DRAFT
SUBSEQUENT ENVIRONMENTAL IMPACT REPORT

FOR THE
INLAND EMPIRE UTILITIES AGENCY
PEACE II PROJECT

(Volume 2 – Technical Appendices)

Prepared for:

Inland Empire Utilities Agency
6075 Kimball Avenue
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Prepared by:

Tom Dodson & Associates
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Integrated Environmental Solutions

VIA EMAIL: tda@tdaenv.com

Mr. Tom Dodson 12 June 2009
Tom Dodson & Associates
2150 North Arrowhead Avenue
San Bernardino, CA 92405

Re: Air Quality Analysis for the Chino Basin Optimum Basin Management Program, Peace II Desalter and Re-operation Project in San Bernardino, California.

Dear Tom:

JE Compliance Services, Inc. (JECSI) was retained by Tom Dodson & Associates (TDA) to prepare a limited air quality analysis to focus on emission calculations for the Chino Basin Optimum Basin Management Program, Peace II Desalter and Re-operation Project in San Bernardino, California. The project involves the following proposed projects: installation of 235,000 feet of pipeline, installation of a five million gallon reservoir, installation of booster stations, installation of production and monitoring wells, installation of regenerable and non-regenerable facilities and expansion of desalter facilities. The maximum daily emissions associated with the preceding proposed projects were calculated independently so that the emissions could be combined if the projects were to overlap. The analysis includes the emissions associated with expansion of operations existing within the project area.

Analysis Methodology for Construction Scenario

The following activities were evaluated; installation of 235,000 feet of pipeline, installation of a five million gallon reservoir, installation of booster stations, installation of production and monitoring wells, installation of regenerable and non-regenerable facilities and expansion of desalter facilities.

Pipeline Phase

The pipeline phase will consist of up to a total of 300 feet of pipeline being installed in developed areas and 900 feet of pipeline installed in undeveloped areas each day. Soil hauling activities will occur due to the excavation of soil. Approximately 200 cubic feet of soil will be exported from the site each day. Emissions from excavation activities were estimated using an emission factor of 10 pounds per acre-day and an expected disturbed area of 0.5 acres. The pipeline phase will also consist of indirect carbon dioxide emissions from the manufacturing of steel. Volatile organic compound (VOC) emissions are also expected to occur as a result of paving operations. The maximum number of acres paved per day during the pipeline phase will be 0.6 acres and the maximum amount of pipeline installed per day will be five tons.

Emissions from pipeline installation occur from fugitive dust, equipment exhaust, worker trips, pavement off-gas and carbon dioxide emissions due to the manufacture of steel. Maximum daily emissions from fugitive dust and pavement off-gas were generated using emission factors from URBEMIS 2007. Maximum daily emissions from off-road equipment were calculated using the CARB (California Air Resources Board) off-road model emission factors[1] and worker trips were generated using EMFAC 2007 emission factors for on-road vehicles[2]. Indirect emissions of carbon dioxide from the manufacturing of steel were calculated using GHG Protocol emission factors. The schedule of off-road equipment, on-road equipment, and steel usage is based on information provided by TDA. Mitigation measures for the pipeline phase involve watering the active areas of the site two times daily. Criteria pollutant emissions from pipeline activities are summarized in **Attachment 1**.

Reservoir Phase

The reservoir phase of the project will include the installation and coating of a five million gallon reservoir. Emissions from reservoir construction occur from fugitive dust due to mass grading activities, equipment exhaust, worker trips, cement and steel manufacturing, and architectural coating activities. Mass grading activities will consist of approximately two acres of soil being disturbed each day and 250 cubic feet of soil being exported from the site each day. VOC emissions are also expected to occur as a result of paving operations. The maximum number of acres paved per day during the reservoir phase will be 0.3 acres per day.

Maximum daily emissions from fugitive dust and pavement off-gas were generated using emission factors from URBEMIS 2007. Maximum daily emissions from off-road equipment were calculated using the CARB off-road model emission factors and worker trips were generated using EMFAC 2007 emission factors for on-road vehicles. Indirect emissions of carbon dioxide from the manufacturing of steel were calculated using GHG Protocol emission factors and emissions of carbon dioxide due to the manufacture of cement were calculated using United States Environmental Protection Agency (USEPA) emission factors[3].

The emissions of VOC due to architectural coating were calculated using an emission factor for pounds of VOC per surface area coated from URBEMIS 2007 and the surface area of the reservoir. The emission factor assumed that the painting VOC content was 250 g/L and the paint thickness was six millimeters. The schedule of off-road equipment, on-road equipment, concrete usage, steel usage, and architectural coating usage for the grading phase and construction phase is based on information provided by TDA. Mitigation measures during the mass grading activities of the reservoir phase involves watering the active areas of the site two times daily. The schedule of off-road equipment and on-road equipment for the foundation and paving phases was based on default URBEMIS 2007 equipment.

Operational emissions due to maintenance of architectural coating on the reservoir are expected. VOC operational emissions due to the maintenance coating of the reservoir were calculated using an emission factor for pounds of VOC per surface area coated from URBEMIS 2007 and the surface area of the reservoir. The emission factor assumed that the painting VOC content was 250 g/L and the paint thickness was six

[1] http://www.aqmd.gov/ceqa/handbook/offroad/offroad.html
[2] http://www.aqmd.gov/CEQA/handbook/onroad/onroad.html
[3] http://www.epa.gov/ttnchie1/conference/ei13/ghg/hanle.pdf

millimeters. It is assumed that approximately 10% of the reservoir will be repainted each year to maintain the architectural coating on the reservoir. Criteria pollutant emissions from reservoir construction activities are summarized in **Attachment 2**.

Booster Station Phase

The booster station phase of the project will include the installation of a booster station. Emissions from booster station construction occur from fugitive dust due to mass grading activities, equipment exhaust, worker trips, and cement and steel manufacturing, and architectural coating activities. Mass grading activities will consist of approximately one half an acre of soil being disturbed each day and 100 cubic feet of soil being exported from the site each day.

Maximum daily emissions from fugitive dust were generated using emission factors from URBEMIS 2007. Maximum daily emissions from off-road equipment were calculated using the CARB off-road model emission factor and worker trips were generated using EMFAC 2007 emission factors for on-road vehicles. Indirect emissions of carbon dioxide from the manufacturing of steel were calculated using GHG Protocol emission factors and emissions of carbon dioxide due to the manufacture of cement were calculated using USEPA emission factors. Mitigation measures during the mass grading activities of the booster station phase involve watering the active areas of the site two times daily.

Operational emissions due to electricity usage were calculated using emission factors from the Climate Action Registry[4] and the California Environmental Quality Act Handbook[5]. Emissions from employee vehicles were calculated using EMFAC 2007 emission factors for on-road vehicles. The schedule of off-road equipment, on-road equipment, concrete usage, steel usage, and architectural coating usage for the grading and construction phases is based on information provided by TDA. The schedule of off-road equipment and on-road equipment for the foundation and trenching phases was based on default URBEMIS 2007 equipment. Criteria pollutant emissions from booster station construction activities are summarized in **Attachment 3**.

Production Wells

The production wells phase of the project will include the installation of production wells. Emissions from production well construction occur from fugitive dust due to soil hauling activities, equipment exhaust, worker trips, and cement and steel manufacturing. Soil hauling activities will consist of approximately one half an acre of soil being disturbed each day and ten cubic feet of soil being exported from the site each day.

Maximum daily emissions from soil hauling were generated using emission factors from URBEMIS 2007. Maximum daily emissions from off-road equipment were calculated using CARB off-road model emission factors and worker trips were generated using EMFAC 2007 emission factors for on-road vehicles. Indirect emissions of carbon dioxide from the manufacturing of steel were calculated using GHG Protocol emission factors and emissions of carbon dioxide due to the manufacture of cement were calculated using USEPA emission factors.

Operational emissions from the production wells due to electricity usage were calculated using emission factors from the Climate Action Registry and the California Environmental Quality Handbook. Emissions from

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[4] California Climate Action Registry, Appendix C, June 2007.
[5] CEQA Air Quality Handbook, SCAQMD, April 1993.

employee vehicles were calculated using EMFAC 2007 emission factors for on-road vehicles. The schedule of off-road equipment, on-road equipment, concrete usage and steel usage for production well installation is based on information provided by TDA. Criteria pollutant emissions from production well construction are summarized in **Attachment 4**.

Monitoring Wells

The monitoring wells phase of the project will include the installation of monitoring wells. Emissions from monitoring well construction occur from fugitive dust due to soil hauling activities, equipment exhaust, worker trips, and cement and steel manufacturing. Soil hauling activities will consist of approximately one half an acre of soil being disturbed each day and ten cubic feet of soil being exported from the site each day.

Maximum daily emissions from soil hauling were generated using emission factors from URBEMIS 2007. Maximum daily emissions from off-road equipment were calculated using CARB off-road model emission factors and worker trips were generated using EMFAC 2007 emission factors for on-road vehicles. Indirect emissions of carbon dioxide from the manufacturing of steel were calculated using GHG Protocol emission factors and emissions of carbon dioxide due to the manufacture of cement were calculated using USEPA emission factors.

Operational emissions from the monitoring wells due to emissions from employee vehicles were calculated using EMFAC 2007 emission factors for on-road vehicles. The schedule of off-road equipment, on-road equipment, concrete usage and steel usage for monitoring well installation is based on information provided by TDA. Criteria pollutant emissions from monitoring well construction are summarized in **Attachment 5.**

Regenerable and Non-regenerable Treatment Facilities

The regenerable and non-regenerable treatment facilities phase of the project will include the installation of a regenerable and non-regenerable treatment facilities and equipment. Emissions from regenerable and non-regenerable treatment facilities construction occur from fugitive dust due to mass grading activities, equipment exhaust, worker trips, and cement and steel manufacturing. Mass grading activities will consist of approximately one half an acre of soil being disturbed each day and 500 cubic feet of soil being exported from the site each day.

Maximum daily emissions from fugitive dust were generated using emission factors from URBEMIS 2007. Maximum daily emissions from off-road equipment were calculated using the CARB off-road model emission factors and worker trips were generated using EMFAC 2007 emission factors for on-road vehicles. Indirect emissions of carbon dioxide from the manufacturing of steel were calculated using GHG Protocol emission factors and emissions of carbon dioxide due to the manufacture of cement were calculated using USEPA emission factors. Mitigation measures during the mass grading activities of the regenerable and non regenerable treatment facilities phase involves watering the active areas of the site two times daily.

Operational emissions due to electricity usage were calculated using emission factors from the Climate Action Registry and the California Environmental Quality Handbook. Emissions from employee vehicles were calculated using EMFAC 2007 emission factors for on-road vehicles. The schedule of off-road equipment, on-road equipment, concrete usage, steel usage, and architectural coating usage for grading and construction activities is based on information provided by TDA. The schedule of off-road equipment and on-road equipment for the foundation and trenching phases was based on default URBEMIS 2007 equipment.

Criteria pollutant emissions from regenerable and non-regenerable treatment facilities construction activities are summarized in **Attachment 6**.

Desalter Facilities

The desalter facilities phase of the project will include the expansion of the desalter facility. Emissions from the desalter facilities expansion occur from fugitive dust due to soil hauling activities, equipment exhaust, worker trips, and cement and steel manufacturing. Soil hauling activities will consist of approximately one half an acre of soil being disturbed each day and 100 cubic feet of soil being exported from the site each day. Maximum daily emissions from soil hauling were generated using emission factors from URBEMIS 2007.

Maximum daily emissions from off-road equipment were calculated using the CARB off-road model emission factors and worker trips were generated using EMFAC 2007 emission factors for on-road vehicles. Indirect emissions of carbon dioxide from the manufacturing of steel were calculated using GHG Protocol emission factors and emissions of carbon dioxide due to the manufacture of cement were calculated using USEPA emission factors.

Operational emissions due to increased electricity usage were calculated using emission factors from the Climate Action Registry and the California Environmental Quality Handbook. Emissions from employee vehicles were calculated using EMFAC 2007 emission factors for on-road vehicles. The schedule of concrete usage, steel usage, and architectural coating usage for construction is based on information provided by TDA. The schedule of off-road equipment and on-road equipment for the construction phase is based on default URBEMIS 2007 equipment. Criteria pollutant emissions from desalter facility expansion activities are summarized in **Attachment 7**.

Emissions Evaluation

South Coast Air Quality Management (SCAQMD) publishes screening levels to determine if a project is regionally significant[6]. Unmitigated criteria pollutant emissions from the construction phase of the project are provided in **Table 1** through **Table 7**. The emissions of criteria pollutants from the construction phase do not exceed the regional significance levels. Unmitigated criteria pollutant emissions from the operational phase of the project are provided in **Table 8** through **Table 13.** Unmitigated criteria pollutant emissions from the operational phases of the project do not exceed regional significance thresholds.

Mitigated criteria pollutant emissions from the construction phase of the project are provided in **Table 14** through **Table 20**. The mitigated emissions of criteria pollutants from the construction phase do not exceed the regional significance levels.

A comparison to localized significance thresholds (LSTs) is not included as part of the evaluation. This is due to the fact that calculations are designed to calculate emissions from each individual scenario for the use in evaluating impacts from future projects. Since the scope of these projects and the location of the projects n to sensitive receptors are not know, it is not possible to compare the emissions to LSTs.

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[6] CEQA Air Quality Handbook, SCAQMD, April 1993, Section 6.4 Significance thresholds updated October 2006.

Federal Conformity

The South Coast Air Basin ("basin") is designated as a non-attainment area for PM10, PM2.5, and ozone. The basin is designated as an attainment area with a maintenance plan for CO and nitrogen dioxide (NO_2). The basin is designated as an attainment area for SO_2. The attainment status of the criteria pollutants is summarized in **Table 21**.

Construction and operational emissions do not exceed the de minimis thresholds established in 40 CFR 93.153. Construction and operational emissions (in tons per year) for the expansion project and the corresponding de minimis thresholds are provided in **Table 22** through **Table 34**.

Average annual daily emissions (in tons per day) for 2014 are provided in the *2007 Air Quality Management Plan* issued by SCAQMD in June 2007. Annual emissions for CO, NOx, and VOC were estimated by taking the average daily planning inventory emissions for 2014 and multiplying by 365 days. Annual emissions for PM2.5 and SO_2 were estimated by taking the predicted average daily emissions for 2014 and multiplying by 365 days. Since predicted average daily emissions for PM10 were not provided in the plan, emissions for PM 2.5 were used for comparison purposes. The emissions from construction and operation (in tons per year) are below 10 percent of the emission inventories for the basin.

Please call me or Daren with any comments or questions.

Sincerely,

Peter G. Stein
Vice President

Daren E. Jorgensen
President

Table 1 - Maximum Daily Unmitigated Construction Emissions for Pipeline Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Pipeline construction	Fugitive dust	0	0	0	0	5.23	0	5.23	1.10	0	1.10	0	0
Pipeline construction	Off-road equipment	7.30	52.72	25.04	0.06	0	3.16	3.16	0	2.81	2.81	4,999.27	0.66
Pipeline construction	On-road equipment	0.73	9.17	2.87	0.01	0.44	0.41	0.84	0.38	0.37	0.76	1,010.69	0.03
Pipeline construction	Worker trips	0.44	0.44	3.97	0.01	0.04	0	0.04	0.03	0	0.03	525.93	0.04
Pipeline construction	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	17,500.00	0
Pipeline construction	Off-gas	1.56	0	0	0	0	0	0	0	0	0	0	0
Maximum Daily Emissions		10.03	62.33	31.87	0.07	5.72	3.56	9.28	1.51	3.19	4.69	24,035.89	0.73
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 2 - Maximum Daily Unmitigated Construction Emissions for Reservoir Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Reservoir construction	Mass grading	7.23	62.44	28.47	0.07	20.49	2.91	23.40	4.62	2.60	7.22	6,404.92	0.62
Reservoir construction	Foundation	1.65	11.82	7.80	0.02	0.24	0.71	0.95	0.21	0.64	0.84	62,130.00	0.13
Reservoir construction	Paving	4.16	21.96	13.09	0.02	0.24	1.45	1.69	0.20	1.30	1.50	2,251.10	0.29
Reservoir construction	Construction	4.48	26.26	16.26	0.03	0.24	1.79	2.03	0.21	1.60	1.81	877,763.06	0.39
Reservoir construction	Architectural coating	32.96	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02
Maximum Daily Emissions		32.96	62.44	28.47	0.07	20.49	2.91	23.40	4.62	2.60	7.22	877,763.06	0.62
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 3 - Maximum Daily Unmitigated Construction Emissions for Booster Station Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Booster station construction	Mass grading	4.23	37.73	17.26	0.04	5.20	1.56	6.76	1.22	1.40	2.62	3,623.98	0.37
Booster station construction	Foundation	1.62	11.79	7.47	0.02	0.24	0.71	0.95	0.20	0.64	0.84	26,165.86	0.13
Booster station construction	Trenching	2.47	18.90	9.55	0.02	0.02	1.01	1.03	0.01	0.90	0.91	1,971.50	0.22
Booster station construction	Construction	3.06	23.66	12.08	0.03	0.24	1.36	1.60	0.20	1.22	1.42	37,465.87	0.26
Booster station construction	Architectural coating	49.48	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02
Maximum Daily Emissions		49.48	37.73	17.26	0.04	5.20	1.56	6.76	1.22	1.40	2.62	37,465.87	0.37
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 4 - Maximum Daily Unmitigated Construction Emissions for Production Well Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Production well construction	Fugitive dust	0	0	0	0	5.00	0	5.00	1.05	0	1.05	0	0
Production well construction	Off-road equipment	5.98	54.88	24.54	0.07	0.00	2.76	2.76	0	2.45	2.45	6,563.18	0.54
Production well construction	On-road equipment	0.33	4.20	1.32	4.54E-03	0.20	0.19	0.39	0.18	0.18	0.35	463.23	0.02
Production well construction	Worker trips	0.07	0.07	0.66	8.62E-04	0.01	0	0.01	4.38E-03	0	4.38E-03	87.65	0.01
Production well construction	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	35,000.00	0
Production well construction	Concrete manufacturing	0	0	0	0	0	0	0	0	0	0	4,940.94	0
Maximum Daily Emissions		6.39	59.16	26.52	0.08	5.21	2.94	8.15	1.23	2.63	3.86	47,055.01	0.56
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 5 - Maximum Daily Unmitigated Construction Emissions for Monitoring Well Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Monitoring well construction	Fugitive dust	0	0	0	0	5.00	0	5.00	1.05	0	1.05	0	0
Monitoring well construction	Off-road equipment	5.98	54.88	24.54	0.07	0	2.76	2.76	0	2.45	2.45	6,563.18	0.54
Monitoring well construction	On-road equipment	0.33	4.20	1.32	4.54E-03	0.20	0.19	0.39	0.18	0.18	0.35	463.23	0.02
Monitoring well construction	Worker trips	0.07	0.07	0.66	8.62E-04	0.01	0	0.01	4.38E-03	0.00	4.38E-03	87.65	0.01
Monitoring well construction	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	35,000.00	0
Monitoring well construction	Concrete manufacturing	0	0	0	0	0	0	0	0	0	0	4,940.94	0
Maximum Daily Emissions		6.39	59.16	26.52	0.08	5.21	2.94	8.15	1.23	2.63	3.86	47,055.01	0.56
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 6 - Maximum Daily Unmitigated Construction Emissions for Treatment Facility Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Treatment facility construction	Mass grading	5.81	57.61	23.47	0.06	6.15	2.44	8.59	2.05	2.20	4.26	5,813.81	0.44
Treatment facility construction	Foundation	1.62	11.79	7.47	0.02	0.24	0.71	0.95	0.20	0.64	0.84	124,984.61	0.13
Treatment facility construction	Trenching	2.47	18.90	9.55	0.02	0.02	1.01	1.03	0.01	0.90	0.91	1,971.50	0.22
Treatment facility construction	Construction	2.85	24.07	11.06	0.03	0.38	1.33	1.71	0.33	1.20	1.52	352,471.14	0.23
Maximum Daily Emissions		5.81	57.61	23.47	0.06	6.15	2.44	8.59	2.05	2.20	4.26	352,471.14	0.44
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 7 - Maximum Daily Unmitigated Construction Emissions for Desalter Facility Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Desalter expansion	Fugitive dust	0	0	0	0	0	5.23	5.23	0	1.10	1.10	0	0
Desalter expansion	Off-road equipment	6.62	49.18	23.90	0.05	0	3.03	3.03	0	2.70	2.70	4,592.29	0.60
Desalter expansion	On-road equipment	1.52	19.11	5.98	0.02	0.91	0.85	1.76	0.80	0.78	1.58	2,105.60	0.07
Desalter expansion	Worker trips	0.73	0.73	6.61	0.01	0.07	0	0.07	0.04	0	0.04	876.55	0.07
Desalter expansion	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	35,000.00	0
Desalter expansion	Cement manufacturing	0	0	0	0	0	0	0	0	0	0	24,704.69	0
Maximum Daily Emissions		8.87	69.02	36.49	0.09	0.98	9.12	10.10	0.84	4.57	5.41	67,279.13	0.73
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 8- Maximum Daily Unmitigated Operational Emissions from Reservoir Operation (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Reservoir coating	Architectural coating	0.04	0	0	0	0	0	0	0	0	0	0	0
Maximum Daily Emissions		0.04	0	0	0	0	0	0	0	0	0	0	0
Regional significance threshold		55	55	550	150	150	150	150	55	55	55	-	-

Table 9 - Maximum Daily Unmitigated Operational Emissions from Booster Station Operation (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Booster station operations	Electricity consumption	0.02	2.65	0.46	0.28	0	0.09	0.09	0	0	0	1,850.44	0.02
Booster station operations	Vehicle trips	0.02	0.02	0.17	2.20E-04	1.74E-03	0	1.74E-03	1.10E-03	0	1.10E-03	21.91	1.63E-03
Booster station operations	Architectural coating	0.03	0	0	0	0	0	0	0	0	0	0	0
	Maximum Daily Emissions	0.04	2.67	0.63	0.28	1.74E-03	0.09	0.09	1.10E-03	0	1.10E-03	1,872.35	0.02
	Regional significance threshold	55	55	550	150	150	150	150	55	55	55	-	-

Table 10 - Maximum Daily Unmitigated Operational Emissions from Production Well Operation (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Production well operations	Electricity consumption	0.03	3.45	0.60	0.36	0	0.12	0.12	0	0	0	2,413.62	0.02
Production well operations	Vehicle trips	0.02	0.02	0.17	2.20E-04	1.74E-03	0	1.74E-03	1.10E-03	0	1.10E-03	21.91	1.63E-03
	Maximum Daily Emissions	0.05	3.47	0.77	0.36	1.74E-03	0.12	0.12	1.10E-03	0	1.10E-03	2,435.53	0.02
	Regional significance threshold	55	55	550	150	150	150	150	55	55	55	-	-

Table 11 - Maximum Daily Unmitigated Operational Emissions from Monitoring Well Operation (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Monitoring well operations	Vehicle trips	0.02	0.02	0.17	2.20E-04	1.74E-03	0	1.74E-03	1.10E-03	0	1.10E-03	21.91	1.63E-03
	Maximum Daily Emissions	0.02	0.02	0.17	2.20E-04	1.74E-03	0	1.74E-03	1.10E-03	0	1.10E-03	21.91	1.63E-03
	Regional significance threshold	55	55	550	150	150	150	150	55	55	55	-	-

Table 12 - Maximum Daily Unmitigated Operational Emissions from Treatment Facility Operation (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Treatment facility operations	Electricity consumption	0.01	1.27	0.22	0.13	0	0.04	0.04	0	0	0	884.99	0.01
Treatment facility operations	Vehicle trips	2.46	30.61	9.90	0.03	1.46	1.35	2.81	1.28	1.25	2.53	3,412.79	0.11
Maximum Daily Emissions		2.47	31.88	10.12	0.17	1.46	1.39	2.86	1.28	1.25	2.53	4,297.78	0.12
Regional significance threshold		55	55	550	150	150	150	150	55	55	55	-	-

Table 13 - Maximum Daily Unmitigated Operational Emissions from Desalter Facility Operation (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Desalter facility operations	Electricity consumption	0.06	6.90	1.20	0.72	0	0.24	0.24	0	0	0	4,827.24	0.04
Desalter facility operations	Vehicle trips	0.04	0.04	0.33	4.30E-04	3.48E-03	0	3.48E-03	2.19E-03	0	2.19E-03	43.83	3.26E-03
Maximum Daily Emissions		0.10	6.94	1.53	0.72	3.48E-03	0.24	0.24	2.19E-03	0	2.19E-03	4,871.07	0.04
Regional significance threshold		55	55	550	150	150	150	150	55	55	55	-	-

Table 14- Maximum Daily Mitigated Construction Emissions for Pipeline Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Pipeline construction	Fugitive dust	0	0	0	0	2.88	0	2.88	0.60	0	0.60	0	0
Pipeline construction	Off-road equipment	7.30	52.72	25.04	0.06	0	3.16	3.16	0	2.81	2.81	4,999.27	0.66
Pipeline construction	On-road equipment	0.73	9.17	2.87	0.01	0.44	0.41	0.84	0.38	0.37	0.76	1,010.69	0.03
Pipeline construction	Worker trips	0.44	0.44	3.97	0.01	0.04	0	0.04	0.03	0	0.03	525.93	0.04
Pipeline construction	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	17,500.00	0
Pipeline construction	Off-gas	1.56	0	0	0	0	0	0	0	0	0	0	0
Total		10.03	62.33	31.87	0.07	3.36	3.56	6.92	1.02	3.19	4.20	24,035.89	0.73
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 15 - Maximum Daily Mitigated Construction Emissions for Reservoir Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Reservoir construction	Mass grading	7.23	62.44	28.47	0.07	11.27	2.91	23.40	2.54	2.60	7.22	6,404.92	0.62
Reservoir construction	Foundation	1.65	11.82	7.80	0.02	0.24	0.71	0.95	0.21	0.64	0.84	62,130.00	0.13
Reservoir construction	Paving	4.16	21.96	13.09	0.02	0.24	1.45	1.69	0.20	1.30	1.50	2,251.10	0.29
Reservoir construction	Construction	4.48	26.26	16.26	0.03	0.24	1.79	2.03	0.21	1.60	1.81	877,763.06	0.39
Reservoir construction	Architectural coating	32.96	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02
	Total	32.96	62.44	28.47	0.07	11.27	2.91	23.40	2.54	2.60	7.22	877,763.06	0.62
	Regional significance threshold	75	100	550	150	150	150	150	55	55	55	-	-

Table 16 - Maximum Daily Mitigated Construction Emissions for Booster Station Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Booster station construction	Mass grading	4.23	37.73	17.26	0.04	2.86	1.56	6.76	0.67	1.40	2.62	3,623.98	0.37
Booster station construction	Foundation	1.62	11.79	7.47	0.02	0.24	0.71	0.95	0.20	0.64	0.84	26,165.86	0.13
Booster station construction	Trenching	2.47	18.90	9.55	0.02	0.02	1.01	1.03	0.01	0.90	0.91	1,971.50	0.22
Booster station construction	Construction	3.06	23.66	12.08	0.03	0.24	1.36	1.60	0.20	1.22	1.42	37,465.87	0.26
Booster station construction	Architectural coating	49.48	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02
	Total	49.48	37.73	17.26	0.04	2.86	1.56	6.76	0.67	1.40	2.62	37,465.87	0.37
	Regional significance threshold	75	100	550	150	150	150	150	55	55	55	-	-

Table 17 - Maximum Daily Mitigated Construction Emissions for Production Well Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Production well construction	Fugitive dust	0	0	0	0	5.00	0	5.00	1.05	0	1.05	0	0
Production well construction	Off-road equipment	5.98	54.88	24.54	0.07	0.00	2.76	2.76	0	2.45	2.45	6,563.18	0.54
Production well construction	On-road equipment	0.33	4.20	1.32	4.54E-03	0.20	0.19	0.39	0.18	0.18	0.35	463.23	0.02
Production well construction	Worker trips	0.07	0.07	0.66	8.62E-04	0.01	0	0.01	4.38E-03	0	4.38E-03	87.65	0.01
Production well construction	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	35,000.00	0
Production well construction	Concrete manufacturing	0	0	0	0	0	0	0	0	0	0	4,940.94	0
	Total	6.39	59.16	26.52	0.08	5.21	2.94	8.15	1.23	2.63	3.86	47,055.01	0.56
	Regional significance threshold	75	100	550	150	150	150	150	55	55	55	-	-

Table 18- Maximum Daily Mitigated Construction Emissions for Monitoring Well Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Monitoring well construction	Fugitive dust	0	0	0	0	5.00	0	5.00	1.05	0	1.05	0	0
Monitoring well construction	Off-road equipment	5.98	54.88	24.54	0.07	0	2.76	2.76	0	2.45	2.45	6,563.18	0.54
Monitoring well construction	On-road equipment	0.33	4.20	1.32	4.54E-03	0.20	0.19	0.39	0.18	0.18	0.35	463.23	0.02
Monitoring well construction	Worker trips	0.07	0.07	0.66	8.62E-04	0.01	0	0.01	4.38E-03	0	4.38E-03	87.65	0.01
Monitoring well construction	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	35,000.00	0
Monitoring well construction	Concrete manufacturing	0	0	0	0	0	0	0	0	0	0	4,940.94	0
Total		6.39	59.16	26.52	0.08	5.21	2.94	8.15	1.23	2.63	3.86	47,055.01	0.56
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 19 - Maximum Daily Mitigated Construction Emissions for Treatment Facility Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Treatment facility construction	Mass grading	5.81	57.61	23.47	0.06	3.38	2.44	8.59	1.13	2.20	4.26	5,813.81	0.44
Treatment facility construction	Foundation	1.62	11.79	7.47	0.02	0.24	0.71	0.95	0.20	0.64	0.84	124,984.61	0.13
Treatment facility construction	Trenching	2.47	18.90	9.55	0.02	0.02	1.01	1.03	0.01	0.90	0.91	1,971.50	0.22
Treatment facility construction	Construction	2.85	24.07	11.06	0.03	0.38	1.33	1.71	0.33	1.20	1.52	352,471.14	0.23
Maximum Daily Emissions		5.81	57.61	23.47	0.06	3.38	2.44	8.59	1.13	2.20	4.26	352,471.14	0.44
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 20 - Maximum Daily Mitigated Construction Emissions for Desalter Facility Construction (2010), lbs/day

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4
Desalter expansion	Fugitive dust	0	0	0	0	0	5.23	5.23	0	1.10	1.10	0	0
Desalter expansion	Off-road equipment	6.62	49.18	23.90	0.05	0	3.03	3.03	0	2.70	2.70	4,592.29	0.60
Desalter expansion	On-road equipment	1.52	19.11	5.98	0.02	0.91	0.85	1.76	0.80	0.78	1.58	2,105.60	0.07
Desalter expansion	Worker trips	0.73	0.73	6.61	0.01	0.07	0	0.07	0.04	0	0.04	876.55	0.07
Desalter expansion	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	35,000.00	0
Desalter expansion	Cement manufacturing	0	0	0	0	0	0	0	0	0	0	24,704.69	0
Total		8.87	69.02	36.49	0.09	0.98	9.12	10.10	0.84	4.57	5.41	67,279.13	0.73
Regional significance threshold		75	100	550	150	150	150	150	55	55	55	-	-

Table 21- Attainment Status for Criteria Pollutants

Pollutant	Status
CO	Attainment (maintenance plan)
SOx	Attainment
NOx	Attainment (maintenance plan)
PM10	Non-attainment (serious)
PM2.5	Non-attainment
Ozone (1-hr)	Non-attainment (extreme)
Ozone (8-hr)	Non-attainment (extreme)

Table 22 - Annual Unmitigated Construction Emissions for Pipeline Construction (2010), tons/year

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Pipeline construction	Fugitive dust	85	0	0	0	0	0.22	0	0.22	0.05	0	0.05	0	0	0
Pipeline construction	Off-road equipment	85	0.31	2.24	1.06	2.35E-03	0	0.13	0.13	0	0.12	0.12	212.47	0.03	2.55
Pipeline construction	On-road equipment	85	0.03	0.39	0.12	4.21E-04	0.02	0.02	0.04	0.02	0.02	0.03	42.95	1.45E-03	0.42
Pipeline construction	Worker trips	85	0.02	0.02	0.17	2.20E-04	1.77E-03	0	1.77E-03	1.12E-03	0	1.12E-03	22.35	1.66E-03	0.04
Pipeline construction	Steel manufacturing	85	0	0	0	0	0	0	0	0	0	0	743.75	0	0
Pipeline construction	Off-gas	15	0.07	0	0	0	0	0	0	0	0	0	0	0	0.07
Total (tons/year)			0.43	2.65	1.35	2.99E-03	0.24	0.15	0.39	0.06	0.14	0.20	1,021.53	0.03	3.08
De minimus threshold (tons/year)			-	100	100	100	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	15,695	-	-	37,230	-	-	37,230	-	-	449,680

Table 23 - Annual Unmitigated Construction Emissions for Reservoir Construction (2010), tons/year

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Reservoir construction	Mass grading	15	0.05	0.47	0.21	5.03E-04	0.15	2.18E-02	0.18	3.46E-02	1.95E-02	0.05	48.04	4.64E-03	0.52
Reservoir construction	Foundation	15	0.01	0.09	0.06	1.27E-04	1.80E-03	5.34E-03	0.01	1.54E-03	4.80E-03	0.01	465.97	9.98E-04	0.10
Reservoir construction	Paving	5	0.01	0.05	0.03	6.16E-05	6.00E-04	3.62E-03	4.22E-03	5.00E-04	3.25E-03	3.75E-03	5.63	7.22E-04	0.07
Reservoir construction	Construction	80	0.18	1.05	0.65	1.23E-03	0.01	0.07	0.08	0.01	0.06	0.07	35,110.52	0.02	1.23
Reservoir construction	Architectural coating	5	0.08	4.50E-04	4.13E-03	5.39E-06	5.00E-05	0	5.00E-05	2.50E-05	0	2.50E-05	0.55	4.07E-05	0.08
Total (tons/year)			0.34	1.66	0.96	1.93E-03	0.17	0.10	0.27	0.04	0.09	0.14	35,630.71	0.02	2.00
De minimus threshold (tons/year)			-	100	100	100	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	15,695	-	-	37,230	-	-	37,230	-	-	449,680

Table 24 - Annual Unmitigated Construction Emissions for Booster Station Construction (2010), tons/year

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Booster station construction	Mass grading	5	0.01	0.09	0.04	9.23E-05	0.01	3.91E-03	0.02	3.05E-03	3.49E-03	6.54E-03	9.06	9.19E-04	0.10
Booster station construction	Foundation	5	4.04E-03	0.03	0.02	4.12E-05	5.93E-04	1.78E-03	2.37E-03	5.08E-04	1.60E-03	2.11E-03	65.41	3.24E-04	0.03
Booster station construction	Trenching	2	2.47E-03	0.02	0.01	2.12E-05	2.00E-05	1.01E-03	1.03E-03	1.00E-05	8.97E-04	9.07E-04	1.97	2.23E-04	0.02
Booster station construction	Construction	5	0.01	0.06	0.03	6.64E-05	6.00E-04	3.39E-03	3.99E-03	5.00E-04	3.05E-03	3.55E-03	93.66	6.51E-04	0.07
Booster station construction	Architectural coating	2	0.20	1.80E-04	1.65E-03	2.15E-06	2.00E-05	0	2.00E-05	1.00E-05	0	1.00E-05	0.22	1.63E-05	0.20
Total (tons/year)			0.22	0.20	0.10	2.23E-04	0.01	1.01E-02	0.02	4.08E-03	9.03E-03	1.31E-02	170.33	2.13E-03	0.42
De minimus threshold (tons/year)			-	100	100	100	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	15,695	-	-	37,230	-	-	37,230	-	-	449,680

Table 25 - Annual Unmitigated Construction Emissions for Production Well Construction (2010), tons/year

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Production well construction	Fugitive dust	15	0	0	0	0	0.04	0	0.04	0.01	0	0.01	0	0	0
Production well construction	Off-road equipment	15	0.04	0.41	0.18	5.30E-04	0	0.02	0.02	0	0.02	0.02	49.22	4.05E-03	0.46
Production well construction	On-road equipment	15	2.48E-03	0.03	0.01	3.41E-05	1.49E-03	1.40E-03	2.89E-03	1.32E-03	1.32E-03	2.64E-03	3.47	1.17E-04	0.03
Production well construction	Worker trips	15	5.48E-04	5.51E-04	4.96E-03	6.46E-06	5.22E-05	0	5.22E-05	3.29E-05	0	3.29E-05	0.66	4.89E-05	1.10E-03
Production well construction	Steel manufacturing	15	0	0	0	0	0	0	0	0	0	0	262.50	0	0
Production well construction	Concrete manufacturing	15	0	0	0	0	0	0	0	0	0	0	37.06	0	0
Total (tons/year)			0.05	0.44	0.20	5.71E-04	0.04	2.21E-02	0.06	9.23E-03	1.97E-02	2.90E-02	315.86	4.21E-03	0.49
De minimus threshold (tons/year)			-	100	100	100	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	15,695	-	-	37,230	-	-	37,230	-	-	449,680

Table 26 - Annual Unmitigated Construction Emissions for Monitoring Well Construction (2010), tons/year

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Monitoring well construction	Fugitive dust	15	0	0	0	0	0.04	0	0.04	7.88E-03	0	7.88E-03	0	0	0
Monitoring well construction	Off-road equipment	15	0.04	0.41	0.18	5.30E-04	0.00	2.07E-02	0.02	0	1.84E-02	1.84E-02	49.22	4.05E-03	0.46
Monitoring well construction	On-road equipment	15	2.48E-03	0.03	0.01	3.41E-05	1.49E-03	1.40E-03	2.89E-03	1.32E-03	1.32E-03	2.64E-03	3.47	1.17E-04	0.03
Monitoring well construction	Worker trips	15	5.48E-04	5.51E-04	4.96E-03	6.46E-06	5.22E-05	0	5.22E-05	3.29E-05	0	3.29E-05	0.66	4.89E-05	1.10E-03
Monitoring well construction	Steel manufacturing	15	0	0	0	0	0	0	0	0	0	0	262.50	0	0
Monitoring well construction	Concrete manufacturing	15	0	0	0	0	0	0	0	0	0	0	37.06	0	0
Total (tons/year)			0.05	0.44	0.20	5.71E-04	0.04	2.21E-02	0.06	9.23E-03	1.97E-02	2.90E-02	315.86	4.21E-03	0.49
De minimus threshold (tons/year)			-	100	100	100	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	15,695	-	-	37,230	-	-	37,230	-	-	449,680

Table 27 - Annual Unmitigated Construction Emissions for Treatment Facility Construction (2010), tons/year

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Treatment facility construction	Mass grading	5	0.01	0.14	0.06	1.46E-04	0.02	6.10E-03	0.02	5.13E-03	5.51E-03	1.06E-02	14.53	1.10E-03	0.16
Treatment facility construction	Foundation	3	2.43E-03	0.02	0.01	2.47E-05	3.56E-04	1.07E-03	1.42E-03	3.05E-04	9.59E-04	1.26E-03	187.48	1.95E-04	0.02
Treatment facility construction	Trenching	5	0.01	0.05	0.02	5.29E-05	5.00E-05	2.52E-03	2.57E-03	2.50E-05	2.24E-03	2.27E-03	4.93	5.58E-04	0.05
Treatment facility construction	Construction	30	0.04	0.36	0.17	3.93E-04	0.01	0.02	0.03	4.90E-03	1.80E-02	0.02	5287.07	3.46E-03	0.40
Total (tons/year)			0.07	0.57	0.26	6.17E-04	0.02	0.03	0.05	0.01	0.03	0.04	5494.01	0.01	0.64
De minimus threshold (tons/year)			-	100	100	100	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	15,695	-	-	37,230	-	-	37,230	-	-	449,680

Table 28 - Annual Unmitigated Construction Emissions for Desalter Facility Construction (2010), tons/year

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Desalter facility expansion	Fugitive dust	10	0	0	0	0	0	0.03	0.03	0	0.01	0.01	0	0	0
Desalter facility expansion	Off-road equipment	10	0.03	0.25	0.12	2.60E-04	0	0.02	0.02	0	1.35E-02	1.35E-02	22.96	2.98E-03	0.28
Desalter facility expansion	On-road equipment	10	0.01	0.10	0.03	1.21E-04	4.57E-03	4.24E-03	0.01	4.00E-03	3.88E-03	0.01	10.53	3.55E-04	0.10
Desalter facility expansion	Worker trips	60	0.02	0.02	0.20	3.00E-04	2.10E-03	0	2.10E-03	1.20E-03	0	1.20E-03	26.30	1.96E-03	0.04
Desalter facility expansion	Steel manufacturing	60	0	0	0	0	0	0	0	0	0	0	1,050.00	0	0
Desalter facility expansion	Cement manufacturing	60	0.00	0	0	0	0	0	0	0	0	0	741.14	0	0
Total (tons/year)			0.06	0.36	0.35	6.81E-04	0.01	0.05	0.05	0.01	0.02	0.03	1,109.79	0.01	0.43
De minimus threshold (tons/year)			-	100	100	100	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	15,695	-	-	37,230	-	-	37,230	-	-	449,680

Table 29 - Annual Unmitigated Operational Emissions from Reservoir Operations (2010), tons/yr

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Reservoir coating	Architectural coating	365	0.01	0	0	0	0	0	0	0	0	0	0	0	0.01
Total (tons/year)			0.01	0	0	0	0	0	0	0	0	0	0	0	0.01
De minimus threshold (tons/year)			-	100	100	-	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	-	-	-	37,230	-	-	37,230	-	-	449,680

Table 30 - Annual Unmitigated Operational Emissions from Booster Station Operations (2010), tons/yr

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Booster station operations	Electricity consumption	365	4.20E-03	0.48	0.08	0.05	0	0.02	0.02	0	0	0	337.71	2.81E-03	0.49
Booster station operations	Vehicle trips	365	3.65E-03	3.65E-03	0.03	4.02E-05	3.18E-04	0	3.18E-04	2.01E-04	0	2.01E-04	4.00	2.97E-04	0.01
Booster station operations	Architectural coating	365	4.93E-03	0	0	0	0	0	0	0	0	0	0	0	4.93E-03
Total (tons/year)			0.01	0.49	0.11	0.05	3.18E-04	0.02	0.02	2.01E-04	0	2.01E-04	341.70	3.11E-03	0.50
De minimus threshold (tons/year)			-	100	100	-	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	-	-	-	37,230	-	-	37,230	-	-	449,680

Table 31 - Annual Unmitigated Operational Emissions from Production Well Operations (2010), tons/yr

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Production well operations	Electricity consumption	365	0.01	0.63	0.11	0.07	0	2.19E-02	0.02	0	0	0	440.49	3.67E-03	0.64
Production well operations	Vehicle trips	365	3.65E-03	3.65E-03	0.03	4.02E-05	3.18E-04	0	3.18E-04	2.01E-04	0	2.01E-04	4.00	2.97E-04	0.01
Total (tons/year)			0.01	0.63	0.14	0.07	3.18E-04	2.19E-02	0.02	2.01E-04	0	2.01E-04	444.48	3.97E-03	0.64
De minimus threshold (tons/year)			-	100	100	-	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	-	-	-	37,230	-	-	37,230	-	-	449,680

Table 32 - Annual Unmitigated Operational Emissions from Monitoring Well Operations (2010), tons/yr

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Monitoring well operations	Vehicle trips	365	3.65E-03	3.65E-03	0.03	4.02E-05	3.18E-04	0	3.18E-04	2.01E-04	0	2.01E-04	4.00	2.97E-04	7.30E-03
Total (tons/year)			3.65E-03	3.65E-03	0.03	4.02E-05	3.18E-04	0	3.18E-04	2.01E-04	0	2.01E-04	4.00	2.97E-04	7.30E-03
De minimus threshold (tons/year)			-	100	100	-	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	-	-	-	37,230	-	-	37,230	-	-	449,680

Table 33 - Annual Unmitigated Operational Emissions from Treatment Facilities Operations (2010), tons/yr

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Treatment facility operations	Electricity consumption	365	2.01E-03	0.23	0.04	0.02	0	8.03E-03	0.01	0	0	0	161.51	1.35E-03	0.23
Treatment facility operations	Vehicle trips	365	0.45	5.59	1.81	0.01	0.27	0.25	0.51	0.23	0.23	0.46	622.83	0.02	6.04
Total (tons/year)			0.45	5.82	1.85	0.03	0.27	0.25	0.52	0.23	0.23	0.46	784.35	0.02	6.27
De minimus threshold (tons/year)			-	100	100	-	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	-	-	-	37,230	-	-	37,230	-	-	449,680

Table 34 - Annual Unmitigated Operational Emissions from Desalter Facilities Operations (2010), tons/yr

Activity	Source	Days	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	NOx/VOC (Ozone)
Desalter facility operations	Electricity consumption	365	0.01	1.26	0.22	0.13	0	0	0.04	0	0	0	880.97	7.34E-03	1.27
Desalter facility operations	Vehicle trips	365	0.01	0.01	0.06	7.85E-05	6.35E-04	0	6.35E-04	4.00E-04	0	4.00E-04	8.00	5.95E-04	0.01
Total (tons/year)			0.02	1.27	0.28	0.13	6.35E-04	0.04	0.04	4.00E-04	0.00	4.00E-04	888.97	7.93E-03	1.28
De minimus threshold (tons/year)			-	100	100	-	-	-	70	-	-	100	-	-	10
Approximate South Coast Air Basin emissions (tons/year)			207,685	241,995	911,405	-	-	-	37,230	-	-	37,230	-	-	449,680

Attachment 1 – Pipeline Calculations

Pipelines

Emissions of Fugitive Dust (PM10) from Excavation

Y = (N)(EF)

where,
Y = Daily emissions of PM10 fugitive dust, lbs/day.
N = Number of acres disturbed per day during soil excavation, 0.52 acres.
EF = Emission factor for PM10 fugitive dust during excavation, 10 lbs/acre-day (URBEMIS 2007, V9.2.4).

