2010 Recharge Master Plan Update

Volume II – Appendices

Prepared for

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

June 2010

Prepared by

Wildermuth Environmental Inc.
Black & Veatch Corporation
Wagner & Bonsignore
Sierra Water Group

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Appendix A

Public Outreach and Process

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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 RAtwater

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;

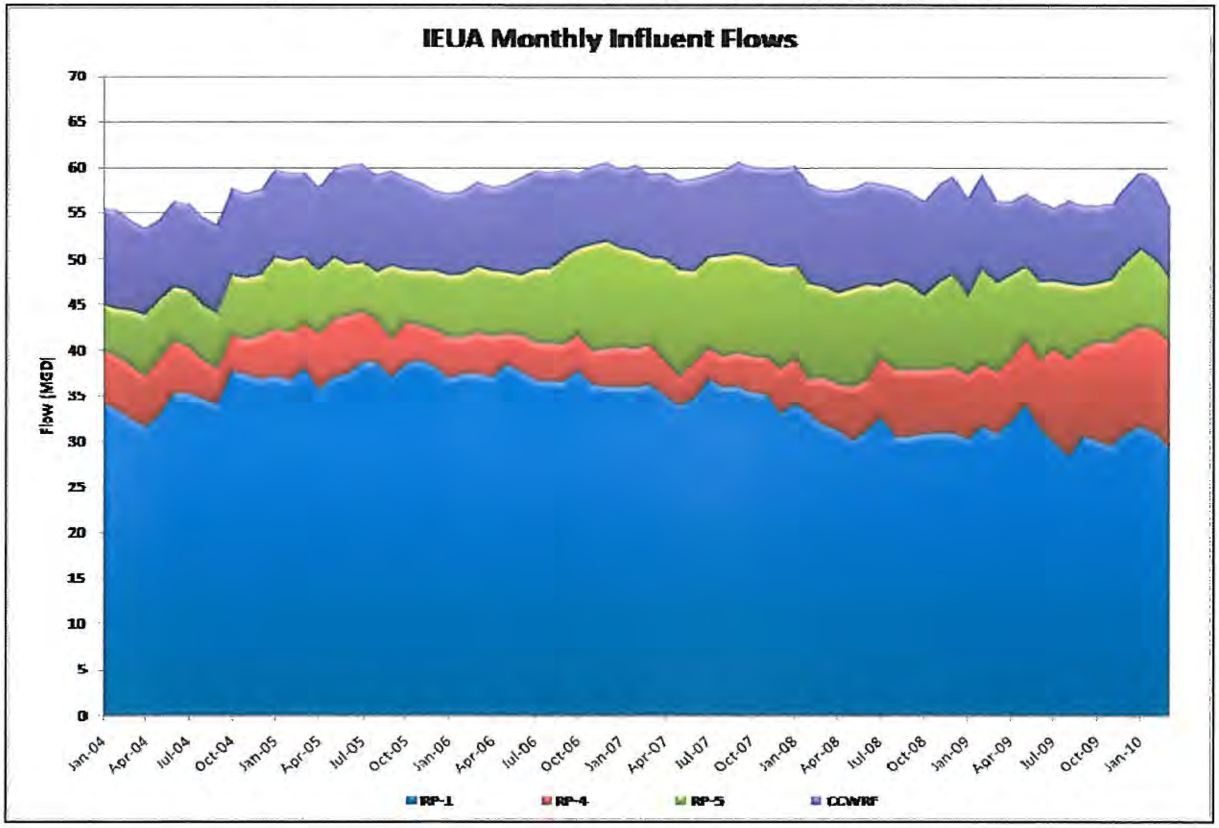
- Lead to the development and implementation of drought and landscape ordinances;

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



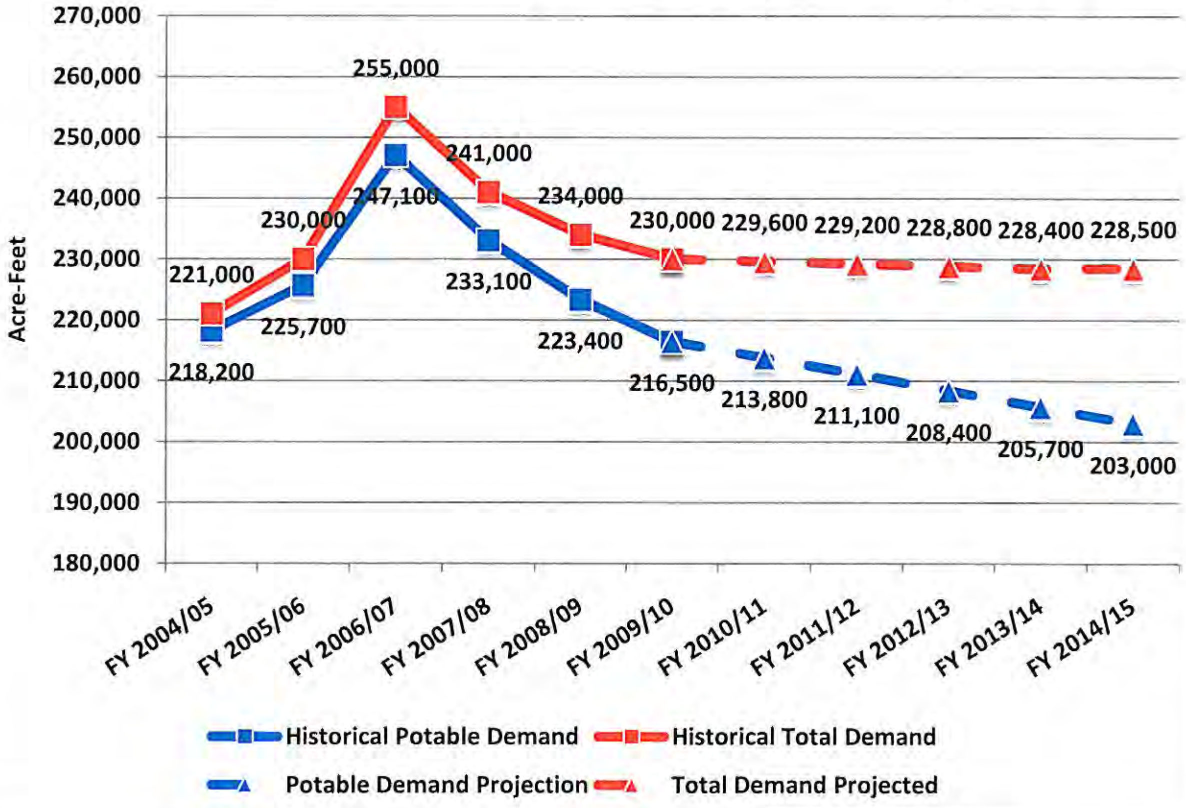
Alternative Near-Term Demand Projections in the Chino Basin

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.

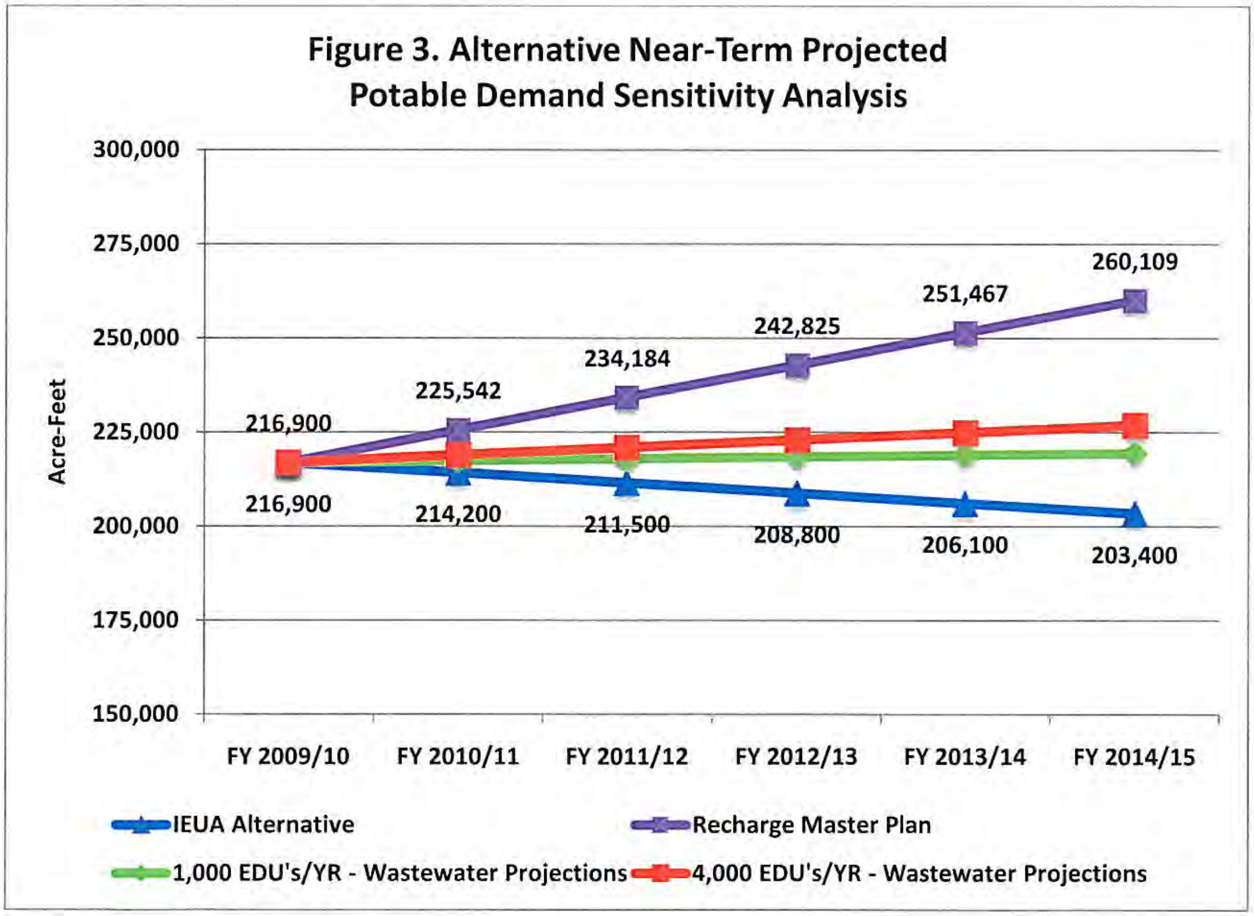
The key drivers that support the assumptions listed above are as follows:

- 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.



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.

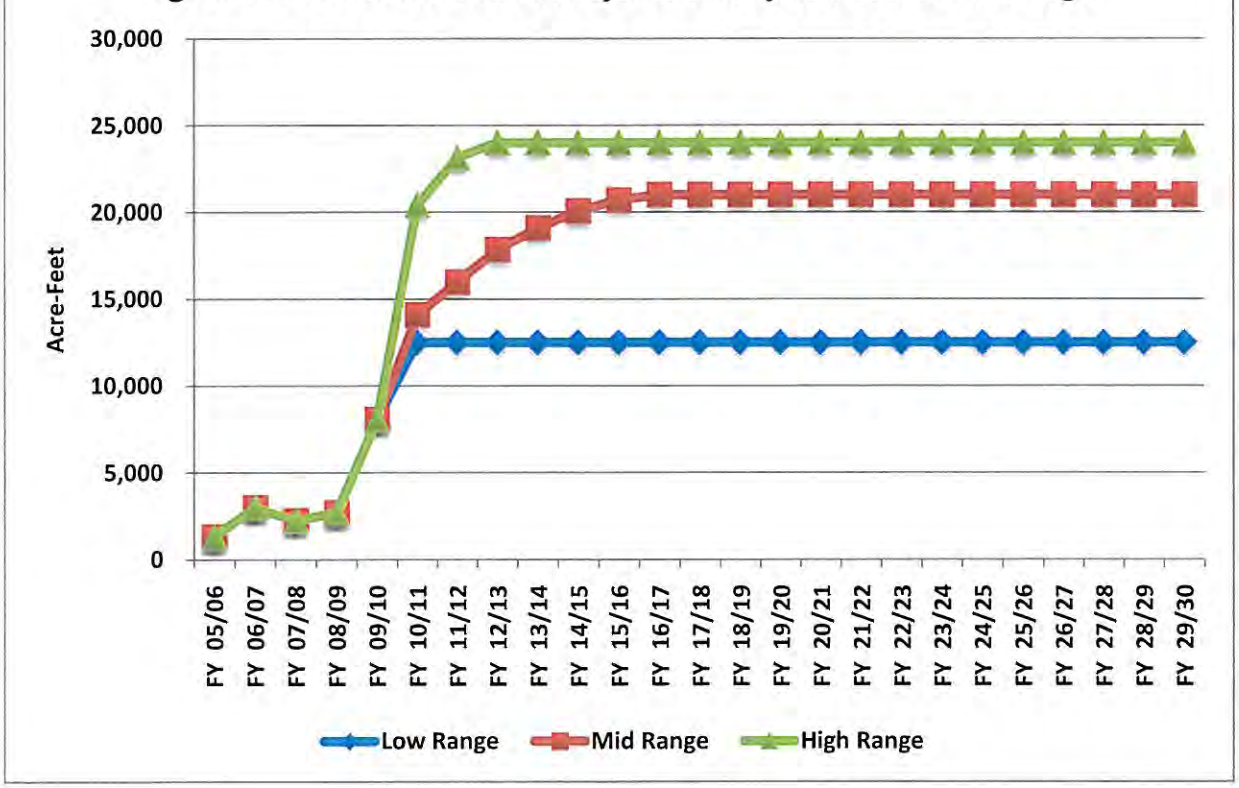
- Recharge of recycled water (see Figure 4 and Table 2) is expected to increase to approximately 20,000 AFY by 2015. This is credited back to the retail agencies as Chino Basin pumping rights, which will reduce the need for wet water replenishment other than recycled water.

    - 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

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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)

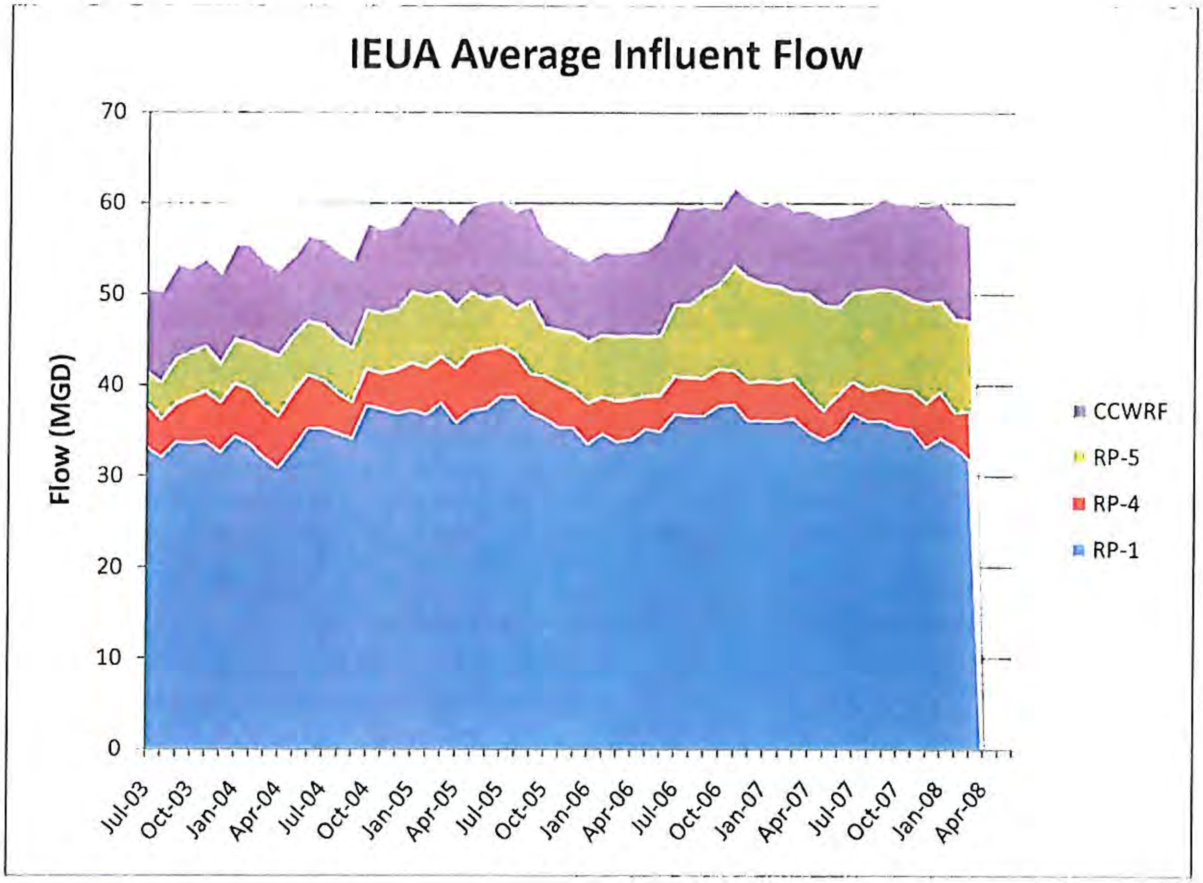


Figure 1 – Shows IEUA's average wastewater influent flow from 2003 to 2008.

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.

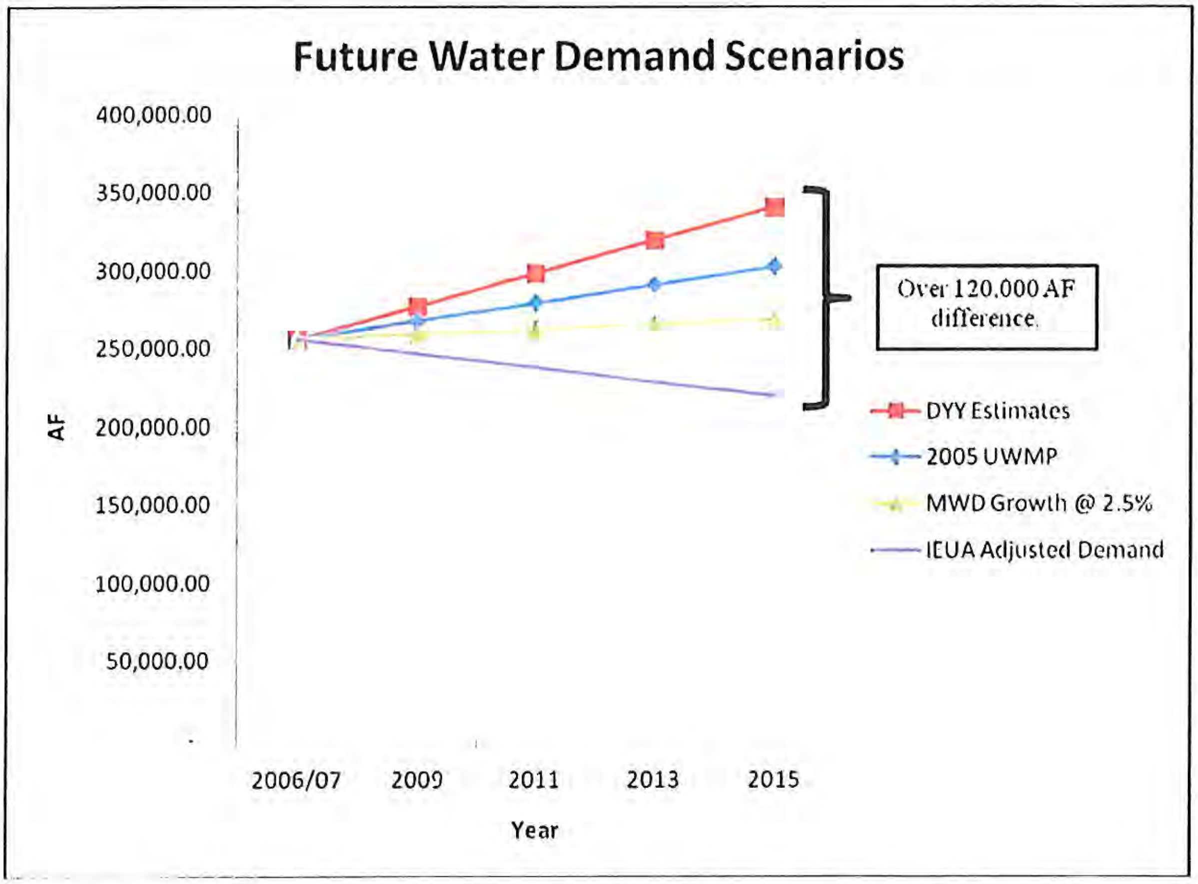


Figure 2 – Future water demand projections, comparing Black & Veatch, the UWMP, a MWD scenario and an IEUA adjusted demand scenario.

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.

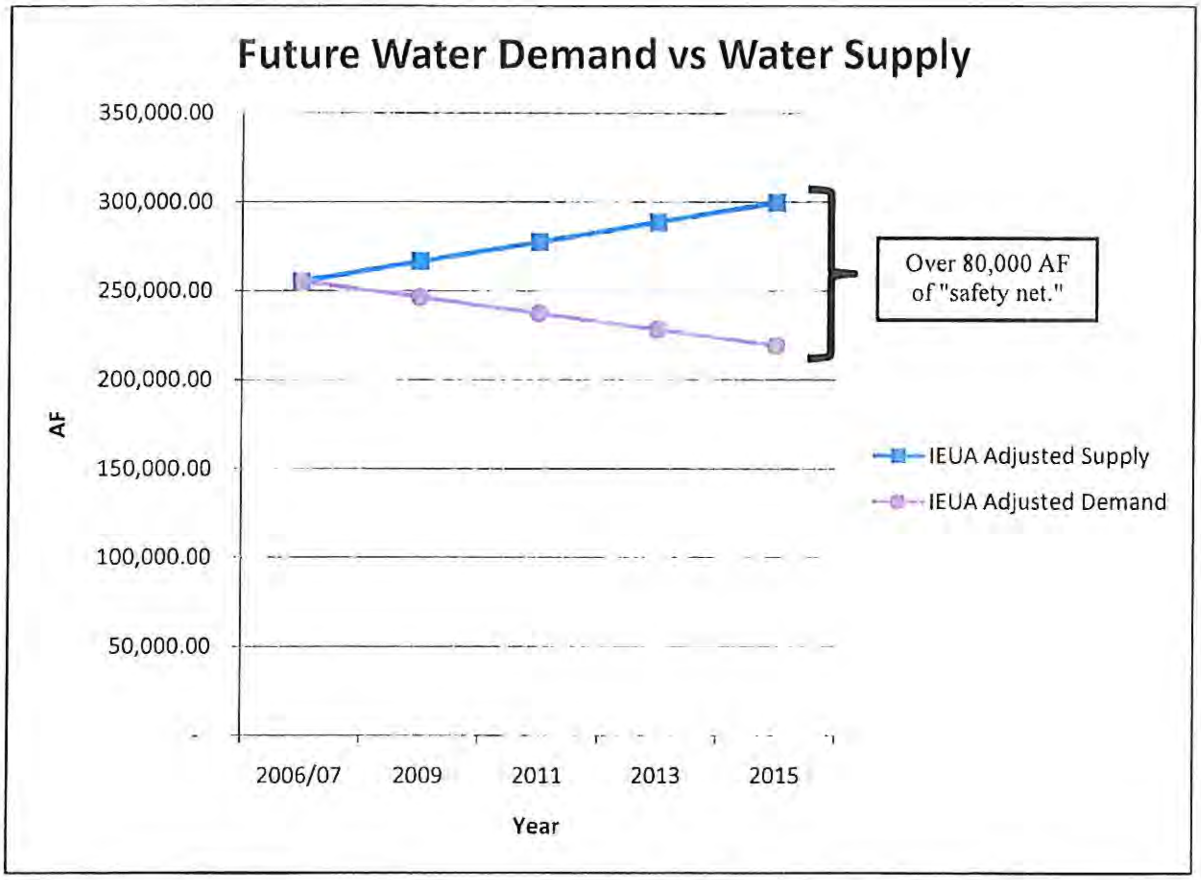


Figure 3 – Shows the comparison between water demand vs supply. There is a large "cushion" between demand and supply.

