, approximately a 13% increase. (See attachment A)

The second scenario is IEUA's "adjusted water demand projection." Water demand projections are expected to decrease from 255,280 AF to 219,200 AF by 2015, approximately a 14% decrease. This scenario takes into account aggressive conservation, minimal growth, and historical trends in water demand. The Chino Basin can expect to see a similar response to a strong conservation message, as it did when Southern California reduced its demand dramatically after the 1988-1993 drought.

Figure 2 shows the comparison of all four water demand projections.

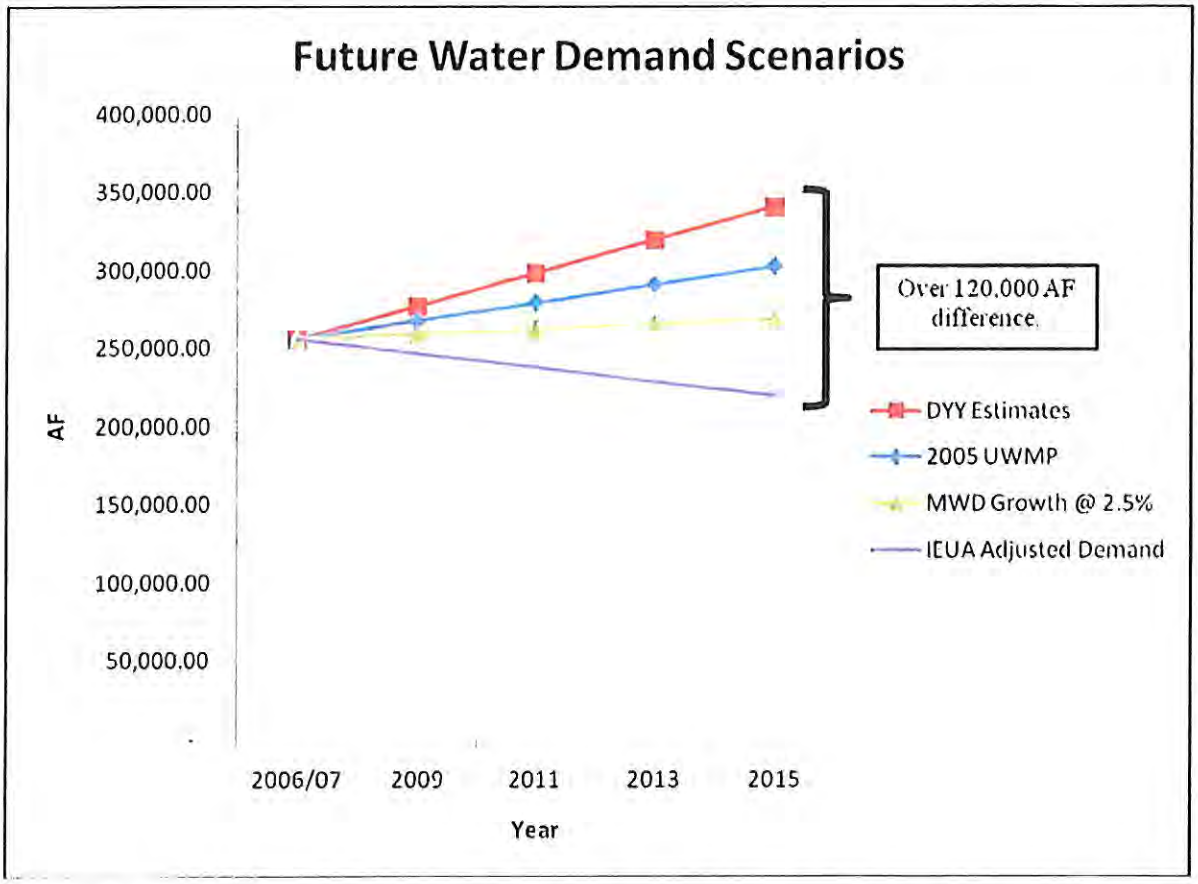


Figure 2 – Future water demand projections, comparing Black & Veatch, the UWMP, a MWD scenario and an IEUA adjusted demand scenario.

Overall, the projections produced by Black and Veatch appear to be significantly high when considering all the realities facing the Chino Basin. In FY 2006/07, California experienced the driest year on record, which also means California produced one of the highest water demand years on record. This suggests that using FY 2006/07 production data from the Chino Basin as a starting point for future projections, will extrapolate extremely high water demand projections. Taking all of the above factors into account, IEUA believes that the future water demand will be much lower than the projections mentioned above.

Future Water Supply Projections

The goal of the IEUA UWMP is to maximize local water sources and minimize the need for imported water, especially during dry years and other emergency shortages from MWD. The integrated plan strives to achieve multiple objectives of increased water supply, enhanced water quality, improved quality of life and energy savings. The UWMP projects that the expected increase of local supplies and the increase in conservation efforts will allow the Chino Basin to be self-reliant in future years, even during droughts.

The IEUA recently developed a 3-Year Recycled Water Business Plan that will increase the use of recycled water, which replaces the potable demand. For example, if recycled water is used in place of groundwater pumping, it will reduce the amount of water needed for groundwater replenishment. Not to mention recycled water is the only water resource that the Chino Basin can still increase, at a minimal cost, and it is virtually drought proof.

The Chino Desalter Authority is another reliable local water resource. The CDA is planning on continuing expanding its production over the next few years. This will reduce other groundwater pumping and will reduce imported water demand, which will be very beneficial in times of drought or emergency.

Overall, the increase of local supplies and conservation efforts will create a growing "cushion" between demand and available supply, with over 80,000 AF net supplies available over projected demand. (Figure 3) These available supplies can be expected to reduce the need for additional groundwater pumping and future replenishment requirements. Water supplies in the Chino Basin easily exceed the future demand, but suggest the need to continue increasing local supplies to allow the Chino Basin to be self-sufficient during a time emergency when no imported water supplies may be available. The increase in local supplies will reduce the groundwater pumping needed for past demands, which will reverse the need for replenishment/recharge that will no longer be required.

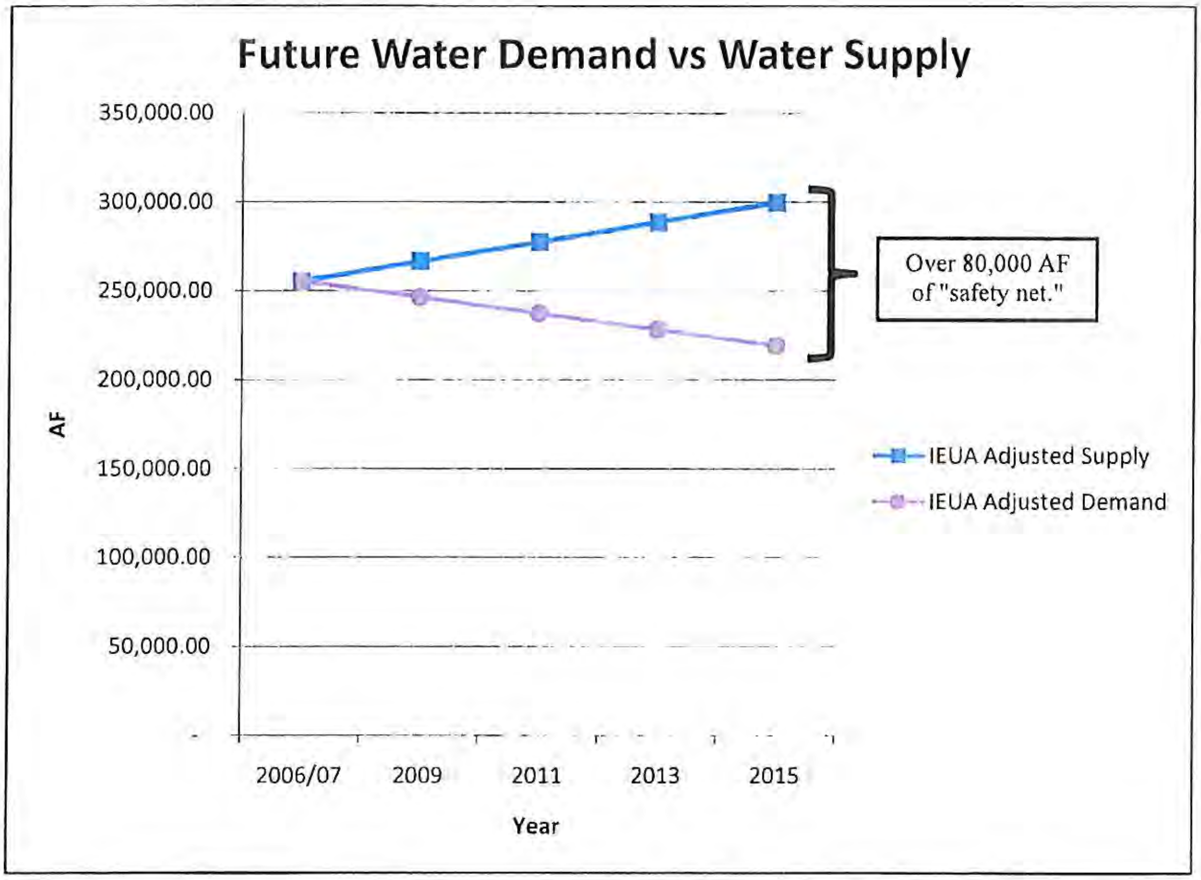


Figure 3 – Shows the comparison between water demand vs supply. There is a large "cushion" between demand and supply.

Net Replenishment Evaluation

Currently the recharge components in the Chino Basin include: the safe yield; the controlled overdraft; replenishment with wet water and by exchange; recharge for cyclic storage and other conjunctive use programs with wet water and by exchange; five-year, 6,500 AFY MZ1 recharge program; new yield from new storm water recharge; and desalter replenishment from new Santa Ana River recharge.

Under the assumptions of a decreasing or "flat-lining" future water demand and increasing development of local supplies, mentioned above, there is no need for additional recharge facilities within the next five years.

- Continued conversion of water rights, as mentioned in the 2006 State of the Basin Report, from the Non-Agricultural and Agricultural Pools to the Appropriative Pool will reduce the groundwater pumping and increase recycled water use. The Non-Ag Pool will shift 5,000 AF to the Appropriative Pool by converting large industries like California Steel Inc. and Sunkist to recycled water. There is no additional recharge required. The Ag Pool will shift 10,000 – 20,000 AF to the Appropriative Pool by converting Chino's Institute for Men (CIM) and others to recycled water.

- The implementation of the 3-Year Recycled Water Business Plan will increase direct reuse as well as recharge. On top of the increase in recycled water use is the decrease in groundwater pumping that would have taken place without the recycled water.
- The Dry Year Yield Program requires an increase in groundwater pumping; however there are not any additional recharge requirements, as a result of the In-Lieu Program.
- The Dry Year Yield Expansion Program will increase from 100,000 AF to 150,000 AF with the development of ASR wells, providing recharge capacity.
- The CDA expansion will be increasing production; however there will not be any additional recharge requirements.

Conclusion

The current conditions suggest that retail urban water demands will probably decrease over the next several years in the Chino Basin. Fiscal Year 2006/07 was the driest year on record, thus the highest water demand recorded in the Chino Basin. The continued conservation efforts and programs combined with the reduction in State Water Project water and the Governor's call for a 20% reduction, will keep the demand lower than what was projected in the UWMP and Black & Veatch's projections.

Continued development of the recycled water program, CDA expansion and conservation efforts will increase local supplies. These supplies are projected to be much higher than the retail urban demand, creating a 80,000 AF "cushion" between supply and demand. These expanding programs may reduce the projected increase in groundwater pumping. Thus, the projected replenishment obligation is not expected to exceed 20,000 AF per year prior to 2015.

Therefore, based on these water demand and water supply scenarios, IEUA staff suggests that with the current recharge facilities (about 90,000 to 100,000 AF) there is no need for additional recharge capacity. The budgeted improvements are adequate for the next 5-10 years. In-lieu replenishment and additional ASR wells can augment the recharge spreading capacity by an additional 25,000 to 40,000 AFY.

IEUA Retail Agencies

Water Demand & Supply Plans

APPENDIX A

	2006/2007 Actuals		IEUA Projected Supply	Black & Veatch Supply Projections	
City of Chino	**IEUA**	**Black & Veatch**	**Next 5 Years**	**2010**	**2015**
Chino Basin GW	8,908.93	8,861.00	8,000.00	9,288.00	12,514.00
CDA Supply (Chino Basin GW)	4,689.57	4,690.00	5,000.00	5,000.00	5,000.00
Other Basin GW	-	-	-	-	-
Imported Water	4,278.59	4,309.00	5,000.00	5,353.00	5,353.00
Recycled Water	2,303.92	3,612.00	5,500.00	4,936.00	7,250.00
Local Surface Water	-	-	-	-	-
Total	**20,181.01**	**21,472.00**	**23,500.00**	**26,587.00**	**32,132.00**
			IEUA's Range of Demand	**17,300 to 20,500**	

City of Chino Hills	**IEUA**	**Black & Veatch**	**Next 5 Years**	**2010**	**2015**
Chino Basin GW	5,190.34	4,154.00	See MVWD	See MVWD	See MVWD
CDA Supply (Chino Basin GW)	3,253.07	5,532.00			
Other Basin GW	-	-			
Imported Water	10,459.49	1,395.00			
Recycled Water	1,630.57	2,942.00			
Local Surface Water	-	-			
Total	**20,533.48**	**14,023.00**			
			IEUA's Range of Demand	**See MVWD**	

CVWD	**IEUA**	**Black & Veatch**	**Next 5 Years**	**2010**	**2015**
Chino Basin GW	18,786.47	18,787.00	20,000.00	33,500.00	38,300.00
CDA Supply (Chino Basin GW)	-	-	-	-	-
Other Basin GW	6,308.04	6,308.00	6,500.00	5,400.00	5,400.00
Imported Water	32,825.07	32,825.00	32,000.00	29,000.00	29,000.00
Recycled Water	253.28	147.00	4,000.00	3,700.00	7,500.00
Local Surface Water	4,368.77	4,369.00	5,000.00	2,500.00	2,500.00
Total	**62,541.63**	**62,436.00**	**67,500.00**	**74,100.00**	**82,700.00**
			IEUA's Range of Demand	**55,000 to 64,000**	

FWC	**IEUA**	**Black & Veatch**	**Next 5 Years**	**2010**	**2015**
Chino Basin GW	16,218.42	16,218.00	20,000.00	25,000.00	25,000.00
CDA Supply (Chino Basin GW)	-	-	-	-	-
Other Basin GW	24,351.20	25,051.00	25,000.00	22,600.00	22,600.00
Imported Water	-	-	5,000.00	23,000.00	23,000.00
Recycled Water	-	-	6,000.00	2,600.00	5,000.00
Local Surface Water	9,971.32	10,263.00	12,000.00	11,000.00	11,000.00
Total	**50,540.94**	**51,532.00**	**68,000.00**	**84,200.00**	**86,600.00**
			IEUA's Range of Demand	**43,000 to 55,000**	

MVWD*	IEUA	Black & Veatch	Next 5 Years	2010	2015
Chino Basin GW	8,529.52	11,279.00	14,000.00	15,372.00	18,567.00
CDA Supply (Chino Basin GW)	-	-	5,000.00	4,200.00	4,200.00
Other Basin GW	-	-	-	9,617.00	10,052.00
Imported Water	3,845.66	11,484.00	16,000.00	13,351.00	11,856.00
Recycled Water	-	-	3,500.00	3,300.00	4,500.00
Local Surface Water	-	-	-	-	-
Total	**12,375.18**	**22,763.00**	**38,500.00**	**45,840.00**	**49,175.00**

IEUA's Range of Demand	**30,300 to 34,500**

City of Ontario	IEUA	Black & Veatch	Next 5 Years	2010	2015
Chino Basin GW	28,014.11	28,014.00	30,000.00	28,000.00	32,400.00
CDA Supply (Chino Basin GW)	4,961.95	5,070.00	7,500.00	8,921.00	8,921.00
Other Basin GW	-	-	-	-	-
Imported Water	13,219.30	13,314.00	12,000.00	16,500.00	16,500.00
Recycled Water	3,672.65	-	8,600.00	7,900.00	8,800.00
Local Surface Water	-	-	-	-	-
Total	**49,868.01**	**46,398.00**	**58,100.00**	**61,321.00**	**66,621.00**

IEUA's Range of Demand	**43,600 to 51,000**

City of Upland	IEUA	Black & Veatch	Next 5 Years	2010	2015
Chino Basin GW	1,270.71	2,237.00	2,000.00	4,000.00	4,000.00
CDA Supply (Chino Basin GW)	-	-	-	-	-
Other Basin GW	15,494.55	14,074.00	15,000.00	13,632.00	15,383.00
Imported Water	4,825.00	4,725.00	7,000.00	6,300.00	5,588.00
Recycled Water	16.74	-	800.00	400.00	1,000.00
Local Surface Water	2,199.11	2,342.00	2,000.00	1,300.00	1,300.00
Total	**23,806.11**	**23,378.00**	**26,800.00**	**25,632.00**	**27,271.00**

IEUA's Range of Demand	**19,500 to 24,200**

San Antonio	IEUA	Black & Veatch	Next 5 Years	2010	2015
Chino Basin GW	3,113.08	3,113.08	5,000.00	-	-
CDA Supply (Chino Basin GW)	-	-	-	-	-
Other Basin GW	7,676.13	7,676.13	7,000.00	-	-
Imported Water	-	-	-	-	-
Recycled Water	-	-	-	-	-
Local Surface Water	4,644.44	4,644.44	5,000.00	-	-
Total	**15,433.65**	**15,433.65**	**17,000.00**	**-**	**-**

IEUA's Range of Demand	**10,500 to 14,000**

Total for Appropriators	IEUA	Black & Veatch	Next 5 Years	2010	2015
Chino Basin GW	90,031.58	92,663.08	99,000.00	115,160.00	130,781.00
CDA Supply (Chino Basin GW)	12,904.59	15,292.00	17,500.00	18,121.00	18,121.00
Other Basin GW	53,829.92	53,109.13	53,500.00	51,249.00	53,435.00
Imported Water	69,453.11	68,052.00	77,000.00	93,504.00	91,297.00
Recycled Water	7,877.15	6,701.00	28,400.00	22,836.00	34,050.00
Local Surface Water	21,183.64	21,618.44	24,000.00	14,800.00	14,800.00
Total	**255,279.99**	**257,435.65**	**299,400.00**	**315,670.00**	**342,484.00**

IEUA's Range of Demand	**219,200 to 263,200**

* Probable Retail Demands & Total Supply Available include MVWD and Chino Hills projections.

APPENDIX B

FY 2006/07 Total Comparison**	IEUA	Black & Veatch	Difference
Chino Basin GW	90,031.58	92,663.08	2,631.50
CDA Supply (Chino Basin GW)	12,904.59	15,292.00	2,387.41
Other Basin GW	53,829.92	53,109.13	(720.79)
Imported Water	69,453.11	68,052.00	(1,401.11)
Recycled Water	7,877.15	6,701.00	(1,176.15)
Local Surface Water	21,183.64	21,618.44	434.80
Total	**255,279.99**	**257,435.65**	**2,155.66**

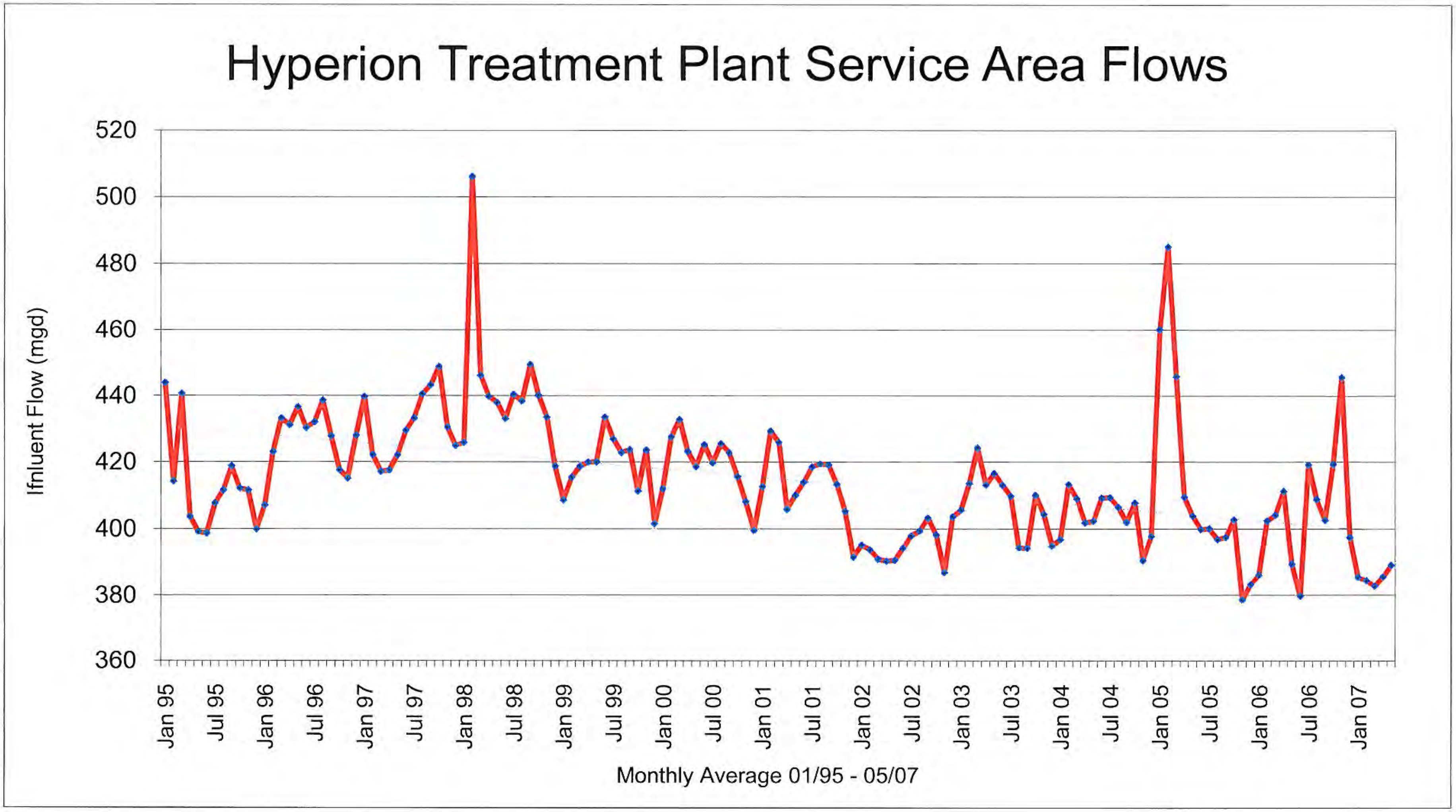
**Comparison doesn't include JSCD or Pomona

APPENDIX C

2015 Total Supply Comparison**	IEUA	Black & Veatch	Difference
Chino Basin GW	99,000.00	130,781.00	31,781.00
CDA Supply (Chino Basin GW)	17,500.00	18,121.00	621.00
Other Basin GW	53,500.00	53,435.00	(65.00)
Imported Water	77,000.00	91,297.00	14,297.00
Recycled Water	28,400.00	34,050.00	5,650.00
Local Surface Water	24,000.00	14,800.00	(9,200.00)
Total	**299,400.00**	**342,484.00**	**43,084.00**

**Comparison doesn't include JSCD or Pomona

Exhibit 1


Hyperion Treatment Plant Service Area Flows
Ifnluent Flow (mgd)
520
500
480
460
440
420
400
380
360
Jan 95
Jul 95
Jan 96
Jul 96
Jan 97
Jul 97
Jan 98
Jul 98
Jan 99
Jul 99
Jan 00
Jul 00
Jan 01
Jul 01
Jan 02
Jul 02
Jan 03
Jul 03
Jan 04
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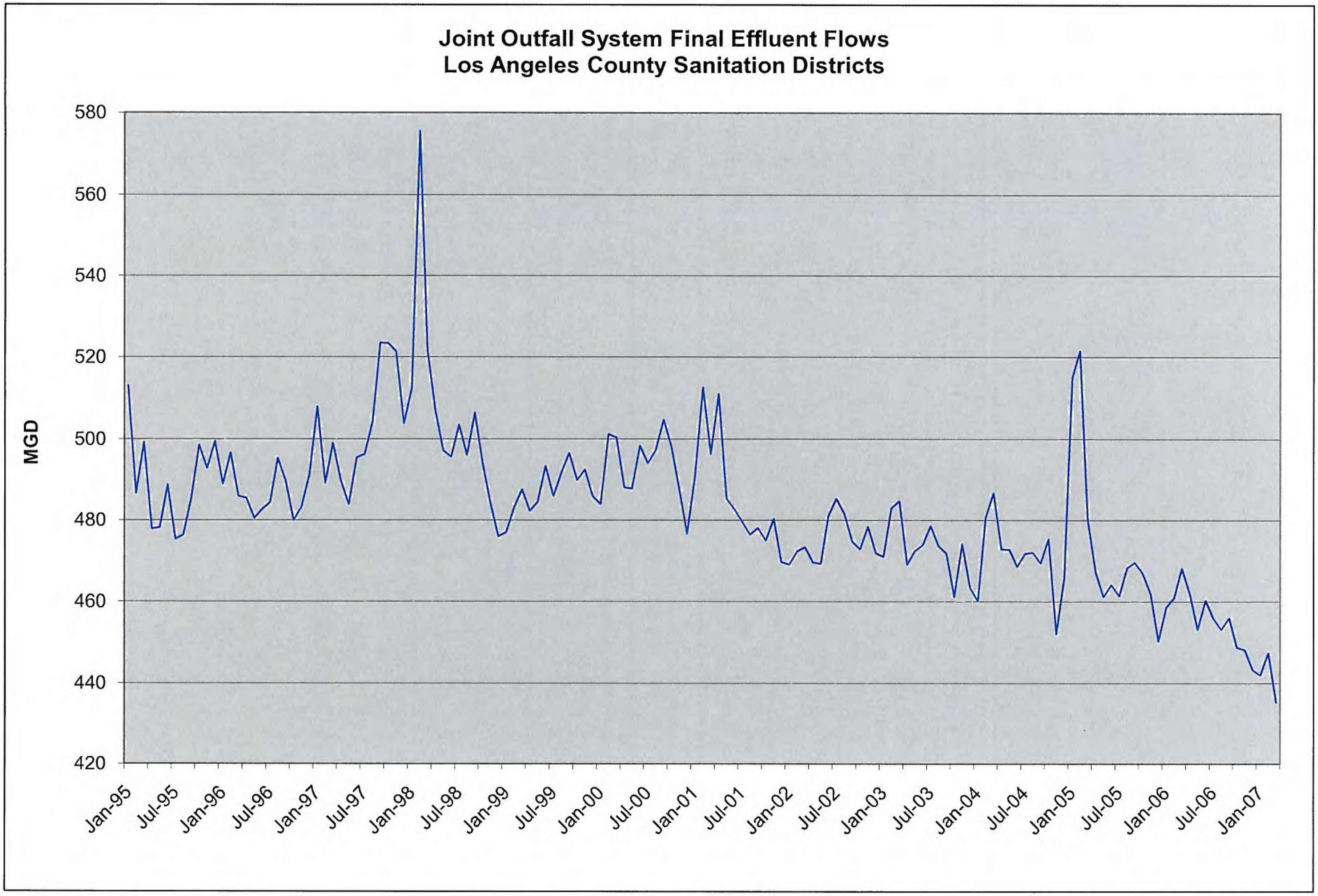
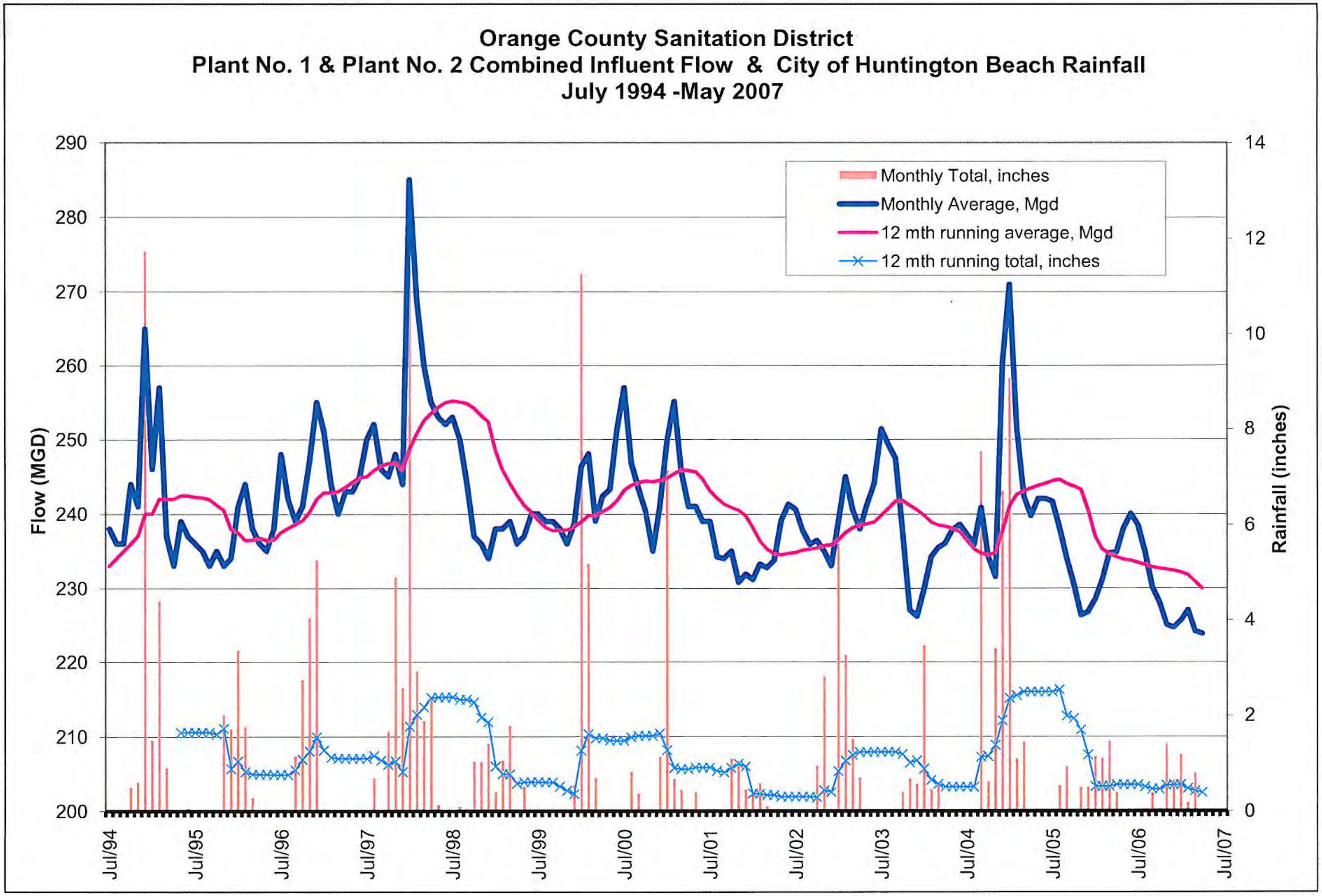
Jan 05
Jul 05
Jan 06
Jul 06
Jan 07
Monthly Average 01/95 - 05/07

Exhibit 2



Joint Outfall System Final Effluent Flows
Los Angeles County Sanitation Districts

Exhibit 3



Orange County Sanitation District
Plant No. 1 & Plant No. 2 Combined Influent Flow & City of Huntington Beach Rainfall
July 1994 -May 2007

g:\excel.dta\om\820\schwab\flow\GWR Master Plan TM 3-31-08

5/5/2010

Chino Basin Conjunctive Use Program (Dry Year Yield)
FY 2007-08 Monthly Retail Demand by Source of Supply (Baseline), FY 2008-09 Actual DYY Performance & FY 2009-10 DRAFT DYY Tracking Summary

FY 2007-08 Monthly Retail Demand by Source of Supply (Baseline)

IEUA & TVMWD	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Chino Groundwater	10,558.91	11,381.40	11,888.63	11,130.09	9,533.62	8,543.37	7,126.87	5,068.02	4,442.98	4,428.83	6,157.38	8,238.09	98,498.19
Imported Water (MWD)	6,994.40	8,422.34	10,214.54	10,810.64	8,955.65	7,611.24	6,037.94	4,173.19	3,886.44	2,408.26	4,953.30	5,796.83	80,264.75
Other Groundwater	2,191.84	2,252.56	2,244.74	2,080.98	1,840.06	1,563.02	1,442.36	744.04	797.80	593.01	1,033.39	1,188.05	17,971.85
Local Surface Water	284.08	248.24	529.51	495.16	426.23	376.69	354.74	353.77	428.75	1,103.90	1,230.82	1,068.52	6,900.40
Desalter Water (CDA)	1,861.82	1,895.70	2,025.36	2,118.56	2,128.82	2,171.52	1,971.52	1,961.33	1,761.53	1,938.76	2,060.11	1,920.76	23,815.79
Total	21,891.05	24,200.24	26,902.77	26,635.43	22,884.38	20,265.84	16,933.43	12,300.36	11,317.49	10,472.76	15,435.00	18,212.25	227,450.99

FY 2008-09 - Actual DYY Performance

IEUA & TVMWD	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Chino Groundwater	10,767.86	11,685.09	12,752.67	12,096.63	10,982.62	10,214.33	8,083.34	6,429.54	7,723.21	5,927.23	8,779.07	9,183.02	114,624.62
Imported Water (MWD)	4,724.27	5,556.26	6,592.80	7,413.99	6,417.91	6,155.38	4,234.24	2,483.36	1,965.67	68.15	104.89	2,157.13	47,874.05
Other Groundwater	1,835.69	2,389.48	2,752.62	2,279.22	2,288.89	2,011.71	1,807.76	972.24	1,422.74	1,039.06	1,658.24	1,863.29	22,320.94
Local Surface Water	926.54	807.16	394.56	293.38	261.37	296.55	244.94	292.83	390.27	632.82	955.25	879.02	6,374.69
Desalter Water (CDA)	1,958.91	2,047.02	2,140.83	2,240.40	2,199.46	2,168.99	1,985.15	2,022.50	2,017.24	1,768.74	1,780.62	1,747.01	24,076.87
Total	20,213.27	22,485.01	24,633.49	24,323.62	22,150.24	20,846.97	16,355.42	12,200.47	13,519.12	9,436.00	13,278.07	15,829.48	215,271.17

FY 2009-10 - DRAFT DYY Tracking Summary

IEUA & TVMWD	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Chino Groundwater	10,009.36	9,728.08	11,438.19	11,665.98	10,648.53	7,126.47	6,195.58	3,926.37	3,673.42	3,847.25	4,015.64	-	82,274.86
Imported Water (MWD)	2,793.58	2,490.99	5,217.21	5,302.69	5,832.60	4,607.80	3,685.29	2,990.08	2,761.72	713.47	777.58	-	37,173.02
Other Groundwater	1,493.57	1,386.97	1,634.68	1,630.39	1,550.62	1,393.40	1,114.93	686.16	622.52	482.69	382.16	-	12,378.10
Local Surface Water	2,140.51	1,783.96	1,951.85	1,937.90	1,386.01	1,301.46	1,386.18	965.71	840.43	895.49	886.92	-	15,476.40
Desalter Water (CDA)	1,721.01	1,641.10	1,854.65	2,102.21	1,956.21	1,903.26	1,166.83	1,238.77	1,287.72	1,138.68	1,283.54	-	17,293.97
Total	18,158.02	17,031.11	22,096.58	22,639.16	21,373.96	16,332.40	13,548.81	9,807.09	9,185.81	7,077.58	7,345.84	-	177,506.85

Potable Water Demand Tracking

Potable Water Performance	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Change in Chino Groundwater	(549.55)	(1,653.32)	(450.44)	535.89	1,114.91	(1,416.90)	(931.29)	(1,141.65)	(769.56)	(581.58)	(2,141.75)		(7,985.24)
Change in Imported Water (MWD)	(4,200.82)	(5,931.35)	(4,997.32)	(5,507.96)	(3,123.04)	(3,003.44)	(2,352.65)	(1,183.11)	(1,124.71)	(1,694.78)	(4,175.71)		(37,294.90)
Change in Other Groundwater	(698.27)	(865.59)	(610.06)	(450.59)	(289.44)	(169.61)	(327.43)	(57.88)	(175.28)	(110.32)	(651.23)		(4,405.70)
Change in Local Surface Water	1,856.43	1,535.72	1,422.34	1,442.74	959.78	924.77	1,031.44	611.94	411.68	(208.41)	(343.91)		9,644.52
Change in Desalter Water (CDA)	(140.81)	(254.60)	(170.71)	(16.36)	(172.61)	(268.26)	(804.69)	(722.56)	(473.81)	(800.08)	(776.57)		(4,601.06)
Change in Potable Demand	(3,733.03)	(6,914.53)	(4,635.48)	(3,979.92)	(1,337.31)	(3,665.10)	(2,579.93)	(1,770.70)	(1,657.87)	(2,595.10)	(7,312.59)	-	(40,182.14)

Non-Potable Water Demand Tracking

Non-Potable Water Performance	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
FY 2007-08 Recycled Water	496.80	776.20	919.00	800.12	1,094.67	642.20	457.82	338.05	280.48	219.37	662.67	586.58	7,273.94
FY 2008-09 Recycled Water	914.95	1,026.94	1,233.58	1,201.40	1,308.07	1,331.43	942.97	574.57	272.75	507.43	313.85	703.96	10,331.90
FY 2009-10 Recycled Water	968.40	1,186.80	2,723.88	2,495.13	2,195.31	1,866.41	1,277.19	601.10	266.56	119.66	-	-	13,700.44
Change in Non-Potable Demand	471.60	410.60	1,804.88	1,695.01	1,100.65	1,224.21	819.37	263.05	(13.92)	(99.71)			7,675.75

DRAFT 08/09 CUP Certification Plan	5,350.33	6,081.34	5,345.08	4,324.06	3,636.97	3,174.70	2,307.08	1,429.88	285.00	285.00	201.00	-	32,924.50
Actual 08/09 CUP Certification	4,040.77	6,024.77	7,748.32	5,213.14	3,156.50	1,289.70	2,410.10	2,022.09	522.30	72.10	-	-	32,505.49
Actual 08/09 IX Certification	274.40	341.32	406.55	584.43	1,087.10	1,165.37	545.63	337.58	206.97	237.05	-	-	5,176.70

DRAFT 09/10 CUP Certification Plan	6,519.93	8,518.44	2,462.50	2,465.66	2,396.67	2,141.38	2,042.68	536.48	1,451.60	1,491.00	1,397.60	187.40	33,382.00
Actual 09/10 CUP Certification	9,420.70	8,692.70	7,244.02	4,478.50	1,807.60	853.10	562.62	187.60	-	-	-	-	33,046.84
Actual 09/10 IX Certification	2,054.50	1,971.90	1,233.20	842.10	584.50	570.80	562.62	187.60	-	-	-	-	8,007.22

DYY Obligation = 33,000 AF

Data highlighted in red is incomplete...missing data.

Appendix A

FY 2008-09 Water Use Data

City of Chino	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	962.1	951.2	917.8	985.2	629.5	407.0	674.3	402.1	611.6	311.9	856.0	779.9	8,488.6
Imported Water (MWD)	505.3	459.8	299.6	252.0	200.4	146.9	36.7	0.0	0.0	216.1	332.1	266.9	2,715.8
DYY (MWD)	0.0	0.0	0.0	238.4	629.5	175.2	0.0	0.0	0.0	0.0	0.0	0.0	1,043.1
Recycled Water	494.2	466.6	515.9	694.1	381.3	300.2	77.5	197.0	142.7	410.4	474.6	472.4	4,626.8
Desalter Water (CDA)	475.2	484.6	464.1	468.3	406.6	389.1	388.5	380.4	430.7	371.0	395.5	390.8	5,044.8
Total	2,436.8	2,362.2	2,197.4	2,399.6	1,617.8	1,243.2	1,177.1	979.5	1,185.0	1,309.3	2,058.2	1,910.0	20,876.1

City of Chino Hills	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	849.3	786.4	772.8	633.0	341.4	210.8	444.4	378.2	690.8	694.1	826.0	864.1	7,491.3
Imported Water (MWD)	911.1	859.9	661.4	807.8	515.6	263.8	148.2	0.0	0.0	369.9	489.4	383.7	5,410.8
DYY (MWD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recycled Water	110.8	238.5	161.9	140.6	124.0	47.7	39.0	40.8	32.9	85.8	119.6	143.2	1,284.8
Desalter Water (CDA)	321.8	399.7	389.6	329.4	423.6	417.9	426.4	350.4	361.7	329.4	383.5	374.7	4,508.0
MVWD Well Water	659.1	653.2	606.8	470.2	341.4	210.8	252.2	275.5	407.2	418.9	518.1	573.1	5,386.5
MVWD/WFA Allotment	911.1	859.9	661.4	807.8	515.6	263.8	148.2	0.0	0.0	369.9	489.4	383.7	5,410.8
Total	2,193.1	2,284.5	1,985.6	1,910.7	1,404.5	940.3	1,058.0	769.4	1,085.4	1,479.3	1,818.5	1,765.7	18,694.9

City of Ontario	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	3,537.5	2,957.0	2,487.3	2,307.4	2,158.4	2,366.7	2,633.7	1,612.0	2,368.2	2,855.0	3,299.0	2,949.0	31,531.2
Imported Water (MWD)	517.5	856.1	828.4	850.8	577.1	440.3	66.6	0.0	0.0	42.0	0.0	5.5	4,184.3
DYY (MWD)	2,000.0	2,000.0	2,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,299.0	2,949.0	12,248.0
Recycled Water	529.4	421.8	559.6	423.7	400.1	205.9	120.0	259.6	60.6	169.4	298.3	506.8	3,955.1
Desalter Water (CDA)	513.1	494.0	500.1	369.1	469.2	490.7	472.6	421.4	393.3	409.2	405.9	318.5	5,257.1
Total	5,097.5	4,728.9	4,375.4	3,951.0	3,604.8	3,503.6	3,292.9	2,293.0	2,822.0	3,475.6	4,003.2	3,779.8	44,927.7

City of Upland	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	330.4	259.2	301.5	326.9	325.6	307.3	344.2	261.4	371.3	198.9	288.8	359.0	3,674.4
Imported Water (MWD)	605.1	988.5	889.3	830.1	144.0	174.0	28.7	0.0	0.0	58.9	10.7	3.4	3,732.7
DYY (MWD)	330.0	259.0	302.0	326.9	275.6	217.6	272.3	72.1	0.0	0.0	288.8	359.0	2,703.3
Other Groundwater	1,583.2	1,151.3	1,160.3	1,034.2	1,210.1	577.5	1,039.1	497.4	842.4	952.7	1,674.7	1,424.9	13,148.0
Local Surface Water	6.1	0.0	0.0	0.0	0.0	0.0	0.0	156.2	311.7	400.6	357.4	357.4	1,589.2
Recycled Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2,524.8	2,399.0	2,351.1	2,191.2	1,679.7	1,058.8	1,411.9	915.0	1,525.4	1,611.1	2,331.6	2,144.7	22,144.2

CVWD	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	2,532.3	2,527.1	2,180.2	1,980.2	1,498.8	1,131.2	1,165.7	1,451.3	2,226.4	1,975.3	2,653.7	2,354.8	23,677.0
Imported Water (MWD)	3,073.5	3,128.8	2,856.8	2,741.1	2,181.9	1,213.1	1,590.9	50.3	82.5	1,378.0	1,634.9	1,535.1	21,466.8
DYY (MWD)	2,532.3	2,527.1	0.0	44.4	1,498.8	1,131.2	0.0	0.0	0.0	0.0	2,653.7	2,354.8	12,742.3
Recycled Water	98.9	71.8	64.3	64.5	27.9	10.4	28.5	8.8	72.7	29.1	75.9	64.4	617.3
Other Groundwater	710.8	713.6	662.0	621.1	318.5	188.0	241.9	401.8	652.1	694.8	769.8	708.1	6,682.3
Local Surface Water	388.5	293.4	261.4	296.6	244.9	292.8	390.3	476.7	643.6	478.5	690.6	393.0	4,850.2
Total	6,804.0	6,734.7	6,024.7	5,703.5	4,272.0	2,835.5	3,417.2	2,388.9	3,677.3	4,555.5	5,824.8	5,055.4	57,293.6

Fontana Water Co	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	2,899.9	2,499.3	2,425.6	1,334.9	716.7	170.4	279.9	263.1	294.4	756.1	697.3	1,031.7	13,369.1
Imported Water (MWD)	406.0	747.3	425.8	500.8	369.0	303.1	49.2	0.0	0.0	376.3	1,178.8	1,304.1	5,660.4
Other Groundwater	1,537.4	1,537.4	1,435.8	2,095.2	1,955.2	1,595.8	2,019.5	1,364.6	1,797.6	1,982.5	1,896.9	1,772.4	20,990.2
Local Surface Water	296.9	253.9	331.4	431.7	426.3	549.3	593.7	654.8	919.8	586.6	481.1	587.4	6,112.9
Total	5,140.2	5,037.8	4,618.6	4,362.6	3,467.2	2,618.6	2,942.3	2,282.5	3,011.7	3,701.4	4,254.1	4,695.6	46,132.6

MVWD	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	892.7	861.8	743.9	859.3	868.1	836.4	481.4	408.1	392.6	570.7	1,018.6	941.4	8,875.1
Imported Water (MWD)	190.4	287.9	233.8	80.3	7.2	298.8	32.3	0.0	0.0	0.2	8.1	0.5	1,139.3
DYY (MWD)	1,700.0	0.0	0.0	0.0	292.0	533.0	250.0	0.0	0.0	0.0	1,536.0	1,514.0	5,825.0
Recycled Water	0.0	2.5	6.4	8.4	9.7	10.3	7.8	1.3	5.0	9.4	20.8	18.0	99.6
Total	1,083.1	1,152.2	984.2	948.0	885.0	1,145.5	521.4	409.4	397.5	580.3	1,047.4	959.9	10,114.0

San Antonio Water Co	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	349.4	341.8	303.9	245.7	263.0	302.3	295.4	232.2	373.9	397.2	405.1	296.2	3,806.0
Other Groundwater	925.6	563.0	517.2	449.7	590.1	70.7	325.2	130.0	225.6	371.5	819.8	608.9	5,597.4
Local Surface Water	344.5	286.7	206.2	173.2	143.1	208.7	235.9	412.7	654.8	694.3	514.3	338.1	4,212.6
Total	1,619.4	1,191.5	1,027.3	868.7	996.2	581.8	856.5	774.9	1,254.2	1,463.1	1,739.2	1,243.2	13,616.0

TOTAL	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	12,353.6	11,183.7	10,133.1	8,672.7	6,801.5	5,732.1	6,318.9	5,008.4	7,329.0	7,759.1	10,044.4	9,576.0	100,912.6
Recycled Water	1,233.3	1,201.2	1,308.1	1,331.4	943.0	574.6	272.8	507.4	313.8	704.0	989.2	1,204.9	10,583.6
Other Groudwater	4,756.9	3,965.4	3,775.4	4,200.2	4,073.8	2,432.0	3,625.7	2,393.8	3,517.7	4,001.5	5,161.1	4,514.3	46,417.9
Surface Water	1,035.9	834.0	799.0	901.5	814.3	1,050.9	1,219.8	1,700.4	2,529.8	2,159.9	2,043.5	1,675.9	16,764.9
Desalter	1,310.1	1,378.3	1,353.8	1,166.8	1,299.4	1,297.7	1,287.5	1,152.2	1,185.6	1,109.6	1,184.9	1,084.0	14,809.9
Imported Water (MWD)	6,208.9	7,328.3	6,195.1	6,062.8	3,995.2	2,840.0	1,952.6	50.3	82.5	2,441.4	3,653.9	3,499.2	44,310.2
DYY (MWD)	6,562.3	4,786.1	2,302.0	609.7	2,695.9	2,057.0	522.3	72.1	0.0	0.0	7,777.5	7,176.7	34,561.7
Totals	26,898.8	25,890.9	23,564.4	22,335.3	17,927.2	13,927.3	14,677.3	10,812.6	14,958.5	18,175.6	23,077.0	21,554.2	233,799.1

Note DYY data is shown for each agency It is not included in the total columns. It is accounted for in the Chino Basin Groundwater resource

Appendix A

FY 2007-08 Water Use Data

City of Chino	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	1,071.2	1,107.0	636.4	603.3	530.7	206.6	194.7	284.1	440.7	894.1	764.2	875.3	7,608.3
Tier 1 (MWD)	460.5	514.6	539.4	483.7	394.8	244.8	277.0	183.6	257.7	181.2	331.6	499.9	4,368.8
DYY (MWD)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-
Recycled Water	244.2	204.5	379.5	197.1	24.9	122.6	165.5	89.7	323.3	270.0	426.9	448.2	2,896.5
Desalter Water (CDA)	381.6	450.9	466.6	478.7	418.2	478.3	471.1	463.2	484.2	467.3	472.4	423.1	5,455.6
Total	2,157.5	2,277.0	2,021.9	1,762.8	1,368.6	1,052.3	1,108.3	1,020.6	1,505.9	1,812.6	1,995.1	2,246.5	20,329.2

City of Chino Hills	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	906.0	736.0	694.5	715.5	714.8	401.2	202.4	260.6	226.5	211.1	202.9	188.2	5,459.6
Tier 1 (MWD)	1,320.0	1,468.6	1,190.6	787.9	303.2	39.4	185.1	177.1	658.6	940.2	557.1	544.9	8,172.7
DYY (MWD)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Recycled Water	204.3	218.7	261.9	126.0	124.6	48.8	21.4	17.6	120.9	76.9	138.7	119.4	1,479.2
Desalter Water (CDA)	384.4	409.0	413.9	381.6	363.5	414.3	423.3	355.9	334.2	328.7	326.2	295.5	4,430.6
MVWD Well Water	542.0	545.5	520.6	538.5	512.8	215.8	69.1	52.6	0.0	20.9	0.0	0.0	3,017.7
MVWD/WFA Allotment	1,276.8	1,267.8	1,082.9	787.9	303.2	39.4	185.1	177.1	658.6	940.2	542.2	544.9	7,806.1
Total	2,814.6	2,832.3	2,560.8	2,011.0	1,506.1	903.8	832.1	811.2	1,340.2	1,556.9	1,225.0	1,148.1	19,542.1

City of Ontario	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	3,133.6	2,948.5	2,555.5	2,296.8	1,800.0	1,052.9	882.9	1,117.8	1,476.2	2,037.2	3,276.0	3,410.8	25,988.3
Tier 1 (MWD)	1,454.3	1,556.3	1,333.7	1,130.6	1,089.7	1,137.2	1,139.0	783.7	1,103.2	1,102.1	199.4	287.3	12,316.5
DYY (MWD)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
Recycled Water	343.7	376.9	437.4	300.7	287.7	143.8	68.1	44.0	156.8	217.1	292.9	336.5	3,005.5
Desalter Water (CDA)	478.4	474.3	459.5	482.1	465.1	364.8	363.3	346.9	450.1	463.9	517.4	549.2	5,414.9
Total	5,410.0	5,356.0	4,786.1	4,210.2	3,642.5	2,698.7	2,453.3	2,292.4	3,186.3	3,820.2	4,285.7	4,583.9	46,725.2

City of Upland	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	185.5	189.0	117.6	164.5	147.4	323.0	344.0	248.0	333.5	328.4	297.1	289.1	2,967.1
Tier 1 (MWD)	940.0	963.2	671.5	502.4	300.1	429.0	500.8	1.5	0.0	250.0	110.4	220.6	4,889.4
DYY (MWD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Groundwater	1,164.00	1,167.00	1,068.60	992.00	974.00	364.40	202.50	240.00	714.00	784.00	1,216.1	1,443.1	10,329.8
Local Surface Water	0.0	0.0	0.0	0.0	0.0	0.0	87.1	420.0	445.6	412.0	399.5	310.2	2,074.4
Recycled Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2,289.5	2,319.2	1,857.7	1,658.9	1,421.5	1,116.4	1,134.4	909.5	1,493.1	1,774.4	2,023.1	2,263.1	20,260.7

CVWD	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	1875.0	1838.7	1573.7	1223.2	827.0	574.2	692.7	727.5	1058.1	1284.7	1602.8	2016.4	15,294.0
Tier 1 (MWD)	4422.2	4729.1	3906.2	3743.4	3371.0	1931.1	1296.5	947.4	2188.6	2882.7	2987.4	3045.5	35,451.1
DYY (MWD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recycled Water	126.8	0.0	15.9	18.3	20.6	22.8	25.5	68.1	61.7	22.6	56.4	122.8	561.6
Other Groundwater	663.2	437.5	338.9	142.2	96.6	126.2	303.0	116.1	15.1	54.0	270.1	477.8	3,040.8
Local Surface Water	196.4	184.6	186.0	205.9	254.0	334.6	394.2	683.9	785.2	656.5	529.4	435.9	4,846.7
Total	7,283.6	7,189.9	6,020.7	5,333.0	4,569.2	2,988.9	2,711.9	2,543.0	4,108.8	4,900.5	5,446.1	6,098.4	59,194.1

Fontana Water Co	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	3,402.5	3,361.2	2,690.4	1,585.0	1,402.8	611.7	409.7	394.8	508.3	995.1	1,501.3	2,335.8	19,198.6
Tier 1 (MWD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7	14.7
Other Groundwater	1,897.7	1,870.9	1,900.1	2,466.0	2,227.4	2,055.7	1,803.6	1,016.8	1,713.7	2,148.8	2,030.8	1,772.4	22,903.9
Local Surface Water	205.0	215.3	183.3	222.1	213.1	140.0	448.4	1,153.6	1,279.2	904.9	867.0	587.4	6,419.3
Lytle Creek Wells	1,288.1	1,147.9	1,245.0	1,169.5	922.0	808.3	944.8	520.2	1,164.6	1,123.9	1,000.9	1,046.5	12,381.7
Colton/Rialto Wells	265.8	306.5	258.4	911.9	918.0	859.6	468.4	175.3	181.5	649.2	700.9	533.0	6,228.5
Other Basin Wells	343.8	416.5	396.7	384.6	387.4	387.8	390.4	321.3	367.6	375.7	329.0	192.9	4,293.7
Total	5,505.2	5,447.4	4,773.8	4,273.1	3,843.3	2,807.4	2,661.7	2,565.2	3,501.2	4,048.8	4,399.1	4,710.3	48,536.5

MVWD	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	878.6	1,013.1	921.7	912.9	812.8	697.3	592.9	548.1	617.6	687.3	553.3	356.8	8,592.4
Tier 1 (MWD)	629.7	469.6	369.6	319.5	111.5	68.6	231.8	180.7	487.3	606.7	133.2	129.2	3,737.4
DYY (MWD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1,508.3	1,482.6	1,291.3	1,232.4	924.3	765.9	824.7	728.8	1,104.9	1,294.0	686.5	486.0	12,329.8

San Antonio Water Co	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	327.2	320.2	275.8	201.2	162.6	217.2	206.0	219.2	216.4	211.1	228.9	213.6	2,799.5
Other Groundwater	1,058.9	1,061.4	947.4	970.6	761.3	78.5	12.1	63.6	220.9	412.8	665.9	872.9	7,126.1
Local Surface Water	103.5	98.5	108.6	82.0	95.2	117.8	272.5	971.4	1,094.1	977.1	692.0	457.5	5,070.2
Total	1,489.5	1,480.0	1,331.9	1,253.8	1,019.1	413.5	490.6	1,254.2	1,531.4	1,601.1	1,586.8	1,544.0	14,995.8

TOTAL	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	11,779.5	11,513.6	9,465.5	7,702.4	6,398.2	4,084.2	3,525.2	3,800.2	4,877.3	6,649.0	8,426.4	9,686.1	87,907.7
Recycled Water	919.0	800.1	1,094.7	642.2	457.8	338.0	280.5	219.4	662.7	586.6	915.0	1,026.9	7,942.8
Other Groudwater	4,783.8	4,536.8	4,255.0	4,570.8	4,059.3	2,624.8	2,321.2	1,436.5	2,663.8	3,399.6	4,182.9	4,566.2	43,400.6
Surface Water	504.9	498.4	477.9	510.0	562.3	592.4	1,202.2	3,228.9	3,604.1	2,950.5	2,487.9	1,791.0	18,410.5
Desalter	1,244.4	1,334.2	1,340.0	1,342.4	1,246.8	1,257.4	1,257.7	1,166.0	1,268.5	1,259.9	1,316.0	1,267.8	15,301.1
Tier 1 (MWD)	9,226.7	9,701.4	8,011.0	6,967.5	5,570.3	3,850.1	3,630.2	2,274.0	4,695.4	5,962.9	4,319.1	4,742.1	68,950.6
DYY (MWD)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Totals	28,458	28,384	24,644	21,735	18,295	12,747	12,217	12,125	17,772	20,809	21,647	23,080	241,913

Note: DYY data is shown for each agency. It is not included in the total columns. It is accounted for in the Tier 1 (MWD) water resource.

FY 2006-07 Water Use Data

City of Chino	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	1,092.3	1,004.7	973.4	686.1	466.6	314.1	423.9	399.0	826.0	757.3	880.9	1,084.7	8,908.9
Tier 1 (MWD)	420.2	444.8	431.1	440.0	417.0	419.4	380.7	195.0	224.2	227.0	323.5	355.7	4,278.6
DYY (MWD)	0.0	447.5	434.5	448.9	423.2	423.9	380.7	199.1	223.1	0.0	0.0	0.0	2,980.9
Recycled Water	188.3	197.7	294.3	383.9	159.9	154.5	109.6	114.2	137.0	220.5	153.1	190.9	2,303.9
Desalter Water (CDA)	382.5	383.2	381.3	376.2	415.3	399.4	378.9	345.7	391.4	373.0	434.3	428.5	4,689.6
Total	2,083.3	2,030.4	2,080.1	1,886.2	1,458.7	1,287.3	1,293.1	1,054.0	1,578.6	1,577.8	1,791.7	2,059.9	20,181.0

City of Chino Hills	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	566.1	604.3	451.9	291.6	300.6	91.4	226.8	262.0	440.7	480.2	603.2	871.5	5,190.3
Tier 1 (MWD)	1,507.5	1,338.9	1,336.4	1,042.2	778.8	736.4	653.4	291.6	554.7	495.8	789.7	934.0	10,459.5
DYY (MWD)	600.0	0.0	600.0	450.0	400.0	400.0	300.0	150.0	0.0	0.0	0.0	0.0	2,900.0
Recycled Water	175.4	141.1	197.2	278.6	174.4	82.5	47.0	61.8	64.3	111.7	112.2	184.3	1,630.6
Desalter Water (CDA)	124.2	125.7	116.0	281.9	298.0	327.1	357.0	346.5	379.8	379.8	360.2	157.0	3,253.1
Total	2,373.3	2,210.0	2,101.5	1,894.2	1,551.7	1,237.3	1,284.2	962.0	1,439.6	1,467.5	1,865.4	2,146.8	20,533.5

City of Ontario	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	3,418.4	3,052.9	3,160.4	2,146.3	1,596.7	1,346.3	1,662.2	1,707.4	2,241.4	2,294.4	2,563.3	2,824.6	28,014.1
Tier 1 (MWD)	1,509.8	1,502.8	1,084.5	1,473.7	1,416.4	1,202.6	995.6	328.7	706.3	685.7	1,107.8	1,205.4	13,219.3
DYY (MWD)	510.0	790.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,300.0
Recycled Water	395.9	706.9	984.7	187.4	81.4	86.0	109.2	224.0	160.5	210.7	205.3	320.6	3,672.6
Desalter Water (CDA)	303.1	367.4	382.2	375.0	426.1	461.5	434.5	414.8	442.5	458.4	476.2	420.2	4,961.9
CDA 1	118.0	118.7	113.9	101.1	107.2	113.7	111.5	94.6	101.8	97.5	69.0	49.0	1,196.0
CDA 2	185.1	248.7	268.4	274.0	318.9	347.7	323.0	320.2	340.7	361.0	407.2	371.2	3,766.0
Total	5,627.2	5,630.0	5,611.8	4,182.4	3,520.6	3,096.3	3,201.4	2,674.9	3,550.6	3,649.2	4,352.6	4,770.8	49,868.0

City of Upland	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	109.2	91.2	93.9	100.8	89.7	49.9	8.2	94.3	115.4	110.2	161.0	247.0	1,270.7
Tier 1 (MWD)	604.8	495.1	458.8	336.9	315.0	267.6	240.6	40.0	192.4	266.2	712.3	895.3	4,825.0
DYY (MWD)	604.8	495.1	458.8	336.9	315.0	267.6	0.0	0.0	0.0	0.0	0.0	0.0	2,478.2
Other Groundwater	1,744.2	1,557.8	1,455.3	1,647.7	1,235.7	1,281.6	1,188.8	829.9	1,039.6	1,154.1	1,177.0	1,183.0	15,494.6
Local Surface Water	478.2	473.3	376.0	116.7	182.1	236.9	27.4	23.6	154.1	130.7	0.0	0.0	2,199.1
Recycled Water	3.5	4.5	4.0	2.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7
Total	2,939.9	2,621.9	2,387.9	2,204.9	1,824.4	1,835.9	1,465.0	987.8	1,501.4	1,661.2	2,050.3	2,325.3	23,806.1

CVWD	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	1,734.9	1,850.2	1,883.5	1,659.2	1,493.2	1,295.7	1,311.4	992.0	1,443.5	1,526.1	1,821.2	1,775.7	18,786.5
Imported Water (MWD)	4,441.6	3,801.5	3,598.5	2,770.5	2,360.0	1,915.6	2,042.6	776.3	2,316.7	2,059.8	3,099.0	3,643.1	32,825.1
Recycled Water	90.0	55.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	26.2	80.4	253.3
Other Groundwater	633.3	661.9	630.2	554.7	367.2	246.0	274.2	600.5	514.3	466.1	646.3	713.4	6,308.0
Local Surface Water	529.5	495.2	426.2	376.7	354.7	353.8	341.7	340.6	318.0	300.1	284.1	248.2	4,368.8
Total	7,429.3	6,863.8	6,538.4	5,361.1	4,575.1	3,811.1	3,969.8	2,709.4	4,592.5	4,353.7	5,876.8	6,460.8	62,541.6

Fontana Water Co	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	2,708.2	2,403.8	2,297.1	796.1	523.0	921.7	631.6	287.3	670.1	962.7	1,431.7	2,585.2	16,218.4
Other Groundwater	1,688.5	1,559.6	1,396.5	2,071.5	2,270.3	1,881.2	2,313.5	1,839.4	2,276.7	2,245.4	2,705.4	2,103.0	24,351.2
Local Surface Water	1,355.8	1,444.8	1,430.2	1,427.3	1,041.0	549.5	564.2	601.8	567.5	388.4	362.2	238.7	9,971.3
Total	5,752.5	5,408.2	5,123.7	4,294.8	3,834.4	3,352.4	3,509.3	2,728.5	3,514.4	3,596.5	4,499.4	4,926.9	50,540.9

MVWD	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	817.8	590.2	726.6	763.1	683.2	599.0	647.7	593.1	737.3	732.6	803.3	835.7	8,529.5
Tier 1 (MWD)	612.6	688.1	458.5	286.6	232.0	189.9	131.4	24.2	176.2	192.4	331.9	521.9	3,845.7
DYY (MWD)	1,300.0	1,300.0	1,200.0	550.0	500.0	400.0	400.0	300.0	650.0	0.0	0.0	0.0	6,600.0
Total	1,430.4	1,278.3	1,185.0	1,049.7	915.2	788.9	779.1	617.2	913.6	925.0	1,135.2	1,357.6	12,375.2

San Antonio Water Co	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	298.3	301.0	280.6	280.0	232.1	234.0	220.2	239.4	268.0	223.1	277.2	259.3	3,113.1
Other Groundwater	993.4	861.0	1,084.4	895.2	459.8	184.7	255.7	355.7	569.2	610.4	684.0	722.8	7,676.1
Local Surface Water	967.7	744.3	503.8	542.5	368.5	308.6	305.8	241.1	226.1	202.3	159.9	74.0	4,644.4
Total	2,259.4	1,906.2	1,868.8	1,717.7	1,060.3	727.3	781.7	836.2	1,063.3	1,035.7	1,121.1	1,056.0	15,433.7

TOTAL	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Chino Groundwater	10,745.2	9,898.2	9,867.2	6,723.0	5,385.0	4,852.0	5,132.0	4,574.5	6,742.5	7,086.6	8,541.8	10,483.6	90,031.6
Recycled Water	853.1	1,105.3	1,480.2	852.7	417.7	323.0	265.8	400.1	361.8	544.5	496.8	776.2	7,877.1
Other Groudwater	5,059.4	4,640.3	4,566.3	5,169.1	4,332.9	3,593.5	4,032.2	3,625.5	4,399.8	4,475.9	5,212.8	4,722.2	53,829.9
Surface Water	3,331.2	3,157.6	2,736.2	2,463.2	1,946.3	1,448.7	1,239.0	1,207.1	1,265.7	1,021.5	806.2	560.9	21,183.6
Desalter	809.8	876.3	879.6	1,033.1	1,139.3	1,187.9	1,170.4	1,107.0	1,213.7	1,211.2	1,270.7	1,005.7	12,904.6
Tier 1 (MWD)	9,096.5	8,271.1	7,367.7	6,349.9	5,519.1	4,731.6	4,444.3	1,655.9	4,170.5	3,926.9	6,364.2	7,555.4	69,453.1
DYY (MWD)	3,014.8	3,032.6	2,693.3	1,785.8	1,638.2	1,491.5	1,080.7	649.1	873.1	0.0	0.0	0.0	16,259.1
Totals	29,895	27,949	26,897	22,591	18,740	16,137	16,284	12,570	18,154	18,267	22,692	25,104	255,280

Note: DYY data is shown for each agency. It is not included in the total columns. It is accounted for in the Tier 1 (MWD) water resource.

Appendix C

Summary of the R4 Model for the Chino Basin

Appendix C
Summary of the R4 Model for the Chino Basin

Description of the R4 Model

Introduction

The *Rainfall, Runoff, Router, and Rootzone* (R4) model is a hydrologic simulation tool that was developed by Wildermuth Environmental, Inc. (WEI). WEI began development of this model in 1994 and has improved it overtime to support several major water resource investigations. The R4 model is a set of modules that simulates the fate of water on the land surface. It routes precipitation and irrigation water on the land surface and through the soil to surface water bodies and groundwater. The model generates runoff from drainage areas with various land use cover and soil types, using daily rainfall data; routes the runoff through drainage system; and estimates recharge to a groundwater basin from precipitation and applied water. The model was created to produce total recharge into a groundwater basin using methods that are scientifically sound and demonstrated by a significant history of use and that can exploit the types of data commonly found in the Santa Ana Watershed

The origin of R4 traces back to WEI's earlier work for the Chino Basin Water Conservation District (CBWCD) and the Chino Basin Watermaster (Watermaster). These agencies sought to estimate the storm water recharge in the Chino Basin that occurred in recharge basins, flood retention basins, and unlined streams. WEI developed a daily simulation model to estimate runoff from daily rainfall, route the runoff through the Chino Basin drainage system, calculate recharge on a daily basis, and produce reports that summarized recharge performance. These models were initially developed for the western Chino Basin in 1994 (Mark J. Wildermuth, 1995) and were expanded to the entire Chino Basin in 1996 (WEI, 1998). Subsequently, this model was used in the Chino Basin to estimate the recharge performance for new basins and the recharge benefits of improved basin maintenance. The *Phase 2 Chino Basin Recharge Master Plan* (Black & Veatch, 2001) used the model results as a basis for recharge facility design and cost estimates.