Y= (0.52 acres)(10 lbs/acre-day) = 5.23 lbs/day

Emissions of Fugitive Dust (PM2.5) from Excavation

Y = (N)(EF)

where,
Y = Daily emissions of PM2.5 fugitive dust, lbs/day.
N = Number of acres disturbed per day during soil excavation, 0.52 acres.
EF = Emission factor for PM2.5 fugitive dust during excavation, 2.1 lbs/acre-day (URBEMIS 2007, V9.2.4).

Y= (0.52 acres)(2.1 lbs/acre-day) = 1.10 lbs/day

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of pieces of equipment in a specified equipment category.
H = Hours per day of equipment operation.
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors).

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Hours	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Backhoe	1	6	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.61	2.36	4.05	4.65E-03	0.31	0.28	400.83	0.06
Crane	1	6	Cranes Composite	0.1594	0.5431	1.4515	0.0014	0.0642	0.0572	128.6554	0.0144	0.96	3.26	8.71	8.26E-03	0.39	0.34	771.93	0.09
Compactor	1	6	Crushing/Proc. Equipment Composite	0.2152	0.7260	1.4394	0.0015	0.0935	0.0833	132.3100	0.0194	1.29	4.36	8.64	8.74E-03	0.56	0.50	793.86	0.12
Roller/vibrator	1	6	Rollers Composite	0.1176	0.4212	0.7749	0.0008	0.0547	0.0487	67.0525	0.0106	0.71	2.53	4.65	4.62E-03	0.33	0.29	402.31	0.06
Pavement cutter	1	6	Concrete/Industrial Saws Composite	0.1270	0.4273	0.6566	0.0007	0.0552	0.0491	58.4636	0.0115	0.76	2.56	3.94	4.18E-03	0.33	0.29	350.78	0.07
Grinder haul truck	1	6	Dumpers/Tenders Composite	0.0108	0.0336	0.0645	0.0001	0.0036	0.0032	7.6244	0.0010	0.06	0.20	0.39	5.80E-04	0.02	0.02	45.75	0.01
Dump truck	2	6	Dumpers/Tenders Composite	0.0108	0.0336	0.0645	0.0001	0.0036	0.0032	7.6244	0.0010	0.13	0.40	0.77	1.16E-03	0.04	0.04	91.49	0.01
Water truck	1	4	Off-Highway Trucks Composite	0.2480	0.7429	2.3885	0.0027	0.0875	0.0779	260.1043	0.0224	0.99	2.97	9.55	1.06E-02	0.35	0.31	1,040.42	0.09
Excavator	1	4	Excavators Composite	0.1483	0.5581	1.1502	0.0013	0.0638	0.0568	119.5813	0.0134	0.59	2.23	4.60	5.26E-03	0.26	0.23	478.33	0.05
Paving machine compactor	1	2	Pavers Composite	0.1774	0.5644	0.9868	0.0009	0.0709	0.0631	77.9351	0.0160	0.35	1.13	1.97	1.79E-03	0.14	0.13	155.87	0.03
Generator	1	6	Generator Sets	0.1395	0.5054	0.9075	0.0009	0.0714	0.0636	77.9494	0.0126	0.84	3.03	5.45	5.49E-03	0.43	0.38	467.70	0.08

Emissions from On Road Equipment

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Soil hauling	2010	10	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.61	2.39	7.64	0.01	0.37	0.34	0.70	0.32	0.31	0.63	842.24	0.03
Worker trips	2010	12	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.44	3.97	0.44	0.01	0.04	0	0.04	0.03	0	0.03	525.93	0.04
Material delivery	2010	1	40	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.12	0.48	1.53	1.65E-03	0.07	0.07	0.14	0.06	0.06	0.13	168.45	0.01

Indirect Emissions of Carbon Dioxide from the Manufacturing of Steel

Y = QFk

where,
Y = Daily emissions of carbon dioxide, lbs/day.
Q = Quantity of steel used, 5 tons/day .
F = Emission factor for carbon dioxide, 1.75 lb/lbs (GHG Protocol, Appendix B).
k = Conversion factor, 2,000 lb/ton.

Y = (5 tons/day)(2000 lb/ton)(1.75 lb/lb)= 17,500 lbs/day

Emissions of VOC from Paving

Y = (N)(EF)

where,
Y = Daily emissions of VOC, lbs/day.
N = Number of acres paved per day, 0.6 acres.
EF = Emission factor for VOC during paving, 2.62 lbs/acre (URBEMIS 2007, V9.2.4).

Y= (0.6 acres)(2.62 lbs/acre) = 1.56 lbs/day

Attachment 2 – Reservoir Calculations

Reservoir

Mass Grading Activities

Emissions of Fugitive Dust (PM10)

Y = (N)(EF)

where,
Y = Daily emissions of PM10 fugitive dust, lbs/day
N = Number of acres disturbed per day during mass grading, 2 acres
EF = Emission factor for PM10 fugitive dust during mass grading, 10 lbs/acre-day (URBEMIS 2007, V9.2.4)

Y= (2 acres)(10 lbs/acre-day) = 20 lbs/day

Emissions of Fugitive Dust (PM2.5)

Y = (N)(EF)

where,
Y = Daily emissions of PM2.5 fugitive dust, lbs/day
N = Number of acres disturbed per day during mass grading, 2 acres
EF = Emission factor for PM2.5 fugitive dust during mass grading, 2.1 lbs/acre-day (URBEMIS 2007, V9.2.4

Y= (2 acres)(2.1 lbs/acre-day) = 4.2 lbs/day

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of pieces of equipment in a specified equipment category
H = Hours per day of equipment operation
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Hours	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Bull dozer	1	6	Rubber Tired Dozers Composite	0.3379	1.4127	2.9891	0.0025	0.1288	0.1146	239.1015	0.0305	2.03	8.48	17.93	0.01	0.77	0.69	1,434.61	0.18
Front end loader	1	6	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.61	2.36	4.05	4.65E-03	0.31	0.28	400.83	0.06
Water truck	1	6	Off-Highway Trucks Composite	0.2480	0.7429	2.3885	0.0027	0.0875	0.0779	260.1043	0.0224	1.49	4.46	14.33	0.02	0.53	0.47	1,560.63	0.13
Grader	1	6	Graders composite	0.1723	0.6314	1.4338	0.0015	0.0753	0.0671	132.7431	0.0155	1.03	3.79	8.60	0.01	0.45	0.40	796.46	0.09
Excavator	1	6	Excavators Composite	0.1483	0.5581	1.1502	0.0013	0.0638	0.0568	119.5813	0.0134	0.89	3.35	6.90	0.01	0.38	0.34	717.49	0.08
Dump/ haul trucks	2	6	Dumpers/Tenders Composite	0.0108	0.0336	0.0645	0.0001	0.0036	0.0032	7.6244	0.0010	0.13	0.40	0.77	1.16E-03	0.04	0.04	91.49	0.01

Emissions from On Road Equipment

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Soil hauling	2010	12.5	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.76	2.99	9.56	0.01	0.46	0.42	0.88	0.40	0.39	0.79	1052.80	0.04
Worker trips	2010	8	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.29	2.64	0.29	3.45E-03	0.03	0	0.03	0.02	0	0.02	350.62	0.03

Foundation Activities

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of pieces of equipment in a specified equipment category
H = Hours per day of equipment operation
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Hours	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Cement and mortar mixers	4	8	Cement and Mortar Mixers	0.0079	0.0388	0.0505	0.0001	0.0029	0.0026	6.3202	0.0007	0.25	1.24	1.62	3.15E-03	0.09	0.08	202.25	0.02
Tractor	1	8	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.82	3.14	5.40	0.01	0.42	0.37	534.44	0.07

Emissions from On Road Equipment

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

Type	Year	Total daily round trips	Miles during trip	Emission factors (lbs/mile)										Emissions (lbs/day)											
				VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Delivery of construction materials	2010	6	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.36	1.43	4.59	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02
Worker trips	2010	6	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.22	1.98	0.22	2.59E-03	0.02	0	0.02	0.01	0	0.01	262.96	0.02

Indirect Emissions of Carbon Dioxide from the Manufacturing of Cement

Y = QPEFk

where,
Y = Daily emissions of criteria pollutant, lbs/day
Q = Quantity of concrete used, 250 tons/day
P = Proportion of cement in concrete, 0.125 lb/lb
EF = Emission factor for carbon dioxide, 0.97 lb/lbs (CO_2 Emission Profile of the U.S. Cement Industry, Environmental Protection Agency, 2001).
k = Conversion factor, 2,000 lb/ton.

Y = (250 tons/day)(0.125 lb/lb)(0.97 lb/lb)(2,000 lb/ton) = 60,625 lbs/day

Construction Activities

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of pieces of equipment in a specified equipment category
H = Hours per day of equipment operation
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors

Equipment	Number	Hours	URBEMIS Designation	Emission factors, lb/hr								Emissions, lbs/day							
				VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Crane	1	6	Cranes	0.1284	0.3166	0.2547	0.0003	0.0289	0.0257	23.1867	0.0116	0.77	1.90	1.53	1.80E-03	0.17	0.15	139.12	0.07
Forklift	1	6	Forklifts	0.0666	0.1824	0.1530	0.0002	0.0163	0.0145	14.6719	0.0060	0.40	1.09	0.92	1.14E-03	0.10	0.09	88.03	0.04
Backhoe	1	6	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.61	2.36	4.05	4.65E-03	0.31	0.28	400.83	0.06
Front loader	1	6	Rubber Tired Loaders Composite	0.1440	0.5078	1.1537	0.0012	0.0651	0.0579	108.6127	0.0130	0.86	3.05	6.92	7.20E-03	0.39	0.35	651.68	0.08
Dump/ haul trucks	2	6	Dumpers/Tenders Composite	0.0108	0.0336	0.0645	0.0001	0.0036	0.0032	7.6244	0.0010	0.13	0.40	0.77	1.16E-03	0.04	0.04	91.49	0.01
Generator	1	8	Generator Sets	0.1395	0.5054	0.9075	0.0009	0.0714	0.0636	77.9494	0.0126	1.12	4.04	7.26	0.01	0.57	0.51	623.60	0.10

Emissions From On Road Equipment

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

Type	Year	Total daily round trips	Miles during trip	Emission factors (lbs/mile)										Emissions (lbs/day)											
				VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Delivery of construction materials	2010	6	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.36	1.43	4.59	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02
Worker trips	2010	6	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.22	1.98	0.22	2.59E-03	0.02	0	0.02	0.01	0	0.01	262.96	0.02

Indirect Emissions of Carbon Dioxide from the Manufacturing of Steel

Y = QFk

where,
Y = Daily emissions of carbon dioxide, lbs/day.
Q = Quantity of steel used, 250 tons/day.
F = Emission factor for carbon dioxide, 1.75 lb/lbs (GHG Protocol, Appendix B).
k = Conversion factor, 2,000 lb/ton.

Y = (250 tons)(2000 lb/ton)(1.75 lb/lb)= 875,000 lbs/day

Paving Activites

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of pieces of equipment in a specified equipment category
H = Hours per day of equipment operation
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Hours	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Paver	1	7	Pavers Composite	0.1774	0.5644	0.9868	0.0009	0.0709	0.0631	77.9351	0.0160	1.24	3.95	6.91	0.01	0.50	0.44	545.55	0.11
Roller/vibrator	1	8	Rollers Composite	0.1176	0.4212	0.7749	0.0008	0.0547	0.0487	67.0525	0.0106	0.94	3.37	6.20	0.01	0.44	0.39	536.42	0.08
Tractor	1	6	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.61	2.36	4.05	4.65E-03	0.31	0.28	400.83	0.06

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Delivery of construction materials	2010	6	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.36	1.43	4.59	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02
Worker trips	2010	6	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.22	1.98	0.22	2.59E-03	0.02	0	0.02	0.01	0	0.01	262.96	0.02

Emission of VOC from Paving

Y = (N)(EF)

where,
Y = Daily emissions of VOC, lbs/day
N = Number of acres paved per day, 0.3 acres
EF = Emission factor for VOC during paving, 2.62 lbs/acre (URBEMIS 2007, V9.2.4)

Y= (0.3 acres)(2.62 lbs/acre) = 0.79 lbs/day

Architectural Coating Activities

Emissions of VOC from Architectural Coating

Y = FA/D

where,
Y = Daily emissions of VOC, lbs/day.
F = Emission factor, 0.0087 lbs VOC/ft^2 of surface area (250 g/L and 6 mil thickness).
A = Surface area of reservoir, 18,840 ft^2.
D = Duration of coating activities, 5 days.

Y = [(0.0087 lbs VOC/ft^2)(18,840 ft^2)/ 5 days = 32.78 lbs/day

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Worker trips	2010	5	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.18	1.65	0.18	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02

Reservoir Operational Emissions

Emissions of VOC from Architectural Coating

Y = FA/D

where,

Y = Daily emissions of VOC, lbs/day.

F = Emission factor, 0.0087 lbs VOC/ft^2 of surface area (250 g/L and 6 mil thickness).

A = Surface area of reservoir coated yearly for maintenance, 1,884 ft^2.

D = Duration of coating activities, 365 days.

Y = [(0.0087 lbs VOC/ft^2)(1,884 ft^2)/ 365 days = 0.04 lbs/day

Maximum Daily Unmitigated Reservoir Construction Emissions (2010) (lbs/day)

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	Comments
Mass grading	Fugitive dust	0	0	0	0	20.00	0	20.00	4.20	0	4.20	0	0	URBEMIS
Mass grading	Off-road equipment	6.18	52.59	22.83	0.05	0	2.49	2.49	0	2.21	2.21	5,001.50	0.56	CARB
Mass grading	On-road equipment	0.76	9.56	2.99	0.01	0.46	0.42	0.88	0.40	0.39	0.79	1,052.80	0.04	EMFAC 2007
Mass grading	Worker trips	0.29	0.29	2.64	0	0.03	0	0.03	0.02	0	0.02	350.62	0.03	EMFAC 2007
Foundation	Off-road equipment	1.07	7.02	4.39	0.01	0	0.51	0.51	0	0.45	0.45	736.69	0.10	CARB
Foundation	Vendor trips	0.36	4.59	1.43	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02	EMFAC 2007
Foundation	Worker trips	0.22	0.22	1.98	2.59E-03	0.02	0	0.02	0.01	0	0.01	262.96	0.02	EMFAC 2007
Foundation	Cement manufacturing	0	0	0	0	0	0	0	0	0	0	60,625	0.00	EPA
Paving	Off-gas	0.79	0	0	0	0	0	0	0	0	0	0	0	URBEMIS
Paving	Off-road equipment	2.80	17.15	9.68	0.02	0	1.25	1.25	0	1.11	1.11	1,482.80	0.25	CARB
Paving	On-road equipment	0.36	4.59	1.43	0	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02	EMFAC 2007
Paving	Worker trips	0.22	0.22	1.98	0	0.02	0	0.02	0.01	0	0.01	262.96	0.02	EMFAC 2007
Reservoir construction	Off-road equipment	3.89	21.45	12.85	0.02	0	1.59	1.59	0	1.41	1.41	1,994.75	0.35	CARB
Reservoir construction	Vendor trips	0.36	4.59	1.43	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02	EMFAC 2007
Reservoir construction	Worker trips	0.22	0.22	1.98	2.59E-03	0.02	0	0.02	0.01	0	0.01	262.96	0.02	EMFAC 2007
Reservoir construction	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	875,000	0	GHG Protocol
Architectural coatings	Architectural coatings	32.78	0	0	0	0	0	0	0	0	0	0	0	SCAQMD
Architectural coatings	Worker trips	0.18	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02	URBEMIS

Attachment 3 – Booster Station Calculations

Booster Station

Mass Grading Activities

Emissions of Fugitive Dust (PM10)

Y = (N)(EF)

where,
Y = Daily emissions of PM10 fugitive dust, lbs/day
N = Number of acres disturbed per day during mass grading, 0.5 acres
EF = Emission factor for PM10 fugitive dust during mass grading, 10 lbs/acre-day (URBEMIS 2007, V9.2.4)

Y= (0.5 acres)(10 lbs/acre-day) = 5.0 lbs/day

Emissions of Fugitive Dust (PM2.5)

Y = (N)(EF)

where,
Y = Daily emissions of PM2.5 fugitive dust, lbs/day
N = Number of acres disturbed per day during mass grading, 0.5 acres
EF = Emission factor for PM2.5 fugitive dust during mass grading, 2.1 lbs/acre-day (URBEMIS 2007, V9.2.4

Y= (0.5 acres)(2.1 lbs/acre-day) = 1.05 lbs/day

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of pieces of equipment in a specified equipment category
H = Hours per day of equipment operation
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Hours	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Bull dozer	1	8	Rubber Tired Dozers Composite	0.3379	1.4127	2.9891	0.0025	0.1288	0.1146	239.1015	0.0305	2.70	11.30	23.91	0.02	1.03	0.92	1,912.81	0.24
Water truck	1	4	Off-Highway Trucks Composite	0.2480	0.7429	2.3885	0.0027	0.0875	0.0779	260.1043	0.0224	0.99	2.97	9.55	0.01	0.35	0.31	1,040.42	0.09
Dump/ haul trucks	1	4	Dumpers/Tenders Composite	0.0108	0.0336	0.0645	0.0001	0.0036	0.0032	7.6244	0.0010	0.04	0.13	0.26	3.87E-04	0.01	0.01	30.50	3.90E-03

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Soil hauling	2010	5	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.30	1.20	3.82	4.13E-03	0.18	0.17	0.35	0.16	0.16	0.32	421.12	0.01
Worker trips	2010	5	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.18	1.65	0.18	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02

Foundation Activities

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of pieces of equipment in a specified equipment category.
H = Hours per day of equipment operation.
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors).

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Hours	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Cement and mortar mixers	4	8	Cement and Mortar Mixers	0.0079	0.0388	0.0505	0.0001	0.0029	0.0026	6.3202	0.0007	0.25	1.24	1.62	3.15E-03	0.09	0.08	202.25	0.02
Tractor	1	8	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.82	3.14	5.40	0.01	0.42	0.37	534.44	0.07

Emissions from On Road Equipment

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Delivery of construction materials	2010	6	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.36	1.43	4.59	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02
Worker trips	2010	5	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.18	1.65	0.18	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02

Indirect Emissions of Carbon Dioxide from the Manufacturing of Cement

Y = QkPEF

where,
Y = Daily emissions of criteria pollutant, lbs/day.
Q = Quantity of concrete used, 50 yd3/day.
K = Density of concrete, 4,075 lb/yd^3.
P = Proportion of cement in concrete, 0.125 lb/lb.
EF = Emission factor for carbon dioxide, 0.97 lb/lbs (CO_2 Emission Profile of the U.S. Cement Industry, Environmental Protection Agency, 2001)

Y = (50 yd3/day)(4,075 lb/yd3)(0.125 lb/lb)(0.97 lb/lb) = 24,704.69 lbs/day

Trenching Activities

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of pieces of equipment in a specified equipment category.
H = Hours per day of equipment operation.
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors).

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Hours	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
General industrial equipment	1	8	Other General Industrial Equipment Composite	0.1847	0.5948	1.6649	0.0016	0.0740	0.0658	152.2399	0.0167	1.48	4.76	13.32	0.01	0.59	0.53	1,217.92	0.13
Tractor	1	8	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.82	3.14	5.40	0.01	0.42	0.37	534.44	0.07

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Worker trips	2010	5	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.18	1.65	0.18	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02

Construction Activities

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of pieces of equipment in a specified equipment category.
H = Hours per day of equipment operation.
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors).

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Operating hours/day	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Backhoe	1	4	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.41	1.57	2.70	3.10E-03	0.21	0.19	267.22	0.04
Crane	1	4	Cranes Composite	0.1594	0.5431	1.4515	0.0014	0.0642	0.0572	128.6554	0.0144	0.64	2.17	5.81	5.51E-03	0.26	0.23	514.62	0.06
Forklift	1	4	Rough Terrain Forklifts Composite	0.1272	0.4766	0.7988	0.0008	0.0678	0.0603	70.2808	0.0115	0.51	1.91	3.20	3.26E-03	0.27	0.24	281.12	0.05
Front loader	1	4	Rubber Tired Loaders Composite	0.1440	0.5078	1.1537	0.0012	0.0651	0.0579	108.6127	0.0130	0.58	2.03	4.61	4.80E-03	0.26	0.23	434.45	0.05
Generator	1	4	Generator Sets Composite	0.0961	0.3293	0.6440	0.0007	0.0396	0.0353	60.9927	0.0087	0.38	1.32	2.58	2.79E-03	0.16	0.14	243.97	0.03

Emissions from On Road Equipment

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Delivery of construction materials	2010	6	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.36	1.43	4.59	4.96E-03	0.22	0.2	0.42	0.19	0.19	0.38	505.34	0.02
Worker trips	2010	5	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.18	1.65	0.18	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02

Indirect Emissions of Carbon Dioxide from the Manufacturing of Steel

Y = QFk

where,
Y = Daily emissions of carbon dioxide, lbs/day.
Q = Quantity of steel used, 10 tons/day.
F = Emission factor for carbon dioxide, 1.75 lb/lbs (GHG Protocol, Appendix B).
k = Conversion factor, 2,000 lb/ton.

Y = (10 tons/day)(2000 lb/ton)(1.75 lb/lb) = 35,000 lbs/day

Architectural Coating Activities

Emissions of VOC from Architectural Coating

Y = FA/D

where,
Y = Daily emissions of VOC, lbs/day.
F = Emission factor, 0.0116 lbs VOC/ft^2 of surface area (250 g/L and 8 mil thickness).
A = Surface area of booster station, 8,500 ft^2.
D = Duration of coating activities, 2 days.

Y = [(0.0116 lbs VOC/ft^2)(8,500 ft^2)/ 2 days = 49.3 lbs/day

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Worker trips	2010	5	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.18	1.65	0.18	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02

Booster Station Operational Emissions

Emissions from Electricity Consumption

Y = FQ

where,
Y = annual emissions of given listed substance, lbs/yr
F = emissions factor for given listed substance, lbs/MWh
Q = quantity of electricity consumed per year, MWh/yr

Substance	F, lbs/MWh	Q, MWh/yr	Y , lbs/yr	Y , lbs/day	Notes
CO_2	804.54	20,148.00	16,209,871.92	44,410.61	see note 1
CH4	0.0067	20,148.00	134.99	0.37	see note 1
CO	2.00E-01	20,148.00	4,029.60	11.04	see note 2
VOC	1.00E-02	20,148.00	201.48	0.55	see note 2
NOx	1.15	20,148.00	23,170.20	63.48	see note 2
SOx	1.20E-01	20,148.00	2,417.76	6.62	see note 2
PM10	4.00E-02	20,148.00	805.92	2.21	see note 2

Notes:
1. Climate Action Registry, Appendix C, June 2007
2. CEQA Handbook, Table A9-11-B, March 1993.

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Worker trips	2010	1	20	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.02	0.17	0.02	2.20E-04	1.74E-03	0	1.74E-03	1.10E-03	0	1.10E-03	21.91	1.63E-03

Emissions of VOC from Architectural Coating

Y = FA/D

where,
Y = Daily emissions of VOC, lbs/day.
F = Emission factor, 0.0116 lbs VOC/ft^2 of surface area (250 g/L and 8 mil thickness).
A = Surface area of booster station coated yearly for maintenance, 850 ft^2.
D = Duration of coating activities, 365 days.

Y = [(0.0116 lbs VOC/ft^2)(850 ft^2)/ 365 days = 0.03 lbs/day

Maximum Daily Unmitigated Booster Station Construction Emissions (2010) (lbs/day)

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	Comments
Mass grading	Fugitive dust	0	0	0	0	5.00	0	5.00	1.05	0	1.05	0	0	URBEMIS
Mass grading	Off-road equipment	3.74	33.72	14.41	0.03	0	1.39	1.39	0	1.24	1.24	2983.73	0.34	CARB
Mass grading	On-road equipment	0.30	3.82	1.20	4.13E-03	0.18	0.17	0.35	0.16	0.16	0.32	421.12	0.01	EMFAC 2007
Mass grading	Worker trips	0.18	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02	EMFAC 2007
Foundation	Off-road equipment	1.07	7.02	4.39	0.01	0	0.51	0.51	0	0.45	0.45	736.69	0.10	CARB
Foundation	Vendor trips	0.36	4.59	1.43	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02	EMFAC 2007
Foundation	Worker trips	0.18	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02	EMFAC 2007
Foundation	Cement manufacturing	0	0	0	0	0	0	0	0	0	0	24,704.69	0	EPA
Trenching	Off-road equipment	2.29	18.72	7.90	0.02	0	1.01	1.01	0	0.90	0.90	1,752.36	0.21	CARB
Trenching	Worker trips	0.18	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02	EMFAC 2007
Building construction	Off-road equipment	2.52	18.89	9.00	0.02	0	1.16	1.16	0	1.03	1.03	1,741.39	0.23	CARB
Building construction	Vendor trips	0.36	4.59	1.43	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02	EMFAC 2007
Building construction	Worker trips	0.18	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02	EMFAC 2007
Building construction	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	35,000.00	0	GHG Protocol
Architectural coatings	Architectural coatings	49.30	0	0	0	0	0	0	0	0	0	0	0	SCAQMD
Architectural coatings	Worker trips	0.18	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02	URBEMIS

Attachment 4 – Production Well Calculations

Production Wells

Emissions of Fugitive Dust (PM10) from Excavation

Y = (N)(EF)

where,
Y = Daily emissions of PM10 fugitive dust, lbs/day.
N = Number of acres disturbed per day during soil excavation, 0.5 acres.
EF = Emission factor for PM10 fugitive dust during excavation, 10 lbs/acre-day (URBEMIS 2007, V9.2.4).

Y= (0.5 acres)(10 lbs/acre-day) = 5.0 lbs/day

Emissions of Fugitive Dust (PM2.5) from Excavation

Y = (N)(EF)

where,
Y = Daily emissions of PM2.5 fugitive dust, lbs/day.
N = Number of acres disturbed per day during soil excavation, 0.5 acres.
EF = Emission factor for PM2.5 fugitive dust during excavation, 2.1 lbs/acre-day (URBEMIS 2007, V9.2.4).

Y= (0.5 acres)(2.1 lbs/acre-day) = 1.05 lbs/day

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of pieces of equipment in a specified equipment category
H = Hours per day of equipment operation
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Operating hours/day	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Drill rig	1	24	Bore/Drill Rigs Composite	0.1052	0.5146	1.1331	0.0017	0.0498	0.0443	164.8533	0.0095	2.53	12.35	27.20	0.04	1.20	1.06	3,956.48	0.23
Front end loader	1	24	Rubber Tired Loaders Composite	0.1440	0.5078	1.1537	0.0012	0.0651	0.0579	108.6127	0.0130	3.46	12.19	27.69	0.03	1.56	1.39	2,606.71	0.31

Emissions from On Road Equipment

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Soil hauling	2010	0.5	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.03	0.12	0.38	4.13E-04	0.02	0.02	0.04	0.02	0.02	0.03	42.11	1.42E-03
Worker trips	2010	2	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.07	0.66	0.07	8.62E-04	0.01	0	0.01	4.38E-03	0	4.38E-03	87.65	0.01
Delivery of construction materials	2010	2	50	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.3	1.2	3.82	4.13E-03	0.18	0.17	0.35	0.16	0.16	0.32	421.12	0.01

Indirect Emissions of Carbon Dioxide from the Manufacturing of Steel

Y = QFk

where,
Y = Daily emissions of carbon dioxide, lbs/day.
Q = Quantity of steel used, 10 tons/day.
F = Emission factor for carbon dioxide, 1.75 lb/lbs (GHG Protocol, Appendix B).
k = Conversion factor, 2,000 lb/ton.

Y = (10 tons/day)(2000 lb/ton)(1.75 lb/lb)= 35,000 lbs/day

Indirect Emissions of Carbon Dioxide from the Manufacturing of Cement

Y = QKPEF

where,
Y = Daily emissions of criteria pollutant, lbs/day
Q = Quantity of concrete used, 10 yd3/day
K = Density of concrete, 4,075 lb/yd^3.
P = Proportion of cement in concrete, 0.125 lb/lb
EF = Emission factor for carbon dioxide, 0.97 lb/lbs (CO_2 Emission Profile of the U.S. Cement Industry, Environmental Protection Agency, 2001).

Y = (10 yd3/day)(0.125 lb/lb)(0.97 lb/lb) = 4,940.94 lbs/day

Production Well Operational Emissions

Emissions from Electricity Consumption

Y = FQ

where,
Y = annual emissions of given listed substance, lbs/yr
F = emissions factor for given listed substance, lbs/MWh
Q = quantity of electricity consumed per year, MWh/yr

Substance	F, lbs/MWh	Q, MWh/yr	Y , lbs/yr	Y , lbs/day	Notes
CO_2	804.54	1,095.00	880,971.30	2,413.62	see note 1
CH4	0.0067	1,095.00	7.34	0.02	see note 1
CO	2.00E-01	1,095.00	219.00	0.60	see note 2
VOC	1.00E-02	1,095.00	10.95	0.03	see note 2
NOx	1.15	1,095.00	1,259.25	3.45	see note 2
SOx	1.20E-01	1,095.00	131.40	0.36	see note 2
PM10	4.00E-02	1,095.00	43.80	0.12	see note 2

Notes:
1. Climate Action Registry, Appendix C, June 2007
2. CEQA Handbook, Table A9-11-B, March 1993.

Emissions from Employee Vehicles and Delivery Trucks

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

Type	Year	Total daily round trips	Miles during trip	Emission factors (lbs/mile)									
				VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4
Worker trips	2010	1	20	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081

Type	Emissions (lbs/day)											
	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Worker trips	0.02	0.17	0.02	2.20E-04	1.74E-03	0	1.74E-03	1.10E-03	0	1.10E-03	21.91	1.63E-03

Attachment 5 – Monitoring Well Calculations

Monitoring Wells

Emissions of Fugitive Dust (PM10) from Excavation

Y = (N)(EF)

where,
Y = Daily emissions of PM10 fugitive dust, lbs/day.
N = Number of acres disturbed per day during soil excavation, 0.5 acres.
EF = Emission factor for PM10 fugitive dust during excavation, 10 lbs/acre-day (URBEMIS 2007, V9.2.4).

Y= (0.5 acres)(10 lbs/acre-day) = 5.0 lbs/day

Emissions of Fugitive Dust (PM2.5) from Excavation

Y = (N)(EF)

where,
Y = Daily emissions of PM2.5 fugitive dust, lbs/day.
N = Number of acres disturbed per day during soil excavation, 0.5 acres.
EF = Emission factor for PM2.5 fugitive dust during excavation, 2.1 lbs/acre-day (URBEMIS 2007, V9.2.4).

Y= (0.5 acres)(2.1 lbs/acre-day) = 1.05 lbs/day

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of pieces of equipment in a specified equipment category
H = Hours per day of equipment operation
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors

Equipment	Number	Operating hours/day	URBEMIS Designation	Emission factors, lb/hr								Emissions, lbs/day							
				VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Drill rig	1	24	Bore/Drill Rigs Composite	0.1052	0.5146	1.1331	0.0017	0.0498	0.0443	164.8533	0.0095	2.53	12.35	27.20	0.04	1.20	1.06	3,956.48	0.23
Front end loader	1	24	Rubber Tired Loaders Composite	0.1440	0.5078	1.1537	0.0012	0.0651	0.0579	108.6127	0.0130	3.46	12.19	27.69	0.03	1.56	1.39	2,606.71	0.31

Emissions from On Road Equipment

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

Type	Year	Total daily round trips	Miles during trip	Emission factors (lbs/mile)										Emissions (lbs/day)											
				VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Soil hauling	2010	0.5	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.03	0.12	0.38	4.13E-04	0.02	0.02	0.04	0.02	0.02	0.03	42.11	1.42E-03
Worker trips	2010	2	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.07	0.66	0.07	8.62E-04	0.01	0	0.01	4.38E-03	0	4.38E-03	87.65	0.01
Delivery of construction materials	2010	2	50	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.3	1.2	3.82	4.13E-03	0.18	0.17	0.35	0.16	0.16	0.32	421.12	0.01

Indirect Emissions of Carbon Dioxide from the Manufacturing of Steel

Y = QFk

where,
Y = Daily emissions of carbon dioxide, lbs/day.
Q = Quantity of steel used, 10 tons/day.
F = Emission factor for carbon dioxide, 1.75 lb/lbs (GHG Protocol, Appendix B).
k = Conversion factor, 2,000 lb/ton.

Y = (10 tons/day)(2000 lb/ton)(1.75 lb/lb)= 35,000 lbs/day

Indirect Emissions of Carbon Dioxide from the Manufacturing of Cement

Y = QKPEF

where,
Y = Daily emissions of criteria pollutant, lbs/day
Q = Quantity of concrete used, 10 yd3/day
K = Density of concrete, 4,075 lb/yd^3.
P = Proportion of cement in concrete, 0.125 lb/lb
EF = Emission factor for carbon dioxide, 0.97 lb/lbs (CO_2 Emission Profile of the U.S. Cement Industry, Environmental Protection Agency, 2001).

Y = (10 yd3/day)(0.125 lb/lb)(0.97 lb/lb) = 4,940.94 lbs/day

Monitoring Well Operational Emissions

Emissions from Employee Vehicles and Delivery Trucks

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)										Emissions (lbs/day)												
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Worker trips	2010	1	20	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.02	0.17	0.02	2.20E-04	1.74E-03	0	1.74E-03	1.10E-03	0	1.10E-03	21.91	1.63E-03

Attachment 6 – Regenerable and Non-regenerable Treatment Facilities Calculations

Regnerable and Non-regenerable Treatment Facilities

Mass grading activites

Emissions of Fugitive Dust (PM10)

Y = (N)(EF)

where,
Y = Daily emissions of PM10 fugitive dust, lbs/day
N = Number of acres disturbed per day during mass grading, 0.5 acres
EF = Emission factor for PM10 fugitive dust during mass grading, 10 lbs/acre-day (URBEMIS 2007, V9.2.4)

Y= (0.5 acres)(10 lbs/acre-day) = 5.0 lbs/day

Emissions of Fugitive Dust (PM2.5)

Y = (N)(EF)

where,
Y = Daily emissions of PM2.5 fugitive dust, lbs/day
N = Number of acres disturbed per day during mass grading, 0.5 acres
EF = Emission factor for PM2.5 fugitive dust during mass grading, 2.1 lbs/acre-day (URBEMIS 2007, V9.2.4

Y= (0.5 acres)(2.1 lbs/acre-day) = 1.05 lbs/day

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of pieces of equipment in a specified equipment category.
H = Hours per day of equipment operation.
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors).