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

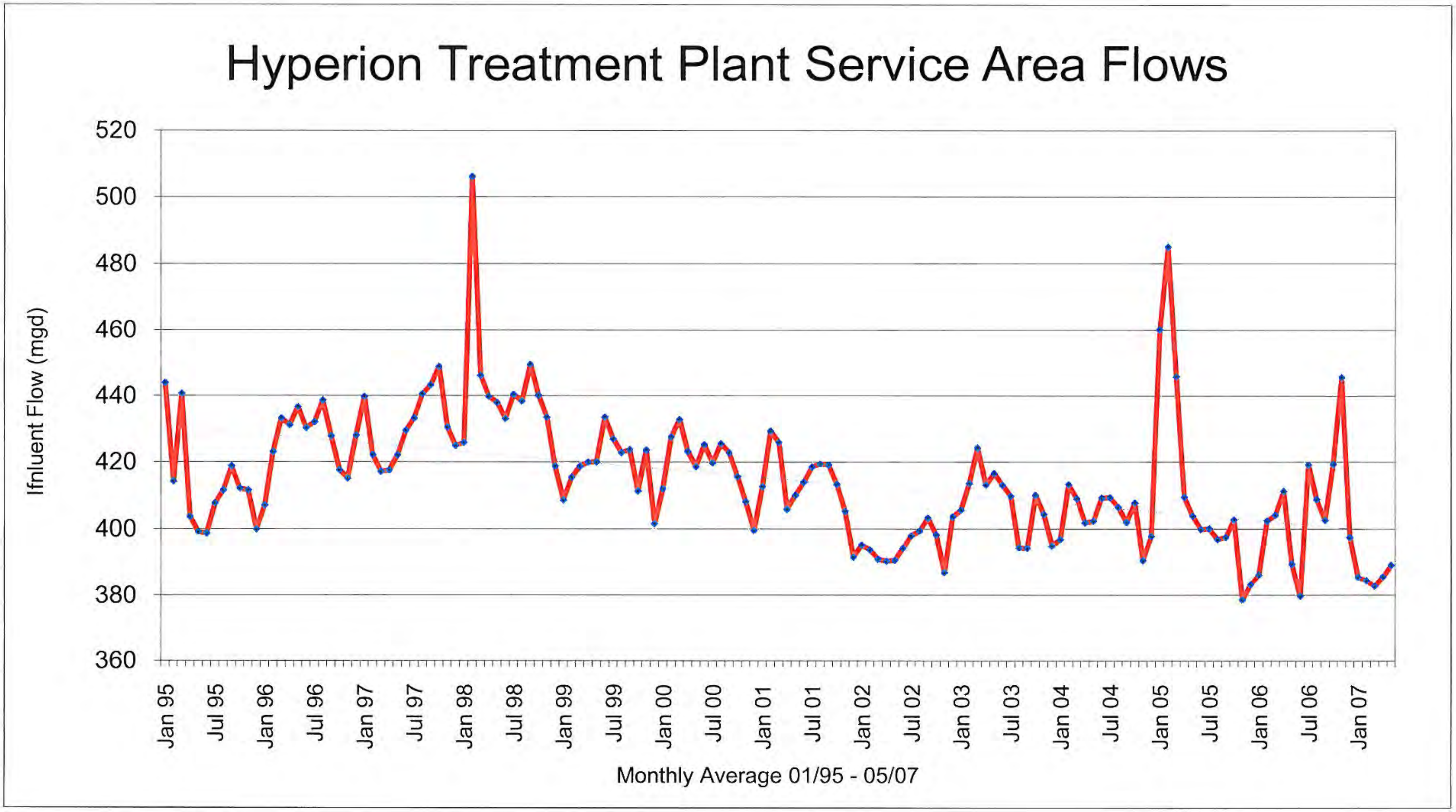
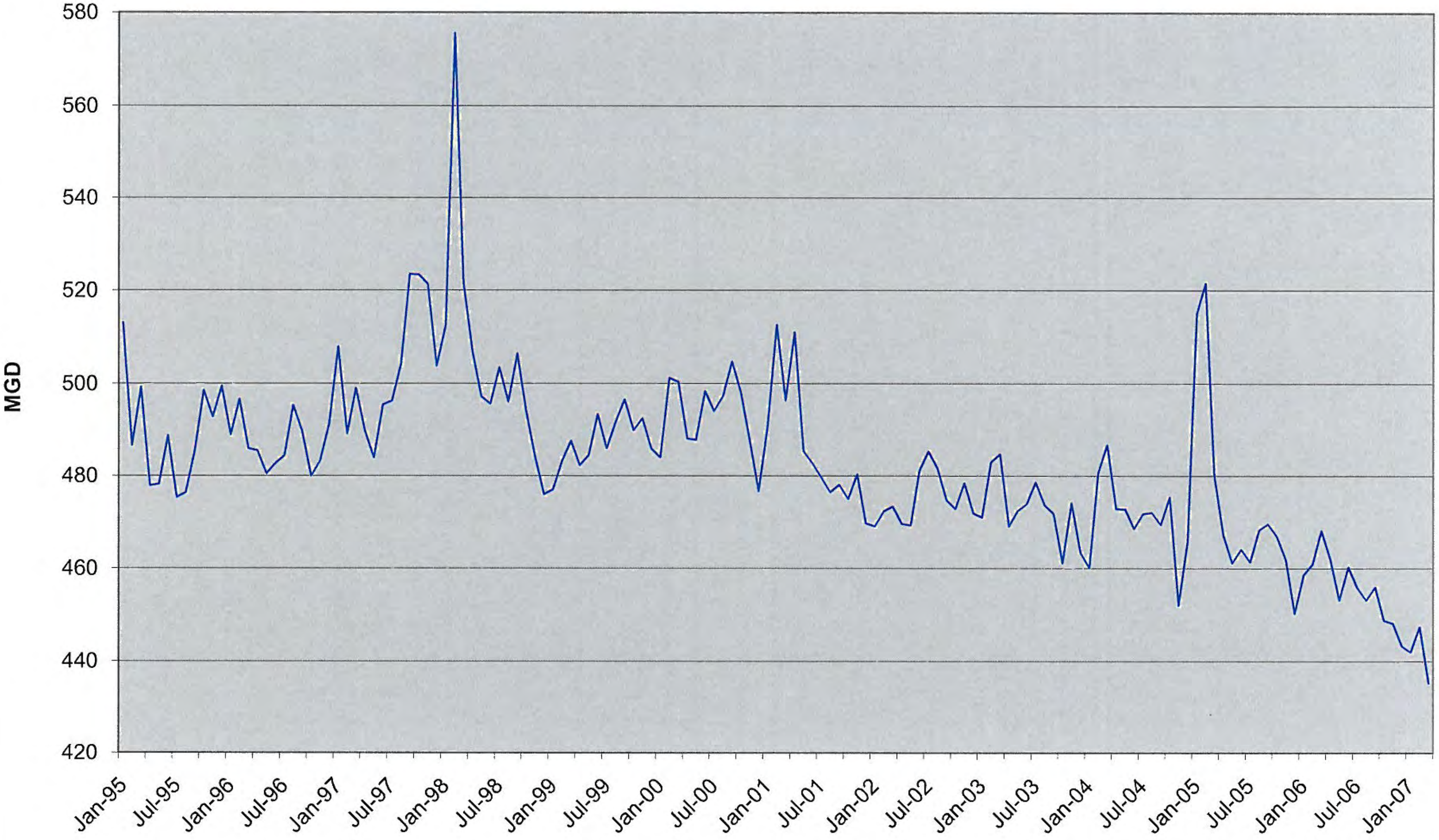

Hyperion Treatment Plant Service Area Flows
Ifnluent Flow (mgd)
520
500
480
460
440
420
400
380
360
Jan 95
Jul 95
Jan 96
Jul 96
Jan 97
Jul 97
Jan 98
Jul 98
Jan 99
Jul 99
Jan 00
Jul 00
Jan 01
Jul 01
Jan 02
Jul 02
Jan 03
Jul 03
Jan 04
Jul 04
Jan 05
Jul 05
Jan 06
Jul 06
Jan 07
Monthly Average 01/95 - 05/07

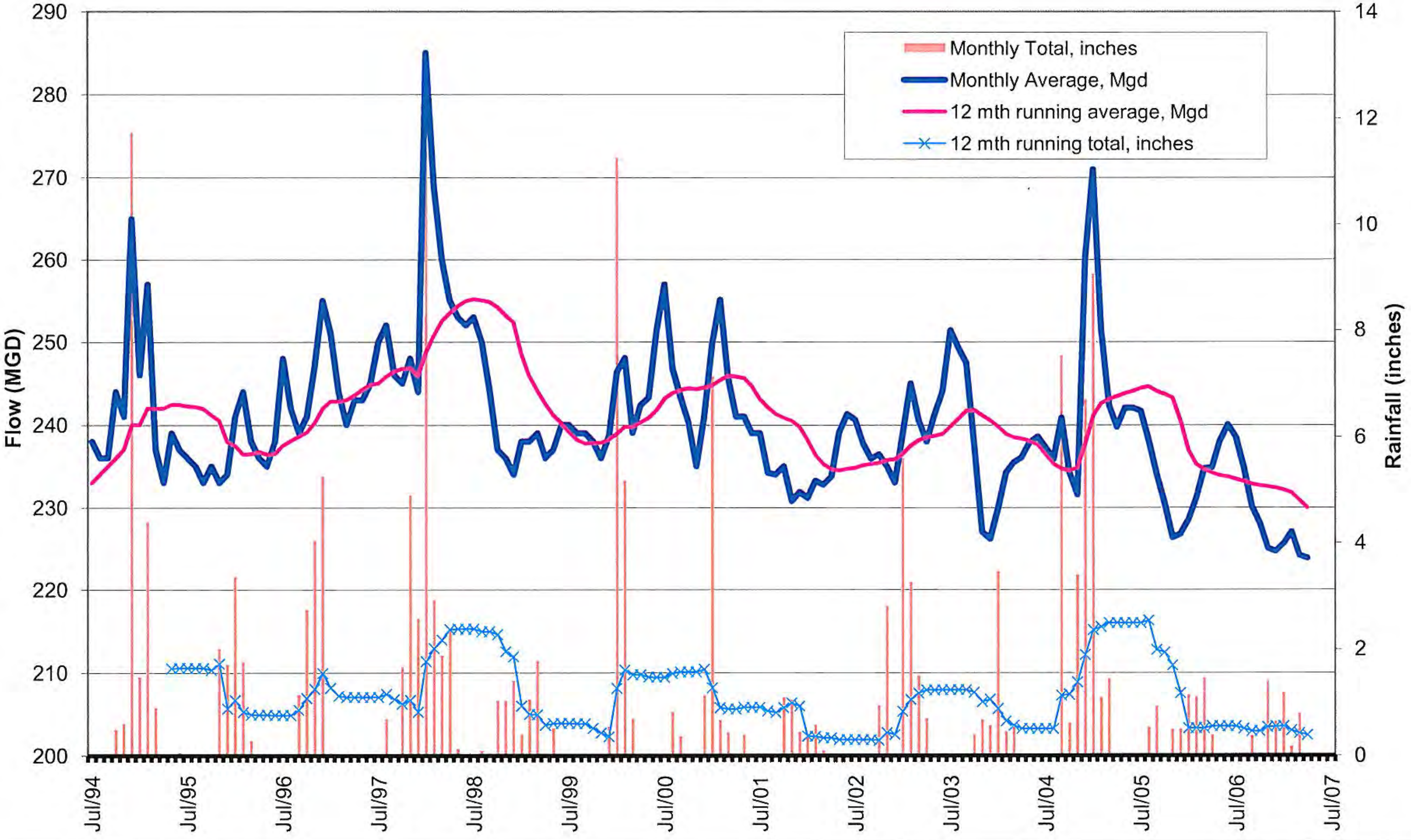
Exhibit 2



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



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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)	(1,337.81)	(3,665.10)	(2,579.93)	(1,770.70)	(1,657.87)	(2,595.10)	(7,312.59)	-	(40,192.14)

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	6,081.84	5,345.08	4,324.06	3,636.87	3,174.79	2,307.06	1,429.88	285.00	285.00	201.60	-	32,924.50
Actual 08/09 CUP Certification	4,040.77	6,024.77	7,748.32	5,213.14	3,156.50	1,299.70	2,410.10	2,022.09	522.30	72.10	-	-	32,506.49
Actual 08/09 IX Certification	274.40	341.52	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	8,516.44	2,462.50	2,465.66	2,396.67	2,141.38	2,842.68	536.48	1,451.60	1,451.60	1,367.60	167.40	32,382.00
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

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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:

$$Q_s = \frac{1.49}{n} \left[\left[y(B + \frac{s_l + s_r}{2} y) \right] \right]^{5/3} \left[B + y(\sqrt{(1+s_l^2)} + \sqrt{(1+s_r^2)} \ \right]^{-2/3} S_b^{1/2}$$

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**

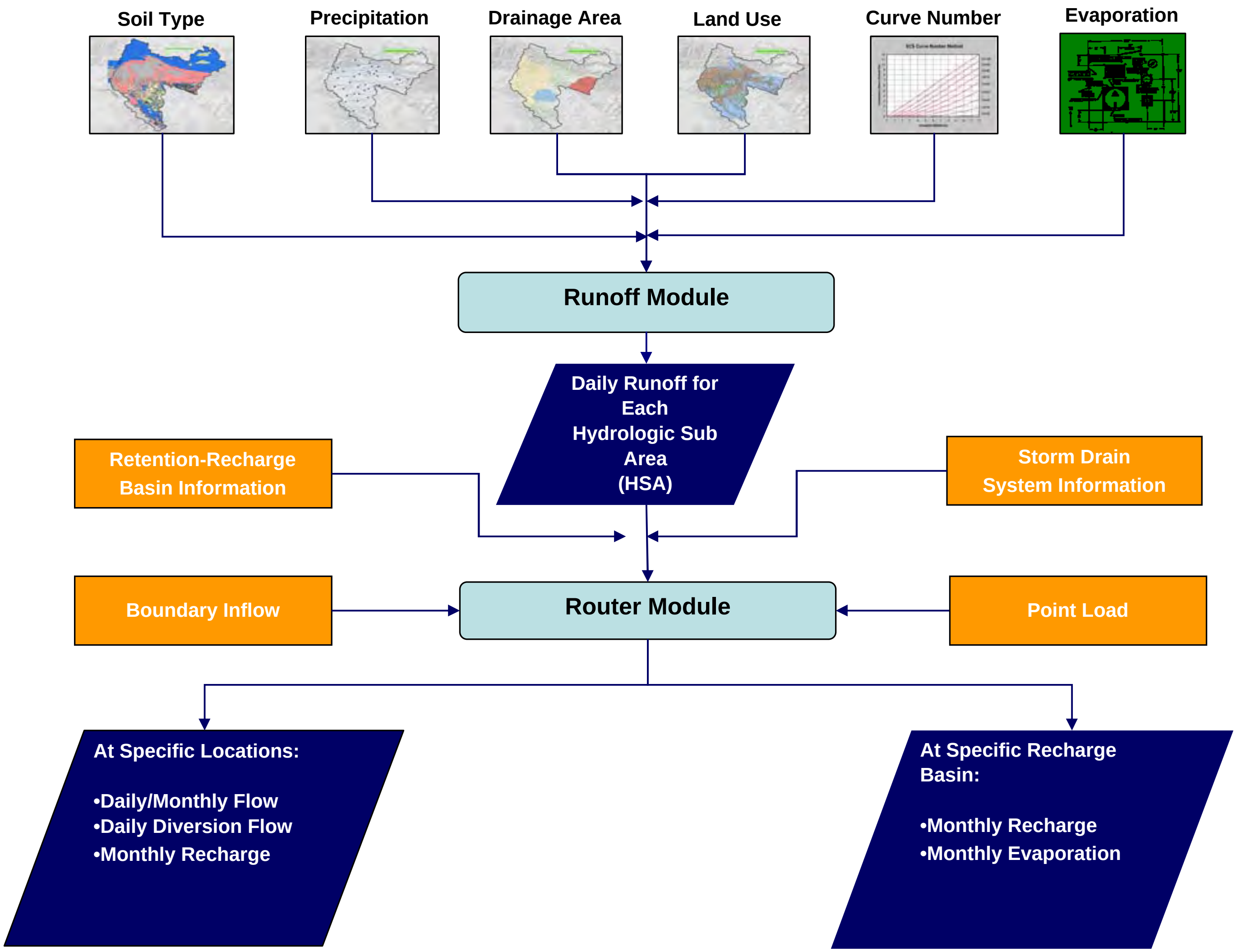
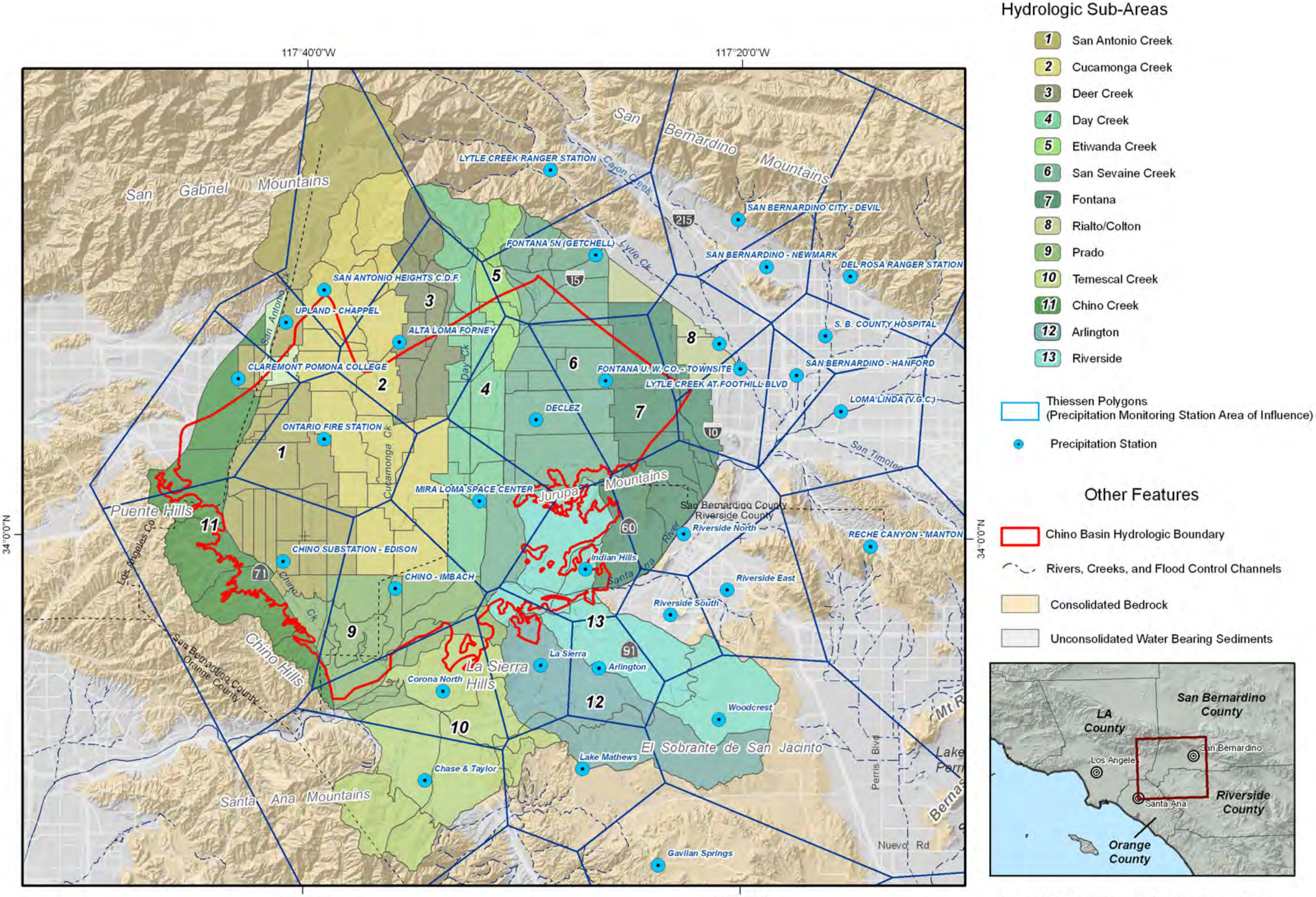


Figure C-1
Organization of the Runoff and Router Modules



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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