In 2001, WEI updated the model to include water quality simulations and expanded the modeling area to the entire Santa Ana River watershed for the wasteload allocation investigation (WEI, 2002) and renamed the model the Wasteload Allocation Model (WLAM).

The WLAM was applied, along with the EPA's Storm Water Management Model (SWMM), to evaluate various water resources management alternatives and facilities for the Beaumont area (WEI, 2006).

WEI added a root zone (or soil zone) soil moisture accounting module to the WLAM, and renamed it the Rainfall, Runoff, Router and Route Zone (R4) model in 2007. The rootzone module is used to estimate irrigation demand, rainfall and applied water infiltration into the soil zone, evapotranspiration, and deep infiltration below the root zone. The rootzone module also computes the associated TDS and nitrogen loads to the soil and infiltration below the root zone.

WEI has successfully applied the R4 model to estimate 40 years of historical recharge in the Beaumont Basin (WEI, 2006a) and Arlington (WEI, 2009b) Basins and 70 years of historical recharge in the Chino Basin (WEI, 2007).

The R4 model was updated, calibrated, and used for the 2009 Waste Load Allocation for the pending 2010 Basin Plan amendment for the Santa Ana Region.

Organization of the Model

The R4 model comprises four major modules: Rainfall, Runoff, Router, and Rootzone, and other modules, as shown in Figure C-1:

- Rainfall Module. The Rainfall module is used to organize and process historical rainfall data from individual monitoring stations and dopplar radar data sets. This module prepares input files for the Runoff and Rootzone modules.
- Runoff Module. The Runoff Module computes daily runoff from drainage areas—which in R4 vernacular are referred to as hydrologic simulation areas (HSAs) —based on the rainfall data prepared in the Rainfall module, land use, and soil types, utilizing a modified version of the NRCS (formerly SCS) method.
- Router Module. The Router Module collects runoff from the HSAs and other discharges and routes that runoff through the storm drainage system and recharge basins.
- Rootzone Module. The Rootzone module simulates the deep infiltration of stormwater and applied water through the soil zone. This module was used in the evaluation of the Peace II Agreement, the results of which are included in Section 3 of the 2010 Recharge Master Plan Update (RMPU).

The flexible structure of the R4 model allows new capabilities to be easily added. For the 2010 RMPU, two new programs were developed:

- MS4 Permit Onsite Runoff and Recharge Evaluation. This program was used to evaluate recharge basin performance with different levels of Municipal Separate Storm Sewage System (MS4) permit compliance.
- Enhanced Storm Water Diversion. This program was used to evaluate the recharge of storm water captured in the retention basins in the lower end of the drainage system and pumped uphill to other recharge basins when those basins had capacity to receive the stormwater.

Data Preparation for Rainfall, Runoff, and Router Modules

In this section, the basic data required for the Rainfall, Runoff, and Router Modules are discussed.

Hydrologic Data

Rainfall Gage Data

Daily rainfall data were obtained from San Bernardino and Riverside Counties and the National Climatic Data Center. Table C-1 lists the twenty-four rain gages that were used in the 2010 RMPU. These stations are well spaced across the watershed, and the majority of these gages have complete records for the simulation period of October 1, 1949 through September 30, 2008. The Thiessen polygon method was applied to the gage network across the model domain to estimate the daily mean areal precipitation (MAP) for each HSA. Figure C-2 shows the station locations and Thiessen polygons.

Radar Data

In late 2001, the National Centers for Environmental Predictions (NCEP) began routinely generating "NCEP Stage IV" Radar-based precipitation estimates. These data are compiled from the regional multi-sensor data (Stage III) produced by the 12 Regional Forecast Centers that cover the contiguous US. On January 1, 2002, archived high spatial-temporal, resolution-gridded precipitation estimate data (Stage IV) became available for download from the National Center for Atmospheric Research (http://data.eol.ucar.edu/codiac/dss/id=21.093). Daily Radar Mean Areal Precipitation (RMAP) data for the Chino Basin watershed were processed to obtain daily average precipitation over the Chino Basin. RMAP is calculated by averaging the values of the gridded cells that fall within the watershed boundaries. These amounts are the total daily time series precipitation estimates from Stage IV Radar data:

$$RMAP_t = \frac{\sum_{i=1}^{N} \left(P_i \times A_i \right)}{A_T}$$

$$A_T = \sum_{i=1}^{N} A_i$$

Where:

$RMAP_t$ = the radar daily mean areal precipitation for the watershed in consideration.

P_i = the daily radar precipitation value for the i^{th} grid cell in the watershed.

A_i = the area of the i^{th} grid cell within the watershed boundary.

A_T = the total area of the watershed.

N = the number of grid cells positioned under the watershed boundary.

Rain-gage networks tend to underestimate the coverage and intensity of heavy precipitation areas in comparison to radar estimates (Smith et al., 1996). Radar measurements augment gage measurements, providing detailed spatial and temporal resolution precipitation measurements over an extensive spatial domain. Essentially, radar is equivalent to a very dense gage network (4-km grids or less).

Radar based precipitation estimates, when compared to gage measurements over the Chino Basin, show a strong relationship in capturing total rainfall within the basin with a maximum difference of 2 inches annually. Figure C-3 shows the long-term average annual rainfall record for the Chino model domain based on rainfall gages and comparable estimates based on the NCEP Stage IV data from 2001 to the present. Figure C-4, which compares the annual scatterplots of the two sources of precipitation data, shows a strong correlation between the gage and radar data with a correlation coefficient of 0.99. The strong relationship between the gage and radar data results from using the bias-adjusted estimates by the hourly rain-gage network of the National Weather Service following a multivariate optimal estimation procedure (Seo, 1998; Fulton & Kondragunta, 2002) in the final radar product.

Evaporation Data

There is one evaporation station near the study area with long period of record. This station, the Puddingstone Reservoir station, is maintained by the County of Los Angeles, Department of Public Works and has a period of record that ranges from 1948 to present. Within this period of record, two years of data are missing: 1991 and 1994. For modeling purposes, these missing data were estimated using long-term average evaporation data. The time history of historical daily evaporation data is shown in Figure C-5.

Stream Flow Data

The USGS maintains several stream gage stations on streams within the study area. These stations are listed in Table C-2. Gaged daily discharge data are used as boundary inflows in the Router Module, and daily discharge data for stations within the model domain are used for the calibration of the Runoff and Router Modules.

Hydrologic Simulation Areas

The model domain is shown in Figure C-2 and consists of the Chino Basin area and part of the Riverside and Temescal area. This watershed is approximately 534 square miles. The HSAs were delineated based on the digital elevation model data and drainage maps prepared by the Counties and the Cities. The storm drain system data were collected from the following agencies:

- San Bernardino County Flood Control District
- Riverside County Flood Control and Water Conservation District
- Chino Basin Water Conservation District
- City of Montclair
- City of Upland
- City of Cucamonga
- City of Ontario
- City of Fontana
- City of Rialto
- City of Riverside
- City of Chino

The complete watershed and the sub-drainages are shown in Figure C-2. The model domain was divided into 166 HSAs. Eight HSAs are located in the San Gabriel Mountains, and the runoff from these mountain watersheds was estimated using classical regional analysis techniques and USGS discharge data. Runoff estimates for the other 158 HSAs, which comprise about 475 square miles, were developed using the Runoff Module.

Land Use

The most recent land use survey data for the model domain is the 2006 Southern California Association of Governments (SCAG) land use data. SCAG's land use survey is based on the four-level Anderson Land Use Classification system. These land use categories were aggregated into the 16 land use types used in the R4 model. Figure C-6 is a map that shows the model domain and the 2006 land use after aggregation into the land use types used in the R4 model. Table C-3 lists the land use types and their total area in the model domain. As of 2006, about 49 percent of the land, or 271 square miles, had been developed into urban uses (land use types 1 through 6 and 11); about 29 percent of the total area, or 137 square miles, could be developed into urban area in the future (land use types 7, 8, 10, and 12); and up to 14 percent, or 67 square miles, will likely remain as it is presently (land use types 9 and 13 through 16). Table C-4 shows the land use conversion from SCAG to R4 land use types. For the 2010 RMPU, WEI used SCAG 2006 land use and general plan land use data to represent current and ultimate land use conditions.

Soils Data

The hydrologic soil types within the model domain are based on Soil Conservation Service (SCS) maps and classifications. Soil surveys for the model domain are contained in *Soil Survey of San Bernardino County, Southwestern Part* (SCS, 1977), *Soil Survey of Western Riverside County* (SCS, 1971), and *Soil Survey of the Pasadena Area, California* (SCS, 1917). The SCS soil classification system rates the runoff producing characteristics of soils from A to D. This classification is defined in Table C-5. Soil type A generates the least runoff and has the greatest amount of infiltration and soil type D generates the most runoff and least infiltration. The Riverside County Flood Control District has a hybrid classification that refines this classification and includes AB, AC, and BC soil types. Figure C-7 shows the areal distribution of hydrologic soil types. Table C-6 summarizes the area with hydrologic soil types by the major drainage areas in the Chino Basin.

Impervious Area

The impervious surface area generates much more runoff than pervious area, given the same amount of rainfall. Table C-7 contains estimates of the total impervious area for various land uses from the Hydrology Manuals of the San Bernardino (1986) and Riverside (1978) Counties.

Residential land use accounts for approximately 37 percent of the total land use in the Chino Basin Area for the year 2006. Medium density residential land use comprises approximately 25 percent and occupies most of the urbanized area. To better estimate the impervious area within this land use category, ten medium density neighborhoods built between the 1950s and 2000s from the Chino, Cucamonga, Ontario, Fontana, and Upland areas were selected for analysis. Arc GIS and a 2008 digital aerial photo of the Chino Basin were used to determine pervious vs. impervious areas. Figure C-8 shows the location of the areas that were used to make this determination. Table C-8 contains the estimated pervious and impervious areas for these areas. The average pervious area is about 39 percent and ranges from about 33 to 54 percent. The average impervious area is about 71 percent and ranges from about 46 to 67 percent.

Not all impervious area is directly connected to the storm drain system. The directly connected impervious area (DCIA) is the portion of the total impervious area (TIA) that generates storm water runoff that discharges directly into a stormwater collection system without flowing over any pervious area. The DCIA is often referred to as the effective impervious area. Dufour (2006) cites several DCIA versus TIA relationships from three references (Alley & Veenhuis, 1983; Laenen, 1983; Sutherland, 2000). While Alley, Veehuis, and Laenen each provide a single equation for estimating DCIA from TIA, Sutherland developed five equations that correspond to different conditions: totally connected, highly connected, somewhat disconnected, extremely disconnected, and average. Figure C-9 plots all seven TIA equations from 0 to 100 percent. Note that the relationship by Alley and Veenhuis and the relationship by Sutherland for the average condition are very close. For this project, the average condition by Sutherland was used to estimate DCIA. Runoff from the portion of the impervious area that is not directly connected to the drain system is redirected to the pervious area and treated as rainfall on the pervious area, as shown in Figure C-10.

Recharge Basin Data

There are three types of recharge basins in the Chino model domain: conservation, multipurpose, and flood control basins. Conservation basins are operated to recharge storm and supplemental water. Multipurpose basins are operated primarily for flood peak attenuation and secondarily for the recharge of storm and supplemental water. Flood control basins are operated for flood peak attenuation only and recharge, if any, is incidental. Table C-9 lists all basins in the area, their type, and their inflow type. The Chino Basin Recharge Facilities Operating Procedures Manual (GRCC, 2006) discusses recharge basin operating rules in detail and the reader is referred to this manual for operating details.

The input data for the recharge basins were digitized consistent with the requirements of the Router Module. The Router Module can simulate all the operational modes described in the manual. The following information is required for each recharge and flood control basin:

- Recharge basin type
- Elevation-Area-Storage (EAS) rating table
- Diversion structure flow rating table
- Outlet structure rating tables
- Infiltration rates

Recharge Basin EAS Tables

For recharge basins that are part of the CBFIP, EAS tables were obtained from construction improvement drawings. For all other recharge basins, construction drawings were obtained from the CBWCD, the IEUA, and San Bernardino County. These drawings were then digitized, and EAS tables were prepared consistent with the input requirements of the Router Module.

Recharge Basin Inflow/Outflow Rating Tables

The hydraulic characteristics of inlets and outlets for recharge and flood control basins were developed from as-built drawings obtained from the CBWCD, the IEUA, and San Bernardino County. Rating curves were developed from hydraulic analysis of these structures and were subsequently digitized consistent with the input requirements of the Router Module.

Recharge Basin Infiltration Data

Recharge basin infiltration rates were based on observed infiltration rates provided by IEUA and other data generated by the CBWCD. A range of reasonable infiltration rates were used for basins without infiltration data, based on an assessment of the underlying soils and hydrogeology.

Runoff Module

The Runoff Module computes daily runoff by the following methods:

- Runoff from the valley floor and some mountainous areas is calculated using a modified version of the Curve Number method described in *Urban Hydrology for Small Watersheds* (USDA, 1986) and other references (SCS, 1985; Limbrunner, 2005).
- Daily discharge data from the USGS is used directly for mountainous areas where discharge records are complete.
- For small mountain watersheds with partial or no measured records, estimates of daily discharge are developed from nearby gaged watersheds, using regional analysis.

The mountain areas consist of the watersheds located in the San Gabriel and Santa Ana Mountains and other mountainous/hill boundary areas. Mountain watershed hydrologic processes are similar to valley floor processes; though, some mountain watersheds produce sustained base flows and delayed runoff due to groundwater and snow pack storage. Measured daily discharges from mountain areas are assumed to be stationary; that is, their daily discharge statistics do not change over time due to influences from land development or other anthropogenic activities.

In contrast, valley floor areas are in a continual state of change, as land is converted from natural to agricultural and then to urban uses. There are no stationary historical stream discharge or water quality data in the valley floor area that can be used to estimate daily discharge and associated water quality statistics. Valley floor runoff is simulated using the Runoff Module.

SCS Method

The SCS method is based on the assumption that the ratio of actual retention to potential retention is same as the ratio to actual runoff to the effective rainfall. This is described mathematically as:

$$\frac{F}{S} = \frac{Q}{P - I_a} \tag{1}$$

Where:

F = the actual retention after runoff begins
S = the potential retention after runoff begins (S > F)
Q = the runoff
I_a = the initial abstraction
P = total rainfall

The continuity of can be written as:

$$P = Q + (F + I_a) \tag{2}$$

This equation states that total rainfall is the sum of runoff, retention, and the initial abstraction. The equation can be rearranged as:

$$F = (P - I_a) - Q \tag{3}$$

Substituting the F term in equation (1) by equation (3) and rearranging for the total storm runoff (*Q*) results in the runoff equation:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \tag{4}$$

This is the basic rainfall-runoff relationship used in SCS method. Figure C-11 illustrates the relationship between SCS method variables.

After reviewing results from many small experimental watersheds, Victor Mockus, the developer of the SCS method, developed an empirical relationship between the initial abstraction and the potential retention, which is expressed as:

$$I_a = 0.2S \tag{5}$$

By substituting I_a into equation (5), the rainfall-runoff equation becomes:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad when\, P > I_a \tag{6}$$

The potential retention (*S*) consists mainly of the infiltration that occurs when runoff begins and remains constant for an individual storm because it is the maximum retention that can occur under existing conditions if the storm continues without limit. A succession of storms increases soil moisture and reduces infiltration capacity, or potential retention (*S*). Conversely, periods of dry weather reduce soil moisture and increase *S*. With the SCS method, the change in *S* is based on an antecedent moisture condition (AMC), which is determined by the total rainfall in the 5-days preceding a storm. The *National Engineering Handbook* defines three levels of AMCs:

- AMC-I Lowest runoff potential. The Watershed soils are dry enough for satisfactory plowing or cultivation to take place.
- AMC-II The average condition.
- AMC-III The highest runoff potential. The watershed is practically saturated from antecedent rains.

The AMC-I condition is the lower limit of soil moisture, or the upper limit of potential retention *S*. Conversely, the AMC-III condition is the upper limit of soil moisture, or the lower limit of *S*.

The SCS simplified equations 4 and 6 through the introduction of the curve number (CN).

$$CN = \frac{1000}{10 + S} \tag{7}$$

The practical implication of this equation is that the CN approaches 100 when *S* approaches zero (when retention is negligible), and the CN approaches zero when *S* approaches infinity. Therefore, the CN indicates the runoff potential—the higher the CN, the higher the runoff potential. The *National Engineering Handbook* contains a table of CNs for hydrologic soil types and various land use types and conditions for the AMC-II condition. Many hydrology manuals, including the ones prepared by San Bernardino, Riverside, and Los Angeles Counties, contain similar tables, modified for local conditions. Table C-10 lists SCS method CNs (for the AMC II condition) for the land use classes and hydrologic soil types used in this project.

Please note that the CNs in this table were developed for the AMC-II condition. As soil moisture conditions change to I or III, the CN number should be adjusted to reflect the soil condition. The handbook lists the values for AMC-I and AMC-III conditions. For this project, WEI developed two curves that fit the AMC-I and AMC-III conditions (as shown in Figure C-12) for use in the Runoff Module.

Router Module

The Router Module collects daily discharge from the HSAs specified in the Runoff Module and other flows, such as stream flow at the modeling area boundary and point discharges (e.g. recycled water discharges to the stream system), and then routes that water through the drainage system. The drainage system is represented by nodes and links. A node collects flows from upstream tributary links and runoff generated by the Runoff Module from tributary HSAs, boundary inflows, and point discharges, and sends the total flow through the downstream link. Figure C-13 shows the link/node systems used for the Chino Basin area. There are five types of links in the Router Module that are used to route discharge through stream reaches in the system:

- Type 1 – Open channels with trapezoidal cross sections
- Type 2 – Closed conduits
- Type 3 – Retention/recharge basins
- Type 4 – Diversions
- Type 5 – Dummy links
- Type 6 – Open channels with predefined flow rating tables

Open Channel Links

Open channel links are used to route flows from an upstream node to a downstream node and to estimate stream bottom infiltration. There are two types of open channel links: Type 1 (trapezoidal) and Type 6 (natural channel with undefined geometry). For Type 1, Manning's equation is used to estimate average stream width and elevation. For Type 6, a predetermined rating curve is used to estimate stream widths and elevations, based on flow rate.

In Manning's equation, the flow is represented as:

$$Q_s = \frac{1.49}{n} AR^{2/3} S_b{}^{1/2}$$

Where:

Q_s = the flow rate (cfs)
n = the roughness coefficient
A = the cross-sectional area
R = the hydraulic radius (cross-sectional area divided by wetted perimeter)
S_b = the channel bottom slope

For a trapezoidal section with a known bottom width (B) and known left (sl) and right (sr) side slopes, the stream top width (T) can be expressed as:

$$T = B + y(s_l + s_r)$$

The cross-sectional area (A) as:

$$A = y(B + \frac{s_l + s_r}{2} y)$$

And the wetted perimeter (P) as:

$$P = B + y(\sqrt{(1+s_l^2)} + \sqrt{(1+s_r^2)}$$

Substituting A and P, the Manning's equation can be written as:

$$Q_s = \frac{1.49}{n} \left[[y(B + \frac{s_l + s_r}{2} y) \right]^{5/3} [B + y(\sqrt{(1+s_l^2)} + \sqrt{(1+s_r^2)} \ ]^{-2/3} S_b^{1/2}$$

For the given daily average flow (Qs), the equation is iteratively solved using Newton's method for the average depth (y), and stream width (T) can be estimated.

The daily stream bottom infiltration in a link can be estimated with the following equation:

$$Q_{sp} = L * T * P_v$$

Where:

Q_{sp} = stream bottom infiltration (ft^3/day)
L = the length of the stream link (ft)
T = the top width of the stream link (ft)
P_v = the vertical infiltration rate (ft/day)

For the rating table stream sections, the relationship of daily average flow versus the average width of the wet section is specified as input data to the Router Module. This feature is useful for a stream section wherein the cross section is irregular, such as the Santa Ana River. The information needed to obtain the average width was developed from the HEC-RAS model that was developed for the Santa Ana River by the Corp of Engineers.

Diversion Links

Diversion links represent stream diversions out of a node. These links are simulated with rating tables that divert flow as a function of the total flow at the link. Diversion links are typically used to divert stream flow to recharge basins.

Recharge Basins

Recharge basins are simulated for flood peak attenuation and groundwater recharge purposes. These basins are represented by rating curves that relate water surface elevation to surface area and storage, to discharge through outlet works and spillways, and to infiltration rates.

The daily mass balance equation for a recharge basin can be expressed as:

$$S_t - S_{t-1} = I_t - Ev_t - Qp_t - Qc_t - Qs_t$$

Where:

S_t = the storage at the end of time step *t*
S_{t-1} = the storage at the end of time step *t-1*
I_t = the total inflow during time step *t*
Ev_t = evaporation
Qp_t = infiltration
Qc_t = outlet works discharge
Qs_t = spillway discharge

Recharge basins are simulated by solving the continuity equation. The computational procedure used in Router Module is the modified Puls method. For mathematical stability, the Router Module adjusts the simulation time steps *on the fly*, comparing the basin storage volume and inflow rate up to a maximum of 240 time steps per day.

Calibration of Runoff and Router Modules

Calibration Data

Calibration Period

The calibration period selected for the 2010 RMPU ran from October 1, 2004 though September 30, 2008. This period was selected because the CBFIP was significantly completed by the winter of 2004-05, recharge basin infiltration data was available for most of these facilities, and the recharge basins were operating during this period. In addition, this period tightly straddles the 2006 land use map, which is the most recent land use map available.

Calibration Data

Daily stream flow data is available for two USGS stream discharge gages in the Chino Basin: Chino and Cucamonga Creek. The discharge data from these stations were used as calibration targets. The proper calibration of a numerical simulation model is contingent on the proper selection of a calibration target. Since the model generates runoff from rainfall, known non-stormwater discharges to the creek system are removed from daily discharge data, including imported water releases to San Antonio Creek from OC59 and reclaimed water discharge by IEUA.

Figure C-14 compares daily stormwater runoff at the stream gages on Chino and Cucamonga Creeks versus daily rainfall. The correlation coefficients are less than 0.2, meaning a very poor correlation. In some cases the rainfall occurred during the day prior to the observed runoff. This figure demonstrates the non-linearity of the rainfall runoff process. Figure C-15 plots daily stormwater water flow at Cucamonga Creek versus daily flow at Chino Creek. The correlation coefficient is 0.67, indicating areal differences in daily precipitation and runoff between the two drainage systems.

During the calibration period, 17 storm events were identified, as shown in Table C-11. These storm events lasted from two to eight days with a four-day average. Rainfall from these storm events ranged from 0.6 inches to 8.4 inches with a 2.75-inch average. Table C-11 contains statistics for total stormwater runoff for the Chino and Cucamonga Creeks. This data was used as the calibration target for the R4 model.

Calibration Results

The model-independent calibration tool PEST (Parameter ESTimation) was used to calibrate the model. Sensitivity analyses were done to determine which parameters should be subject to automatic calibration and optimization. The most sensitive parameter was total imperviousness and connected imperviousness. These parameters were investigated in the calibration process using an iterative process with PEST code. Figure C-16 is a scatter diagram, showing the model-calculated stormwater runoff versus measured stormwater runoff. The correlation coefficient between the two data series is 0.97. The R4 model can explain 94 percent of the variability in runoff from rainfall for the 17 storms selected in the calibration.

Application of the R4 Model for Recharge Planning

The planning period for the 2010 RMPU is 2010 to 2030. The R4 model was used to estimate the stormwater recharge in the Chino Basin for the existing recharge basins for 2006 landuse conditions and for buildout landuse conditions. Based on the review of how much runoff is generated, recharged, and not recharged, a series of new recharge projects were postulated and tested with the R4 model. This information was supplied to Wagner and Bonsignore Engineers (W&B) for an analysis of engineering feasibility of new stormwater recharge facilities. W&B then supplied revisions of the potential recharge projects to WEI and new simulations were done to reevaluate the potential projects.

The metric used to evaluate the recharge from new stormwater recharge projects was the annual average recharge. The annual average recharge was estimated by simulating daily runoff and recharge for the 57-year period of October 1, 1949 through September 30, 2007. Daily runoff was computed and routed through the drainage systems in the Chino Basin and the average annual recharge was estimated at each existing and proposed recharge basin.

Hydrologic Data

Evaluation of Climate Change Effects on Precipitation in the Chino Basin

The Intergovernmental Panel on Climate Change (IPCC), established by the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO), produced several reports for assessing climate change and its global effects on the environment in the past, present, and in the future. In the US, climate change studies have focused on factors influencing agriculture, land resources, water resources, and biodiversity under the US Climate Change Science Program (i.e. Synthesis and Assessment Product 4.3, May 2008). This report finds that climate change is already affecting US water resources, agriculture, land resources, and biodiversity, and will continue to do so. The average temperature in the US has risen more than 2°F over the past 50 years (NOAA, 2009). This rising trend is clearly noticed on global, US, regional (i.e., California), and sub-regional (i.e. Southern California) scales. In terms of global precipitation trends, a report by World Climate Research Programme (WCRP, 2008) argues that the precipitation has remained more or less constant. However, regional-scale studies show that heavy precipitation events are already widespread in the Northern Hemisphere (Cubasch et al. 2001) and that in the United States, there has been an average 5-percent increase in precipitation over the past 50 years (NOAA, 2009). While this increase may have resulted from the human effect on climate change, a study by Kunkel et al. (2003) suggests that natural variability in precipitation is the cause of such increases.

In California, the Department of Water Resources (DWR) has taken the lead in incorporating climate change information into its planning process (i.e. the draft *State of Climate Change Sciences for Water Resources Operations, Planning and Management*, [DWR, January 2009]). According to the DWR (i.e. *Progress on Incorporating Climate Change into Management of California's Water Resources, Technical Memorandum Report*, [DWR, July 2006]), more analyses of precipitation trends on a sub-regional scale in California are needed to determine whether changes in California's regional annual precipitation totals have occurred as the result of climate change or other factors.

Precipitation data from four precipitation stations were used to analyze the effects of climate change on precipitation in the Chino Basin. These data consist of daily gage precipitation from the Ontario area (station 1026 from 1950 to 2009) and the San Bernardino Hospital Gage (station 2146 from 1900 to 2009), monthly gridded reanalysis data from the National Centers for Environmental Prediction (NCEP) of the National Weather Service (NWS) (grid overlaying the Chino Basin from 1950 to 1999), and monthly downscaled gridded data from MPI-ECHAM5[1], following three IPCC A2, B1, and A1B emission scenarios[2] (from 1950 to 2009). The 1/8° by 1/8° grid (about 7.77 by 7.77 miles) that covers the Chino area was selected. The A2 and B1 scenarios were used in the 2007 DWR State Water Project Delivery Reliability Report while the A2 scenario was adopted in the 2009 DWR State Water Project Delivery Reliability Report to estimate the forecasted water deliveries under the worst case scenario.

The analysis consisted of testing for trends in the gage station data, investigating the change of intensity and frequency in precipitation, and comparing gage data with gridded data on a monthly basis.

Due to the high monthly and seasonal variability of precipitation, the trend detection analysis consisted on applying the Mann-Kendall test on monthly precipitation, to each set of monthly data for station 2146 (i.e. January time series from 1900 to 2009) and dividing each monthly time series into two periods (1900-1955 and 1956-2009) and four periods (1902-1928, 1929-1955, 1956-1982, and 1983-2009). Table C-12 summarizes the Mann-Kendall test results and shows no detection of any significant trend in monthly precipitation time series.

Figure C-17 shows the progression of rainfall data, based on the two-year (Figure C-17a) and four–year periods (Figure C-17b). Although Figure C-17a shows a downward trend between the 1900-1955 and 1956-2009 periods during rainy months, Figure C-17b shows that this downward trend is not monotonic and that there is no consistent increase or decrease in the precipitation trend between the four divided periods.

The daily time series of precipitation from the San Bernardino Hospital Gage was used to test the change in frequency of heavy precipitation from 1900 through 2009. Three thresholds of heavy precipitation were selected: the 90th, 95 th, and 99th percentiles. Figure C-18 shows the variation of the number of heavy precipitation events by year. Interestingly, the period between 1990 and 2000 shows an increase in 99 th percentile events (above 2.41 inch) while the period from 1935 to 1945 shows the highest count of precipitation events above the 90th percentile. Table C-13 summarizes the heavy events by the same four periods used in the trend analysis.

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[1] Max-Plank Institute for Meteorology-European Centre Hamburg Model (MPI-ECHAM5) is the global climate model that was selected for the 2009 DWR Project Delivery Reliability Report.

[2] The A2 emissions scenario assumes slow technological changes and high population growth, which results in significantly higher Greenhouse Gas (GHG) emissions. The B1 scenario represents sustainable development and results in the lowest increase of GHG emissions of the IPCC scenarios. The A1B scenario represents a mid-line scenario between A2 and B1 in terms of GHG emissions.

The objective of the comparison analysis of historical gage and gridded data was to check the reliability of the MPI-ECHAM5 climate model precipitation output. This model was used in the 2009 DWR Project Delivery Reliability Report to forecast future SWP deliveries for 2029. Figure C-19a shows that the MPI-ECHAM5 model overestimated the monthly gage precipitation in Ontario between 1950 and 1965 and that it did not pick up the large events in 1969, 1978, 1980, and 1983. Starting from 1983 onwards, the model prediction seems to be more or less tracking the gage and reanalysis data. The climate change model output data start to diverge after 2001, depending on the IPCC climate scenario as shown in Figure C-19b. A further quantitative comparison was applied by plotting the frequencies of rainfall amounts, occurrences of gage data, and MPI-ECHAM5 model scenario A1b data as depicted in Figure C-20. This figure shows that the model outputs mimic rainfall events that are higher than 0.6 inches with a slight overestimation for events between 2 and 6 inches. Also, the annual average of the Ontario Station gage data (14.6 inches) was similar to the climate model data (14.8 inches) for the period 1950-2009, while the average for the projected climate data from 2010-2050 dropped under scenario A1B (13.2 inches) and A2 (13.4 inches), and slightly increased under scenario B1 (14.9 inches).

This analysis of historic precipitation data in the Chino Basin indicates that there is not enough evidence to suggest a change in the precipitation pattern in the Chino Basin; therefore, the historical precipitation data for 1950 to 2007 can be used for recharge planning in the Chino Basin until compelling new evidence exists to show otherwise.

Precipitation and Evaporation Data

Daily rainfall data for 24 rainfall stations from October 1, 1949 through September 30, 2001 and daily radar-generated rainfall data from October 1, 2002 to September 30 2007 were used to generate runoff for current and future land use conditions. Daily evaporation data recorded at puddingstone reservoir for the same period were used to simulate evaporation from retention basins. Historical daily stream-flow data from mountain watersheds, recorded by the USGS, were used as boundary inflow data for the stream system.

Land Use Data

For current land use conditions, the SCAG 2006 land use data were used.

For the ultimate land use condition, the SCAG 2006 and general plan land use data were combined. Fully developed areas with urban land use types in 2006 are assumed to remain unchanged in the future. Mountain and riparian areas along the Santa Ana River and Prado Dam are also assumed to remain unchanged. Figure C-21 shows the 2006 land use area that will remain unchanged in the future. The undeveloped areas that will likely be developed in the future are shown in Figure C-22. The land use types that belong to this group include types 7, 8, 10, and 12. Other undeveloped urban areas and agricultural and dairy areas are assumed to be developed in the future. SCAG-prepared general plan land use data were used in these areas, as shown in Figure C-23.

Table C-14 summarizes current and future land use data. In 2006, about 190,000 acres, or 63 percent, can be classified as fully developed urban area and will not change in the future.

About 26,000 acres are small hills, the Santa Ana River, and the Prado riparian area. Currently, about 87,000 acres, or 29 percent, are covered with agricultural, dairy and undeveloped urban area, which will be likely developed in the future.

Using the general plan land use data for the undeveloped area, the total urban area in the future will be about 256,000 acres or about 84 percent. Commercial and industrial land use will increase from 12 percent to 18 percent. And, residential and mixed urban area land uses (land use types 1, 2, 3, and 6) will increase from 37 percent to 50 percent. Figure C-24 is a composite map of the 2006 developed urban area and the future developed urban area.

Sensitivity Analysis

A sensitivity analysis was conducted on the existing recharge facilities to determine if resources should be devoted to these facilities to improve recharge. Two parameters were investigated: infiltration rate and operable storage capacity. A marginal increase in infiltration rate could be created in some basins by increased maintenance and/or possibly removing low permeability soils in the basin. An increase in operable storage capacity could be accomplished by deepening a basin, modifying its outlet works, or changing its operating plan.

Three simulations were done. The first simulation, hereafter baseline, used the best estimate of infiltration rate for each basin and used the current operable storage capacity. The second simulation was the same as the baseline except that the infiltration rate for each basin was increased by 10 percent. The third simulation was identical to the baseline simulation except that the operable storage capacity was increased by variable amounts depending on the site specific conditions. For example, Montclair Basins 3 and 4 and the Brooks Basins were not considered for enlargement due to physical constraints while the operable storage capacities for other basins were assumed to be enlarged by 20 to 50 acre-ft. Table C-15 shows the assumed infiltration rates, operable storage, and the changes assumed in the sensitivity analysis. Table C-16 summarizes the results of this analysis. For a uniform increase in infiltration rate of ten percent, the increase in average annual stormwater recharge is estimated to be about 310 acre-ft/yr or 2.2 percent. If the total operable storage capacity is increased by 1,000 acre-ft, the average annual stormwater recharge will increase by about 1,100 acre-ft/yr more or about 8.2 percent.

2010 MS4 Permit Simulation

In 2010, the RWQCB issued new MS4 permits to the Santa Ana Watershed parts of the Counties of Riverside and San Bernardino and the cities within the Santa Ana Watershed. These permits contain stormwater management requirements for stormwater that is generated from new development and will increase recharge in the Chino Basin.

Essentially, the new permits require that all stormwater generated from new development from a 24-hour, 85th percentile storm either be detained and recharged on site if recharge is feasible; if recharge is not feasible, the stormwater must be detained and treated and subsequently discharged. For most of the Chino Basin, the recharge of this stormwater is feasible. In the Chino Basin, this roughly corresponds to 1 inch over 24 hours. The specific technologies for detention and recharge are to be developed by the landuse control entities. The landuse control entities are responsible for the inspection and maintenance of these new stormwater management facilities. The recharge facilities could include detention and sedimentation basins, recharge basins, dry wells, and managed swales.

To estimate the average 85th percentile of daily rainfall in the Chino Basin, four rainfall stations in the Chino Basin area were selected based on their long-term records and geographic distribution in the Chino Basin (Ontario Fire Station, Fontana Union Water Company, Claremont/Montclair Hybrid Station, and Ontario Airport Station). The time series of rainfall data used in the analysis range from 73 to 109 years, as shown in Table C-17. The estimated 85th percentile rainfall data ranges from 0.86 to 1.03 inches/year with an average 0.96 inches/yr. For this analysis, 0.96 inches/yr was used as the 85th percentile rainfall for the modeling area.

The 2010 MS4 permits have specific water quality requirements and require that recharge be done where feasible. To evaluate the impacts of future development, analyses were done assuming that zero percent, 50 percent, and 100 percent of the runoff from new development would be recharged. The runoff from new developed areas was assumed to be subject to an MS4 permit for up to 0.96 inches of rain, which (as previously stated) was assumed to be the average 85th percentile. The runoff subject to the MS4 permit was then summarized for total onsite recharge. The runoff from existing urban areas and discharge from new development, based on the onsite recharge assumption, were added as the total runoff from each hydrologic subarea. This was done on a daily basis for each HSA and summarized for total onsite recharge and runoff. The Router Module was then used to determine the change in stormwater recharge that would occur at the recharge basins with varying levels of onsite recharge from compliance with the 2010 MS4 permit. Table C-18 shows, by landuse control entity, the new recharge for the Chino Basin area watershed and the land overlying the Chino Basin. The new stormwater recharge created through permit compliance is estimated to range from about 6,300 acre-ft/yr if half of the stormwater managed pursuant to the MS4 permit is recharged to about 12,600 acre-ft/yr if all of the stormwater managed pursuant to the MS4 permit is recharged. Implementation of the new MS4 permits will offset some of the lost recharge from landuse and drainage changes.

Baseline Stormwater Recharge with Existing Recharge Facilities in 2010

A 2010 estimate of stormwater recharge was developed to compare against the stormwater recharge estimates developed for the CBFIP projects prior to their construction and as baseline to measure recharge improvements for the projects evaluated in Section 5 of the RMPU. This baseline recharge estimate is the long-term average annual stormwater recharge from existing stormwater management facilities, including the CBFIP facilities constructed as part of the implementation of the OBMP. Recharge estimates were prepared for each existing recharge facility using the 57-year daily precipitation record described above. These estimates are based on the *2006 Chino Basin Recharge Facilities Operation Procedures Manual* (GRCC, 2006) with some operating procedure modifications, provided by the IEUA. The results are summarized in Table C-19 for current conditions and buildout. The long-term average annual stormwater recharge with the recharge facilities existing in 2009-10 is estimated to be about 13,600 acre-ft/yr, and this recharge will increase slightly over time due to new stormwater generated by development that is not captured in the local recharge facilities, as required to comply with the 2010 MS4 permit.

Table C-19 also shows the interrelationship of the new recharge created by compliance with the 2010 MS4 permit and recharge at the regional stormwater recharge facilities. Note that the stormwater recharge created through compliance with the 2010 MS4 permit actually reduces the future stormwater recharge that would otherwise occur at the regional stormwater recharge facilities; thus, the net new recharge created by the MS4 permits is reduced slightly to about 5,300 acre-ft/yr if half of the stormwater managed pursuant to the MS4 permit is recharged and about 10,500 acre-ft/yr if all of the stormwater managed pursuant to MS4 permit is recharged.

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Table C-1
Rainfall Monitoring Stations

Station ID	Station Name	Location		Elevation	Source of Data
		Latitude	Longitude	(ft-msl)	
1026	Ontario Fire Station	34.06	117.65	986	SBCFCD
1034	Claremont Pomona College	34.1	117.72	1196	SBCFCD
1019	Upland - Chappel	34.14	117.68	1609	SBCFCD
1021	Mira Loma Space Center	34.03	117.54	827	SBCFCD
1067	Chino Substation - Edison	33.98	117.68	670	SBCFCD
1079	Chino - Imbach	33.97	117.6	642	SBCFCD
1085	San Antonio Heights C.D.F.	34.16	117.65	1901	SBCFCD
1175	Alta Loma Forney	34.12	117.59	1865	SBCFCD
2017	Fontana 5N (Getchell)	34.18	117.44	2020	SBCFCD
2194	Fontana Union Water Company - Townsite	34.1	117.44	1289	SBCFCD
2005	Declez	34.08	117.49	900	SBCFCD
2037	Lytle Creek Ranger Station	34.23	117.48	2730	SBCFCD
2159	Lytle Creek At Foothill Boulevard	34.11	117.33	1225	SBCFCD
2198	San Bernardino City - Lytle Creek	34.12	117.35	1225	SBCFCD
007	Arlington	33.92	117.44	805	RCFC&WCD
044	Corona North	33.90	117.56	638	RCFC&WCD
100	La Sierra	33.92	117.49	712	RCFC&WCD
102	Lake Mathews	33.85	117.45	1400	RCFC&WCD
177	Riverside East	33.97	117.34	986	RCFC&WCD
178	Riverside North	34.00	117.38	800	RCFC&WCD
179	Riverside South	33.95	117.39	840	RCFC&WCD
250	Woodcrest	33.88	117.35	1557	RCFC&WCD
265	Indian Hills	33.98	117.45	840	RCFC&WCD
035	Chase & Taylor	33.85	117.57	1055	RCFC&WCD

Table C-2
USGS Stream Gage Stations in the Area

Site Number	Site name	Location	
		Latitude	Longitude
11066460	Santa Ana River at MWD Crossing, CA	33°58'07"	117°26'51"
11066500	Santa Ana River at Riverside Narrows near Arlington, CA	33°57'53"	117°27'55"
11072000	Temescal Creek near Corona, CA	33°50'29"	117°30'37"
11072100	Temescal Creek Above Main Street at Corona, CA	33°53'21"	117°33'43"
11072200	Temescal Creek at Corona, CA	33°53'46"	117°34'50"
11073360	Chino Creek at Schaefer Avenue near Chino, CA	34°00'14"	117°43'34"
11073495	Cucamonga Creek near Mira Loma, CA	33°58'58"	117°35'55"
11074000	Santa Ana River below Prado Dam, CA	33°53'00"	117°38'40"

Table C-3
Land Use Types Used in Calibration

WEI Land Use Code	Land Use Category/Description	Area	
		(mile^2)	%
1	Low Density Residential	44.9	9%
2	Medium Density Residential	116.9	25%
3	High Density Residential	15.4	3%
4	Commercial	40.3	8%
5	Industrial	17.4	4%
6	Mixed Urban	0.1	0%
7	Orchards and Vineyards	11.3	2%
8	Irrigated Cropland and Improved Pasture Land	14.8	3%
9	Golf Courses, Cemeteries, Developed Parks, Schools	20.5	4%
10	Dairy, poultry, horse ranch, etc	12.8	3%
11	Impervious	36.3	8%
12	Undeveloped urban area	97.9	21%
13	Native/mountain	32.2	7%
14	Native/riparian	9.0	2%
15	Open space, pervious and unvegetated area	3.7	1%
16	Facilities with no percolation or runoff	1.6	0.3%
	Total	475	100%

Table C-4
Land Use Conversion from SCAG Land Use Code to R4 Model Land Use Types

SCAG Land Use Classification	Description	R4 Land Use Types
1000	Urban or Built-Up	2
1100	Residential	2
1110	Single Family Residential	2
1111	High-Density Single Family Residential	2
1112	Low-Density Single Family Residential	1
1120	Multi-Family Residential	3
1121	Mixed Multi-Family Residential	3
1122	Duplexes, Triplexes and 2-or 3-Unit Condominiums and Townhouses	3
1123	Low-Rise Apartments, Condominiums, and Townhouses	3
1124	Medium-Rise Apartments and Condominiums	3
1125	High-Rise Apartments and Condominiums	3
1130	Mobile Homes and Trailer Parks	3
1131	Trailer Parks and Mobile Home Courts, High-Density	3
1132	Mobile Home Courts and Subdivisions, Low-Density	2
1140	Mixed Residential	3
1150	Rural Residential	2
1151	Rural Residential, High-Density	2
1152	Rural Residential, Low-Density	1
1200	Commercial and Services	4
1210	General Office Use	4
1211	Low- and Medium-Rise Major Office Use	4
1212	High-Rise Major Office Use	4
1213	Skyscrapers	4
1220	Retail Stores and Commercial Services	4
1221	Regional Shopping Center	4
1222	Retail Centers (Non-Strip With Contiguous Interconnected Off-Street Parking)	4
1223	Modern Strip Development	4
1224	Older Strip Development	4
1230	Other Commercial	4
1231	Commercial Storage	4
1232	Commercial Recreation	4
1233	Hotels and Motels	4
1234	Attended Pay Public Parking Facilities	11
1240	Public Facilities	4
1241	Government Offices	4
1242	Police and Sheriff Stations	4
1243	Fire Stations	5
1244	Major Medical Health Care Facilities	5
1245	Religious Facilities	4
1246	Other Public Facilities	4
1247	Non-Attended Public Parking Facilities	11
1250	Special Use Facilities	4
1251	Correctional Facilities	9
1252	Special Care Facilities	4
1253	Other Special Use Facilities	4
1260	Educational Institutions	9
1261	Pre-Schools/Day Care Centers	9
1262	Elementary Schools	9
1263	Junior or Intermediate High Schools	9
1264	Senior High Schools	9
1265	Colleges and Universities	9
1266	Trade Schools and Professional Training Facilities	4
1270	Military Installations	9
1271	Base (Built-up Area)	2
1272	Vacant Area	12
1273	Air Field	5
1274	Former Base (Built-up Area)	12

Table C-4
Land Use Conversion from SCAG Land Use Code to R4 Model Land Use Types

SCAG Land Use Classification	Description	R4 Land Use Types
1275	Former Base Vacant Area	12
1276	Former Base Air Field	11
1300	Industrial	5
1310	Light Industrial	5
1311	Manufacturing, Assembly, and Industrial Services	5
1312	Motion Picture and Television Studio Lots	5
1313	Packing Houses and Grain Elevators	5
1314	Research and Development	5
1320	Heavy Industrial	5
1321	Manufacturing	5
1322	Petroleum Refining and Processing	5
1323	Open Storage	11
1324	Major Metal Processing	5
1325	Chemical Processing	5
1330	Extraction	12
1331	Mineral Extraction - Other Than Oil and Gas	12
1332	Mineral Extraction - Oil and Gas	12
1340	Wholesaling and Warehousing	4
1400	Transportation, Communications, and Utilities	11
1410	Transportation	11
1411	Airports	11
1412	Railroads	15
1413	Freeways and Major Roads	11
1414	Park-and-Ride Lots	11
1415	Bus Terminals and Yards	11
1416	Truck Terminals	11
1417	Harbor Facilities	4
1418	Navigation Aids	4
1420	Communication Facilities	4
1430	Utility Facilities	11
1431	Electrical Power Facilities	11
1432	Solid Waste Disposal Facilities	16
1433	Liquid Waste Disposal Facilities	16
1434	Water Storage Facilities	11
1435	Natural Gas and Petroleum Facilities	5
1436	Water Transfer Facilities	11
1437	Improved Flood Waterways and Structures	11
1438	Mixed Utilities	11
1440	Maintenance Yards	11
1450	Mixed Transportation	11
1460	Mixed Transportation and Utility	11
1500	Mixed Commercial and Industrial	4
1600	Mixed Urban	6
1700	Under Construction	12
1800	Open Space and Recreation	12
1810	Golf Courses	9
1820	Local Parks and Recreation (1990 Database only)	9
1821	Developed Local Parks and Recreation	9
1822	Undeveloped Local Parks and Recreation	12
1830	Regional Parks and Recreation (1990 Database only)	9
1831	Developed Regional Parks and Recreation	9
1832	Undeveloped Regional Parks and Recreation	12
1840	Cemeteries	9
1850	Wildlife Preserves and Sanctuaries	14
1860	Specimen Gardens and Arboreta	7
1870	Beach Parks	9
1880	Other Open Space and Recreation	12
2000	Agriculture	8

Table C-4
Land Use Conversion from SCAG Land Use Code to R4 Model Land Use Types

SCAG Land Use Classification	Description	R4 Land Use Types
2100	Cropland and Improved Pasture Land	8
2110	Irrigated Cropland and Improved Pasture Land	8
2120	Non-Irrigated Cropland and Improved Pasture Land	12
2200	Orchards and Vineyards	7
2300	Nurseries	7
2400	Dairy, Intensive Livestock, and Associated Facilities	10
2500	Poultry Operations	10
2600	Other Agriculture	7
2700	Horse Ranches	10
3000	Vacant	12
3100	Vacant Undifferentiated	12
3200	Abandoned Orchards and Vineyards	12
3300	Vacant With Limited Improvements	12
3400	Beaches (Vacant)	12
4000	Water	11
4100	Water, Undifferentiated	11
4200	Harbor Water Facilities	11
4300	Marina Water Facilities	11
4400	Water Within a Military Installation	11
4500	Area of Inundation (High Water) (1990 Database only)	11
9999	No Photo Coverage/Not in Update Study Area	

Table C-5
Soil Conservation Service Hydrologic Soil Types

Type Class	Description
A	Low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands or gravels. These soils have a high rate of water transmission.
B	Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
C	Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.
D	High runoff potential. Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

Table C-6
Summary of Hydrologic Soil Groups in Areas Tributary to Main Drainage in Chino Basin

Storm Drain System		Hydrologic Soil Group				
		A	B	C	D	Total (acres)
San Antonio/Chino	(acres)	22,527	18,283	10,709	2,641	54,160
	%	42%	34%	20%	5%	
Cucamonga/Deer	(acres)	25,004	26,519	3,784	371	55,679
	%	45%	48%	7%	1%	
Day/Etiwanda	(acres)	16,620	4,891	1,317	56	22,885
	%	73%	21%	6%	0%	
San Sevaine	(acres)	25,816	5,252	1,201	372	32,641
	%	79%	16%	4%	1%	
All Area	(acres)	89,968	54,945	17,011	3,440	165,365
	%	54%	33%	10%	2%	

Table C-7
Impervious Cover

Land Use Category/Description	Range (%)	Recommended Value for Average Conditions (%)	Reference
Natural or Agriculture	0 - 10	0	S, R
Public Park	10 - 25	15	S
School	30 - 50	40	S
Single Family Residential: (3)			
2.5 acre lots	5 - 15	10	S
1 acre lots	10 - 25	20	S
2 dwellings/acre	20 - 40	30	S
3-4 dwellings/acre	30 - 50	40	S
5-7 dwellings/acre	35 - 55	50	S
8-10 dwellings/acre	50 - 70	60	S
More than 10 dwellings/acre	65 - 90	80	S
40,000 S.F. (1 acre) Lots	10 - 25	20	R
20,000 S.F. (1/2 acre) Lots	30 - 45	40	R
7,200 - 10,000 S.F. Lots	45 - 55	50	R
Multiple Family Residential:			
Condominiums	45 - 70	65	S, R
Apartments	65 - 90	80	S, R
Mobile Home Park	60 - 85	75	S, R
Commercial, Downtown Business or Industrial	80 - 100	90	S, R

Reference

S - Hydrology Manual by San Bernardino County Flood Control District, August, 1986

R - Hydrology Manual by Riverside County Flood Control and Water Conservation District, 1978

Table C-8
Estimation of Impervious Area in Medium Density Residential Areas

Sample Location	Year Community Was Built	Fraction of Pervious Area on Parcel	Fraction of Impervious Area Including 25% for Road
Chino	1975	0.35	0.74
Chino	1984	0.33	0.75
Cucamonga	1981	0.54	0.60
Cucamonga	1986	0.36	0.73
Ontario	2001	0.35	0.74
Ontario	1979	0.38	0.71
Fontana	1987	0.38	0.71
Fontana	1995-96	0.39	0.71
Fontana	2003	0.36	0.73
Upland	1950’s	0.42	0.68
Average		0.39	0.71

Note: These estimates were made at WEI based on selected sample locations in the Chino Basin

Table C-9
Characteristics of Recharge and Retention Basins in the Project Area

Stream System	Basin Name	Owner	Operation Mode	Inflow Diversion
San Antonio/Chino				
	College Heights	CBWCD	C	RD
	Upland	Upland	M	DI, LR
	Montclair No. 1	CBWCD	C	DI, LR
	Montclair No. 2	CBWCD	C	DU, LR
	Montclair No. 3	CBWCD	C	DU, LR
	Montclair No. 4	CBWCD	C	DU, LR
	Brooks	CBWCD	C	DI, LR
Cucamonga/Deer				
	8th St	SBCFCD	M	FT, LR
	7th St	SBCFCD	M	FT, LR
	ELY	SBCFCD/CBWCD	C	FT
	Turner 1&2	SBCFCD	C	RD
	Turner 3&4	SBCFCD	C	DI
	Grove	SBCFCD	F	FT
Day/Etiwanda				
	Victoria	SBCFCD	C	DI, LR
	Etiwanda Debris	SBCFCD	F	FT
	Lower Day	SBCFCD	M	RD, LR, SD
	Wineville Basin	SBCFCD	M	FT, LR
San Sevaine				
	San Sevaine No. 1	SBCFCD	M	FT
	San Sevaine No. 2	SBCFCD	M	FT
	San Sevaine No. 3	SBCFCD	M	FT
	San Sevaine No. 4	SBCFCD	M	FT, LR
	San Sevaine No. 5	SBCFCD	M	FT, DI
	Banana	SBCFCD	M	FT
	Hickory	SBCFCD	M	FT, RB
	Jurupa	SBCFCD	M	LR, SD
	RP3	IEUA	C	RD
	Declez	SBCFCD	M	FT

Operation Mode

C	Conservation
M	Multipurpose
F	Flood Control

Inlet Diversion

RD	Rubber Dam Diversion
DI	Drop Inlet Diversion
LR	Local Runoff
FT	Flow Through
DU	Diversion from Upstream Basin
DO	Other Diversion
SD	Side Diversion

Table C-10
Hydrologic Properties of Each Land Use Type

WEI Land Use Code	Land Use Type Description	Fraction of Total Impervious Area (%)	Fraction of Directly Connected Impervious Area (%)	Curve Number			
				Soil Type			
				A	B	C	D
1	Low Density Residential	45	61	32	56	69	75
2	Medium Density Residential	71	77	32	56	69	75
3	High Density Residential	77	81	32	56	69	75
4	Commercial	90	98	32	56	69	75
5	Industrial	90	98	32	56	69	75
6	Mixed Urban	75	80	32	56	69	75
7	Orchards and Vineyards	2	14	39	62	75	81
8	Irrigated Cropland and Improved Pasture Land	2	14	53	70	80	85
9	Golf Courses, Cemeteries, Developed Parks, Schools	20	45	39	61	74	80
10	Dairy, poultry, horse ranch, etc	0	0	n/a	n/a	n/a	n/a
11	Impervious	95	99	32	56	69	75
12	Undeveloped urban area	2	14	78	86	91	93
13	Native/mountain	2	14	47	67	78	83
14	Native/riparian	0	0	30	58	71	78
15	Open space, pervious and unvegetated area	2	14	78	86	91	93
16	Facilities with no percolation or runoff	100	0	n/a	n/a	n/a	n/a

Table C-11
Storm Events Rainfall and Runoff during Calibration Period

Storm Period			Rainfall	Runoff	
				Chino Creek	Cucamonga Creek
Start	End	Days	(inches)	(acre-ft)	(acre-ft)
10/16/2004	10/22/2004	7	4.43	2437	6608
10/26/2004	10/29/2004	4	2.25	1529	3328
12/28/2004	12/31/2004	4	4.09	2006	3472
1/7/2005	1/14/2005	8	8.41	8580	21558
2/11/2005	2/12/2005	2	1.51	1135	1519
2/18/2005	2/24/2005	7	6.93	5147	13229
3/22/2005	3/23/2005	2	0.81	694	1057
4/28/2005	4/29/2005	2	0.61	380	829
10/16/2005	10/19/2005	4	1.57	531	1337
12/31/2005	1/3/2006	4	1.97	695	1728
2/27/2006	3/1/2006	3	2.05	883	2411
3/28/2006	3/30/2006	3	1.04	788	1742
4/4/2006	4/6/2006	3	2.20	911	2626
4/14/2006	4/15/2006	2	0.70	324	488
11/30/2007	12/1/2007	2	1.57	580	956
1/4/2008	1/7/2008	4	3.45	1569	4184
1/23/2008	1/29/2008	7	3.16	1213	2453
Minimum		2	0.61	324	488
Maximum		8	8.41	8580	21558
Average		4	2.75	1729	4090

Table C-12

Summary of the Mann-Kendall Test Results for Trend Detection in Monthly Precipitation at San Bernardino Hospital Gage

Month	Mean Value	Z statistic	Sen's Nonparametric Estimator:			Note
			Slope Estimate	Lower Confidence Limit	Upper Confidence Limit	
Jan	3.20	-0.84	-0.01	-0.02	0.01	No significant trend
Feb	3.39	0.19	0.00	-0.01	0.02	No significant trend
Mar	2.77	-1.10	-0.01	-0.02	0.00	No significant trend
Apr	1.38	-1.27	0.00	-0.01	0.00	No significant trend
May	0.49	-2.40	0.00	0.00	0.00	Downward trend detected
Jun	0.10	-0.36	0.00	0.00	0.00	No significant trend
Jul	0.03	-0.04	0.00	0.00	0.00	No significant trend
Aug	0.14	-2.50	0.00	0.00	0.00	Downward trend detected
Sep	0.31	-0.77	0.00	0.00	0.00	No significant trend
Oct	0.74	-1.81	0.00	-0.01	0.00	No significant trend
Nov	1.36	0.39	0.00	0.00	0.01	No significant trend
Dec	2.38	-0.23	0.00	-0.01	0.01	No significant trend

Table C-13
Summary of Heavy Rainfall Events at the San Bernardino Hospital Gage

Return Period	Period			
	1902-1928	1929-1955	1956-1982	1983-2009
90% or above	116	138	117	113
95% or above	49	68	59	64
99% or above	10	15	10	13

Table C-14
Current and Future Land Use

Land Use Code	Land Use Description	2006 Land Use		Subject to MS4 ?			General Plan in Area Subject to MS4 Permit		General Plan Land Use		
		Total (acres)	Fraction (%)	Urban No	Native No	Agricultural/ Dairy Yes	Total (acres)	Fraction (%)	Total (acres)	Fraction (%)	Urban
1	Low Density Residential	28727	9%	28727			7814	9%	36541	12%	36541
2	Medium Density Residential	74833	25%	74833			21855	25%	96688	32%	96688
3	High Density Residential	9883	3%	9883			6239	7%	16122	5%	16122
4	Commercial	25815	8%	25815			7936	9%	33751	11%	33751
5	Industrial	11107	4%	11107			10584	12%	21690	7%	21690
6	Mixed Urban	44	0%	44			4144	5%	4188	1%	4188
7	Orchards and Vineyards	7246	2%			7246	693	1%	693	0%	
8	Irrigated Cropland and Improved Pasture Land	9446	3%			9446	1382	2%	1382	0%	
9	Golf Courses, Cemeteries, Developed Parks, Schools	13144	4%	13144			2359	3%	15502	5%	15502
10	Dairy, poultry, horse ranch, etc	8207	3%			8207	315	0%	315	0%	
11	Impervious	23244	8%	23244			3937	4%	27181	9%	27181
12	Undeveloped urban area	62630	21%			62630	19471	22%	19471	6%	
13	Native/mountain	20622	7%		20622		0	0%	20622	7%	
14	Native/riparian	5736	2%		5736		0	0%	5736	2%	
15	Open space, pervious and unvegetated area	2384	1%	2384			628	1%	3012	1%	3012
16	Facilities of no percolation or runoff	1034	0%	1034			163	0%	1197	0%	1197
	Total	304103	100%	190216	26358	87529	87519	100%	304094	100%	255874
	Fraction of Total			62.5%	8.7%	28.8%					84%

Table C-15

Sensitivity Analysis Parameters

Basin	Infiltration Rate (ft/day)	Infiltration Rate Increase (%)	Storage at Spillway Elevation (acre-ft)	Additional Storage (acre-ft)
Brooks	0.1 to 3.9	10%	503	0
College Heights	2.5	10%	254	50
Montclair No. 1	0.9 to 3.5	10%	70	20
Montclair No. 2	0.75 to 4	10%	454	50
Montclair No. 3	0.4 to 3.8	10%	39	0
Montclair No. 4	0.3 to 3.8	10%	102	0
8th St	0.5	10%	113	50
7th St	0.5	10%	61	20
Upland	2	10%	860	50
Ely	0.5	10%	381	50
Etiwanda Debris	2			
Hickory	0.11	10%	161	50
Lower Day	1.6	10%	553	50
San Sevaine No. 1	2.5	10%	74	50
San Sevaine No. 2	0.5	10%	53	50
San Sevaine No. 3	0.5	10%	46	20
San Sevaine No. 4	0.5	10%	13	0
San Sevaine No. 5	0.5	10%	800	50
Turner No. 1&2	0.5	10%	330	50
Turner No. 3&4	0.5	10%	205	50
Victoria	1.5	10%	377	50
Grove	0.15	10%	341	50
Banana	1.4	10%	42	20
Declez	2.5	10%	281	50
RP3	2.5	10%	331	50
Wineville	0.5	10%	199	50
Total			6643	930
Percent of Increase				14%

Table C-16
Sensitivity Analysis Results Using 2006 Land Use Data and 58-Year Hydrology

Basins	Scenarios		
	Baseline (acre-ft)	10% Percolation Rate Increase (acre-ft)	Enlarged Storage (acre-ft)
Brooks	672	673	672
College Heights	0	0	0
Montclair No. 1	290	296	297
Montclair No. 2	118	112	111
Montclair No. 3	274	281	274
Montclair No. 4	341	346	341
8th St	785	814	883
7th St	438	447	467
Upland	479	479	479
ELY	1366	1411	1443
Etiwanda Debris	883	906	921
Hickory	213	222	247
Lower Day	555	552	560
San Sevaine No. 1	903	935	950
San Sevaine No. 2	117	113	128
San Sevaine No. 3	652	677	510
San Sevaine No. 4	68	69	51
San Sevaine No. 5	1124	1113	989
Turner No. 1&2	752	755	754
Turner No. 3&4	733	759	809
Victoria	561	562	568
Grove	259	271	302
Banana	445	459	513
Declez	912	945	1028
RP3	444	460	500
Wineville Basin	239	262	711
Total	13625	13920	14508
Change (acre-ft)		295	883
Change (%)		2.2%	6.5%

Table C-17

85th Percentile Rainfall for Selected Stations in Chino Basin

Station	Record Length (years)	85th percentile (inches)
Ontario Fire Station	74	0.94
Fontana Union Water Company - Townsite	73	0.86
Claremont/Montclair	109	1.00
Ontario Airport/Turner	96	1.03
Average	**88**	**0.96**

Table C-18
Runoff Captured from Future Development from Compliance with 2010 MS4 Permits

City	From Areas Overlying Chino Groundwater Basin	
	100% Capture (acre-ft)	50% Capture (acre-ft)
Claremont	3	2
Montclair	82	41
Upland	210	105
Rancho Cucamonga	1721	861
Fontana	1616	808
Rialto	145	72
Ontario	3934	1967
Chino	1787	893
Chino Hills	33	16
Riverside	4	2
Corona	0	0
Norco	19	9
Pomona	38	19
San Bernardino County	589	294
Riverside County	2423	1212
Others	0	0
Total	**12604**	**6302**

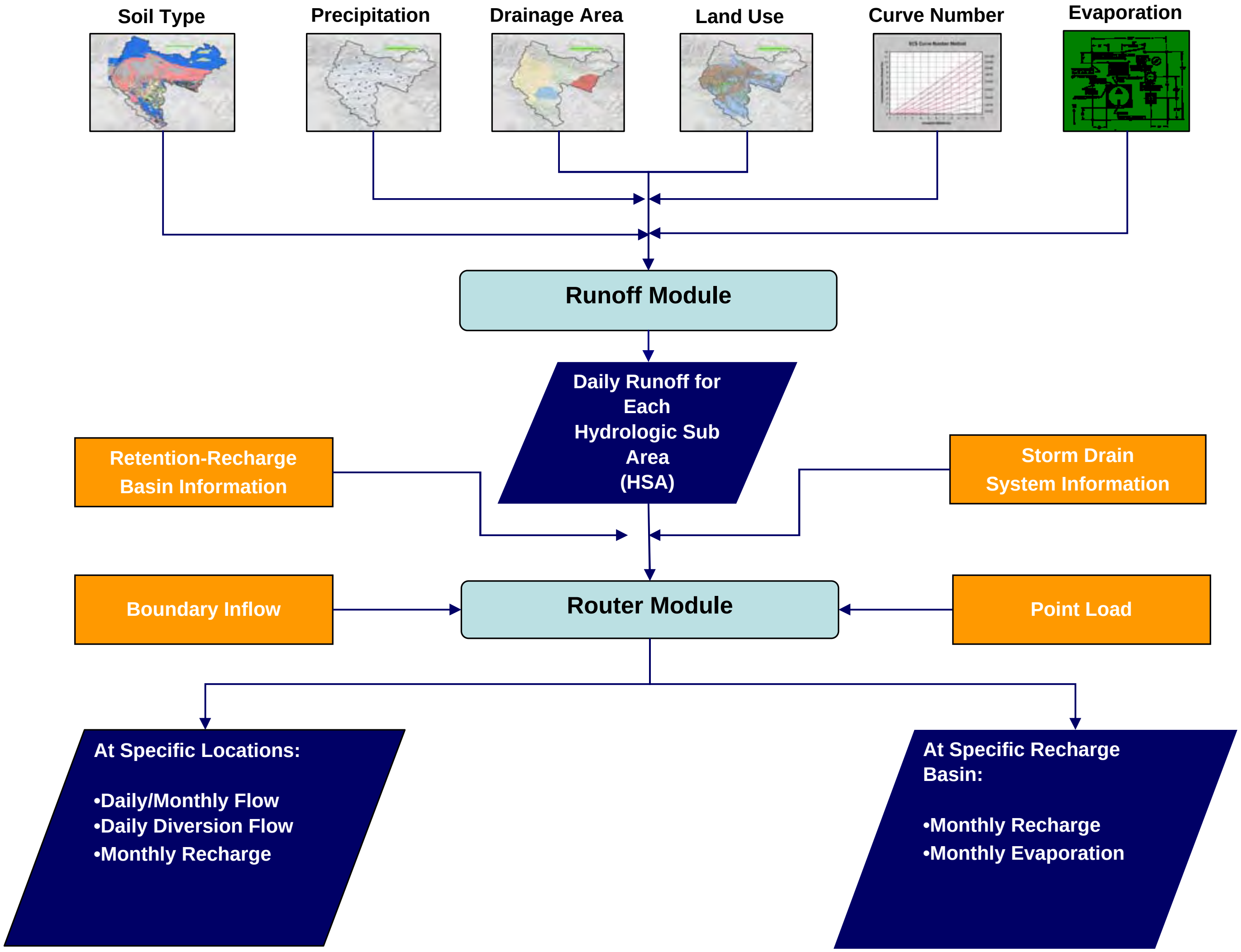
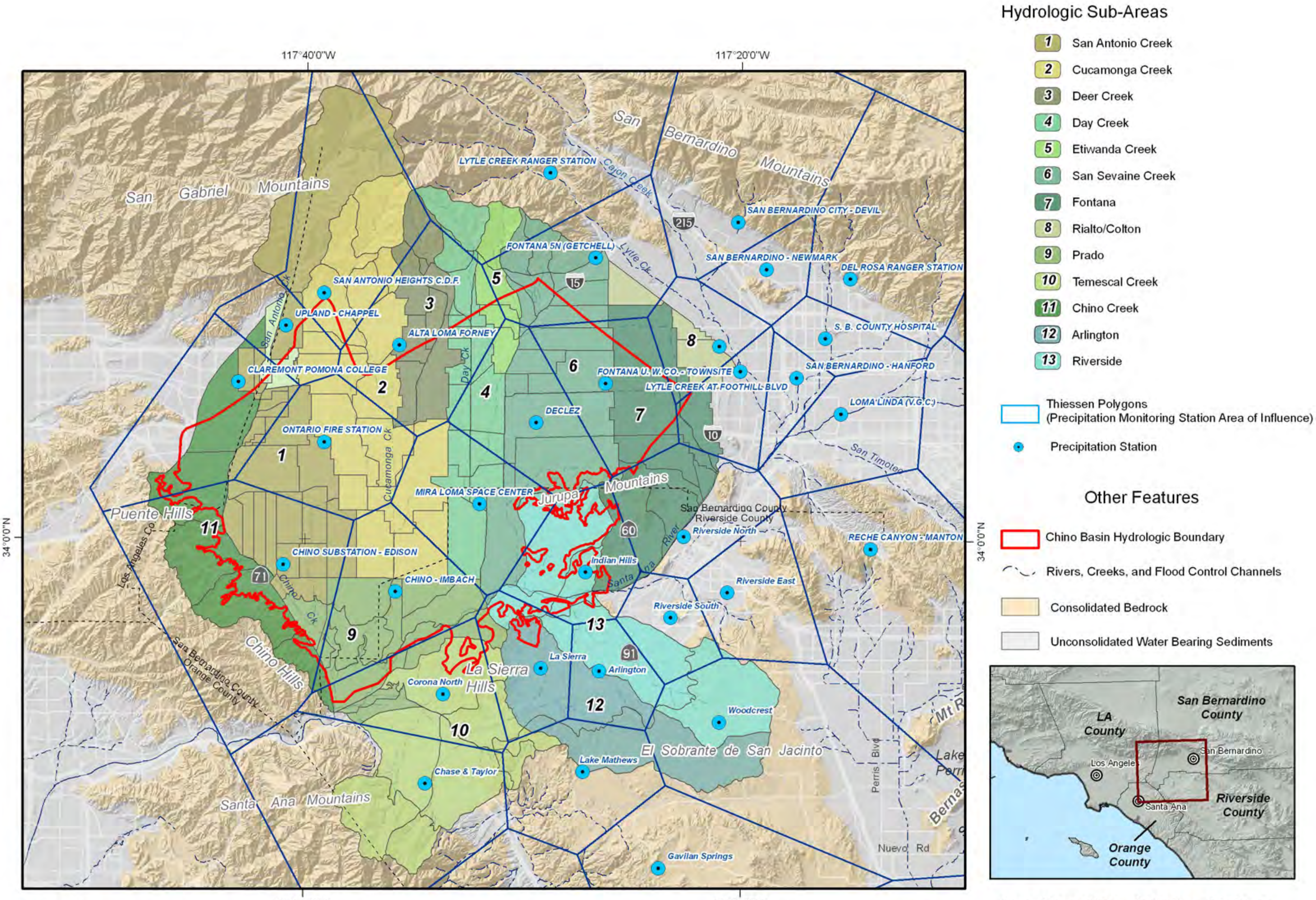