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Operating hours/day	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Bull dozer	1	8	Rubber Tired Dozers Composite	0.3379	1.4127	2.9891	0.0025	0.1288	0.1146	239.1015	0.0305	2.70	11.30	23.91	0.02	1.03	0.92	1,912.81	0.24
Water truck	1	4	Off-Highway Trucks Composite	0.2480	0.7429	2.3885	0.0027	0.0875	0.0779	260.1043	0.0224	0.99	2.97	9.55	0.01	0.35	0.31	1,040.42	0.09
Dump/ haul trucks	1	4	Dumpers/Tenders Composite	0.0108	0.0336	0.0645	0.0001	0.0036	0.0032	7.6244	0.0010	0.04	0.13	0.26	3.87E-04	1.46E-02	1.30E-02	30.50	3.90E-03

Emissions from Employee Vehicles and Delivery Trucks

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Soil hauling	2010	25	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	1.52	5.98	19.11	0.02	0.92	0.84	1.76	0.80	0.78	1.58	2105.60	0.07
Worker trips	2010	5	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.18	1.65	0.18	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02
Delivery of construction materials	2010	6	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.36	1.43	4.59	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02

Foundation Activities

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of pieces of equipment in a specified equipment category
H = Hours per day of equipment operation
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Hours	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Cement and mortar mixers	4	8	Cement and Mortar Mixers	0.0079	0.0388	0.0505	0.0001	0.0029	0.0026	6.3202	0.0007	0.25	1.24	1.62	3.15E-03	0.09	0.08	202.25	0.02
Tractor	1	8	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.82	3.14	5.40	0.01	0.42	0.37	534.44	0.07

Emissions from On Road Equipment

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day.
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Delivery of construction materials	2010	6	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.36	1.43	4.59	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02
Worker trips	2010	5	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.18	1.65	0.18	2.15E-03	0.02	0	0.02	0.01	0.00	0.01	219.14	0.02

Indirect Emissions of Carbon Dioxide from the Manufacturing of Cement

Y = QKPEF

where,
Y = Daily emissions of criteria pollutant, lbs/day
Q = Quantity of concrete used, 250 yd3/day
K = Density of concrete, 4,075 lb/yd^3.
P = Proportion of cement in concrete, 0.125 lb/lb
EF = Emission factor for carbon dioxide, 0.97 lb/lbs (CO_2 Emission Profile of the U.S. Cement Industry, Environmental Protection Agency, 2001).

Y = (250 yd3/day)(4,075 lb/yd3)(0.125 lb/lb)(0.97 lb/lb) = 123,523.44 lbs/day

Trenching Activities

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of pieces of equipment in a specified equipment category
H = Hours per day of equipment operation
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Hours	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
General industrial equipment	1	8	Other General Industrial Equipment Compos	0.1847	0.5948	1.6649	0.0016	0.0740	0.0658	152.2399	0.0167	1.48	4.76	13.32	0.01	0.59	0.53	1,217.92	0.13
Tractor	1	8	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.82	3.14	5.40	0.01	0.42	0.37	534.44	0.07

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day
N = Number of trips per day.
D = Distance per trip, miles
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD)

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Worker trips	2010	5	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.18	1.65	0.18	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02

Construction Activities

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of pieces of equipment in a specified equipment category.
H = Hours per day of equipment operation.
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors).

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Operating hours/day	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Backhoe	1	4	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.41	1.57	2.70	3.10E-03	0.21	0.19	267.22	0.04
Crane	1	4	Cranes Composite	0.1594	0.5431	1.4515	0.0014	0.0642	0.0572	128.6554	0.0144	0.64	2.17	5.81	5.51E-03	0.26	0.23	514.62	0.06
Forklift	1	4	Rough Terrain Forklifts Composite	0.1272	0.4766	0.7988	0.0008	0.0678	0.0603	70.2808	0.0115	0.51	1.91	3.20	3.26E-03	0.27	0.24	281.12	0.05
Front loader	1	4	Rubber Tired Loaders Composite	0.1440	0.5078	1.1537	0.0012	0.0651	0.0579	108.6127	0.0130	0.58	2.03	4.61	4.80E-03	0.26	0.23	434.45	0.05

Emissions from On Road Equipment

Y = (N)(D)(EF)

where,

Y = Daily emissions of criteria pollutant, lbs/day.

N = Number of trips per day.

D = Distance per trip, miles.

EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Delivery of construction materials	2010	5	40	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.608314	2.390911	7.644203	0.008262	0.366124	0.337723	0.703847	0.320165	0.31087	0.631035	842.24	0.03
Worker trips	2010	6	20	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.109679	0.991531	0.110177	0.001293	0.010437	0	0.010437	0.006574	0	0.006574	131.48	0.01

Indirect Emissions of Carbon Dioxide from the Manufacturing of Steel

Y = QFk

where,

Y = Daily emissions of carbon dioxide, lbs/day.

Q = Quantity of steel used, 100 tons/day.

F = Emission factor for carbon dioxide, 1.75 lb/lbs (GHG Protocol, Appendix B).

k = Conversion factor, 2,000 lb/ton.

Y = (100 tons/day)(2000 lb/ton)(1.75 lb/lb)= 350,000 lbs/day

Regenerable and Non-regenerable Treatment Facilities Operational Emissions

Emissions from Electricity Consumption

Y = FQ

where,
Y = annual emissions of given listed substance, lbs/yr.
F = emissions factor for given listed substance, lbs/MWh.
Q = quantity of electricity consumed per year, MWh/yr.

Substance	F, lbs/MWh	Q, MWh/yr	Y , lbs/yr	Y , lbs/day	Notes
CO_2	804.54	9,636.00	7,752,547.44	21,239.86	see note 1
CH4	0.0067	9,636.00	64.56	0.18	see note 1
CO	2.00E-01	9,636.00	1,927.20	5.28	see note 2
VOC	1.00E-02	9,636.00	96.36	0.26	see note 2
NOx	1.15	9,636.00	11,081.40	30.36	see note 2
SOx	1.20E-01	9,636.00	1,156.32	3.17	see note 2
PM10	4.00E-02	9,636.00	385.44	1.06	see note 2

Notes:
1. Climate Action Registry, Appendix C, June 2007.
2. CEQA Handbook, Table A9-11-B, March 1993.

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)									
Year	Type	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4
2010	Worker trips	1	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081
2010	Delivery of sodium chloride	1	100	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142
2010	Delivery of resin	1	100	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142
2010	Resin transfer to landfill	1	600	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142

		Emissions (lbs/day)											
Year	Type	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
2010	Worker trips	0.04	0.33	0.04	4.30E-04	3.48E-03	0	3.48E-03	2.19E-03	0	2.19E-03	43.83	3.26E-03
2010	Delivery of sodium chloride	0.30	1.20	3.82	4.13E-03	0.18	0.17	0.35	0.16	0.16	0.32	421.12	0.01
2010	Delivery of resin	0.30	1.20	3.82	4.13E-03	0.18	0.17	0.35	0.16	0.16	0.32	421.12	0.01
2010	Resin transfer to landfill	1.82	7.17	22.93	2.48E-02	1.10	1.01	2.11	0.96	0.93	1.89	2526.72	0.09

Maximum Daily Unmitigated Treatment Facility Construction Emissions (2010) (lbs/day)

Activity	Source	VOC	NOx	CO	SO2	PM10 (Dust)	PM10 (Exh)	PM10 (Total)	PM2.5 (Dust)	PM2.5 (Exh)	PM2.5 (Total)	CO2	CH4	Comments
Mass grading	Fugitive dust	0	0	0	0	5.00	0	5.00	1.05	0	1.05	0	0	URBEMIS
Mass grading	Off-road equipment	3.74	33.72	14.41	0.03	0	1.39	1.39	0	1.24	1.24	2,983.73	0.34	CARB
Mass grading	On-road equipment	1.89	23.70	7.41	0.03	1.13	1.05	2.18	0.99	0.96	1.96	2,610.95	0.09	EMFAC 2007
Mass grading	Worker trips	0.18	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02	EMFAC 2007
Foundation	Off-road equipment	1.07	7.02	4.39	0.01	0	0.51	0.51	0	0.45	0.45	736.69	0.10	CARB
Foundation	Vendor trips	0.36	4.59	1.43	4.96E-03	0.22	0.20	0.42	0.19	0.19	0.38	505.34	0.02	EMFAC 2007
Foundation	Worker trips	0.18	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02	EMFAC 2007
Foundation	Cement manufacturing	0	0	0	0	0	0	0	0	0	0	123,523	0	EPA
Trenching	Off-road equipment	2.29	18.72	7.90	0.02	0	1.01	1.01	0	0.90	0.90	1,752.36	0.21	CARB
Trenching	Worker trips	0.18	0.18	1.65	2.15E-03	0.02	0	0.02	0.01	0	0.01	219.14	0.02	EMFAC 2007
Treatment facility construction	Off-road equipment	2.13	16.31	7.68	0.02	0	1.00	1.00	0	0.89	0.89	1,497.42	0.19	CARB
Treatment facility construction	Vendor trips	0.61	7.64	2.39	0.01	0.37	0.34	0.70	0.32	0.31	0.63	842.24	0.03	EMFAC 2007
Treatment facility construction	Worker trips	0.11	0.11	0.99	1.29E-03	0.01	0	0.01	0.01	0	0.01	131.48	0.01	EMFAC 2007
Treatment facility construction	Steel manufacturing	0	0	0	0	0	0	0	0	0	0	350,000	0	GHG Protocol

Attachment 7 – Desalter Facilities Calculations

Desalter Facilities

Emissions of Fugitive Dust (PM10) from Excavation

Y = (N)(EF)

where,
Y = Daily emissions of PM10 fugitive dust, lbs/day.
N = Number of acres disturbed per day during soil excavation, 0.52 acres.
EF = Emission factor for PM10 fugitive dust during excavation, 10 lbs/acre-day (URBEMIS 2007, V9.2.4).

Y= (0.52 acres)(10 lbs/acre-day) = 5.23 lbs/day

Emissions of Fugitive Dust (PM2.5) from Excavation

Y = (N)(EF)

where,
Y = Daily emissions of PM2.5 fugitive dust, lbs/day.
N = Number of acres disturbed per day during soil excavation, 0.52 acres.
EF = Emission factor for PM2.5 fugitive dust during excavation, 2.1 lbs/acre-day (URBEMIS 2007, V9.2.4).

Y= (0.52 acres)(2.1 lbs/acre-day) = 1.10 lbs/day

Emissions from Off Road Equipment

Y = (N)(H)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of pieces of equipment in a specified equipment category.
H = Hours per day of equipment operation.
EF = Emission factor for criteria pollutant, lb/hr (CEQA Air Quality Handbook (SCAQMD 1993) Table A9-8 Off-road Mobile Sources Emission Factors).

				Emission factors, lb/hr								Emissions, lbs/day							
Equipment	Number	Operating hours/day	URBEMIS Designation	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4	VOC	CO	NOx	SOx	PM10	PM2.5	CO2	CH4
Backhoe	1	8	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.82	3.14	5.40	0.01	0.42	0.37	534.44	0.07
Crane	1	6	Cranes Composite	0.1594	0.5431	1.4515	0.0014	0.0642	0.0572	128.6554	0.0144	0.96	3.26	8.71	0.01	0.39	0.34	771.93	0.09
Forklift	2	6	Rough Terrain Forklifts Composite	0.1272	0.4766	0.7988	0.0008	0.0678	0.0603	70.2808	0.0115	1.53	5.72	9.59	0.01	0.81	0.72	843.37	0.14
Generator	1	8	Generator Sets Composite	0.0961	0.3293	0.6440	0.0007	0.0396	0.0353	60.9927	0.0087	0.77	2.63	5.15	0.01	0.32	0.28	487.94	0.07
Cement and mortar mixers	4	8	Cement and Mortar Mixers	0.0079	0.0388	0.0505	0.0001	0.0029	0.0026	6.3202	0.0007	0.25	1.24	1.62	0.00	0.09	0.08	202.25	0.02
Tractor	1	8	Tractors/Loaders/Backhoes Composite	0.1021	0.3930	0.6747	0.0008	0.0521	0.0463	66.8051	0.0092	0.82	3.14	5.40	0.01	0.42	0.37	534.44	0.07
General industrial equipment	1	8	Other General Industrial Equipment Composite	0.1847	0.5948	1.6649	0.0016	0.0740	0.0658	152.2399	0.0167	1.48	4.76	13.32	0.01	0.59	0.53	1,217.92	0.13

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

				Emission factors (lbs/mile)										Emissions (lbs/day)											
Type	Year	Total daily round trips	Miles during trip	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Delivery of construction materials	2010	10	40	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	1.22	4.78	15.29	0.02	0.73	0.68	1.41	0.64	0.62	1.26	1,684.48	0.06
Worker trips	2010	20	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.73	6.61	0.73	0.01	0.07	0	0.07	0.04	0	0.04	876.55	0.07
Soil hauling	2010	5	20	0.003042	0.011955	0.038221	0.000041	0.001831	0.001689	0.001601	0.001554	4.211206	0.000142	0.30	1.20	3.82	0.00	0.18	0.17	0.35	0.16	0.16	0.32	421.12	0.01

Indirect Emissions of Carbon Dioxide from the Manufacturing of Steel

Y = QFk

where,
Y = Daily emissions of carbon dioxide, lbs/day.
Q = Quantity of steel used, 10 tons/day.
F = Emission factor for carbon dioxide, 1.75 lb/lbs (GHG Protocol, Appendix B).
k = Conversion factor, 2,000 lb/ton.

Y = (10 tons/day)(2000 lb/ton)(1.75 lb/lb)= 35,000 lbs/day

Indirect Emissions of Carbon Dioxide from the Manufacturing of Cement

Y = QKPEF

where,

Y = Daily emissions of criteria pollutant, lbs/day.

Q = Quantity of concrete used, 50 yd^3/day.

K = Density of concrete, 4,075 lb/yd^3.

P = Proportion of cement in concrete, 0.125 lb/lb.

EF = Emission factor for carbon dioxide, 0.97 lb/lbs (CC_2 Emission Profile of the U.S. Cement Industry, Environmental Protection Agency, 2001

Y = (50 yd3)(4,075 lb/yd3))(0.125 lb/lb)(0.97 lb/lb) = 24,704.69 lbs/day

Desalter Facilities Operational Emissions

Emissions from Electricity Consumption

Y = FQ

where,
Y = annual emissions of given listed substance, lbs/yr.
F = emissions factor for given listed substance, lbs/MWh.
Q = quantity of electricity consumed per year, MWh/yr.

Substance	F, lbs/MWh	Q, MWh/yr	Y , lbs/yr	Y , lbs/day	Notes
CO_2	804.54	2,190.00	1,761,942.60	4,827.24	see note 1
CH4	0.0067	2,190.00	14.67	0.04	see note 1
CO	2.00E-01	2,190.00	438.00	1.20	see note 2
VOC	1.00E-02	2,190.00	21.90	0.06	see note 2
NOx	1.15	2,190.00	2,518.50	6.90	see note 2
SOx	1.20E-01	2,190.00	262.80	0.72	see note 2
PM10	4.00E-02	2,190.00	87.60	0.24	see note 2

Notes:
1. Climate Action Registry, Appendix C, June 2007.
2. CEQA Handbook, Table A9-11-B, March 1993.

Emissions from On Road Vehicles

Y = (N)(D)(EF)

where,
Y = Daily emissions of criteria pollutant, lbs/day.
N = Number of trips per day.
D = Distance per trip, miles.
EF = Emission factor for criteria pollutant, lb/mile (EMFAC 2007 (v2.3) Emission Factors for On-Road Vehicles, SCAQMD).

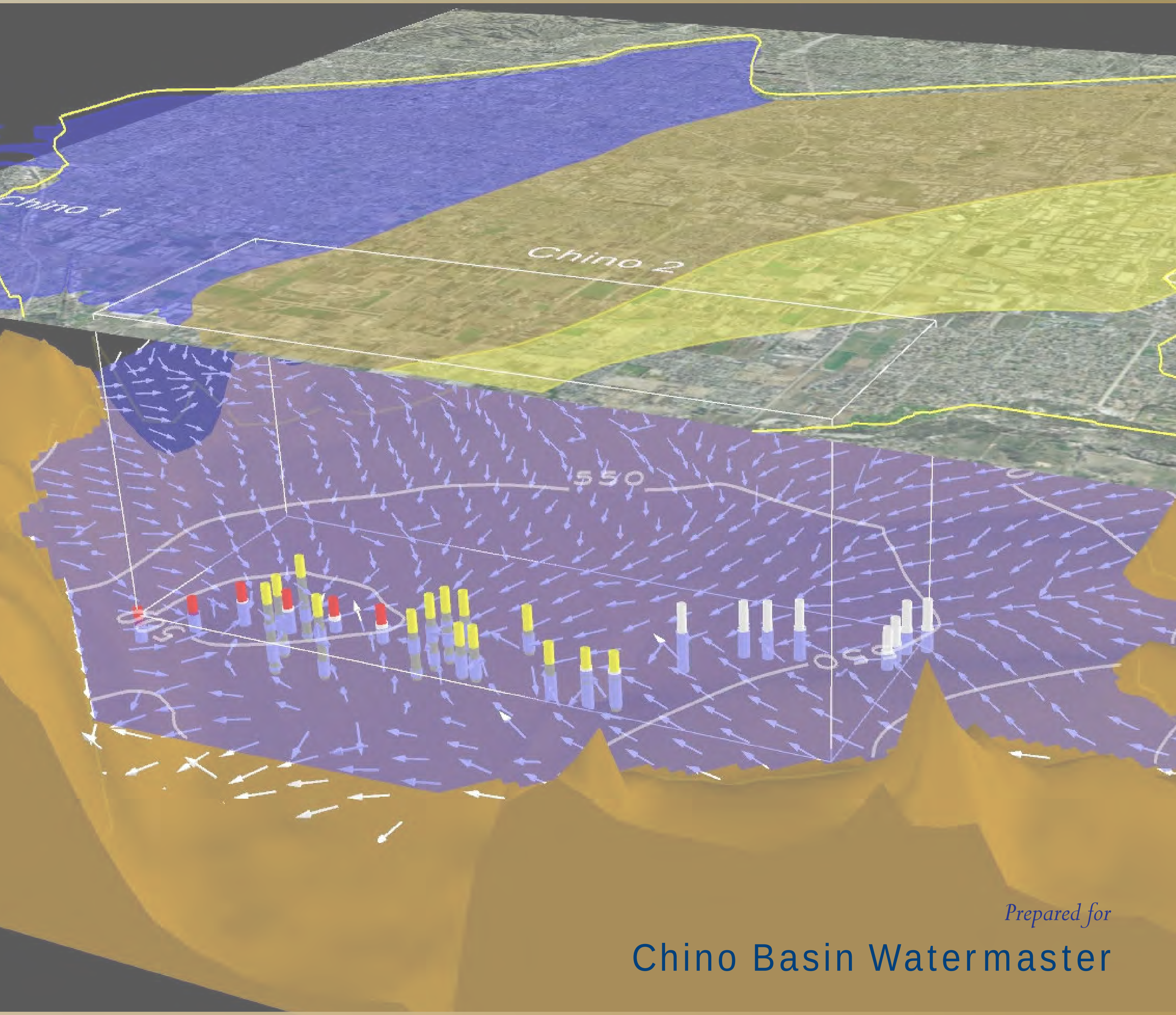
Type	Year	Total daily round trips	Miles during trip	Emission factors (lbs/mile)										Emissions (lbs/day)												
				VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	PM2.5, tire and brake	PM2.5, exhaust	CO2	CH4	VOC	CO	NOx	SOx	PM10, tire and brake	PM10, exhaust	Total PM10	PM2.5, tire and brake	PM2.5, exhaust	Total PM2.5	CO2	CH4
Worker trips	2010	1	40	0.000914	0.008263	0.000918	0.000011	0.000087		0.000055		1.095682	0.000081	0.04	0.33	0.04	4.30E-04	3.48E-03	0	3.48E-03	2.19E-03	0	2.19E-03	43.83	3.26E-03

APPENDIX 2

WEI ANALYSIS
(2009 Production Optimization and
Evaluation of the Peace II)

2009 Production Optimization and Evaluation of the Peace II Project Description

Final Report



Prepared for

Chino Basin Watermaster

November 25, 2009

WILDERMUTH™ ENVIRONMENTAL INC.

2009 PRODUCTION OPTIMIZATION AND EVALUATION OF THE PEACE II PROJECT DESCRIPTION

FINAL REPORT

PREPARED FOR:

PREPARED BY:

NOVEMBER 25, 2009

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Acronyms, Abbreviations, and Initialisms

µg/L	micrograms per liter
acre-ft/yr	acre-feet per year
ASR	aquifer storage and recovery
CBWCD	Chino Basin Water Conservation District
CCWF	Chino Creek Well Field
Chino	City of Chino
CURO	cumulative unmet replenishment obligation
CVWD	Cucamonga Valley Water District
DYYP	Dry-Year Yield Program
EIR	Environmental Impact Report
FWC	Fontana Water Company
GE	General Electric
IEUA	Inland Empire Utilities Agency
JCSD	Jurupa Community Services District
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
mgd	million gallons per day
MSL	Milliken Sanitary Landfill
MVWD	Monte Vista Water District
MWDSC	Metropolitan Water District of Southern California
MZ	Management Zone
NPDES	National Pollutant Discharge Elimination System
OBMP	Optimum Basin Management Program
Ontario	City of Ontario
Pomona	City of Pomona
VOC	Volatile Organic Compound
RWQCB	Regional Water Quality Control Board
SWP	State Water Project
TOC	total organic carbon
Upland	City of Upland
Watermaster	Chino Basin Watermaster
WEI	Wildermuth Environmental, Inc.
WMWD	Western Municipal Water District

In December 2007, the Honorable Judge J. Michael Gunn approved the suite of documents known as the Peace II Agreement and directed the Watermaster to amend the Judgment (Paragraph 8, Exhibit G and Exhibit I) and implement the Peace II Agreement. The Inland Empire Utilities Agency (IEUA) is acting as lead agency in the preparation of a Program Environmental Impact Report (PEIR) for the Project Description contained in the Peace II Agreement. This report contains an analysis of the hydrologic changes that are expected to occur through the implementation of the Peace II Project Description.

In 2006 and 2007, Watermaster conducted extensive hydrologic and modeling investigations in support of the development of the Peace II Agreement and the facilities and basin operating strategies that are contained in the Peace II Agreement. And, Watermaster developed a sophisticated suite of computer simulation tools that are collectively referred to as the 2007 Watermaster Model. Based on these investigations, Wildermuth Environmental Inc. (WEI), Watermaster's consultant, concluded that:

- the safe yield of the Basin would likely decline from about 140,000 acre-ft/yr in 2006 to about 130,000 acre-ft/yr in 2030;
- projected future production may not be sustainable for some Appropriators due to excessive drawdown; and
- given Watermaster's traditional approach to replenishment operations, future production may have to be limited by Watermaster's existing replenishment capacity (WEI, 2007).

In 2008, Watermaster conducted a material physical injury analysis of the proposed Dry-Year Yield Expansion—using updated groundwater production projections provided by the IEUA (IEUA, 2008a)—and reached identical conclusions regarding production sustainability and replenishment limitations (WEI, 2008a). However, in this analysis, WEI recommended additional work to optimize the location and magnitude of groundwater production and replenishment in order to maximize groundwater production capabilities.

The sustainability issue identified in these reports occurs because the municipal groundwater producers had not coordinated their future groundwater production plans that include new wells and increased production. In early 2009, the preparation of an environmental impact report PEIR for the Peace II Agreement commenced. Prior to evaluating the hydrologic changes that are expected to occur through the implementation of the Peace II Project Description, Watermaster conducted an analysis of existing and future projected groundwater production patterns and developed new groundwater production patterns and supplemental water recharge plans that ensure sustainability. These new groundwater production and replenishment patterns are based on optimization studies that were constrained to meet projected production requirements, to use existing and master-planned well locations, to use existing spreading basins and planned injection wells, and to balance recharge and discharge in every area and subarea (a Peace Agreement requirement).

The following criteria were used to evaluate the hydrologic changes that are expected to occur through the implementation of the Peace II Project Description.:

- Changes in the overall hydrology of the basin;
- Changes in groundwater level across the basin, at individual wells and in the riparian areas in the lower part of the basin;
- Subsidence potential in the managed area of Management Zone 1;
- Changes in the movement of contaminant plumes in the basin; and
- Ability to achieve hydraulic control.

This report is organized into six sections, including this introduction. The remaining sections are listed below:

Section 2 – Planning Alternatives: This section describes the features of the Baseline and Peace II Alternatives.

Section 3 – Environmental Impact Evaluation Criteria: This section describes the various hydrologic impact criteria that were used to evaluate the hydrologic response of the basin to both the Baseline and Peace II Alternatives.

Section 4 – Evaluation of the Baseline Alternative: This section presents an assessment of the hydrologic conditions in the basin in the absence of the Peace II Project Description and describes Watermaster's investigation to optimize future groundwater production and recharge patterns.

Section 5 – Evaluation of the Peace II Alternative: This section presents an assessment of the hydrologic conditions in the basin with the Peace II Project Description and compares the Peace II Alternative to the Baseline Alternative.

2.1 Background

The Chino Basin is bounded by the Cucamonga Basin and the San Gabriel Mountains to the north; the Rialto-Colton Basin to the northeast; the Jurupa, Pedley, and La Sierra Hills to the southeast; the Temescal Basin to the south; the Chino and Puente Hills to the southwest; and the San Jose Hills and the Pomona and Claremont Basins to the northwest. The basin is within the Counties of San Bernardino and Riverside and includes the Cities of Chino (Chino), Ontario (Ontario), Chino Hills, and Norco, as well as several other communities.

Figure 2-1a shows the legal boundary of the Chino Basin and the boundaries of the Optimum Basin Management Program (OBMP) management zones (MZ). The OBMP MZ boundaries are the management units described in the OBMP and are used, in part, to manage the balance of recharge and discharge in the basin. Figure 2-1b shows the legal boundary of the Chino Basin and the boundaries of the four Regional Water Quality Control Board (RWQCB) MZs. The RWQCB MZs were developed during the TIN/TDS Study (WEI, 2000).

Detailed descriptions of the Chino Groundwater Basin are provided in two recent reports that were prepared by the Watermaster:

- *Final Report, 2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description* (WEI, 2007)
- *2008 Chino Basin Optimum Basin Management Program, State of the Basin Report* (WEI, 2009)

The detailed descriptions of the Chino Basin within these reports are incorporated herein by reference.

The Peace II Agreement is provided on the Watermaster website. Two main hydrologic features of the Peace II Project Description, which is contained in the Peace II Agreement, were investigated and are reported on herein: 1) the expansion of the desalter program such that desalter groundwater production reaches about 40,000 acre-ft/yr and occurs in amounts and at locations that contribute to the achievement of hydraulic control and 2) a strategic reduction in groundwater storage (re-operation) that, along with the expanded desalter program, will achieve hydraulic control. The expanded desalter program and re-operation are discussed below and in the description of the Peace II Alternative in greater detail.

2.2 Peace II Project Description

The fundamental bases for the Peace II Project Description, which include the requirements of the 2004 Amendment to the Water Quality Control Plan for the Santa Ana Watershed and the Peace II Agreement, are presented below.

2.2.1 Requirements of the 2004 Amendment to the Water Quality Control Plan for the Santa Ana Watershed

Water quality objectives are established by the RWQCB to preserve the beneficial uses of the

Chino Basin and the Orange County Basin, located downstream of the Chino Basin. Prior to the 2004 Amendment, the Regional Water Quality Control Plan (Basin Plan) contained restrictions on the use of recycled water within the Chino Basin for irrigation and groundwater recharge. The pre-2004 Basin Plan contained "anti-degradation" TDS objectives that ranged from 220 to 330 mg/L over most of the Chino Basin. Ambient TDS concentrations slightly exceeded these objectives. There was no assimilative capacity for TDS; thus, the use of the IEUA's recycled water for irrigation and groundwater recharge would have required mitigation even though the impact of this reuse would not have materially impacted future TDS concentrations or impaired the beneficial uses of Chino Basin groundwater.

In 1995, the RWQCB initiated a collaborative study with 22 water supply and wastewater agencies, including Watermaster and the IEUA, to devise a new TDS and nitrogen (total inorganic nitrogen or TIN) control strategy for the Santa Ana Watershed. This study culminated in the RWQCB's adoption of the 2004 Basin Plan Amendment in January 2004 (RWQCB, 2004). The 2004 Basin Plan Amendment included two sets of TDS objectives: antidegradation objectives that ranged between 280, 250 and 260 mg/L for Management Zones 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. The relationship between the management zones that was developed for the OBMP and the "maximum benefit"-based management zones is shown in Figure 2-1b. 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 the IEUA's National Pollutant Discharge Elimination System (NPDES) permits for its wastewater treatment facilities.

For the IEUA and Watermaster to gain access to the assimilative capacity afforded by the "maximum benefit"-based objectives, they have to demonstrate that the maximum beneficial use of the waters of the State is being achieved. The 2004 Basin Plan Amendment contains a series of commitments that must be met in order to demonstrate that the maximum benefit is being achieved, including:

1. The implementation of a surface water monitoring program
2. The implementation of groundwater monitoring programs
3. The expansion of Desalter I to 10 million gallons per day (mgd) and the construction of a 10-mgd Desalter II
4. The commitment to future desalters pursuant to the OBMP and the Peace Agreement
5. The completion of the recharge facilities included in the Chino Basin Facilities Improvement Program
6. The management of recycled water quality
7. The management of the volume-weighted TDS and nitrogen in artificial recharge to less than or equal to the maximum benefit objectives
8. The achievement and maintenance of hydraulic control of subsurface outflows from the Chino Basin to protect the Santa Ana River water quality
9. The determination of the ambient TDS and nitrogen concentrations in the Chino Basin every three years

The IEUA and Watermaster have previously demonstrated compliance with all of these requirements with the sole exception of hydraulic control. Hydraulic control is defined as the reduction of groundwater discharge from the Chino North Management Zone to the Santa Ana River to de minimus quantities. Hydraulic control ensures that water management activities in the Chino North Management Zone do not result in adverse material impacts on the beneficial uses of the Santa Ana River downstream of Prado Dam. Achieving hydraulic control also maximizes the safe yield of the Chino Basin as required by paragraphs 30 and 41 of the 1978 Chino Basin Judgment (Judgment) (Case No. RCV 51010, Chino Basin Municipal Water District vs. City of Chino et al.). Two reports by Wildermuth Environmental, Inc. (WEI), prepared in 2006 at the direction of Watermaster, demonstrate that hydraulic control has not yet been achieved in the area between the Chino Hills and Chino Desalter I, well number 5 (WEI, 2006a and b).

Without hydraulic control, the IEUA and Watermaster will have to cease using recycled water in the Chino Basin and mitigate the effects of using recycled water back to the adoption of the 2004 Basin Plan Amendment (December 2004). The demand for recycled water in the Chino Basin is projected to grow from about 12,500 acre-ft/yr in 2005 to 58,000 acre-ft/yr in 2010, 68,000 acre-ft/yr in 2015, 79,000 acre-ft/yr in 2020, and 89,000 acre-ft/yr in 2025. Recycled water reduces the demand of State Water Project (SWP) water by an equal amount, thereby reducing demand on the Sacramento Delta and reducing energy consumption. Recycled water is a critical element of the OBMP and water supply reliability in the Chino Basin area.

In addition, failure to achieve hydraulic control will lead to restrictions from the RWQCB on the use of imported SWP water for replenishment when the TDS concentration exceeds the antidegradation objectives. The RWQCB has prepared a draft order that would treat the recharge of SWP water as a waste discharge. There would be no assimilative capacity if the Chino Basin antidegradation objectives were enforced. Figure 2-2 shows the percent of time that the TDS concentration at Devil Canyon is less than or equal to a specific value, based on observed TDS concentrations at Devil Canyon Afterbay. This restriction will occur about 35, 52, and 50 percent of the time for Management Zones 1, 2, and 3, respectively. This will affect other basins in the Santa Ana Watershed, and the RWQCB is encouraging all basin managers to propose "maximum benefit"-based objectives similar to those in the Chino Basin. With the "maximum benefit"-based TDS objective, there is assimilative capacity in the Chino Basin, and there would be no such restriction on the recharge of imported water.

The RWQCB is using its discretion in granting "maximum benefit" objectives even though hydraulic control has not been demonstrated. The RWQCB will continue to use "maximum benefit"-based objectives in the Chino Basin as long as the IEUA and Watermaster continue to develop and implement, in a timely manner, the OBMP desalter program as described in the project description below.

2.2.2 The Peace II Agreement

The Peace II Agreement includes several items that, collectively, will further implement the existing OBMP Implementation Plan. The two items of interest in the Peace II project description are the expansion of the desalting program and "Basin Re-Operation," which are physically described in Section II, Refined Basin Management Strategy, Subsections A and B, and Section IV, Future Desalters.

New groundwater production for the expanded desalter program will occur in the southern end of the basin. Some of this new desalter supply will come from a new well field that will be constructed among existing Desalter I wells 1 through 4 and west of these wells. The construction of a new desalter well field will be sized and located to achieve hydraulic control. The desalter will produce at least 9 mgd of product water. These wells will be constructed to pump groundwater from the shallow part of the aquifer system, which is defined herein as the saturated zone that occurs within about 300 feet of the ground surface. The total groundwater production for all of the desalters authorized in the agreement will be about 40,000 acre-ft/yr.

"Re-operation" means the increase in controlled overdraft, as defined in the Judgment, from 200,000 acre-ft over the period of 1978 through 2017 to 600,000 acre-ft through 2030 with the 400,000 acre-ft increase allocated specifically to the meet the replenishment obligation of the desalters. Re-operation is required to achieve hydraulic control.

2.2.3 The Project Description

The proposed project has two main features: (i) the expansion of the desalter program such that the groundwater production for the desalters will reach about 40,000 acre-ft and that the production will occur in amounts and at locations that contribute to the achievement of hydraulic control and (ii) the strategic reduction in groundwater storage (re-operation) that, along with the expanded desalter program, will significantly achieve hydraulic control.

2.2.3.1 The Expanded Desalting Program

A new desalter well field, referred to as the Chino Creek Well Field (CCWF), will be constructed. The capacity of this well field could range from about 5,000 acre-ft/yr to 7,700 acre-ft/yr. The capacity of the CCWF will be determined during the design of the well field. Groundwater produced at the CCWF will be conveyed to Desalter I. The approximate location of the CCWF is shown in Figure 2-3. The capacity of Desalter I will not be increased; although, it is likely that the treatment systems at Desalter I will be modified to accommodate the chemistry of the raw water pumped from the CCWF. The product water capacity of Desalter I is about 14,200 acre-ft/yr, which corresponds to a raw water production requirement of about 16,100 acre-ft/yr. The volume of groundwater pumped at existing Desalter I wells 13, 14, and 15, and conveyed to Desalter I will be reduced to accommodate new production at the CCWF. The total annual production by all desalters will be about 40,000 acre-ft/yr.

The treatment capacity of Desalter II will be increased from 10,400 acre-ft/yr to about 21,000 acre-ft/yr, which corresponds to expanding the raw water production requirement from 11,800 acre-ft/yr to 23,900 acre-ft/yr. The increase in groundwater production for Desalter II will come, in part, from the greater utilization of existing Desalter II wells and the addition of new wells to the Desalter II well field from the construction of new wells and/or connecting Desalter I wells 13, 14, and 15.

The new product water developed at Desalter II will be conveyed to the Jurupa Community

Services District (JCSD), Ontario, and/or Western Municipal Water District (WMWD) through existing and new pipelines. The facilities required to convey this water include pipelines, pump stations, and reservoirs. The precise locations of these facilities are unknown at this time.

The current working description of these facilities is contained *Chino Desalter Phase 3 Alternatives Evaluation* (Carollo, 2007), a report prepared for Ontario and the WMWD. Currently (September 2007), Ontario and the WMWD are working with the JCSD and others to refine the alternatives in the Carollo report. The assumed startup for the expanded desalters is 2013.

2.2.3.2 Re-Operation

Through re-operation and pursuant to a Judgment Amendment, Watermaster will engage in controlled overdraft and use up to a maximum of 400,000 acre-ft to offset desalter replenishment through 2030. After the 400,000 acre-ft is exhausted and the period of re-operation is complete, Watermaster will recalculate the safe yield of the basin. Re-operation will have no impact on operating safe yield or on the parties' respective rights thereto.

The new yield, as defined by the Peace Agreement, attributed to the authorized desalters and the reduction in storage from re-operation will be assigned to the authorized desalters. The resulting replenishment obligation assigned to the authorized desalters will then be handled as any other replenishment obligation pursuant to the Judgment. The new yield is expected to come from a reduction in groundwater discharge from the Chino Basin to the Santa Ana River within the reservoir created by Prado Dam and from new induced recharge of the Santa Ana River upstream of Prado Dam.

2.2.4 Other Important Facility and Operational Plans That Will Occur Concurrently with the Proposed Project

2.2.4.1 Expansion of Artificial Recharge Capacity

Watermaster and the IEUA will need to expand artificial recharge capacity in the Chino Basin to meet future replenishment obligations. This will occur independently from the proposed project. Current supplemental water recharge capacity is about 84,000 acre-ft/yr. The recharge capacity required to meet future replenishment obligations is about 150,000 acre-ft—a capacity expansion of about 66,000 acre-ft/yr. This expansion will occur through the construction of new spreading basins, improvements to existing spreading basins, and aquifer storage and recovery wells. The expansion of the artificial recharge capacity in the Chino Basin is currently underway and a revised recharge master plan will be submitted by the Watermaster to the Court before July 1, 2010.

2.2.4.2 Expansion of Storage and Recovery Programs

Currently, there is only one groundwater storage and recovery program approved in the Chino Basin: the 100,000 acre-ft Dry-Year Yield Program (DYYP) with the Metropolitan Water District of Southern California (MWDSC). The MWDSC, the IEUA, and Watermaster are considering expanding this program to 150,000 acre-ft over the next few years. In fact, since the Peace II Agreement was approved by the Court in December 2007, the IEUA, acting as a lead agency, has completed planning investigations and environmental documentation to expand the DYYP from 100,000 acre-ft to 150,000 acre-ft (IEUA, 2008).

2.3 Baseline Alternative

The Baseline Alternative is the groundwater management strategy incorporated in the 2000 Peace Agreement and would be implemented in the absence of the Peace II Alternative. The Baseline Alternative includes the physical solution contained in the Judgment, the expansion of the desalter program as described in the Peace II Alternative project description, and the MZ1 long-term subsidence management program, and the requirement that Watermaster balance recharge and discharge in every area and subarea when determining the location and magnitude of the recharge of supplemental water for replenishment purposes.

During the summer of 2008, the IEUA developed a groundwater production projection for the Chino Basin (IEUA, 2008a) to evaluate the proposed expansion of the MWDSC DYYP. The IEUA groundwater production projection was used in the Baseline and Peace II Alternatives.

Since the 2000 Peace Agreement was approved, the availability of replenishment water from the MWDSC has been substantially reduced due to environmental and judicial constraints and drought. While no official forecast is available from the MWDSC to characterize the availability of replenishment water, MWDSC staff has presented information to its member agencies as part of its Integrated Regional Plan update (B. Goshi, personal communication, August 29, 2008; October 30, 2008), showing the impacts of different water supply and demand scenarios on the availability of surplus water for groundwater replenishment and local groundwater storage programs. MWDSC staff presented the same information at the Watermaster Strategic Planning Meeting (G. Chan, personal communication, September 29, 2008). In these presentations, the MWDSC stated that replenishment water would be available approximately three out of ten years. In contrast, prior to the 2003 Peace Agreement, the MWDSC forecasted that it would be able to provide replenishment water seven out of ten years. Furthermore, the engineering work for the OBMP and the 2000 Peace Agreement was based on the MWDSC's ability to deliver replenishment water seven out of ten years. For the current projected groundwater production plan to be sustainable, Watermaster and the parties will to need to acquire replenishment water above that which can be supplied directly from the MWDSC.

The assumed expansion of the desalting program from about 28,000 acre-ft/yr of desalter groundwater production to about 40,000 acre-ft/yr is the same for the Baseline Alternative and Peace II Alternative, as the 2000 Peace Agreement anticipated the same desalter well field expansion.

2.4 Peace II Alternative

The Peace II Alternative is identical to the Baseline Alternative except for replenishment operations related to re-operation. Table 2-1 provides the re-operation schedule approved by the Court in 2008. Re-operation water is divided into two blocks: the first block of about

225,000 acre-ft is dedicated for the replenishment of groundwater produced by the existing desalters and appears to be used up in 2013 and the second block of about 175,000 acre-ft is used at a rate of 10,000 acre-ft/yr to meet the replenishment obligation of the desalter expansion. New yield created by re-operation is credited to the desalters and reduces the desalter replenishment obligation.