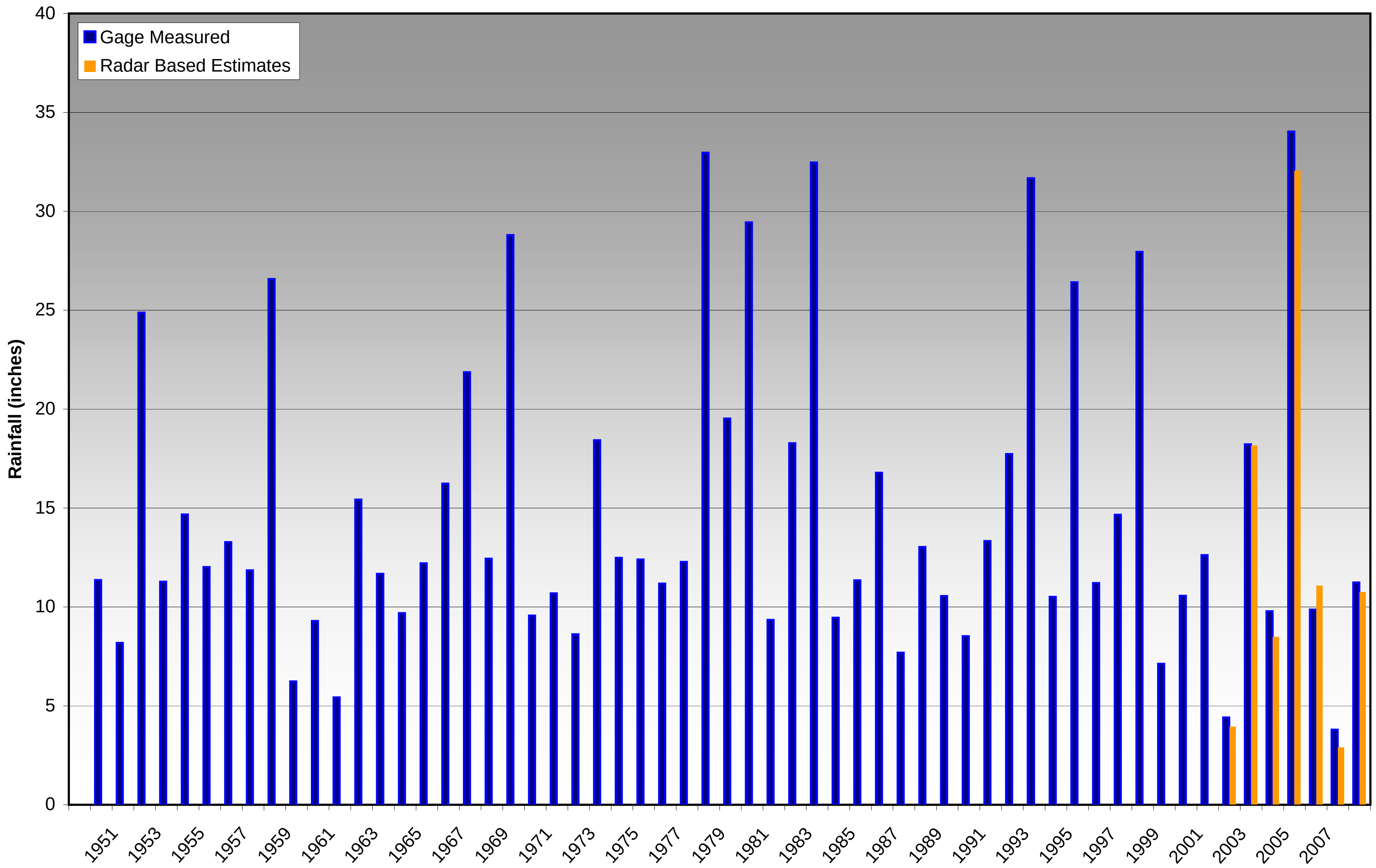


Figure C-4

Comparison of Annual Gage-Measured Rainfall versus Radar-Based Rainfall

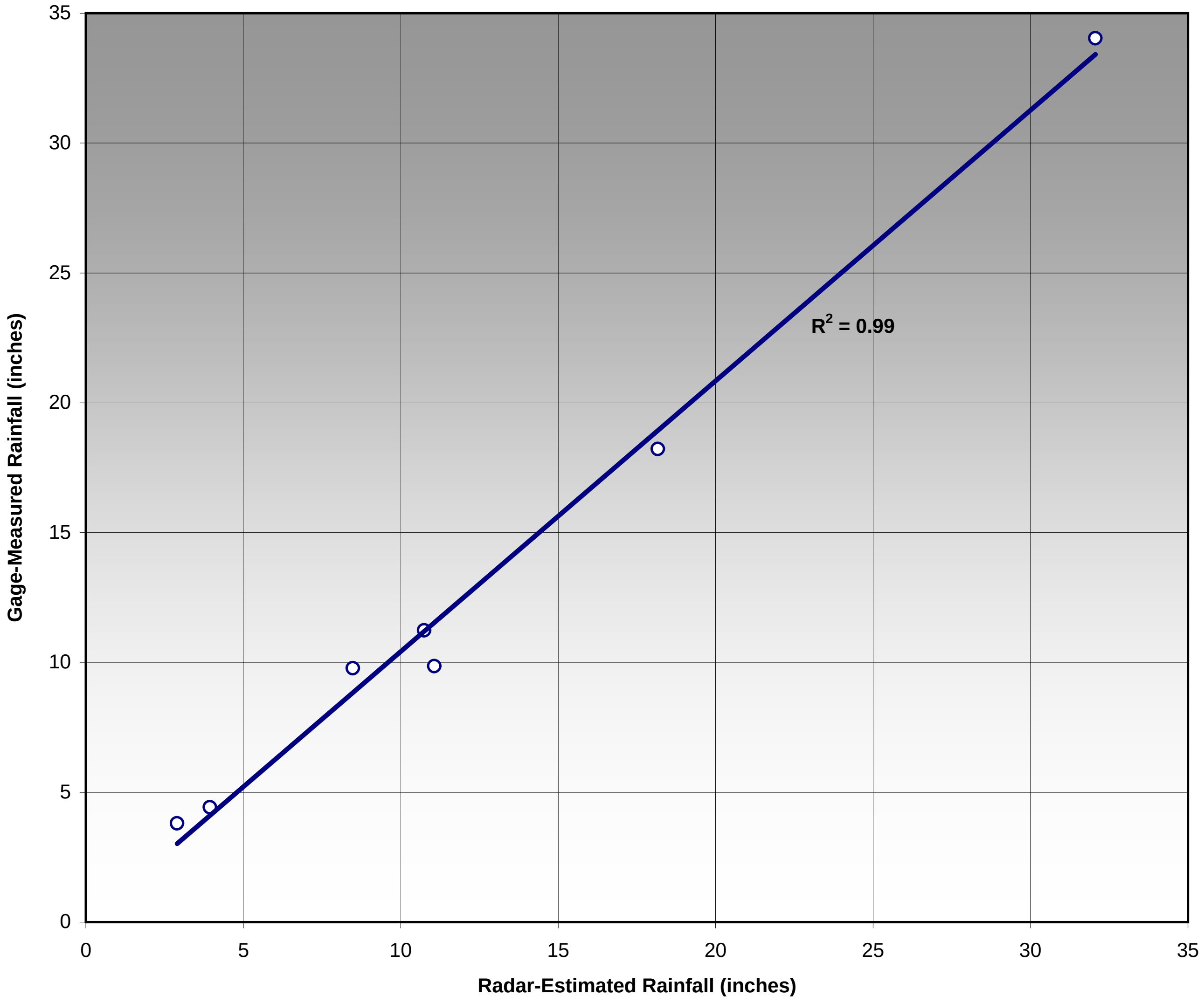
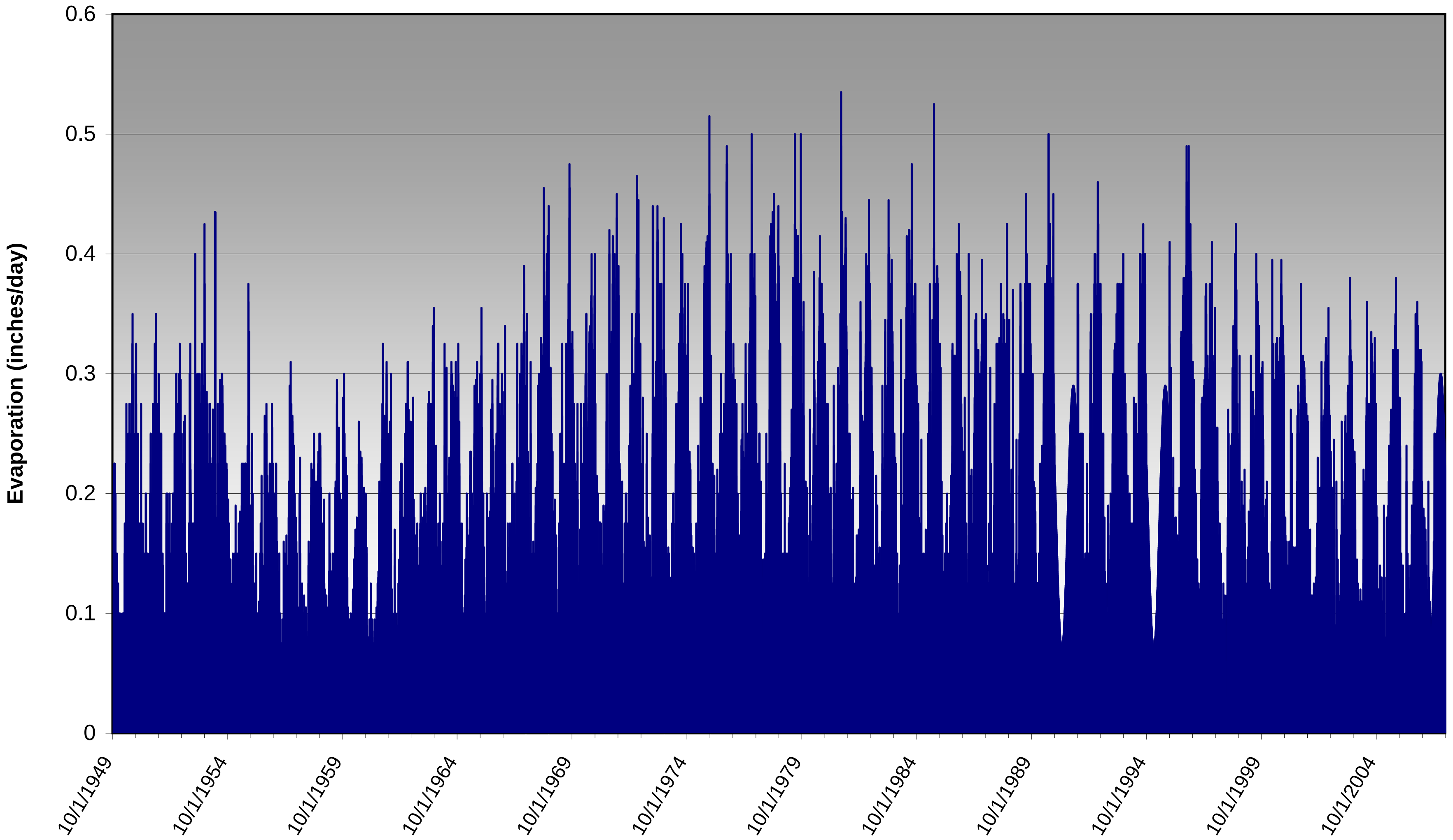


Figure C-5

Historical Evaporation Recorded at Puddingstone Station



V:\cbrm\ReportPreparation\Copy of Figure_v1.xls--Figure C-5

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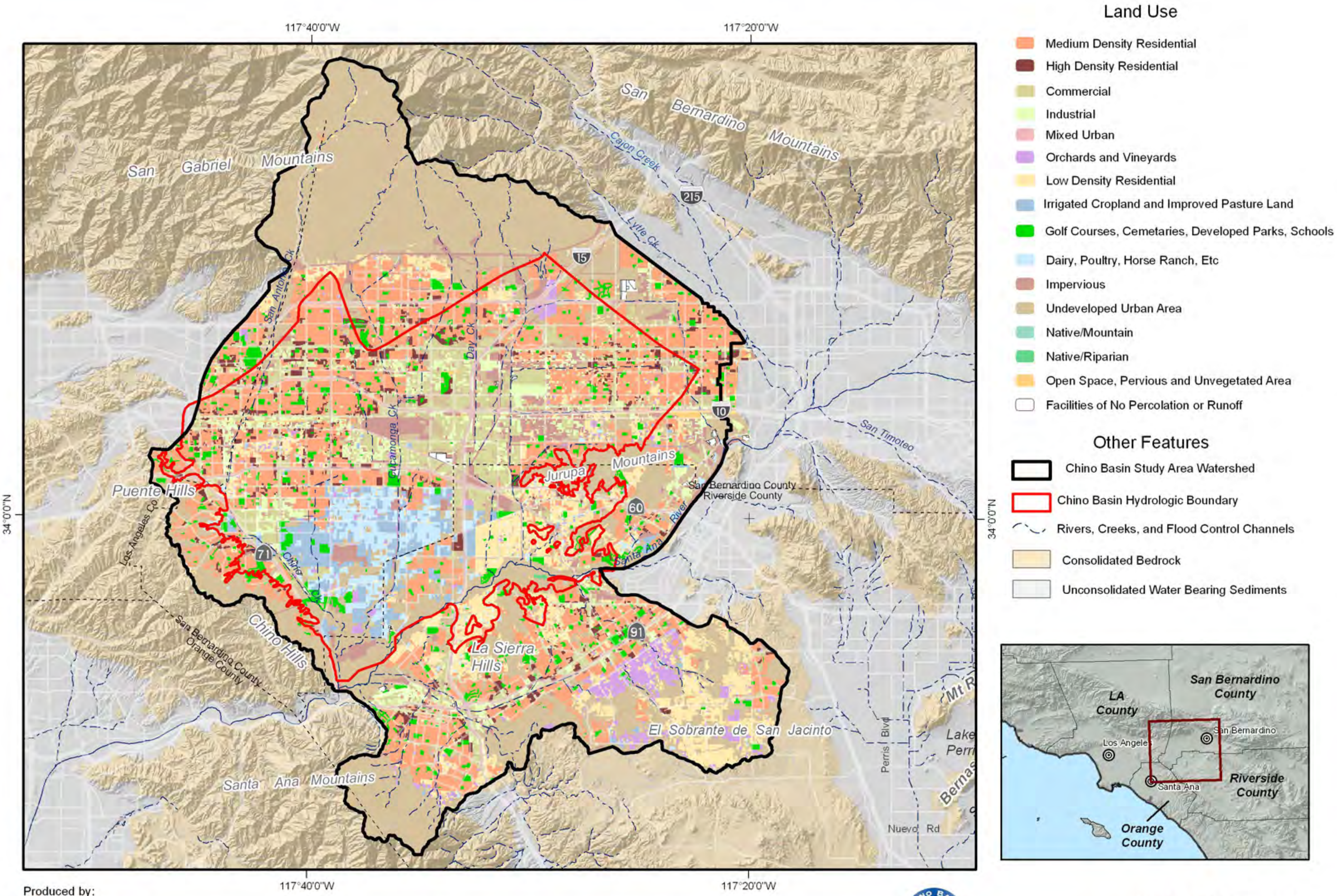

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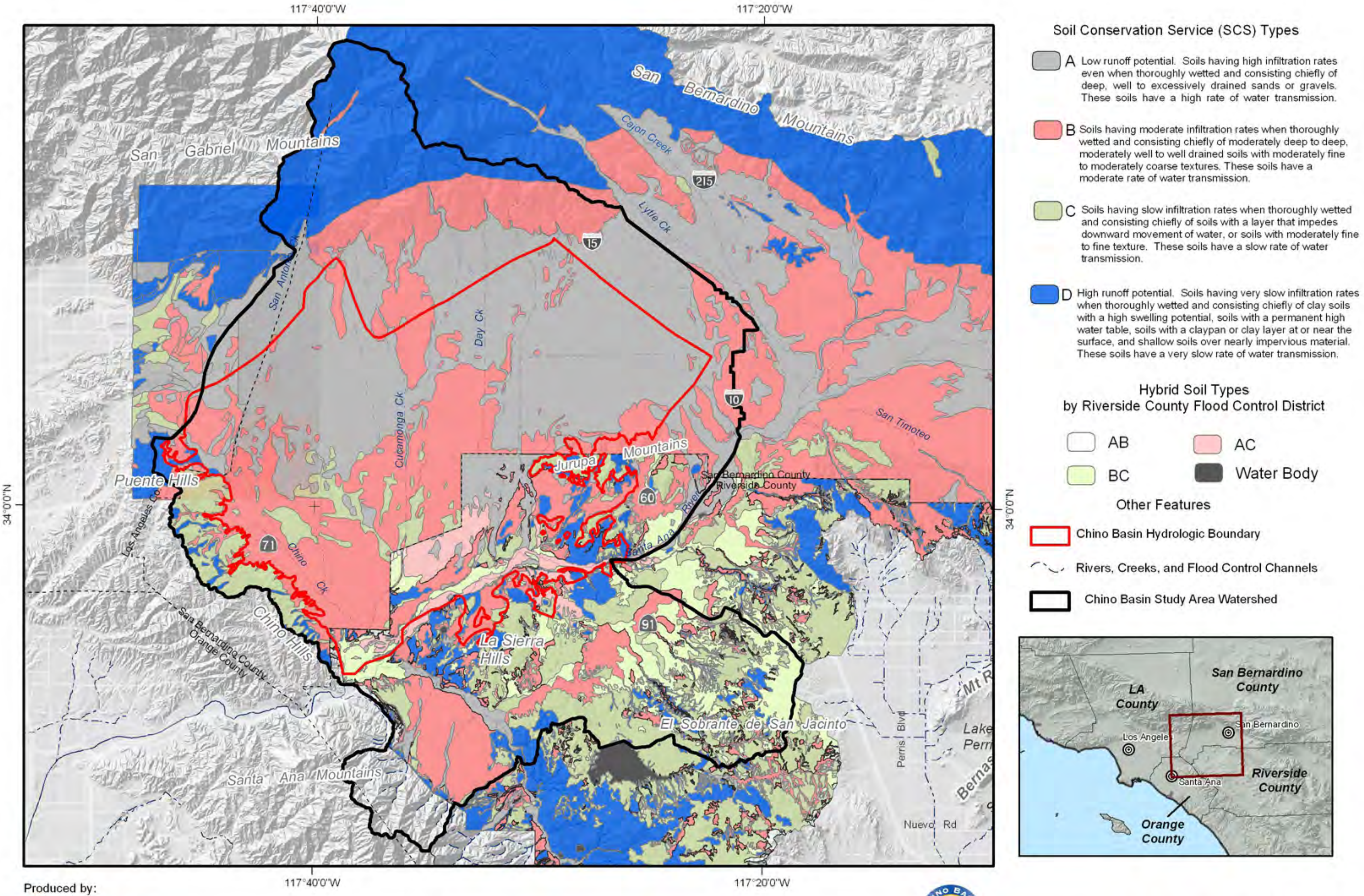
SCAG 2006 Land Use in the Chino Basin Area

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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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

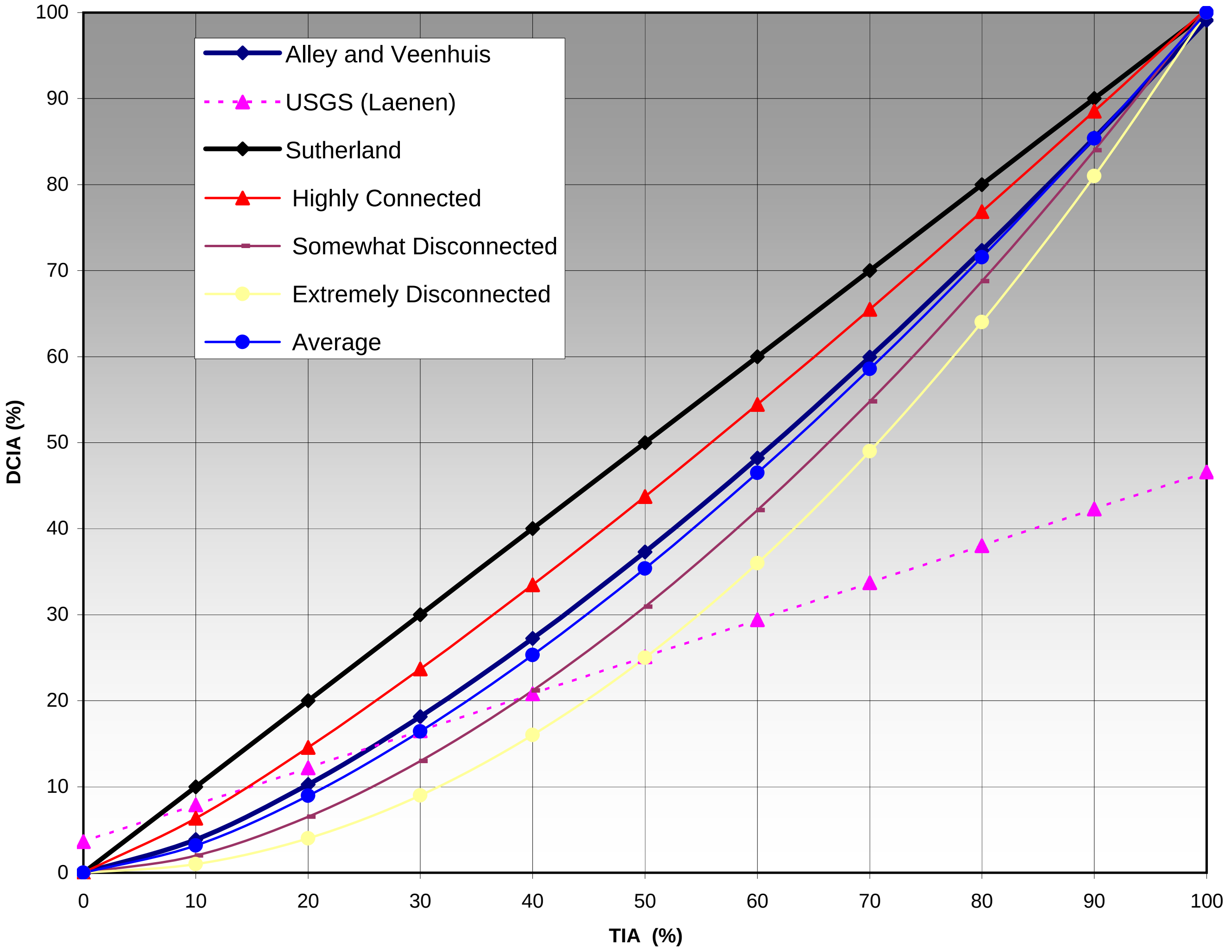
CHINO BASIN WATERMASTER

2010 Recharge Master Plan Update

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)



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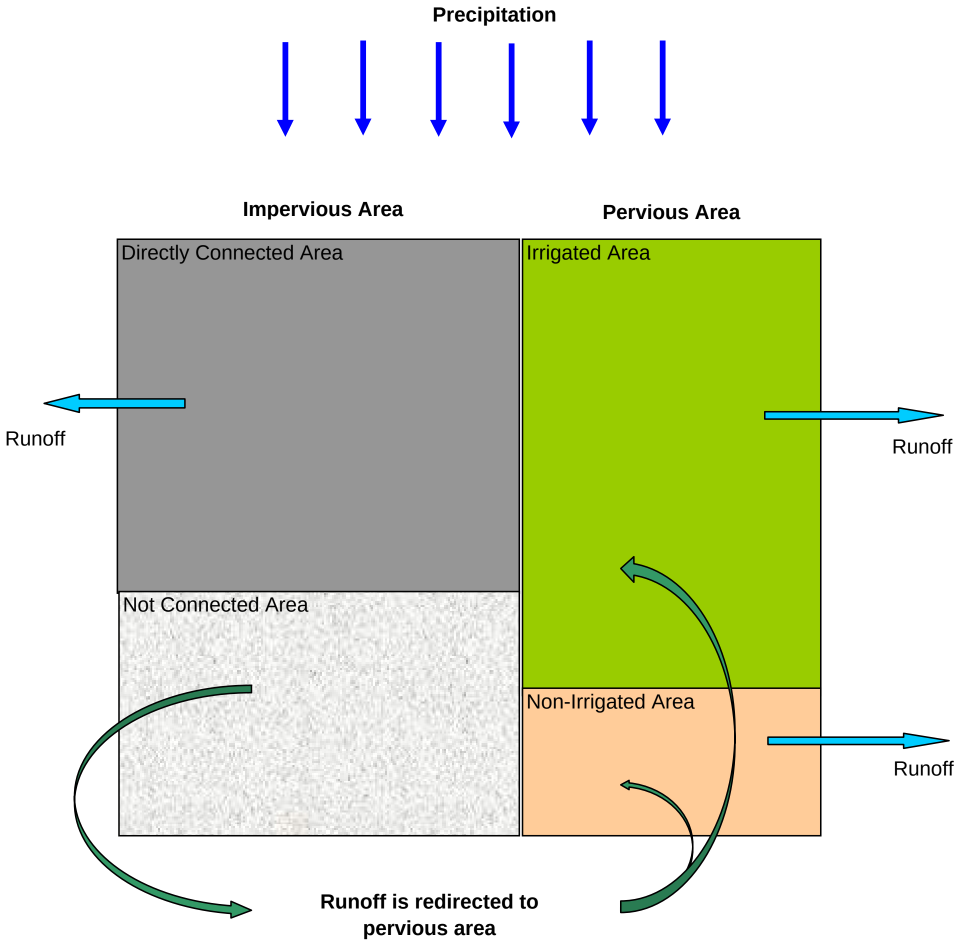