Figure C-1
Organization of the Runoff and Router Modules



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0 2 4 6 8 Miles
0 4 8 12 KM

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Location of Precipitation Stations, Hydrologic Sub-Areas, and Thiessen Polygons

Figure C-2

Figure C-3

Historical Annual Rainfall in the Chino Watershed Modeling Area

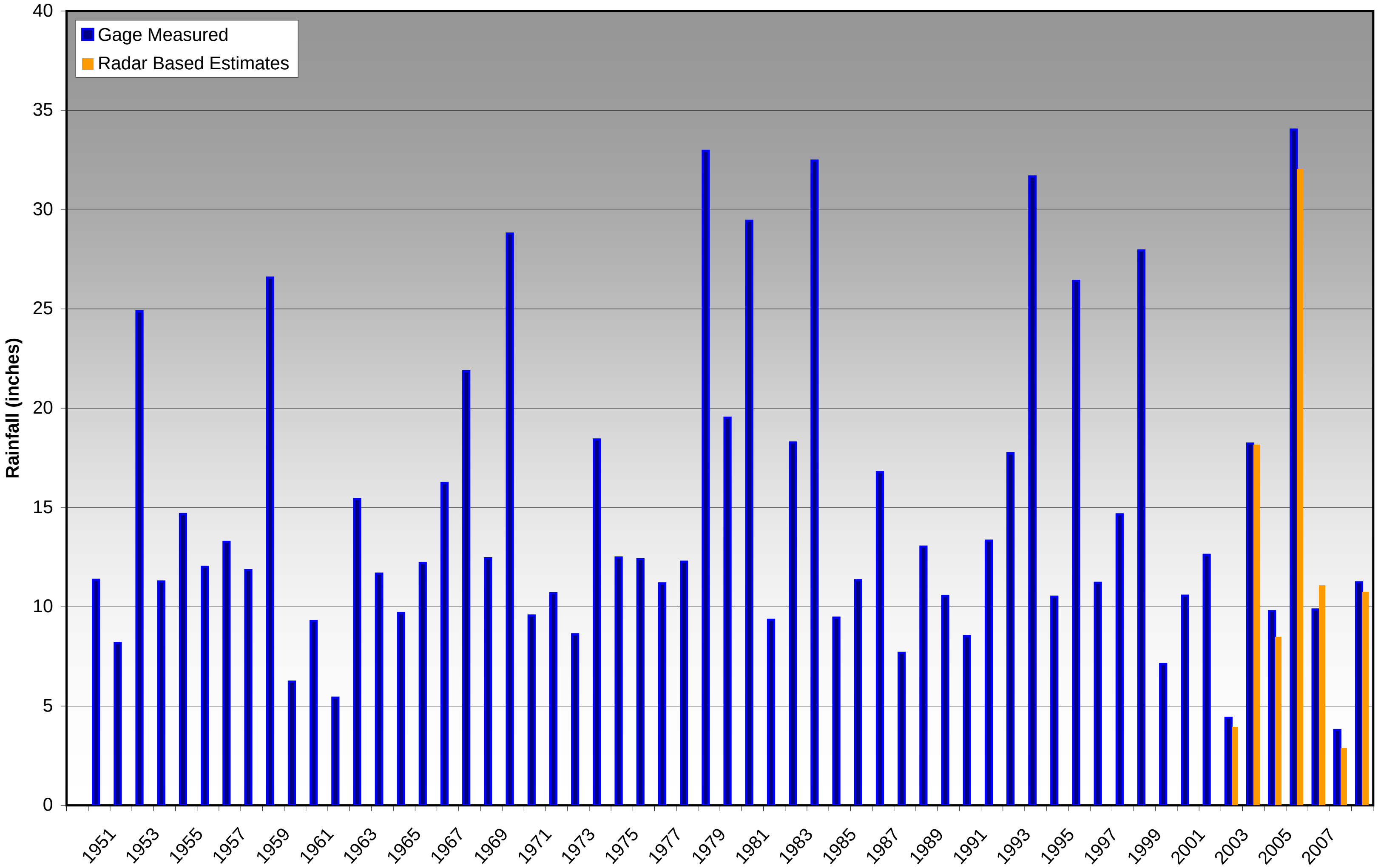


Figure C-4

Comparison of Annual Gage-Measured Rainfall versus Radar-Based Rainfall

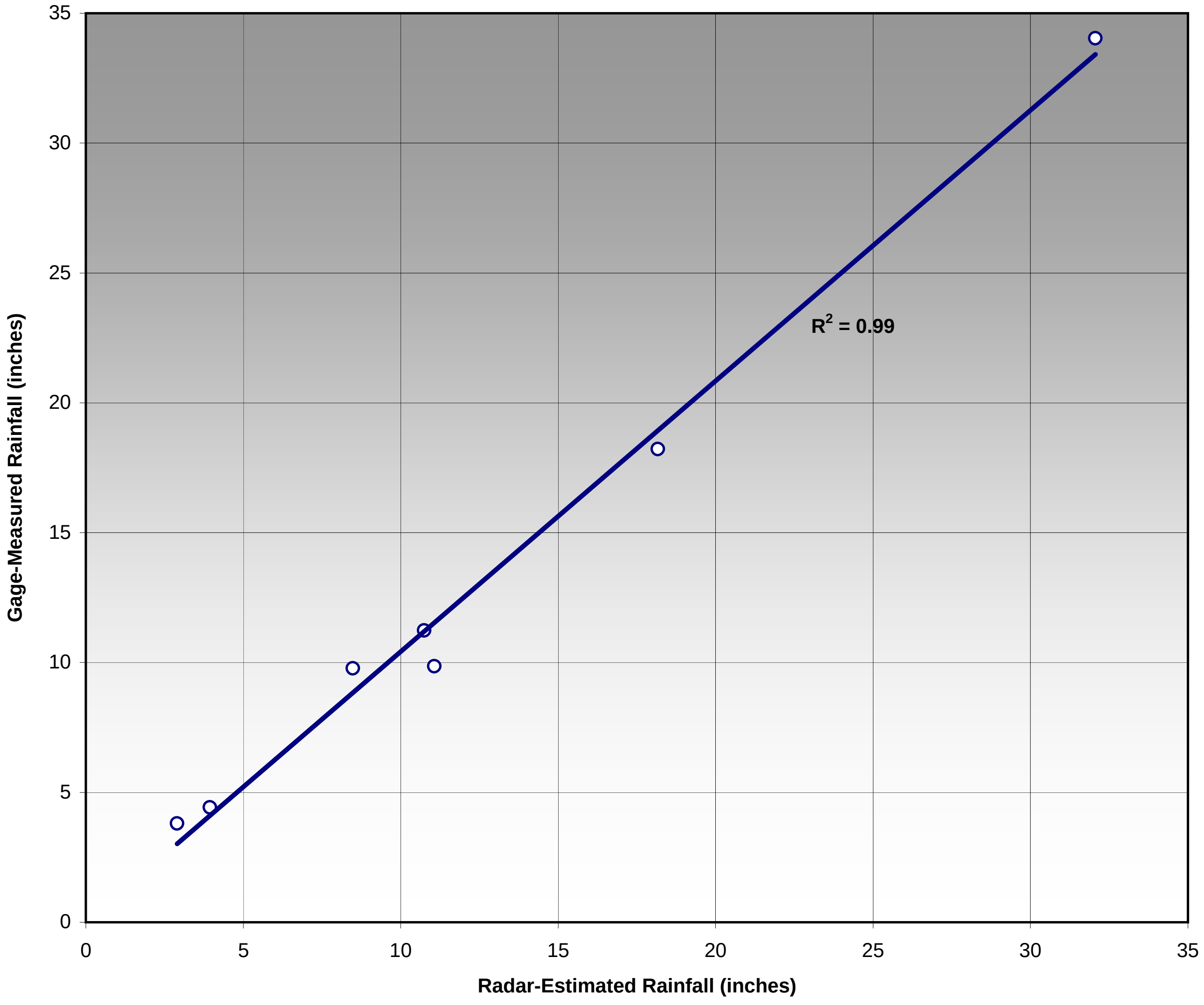
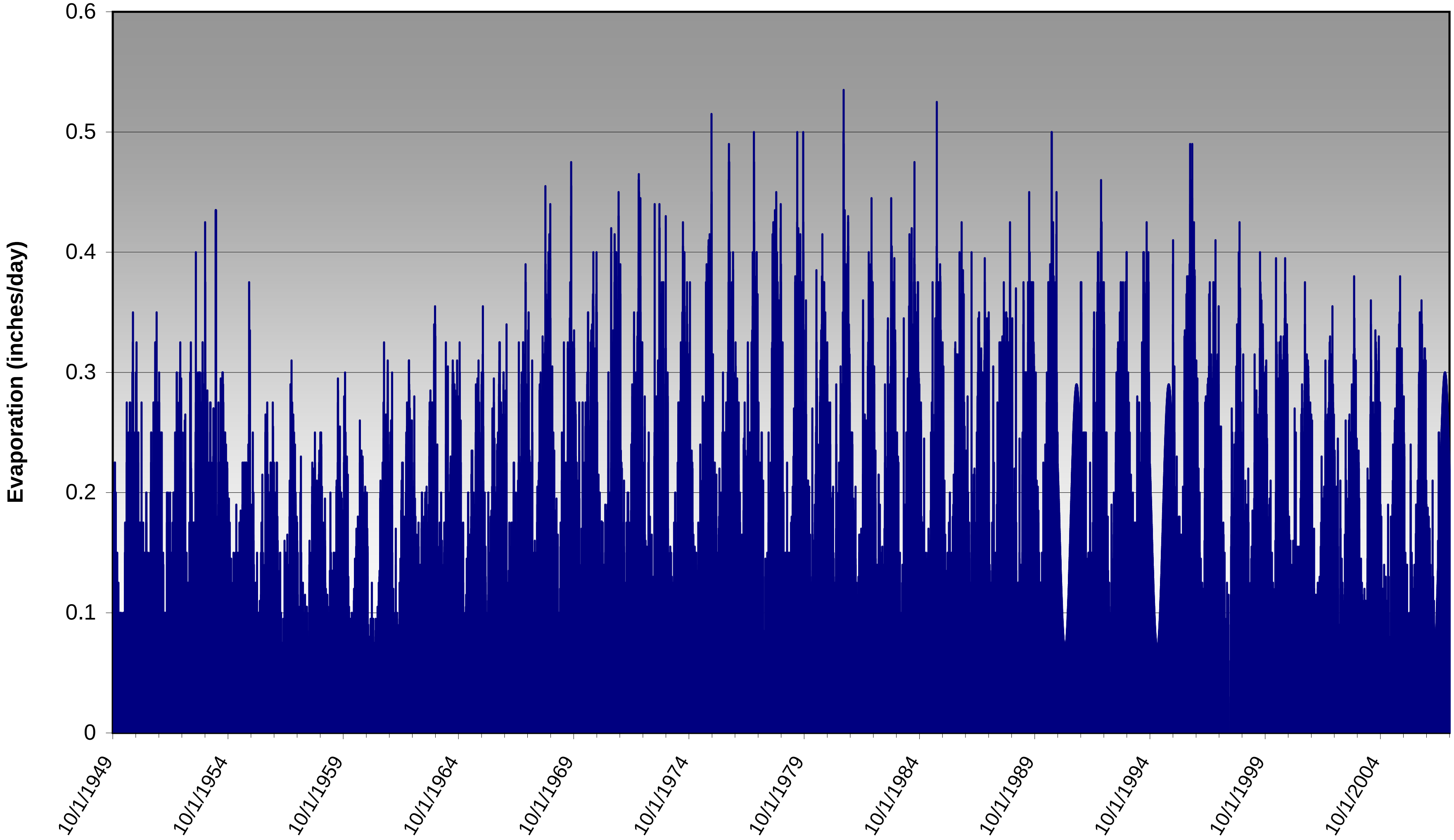
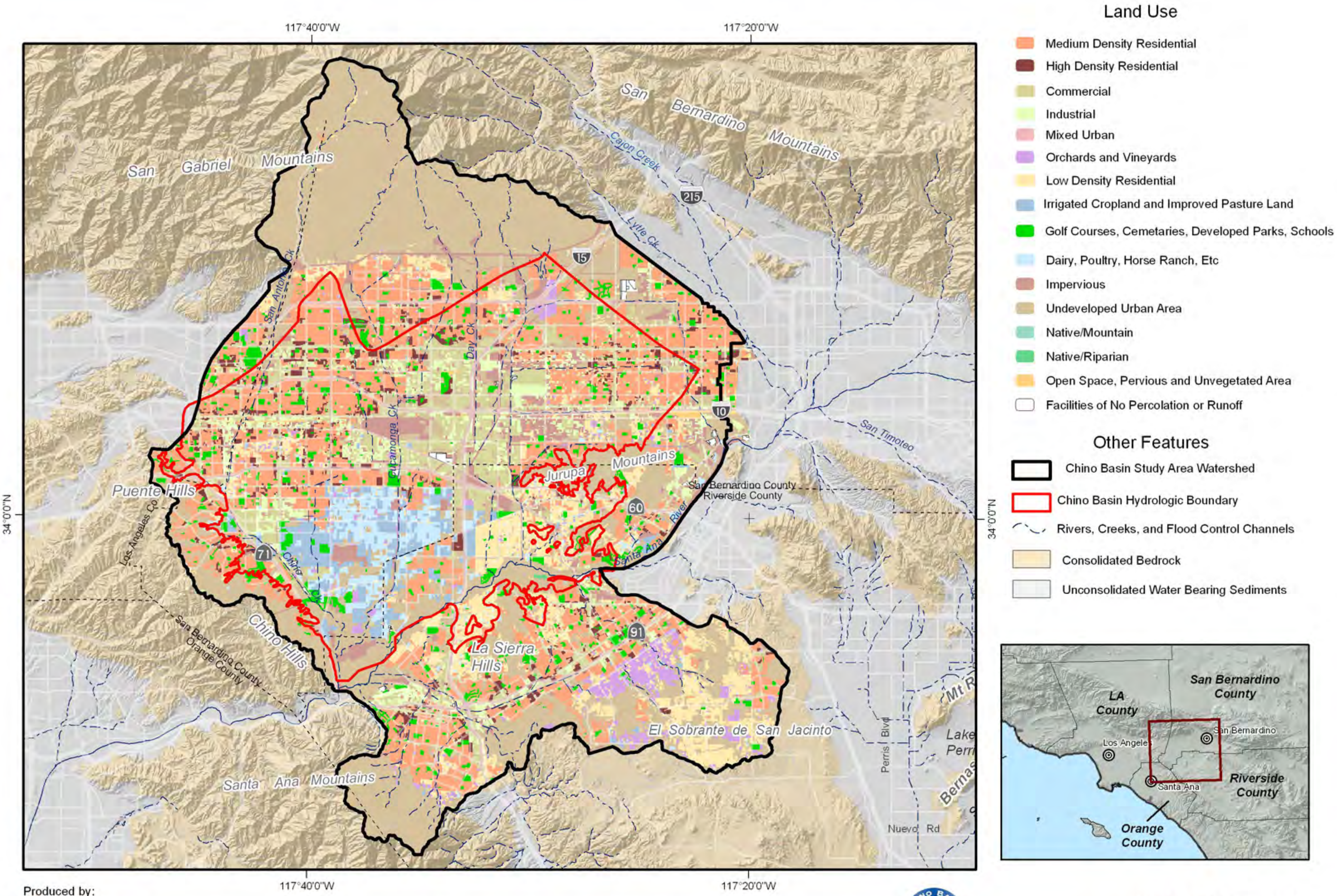


Figure C-5
Historical Evaporation Recorded at Puddingstone Station





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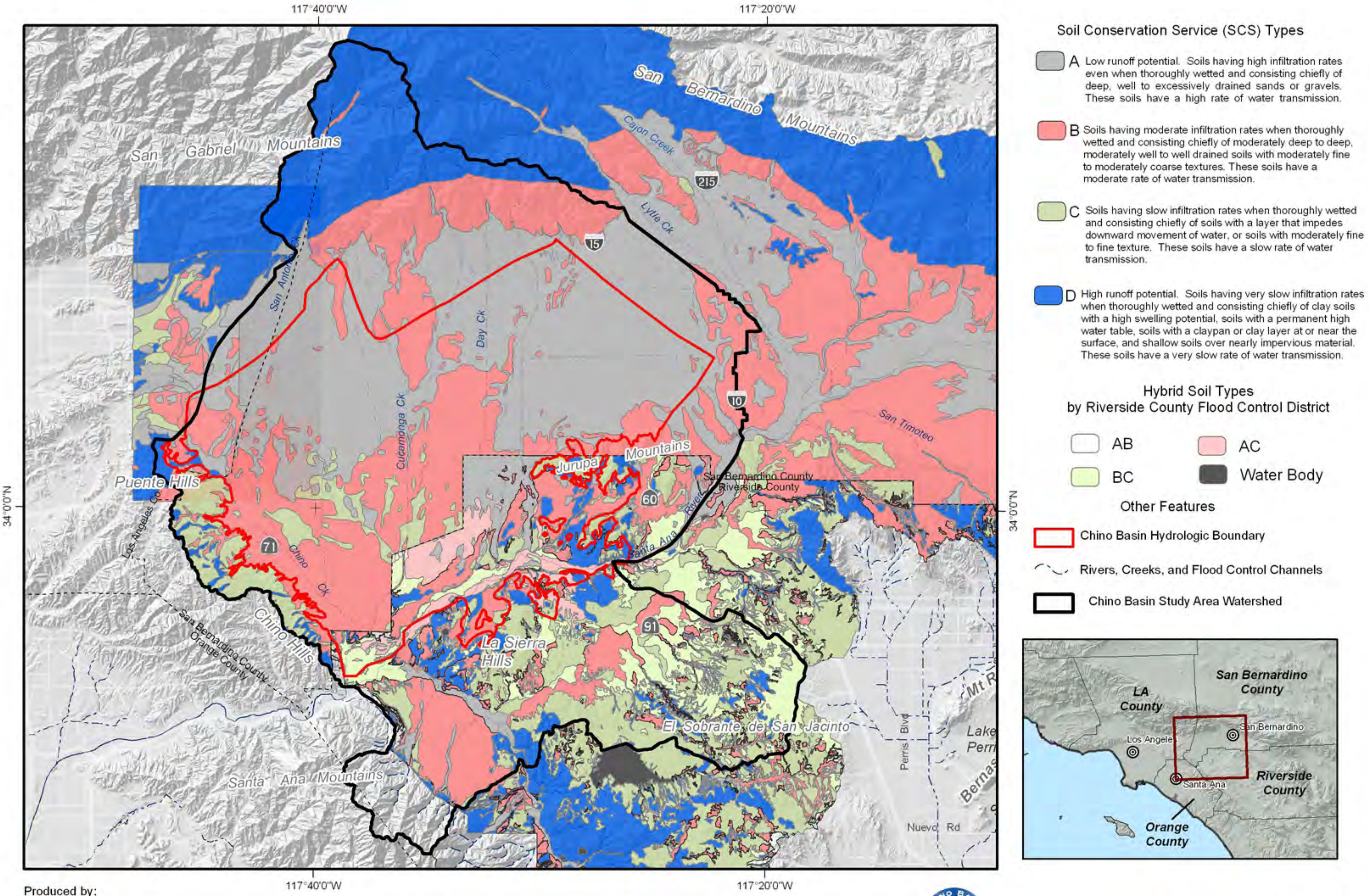
SCAG 2006 Land Use in the Chino Basin Area

Figure C-6



Soil Conservation Service (SCS) Types

A Low runoff potential. Soils having high infiltration rates even when thoroughly wetted and consisting chiefly of deep, well to excessively drained sands or gravels. These soils have a high rate of water transmission.

B Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

C Soils having slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.

D High runoff potential. Soils having very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

Hybrid Soil Types by Riverside County Flood Control District

AB
AC
BC
Water Body

Other Features

Chino Basin Hydrologic Boundary
Rivers, Creeks, and Flood Control Channels
Chino Basin Study Area Watershed

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0 2 4 6 8 Miles
0 4 8 12 KM

CHINO BASIN WATERMASTER Partners in Basin Management

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SCS Hydrologic Soil Types

Figure C-7

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0 2 4 6 8 Miles
0 4 8 KM

🟥 Location of areas that were analyzed to determine impervious and pervious areas

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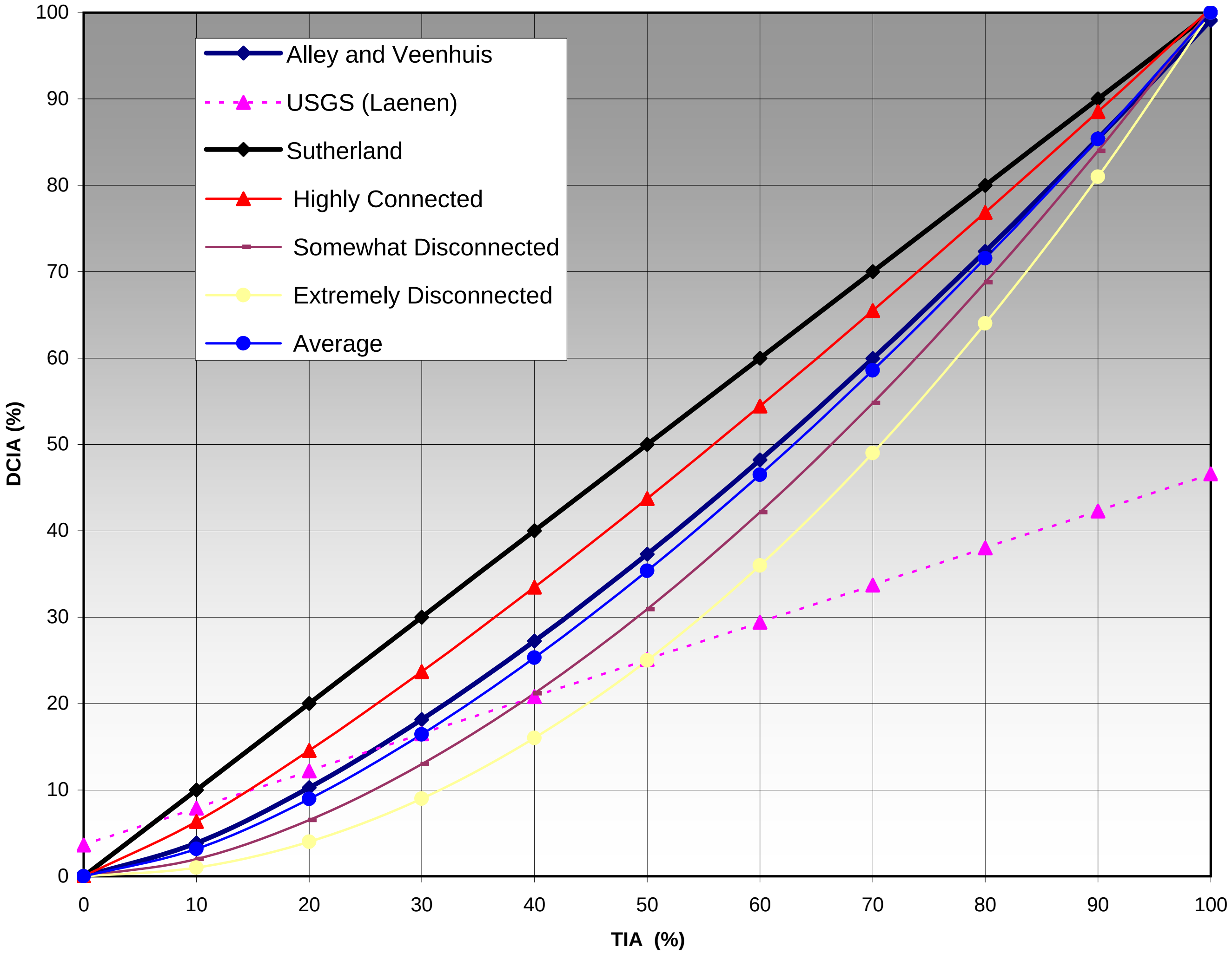
Medium Density Residential Areas Used to Determine Pervious and Impervious Area

Figure C-8

Figure C-9
Directly Connected Impervious Area (DCIA) versus Total Impervious Area (TIA)



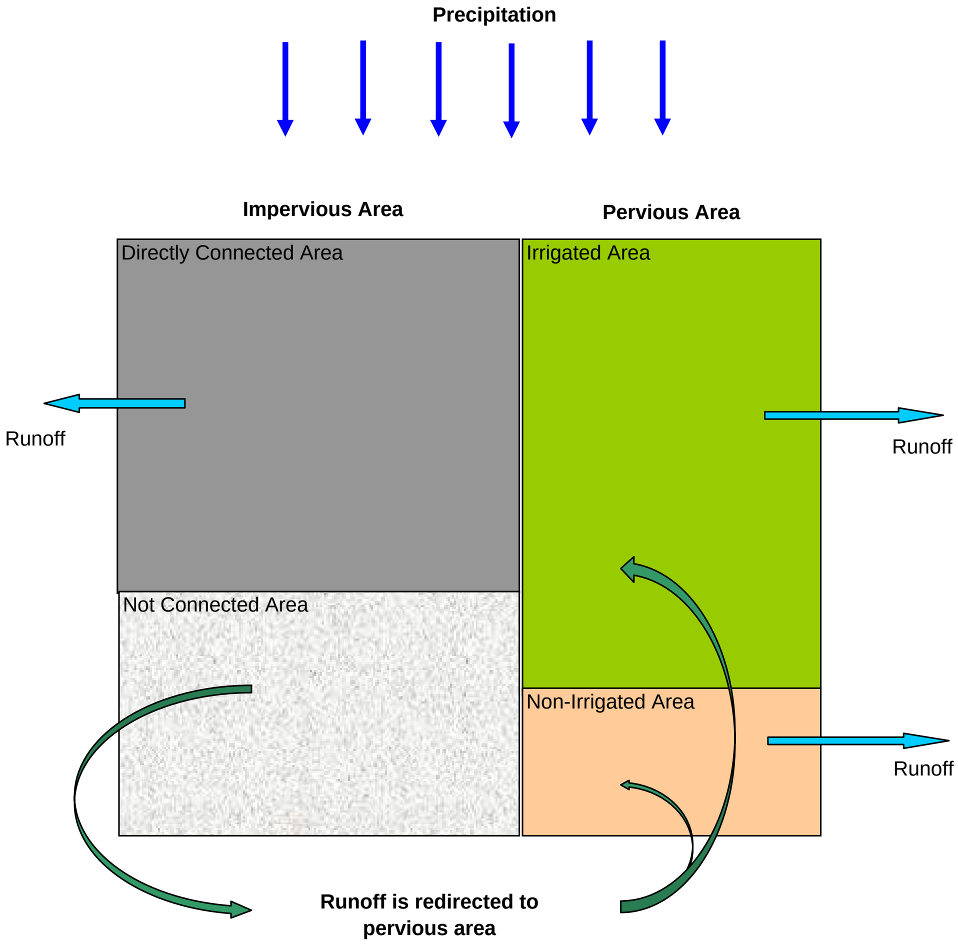


Figure C-10

Schematic Diagram to Redirect Runoff from Impervious Area to Pervious area

Figure C-11
Graphical Explanation of SCS Method Variables

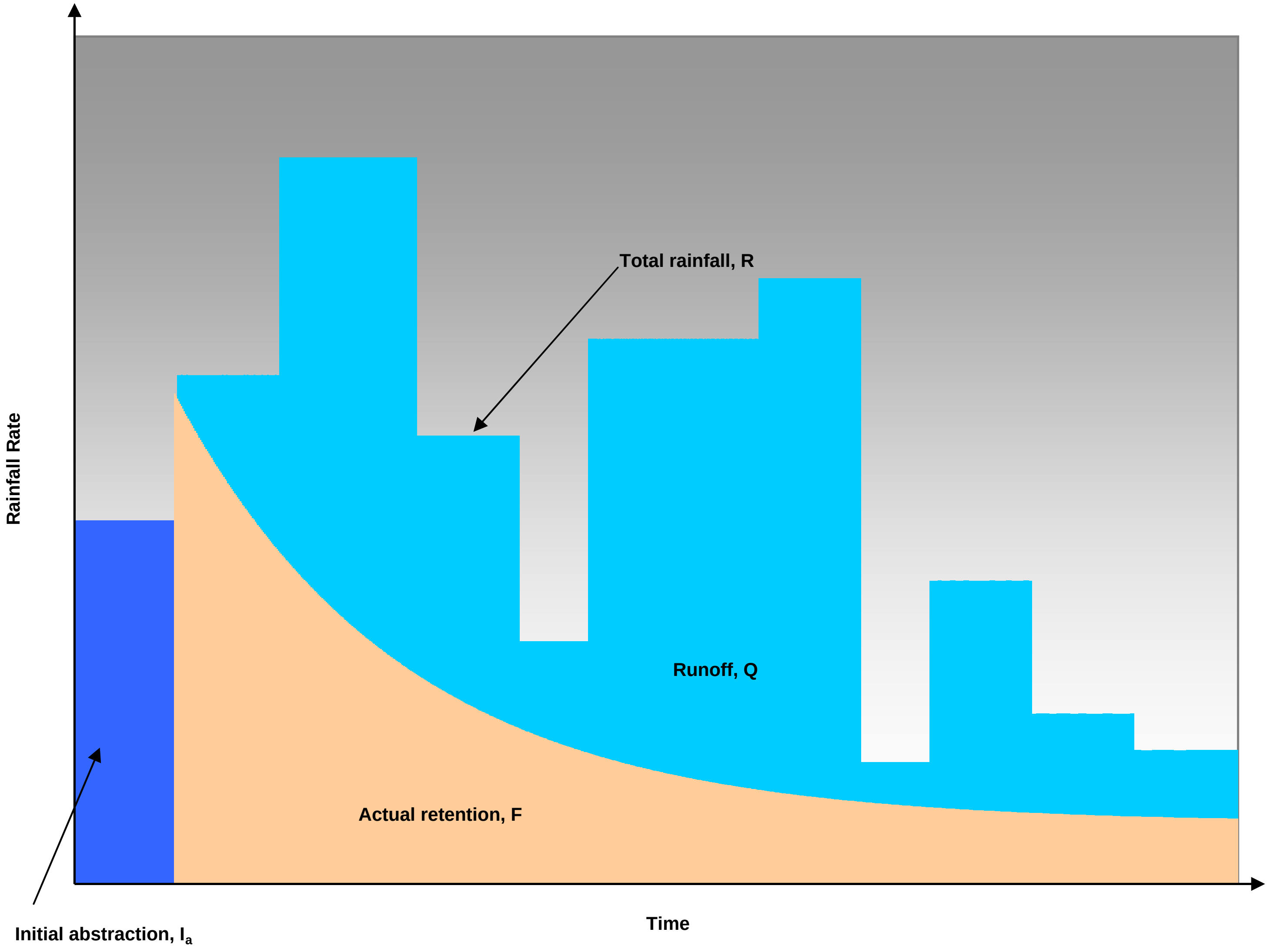
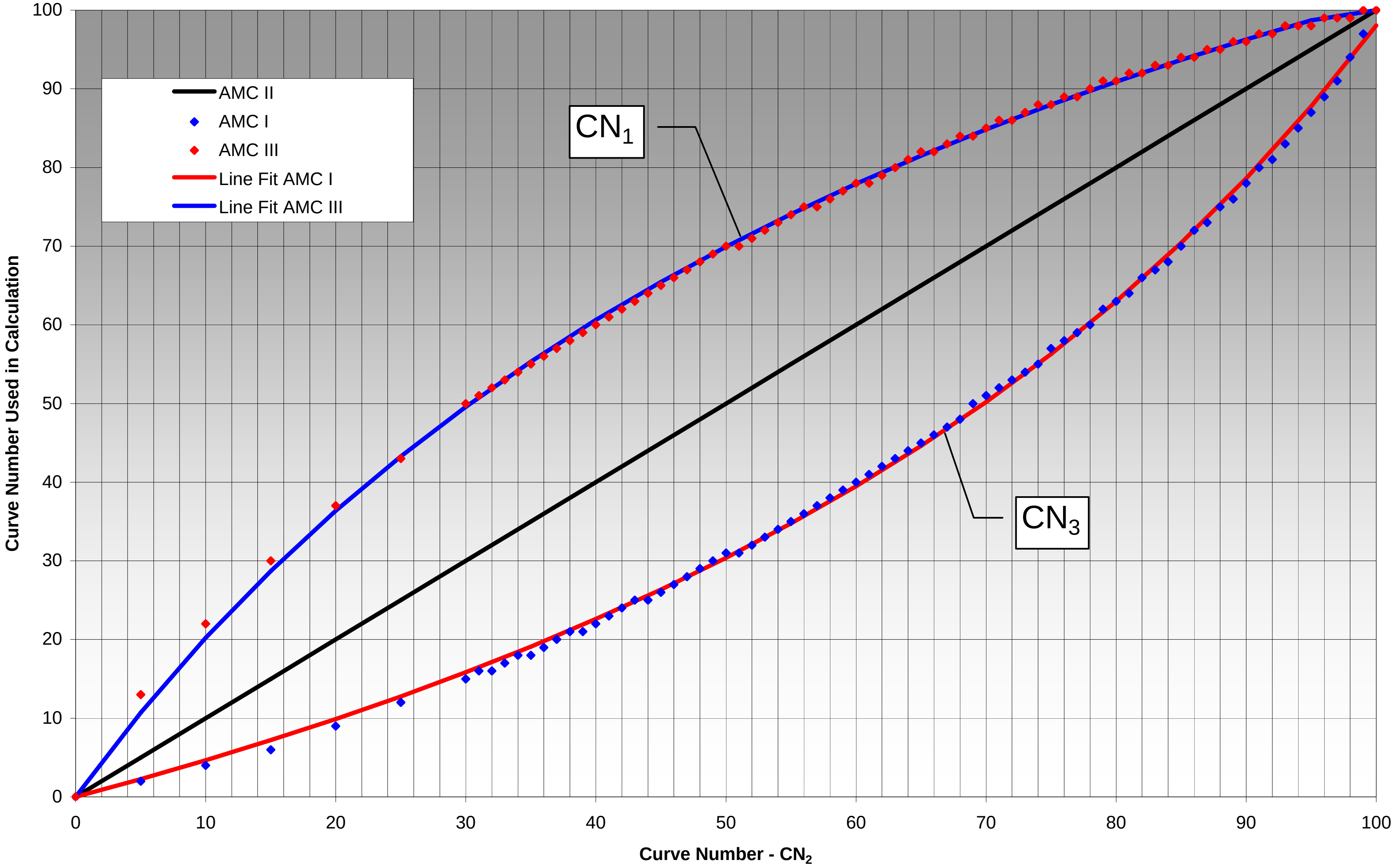
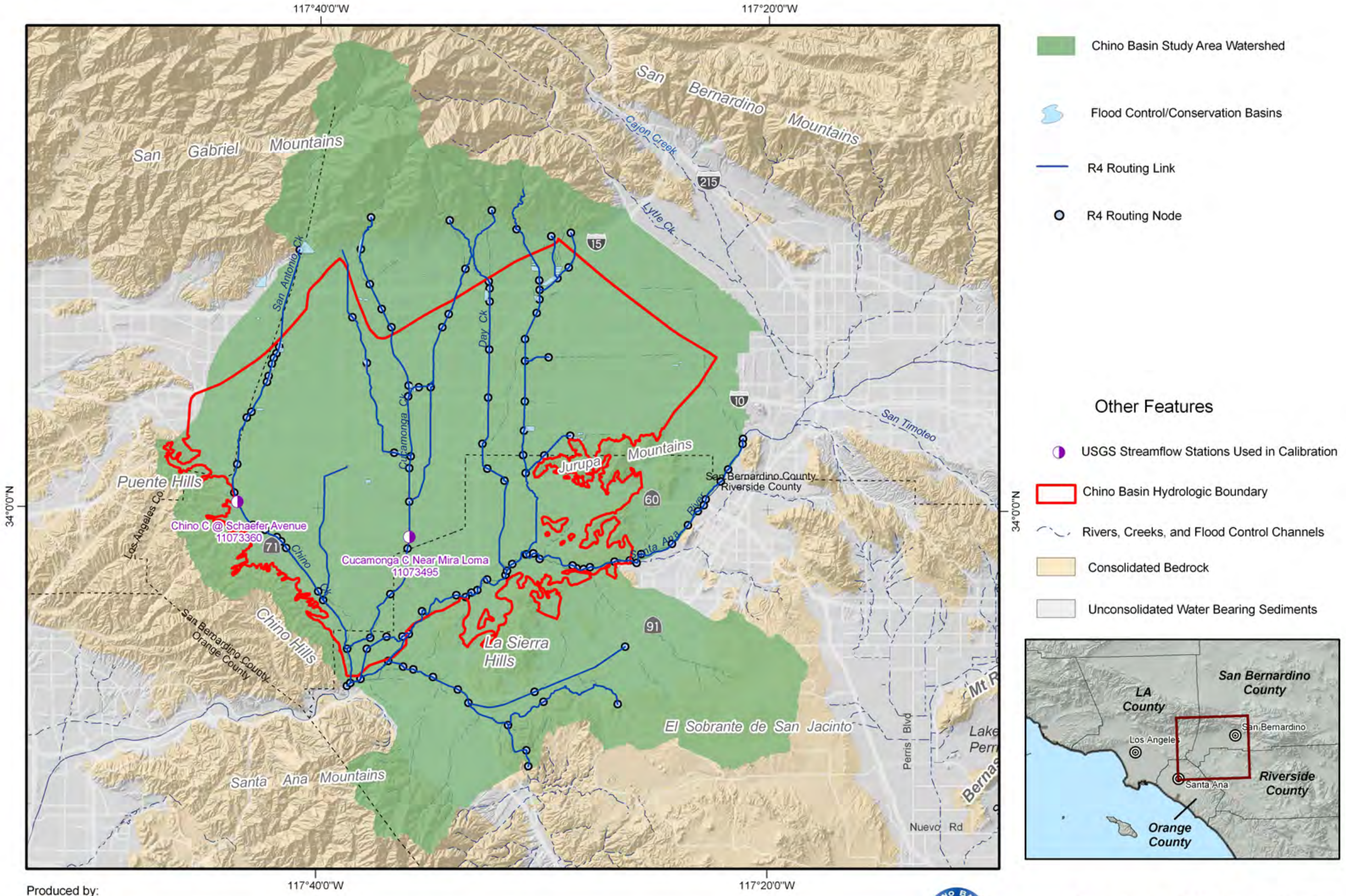


Figure C-12

Variation of Curve Number Due to Antecedent Soil Moisture Condition (AMC)





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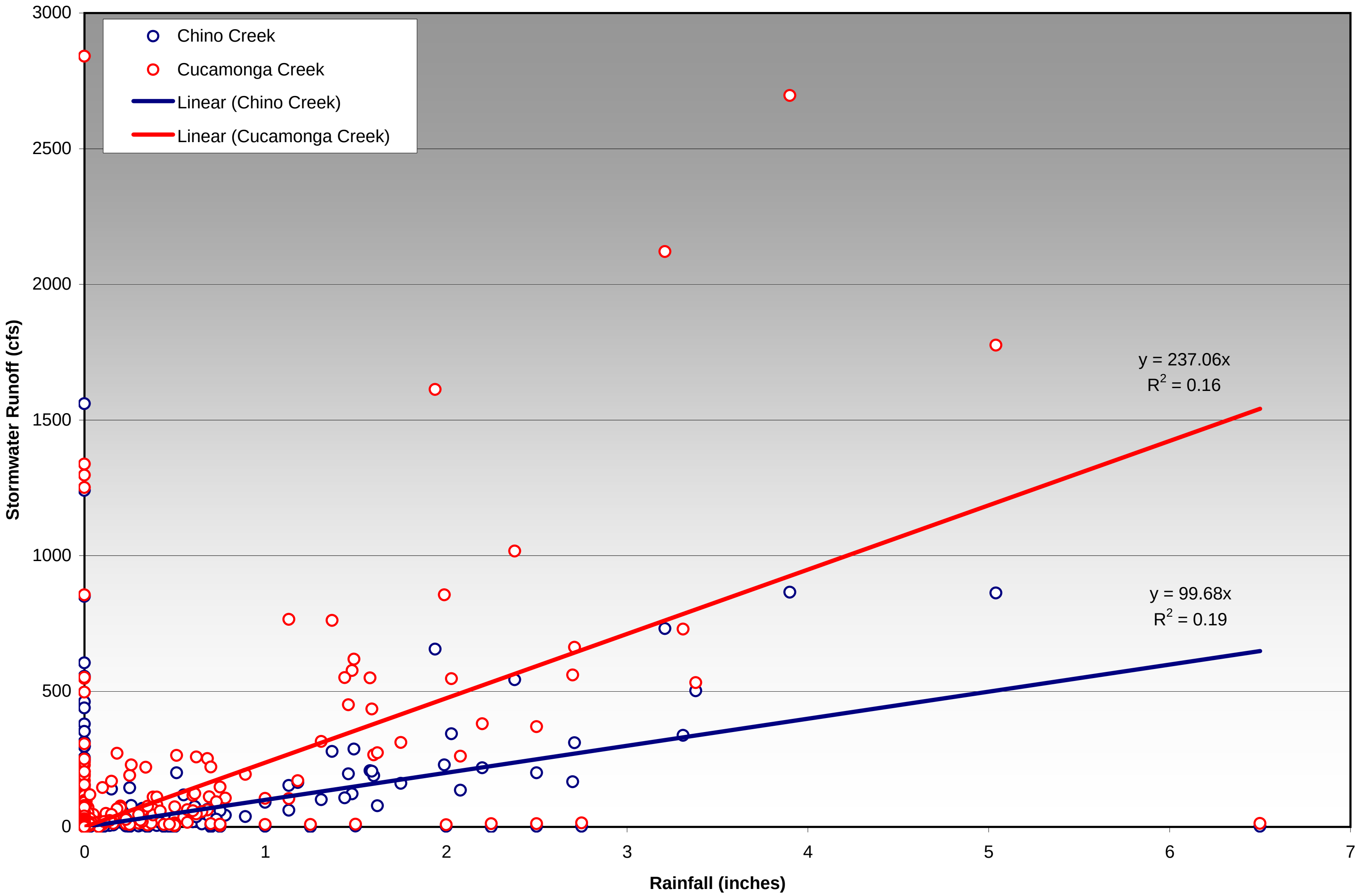
Locations of Recharge Basins, Model Links and Nodes

Figure C-13

Figure C-14
Daily Stormwater Runoff versus Total Daily Rainfall



Figure_v1.xls -- Figure C-14

Figure C-15
Comparison of Historical Daily Flow at Cucamonga Creek versus Flow at Chino Creek

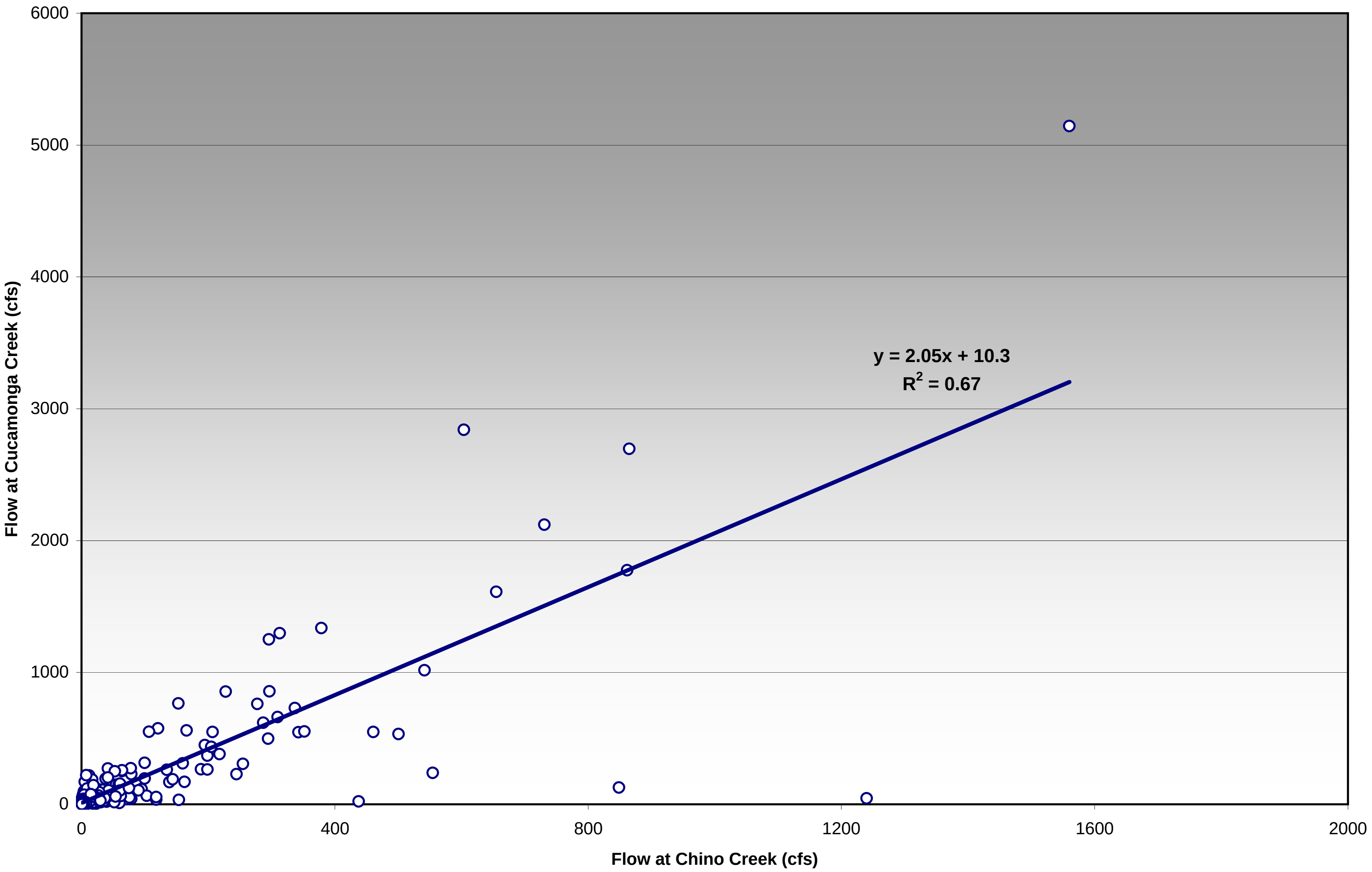


Figure C-16
Modeled versus Measured Stormwater Runoff

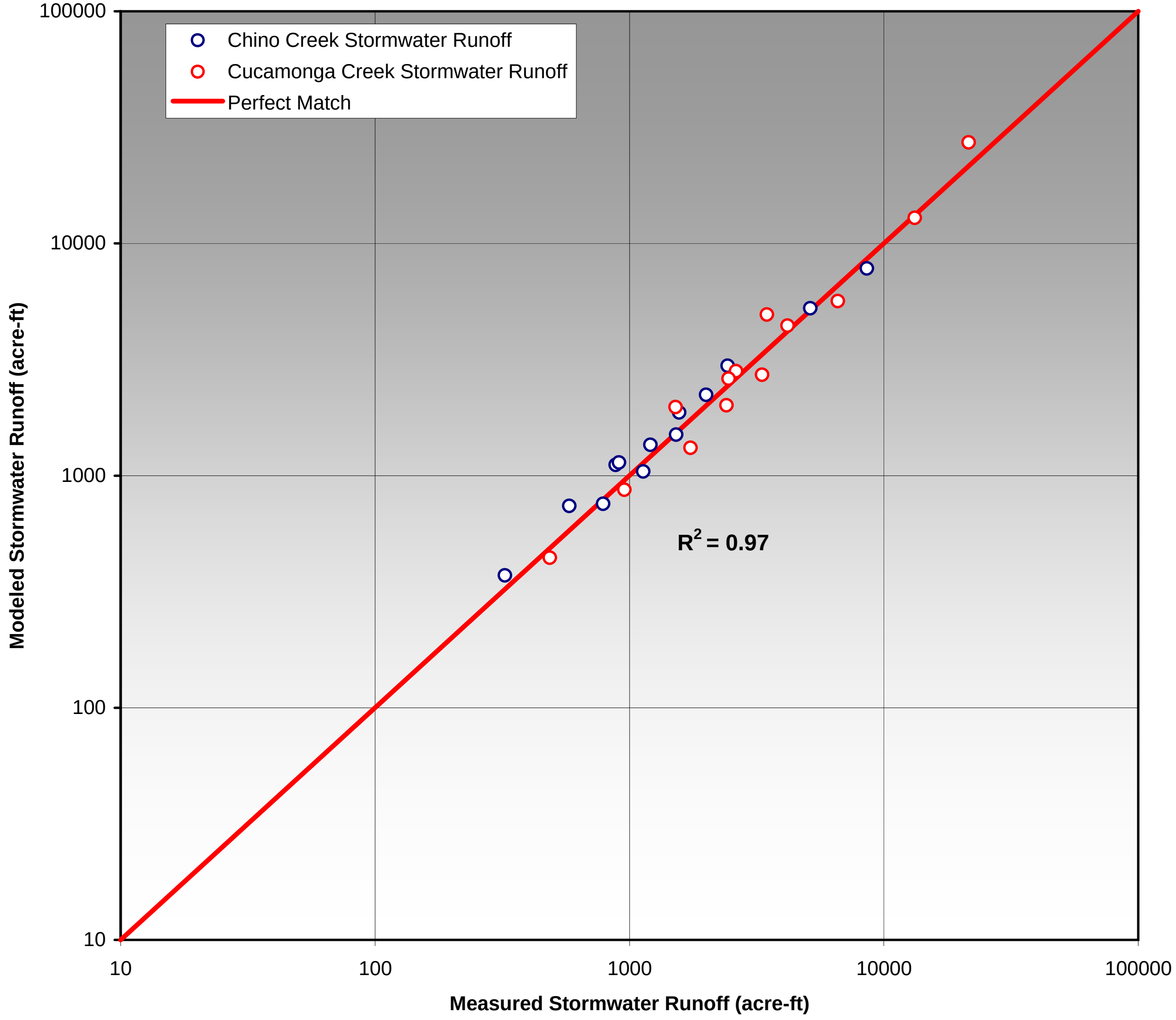


Figure C-17a

Monthly Rainfall Averages for a 55-Year Window, San Bernardino Hospital Gage

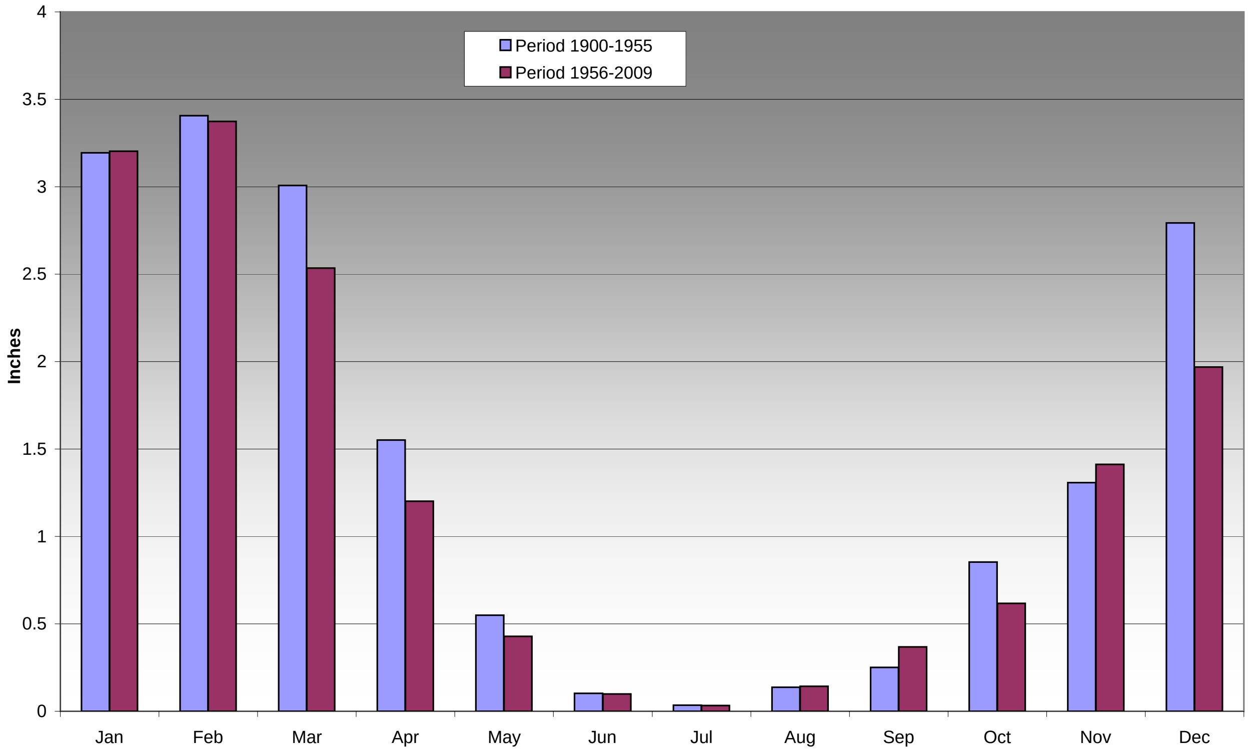


Figure C-17b

Monthly Rainfall Averages for a 27-Year Window, San Bernardino Hospital Gage

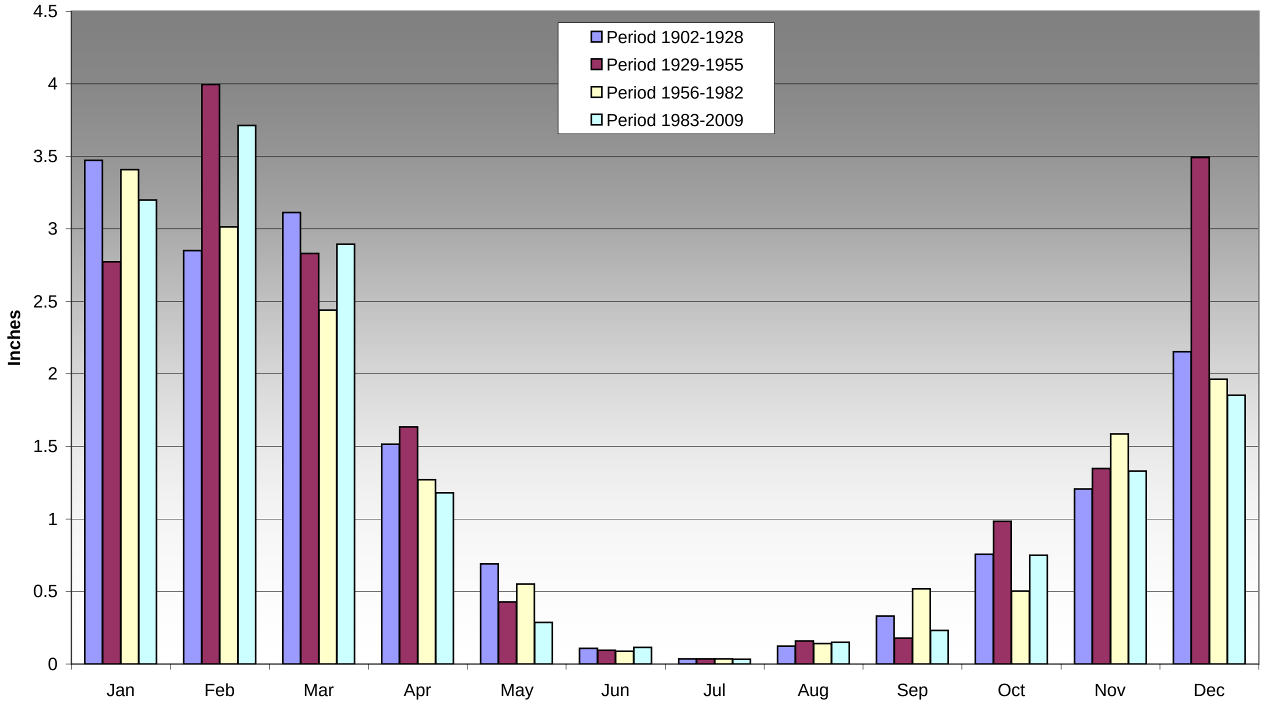
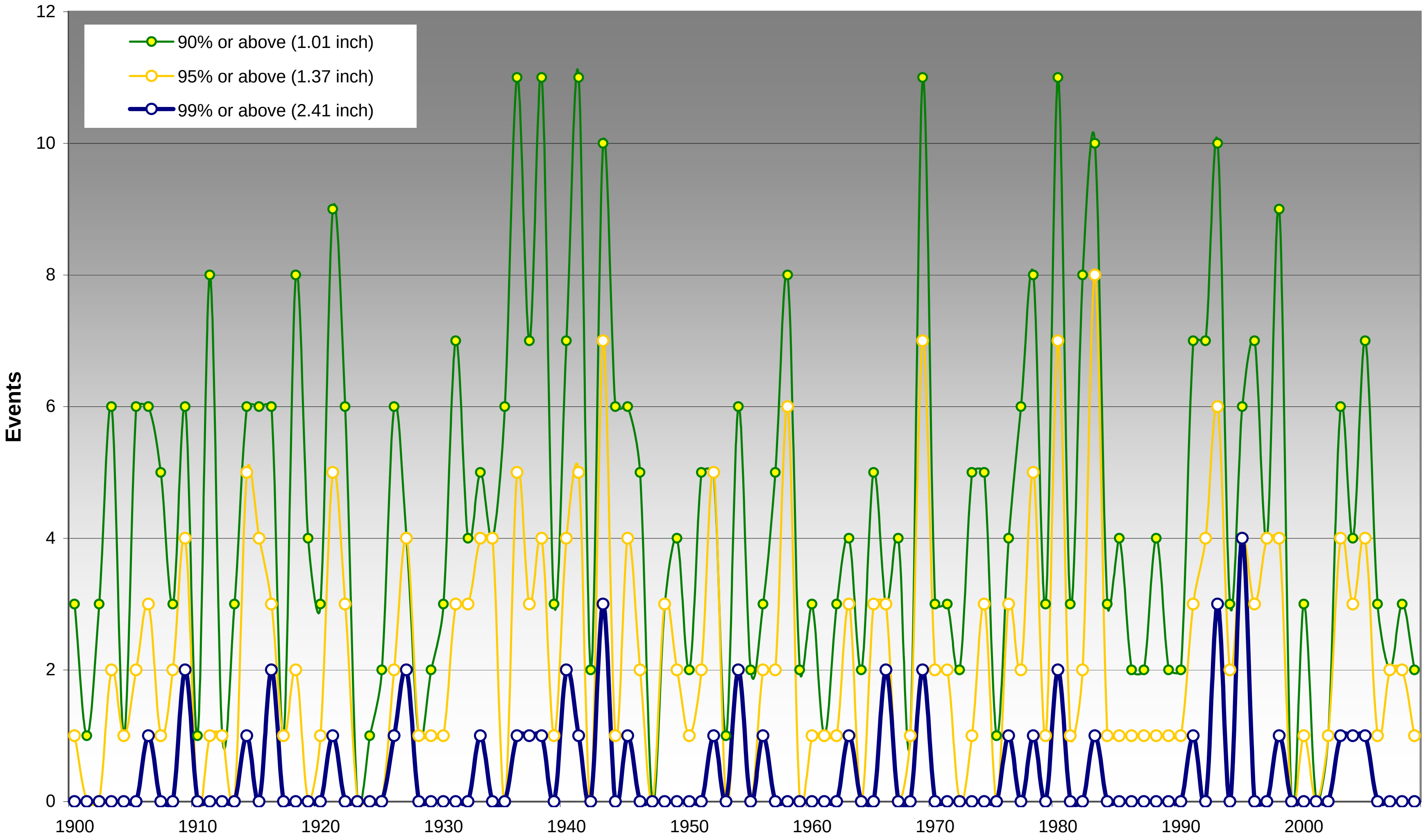


Figure C-18

Change in Number of High Precipitation Daily Events at the San Bernardino Hospital Gage



SBHospital_1900-2009.xlsChart1

Figure C-19a

Mass Curve Plot of Monthly Precipitation Estimates in the Ontario Area, Period 1950-2009

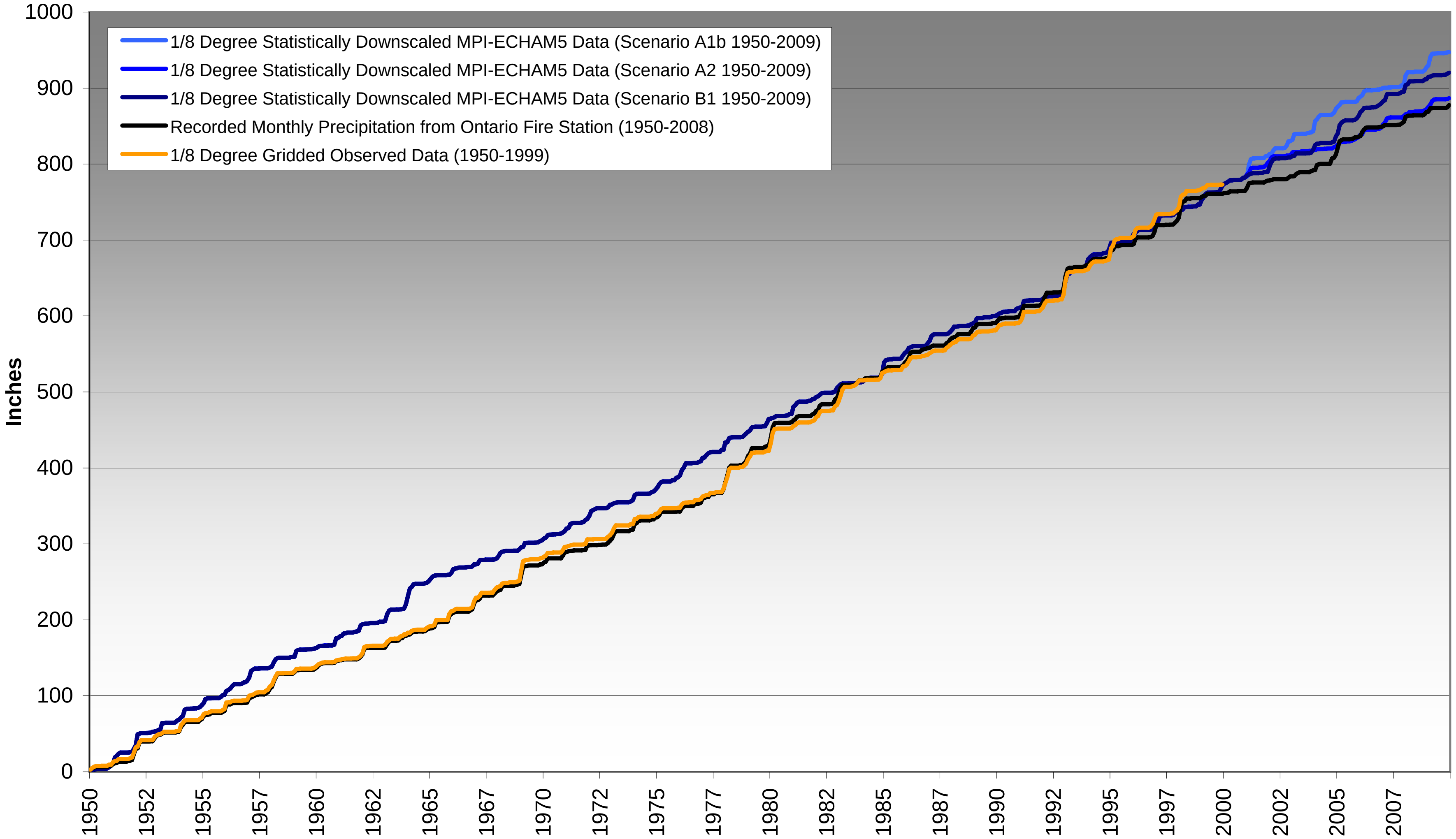


Figure C-19b
Mass Curve Plot of Monthly Precipitation Estimates in the Ontario Area, period 1950-2098