Table 2-1

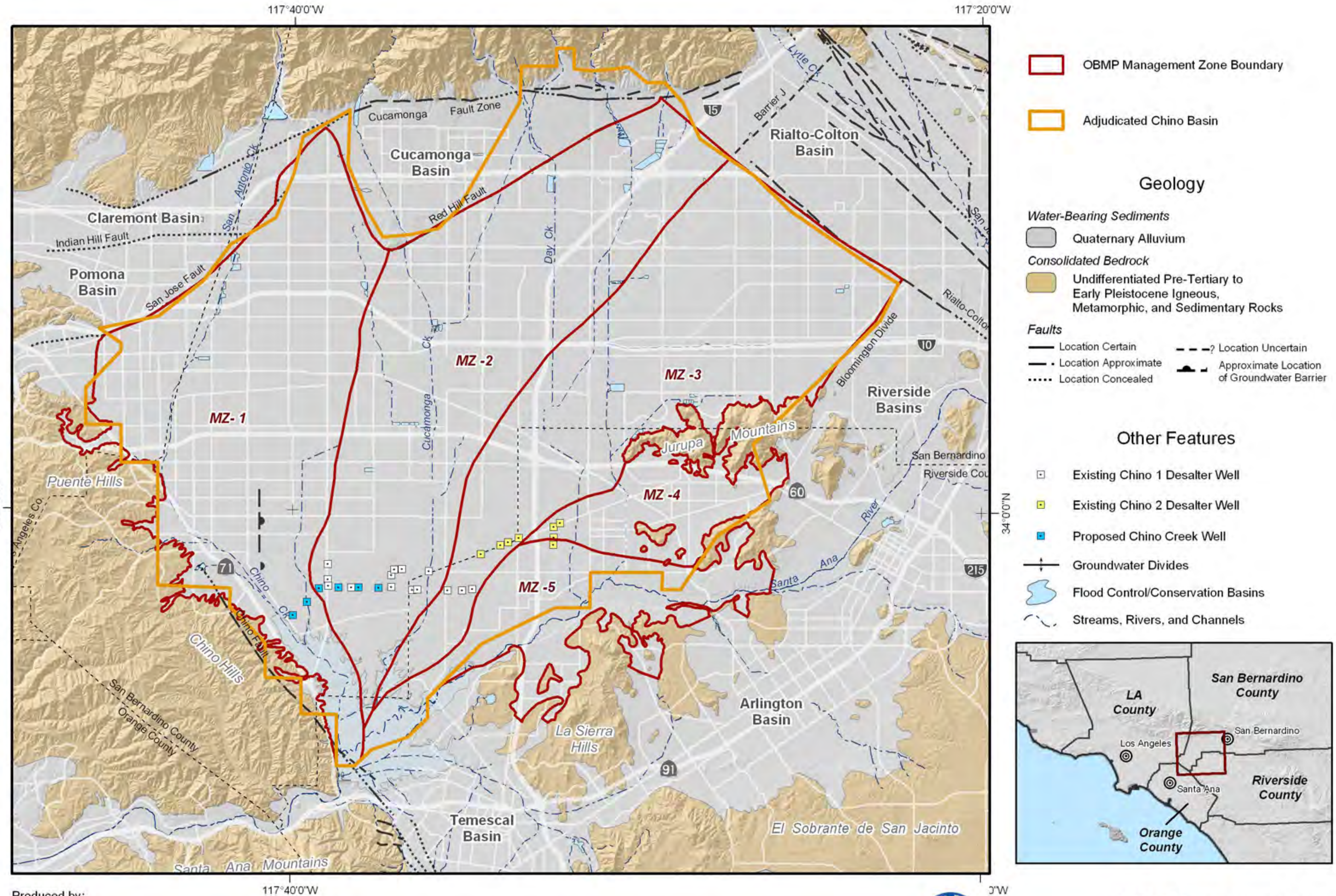
Initial Corrected Schedule Updated to Show Desalter Replenishment Accounting and Santa Ana River Inflow From 2000/01 through 2029/30, Shortfall Deducted from the Non-WMWD Re-operation Account[1]

(acre-ft)

Fiscal Year	Desalter Produciton	New Yield[2]	Desalter Replenishment				Residual Replenishment Obligation
			Desalter (aka Kaiser) Account	Re-Operation			
				Replenishment Allocation for Peace II Desalter Expansion	Replenishment Allocation to Pre-Peace II Desalters CDA	Balance	
2001	7,989	0	3,995	0	0	0	3,995
2002	9,458	0	4,729	0	0	0	4,729
2003	10,439	0	5,220	0	0	0	5,220
2004	10,605	0	5,303	0	0	0	5,303
2005	9,854	0	4,927	0	0	0	4,927
2006	16,476	0	11,579	0	0	400,000	4,897
2007	26,356	0	608	0	25,748	374,252	0
2008	26,356	0	0	0	26,356	347,896	0
2009	26,356	0	0	0	55,426	292,470	-29,070
2010	26,356	0	0	0	26,356	266,114	0
2011	28,965	0	0	0	28,965	237,149	0
2012	31,574	75	0	0	31,500	205,649	0
2013	34,182	442	0	5,000	28,740	171,909	0
2014	36,791	962	0	10,000	1,909	160,000	23,920
2015	39,320	1,629	0	10,000	0	150,000	27,691
2016	39,320	2,255	0	10,000	0	140,000	27,065
2017	39,320	2,771	0	10,000	0	130,000	26,549
2018	39,320	3,275	0	10,000	0	120,000	26,045
2019	39,320	3,767	0	10,000	0	110,000	25,553
2020	39,320	4,283	0	10,000	0	100,000	25,037
2021	39,320	4,764	0	10,000	0	90,000	24,556
2022	39,320	5,198	0	10,000	0	80,000	24,122
2023	39,320	5,570	0	10,000	0	70,000	23,750
2024	39,320	5,854	0	10,000	0	60,000	23,466
2025	39,320	5,959	0	10,000	0	50,000	23,361
2026	39,320	5,834	0	10,000	0	40,000	23,486
2027	39,320	5,698	0	10,000	0	30,000	23,622
2028	39,320	5,546	0	10,000	0	20,000	23,774
2029	39,320	5,479	0	10,000	0	10,000	23,841
2030	39,320	5,594	0	10,000	0	0	23,726
Totals	930,877	74,953	36,360	175,000	225,000		419,565

1. Source: WEI, Response to Condition Subsequent Number 7, November 2008

2. Note that the new yield projection shown above relates only to the storage reduction caused by the use of the re-operation water listed in this schedule. There was over 60,000 acre-ft of additional storage reduction that occurred during 2000/01 and 2005/06 that is not reflected in the new yield schedule. In the near future, Watermaster will determine the additional new yield created by the pre-Peace II reductions in storage and will include a new schedule for yield.



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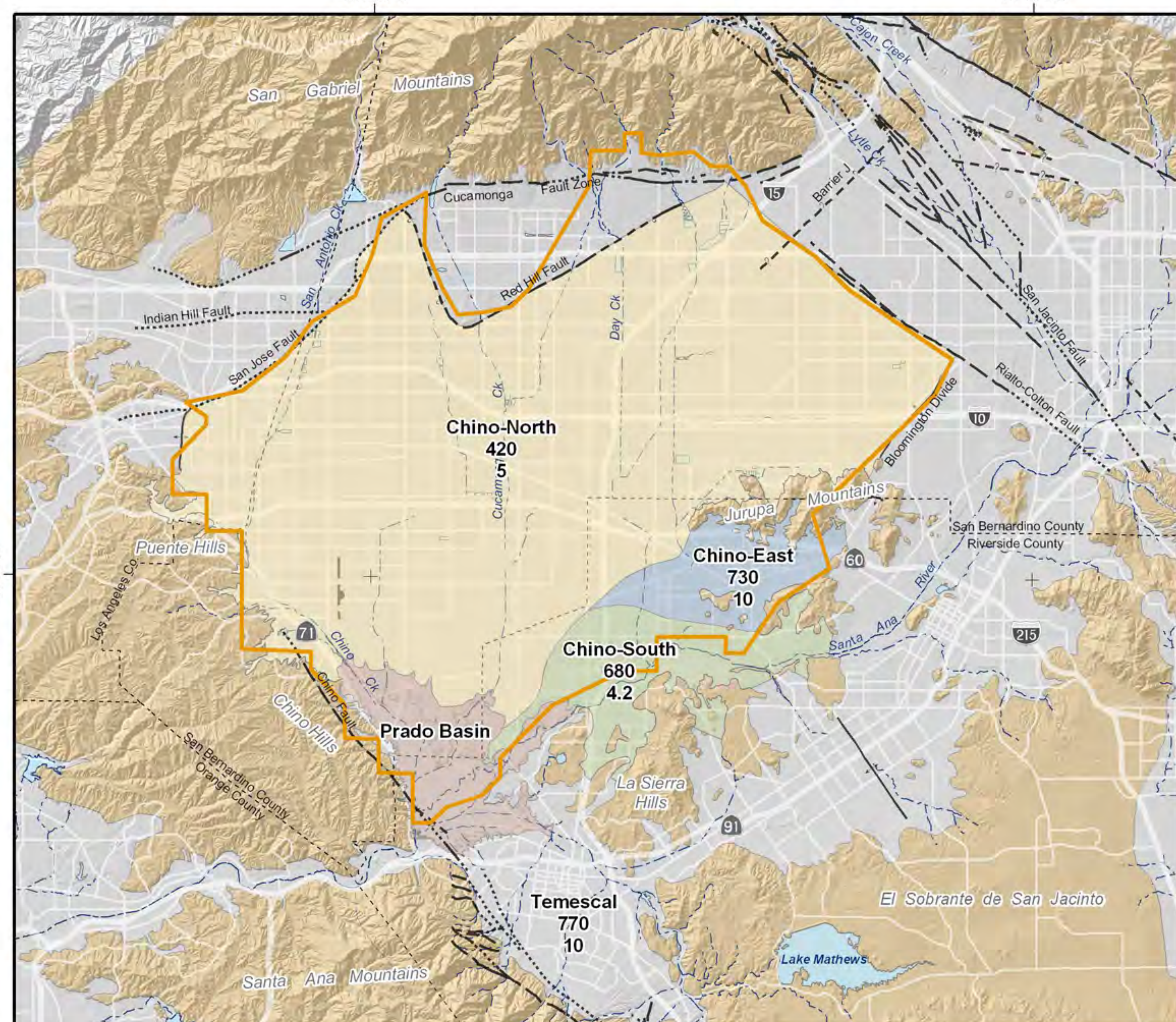
2009 Production Optimization and Evaluation of the Peace II Project Description

OBMP Management Zones

Figure 2-1a



Management Zone Labeling Key

Chino-North — Management Zone Name
420 — TDS Maximum Benefit Objective
5 — Nitrate Maximum Benefit Objective

Adjudicated Chino Basin

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

Location Certain
Location Approximate
Location Concealed
Location Uncertain
Approximate Location of Groundwater Barrier

Other Features

Groundwater Divides
Flood Control/Conservation Basins
Streams, Rivers, and Channels

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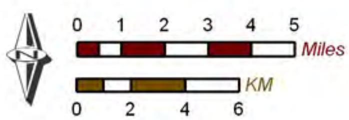


RWQCB Basin Plan Management Zones

2009 Production Optimization and Evaluation of the Peace II Project Description

Figure 2-1b

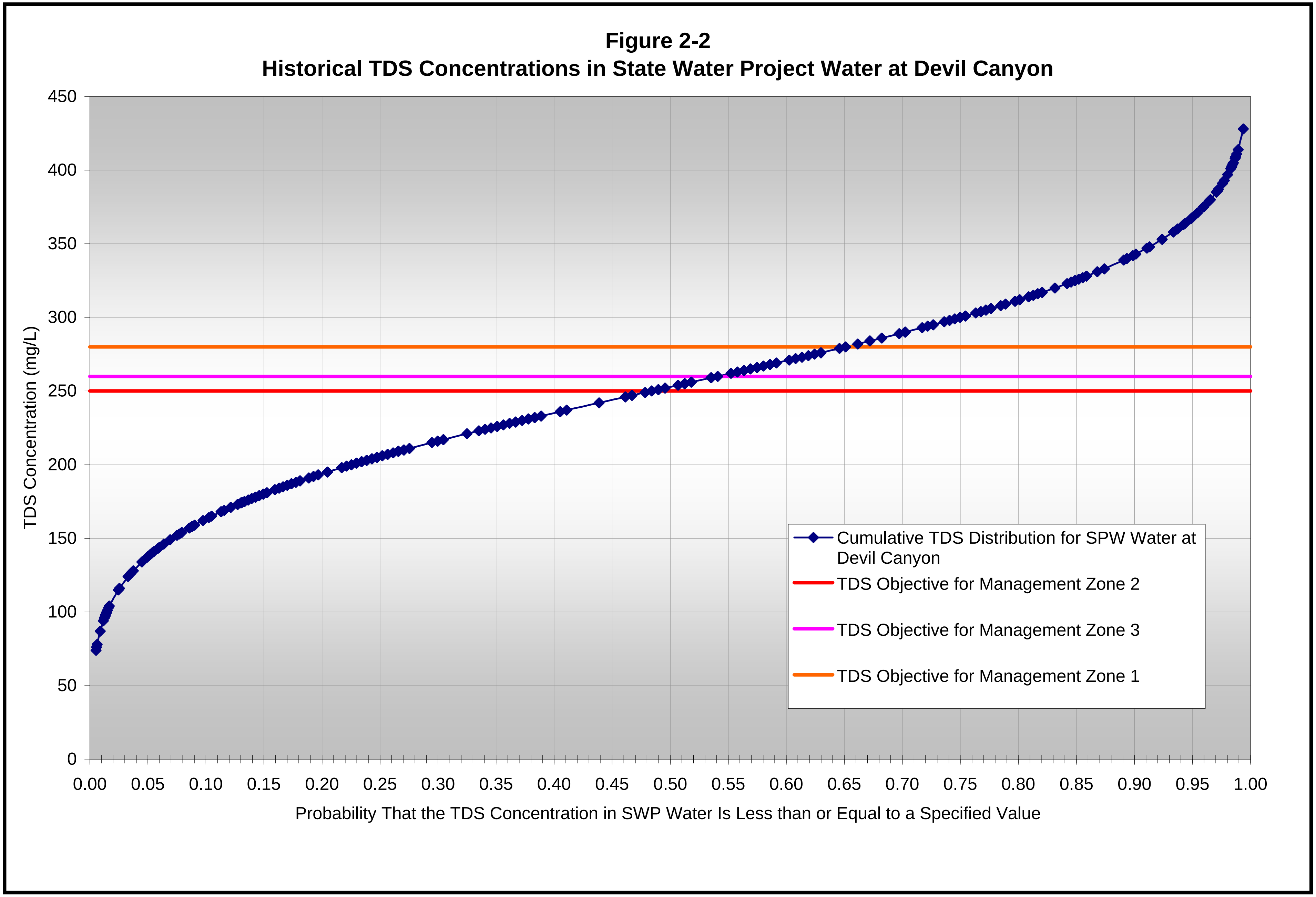
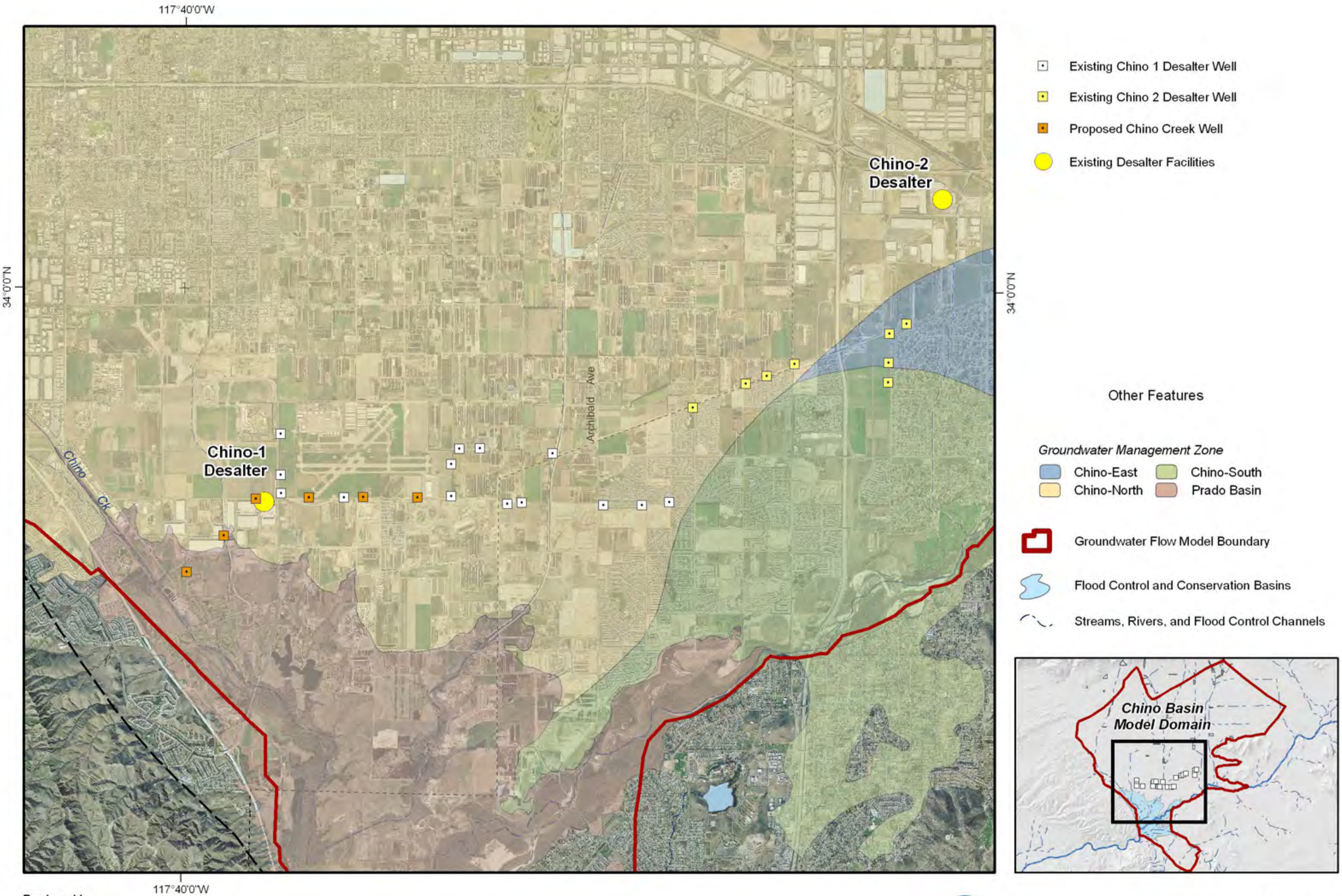


Figure 2-2
Historical TDS Concentrations in State Water Project Water at Devil Canyon
TDS Concentration (mg/L)
0
50
100
150
200
250
300
350
400
450
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
1.00
Probability That the TDS Concentration in SWP Water Is Less than or Equal to a Specified Value
Cumulative TDS Distribution for SPW Water at Devil Canyon
TDS Objective for Management Zone 2
TDS Objective for Management Zone 3
TDS Objective for Management Zone 1



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2009 Production Optimization and Evaluation of the Peace II Project Description

Chino Creek Well Field

Figure 2-3

Section 3 – Environmental Impact Evaluation Criteria

Per the Peace Agreement, material physical injury is defined as "material injury that is attributable to Recharge, Transfer, storage and recovery, management, movement or Production of water or implementation of the OBMP, including, but not limited to, degradation of water quality, liquefaction, land subsidence, increases in pump lift and adverse impacts associated with rising groundwater" (Peace Agreement, p. 8). An analysis of material physical injury was performed in 2007 for the Peace II Agreement, using the evaluation criteria described below, and reported in *Final Report, 2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description* (WEI, 2007a). These criteria were used in this investigation to evaluate the hydrologic impacts of the Peace II Agreement for the Peace II Agreement EIR.

3.1 Evaluation Criteria

The Baseline and Peace II Alternatives were evaluated to determine changes in groundwater level, changes in Santa Ana River discharge, changes in basin balance, hydraulic control effectiveness, changes in safe yield, and potential subsidence. This was accomplished using the updated 2007 Watermaster Model to estimate groundwater and surface water responses to the Baseline and Peace II Alternatives. The impacts of Peace II Alternative were assessed by comparing the results of the Peace II Alternative simulation to those of the Baseline Alternative simulation. Information was extracted from the model results to produce:

- Groundwater level projections to determine the change in groundwater levels throughout the basin and to assess hydraulic control and potential new subsidence. Time series charts were prepared to show the projected groundwater level changes at selected wells in the basin. Maps were produced, showing the areal distribution of groundwater elevations, the change in groundwater elevations relative to the start of the planning period, and the difference in groundwater elevations caused by implementing the Peace II Agreement. Local maps were prepared in the southern end of the basin to assess hydraulic control and potential impacts on riparian vegetation.
- Surface water discharge projections of the Santa Ana River at Prado Dam to estimate the induced Santa Ana River recharge caused by implementing the Peace II Agreement
- Water balance tables to determine outflow from the Chino North Management Zone to the Prado Basin Management Zone and the Santa Ana River, new recharge from the Santa Ana River to the Chino South and Prado Basin Management Zones, the change in storage, and the change in safe yield
- Projections of the change in direction and speed of contaminant plumes caused by implementing the Peace II Agreement

The groundwater-level impacts are presented in a series of maps that show basin-wide and local-scale groundwater level changes, time history charts for 98 wells that belong to various municipal water supply agencies, and tabular format, which indicates groundwater level changes in selected municipal water supply agency service areas.

4.1 Projected Groundwater Production for the Planning Period

In 2008, the IEUA developed water supply plans for all municipal water supply agencies that utilize the Chino Basin (IEUA, 2008a). Figure 4-1 shows the service areas of the water supply agencies in the Chino Basin area. A groundwater production projection for the Chino Basin was extracted from these water supply plans. Table 4-1 shows projected groundwater production, and Figure 4-2a shows the aggregate projected groundwater production in the Chino Basin over the planning period. The water supply agencies' water supply plans include existing and planned wells, planned groundwater treatment facilities, existing desalters, and the planned expansion of the Chino Basin desalters. Figure 4-3 shows the location of existing and planned production wells in the Chino Basin. The IEUA-developed water supply plans and groundwater production plan were vetted through the Watermaster process during the summer of 2008 and accepted by the appropriators in September 2008. Table 4-1 shows projected groundwater production by party for the period of 2007/08 through 2029/30. Agricultural production is estimated to be about 26,000 acre-ft/yr in 2010, is projected to decline to about 5,000 acre-ft/yr by 2020, and remains at about 5,000 acre-ft/yr thereafter. Overlying non-agricultural pool production is estimated to remain constant over the planning period at about 3,150 acre-ft/yr. The total production of the appropriators averages about 180,000 acre-ft/yr and ranges from a low of about 145,000 acre-ft/yr to a high of about 210,000 acre-ft/yr. Groundwater production projections for the overlying agricultural pool are based on recent Watermaster projections (WEI, 2008b). Total production for the Chino Basin averages about 200,000 acre-ft/yr during this period and ranges from a low of about 174,000 acre-ft/yr to a high of about 220,000 acre-ft/yr.

4.2 Projected Recharge and Replenishment for the Planning Period

Watermaster recharges supplemental water into the Chino Basin pursuant to the Judgment and the 2000 Peace Agreement. Total annual replenishment was calculated based on projected groundwater production, recharge facility capacity, and the following assumptions:

- The safe yield is 140,000 acre-ft/yr through 2010 and the 2007 Watermaster Model-calculated safe yield thereafter.
- The Judgment allows a 5,000 acre-ft/yr controlled overdraft of the Chino Basin through 2017.
- Recycled water recharge was assumed to occur pursuant to Watermaster and the IEUA's recharge permit (Order R8-2007-as amended in October 2009 (Order R8-2009-0057)0039 and as projected by the IEUA: 10,000 acre-ft/yr in 2010, 15,000 acre-ft/yr in 2020, and 24,000 acre-ft/yr in 2030.

Total production rights are about 155,000 acre-ft/yr in 2010 and vary between 150,000 acre-ft/yr to 155,000 acre-ft/yr through 2030. Watermaster's replenishment obligation was estimated using the following assumptions:

- Water in storage accounts as of fiscal year 2007/08 is not used to meet future replenishment obligations. This is a conservative assumption that reserves discretion regarding the use of this water to individual appropriators.
- On a go forward basis, under-producers will transfer un-pumped rights to over-producers each year; that is, there is an efficient market that moves unused production rights from under-producers to over-producers.

For this investigation, the average annual replenishment obligation was assumed to be equal to the greater of zero and the difference between actual production and production rights. The replenishment obligation for the Baseline Alternative is projected to be 34,000 in 2010 and about 67,000 acre-ft/yr by 2030. This assumes that under-producers will transfer un-pumped rights to over-producers each year; as stated above, there is an efficient market that moves unexercised rights from under-producers to over-producers. This assumption tends to underestimate the replenishment obligation for some years. Yet, over the long term, this assumption is valid; appropriator parties cannot store unused production rights forever, and the demand for replenishment water will provide financial incentives for unused production rights to be sold to over-producers. Figures 4-2a and 4-2b show the projected groundwater production for the Baseline and Peace II Alternatives, respectfully as a stacked bar chart that consists of the production right and replenishment obligation for each year in the planning period. For the Baseline Alternative, Figure 4-2a shows the production rights running fairly constant between 150,000 acre-ft/yr to 155,000 acre-ft/yr and an escalating replenishment obligation running from about 32,000 acre-ft/yr in 2009 to about 67,000 acre-ft/yr in 2030. For the Peace II Alternative, Figure 4-2b shows the production rights approximately equal to production through 2012 and, thereafter, running fairly constant between 161,000 acre-ft/yr to 167,000 acre-ft/yr and an escalating replenishment obligation running from about 16,000 acre-ft/yr in 2013 to about 57,000 acre-ft/yr in 2030.

4.2.1 Recharge and Replenishment Capacity

Figure 4-4 shows the locations of the recharge facilities used by Watermaster, the Chino Basin Water Conservation District (CBWCD), and the IEUA for storm and supplemental water recharge. At most of these recharge facilities, supplemental water can only be recharged during non-storm periods. At dedicated conservation basins, supplemental water may be recharged during storm periods, but there is a risk that it may be lost due to overflow.

Table 4-2 lists the recharge facilities, their operational availability for supplemental water recharge, their supplemental water recharge capacities, and the theoretical maximum recharge capacities for supplemental water recharge. The table is organized as follows:

- The first column lists the recharge facilities and aggregates them by OBMP management zone.
- The next twelve columns (columns 2 through 13) show the estimated availability of the recharge facilities by month, based on the mean availability of the recharge facilities in consideration of the number of storm events each month. Availability is dependent upon operation and maintenance schedules and forecasted precipitation. For a detailed description of the mean availability concept, see *2010 Recharge Master Plan Update, Technical Memorandum: Task 5 Replenishment Projections, Task 7.1 Supplemental*

Water Recharge Capacity (WEI, 2009).

- Column 14 contains the average recharge rate for each recharge facility or group of facilities. These rates were provided by the IEUA and are based on recent operational performance.
- Column 15 lists the supplemental water recharge capacity.
- Columns 16 through 20 list details associated with MWDSC turnouts.
  - Column 16 indicates which MWDSC turnout is tributary to each basin.
  - Columns 17 and 18 provide the turnouts' maximum and useful discharge rates to the recharge facilities. The useful discharge rate is what can be used without downstream losses.
  - Column 19 indicates whether a turnout's capacity limits the recharge capacity of a facility; "no" means that the capacity of the turnout exceeds the recharge capacity of the facility, and a positive value indicates that the recharge capacity is limited by turnout capacity.
  - Column 20 shows the annual theoretical supplemental water recharge capacity constrained by turnout capacity, which is estimated as the sum of the products of operational availability for each month times the number of days in each month times the average recharge rate of a given basin or the useful discharge rate for a given basin. As the table shows, CB13 is the only turnout with a discharge capacity that is less than the downstream recharge basin's capacity. CB13 is used to supply replenishment water to the San Sevaine Basins and was designed to discharge 33 cfs despite the 50 cfs average recharge rate of the San Sevaine Basins. The total maximum supplemental water recharge capacity for the Chino Basin, constrained by turnout capacity, is about 84,600 acre-ft/yr.

The last five columns summarize the theoretical maximum supplemental water recharge capacity per year and per quarter.

4.2.2 Projected Replenishment

Watermaster purchases replenishment water when one or more of the parties overproduces. Table 4-3 shows the replenishment schedule for the Baseline and Peace II Alternatives. This table contains projected groundwater production, production rights, replenishment obligation, demand for replenishment, replenishment supply, the amount of imported water spread at recharge basins, and the amount of imported water recharged by injection. As noted above, the replenishment obligation for the Baseline Alternative is projected to be 32,000 in 2009 and about 67,000 acre-ft/yr by 2030. Watermaster has traditionally met its replenishment obligations by purchasing imported water from the MWDSC and purchasing water from the appropriators. In the past, the MWDSC was typically able to supply all of the replenishment needs in its service area with replenishment water service available seven out of ten years. Recent court rulings regarding endangered species and the drought have severely limited the ability of the MWDSC and other State Water Project contractors to obtain SWP water. In 2008, the MWDSC 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, the MWDSC has depleted 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 the MWDSC's storage assets prior to being used for groundwater replenishment. The Chino Basin and the other major groundwater basins in the MWDSC service area that depend on replenishment water service may become seriously overdrafted in the next ten to twenty years unless other replenishment supplies are found, groundwater production is reduced, or both. Watermaster has an unbounded obligation to acquire replenishment water (literal reading of the Judgment and confirmed at the Watermaster 2006 and 2009 Strategic Planning Meetings) to meet replenishment obligations and now plans to acquire new non-traditional supplemental water supplies. These non-traditional supplemental water supplies could consist of MWDSC Tier 1 and Tier 2 service waters, if available, and other imported supplies from the Central Valley, the Colorado River, and other basins. In this investigation, MWDSC and non-traditional supplemental water supplies were used for replenishment with the following assumptions:

- Non-traditional supplemental water supplies were assumed to be conveyed to the Chino Basin through MWDSC infrastructure and the Azusa-Devil Canyon Pipeline.
- Non-traditional supplemental water supplies from the Central Valley and the Colorado River were assumed to be available six out of ten years, corresponding to years when State Water Project allocations range from 25 to 75 percent.
- Deliveries to the Chino Basin through MWDSC infrastructure and the Azusa-Devil Canyon Pipeline were limited to a part of the facilities' unused capacity.
- The new supplemental water supply was assumed to be unavailable until 2013 to allow adequate time for planning and acquisition.

Watermaster traditionally purchases replenishment water in arrears. That is, Watermaster determines that a replenishment obligation exists after the conclusion of a fiscal year and purchases replenishment water to cover this obligation in the subsequent year. With the current and expected future constraints on the availability of supplemental water for replenishment, it is likely that a large cumulative unmet replenishment obligation (CURO) will occur and could grow so large that Watermaster may not be able to catch up. This was first predicted in the original engineering work for the Peace II process and reported in *2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description* (WEI, 2007a). Furthermore, this was discussed at the Watermaster 2009 Strategic Planning Meeting, and the consensus opinion of that meeting was that Watermaster would do what it takes to ensure that projected groundwater production could be sustained with acquisitions of replenishment water. In implementation, this means that Watermaster will have to purchase and recharge supplemental water when available and in advance of replenishment obligations, referred to herein as preemptive replenishment. This will require Watermaster to use some of the available storage space in the Chino Basin to store this water in advance of overproduction. Figure 4-5 shows the assumed replenishment deliveries to the Chino Basin, using the assumptions described above. Replenishment deliveries occur in years when unused capacity exists in the SWP and Colorado River aqueducts, the MWDSC infrastructure and the Azusa-Devil Canyon Pipeline, and recharge facilities in the Chino Basin.

Figure 4-6a and 4-6b show the projected replenishment obligation and the CURO for the Baseline and Peace II Alternatives, using the assumptions articulated above. A positive CURO indicates an outstanding replenishment obligation. A negative CURO indicates that Watermaster has recharged more supplemental water than required to meet an annual replenishment obligation and that this water is in storage in the Chino Basin.

4.3 Production and Replenishment Optimization

In 2007, a Baseline and three Peace II alternatives were modeled. The results of this modeling work are documented in *2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description* (WEI, 2007a). The Baseline Alternative projected that groundwater levels in the southern Cucamonga Valley Water District (CVWD) service area would rapidly decline. In the out years, the computational cells near some of these wells dried up, effectively eliminating production. The JCSD service area also exhibited significant water level declines. In 2008, the DYYP Expansion investigation (WEI, 2008a) yielded similar results. A baseline condition with updated groundwater production estimates—similar to the projections listed in Table 4-1—was modeled. The results indicated that production could not be sustained. In both of these modeling investigations, projected groundwater production had to be reduced for some appropriators. And, even with reduced groundwater production, significant pumping depressions developed. These groundwater level depressions are the result of projected and uncoordinated increases in groundwater production.

Based on the findings of the 2007 and 2008 modeling work, research was undertaken as part of this investigation to develop a near-optimal distribution of groundwater production and replenishment that would ensure sustainable production and reduce drawdown. This involved working with individual Chino Basin appropriators to determine how they could operate their wells with potential lower groundwater levels in the future, revising the locations and capacities of some planned wells, assigning well operating priorities, and prioritizing replenishment amounts and locations to better balance recharge and discharge in the Chino Basin.

The decision variables for the optimization were production rate, production well operating priority (production well location), and replenishment amount and location. Well production was constrained to meet production goals and to ensure that groundwater levels exceeded minimum levels at specific production wells. To meet production demands and groundwater level constraints, production must be spread out from the concentrated areas of production and targeted recharge must be conducted to balance recharge and discharge. Meetings were conducted with appropriators to review projected changes in groundwater levels, how their operations contributed to excessive drawdown, the optimization process, and to define the information needs for conducting the optimization. The information obtained from the appropriators included: planned future well locations, pump settings, the quantification of drawdown constraints relative to pump settings, and well priority. Well priority is the order in which wells are utilized to meet the projected production demand. Based on these data, operating constraints were prepared.

Drawdown constraints were prepared for the CVWD, Ontario, the JCSD, and the Monte Vista Water District (MVWD), and are listed in Table 4-4 by well. Drawdown was limited to 40 feet above the pump bowls for the CVWD, 20 feet above the pump bowls for Ontario, 20 feet above the pump bowls for the MVWD, and 10 feet above pump bowls for the JCSD. A pump bowl is the top of the pump assembly that must remain submerged to avoid cavitation and maintain suction head. These constraints were based on input from each agency.

The optimization process consisted of several model iterations with adjustments to decision variables to meet optimization constraints. The first optimization iteration was prepared with initial well operating priorities and initial recharge basin priorities for replenishment. A manual trial-and-error approach was used to iteratively adjust decision variables and to check constraints. Figure 4-8 illustrates the optimization process. Each iteration consisted of running the model, evaluating total groundwater production, evaluating satisfaction of the drawdown constrains, and revising the decision variables (production rate, production well operating priority, and replenishment amount and location).

The optimization was completed for the Baseline Alternative. Optimization iterations were completed until no significant improvements could be made in meeting the drawdown constraints. The projected groundwater production could be met, but all of the drawdown constraints could not. A total of ninety-eight wells, located across the basin, were reviewed after each model iteration. Figure 4-9 shows the locations of these wells. Thirty-eight wells were used to track water levels outside areas where drawdown constraints were applied. For sixty of the ninety-eight wells, a drawdown limit was adhered to as a constraint of the optimization; of these wells, ten could not meet the drawdown constraints at all times. For those wells where drawdown constraints could not be met, it was assumed that the well owners would have to lower their pumps and make operational changes to sustain production. Appendix A contains water level hydrographs for each well.

4.4 Hydrologic Response to the Baseline Alternative

The basin's hydrologic response to the Baseline Alternative was estimated by simulating the implementation of the Baseline Alternative with the 2007 Chino Basin Watermaster Model. The model results were extracted and summarized pursuant to the evaluation criteria described in Section 3.

4.4.1 Hydrologic Balance for the Baseline Alternative

The Baseline Alternative was simulated with the 2007 Watermaster Model to evaluate the hydrologic response of the Chino Basin to implementing the Baseline Alternative. The combined hydrologic water budget for the Chino North, Chino South, Chino East, and Prado Management Zones for the Baseline Alternative is shown in Table 4-7. This water budget table shows outflow from the Chino Basin, recharge from the Santa Ana River, and the change in storage. At the end of fiscal 2030, the storage in the basin is about 203,000 acre-ft less than at the start of the simulation. This 203,000 acre-ft decrease includes +62,000 acre-ft of CURO and, therefore, the ending storage, adjusted for CURO, is -141,000 acre-ft.

Santa Ana River recharge increases by about 14,000 acre-ft/yr over the planning period, and rising groundwater to the Santa Ana River decreases by about 5,000 acre-ft/yr, netting an increase of about 19,000 acre-ft/yr. Some of the increase in Santa Ana River recharge discharges to the Temescal Basin in response to a projected chronic overdraft in that basin.

4.4.2 Projected Groundwater Levels with the Baseline Alternative

Figures 4-10a and 4-10b show the estimated groundwater elevation contours for July 2005 for model layers 1 and 2, respectively. These maps show the initial groundwater elevations throughout the basin and illustrate the initial groundwater levels for the planning period.

Figures 4-11a and 4-11b show the projected groundwater elevations in June 2030, the end of the planning period, for model layers 1 and 2, respectively. And, Figures 4-12a and 4-12b show the change in groundwater levels across the basin over the planning period for model layers 1 and 2, respectively. Figures 4-12a and 4-12b also show the appropriators' water service area boundaries.

The direction of groundwater flow in the Chino Basin is generally the same in 2005 and in 2030 with groundwater flowing from the northeast and north to the southwest and south. Some areas in the basin experience slight groundwater elevation increases, though most of the basin experiences declines. Figures 4-11a and 4-11b show a groundwater depression in the desalter well field area. Over time, groundwater elevation changes are almost identical in layers 1 and 2 in the eastern half of the basin but are different in the western part of the basin with greater declines observed in layer 2.

4.4.2.1 Groundwater Level Changes in Water Service Areas

Figure 4-9 shows the locations of the appropriator wells that were used in the production and replenishment optimization, discussed in Section 4.3, and for which groundwater level projections were extracted from the Baseline Alternative simulation. Appendix B contains charts that illustrate the projected groundwater elevation time series for these 98 wells. Figures 4-13a through 4-13j illustrate projected groundwater elevations at some of these appropriator wells. And, Table 4-8 characterizes the average, maximum, and minimum groundwater elevation changes across the water service areas of appropriators that overlie the Chino Basin from 2005 through 2030.

The groundwater elevation projections in Appendix B and in Figures 4-13a through 4-13j show that groundwater production is sustainable for the Baseline Alternative. At some wells, the groundwater elevation falls below the constraints prescribed by the appropriators. For these cases, it was assumed that the pumps would be lowered to maintain production. It is also the case that, under 2005 and the years immediately following, the constraint established by the appropriator was violated and yet those wells were in use.

As shown in Table 4-8, the average changes in layers 1 and 2 were essentially identical in eastern half of the basin but were significantly different in the western half of the basin. In layer 1, the average groundwater elevation change ranges from a low of -3 feet for the City of Upland (Upland) service area to -18 feet for the JCSD service area; in layer 2, it ranges from a low of -3 feet for the Upland service area to -28 feet for the MVWD service area.

The maximum and minimum groundwater elevation changes, depicted in Table 4-8, were computed for each 200-foot by 200-foot model cell. For example, the maximum layer 1 groundwater elevation change in a model cell within the CVWD service area is -38 feet, a decline of 38 feet for that cell from 2005 through 2030. The corresponding minimum layer 1 groundwater elevation change in a model cell within the CVWD service area is +10 feet, an increase of 10 feet for that cell from 2005 through 2030. In layer 1, the maximum groundwater elevation change ranges from a low of -23 feet for the City of Pomona (Pomona) service area to -49 feet for the JCSD service area; in layer 2, it ranges from a low of -26 feet for the Fontana Water Company (FWC) service area to -63 feet for the Chino service area. In layer 1, the minimum change in groundwater elevation ranges from a low of zero feet for the

JCSD service area to +21 feet for the Pomona service area; in layer 2, it ranges from a low of -14 feet for the Pomona service area to +14 feet for the CVWD service area.