Figure C-10

Schematic Diagram to Redirect Runoff from Impervious Area to Pervious area

Figure C-11
Graphical Explanation of SCS Method Variables

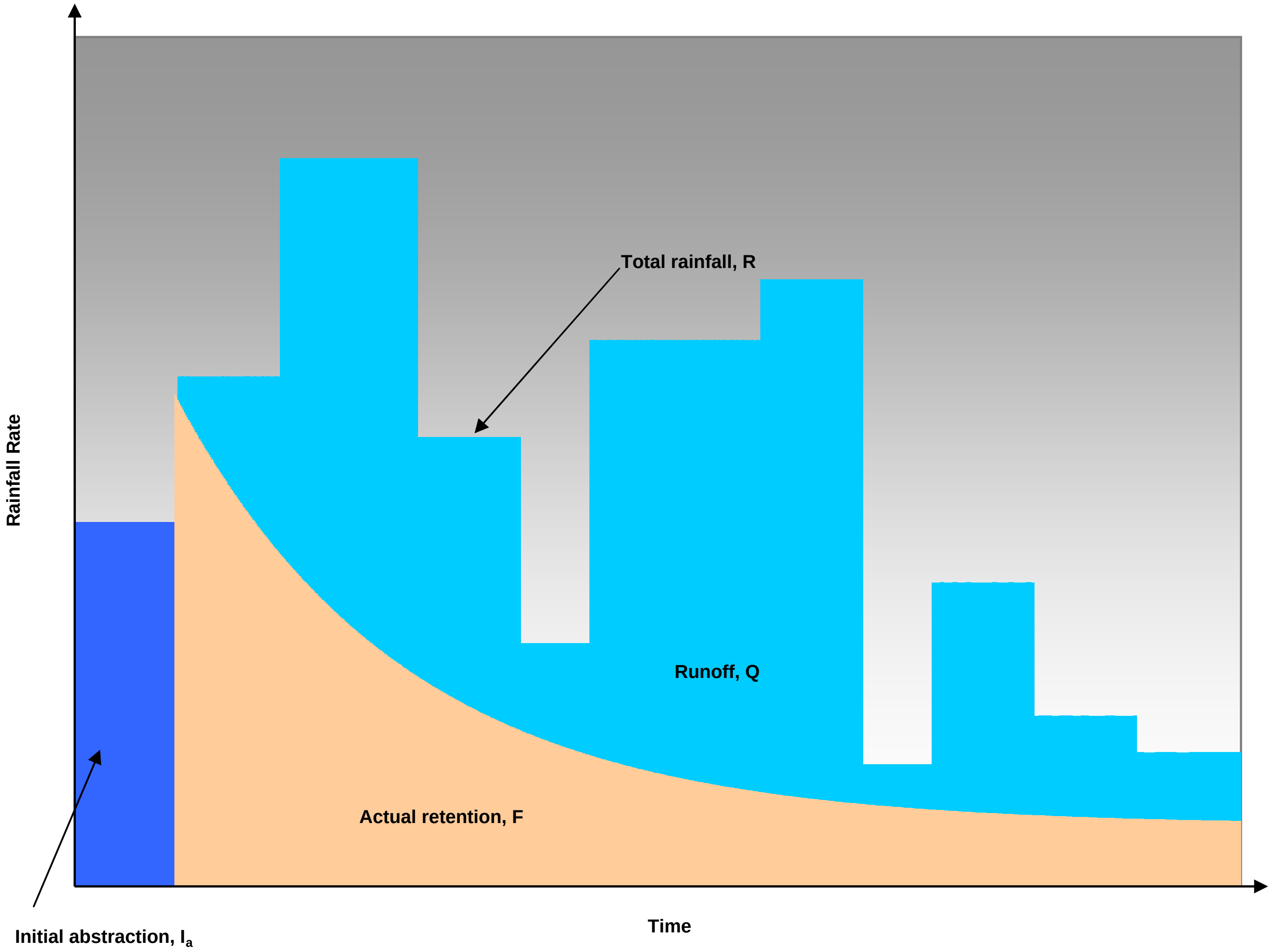
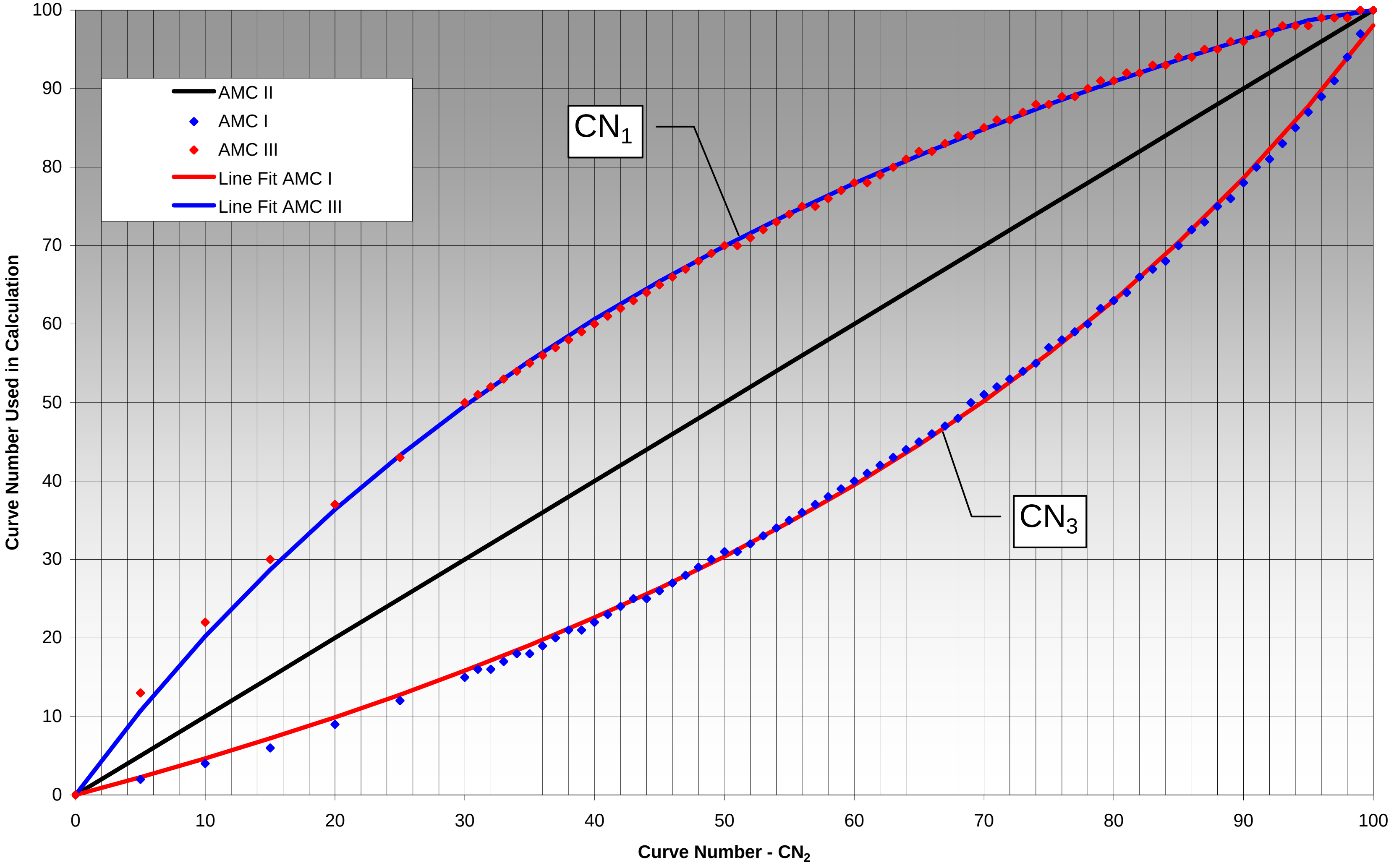
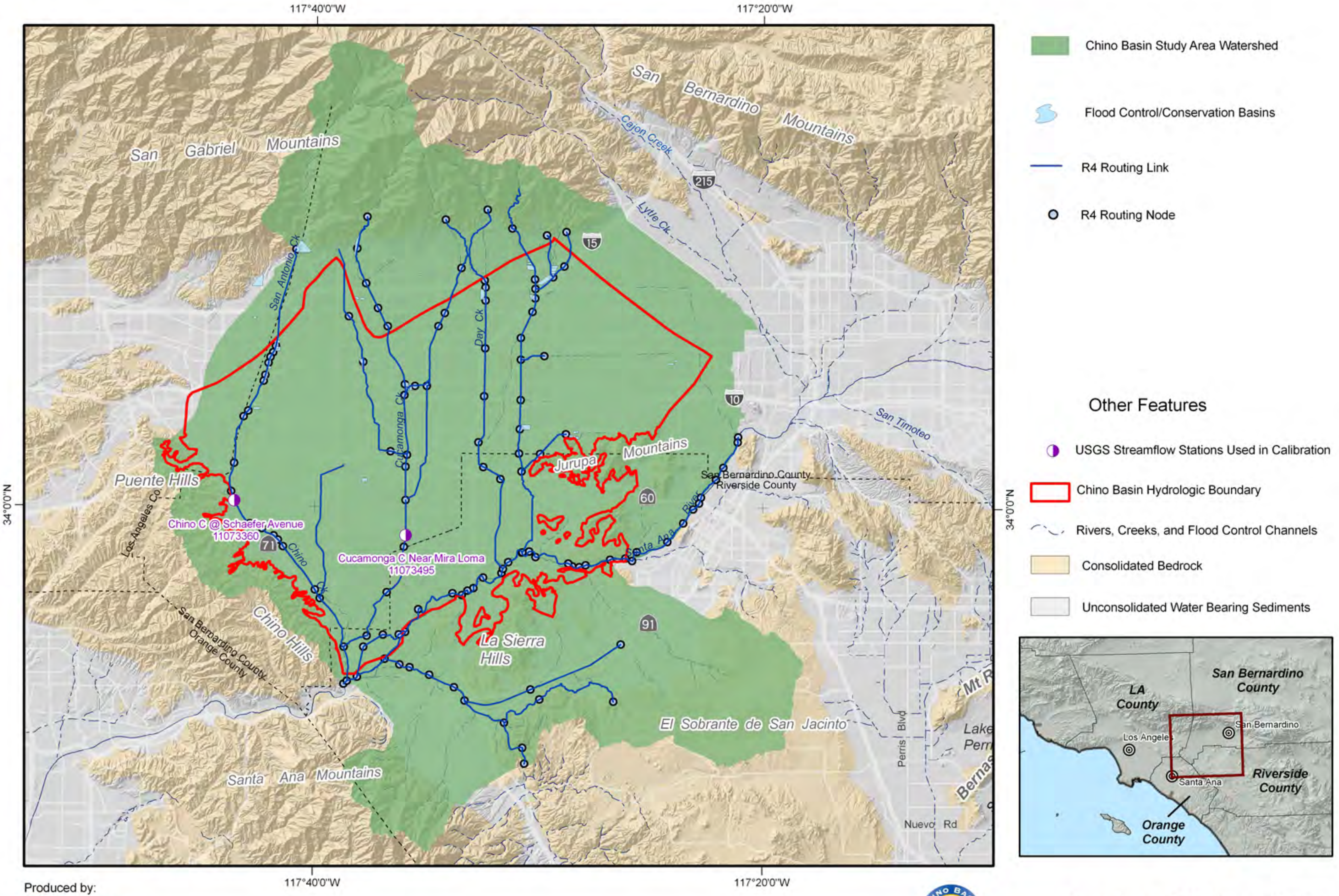


Figure C-12

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

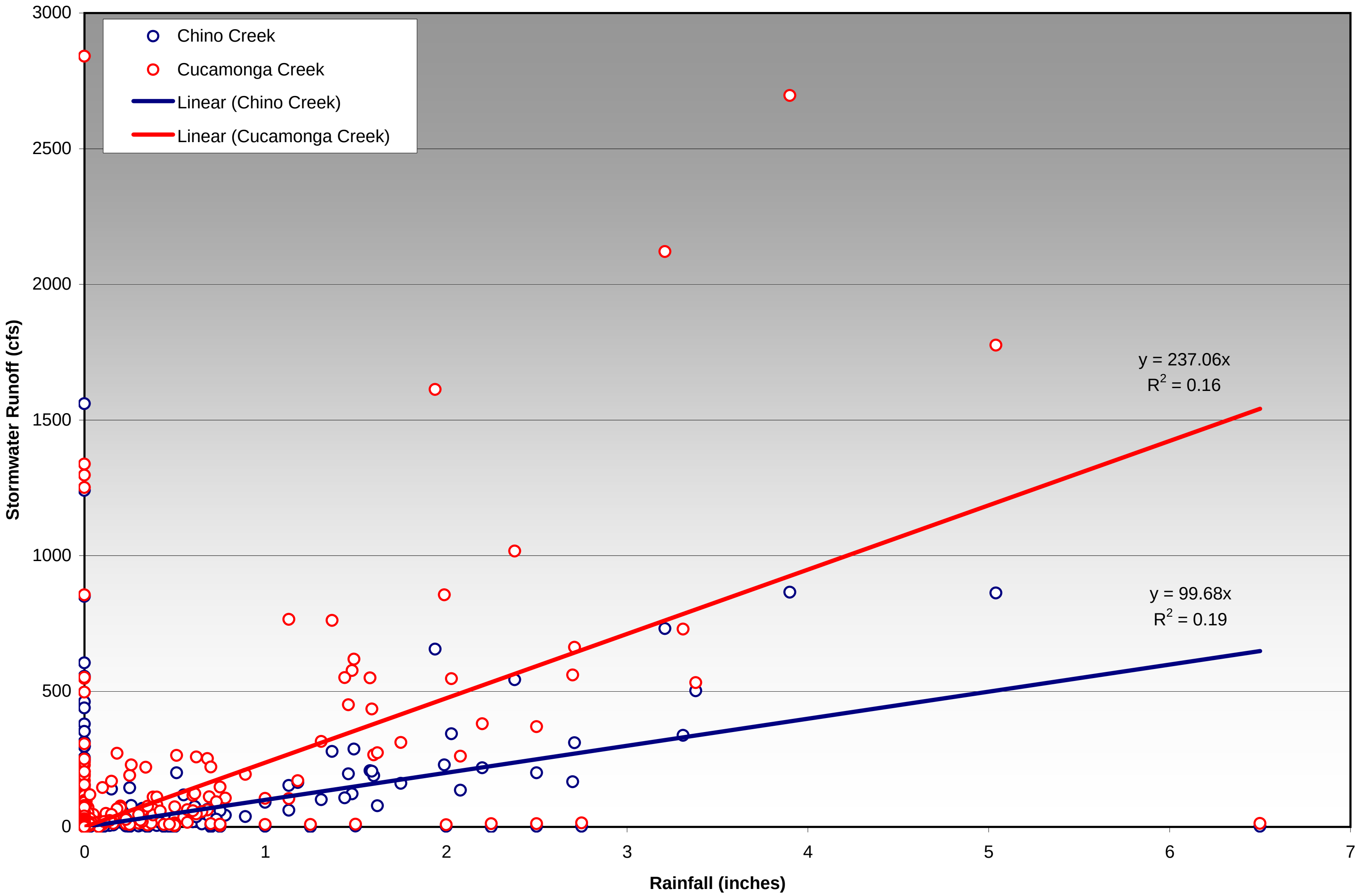


Figure C-15
Comparison of Historical Daily Flow at Cucamonga Creek versus Flow at Chino Creek