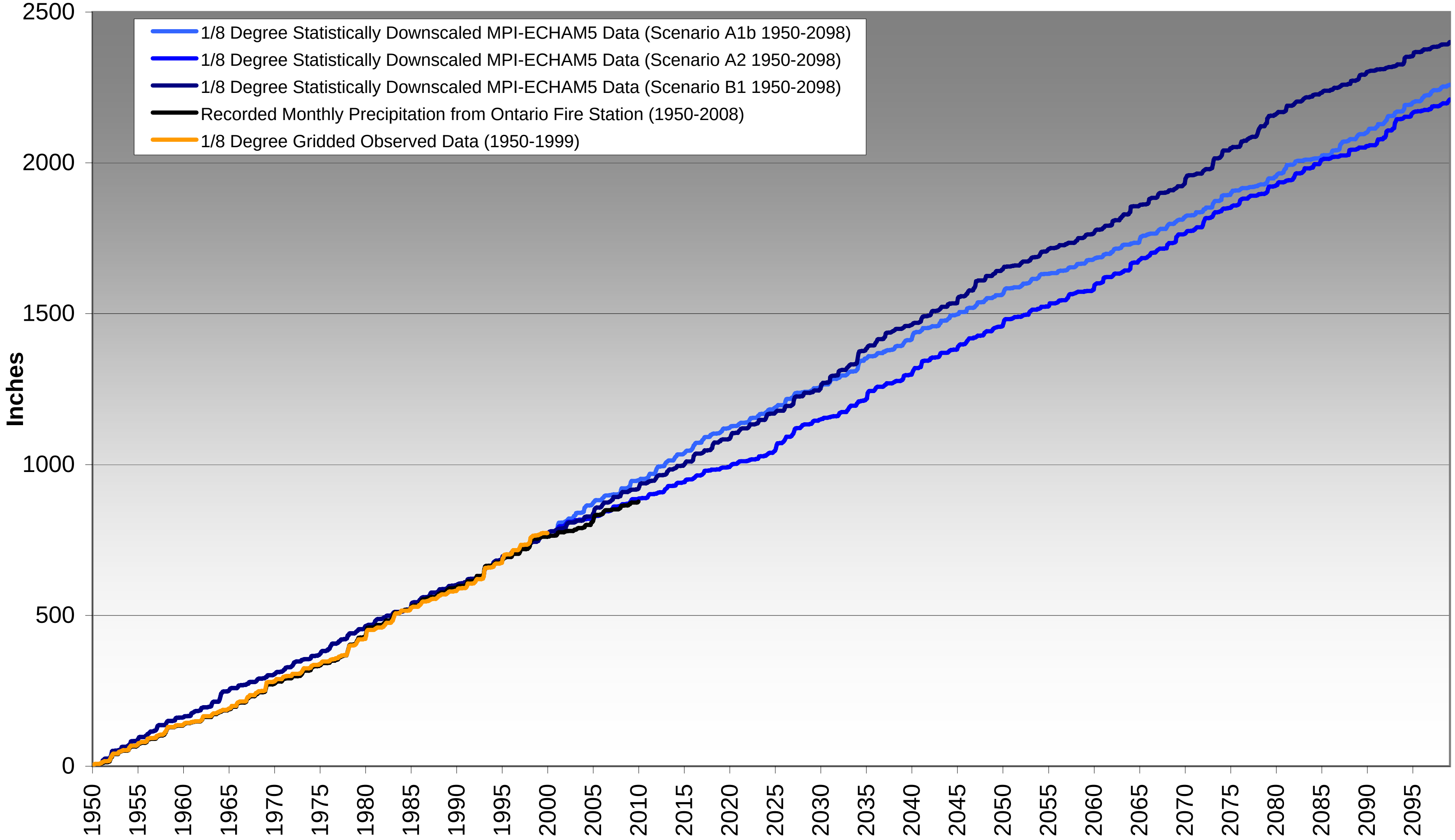
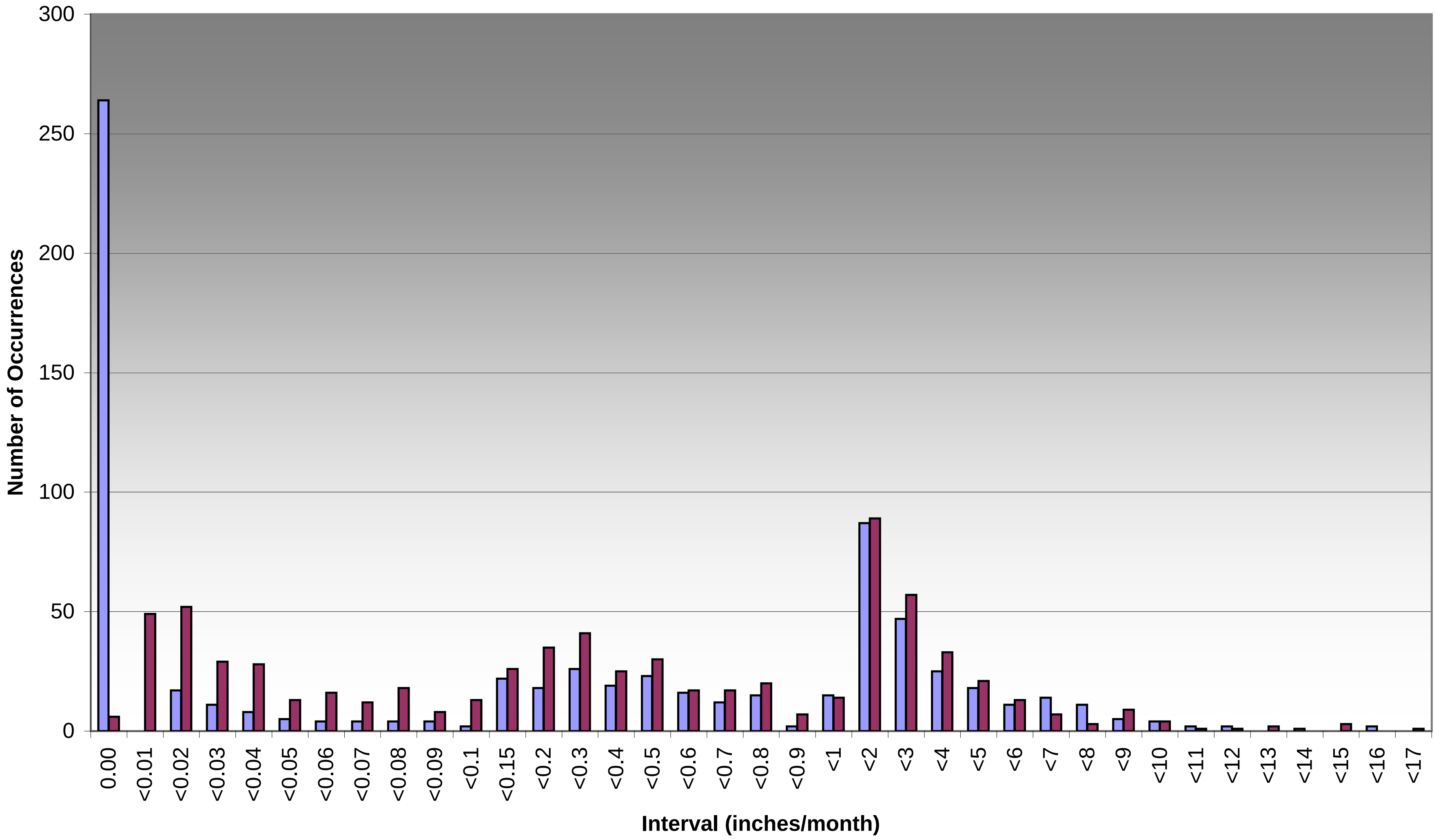


Figure C-20
Frequency of Occurrence-Ontario Gage, Scenario A1b



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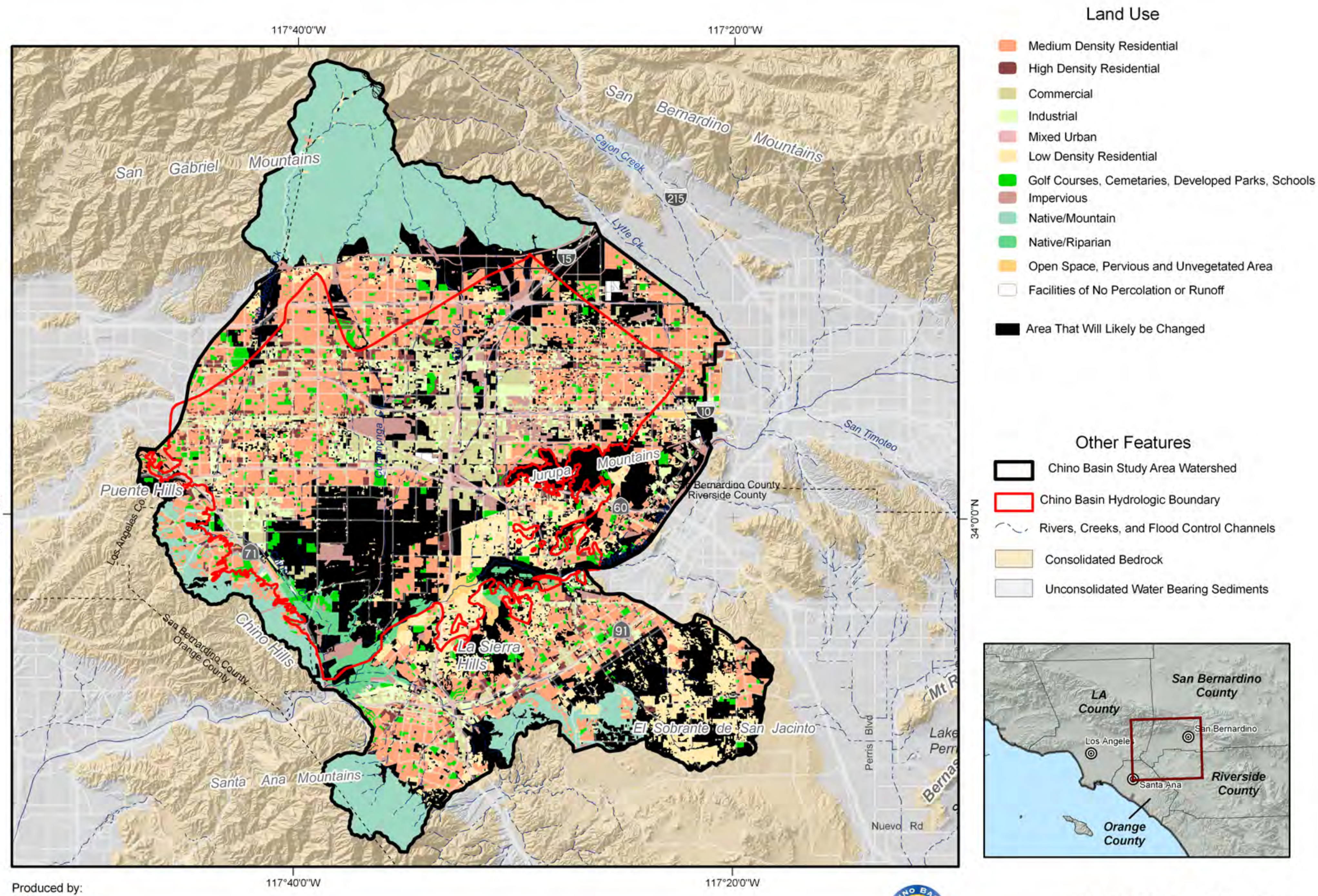

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0 2 4 6 8 Miles
0 4 8 12 KM

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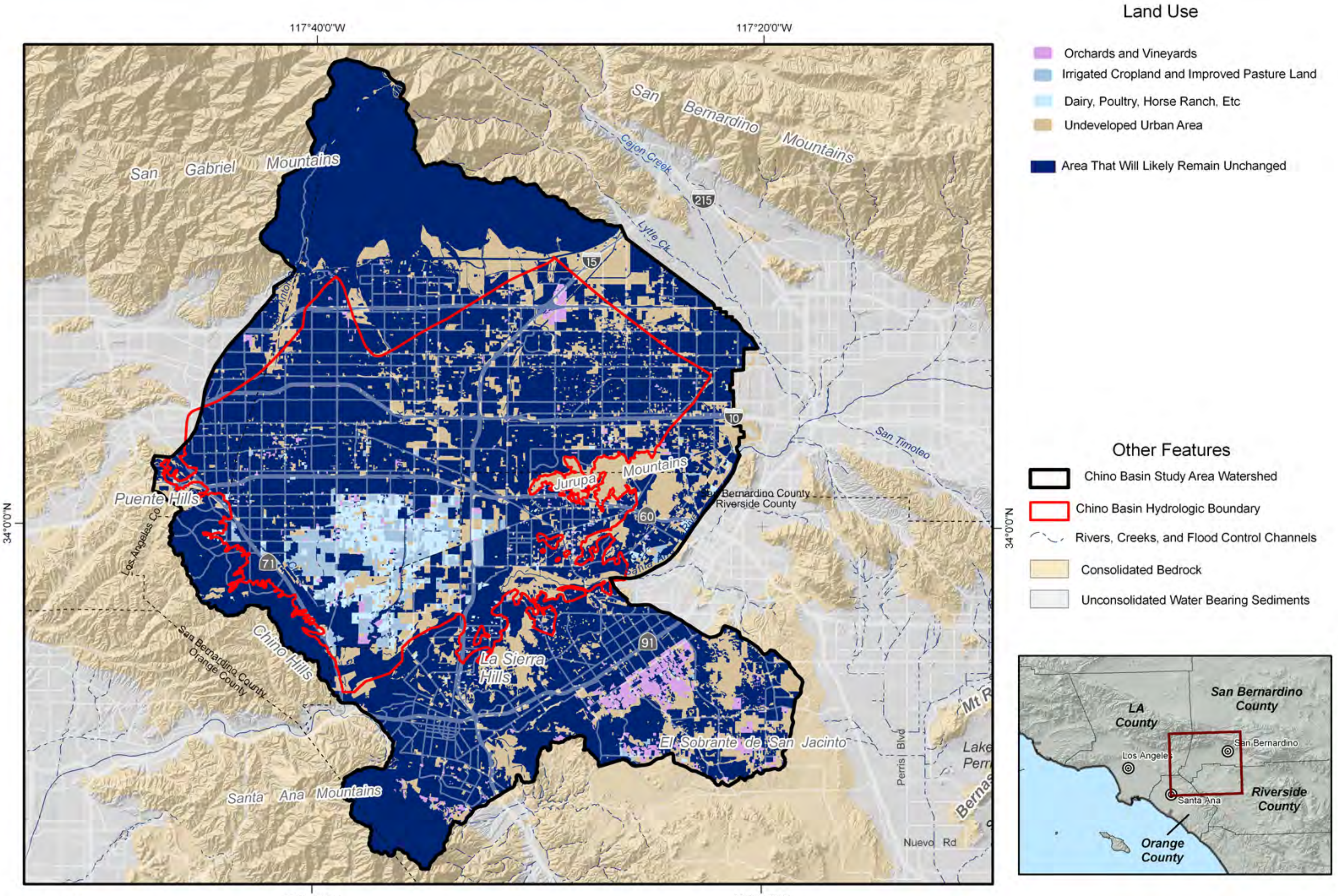
SCAG 2006 Land Use Area That Will Likely Remain Unchanged

Figure C-21



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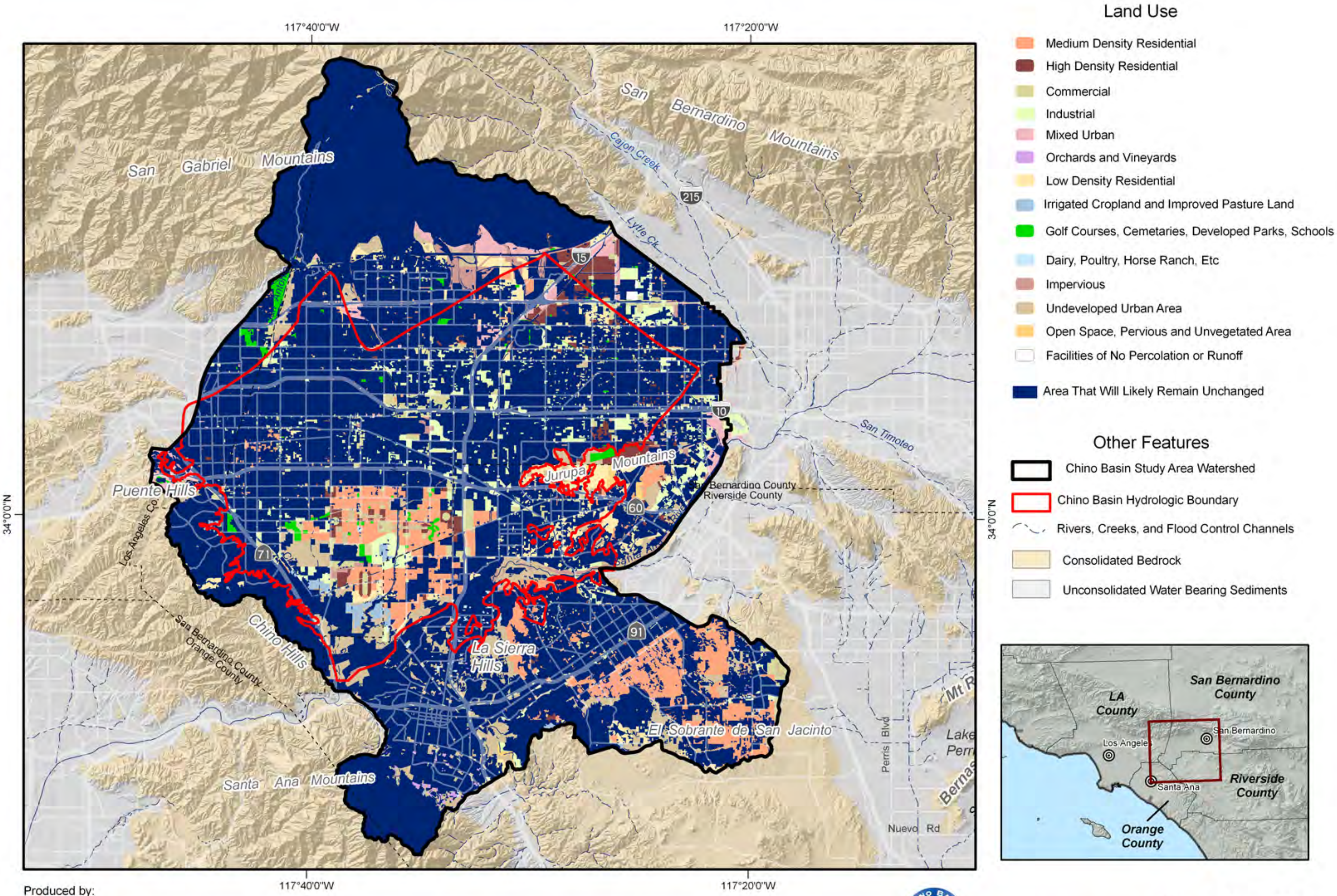
SCAG 2006 Land Use Area That Will Likely be Changed

Figure C-22



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0 2 4 6 8 Miles
0 4 8 12 KM

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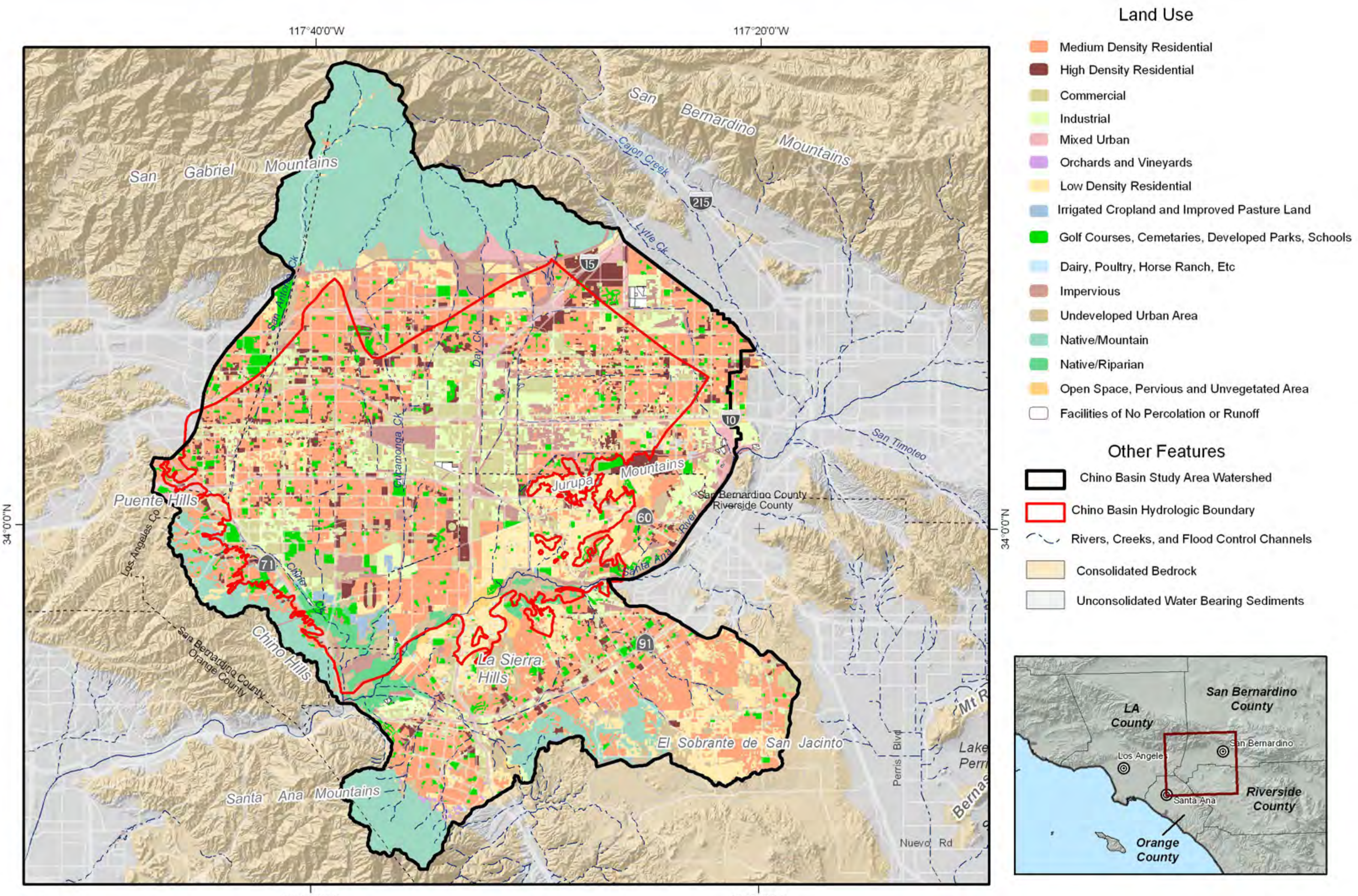
General Land Use
Undeveloped Urban Areas in 2006

Figure C-23



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Future Land Use

Figure C-24

Table C-19
Expected Theoretical Stormwater Recharge at CBFIP Facilities

Basins	Recharge with 2006 Land Use Condition	Average Annual Future Stormwater Recharge at CBFIP Facilities for Buildout Conditions and Varying Amounts of New Runoff Management Pursuant the MS4 Permits		
		No New Recharge	50% Recharge	100% Recharge
	(acre-ft)	(acre-ft)	(acre-ft)	(acre-ft)
Brooks	672	713	697	680
College Heights	0	0	0	0
Montclair #1	290	325	312	300
Montclair #2	118	130	127	125
Montclair #3	274	276	275	274
Montclair #4	341	345	343	342
8th St	785	789	787	785
7th St	438	445	441	438
Upland	479	637	582	528
Ely	1,366	1,411	1,390	1,368
Etiwanda Debris	883	1,617	1,369	1,105
Hickory	213	231	224	213
Lower Day	555	637	603	568
San Sevaine #1	903	1,048	993	935
San Sevaine #2	117	161	149	139
San Sevaine #3	652	747	714	659
San Sevaine #4	68	93	84	73
San Sevaine #5	1,124	1,926	1,683	1,448
Turner 1&2	752	814	784	756
Turner 3&4	733	772	754	735
Victoria	561	937	812	674
Grove	259	268	264	260
Banana	445	483	465	445
Declez	912	995	960	912
RP3	444	466	466	466
Wineville	239	296	274	252
Total	13,625	16,562	15,555	14,480
MS4 Decision Impact on CBFIP Facilities		0	-1,007	-2,081
Estimated Recharge at New MS4 Facilities			6,290	12,581
Net MS4 Recharge Due to Reduction at Existing Facilities			5,283	10,499

Appendix D

Sierra Water Group Task Report for Supplemental Water Sources

APPENDIX D

WATER TRANSFERS REPORT

INTRODUCTION

The purpose of this report is to evaluate the potential of the Chino Basin Watermaster ("Watermaster") to acquire and wheel imported water into the Chino Groundwater Basin (the "Basin") for recharge (the "Water Transfers"). The Cumulative Unmet Replenishment Obligation (the "CURO") is the overproduction of groundwater in the Basin over a twenty ("20") year period. The Water Transfers should consist of a mix of water supplies that are competitive as to cost and reliability. This report describes the types of water, location, range of costs, and institutional/regulatory constraints for the acquisition and delivery of the Water Transfers.

For purposes of this report, the Water Transfers do not include water provided by Metropolitan Water District of Southern California ("Metropolitan"). Watermaster has the option of acquiring imported water from Metropolitan without developing an active water marketing program. With the CURO, it is recommended that Watermaster pursue all options to increase water supply to the Basin. As discussed in this report, Watermaster can purchase imported water from Metropolitan and develop the Water Transfers at the same time.

Without an active program to acquire the Water Transfers, Watermaster will have to manage the CURO by reducing the amount of groundwater production by the various entities in the Basin. Current water supplies are not sufficient to meet the projected long-term demand. This may result in a reduction of water available to meet the operational management of the Basin. To avoid this outcome, this report discusses the water supply options and avoided costs of the Water Transfers.

To provide context for the Water Transfers, this report presents criteria for successful water marketing transactions. Watermaster can use these criteria as a guide to identify qualified prospects for potential transactions. If followed, the criteria will save Watermaster time and money in pursuit of the Water Transfers. Timing is critical. The CURO is a cumulative balance. If the water balance is not addressed on an annual basis, then the water "deficit" will accumulate in future years. With limitations on conveyance and availability of transferrable water in California, Watermaster may not be able to sufficiently offset the CURO.

Despite the challenges, the developing water market in California will provide Watermaster with choices. In the past, Watermaster relied on Metropolitan through the Inland Empire Utilities Agency ("IEUA") as the local wholesaler to provide replenishment water. In the future, Watermaster will have to actively manage the acquisition of all imported water supplies (Metropolitan and the Water Transfers). The principal issue for Watermaster will be cost. The report provides program criteria that need to be implemented by Watermaster to acquire the Water Transfers.

PROBLEM

The Basin has relied on Metropolitan to provide Tier 1 water service ("Tier 1") for direct use and the replenishment water service ("Replenishment") for recharge operations. Replenishment was priced below Tier 1 to encourage the delivery and storage of surplus water. Beginning in 2008, the surplus water became unavailable. This has forced the Basin to switch from low cost Replenishment to higher cost alternatives. At this time, Watermaster is facing the purchase of water from Metropolitan's Tier 2 water service ("Tier 2"). The problem is the long-term reliability and projected cost of Tier 2 for recharge operations.

APPROACH

This Water Transfers report is designed to evaluate the "input" side of the equation for groundwater recharge. After projecting the amount of the CURO for the Basin, multiple water supply options are identified and analyzed. The analysis includes the criteria and assumptions needed to build a Water Transfers program. It is the intent of this report to provide Watermaster with the decision making tools to evaluate the Water Transfers for short and long-term acquisition of water supply.

Watermaster will have to determine the preferred mix of imported and local water supplies. This will be based on the availability and the cost of these water supplies in the future. Watermaster will have to develop a flexible program that can adjust on an annual basis to changing water conditions in California. The program must include a funding mechanism that allows Watermaster to act quickly to secure short-term and long-term Water Transfers.

The Water Transfers report provides projections of future water supply costs and water supply availability. The projections rely heavily on past conditions. This assumes that future trends will be similar to the past. This may not be true. With the environmental issues affecting the Delta and protracted drought impacting the major water projects, there may be a reduction in the imported water for Southern California.

The analysis attempts to identify conveyance constraints and water marketing limitations. This will provide for an expected range of available Water Transfers. To compare future Water Transfers options, the projected Tier 2 rates are used to create a benchmark value. To provide long-term costs, the annual Tier 2 rates are projected over a 20 year basis. The future lease rates are discounted at five percent (5.0%). This rate is equivalent to the municipal cost of capital to finance infrastructure improvements on a tax-exempt basis to create a present value calculation. This will allow the Watermaster to evaluate the long-term costs of the Water Transfers. This will provide an "apples-to-apples" comparison to current water options.

IMPORTED WATER PROJECTIONS

The imported water demand is based on the overproduction by the Basin entities. Due to the relatively low production costs, the Basin is the first choice for the producers for water supply. As additional supply is required, the Basin producers rely on imported water from Metropolitan. Watermaster will have the option to acquire imported water from Metropolitan and/or develop supplemental water supplies (including the Water Transfers).

As a Metropolitan member agency, IEUA provides imported water supply for the Basin. Each member agency has a purchase order which provides Metropolitan with a fixed amount of water sales over a ten-year period. IEUA's purchase order for Tier 1 water supplies provides for the delivery of 398,348 acre-feet of water over a ten-year period (from January 1, 2003 through December 31, 2012). In 2010, IEUA can take up to 59,792 acre-feet of Tier 1.[1]

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[1] Metropolitan Water District of Southern California Fiscal Year 2009/10 Cost of Service, Board Letter, April 14, 2009

For water demand above the purchase order amount, Watermaster can purchase Tier 2 and Replenishment from IEUA for the Basin. Watermaster has relied on Replenishment to augment water supplies in the Basin. With the recent drought and environmental issues in the Sacramento-San Joaquin Delta (the "Delta"), Metropolitan has not made Replenishment available for its member agencies. As discussed below, Replenishment may be limited to 3-out-of-10 years.

Without Replenishment, Watermaster will have to consider the purchase of Tier 2 from IEUA for recharge operations. Effective January 1, 2010, Tier 2 full service untreated water rate is $594 per acre-foot.[2] This compares to the posted Replenishment water rate of $366 per acre-foot. The lack of available Replenishment water in 2010 will cost the Watermaster an additional $228 per acre-foot to restore the Basin for overproduction.

The only way for Watermaster to make recharge water available and hedge the long-term cost of Tier 2 is to pursue the acquisition of the Water Transfers. Even with the additional costs from Metropolitan, the CURO will require a mix of water supplies including Metropolitan Tier 1, Tier 2, and Replenishment in the future. The projected CURO is too large not to take advantage of all available water supplies.

The CURO is estimated at 657,573 acre-feet through the year 2030 by Wildermuth Environmental, Inc.[3] (Refer to Table 1 of this report for the 20-year projection in chart form.) This figure assumes that Metropolitan provides Replenishment water 30.0% of the time. Based on the Peace II Alternative, it is planned that the Watermaster will spread up to 70,886 acre-feet of imported water per year and create a positive storage balance of up to 157,561 acre-feet. Given these projections, Watermaster will have to actively manage the CURO through the acquisition of imported water and the Water Transfers. This analysis assumes that Watermaster will pursue the imported water and the Water Transfers instead of reducing groundwater production.

METROPOLITAN SUPPLY & DEMAND

Metropolitan will be the primary supplier of imported water to the Basin. This will continue on a long-term basis. To develop a long-term acquisition plan for the Water Transfers, Watermaster needs to project the availability of imported water from Metropolitan. This requires an

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[2] www.mwdh2o.com/mwdh2o/pages/finace/finance.03.html

[3] Chino Basin Recharge Master Plan Update, Wildermuth Environmental, Inc., April 2010, Table 4-3

understanding of Metropolitan’s water supplies (and its projections). As hydrology changes each year, Watermaster will be able to adjust the acquisition plan. This will help Watermaster maximize the delivery of imported water at the lowest cost.

Metropolitan obtains imported water from two major sources: 1) the State Water Project (“SWP”); and, 2) the Colorado River. To meet the future water supply needs of the Basin, Watermaster will have to rely on Metropolitan to provide the primary supply of imported water. This analysis will review Metropolitan’s current water supplies and identify ways to augment the existing sources.

State Water Project

The SWP Table A (“Table A”) refers to a chart which shows each SWP Contractor and the related contract amount of water supply. It is the contract mechanism that the Department of Water Resources (“DWR”) uses to annually allocate the fixed and variable costs to the SWP Contractors. DWR does not guarantee a specific level of delivery of the annual Table A quantity. The SWP contract provides for 1,911,500 acre-feet of the Table A on an annual basis.[4]

The Table A amount is the theoretical maximum amount (100.0%) of contract water to be delivered under the SWP contract. It is also used to determine the amount of conveyance capacity for a SWP Contractor. Based on hydrology, delivery, and environmental conditions, DWR makes a determination by May of each year on the level of allocation of the Table A for the SWP Contractors.

In 2009, Metropolitan was allocated 40.0% or 764,600 acre-feet of the Table A water. The following chart shows Metropolitan’s Table A and the SWP allocation for the last ten years:

Year	MET Table A	SWP Allocation	SWP Yield
2000	2,011,500	86.7%	1,743,971
2001	2,011,500	39.0%	784,485
2002	2,011,500	70.0%	1,408,050

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[4] Contract Between The Metropolitan Water District of Southern California and The State of California Department of Water Resources for a Water Supply and Selected Related Agreements, as of January 1, 2005, page 156

2003	2,011,500	90.0%	1,810,350
2004	2,011,500	65.0%	1,307,475
2005	1,911,500	90.0%	1,720,350
2006	1,911,500	100.0%	1,911,500
2007	1,911,500	60.0%	1,146,900
2008	1,911,500	35.0%	669,025
2009	1,911,500	40.0%	764,600
Average	**1,961,500**	**67.6%**	**1,326,671**

Source: Department of Water Resources

The allocations for 2008 and 2009 were affected by the drought and the status of the Delta Smelt. On December 15, 2008, the United States Fish and Wildlife Service issued a new biological opinion that impacted both the SWP and the Central Valley Project ("CVP").[5] According to DWR, "SWP deliveries throughout California could be permanently reduced by up to 50 percent under a new Delta Smelt Biological Opinion issued today. Water deliveries to cities, farms and businesses throughout much of the state will be reduced about 20 to 30 percent on average, but cuts could be greater under certain hydrologic conditions.[6] (The actual impact and reductions as the result of the biological opinion are still being assessed.)

Colorado River

The Colorado River was the initial imported water supply for Metropolitan. The Colorado River water from the Bureau of Reclamation ("BOR") is limited to the capacity of the Colorado River Aqueduct ("CRA") to approximately 1.2 million acre-feet per year. The BOR supplies the water to Metropolitan based on a priority system created in 1931. The water is provided under a permanent service contract and an interstate compact. For California the allocation is as follows:

PRIORITIES UNDER 1931 CALIFORNIA SEVEN PARTY AGREEMENT		
Priority 1	Palo Verde Irrigation District	3,850,000
Priority 2	Imperial Irrigation District	(included above)
Priority 3	Coachella Valley Water District	(included above)
Priority 4	Metropolitan Water District	550,000
California Basic Apportionment		**4,400,000**
Priority 5(a)	Metropolitan Water District	550,000
Priority 5(b)	Metropolitan Water District	112,000
Priority 6(a)	Imperial Irrigation District	300,000

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[5] United States Department of the Interior, Fish and Wildlife Service, Formal Endangered Species Act Consultation Memorandum on the Proposed Coordinated Operations of the CVP and SWWP, December 15, 2008

[6] Department of Water Resources, News for Immediate Release, "Delta Exports Could be Reduced by up to 50 Percent Under New Federal Biological Opinion, December 15, 2008

Priority 6(b)	Palo Verde Irrigation District	(included above)
Surplus Allocation		962,000
	Total	**5,362,000**
Priority 7	Colorado River Basin	Remaining Surplus

Source: Metropolitan Water District of Southern California

For Metropolitan, only Priority 4 is part of the basic apportionment of 4.4 million acre-feet of Colorado River for California. Metropolitan can only divert Priorities 5 (a) and (b) if there is surplus water and apportioned but unused water within the Colorado River system (surplus to Priorities 1, 2, and 3). According to Metropolitan, it was able to take delivery of 1.2 million acre-feet of the Colorado River water through 2002. Metropolitan averaged 762,000 acre-feet per year from 2003 through 2008. This is due to the drought on the Colorado River system and the increase of water diversions by Nevada and Arizona.[7]

The amount of the Colorado River water available to the Metropolitan's service area has been augmented with the long-term transfer agreement between the Imperial Irrigation District ("IID") and the San Diego County Water Authority ("SDCWA"). The transfer agreement provides up to 200,000 acre-feet of water per year for a seventy-five year term. The transfer agreement is dependent upon the Quantification Settlement Agreement ("QSA"). On January 14, 2010, a Sacramento Superior Judge issued a final ruling that invalidates the QSA.[8] If the ruling survives an appeal, then the IID-SDCWA transfer agreement may have to revised and renegotiated.

Metropolitan Water in Storage

Metropolitan has assembled a mix of projects that provide water storage capacity and water in storage ("Water Storage Program"). The Water Storage Program provides water to meet demand during dry years. The Water Storage Program includes projects that utilize surplus water that can be banked or exchanged for later use. According to Metropolitan, the Water Storage Program has a maximum storage capacity of 5.2 million acre-feet. As the result of the current multi-year drought, federal administrative opinions, and state judicial decisions, Metropolitan has drawn on the Water Storage Program to meet demand. The current stored amount is 1.32 million acre-feet (as of January 1, 2010). This is approximately 650,000 acre-feet above the

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[7] Metropolitan Water District of Southern California Waterworks General Obligation Refunding Bonds, 2009 Series, dated December 1, 2009, Appendix A, page A-13

[8] Superior Court of California, County of Sacramento, Judge Roland L. Candee, Case No.: JC4353, QSA Coordinated Cases, issued January 14, 2010

minimum of 674,000 acre-feet Metropolitan has reserved for supply interruptions from earthquakes or other similar emergencies. The details are shown in the chart below.

METROPOLITAN'S WATER STORAGE CAPACITY AND WATER IN STORAGE
(In Acre-Feet)

Water Storage Resource	Storage Capacity	Est. Storage 1/1/2010	Water Stored 1/1/2009	Water Stored 1/1/2008
Colorado River Aqueduct	2,300,000	222,000	187,000	234,000
State Water Project	1,194,000	455,000	495,000	742,000
Within MET's Service Area	1,036,000	553,000	521,000	750,000
Member Agency Storage	662,000	90,000	188,000	302,000
TOTAL	**5,192,000**	**1,320,000**	**1,391,000**	**2,028,000**

Source: Metropolitan Water District

As shown in the chart, water in storage dropped from 2,028,000 acre-feet to 1,320,000 acre-feet over a two year period. To restore the 708,000 acre-feet to January 1, 2008 levels, Metropolitan will have to divert surplus water (when available) to these projects. The following quote from Metropolitan describes the approach to surplus water and its use for the storage accounts:

"Metropolitan replenishes its storage accounts when imported supplies exceed demands. Effective storage management is dependent on having sufficient years of excess supplies to store water so that it can be used during times of shortage. Historically, excess supplies have been available in about seven of every ten years. Metropolitan forecasts that, with anticipated supply reductions from the SWP due to pumping restrictions, it will need to draw down on storage in about seven of ten years and will be able to replenish storage in about three years out of ten. This reduction in available supplies extends the time required for storage to recover from drawdowns and could require Metropolitan to implement its water supply allocation plan during extended dry periods."[9]

Metropolitan will only have Replenishment available after increasing the storage accounts in the Water Storage Program. The program is currently at 25.4% of its capacity. After deducting the

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[9] Metropolitan Water District of Southern California Waterworks General Obligation Refunding Bonds, 2009 Series, dated December 1, 2009, Appendix A, page A-23

674,000 acre-feet of emergency storage, the remaining storage account is 14.3% of the available and unreserved space in the Water Storage Program.

Imported Demand

In the past, Tier 1 and Replenishment were sufficient to meet the annual demands of Metropolitan member agencies. With the decreased reliability of imported water supplies, demand by Metropolitan member agencies has exceeded Tier 1 and Replenishment supplies. This has forced Metropolitan to acquire water to fill Tier 2 requests and impose penalty rates to encourage conservation.

Over the last 10 years, the average total demand for Water Transfers in Metropolitan's service area was 2.2 million acre-feet per year. As described above in the discussions about the SWP and Colorado River water supplies, Metropolitan has averaged 1.3 million acre-feet over the last ten years from the SWP. Even though Metropolitan received 1.0 million acre-feet from the Colorado River in 2009, from 2003 through 2008 the average delivery was 762,000 acre-feet per year. Based on this recent history of deliveries, Metropolitan should expect a range of 2.0 to 2.3 million acre-feet of water from both the SWP and Colorado River. In addition, Metropolitan needs to restore its Water Storage Program. This effort will require an additional 300,000 acre-feet to 500,000 acre-feet of water per year.

For future water deliveries, Metropolitan will have to concentrate on delivering Tier 1 and Tier 2 water supplies to its member agencies. If surplus water is available in the system, Metropolitan will need to divert it to the Water Storage Program. Until the Water Storage Program is at an appropriate account balance (above 50.0% or 2.6 million acre-feet) then Metropolitan will not have surplus water available for Replenishment. Metropolitan can acquire supplemental water in the short-term water market but the pricing will have to reflect the cost of acquisition (which will exceed historic Replenishment prices). It is unlikely that Metropolitan will have Replenishment water available for its member agencies until the Water Storage Program is restored to an appropriate operating level.

CONVEYANCE AND DELIVERY CONSTRAINTS

There are numerous conveyance constraints for imported. The primary constraint to deliverability is the federal judicial decisions affecting the Delta (known as the Wanger Decisions) which impact the ability of the DWR to deliver Table A. The SWP Contractors have experienced restrictions in the SWP exports, reductions in Table A allocations, and loss of Article 21 water (surplus SWP water). The DWR has stated that the federal court decision has reduced the delivery capability for Table A from the Delta. The federal court decision also reduces the ability of the SWP to augment non-project water supplies for transfer through the Delta.

DWR issued a report in December 2009 entitled, "The SWP Delivery Reliability Report 2009" (2009 Report). This was an update of the reports originally issued for 2003, 2005 and 2007. The report analyzed 82 years of historical records (1922 through 2003) for rainfall and runoff. The numbers were adjusted to reflect current and future development. The 2009 Report divides the SWP Table A into three categories for long-term delivery: 1) average; 2) maximum; and, 3) minimum. Each category is described below.

For the “average” delivery, DWR projects 60.0% reliability for the SWP Table A water. (This is a long-term projection based on current conditions and restrictions in SWP operations.) This is down from 63.0% projected in the 2007 report. For Metropolitan, this amounts to a long-term average of approximately 1,147,000 acre-feet per year of the SWP water (1,911,000 of the SWP Table A multiplied by 60.0%). The average delivery is used to calculate the long-term costs for a SWP Contractor and produce an avoided cost figure (for comparison to local or regional long-term water supply costs).

The largest change in the 2009 Report was the “maximum” delivery category. Since the 2007 report, the maximum delivery has been reduced from 91.0% to 80.0%. This long-term reduction of 11.0% is equivalent to approximately 455,000 acre-feet of water per year. Historically, Metropolitan has used the surplus water from its Table A contract to provide Replenishment water to its member agencies. With the reduction in the “maximum” delivery of the SWP Table A, there will be less surplus water on a long-term basis.

The last category is “minimum” delivery. According to the DWR, the long-term minimum delivery increased from 6.0% to 7.0% of the SWP Table A contract amount. These are conditions that duplicate the drought years of 1976-77. For planning purposes, these types of water years should occur less than 5.0% of time.

Another important issue is the priority of water deliveries through the Delta. Table A water has first priority for conveyance through the Delta. With Delta pumping restrictions, there may not be capacity in certain years to transport non-SWP water supplies. For planning purposes, a range of 25.0% to 75.0% for the SWP allocation is targeted.

REPLENISHMENT GUIDELINES

Given the institutional constraints of water marketing, there are a number of guidelines that have been developed for the Water Transfers analysis. These guidelines are designed to address the CURO. The guidelines are important in the financial analysis of long-term costs for the Water Transfers (described later in this report). The guidelines are based, in part, on the success of other water marketing transactions. The guidelines are dynamic and will change to meet the evolving needs of Watermaster. The guidelines and brief descriptions are as follows:

1. **Benchmark Pricing**. Metropolitan Water District Tier 2 is the benchmark for all Water Transfers transactions. Tier 2 represents the cost for Metropolitan to acquire new imported water supplies. When Watermaster evaluates a new project, Tier 2 should be used for comparison (since Tier 1 has already been fully subscribed). For this analysis, the long-term Tier 2 value has been calculated on a 20-year basis and discounted to present value (today's dollars) to provide an "apples-to-apples" comparison with other alternatives.

2. **Short-Term Water Pricing**. The price of imported water changes each year based on hydrology and delivery limitations. This analysis assumes that the Basin will purchase Water Transfers when the SWP allocation is high and that short-term water can be acquired at a relatively low price. The availability and pricing of the Water Transfers will be based on supply and demand. There is an active market for short-term water transfers in California.

3. **Long-Term Water Pricing**. The price of Water Transfers is more static on a long-term basis. The pricing tends to reflect the avoided cost of Metropolitan water supplies (Tier 2). Long-term water pricing can also be compared to new or planned regional or local infrastructure projects. Unlike short-term water pricing, the value of long-term water is more subjective and based on negotiation. There is no current market for the sale and purchase of long-term water supplies in California. Each transaction is individually structured and negotiated.

4. **Operational Storage**. Watermaster will take direct delivery of the Water Transfers for use. The concept of "operational storage" is based on importing water supplies for storage within the Basin for production on a short to mid-term basis. Operational storage assumes that the Water Transfers will be produced over a three-to-five year basis (as opposed to long-term storage of ten years or more). It is assumed that Watermaster will not need to regulate the Water Transfers for storage in groundwater basins outside of the Basin (for example, within the Semitropic Water Storage District). This reduces the capital investment in new storage programs.

5. **Availability of Replenishment Water**. For purposes of modeling different water supply costs, the financial analysis assumes that Replenishment will be available 3-out-of-10 years.

6. **Chino Basin Capacity**. Any Water Transfers option is limited by the capacity in the Basin. The analysis assumes that a maximum of 84,600 acre-feet per year of Water Transfers can be delivered to the Basin.[10] There are also limitations on the monthly delivery of Water Transfers due to summer peaking of water demand.

7. **Cumulative Purchases**. Each year provides Watermaster with an opportunity to acquire a certain quantity of Water Transfers. If the Water Transfers is available and not acquired, then it may become a lost opportunity that has a cumulative effect. It may not be possible for Watermaster to make up for the lost opportunity in future years (due to lack of availability, conveyance capacity, and recharge capacity).

8. **Delta Transfer Restrictions**. Due to the mitigation efforts in the Delta, both the SWP and the Central Valley Project ("CVP") have experienced reductions in water deliveries. The analysis assumes that the Basin will be able to move water from the Delta during years in which the SWP allocation ranges from 25.0% to 75.0%. Below 25.0% there is no surplus water available (on a short-term basis). Above 75.0% there is no capacity to move water through the Delta (all the SWP and the CVP Contractors are fully utilizing the capacity to move contract water).

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[10] Chino Basin Recharge Master Plan Update, Wildermuth Environmental, Inc., April 2010, Table 4-2

9. **Water Transfers Rate Structure**. The analysis assumes that Watermaster will develop a funding program for the purchase of future Water Transfers. This will provide Watermaster with the ability to make opportunity purchases as water supplies become available at reasonable cost.

10. **Dry-Year Water Supplies**. Historically, when Metropolitan needs dry-year water supplies it has participated in the Drought Water Bank operated by the DWR or arranged individual transfers in the Sacramento Valley. Dry-year water supplies are typically pursued in years when the SWP allocation is below 40.0%. Dry-year water supplies are typically available north of the Delta.

11. **Wet-Year Water Supplies**. During years when the SWP allocation is high, there is no capacity in the Delta to move non-SWP water. The SWP Contractors are maximizing the amount of Table A water to be delivered. This occurs in years when the SWP allocation is above 70.0%. Watermaster should look south of the Delta in wet-years to acquire Water Transfers.

12. **SWP Transfer Limitations**. Watermaster cannot acquire the SWP water from another SWP service area and convey it to the Basin. Metropolitan has the right to sell the SWP water within its service area. Metropolitan can, and will, wheel non-SWP water to the Basin. Watermaster will have to focus on non-SWP water sources for the Water Transfers (assuming that Watermaster does not purchase supplemental Tier 2 or Replenishment from Metropolitan).

Taken together, these guidelines provide Watermaster with a framework for acquiring the Water Transfers. The guidelines are the first step in developing a water marketing program to address the CURO.

INSTITUTIONAL/REGULATORY APPROVALS

The Water Transfers will be subject to various institutional and regulatory approvals for short-term and long-term water transfers. In developing an acquisition plan, the Watermaster should pursue the opportunities that have the highest probability of meeting the water supply needs generated by the CURO. The time needed to complete a short-term water transfer is typically 6-

12 months. For a long-term water transfer the process can take 15-24 months (assuming all approvals are obtained without litigation). In both cases, planning is critical to success. The institutional and regulatory approvals are discussed below.

State Water Resources Control Board

Most water transfers require regulatory review and approval of the State Water Resources Control Board ("SWRCB"). In order to help interested parties understand the processes involved and the information needed to complete water transfers, the SWRCB released a draft report.[11] The information contained in this report was summarized from the SWRCB report.

According to the SWRCB, there are at least four different sources of transferable water depending on the nature of the water being transferred: 1) contract supply; 2) surface water; 3) groundwater; and, 4) the Water Transfers. All of the defined categories of transferable water must meet specific provisions in the California Water Code ("Water Code") that deal with the concepts of "no injury rule," "impacts to fish and wildlife," and "third party impacts." The specific water transfer criteria set forth by SWRCB are discussed below.

1. **Contract Supply**. This applies generally to the SWP and the CVP. When the entity that contracts for a water supply does not hold the underlying water right, then the contracting agency sets the rules. Both the DWR, which sets the criteria for transfer of the SWP contract water, and the BOR, which governs transfers of the CVP water supply, place special conditions on contractors that want to transfer a portion of their contract water supply.

   While the contracting agency must approve all transfers of contract supply by the transferor, it is not necessary to also seek approval from SWRCB for such transfers (as long as the transfer falls within the conditions of the underlying water rights of the contracting entity). Place of use, point of diversion, and purpose of use are typical issues for consideration.

2. **Surface Water**. California has a "dual system" of water rights recognizing both riparian and appropriative water rights. These water rights are typically quantified. The measure of the water right is the amount of water diverted and put to beneficial use. Water transfers do not create a new form of water right – they change an existing water right. Water rights are granted for a given water source specifying an annual quantity of water,

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[11] A Guide to Water Transfers, State Water Resources Control Board, July 1999 Draft

a rate of diversion, a season of diversion, point of diversion, purpose of use, and place of use.

Riparian water rights attach to the land. These rights can be lost if the property's connection to the stream is severed when ownership is changed. Riparian water rights allow the landowner to take as much water as can be reasonably and beneficially used on riparian land in the watershed of a stream. Riparian water rights cannot be lost through non-use and can be initiated or reactivated at any time. Since they attach to the land, riparian water rights cannot typically be transferred.

Appropriative water rights allow the use of the natural flow of the stream provided riparian water rights are satisfied. The appropriative system developed from the concept of "first-in-time, first-in-right." This allowed diversions from a stream system to be prioritized based on available water supplies. Appropriative water rights are divided into two categories as follows:

A. ***Pre-1914***. These appropriative water rights refer to water supplies that were simply put to use with few laws governing the appropriation. Pre-1914 water rights holders are required to file statements of water diversion and use. These types of water rights do not require approval by SWRCB to transfer. On the other hand, it is very difficult to quantify the historic use of pre-1914 water rights. This can delay or prevent the transfer of these water rights to another party.

B. ***Post-1914***. These appropriative water rights are the result in changes in water law to provide statewide oversight. It established an administrative process to issue water right permits and licenses. Modern appropriative water rights are currently obtained by application to SWRCB which has regulatory oversight of post-1914 water rights. Water transfers in California typically involve post-1914 water rights.

3. **Groundwater**. SWRCB does not regulate groundwater production. Groundwater laws in California rely on local control and management. Groundwater can be difficult to quantify unless there is a record of production in a groundwater basin. There are three types of transfers that involve groundwater. They are: (1) us e of groundwater "in-lieu" of surface water, (2) use of "banked" groundwater, and (3) "direct" transfer of groundwater. Each has its own unique set of issues as follows:

A. ***In-Lieu***. An in-lieu transfer involves surface water which is transferred to another user and the seller is compensated for the extra costs of pumping groundwater (to replace the surface water supplies). The buyer acquires the groundwater and trades it for the surface water. This type of transfer must comply with any local groundwater management plans.

B. ***Banked***. Banked groundwater refers to water stored in a groundwater basin for later use. Transfer of a banked groundwater supply involves making sure that the entity who banked the water did so in compliance with the appropriate provisions of the Water Code, and making sure that the place of use where the banked water is to be used is covered in the permits of the original water rights holder. Any groundwater management plans (if they exist) must also be complied with for the transfer to be approved.

C. ***Direct***. The export of groundwater directly from a groundwater basin is limited by state law and/or local adjudication. For groundwater located within the stream systems that flow to the Delta, there is a prohibition on transferring the groundwater (a claim is made by other appropriators that the groundwater is actually underflow of the river system). For adjudicated or managed groundwater basins, each basin has different regulations concerning the export of groundwater.

4. **Water Transfers**. These supplies are, by definition, foreign to the water basin it is imported into. Therefore, water users downstream from the Water Transfers source have no water right claim on this water. This is especially important in the consideration of the "no injury" rule.[12] Since water users have no prior legal claim to Water Transfers, they cannot be injured (in a legal sense) by its removal.

Department of Water Resources

In interpreting Water Code with respect to long-term water transfers, DWR takes a much more aggressive stance than SWRCB. To encourage participation in the State's 2002 Dry Year Water Purchase Program and the Environmental Water Account, DWR issued an announcement in

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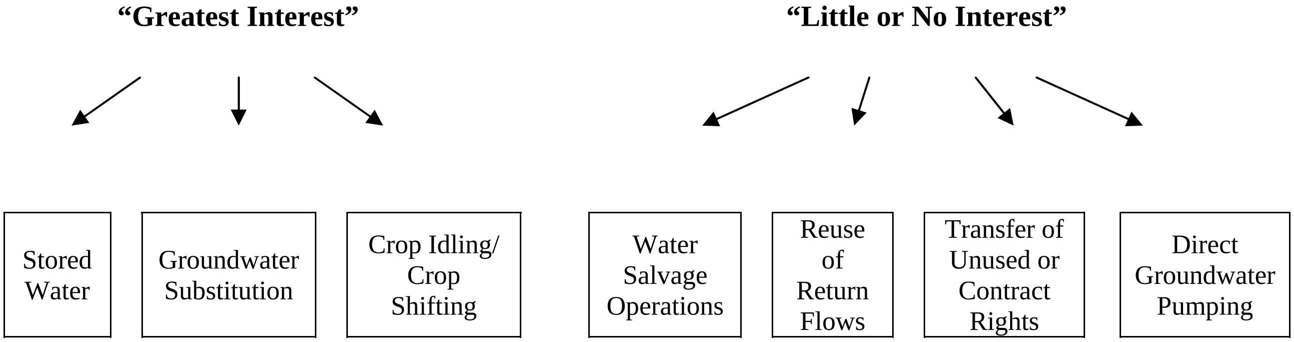
[12] California Water Code Sections 1706 (post-1914 water rights) and 1702 (pre-1914 water rights)

draft form on March 2002 stating its position related to water transfers.[13] In the announcement, DWR first established its basic water transfer principles, which stressed the importance of assuring that local water needs are being met before supplies are made available to others. The water transfer principles also place strong emphasis on addressing third party impacts and environmental protection requirements.

With those guidelines in mind, DWR differentiated between those types of water transfers that, in its opinion, would be of "greatest interest" and water transfers that would be of "little or no interest." The diagram below illustrates DWR's preferences, and a more complete explanation follows:

DWR's Water Transfer Guidelines



"Greatest Interest" Alternatives. Numerous water agencies have successfully developed and completed these types of water transfers. DWR provides the following definitions for its preferred water transfer options:

1. ***Stored Water***. Release of stored water from a reservoir that would remain in storage or would be stored in absence of the water transfer. This typically applies to federal reservoirs, state reservoirs, and locally owned reservoirs in the Sierra foothills.

2. ***Groundwater Substitution***. Reduction in surface water use replaced with additional groundwater pumping (sometimes referred to as "in-lieu" transfers).

3. ***Crop Idling/Crop Shifting***. Reduction in surface water use as the result of fallowing or conservation measures. The consumptive use component of the saved water can be transferred.

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[13] Department of Water Resources, "Information to Parties Interested in Making Water Available to the Environmental Water Account or the State's 2002 Dry Year Water Purchase Program," draft released March 2002

DWR provides additional guidelines for Sacramento Valley water suppliers for the second and third alternatives listed above. A transfer of water from rice farmland is typically applied a factor of 50.0% to generate the amount of water that is transferrable. For example, an acre of rice land that needs 6.6 acre-feet of water per acre, will be allowed to transfer 3.3 acre-feet in a fallowing program.

"Little or No Interest" Alternatives. The process to complete these alternatives is very difficult (if not impossible). DWR gave the explanations listed below for not supporting transfers in this category:

1. ***Water Salvage Operations***. This includes efforts to reduce consumptive use of natural vegetation and transfer the water savings. DWR believes these programs raise environmental concerns and the benefits are difficult to quantify.

2. ***Reuse of Return Flows***. Efforts to recapture historic return flows and transfer the savings in reduced surface water diversions. According to DWR, transfers of surface return flows are limited without causing injury to downstream water users.

3. ***Transfer of Unused Water Rights or Contract Rights***. It is DWR's position that water from unused water rights or contract rights are typically used by downstream water users, and the transfer of these unused rights "often results in injury to downstream users."

4. ***Direct Pumping of Groundwater***. DWR states that it is not interested in facilitating the direct transfer of groundwater from one area to another.

In addition to the above guidelines, there is SWRCB's interpretation of the California Water Code's concepts of "no injury rule," "impacts to fish and wildlife," and "third party impacts." Each of these concepts is further defined by DWR in the 2001 announcement. A successful long-term water transfer requires the identification and mitigation of these issues.

California Environmental Quality Act

All long-term transfers are subject to the requirements of the California Environmental Quality Act ("CEQA"). In addition, they are subject to a standard public noticing and protest process required by state law. The environmental review process involves the determination that the new use of water supply will not have a detrimental impact on the environment. The review process is comprehensive and time consuming.

Institutional Issues

Watermaster will likely be confronted with many institutional issues in the pursuit of securing long-term water supplies for the Basin. Institutional issues can contend with anything from environmental concerns to senior water rights priorities. Typically, institutional issues often address matters such dealing with local relationships and political powers that exist among and between the parties involved in a particular transaction.

With any institutional issue, the objective is to avoid conflict among the involved parties before it affects the progress of a water transfer. While certain institutional issues such as wheeling agreements with Metropolitan can be anticipated for almost any transaction, there are also source specific issues. For Watermaster, transfers from the Sacramento Valley may include the movement of water from the CVP to the SWP. This type of transfer creates institutional issues that may not apply to other options. The following are some specific issues that will confront Watermaster in the process:

1. **Water Rights**. Many water agencies are reluctant to sell water rights. They will consider short-term and long-term leases, but rarely the outright sale of a water right. The pursuit of water rights by Watermaster will require active participation in local politics.

2. **Physical Conveyance**. The physical conveyance of water from the seller to Watermaster will likely include traveling through a number of water systems and/or miles of infrastructure. Issues to consider with respect to the physical conveyance of the water include: 1) available capacity in the system; 2) possession of a legal right or contract to use the system; and, 3) quality requirements for water introduced to the system.

3. **Carriage Losses**. For water transfers through the Delta, DWR has imposed a carriage loss of 20.0%. It can be higher depending upon the time of year and the conditions under which the transfer takes place. Carriage losses require the buyer to purchase additional water and assume greater cost for the transfer.

4. **Power Costs**. The use of the California Aqueduct is reserved for the SWP Contractors. Although other public and private entities may access the California Aqueduct under

California law, it can be prohibitive because of the cost of power. For a non-SWP entity, the cost increases to move water at market power rates from the Delta to Southern California. (Metropolitan's wheeling policy addresses this issue as described in a later portion of this report.)

5. **Shortages**. In the event that Metropolitan is unable to import sufficient water supplies to meet demands in Southern California, there may voluntary or mandatory conservation imposed. This may or may not apply to Watermaster. This institutional issue will be subject to negotiation. For political reasons, it may be appropriate to take the same reductions allocated to other member agencies of Metropolitan.

6. **Financial**. The acquisition of the Water Transfers can include different financing terms. An outright acquisition of water rights will likely require a cash purchase (asset acquisition). A long-term lease of water will require annual payments over the term (operating costs). The financial terms may play a role in deciding a specific water supply option.

Any of the institutional issues described in this report can affect the ability of Watermaster to acquire and transfer Water Transfers. Watermaster will have to develop a strategy to address the institutional issues.

METROPOLITAN WHEELING

This report describes the guidelines used by Metropolitan to convey and transport water into its service area ("Wheeling"). Although the concept of Wheeling applies to the delivery of non-Metropolitan water supplies, most of the cost components are the same. As described below, the only basic difference between Metropolitan water supplies and non-Metropolitan water supplies is the water resource and power costs. Even though there is not a formal checklist or procedures for a water transfer, Metropolitan member agencies and retailers have successfully completed short and long-term wheeling of water supplies.

Watermaster has the opportunity to access Metropolitan's conveyance system with the payment of wheeling fees. Metropolitan will "wheel the water in available SWP capacity under the terms of the Monterey Amendment and in the Metropolitan system on an as-available basis."

Metropolitan has guidelines for the wheeling of non-Metropolitan water on behalf of Metropolitan member agencies and retailers. These guidelines are based on California Water Code Sections 1810-1814 and Section 4405 of Metropolitan's Administrative Code.

Referred to as the "Wheeling Statute," the Water Code Sections 1810-1814 allow for the use of a water conveyance facility which has unused capacity. There are three basic parts of the Wheeling Statute: 1) use; 2) availability; and, 3) fair compensation. These parts are qualified by the requirement to prevent injury to local water quality and affecting other beneficial uses (for example, fish and wildlife and other instream uses). Each part is further defined with legislative direction to both parties in a water transfer.

No state, regional or local agency can deny a legitimate transferor of water access to conveyance facilities if there is unused capacity. The Water Code specifies that seventy percent (70.0%) of the unused capacity can be utilized.[14] An important provision in the Wheeling Statute works for the benefit of Watermaster. Any transferor that has a long-term water service contract or the right to receive water from the owner of the conveyance facility has the first priority for the unused capacity. This situation applies between Watermaster (through IEUA) and Metropolitan. The difficulty is in determining the amount of unused capacity.

A related concept in the Wheeling Statute is availability. The transferor can only access the conveyance facilities when the unused capacity is not being utilized by the owner. It is very difficult to determine the availability of the capacity. Short-term water transfers are more manageable. Long-term water transfers usually require a study to determine utilization of the conveyance facility. Availability becomes a negotiable item in the long-term wheeling contract.

Once capacity and availability are determined, there is the issue of "fair compensation." According to the Water Code, fair compensation is defined as "the reasonable charges incurred by the owner of the conveyance system, including capital, operation, maintenance, and replacement costs, increased costs from any necessitated purchase of imported power, and including reasonable credit for any offsetting benefits for the use of the conveyance system."[15] For each public agency this term has a different meaning and the costs are calculated differently. Metropolitan has combined different approaches to develop the unbundled rate structure used for wheeling. Some of the rates are based on actual cost reimbursement while other rates represent a postage stamp approach.

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[14] California Water Code Section 1814

[15] California Water Code Sections 1810-1814

Section 4405 ("Wheeling Service") of Metropolitan's Administrative Code makes Wheeling available subject to a determination that there is unused capacity in Metropolitan's conveyance system. Section 4405 (a) and (b) contain the Wheeling guidelines and states that:

> "(a) Subject to the General Manager's determination of available system capacity, Metropolitan will offer wheeling service. The determination whether there is unused capacity in Metropolitan's conveyance system, shall be made by the General Manager on a case-by-case basis in response to particular requests for wheeling.
>
> (b) The rates for wheeling service shall include the System Access Rate, Water Stewardship Rate and, for treated water, the Treatment Surcharge, as set forth in Section 4401. In addition, wheeling parties must pay for their own cost for power (if such power can be scheduled by the District) or pay the District for the actual cost (not system average) of power service utilized for delivery of the wheeled water. Further, wheeling parties shall be assessed an administrative fee of not less than $5,000 per transaction."

Watermaster will have to pay the System Access Rate and Water Stewardship Rate. In addition, Watermaster will have to pay the actual cost (not system average) of power service utilized for delivery of the Water Transfers. For planning purposes, the System Power Rate is used to estimate costs. The following summarizes the definitions used by Metropolitan for the three water rates:[16]

1. **System Access Rate**. The System Access Rate is intended to recover a portion of the costs associated with the conveyance and distribution system, including capital, operating and maintenance costs. All users (including member agencies and third-party wheeling entities) pay this rate in the Metropolitan system.

2. **Water Stewardship Rate**. This rate is charged on a dollar per acre-foot basis to collect revenues to support Metropolitan's financial commitment to conservation, water recycling, groundwater recovery and other water management programs approved by the Board. The Water Stewardship Rate is charged for every acre-foot of water conveyed by Metropolitan.

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[16] www.mwdh2o.com/mwdh2o/pages/finace/finance.03.html

3. **System Power Rate**. The System Power Rate is charged on a dollar per acre-foot basis to recover the cost of power necessary to pump water from the SWP and Colorado River through the conveyance and distribution system for Metropolitan's member agencies. Entities wheeling non-Metropolitan water supplies will pay the actual costs of power to convey water on the SWP, the CRA or the Metropolitan distribution system, whichever is applicable.

Effective January 1, 2010, the water rates associated with wheeling are as follows: 1) System Access Rate - $154 per acre-foot; 2) Water Stewardship Rate - $41 per acre-foot; and, 3) System Power Rate - $119 per acre-foot.[17] Together, the wheeling costs are approximately $314 per acre-foot to transfer water through Metropolitan's distribution system. Depending upon the source of the non-Metropolitan water supplies, the wheeling costs may be less or more based on actual power costs.

The wheeling service is geared for short-term water transfers. Since Wheeling is based on identified surplus conveyance capacity, Metropolitan is reluctant to commit future capacity to non-Metropolitan water deliveries. The major exception is the IID-SDCWA long-term water transfer of Colorado River water.

TRANSACTION CRITERIA

Watermaster must determine the type and quantity of water supplies to be acquired. This report is designed to provide transaction criteria for the Water Transfers. Successful water marketing transactions have many elements in common. The transaction criteria will help guide Watermaster in evaluating qualified sources of the Water Transfers. Although there is no minimum requirement of elements, successful transactions satisfy many of the transaction criteria as follows:

1. **Marketable Supply**. The Water Transfers must be available on an annual basis in sufficient quantity and at reasonable cost. The water supply must also be recognized legally as transferable and meet all delivery and regulatory requirements.

2. **Water Rights**. The seller must be recognized as the legal owner of the Water Transfers. If not, the Water Transfers must be under license or assignment from the applicable public body to allow for its transfer. The right is qualified by date of diversion, historic use, hydrology, and other beneficial uses.

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[17] www.mwdh2o.com/mwdh2o/pages/finace/finance.03.html

3. **Annual Yield**. The seller and Watermaster must agree to the amount of Water Transfers to be delivered on an annual basis. There are many factors that affect annual yield including water supply reliability, water supply deliverability, and conveyance capacity (each discussed below).

4. **Water Quality**. The Water Transfers must have a water quality level at or better than regional, state and/or federal standards for its type and use. The Water Transfers will have to be conveyed through either the SWP or Colorado River Aqueduct and subject to standards imposed by DWR and by Metropolitan.

5. **Annual Reliability**. The Water Transfers will be subject to fluctuations due to annual hydrology. The value of the Water Transfers is dependent upon its availability each year and during the term of a contract. Watermaster will want to pursue water supplies that are over 90.0% reliable for delivery to the Basin.

6. **Conveyance Capacity**. Use of existing pipelines, aqueducts, and infrastructure is critical in reducing the cost of the Water Transfers. Scheduling is also important. Peak and off-peak water deliveries (summer versus winter) affect the cost of the Water Transfers.

7. **Regulatory Approvals**. The Water Transfers should require the minimum amount of regulatory approval and environmental review. Any delays in regulatory approvals can be costly and reduce the likelihood of transaction completion.

8. **Acquisition Cost**. The cost of acquiring the Water Transfers must be competitive with other alternatives and current water supplies. For Metropolitan Tier 2, Watermaster will want to seek water resource costs that are competitive to the Supply Rate (for 2010 the published water rate is $280 per acre-foot).[18]

9. **Capital Investment**. The Water Transfers should be structured to fully utilize the current capacity in the Basin. Any new capital investment in Basin capacity for recharge requires a matching of the long-term costs of the infrastructure and the Water Transfers.

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[18] www.mwdh2o.com/mwdh2o/pages/finace/finance.03.html

10. **Transaction Complexity**. The Water Transfers transaction can be completed in a reasonable timeframe and a minimum number of players (i.e. approval by water districts and governmental agencies). By reducing the transaction complexity, Watermaster will increase the likelihood of a successful transaction.

11. **Transaction Timing**. Watermaster must match the availability of the Water Transfers with the ability for Watermaster to take delivery. This requires an understanding of Metropolitan's distribution system and its utilization.