4.4.2.2 Groundwater Level Changes in Riparian Habitat Areas

In the southern Chino Basin and the Prado Basin, riparian habitat is supported by the infiltration of surface water and groundwater. In 2006, vegetation maps were digitized from 1974, 1984, and 2006 aerial photographs at a scale of 1:12,000 for the development of the 2007 Watermaster Model. This work was completed by Merkel and Associates and is documented in Appendix C of *2007 CBWM Groundwater Model Documentation and Evaluation of the Peace II Project Description* (WEI, 2007a). For 2006, digitizing was completed using a color orthorectified aerial photograph with a 1-meter resolution. Ground truthing of the 2006 vegetation map was carried out and included on-site observations of each vegetation type. A total of 13 unique vegetation types were identified within the study area, including:

- Un-vegetated Sandbar
- Disturbed Habitat
- Dry Land Agriculture
- Irrigated Agriculture
- Turf Irrigated
- Non-native Grassland
- Non-native Trees
- Olive Grove
- Emergent Wetland
- Freshwater Marsh
- Recharge Pond/Treatment Wetlands
- Southern Cottonwood Willow Riparian Forest (Riparian Forest)
- Southern Willow Scrub

Of these, Emergent Wetland, Freshwater Marsh, Riparian Forest, and Southern Willow Scrub are riparian habitats. The Emergent Wetland vegetation unit is a minor cover class within the Prado Basin and exists as a result of extended periods of inundation and resulting anaerobic conditions. The dominant vegetation of this unit within the Prado Basin includes typical perennial monocots as well as several opportunistic, facultative species, which occur in less saturated areas. The Freshwater Marsh vegetation unit is a minor coverage class within the Prado Basin. Freshwater Marsh is classified as having prolonged periods of inundation, which permits the accumulation of peaty soils, and is dominated by perennial macrophytes. Areas mapped as Freshwater Marsh occur within the highly managed constructed wetlands. Riparian Forest is the dominant cover class within the Prado Basin. Throughout the basin, Riparian Forest exists predominantly as a mature forest with a solid canopy of mature deciduous trees and a patchy understory comprised of lower stature species, resulting from scouring created by periodic natural and anthropogenic activities, such as river channel maintenance. Southern Willow Scrub is minor cover class within Prado Basin and is often found in very dense thickets adjacent to creeks and ponded areas.

Figure 4-14a shows the Emergent Wetland, Freshwater Marsh, Riparian Forest, and Southern Willow Scrub vegetation units, grouped and mapped as riparian vegetation, and the July 2005 depth to water in the riparian vegetation area. Figure 4-14b shows the change in depth to water between 2005 and 2030 for the Baseline Alternative. North of the Santa Ana River, changes in depth to water range from zero feet for most of the riparian vegetation area to less than 3 feet. South and east of the Santa Ana River, depth to water changes are attributable to groundwater production in the Temescal Basin. The consumptive use by riparian vegetation is projected to decline by a total of about 1,900 acre-ft/yr, based on the water budget for the Baseline Alternative (see Table 4-7).

4.4.3 Subsidence

Watermaster has been conducting subsidence investigations in MZ-1 since September 2000. Detailed information on Watermaster subsidence investigations, causes of subsidence, and Watermaster's subsidence management plan can be found in *Chino Basin Optimum Basin Management Program, Management Zone 1 Subsidence Management Plan* (WEI, 2007), *2008 State of the Basin Report* (WEI, 2009), and *Chino Basin Optimum Basin Management Program, 2008-09 Annual Report, Management Zone 1 Subsidence Management Plan* (WEI, 2009). This work has included the review of recent historical subsidence across the basin using InSAR, ground level surveys, and controlled pumping tests, and a rigorous review of basin hydrogeology. Figure 4-15 shows the location of recent subsidence in MZ-1 (2005 to 2008) and defines the boundary of the MZ-1 managed area and other subsidence areas of interest.

PA-7 is the key subsidence indicator well used in Watermaster's MZ-1 Long Term Management Plan. Under this plan, basin management activities must maintain piezometric elevations greater than the guidance level of 400 feet (mean sea level) at PA-7. The guidance level is defined as the threshold water level at the onset of inelastic compaction of the aquifer system as recorded by the extensometer. The guidance level was established by Watermaster and is subject to change based on the periodic review of monitoring data. Figure 4-16 shows the guidance level and the projected groundwater elevation time series at the PA-7 piezometer (PA-7) for the Baseline Alternative. The minimum projected groundwater elevation at PA-7 drops from about 480 feet in 2009 to about 470 feet in the out years and is well above the guidance level.

4.4.4 Movement of Water Quality Anomalies

Previous reports and technical memoranda prepared by Watermaster have described water quality conditions across the Chino Basin and have summarized existing information about contaminant plumes within the basin (WEI 2003, 2007b, and 2009). These plumes are discussed briefly below, followed by a description of how they could be affected by the implementation of the Baseline Alternative.

4.4.4.1 Groundwater Plume Descriptions

Chino Airport. The Chino Airport is located approximately four miles east of Chino and six miles south of Ontario International Airport and occupies about 895 acres. From the early

1940s until 1948, the airport was owned by the Department of Defense and used for flight training, aircraft storage and maintenance, and aircraft salvage operations. The County of San Bernardino acquired the airport in 1948 and has since operated and/or leased portions of the facility. Past and present businesses and activities at the airport since 1948 have included the modification of military aircraft; crop-dusting; aircraft-engine repair; aircraft painting, stripping, and washing; dispensing of fire-retardant chemicals to fight forest fires; and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes is widespread throughout the airport's history (RWQCB, 1990). From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells down gradient of the Chino Airport. The most common VOC detected above its MCL was TCE with concentrations ranging from 6 to 75 μg/L. The plume is elongate in shape, up to 3,600 feet wide, and extends approximately 14,200 feet from the airport's northern boundary in a south to southwestern direction.

General Electric Flatiron Facility. The General Electric Flatiron Facility (Flatiron Facility) occupied the site at 234 East Main Street, Ontario, California from the early 1900s to 1982. Its operations primarily consisted of manufacturing clothes irons. Currently, the site is occupied by an industrial park. The RWQCB issued an investigative order to General Electric (GE) in 1987 after an inactive well in Ontario was found to contain TCE and chromium above drinking water standards. Analytical results from groundwater sampling have indicated that VOCs and total dissolved chromium are the major groundwater contaminants in this plume. The most common VOC detected at levels significantly above its MCL is TCE, which reached a measured maximum concentration of 3,700 μg/L. Other VOCs—including PCE, toluene, and total xylenes—are periodically detected but commonly below MCLs (Geomatrix Consultants, 1997). The plume is up to 3,400 feet wide and extends about 9,000 feet south-southwest (hydraulically down gradient) from the southern border of the site. From 2001 to 2006, the maximum TCE concentration in groundwater detected at an individual well within the Flatiron Facility plume was 3,200 μg/L. The plume is currently being remediated by GE and is considered fully contained by a well extraction system.

General Electric Test Cell Facility. The GE Engine Maintenance Center Test Cell Facility (Test Cell Facility) is located at 1923 East Avon, Ontario, California. Primary operations at the Test Cell Facility included the testing and maintenance of aircraft engines. A soil and groundwater investigation, followed by a subsequent quarterly groundwater monitoring program, began in 1991 (Dames & Moore, 1996). The results of these investigations showed that VOCs exist in the soil and groundwater beneath the Test Cell Facility and that the released VOCs had migrated offsite. Analytical results from subsequent investigations indicated that the most common and abundant VOC detected in groundwater beneath the Test Cell Facility was TCE. The historical maximum TCE concentration measured at an onsite monitoring well (directly beneath the Test Cell Facility) was 1,240 μg/L. The historical maximum TCE concentration measured at an offsite monitoring well (down gradient) was 190 μg/L (BDM International, 1997). Other VOCs that have been detected include PCE, cis-1,2-DCE, 1,2-dicholoropropane, 1,1-DCE, 1,1-DCA, benzene, toluene, xylenes, and others. The plume is elongate in shape, up to 2,400 feet wide, and extends approximately 10,300 feet from the Test Cell Facility in a southwesterly direction. From 2001 to 2006, the maximum TCE and PCE concentrations in groundwater detected at an individual well within the Test Cell Facility plume were 900 μg/L and 17 μg/L, respectively.

Kaiser Steel, Fontana Steel Site. Between 1943 and 1983, the Kaiser Steel Corporation (Kaiser) operated an integrated steel manufacturing facility in Fontana. During the first 30 years of operations (1945-1974), a portion of Kaiser's brine wastewater was discharged to surface impoundments and allowed to percolate into the soil. In the early 1970s, the surface impoundments were lined to eliminate percolation to groundwater (Mark J. Wildermuth, 1991). In July 1983, Kaiser initiated a groundwater investigation that revealed the presence of a plume of degraded groundwater under the facility. In August 1987, the RWQCB issued CAO Number 87-121, which required additional groundwater investigations and remediation activities. The results of these investigations showed that the major constituents of release to groundwater were inorganic dissolved solids and low molecular weight organic compounds. The wells sampled during the groundwater investigations had TDS concentrations ranging from 500 to 1,200 mg/L and TOC concentrations ranging from 1 to 70 mg/L. As of November 1991, the plume had migrated almost entirely off the Kaiser site. Based on a limited number of wells, including City of Ontario Well No. 30, the plume is up to 3,400 feet wide and extends about 17,500 feet from northeast to southwest.

Milliken Landfill. The Milliken Sanitary Landfill (MSL) is a Class III Municipal Solid Waste Management Unit, located near the intersections of Milliken Avenue and Mission Boulevard in Ontario. This facility is owned by the County of San Bernardino and managed by the County's Waste System Division. The facility was opened in 1958 and continues to accept waste within an approximate 140-acre portion of the 196-acre permitted area (GeoLogic Associates, 1998). Groundwater monitoring at the MSL began in 1987 with five monitoring wells as part of a Solid Waste Assessment Test investigation (IT, 1989). The results of this investigation indicated that the MSL had released organic and inorganic compounds to the underlying groundwater. Due to the presence of such compounds, the MSL conducted an evaluation monitoring program investigation. Following the completion of the evaluation monitoring program, a total of 29 monitoring wells were drilled to evaluate the nature and extent of the groundwater impacts identified in the vicinity of the MSL (GeoLogic Associates, 1998). Analytical results from groundwater sampling have indicated that VOCs are the major constituents of release. The most common VOCs detected are TCE, PCE, and dichlorodifluoromethane. Other VOCs detected above their MCLs include vinyl chloride, benzene, 1,1-dichloroethane, and 1,2-dichloropropane. The historical maximum total VOC concentration detected at an individual monitoring well is 159.6 μg/L (GeoLogic Associates, 1998). The plume is up to 1,800 feet wide and extends about 2,100 feet south of the MSL's southern border. From 2001 to 2006, the maximum TCE and PCE concentrations detected at an individual well within the MSL plume were 96 μg/L and 44 μg/L, respectively.

Ontario International Airport. A VOC plume, primarily containing TCE, exists south of the Ontario Airport. This plume extends approximately from State Route 60 on the north and Haven Avenue on the east to Cloverdale Road on the south and South Grove Avenue on the west. In July 2005, draft CAOs were issued by the RWQCB. These CAOs were presented to the companies that they named in August 2005. From 2001 to 2006, the maximum TCE concentration detected at an individual well within this plume was 38 μg/L. The plume is up to 17,700 feet wide and 20,450 feet long.

Pomona Area Plume. This VOC plume is uncharacterized. It extends approximately from Holt

Boulevard on the north and East End Avenue on the east to Philadelphia Street on the south and Towne Avenue on the west. From 2000 to 2008, the maximum TCE concentration within this plume was 46 μg/L. The plume is up to 5,000 feet wide and 7,900 feet long.

Stringfellow NPL Site. The Stringfellow site is on the current NPL of Superfund Sites. This site is located in Pyrite Canyon north of Highway 60 near the community of Glen Avon in Riverside County (see Figure 4-17a). From 1956 until 1972, this 17-acre site was operated as a hazardous waste disposal facility. More than 34-million gallons of industrial waste—primarily from metal finishing, electroplating, and pesticide production—were deposited at the site (US EPA, 2001). A groundwater plume of site-related contaminants exists underneath portions of the Glen Avon area. Groundwater at the site contains various VOCs, perchlorate, NDMA, and trace metals, such as cadmium, nickel, chromium, and manganese. In the original disposal area, soil is contaminated with pesticides, polychlorinated biphenyls (PCBs), sulfates, perchlorate, and trace metals. The original disposal area is covered by a clay cap, fenced, and guarded by security services.

Contamination at the Stringfellow site has been addressed by cleanup remedies described in four EPA RODs. Since 1986, cleanup actions have focused on controlling the source of contamination, installing an onsite pretreatment plant, the cleanup of the lower part of Pyrite Canyon, and the cleanup of the community groundwater area below Highway 60. In 1996, the DTSC assumed responsibility for the maintenance of the Stringfellow Superfund Site through a Cooperative Agreement with the USEPA. In December 2007, the DTSC submitted the Draft Final Supplemental Feasibility Study (SFS), which identified and evaluated the final remedial alternatives for cleanup. The 2007 Draft SFS is a revised version of an earlier 2000 draft; reconsideration was required after perchlorate and other new contaminates were discovered in 2001. Once finalized, the SFS will be used by the US EPA to select a final remedial strategy and prepare a draft ROD. The draft ROD is anticipated in December 2009.

Figure 4-17a shows the approximate areal extent of the Stringfellow VOC plume as of 2008. The VOC plume is elongate in shape, up to 1,500 feet wide, and extends approximately 14,500 feet from the original disposal area in a southwesterly direction. The most common VOC detected at levels above the MCL is TCE. There are approximately 70 extraction wells throughout the length of the plume, which have been effective in stopping plume migration and removing TCE contamination. South of Highway 60, there are only a few isolated areas where TCE exceeds 5 μg/L (DTSC, 2008). During the 2003 to 2008 period, the maximum TCE concentration detected in the Stringfellow plume was 170 μg/L.

High levels of perchlorate associated with the Stringfellow site were detected south of Highway 60 in 2001. Residents connected to JCSD water service were provided bottled water, and the DTSC contracted to install water mains and hookups at each residence. Concurrent with the SFS, the DTSC is conducting a Remedial Investigation and Feasibility Study of remedial alternatives for perchlorate in the downgradient community area. As with TCE, the operation of the groundwater treatment system has resulted in a reduction of perchlorate. Since its discovery in 2001, perchlorate concentrations have been reduced by 30% to 50% throughout the monitored area (DTSC, 2008). Figure 4-17a shows the approximate areal extent of perchlorate concentrations exceeding the Notification Level (6 μg/L) as of 2008. The perchlorate plume is elongate in shape, up to 2,000 feet wide, and extends approximately 25,000 feet to the southwest from the original disposal area. During the 2003 to 2008 period, the maximum perchlorate concentration detected in the Stringfellow plume was 870 μg/L.

4.4.4.2 Projected Plume Movement under the Baseline Alternative

Figure 4-17a illustrates the locations of these groundwater contaminant plumes, with the exception of the Kaiser Plume, at the beginning of the planning period and their estimated locations at the end of the planning period for the Baseline Alternative. Figure 4-17b is a similar map for the Kaiser Plume. The plume locations at the start of the planning period were mapped from recent data (2006). Initial concentrations were prepared as input files for MT3D (Zheng & Wang, 1999). MT3D is a 3-dimensional solute transport model code for the simulation of advection, dispersion, and chemical reactions of dissolved constituents in groundwater systems. This code, in conjunction with the 2007 Watermaster Model, was used to simulate plume movement during the planning period. The simulation results for the Baseline Alternative are discussed below for each contaminant plume:

- Chino Airport – At the beginning of the planning period, the Chino Airport plume underlies and extends southwest of the Chino Airport. In the Baseline Alternative simulation, the leading edge of the plume travels approximately 1.0 miles in a southeasterly direction. The primary factors that affected plume migration were regional hydraulic gradient and desalter groundwater production. At the end of the planning period, the plume is south and east of Pine and Euclid Avenues, underlying the northern reaches of the Prado Flood Control Basin. A significant part of the plume is captured in the CCWF.
- General Electric Flatiron Facility – At the beginning of the planning period, the GE Flatiron plume extends south of Mission Boulevard along Euclid Avenue. In the Baseline Alternative simulation, the leading edge of the plume travels approximately 0.5 miles in a southerly direction. The primary factors that affected plume migration in the simulations were regional hydraulic gradient, local groundwater production, and recharge at the Ely Basins. The model-projected extension of the plume will probably not occur as GE's remediation program includes monitoring that would detect movement beyond the current plume location and features a treatment system that could be adjusted to ensure containment.
- General Electric Test Cell Facility – At the beginning of the planning period, the GE Test Cell plume is located south of the Ontario Airport, extending southwest of Mission Boulevard to Grove Avenue. In the Baseline Alternative simulation, the leading edge of the plume travels approximately 0.6 miles in a westerly direction north of the Ely Basins and slightly north towards some of City of Ontario's wells. The primary factors that affected plume migration in the simulations were regional hydraulic gradient, local groundwater production, and recharge at the Ely Basins.
- Kaiser Steel Fontana Steel Site – The location of the Kaiser plume is shown in Figure 4-17b. Its starting location was estimated using past modeling studies (through the mid-1980s) and updated through 2007/08. Kaiser stopped monitoring in the early 1990s. Thus, the projection described herein is more speculative than those of the other plumes. At the beginning of the planning period, the elongated Kaiser plume extends in a southwesterly direction from the former Kaiser Steel site to Mission Boulevard. In the Baseline simulation, the leading edge of the plume travel approximately 4.4 miles in the southwesterly direction to the Desalter II well field. The

Kaiser plume is completely intercepted by the Desalter II well field. The primary factors that affected plume migration in the simulations were regional hydraulic gradient and groundwater production at wells owned by Ontario, the JCSD, and the Chino Desalter Authority. At the end of the planning period, the plume is aligned along the west side of Interstate 15 between S. Archibald Avenue and S. Milliken Avenue, north and south of Highway 60.

- Milliken Landfill – At the beginning of the planning period, the Milliken Landfill plume extends southwest from the landfill site, just north of Mission Boulevard. In the Baseline Alternative simulation, the leading edge of the plume travels approximately 1.2 miles in the southerly direction. The primary factors that affected plume migration in the simulations were regional hydraulic gradient and local groundwater production. At the end of the planning period, the plume is located just southeast of the intersection of E. Chino Avenue and Haven Avenue.
- Ontario International Airport Plume – At the beginning of the planning period, the plume underlies a broad area south of Riverside Drive, north of Kimball Avenue, west of Grove Avenue, and east of Archibald Avenue. In the Baseline Alternative simulation, the leading edge of the plume is completely intercepted by the Desalter I well field. The primary factors that affected plume migration in the simulation were regional hydraulic gradient, local groundwater production, and the Desalter I well field.
- Stringfellow NPL Site – At the beginning of the planning period, the plume underlies the area south of Highway 60 and about 1,000 feet north of the Santa Ana River. In the Baseline Alternative simulation, the plume is projected to be intercepted by the Santa Ana River Water Company well field and the Desalter II well field. The primary factors that affected plume migration in the simulation were hydraulic gradient, local groundwater production, and the Desalter II well field. At the end of the planning period, the plume is L-shaped and located just north of Bellegrave Ave.
- Pomona Area Plume – At the beginning of the planning period, the plume underlies the area south of Holt Boulevard and north of Philadelphia Street. In the Baseline Alternative simulation, the plume is projected to be intercepted by the Pomona wells. The primary factor that affected plume migration is groundwater production at the Pomona well field.

4.4.5 Hydraulic Control

Hydraulic control refers to the elimination or reduction of groundwater discharge from the Chino North Management Zone to the Santa Ana River to negligible levels. It is a requirement of Watermaster and the IEUA's recycled water recharge permit and a condition to gaining access to the assimilative capacity for TDS and nitrogen afforded by the maximum benefit based TDS and nitrogen objectives. Hydraulic control was assessed from groundwater elevation contour maps.

Hydraulic control is weakest when water levels are highest in the southern portion of the basin. During the planning period, groundwater levels are the highest in the southern part of the basin in 2020 for the Baseline Alternative. Figure 4-18 is a groundwater elevation contour map for the lower part of the Chino Basin and shows the locations of the desalter well fields, directional groundwater flow vectors for every fifth model cell, and the southern boundary of the Chino North Management Zone. This map demonstrates that groundwater flows away from the Santa Ana River upstream of the Prado Reservoir, south of the Desalter II well field, and south of the eastern part of the Desalter I well field. There is some indication that hydraulic control is achieved by the Baseline Alternative with a maximum groundwater level depression of about 9 feet in the center of the CCWF, relative to the apparent stagnation point down-gradient of the CCWF in 2020.

Table 4-1
Projected Groundwater Production for the Chino Basin
(acre-ft/yr)

Producer	Production Projection 2007/08	2009/10	2014/15	2019/20	2024/25	2029/30
Overlying Agricultural Pool						
Combined total Agricultural Pool Production	*25,612*	*21,492*	*13,251*	*5,010*	*5,010*	*5,010*
Overlying Non-Agricultural Pool						
San Bernardino Cty (Chino Airport)	0	0	0	0	0	0
Ameron Inc	0	0	0	0	0	0
California Steel Industries Inc	1,284	1,284	1,284	1,284	1,284	1,284
Swan Lake Mobile Home Park	0	0	0	0	0	0
Vulcan Materials Company	5	5	5	5	5	5
Space Center Mira Loma Inc.	0	0	0	0	0	0
Angelica Textile Service	29	29	29	29	29	29
Sunkist Growers Inc	147	147	147	147	147	147
Praxair Inc	0	0	0	0	0	0
General Electric Company	451	451	451	451	451	451
California Speedway	621	621	621	621	621	621
Reliant Energy Etiwanda	705	705	705	705	705	705
Subtotal Overlying Non-Agricultural Pool Production	*3,241*	*3,241*	*3,241*	*3,241*	*3,241*	*3,241*
Appropriative Pool						
Arrowhead Mountain Spring Water Company	332	263	0	0	0	0
Chino Desalter Authority	26,356	26,356	39,400	39,400	39,400	39,400
City of Chino	7,608	9,971	10,844	11,811	14,900	14,900
City of Chino Hills	3,815	4,823	4,823	4,823	4,823	4,823
City of Norco	0	0	0	0	0	0
City of Ontario	26,027	28,796	27,211	32,360	37,508	42,658
City of Pomona	13,188	13,000	13,000	13,000	13,000	13,000
City of Upland	1,729	1,284	2,140	2,140	2,140	2,140
Cucamonga Valley Water District	15,294	16,598	21,229	26,729	32,229	37,729
Fontana Union Water Company	0	0	0	0	0	0
Fontana Water Company	17,407	13,500	10,000	11,000	11,500	12,000
Jurupa Community Services District	15,934	20,087	18,123	21,616	21,616	21,616
Inland Empire Utilities Agency	0	0	0	0	0	0
Marygold Mutual Water Company	544	0	0	0	0	0
Metropolitan Water District of Southern California	0	0	0	0	0	0
Monte Vista Irrigation Company	0	0	0	0	0	0
Monte Vista Water District	14,250	16,000	17,000	18,500	20,000	21,500
Mutual Water Company of Glen Avon Heights	0	0	0	0	0	0
Niagara	988	657	795	838	770	770
San Antonio Water Company	416	894	1,149	1,282	1,282	1,282
San Bernardino County (Olympic Facility)	15	13	16	17	17	17
Santa Ana River Water Company	356	263	318	335	335	335
Golden State Water Company	599	329	397	419	419	419
West End Consolidated Water Company	0	0	0	0	0	0
West Valley Water District	0	0	0	0	0	0
Subtotal Appropriators	*144,857*	*152,834*	*166,445*	*184,269*	*199,939*	*212,589*
Total Production	173,710	177,567	182,937	192,520	208,190	220,840

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Table 4-2
Supplemental Water Recharge Capacity Estimates[1]
Availability for Supplemental Water Recharge Based on Mean Number of Storm Events

(1) Basin	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(16)	(17)	(18)	(19)	(21)	(22)	(23)	(24)	(25)
	Supplemental Water Recharge																					
	Operational Availability for Supplemental Water Recharge												Average Recharge Rate[2]	Turn Out Capacity				Theoretical Maximum Supplemental Water Recharge Capacity				
	Quarter 3			Quarter 4			Quarter 1			Quarter 2				Turn Out Name	Max Discharge Rate	Useful Discharge Rate	Turn Out Limited[3]?	Annual	Q3	Q4	Q1	Q2
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(cfs)		(cfs)	(cfs)		(acre-ft/Qtr)				
Brooks Street Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5				No	2,474	652	794	281	746
College Heights Basins	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	15				No	7,421	1,957	2,383	843	2,238
Montclair Basin 1	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	40	OC59	80	80	No	19,789	5,219	6,355	2,247	5,968
Montclair Basin 2	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77										
Montclair Basin 3	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77										
Montclair Basin 4	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77										
Seventh and Eighth Street Basins	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	CB20	30	*30*	No	2,474	652	794	281	746
Upland Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	20	OC59	80	80	No	9,895	2,610	3,177	1,124	2,984
Subtotal Management Zone 1																		***42,052***	***11,091***	***13,504***	***4,775***	***12,682***
Ely Basins	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	CB20	30	*30*	No	2,474	652	794	281	746
Etiwanda Spreading Area (Joint Use of Etiwanda Debris Basin)	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	7	CB14	30	*30*	No	3,463	913	1,112	393	1,044
Hickory Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	CB18	30	30	No	2,474	652	794	281	746
Lower Day Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	9	CB15	30	20	No	4,453	1,174	1,430	506	1,343
San Sevaine No. 1	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	50	CB13	33	33	16,326	16,326	4,306	5,243	1,854	4,924
San Sevaine No. 2	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77										
San Sevaine No. 3	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77										
San Sevaine Nos. 4 and 5	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77										
Turner Basins Nos. 1 and 2	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	3	CB11	40	9	No	1,484	391	477	169	448
Turner Basins Nos. 3 and 4	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77										
Victoria Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	6	CB14	30	*30*	No	2,968	783	953	337	895
Subtotal Management Zone 2																		***33,641***	***8,872***	***10,803***	***3,820***	***10,146***
Banana Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	5	CB18	30	*30*	No	2,474	652	794	281	746
Declez Basin	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	6					2,968	783	953	337	895
IEUA RP3 Ponds	0.71	0.71	0.74	0.80	0.90	0.93	0.00	0.00	0.93	0.87	0.83	0.77	7					3,463	913	1,112	393	1,044
Subtotal Management Zone 3																		***8,905***	***2,349***	***2,860***	***1,011***	***2,686***
Total																		**84,598**	**22,312**	**27,166**	**9,606**	**25,514**

1 -- Historical recharge estimates provided by IEUA. Recharge basins not optimized for storm water recharge; actual recharge performance could be improved.
2 -- Per Andy Campbell of IEUA, August 2007
3 -- Turn Out Capacity for the San Sevaine Basins is 30 cfs but is limited to 23 cfs due to operational considerations on the Rialto Feeder; 23 cfs assumed. All other turnouts exceed the recharge capacity of spreading basins.

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Table 4-3
Projected Groundwater Production, Replenishment, and Cumulative Unmet Replenishment Obligation
Baseline and Peace II Alternatives
(acre-ft)

Fiscal Year	Baseline Alternative							Peace II Alternative						
	Projected Production	Projected Production Rights	Projected Replenishment Obligation	Projected Replenishment			Cumulative Unmet Replenishment Obligation[1]	Projected Production	Projected Production Rights	Projected Replenishment Obligation	Projected Replenishment			Cumulative Unmet Replenishment Obligation
				Spreading	Injection	Total					Spreading	Injection	Total	
2007 - 2008	167,173	162,000	5,173	0	0	0	5,173	167,173	190,128	0	0	0	0	5,173
2008 - 2009	181,868	150,000	31,868	0	0	0	127,530	181,868	182,920	0	0	0	0	20,000
2009 - 2010	188,574	155,000	33,574	0	0	0	161,105	188,574	183,910	4,664	0	0	0	24,665
2010 - 2011	186,659	153,472	33,187	0	0	0	194,292	186,659	184,971	1,688	0	0	0	26,353
2011 - 2012	184,744	153,906	30,838	0	0	0	225,130	184,744	187,645	0	0	0	0	26,353
2012 - 2013	182,828	155,281	27,547	72,386	12,193	84,579	168,099	182,828	167,190	15,638	0	0	0	41,991
2013 - 2014	187,393	154,823	32,569	71,886	12,193	84,079	116,589	187,393	164,823	22,569	12,000	0	12,000	52,560
2014 - 2015	185,477	155,390	30,087	71,386	12,193	83,579	63,097	185,477	165,390	20,087	71,386	6,170	77,556	-4,909
2015 - 2016	186,953	153,317	33,635	70,886	12,193	83,079	13,654	186,953	163,317	23,635	70,886	6,170	77,056	-58,330
2016 - 2017	188,429	154,465	33,964	70,386	12,193	82,579	-34,961	188,429	164,465	23,964	70,386	6,170	76,556	-110,922
2017 - 2018	189,905	150,488	39,417	69,886	12,193	82,079	-77,623	189,905	160,488	29,417	69,886	6,170	76,056	-157,561
2018 - 2019	191,380	151,068	40,313	0	0	0	-37,310	191,380	161,068	30,313	0	0	0	-127,249
2019 - 2020	192,856	151,384	41,472	0	0	0	4,162	192,856	161,384	31,472	0	0	0	-95,777
2020 - 2021	195,925	151,930	43,995	0	0	0	48,157	195,925	161,930	33,995	0	0	0	-61,782
2021 - 2022	198,994	152,336	46,658	0	0	0	94,815	198,994	162,336	36,658	0	0	0	-25,124
2022 - 2023	202,064	152,791	49,273	66,186	19,632	85,818	58,269	202,064	162,791	39,273	66,186	6,170	72,356	-58,207
2023 - 2024	205,133	153,046	52,086	65,286	19,632	84,918	25,437	205,133	163,046	42,086	65,286	6,170	71,456	-87,577
2024 - 2025	208,202	153,152	55,050	64,386	19,632	84,018	-3,531	208,202	163,152	45,050	64,386	6,170	70,556	-113,083
2025 - 2026	210,632	153,157	57,475	63,486	19,632	83,118	-29,175	210,632	163,157	47,475	63,486	6,170	69,656	-135,264
2026 - 2027	213,062	153,167	59,895	62,586	19,632	82,218	-51,498	213,062	163,167	49,895	62,586	6,170	68,756	-154,125
2027 - 2028	215,492	153,177	62,315	61,686	19,632	81,318	-70,502	215,492	163,177	52,315	36,000	0	36,000	-137,810
2028 - 2029	217,922	153,286	64,636	0	0	0	-5,866	217,922	163,286	54,636	0	0	0	-83,175
2029 - 2030	220,852	153,445	67,407	0	0	0	61,541	220,852	163,445	57,407	0	0	0	-25,767
Total	4,502,517	3,530,081	972,436	810,435	190,949	1,001,384		4,502,517	3,867,187	662,238	652,476	55,530	708,006	
Average	195,762	153,482	42,280	35,236	8,302	43,538		195,762	168,139	28,793	28,369	2,414	30,783	

1. In 2009 the CURO increases by an additional 107,530 acre-ft for the Baseline Alternative to account for the unsatisfied replenishment obligation that would have occurred in the absence of re-operation.

Table 4-4
Optimization Constraints

Well Name	Owner	Ground Surface Elevation[1] (ft)	Pump Setting (ft bgs[3])	Pump Setting Elevation[1] (ft)	Constraint Type[2]	Drawdown Constraint Elevation[1] (ft)
ONT 17	City of Ontario	958	448	510	Pump Setting Elev. + 20 ft	530
ONT 20	City of Ontario	1047	536	511	Pump Setting Elev. + 20 ft	531
ONT 24	City of Ontario	991	492	499	Pump Setting Elev. + 20 ft	519
ONT 25	City of Ontario	981	500	481	Pump Setting Elev. + 20 ft	501
ONT 26	City of Ontario	958	440	518	Pump Setting Elev. + 20 ft	538
ONT 27	City of Ontario	906	361	545	Pump Setting Elev. + 20 ft	565
ONT 29	City of Ontario	961	440	521	Pump Setting Elev. + 20 ft	541
ONT 31	City of Ontario	938	420	518	Pump Setting Elev. + 20 ft	538
ONT 34	City of Ontario	906	500	406	Pump Setting Elev. + 20 ft	426
ONT 35	City of Ontario	977	522	455	Pump Setting Elev. + 20 ft	475
ONT 36	City of Ontario	892	420	472	Pump Setting Elev. + 20 ft	492
ONT 37	City of Ontario	978	394	584	Pump Setting Elev. + 20 ft	604
ONT 38	City of Ontario	1014	634	380	Pump Setting Elev. + 20 ft	400
ONT 39	City of Ontario	981	390	591	Pump Setting Elev. + 20 ft	611
ONT 40	City of Ontario	989	323	666	Pump Setting Elev. + 20 ft	686
ONT 41	City of Ontario	1030	455	575	Pump Setting Elev. + 20 ft	595
ONT 44	City of Ontario	1075	603	472	Pump Setting Elev. + 20 ft	492
ONT 45	City of Ontario	1023	560	463	Pump Setting Elev. + 20 ft	483
ONT 46	City of Ontario	1200	695	505	Pump Setting Elev. + 20 ft	525
ONT 47	City of Ontario	1024	500	524	Pump Setting Elev. + 20 ft	544
ONT 49	City of Ontario	903	405	498	Pump Setting Elev. + 20 ft	518
ONT 50	City of Ontario	794	316	478	Pump Setting Elev. + 20 ft	498
ONT 52	City of Ontario	1097	656	441	Pump Setting Elev. + 20 ft	461
CB-3	CVWD	1063	550	513	Pump Setting Elev. + 40 ft	553
CB-5	CVWD	1093	520	573	Pump Setting Elev. + 40 ft	613
CB-4	CVWD	1093	640	453	Pump Setting Elev. + 40 ft	493
CB-30	CVWD	1089	640	449	Pump Setting Elev. + 40 ft	489
CB-38	CVWD	1089	620	469	Pump Setting Elev. + 40 ft	509
CB-39	CVWD	1280	665	615	Pump Setting Elev. + 40 ft	655
CB-40	CVWD	1276	875	401	Pump Setting Elev. + 40 ft	441
CB-41	CVWD	1098	663	435	Pump Setting Elev. + 40 ft	475
CB-42	CVWD	1093	622	471	Pump Setting Elev. + 40 ft	511
CB-46	CVWD	1083	800	283	Pump Setting Elev. + 40 ft	323
JCSD 06	JCSD	843	301	542	Pump Setting Elev. + 10 ft	552
JCSD 08	JCSD	766	250	516	Pump Setting Elev. + 10 ft	526
JCSD 11	JCSD	774	270	504	Pump Setting Elev. + 10 ft	514
JCSD 12	JCSD	772	300	472	Pump Setting Elev. + 10 ft	482
JCSD 14	JCSD	770	260	510	Pump Setting Elev. + 10 ft	520
JCSD 15	JCSD	789	262	527	Pump Setting Elev. + 10 ft	537
JCSD 16	JCSD	777	260	517	Pump Setting Elev. + 10 ft	527
JCSD 17	JCSD	824	295	529	Pump Setting Elev. + 10 ft	539
JCSD 18	JCSD	810	365	445	Pump Setting Elev. + 10 ft	455
JCSD 19	JCSD	843	261	582	Pump Setting Elev. + 10 ft	592
JCSD 20	JCSD	830	307	523	Pump Setting Elev. + 10 ft	533
JCSD 22	JCSD	812	283	529	Pump Setting Elev. + 10 ft	539
JCSD 23	JCSD	767	262	505	Pump Setting Elev. + 10 ft	515
JCSD 24	JCSD	747	320	427	Pump Setting Elev. + 10 ft	437
JCSD 25	JCSD	805	257	548	Pump Setting Elev. + 10 ft	558
MVWD 04	MVWD	1191	690	501	Pump Setting Elev. + 20 ft	521
MVWD 05	MVWD	1172	740	432	Pump Setting Elev. + 20 ft	452
MVWD 06	MVWD	1122	620	502	Pump Setting Elev. + 20 ft	522
MVWD 10	MVWD	1057	700	357	Pump Setting Elev. + 20 ft	377
MVWD 19	MVWD	1043	620	423	Pump Setting Elev. + 20 ft	443
MVWD 26	MVWD	1119	685	434	Pump Setting Elev. + 20 ft	454
MVWD 27	MVWD	1188	700	488	Pump Setting Elev. + 20 ft	508
MVWD 28	MVWD	1053	760	293	Pump Setting Elev. + 20 ft	313
MVWD 30	MVWD	1074	585	489	Pump Setting Elev. + 20 ft	509
MVWD 31	MVWD	1196	880	316	Pump Setting Elev. + 20 ft	336
MVWD 32	MVWD	1031	600	431	Pump Setting Elev. + 20 ft	451
MVWD 33	MVWD	1101	630	471	Pump Setting Elev. + 20 ft	491

1. All elevations in feet above mean sea level
2. Constraints provided by well owner.
3. bgs = below ground surface

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Table 4-5
Production Well Pumping Priorities[1]

Agency	Well	Priority	Agency	Well	Priority
Cucamonga Valley Water District			***City of Ontario***		
	ASR1	1		16	1
	ASR4	1		17	1
	CB-2C	2		20	1
	CB-38	2		25	1
	CB-39	2		27	1
	ASR2	2		29	1
	CB-43	3		31	1
	CB-3	4		34	1
	ASR3	5		35	1
	CB-46	6		36	1
	CB-4	7		45	1
	CB-40	8		46	1
	CB-5	9		48	1
	CB-42	10		49	1
	CB-30	10		50	1
	CB-41	10		51	1
				52	1
Monte Vista Water District				101	1
	4	1		103	1
	5	1		104	1
	19	1		105	1
	26	1		106	1
	27	1		109	1
	28	1		119	1
	31	1		138	1
	33	1		100	2
	6	2		43	3
	30	3		47	4
	32	4		115	5
	34	5		44	6
	10	6		120	7
				136	8
Jurupa Community Services District				134	9
	IDI-1	1		111	10
	IDI-2	2		38	10
	ODA	3		42	11
	13	4		26	12
	18	4		126	12
	20	4		24	13
	25	5		37	13
	23	5		39	13
	17	5		41	13
	6	5		40	13
	Galleano	6			
	14	7			
	12	8			
	11	9			
	22	10			
	19	11			
	15	12			
	16	13			
	8	14			
	24	15			

1. ASR wells used for injection and other master planned production wells are assumed inoperable until after their planned start up dates.