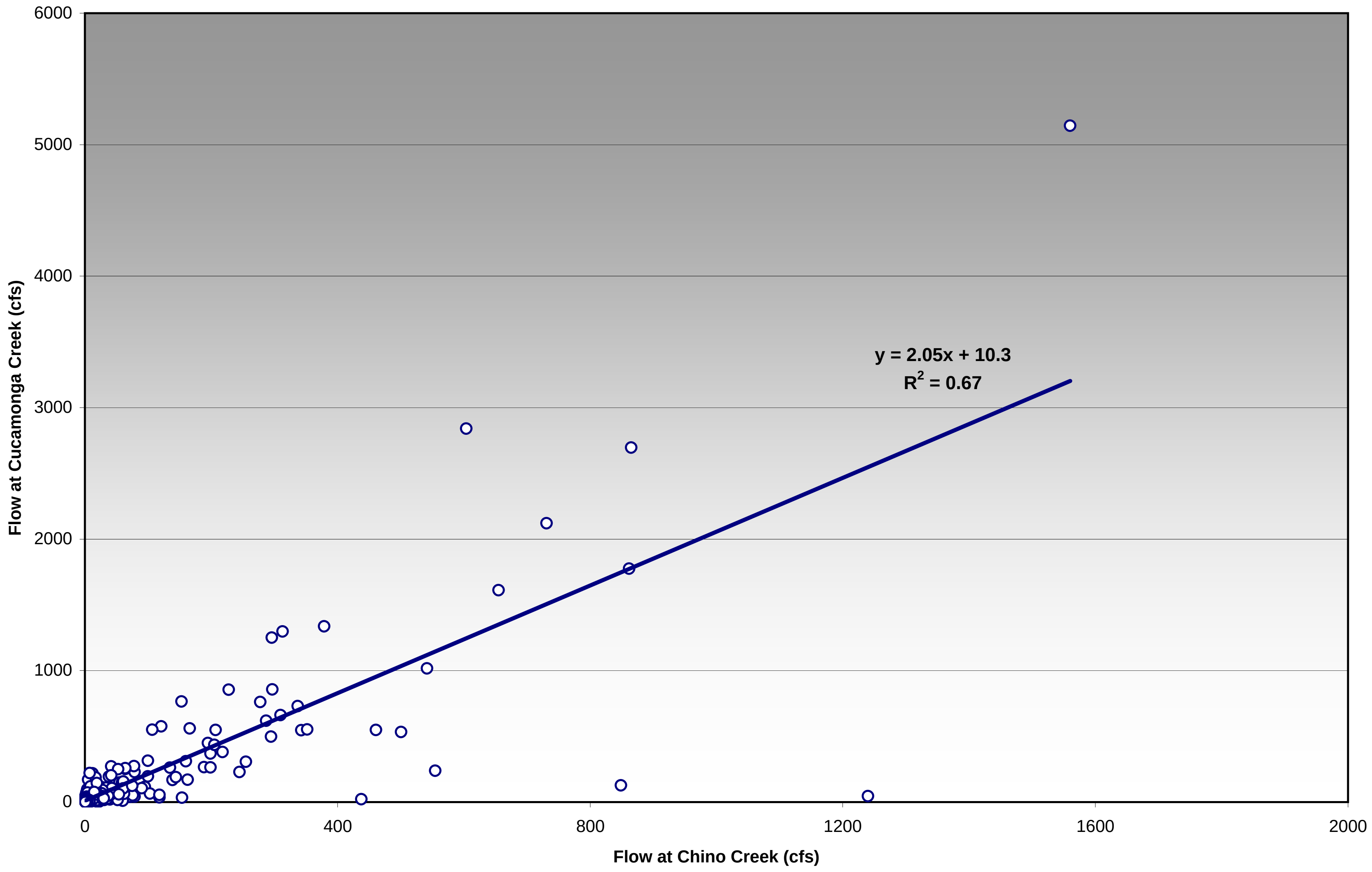


Figure C-16
Modeled versus Measured Stormwater Runoff

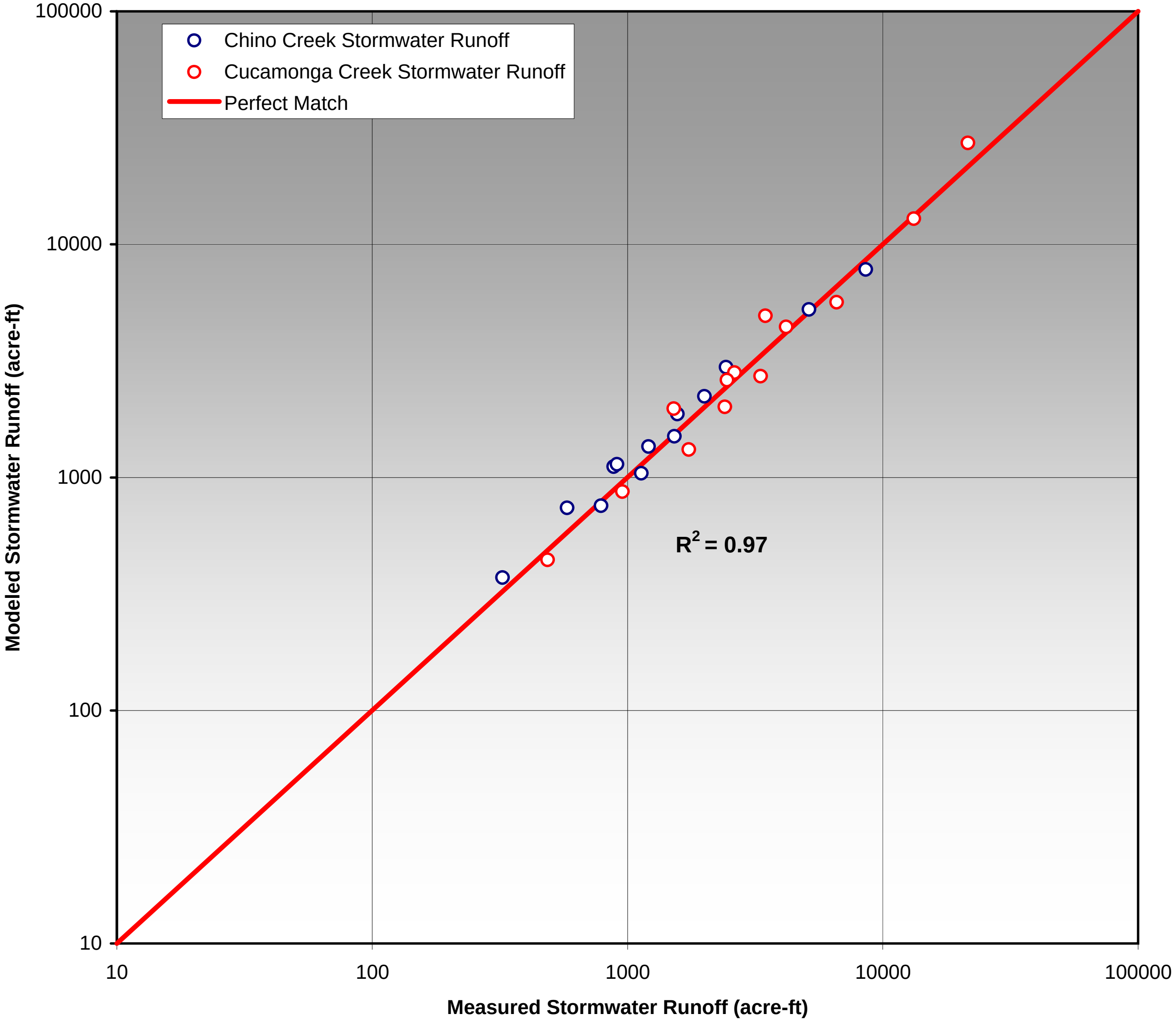


Figure C-17a

Monthly Rainfall Averages for a 55-Year Window, San Bernardino Hospital Gage

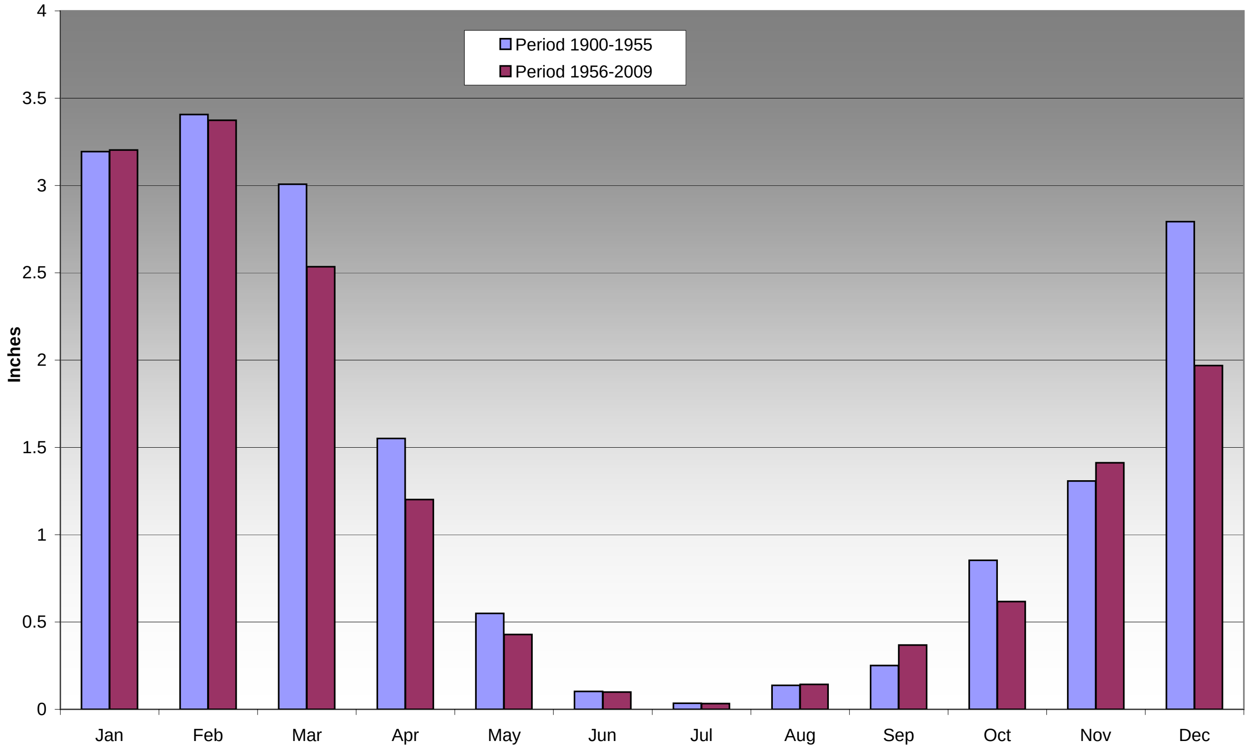


Figure C-17b

Monthly Rainfall Averages for a 27-Year Window, San Bernardino Hospital Gage

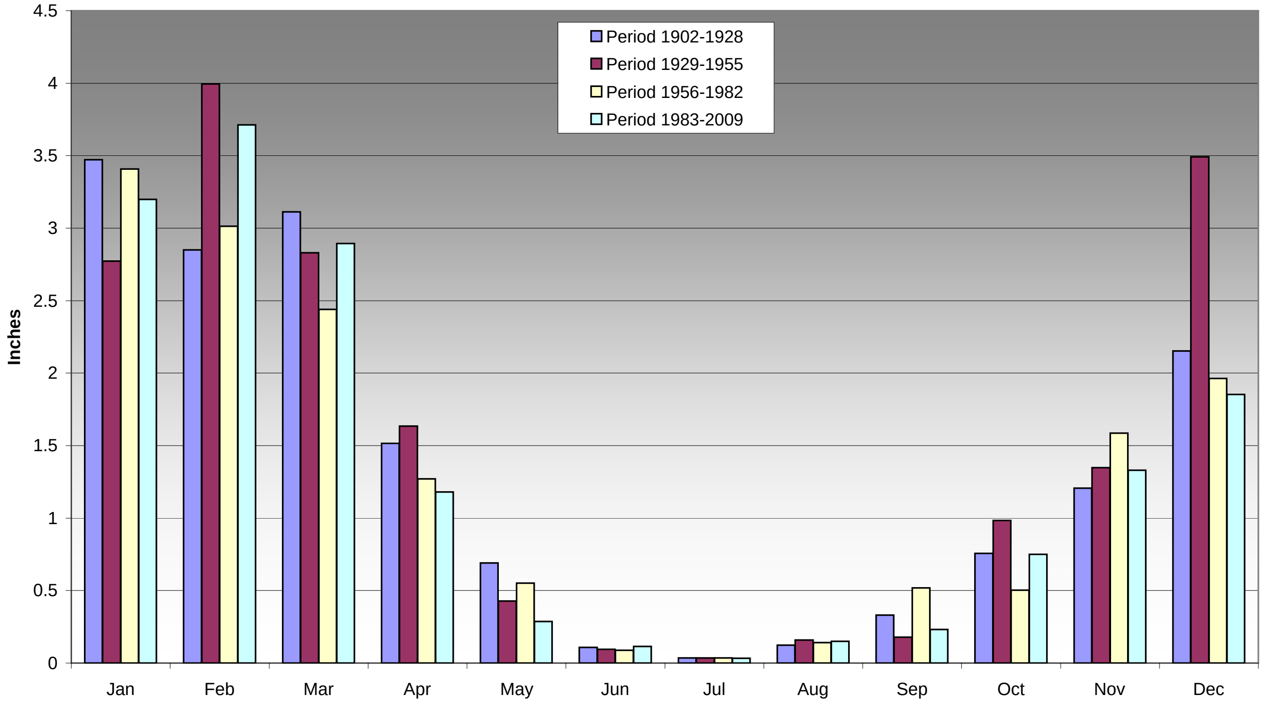
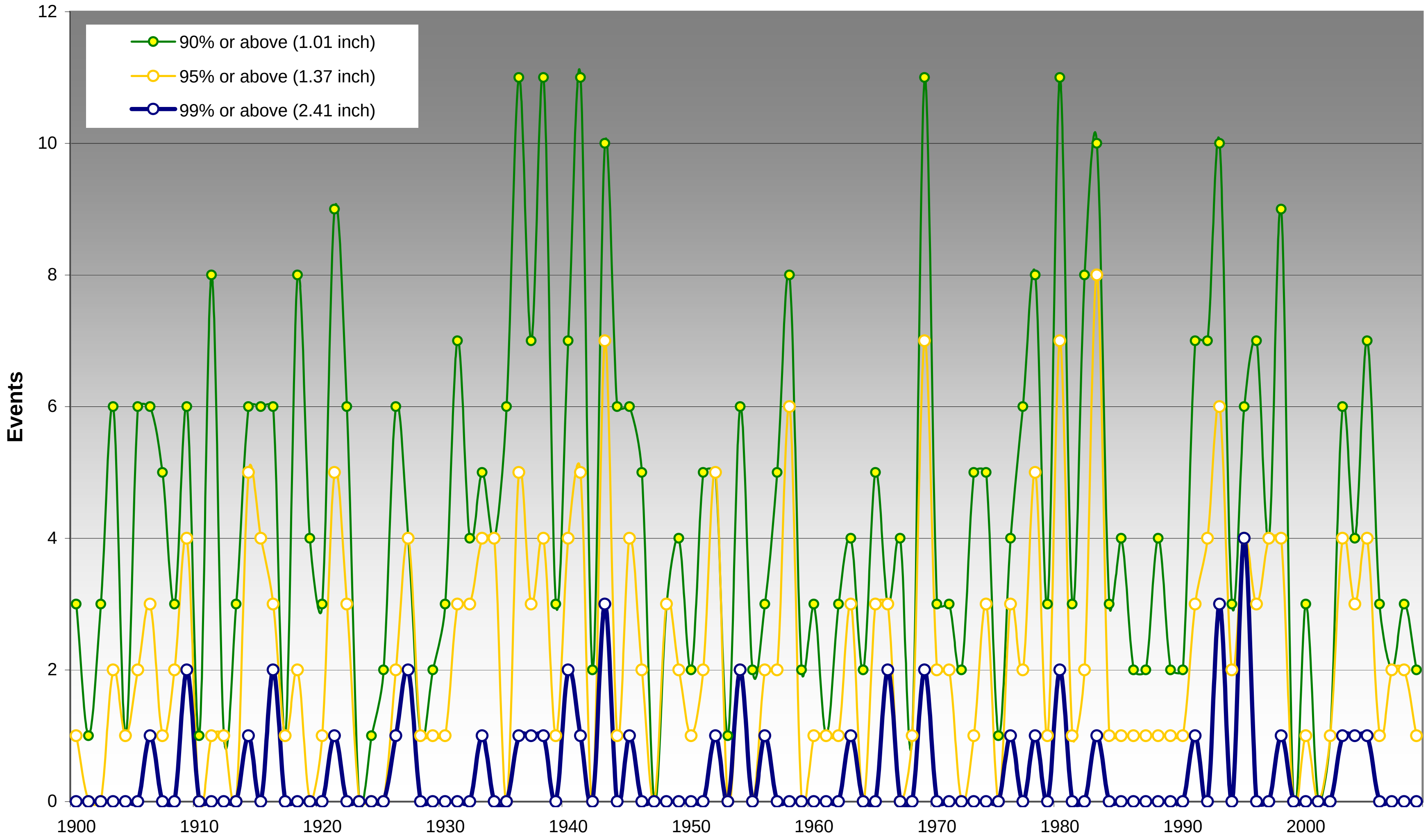


Figure C-18
Change in Number of High Precipitation Daily Events at the San Bernardino Hospital Gage



SBHospital_1900-2009.xlsChart1

Figure C-19a
Mass Curve Plot of Monthly Precipitation Estimates in the Ontario Area, Period 1950-2009

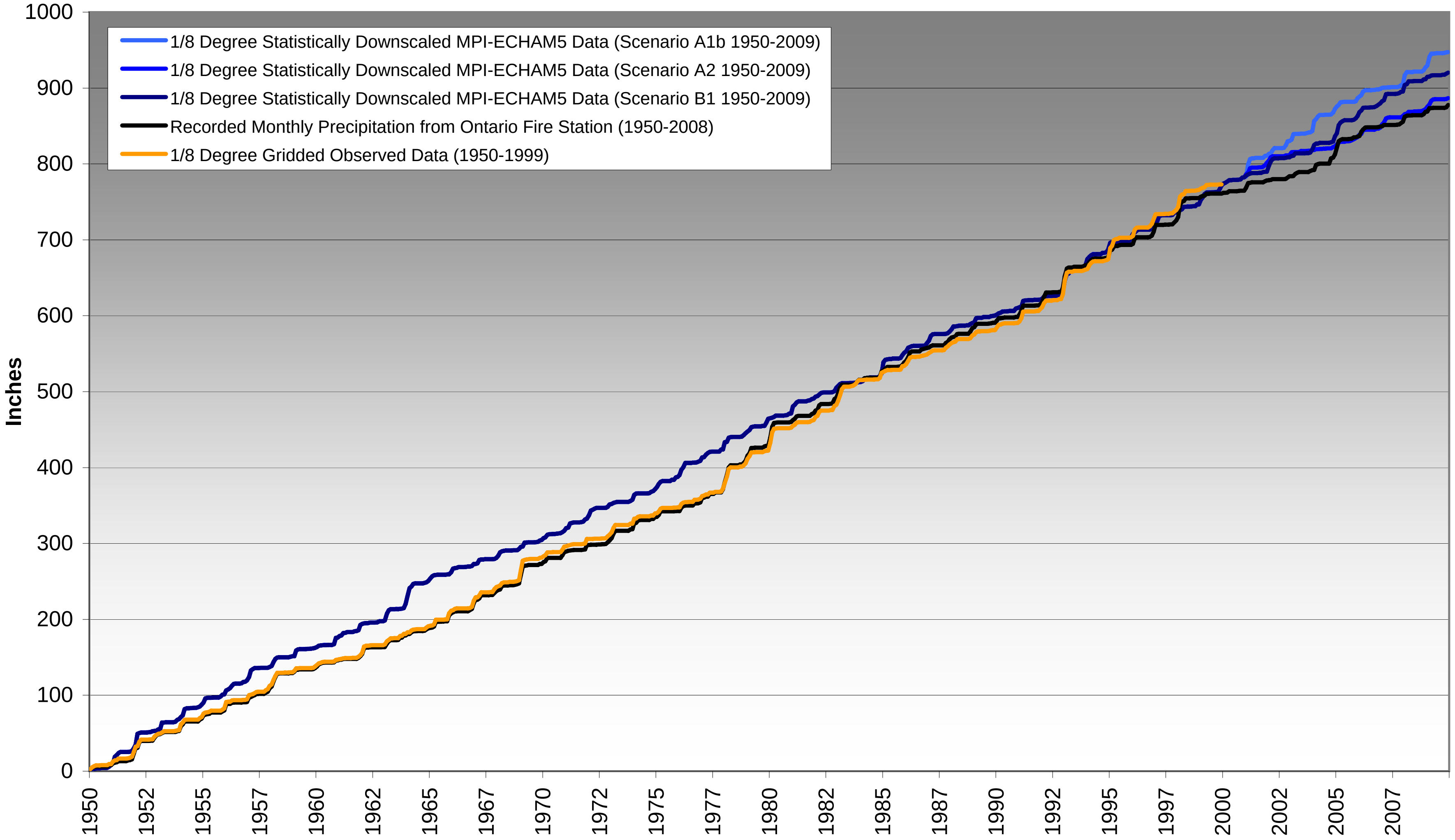


Figure C-19b

Mass Curve Plot of Monthly Precipitation Estimates in the Ontario Area, period 1950-2098

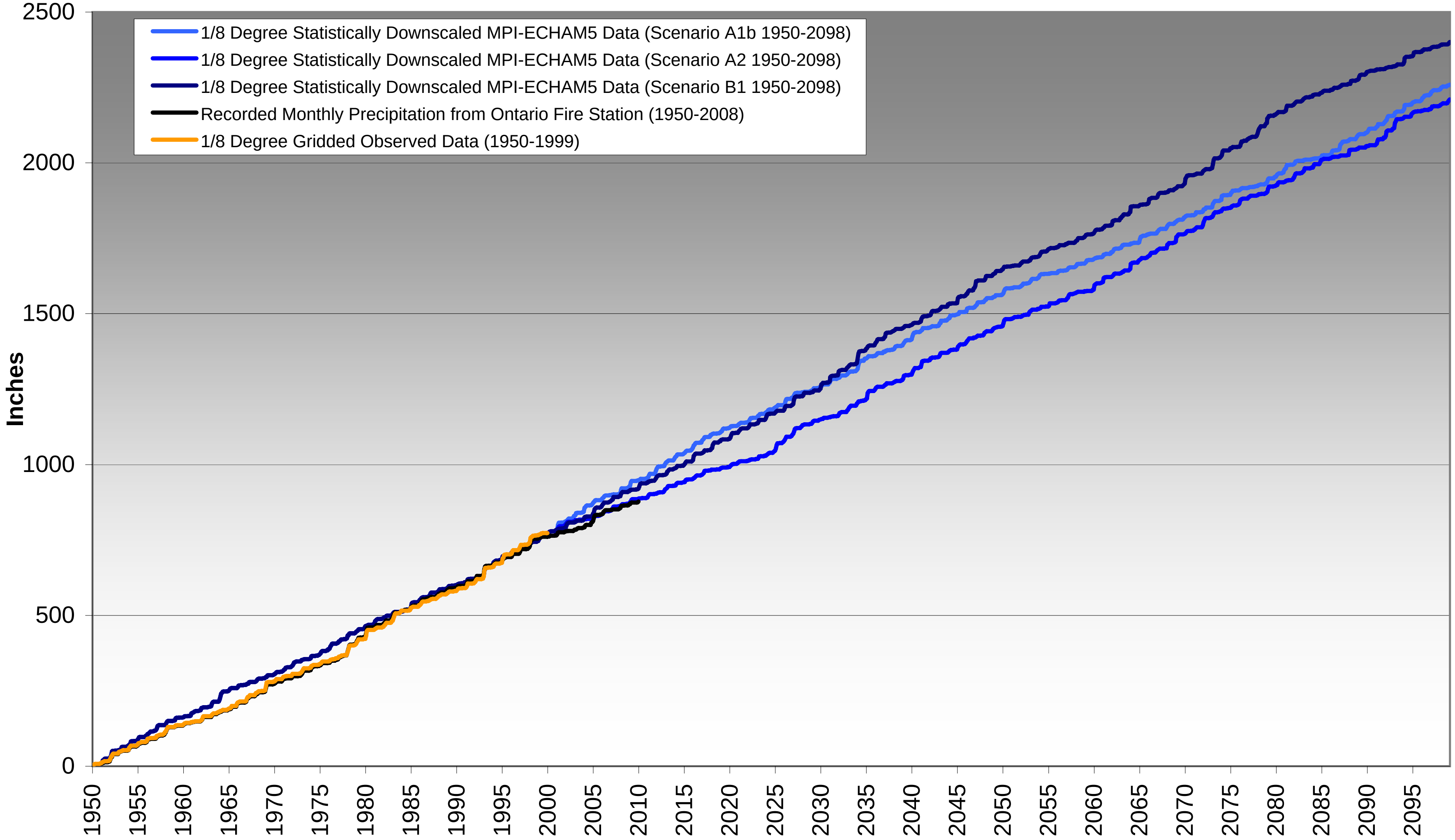
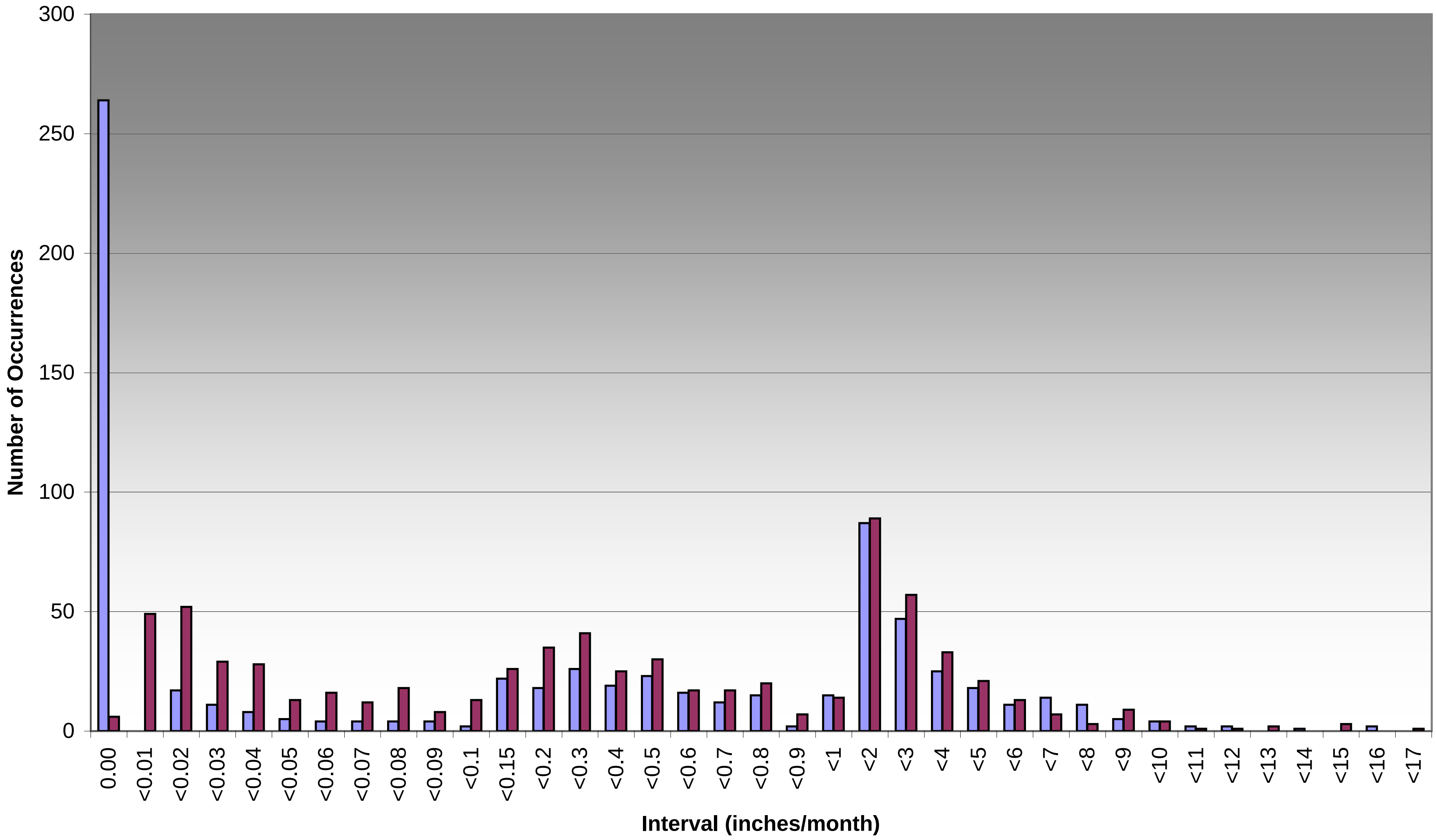