12. **Probability of Completion**. Given the previous criteria, it is determined that the potential transaction for the Water Transfers has a high probability of completion.

Taken together, the transaction criteria provide a structure for the acquisition of the Water Transfers. Watermaster will have to consider each of the transaction criteria in building an acquisition program. This applies to both short-term and long-term Water Transfers purchases.

SOURCES OF WATER TRANSFERS

Watermaster needs to consider all potential sources of the Water Transfers. This may include water supplies that are available regionally. The Water Transfers require the payment of wheeling fees to Metropolitan. The cost to develop and convey local/regional water supplies may be cheaper when adjusting for the cost of Metropolitan's wheeling fees. The Water Transfers need to include local/regional opportunities to create a cost effective mix of water supplies. To meet the CURO, Watermaster will have to consider all types of water supplies (at various prices on a short-term and long-term basis).

There are three primary regions to acquire the Water Transfers (also used by Metropolitan to provide water to Watermaster). These are the Sacramento Valley, the San Joaquin Valley, and the Colorado River. The following chart shows the each region and a ranking of the transaction criteria (from the above description).

Transaction Criteria	Model Transaction	Sacramento Valley	San Joaquin Valley	Colorado River
1. Marketable Supply	Transferable	Need to Develop	Need to Develop	Need to Develop
2. Water Rights	Ownership	Ownership/Lease	Lease	Lease
3. Annual Yield	High	Medium	Low	High
	(>25kafy)	(10kafy-25kafy)	(<10kafy)	(>25kafy)
4. Water Quality	Untreated	Untreated	Untreated	Untreated
5. Annual Reliability	High	Medium	High	High
	(>90.0%)	(75.0%-90.0%)	(>90.0%)	(>90.0%)
6. Conveyance Capacity	High	Low (Delta)	High	Medium
	(>90.0%)	(40.0%-70.0%)	(>90.0%)	(>70.0%)
7. Regulatory Approvals	Low	High	Medium	High
8. Acquisition Cost	Low	Low	High	Medium
9. Capital Investment	None	Low/None	Low/None	Medium/Low
10. Transaction Complexity	Low	Medium	Low	High
11. Transaction Timing	15-18 months	15-36 months	12-24 months	24-36 months
12. Probability of Completion	High	Medium	Medium	Low

The above chart compares each region to a "model transaction." The model assumes that Watermaster is able to obtain or negotiate the best outcome for each transaction criteria. It is highly unlikely that Watermaster will find potential transactions that meet all the criteria of the model transaction. On the other hand, the model transaction provides a guide for comparing the regions for acquisition of the Water Transfers. (The criteria are based on the water marketing experience of Sierra Water Group, Inc.)

It is proposed that Watermaster seek senior water rights as the source of the Water Transfers. This will give Watermaster priority during low allocations. The following describes the regions in which the Water Transfers can be acquired. Within each region, there are descriptions of water sellers. The water sellers are potential transactions for Watermaster. This report does not identify the estimated costs of the Water Transfers transactions (Watermaster will not want to share this information with potential sellers).

Sacramento Valley - Description

The Sacramento Valley has the greatest quantity of water available for the Water Transfers. Most of the major irrigation districts do not fully utilize their water supplies or water rights. These water agencies are oftentimes referred to as the “senior appropriators” in the Sacramento Valley. Their water supplies are provided first before the contractors of the SWP and CVP are allocated water. As a junior appropriator, the SWP relies on the surplus water to fill the California Aqueduct. It can be tricky identifying surplus water supplies that are not utilized by the SWP. In general, the water supplies of the senior appropriators are highly reliable.

The basic water available to the Basin from the Sacramento Valley is the SWP water imported by Metropolitan. The water originates in Lake Oroville and flows through the Feather and Sacramento Rivers to the Delta. The water is pumped from the Delta and transported through the California Aqueduct to Southern California. The SWP water provides a portion of the Replenishment, Tier 1 and Tier 2 from Metropolitan.

Another source for the Water Transfers is the federal CVP. The BOR operates the CVP and provides water from Lake Shasta which flows through the Sacramento River. The BOR delivers the federal water to settlement exchange contractors and federal contractors along the Sacramento River. The federal water is also pumped from the Delta and transported through the Delta Mendota Canal to deliver to contractors south of the Delta.

The SWP contract provides Metropolitan with an opportunity to transport non-SWP water through the California Aqueduct. Non-SWP water has a lower priority for use of the SWP facilities (including conveyance through the Delta). In addition, non-SWP water supplies are subject to 20.0% carriage losses when water is conveyed through the Delta. Non-SWP water supplies include pre-1914 water rights, post-1914 water rights, and BOR settlement contract water, riparian water rights, and groundwater. Most of these water supplies are senior to the SWP (which reduces the likelihood of loss during reductions or drought).

The Sacramento Valley was the primary source for the 2009 Drought Water Bank. Sources include cities and water districts that have water rights in the Sacramento River, Feather River, Yuba River, American River, and the San Joaquin River. Watermaster, Table A provides the total quantity available from the identified sellers. This is not the actual sales to the Drought Water Bank. For Watermaster, the amount of water available from identified sellers is more important for future transactions (completed transactions and pricing are the result of annual hydrology).

Sacramento Valley – Potential Sellers

The Sacramento Valley has the most surplus water available of all three regions. Despite the quantity of water available, the institutional and environmental issues in the Delta make it difficult to schedule water transfers. This will continue until a "Delta fix" is implemented. Also, both the federal and state water projects export water from the Sacramento Valley. The challenge is to identify senior water rights or contract supplies that have priority and/or do not impact the water projects.

Federal settlement contracts ("Settlement Contract") combine the features of senior water rights and contract water supplies. Before the BOR could impound water behind Shasta Dam, it had to "settle" water delivery disputes with Sacramento River diverters. The settlement contracts provide for a "base water supply" that is associated with the historic water right. This is not considered federal water. It is also very reliable (subject to a maximum of 25.0% reduction under very dry conditions). In addition, the Settlement Contracts provide for "contract water supply" to be delivered as available from the BOR. Many of the potential sellers described below have Settlement Contracts that are used to provide transferable water.

All the potential sellers have experience in selling water on a short-term basis. As a result, these potential sellers have worked through the institutional and environmental issues required of the water transfer process. This makes them "qualified" sellers for the sale of the Water Transfers to Watermaster. A brief description of some representative sellers is as follows:

South Feather Water and Power Agency ("South Feather") is a municipal and irrigation water agency with water and diversion rights located above Lake Oroville (the initial reservoir for the SWP). South Feather has 10,000 acre-feet of water available each year for marketing. During the last ten years, South Feather has marketed a total of 60,000 acre-feet of water through one-year sales.

South Feather has been limited in the past by the use of the water for power generation by Pacific Gas & Electric ("PG&E"). South Feather has a major hydropower operation. They are at the end of a 50-year contract with PG&E that will transfer ownership of the entire operation to South Feather in July of 2010. Subject to the negotiation of a new power contract, South Feather will be able to make long-term commitments for sale of the water.

Operationally, the South Feather water is located in a perfect location for transfer to Metropolitan and subsequent wheeling to the Basin. South Feather stores the water in its reservoir system located above Lake Oroville. With substantial capacity, South Feather can divert the water to Lake Oroville on call. From Lake Oroville, the water can be transported like the rest of the Metropolitan's SWP water supplies. From a physical standpoint, this is an easy water transfer. South Feather water has been one of the better priced options available in the Sacramento Valley.

Glenn-Colusa Irrigation District ("GCID") is an irrigation district located in Willow approximately ninety miles north of Sacramento with 175,000 acres of land within its service area. The primary crop in GCID is rice. GCID has a Settlement Contract that provides for the delivery of 720,000 acre-feet of water from the Sacramento River during the months of April through October. In addition, GCID has a contract for 105,000 of CVP water deliverable during the months of July and August. The water supply contract with the BOR is based on the district's water rights that are some of the oldest and largest on the Sacramento River.

GCID also has a permit with SWRCB for winter water from November through March in the amount of 1,200 cubic feet per second (potential maximum diversion of 357,000 acre-feet of water). GCID can produce up to 50,000 acre-feet of groundwater from district and privately owned landowner wells. GCID has substantial water resources to meet the agricultural water needs of its landowners.

According to GCID, the district views water transfers as a short-term action to help other regions meet shortages. GCID is concerned about the protection of its water supplies and water rights. Despite concerns, GCID has made it clear that prices for short-term water must reflect the tradeoff between land fallowing and commodity prices. Also, regulatory approvals for water transfers have to be streamlined. GCID offered 50,000 acre-feet of surplus water to the 2009 Drought Water Bank.

Butte Water District ("BWD") is located in the Feather River system. BWD is an irrigation water district located about 60 miles north of Sacramento. BWD's service area includes approximately 27,500 acres of land. Headquartered in Gridley, BWD serves about 550 customers. Approximately 18,000 acres of BWD's service area are irrigated on an annual basis planted with peaches, plums, walnuts, kiwis, and alfalfa. BWD is an annual seller of surplus water. BWD is entitled to take up to 132,000 acre-feet of annual water supply from the Feather River.

BWD is a member of the Joint Water Board, a collection of four water agencies with senior water rights in the Feather River. When the Oroville Dam was constructed, DWR had to exchange the Joint Water Board water rights for long-term contract supplies. BWD is one of the most active irrigation districts in the Sacramento Valley for marketing surplus water supplies. Typically, BWD has 20,000 to 30,000 acre-feet of surplus water available for water marketing. BWD offered 20,000 acre-feet of surplus water to the 2009 Drought Water Bank.

Yuba County Water Agency ("YCWA") is the largest surplus water seller in the Sacramento Valley. Located in Marysville, YCWA is approximately 50 miles north of Sacramento. YCWA was created in 1959 to develop alternative water resources for farmers and provide local flood control. The agency operates numerous powerhouses, dams, reservoirs, tunnels, and canals in its service area.

The Yuba River watershed covers an area of approximately 1,357 square miles. The Yuba River begins in the Sierra Nevada and joins the Feather River near Marysville. During an average year, the annual snow and water runoff that passes down the Yuba River is about 2.4 million acre-feet. The maximum annual runoff experienced on the river has exceeded five million acre-feet.

YCWA owns substantial pre-1914 and appropriative water rights on the Yuba River. To retain the right to use its surplus water, YCWA stores Yuba River water in two surface water reservoirs with a capacity of approximately 1.3 million acre-feet of water. YCWA primarily uses stored water from its reservoirs for water marketing purposes. YCWA offered 110,000 acre-feet of surplus water to the 2009 Drought Water Bank.

Natomas Central Mutual Water Company ("Natomas") is located in Sacramento and Sutter Counties (located east of the Sacramento International Airport). Natomas has certain senior water rights to divert water from the Sacramento River. Natomas has a Settlement Contract that provides for the delivery of 98,200 acre-feet of base water supply and 22,000 acre-feet of contract water supply. Natomas distributes water to its shareholders which are all agricultural customers.

Natomas has been actively marketing surplus water. In 2000, the SWRCB recognized a conservation program within Natomas that produces approximately 17,000 acre-feet of water per year. Natomas has the right to remarket this water. As a result, Natomas has offered long-term contracts for the sale of the water. Natomas offered 10,000 acre-feet of surplus water to the 2009 Drought Water Bank.

Western Canal Water District ("Western Canal") was formed in 1984 when current landowners purchased the land and water rights owned by Pacific Gas & Electric ("PG&E"). PG&E had obtained the assets from the Great Western Power Company, who had developed the hydroelectric power facilities on the Feather River in the early 1900s.

The acquisition included pre-1914 water rights on the Feather River for use by Western Canal. The water rights total 295,000 acre-feet. The water rights are divided into 150,000 acre-feet of natural flow of the river and 145,000 acre-feet of water stored in the North Fork Feather River Project. Similar to the Joint Water Board, Western Canal has a water supply contract with DWR. The district also has adjudicated rights to a small amount of Butte Creek water. In addition, Western Canal landowners can pump water from the groundwater basin.

Western Canal is comprised of 65,000 acres with irrigable acreage of about 58,500 acres. The primary crop is rice with a small amount of pasture and orchard crops. Two-thirds of Western Canal lies in Butte County, and the rest in Glenn County. The district's water originates in Lake Oroville and delivered from two outlet structures on the west bank of the Thermalito Afterbay with a capacity of 1,250 cubic feet per second (approximately 2,480 acre-feet per day). Western Canal offered 20,000 acre-feet of surplus water to the 2009 Drought Water Bank.

San Joaquin Valley – Description

There are numerous water supplies that originate in the San Joaquin Valley that are not subject to the restrictions in the Delta. The water has to be conveyed and transported through the California Aqueduct to be delivered to Watermaster. Water sources include Semitropic Water

Storage District banking programs, Kern County Water Agency, and water rights in the Friant-Kern Canal, King’s River and Kern River.

The SWP Contractors have developed complex water exchanges to avoid direct sales of surplus SWP water (which is limited by DWR). The water exchanges require an investment in groundwater storage infrastructure and the acquisition or development of the water resources used for this type of water transfer. This led to water sales in the San Joaquin Valley that are substantially higher in cost than the Sacramento Valley (after adjusting for carriage losses and transport costs).

The principle advantage of purchasing water south of the Delta is avoiding the mitigation and conveyance issues of the Delta. Scheduling is more flexible. Although the price is higher (for a comparable acre-foot of water), the reliability is greater.

San Joaquin Valley – Potential Sellers

The San Joaquin Valley includes water agencies that are directly and indirectly affected by the Delta. Those agencies directly affected divert water from the San Joaquin River or its tributaries. Those agencies indirectly affected benefit from the Friant-Kern Canal or the California Aqueduct. The challenge is to identify water in the San Joaquin Valley that can be regulated to the California Aqueduct without violating provisions of the federal and state water contracts. For example, Watermaster cannot purchase stored SWP water (from a SWP Contractor other than Metropolitan) in the Semitropic Water Storage District Water Bank and request it be transferred into Metropolitan’s system.

The potential sellers in the San Joaquin Valley have the advantage of using the SWP water to exchange for the delivery of local surface and groundwater supplies. For example, a water agency with a SWP Contract and Kern River water rights can lease the rights and deliver the SWP water in exchange. This is a common exchange used by member units of KCWA to sell short-term water to the Drought Water Bank and the Environmental Water Account.

The following potential sellers represent the types of water available in the San Joaquin Valley:

North Kern Water Storage District ("North Kern") is located north of Bakersfield. The district has approximately 60,000 acres of irrigated agriculture, with nuts and grapes accounting for more than one-half of the cropped area. North Kern water supplies principally include local Kern River water and pumped groundwater. The amount of water available for the district's water rights on the Kern River can range from 10,000 acre-feet in a dry year to nearly 400,000 acre-feet in a wet year. North Kern utilizes 1,500 acres of recharge basins to capture the high water flows and store the water for later groundwater production by its farmers.

With its location on the Kern River, North Kern can participate in water exchanges with other water agencies. North Kern has access to both the SWP and the CVP conveyance facilities and service areas. Basically, North Kern can exchange local river water for state and federal water supplies. This provides North Kern substantial diversity of its water supplies.

The district's Kern River water rights date back to the early 1870s. This gives North Kern a high level of water supply reliability. With the ability to divert the water to storage, North Kern can create substantial groundwater for later use. With its location to the major water state and federal conveyance facilities, the stored groundwater can be sold or exchanged for delivery of water to Southern California. North Kern is in the process of creating a conjunctive use program. The district is looking for financial and banking partners for the program.

Buena Vista Water Storage District ("Buena Vista") is located in the southern San Joaquin Valley northwest of Bakersfield. Buena Vista has an agricultural service area of 49,057 acres. The Miller and Lux Land Company originally owned the land served by Buena Vista. The district was organized in 1924 to represent and protect the water rights acquired from the Kern River. The lands in Buena Vista are dedicated primarily to intensive agricultural use, with the principal crop being cotton (about 85.0% of the annual cropping pattern), grain, sugar beets, and alfalfa.

Buena Vista has substantial surface and groundwater resources. These include: 1) subcontract of 21,300 acre-feet of the SWP Table A subcontract with KCWA; 2) capacity to recharge up to 190,000 acre-feet of surface water per year; 3) groundwater account of approximately 1 million acre-feet; 4) Kern River water rights averaging 158,000 acre-feet per year; 5) surface storage in Lake Isabella of 170,000 acre-feet of water; and, 6) storage rights of 25,000 acre-feet in Buena Vista Lake.

The district maintains inflow capacity from the Kern River, the Friant-Kern Canal, and the California Aqueduct. Buena Vista has extensive groundwater recharge facilities and established groundwater capacity. The district has access to seven turnouts from the California Aqueduct. Its unique geographic location and minimal power requirements have provided Buena Vista with the opportunity for a number of exchanges of its Kern River water rights for SWP Table A water.

Rosedale-Rio Bravo Water Storage District ("Rosedale") is located just west of Bakersfield. Rosedale was formed in 1959 for the purpose of constructing and operating a groundwater recharge project. Rosedale does not directly deliver surface water to the 44,000 acres of irrigated agriculture. Instead, the district exchanges its SWP Table A subcontract with KCWA for the diversion and storage of Kern River water supplies. The district's recharge project was designed to manage variable water supplies through conjunctive use of the groundwater basin. Water is recharged and stored in the underlying groundwater aquifer in times of surplus and then pumped annually to meet irrigation needs.

Rosedale owns 1,000 acres of recharge ponds. The recharge facilities consist of recharge basins, improved unlined channels, and natural channels. Rosedale has a diversion capacity from the Kern River of 450 cubic feet per second or 893 acre-feet of water per day. Since inception of the district, the total amount of water deliveries to Rosedale's facilities have exceeded two million acre-feet. In addition, Rosedale has a subcontract for the SWP water with KCWA in the amount of 29,900 acre-feet annually.

Colorado River – Description

Metropolitan has priorities 5(a) and 5(b) for the delivery of up to an additional 550,000 acre-feet per year of Colorado River. In practice, these priorities provide that surplus water not delivered to PVID, IID, and CVWD can be reallocated to Metropolitan. The agreements Metropolitan and SDCWA has completed with PVID and IID have "firmed up" priorities 5(a) and 5(b). It is expected that this process will continue with additional water transfers in the future.

At this time, the institutional barriers to interstate water transfers will reduce or eliminate non-California opportunities. Both Nevada and Arizona are taking full allocation of available Colorado River water. There are other potential sellers (for example, Indian tribes) that have surplus water available. The surplus water is difficult to contract for since the water has not been diverted and put to beneficial use. Metropolitan has been the recipient of surplus water not utilized by other higher priority diverters.

On January 14, 2010, a state court judgment invalidated the 2003 Quantification Settlement Agreement ("QSA") which includes 13 agreements between state and local water agencies.[19] The judges' ruling held that the QSA was void because the State of California unconstitutionally agreed to pay for unlimited costs for restoration of the Salton Sea. If the ruling is upheld on appeal, the long-term water transfer between IID and SDCWA will be invalidated. This will require SDCWA to start over on negotiation of another water transfer. If this results, Watermaster may have an opportunity to acquire the Water Transfers from IID.

Colorado River – Potential Sellers

The potential sellers on the Colorado River are represented by the water agencies that have a higher priority than Metropolitan for the water allocated to California. The two potential sellers are PVID and IID. The following provides a description of the water supplies and available water.

Palo Verde Irrigation District ("PVID") occupies roughly 130,000 acres of land in Riverside and Imperial Counties, California. PVID has the first priority for Colorado River among the California diverters. The district has part of the 3.85 million acre-feet allocated to priorities 1, 2, and 3. For operating purposes, PVID consumes about 5.0 acre-feet of Colorado River water for each acre given the current types of crops. For 2008, PVID reported 121,030 gross acres in cultivation. This amounts to a total consumption of approximately 600,000 acre-feet of Colorado River water.

PVID signed a long-term agreement with Metropolitan that provided for the fallowing of up to 26,000 acres of land. The fallowing will produce up to 111,000 acre-feet of water for transfer to Metropolitan over a 35-year term (beginning January 1, 2005). Metropolitan is required by contract to make a call each year for the fallowing of the acreage in the program. Metropolitan paid the landowners an upfront payment to create the program and an annual fee per acre when fallowed.

Although PVID has a long-term fallowing program with Metropolitan, the district has increased water sales to Metropolitan on a short-term basis. PVID fallowed 13,350 acres to make the

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[19] Superior Court of California, County of Sacramento, Judge Roland L. Candee, Case No.: JC4353, QSA Coordinated Cases, issued January 14, 2010

water available to Metropolitan. At a ratio of approximately 5:1 (acre-feet to acre), the district made 66,000 acre-feet of additional conserved water to Metropolitan in 2009. This water represents the additional water marketing interest by PVID.

Imperial Irrigation District ("IID") occupies over 450,000 acres of agricultural land as the nation's largest irrigation district. IID's Colorado River entitlement allows for the diversion of up to 3.1 million acre-feet of water per year. The water rights are referred to as "present perfected rights" which are senior to water delivered by the BOR under federal contracts.

According to IID, the district will transfer up to 200,000 acre-feet per year of conserved water to SDCWA for a term of 75 years. In addition, IID will transfer conserved water to Coachella Valley Water District and Metropolitan up to 103,000 acre-feet per year from delivery system improvements and on-farm efficiency improvements.[20] The district is a potential seller due to the total quantity of Colorado River it controls and the current status of the QSA.

Summary – Sources of Water Transfers

The list of potential sellers by the three regions is a subset of the opportunities for the Water Transfers. Prices and terms of potential transactions have been left out of this report on purpose. Watermaster will want to develop an acquisition strategy and review its willingness-to-pay for Water Transfers before advertising the information.

FINANCIAL ANALYSIS

The financial analysis is focused on the Peace II alternative. The objective is to determine the likely future cost of the Water Transfers. The Water Transfers may consist of a mix of supplies as described above. The preferred mix will depend upon marginal reliability, future availability, and cost. To guide an acquisition plan, the financial analysis estimates the 20-year costs of Metropolitan water supplies for the Water Transfers. This will create a benchmark for comparing acquisition options.

With Metropolitan water supplies, there are two choices: 1) Replenishment; and, 2) Tier 2. It is unlikely that Replenishment will be available in sufficient quantity during the 20-year period to meet the demands of the CURO. Replenishment will be an "as available" supply with few years of availability. The Tier 1 will be committed to the base demand of the Metropolitan member

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[20] http://www.iid.com/Water/QSAWaterTransfer

agencies. The lack of Replenishment will force Watermaster to rely on the Tier 2 purchases for recharge operations. Even though the purchase of Tier 2 qualifies as the Water Transfers, it does not require an active program by Watermaster. For the analysis, this becomes the starting point.

Water Transfers – Cost Components

For Watermaster, each acre-foot of the imported water from Metropolitan has five basic cost components. Watermaster will be subject to the following: 1) Metropolitan Supply Rate (or water resource cost from transferred water); 2) Delta Supply Surcharge; 3) System Access Rate; 4) Water Stewardship Rate; and, 5) System Power Rate. The only component that Watermaster can improve is Metropolitan's Supply Rate (by replacing it with transferred water).

Rate Component	**Replenishment**	**%**	**Tier 1**	**%**	**Tier 2**	**%**
1. Supply Rate	$52.00	14.2%	$101.00	20.9%	$280.00	47.1%
2. Delta Supply Surcharge	-	0.0%	69.00	14.3%	-	0.0%
3. System Access Rate	154.00	42.1%	154.00	31.8%	154.00	25.9%
4. Water Stewardship Rate	41.00	11.2%	41.00	8.5%	41.00	6.9%
5. System Power Rate	119.00	32.5%	119.00	24.6%	119.00	20.0%
TOTAL	**$366.00**	**100.0%**	**$484.00**	**100.0%**	**$594.00**	**100.0%**

Metropolitan wheeling costs apply to the Water Transfers. As a percentage of the total cost, Watermaster will have no control over this portion of the cost components. On the other hand, the water resource component changes with each source of supply. It is important to realize that of the total costs, less than 50.0% can be controlled by Watermaster. Despite this limitation, the water resource cost is large enough for special focus and action.

As shown by the chart, the Supply Rate and the Delta Supply Surcharge are the only variables in the Water Transfers for Watermaster with water delivered from Metropolitan. Since it is unlikely that Tier 1 water will be available for future replenishment, the only variable that applies to Replenishment and Tier 2 water supplies is the Supply Rate. Only the Tier 2 Supply Rate reflects the "market" cost to acquire the Water Transfers. For purposes of the analysis, the Tier 2 Supply Rate is used as the benchmark for comparing options.

Also, the Supply Rate goes from 14.2% of the total cost (Replenishment) to 47.1% of the total cost (Tier 2). The nominal increase for 2010 is $228.00 per acre-foot. The amount of current and future cost represented by Tier 2 is material for Watermaster. If Watermaster has to rely on Tier 2, then other water supply options may become cost effective.

Peace II Alternative

A likely scenario has been created that assumes a certain quantity and type of Metropolitan water will be available over the next twenty years. To project the costs, the Replenishment and Tier 2 costs are escalated at 7.5% per year. This is the average water rate increases by Metropolitan over the last 30 years. The future payments are discounted at 5.0% (Watermaster cost of capital) to produce the net present value ("NPV") cost. This is the cost in today's dollars. This allows for the comparison of different options.

There are three options analyzed for the Water Transfers Report. The first option assumes that Watermaster can purchase 100.0% of the water from Replenishment. Option 1 provides the minimum cost imported water supply cost to address the CURO. The second option assumes that no Replenishment is available and requires Tier 2 for all water purchases. Option 2 generates the avoided cost for imported water supply purchased from Metropolitan. This allows for a range for the total cost of the Water Transfers.

Option 1 – 100% Replenishment. This option is unlikely to result over the twenty year study period. It provides a minimum cost for Water Transfers. As shown in the cost components above, the Supply Rate component of Replenishment is $52.00 per acre-foot for 2010. There are no water supply options from the three marketing regions that can compete with this price. It is not expected that this price will be available given the current and projected water issues faced by Metropolitan. The total projected nominal and present value costs are shown in Table 2 of this report. The chart below summarizes the data:

"100.0% Replenishment"

Rate Component	% of Cost	Total Cost	per AF	NPV Cost	per AF
Supply Rate (Replenishment)	14.2%	$87,809,281	$124.02	$45,972,966	$64.93

System Access Rate	42.1%	260,050,563	367.30	136,150,708	192.30
Water Stewardship Rate	11.2%	69,234,241	97.79	36,247,916	51.20
System Power Rate	32.5%	200,48,163	283.83	105,207,366	148.60
TOTAL	**100.0%**	**$618,042,248**	**$872.94**	**$323,578,956**	**$457.03**

Option 2 – No Replenishment. This option is more likely given the water supply issues faced by Metropolitan. It provides the avoided cost for the Water Transfers. It is assumed that Metropolitan can acquire sufficient water supplies to fill all Tier 2 orders. Metropolitan does not publish the long-term reliability of its water supplies. The total projected nominal and present value costs are shown in Table 3 of this report. The chart below summarizes the data:

"No Metropolitan Replenishment Water"

Rate Component	% of Cost	Total Cost	per AF	NPV Cost	per AF
Supply Rate (Tier 2)	47.1%	$472,819,206	$667.82	$247,546,743	$349.64
System Access Rate	25.9%	260,050,563	367.30	136,150,708	192.30
Water Stewardship Rate	6.9%	69,234,241	97.79	36,247,916	51.20
System Power Rate	20.0%	200,948,163	283.82	105,207,366	148.60
TOTAL	**100.0%**	**$1,003,052,173**	**$1,416.73**	**$525,152,733**	**$741.74**

If Watermaster is unable to obtain any Replenishment from Metropolitan, then the long-term costs increase. As shown in the chart above, the total cost of the Water Transfers increases to a projected $1.0 billion (approximately $1,417.00 per acre-foot). In 2010 dollars, the total projected cost is $525.2 million (approximately $742.00 per acre-foot). To meet the Peace II objectives, Watermaster will have to make a major investment in imported water and/or the Water Transfers. Without Replenishment, the Water Transfers will cost Watermaster an average projected cost of $50.2 million per year for the 20-year period.

FUNDING MECHANISM

The Basin needs to be prepared to acquire the Water Transfers on a short-term and long-term basis. This requires a dedicated source of funding. Currently, Watermaster purchases replenishment water to offset overproduction. This is conducted on a year-to-year basis in arrears. With the CURO, Watermaster will need to conduct purchases on an annual basis. Watermaster will have to engage in “pre-emptive replenishment program” to make sure that an opportunity is not lost to acquire and store water each year.

RECOMMENDATIONS

Watermaster should consider all options when addressing the long-term CURO. Both Metropolitan Tier 2 and the Water Transfers have to be pursued. Based on the quantity of water needed for the CURO, Watermaster has to begin to acquire water on an annual basis. This requires the development and implementation of a water marketing program. To pay for the imported water and the Water Transfers, Watermaster needs a funding program that is proactive. The Water Transfers must be flexible and able to adapt to the changes in the California water market. Properly structured, the Water Transfers can complement the imported water to meet the long-term recharge needs of the Basin.

Water Transfers Report - Table 1

CHINO BASIN WATERMASTER

Projected Cumulative Unmet Replenishment Obligation ("CURO")

20-Year Projection (FYE 2011-2030)

		PEACE II ALTERNATIVE				
	FYE	**Replenish. Obligation**	**Spreading**	**Injection**	**Total**	**CURO**
0	2010					24,665
1	2011	1,688	-	-	1,688	26,353
2	2012	-	-	-	-	26,353
3	2013	15,638	-	-	15,638	41,991
4	2014	22,569	12,000	-	10,569	52,560
5	2015	20,087	71,386	6,170	(57,469)	(4,909)
6	2016	23,635	70,886	6,170	(53,421)	(58,330)
7	2017	23,964	70,386	6,170	(52,592)	(110,922)
8	2018	29,417	69,886	6,170	(46,639)	(157,561)
9	2019	30,313	-	-	30,313	(127,249)
10	2020	31,472	-	-	31,472	(95,777)
11	2021	33,995	-	-	33,995	(61,782)
12	2022	36,658	-	-	36,658	(25,124)
13	2023	39,273	66,186	6,170	(33,083)	(58,207)
14	2024	42,086	65,286	6,170	(29,370)	(87,577)
15	2025	45,050	64,386	6,170	(25,506)	(113,083)
16	2026	47,475	63,486	6,170	(22,181)	(135,264)
17	2027	49,895	62,586	6,170	(18,861)	(154,125)
18	2028	52,315	36,000	-	16,315	(137,810)
19	2029	54,636	-	-	54,636	(83,174)
20	2030	57,407	-	-	57,407	(25,767)
	TOTAL	**657,573**	**652,474**	**55,530**	**(50,431)**	**-**

Water Transfers Report - Table 2

PEACE II ALTERNATIVE (100.0% Metropolitan Replenishment)

Projected Replenishment Costs

20-Year Period (FYE 2011-2030)

		PEACE II ALTERNATIVE							
	FYE	**Spreading**	**Replenish. Quantity**	**Replenish. Cost**	**Tier 2 Quantity**	**Tier 2 Cost**	**Injection**	**Replenish. Cost**	**Total Cost**
0	2010	-	-	-	-	-	-	-	-
1	2011	-	-	-	-	-	-	-	-
2	2012	-	-	-	-	-	-	-	-
3	2013	-	-	-	-	-	-	-	-
4	2014	12,000	12,000	$5,865,380	-	-	-	-	$5,865,380
5	2015	71,386	71,386	37,509,084	-	-	6,170	$3,241,967	40,751,050
6	2016	70,886	70,886	40,039,841	-	-	6,170	3,485,114	43,524,955
7	2017	70,386	70,386	42,739,223	-	-	6,170	3,746,498	46,485,721
8	2018	69,886	69,886	45,618,288	-	-	6,170	4,027,485	49,645,773
9	2019	-	-	-	-	-	-	-	-
10	2020	-	-	-	-	-	-	-	-
11	2021	-	-	-	-	-	-	-	-
12	2022	-	-	-	-	-	-	-	-
13	2023	66,186	66,186	62,023,641	-	-	6,170	5,781,976	67,805,617
14	2024	65,286	65,286	65,768,759	-	-	6,170	6,215,624	71,984,383
15	2025	64,386	64,386	69,726,761	-	-	6,170	6,681,796	76,408,557
16	2026	63,486	63,486	73,908,515	-	-	6,170	7,182,931	81,091,446
17	2027	62,586	62,586	78,325,319	-	-	6,170	7,721,651	86,046,970
18	2028	36,000	36,000	48,432,395	-	-	-	-	48,432,395
19	2029	-	-	-	-	-	-	-	-
20	2030	-	-	-	-	-	-	-	-
	TOTAL	**652,474**	**652,474**	**$569,957,206**	**-**	**$0**	**55,530**	**$48,085,042**	**$618,042,248**
	NPV	**-**	**-**	**$298,237,501**	**-**	**$0**	**-**	**$25,341,456**	**$323,578,956**

Water Transfers Report - Table 3

PEACE II ALTERNATIVE (No Replenishment)

Projected Replenishment Costs

20-Year Period (FYE 2011-2030)

		PEACE II ALTERNATIVE						
	FYE	Spreading	Replenish. Quantity	Replenish. Cost	Tier 2 Quantity	Injection	Tier 2 Cost	Total Cost
0	2010	-	-	-	-	-	-	-
1	2011	-	-	-	-	-	-	-
2	2012	-	-	-	-	-	-	-
3	2013	-	-	-	-	-	-	-
4	2014	12,000	-	-	12,000	-	$9,978,706	$9,978,706
5	2015	71,386	-	-	71,386	6,170	69,329,307	69,329,307
6	2016	70,886	-	-	70,886	6,170	74,048,520	74,048,520
7	2017	70,386	-	-	70,386	6,170	79,085,638	79,085,638
8	2018	69,886	-	-	69,886	6,170	84,461,800	84,461,800
9	2019	-	-	-	-	-	-	-
10	2020	-	-	-	-	-	-	-
11	2021	-	-	-	-	-	-	-
12	2022	-	-	-	-	-	-	-
13	2023	66,186	-	-	66,186	6,170	115,356,939	115,356,939
14	2024	65,286	-	-	65,286	6,170	122,466,227	122,466,227
15	2025	64,386	-	-	64,386	6,170	129,993,026	129,993,026
16	2026	63,486	-	-	63,486	6,170	137,959,972	137,959,972
17	2027	62,586	-	-	62,586	6,170	146,390,749	146,390,749
18	2028	36,000	-	-	36,000	-	82,397,492	82,397,492
19	2029	-	-	-	-	-	-	-
20	2030	-	-	-	-	-	-	-
	TOTAL	**652,474**	**-**	**$0**	**652,474**	**55,530**	**$1,051,468,377**	**$1,051,468,377**
	NPV	**-**	**-**	**$0**	**-**	**-**	**$550,501,267**	**$550,501,267**

Appendix E

Black and Veatch Task Report for Supplemental Water Recharge Projects

Chino Basin
Recharge Master Plan Update

Supplemental Water Recharge Concept Development

Technical Memorandum

May 2010

Prepared for:

CHINO BASIN WATERMASTER
Partners in Basin Management

WILDERMUTH™
ENVIRONMENTAL INC.

Prepared by:

BLACK & VEATCH
building a world of difference™

B&V Project No. 163891

1.0 INTRODUCTION

1.1 Overview

This Technical Memorandum (TM) consists of a discussion of existing and planned supplemental recharge within the Chino Basin (Basin), as well as a menu of potential alternatives that could be implemented to increase recharge within the Basin. This TM is intended to be supplemental to the 2010 Chino Basin Recharge Master Plan (RMP) Update prepared by Wildermuth Environmental, Inc. (WEI).

The following paragraphs of this section discuss the purpose and background of the RMP, which builds upon previous information provided in reports including the Recharge Master Plan Phase II Report prepared by Black & Veatch (B&V) in 2001. The Recharge Master Plan Phase II Report developed the original concepts and proposed projects to increase recharge in the Chino Basin with increased imported water from MWD, enhanced stormwater capture through improvements in the San Bernardino Flood Control District (SBFCD) and Chino Basin Water Conservation District (CBWCD) facilities [and Inland Empire Utility Agency's (IEUA) Regional Plant No. 3 (RP-3)], plus significant increase in the recharge of recycled water. In addition, the term "supplemental water" is defined and the organization of the report, acronyms used, and references cited are provided.

1.2 Purpose

The Chino Basin Watermaster (Watermaster) has traditionally met its replenishment obligations through purchase of imported water from the Metropolitan Water District of Southern California (MWD) and by purchasing water from the storage accounts or unproduced water pursuant to the rights of the Basin appropriators. Historically, MWD has been able to supply all of the replenishment needs of its service area with replenishment water available on average seven out of ten years. Since it is considered surplus water by definition, this replenishment water typically costs substantially less than other water served to municipal water users by MWD.

The amount of water available in the State Water Project (SWP) has become severely limited due to recent drought conditions and restrictions on the Bay Delta resulting from court rulings regarding endangered species. In 2008, MWD issued a revised replenishment water service forecast projecting that replenishment water would be available three out of ten years [WEI, Sept 2009]. As a result of the drought conditions, MWD has depleted storage in its various storage programs and it is likely that any surplus water available in the future will be used to refill MWD's storage accounts first prior to use as replenishment supplies. As a result, major groundwater basins in the MWD service area may become overdrafted in the next ten to twenty years unless replacement replenishment supplies are found, groundwater production is reduced, or a combination of both [WEI, Sept 2009]. The RMP update will include provisions to provide replenishment capabilities to the Watermaster to ensure that the Basin is operated in a sustainable manner.

1.3 Background

The Chino Basin consists of about 235 square miles of the upper Santa Ana River watershed. Figure 1-1 shows the Basin boundaries with the Cucamonga Basin and the San Gabriel Mountains to the north; the Rialto-Colton Basin to the northeast; the chain of Jurupa, Pedley, and La Sierra Hills to the southeast; the Temescal Basin to the south; Chino Hills and Puente Hills to the southwest; and San Jose Hills and the Pomona and Claremont Basins to the northwest. In addition, the Basin lies within the Counties of San Bernardino and Riverside and includes some or all of the Cities of Chino, Chino Hills, Fontana, Montclair, Norco, Ontario, Pomona, Rancho Cucamonga, Upland, and several other communities.

One of the largest groundwater basins in Southern California, the Basin contains about 5,000,000 acre-feet (acre-ft) of water and has an unused storage capacity of about 1,000,000 acre-ft. Cities and other water supply entities produce groundwater for all or part of their municipal and industrial supplies. Agricultural users also produce groundwater from the Basin, but irrigated agriculture has declined substantially in recent years and is projected to continue to decline [CBWM, 1999].

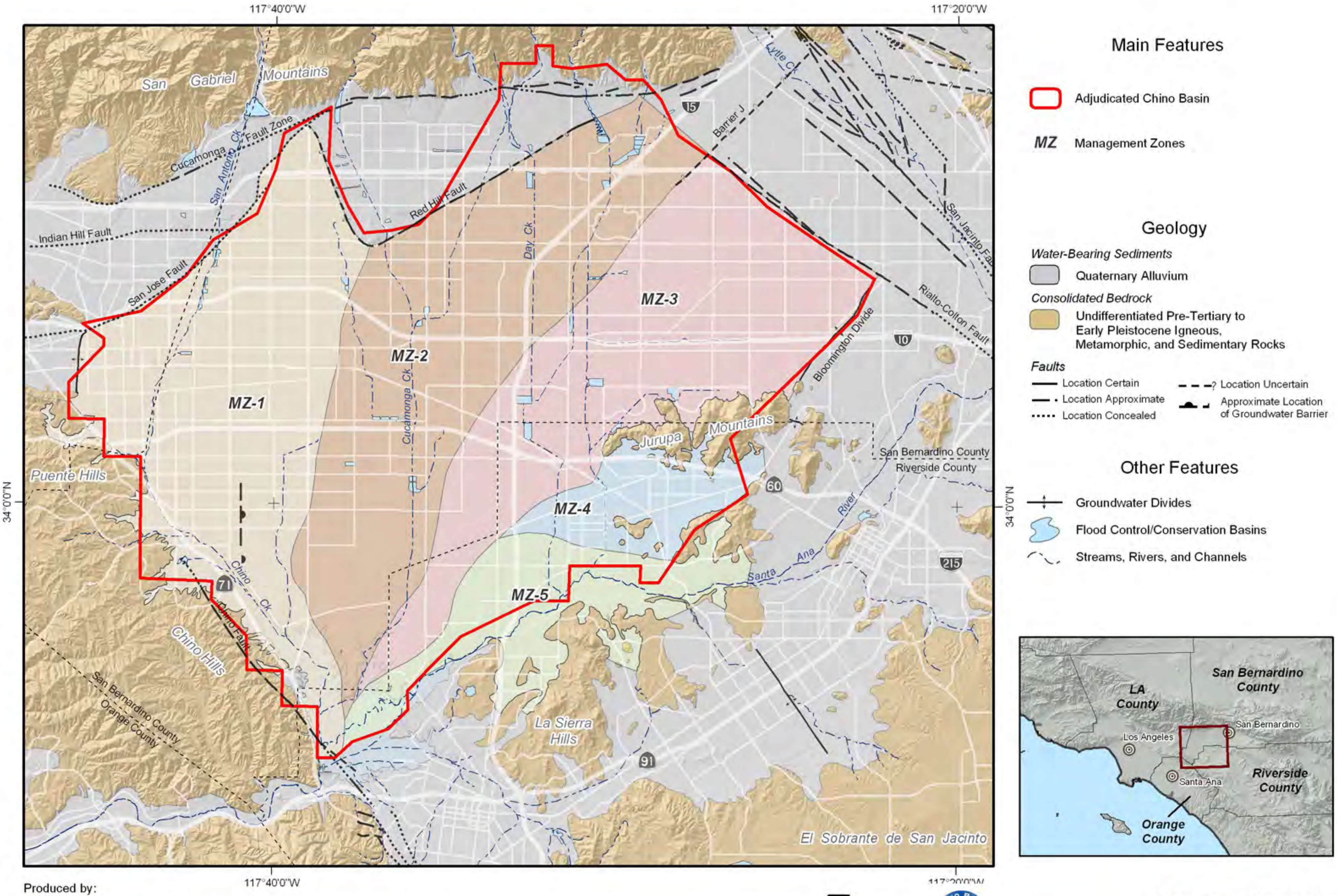
The Basin is legally defined in the Judgment of the case of Chino Basin Municipal Water District vs. the City of Chino et al. (Judgment) (Superior Court of California for San Bernardino Case No. RCV 51010), issued in 1978 [SCSC, 1978]. Since that time, the Basin has been operated as described in the Judgment under the direction of the court-appointed Watermaster.

The RMP update is a component of Program Element 2 from the Chino Basin Optimum Basin Management Program (OBMP): Develop and Implement a Comprehensive Recharge Program.

As mentioned previously, the 2001 Recharge Master Plan Phase II Report developed the original concepts and proposed projects to increase recharge in the Chino Basin. Such concepts and projects were realized via the IEUA Phase I and Phase II Improvements Project. The total construction costs from the Phase I and II projects were $38,580,000 and $10,500,000, respectively. Appendix A to this TM provides summary tables of the actual improvements and associated costs for the Phase I and II Improvements Projects (courtesy IEUA).

1.4 Definition of Supplemental Water and Recharge

Water used for groundwater recharge within the Basin comes from storm water, imported water, and recycled water. Storm water is considered a primary source for recharge and opportunities to maximize the use of storm water are addressed in the RMP update. Imported and recycled water together are considered supplemental water since they are used to supplement recharge operations when storm water availability is low or unavailable. This TM summarizes existing and planned supplemental recharge facilities and presents a menu of alternatives to increase supplemental recharge in the Basin.



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2010 Chino Basin Recharge Master Plan Update
Supplemental Water Recharge Concept Development

Chino Basin Boundaries and OBMP Management Zones

Figure 1-1

1.5 Abbreviations And Acronyms

The following abbreviations/acronyms are used in this report:

acre-ft	acre-feet
ADC	Azusa Devil Canyon
AFY	acre-feet per year
amsl	above mean sea level
ASR	aquifer storage and recovery
Bay Delta	Sacramento-San Joaquin Delta
B&V	Black & Veatch
Basin	Chino Basin
ft/day	feet per day
FY	fiscal year
CBWCD	Chino Basin Water Conservation District
CBWM	Chino Basin Watermaster
CCWRF	Carbon Canyon Wastewater Reclamation Facility
CDA	Chino Desalter Authority
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
cfs	cubic feet per second
Chino	City of Chino
Chino Hills	City of Chino Hills
CRA	Colorado River Aqueduct
CVWD	Cucamonga Valley Water District
CURO	Cumulative Unmet Replenishment Obligation
DWR	California Department of Water Resources
EIR	Environmental Impact Report
FWC	Fontana Water Company
gpm	gallons per minute
HP	horsepower
I&C	instrumentation and controls
IEUA	Inland Empire Utilities Agency
JCSD	Jurupa Community Services District
Judgment	Chino Basin Municipal Water District vs. the City of Chino et al. (1978)
LACSD	Los Angeles County Sanitation District
LMWTP	Lloyd Michael Water Treatment Plant
LS	lump sum
mgd	million gallons per day
Metropolitan	Metropolitan Water District of Southern California
MVWD	Monte Vista Water District

MZ	Management Zone
Ontario	City of Ontario
O&M	operation and maintenance
OBMP	Optimum Basin Management Program
Pomona	City of Pomona
psi	pounds per square inch
RC	Riverside-Corona
Riverside	City of Riverside
RIX	rapid infiltration/exfiltration
RMP	Recharge Master Plan
RNWTP	Royer Nesbit Water Treatment Plant
RPs	Recycled Water Plants
RO	reverse osmosis
ROW	right of way
RWC	recycled water contribution
RWQCB	Regional Water Quality Control Board
SAWPA	Santa Ana Watershed Project Authority
SBCFCD	San Bernardino County Flood Control District
SCE	Southern California Edison
SGVMWD	San Gabriel Valley Municipal Water District
SWP	State Water Project
TDH	total dynamic head
TDS	total dissolved solids
Upland	City of Upland
Watermaster	Chino Basin Watermaster
WEI	Wildermuth Environmental, Inc.
WFA	Water Facilities Authority
WRCRWA	Western Riverside County Regional Wastewater Authority
WTP	water treatment plant
WMWD	Western Municipal Water District

1.6 References

References consulted for the RMP Update are listed below.

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[SCSC, 1978]	*Chino Basin Municipal Water District v. City of Chino, et al.*, prepared for both parties, Superior Court of the State of California for the County of San Bernardino, January 1978.
[WEI, Sept 2009]	*The Challenge of Cumulative Unmet Replenishment Obligation, handout*, 2009 Strategic Planning Conference, September 28, 2009.
[WEI, Nov 2009]	*2009 Production Optimization and Evaluation of the Peace II Project Description, Final Report*, prepared for the Chino Basin Watermaster, November 2009.

2.0 SUPPLEMENTAL RECHARGE FACILITIES

2.1 Overview

This section provides an overview of the existing supplemental water recharge facilities in use today as a baseline to develop potential new supplemental water recharge concepts described in Section 3.0. Both existing and planned regional and local supplemental recharge facilities are also described.

2.2 Regional Supplemental Recharge Facilities

Existing regional supplemental recharge facilities include both imported and recycled water sources and consist of components such as pipelines, treatment plants, service connection turnouts, drainage channel systems, and recharge basins.

This section describes a summary of imported water sources available to the Basin, including a brief discussion on imported water availability and key water quality concerns, as well as a description of imported water facilities that are related to supplemental water recharge. This includes pipelines to convey imported water to the Basin, pertinent service connections, and drainage channels which allow delivery of supplemental recharge water to the existing basins.

The Inland Empire Utility Agency's (IEUA) regional recycled water system is also discussed including regional treatment plants, recycled water distribution system, and basins which currently receive recycled water for recharge.

2.2.1 Imported Water Facilities (Sources)

Imported water for direct recharge is currently coordinated with MWD's Member Agency, IEUA. Metropolitan provides imported water to Southern California through the Department of Water Resources (DWR) State Water Project (SWP) and the Colorado River Aqueduct (CRA).

State Water Project

The 444-mile California Aqueduct conveys water from the Sacramento-San Joaquin Delta (Bay Delta) to Southern California. The main stem of the Aqueduct flows through the Central Valley and then travels up and over the Tehachapi Mountains. At the bottom of the mountains, the Aqueduct bifurcates into two branches: West Branch (serving Los Angeles, Orange, and San Diego Counties) and East Branch (serving Riverside and San Bernardino Counties). SWP water is delivered to the Basin through the Rialto Pipeline (an MWD facility) that flows east to west along the northern portion of the Basin. Artificial recharge from the designated replenishment connections to the Rialto Pipeline for the Basin has occurred through the Watermaster since the Basin was adjudicated.

Colorado River Aqueduct

The CRA is a 242-mile aqueduct which diverts water from the Colorado River at Lake Havasu on the California-Arizona border west across the Mojave and Colorado Deserts to the east side of the Santa Ana Mountains. The CRA terminates at Lake Mathews in western Riverside County, where water is then distributed to MWD's member agencies via the Upper Feeder. CRA water is essentially no longer used in the Basin due to high TDS concentrations, which make it difficult for wastewater treatment plants to comply with discharge requirements in their National Pollutant Discharge Elimination System (NPDES) permits [CBWM, 2001].

Treated and untreated SWP water is used as both municipal supply and groundwater replenishment, respectively. As described in paragraph 1.2, the current projected availability of surplus SWP water to the Watermaster is 30 percent (i.e., water is available three out of every ten years). The projected availability of CRA water is essentially the same as SWP water with unused capacity available only during winter months. Table 2-1 summarizes the imported water sources currently available to the Chino Basin.

Table 2-1
Summary of Imported Water Sources

Source	Purveyor	Key Water Quality Concerns	Availability
State Water Project (SWP) Water	MWD	Moderate TOC(1)	Low Availability (30%)(2)
Colorado River Aqueduct (CRA) Water	MWD	Moderate TOC; High TDS	Low Availability (30%)

Notes:
(1) TOC = Total Organic Carbon
(2) Per 2008 MWD replenishment service water forecast.

Through conversations with MWD, WEI developed a set of graphs to generally illustrate the estimated unused capacity in both the Upper Feeder and Rialto pipelines on a monthly basis through 2035. As shown on Figures 2-1 and 2-2, both pipelines generally have some unused capacity in the winter months (Nov.-Feb.). The Upper Feeder has virtually zero unused capacity during the months of May to October, while 95 percent of the time, capacity in the Rialto Pipeline is unavailable during the late summer (Jul.-Oct.). The availability of unused capacity in the winter months was factored into the evaluation of supplemental recharge concepts described in this TM.

Figure 2-1
Unused Capacity per Month by Percentile in the Upper Feeder (2009-2035)

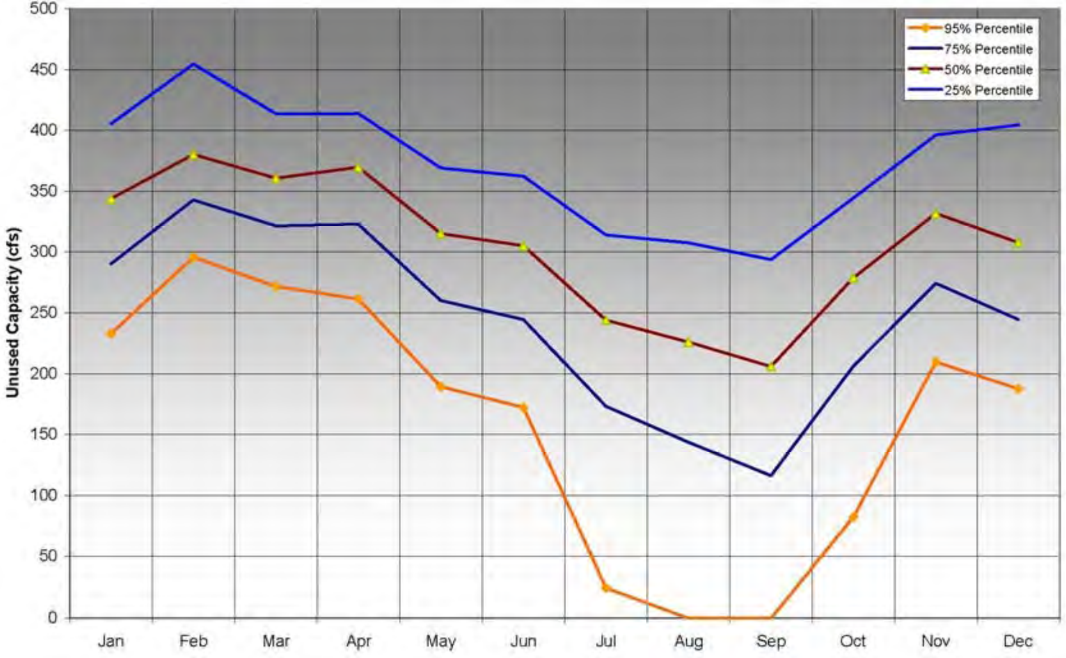
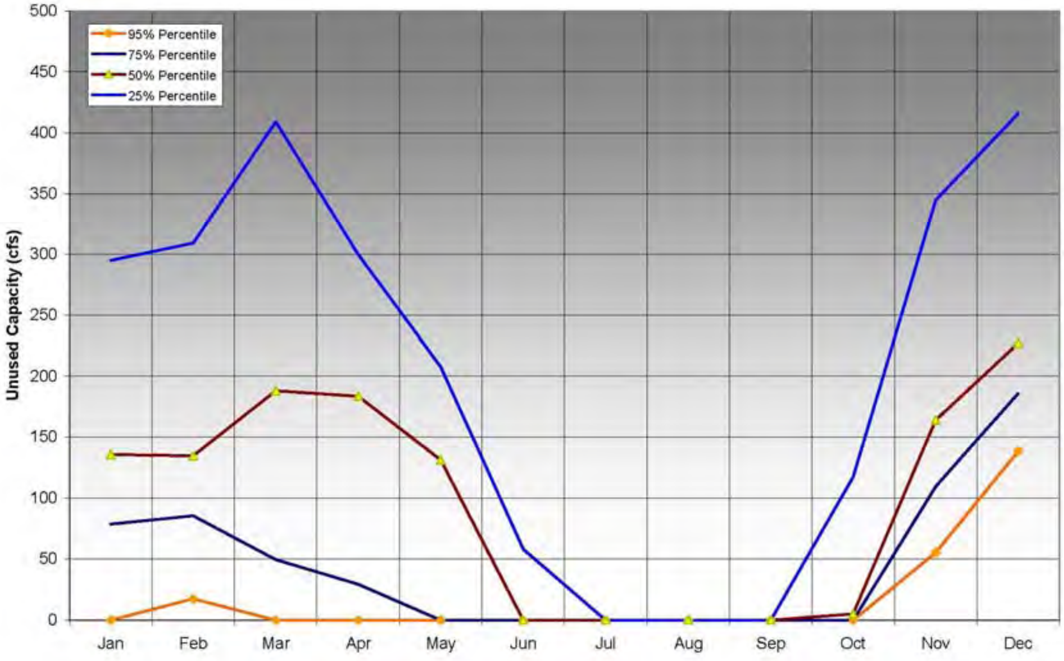


Figure 2-2
Unused Capacity per Month by Percentile in the Rialto Pipeline (2009-2035)



2.2.1.1 Pipelines and Interconnections

SWP water is primarily conveyed to the Chino Basin through the MWD Rialto Pipeline (also called the Foothill Feeder) that flows east to west along the northern portion of the Basin. CRA water is conveyed via the MWD Upper Feeder from Lake Mathews in Riverside County entering the Chino Basin in the Jurupa area and flowing to the west across the middle of the Basin.

In addition to the Rialto and Upper Feeder pipelines, a secondary source of SWP water may include use of the following pipelines: San Gabriel Valley Municipal Water District's (SGVMWD) Azusa-Devil Canyon (ADC) Pipeline, Western Municipal Water District's (WMWD) Riverside-Corona Feeder (RC Feeder), and the MWD Etiwanda Cross Feeder Connection.

Imported water pipeline alignments are shown on Figure 2-3.

Azusa Devil Canyon Pipeline

The ADC pipeline is a 38 mile pipeline ranging in diameter from 30 to 54 inches capable of delivering up to 55 cubic feet per second (cfs) of SWP water to the SGVMWD service area. The pipeline runs west from the Devil Canyon Metering Facility in the San Bernardino Mountains to the San Gabriel Canyon Spreading Grounds in Azusa. Since the pipeline alignment crosses through the northern edge of the Chino Basin, several projects identified within this RMP update include utilization of the ADC pipeline as a potential imported water supply.

Available capacity in the ADC pipeline is dependent upon SGVMWD's SWP allocation and service obligations to its customers, which include the cities of Azusa, Sierra Madre, Alhambra, and Monterey Park [MWD, 2006]. SGVMWD prefers to take its annual allocation of SWP water (11,500 acre-feet in 2009) during the summer/fall months, approximately May to October. A banking agreement with a Central Valley SWP contractor aids in reliability of service. SGVMWD has a short-term contract with the City of Azusa to generate power via the hydroelectric power plant at the San Dimas turnout, typically during summer months. This agreement requires SGVMWD to provide power only after all water service needs are met. In winter months, when flow is typically zero, SGVMWD maintains the pipeline full and under hydrostatic pressure. During these months, capacity may be obtained with proper coordination, negotiation with the parties, and a potential wheeling fee. However, several projects are currently competing for this capacity: a Three Valleys Municipal Water District turnout, an MWD interconnection to the Rialto Pipeline, and an emergency connection to Cucamonga Valley Water District.

Riverside-Corona Feeder

WMWD's RC Feeder project has been implemented to serve as a primary backbone of WMWD's water distribution system. The planned RC Feeder will convey water from the San Bernardino Valley Municipal Water District's (SBVMWD) Baseline Feeder Extension to the WMWD service area. The RC Feeder alignment has been divided into three reaches: North, Central and South (future expansion). The North and Central reaches total approximately 108,000 feet, mainly routed along pubic streets in the cities of San Bernardino, Colton, and Riverside and unincorporated areas of Riverside County. The proximity of the RC Feeder to the JCSD service area could serve as a potential link to provide additional imported water to the Basin.

Etiwanda Cross Feeder Connection

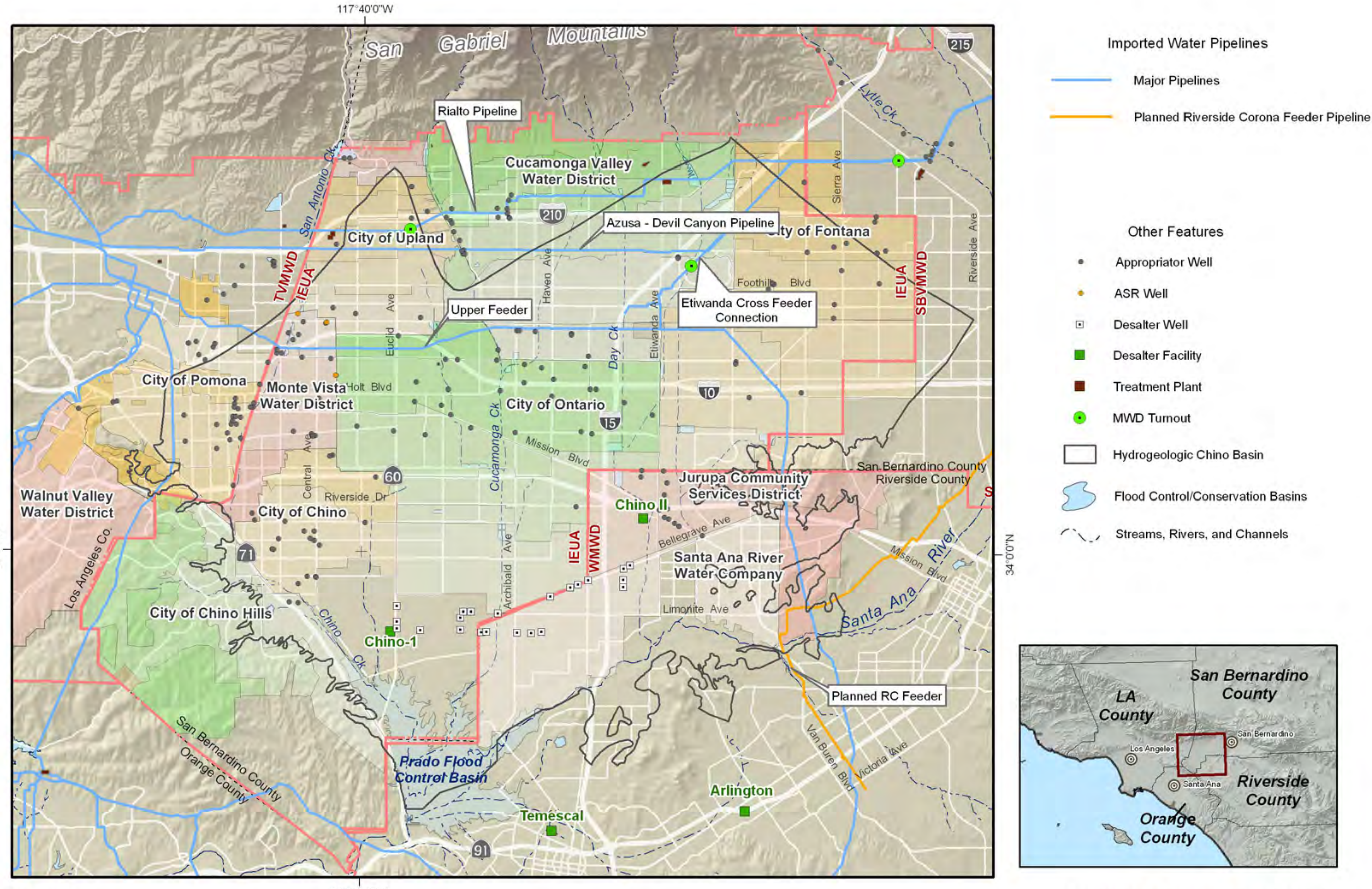
The Etiwanda pipeline, owned by MWD, is a 6.6 mile long pipeline with diameters ranging from 120 to 144 inches and a design capacity of 1,000 cubic cfs. The Etiwanda pipeline branches from the Rialto Pipeline near the intersection of Citrus Avenue and Summit Avenue in Rancho Cucamonga and conveys water southwest from Silverwood Lake to the Upper Feeder. The pipeline terminates near the intersection of Etiwanda Avenue and Napa Street in the City of Fontana.

Table 2-2 summarizes the key regional pipelines used to deliver imported water to the Basin.

Table 2-2
Summary of Key Chino Basin Imported Water Pipelines

Pipeline	Purveyor	Primary Water Source	Diameter (inch)	Design Capacity (cfs)	Hydraulic Grade Line (feet amsl)(1)	Issues
Rialto Pipeline	MWD	SWP	96	614	Varies 1650 to 1,854	Unused capacity may only be available during winter months
Azusa Devil Canyon Pipeline	SGVMWD	SWP	54	55	1,686	Competing interests for available capacity (winter only)
Riverside Corona Feeder	WMWD	SWP	Varies 78 to 54	90	Varies 1,149 to 1,416	Not yet constructed
Etiwanda Cross Connection	MWD	SWP	144	1000	Varies 1,657 to 1,698	Unused capacity may only be available during winter months
Upper Feeder Pipeline	MWD	SWP/ CRA	152	750	1,150	Unused capacity generally not available; high TDS

Notes:
(1) Above mean sea level. Range in HGL was not available for some sources.



Location of Imported Water Facilities

Figure 2-3

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0 2.5 5 7.5 Miles
0 5 10 Kilometers

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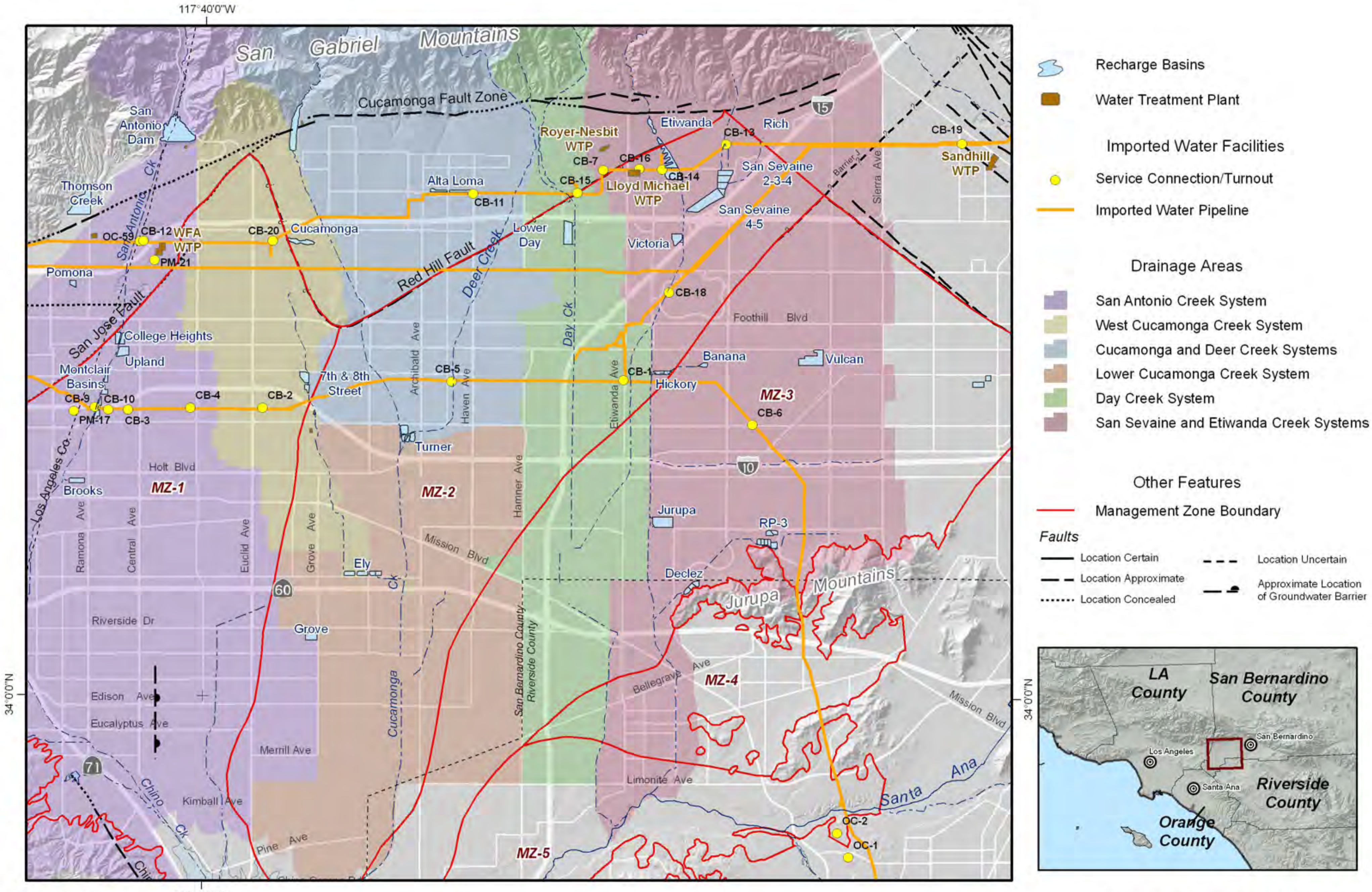
Seven MWD connections along the Rialto Pipeline provide SWP replenishment water deliveries to the Basin. Table 2-3 lists these connections and provides information about operational capacity and basin and drainage system information. Figure 2-4 shows the service connections/turnouts and the drainage areas for the Basin. Although shown on the figure, turnouts along the Upper Feeder are not used for Basin replenishment operations.