Table 4-6

Assumed Capacities of Aquifer Storage and Recovery Wells Available to Watermaster for Replenishment

Well	Owner	Well Status	Extraction Rate (gpm)	Assumed Injection Rate[1] (gpm)	Assumed Injection Capacity[1] (acre-ft/yr)
27	Ontario	Existing non-ASR Well	1,100	550	444
51	Ontario	Planned	1,600	800	645
106	Ontario	Planned	2,500	1,250	1,008
109	Ontario	Planned	2,500	1,250	1,008
119	Ontario	Planned	2,500	1,250	1,008
138	Ontario	Planned	2,250	1,125	907
Assumed Ontario Total Injection Capacity				*6,225*	*5,020*
4	MVWD	Existing ASR Well	830	415	335
30	MVWD	Existing ASR Well	2,000	1,000	807
32	MVWD	Existing ASR Well	2,000	1,000	807
33	MVWD	Existing ASR Well	2,000	1,000	807
34	MVWD	Existing ASR Well	2,000	1,000	807
Assumed MVWD Total Injection Capacity				*4,415*	*3,561*
22	JCSD	Existing non-ASR	3,600	1,800	1,452
23	JCSD	Existing non-ASR	3,700	1,850	1,492
IDI-1	JCSD	Planned	2,000	1,000	807
IDI-2	JCSD	Planned	2,000	1,000	807
ODA	JCSD	Planned	2,000	1,000	807
Galleano	JCSD	Planned	2,000	1,000	807
Assumed JCSD Total Injection Capacity				*7,650*	*6,170*
CB-2C	CVWD	Planned	1,500	750	605
CB-38	CVWD	Existing non-ASR Well	2,550	1,275	1,028
CB-39	CVWD	Existing non-ASR Well	3,400	1,700	1,371
CB-46	CVWD	Existing non-ASR Well	2,500	1,250	1,008
ASR1	CVWD	Planned	2,000	1,000	807
ASR2	CVWD	Planned	2,000	1,000	807
ASR3	CVWD	Planned	2,000	1,000	807
Assumed CVWD Total Injection Capacity				*7,975*	*6,432*
Assumed Total Chino Basin Injection Capacity				26,265	21,183

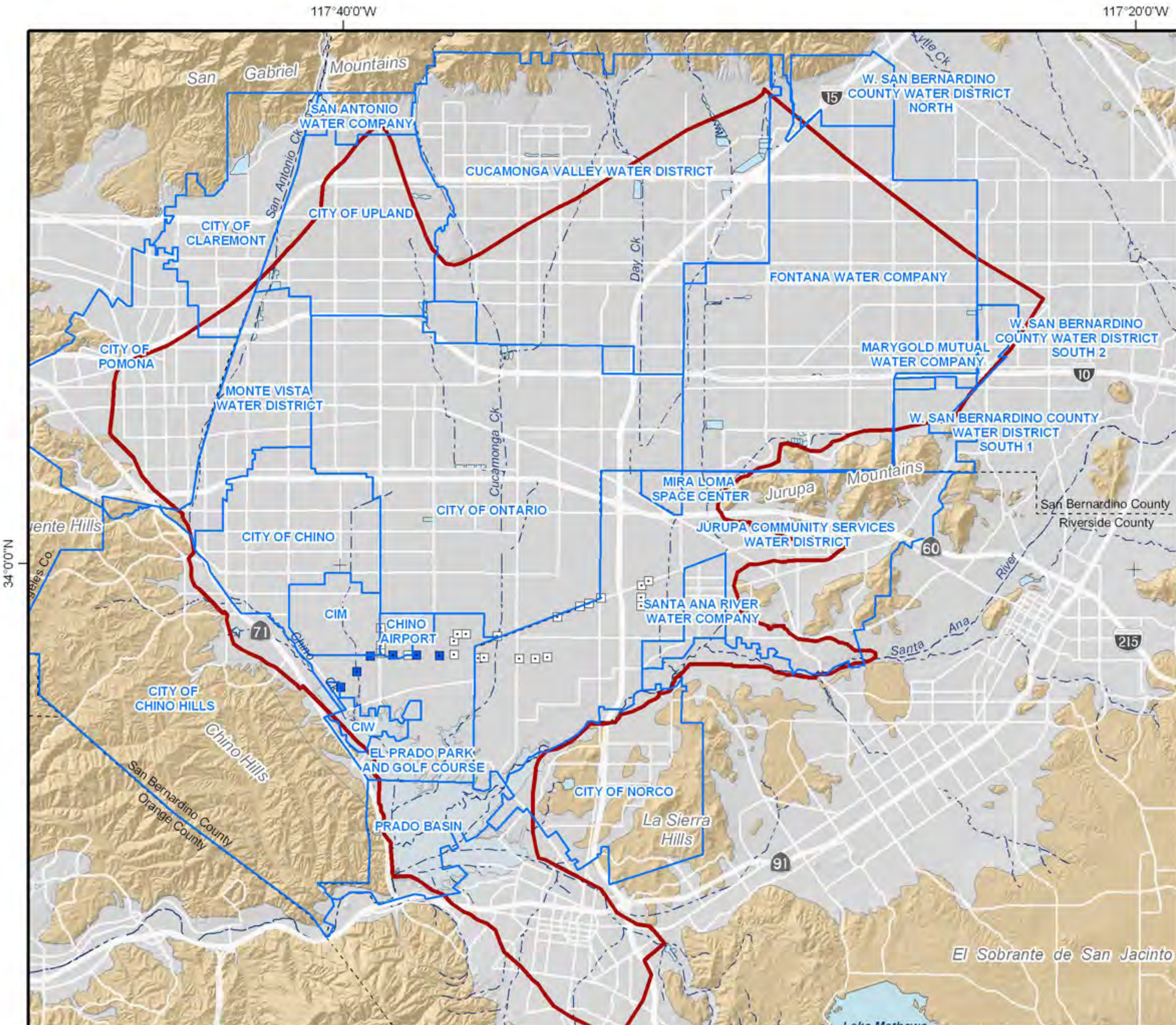
1. Injection rate is assumed to be 50 percent of extraction rate. Injection is assumed to only occur over winter 6-months period.

Table 4-7
Water Budget for Chino North, Chino East, Chino South, and Prado Basin Management Zones
Baseline Alternative
(acre-ft)

	Inflows								Outflows						
					Artificial Recharge										
	Boundary Inflow	Temescal to PBMZ	Deep Percolation of Precipitation and Applied Water	Stream Recharge	Storm	Imported Water	Recycled Water	Subtotal Inflows	Production	PBMZ to Temescal	ET	Rising Groundwater	Subtotal Outflow	Change in Storage	Cumulative Change in Storage
2006	32,703	6,294	86,301	25,507	11,646	24,759	2,980	190,190	151,206	2,069	14,799	15,658	183,732	6,458	6,458
2007	32,703	6,354	82,094	28,342	11,646	0	2,340	163,479	174,244	2,058	14,469	14,284	205,055	-41,576	-35,119
2008	32,703	5,926	83,013	30,153	11,646	0	5,000	168,441	167,173	2,013	14,333	13,869	197,389	-28,948	-64,066
2009	32,703	5,417	83,671	31,742	11,646	0	5,000	170,180	181,868	1,986	14,131	13,295	211,280	-41,101	-105,167
2010	32,703	5,566	82,150	33,578	11,646	0	10,000	175,643	188,574	2,235	13,943	12,459	217,212	-41,569	-146,736
2011	32,703	5,508	81,850	34,961	11,646	0	10,500	177,167	186,659	2,305	13,835	12,000	214,799	-37,632	-184,368
2012	32,703	5,263	79,177	35,997	11,646	0	11,000	175,785	184,744	2,310	13,719	11,687	212,460	-36,675	-221,043
2013	32,703	4,987	78,267	36,458	11,646	80,886	11,500	256,446	182,828	2,304	13,619	11,493	210,245	46,202	-174,841
2014	32,703	4,708	77,834	36,891	11,646	80,386	12,000	256,169	187,393	2,297	13,468	11,155	214,312	41,856	-132,985
2015	32,703	4,438	77,243	37,343	11,646	79,886	12,500	255,759	185,477	2,290	13,332	10,860	211,959	43,800	-89,185
2016	32,703	4,179	76,196	37,320	11,646	79,386	13,000	254,429	186,953	2,284	13,278	10,796	213,311	41,118	-48,067
2017	32,703	3,935	75,761	36,962	11,646	78,886	13,500	253,393	188,429	2,279	13,270	10,855	214,832	38,561	-9,506
2018	32,703	3,707	74,232	36,423	11,646	78,386	14,000	251,096	189,905	2,274	13,288	10,989	216,455	34,641	25,135
2019	32,703	3,498	73,531	35,996	11,646	0	14,500	171,874	191,380	2,269	13,316	11,140	218,106	-46,232	-21,097
2020	32,703	3,303	71,573	36,110	11,646	0	15,000	170,335	192,856	2,266	13,332	11,194	219,648	-49,313	-70,410
2021	32,703	3,120	71,111	36,489	11,646	0	15,900	170,970	195,925	2,264	13,320	11,145	222,654	-51,684	-122,095
2022	32,703	2,951	70,147	37,117	11,646	0	16,800	171,364	198,994	2,261	13,271	10,982	225,509	-54,145	-176,240
2023	32,703	2,792	68,772	37,720	11,646	85,186	17,700	256,518	202,064	2,258	13,204	10,778	228,303	28,214	-148,026
2024	32,703	2,640	67,887	37,943	11,646	84,286	18,600	255,704	205,133	2,258	13,156	10,667	231,213	24,491	-123,535
2025	32,703	2,498	66,934	38,122	11,646	83,386	19,500	254,789	208,202	2,256	13,120	10,593	234,172	20,617	-102,918
2026	32,703	2,366	66,058	38,341	11,646	82,486	20,400	254,000	210,632	2,249	13,076	10,496	236,452	17,548	-85,371
2027	32,703	2,241	65,444	38,481	11,646	81,586	21,300	253,401	213,062	2,241	13,034	10,417	238,754	14,647	-70,723
2028	32,703	2,120	64,550	38,585	11,646	80,686	22,200	252,490	215,492	2,235	13,003	10,365	241,095	11,395	-59,328
2029	32,703	2,006	64,037	38,879	11,646	0	23,100	172,372	217,922	2,229	12,969	10,277	243,397	-71,025	-130,354
2030	32,703	1,903	63,215	39,704	11,646	0	24,000	173,170	220,852	2,224	12,911	10,087	246,075	-72,904	-203,258
Total	817,567	97,720	1,851,046	895,165	291,150	1,000,194	352,320	5,305,161	4,827,967	55,713	337,198	287,541	5,508,419	-203,258	
Average	32,703	3,909	74,042	35,807	11,646	40,008	14,093	212,206	193,119	2,229	13,488	11,502	220,337	-8,130	
Maximum	32,703	6,354	86,301	39,704	11,646	85,186	24,000	256,518	220,852	2,310	14,799	15,658	246,075	46,202	
Minimum	32,703	1,903	63,215	25,507	11,646	0	2,340	163,479	151,206	1,986	12,911	10,087	183,732	-72,904	

Table 4-8
Summary of Groundwater Level Changes by Water Service Area, 2005 through 2030
(feet)

Agency Service Area	Initial Groundwater Elevation (07/2005)			Projected Baseline Groundwater Elevation 06/2030			Projected Peace II Alternative Groundwater Elevation 06/2030			Projected Change in Groundwater Elevation Baseline 2030-2005			Projected Change in Groundwater Elevation Peace II Alternative 2030-2005			Projected Difference in Groundwater Elevation Between Baseline and Peace II Alternative		
Layer 1	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**	**Max**	**Min**	**Average**	**Max**	**Min**	**Average**	**Max**	**Min**	**Average**
Cucamonga Valley Water District	593	798	705	601	797	690	575	786	671	-38	10	-15	-56	-7	-34	-27	-11	-19
Fontana Water Company	617	824	742	607	797	736	591	789	723	-26	7	-6	-41	-6	-19	-18	-8	-13
City of Upland	603	685	636	567	688	632	540	672	610	-43	4	-3	-70	-14	-27	-28	-17	-23
City of Pomona	548	589	565	557	592	577	529	570	552	-23	21	11	-49	-3	-14	-28	-21	-25
Monte Vista Water District	561	612	583	560	593	575	532	575	551	-43	16	-8	-71	-5	-33	-28	-16	-24
City of Ontario	527	690	588	518	679	575	508	664	556	-40	6	-13	-57	-12	-32	-27	-10	-20
City of Chino	486	598	547	486	595	539	478	579	526	-27	5	-7	-43	0	-20	-25	0	-13
Jurupa Community Services District	507	701	587	506	695	569	504	692	561	-49	0	-18	-65	1	-26	-21	0	-8
Layer 2	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**	**Max**	**Min**	**Average**	**Max**	**Min**	**Average**	**Max**	**Min**	**Average**
Cucamonga Valley Water District	591	799	705	595	798	690	570	787	671	-37	14	-15	-56	-7	-34	-25	-11	-19
Fontana Water Company	617	824	742	607	797	736	590	789	723	-26	9	-6	-41	-4	-19	-18	-8	-13
City of Upland	604	684	636	566	687	632	539	670	609	-43	4	-3	-70	-14	-26	-27	-17	-23
City of Pomona	529	561	545	501	537	525	478	512	501	-32	-14	-21	-56	-38	-44	-25	-20	-23
Monte Vista Water District	533	612	566	505	585	537	482	558	514	-47	-13	-28	-73	-38	-52	-27	-18	-23
City of Ontario	529	690	584	513	680	567	493	663	548	-40	6	-17	-60	-14	-36	-26	-10	-19
City of Chino	490	558	533	480	537	509	463	518	497	-63	0	-24	-80	0	-36	-21	0	-12
Jurupa Community Services District	507	657	564	501	649	541	493	634	531	-52	0	-23	-67	-1	-33	-21	0	-10



117°40'0"W

Main Features

Water Service Area Boundaries

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- ? Location Uncertain
- Approximate Location of Groundwater Barrier

Other Features

- Existing Chino Desalter Well
- Proposed Chino Desalter Well
- Groundwater Flow Model Boundary
- Flood Control/Conservation Basins
- Streams, Rivers, and Channels

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0 1 2 3 4 Miles

0 2 4 6 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Water Service Areas

Figure 4-1

Figure 4-2a
Projected Groundwater Production in the Chino Basin for the Baseline Alternative

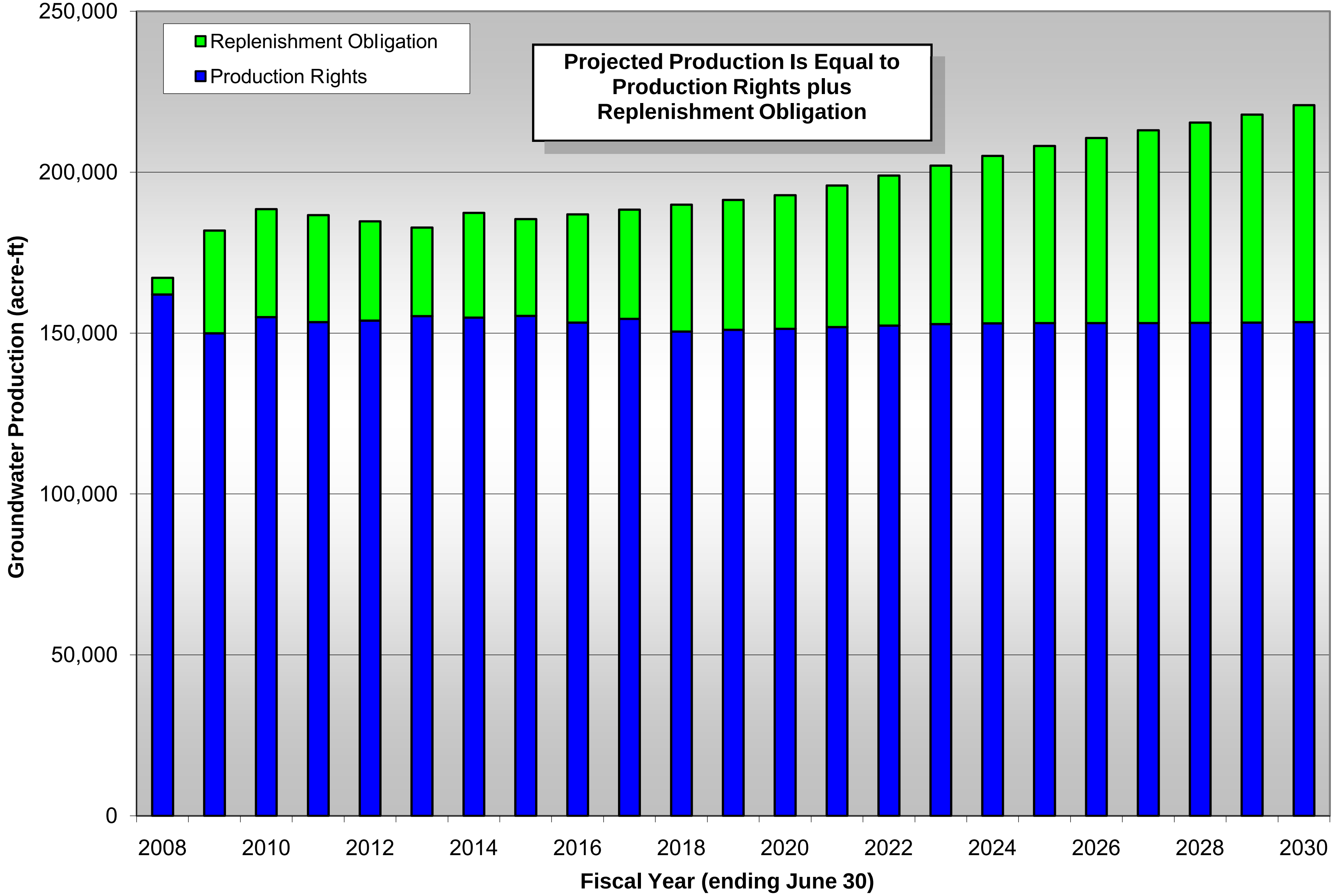

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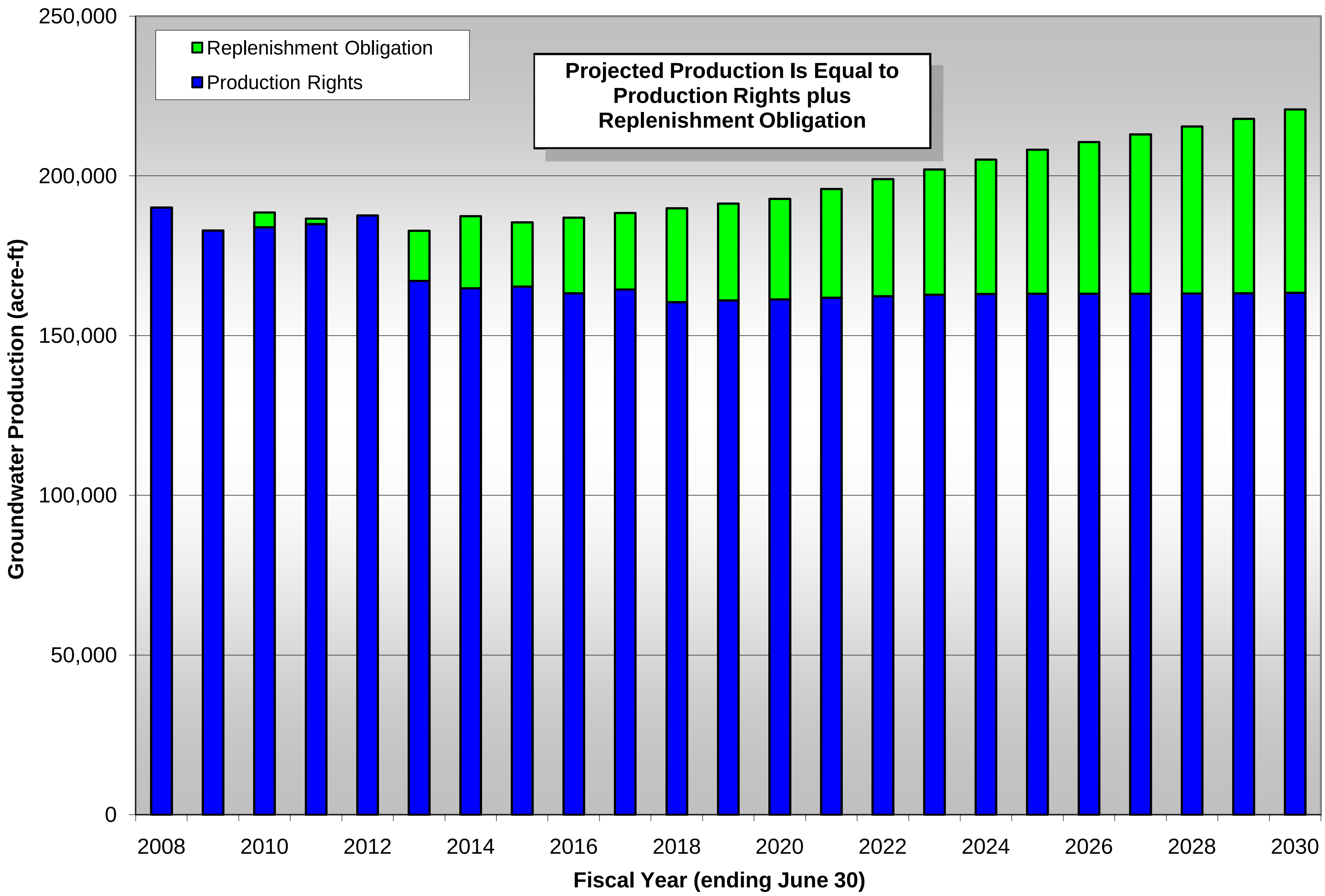
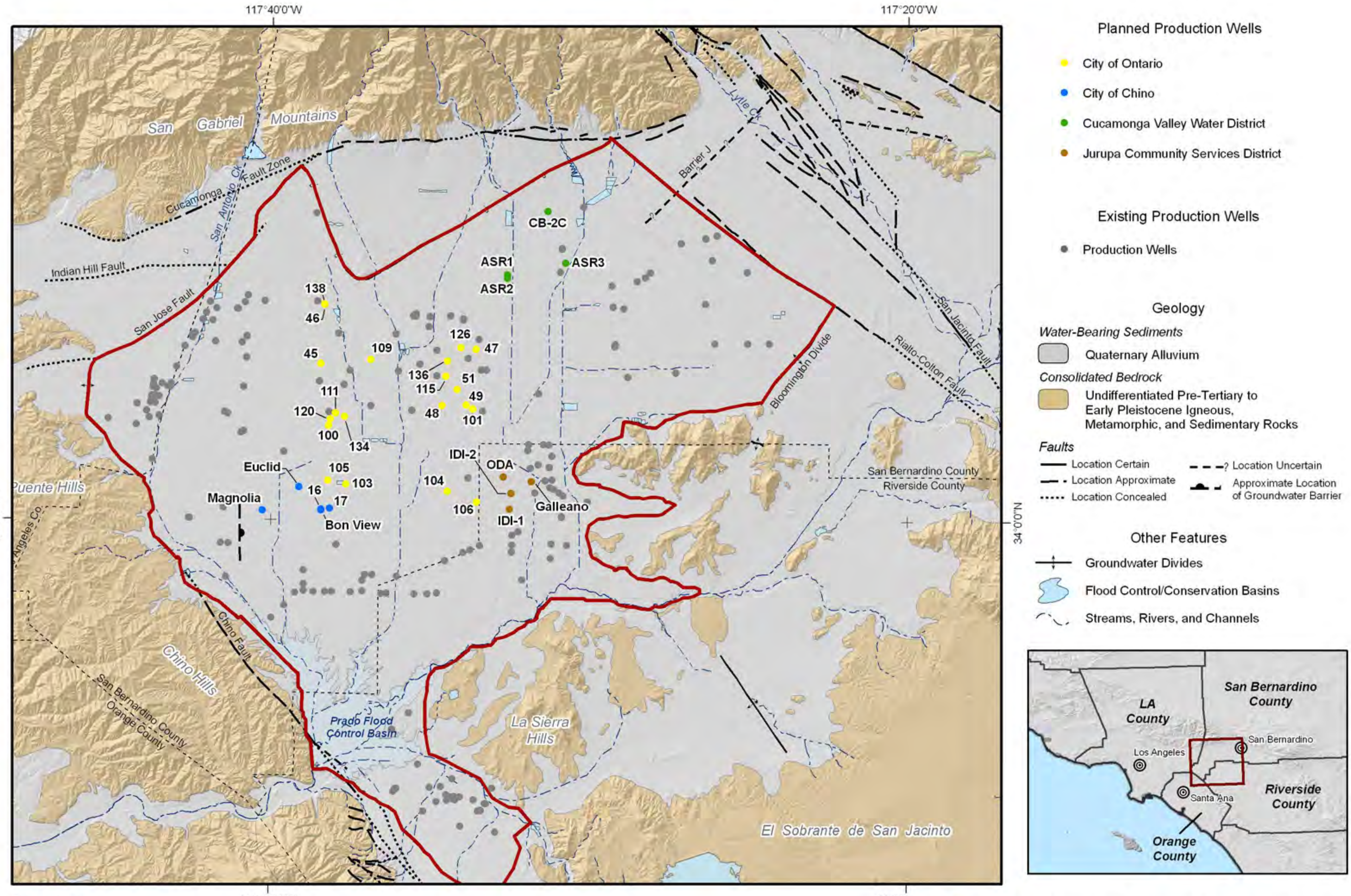
Figure 4-2b
Projected Groundwater Production in the Chino Basin for the Peace II Alternative





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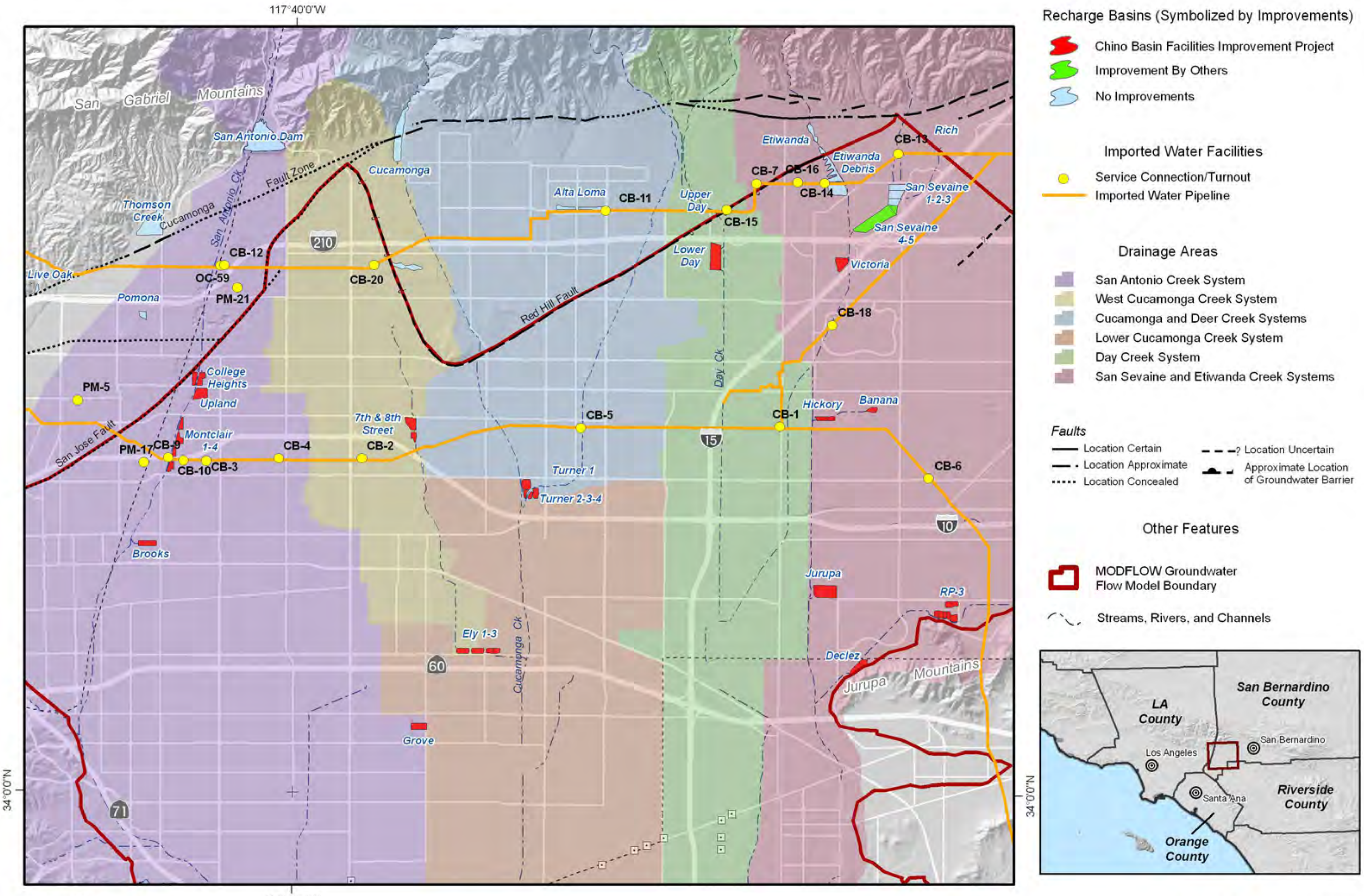
CHINO BASIN WATERMASTER — Partners in Basin Management

2009 Production Optimization and Evaluation of the Peace II Project Description

Existing and Planned Production Wells

Figure 4-3



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2009 Production Optimization and Evaluation of the Peace II Project Description

Groundwater Recharge and Imported Water Facilities

Figure 4-4

Figure 4-5
Assumed Replenishment Water Deliveries for the Chino Basin

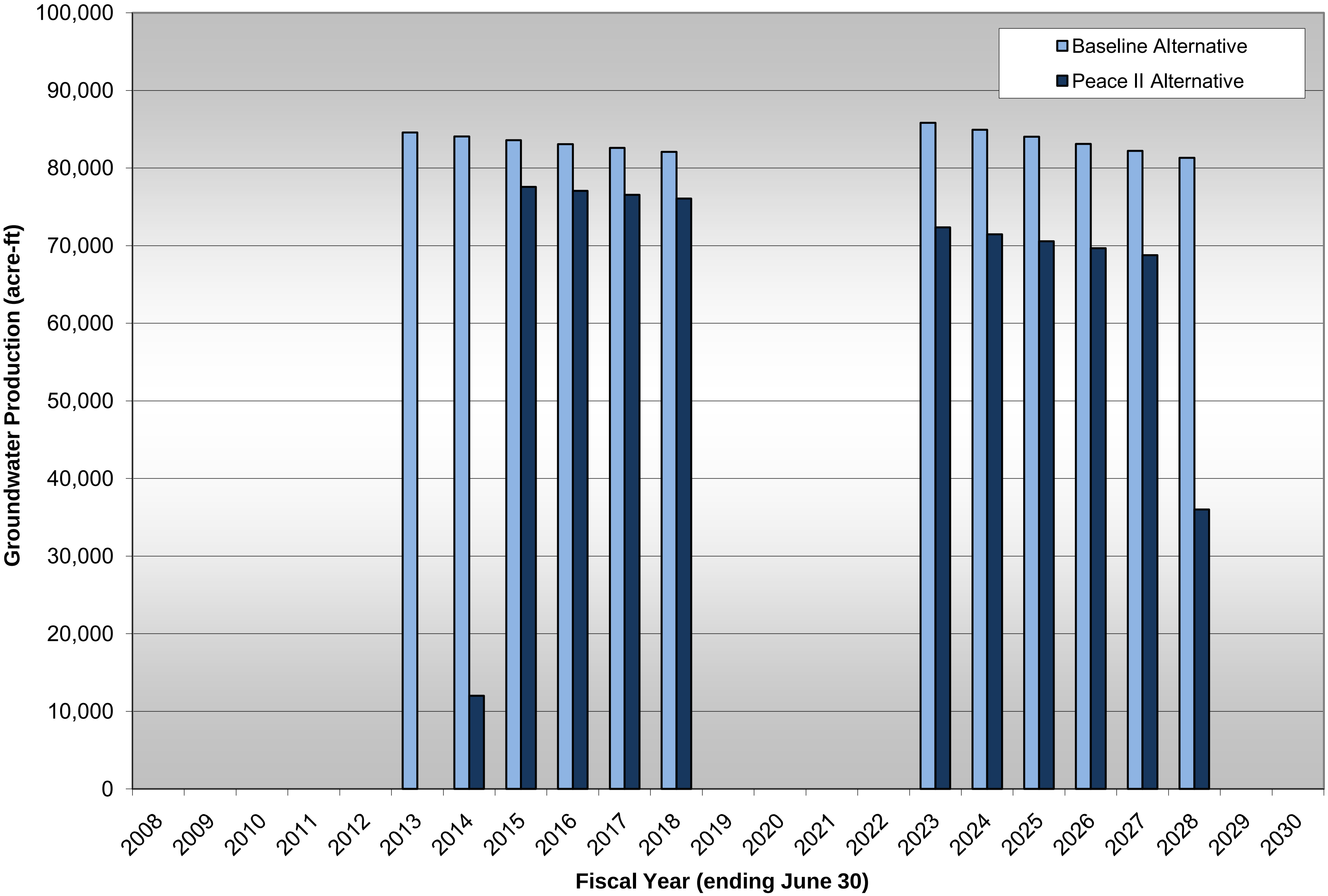
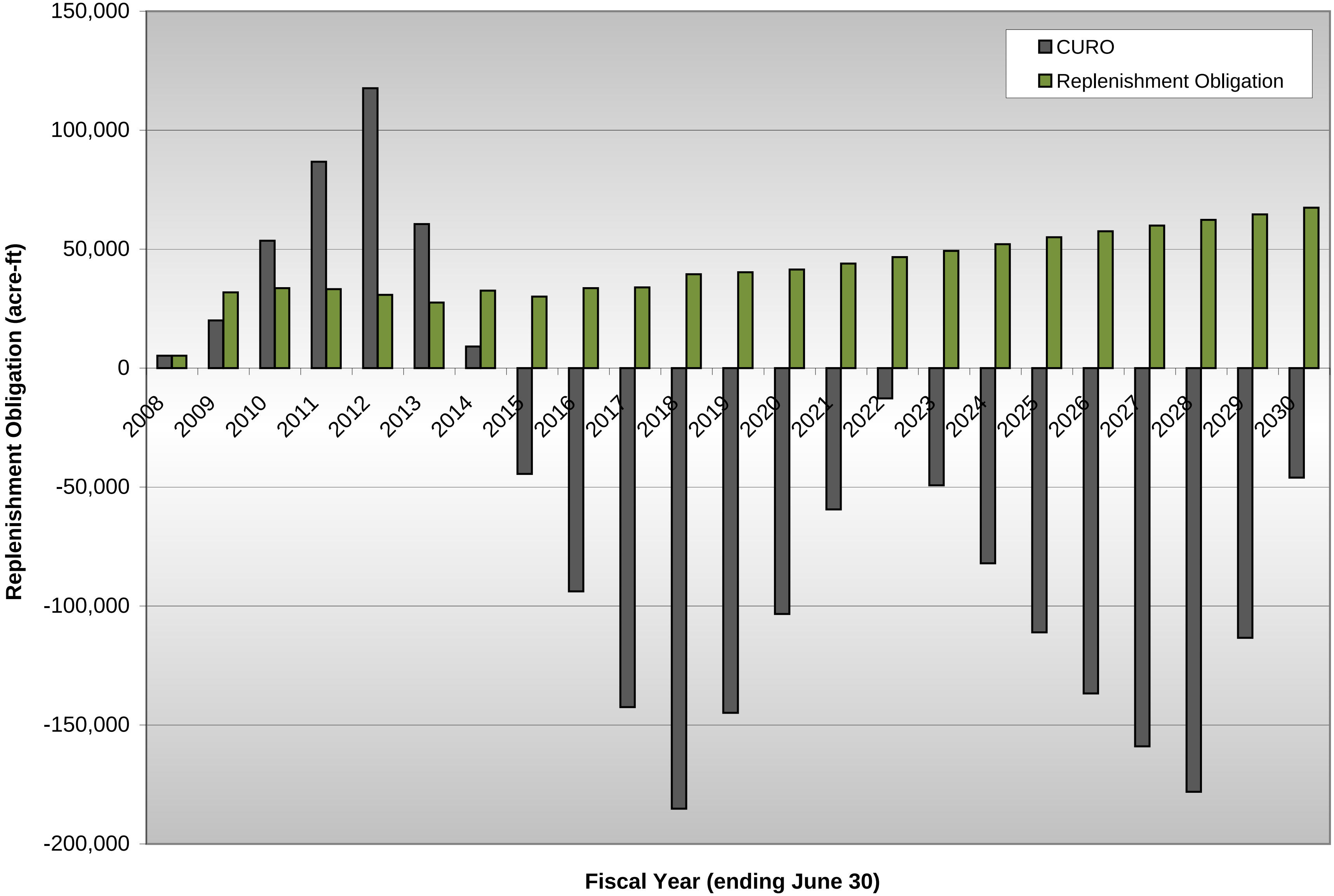


Figure 4-6a
Projected Groundwater Replenishment Obligation and CURO for the Baseline Alternative



20091111_Revised 20100409 Figures 4-2_4-4_4-5 (2) -- Figure 4-6a
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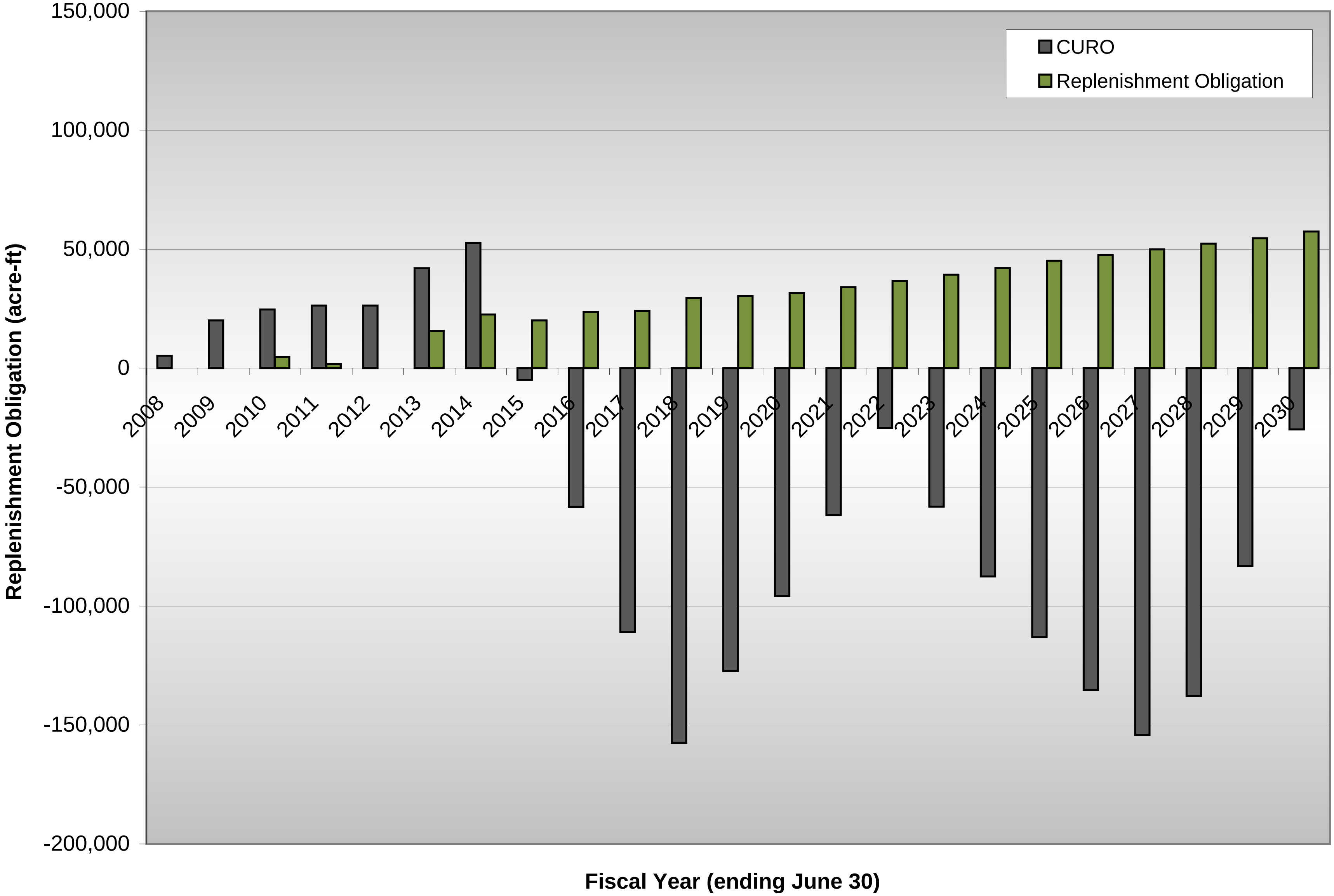
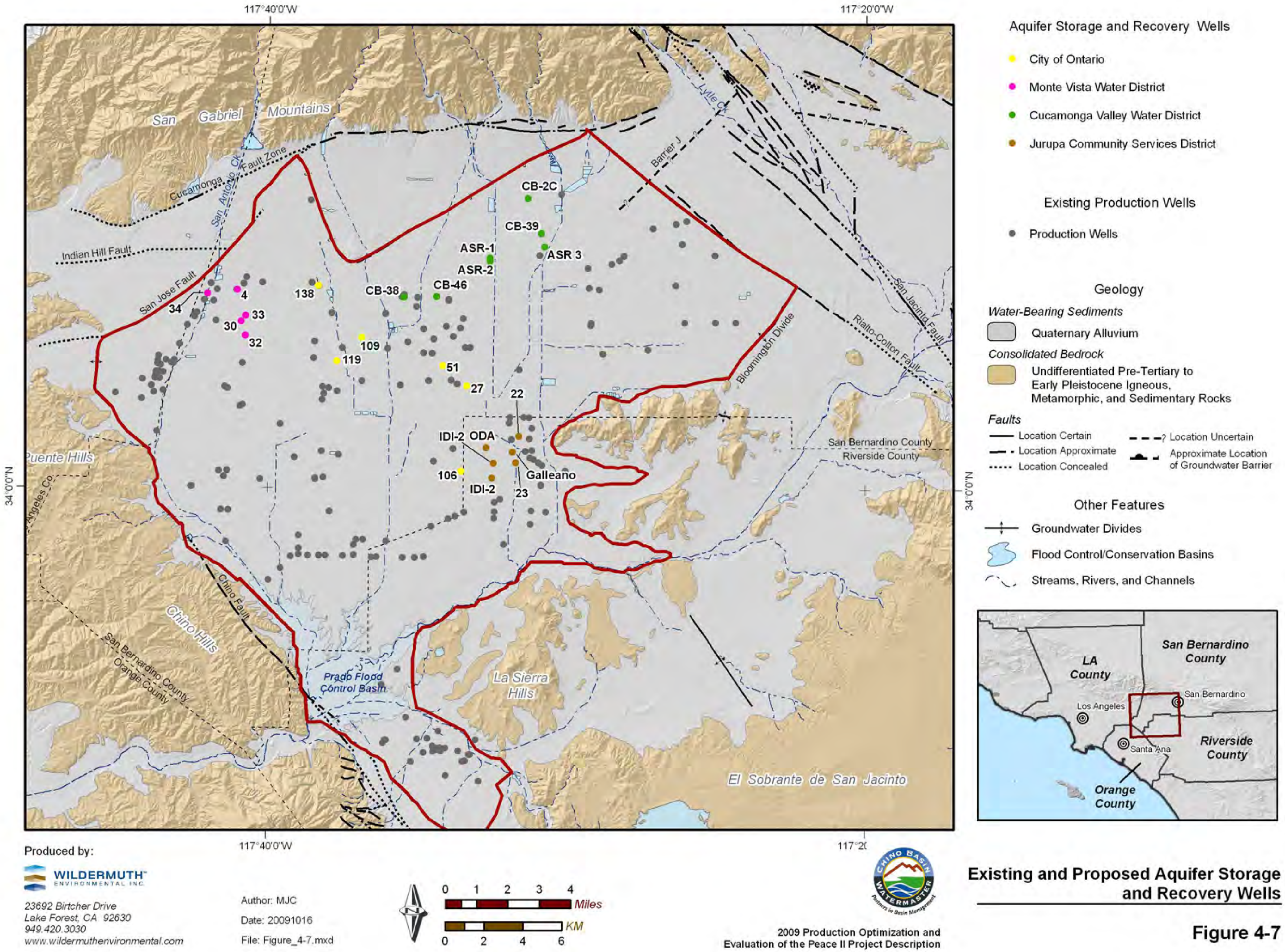
Figure 4-6b
Projected Groundwater Replenishment Obligation and CURO for the Peace II Alternative