Figure C-20
Frequency of Occurrence-Ontario Gage, Scenario A1b



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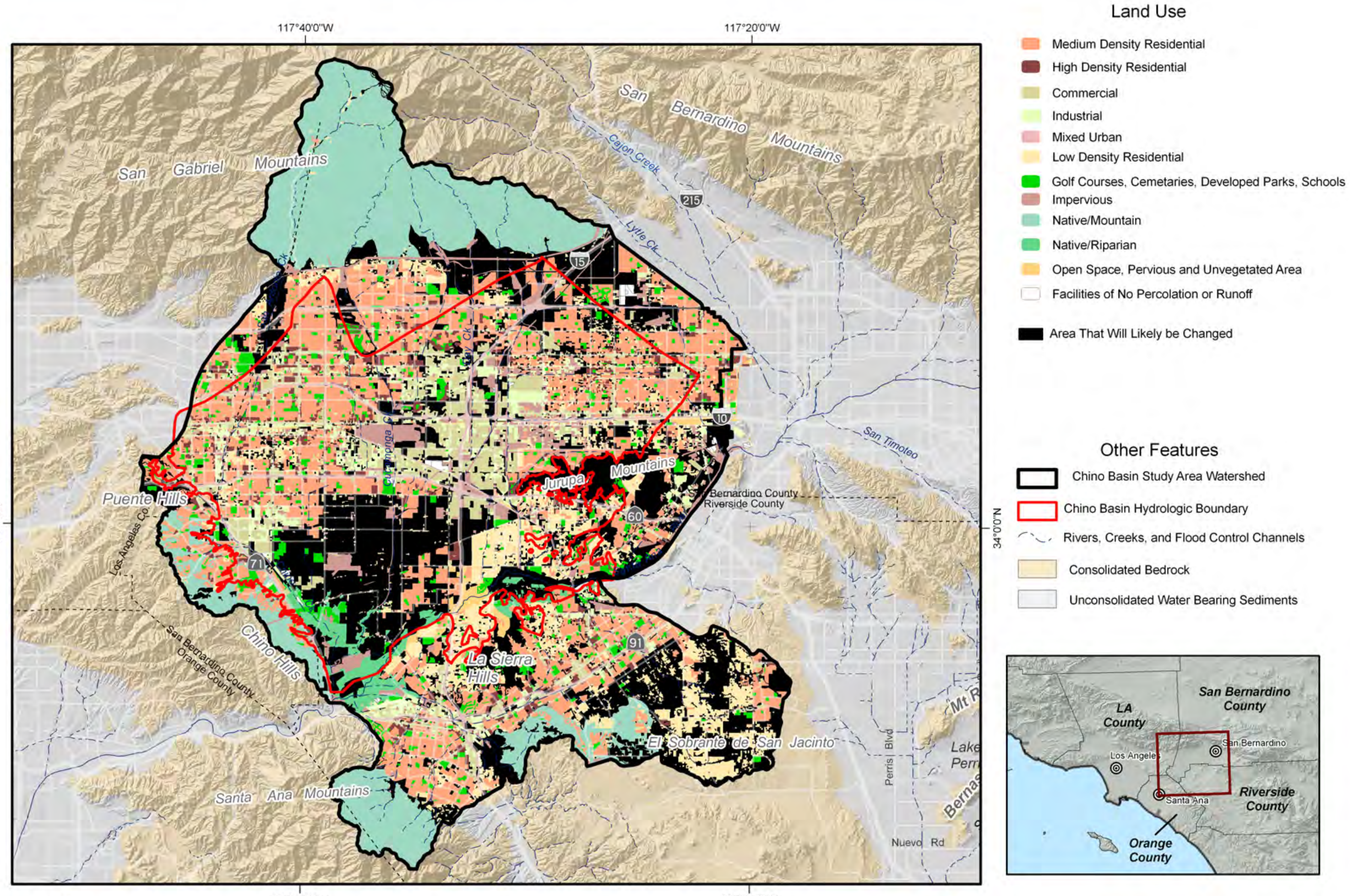

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0 2 4 6 8 Miles
0 4 8 12 KM

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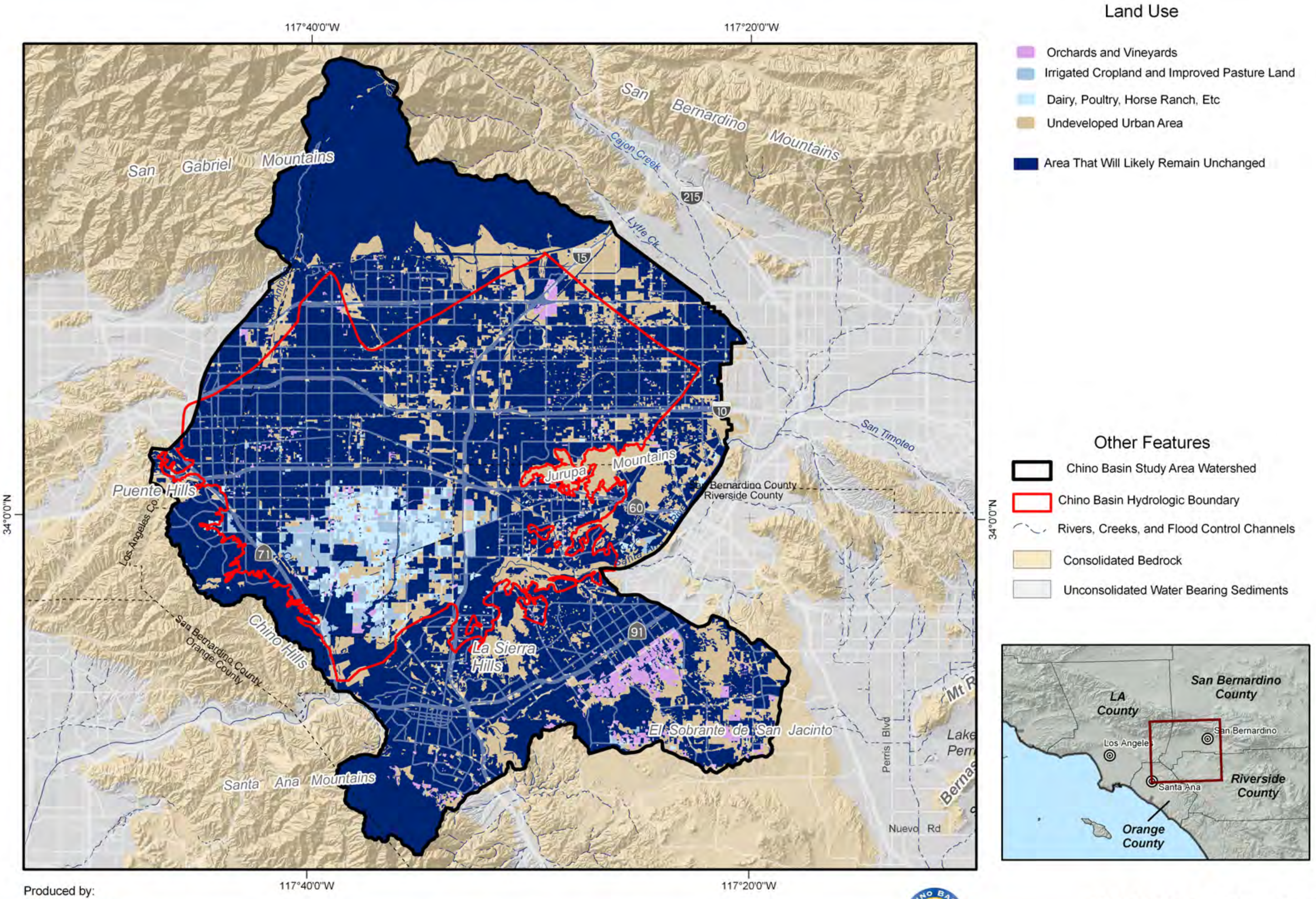
SCAG 2006 Land Use Area That Will Likely Remain Unchanged

Figure C-21



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0 2 4 6 8 Miles
0 4 8 12 KM

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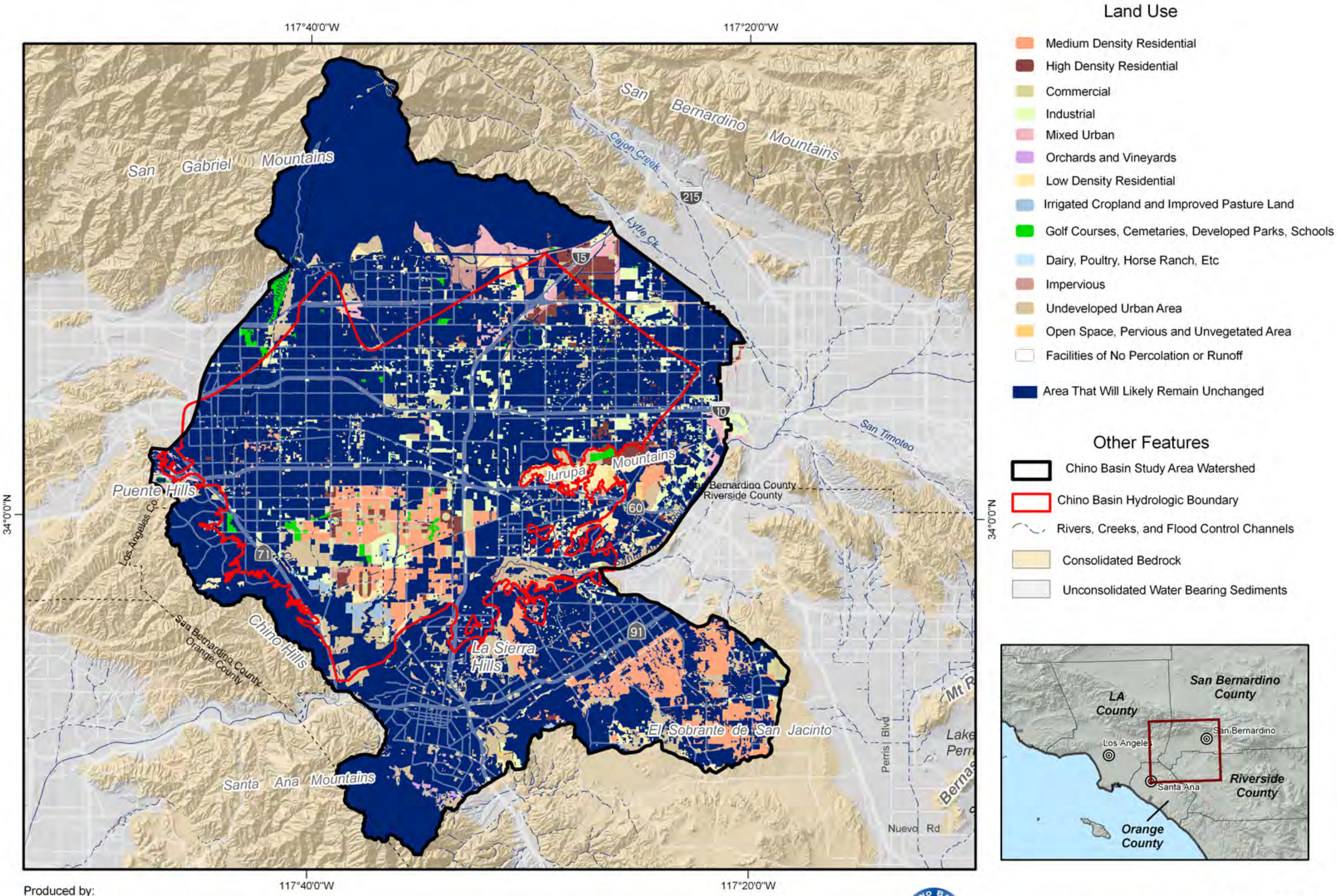
SCAG 2006 Land Use Area That Will Likely be Changed

Figure C-22



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0 2 4 6 8 Miles
0 4 8 12 KM

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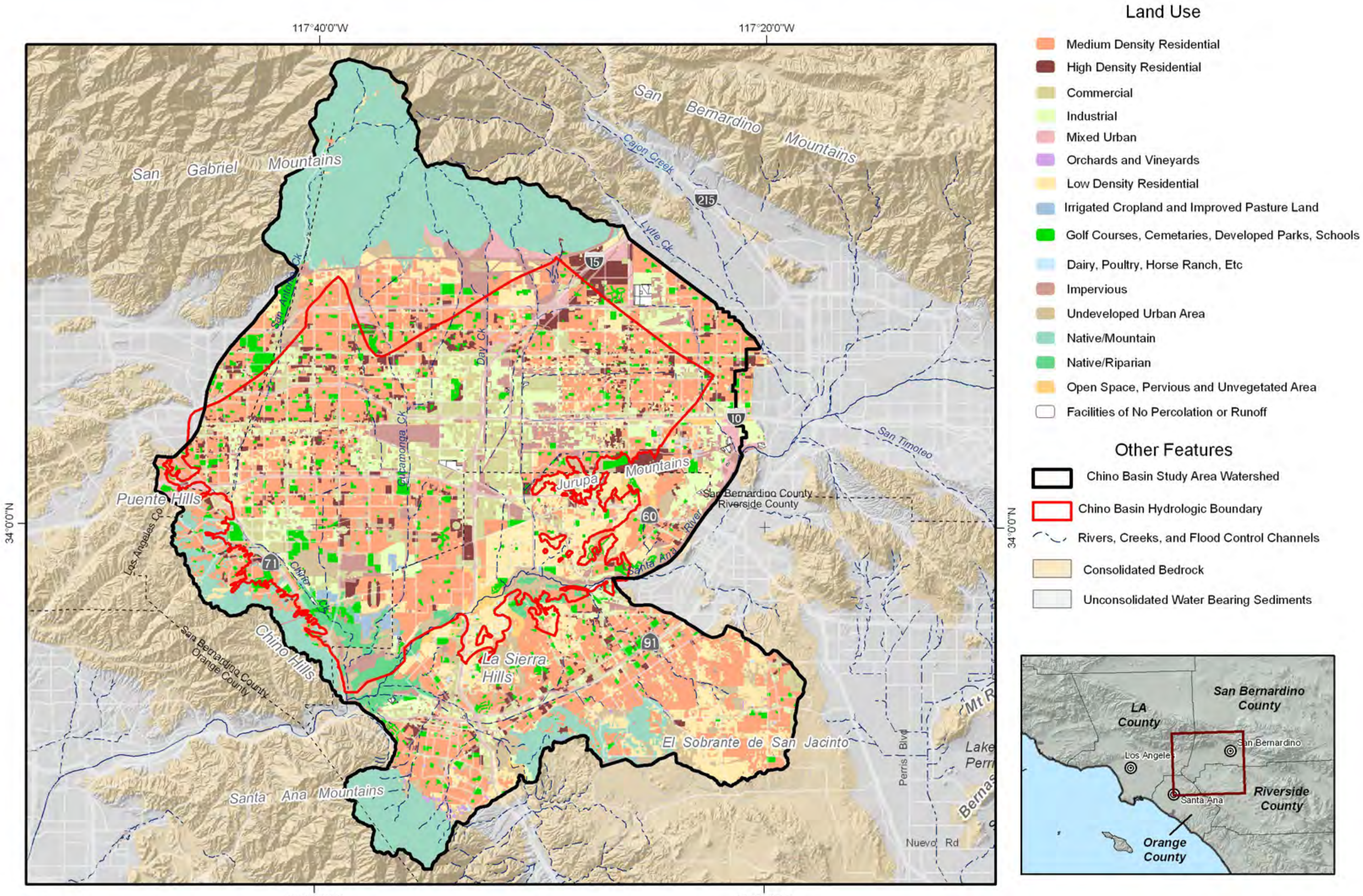
General Land Use
Undeveloped Urban Areas in 2006

Figure C-23



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0 2 4 6 8 Miles
0 4 8 12 KM

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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 (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

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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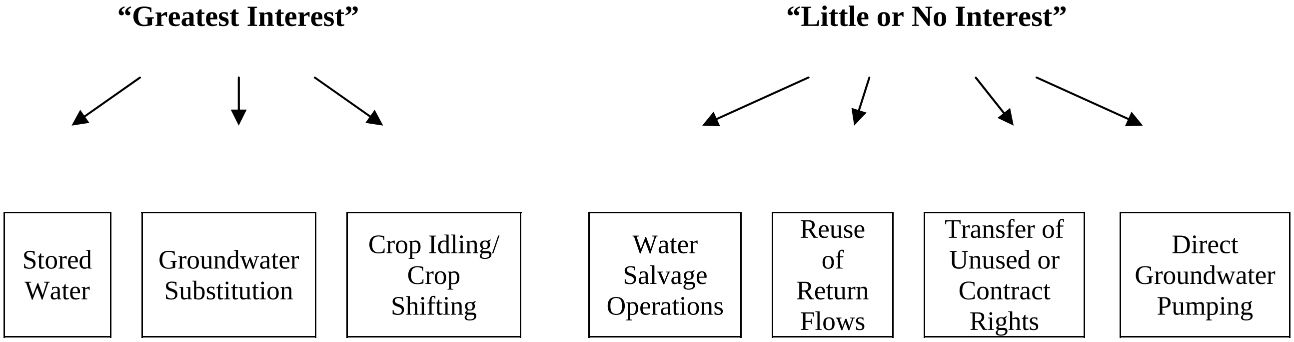
[12] California Water Code Sections 1706 (post-1914 water rights) and 1702 (pre-1914 water rights)

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
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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].

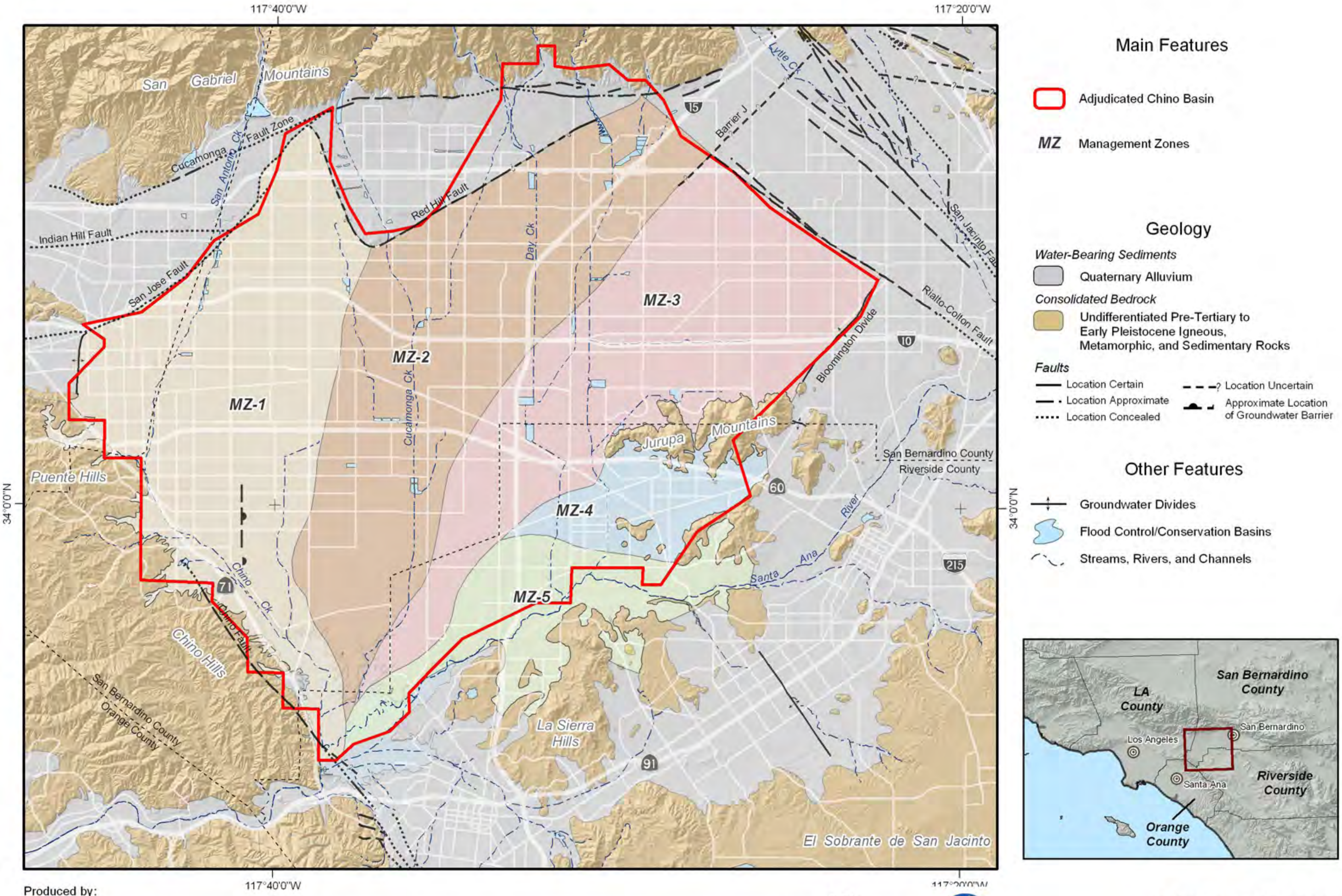
The Basin is legally defined in the Judgment of the case of Chino Basin Municipal Water District vs. the City of Chino et al. (Judgment) (Superior Court of California for San Bernardino Case No. RCV 51010), issued in 1978 [SCSC, 1978]. Since that time, the Basin has been operated as described in the 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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CHINO BASIN WATERMASTER Partners in Basin Management

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)

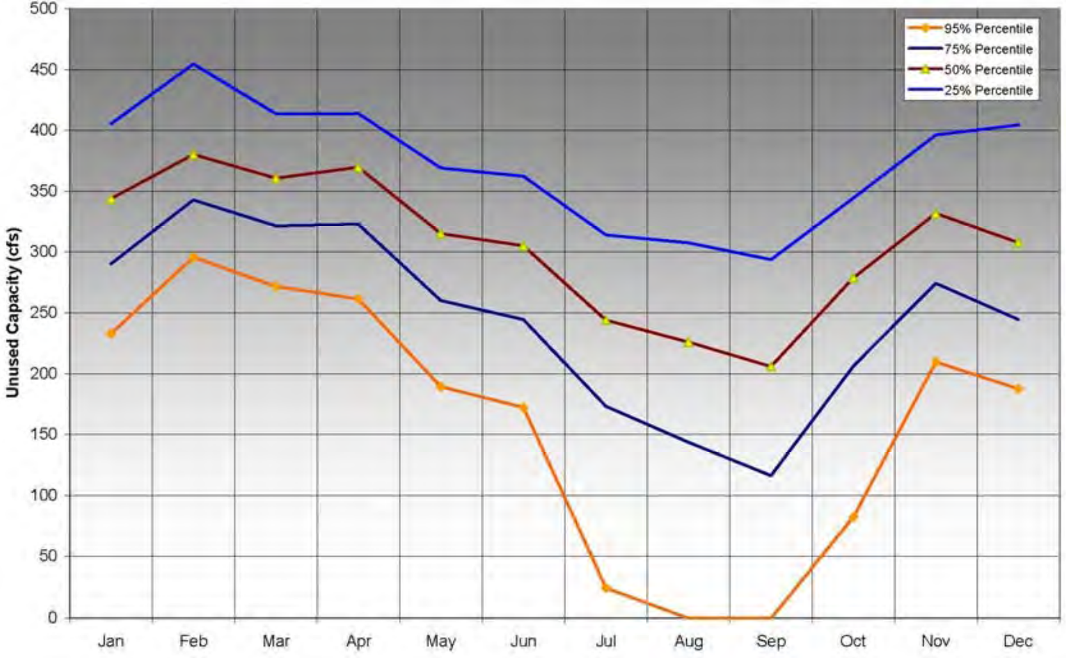
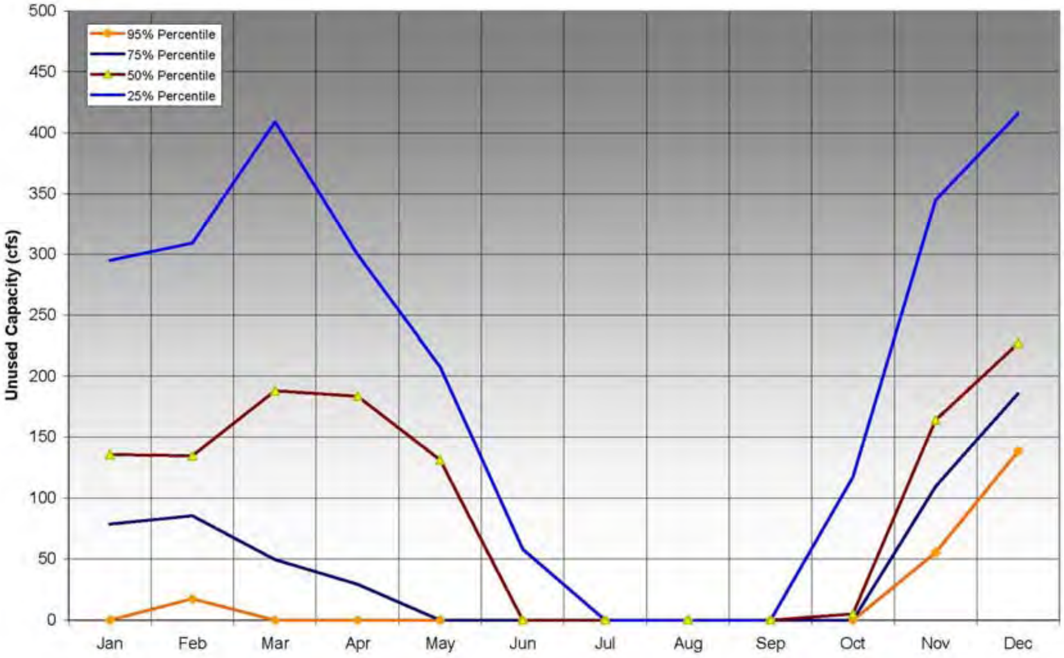