Table 2-3
Summary of SWP Service Connections for Replenishment Water Use

Service Connection / Turnout	MWD Pipeline	Delivery Capacity (cfs)	Operational Limits (cfs)	Intercepting Drainage System	Basins Served
OC59	Rialto Pipeline	300	60-80	San Antonio Creek	Brooks; College Heights; Montclair 1-4; Upland
CB8	Upper Feeder	NA	NA	NA (located where Upper Feeder crosses Etiwanda Ave.)	NA (serves CRW)
CB20	Rialto Pipeline	30	not tested	West Cucamonga Creek	Seventh Street; Eighth Street, Ely 1-3
CB14	Rialto Pipeline	30	not tested	San Sevaine and Etiwanda Creeks	Etiwanda; Victoria
CB15	Rialto Pipeline	30	15-20	Day Creek	Lower Day
CB13	Rialto Pipeline	30	13-23	San Sevaine and Etiwanda Creeks	San Sevaine 1-5
CB11	Rialto Pipeline	40	6-9	Cucamonga and Deer Creeks	Turner 1-4
CB18	Etiwanda Pipeline	30	30	San Sevaine and Etiwanda Creeks	Hickory; Declez; Banana; RP3 Ponds; Jurupa



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Location of Groundwater Recharge and Imported Water Facilities

Figure 2-4

2.2.1.2 Treatment Plants

Currently, SWP water is treated at four plants located in the northern portion of the Basin near the Rialto Pipeline. The Water Facilities Authority (WFA) Agua de Lejos plant is located in the City of Upland and serves the cities of Chino, Chino Hills, Ontario, Upland and the Monte Vista Water District (MVWD). Cucamonga Valley Water District (CVWD) operates two WTP's, the Lloyd W. Michael WTP (LMWTP) and the Royer-Nesbit WTP (RNWTP), located in the City of Rancho Cucamonga. The Fontana Water Company also recently commissioned its Sandhill WTP which can now receive SWP supplies from a new turnout (CB-19) along the Rialto Pipeline. Table 2-4 summarizes the Chino Basin imported water treatment plants. The locations are shown on Figure 2-3.

Table 2-4
Imported Water Treatment Plants Serving the Basin

Plant	Owner	Location (City)	Water Source(s)	Capacity (mgd)(1)			Retail Agencies Served(3)
				Current/ Ultimate	Avg. Winter Use	Winter In-Lieu(2)	
Agua de Lejos	WFA	Upland	SWP	81/81	40	41(4)	Upland, MVWD, Ontario, Chino, Chino Hills
Lloyd W. Michael	CVWD	Rancho Cucamonga	SWP	60/60	30	30(5)	CVWD
Miramar	TVMWD	Claremont	SWP	25/25	25	0(6)	Pomona
Royer-Nesbit	CVWD	Rancho Cucamonga	Local surface/ SWP	11/11	11	0(7)	CVWD
Sandhill	FWC	Rialto	Local surface/ SWP	20/30	20	0(8)	FWC

Notes:
(1) million gallons per day.
(2) Assumed available WTP capacity for potential in-lieu use during winter months (December through March).
(3) Agencies within the Chino Basin
(4) Assumed based on average annual WTP flow information provided by WFA.
(5) Requires confirmation with CVWD.
(6) Requires confirmation with TVMWD.
(7) Requires confirmation with CVWD. Entire WTP capacity may be available should LMWTP be modified to receive local surface flows.
(8) Requires confirmation with FWC. Additional winter-time capacity may be available when local Lytle Creek flows are less than 20 mgd.

2.2.1.3 Intercepting Conveyance Systems

The surplus imported replenishment water is captured by various drainage systems which consist of open concrete lined storm channels typically used for capturing storm flow for flood control purposes. The flow is diverted into the existing network of recharge basins via drop inlet structures, inflatable rubber dams, or channels that lead directly into flow-through type basins. The percolation from the basins contributes to recharge in either Management Zone (MZ) 1, 2, or 3, (or a combination of) depending on its geographic location. Table 2-5 lists the drainage systems that convey imported water to the recharge basins. The channels and recharge basins are also shown on Figure 2-4.

Table 2-5
Summary of Intercepting Drainage Systems

Channel Name	Management Zone	Basins Served	Basin Type(1)	Average Basin Percolation Rate (cfs)(2)	Recycled Water Available
San Antonio Creek Channel					
	MZ1	College Heights	FB	15	No
	MZ1	Upland	FB	20	No
	MZ1	Montclair 1, 2, 3, 4	FB	40	No
	MZ1	Brooks	FB	5	Yes
West Cucamonga Channel					
	MZ1	8th Street	FT	5	Yes
	MZ1	7th Street	FT		No
	MZ2	Ely	FT	5	Yes
Cucamonga / Deer Creek					
	MZ2	Turner 1 & 2	FB	3	Yes
	MZ2	Turner 3 & 4	FB		Yes
Day Creek Channel					
	MZ1	Lower Day	FB	9	No
Etiwanda Channel					
	MZ2	Etiwanda	FT	7	In Design
	MZ2	Victoria	FB	6	In Design
San Sevaine Channel					
	MZ2	San Sevaine 1-5	FT	50	No
West Fontana Channel (CB13)					
	MZ2	Hickory	FB	5	Yes
	MZ3	Banana	FT	5	Yes
Declez					
	MZ3	Declez	FT	6	No
	MZ3	RP3	FB	7	Yes

Notes:
(1) FB = Flow-by, FT = Flow-through
(2) Per 2009 Production Optimization and Evaluation of the Peace II Project Description, Table 4-2, WEI.

2.2.2 Recycled Water Facilities

IEUA provides water, wastewater, and recycled water services to eight cities and water districts in the Chino Basin. IEUA recognized the region's water supply limitations and has adopted a policy for use of recycled water to supplement potable water demands.

The quantity of recycled water that is permitted to be used for recharge in the Basin is governed by Order No. R8-2009-0057 (amends Order No. R8-2009-0057) provided by the California Regional

Water Quality Control Board (RWQCB) and is dependent on the volume of diluents water available. The RWQCB issues the necessary permits for IEUA to produce and distribute recycled water to its member agencies. RWQCB enforces Title 22 regulations set forth by CDPH, and self-monitoring is required to ensure water quality standards are being met. Data from daily monitoring is compiled by IEUA into reports subsequently filed with the RWQCB.

Four IEUA regional recycled water plants (RP's) produce tertiary recycled water in compliance with Title 22 of the California Code of Regulations. These plants provide recycled water to the cities of Chino, Chino Hills, Montclair, Rancho Cucamonga, Ontario, and Upland. Currently, IEUA's facilities can produce approximately 60 million gallons per day (mgd) of recycled water for direct non-potable use or recharge.

The IEUA 3-year Recycled Water Business Plan, released in the summer of 2007, states that the recycled water production for direct use and groundwater recharge would increase to approximately 35,600 AFY and 17,500 AFY, respectively, by the fiscal year (FY) 2010/11. IEUA's Draft Annual Water Use Report for FY 2008/09, dated October 1, 2009, noted that it had expanded its connected demand to over 27,000 AFY and the FY 2008/09 recycled water use was over 16,000 AFY (includes direct use and recharge).

Table 2-6 summarizes the regional recycled water treatment plants in the Chino Basin.

Table 2-6
Recycled Water Treatment Plants in the Chino Basin

Agency	Facility	Location	Current Treatment Capacity (mgd)
IEUA	Regional Plant (RP) RP-1	City of Ontario	44.0
	CCWRF[1]	City of Chino	11.4
	RP-4	City of Rancho Cucamonga	14.0
	RP-5	City of Chino	15.0
City of Upland	Upland Hills Water Reclamation Plant	Upland Hills Country Club, City of Upland	0.2

Notes:
(1) Carbon Canyon Water Reclamation Facility.

2.2.2.1 Regulations Governing Recycled Water Use

Due to water quality concerns, CDPH has developed a comprehensive set of regulations governing the use of recycled water for groundwater recharge. The latest Draft Groundwater Recharge Reuse Regulation was released on August 5, 2008. An important criterion from these initial regulations is the maximum recycled water contribution (RWC) that limits the amount of recycled water to 50 percent of total recharge and diluent water. In other words, the recycled water must be blended

50/50 with another source for recharge. The RWC is calculated on the total volume of recycled municipal wastewater and dilution water for the preceding 60 calendar months [CDPH, 2008].

Since inception of its recycled groundwater recharge program, IEUA has carefully monitored and managed each basin's RWC and total organic carbon (TOC) loading. In March 2009, IEUA submitted an initial letter to the CDPH requesting a change in the RWC averaging period for the Basin's recycled groundwater recharge program. IEUA requested that the current 60-month averaging period be changed to a 120-month averaging period to help mitigate water supply shortage conditions. On August 24, 2009, the CDPH responded with a recommendation to grant approval for this increase. In addition, due to the documentation provided by IEUA, the typically required contingency plan of incorporating advanced treatment into the process was waived. CDPH's letter also highlights that, although IEUA has not utilized the Basin aquifer underflow in the calculations for diluent water, a *fraction* of the Basin's underflow may be considered for credit towards diluent water.

On October 23, 2009, the RWQCB adopted Order No. R8-2009-0057, and thereby amending Order No. R8-2007-0039, allowing IEUA and Watermaster to operate the Chino Basin Recycled Water Groundwater Recharge Program assuming a 120-month averaging period, versus the initially permitted 60-month averaging period. Additional compliance, monitoring and operating conditions were required in the amended order. Appendix B to this TM provides a copy of the RWQCB Order No. R8-2009-0057.

In addition, the use of high-TDS water for recharge would exceed the 2004 Basin Plan Amendment which includes two sets of TDS objectives: anti-degradation objectives that ranged between 280, 250 and 260 mg/L for MZs 1, 2, and 3, respectively; and a maximum benefit-based TDS objective of 420 mg/L for the Chino North Management Zone, which consists of almost all of Management Zones 1, 2, and 3. Under the maximum benefit-based objective, the new TDS concentration limit for recycled water that is to be used for recharge and other direct uses is 550 mg/L as a 12-month average. This discharge requirement has been incorporated into IEUA's NPDES permits for water reclamation facilities. [CBWM, July 2007].

2.3 Local Supplemental Recharge Facilities

This section presents an overview of the existing and planned local supplemental water recharge facilities in the Basin. These facilities include both injection and aquifer storage and recovery (ASR) wells used by Basin appropriators to replenish groundwater storage. The purpose of this section is to summarize both existing and planned local supplemental water recharge facilities that will be used in conjunction with regional facilities (spreading basins) to satisfy replenishment projections.

2.3.1 ASR Wells for Aquifer Recharge

In addition to the use of spreading basins, injection and ASR wells are an effective strategy for artificial groundwater recharge. Use of injection or ASR wells for recharge allows existing recharge basins to be used or reserved for opportunistic storm and recycled water recharge. The purpose of an injection well is to provide a conduit for treated water to be injected into a confined aquifer system. Treated water is required for injection to reduce the potential for clogging of the well packing and casing.

An injection well does not require a pump and motor and other electrical components that would be standard for a traditional extraction well. Injection is typically achieved via gravity or through residual pipeline pressure without the need for additional pumping.

ASR wells are intended to operate as injection wells until the required amount of water is stored in the aquifer. When groundwater is required, ASR wells can reverse operations and extract groundwater as a typical production well. Similar to injection wells, ASR also requires the use of treated water. In general, the recovered water quality would not be the same as the quality of the injected water because of mixing within the aquifer between native groundwater and recharged water. Typically, the recovered water quality improves over successive cycles; however, the complex geochemical reactions involved with mixing sources with different water quality characteristics can potentially lead to issues such as clogging or blocking of the aquifer, thereby impacting the long term production capacity of the well. For these reasons, testing of the groundwater and recharge water blending is recommended.

New injection or ASR wells would utilize surplus SWP water, when available, treated prior to injection using nearby existing surface water treatment plants: CVWD’s Lloyd Michael WTP, Royer-Nesbit WTP and/or the WFA Agua de Lejos WTP. The Fontana Water Company also operates its Sandhill WTP which now receives SWP supplies from a new turnout along the Rialto Pipeline (CB-19) and could provide opportunities for recharge on the east side of the Basin in MZ3.

2.3.2 Existing Local Recharge Facilities

Currently within the Basin, most artificial recharge is achieved through the use of large regional spreading basins. However, with the cost of land increasing and availability decreasing, smaller footprint facilities, such as injection or ASR wells, are viable alternatives. Currently, all existing ASR wells are owned and operated by the Monte Vista Water District (MVWD), which utilizes ASR to help manage groundwater production and storage in MZ1. Table 2-8 summarizes the existing local recharge facilities owned by MVWD.

Table 2-8
Summary of Existing Local Recharge Facilities

Owner	Well No.	Facility Type	Mgmt. Zone	Treated Water Source (SWP)	Production Capacity (gpm)	Assumed Injection Rate (low) (gpm)(1)	Assumed Injection Rate (high) (gpm)(2)	Assumed Injection Capacity (high) (AFY)(3)
MVWD	4	ASR	MZ1	WFA	830	415	830	669
MVWD	30	ASR	MZ1	WFA	2,000	1,000	2,000	1,613
MVWD	32	ASR	MZ1	WFA	2,000	1,000	2,000	1,613
MVWD	33	ASR	MZ1	WFA	2,000	1,000	2,000	1,613
				TOTAL	**6,830**	**3,415**	**6,830**	**5,508**

Notes:
(1) Injection rate is assumed to be 50 percent of production rate. WEI, 2010.
(2) Injection specific capacity assumed to be 50 percent of pumping specific capacity; injection rate capped at production rate. WEI, 2010.
(3) Assumes injection occurs only six months per year (Nov.-Apr.).

2.3.3 Planned Local Recharge Facilities

A list of ASR wells currently under consideration within the next several years is provided in Table 2-9, which includes 17 existing and planned wells from three water supply agencies. This latest list of ASR wells is based on communications with the appropriators in late 2009 and early 2010. The wells listed in Table 2-8 are located generally within historical groundwater recharge areas in the Chino Basin, where unconfined groundwater conditions exist. These ASR wells, located strategically throughout the Basin, would help to address the imbalance between recharge and discharge leading to depressed groundwater levels in MZ2 and MZ3. Fontana Water Company has also expressed an interest in developing future injection or ASR wells for local and regional benefit. Specific details on well location and capacity were not available at the time this TM was prepared.

Assuming a combined low injection rate of 18,200 gpm from these planned wells (conservative approach), the total additional annual recharge would be approximately 14,700 AFY. This is a significant amount of new potential recharge that would help mitigate future replenishment obligations. The wells listed in Table 2-9 are shown on Figure 2-5.

2.3.4 Methodology for ASR Injection Rates

Injection rates for ASR wells are typically developed using some fraction of production rates for the well. For example, planned injection rates for proposed ASR wells in the Chino Basin previously were assumed to be about 30 to 66 percent of production rates or 50 percent of production rates [WEI, Nov 2009]. These types of guidelines (i.e., a fixed percentage) are appropriate and provide a factor of safety for the injection rate during initial testing of an ASR well. However, they can be relaxed as subsequent injection rates are increased to a desired, long-term injection rate, which could be close to the production rate of a well. While some appropriators may choose to restrict long-term injection rates to no more than 50 percent of production rates, this guideline may significantly underestimate the injection rate that can actually be achieved in an aquifer. This is particularly the case where the allowable amount of water level rise in an unconfined aquifer is large, which is the case in much of the Chino Basin where groundwater depths routinely exceed 100 feet or more below ground surface. Therefore, in an effort to reasonably maximize the recharge capacity of potential ASR facilities in the Chino Basin, this report presents a range of injection rates for each ASR well, ranging from 50 percent to 100 percent of the production rate shown in Table 2-9 [WEI, 2010].

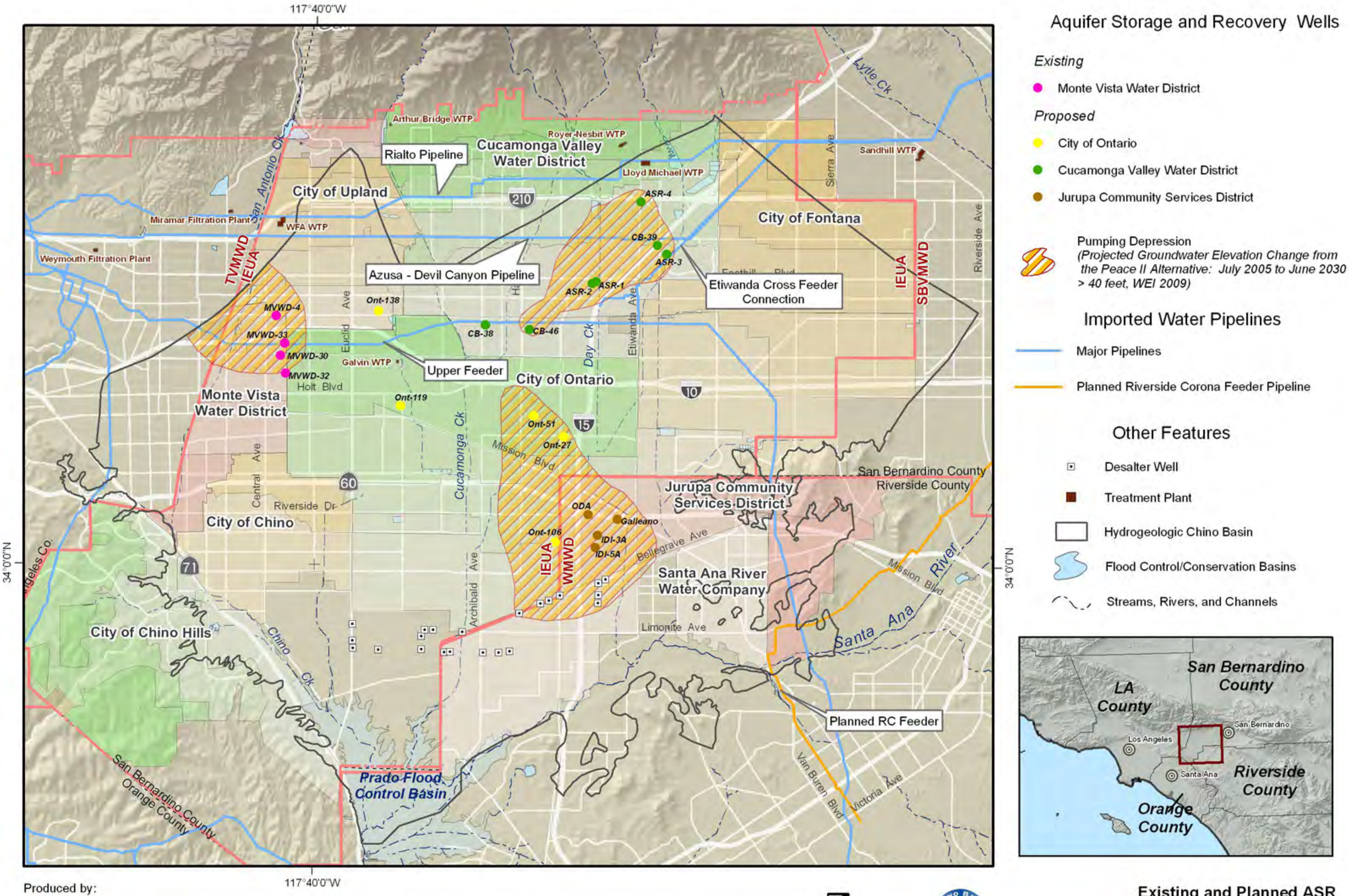
The higher injection rates listed in Table 2-9, which are equal to production rates, account for a water level rise in each ASR well, assumed to reach no more than 100 feet below ground surface. Water levels for the ASR wells during injection have been estimated using injection rate, specific capacity, and static groundwater level data. For initial planning purposes, specific capacity of an ASR well during injection into aquifers of the Basin is conservatively assumed to be equal to 50 percent of the specific capacity of the same well (i.e., for existing wells), or similar, nearby wells under pumping conditions. This is a rule-of-thumb, which reflects a larger difference between non-operating and operating groundwater levels in a well during injection than during production, as a result of clogging of well screens and gravel pack and the potential for air entrainment during injection [Pyne, 2005]. In particular, the specific capacity of the ASR wells listed in Table 2-8 is assumed to be either the specific capacity of the well itself (i.e. for existing wells), or is assumed to be similar to one or more existing, nearby wells with similar construction to the planned wells.

Table 2-9
Summary of Planned Local Recharge Facilities

Owner	Well No.	Facility Type	Mgmt. Zone	Treated Water Source	Production Capacity (gpm)	Assumed Injection Rate (low) (gpm)(1)	Assumed Injection Rate (high) (gpm)(2)	Assumed Injection Capacity (high) (AFY)(3)
ONT	27	Convert Existing to ASR	MZ2	WFA/ LMWTP(4)	1,100	550	1,100	887
ONT	51	New ASR	MZ2	WFA/ LMWTP(4)	1,600	800	1,600	1,290
ONT	106	New ASR	MZ2	WFA/ LMWTP(4)	2,500	1,250	2,500	2,016
ONT	109	New ASR	MZ2	WFA/ LMWTP(4)	2,500	1,250	2,500	2,016
ONT	119	New ASR	MZ2	WFA/ LMWTP(4)	2,500	1,250	2,500	2,016
ONT	138	New ASR	MZ2	WFA/ LMWTP(4)	2,250	1,125	2,250	1,815
CVWD	ASR-4	New ASR	MZ2	LMWTP	1,500	750	1,500	1,210
CVWD	CB-38	Convert Existing to ASR	MZ2	LMWTP	2,550	1,275	2,550	2,057
CVWD	CB-39	Convert Existing to ASR	MZ2	LMWTP	3,400	1,700	3,400	2,742
CVWD	CB-46	Convert Existing to ASR	MZ2	LMWTP	2,500	1,250	2,500	2,016
CVWD	ASR-1	New ASR	MZ2	LMWTP	2,000	1,000	2,000	1,613
CVWD	ASR-2	New ASR	MZ2	LMWTP	2,000	1,000	2,000	1,613
CVWD	ASR-3	New ASR	MZ2	LMWTP	2,000	1,000	2,000	1,613
JCSD	Oda	Convert Existing to ASR	MZ3	RC Feeder	2,000	1,000	2,000	1,613
JCSD	Galleano	Convert Existing to ASR	MZ3	RC Feeder	2,000	1,000	2,000	1,613
JCSD	IDI-3A	Convert Existing to ASR	MZ3	RC Feeder	2,000	1,000	2,000	1,613
JCSD	IDI-5A	Convert Existing to ASR	MZ3	RC Feeder	2,000	1,000	2,000	1,613
				TOTAL MZ2	**28,400**	**14,200**	**28,400**	**22,904**
				TOTAL MZ3	**8,000**	**4,000**	**8,000**	**6,452**

Notes:

(1) Injection rate is assumed to be 50 percent of production rate. WEI, 2010.
(2) Injection specific capacity assumed to be 50 percent of pumping specific capacity; injection rate capped at production rate. WEI, 2010.
(3) Assumes injection occurs only six months per year (Nov.-Apr.).
(4) In addition to existing WFA supplies, assumes potential future connection to CVWD to receive SWP water from LMWTP.



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2010 Chino Basin Recharge Master Plan Update
Supplemental Water Recharge Concept Development

Existing and Planned ASR Facilities Location Map

Figure 2-5

3.0 SUPPLEMENTAL RECHARGE CONCEPTS

3.1 Overview

This section presents the rationale used to develop a menu of recharge concepts and provides a narrative description of each concept as presented during a workshop held in August 2009. The methodology and results for the preliminary screening process is also discussed.

3.2 Rationale Used for Recharge Concept Development

The current projected availability of surplus water from Metropolitan has been substantially reduced due to drought and the uncertainty of pumping operations from the SWP due to the protection of the Delta Smelt and other environmental issues. In 2008, MWD provided a revised replenishment water service forecast, projecting that replenishment water would be available three out of ten years. In response to the current drought, MWD has used water stored in its various storage programs, and it is likely that when surplus water is available, some or all of it will be used to refill MWD's assets prior to being used for groundwater replenishment. Therefore, assuming replenishment water is available three out of every ten years may be an optimistic assumption.

The need for development of additional supplemental water recharge concepts is further described in the *2009 Production Optimization and Evaluation of the Peace II Project Description Final Report* [CBWM, 2009]. As noted in this report, due to the anticipated constraints on future reliability of supplemental replenishment supplies, it is likely that a large cumulative unmet replenishment obligation (CURO) will occur and could grow to a size that the Watermaster may not be able to catch up. Therefore, implementation of new supplemental water recharge concepts may be required to provide enhanced recharge capabilities when replenishment supplies are available.

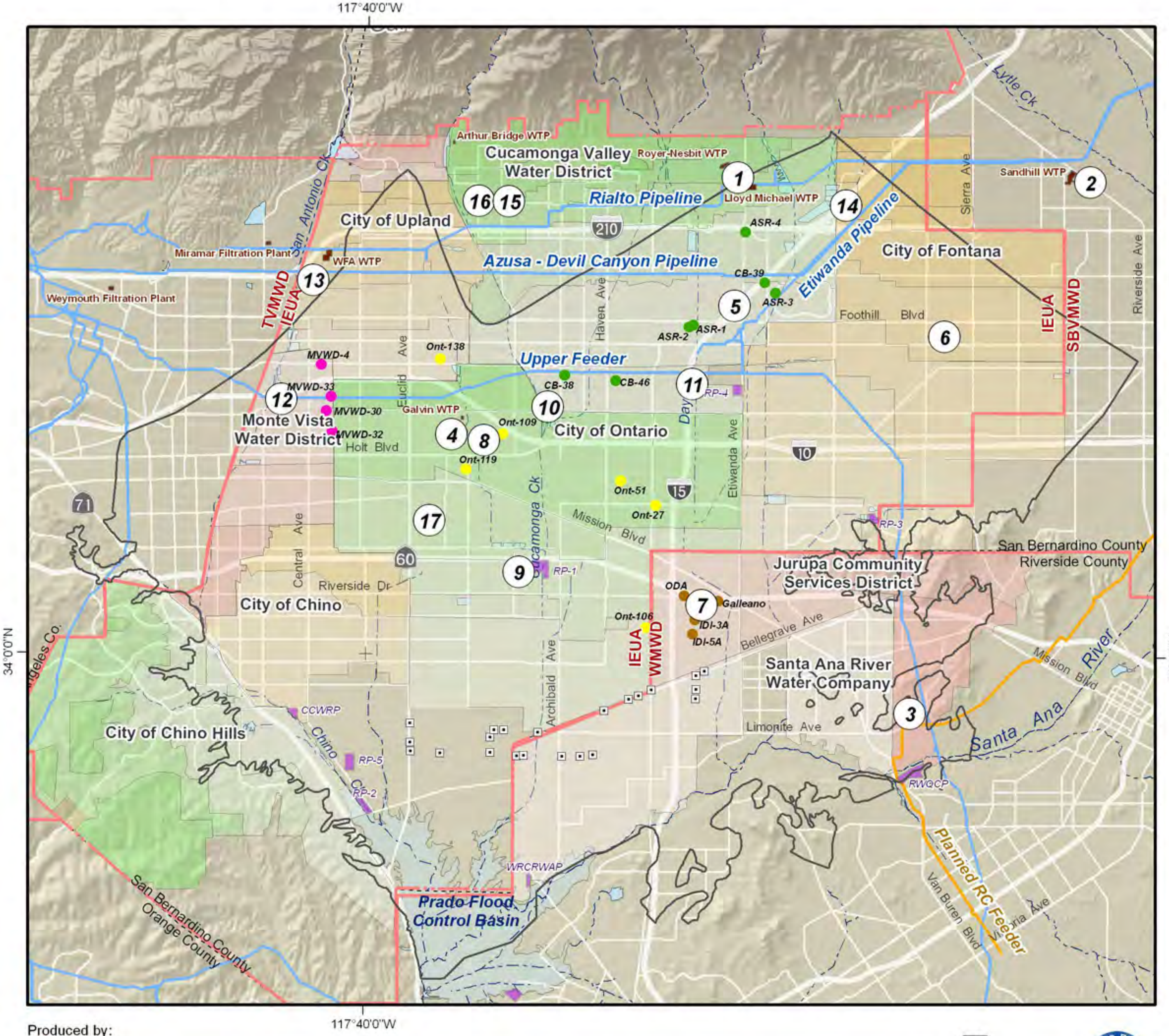
Seventeen preliminary concepts for recharge management were developed as a "toolbox" of alternatives to increase recharge in the Basin and reduce the CURO. The concepts include new sources of imported water, ASR wells for injection, enhanced recycled water use, new water sources for existing spreading facilities, new spreading facilities, and in-lieu use of new sources by appropriators. The general location of each of the seventeen concepts is presented on Figure 3-1.

3.3 New Imported Sources (Local Projects)

The following concepts were developed as projects that would benefit a local area or agency utilizing a new imported water source. The concepts involve treatment and use of additional imported water when available. This source of water would be used in place of an equal amount of groundwater production, thereby reducing the replenishment obligation.

3.3.1 Concept No. 1: CVWD

This concept involves treating additional imported water from MWD at CVWD's Lloyd Michael WTP. The additional treated water would be used in CVWD's service area, while reducing groundwater pumping by an equal amount. This reduction in groundwater production would help mitigate the pumping depression in this area as shown on Figure 2-5.



Concept	Description
1	CVWD - Take more imported water at LMWTP or RNWTP
2	FWC - Take more imported water at Sandhill WTP
3	JCSD - New source from RC Feeder
4	City of Ontario - New source from Galvin WTP
5	CVWD - Injection of Imported Water (ASR Wells)
6	FWC - Injection of Imported Water(ASR Wells)
7	JCSD - Injection of Imported Water (ASR Wells)
8	City of Ontario - Injection of Imported Water(ASR Wells)
9	Advanced WTP at IEUA's RP's
10	Increase recycled water recharge
11	Spread UF water via turnout at Day Creek
12	Spread UF water via turnout at San Antonio Channel
13	Spread ADC water via turnout to San Antonio Channel
14	Spread ADC water in San Sevaine
15	Spread UF water at Future Vulcan Properties
16	Spread ADC water at Future Vulcan Properties
17	Basin-Wide AD-HOC "in-lieu"

Other Features

⊡	Desalter Well
■	Treatment Plant
☐	Hydrogeologic Chino Basin
🟦	Flood Control/Conservation Basins
╌	Streams, Rivers, and Channels

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2010 Chino Basin Recharge Master Plan Update
Supplemental Water Recharge Concept Development

Supplemental Recharge Concepts

Figure 3-1

3.3.2 Concept No. 2: Fontana Water Company

Although Fontana Water Company (FWC) does not have pumping rights within the Basin (albeit, minimal), they have consistently produced in excess of 10,000 AFY from the Basin during the past several years. Each acre-foot is assessed a replenishment charge from the Watermaster. As of mid-2009, FWC's new Sandhill WTP came online and is capable of treating SWP water from MWD's Rialto Pipeline. Opportunities may now be available to purchase and use additional imported supplies while reducing groundwater production from the Basin. Any reduction in FWC's groundwater production is a reduction in the Basin's replenishment obligation and, in turn, the CURO.

3.3.3 Concept No. 3: JCSD

Western Municipal Water District's (WMWD) future Riverside-Corona (RC) Feeder consists of a 48-inch treated water main to convey water from the Baseline Feeder to the WMWD service area. Based on conversations with WMWD, the RC Feeder Central Reach is scheduled to enter the design phase within the next five years. The proposed alignment for the RC Feeder runs to the southeast of Jurupa Community Services District (JCSD), providing an opportunity to construct an interconnection between the RC Feeder and JCSD's service area. In this concept, JCSD would use imported water via a new connection to the RC Feeder and reduce pumping in the Basin.

This concept would be implemented through use of treated water from the RC Feeder within JCSD's service area and a reduction of groundwater pumping by an equal amount. The facilities would consist of a new joint interconnection pipeline beginning at the proposed location of the RC Feeder at Clay Street and Limonite Avenue. The new pipeline would continue east on Limonite and turn north on Van Buren Boulevard to an existing JCSD pipeline on 56th Street. The pipeline interconnection would provide treated water to the Pedley and 56th Street Reservoirs which serve JCSD's 870 zone. This pipeline was also included in the DYY Expansion as part of WMWD's project to participate on the "take" side and receive water from the Chino Basin. Coordination with WMWD and the DYY Program participants may be required if this concept were to move forward.

3.3.4 Concept No. 4: City of Ontario

The City of Ontario is interested in rehabilitating and reactivating its existing Galvin WTP, which was initially designed in 1958 and has been out of service for over ten years. Once the Surface Water Treatment Rule was implemented by the CDPH in June 1993, the existing WTP could no longer comply with regulatory criteria, nor was there sufficient space within the existing building for additional processes. The WTP would likely require demolition, expansion, and conversion to membrane filtration. The raw water supply for the Galvin WTP is Metropolitan's Upper Feeder, which is a blend of SWP and Colorado River supplies. By rehabilitating the plant, Ontario could increase imported water purchases and decrease groundwater pumping by an equivalent amount.

An inactive service connection exists along the Upper Feeder near the City of Ontario water service area which used to provide CRA water to the existing decommissioned Galvin WTP. This connection may be considered for rehabilitation and reactivation and could provide a replenishment connection for CRA water in the future. Treatment obstacles would need to be considered to manage water quality issues associated with CRA water to maintain salt balance in the Basin.

3.4 Aquifer Injection (Local Projects)

3.4.1 Concept No. 5: CVWD

This concept would be implemented through construction of several planned ASR wells located within the CVWD service area. To accomplish basin recharge, imported SWP water deliveries via MWD’s Rialto Pipeline to CVWD’s Lloyd Michael Water Treatment Plant (LMWTP) would be increased when surface water is available. The additional treated water from the LMWTP would be wheeled through the CVWD service area using existing infrastructure where available, to provide an injection supply to the ASR wells. This concept would require construction of up to four new ASR wells and conversion of up to three existing extraction wells to ASR wells.

3.4.2 Concept No. 6: Fontana Water Company

This concept is similar to Concept No. 2 where FWC would treat additional imported water at the Sandhill WTP. The treated water would be injected into the Basin via new injection or ASR wells. Details on specific existing wells to modify for injection use are not available at this time.

3.4.3 Concept No. 7: JCSD

This option would be similar to Concept No. 3 where JCSD would purchase additional imported water via a new connection to the RC Feeder. Treated water from WMWD RC Feeder would be conveyed to converted ASR wells for injection into the Basin.

This concept would include conversion of up to four extraction wells to ASR wells, and construction of a new dedicated pipeline connecting the ASR wells to the RC Feeder. It should be noted that the extraction wells are not currently constructed. However because the plans for the wells are under way, it was assumed that they will be completed before projects outlined in the RMP were constructed. A 36,000 foot long, 30-inch diameter pipeline would also be required to convey treated imported water (injection supply) from the RC Feeder to JCSD’s converted ASR wells. The RC Feeder turnout vault would contain a flowmeter (to get an accurate measure of flow to JCSD), isolation valves, and a check valve to prevent backflow.

3.4.4 Concept No. 8: City of Ontario

This concept would be implemented through construction of new ASR wells, which would be owned and operated by the City of Ontario. Imported water is currently conveyed to the Ontario distribution system via the WFA Agua de Lejos WTP that currently serves the cities of Ontario, Upland, Chino, Chino Hills, and the Monte Vista Water District. The plant, located on Benson Avenue in the City of Upland, could be used to treat surplus imported water for distribution throughout the Ontario service area, thereby allowing injection at the various ASR well locations. For this option to be feasible, the infrastructure to convey the WFA water to the city’s western distribution area is required.

Another source for treated imported water would be the CVWD LMWTP, located on Etiwanda Avenue in Rancho Cucamonga. This scenario would be dependent on construction of a connection between the Ontario distribution system and CVWD’s existing 30-inch transmission main running along Rochester Avenue, which was included in the DYY Expansion Program. Development of this concept assumes construction of ASR wells only and that delivery of treated water to the new wells is feasible and facilities to do so are in place. This concept would include construction of up to five new ASR wells and conversion of one existing extraction well to an ASR well.

3.5 Enhanced Recycled Water Use (Regional Projects)

Development of supplemental water supply options also includes an evaluation of enhanced uses of recycled water, whether via direct use or groundwater recharge. As reviewed in Section 2.0 of this TM, IEUA is the primary recycled water utility within the Basin. IEUA's 3-year business plan to develop up to a 50,000 AFY recycled water supply is a fundamental step to enhance recycled water use within the Basin. IEUA is already enhancing the availability of recycled water for direct use by agencies which would reduce groundwater production, thereby reducing the overall replenishment obligation of the Basin. IEUA also provides a significant amount of recycled water for recharge. This section describes two potential concepts to further recycled water recharge within the Basin.

3.5.1 Concept No. 9: Advanced Treatment at IEUA Regional Plants

IEUA's existing regional plants that are capable of providing recycled water generally include a conventional tertiary treatment process to produce a recycled water source with a quality suitable for spreading or indirect uses. Recharge of this source generally begins with a required RWC of approximately 20 to 30 percent. That is, for every acre-foot of recycled water recharged, about 3 to 4 acre-feet of storm or imported water blending supplies are required to meet CDPH recharge regulations. Adding advanced treatment to the process (i.e., membrane filtration, reverse osmosis and advanced oxidation) can increase the initial RWC up to 50 percent, thereby reducing the volume of blending water required to meet regulations. A higher RWC is possible for surface spreading with monitoring. Such advanced treatment could be centralized at any of IEUA's regional plants or located as a satellite facility near any of the recharge facilities that current receive recycled water.

One benefit of this concept is to reduce spending on costly, and less reliable, imported water supplies required to meet regulations. Although construction of advanced treatment facilities is costly, the capital is used to enhance local supplies and reduce dependency on imported supplies. This is a viable concept for areas where additional wastewater effluent is available for recycled water use and/or areas where replenishment obligations can still be met with reductions in blending supplies.

IEUA's budgeted forecasted wastewater flows increase from approximately 57.9 mgd in FY 2009/10 to approximately 61.2 mgd in FY 2019/20 (assuming 250 gpd/EDU) [IEUA, 2010]. Therefore, over the next 10 or so years, IEUA anticipates an increase in wastewater flows of approximately 6 percent. Assuming realization of IEUA's 3-year business plan of over 53,000 AFY of recycled water is used for direct use and recharge and assuming some effluent releases to the Santa Ana River, it does not seem prudent to assume, on average, that additional recycled water supplies are available each year.

The Chino Basin is also supply-limited when referring to its replenishment obligation. Adding advanced treatment for higher-quality recycled water supplies would reduce the amount of blending water required to achieve permitted RWCs at each recharge facility. As continued recharge of imported supplies is likely to help meet the replenishment obligation of the Basin, adding advanced treatment as a near-term concept would not be needed. In addition, due to the documentation provided by IEUA and their recently amended RWQCB permit, the typically required contingency plan of incorporating advanced treatment into the process was waived.

Should additional recycled water supplies become available in the long-term or a higher quality source is needed to meet Basin water quality objectives, the advanced treatment of recycled water should again be considered. For instance, should recharge of CRW from the Upper Feeder be conducted in the future, advanced treatment of recycled water could be considered to offset the salt loading in the Basin resulting from recharge of the higher-TDS CRW.

3.5.2 Concept No. 10: Opportunistic Increased Recycled Water Recharge

As discussed in Section 2, IEUA has received approval to increase its RWC averaging period from 60 to 120 months. This increase provides flexibility for IEUA staff to recharge additional recycled water when supplies are plentiful or continue to recharge recycled water during periods when blending sources are not available, or in reduced supply. Depending on climatic variability and timing of direct use recycled water sales, additional recycled water supplies may be available for recharge.

This concept is introduced as an alternative supply for the purposes of this RMP; however, it is likely that IEUA has already modified its operations plan to reflect the new averaging period and incorporation of the Basin underflow into its diluent water calculations (see Section 2.2.2.1 for further discussion of IEUA’s recharge operations). The facilities and mechanisms needed to enhance recycled water recharge are already in place.

3.6 New Sources for Existing Surface Spreading Facilities (Regional Projects)

3.6.1 Concept No. 11: Upper Feeder to Day Creek Channel

This concept would be implemented through construction of a new turnout along the Upper Feeder pipeline to the Day Creek Channel. The Upper Feeder is a major water conveyance artery owned and operated by MWD. The Upper Feeder conveys water from Lake Mathews in Riverside County and enters the Chino Basin in the Jurupa area flowing west across the Basin. Water from the Upper Feeder would be diverted to the Day Creek Channel through a new turnout and flow by gravity south to Wineville and Riverside Basins north of Jurupa.

3.6.2 Concept No. 12: Upper Feeder to San Antonio Channel

Similar to the previous concept, this concept would be implemented through construction of a new turnout along the Upper Feeder pipeline to the San Antonio Channel. Water from the Upper Feeder would be diverted to the San Antonio Channel through either an existing turnout (PM-17) or new turnout and metering structure and flow by gravity south to the Montclair and Brooks basins located in MZ1.

3.6.3 Concept No. 13: ADC Pipeline to San Antonio Channel

This concept would be implemented through construction of a new turnout along the Azusa-Devil Canyon (ADC) pipeline. The San Gabriel Valley Municipal Water District (SGVMWD) owns and operates the ADC pipeline that conveys SWP water from Silverwood Lake to its retail agencies.

Water from the ADC pipeline would be diverted to the San Antonio Channel through a turnout and metering structure and flow south to several Chino Basin recharge facilities, including the Montclair and Brooks basins.

A new pipeline would be constructed connecting the ADC pipeline on West 16th Street to the San Antonio Channel. The pipeline would be approximately 800 feet long and 36 inches in diameter and would also include a metering, flow control and air gap facility at the connection to the San Antonio Channel. The turnout vault would contain a flowmeter (to get an accurate measure of flow to the channel), a fixed orifice sleeve to reduce pressure head, and a check valve to prevent backflow. The water would then enter an air gap structure to ensure stormwater from the channel would not enter into the turnout vault during high flow events and to maintain a constant discharge head from the turnout. From this structure, a connection to the San Antonio Channel would be made and a flap gate would be installed to further prevent backflow and to protect the conveyance facility from debris.

3.6.4 Concept No. 14: New Pipeline Turnout to San Sevaine Basin No. 1

Similar to the concept involving the San Antonio Channel, this concept would be implemented through construction of a new turnout along the ADC pipeline or from MWD's Etiwanda pipeline. Water from either source would be diverted to the San Sevaine Basin No. 1 through a turnout and metering structure. Should recycled water recharge of San Sevaine Basin No. 1 be conducted in the future, the concept provides an additional blending option.

San Sevaine Basin No. 1 is located along the north side of Interstate-15 high up in MZ2. The basin is part of the San Sevaine Channel System owned by the San Bernardino County Flood Control District (SBCFCD). A new pipeline would be constructed connecting the selected supply pipeline near the intersection of Cherry Avenue and South Highland Avenue to the San Sevaine Recharge Basin No.1. (At this location, the ADC and Etiwanda pipelines run parallel in close proximity to each other; therefore, connection to either pipeline would require approximately the same length of pipe.) The pipeline would be approximately 6,000 feet long and 36 inches in diameter and would also include a metering, flow control, and air gap facility at the connection to the San Sevaine Basin. The turnout vault would contain a flowmeter (to get an accurate measure of flow to the channel), a fixed orifice sleeve to reduce pressure head, and a check valve to prevent backflow. Energy dissipation head walls near the pipe discharge may be constructed instead of the fixed sleeve as a barrier from high velocity streams exiting the structure.

3.7 New Surface Spreading Facilities (Regional Projects)

3.7.1 Concept No. 15: VMC Pits at Foothills Via Upper Feeder

Vulcan Materials Company (Vulcan) is a major producer of aggregates, primarily crushed stone, sand and gravel, used for construction and currently owns and operates quarries within the Inland Empire. An opportunity exists to coordinate with Vulcan and San Bernardino County to convert one or more of the quarries to recharge basins. Following development of an agreement with San Bernardino County, Vulcan would pay to mine the aggregates in exchange for developing the quarry into an engineered basin upon completion of their excavation activities.

The concept would involve a new pipeline and potential booster station (if required) to convey water from the Upper Feeder pipeline for recharge to potential quarry sites located at the foothills of the San Gabriel Mountains for recharge. Depending on the location of the turnout and the quarry, the pipeline may be required to cross the 10 Freeway and/or the 210 Freeway.

3.7.2 Concept No. 16: VMC Pits at Foothills Via ADC Pipeline

Similar to Concept No. 15, this project would also involve constructed a new pipeline and potential booster station to convey water from the ADC pipeline to a selected quarry in the San Gabriel Mountains for recharge. Depending on the location of the turnout and the quarry, the pipeline may be required to cross the 210 Freeway.

3.8 Concept No. 17: Ad-Hoc Appropriator In-Lieu Exchange (Local Projects)

This concept builds from a water supply strategy currently employed within the Basin for management of replenishment obligations, contributions to local storage accounts and meeting DYY shift commitments. As replenishment supplies become available, mechanisms should be in place to promote use of imported water in-lieu of groundwater production. This concept assumes that any appropriator within the Basin that has access to imported water has the ability to use additional imported water, in-lieu of pumping groundwater, during periods of surplus supply and at a cost-effective rate.

3.9 Preliminary Screening

The concepts were presented at an RMP workshop on August 27, 2009, following the monthly Board Meeting at the Watermaster offices. The purpose of the presentation was to introduce the seventeen conceptual alternatives to the stakeholders and review the results of the preliminary screening evaluation to obtain consensus of the methodology and results.

3.9.1 Methodology

The purpose of the screening and evaluation process is to comparatively evaluate how each concept may contribute to increased recharge in the Basin. The procedure helps to qualitatively examine the concepts to determine early on whether a specific concept would be both beneficial and cost-effective to implement as part of the overall RMP process. The goal of the screening process was to reduce the list of potential recharge projects in order to focus on the concepts that are most viable to move forward.

3.9.2 Criteria and Weighting Factors

For this preliminary screening exercise, the concepts were compared against a series of five criteria, each having an assigned weighting factor to illustrate relative importance. The criteria and weighting factors were reviewed during the workshop and are summarized in Table 3-1.

Table 3-1
Preliminary Screening Criteria and Weighting Factors

Criteria	Weighting Factor
Cost (relative to other options and overproduction)	20%
Cost (O&M)	20%
Location (balance recharge and discharge)	25%
Reliability (delivery)	25%
DYY Integration (stacked "put")	10%
Total	100%

The criteria were selected based upon an understanding of critical components of a feasible recharge alternative. Weighting factors were assigned to each criterion to illustrate relative importance. During the screening evaluation, an alternative was assigned a rating of -1, 0, or 1 based upon how it is perceived to meet the goals of the RMP, as described below:

- Alternatives receiving a rating of -1 have a disadvantage compared to others
- Alternatives receiving a rating of 0 are neutral compared to others
- Alternatives receiving a rating of 1 have an advantage compared to others

The criteria are defined as follows:

- **Cost** – an order of magnitude cost relative to other alternatives and overproduction in the Basin. No actual cost estimates were prepared for this stage of screening. Alternatives with lower estimated costs were given a higher rating.
- **Cost (O&M)** – an order of magnitude cost for estimated O&M cost relative to other alternatives. Alternatives with lower estimated O&M costs were given a higher rating.
- **Location** – the location of the recharge relative to the MZs in the Basin. Alternatives that recharge MZ1 or MZ3 to balance recharge and discharge were given a higher rating.
- **Reliability** – the ability for delivery infrastructure (new or existing) to provide water for recharge. Alternatives utilizing more reliable facilities were given a higher rating.
- **DYY Integration** – some projects may also be utilized as "put" facilities for the DYY Program. Facilities that would not require coordination with DYY were given a higher rating as their use would not require sharing with RMP replenishment deliveries.

3.9.3 Results and Analysis

The results of the preliminary screening using the assigned waiting factors and ratings provided an indication as to which alternatives were the most viable for moving forward for the RMP. The data was input into a spreadsheet model to calculate a raw score and assign a rank to each concept.

Table 3-2 shows the ratings and the associated ranking of each of the projects. It should be noted that the numbering and order of projects in the table have been modified from the version used in the August 27, 2009, presentation to better reflect the organization of this TM. In addition, the concept to construct satellite plants at specific recharge basins to increase recycled water recharge was eliminated from concepts included in the RMP. It is, however, described in this TM as an option of concept No. 9. A new concept to construct a turnout from the Upper Feeder to the San Antonio Channel was added.

Based on the preliminary screening, alternatives that involve a turnout from the ADC Pipeline, purchase of additional imported water "in-lieu" of pumping, and those involving ASR generally received the highest ranking due to their ability to best satisfy the criteria. It is assumed that any concepts involving in-lieu exchange can be implemented where and when appropriate. The following concepts were carried forward for further development in Section 4.0:

- Alt. No. 5: CVWD ASR Wells
- Alt. No. 7: JCSD ASR Wells
- Alt. No. 8: Ontario ASR Wells
- Alt. No. 13: ADC Turnout to San Antonio Channel
- Alt. No. 14: New (ADC or Etiwanda) Pipeline Turnout to San Sevaine Basin No. 1

Since projects involving the use of additional imported water "in-lieu" of groundwater pumping do not generally require construction of new facilities (the WTPs have surplus capacity to treat more SWP), those "in-lieu" concepts are not further developed in Section 4.0 of this TM. They are, however, still valid options to include in the RMP "toolbox" to help reduce the overall replenishment obligation of the Basin.

Table 3-2
Summary of Concept Ratings from Initial Screening

Alt.		Capital Cost	O&M Cost	Location	Reliability	DYY Integration	Total Raw Score	Score w/ WF	Rank
1	CVWD: Purchase Addt'l Water at LMWTP and RNWTP ("in-lieu")	1	1	1	0	-1	2	0.55	3
2	FWC: Purchase Addt'l Water at Sandhill WTP ("in-lieu")	1	0	1	0	1	3	0.55	3
3	JCSD: Purchase New Imported Water via RC Feeder ("in-lieu")	1	1	1	0	-1	2	0.55	3
4	Ontario: Rehabilitate Galvin WTP ("in-lieu")	-1	-1	1	-1	1	-1	-0.3	12
5	CVWD: Purchase Addt'l Water at LMWTP and RNWTP (ASR)	0	0	1	0	0	1	0.25	6
6	FWC: Purchase Addt'l Water at Sandhill (ASR)	0	0	1	0	1	2	0.35	5
7	JCSD: Purchase New Source via RC Feeder (ASR)	-1	0	1	0	1	1	0.15	8
8	Ontario: New Source via CVWD or WFA (ASR)	-1	-1	1	1	1	1	0.2	7
9	IEUA: AWTP at RP's to offset TDS from Spreading UF	-1	-1	1	-1	1	-1	-0.3	12
10	IEUA: Opportunistic Increase in Recycled Water	-1	-1	1	0	1	0	-0.05	11
11	UF: Construct New Turnouts to Day Creek	0	1	0	-1	1	1	0.05	9
12	UF: Construct New Turnout to San Antonio Channel	0	1	0	-1	1	1	0.05	9
13	ADC: New Turnouts to San Antonio Channel	1	1	0	0	1	3	0.5	4
14	New Pipeline Turnout to San Sevaine Basin No. 1	1	1	1	0	1	4	0.75	1
15	Vulcan: New Turnout and Booster Station From UF	-1	-1	0	-1	1	-2	-0.55	15
16	Vulcan: New Turnout and Booster Station from ADC	-1	-1	0	0	1	-1	-0.3	12
17	ALL: Ad-hoc "in-lieu" among all Appropriators	1	1	1	0	0	3	0.65	2

4.0 DEVELOPMENT OF SUPPLEMENTAL RECHARGE PROJECTS

4.1 Overview

This section presents a project template and preliminary estimate of capital and operation and maintenance (O&M) costs for each of the projects that passed the initial pre-screening process described in paragraph 3.9.

4.2 Project Development

Following the pre-screening process where the top five concepts were selected (plus any concept utilizing in-lieu recharge), two additional concepts were developed that were not previously considered. (Although the FWC ASR wells concept passed the preliminary screening steps, details for specific ASR well development were not available at the time this TM was prepared.) These two additional concepts evolved through several discussions with WEI and include (1) new recycled water supplies via a connection from the Rapid Infiltration and Extraction (RIX) Facility to IEUA's recycled water distribution system and (2) new recycled water supplies via a connection from the Western Riverside County Regional Wastewater Authority Plant (WRCRWAP) to IEUA's recycled water distribution system. These concepts, together with the five from the pre-screening process, were carried forward into conceptual design detail for a total of seven projects.

All project concepts in this section include a project template consisting of a project overview, operational features, potential recharge capacity, institutional challenges, estimated capital cost, and estimated annual cost. In addition, a figure is provided to show the location and components of the project. The recharge capacity and potential recharge capacity for the projects are summarized in Table 4-1.

Table 4-1
Summary of Potential Supplemental Recharge Concepts

Concept(1)	Potential Maximum Recharge Capacity (AFY)
No. 1 – Turnout to San Sevaine Basin No. 1	10,000
No. 2 – CVWD ASR Wells	6,433
No. 3 – JCSD ASR Wells	3,228
No. 4 – ADC Turnout to San Antonio Channel	10,000
No. 5 – Ontario ASR Wells	5,020
No. 6 – Delivery of Recycled Water from RIX to IEUA	4,400 - 10,000
No. 7 – Delivery of Recycled Water from WRCRWAP to IEUA	2,000 - 4,500

Notes:
(1) Although the FWC ASR wells concept passed the preliminary screening step, details for specific ASR well development were not available at the time this TM was prepared.

4.3 Estimated Project Costs

The conceptual-level estimated capital and operation and maintenance (O&M) costs developed in this TM were derived from a prior survey of bid pricing of similar facilities from participating agencies and bid results or construction cost estimates from similar and recent B&V projects. The Cost Development Tool (spreadsheet) used to develop the costs is included in Appendix A. Table 4-2 summarizes the estimated costs for the seven supplemental recharge concepts described in this section.

Table 4-2
Summary of Supplemental Recharge Concepts Estimated Costs

Concept	Estimated Capital Cost	Estimated Annual O&M Cost
No. 1 – Turnout to San Sevaine Basin No. 1	$7,712,000	$5,000
No. 2 – CVWD ASR Wells	$25,844,000	$176,000
No. 3 – JCSD ASR Wells(2)	$32,200,000	$127,000
No. 4 – ADC Turnout to San Antonio Channel	$2,636,000	$1,000
No. 5 – Ontario ASR Wells	$27,636,000	$151,000
No. 6 – Delivery of Recycled Water from RIX to IEUA (3)	$52,604,000	$701,000 - $1,293,000
No. 7 – Delivery of Recycled Water from WRCRWAP to IEUA(3)	$11,619,000	$990,000 - $1,193,000

Notes:

(1) These unit costs do not include the cost of the water supply.

(2) This estimated cost includes a 36,000-foot conveyance pipeline in addition to the wells.

(3) This estimated cost includes conveyance facilities to connect to IEUA's system only and does not include an evaluation of the system compatibility or modifications to the treatment plants. A more detailed analysis of the treatment processes is recommended.

4.4 Project Descriptions

This section presents the project description templates for the seven supplemental water recharge concepts carried forward in this evaluation.

4.4.1 Concept No. 1 - Turnout to San Sevaine Basin No. 1 via Azusa Devil Canyon (ADC) or Etiwanda pipelines

Overview: This concept would be implemented through construction of a new turnout along either the ADC pipeline or Etiwanda pipeline. The San Gabriel Valley Municipal Water District (SGVMWD) and Metropolitan Water District of Southern California (MWD) own and operate the ADC and Etiwanda pipelines, respectively. Both pipelines convey State Water Project (SWP) water from Silverwood Lake to the districts' individual retail agencies. Water from either the ADC pipeline or Etiwanda pipeline would be diverted north to the San Sevaine Recharge Basin No. 1 through a turnout, metering structure and conveyance pipeline. The proposed facilities are shown on Figure 4-1.

A new pipeline would be constructed connecting the selected supply pipeline near the intersection of Cherry Avenue and South Highland Avenue to the San Sevaine Basin No. 1. At this location, the ADC and Etiwanda pipelines run parallel in close proximity to each other; therefore, connection to either pipeline would require approximately the same length of new pipe materials. The pipeline would be approximately 6,000 feet long and 36 inches in diameter and would include a flow control and air gap structure at the connection to the San Sevaine Basin. The turnout vault would contain a flowmeter to get an accurate measure of flow to the basin, a fixed orifice sleeve to reduce pressure head, and a check valve to prevent backflow. The water would then enter an air gap structure to ensure backflow from the basin would not enter into the turnout vault and to maintain a constant discharge head from the turnout.

The ADC pipeline has a capacity of 55 cfs (39,800 AFY) which would only be available during three winter months when SGVMWD has met the delivery requirements of their service area. Therefore, the maximum assumed capacity of this concept for the purposes of the RMP would be approximately 10,000 AFY (assuming delivery of 55 cfs for three months, uninterrupted). Selection of the supply pipeline (ADC or Etiwanda pipeline) would be determined by the available capacity during the design phase of the project.

Owner: San Bernardino County Flood Control District (basin)

SGVMWD (ADC)

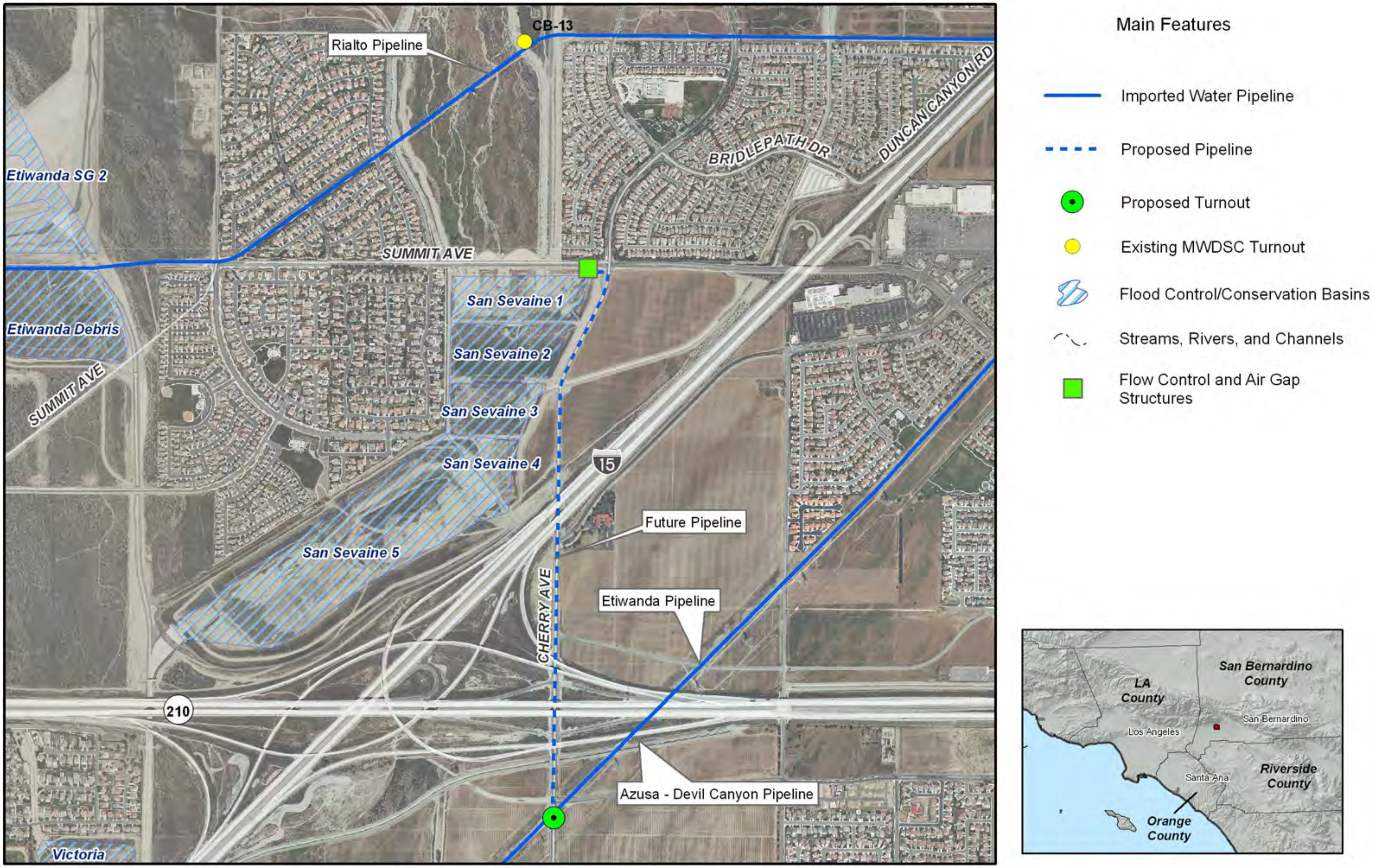
MWD (Etiwanda Pipeline)

Management Zone: 2

<u>Major Physical and Operational Features of the Project:</u>

Imported Water:

- Approximately 6,000 feet of 36 inch diameter pipe
- Turnout facility from ADC or Etiwanda pipeline
- Flow control and air gap structure



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Concept No. 1
Turnout to San Sevaine Basin No.1 via ADC or Etiwanda Pipelines

Figure 4-1

Existing and Potential Recharge Capacity:

	Existing, AFY[1]	Master Plan Improvements, AFY	New Total Yield, AFY
Stormwater	2,100[2]	N/A	N/A
Imported Water	11,283[2]	10,000[3]	21,283
Recycled Water	N/A	N/A	N/A

Notes:
(1) AFY = Acre-feet per year
(2) Per WEI Table 3. Capacity shown for San Sevaine Basins 1-5.
(3) Annual yield assumes three months of operation per year (at maximum capacity of 55 cfs for ADC pipeline).

Institutional Challenges:

- Operation will be dependent on available capacity in the ADC or Etiwanda pipeline, which is typically during winter months.

Capital Cost Estimate:

Component	Cost
Construction Cost	
Pipeline installed	$3,240,000
Transmission pipeline turnout	$750,000
Flow Control and Airgap Structure	$250,000
Misc. Valves & metering	$25,000
General mechanical (1)	$128,000
General electrical (2)	$427,000
General site work (3)	$213,000
General requirements (mob/demob) (4)	$213,000
Total Construction Cost	**$5,246000**
Contingency (5)	$1,312,000
Engineering/Administration (6)	$787,000
Construction Management (7)	$367,000
Total Capital Cost	**$7,712,000**

Notes:
(1) Based on 3% of total construction cost for all facilities.
(2) Based on 10% of total construction cost for all facilities.
(3) Based on 5% of total construction cost for all facilities.
(4) Based on 5% of total construction cost for all components except land.
(5) 25% added for contingency at this preliminary phase of project design.
(6) Based on 15% of total project cost.
(7) Based on 7% of total project cost.
*All other costs were developed based on assumptions as defined in the Task 3 Planning Criteria Memo dated March 19, 2009.

Annual Cost Estimate:

Component	Cost
Annual O&M Cost	
Pipelines	$5,000
Total Annual O&M	**$5,000**
Annualized Capital Cost (1)	$502,000
Total Annual Cost	**$507,000**
Total Maximum Recharge, AFY	**10,000**
Total Unit Water Cost, ($/AFY) (2) (3)	**$51**

Notes:
(1) Amortized cost assumes a 30 year project life and 5% interest. as
(2) This unit cost includes facilities only and does not include the cost of the water supply.
(3) This unit cost does not include improvements to the basin.

4.4.2 Concept No. 2 - Cucamonga Valley Water District (CVWD) Aquifer Storage and Recovery (ASR) Wells

Overview: This concept would be implemented through construction of several ASR wells located within the CVWD service area. To accomplish basin recharge, imported SWP water deliveries via MWD's Rialto Pipeline to CVWD's Lloyd Michael Water Treatment Plant (LMWTP) would be increased when additional surface supplies are available or purchased. The additional treated water from the LMWTP would be wheeled through the CVWD service area, using existing infrastructure where available, to provide an injection supply to the ASR wells.

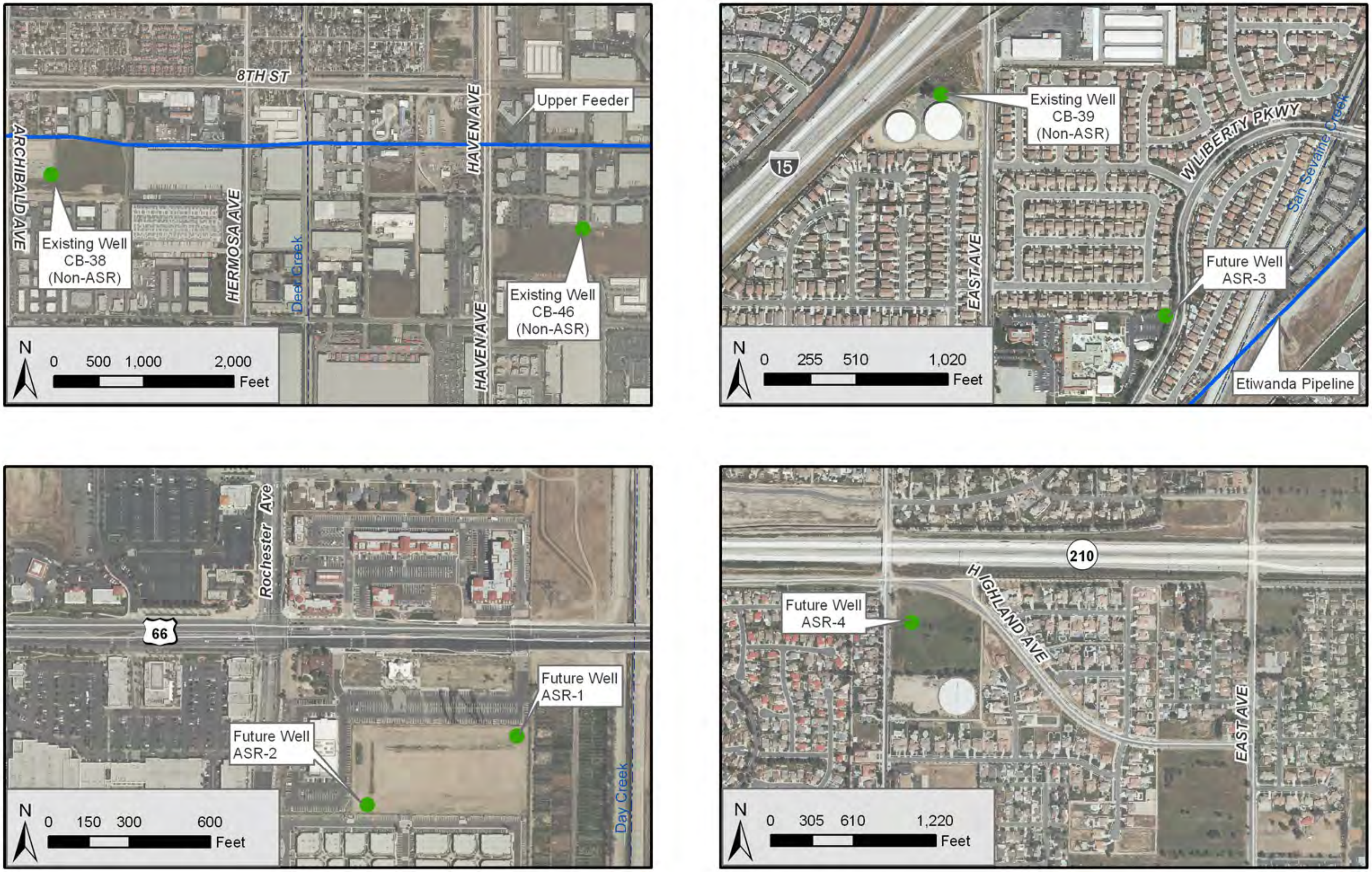
This concept would require conversion of up to three existing extraction wells to ASR and construction of up to four new ASR wells. The following table provides the proposed ASR well locations and assumed injection rates. The well locations are also shown in Figure 4-2.