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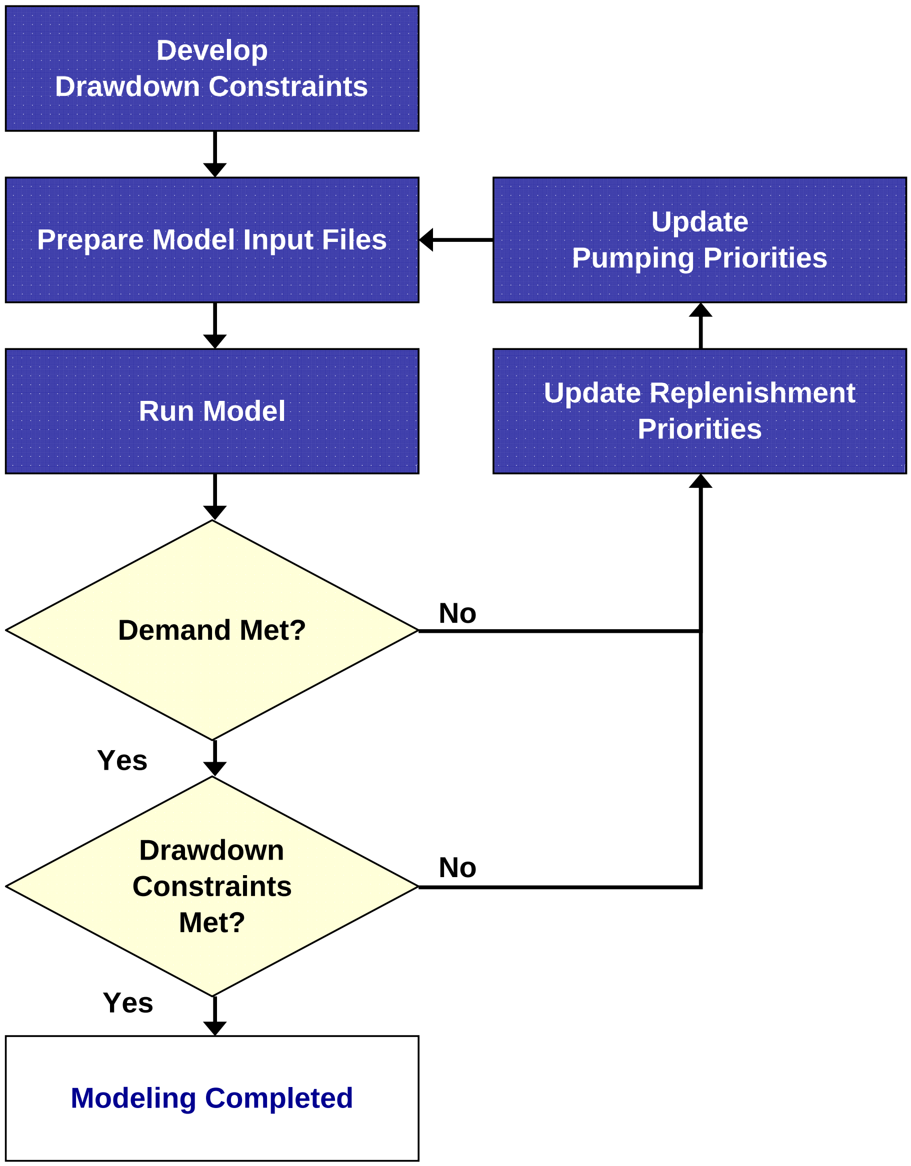
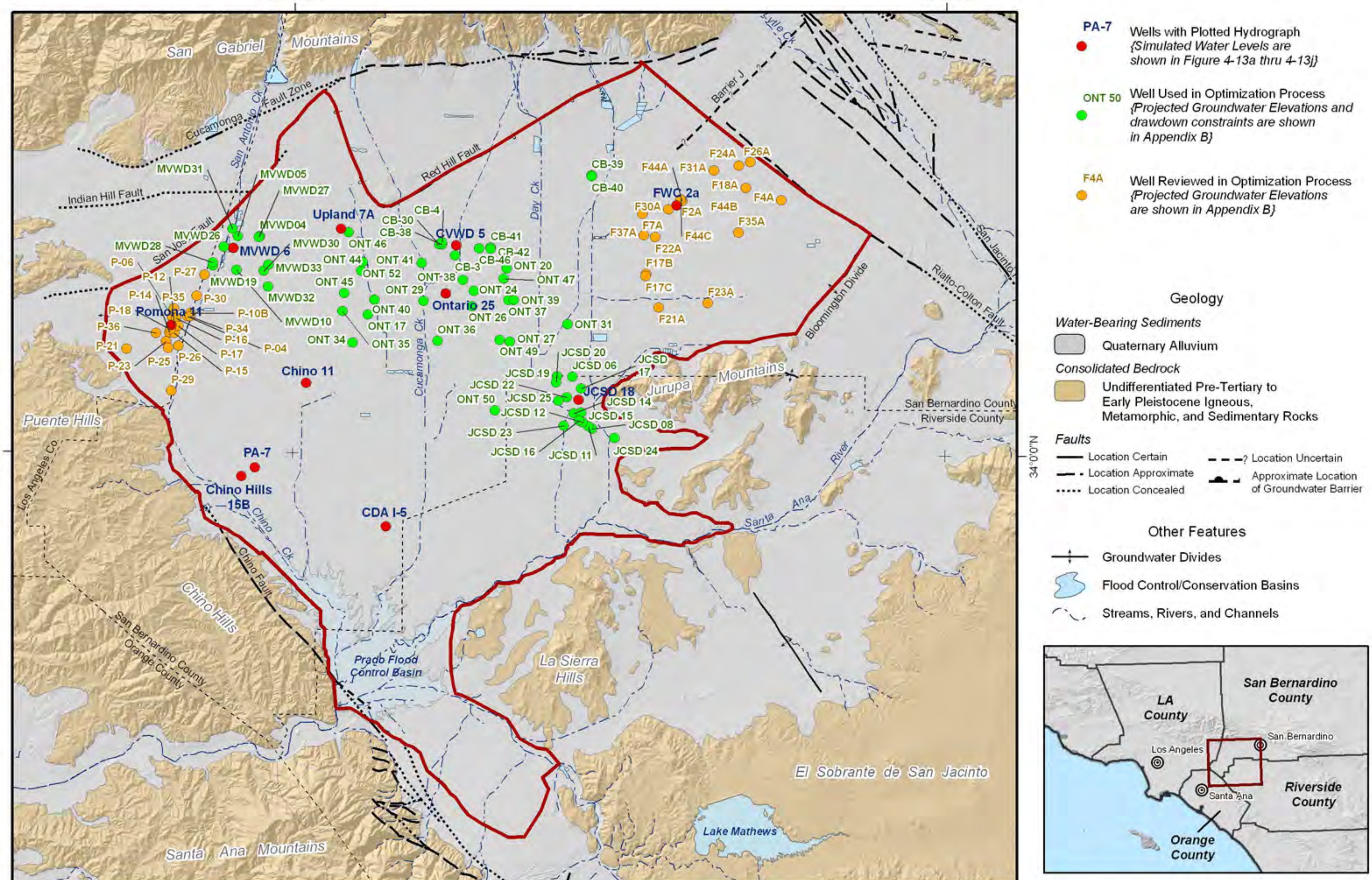
Existing and Proposed Aquifer Storage and Recovery Wells

Figure 4-7

Figure 4-8
Process Flow Diagram for Production and Replenishment Optimization





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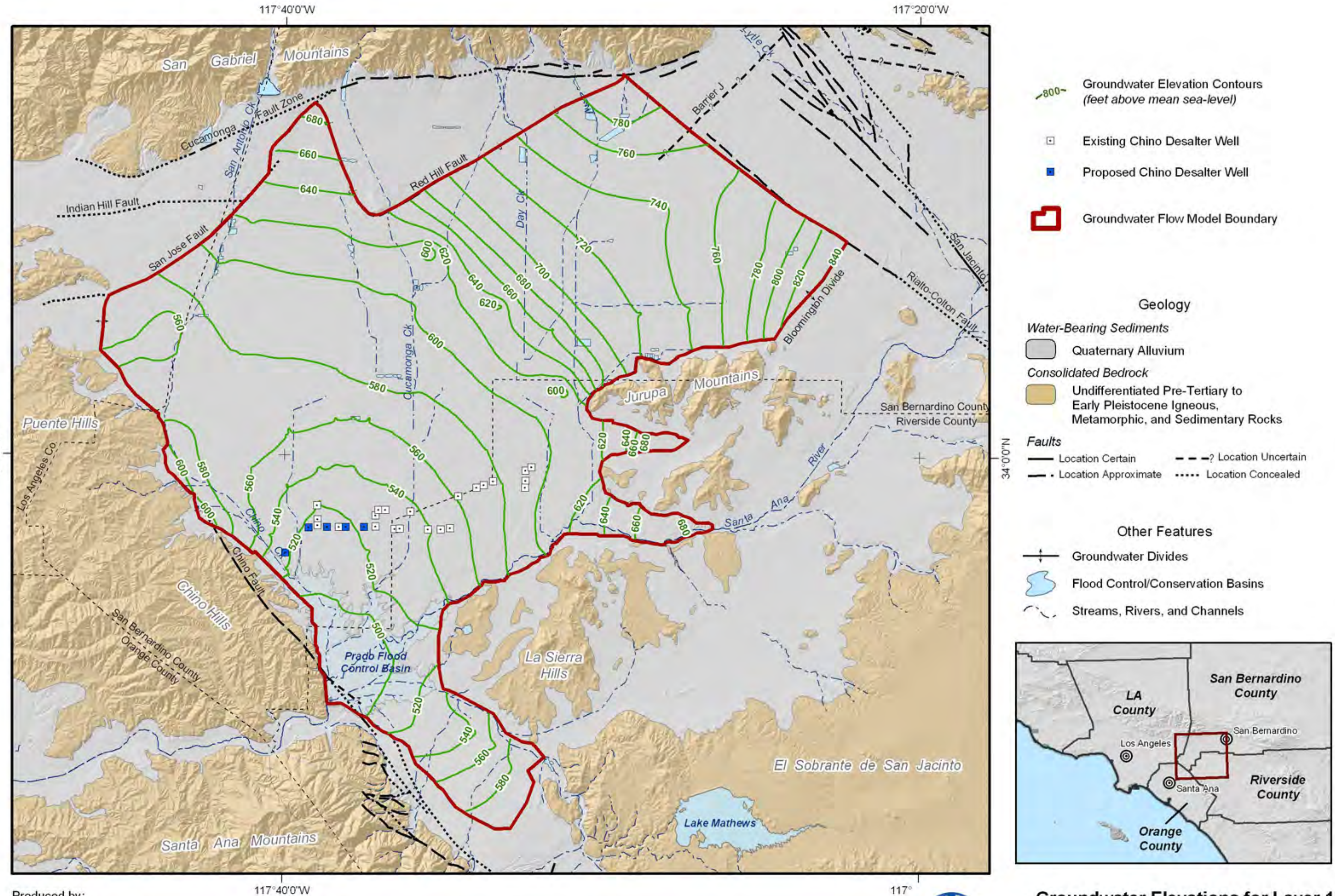
0 1 2 3 4 Miles

0 2 4 6 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Wells of Interest for Production and Recharge Optimization

Figure 4-9



Groundwater Elevation Contours (feet above mean sea-level)

Existing Chino Desalter Well

Proposed Chino Desalter Well

Groundwater Flow Model Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

Location Certain

Location Approximate

Location Uncertain

Location Concealed

Other Features

Groundwater Divides

Flood Control/Conservation Basins

Streams, Rivers, and Channels

0 1 2 3 4 Miles

0 2 4 6 KM

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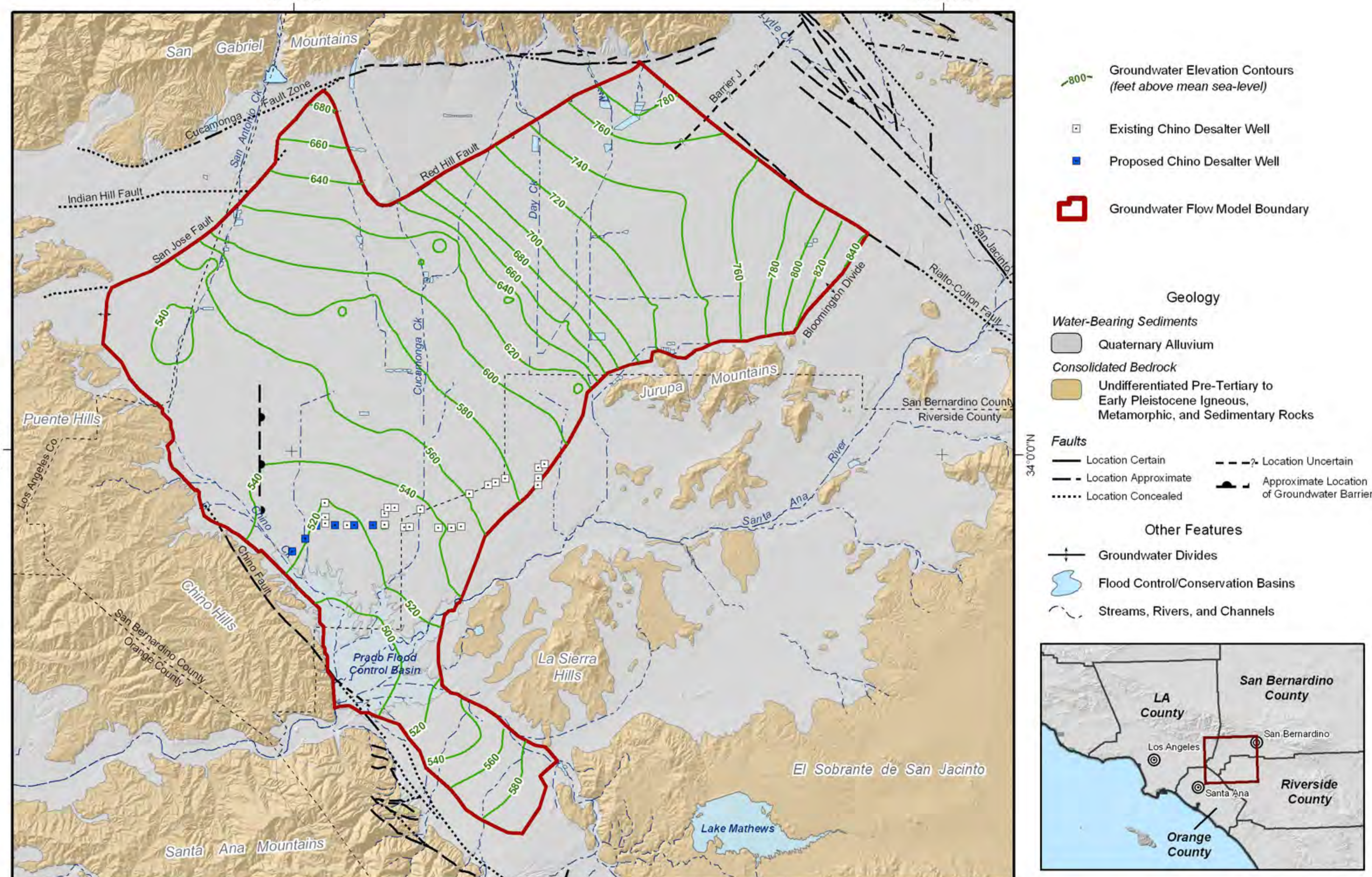
2009 Production Optimization and Evaluation of the Peace II Project Description

Groundwater Elevations for Layer 1

July 2005

Figure 4-10a



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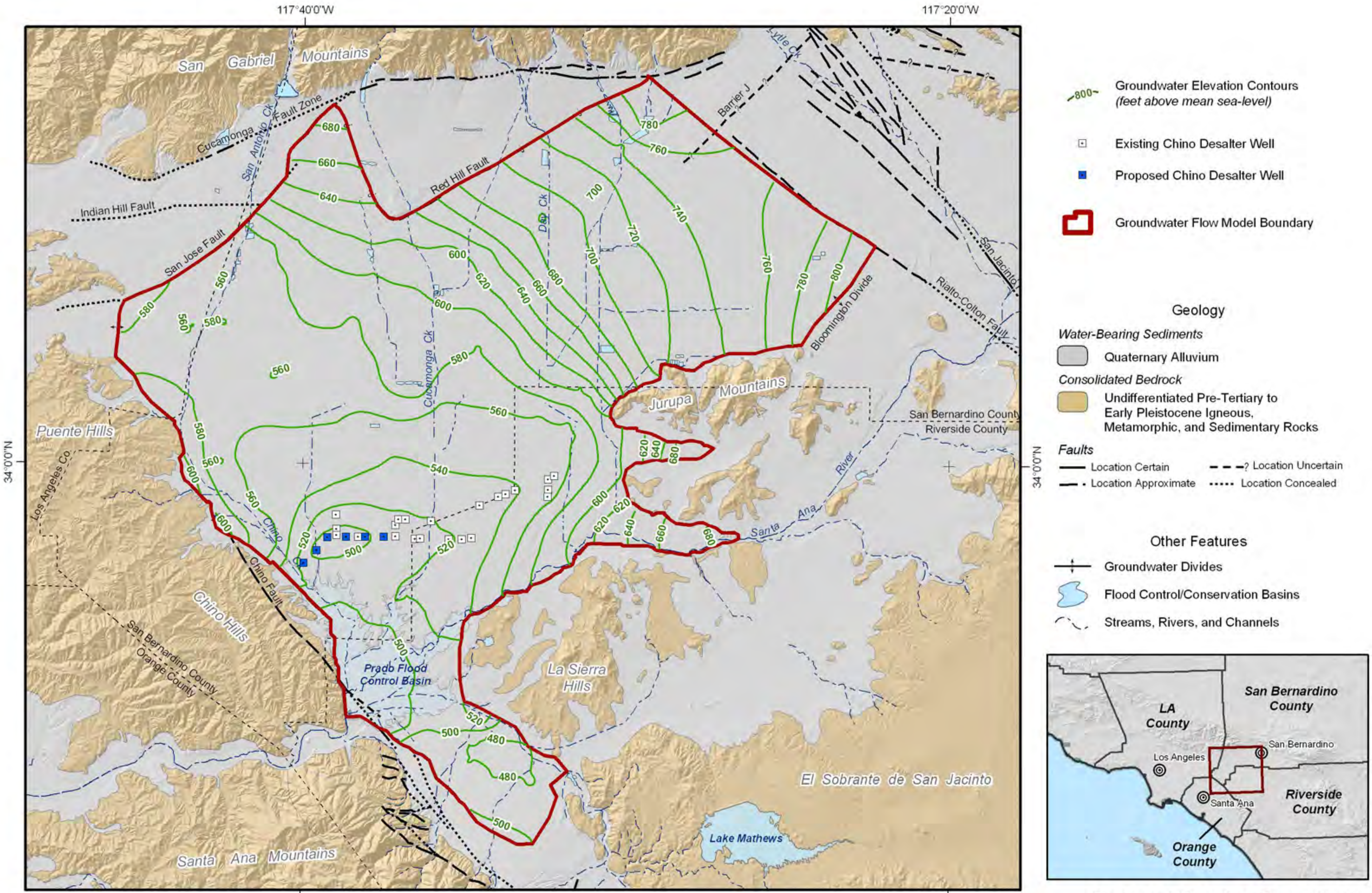
2009 Production Optimization and Evaluation of the Peace II Project Description

Groundwater Elevations for Layer 2

July 2005

Figure 4-10b



Projected Baseline Groundwater Elevations for Layer 1

July 2030

Figure 4-11a

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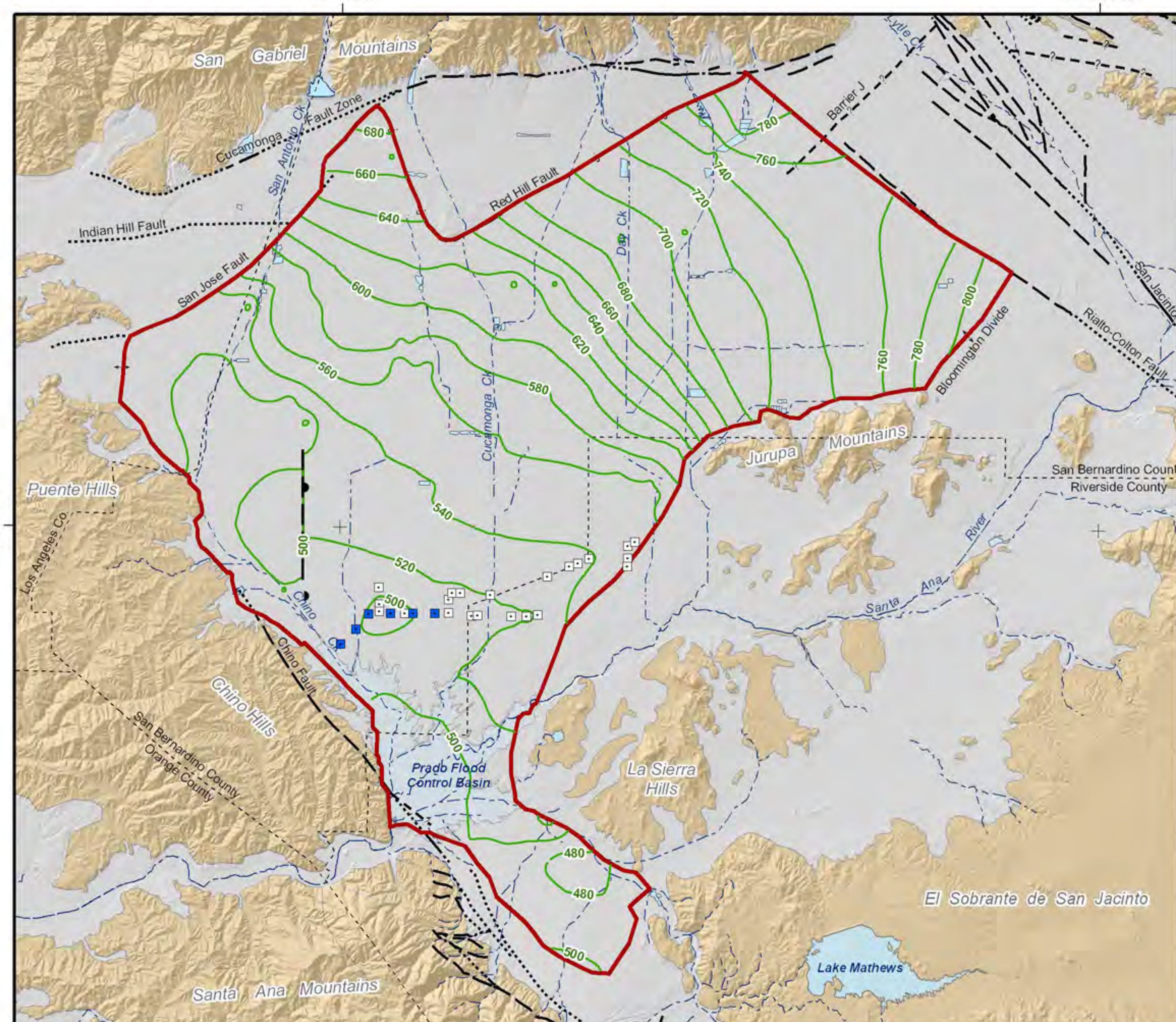

Groundwater Elevation Contours *(feet above mean sea-level)*

Existing Chino Desalter Well

Proposed Chino Desalter Well

Groundwater Flow Model Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

Location Certain

Location Approximate

Location Concealed

Location Uncertain

Approximate Location of Groundwater Barrier

Other Features

Groundwater Divides

Flood Control/Conservation Basins

Streams, Rivers, and Channels

Projected Baseline Groundwater Elevations for Layer 2

July 2030

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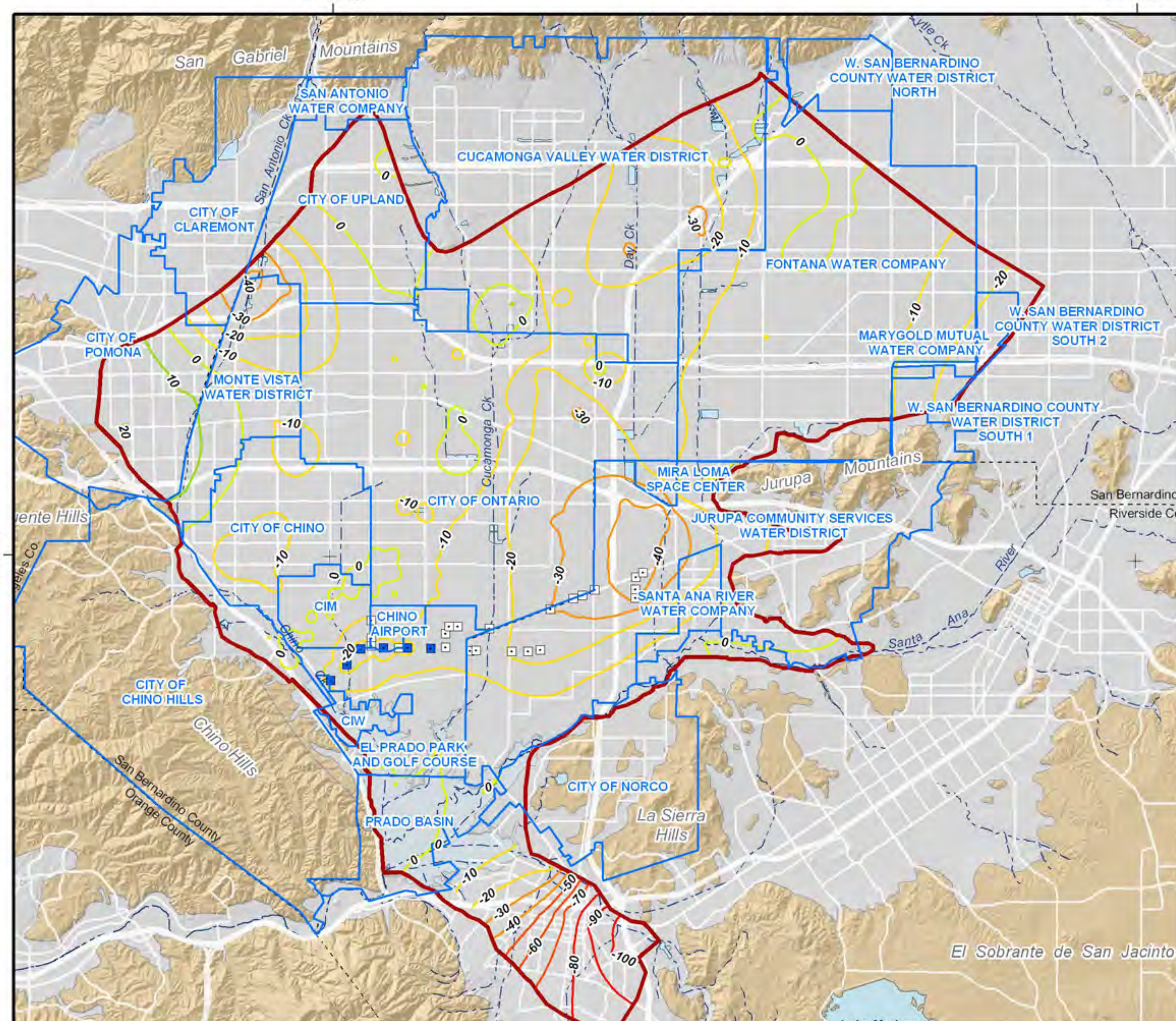
0 1 2 3 4 Miles

0 2 4 6 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Figure 4-11b



Main Features

Contours of Equal Groundwater Elevation Change from July 2005 to June 2030 (feet)

- 50 - 75
- 25 - 50
- 0 - 25
- 0
- 0 - -25
- -25- -50
- -50 - -75
- -75 - -100

Water Service Area Boundaries

Other Features

- Existing Chino Desalter Well
- Proposed Chino Desalter Well
- Groundwater Flow Model Boundary
- Flood Control/Conservation Basins
- Streams, Rivers, and Channels

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0 1 2 3 4 Miles

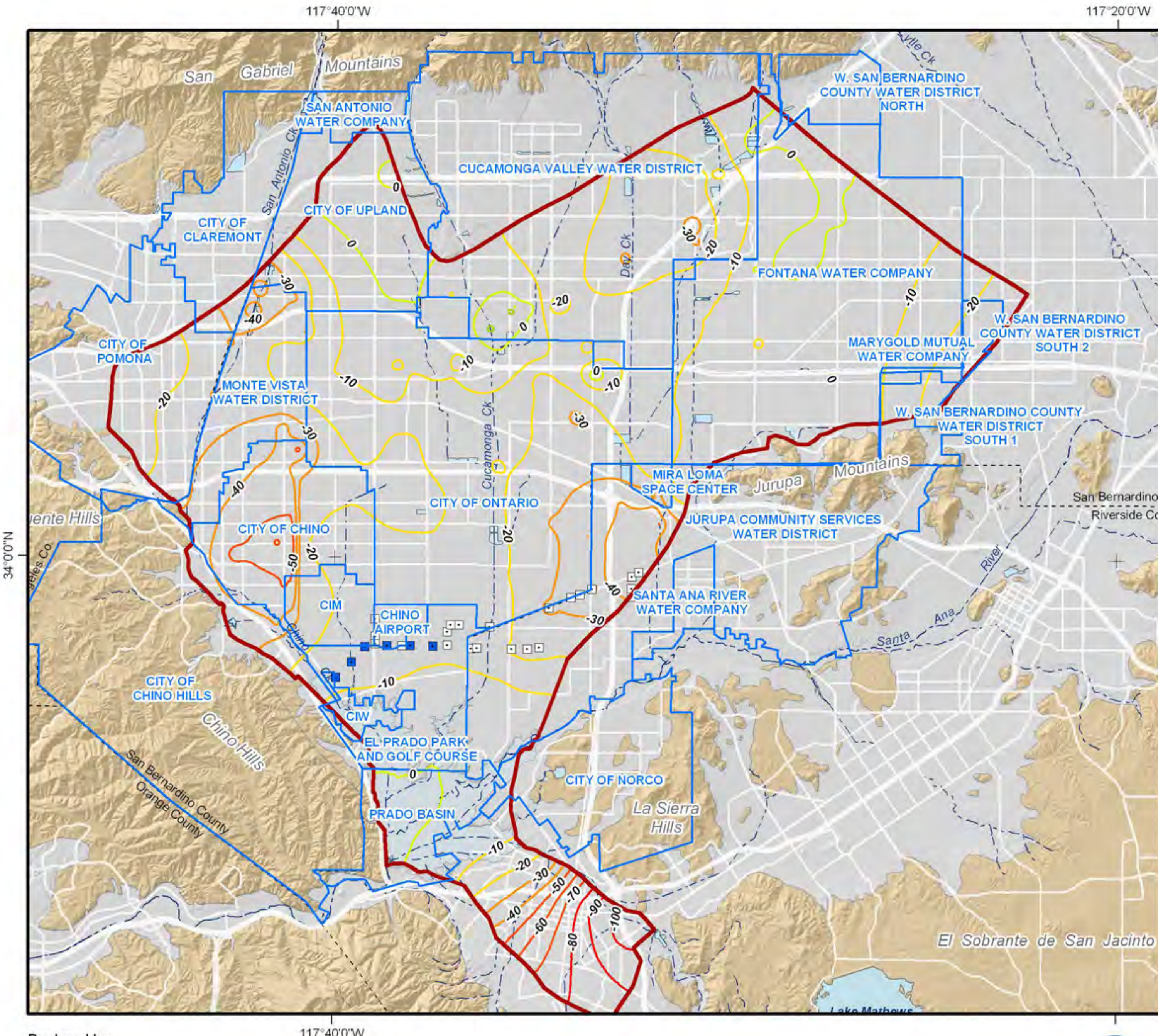
0 2 4 6 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Projected Baseline Groundwater Elevation Change

for Layer 1 in June 2030

Figure 4-12a



Main Features

- 50 - 75
- 25 - 50
- 0 - 25
- 0
- 0 - -25
- -25- -50
- -50 - -75
- -75 - -100

Contours of Equal Groundwater Elevation Change from July 2005 to June 2030 (feet)

Water Service Area Boundaries

Other Features

Existing Chino Desalter Well

Proposed Chino Desalter Well

Groundwater Flow Model Boundary

Flood Control/Conservation Basins

Streams, Rivers, and Channels

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0 1 2 3 4 Miles

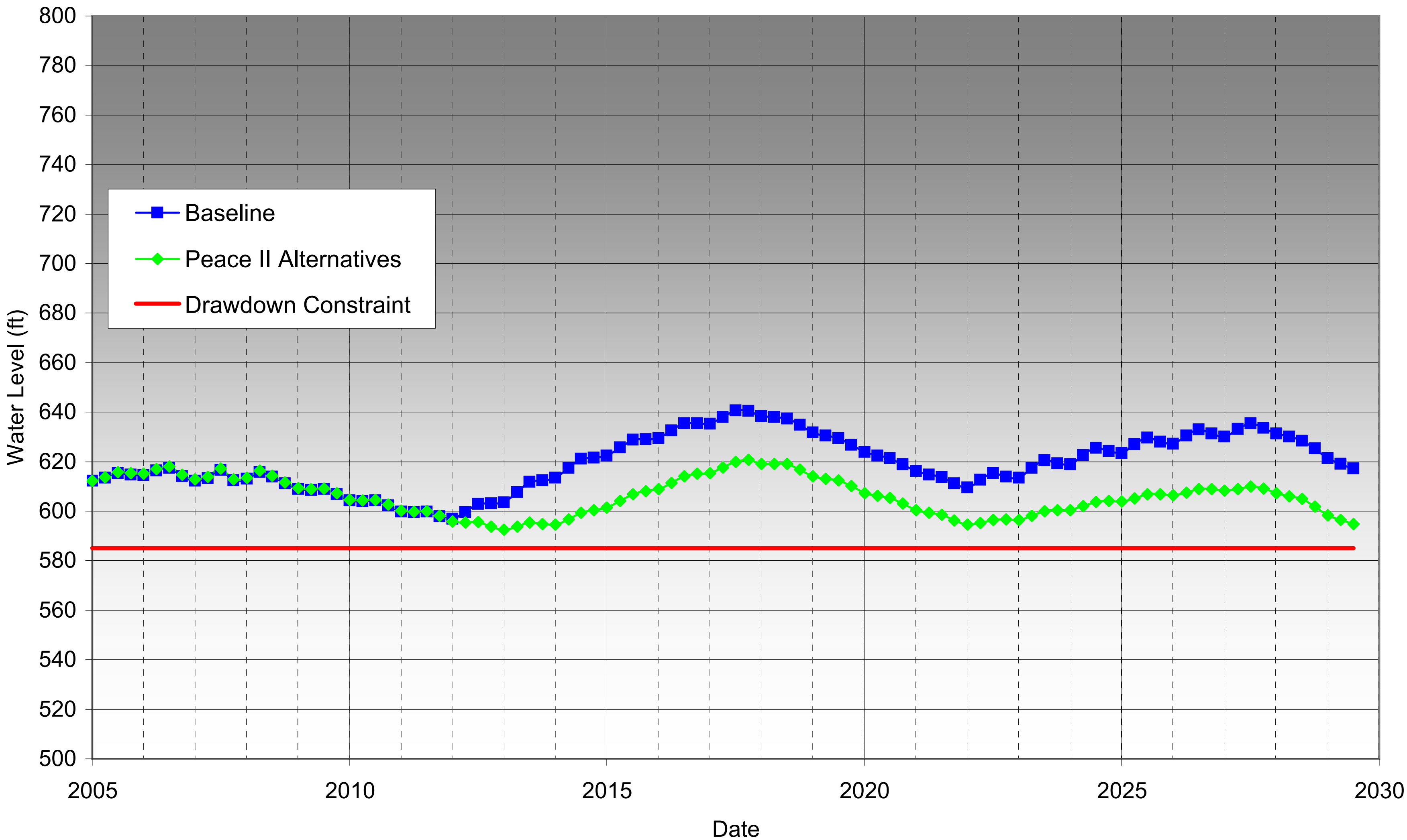
0 2 4 6 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

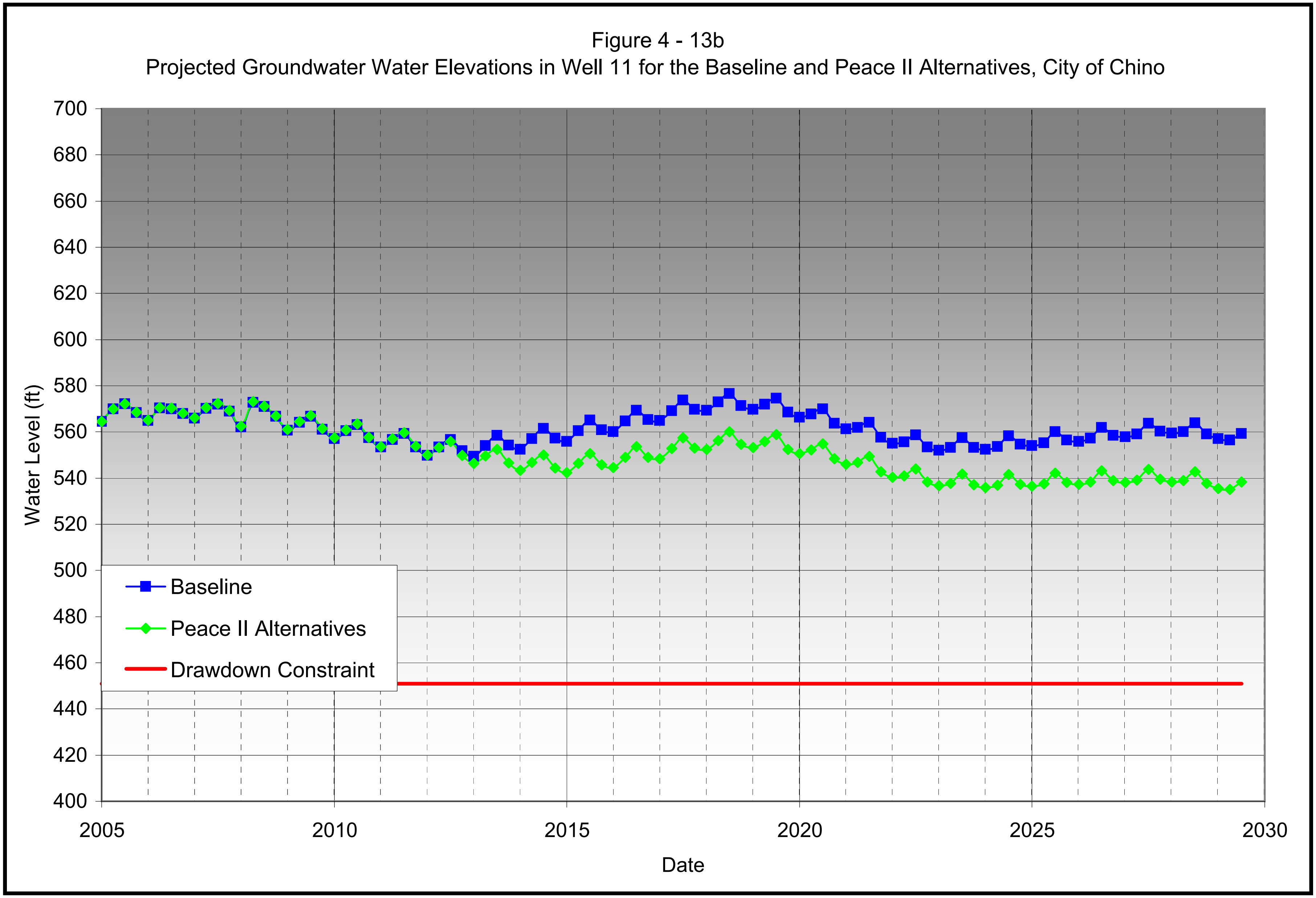
Projected Baseline Groundwater Elevation Change
for Layer 2 in June 2030