Figure 2-2
Unused Capacity per Month by Percentile in the Rialto Pipeline (2009-2035)



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

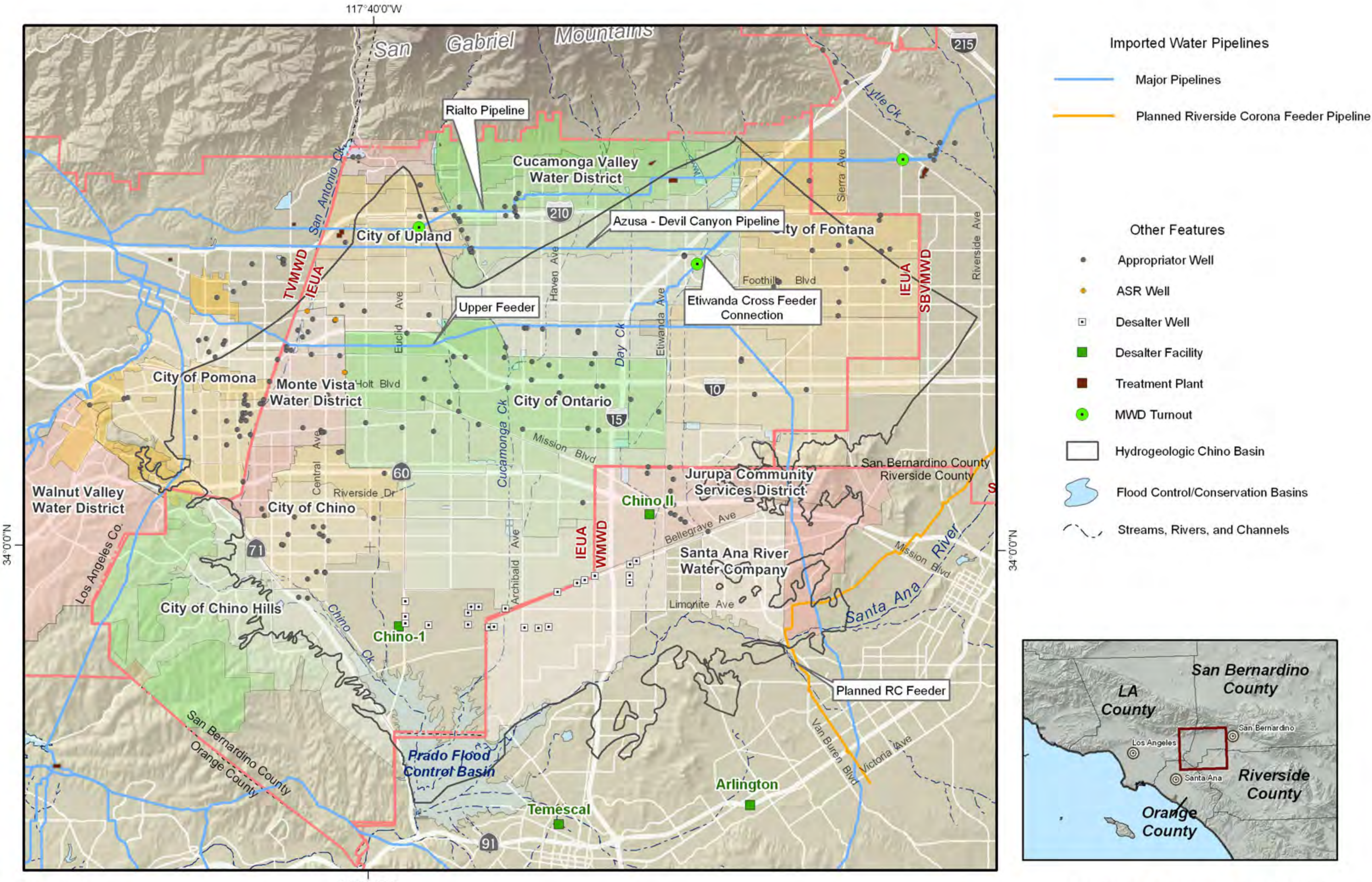
The Etiwanda pipeline, owned by MWD, is a 6.6 mile long pipeline with diameters ranging from 120 to 144 inches and a design capacity of 1,000 cubic cfs. The Etiwanda pipeline branches from the Rialto Pipeline near the intersection of Citrus Avenue and Summit Avenue in Rancho Cucamonga and conveys water 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.



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Supplemental Water Recharge Concept Development

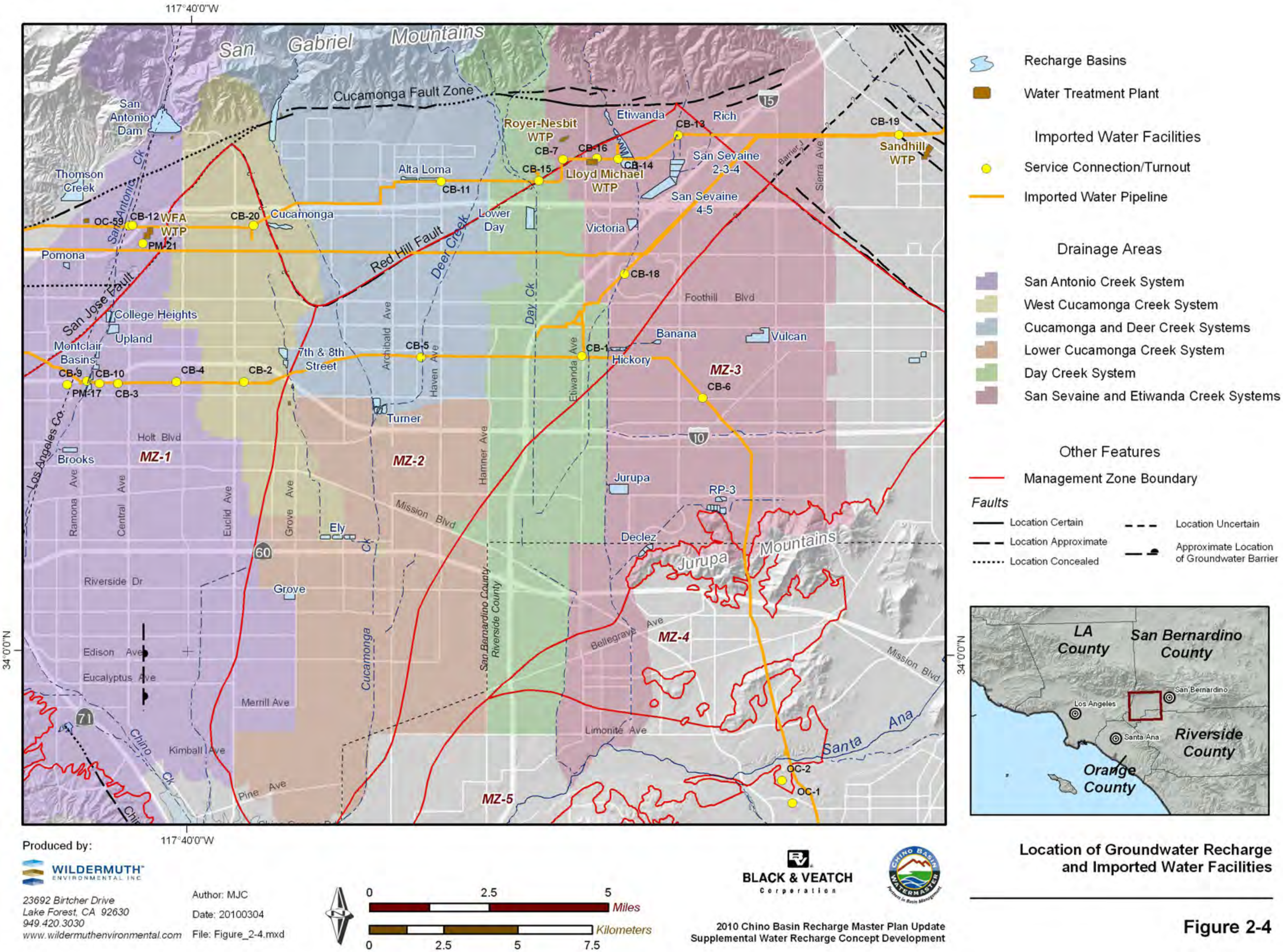
Location of Imported Water Facilities

Figure 2-3

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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Supplemental Water Recharge Concept Development

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].

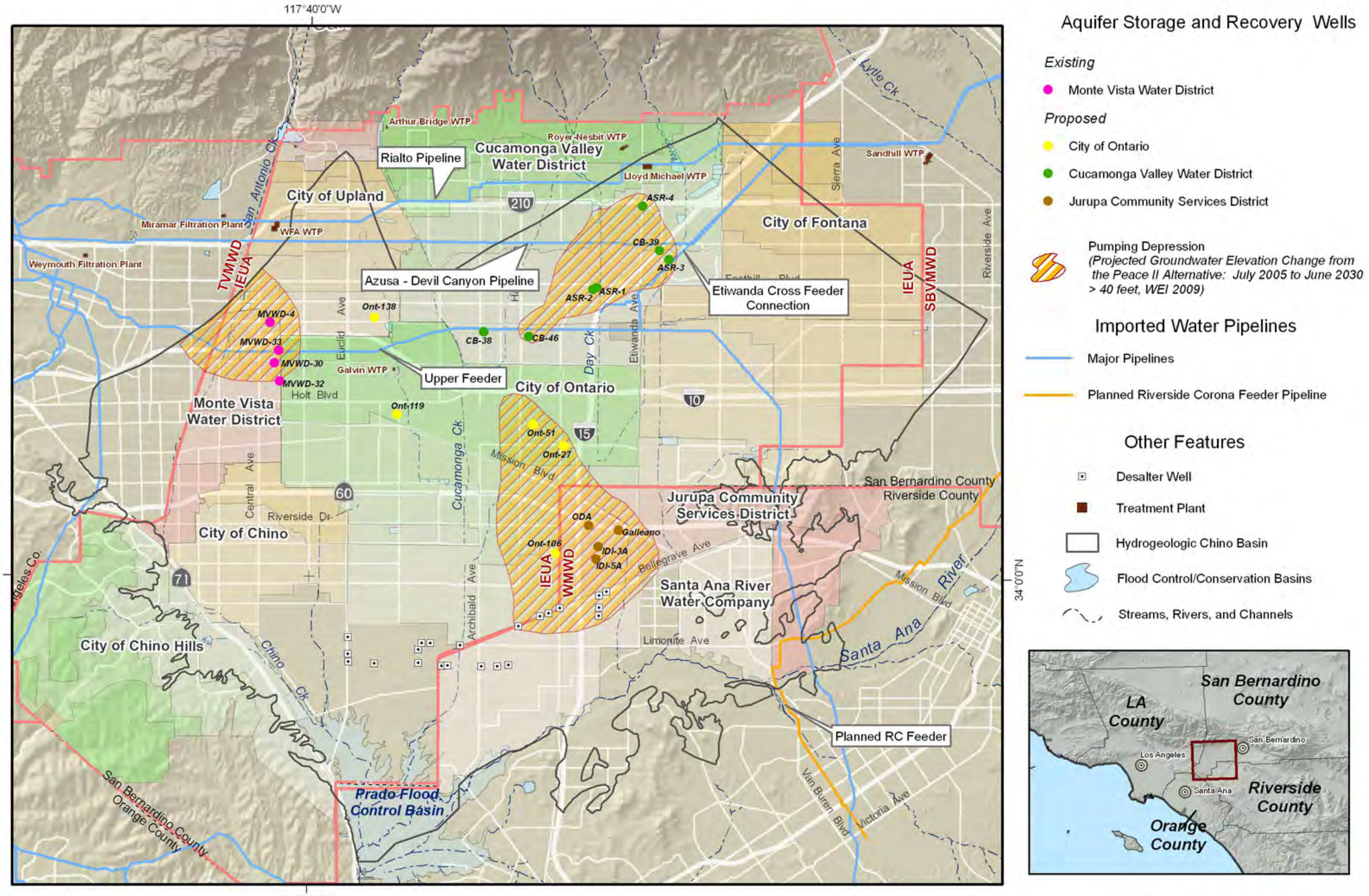
The higher injection rates listed in Table 2-9, which are equal to production rates, account for a water level rise in each ASR well, assumed to reach no more than 100 feet below ground surface. Water levels for the ASR wells during injection have been estimated using injection rate, specific capacity, 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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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.

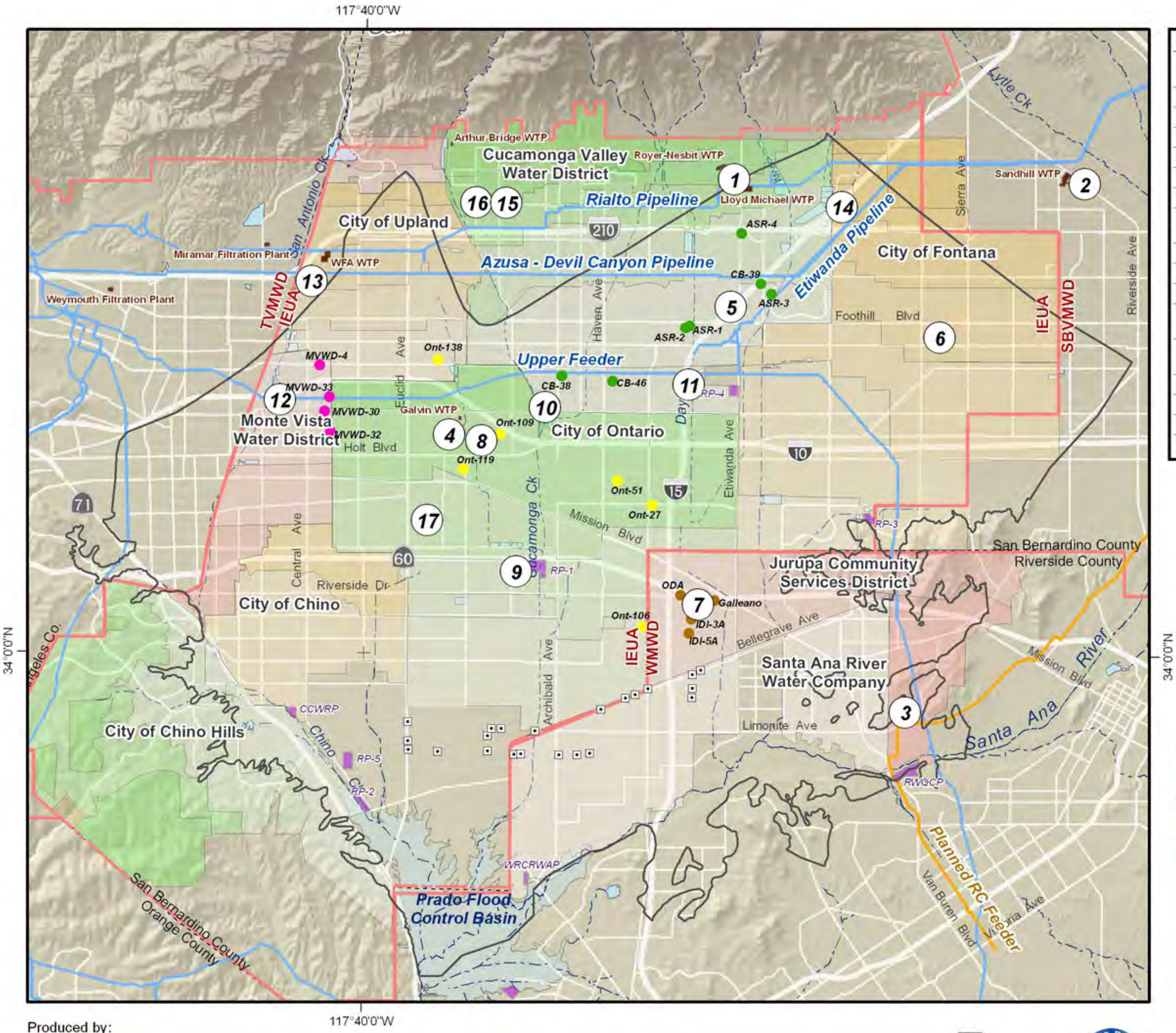
Seventeen preliminary concepts for recharge management were developed as a "toolbox" of alternatives to increase recharge in the Basin and reduce the CURO. The concepts include new sources of imported water, ASR wells for injection, enhanced recycled water use, new water sources for existing spreading 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)

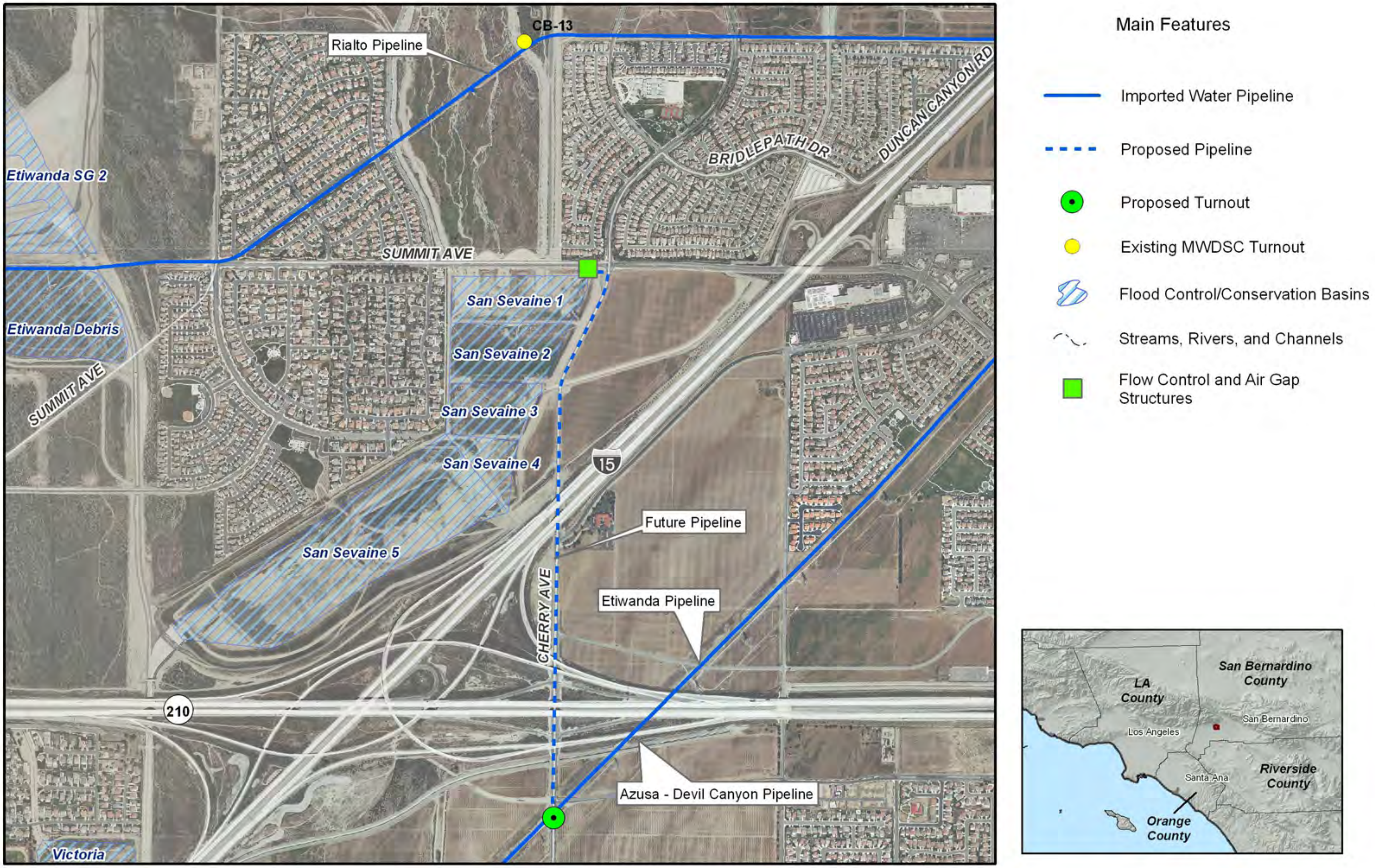
MWD (Etiwanda Pipeline)

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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0 1,000 2,000 3,000 Feet
0 500 1,000 Meters

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Supplemental Water Recharge Concept Development

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.