Well (1)	Location	Project Type	Assumed Injection Rate, gpm(2)	Assumed Injection Capacity, AFY(3)
CB-38	Southeast corner of Acacia Street and Archibald Avenue	ASR Conversion	750	605
CB-39	North of Woodchase Court, west of East Avenue, east of 15 freeway	ASR Conversion	1,275	1,028
CB-46	Utica Avenue, south of 7th Street	ASR Conversion	1,700	1,371
ASR 1	West of Day Creek, south of Foothill Boulevard, east of Rochester Avenue	New ASR Well	1,250	1,008
ASR 2	West of Day Creek, south of Foothill Boulevard, east of Rochester Avenue	New ASR Well	1,000	807
ASR 3 (48)	West Liberty Parkway and Miller Avenue	New ASR Well	1,000	807
ASR 4 (47)	East of Etiwanda between Highland Avenue and Carnesi Drive	New ASR Well	1,000	807
		TOTAL	**7,975**	**6,433**

Notes:
(1) Well locations determined via conversations between WEI and CVWD staff.
(2) Assumed injection rate and capacity determined by WEI staff.
(3) Assumes injection over a six month period.

Owner: CVWD

Management Zone: 2



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Concept No. 2
CVWD ASR Wells

Figure 4-2

Major Physical and Operational Features of the Project:

Imported Water:

- Construction of four new ASR wells and 200 feet of 16-inch pipe per well
- Conversion of three extraction wells to ASR wells
- Use of existing surplus capacity at the LMWTP

Use of unused capacity in the Rialto Pipeline

Existing and Potential Recharge Capacity:

	Existing, AFY(1)	Master Plan Improvements, AFY	Total New Yield, AFY(2)
Stormwater	N/A	N/A	N/A
Imported Water	0	6,433	6,433
Recycled Water	N/A	N/A	N/A

Notes:
(1) AFY = Acre-feet per year
(2) Annual yield assumes six months of operation per year.

Institutional Challenges:

- Operation is contingent on available capacity within the Rialto Pipeline.
- Some of the ASR wells described in this concept were also included in the DYY Expansion Program and would require coordination when the facilities are in use for “put” cycles.
- Assumes that the CVWD distribution system infrastructure is available with capacity to serve the surplus treated water to the ASR locations.

Capital Cost Estimate:

Component	Cost
Construction Cost	
New ASR wells installed	$11,200,000
Pipelines installed	$192,000
ASR well conversions	$2,700,000
Undeveloped land	$210,000
General mechanical (1)	$429,000
General electrical (2)	$1,430,000
General site work (3)	$715,000
General requirements (mob/demob) (4)	$705,000
Total Construction Cost	**$17,581,000**
Contingency (5)	$4,395,000
Engineering/Administration (6)	$2,637,000
Construction Management (7)	$1,231,000
Total Capital Cost	**$25,844,000**

Notes:

(1) Based on 3% of total construction cost for all facilities.

(2) Based on 10% of total construction cost for all facilities.

(3) Based on 5% of total construction cost for all facilities.

(4) Based on 5% of total construction cost for all components except land.

(5) 25% added for contingency at this preliminary phase of project design.

(6) Based on 15% of total project cost.

(7) Based on 7% of total project cost.

*All other costs were developed based on assumptions as detailed in the Task 3 Planning Criteria Memo dated March 19, 2009.

Annual Cost Estimate:

Component	Cost
Annual O&M Cost	
Well maintenance	$175,000
Pipeline maintenance	$1,000
Total Annual O&M(1)	**$176,000**
Annualized Capital Cost (2)	$1,681,000
Total Annual Cost	**$1,857,000**
Total Maximum Recharge, AFY	**6,433**
Total Unit Water Cost, ($/AFY) (3)	**$289**

Notes:

(1) It is assumed that recharge would be accomplished by gravity. Power costs not included.

(2) Amortized cost assumes a30 year project life and 5% interest.

(3) This unit cost includes facilities only and does not include the cost of the water supply.

4.4.3 Concept No. 3 - Jurupa Community Services District (JCSD) Aquifer Storage and Recovery (ASR) Wells

Overview: This concept would be implemented through use of several wells owned and operated by JCSD. Treated water from Western Municipal Water District's (WMWD) future Riverside-Corona (RC) Feeder Central Reach would be conveyed to the ASR wells for injection into the Basin.

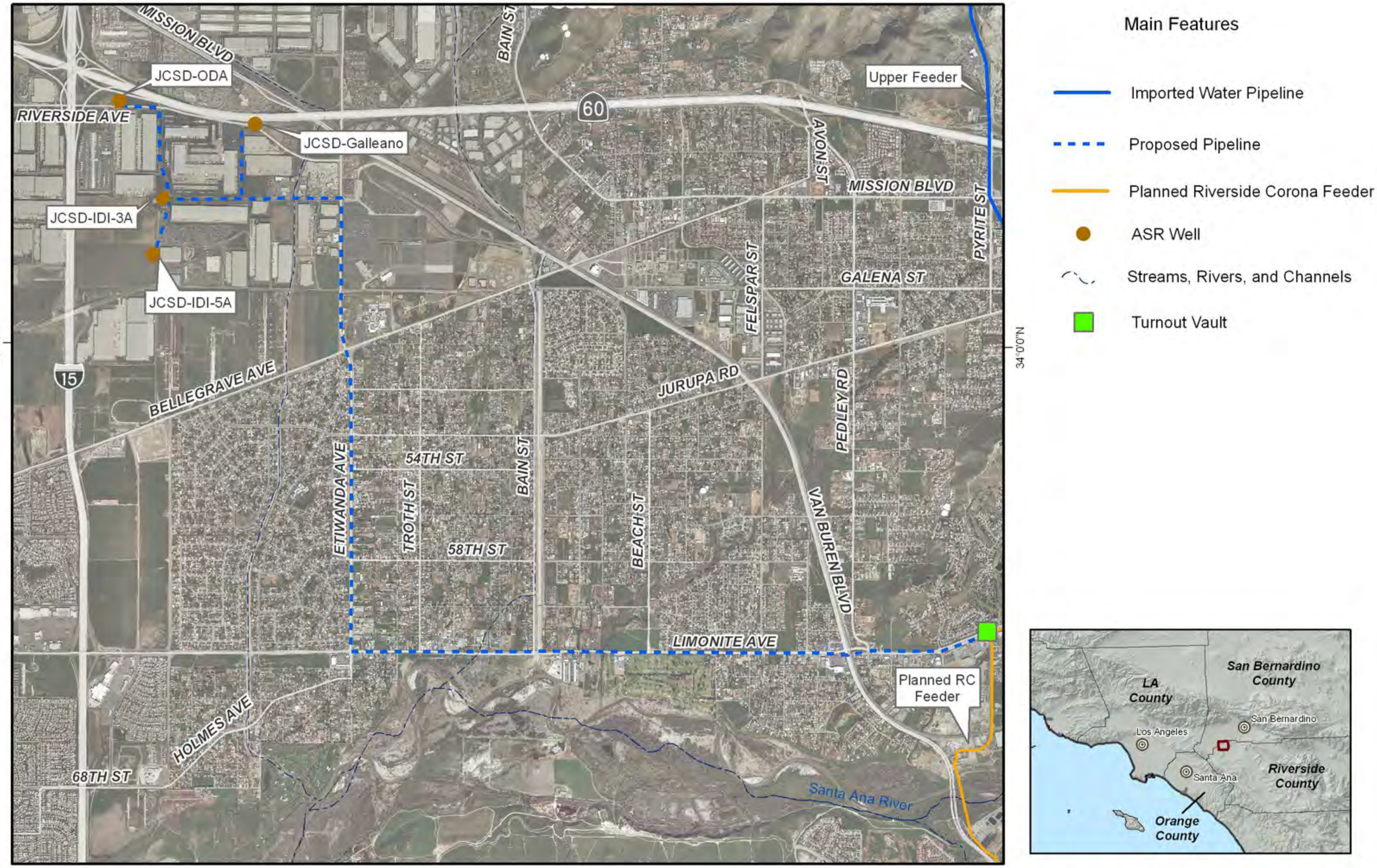
This concept would include conversion of up to four extraction wells to ASR wells, and construction of a new pipeline connecting the RC Feeder to the ASR wells. It should be noted that the extraction wells are not currently constructed at the time this TM was drafted; however, it has been assumed that they will be constructed before the RMP is implemented. The wells would be located within JCSD's service area near the intersection of Interstate-15 and State Route 60. The following table provides the ASR well locations and assumed injection rates. The well locations are also shown on Figure 4-3.

Well(1)	Location	Project Type	Assumed Injection Rate, gpm(2)	Assumed Injection Capacity, AFY(3)
IDI-3A	Wineville Avenue 2,000 feet south of Riverside Drive	ASR Conversion	1,000	807
IDI-5A	Northeast corner of I-15 and Cantu-Galleano Ranch Road	ASR Conversion	1,000	807
Oda	NW corner of Riverside Drive and 280 feet west of Wineville Avenue	ASR Conversion	1,000	807
Galleano	2,700 feet west of intersection of Etiwanda Avenue and San Sevaine Way	ASR Conversion	1,000	807
		TOTAL	**4,000**	**3,228**

Notes:
(1) Well locations determined via conversations between WEI and JCSD staff.
(2) Assumed injection rate determined by WEI staff.
(3) Assumes injection over a six-month period.

Based on preliminary hydraulic calculations, it does not appear that a booster station would be required to convey water from the RC Feeder to the wells. The hydraulic grade line (HGL) of the planned RC Feeder is 1,390 feet and wells are located at approximately 1,000 feet. Even though a connection from the RC Feeder to JCSD's 870 pressure zone was included as a facility to export water to WMWD in the Dry Year Yield (DYY) Program Expansion, a dedicated pipeline would be required for this concept to deliver water to the higher 1,100 zone that the wells will serve. (Existing infrastructure is required to deliver water from JCSD's wells to its lower 870 zone.) An analysis should be performed to confirm the system hydraulics prior to design.

The conveyance pipeline would be approximately 36,000 feet long and 30 inches in diameter and would also include a metering and flow control facility at the connection to the RC Feeder. The turnout vault would contain a flowmeter, isolation valves, and a check valve to prevent backflow.



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0 2,500 5,000 7,500 Feet
0 1,000 2,000 Meters

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Concept No. 3
Jurupa Community Services District
ASR Wells

Figure 4-3

Owner: JCSD (wells)
WMWD (RC Feeder)

Management Zone: 3

Major Physical and Operational Features of the Project:

Imported Water:

- Conversion of four extraction wells to ASR wells
- Approximately 36,000 feet of 30 inch diameter pipe
- Turnout facility from RC Feeder pipeline

Existing and Potential Recharge Capacity:

	Existing, AFY[1]	Master Plan Improvements, AFY	New Total Yield, AFY[2]
Stormwater	N/A	N/A	N/A
Imported Water	N/A	3,228	3,228
Recycled Water	N/A	N/A	N/A

Notes:
(1) AFY = Acre-feet per year
(2) Assumes facilities are in operation six months of the year.

Institutional Challenges:

- Operation would be dependent on the construction of the RC Feeder moving forward and having available capacity of the RC Feeder to convey treated water from WMWD to JCSD.
- Three wells (Oda, IDI, and Galleano) and the connection to the RC Feeder were also included in the DYY Expansion Program and would require coordination during "put" cycles.

Capital Cost Estimate:

Component	Cost
Construction Cost	
ASR well conversion	$3,600,000
Pipeline installed	$16,200,000
Railroad Crossing	$200,000
Transmission pipeline turnout	$750,000
Valves & Metering	$125,000
General mechanical (1)	$134,000
General electrical (2)	$448,000
General site work (3)	$224,000
General requirements (mob/demob) (4)	$224,000
Total Construction Cost	**$21,905,000**
Contingency (5)	$5,476,000
Engineering/Administration (6)	$3,286,000
Construction Management (7)	$1,533,000
Total Capital Cost	**$32,200,000**

Notes:

(1) Based on 3% of total construction cost for all facilities, except pipeline and RR crossing.

(2) Based on 10% of total construction cost for all facilities, except pipeline and RR crossing.

(3) Based on 5% of total construction cost for all facilities, except pipeline and RR crossing.

(4) Based on 5% of total construction cost for all components except land, pipeline, and RR crossing.

(5) 25% added for contingency at this preliminary phase of project design.

(6) Based on 15% of total project cost.

(7) Based on 7% of total project cost.

*All other costs were developed based on assumptions as defined in the Task 3 Planning Criteria Memo dated March 19, 2009.

Annual Cost:

Component	Cost
Annual O&M Cost	
Well maintenance	$100,000
Pipeline maintenance	$27,000
Total Annual O&M(1)	**$127,000**
Annualized Capital Cost (2)	$2,095,000
Total Annual Cost	**$2,222,000**
Total Maximum Recharge, AFY	**3,228**
Total Unit Water Cost, ($/AFY) (3)	**$688**

Notes:

(1) It is assumed that delivery of water via the RC Feeder would be accomplished by gravity flow. Power costs not included if boosting would be required.

(2) Amortized cost assumes a 30 year project life and 5% interest.

(3) This unit cost includes facilities only and does not include the cost of the water supply.

4.4.4 Concept No. 4 - Turnout to San Antonio Channel via Azusa Devil Canyon (ADC) Pipeline

Overview: This concept would be implemented through construction of a new turnout along the ADC pipeline. The San Gabriel Valley Municipal Water District (SGVMWD) owns and operates the ADC pipeline which conveys SWP water from Silverwood Lake to its retail agencies. Water from the ADC pipeline would be diverted to the San Antonio Channel through a turnout and metering structure and flow south to several Chino Basin recharge facilities including College Heights, Upland, Montclair, and Brooks basins. The proposed facilities are shown on Figure 4-4.

A new pipeline would be constructed connecting the ADC pipeline on West 16th Street to the San Antonio Channel. The pipeline would be approximately 800 feet long and 36 inches in diameter and would also include a flow control and air gap structure at the connection to the channel. The turnout vault would contain a flowmeter, a fixed orifice sleeve to reduce pressure head, and a check valve to prevent backflow. The water would then enter an air gap structure to ensure stormwater from the channel would not enter into the turnout vault during high flow events and to maintain a constant discharge head from the turnout. From this structure, a connection to the San Antonio Channel would be made and a flap gate would be installed to further prevent backflow and to protect the conveyance facility from debris. Within the channel, energy dissipation head walls may be constructed instead of the fixed sleeve as a barrier from high velocity streams exiting the structure. Coordination with the Army Corps of Engineers would be necessary to ensure compliance with all codes and standards.

The ADC pipeline has a capacity of 55 cfs (39,000 AFY) which would only be available during the winter months when SGVMWD has met the delivery requirements of their service area. Therefore, the assumed capacity of this concept for the purposes of the RMP would be approximately 10,000 AFY.

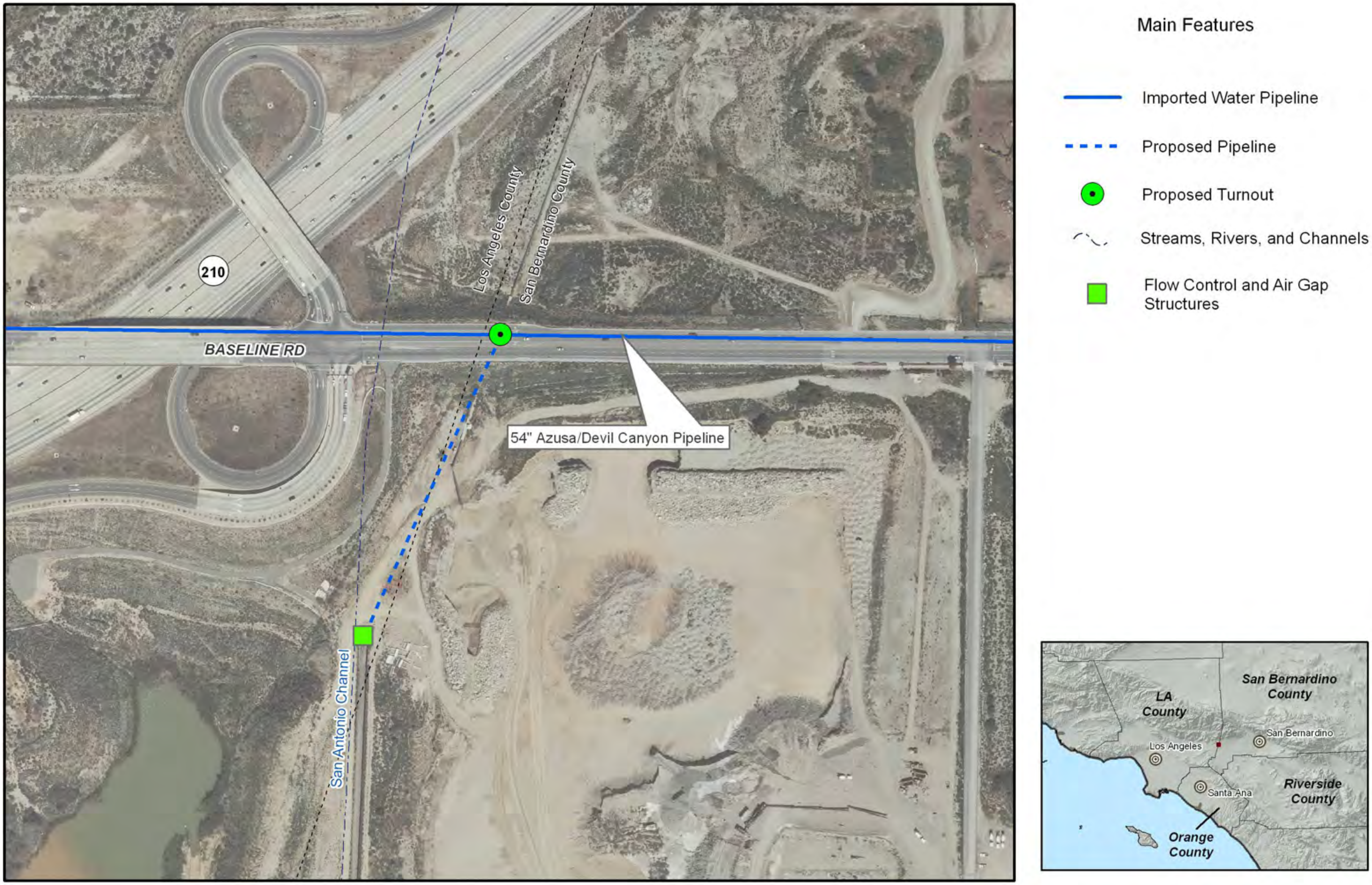
Owner: San Bernardino Flood Control District (San Antonio Channel)
SGVMWD (ADC)

Management Zone: 1

<u>Major Physical and Operational Features of the Project:</u>

Imported Water:

- Approximately 800 feet of 36 inch diameter pipe
- Turnout facility from ADC pipeline
- Flow control and air gap structure



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Date: 20100304
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2010 Chino Basin Recharge Master Plan Update
Supplemental Water Recharge Concept Development

Concept No. 4
Turnout to San Antonio Channel via ADC

Figure 4-4

Existing and Potential Recharge Capacity:

	Existing, AFY(1)	Master Plan Improvements, AFY	New Total Yield, AFY
Stormwater	6,934(2)	N/A	N/A
Imported Water	N/A	10,000(3)	10,000
Recycled Water	N/A	N/A	N/A

Notes:

(1) AFY = Acre-feet per year

(2) Includes maximum stormwater recharge FY 2004/2005 to FY 2007/2008 from WEI Table 3 for Brooks, Upland, College Heights, and Montclair basins that receive flow from the channel.

(3) Annual yield assumes three months of operation per year.

Institutional Challenges:

- Operation will be dependent upon available capacity in the ADC pipeline, which is typically during winter months.
- Concept was also included in the DYY Expansion Program and would require coordination with Three Valleys Municipal Water District for when the facility is in use for "put" cycles.

Capital Cost Estimate:

Component	Cost
Construction Cost	
Pipeline installed	$432,000
Transmission pipeline turnout	$750,000
Flow Control and Air Gap Structure	$250,000
Valves & metering	$25,000
General mechanical (1)	$44,000
General electrical (2)	$146,000
General site work (3)	$73,000
General requirements(mob/demob) (4)	$73,000
Total Construction Cost	**$1,793,000**
Contingency (5)	$448,000
Engineering/Administration (6)	$269,000
Construction Management (7)	$126,000
Total Capital Cost	**$2,636,000**

Notes:

(1) Based on 3% of total construction cost for all facilities.

(2) Based on 10% of total construction cost for all facilities.

(3) Based on 5% of total construction cost for all facilities.

(4) Based on 5% of total construction cost for all components except land.

(5) 25% added for contingency at this preliminary phase of project design.

(6) Based on 15% of total project cost.

(7) Based on 7% of total project cost.

*All other costs were developed based on assumptions as defined in the Task 3 Planning Criteria Memo dated March 19, 2009.

Annual Cost Estimate:

Component	Cost
Annual O&M Cost	
Pipelines	$1,000
Total Annual O&M	**$1,000**
Annualized Capital Cost (1)	$171,000
Total Annual Cost	**$172,000**
Total Maximum Recharge, AFY	**10,000**
Total Unit Water Cost, ($/AF-yr) (2)(3)	**$17**

Notes:

(1) Amortized cost assumes a 30 year project life and 5% interest.,

(2) This unit cost includes facilities only and does not include the cost of the water supply.

(3) This unit cost does not include improvements to the channel.

4.4.5 Concept No. 5 - City of Ontario Aquifer Storage and Recovery (ASR) Wells

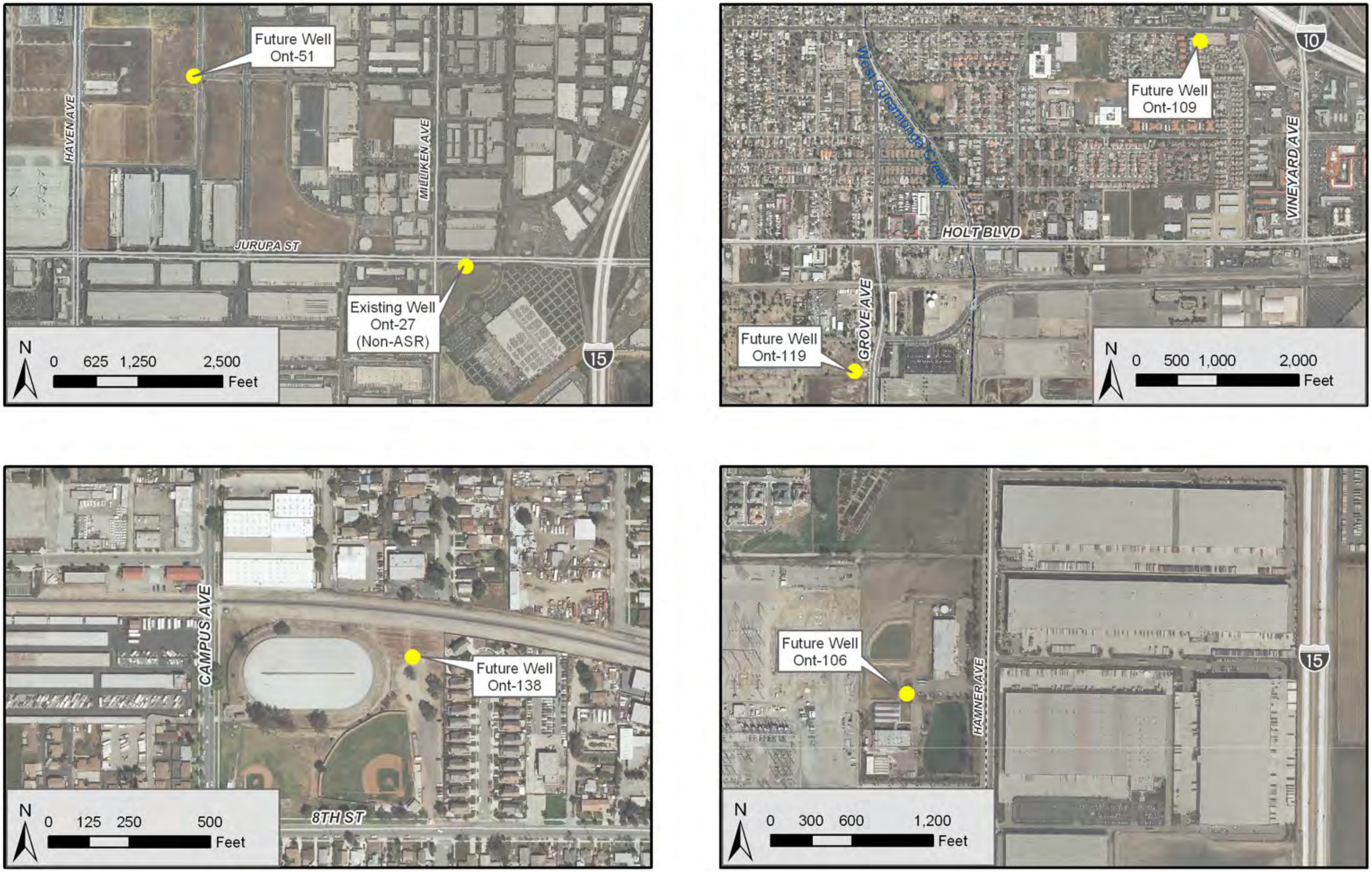
Overview: This concept would be implemented through construction of new ASR wells, which would be owned and operated by the City of Ontario. Imported water is currently conveyed to the Ontario distribution system via the Water Facilities Authority (WFA) Agua de Lejos water treatment plant (WTP) that currently serves the cities of Ontario, Upland, Chino, Chino Hills, and the Monte Vista Water District. The plant, located on Benson Avenue in the City of Upland, has unused capacity during the winter months that could be used to treat surplus imported water for distribution throughout the Ontario service area, thereby allowing injection at ASR well locations. For this option to be feasible, the infrastructure to convey the WFA water to the city's western distribution area is required. An analysis of the system hydraulics is recommended to confirm the system's ability to wheel water.

Another source for treated imported water would be Cucamonga Valley Water District's (CVWD) Lloyd Michael WTP, located on Etiwanda Avenue in Rancho Cucamonga. This scenario would be dependent on construction of a connection between the Ontario distribution system and CVWD's existing 30-inch transmission main running along Rochester Avenue, which was included in the Dry Year Yield (DYY) Expansion Program. This RMP assumes that one of the above options would be feasible and that this concept would require only the construction of the ASR wells.

This concept would include construction of up to five new ASR wells and conversion of one existing extraction well to an ASR well. The following table provides the ASR well locations and assumed injection rates. The well locations are also shown on Figure 4-5.

Well (1)	Location	Project Type	Assumed Injection Rate, gpm(2)	Assumed Injection Capacity, AFY(3)
No. 27	South of Jurupa Street, east of Milliken Avenue	ASR Conversion	550	444
No. 51	West of Carnegie Avenue and Santa Ana Street	New ASR Well	800	645
No. 106	Southwest corner of Milliken Avenue and Chino Avenue	New ASR Well	1,250	1,008
No. 109	South of East G Street, west of Corona Avenue	New ASR Well	1,250	1,008
No. 119	South of East State Street, west of South Grove Avenue	New ASR Well	1,250	1,008
No. 138	North of 8th Street, east of Campus Avenue	New ASR Well	1,125	907
		TOTAL	**6,225**	**5,020**

Notes:
(1) Well locations determined via conversation between WEI and City of Ontario staff.
(2) Assumed injection rate determined by WEI staff.
(3) Assumes injection over a six-month period.



Author: MJC Date: 20100301 File: Figure 4-5.mxd

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● ASR Well

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Partners in Basin Management

2010 Chino Basin Recharge Master Plan Update
Supplemental Water Recharge Concept Development

Concept No. 5
City of Ontario ASR Wells

Figure 4-5

Owner: City of Ontario (wells)
WFA (Agua de Lejos WTP)
CVWD (LMWTP)

Management Zone: 2

Major Physical and Operational Features of the Project:

Imported Water:

- Construction of up to five ASR wells and 200 feet of pipe per well
- Conversion of one existing extraction well to an ASR well
- Use of existing surplus capacity at either the WFA's Agua de Lejos WTP or CVWD's LMWTP.

Existing and Potential Recharge Capacity:

	Existing, AFY[1]	Master Plan Improvements, AFY	New Total Yield, AFY[2]
Stormwater	N/A	N/A	N/A
Imported Water	N/A	5,020	5,020
Recycled Water	N/A	N/A	N/A

Notes:
(1) AFY = Acre-feet per year
(2) Annual yield assumes six months of operation per year.

Institutional Challenges:

- Operation would be contingent on the availability of infrastructure to move water from WFA to Ontario's western distribution system or construction of the CVWD/Ontario connection as defined in the DYY Expansion Program.
- Coordination would be required with either WFA or CVWD regarding available water treatment plant and conveyance capacities.
- The CVWD/Ontario connection concept was also included in the DYY Expansion Program and would require coordination when the facility is in use for "put" cycles.

Capital Cost Estimate:

Component	Cost
Construction Cost	
New ASR wells installed	$14,000,000
Pipelines installed	$240,000
ASR well conversion	$900,000
Undeveloped land	$150,000
General mechanical (1)	$459,000
General electrical (2)	$1,529,000
General site work (3)	$765,000
General requirements (mob/demob) (4)	$757,000
Total Construction Cost	**$18,800,000**
Contingency (5)	$4,700,000
Engineering/Administration (6)	$2,820,000
Construction Management (7)	$1,316,000
Total Capital Cost	**$27,636,000**

Notes:

(1) Based on 3% of total construction cost for all facilities.

(2) Based on 10% of total construction cost for all facilities.

(3) Based on 5% of total construction cost for all facilities.

(4) Based on 5% of total construction cost for all components except land.

(5) 25% added for contingency at this preliminary phase of project design.

(6) Based on 15% of total project cost.

(7) based on 7% of total project cost.

*All other costs were developed based on assumptions as defined in the Task 3 Planning Criteria Memo dated March 19, 2009.

Annual Cost Estimate:

Component	Cost
Annual O&M Cost	
Well maintenance	$150,000
Pipeline maintenance	$1,000
Total Annual O&M(1)	**$151,000**
Annualized Capital Cost (2)	$1,798,000
Total Annual Cost	**$1,949,000**
Total Maximum Recharge, AFY	**5,020**
Total Unit Water Cost, ($/AFY) (3)	**$388**

Notes:

(1) It is assumed that delivery of water to the wells for recharge would be accomplished by gravity flow. Power costs not included.

(2) Amortized cost assumes a 30 year project life and 5% interest.

(3) This unit cost includes facilities only and does not include the cost of the water supply.

4.4.6 Concept No. 6 - Rapid Infiltration and Extraction (RIX) Facility Connection to Inland Empire Utilities Agency's (IEUA) Recycled Water Distribution System

Overview: This concept would be implemented through construction of a new connection from the RIX facility to IEUA's recycled water distribution system. The San Bernardino Regional Tertiary & Water Reclamation Authority (Authority) owns and operates the 40 million gallon per day (mgd) RIX facility located on Agua Mansa Road within the City of Colton. The RIX plant treats secondary effluent from San Bernardino and Colton to tertiary standards using rapid infiltration, followed by well extraction and disinfection, ultimately discharging the treated effluent to the Santa Ana River. This project could utilize between 4,400 and 10,000 acre-feet per year (AFY) of recycled water to supplement IEUA's supply for recharge into the Basin.

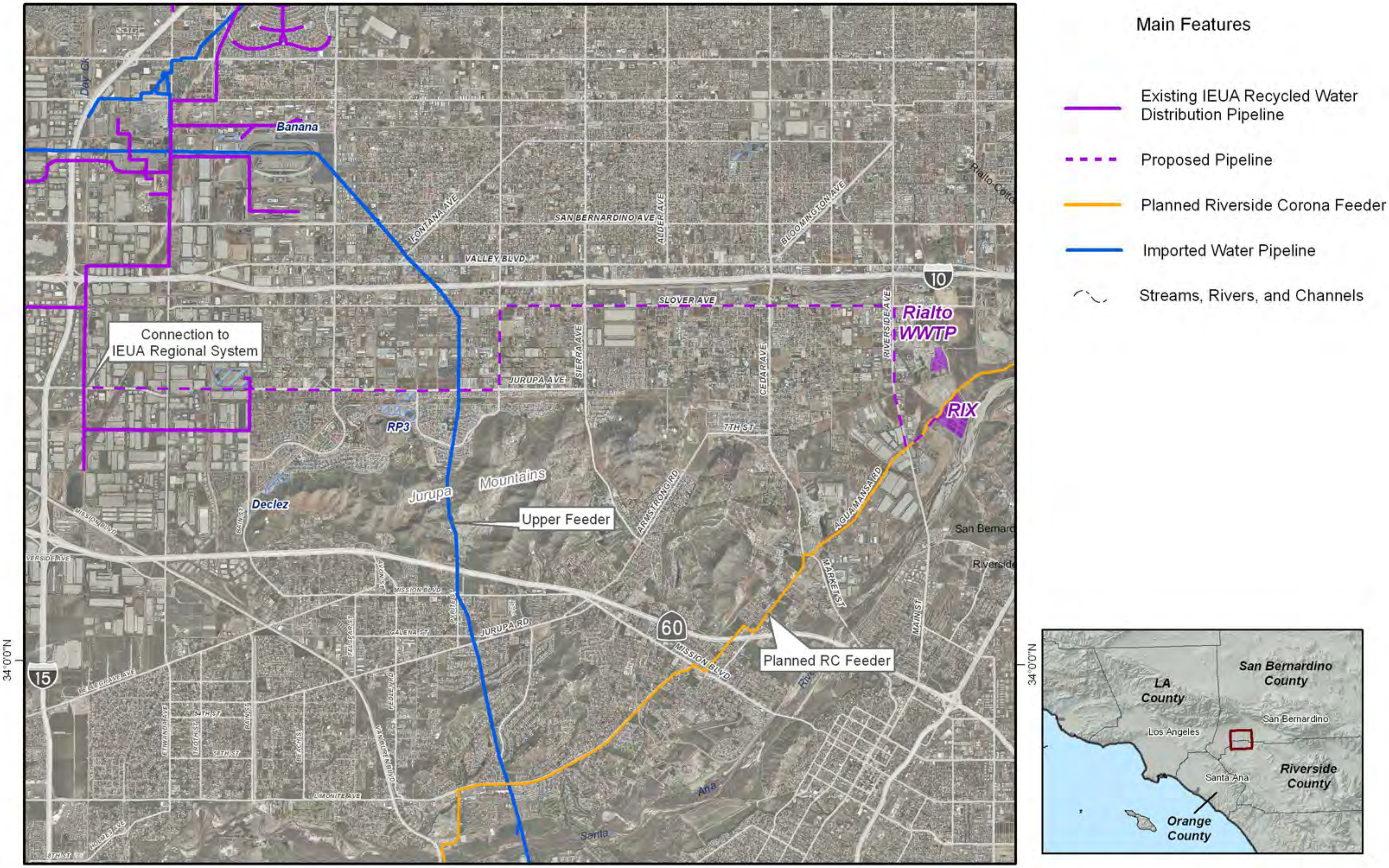
Discussions with IEUA indicate that only during four summer months (June through September) would there be insufficient recycled water to recharge. Therefore, for the purposes of this TM, conveyance capacity for delivery of a new recycled supply of 4,400 AFY over 4 months was assumed (approximately 18.7 cfs). Should IEUA's supply be insufficient during the remainder of the year or additional capacity is available, this conveyance capacity would allow delivery of up to 10,000 AFY over 9 months (assuming capacity is not available 3 months of the year).

A new pipeline and booster pump station would be constructed to connect the RIX facility to the IEUA distribution system near the intersection of the Interstate-15 Freeway and Jurupa Road. The pipeline would be approximately 13 miles long and 24 inches in diameter and would include metering and flow control. The connection would include a flowmeter, a check valve to prevent backflow, and isolation valves. Based on preliminary calculations, a 1,750 horsepower (HP) booster pump station would also be required to overcome elevation changes, pipeline losses, and to meet the hydraulics within the IEUA distribution system. In order to size the booster pump station for the purposes of this TM, connection to the IEUA 1,158 pressure zone was assumed. Prior to implementation, a hydraulic evaluation of the two systems would need to be performed as well as tests to confirm whether the water chemistry in both systems is compatible. The facilities are shown on Figure 4-6.

Coordination with IEUA would be necessary to ensure compliance with their recycled water quality standards. Treatment plant improvements to the RIX facility are anticipated in order to achieve the water quality standards required by IEUA; however, a treatment process evaluation is outside the scope of the RMP. Extensive analysis and inter-agency discussions will be required prior to determining facility improvements and resultant costs. It is likely that potential implementation of this project is more than 10 years out. Also, its cost-effectiveness would be compared to the current MWD Tier 2 rate. That is, if the unit cost of water for development of the project is less than the forecasted Tier 2 rate, it can be considered cost-effective.

Current Owner: City of San Bernardino & City of Colton (Authority) - RIX facility
IEUA - Recycled Water Distribution System

Management Zone: 3



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Date: 20100301
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0 1 2 Miles
0 2 4 Kilometers

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2010 Chino Basin Recharge Master Plan Update
Supplemental Water Recharge Concept Development

Concept No. 6
RIX Recycled Water Connection to IEUA Distribution System

Figure 4-6

Major Physical and Operational Features of the Project:

Recycled Water:

- Approximately 13 miles (68,600 feet) of 24-inch diameter pipe
- 1,750 HP booster pump station
- Metering Structure

Existing and Potential Recharge Capacity:

	Existing, AFY(1)	Master Plan Improvements, AFY	New Total Yield, AFY(2)
Stormwater	N/A	N/A	N/A
Imported Water	N/A	N/A	N/A
Recycled Water	N/A	4,400 - 10,000	4,400 - 10,000

Notes:

(1) AFY = Acre-feet per year

(2) Annual yield assumes minimum of four months of operation per year.

Institutional Challenges:

- Concept will require extensive coordination with IEUA in order to utilize their distribution system. A wheeling fee may be required by IEUA to make use of their invested infrastructure.
- Variations in water quality between the two systems may result in incompatibility issues for specific direct uses.

Capital Cost Estimate:

Component	Cost
Construction Cost	
Pipeline installed	$24,696,000
Booster pump station	$8,750,000
Valves & metering	$25,000
Undeveloped land	$250,000
General mechanical (1)	$271,000
General electrical (2)	$903,000
General site work (3)	$451,000
General requirements (mob/demob) (4)	$439,000
Total Construction Cost	**$35,785,000**
Contingency (5)	$8,946,000
Engineering/Administration (6)	$5,368,000
Construction Management (7)	$2,505,000
Total Capital Cost	**$52,604,000**

Notes:

(1) Based on 3% of total construction cost for all facilities, except pipeline costs.

(2) Based on 10% of total construction cost for all facilities, except pipeline costs.

(3) Based on 5% of total construction cost for all facilities, except pipeline costs.

(4) Based on 5% of total construction cost for all components except land and pipeline costs.

(5) 25% added for contingency at this preliminary phase of project design.

(6) Based on 15% of total project cost.

(7) Based on 7% of total project cost.

*All other costs were developed based on assumptions as defined in the Task 3 Planning Criteria Memo dated March 19, 2009.

Annual Cost Estimate:

Component	Cost	
Delivery Duration, months	4	9
Annual O&M Cost		
Pipelines	$52,000	$52,000
Pump station general	$175,000	$175,000
Pump station power	$474,000	$1,066,000
Total Annual O&M	**$701,000**	**$1,293,000**
Annualized Capital Cost (1)	$3,422,000	$3,422,000
Total Annual Cost	**$4,123,000**	**$4,715,000**
Total Maximum Recharge, AFY	**4,400**	**10,000**
Total Unit Water Cost, ($/AFY) (2) (3)	**$937**	**$472**

Notes:

(1) Amortized cost assumes a 30 year project life and 5% interest.

(2) This unit cost includes facilities to connect the RIX plant to IEUA's system only and does not include the cost of the water supply or an evaluation of system compatibility.

(3) Costs to modify the RIX plant have not been included. A more detailed analysis of the plant's treatment process is recommended.

4.4.7 Concept No. 7 - Western Riverside County Regional Wastewater Authority Plant (WRCRWAP) Connection to Inland Empire Utilities Agency’s (IEUA) Recycled Water Distribution System

Overview: This concept would be implemented through construction of a new connection from the WRCRWAP to IEUA’s recycled water distribution system. Western Municipal Water District (WMWD) owns and operates the 8 million gallon per day (mgd) WRCRWAP located on River Road within the City of Corona. The WRCRWAP treats secondary effluent from the City of Norco, JCSD and Home Gardens Sanitary District to tertiary standards, ultimately discharging the treated effluent to the Santa Ana River. This concept would provide up to 4,500 acre-feet per year (AFY) of recycled water to supplement IEUA’s supply for recharge into the Basin.

As developed in Concept No. 6, IEUA has indicated that only during four summer months (June to September) would there be insufficient recycled water to recharge. Therefore, for the purposes of this TM, conveyance capacity for delivery of a new recycled supply of 2,000 AFY over 4 months was assumed (approximately 8.4 cfs). Should IEUA’s supply be insufficient during the remainder of the year or additional capacity is available, this conveyance capacity would allow delivery of up to 4,500 AFY over 9 months (assuming capacity is not available 3 months of the year).

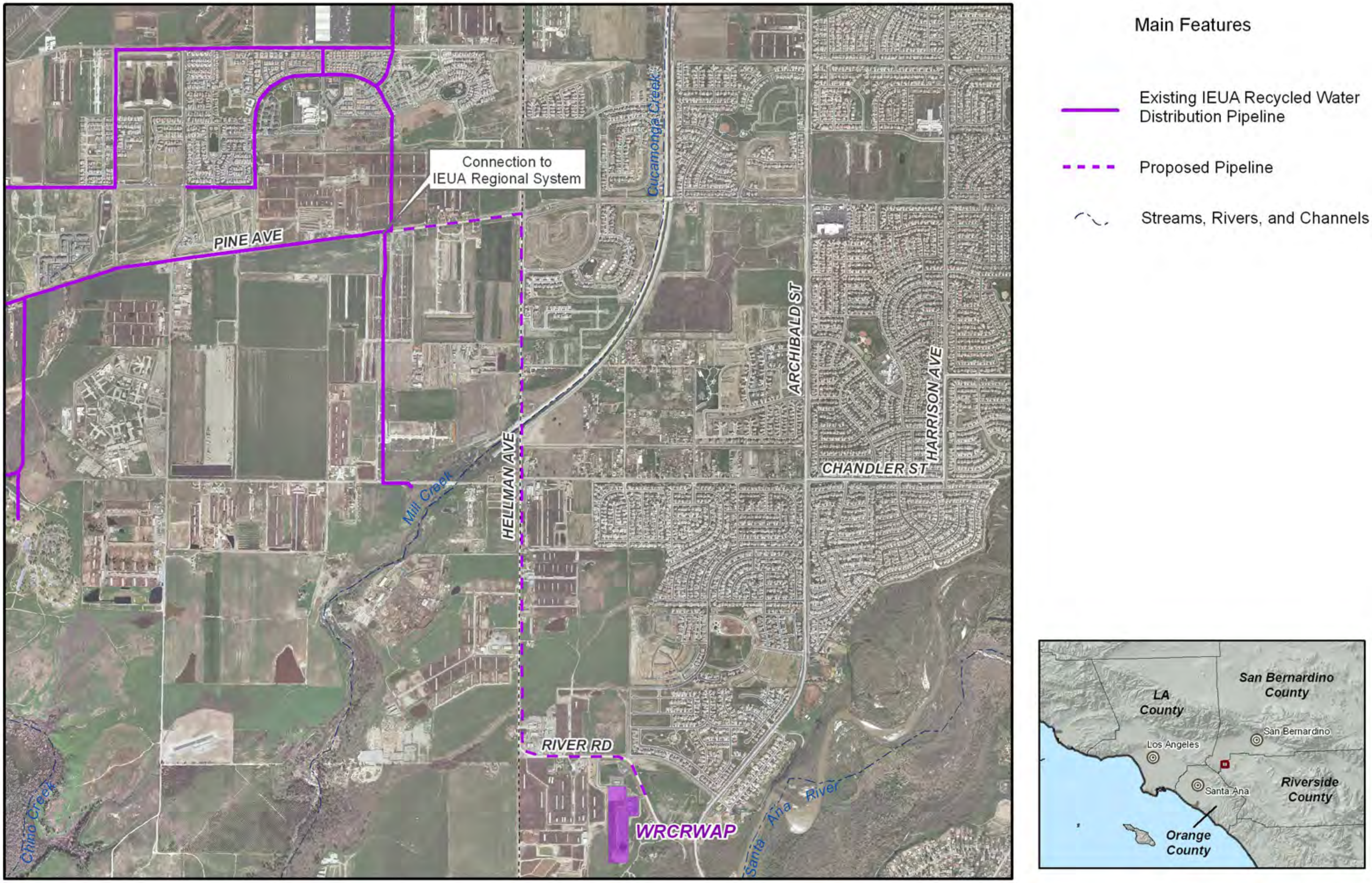
A new pipeline and booster pump station would be constructed to connect the WRCRWAP to IEUA’s recycled water distribution system. The pipeline would be approximately 16 inches in diameter and three miles long. The facilities would include metering and flow control, a check valve to prevent backflow, and isolation valves. Based on preliminary calculations, a 600 horsepower (HP) booster pump station would be required to overcome elevation changes, pipeline losses, and to meet the hydraulics within the IEUA distribution system. In order to size the booster pump station, connection to the IEUA 930 pressure zone at Pine Avenue was assumed. Prior to implementation, a hydraulic evaluation of the two systems would need to be performed as well as tests to confirm whether the water chemistry in both systems is compatible. The facilities are shown on Figure 4-7.

Coordination with IEUA would be necessary to ensure compliance with their recycled water quality standards. Treatment plant improvements to the WRCRWAP facility are anticipated in order to achieve the water quality standards required by IEUA; however, a treatment process evaluation is outside the scope of the RMP. Extensive analysis and inter-agency discussions will be required prior to determining facility improvements and resultant costs. It is likely that potential implementation of this project is more than 10 years out. Also, its cost-effectiveness would be compared to the current MWD Tier 2 rate. That is, if the unit cost of water for development of the project is less than the forecasted Tier 2 rate, it can be considered cost-effective.

An alternative to this concept includes implementation of JCSD’s recycled water distribution system and connection to the WRCRWAP supply. IEUA has estimated that approximately 3,000 to 4,000 AFY of new recycled water supply could be made available to JCSD, which would reduce Chino Basin groundwater production by an equivalent amount (thereby providing in-lieu recharge).

Current Owner: Western Municipal Water District - WRCRWAP
IEUA – Recycled water distribution system

Management Zone: 5



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0 1,000 2,000 3,000 4,000 5,000 Feet

0 500 1,000 1,500 Meters

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2010 Chino Basin Recharge Master Plan Update
Supplemental Water Recharge Concept Development

Concept No. 7
WRCRWAP Recycled Water Connection to IEUA Distribution System

Figure 4-7

Major Physical and Operational Features of the Project:

Recycled Water:

- Approximately 3 miles of 16-inch diameter pipe
- 600 HP booster pump station
- Metering structure

Existing and Potential Recharge Capacity:

	Existing, AFY(1)	Master Plan Improvements, AFY	New Total Yield, AFY(2)
Stormwater	N/A	N/A	N/A
Imported Water	N/A	N/A	N/A
Recycled Water	N/A	2,000 - 4,500	2,000 - 4,500

Notes:
(1) AFY = Acre- feet per year
(2) Annual yield assumes minimum of four months of operation per year.

Institutional Challenges:

- Concept will require extensive coordination with IEUA in order to utilize their distribution system. A wheeling fee may be required by IEUA to make use of their invested infrastructure.
- Variations in water quality between the two systems may result in incompatibility issues for specific direct uses.

Capital Cost Estimate:

Component	Cost
Construction Cost	
Pipeline installed	$3,888,000
Booster pump station	$3,000,000
Valves & metering	$25,000
Undeveloped land	$250,000
General mechanical (1)	$98,000
General electrical (2)	$328,000
General site work (3)	$164,000
General requirements (mob/demob) (4)	$151,000
Total Construction Cost	**$7,904,000**
Contingency (5)	$1,976,000
Engineering/Administration (6)	$1,186,000
Construction Management (7)	$553,000
Total Capital Cost	**$11,619,000**

Notes:

(1) Based on 3% of total construction cost for all facilities, except for pipeline costs.

(2) Based on 10% of total construction cost for all facilities, except for pipeline costs.

(3) Based on 5% of total construction cost for all facilities, except for pipeline costs.

(4) Based on5% of total construction cost for all components except land and pipeline costs.

(5) 25% added for contingency at this preliminary phase of project design.

(6) Based on 15% of total project cost.

(7) Based on 7% of total project cost.

*All other costs were developed based on assumptions as defined in the Task 3 Planning Criteria Memo dated March 19, 2009.

Annual Cost Estimate:

Component	Cost	
Delivery Duration, months	4	9
Annual O&M Cost		
Pipelines	$12,000	$12,000
Pump station general	$60,000	$60,000
Pump station power	$162,000	$365,000
Total Annual O&M	**$234,000**	**$437,000**
Annualized Capital Cost (1)	$756,000	$756,000
Total Annual Cost	**$990,000**	**$1,193,000**
Total Maximum Recharge, AFY	**2,000**	**4,500**
Total Unit Water Cost, ($/AFY) (2) (3)	**$495**	**$265**

Notes:

(1) Amortized cost assumes a 30 year project life and 5% interest.

(2) This unit cost includes facilities to connect the WRCWRAP to IEUA's system only and does not include the cost of the water supply or an evaluation of system compatibility.

(3) Costs to modify the WRCWRAP have not been included. A more detailed analysis of the plant's treatment process is recommended.

Appendix A

Chino Basin Facilities Improvement Program, Phase I and II
Facilities and Cost Summary Tables (Courtesy IEUA)

Chino Basin Facilities Improvement Program, Phase I, Cost Summary

Construction Phase	Construction Scope	Actual Cost	Budgeted Cost
Bid Package No. 1	Redevelopment of Banana Basin, Lower Day Basin, Turner Basin No. 1, and Turner Basins No. 2, 3,& ; construction of two new sites: RP-3 Basins and College Heights Basins	$8,246,175	$8,250,000
Bid Package No. 2	Basin enhancements, rubber dam construction, drop inlet construction, and sluice gate construction	$7,019,137	$7,020,000
Bid Package No. 3	11,000 linear feet of 365-inch diameter pressure from Jurupa Basin to RP-3 Basins	$3,615,746	$3,800,000
Bid Package No. 4	Jurupa Pump Stations and wet well	$2,134,324	$2,300,000
Bid Package No. 5	Supervisory Control and Data Acquisition System to monitor and govern water levels in all basins, controls of the drop inlets, rubber dams, and the sluice gates	$4,037,936	$3,870,000
Bid Package No. 6	MWD CB Turnouts: CB-11 CB-15 and new on the Etiwanda Intertie	$1,413,861	$1,450,000
Bid Package No. 7	RP-3 Mitigation project, Hickory Basin manifold and pump stationrubber dam in San Sevaine Channel to Hickory Basin, discharge pipeline from Whittram recycled water to Banana Basin, Improvements to Victoria Basin	$3,067,576	$3,000,000
Non-Construction Cost	Equipment purchases, Engineering Administration, and cooperative contribution from other agencies	$9,045,331	$9,000,000
Total Budget		$38,580,086	$38,690,000

Chino Basin Facilities Improvement Program, Phase II - Cost Summary

Location	Recharge Improvement	Initial Proposed Cost	Final Implemented Improvements
		Proposed Construction Cost	**Construction Cost**
CB-20 Turnout	Add Imported Water Flow to 7th & 8th Street Basin (25-cubic feet per second)	$3,168,400	$2,974,523
CB-14 Turnout	Improve Control of Imported Water Flow to Etiwanda Debris Basins	$1,522,777	$1,429,597
	Add Imported Water Flow to Victoria Basin (40-cubic feet per second)		
San Sevaine Basins, Lower Day Basins, Upland Basins, Brooks Basin, and Turner Basin	Basin SCADA Improvements - Install level transmitters and convert several manually operated gates into remotely automated gates	$300,430	$282,046
Declez Basins	Basin 1 - Reconstruct existing berm with native soil and raise berm elevation, construct a new concrete spillway	$191,100	$151,539
	Basin 3 - Reconstruct existing berm with soil cement and raise berm elevation	$199,000	$186,823
8th Street Basin	Berm 1 - Reconstruct existing berm with native soil and raise berm elevation	$258,200	$242,401
	Berm 2 - Reconstruct existing berm with soil cement and raise berm elevation and construct a new spillway	$213,300	$169,143
Hickory Basin	Berm 1 - Remove existing berm and replace with new harden, soil cement berm	$325,500	$305,582
	Berm 2 - Reconstruct existing berm with native soil and soil cement and raise berm elevation	$258,900	$243,058
	Access Road - Construct a soil cement access ramp across inlet channel to gain maintenance access of the north side	$78,700	$56,000
San Sevaine Basin	Basin 5 - Reconstruct existing berm with native soil, raise berm elevation and construct a new concrete spillway	$185,535	$185,535
Monitoring Wells and Lysimeters	Provide within RP-3 Basin, Declez Basin, Eight Street Basin, and Brooks Basin Monitoring Wells and Lysimeters as part of the requirement to recharge the basins with recycled water.	$1,178,658	$1,106,535
		Initial Project Cost	**Final Project Cost/Budget**
	(sum of above cost) - Construction Cost:	$7,880,500	$7,332,782
	Construction Management & Inspection/Survey Support Cost:	$1,114,442	$1,036,985
	Design & Environmental Services and Project Management Cost:	$1,534,887	$1,428,208
	(MWD, Mitigation Land, Upland Agreement, Permitting) - Other Cost:	$702,025	$702,025
	Total Cost:	**$11,231,854**	**$10,500,000**

Appendix B

RWQCB Order No. R8-2009-0057
Chino Basin Recycled Water Recharge Program

California Regional Water Quality Control Board
Santa Ana Region

Linda S. Adams
Secretary for
Environmental Protection

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Arnold
Schwarzenegger
Governor

October 30, 2009

Patrick Sheilds, Executive Manager of Operations psheilds@ieua.org
Inland Empire Utilities Agency
6063 Kimball Avenue
Chino, CA 91708

TRANSMITTAL OF ADOPTED ORDER NO. R8-2009-0057

At the regular Board Meeting of October 23, 2009, the Regional Board adopted Order No. R8-2009-0057, amending Order No. R8-2007-0039, Water Recycling Requirements for the Inland Empire Utilities Agency and Chino Basin Watermaster Chino Basin Recycled Water Groundwater Recharge Program Phase I and Phase II projects, San Bernardino County. A certified copy is enclosed for your records.

Sincerely,

Fe Carrillo

Felipa Carrillo
Executive Assistant

Enclosure: Adopted Order No. R8-2009-0057

cc via e-mail: SWRCB, DWQ–Phil Isorena pisorena@waterboards.ca.gov
US EPA, Permits Issuance (WTR-5)–Doug Eberhardt Eberhardt.Doug@epamail.epa.gov
Tetra Tech - Lee Solomon (via email)
Jae Kim - jae.kim@tetratech-ffx.com
Ahyung Kim- ahyung.kim@tetratech-ffx.com

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 I and Phase II Projects
San Bernardino County

The California Regional Water Quality Control Board, Santa Ana Region (hereinafter, Regional Board), finds that:

1. On June 29, 2007, the Regional Board adopted Order No. R8-2007-0039 prescribing Water Recycling Requirements for the Inland Empire Utilities Agency (IEUA) and Chino Basin Watermaster (CBWM) Chino Basin Recycled Water Groundwater Recharge Program, Phase I and Phase II Projects. The Order authorizes the use of recycled water generated from IEUA's Regional Water Recycling Plants No. 1 and 4, for groundwater recharge via spreading in seven Phase I and six Phase II recharge basin sites located within the Chino North Groundwater Management Zone.

2. Order No. R8-2007-0039 allows IEUA and CBWM to apply a 60-month averaging period to comply with the approved maximum average recycled water contribution (RWC) and total organic carbon (TOC) limits for each recharge basin. The maximum average RWC and TOC limits are determined through the Start-Up Period and approved by the California Department of Public Health (CDPH) and the Regional Board. Also, the maximum average RWC and TOC limits for each basin can be increased upon approval by CDPH and the Regional Board after the first year following the Start-Up Period.

3. IEUA submitted a letter dated March 23, 2009 and a supplemental report dated July 2, 2009, to CDPH requesting a change in the RWC averaging period for the Chino Basin Recycled Water Groundwater Recharge Program. IEUA requested that the 60-month averaging period be changed to a 120-month averaging period to address the water supply shortage of imported water from State Water Project needed as diluent water in the groundwater recharge basins, while providing an equivalent level of public health protection.

4. In June 2009, IEUA and CBWM completed an evaluation of the total dissolved solids and nitrate projections for Chino North Management Zone showing that a change from a 60-month to a 120-month RWC averaging period will have a negligible impact on the Chino North Groundwater Management Zone's maximum benefit based total dissolved solids and total inorganic nitrogen water quality objectives.

5. In a letter dated August 24, 2009, CDPH determined that based on the information submitted by IEUA a 120-month averaging period provides an equivalent level of public health protection as the 60-month averaging period. Therefore, CDPH recommended to the Regional Board the approval of IEUA's request to operate its recycled water groundwater recharge program utilizing an extended RWC compliance period beyond the current 60-month period but not to exceed 120 months.

6. On August 31, 2009, IEUA and CBWM requested that Order No. R8-2007-0039 be amended in accordance with the recommendations forwarder to the Regional Board by CDPH in their letter dated August 24, 2009.

7. It is appropriate to amend Order No. R8-2007-0039 to incorporate the recommendations forwarder to the Regional Board by CDPH in their letter dated August 24, 2009.

8. In compliance with the California Environmental Quality Act (Public Resources Code Section 21000 et seq.), IEUA and CBWM prepared and certified an Environmental Impact Report for Phase I and Phase II Recharge Projects. The Optimum Basin Management Program Environmental Impact Report was approved on June 29, 2000. It identified no significant adverse impact to water quality as a result of the use of recycled water.

9. The Board has notified IEUA, CBWM, and other interested agencies and persons of its intent to amend water recycling requirements for the discharge and has provided them with an opportunity to submit their written views and recommendations.

10. The Board, in a public meeting, heard and considered all comments pertaining to the use of recycled water.

IT IS HEREBY ORDERED that Order No. R8-2007-0039 be amended as follows:

1. Recycled Water Quality Specification A.11. shall be replaced with the following:

    11. For each recharge basin, during the initial year of recharge operation after the Start-Up Period (See Provisions H.9), the maximum average RWC[10] and the TOC limit shall not exceed the maximum average RWC and TOC limits identified in the approved Start-Up Period report. After the first year following the Start-Up Period, the average RWC may be increased at each recharge basin. If the users propose to increase the maximum average RWC, prior approval shall be obtained from CDPH in accordance with CDPH Condition 4 of the Phase I and Phase II Reports (See Attachment A) and from the Executive Officer of the Regional Board. (See also Compliance Determination B.7.). If the approved maximum average RWC is exceeded, the Discharger shall implement measures such that the

maximum average RWC is reduced over a period of 120 months. IEUA shall maintain the RWC volume-based percentage as established and approved by CDPH in each of the basins start up plans. Also, IEUA shall maintain an ongoing assessment of the individual basin's soil aquifer treatment (SAT) efficiency and report any changes to an individual basin's SAT efficacy and the resulting RWC.

2. Compliance Determination B.7. shall be replaced with the following:

    7. Calculation of the running monthly average RWC shall commence after 30 months of operation and shall be based on the total volume of the recycled water and diluent water recharged over the preceding months. For each recharge basin, compliance with the current approved maximum average RWC shall be achieved no later than upon the completion of 120 months of operation after the start-up period. The average RWC shall be calculated by dividing the total volume of recycled water applied to the spreading area during the preceding 120 calendar months by the sum of the total recycled water applied to the spreading area and the diluent water applied during that 120-month period.

3. Conditions for Suspending Groundwater Recharge, E.5. shall be added as follows:

    5. IEUA shall suspend recycled water deliveries to a basin approved for recharge upon reaching the RWC limit on or after month 96 of the 120 month period. Prior to resuming recycled water deliveries, IEUA shall prepare and submit for review and approval a plan to achieve compliance with the RWC limit.

4. Required Notices and Reports F.20. shall be replaced with the following:

    20. The Discharger shall submit a RWC Management Plan to the CDPH and the Regional Board that includes estimates of future average RWCs based on anticipated recharge operations over the first 120 months of recycled water recharge at each recharge site. The RWC Management Plan shall be submitted with the Start-Up Period Report and updated with IEUA's annual report to the Regional Board during the first 120-months and shall clearly identify the plan to achieve compliance with the maximum recycled water contribution by the 120th month at each recharge site. IEUA shall update the basin-specific RWC plans annually to reflect the estimated diluent water and recycled water contributions for the upcoming year. For the purpose of the diluent water projections, implementation of a weighted averaging should be considered when it is known that imported water supplies will not be available for purposes of recharging the aquifer. The underflow of the Chino Basin aquifer may be used as a source of diluent water. CDPH may consider crediting a fraction of the flow as

diluent water, which would be dependent on the accuracy of the method used to measure the flow, its distribution, and the ability to meet the other diluent water criteria in the draft regulation.

5. Required Notices and Reports F.22 shall be added as follows:

    22. By March 1, 2011, the Discharger shall submit a written report based on the findings of a scientific peer review panel. The peer review panel will consist of at least one panel member experienced in the engineering, design, and operation of SAT systems and one research-oriented expert in the SAT field.

6. These amendments shall become effective upon the adoption of this Order.

7. All other conditions and requirements of Order No. R8-2007-0039 shall remain unchanged.

I, Gerard J. Thibeault, Executive Officer, do hereby certify that the forgoing is a full, true, and correct copy of an order adopted by the California Regional Water Quality Control Board, Santa Ana Region, on October 23, 2009.

GJ Thibeault

Gerard J. Thibeault
Executive Officer

Appendix F

Comments and Responses on Draft RMPU

F.1 CITY OF POMONA – RAUL GARIBAY

Comment Number	Page Reference in Draft	Comment	Response
		Section 5: Storm Water Recharge and Recharge Enhancement Opportunities	
1		General comment: What is the marginal benefit of each successive phase? For example, going from Phase III to Phase IV, increases the potential recharge about 2,000 AF at a cost of $84,552,000 in capital costs. What about increase in Energy and O&M costs as well?	Energy and O&M costs are discussed in Section 5.4.8 & 5.4.9; Add incremental cost to Table 5.4-15 *(to be renumbered)* to show annualized cost increases by phase including energy and O&M. *WBE*
2	60	Figure 5.2.2-1: Since San Bernardino County and Chino Conservation District have facilities in the area, this figure would be more useful if the boundaries of these agencies were superimposed here for clarity.	What is shown on Figure 5.2.2.1 are possible locations of potential recharge sites. No assertion is made that they were or are viable as recharge sites and there is no relevance to adding County or District boundaries. *WBE*
3	79	Table 5.3.2-1: a. Wouldn't the size of the basins be limited if you are trying to adhere to a certain embankment slopes? b. Is this practical, from a maintenance perspective, to have embankment heights of up to 40 feet?	a. Embankment slopes alone are not the limiting factor in basin sizing. Basin area would expand as required to meet the required capacity while maintaining desired embankment slopes. *WBE* b. Embankment slopes can be designed to accommodate maintenance requirements. *WBE*

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4.	85	Figure 5.3.1-1: a. Since a range of embankment heights is being considered, the piping and pumping infrastructure would vary for the Diversion Pump Station as well as the Transfer Pump station, correct? b. What embankment height is the conceptual drawing able to accommodate?	a. Yes, however for conceptual evaluation the piping and pumping facilities were not considered to vary significantly. *WBE* b. Question is not clear. *WBE*
5	93	Table 5.4-2: a. According to the numbers, the potential recharge capacity of the Jurupa Basin would decrease by 396 acre-feet. Why would we want to invest in a project that would yield less recharge capacity? The only way this makes sense if, in making the improvements, it helps Wineville Basin in its recharge efforts. b. Spillway Gate improvements have been identified for Wineville Basin. But, I recall reading somewhere in the Section that the current percolation rate is low due to clay layers. Does this number include work to rehabilitate the soil to improve percolation?	a. Total recharge to the Chino Basin is improved in aggregate of all project components. Recharge at RP3 is improved by Jurupa Basin improvements by an amount greater than the reduction of recharge at Jurupa Basin. Phase I project improvements proposed transfer of storm water from Jurupa to RP3 basin. Improvements to Jurupa will not affect Wineville recharge in Phase I development. *WBE* b. The existing basin will be cleaned and recontoured. Percolation rates are estimated to be between 0.25 and 0.5 ft/day. *WBE*
6	93	Table 5.4-3: The inlet improvements must be tied to a certain embankment height. What embankment	Do not understand question. Embankment heights are not changed from existing conditions. Inlet improvements are proposed to divert additional

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		height numbers are these related to?	storm water into basin without enlargement to the basin itself. RP3 is a minor exception as the inlet improvement will enable storage at a higher elevation, but no enlargement of the embankment is proposed. *WBE*
7	97	Table 5.4-4: The potential recharge numbers for Wineville Basin go from 3,474 in Table 5.4-2 to 2,425 AF in this Table. Why would we make improvements to a basin if the recharge capacity would decrease by about 1,000 AF?	Total recharge to the Chino Basin is improved at other facilities by an amount greater than the reduction in recharge at Wineville. *WBE*
8	106	Table 5.4-8: a. The potential recharge numbers for Phase IV, Wineville Basin go from 2,425 AF in Table 5.4-6 to 1,875 AF in this Table. Why would we make improvements to a basin if the potential recharge decreases by about 450 AF? b. It seems that by implementing Phase IV, there will be an additional 2,300 AF potential recharge gained but it is at the expense of a 4,500 AF decrease in Phase I improvements. Is this correct?	a. Same as above. *WBE* b. No. Storm water is redistributed to other basin to improve total Chino Basin recharge amount. *WBE*
9	116	116, 2nd Para: a. If the height of the basin embankment creates a “dam” by the State standards, what other requirements may be imposed? Could it lead to annual surveys, etc?	a. Following completion of construction, DSOD will perform an annual inspection of the dam. An annual fee will also be assessed based on height of completed dam. *WBE*

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		b. Might there be limitations imposed that will restrict maintenance procedures?	b. Maintenance procedures that do not affect the dam structure or increase the storage capacity of the dam above the elevation of the downstream toe of the embankment will not be restricted by DSOD. *WBE*
10	118	Table 5.5.1-1: Of the Potential Recharge in Basin Export column, how much of the 2,597 AF is attributable to export?	There is no export. Column heading will be revised to remove reference to export. *WBE*
11	119	Table 5.5.1-2: The estimated costs for engineering and administration costs appear to be low. How does this value compare with IEUA previous work on basin improvements	E&A were assumed at 10% and include efforts to design and build the proposed project. Will consult with IEUA on their direct project experience. *WBE*
12	120	2nd Para: Roughly the same amount of excavated material, 1,000,000+ CY, is being taken out of the Wineville Basin. As a result of this work, this basin will increase it additional storage by 158 AF while the Wineville Basin will increase by 895 AF. Is this difference attributable to basin configurations?	Lower Day basin would require excavation of 40 to 80 feet of material just to reach the maximum storage elevation of the existing basin. Wineville excavation would occur within the existing storage area of the basin and would directly improve storage capacity by an amount equal to excavated volume. *WBE*
13	123	Section 5.5.2.3.3: Need to clarify that the 1,469 AF is additional recharge.	Noted. *WBE*

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14	124	Section 5.5.3.3, Option 2: Need to clarify what is meant by the term *dead storage*.	Will add clarification. *WBE*
15	126	Table 5.5.3-1: Given that the Potential Recharge numbers change for each phase, which phase do these numbers represent?	Recharge at the facility as a stand-alone project with no export of storm water to other facilities. *WBE*
16	127	Table 5.5.3-2: Given that the Costs Estimates change for each phase, which phase do these numbers represent? Do they represent Phase I or Phase I&II?	Cost estimate for 15 feet of excavation is an option in the improvement of Jurupa Basin. Option 1 improvement is not utilized in the phased development. Option 2 is included in Phase V developments. Inlet improvements estimated on Tables 5.5.3-4 and 5.5.3-5 are included in Phase I-IV developments. *WBE*
17	135	Table 5.5.4-3: This Table is for the RP3 project with excavation while Table 5.5.4-2 is without excavation. Although the line item for excavation is different in this Table, other line items are impacted as well. So that it is easier to follow, the other line items that changed need to be placed in bold font for extra emphasis.	Noted. *WBE*
18	140	Section 5.5.6.3: a. Because modifying the Lower Cucamonga Basin would disrupt the Cucamonga Creek (a waterway), would this trigger the need to coordinate with the US Army Corps of Engineers or Fish and Game officials?	a. Yes. Will review project with all responsible permitting agencies as necessary. *WBE* b. Yes. Maintenance will be required. *WBE*

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		b. Would this basin have the potential for high sediment deposits?	
19	145	Section 5.5.7.3: a. Because modifying the Lower San Sevaine Basin would disrupt the San Sevaine and Etiwanda Creek (waterways), would this trigger the need to coordinate with the US Army Corps of Engineers or Fish and Game officials? b. Would this basin have the potential for high sediment deposits?	a. Yes. Will review project with all responsible permitting agencies as necessary. *WBE* b. Yes. Maintenance will be required. *WBE*
		Section 6: Supplemental Water Recharge Enhancement Opportunities	
20	6-3	Section 6.3.1: Based upon what is stated in this section, there is no recycled water being recharged in the basins during rain events. The reason I ask is that the monthly reports, provided by Watermaster show stormwater and recycled water recharge occurring in the same months.	Recycled water recharge can occur during the same month as storm water recharge but not during storm events. *WEI*
		After reviewing, I still have some lingering questions. A. If there is recycled water recharge taking place in the same month as storm water for a basin, is there a chance that recycled water might already be in the basin prior to the rainfall? B. At what point does the recharge of recycled water	A. Absolutely. B. The recharge of recycled water stops when there is no more recycled water left in the basin. C. IEUA terminates the discharge of recycled water to recharge basins when they believe, based on weather forecasts, that the recycled water will interfere with the recharge of stormwater. D.