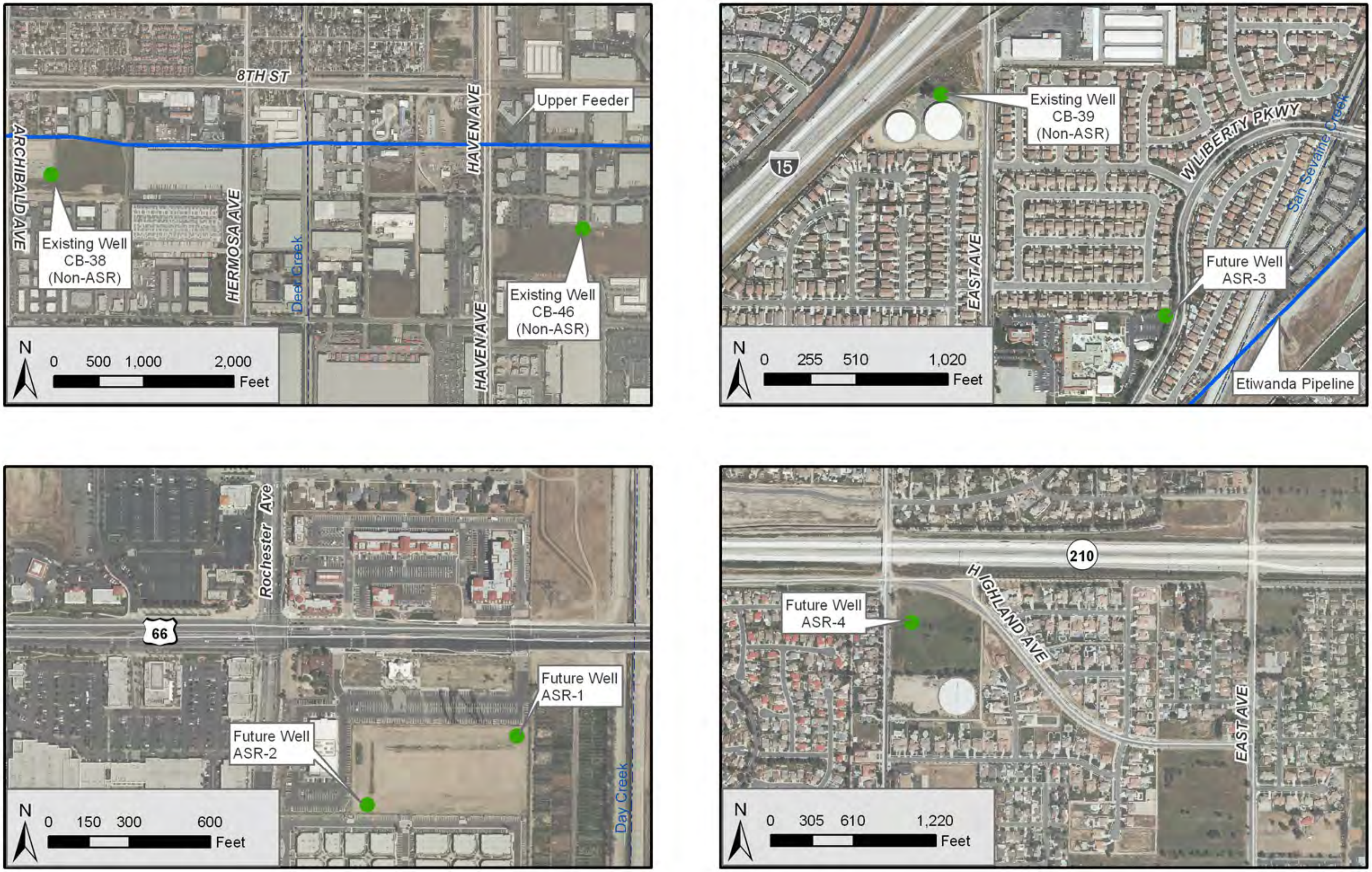
This concept would require conversion of up to three existing extraction wells to ASR and construction of up to four new ASR wells. The following table provides the proposed ASR well locations and assumed injection rates. The well locations are also shown in Figure 4-2.

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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● ASR Well

▬ Imported Water Pipeline

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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.

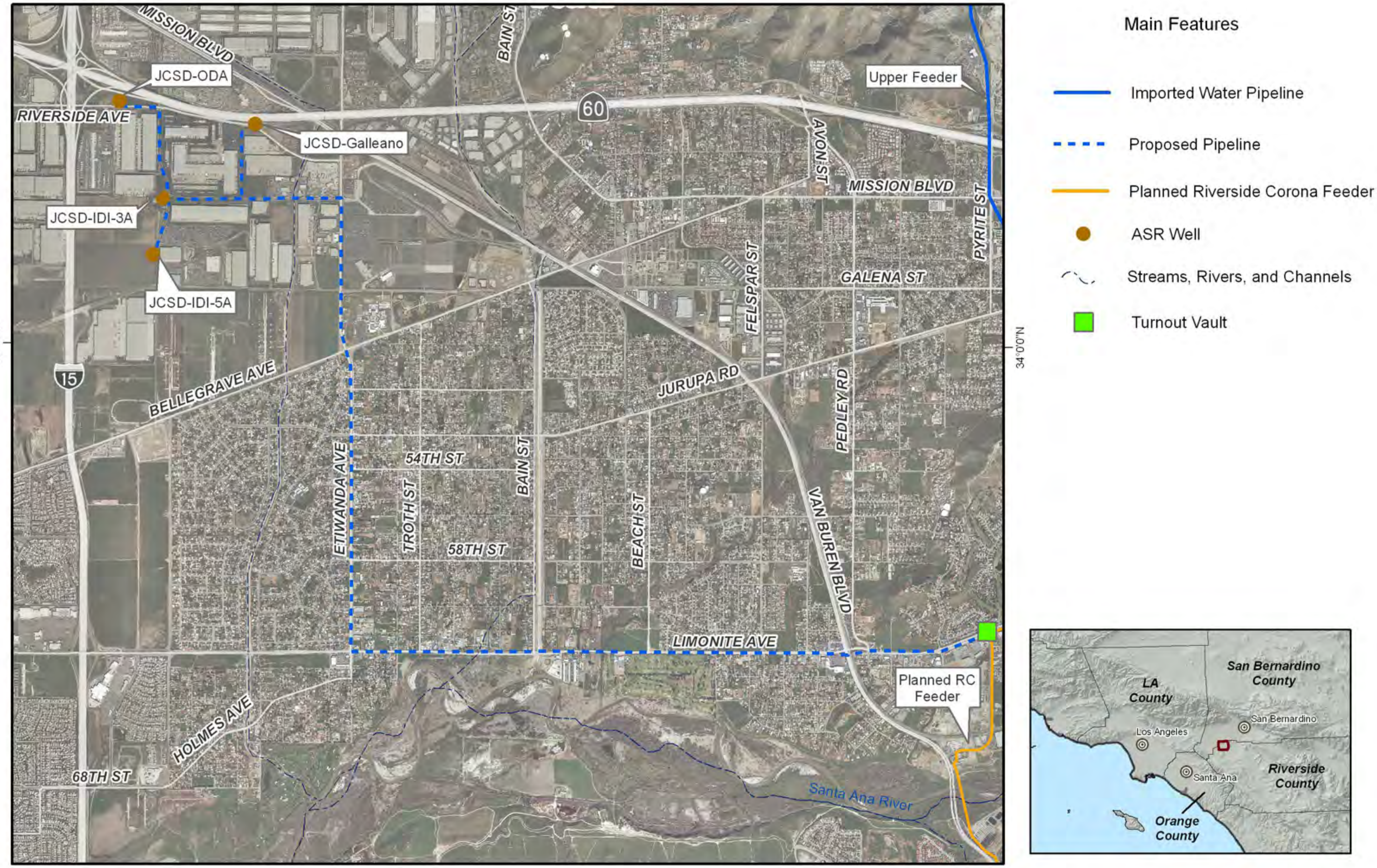
This concept would include conversion of up to four extraction wells to ASR wells, and construction of a new pipeline connecting the RC Feeder to the ASR wells. It should be noted that the extraction wells are not currently constructed at the time this TM was drafted; however, it has been assumed that 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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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.

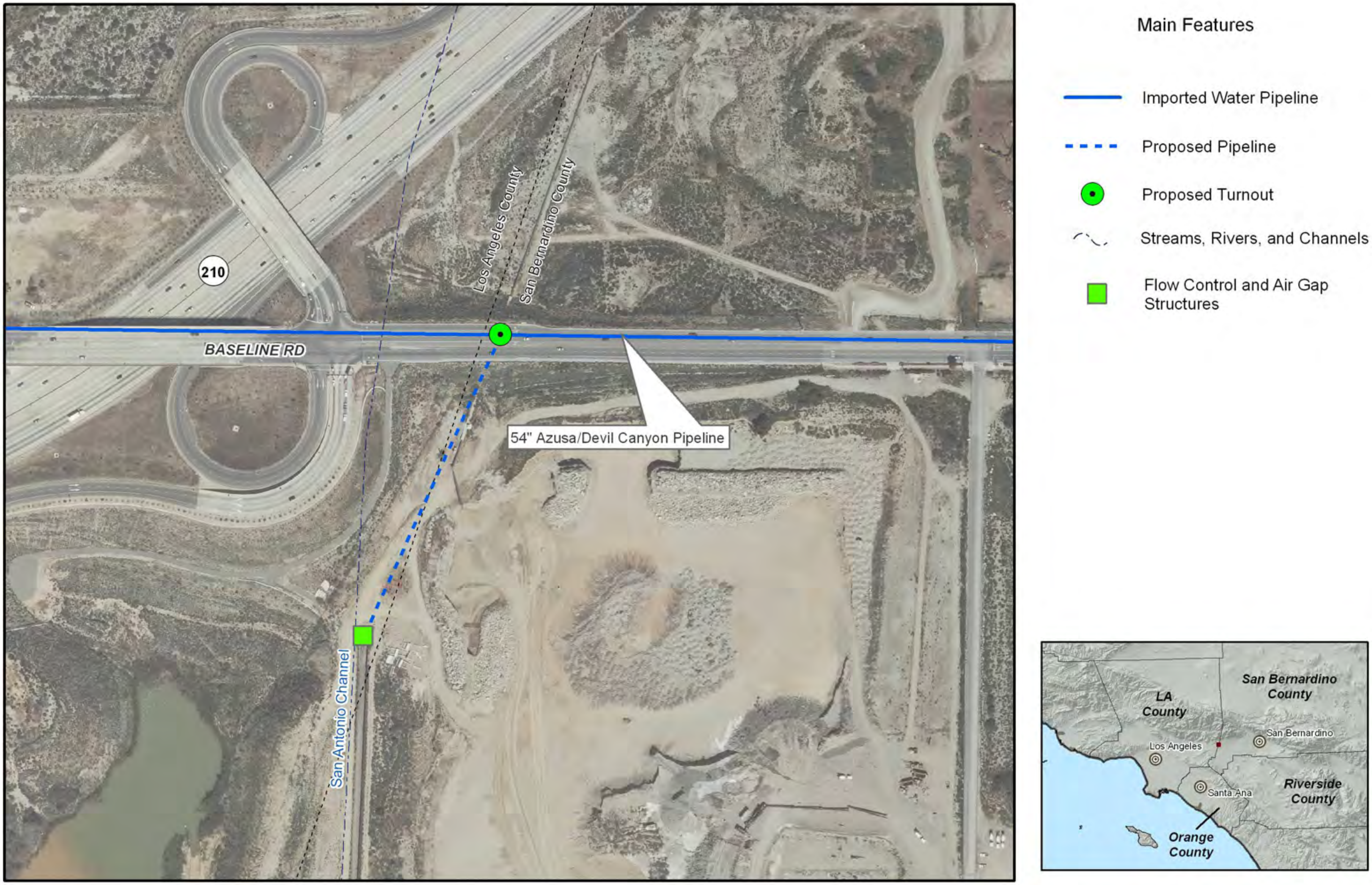
Owner: San Bernardino Flood Control District (San Antonio Channel)
SGVMWD (ADC)

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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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

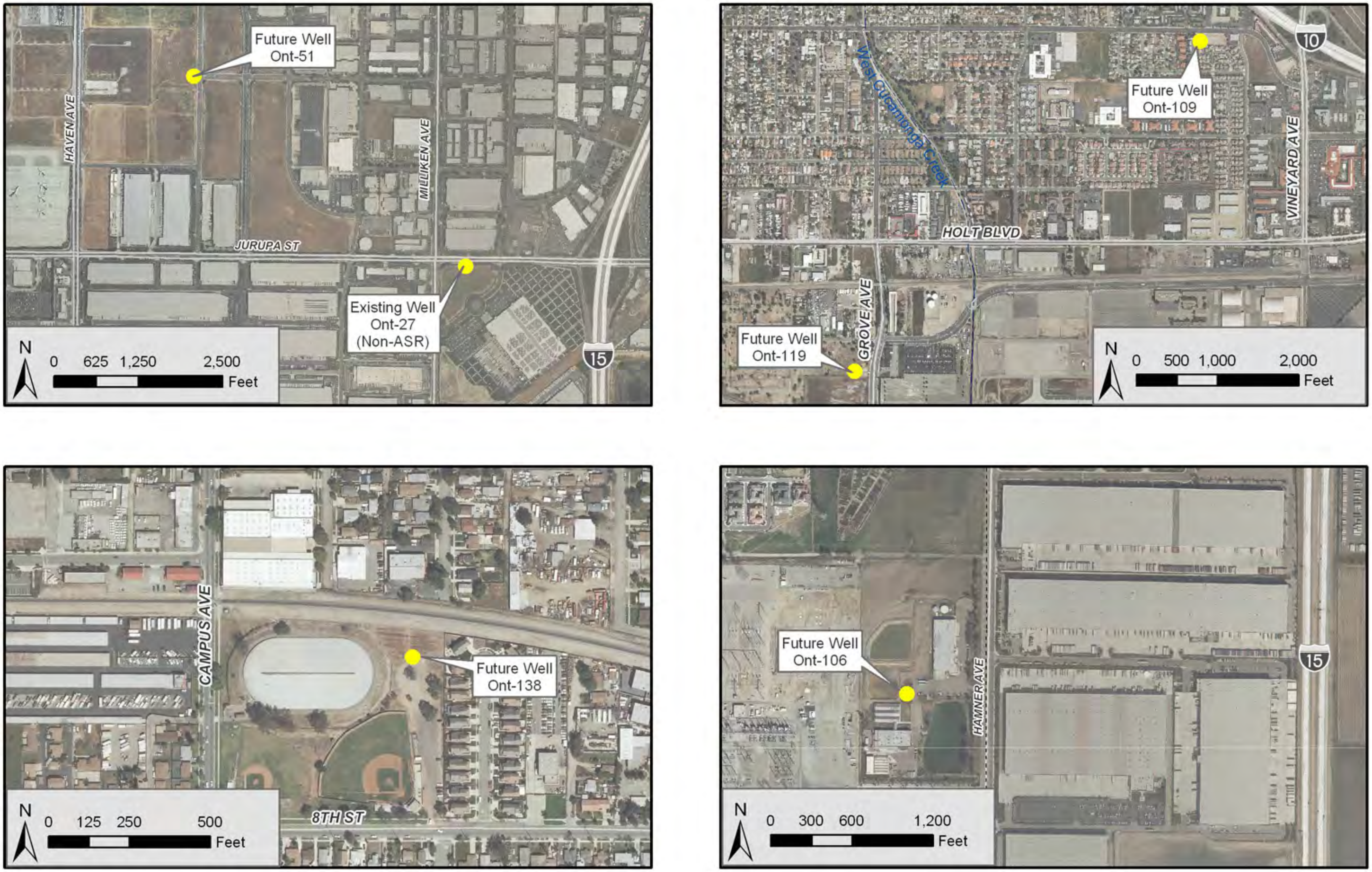
Overview: This concept would be implemented through construction of new ASR wells, which would be owned and operated by the City of Ontario. Imported water is currently conveyed to the Ontario distribution system via the Water Facilities Authority (WFA) Agua de Lejos water treatment plant (WTP) that 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.



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● ASR Well

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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.

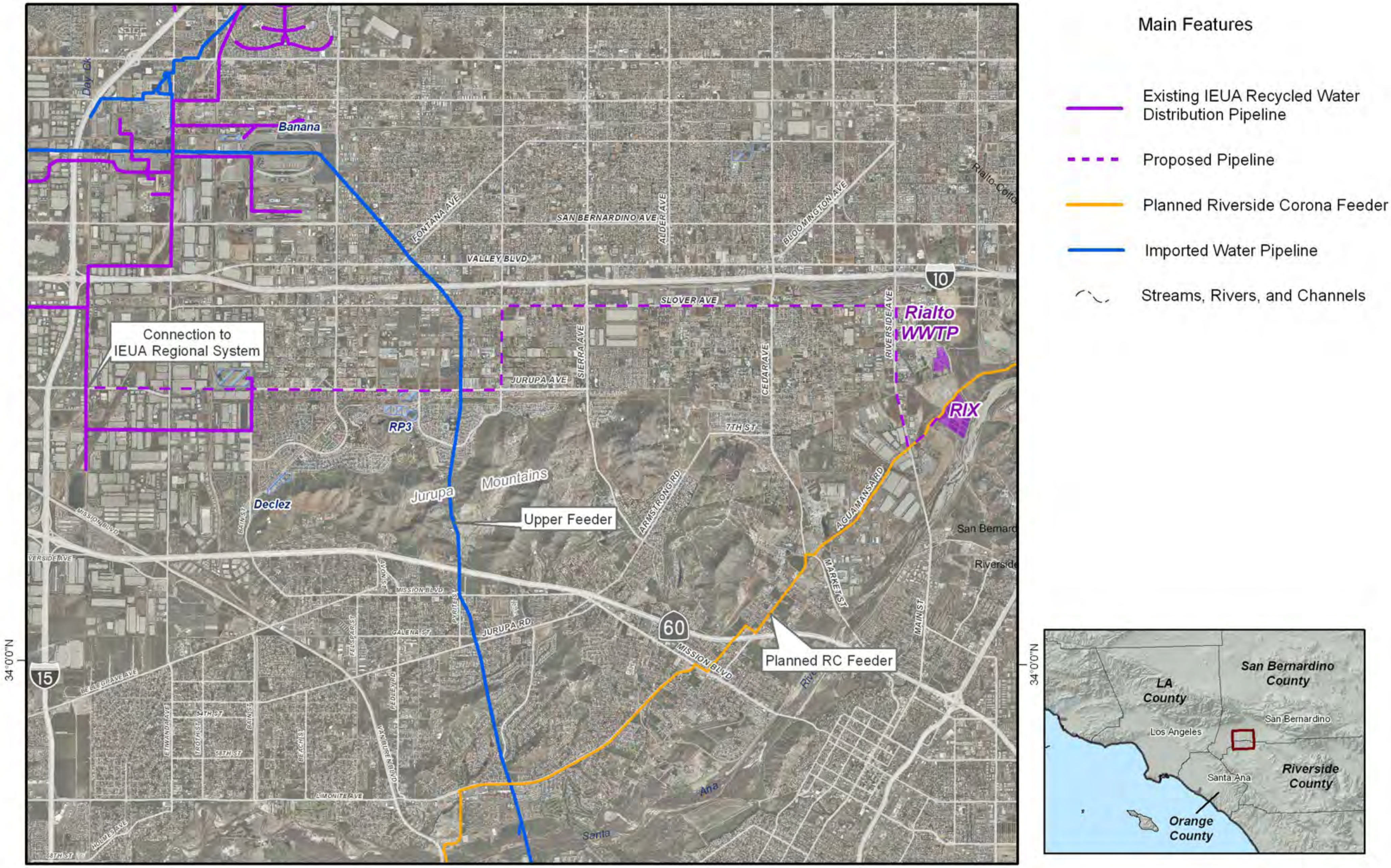
Discussions with IEUA indicate that only during four summer months (June through September) would there be insufficient recycled water to recharge. Therefore, for the purposes of this TM, conveyance capacity for delivery of a new recycled supply of 4,400 AFY over 4 months was assumed (approximately 18.7 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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File: Figure_4-6.mxd

BLACK & VEATCH Corporation

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).

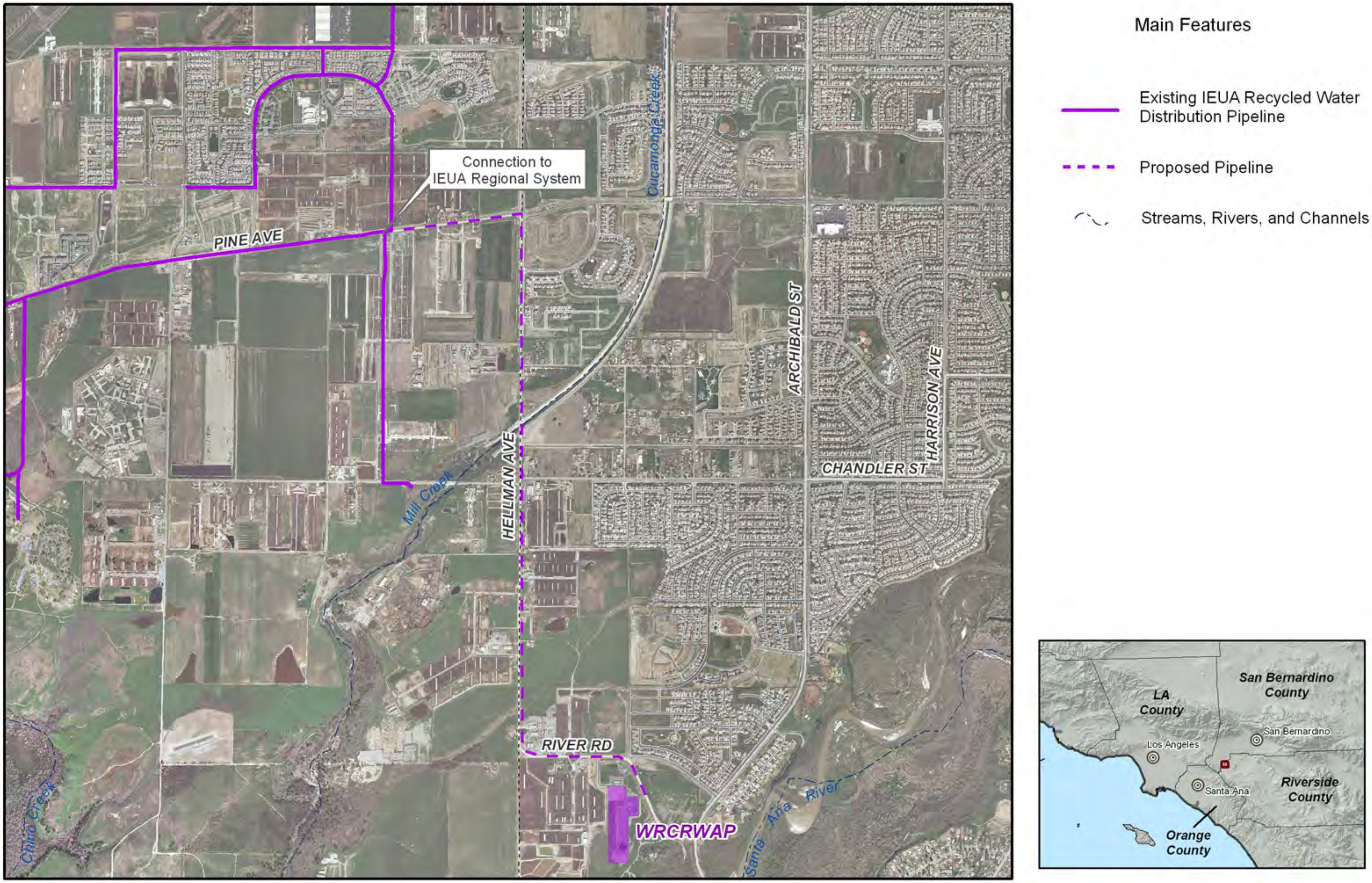
A new pipeline and booster pump station would be constructed to connect the WRCRWAP to IEUA's recycled water distribution system. The pipeline would be approximately 16 inches in diameter and three miles long. The facilities would include metering and flow control, a check valve to prevent backflow, 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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Date: 20100301
File: Figure_4-7.mxd

BLACK & VEATCH Corporation

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,

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.

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

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		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.