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		stop? C. Does IEUA stop filling the basin a day or two prior to anticipated rainfall? D. The reason I ask this is what happens if the rainfall is significant and water eventually overflows from the basin? E. Since stormwater has a priority, I would suspect that the overflow is deducted from the recycled water recharge and not the storm water recharge, correct? If this is the case, then shouldn't it be stated here?	Presuming there is recycled water in a basin and the volume of storm water causes water stored in the basin (recycled and storm water) to overflow, then the first water lost should be recycled water. E. In recent discussions with Andy Campbell of IEUA he said that he has not given stormwater recharge priority over recycled water recharge when he computes recharge for each basin; and that he doesn't think that this has happened. Watermaster staff has requested detailed operational histories for the CBFIP basins from IEUA to determine if stormwater recharge was lost to recycled water recharge and this request has not yet been fulfilled. *WEI*

F.2 IEUA

Comment Number	Page Reference in the Draft	Comment	Response
		Section 1 – Introduction	
1		General Comment: Two years ago, when we initiated the RMPU process with Chino Basin Watermaster (Watermaster) and Chino Basin Water Conservation District (CBWCD), we agreed to have a financing plan included in the RMPU report. Why has this been deleted from the current outline?	The assumptions that were made during the development of the RMPU outline regarding planning information were determined to be not valid during the development of the actual 2010 RMPU – the projected groundwater production and the need for new replenishment facilities respectively. As to stormwater recharge, significant additional engineering and planning work will be required. A financing plan will be developed later if and when the RMPU stakeholders determine the need to construct the new stormwater recharge facilities. *WEI*
2	1-1	The opening paragraph outlines the schedule of how Watermaster is going to comply with the Chino Basin Groundwater Recharge Master Plan Update (RMPU) portion of Condition Subsequent 5 and 6; however it doesn't outline the schedule that shows how Watermaster will comply with the CEQA portion of Condition Subsequent 5 and 6.	See response to comment 1 above. Watermaster cannot be a lead agency for purposes of CEQA. If and when the RMPU stakeholders determine the need to construct the new stormwater and/or supplemental water recharge facilities, a lead agency will be determined. *WEI*
3	1-2	The table in this section outlines the 10 sections that make up the RMPU. This is different than what is currently outlined on the RMPU website.	The outline of the RMPU changed slightly to reflect how the investigation actually proceeded, but the content has remained faithful to the outline that was submitted to

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			Court. *WEI*
4	1-2	What is the schedule to complete section 8, which is titled "Integrated Review of Water Supply Plans – Part 2?"	See response to comment 1 above. The actual report organization was changed to comport with the actual work that was done. The RMPU report contains all the content required by the Court. *WEI*
5	1-2	What is the approach and process to rank and recommend projects? Will there be a schedule associated?	See response to comment 1 above. No ranking was done and no projects were prioritized. *WEI*
		Section 2 – Planning Criteria	
6		General Comment: Sections 5 and 6 are not consistently following the described planning criteria such as Engineering Cost, Piping etc. Recommend updating this section to match the entire document's planning assumptions.	Construction costs were evaluated utilizing as-bid project information obtained from completed portions of the CBFIP together with discussions with various material and equipment suppliers and contractors to obtain a reasonable estimate of potential construction costs. Engineering costs were estimated based on considerations of engineering effort or work required to administer and complete the proposed projects. Projects which have a large number of units such as excavation of a basin generally require a smaller percentage of engineering work than projects with small number of units and/or a high degree of complexity. Similarly projects which involve integration and coordination of many different

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			specialties will require more engineering work than projects involving only one, or few. Engineering costs utilized in Section 5 projects cost evaluations were estimated to provide a balance between simple and complex projects. *WBE* *B&V response:* Acknowledged. Edits to section 2 will be made for consistency with TM (Appendix F).
7	2-1	The Introduction (as well as the RMPU) should also include planning criteria for financial, design, operation and regulatory components that are required for the court and listed in the RMPU Outline. It would be helpful if a discussion of permitting requirements was included with the planning criteria.	See response to comment 1 above. *WEI*
8	2-5	According to the "Watermaster Compliance with Condition Subsequent 5 and 6" court document, the first element requires a number of factors to be included in the baseline conditions; one of which is the total Basin water demand. Where is/will this be discussed in the RMPU?	Total Basin water demand was in the Draft of Section 4 and will be updated slightly in the final. *WEI*
9	2-5	According to the "Watermaster Compliance with Condition Subsequent 5 and 6" court document, the fifth element requires that the "Projections should be supported by thorough technical analysis." Along	The Optimization Modeling by WEI and the three previously submitted IEUA Tech Memos have been included by reference and discussion in the text and tables. The IEUA Tech Memos are included as a

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		with the Optimization Modeling that Wildermuth Environmental Inc. (WEI) has done, the three previously submitted IEUA Tech Memos discussing these projections should also be included as part of this analysis and considered included/addressed in the RMPU.	separate appendix. *WEI*
10	2-6	According to the “Watermaster Compliance with Condition Subsequent 5 and 6” court document, the ninth element requires an appropriate schedule to plan, design and construct recommended projects. IEUA recommends, in coordination with Watermaster and WEI, developing “trigger-points” that signal when a project is needed. One approach would be to develop a Ten-Year Capital Improvement Program based on priorities when funding is available. The “trigger-points” should include consideration of more aggressive implementation of new resource policies and regulations (SBx-7x 20% reduction in per capita use, MS4 permit requirements and AB 1881 implementation) and their potential to defer the need for more costly infrastructure projects.	See response to comment 1 above. *WEI*
11	2-7	The recently upgraded Sanhill water treatment plant, owned by the Fontana Water Company, should also be included in section 2.3.4.1.	*B&V Response:* Acknowledged. This will be added to the Memo.

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12	2-8	Section 2.3.4.2 should include a discussion about brine disposal, discussing capacity, ownership and volume of brine because in the future this will be a critical constraint for exporting non-reclaimable wastewater.	*B&V Response:* Acknowledged. A brief paragraph will be added to the Memo.
13	2-9	Section 2.3.4.2 discusses bringing Colorado River Aqueduct water into the Chino Basin. One of the facilities suggested to get water into the Chino Basin was the rehabilitation of the Galvin WTP. Since this is not allowed by the Regional Board's Basin Plan it should be noted that this proposal would require an amendment to the Basin Plan. Is this in Ontario's 2010 General Plan?	B&V Response: This same concept was developed for the DYY Program with no comment. B&V understands this concept may be feasible due to Met's 50 CRW/50 SWP Upper Feeder blend goal. Also, this project may be feasible if: (1) TDS from Upper Feeder supply can be blended with local groundwater prior to delivery to customers; (2) RO with appropriate brine disposal is incorporated into the plant design; (3) excess salt credits from the desalters and/or maximum benefit would offset any additional salt loading in the Basin; or (4) change the Basin Plan.
14	NA	Table 2-3: The table summarizing Recharge Basin Design Criteria has the facility component "basin depth, ft" listed with a design criteria of 16-Aug. This should be updated.	Table has been corrected. Thank you. *WEI*
15	NA	Tables 2-3 and 2-7: This table should also include normal groundwater recharge components such as; storage volume, local run-off flow, flow-through/off-channel, pump stations, rubber dams, drop inlets,	Storage is a grading issue and is covered. Pump stations, rubber dams, drop inlets, internal berms are site specific and are estimated on a project specific basis. The other listed items in the comment are not

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		internal berms, etc.	relevant to either table. *WEI*
16	NA	Table 2-4: The title for this table ends in the word Plan, it should be Plant.	Table has been corrected. Thank you. *WEI*
17	NA	Table 2-5: This table is titled as the CVWD WTP; it should be listed as the WFA WTP.	Table has been corrected. Thank you. *WEI*
18	NA	Table 2-8: Is this a summary of annual unit costs? MWD rates should be updated. There are several footnotes missing. What are the costs associated with the advanced treatment line items? What are the costs associated with the pump station line item? What are the costs associated with the misc. basin maintenance line item?	Table has been corrected. Thank you. *WEI*
19	NA	Table 2.9: Based on previous engineering and construction management experience of the Phase 1 and Phase 2 CBFIP, IEUA recommends the following: use 15% for engineering service. This is a typical percentage which covers consulting/design services, project management and administrative support. Recommend separating CM support and using 7%. Recommend adding a line item cost for a 5% mobilization. Is the 90% on-line factor for all alternatives/projects?	Review of the project costs elements incorporating the percentages suggested by IEUA for mobilization, E&A and CM indicates that the total cost of the project is unchanged when compared with the +15-percent range shown on Table 5.4-15. The majority of the additional cost occurs in the latter phases of the project where significant costs attributable to excavation and pipelines occur which generally would have a less intensive per-unit cost for engineering and contract management. In addition, an additional 7% of the project cost for CM is not within the Task 3 Planning Criteria document

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			prepared for the RMPU. *WBE*
		Section 3 – Safe Yield	
20	3-3	Section 3.2.2 states that the safe yield can be calculated in one of two ways: either by negotiation among interested parties or based on hydrologic principles. If and/or when has the safe yield been calculated by negotiation? Does Watermaster foresee this method being used in the planning period of the RMPU?	There are several adjudicated basins in California where the *final* safe yield is determined by negotiations. Watermaster will compute safe yield based on hydrologic principles. *WEI*
21	3-6	The title for Section 3.2.5 is listed as Areal.	The correct title is Areal Considerations. Thank you. *WEI*
22	3-10	The last sentence in section 3.3.4 states that Watermaster will re-calculate the safe yield for the first time in FY 2010/11. Is there a proposed schedule for how often the safe yield will be re-calculated, going forward?	The Special Referee reported to the Court that Watermaster *should* compute safe yield every year and Court included her recommendations in its Approval of the Peace II Agreement on December 21, 2007 and acknowledged that Watermaster would recomputed the safe yield in 2010-11. Watermaster will recompute safe yield in fiscal 2010-11. Watermaster will need to determine the frequency of recomputation thereafter. *WEI*
23	NA	Table 3-7: It appears that the footnotes were cut-off.	Table has been corrected. Thank you. *WEI*
24	NA	Table 3-6: Does the Deep Percolation of Applied Water column include the potential stormwater	No. *WEI*

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		capture via MS4 permits; which ranges from 25,000 AF – 50,000 AF, according to Table 3-7?	
25	NA	Table 3-6: The recycled water recharge projections should be updated with the revised projections provided by IEUA in the previously submitted Tech Memo #3.	Table 3-6 shows the water budget from a prior modeling study conducted by WEI in 2009 and predates IEUA's May 2010 recycled water estimates. Table 3-6 was included to illustrate the change in safe yield. Recycled water recharge is not included in the safe yield calculation. The recycled water estimates used in Section 6 reflect the May 2010 "Mid-Range" recycled water recharge estimates. *WEI*
		Section 4 – Integrated Review of Water Supply Plans – Part I	Note that in the final report this section name has been changed slightly to *Section 4 – Integrated Review of Water Supply Plans. WEI*
26	4-1	The opening paragraph explains how the Peace Agreement holds the Watermaster responsible for constructing recharge capacity to meet all of its replenishment needs through "wet" water recharge. Does the Peace Agreement or Watermaster ever address "in-lieu" actions as a possible recharge capacity?	The final Section 6 does include in-lieu recharge capacity and the final Sections 6 and 7 include recommendations for in-lieu recharge to address the balance of recharge and discharge in the managed area of MZ1, JCSD service area and in the north central Chino Basin. *WEI.*
27	4-1	Section 4.1 is titled "Initial Water Supply Plans for All Entities That Use the Chino Basin." Is there an approach and/or schedule for developing "Final	Both the final Section 4 and 7 contain recommendation that the 2010 RMPU be updated in fiscal 2011-12 to incorporate the groundwater

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		Water Supply Plans?"	production projections from the 2010 Urban Water Management Plans and to complete subsequent RMPUs with 12 months of completing future UWMPs. *WEI*
28	4-1	Please include information from IEUA's previously submitted Tech Memo's (#1-3).	Based on our conversation with the Appropriator parties, the IEUA Tech Memo's 1 through 3 do not reflect the groundwater production projections of the appropriator parties. The projected 2010 production was replaced with the actual production in 2008-09 to make the short-term production projection consistent with actual production. *WEI*
29	4-3	Section 4.2 can be updated with the revised recycled water recharge projections provided by IEUA in the previously submitted Tech Memo #3.	The "midrange" recycled water recharge projection from IEUA's May 2010 Tech Memo #3 was incorporated into production rights in Section 4. *WEI*
30	4-3	The last few paragraphs highlight a few of the current and future demand conditions that can be found in IEUA's previously submitted Tech Memo's (#1-3) on the Water Supply Plans. IEUA recommends including all the conditions in these Tech Memo's, in this section of the RMPU.	Comment noted. *WEI*
		Section 5 – Stormwater Recharge Enhancement Opportunities	
31	NA	Cost Estimate Comments: Recommend adding an O&M cost for each improvement as part of the	O&M costs were calculated and added to the total project cost in the aggregate of all storm water

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		evaluation and discussion; recommend the use of the revised percentage for engineering, CM support and permitting cost; and recommend adding a line item cost of 5% for mobilization for each estimate table.	recharged in the basins for each phase of project development evaluated for the RMPU. A more detailed O&M cost evaluation will be computed upon completion of a preliminary design of each project component. *WBE* (See A.4 for WBE's *General Responses to Comments.*)
32	NA	General Comment: Recommend using a lower percolation rate for each proposed project (ie. ½ ft/day) to give a range of possible recharge. Stated recharge estimates will likely provide overestimates of recharge capability.	The ranges of recharge for each project component shown in Section 5.5 are applicable to recharge operations when the project component is operated independently of other storm water distribution systems. Estimates of recharge for facilities included in the recharge distribution system are assumed to be more dependent upon diversion rates and timing of diversions between basins than the recharge rates of the basin themselves. Verification and/or determination of recharge rates should be performed for each component of the RMP along with optimization of the diversion and distribution system as the planning and implementation process is further developed. *WBE*
33	NA	General Comment: It is difficult to follow the potential recharge and costs from phase to phase. A more detailed discussion for each phase, and the differences, is needed. Recharge improvements are	A discussion section of recharge and costs will be added to the report to clarify that the phasing is more convenience for design and construction rather than marginal cost analysis. Each time we add a phase

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		shown to be moved into subsequent phases within the document which results in changes to previously stated project phase cost effectiveness. Request that each phase clearly identify the amount of water to be developed and the cost for that phase. If a subsequent phase results in changes to either the amount of water being recharged or cost to an earlier phase, this needs to be clearly identified and the estimates for the early phases modified so that the impacts of the additional investments can be evaluated.	the incremental water cost is significantly higher. The project is not prioritized or fully optimized and there is no recommendation that water be purchased at a price higher than its actual value. Looking at total asset costs the presumption that the water captureable is firm annual yield and is not available somewhere else. If water is available somewhere else, either by purchase or conservation, there will not be need to press forward with advanced phases of the project. *WBE*
34	NA	General Comment: Recommend review of DSOD limitation at each facility and opportunities to work with DSOD and/or SBCFCD to increase storage volume and time based on coordination and study as necessary.	Noted. Will be evaluated during the preliminary design and project optimization of the RMPU. *WBE*
35	NA	General Comment: Recommend reviewing San Antonio dam release coordination and agreements, as well as other opportunities to coordinate operations with ACOE and SB County in the upper watershed (ie. there are debris dams that could also be evaluated).	Will be considered for incorporation into the RMPU during further optimization of the project. *WBE*
36	11	Section 5.1.1.2: The Victoria Basin inlet from San Sevaine Channel (destroyed in the 2003 winter) is assumed to exist. While there has been discussion	Will be considered for incorporation into the RMPU during further optimization of the project. We question why the inlet has not been repaired. *WBE*

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		with SBCFCD, these repairs have not been made to date. The reconstruction of this inlet is important to capturing water that escapes the Etiwanda Debris basin and San Sevaine 5. These costs need to be added to the evaluation.	
37	11	Section 5.1.1.2: A small upper level basin exists at the Lower Day basin site can be easily modified to hold stormwater. Currently stormwater enters this smaller basin and runs into the active recharge portion of the site. Holding water in the upper level would preserve capacity in the lower level. The upper level and lower level designations are not to be confused with the Upper Day basin located north of Banyon Street adjacent Day Creek. The Lower Day facility is incorrectly labeled “Days” on Figure 5.1.1-1. The figure also incorrectly labels the “Upper Days” basin. The Upper Day basin is located to the north in the Cucamonga Basin.	Will be considered for incorporation into the RMPU during further optimization of the project. *WBE*
38	11	Section 5.1.1.2: [1] Channel and inlet modifications to the Lower Day basin were evaluated in the W&B report as necessary. IEUA has not observed a need for increasing the inlet capacity. There may be some confusion between the actual inlet capacity and the maximum rate of imported water delivered to the site. Imported water delivery is limited to 22	[1] Modifications were made to inlet facilities to maximize use of the basin to accommodate the hydrologic modeling performed by WEI. *WBE* [2] Hydrologic modeling by WEI assumed the entire flow of Day Creek flowed into the Lower Day basin. The capacity of the inlet for the proposed inlet modifications is assumed to equal the design

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		cfs. [2] Above this rate, rolling waves develop in the channel and can periodically surge water over the rubber dam. Due to the high cost of imported water, its loss is controlled by lowering the delivery rate. IEUA was not able to find a reference to the inlet capacity used by B&W. For stormwater a higher capacity should be used to represent actual inflow. [3] The existing flow control gate at Lower Day basin does not open to its full diameter due to its construction. While this had not been seen to impact inflow, removal of this restriction would improve flow through should any limit exist. Lower Day is located high on the alluvial fan at the basin of the mountains and generally receives only small flows during times when snow pack accumulates. For Lower Day the WEI rainfall-run off model should account for periods of snow accumulation and melting prior to implementation of inlet improvements, which may preclude the need to upgrade the channel inlet.	capacity of the existing flood control inlet channel. *WBE* [2] We were unaware of the delayed maintenance of the facility. Will be considered for incorporation into the RMPU during further optimization of the project. *WBE*
39	11	Section 5.1.1.2: A mid level uncontrolled outlet exists at Lower Day at an invert water depth of about 15 feet. Additional controls to this outlet can preserve water above this depth.	Will be considered for incorporation into the RMPU during further optimization of the project. *WBE*

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40	11	Section 5.1.1.2: This section mentions improving Lower Day banks to meet DSOD requirements. The facility currently meets DSOD requirements.	Noted. Modifications to the facility or facility operations, including flood routing changes, will require review and approval from DSOD. *WBE*
41	13	Section 5.1.1.2: The habitat referenced in Cell 2 at Declez is actually at the RP-3 Basins.	Noted. *WBE*
42	47	Section 5.2.1: Paragraph 1 indicates the LID facilities in Table 5.2.1-1 are upstream of recharge basins and that their use would not create significant new recharge. Figure 5.1.2-5 is a map of the LID facilities and shows they are downstream of existing recharge basins. This statement on page 47 is only true if the Lower Cucamonga basin is developed for stormwater capture. Please correct the figure and subsequent evaluation. The discussion of Lower Cucamonga Basin should include discussion of LID ability to capture stormwater and the net potential improvement gained through the development of this facility.	The facilities listed in Table 5.2.1-1 are not LID facilities. Facilities listed in Table 5.2.1-1 and shown on Figure 5.2.1-1 are potential recharge basin locations or locations where open space exists within the Chino Basin where a recharge basin could potentially be constructed if the land was available and could be purchased. *WBE*
43	69	Section 5.3: This section discusses that stormwater water is available for capture above that currently captured. While there is no disagreement, there is no clear documentation of this availability. What is documented is how much could be captured with improvements, but not how much actually exists to	Hydrology models were prepared by WEI based on 58 years of hydrologic record. The amount of recharge for stormwater projects is the amount of increase above the historic operations. *WBE*

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		capture.	
44	76	Section 5.3.1: This section references an option to remove the basin cells. This option provides insignificant volumetric benefit and significantly hinders basin operations and maintenance.	Removal of the basin cells was conceptually evaluated as part of a preliminary review of potential recharge improvement projects. This concept was not evaluated in the conceptual project evaluation presented as part of the RMPU project. *WBE*
45	82	Section 5.3.3: Paragraph 3 indicates the RP-3 site is a SBCFCD-owned facility. It is not, it is an IEUA-owned facility.	Noted. *WBE*
46	82	Section 5.3.5: Indicates the Cucamonga Creek inlet to Turner could be improved to bring more water into Turner up to the outlet spillways. In fact, Turner 1&2 are filled to capacity with little water being bypassed during storms. Limitations on capture at Turner 1 are mostly due to muddy water. The limitation is on the elevation of the inlet on Deer Creek into the Turner 3&4 basins. Discussion needs to be added regarding development of the Turner basins east of Archibald Avenue, which have the potential capturing the estimated additional 700 to 1,200 AF of stormwater from Deer Creek.	Inlet modifications were a part of a preliminary review of potential recharge improvement projects. When sufficient details of the Turner basins east of Archibald Avenue become available, an evaluation of the Deer Creek inlets could be completed. *WBE*
47	88	Section 5.4: The bullet that suggests adding a pump station to Hickory basin to pump stormwater to Banana basin is not necessary. Such a facility	Noted. Will be incorporated in further optimization of the project. *WBE*

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		already exists, but is used for imported water transfers. Operations experience has indicated that Banana Basin overtops in larger storms and would not benefit from pump station operation during winter months.	
48	88	Section 5.4: The bullets suggest enlargement of the RP3 basins to increase storage. While there is some area not used for recharge, operational uses the open space to dry out weeds and to store and process soils for construction contractors. Recommendations to use available space should be weighed with the space's value for maintenance activities on IEUA-owned basins given the SBCFCD's practice of prohibiting such activities at their basins.	Enlargement to RP3 basins involves excavation of the existing basin cells to a deeper depth and not expanding the footprint area. No expansion of the existing cells is proposed in the conceptual project evaluations, however the expansion of the cells to include area not currently utilized for recharge may be considered during further optimization of the project. *WBE*
49	93	Section 5.4.3.1: the current recharge at RP3 is estimated too low. The low for the past 5 years has been 511 AF while that listed in table 5.4-2 is 244 AF. All current recharge numbers in the evaluation should be reviewed with historical operations.	Noted. Recharge rates will be reviewed and/or verified for all recharge facilities as part of the preliminary design and optimization of the RMPU project. *WBE*
50	93	Table 5.4-2: [1] It is unclear whether operations guidelines, modes, and SBCFCD flood routing would allow operation at the levels indicated. Current groundwater recharge operations agreements with SBCFCD should be incorporated	[1] Noted. Will review and incorporate as necessary during the preliminary design and optimization of the RMPU project. *WBE* [2] Noted. *WBE*

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		and resolved that would allow more water to be stored and recharged in existing basins. [2] Existing agreements require water to be released from Grove Basins when it is over 5 feet deep. The Grove basin midlevel outlet and spillway are at depths of approximately 17 feet and 25 feet, and the basin area is approximately 13 and 14 acres at these depths. [3] For Ely Basin, storm water releases are required at a water depth above 835 feet. The Ely spillway is at an elevation of approximately 838 feet, and the basin area is approximately 32 acres at that depth. Additional storage could also be made available at Lower Day, San Sevaine (1, 2, and 3), and Victoria by increasing the operational depth and basin modifications such as increasing the spill point elevation.	[3] Noted. Will be considered for incorporation into the RMPU during further optimization of the project. *WBE*
51	94	Section 5.4.4: Declez basin is currently fully utilized with winter flows and would not have available space to receive pumped water from Wineville, Jurupa, or Lower Cucamonga basins until summer months (page 94).	Hydrologic modeling by WEI indicates similar results. Declez Basin improvements were removed from the RMPU as significant increases in recharge were not realized by the proposed improvements. Removal of the improvements to Declez basin does not remove its capability to recharge additional water as part of the recharge distribution system as water pumped from Jurupa basin into RP3 basin, in excess of RP3

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			basin's storage or recharge capacity, will accrue to the Declez basin where it can be recharged. *WBE*
52	94	Section 5.4.4: Jurupa Basin is currently limited by the pump station capacity (20 cfs). A second pump bay exists for another 20 cfs pump. Addition of this pump and full utilization of the Jurupa basin storage should be a priority project. While it has been expressed to increase the inlet capacity of Jurupa basin from the San Sevaine Channel, during local intense rain events the three existing large storm drains entering along the north basin wall provide storm water approaching the current 20 cfs pump capacity. Prioritization of a second pump over the inlet upgrade should be made in Phase 1 and not in Phase 2. Ability to increase channel diversions into Jurupa basin would be most effectively used if additional storage capacity within Jurupa basin could be utilized (i.e. increase operating depth currently restricted by SBCFCD contractor mobilized in basin).	Noted. Will be considered for incorporation into the RMPU during further optimization of the project. *WBE*
53	97	Section 5.4.4.1: For Tables 5.4-4 through 5.4-7, please provide clarification for the justification for Phases II and III. These tables show no potential recharge increase at a construction cost of $46 million.	The potential recharge increases realized by Phase II and Phase III projects are shown by the increase recharge in the recharge basins served by the improvements (the end use facilities). Following completion of Phase II projects, improvements in Phase III, at an additional construction cost of

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			$37,777,000, result in an additional 3,206 acre-feet of total recharge to Chino Basin. *WBE*
54	97	Section 5.4.4.2: Table 5.4-5 uses cost estimates that do not match the detailed estimates prepared in Tables 5.5.9-1 and 5.5.9-2.	Noted. Tables 5.5.9-1 and 5.5.9-2 will be updated. *WBE*
55	102	Section 5.4.5.2: Table 5.4-7 uses cost estimates that do not match the detailed estimates prepared in Tables 5.5.9-1 and 5.5.9-2.	Noted. Tables 5.5.9-1 and 5.5.9-2 will be updated. *WBE*
56	103	Section 5.4.6: This section suggested removal of the Cell 2 habitat. This habitat is permitted to exist in perpetuity as mitigation for the CBFIP. While the site has a place in stormwater capture and release to other RP3 cells, there should not be a suggestion for its removal. IEUA suggests the current afterbay of cell 2 (not habitat) be connected to adjacent cell 3 to facility use of the habitat as a settling basin and water holding/transfer basin.	Removal of the cell 2 habitat is presented as a consideration to be evaluated in the preliminary design or optimization portion of the RMPU project. It may be possible to provide the mitigation at an alternate location. Incorporation of the existing afterbay portion of cell 2 into the improvements of the RP3 basin will be considered in the preliminary design or optimization portion of the RPMU project. *WBE*
57	119	Section 5.5.1.3.2: For tables 5.5.1-2 thru 5.5.9-2, the planning criteria in this section is not consistent with the cost methodology noted in Section 2, Planning Criteria. Recommend using a 5% cost for mobilization, recent project costs are averaging at this percentage.	Noted, see previous comments. *WBE*

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58	132	Section 5.5.4.3: Figures 6.5.4-3 shows concepts for reconfiguration of the RP3 basin site. The concepts include a transfer pipe from Cell 1 to cell 3. In fact, such a transfer pipe already exists and the cost of which should be removed from the evaluation. While a second inlet to the RP3 site may be warranted, its purpose is in part to retain water that would flow to and overflow from Declez basin. A significant flow originates from a storm drain located immediately downstream of the existing rubber dam at the RP3 basins. A new diversion located at the currently outlet to the RP3 basins would pick up these flows and eliminate the need for the approximately 1,000 feet of 8ftx10ft diversion conduit shown on the concept map through the SCE easement. The overflow spillways and energy dissipaters shown on the concept map are not required as the basin currently is constructed to spill back into the Declez channel when full. Significant discussion is given to building pipelines and pumping captured storm water to RP3 basins from Wineville, Lower Cucamonga, and Jurupa Basin. During wet years, the RP3 capacity will be occupied by local flows and Jurupa basin pumping. The report should address that the use of RP3 storm capacity for Wineville and Lower Cucamonga Basin pumping may only be available in drier years.	The transfer pipe from cell 1 to cell 3 is proposed to hydraulically connect the two cells with a conduit of sufficient capacity such that the cells would operate as one basin. The existing transfer pipe is relatively small in size and capacity and would limit the transfer of water between cells. The second inlet is proposed to divert additional water which the existing inlet structure is not capable of diverting and will also allow for water to be stored at a higher elevation thereby creating additional storage and recharge. A new diversion located at the current outlet to the RP3 basins will be limited in diversion potential as the elevation of the channel at this point would limit storage to only the lower portions of cells 3 and 4. This can be evaluated further in the preliminary design or optimization portion of the project. The overflow spillways and energy dissipaters are required to accommodate the additional inflow from the new diversion inlet and conveyance conduits between the cells and the increase in storage elevation allowed by the new inlet diversion. The spillways located in each cell will provide operational flexibility and redundancy in case operational controls malfunction or in case flows in excess of the

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			existing overflow system are experienced. This will be evaluated further in the preliminary design or optimization portion of the project. Hydrologic modeling by WEI indicates that on average there is and will be capacity at RP3 basin for storm water to be pumped from Wineville, Lower Cucamonga, and Jurupa Basins. This will be evaluated further in the preliminary design and optimization portion of the project. *WBE*
59	138	Section 5.5.5.3.1: This section lists the cost-share of CBWM as being $2,446,000. There should be a list of the total project costs, who the other cost sharing parties might be, and what the other shares would be. The basin concepts as should are only a minimal, and should include internal management of the water in cells and perhaps a pump station to drain the basin. Flows on West Fontana Channel are muddy and would require such management.	The other parties involved in the cost sharing are the current pit owners/operators, SBCFCD, and Watermaster. Elements to be incorporated in the preliminary design of the project will be developed in consultation with all parties involved. *WBE*
60	140	Section 5.5.6.3: This section mentions an IEUA bacteria problem of dry weather flows. How is this defined as an IEUA problem? The incorrect acronym IEUD is used in the second paragraph.	Memorandum dated February 24, 2010 prepared by CDM suggests collaboration with IEUA to resolve the bacteria problem. The idea is to incorporate facilities to divert bacteria-laden dry-weather flows, which could also be used in wet-weather conditions, into the proposed Lower Cucamonga Basin as part of the RMPU project of which IEUD is a principal member.

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			Further review of the concept would need to be undertaken to determine if the potential idea is viable and could be incorporated into the RMPU project. *WBE*
61	141	Section 5.5.6.3: This section mentions relocating burrowing owls from this site. F&G mitigation for disturbing burrowing owls is 6 acres per owl. With this restriction, it may be preferable to purchase the required land and use it for recharge. The conceptual reconfiguration of the Lower Cucamonga Basin should retain internal cells to facilitate management and maintenance of water held at this location.	Noted. *WBE*
62	153	Section 5.5.9.4: For Tables 5.5.9-1 and 5.5.9-2, the noted cost for conveying and pumping from Hickory West to Victoria is not fully discussed in this section. Please clarify if the line item is included or excluded from the proposed improvements.	Question is unclear. The cost for conveying and pumping from Hickory West to Victoria is included in the proposed improvements. *WBE*
63	NA	DSOD Facilities – Working with the Division of Safety of Dams (DSOD) to allow longer than 24 hours of storage on the existing DSOD jurisdictional facilities was initiated by CBWM with Gordon Treweek, but has not been carried further since his retirement. These include Jurupa, Lower Day, San Sevaine 5, and Hickory. Evaluation and possible	Noted. Consultation with DSOD will be integral to the preliminary design of the proposed RMPU project components and will be included in the preliminary design process. *WBE*

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		modification to the water-soil interface at these locations could allow longer storage and increased storm water volume to be captured and recharged at these existing locations.	
64	NA	Turbidity Sensing to Prevent Degradation of Infiltration Rates – IEUA has advocated the use of turbidity sensors at all basin inlets. Use of these sensors would allow automated control of basin gates, would minimize storm water lost in a first flush and would also minimize damage to basin infiltration rates during intermittent periods of muddy water flows during storms. This alternative should be addressed by the evaluation.	Will be considered for incorporation into the RMPU during further optimization of the project. *WBE*
65	NA	Etiwanda Conservation Basin/Etiwanda Regulatory Storage Tanks – CBWM currently is leasing the rights to develop this location. The report gives no discussion of the use of this site for recharge, and or use for a transfer facility.	The location of the regulatory storage tanks at the Etiwanda Conservation Basin site was chosen for its general proximity to the proposed project alignment. Alternate sites can be evaluated in the preliminary design of the project. *WBE*
66	NA	San Sevaine 5 – San Sevaine Basin 5 routinely fills and spills during storm events while its adjacent basins San Sevaine 3 and 4 can receive little to no water during the same event. Rather than let this water spill to lower basin, a pump station from basin 5 to basin 3 should be evaluated. Preserving the capture of water in the upper watershed can	Will be considered for incorporation into the RMPU during further optimization of the project. *WBE*

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		significantly change the need for a pump station in Lower Cucamonga basin.	
67	NA	Lower San Sevaine (Victoria Basin) – A new basin is mentioned in this report as Lower San Sevaine Basin. This new basin has been discussed in previous Watermaster discussions and meetings as the Lower Victoria Basin. The name use is irrelevant, but this point should be made to avoid confusion.	Noted. *WBE*
		Section 6 – Supplemental Recharge Enhancement Opportunities	
68	6-1	Section 6.2: Paragraph should be updated with the revised replenishment requirements considering the revised production data and recycled water recharge data.	Section 6.2 has been updated based on the update to Section 4 and the May 2010 Tech memo. *WEI*
69	6-2	Section 6.2: As discussed in this section, one of the outcomes of the 2009 Watermaster Strategic Planning Meeting was to “give authority” to Watermaster to do whatever it takes to acquire supplemental water. Prior to Watermaster acquiring new supplemental water (most likely extremely expensive water) there are numerous “low-hanging fruit” projects that should be considered and evaluated that will reduce or even eliminate the	Our review of IEUA’s “low hanging fruit” suggests that the total increase in new stormwater recharge would be small compared to the projected replenishment demand. *WBE and WEI*

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		need to acquire new supplemental water (many of these were discussed at our meeting on 5/12/10 at IEUA and detailed in Section 5 comments).	
70	6-3	Section 6.3.1: One of the recommendations given at the April 25, 2010 RMPU workshop was to develop a CURO limit; 100,000 AF was recommended. What are the next steps in developing a CURO limit, assuming it is still necessary? Recommend using “trigger-points” to determine when approved projects should begin; this is similar to IEUA’s Regional Sewage system expansions.	The 100,000 acre-ft limit to CURO is recommended as an interim limit and that final CURO limit should be determined based on updated projections of production and production rights. *WEI*
71	6-5	Section 6.3.3: This section mentions an in-lieu limit of 25,000 AFY. Where did this come from?	Section 6.3.3 was revised to say that the existing in-lieu recharge capacity ranges between 25,000 to 40,000 acre-ft/yr and that this capacity will increase when the Riverside Corona feeder connection to JCSD is completed. *WEI*
72	6-5	Section 6.3.4: Why were there two different supplemental recharge capacity used for the Baseline Scenario and Peace II Scenario?	The Peace II scenario required less recharge capacity because the amount of replenishment is less. See *2009 Production Optimization and Evaluation of the Peace II Project Description* (WEI, 2009). *WEI*
73	6-11	Section 6.5.2: Please update the Historical and Planned Recycled Water Recharge table with the most recent projections previously provided in	The text and table have been updated. *WEI*

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		IEUA's Tech Memo #3.	
74	6-11	Section 6.6.1: There are several non-MWD imported water sources listed; is there an estimate of how much these would cost and what MWD's wheeling fees would be?	The commodity cost is unknown. The current (2010) rate for MWD's wheeling fees is $314 per acre-ft and may increase to $372 in 2011 and to $396 in 2012 based on MWD's published rates. *SWG*
75	6-13	Section 6.6.2: Please refer to comments on Appendix F about the RIX and WRCRWAP concepts.	Comment noted. *WEI*
		Appendix B – IEUA Tech Memo's	
76	NA	No comment.	
		Appendix E – Water Transfers Report	
77	NA	General Comment: In several locations of this report, it is mentioned that Watermaster would not want to share the estimated costs of Water Transfer transactions in this report; what is the plan to share this information with IEUA and the retail agencies?	Currently, there is no active water market for long-term water transactions in California. Water pricing tends to be very subjective. In addition, there is little or no advertising of potential transactions. Watermaster has paid for consulting services to develop pricing and transaction information to address the CURO. Until Watermaster has an opportunity to fully utilize the information, it should not be included in a public document. *SWG*
78	3	The first sentence of the first paragraph in the "Imported Water Projections" section should be	: In the Water Transfers Report, imported water demand refers to water supply used for direct

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		revised to; "The imported water demand for replenishment purposes is based on the overproduction by the Basin entities."	delivery and for replenishment purposes. Both types of imported water impact the groundwater balance in the Chino Basin. For operational or cost reasons, a water retailer in the Chino Basin may switch between both types of imported water to meet its water demands. The reduction in the direct delivery of imported water may result in overproduction from the groundwater basin. The report does not distinguish between the operational uses of the imported water. *SWG*
79	4	The first sentence of the fourth paragraph uses a CURO estimate from work done in April 2010 by WEI. This should be updated with a range of possibilities based on our recent technical comments and meetings with WEI.	The CURO estimate is a moving target. The recent technical comments by IEUA do not change the direction or the magnitude of the CURO estimate. Since the CURO will continue to change, the April 2010 estimate by WEI is sufficient for the current analysis. *SWG*
80	9	The third paragraph in the "Imported Demand" section states that MWD replenishment water can only be made available if 50% of their storage is full. Please provide reference.	The report states that Metropolitan's Water Storage Program needs to be at an appropriate account balance before Replenishment Water becomes available. Metropolitan has to focus on the delivery of Tier 1 water supplies to its member agencies. Over the last three years, Tier 1 water deliveries would have been substantially reduced without the Water Storage Program. The last time that Metropolitan provided Replenishment Water to the groundwater basins was fiscal year 2006-07. During

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			that period, the Water Storage Program was approximately 50.0% of capacity. Metropolitan's storage account peaked at 2.74 million acre-feet of water in July 2006 (Metropolitan Water District of Southern California Waterworks General Obligation Refunding Bonds, 2009 Series, dated December 1, 2009, Appendix A, page A-23). From a water management perspective, it is prudent for Metropolitan to restore the Water Storage Program to pre-drought levels before providing Replenishment Water to the groundwater basins. *SWG*
81	12	In the "Replenishment Guidelines" section, guideline #6 (Chino Basin Capacity) states that a maximum of 84,600 AFY of Transferred Water could be delivered. Does this exclude stormwater and recycled water recharge?	No. *WEI*
82	13	In the "Replenishment Guidelines" section, guideline #9 (Water Transfers Rate Structure) states that Watermaster will develop a funding program for the purchase of future Water Transfers. Are there any concepts being put forth in this RMPU?	Historically, Watermaster allowed overproduction in the Basin with the expectation that Metropolitan would provide Replenishment Water. The payment by the producers for the overproduction was made in arrears. This was a year-to-year approach to address the overproduction. This approach has changed without the availability of Replenishment Water. The acquisition of long-term water supplies may require upfront payments or financing. In either case, Watermaster will have to develop a program to

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			identify the sources of funding before long-term commitments are made. At this time, the funding program is a concept. *SWG*
83	20	In the "Institutional Issues" section, a brief summary of MWD's Water Supply Allocation Plan may be appropriate under issue #5-Shortages.	Metropolitan's Water Supply Allocation Plan provides guidelines for the reduction of water use during a multi-year drought. The Plan does not create a framework for long-term planning. It is unclear if the Plan will be implemented on a multi-year basis. As a result, it was premature to summarize the Plan in the Water Transfers Report. *SWG*
84	32	Why is it assumed that the price of water south of Delta is more expensive than above?	Put simply, south of Delta water transfers do not have the same transfer risks. Buyers are willing to pay more for the certainty of delivery in a drought year from a source south of the Delta. *SWG*
85	38	Under the "Peace II Alternative" section, the second paragraph mentions three options were analyzed but only two are represented in this report. Is there a third option?	Corrected – only two are analyzed in the report. *SWG*
86	38-39	The two replenishment options that were analyzed appear to have extremely conservative cost assumptions. For example, option 2 (No Metropolitan Replenishment Water) states it will cost $1 billion to meet a full CURO in 2030 of 700,000 AF ($1400/AF). Does this mean that the	Both options are based on twenty year projections of water rates by Metropolitan. The water rates are escalated each year by the historic average increases by Metropolitan. The charts are a summary of the spreadsheets prepared to project the costs of each option. The first option ("100.0%

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		replenishment water purchased in the year 2020 or 2030 are also $1400/AF or is there an increasing cost as time goes on?	Replenishment") sets the floor on expected costs. The second option ("No Metropolitan Replenishment Water") sets the ceiling on expected costs. The only variable that changes between the two options is the cost of the water resource (System Access Rate, Water Stewardship Rate, and System Power Rate are the same for both options). Without a Water Transfer Program that seeks non-Metropolitan water supplies, these two options provide the range of expected costs for water to address the CURO over the next twenty years. *SWG*
		Appendix F – Supplemental Water Recharge Concept Development (Black & Veatch)	
87	1	Section 1.2: The section should reference the 2002 RMP which developed the original concepts and proposed projects to increase recharge into the Chino basin with increased imported water from MWD, enhanced stormwater capture through improvements in the SBFCD and CBWCD facilities (and IEUA's RP-3), plus significant increase in the recharge of recycled water.	*B&V Comment:* A reference was incorporated into Section 1.1. An additional summary sentence similar to above shall be added.
88	1	Section 1.2: The references to MWD revised forecast (2008) on availability of replenishment supplies should be referenced.	*B&V Comment:* Referenced from a Watermaster-approved, WEI handout from the 2009 Strategic Planning Conference, dated 9-28-09, titled "The Challenge of the Cumulative Unmet Replenishment

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			Obligation.” Reference shall be incorporated into text and references section.
89	1	Section 1.2: The sentence, “as a result, major groundwater basins in the MWD service area may become over drafted in the next ten or twenty years,” is unsubstantiated based on any technical analyses and appears to be another’s opinion.	*B&V Comment:* Referenced from a Watermaster-approved, WEI handout from the 2009 Strategic Planning Conference, dated 9-28-09, titled “The Challenge of the Cumulative Unmet Replenishment Obligation.” Reference shall be incorporated into text and references section.
90	2	Section 1.3: This section should discuss the 2002 RMP and summarize the Phase I and Phase II improvements implemented to date as an approximate cost of $50 million.	*B&V Comment:* Acknowledged. Information requested from IEUA.
91	8	Section 2.2.1: Table 2-1 lists SWP water with moderate to high TOC. What is this compared to? SWP water typically has low TOC in comparison to CRA or other local sources.	*B&V Comment:* Historical SWP TOC concentrations can be higher than CRW TOC concentrations during certain times of the year. However, it appears on average, the TOC concentrations between the two sources are fairly comparable. Text will be modified to “Moderate TOC.”
92	10	Section 2.2.1.1: Please reference the agreement (2005) between MWD, SGVMWD, TVMWD and IEUA regarding one of the Azusa Devil Canyon Pipeline and the approved connections.	*B&V Comment:* Acknowledged. A reference shall be added.
93	11	Section 2.2.1.1: Please reference the replenishment	*B&V Comment*: Details requested from IEUA.

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		connector, CB-8.	
94	11	Table 2-2: The notes in the "Issues" column are inaccurate (e.p. Rialto was at full capacity generally from 2002-2006 and will be in the future when the CRA is reduced in flow or has an outage).	*B&V Comment:* See Figure 2-2 for availability of Rialto Pipeline. Comment in notes column for the Rialto pipeline will be modified to "Unused capacity may only be available during winter months."
95	15	Table 2-4: This table should include TVMWD Miramar water treatment since it serves Pomona and is proposed to be interconnected with the WFA.	*B&V Comment:* Acknowledged. The Miramar WTP will be added.
96	16	Table 2-5: The "Basin Type" column shows Upland, Montclair and Brooks basins along the San Antonio Creek Channel as flow-through Basins; they should all be flow-by.	*B&V Comment:* Acknowledged. Change to flow-by will be made.
97	16	Table 2-5: RP-3 began receiving recycled water for recharge in August 2009.	*B&V Comment:* Acknowledged. Column entry will be changed to "yes."
98	16	Section 2.2.2: The last sentence on page 16 should end by saying "…is dependent on the volume of diluents water available."	*B&V Comment:* Acknowledged. Edit will be made.
99	16-17	Section 2.2.2: This section is out of date with regards to the permit for recharge of recycled water (Section 2.2.2.1). The Upland Hills Water Reclamation Plant is out of service and inoperable. Why the reference to the Indian Hills Golf Course?	*B&V Comment:* Acknowledged. Reference to both the Upland Hills and Indian Hills plants will be deleted.

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100	17	Section 2.2.2: In paragraph 2, the Cities of Upland and Montclair should also be listed as agencies that IEUA provides recycled water to.	*B&V Comment:* Acknowledged. Cities will be added.
101	17	Table 2-6: The title of Table 2-6 is Recycled Water Treatment Plants in the Chino Basin; RIX and WRCRWAP are not permitted to recharge in the Chino Basin. RP-5 has been permitted at 16.5 mgd (not 15 mgd). WRCRWAP is only 8 mgd not 32 mgd.	*B&V Comment:* Acknowledged. References to the RIX and WRCRWAP plants have been removed from the table. Each of these plants is described in section 4 (Concept Nos. 6 and 7). Edit to WRCRWAP capacity was made.
102	18	Section 2.2.2.1: Paragraph 1 has a sentence that should include the following change; "…recycled water to 50% of total recharge and diluent water."	*B&V Comment:* Acknowledged. Edit will be made.
103	18	Section 2.2.2.1: Please update Table 2-7 and the following paragraphs with language from the RWQCB permit amendment and expert-panel report	*B&V Comment:* Edits will be made upon receipt of RWQCB permit from IEUA.
104	18	Section 2.2.2.1: The last sentence on this page should include the following change; "…NPDES permits for water reclamation facilities."	*B&V Comment:* Acknowledged. Edit will be made.
105	24	Section 3.0: Shouldn't in-lieu be discussed in this section?	*B&V Comment:* In-lieu is discussed in section 3.2 and also in section 3.8 (concept for ad-hoc appropriator in-lieu). No edits have been made.
106	26	Section 3.3.3: Isn't a more cost effective alternative	*B&V Comment:* Acknowledged. This concept will be

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		concept for Jurupa CSD to use WRCRWAP recycled water for irrigation of parks, schools, etc. The estimate is about 3,000-4,000 AFY and would reduce Chino basin groundwater pumping by an equivalent amount.	mentioned in section 4.4.7 (Concept No. 7).
107	28	Section 3.5.1: With the new Regional Board permit amendment approved in October 2009, advanced treatment is not cost effective at IEUA's water recycling facilities.	*B&V Comment:* Acknowledged. This is mentioned in Section 2.2.2.1. A similar sentence will be added to section 3.5.1.
108	28	Section 3.5.1: Paragraph 1 includes statements without reference. Please reference or update. Paragraph 3 should be updated with information from IEUA's FY 2010/11 TYCIP.	*B&V Comment:* Reference is provided in first sentence of paragraph 3 under section 3.5.1. Data provided is from e-mail received from Ryan Shaw dated 8/3/09. If data has been updated since this e-mail, please provide TYCIP for review.
109	29-30	Section 3.6: These are good concepts; however, all new connections and pipelines would need to be funded by Watermaster and its stakeholders.	*B&V Comment:* The supplemental water TM is not intended to address funding concepts.
110	35	Section 4.2: Concepts No. 6 and 7 (recycled water from RIX and WRCRWP) have many technical and institutional issues. In addition, the cost estimates appear to be very low based on an assumption of using the supply for 9 months. IEUA has surplus recycled water supplies generally from October through May each year. Therefore, only during	*B&V Comment:* Acknowledged. Additional background information will be added to these sections.

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		June-Sept is it likely that any supplemental recycled supply could be recharged (and that would not be on a continuous basis). Please also note that WRCRWAP TDS averages over 600 mg/L and JCSD and Norco plants use locally for greenbelt irrigation. Recommend that WRCRWAP uses recycled water locally within the JCSD service area.	
111	35	Section 4.2: Table 4-1 lists turnout potential capacity, where will this additional water come from? Any existing turnouts should already have enough capacity to take the amount of water needed (or that there would be basin capacity for).	*B&V Comment:* Concept includes new turnout from either the Azusa Devil Cyn Pipeline or the Met Etiwanda Pipeline in order to enhance turnout capacity and flexibility if Rialto Pipeline is at capacity.
112	36	Section 4.3: Please remove the “Unit Water Cost” column from Table 4-2. It shouldn’t use “capacity” to define this unit cost. It should reflect expected/actual cost.	*B&V Comment:* Acknowledged. Unit cost column shall be deleted from Table 4-2. Unit costs shall remain in detailed annual cost tables for concepts.
113	37	Section 4.4.1: Paragraph 3 mentions the ADC pipeline, for the purposes of the RMPU, with a capacity of approximately 10,000 AFY. What flow is assumed and what time of the year?	*B&V Comment:* From discussions with SGVMWD (referenced in TM), the ADC pipeline is currently not used during 3 winter months and remains hydrostatic. Assuming full capacity of ADC (55 cfs) can be conveyed for Basin use during 3 months, this equates to 10,000 afy.
114	38	Figure 4-1: This figure should show the existing turnout on the Rialto Pipeline.	*B&V Comment:* Acknowledged. Existing turnout has already been added.

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115	40	Section 4.4.1: Recommend changing the "Total Increased Recharge AFY" row to "Total Maximum Recharge AFY." What does the $5,000 for annual O&M cover? Expenses for additional water to the basin?	*B&V Comment:* Acknowledged. This edit will be made to the same table for each concept. $5k annual O&M covers general pipeline maintenance (see Section 2 for criteria). Footnote 2 notes that the unit cost shown does not include the cost of water supply.
116	57	Section 4.4.6: A general comment; there is no RP-3 recycled water distribution system. The nearest regional recycled water pipeline is in the vicinity of the I-15 and Jurupa Road. The pipeline at RP-3 is the pump discharge pipeline from Jurupa basin, not a recycled water pipeline	*B&V Comment:* Acknowledged. Paragraph will be modified.
117	57	Section 4.4.6: Paragraph 1 suggests that 5,000 – 10,000 AFY of recycled water from RIX could be moved to IEUA's distribution system. Please keep in mind that only the peaking months (generally summer months) is when IEUA would not have excess recycled water to recharge.	*B&V Comment:* Acknowledged. Additional background will be added to this concept description.
118	60	Section 4.4.6: Please give further explanation of the assumptions behind the costs listed in the two tables on page 60.	*B&V Comment:* Unit cost assumptions are provided in Section 2 and page 59 provides a description of the major facilities that are part of the concept. See footnotes 2 and 3 under the Annual Cost Estimate table on page 60 for additional assumptions. See also final paragraph on page 57 for additional

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			caveats.
119	61	Section 4.4.7 The WRCRWAP is only 8 mgd, not 32 mgd as listed in paragraph 1.	*B&V Comment:* Acknowledged. Capacity has been modified.

F.3 IEUA – ANDY CAMPBELL

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		Section 5 – Stormwater Recharge Enhancement Opportunities	(All responses below provided by WBE.)
1	69	Available Storm Water Not Currently Captured: Page 69 discusses that stormwater water is available for capture above that currently captured. While there is no disagreement, there is no clear documentation of this availability. What is documented is how much could be captured with improvements, but not how much actually exists.	See IEUA Comment #43
2	NA	SBCFCD Operations Modes: Potential increases in recharge are highlighted in the report table 6-4.2. It is unclear to whether operations guidelines, modes, and SBCFCD flood routing would allow operation at the levels indicated. Current groundwater recharge operations agreements with SBCFCD should be incorporated and resolved that would allow more water to be stored and recharged in existing basins. Existing agreements require water to be released from Grove Basins when it is over 5 feet deep. The Grove basin midlevel outlet and spillway are at depths of approximately 17 feet and 25 feet, and the	See IEUA Comment #50

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		basin area is approximately 13 and 14 acres at these depths. For Ely Basin, storm water releases are required at a water depth above 835 feet. The Ely spillway is at an elevation of approximately 838 feet, and the basin area is approximately 32 acres at that depth. Additional storage could also be made available at Lower Day, San Sevaine (1, 2, and 3), and Victoria by increasing the operational depth and basin modifications such as increasing the spill point elevation.	
3	NA	DSOD Facilities: Working with the Division of Safety of Dams (DSOD) to allow longer than 24 hours of storage on the existing DSOD jurisdictional facilities was initiated by CBWM with Gordon Treweek, but has not been carried further since his retirement. These include Jurupa, Lower Day, San Sevaine 5, and Hickory. Evaluation and possible modification to the water-soil interface at these locations could allow longer storage and increased storm water volume to be captured at these existing locations.	See IEUA Comment #63
4	NA	Turbidity Sensing to Prevent Degradation of Infiltration Rates: IEUA has advocated the use of turbidity sensors at all basin inlets. Use of these sensors would allow automated control of basin gates and would minimize storm water lost in a first flush and also minimize damage to basin infiltration rates during intermittent periods of muddy water	See IEUA Comment #64

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		flows during storms. This alternative should be addressed by the evaluation.	
5	47	Low Impact Developments: Page 47, paragraph 1 indicates the LID facilities in Table 6.2.1-1 are upstream of recharge basins and that there use would not create significant new recharge. Figure 6.1.2-5 is a map of the LID facilities and shows they are all downstream of existing recharge basins. This statement on page 47 is only true if the Lower Cucamonga basin is developed for stormwater capture.	See IEUA Comment #42
6	Multiple	[1] Declez Basin: Page 13 erroneously refers to the Cell 2 habitat at Declez. In fact this cell 2 habitat is at RP3 basins. [2] Declez basin is currently fully utilized with winter flows and would not have available space to receive pumped water from Wineville, Jurupa, or Lower Cucamonga basins until summer months (page 94).	[1] See IEUA Comment #41 [2] See IEUA Comment #51
7	NA	Etiwanda Conservation Basin / Etiwanda Regulatory Storage Tanks: CBWM currently is leasing the rights to develop this location. The report gives no discussion of the use of this site for recharge, and or use for a transfer facility.	See IEUA Comment #65
8	88	Hickory Basin: Page 88 contains a bullet to add a	See IEUA Comment #47

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		pump station to Hickory basin to pump stormwater to Banana basin. Such a facility already exists, but is used for imported water transfers. Operations experience has indicated that Banana Basin overtops in larger storms and would not benefit from pump station operation during winter months.	
9	NA	Jurupa Basin: Jurupa Basin is currently limited by the pump station capacity (20 cfs). A second pump bay exists for another 20 cfs pump. Addition of this pump and full utilization of the Jurupa basin storage should be a priority project. While it has been expressed to increase the inlet capacity of Jurupa basin from the San Sevaine Channel, during local intense rain events the three existing large storm drains entering along the north basin wall provide storm water approaching the current 20 cfs pump capacity. Prioritization of a second pump over the inlet upgrade should be made in Phase 1 and not in Phase 2 (page 94).	See IEUA Comment #52
10	NA	[1] Lower Day Basin: A small upper level basin exists at the Lower Day basin site can be easily modified to hold stormwater. Currently stormwater enters this smaller basin and runs into the active recharge portion of the site. Holding water in the upper level would preserve capacity in the lower level. The upper level and lower level designations are not to be confused with the Upper Day basin	[1] See IEUA Comment #37 [2] See IEUA Comment #38 [3] See IEUA Comment #40 [4] See IEUA Comment #39

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		located north of Banyon Street adjacent Day Creek. The Lower Day facility is incorrectly labeled “Days” on Figure 6.1.1-1. The figure also incorrectly labels the “Upper Days” basin. The Upper Day basin is located to the north in the Cucamonga Basin. [2] Channel and inlet modifications to the Lower Day basin were evaluated in the W&B report as necessary. IEUA has not observed a need for increasing the inlet capacity. There may be some confusion between the actual inlet capacity and the maximum rate of imported water delivered to the site. Imported water delivery is limited to 22 cfs above this rate, rolling waves develop in the channel and can periodically surge water over the rubber dam. Due to the high cost of imported water, its loss is controlled by lowering the delivery rate. IEUA was not able to find a reference to the inlet capacity used by B&W. The existing flow control gate at Lower Day basin does not open to its full diameter due to its construction. While this had not been seen to impact inflow, removal of this restriction would improve flow through should any limit exist. Lower Day is located high on the alluvial fan at the basin of the mountains and generally receives only small flows during times when snow pack accumulates. The WEI rainfall-run off model should account for periods of snow accumulation	

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		and melting prior to implementation of inlet improvements. [3] Page 121 mentions improving Lower Day banks to meet DSOD requirements. The facility currently meets DSOD requirements. [4] A mid level uncontrolled outlet exists at Lower Day at an invert water depth of about 15 feet. Additional controls to this outlet can preserve water at this location.	
11	Multiple	[1] RP3 Basins: Page 82, paragraph 3, indicates the RP3 site is a SBCFCD-owned facility. It is not – it is an IEUA-owned facility. [2] Page 103 suggested removal of the Cell 2 habitat. This habitat is permitted to exist in perpetuity as mitigation for the CBFIP. While the site has a place in stormwater capture and release to other RP3 cells, there should not be a suggestion for its removal. IEUA suggests the current afterbay of cell 2 (not habitat) be connected to adjacent cell 3 to facility use of the habitat as a settling basin and water holding/transfer basin. [3] Figures 6.5.4-3 shows concepts for reconfiguration of the RP3 basin site. The concepts include a transfer pipe from Cell 1 to cell 3. In fact, such a transfer pipe already exists and	[1] See IEUA Comment #45 [2] See IEUA Comment #56 [3] See IEUA Comment #58 [4] See IEUA Comment #48 [5] See IEUA Comment #44 [6] See IEUA Comment #49

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		the cost of which should be removed from the evaluation. [3] While a second inlet to the RP3 site may be warranted, its purpose is in part to retain water that would flow to and overflow from Declez basin. A significant flow originates from a storm drain located immediately downstream of the existing rubber dam at the RP3 basins. A new diversion located at the currently outlet to the RP3 basins would pick up these flows and eliminate the need for the approximately 1,000 feet of 8ftx10ft diversion conduit shown on the concept map through the SCE easement. [3] The overflow spillways and energy dissipaters shown on the concept map are not required as the basin currently is constructed to spill back into the Declez channel when full. [3] Significant discussion is given to building pipelines and pumping captured storm water to RP3 basins from Wineville, Lower Cucamonga, and Jurupa Basin. During wet years, the RP3 capacity will be occupied by local flows and Jurupa basin pumping. The report should address that the use of RP3 storm capacity for Wineville and Lower Cucamonga Basin pumping may only be available in drier years.	

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		[4] Page 88 bullets suggest enlargement of the RP3 basins to increase storage. While there is some area not used for recharge, operational uses the open space exist to dry out weeds and to store and process soils for construction contractors. Recommendations to use available space should be weighed with the space's value for maintenance activities on IEUA-owned basins given the SBCFCD's practice of prohibit such activities at their basins. [5] Page 76 references an option to remove the basin cells. This option provides insignificant volumetric benefit and significantly hinders basin operations and maintenance. [6] Page 93 the current recharge at RP3 is estimated too low. The low for the past 5 years has been 511 AF while that listed in table 6.4-2 is 244 AF. All current recharge numbers in the evaluation should be scrutinized with historical operations.	
12	NA	San Sevaine 5: San Sevaine Basin 5 routinely fills and spills during storm events while its adjacent basin San Sevaine 3 and 4 can receive little to no water during the same event. Rather than letter this water spill to lower basin, a pump station from basin 5 to basin 3 should be evaluated. Preserving the capture of water in the upper watershed can	See IEUA Comment #66

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		significantly change the need for a pump station in Lower Cucamonga basin.	
13	82-83	Turner Basin: Page 82/83 – Indicates the Cucamonga Creek inlet to Turner could be improved to bring more water into Turner up to the outlet spillways. In fact, Turner 1&2 are filled to capacity with little water being bypassed during storms. Limitations on capture at Turner 1 are mostly due to muddy water. The limitation is on the elevation of the inlet on Deer Creek into the Turner 3&4 basins. Discussion needs to be added regarding development of the Turner basins east of Archibald Avenue, which have the potential capturing the estimated additional 700 to 1,200 AF of stormwater in Deer Creek.	See IEUA Comment #46
14	11	Victoria Basin: The Victoria Basin inlet from San Sevaine Channel (destroyed in the 2003 winter) is assumed to exist by the evaluation (p. 11). While there has been discussion with SBCFCD, the reconstruction of this inlet is important to capturing water that escapes the Etiwanda Debris basin and San Sevaine 5.	See IEUA Comment #36
15	NA	Lower San Sevaine (Victoria) Basin: A new basin is mentioned in this report as Lower San Sevaine	See IEUA Comment #67

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		Basin. This new basin has been discussed in previous Watermaster discussions and meetings as the Lower Victoria Basin. The name use is irrelevant, but this point should be made to avoid confusion.	
16	138	Vulcan Pit: Page 138 lists the cost-share of CBWM as being $2,446,000. There should be a list of the total project costs, who the other cost sharing parties might be, and what the other shares would be. The basin concepts as should are only a minimal, and should include internal management of the water in cells and perhaps a pump station to drain the basin. Flows on West Fontana Channel are muddy and would require such management.	See IEUA Comment #59
17	140-141	[1] Lower Cucamonga/Chris Basin: Page 140 mentions an IEUA bacteria problem of dry weather flows. Is this an IEUA problem? The incorrect acronym IEUD is used in the second paragraph of page 140. [2] Page 141 mentions relocating burrowing owls from this site. F&G mitigation for disturbing burrowing owls is 6 acres per owl. With this restriction, it may be preferable to purchase the required land and use it for recharge. [2] The conceptual reconfiguration of the Lower	[1] See IEUA Comment #60 [2] See IEUA Comment #61

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		Cucamonga Basin should retain internal cells to facilitate management and maintenance of water held at this location.	

F.4 GEOFFREY VANDEN HEUVEL

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		I do not think that the recommendation to lower the baseline recharge from 5600 to 3200 should be part of the RMP. As we have discussed, if a new safe yield is adopted by Watermaster, then in the course of developing that new safe yield calculation the information you have developed in conjunction with the RMP is very relevant. The RMP is a court ordered planning document. It can be used to identify policy issues that Watermaster needs to address. I think the recommendation with regards to adjusting the baseline recharge is outside of the scope of the RMP.	The recommendation to lower the baseline recharge from 5,600 acre-ft/yr to 3,200 acre-ft/yr has been deleted from the RMPU. *WEI*

F.5 WAGNER & BONSIGNORE CONSULTING CIVIL ENGINEERS – GENERAL RESPONSES TO COMMENTS

We received written comments on the RMPU from the City of Pomona, and from Inland Empire Utility Agency. We also heard comments from various individuals as questions during the RMPU Workshops hosted by Chino Basin Watermaster. Comments fall generally into three categories. 1) The cost estimates for the stormwater conceptual projects are not cost effective from a marginal cost perspective. The comments suggest that each subsequent phase is more expensive than the previous phase and sacrifices cheaper water for more expensive water. 2) Cost estimates for construction are understated and should conform to a standard preferred by IEUA. 3) Institutional constraints, particularly related to jurisdiction of California Division of Safety of Dams are understated. We provide the following general response to these comments and also provide a more detailed response to individual comments.

1) Marginal Cost of individual conceptual projects. The Phase I projects look compelling due to their relative simplicity and relatively low cost per acre foot. The hydrologic modeling provided by WEI indicates Phase I will allow recharge of an additional 7600 acre-feet annual yield, above the historical amount recharged by the existing recharge basin configuration. Subsequent phases, II and III, for example add recharge to the project as a whole but at a much greater incremental cost. Comments have correctly brought into question the rationale for paying a higher cost for the next increment of water. A more important question might be how much would someone pay for the last acre foot of water (the actual marginal cost). If there is a need for more water, and if there is a cheaper source, then subsequent phases of the conceptual project would be unnecessary. The cheaper source certainly would be preferred, however, if there is no other reliable source we can either decide to pay the incremental cost, or not invest in developing additional recharge.

2) The cost estimates that have been developed have generally followed the Technical Memorandum Task 3 Planning Criteria. That criteria assumes a 15% surcharge for Engineering , Inspection and Contract Management. The IEUA comments suggest that we use 15% for Engineering, and 7% for Contract Management. We developed a cost window by increasing the total cost estimate by 15%. For comparison, we re-estimated total project costs using the IEUA criteria from its comments. The result was within the original 15% cost window. We want to point out however that a large part of the project cost is in excavation and hauling. This activity most likely will require substantially less than the indicating amount for Engineering, Administration and Contract Management. While the actual cost for the

components of the conceptual project will undoubtedly vary, the overall estimate is probably sufficient for planning purposes and prioritizes project selection.

3) Administrative constraints will ultimately drive decision making either by requiring re-design, re-conceptualization or abandonment entirely of various components. Discussions with various interested agencies and satisfaction of certain requirements, and obtaining approvals from, for example, Dam Safety, Flood Control, Department of Fish and Game and others, will be necessary.