Figure 4-12b

Figure 4 - 13a
Projected Groundwater Water Elevations in Well 7A for the Baseline and Peace II Alternatives, City of Upland



Well Hydrographs_BSL8vsALT8.xls



Well Hydrographs_BSL8vsALT8.xls

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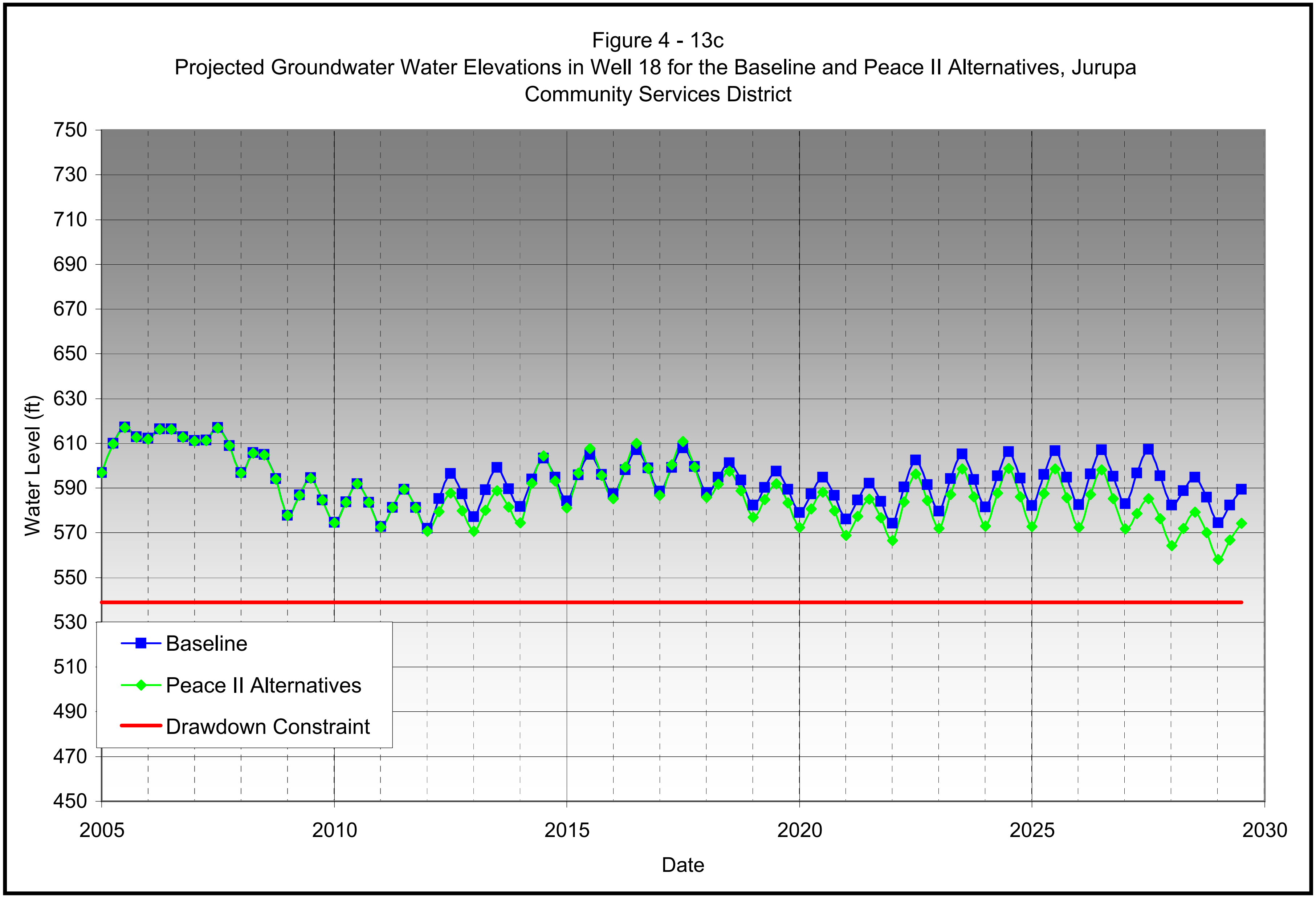

Well Hydrographs_BSL8vsALT8.xls

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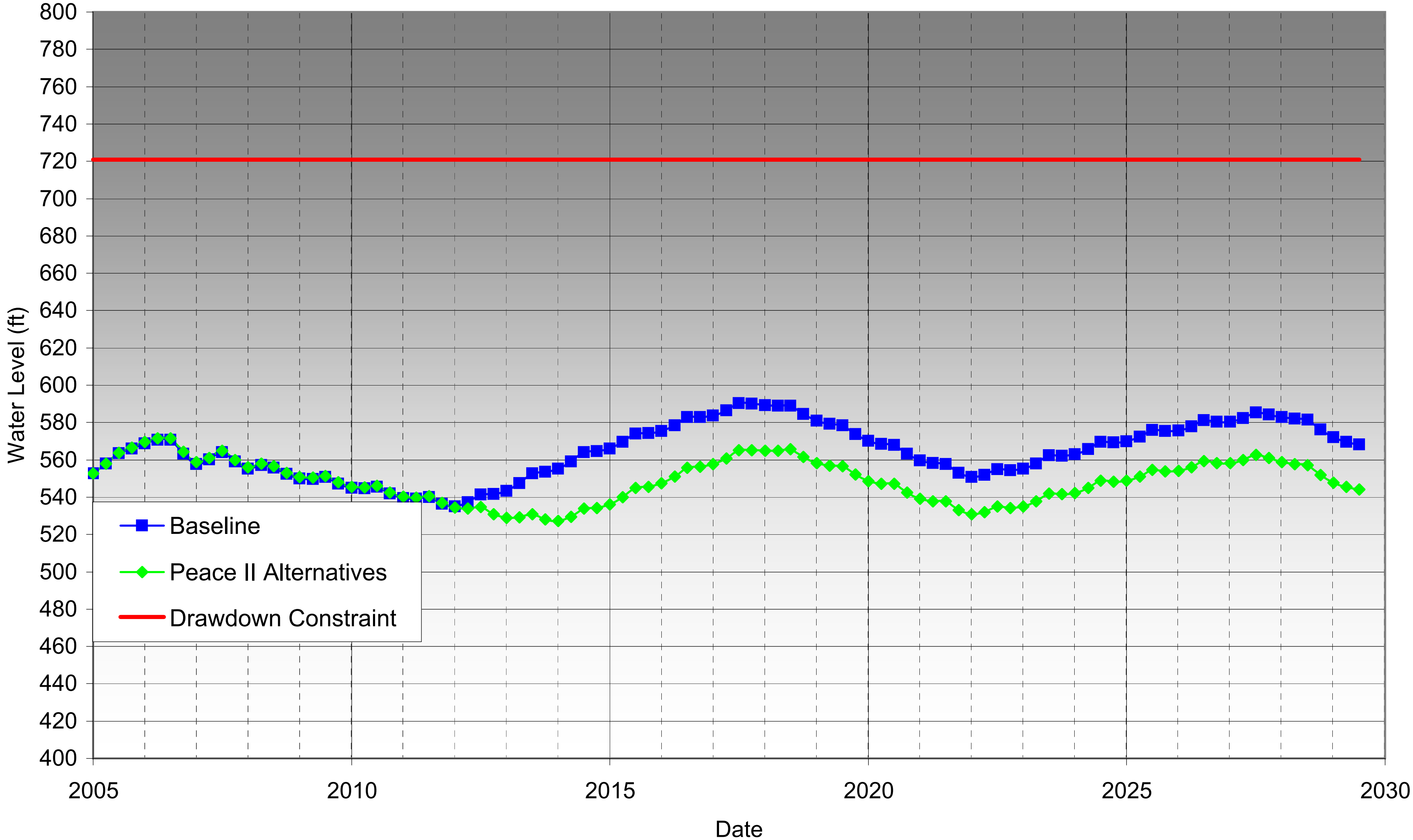
Figure 4 - 13d
Projected Groundwater Water Elevations in Well P-11 for the Baseline and Peace II Alternatives, City of Pomona



Well Hydrographs_BSL8vsALT8.xls

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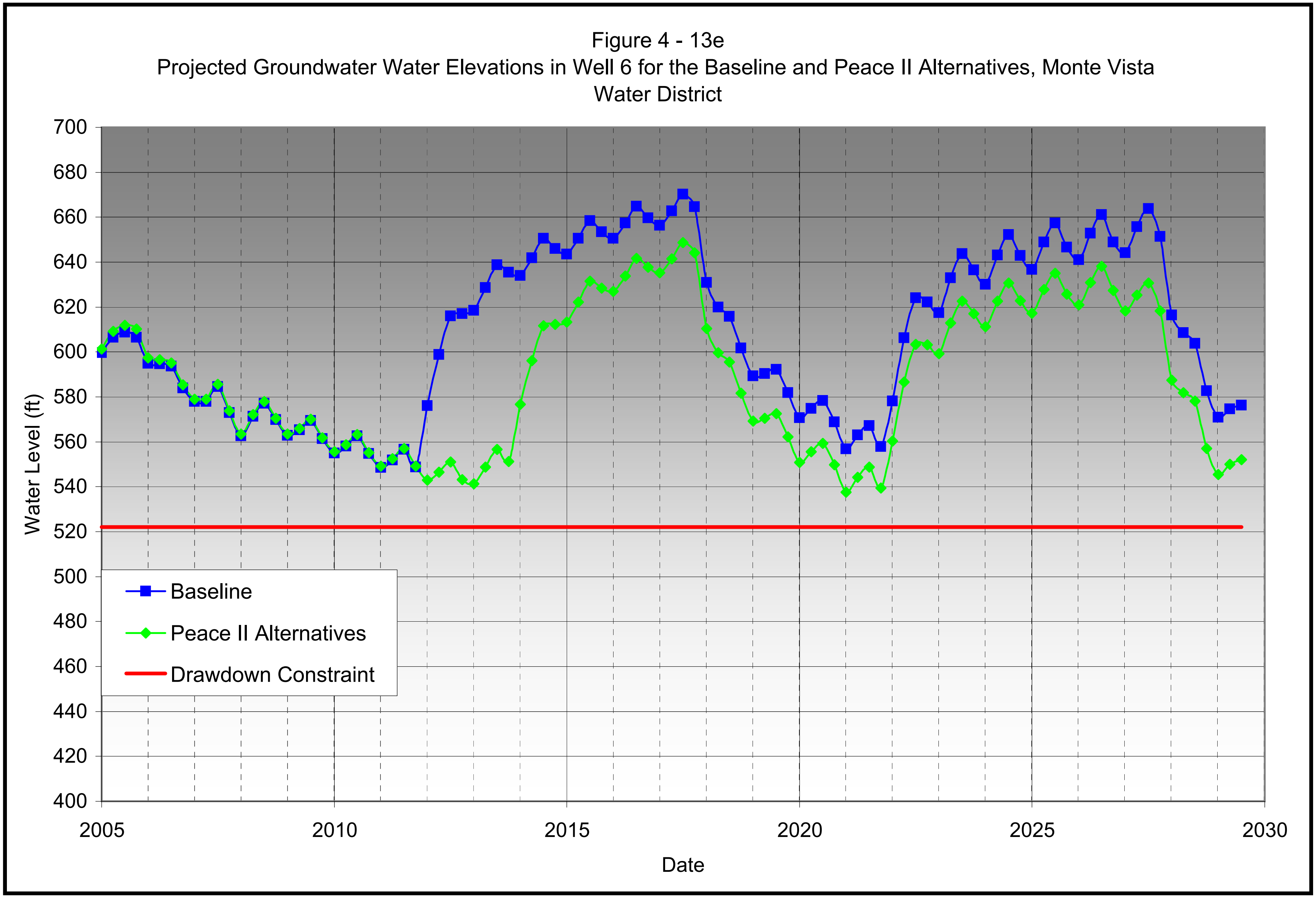

Well Hydrographs_BSL8vsALT8.xls

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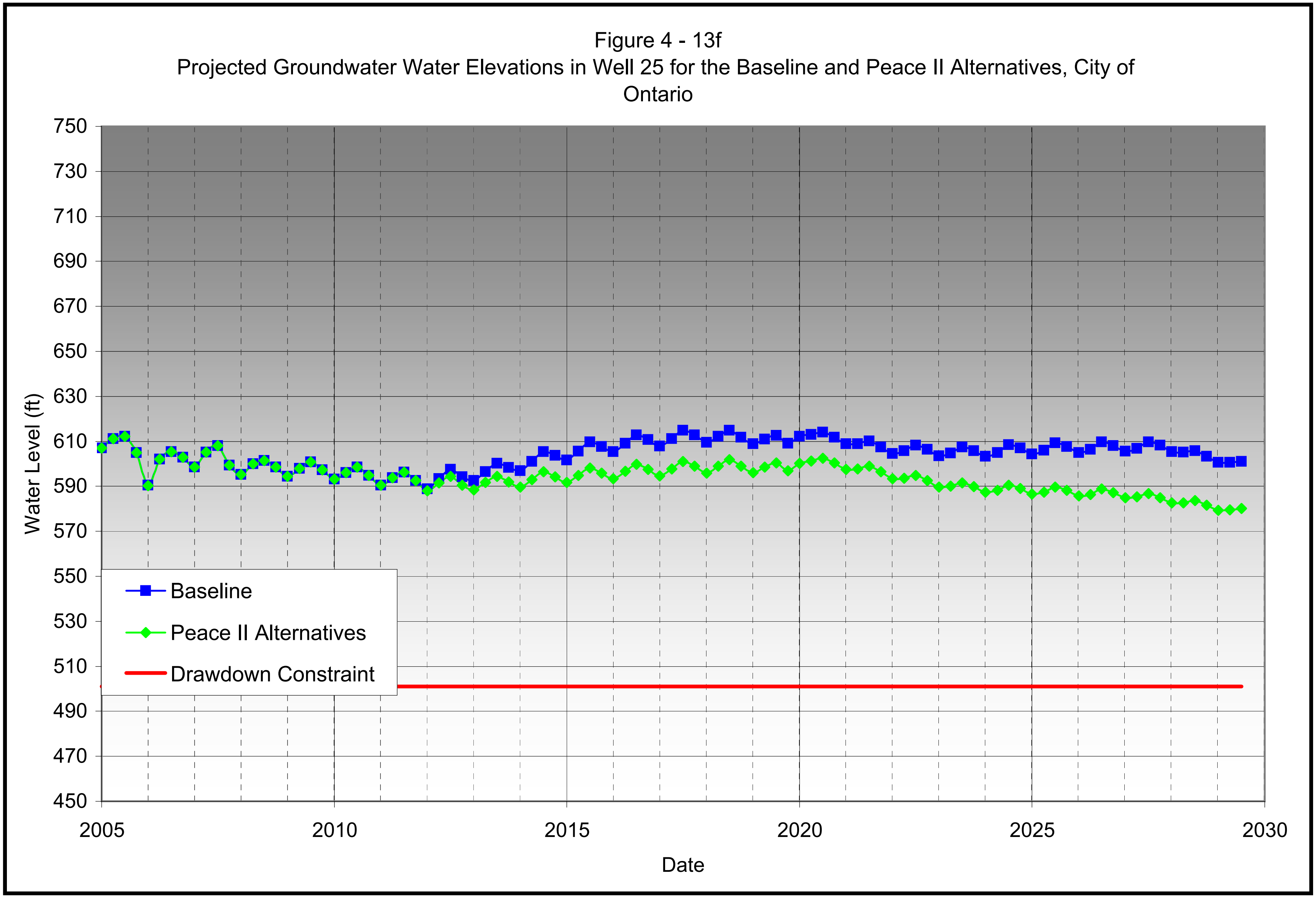

Well Hydrographs_BSL8vsALT8.xls

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Figure 4 - 13g
Projected Groundwater Water Elevations in Well CB-5 for the Baseline and Peace II Alternatives, Chino Basin Watermaster

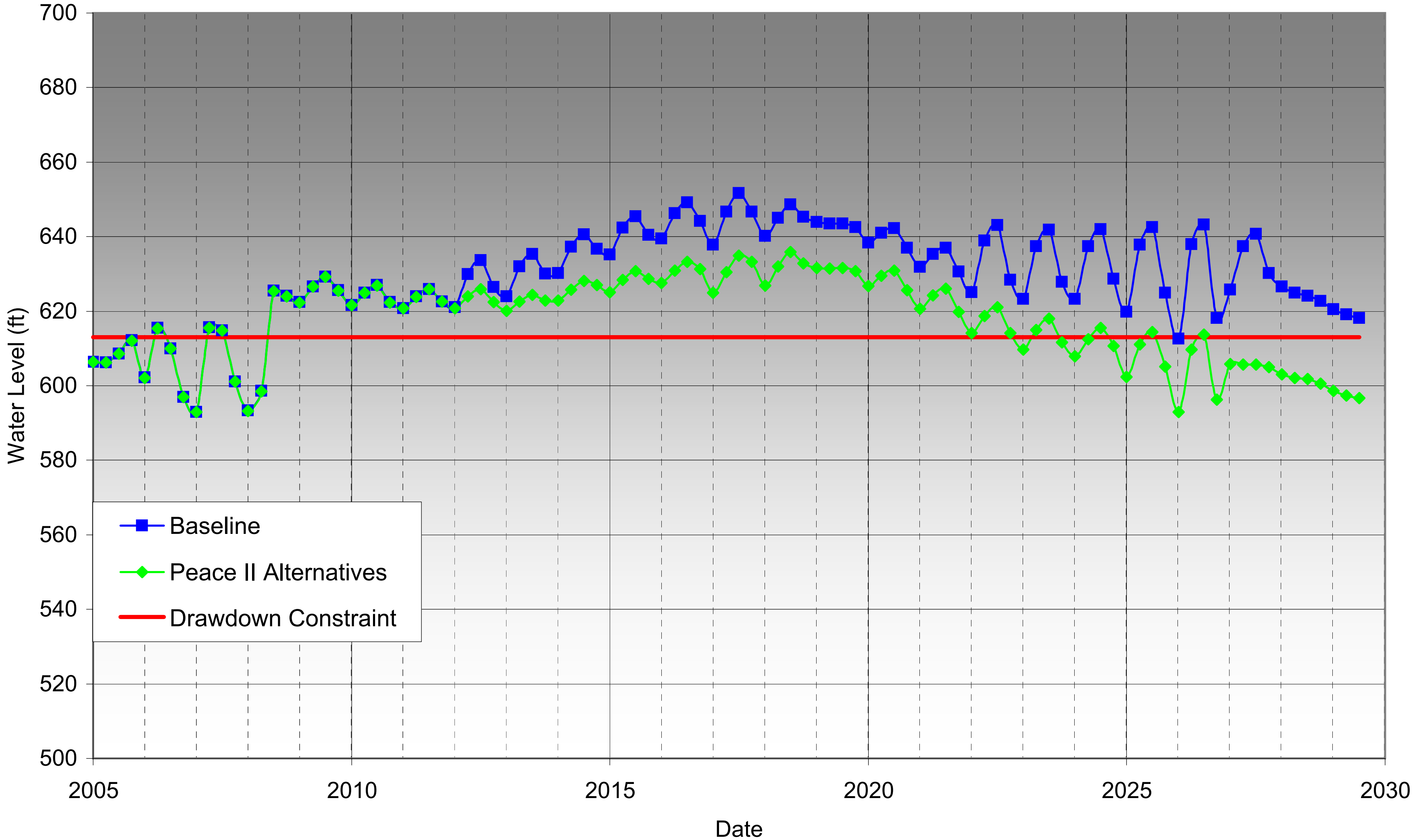
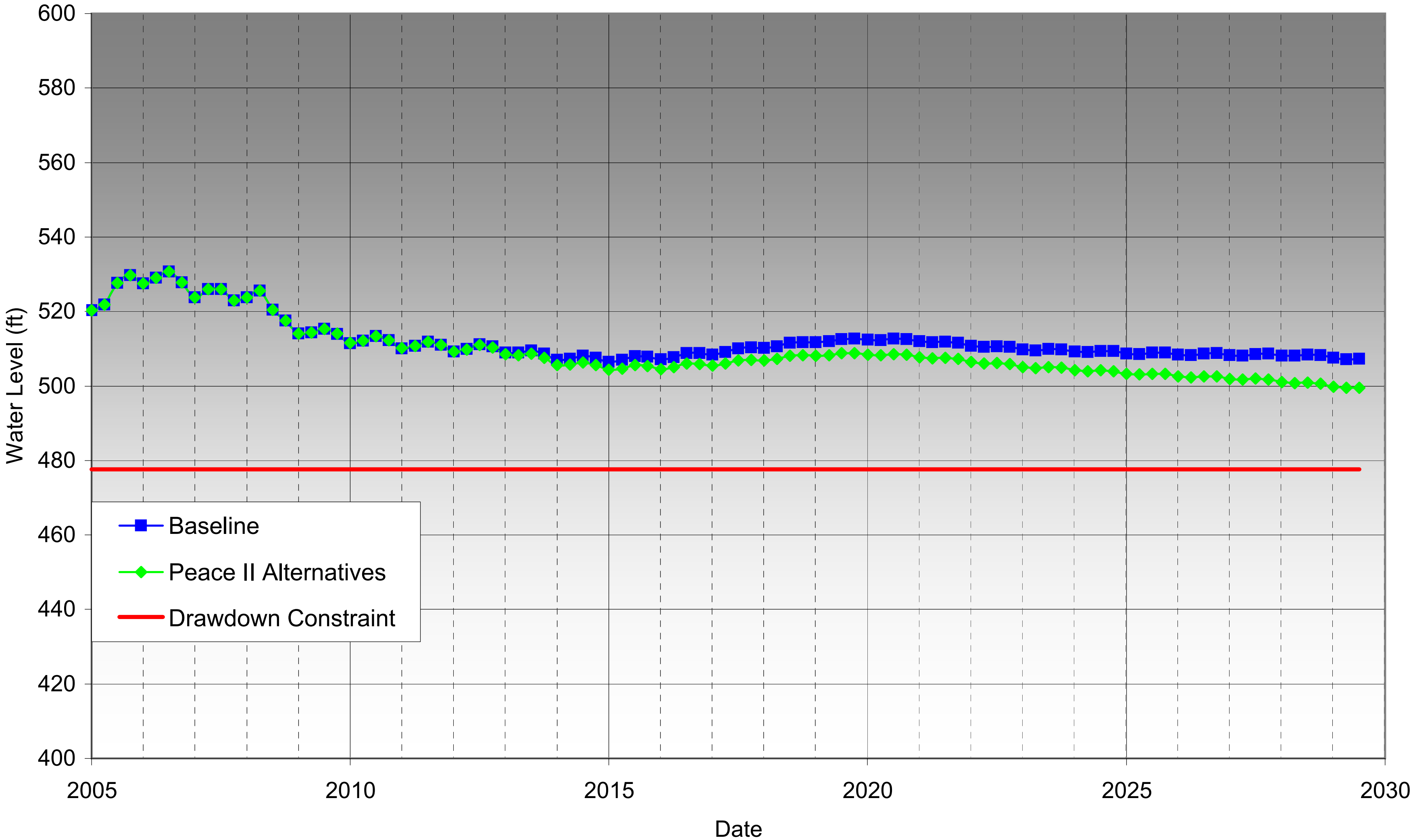


Figure 4 - 13h
Projected Groundwater Water Elevations in Well CDA1 for the Baseline and Peace II Alternatives, Chino Desalter Authority



Well Hydrographs_BSL8vsALT8.xls

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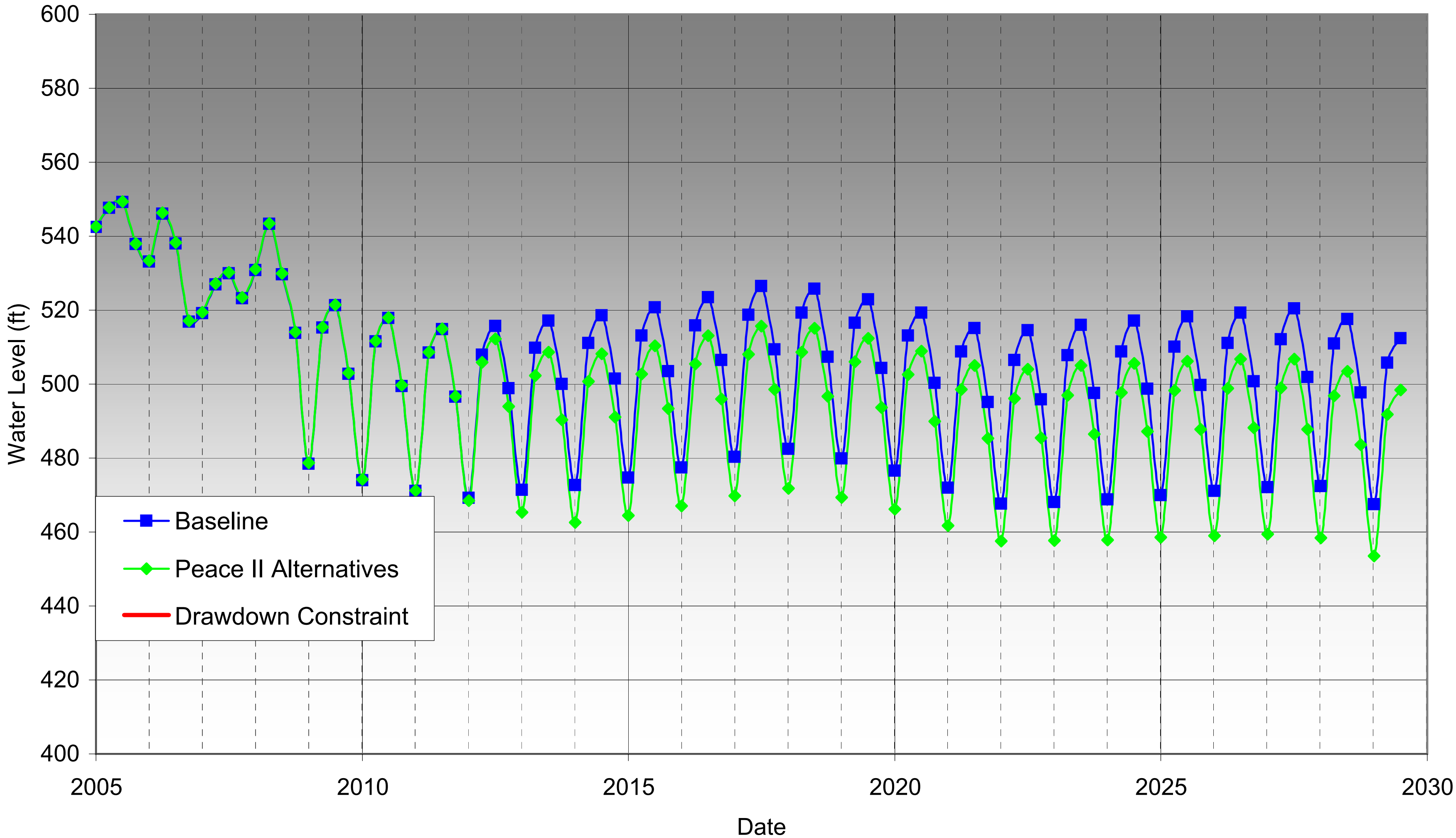
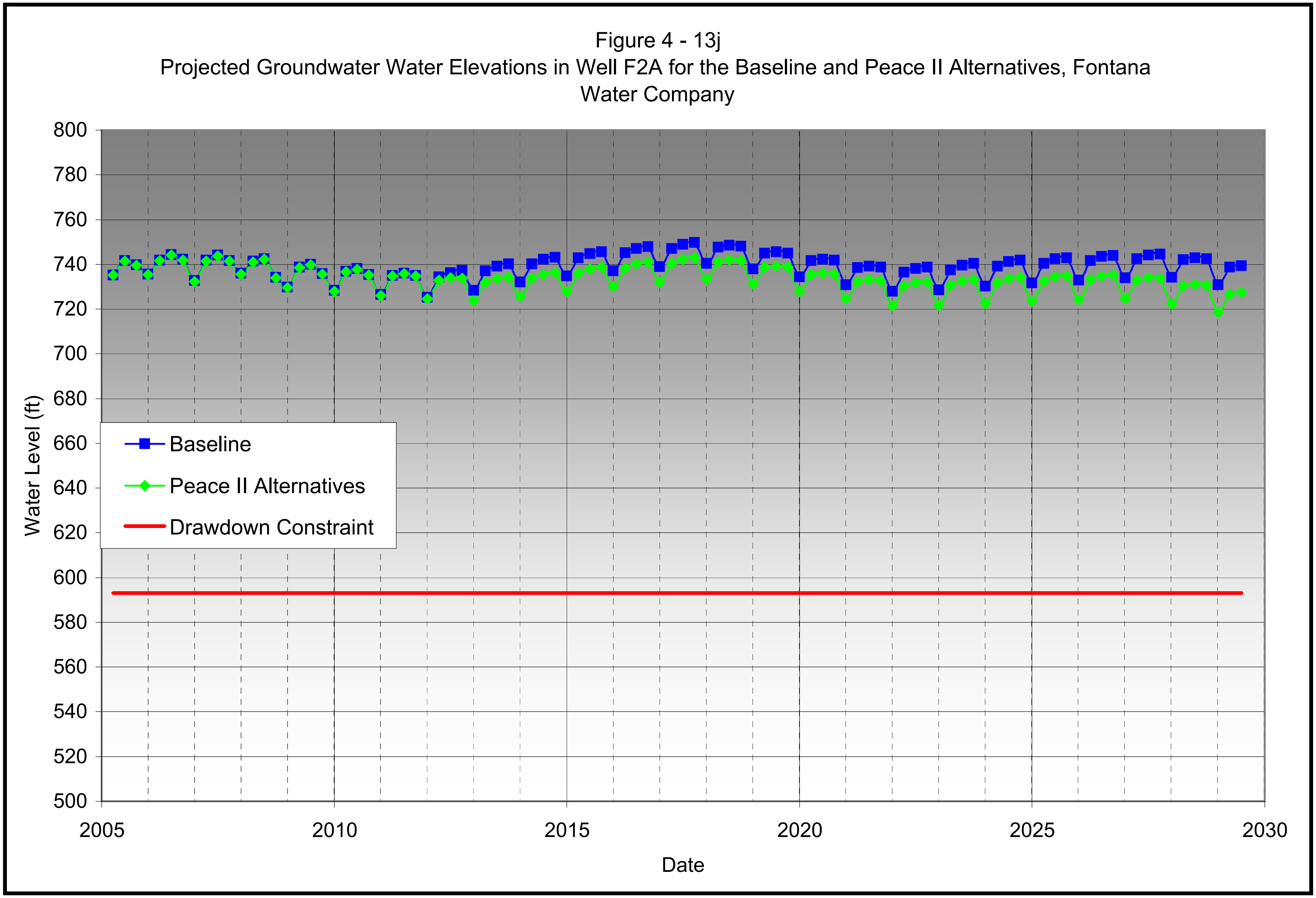
Figure 4 - 13i
Projected Groundwater Water Elevations in Well 15B for the Baseline and Peace II Alternatives, City of Chino Hills



Well Hydrographs_BSL8vsALT8.xls



Well Hydrographs_BSL8vsALT8.xls

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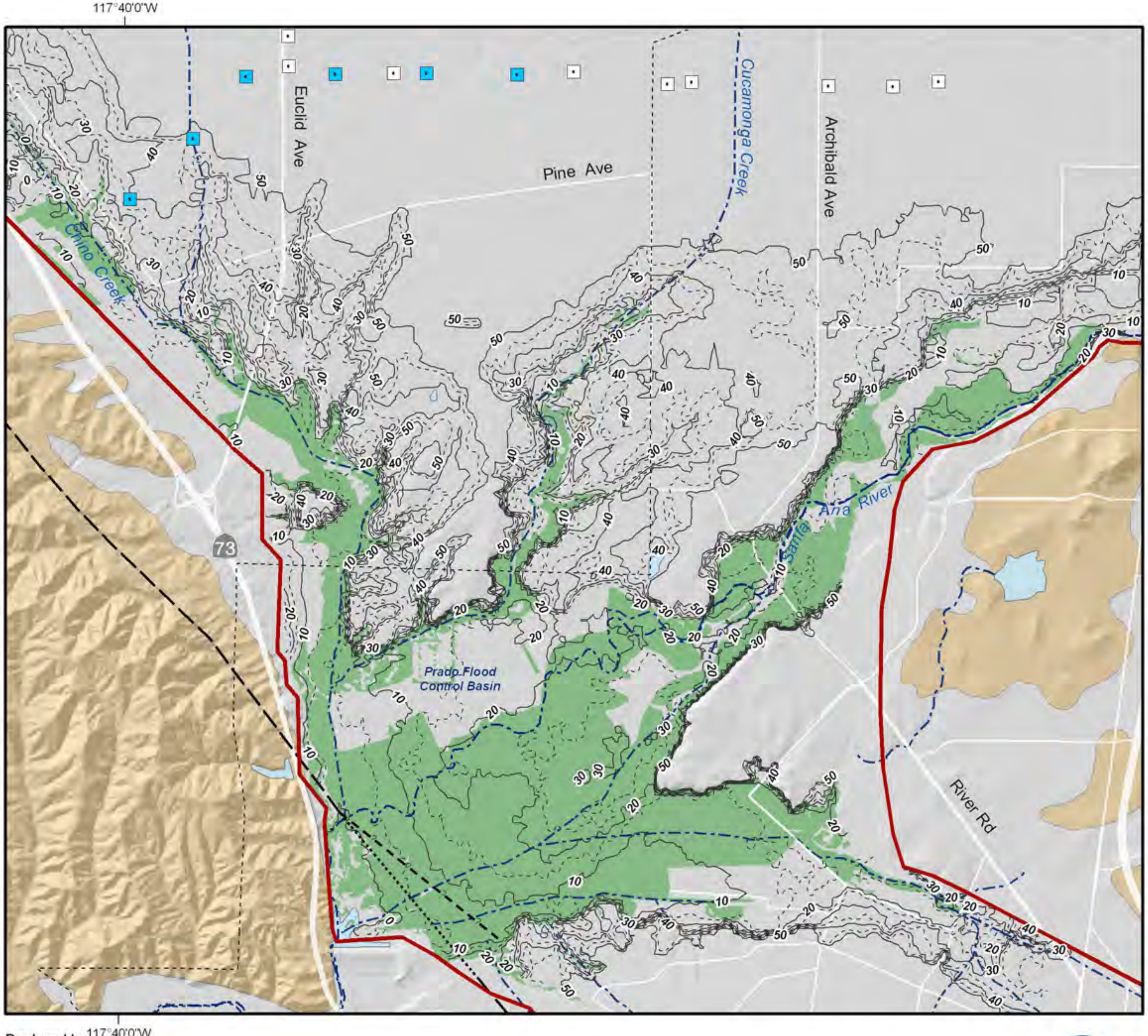

Riparian Habitat

Depth to Water Contours where groundwater is less than 50 feet

Existing Chino 1 Desalter Well

Proposed Chino Creek Well

Groundwater Flow Model Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Other Features

Flood Control/Conservation Basins

Streams, Rivers, and Channels

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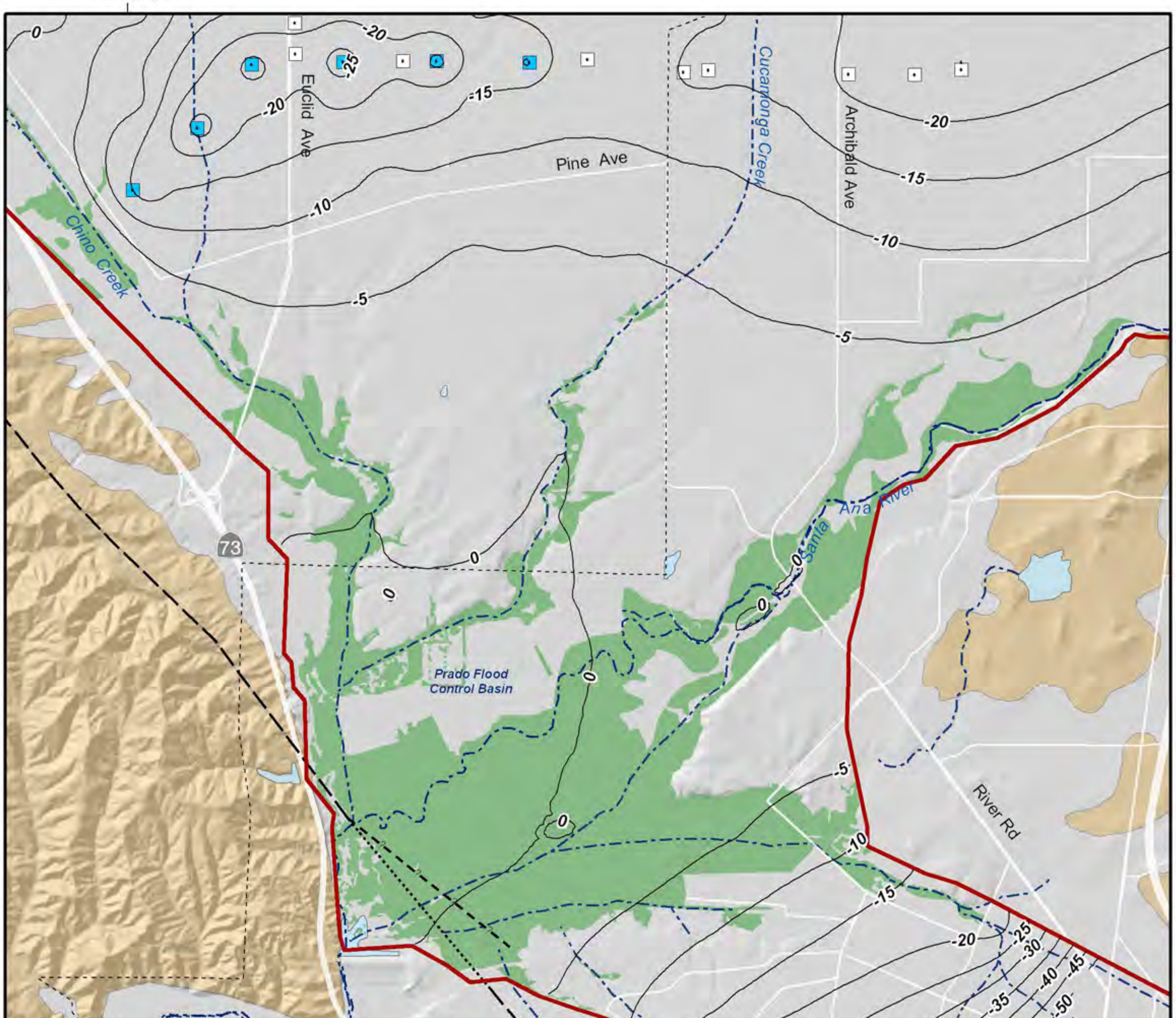
0 1 Miles

0 2 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Depth to Water in July 2005 in the Riparian Vegetation Area of the Prado Dam Reservoir

Figure 4-14a



Riparian Habitat

Change in Depth to Water (feet)

Existing Chino 1 Desalter Well

Proposed Chino Creek Well

Groundwater Flow Model Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Other Features

Flood Control/Conservation Basins

Streams, Rivers, and Channels

Change in Depth to Water from 2005 to 2030 in the Riparian Vegetation Area of the Prado Dam Reservoir with the Baseline Alternative

Figure 4-14b

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0 1 Miles

0 2 KM

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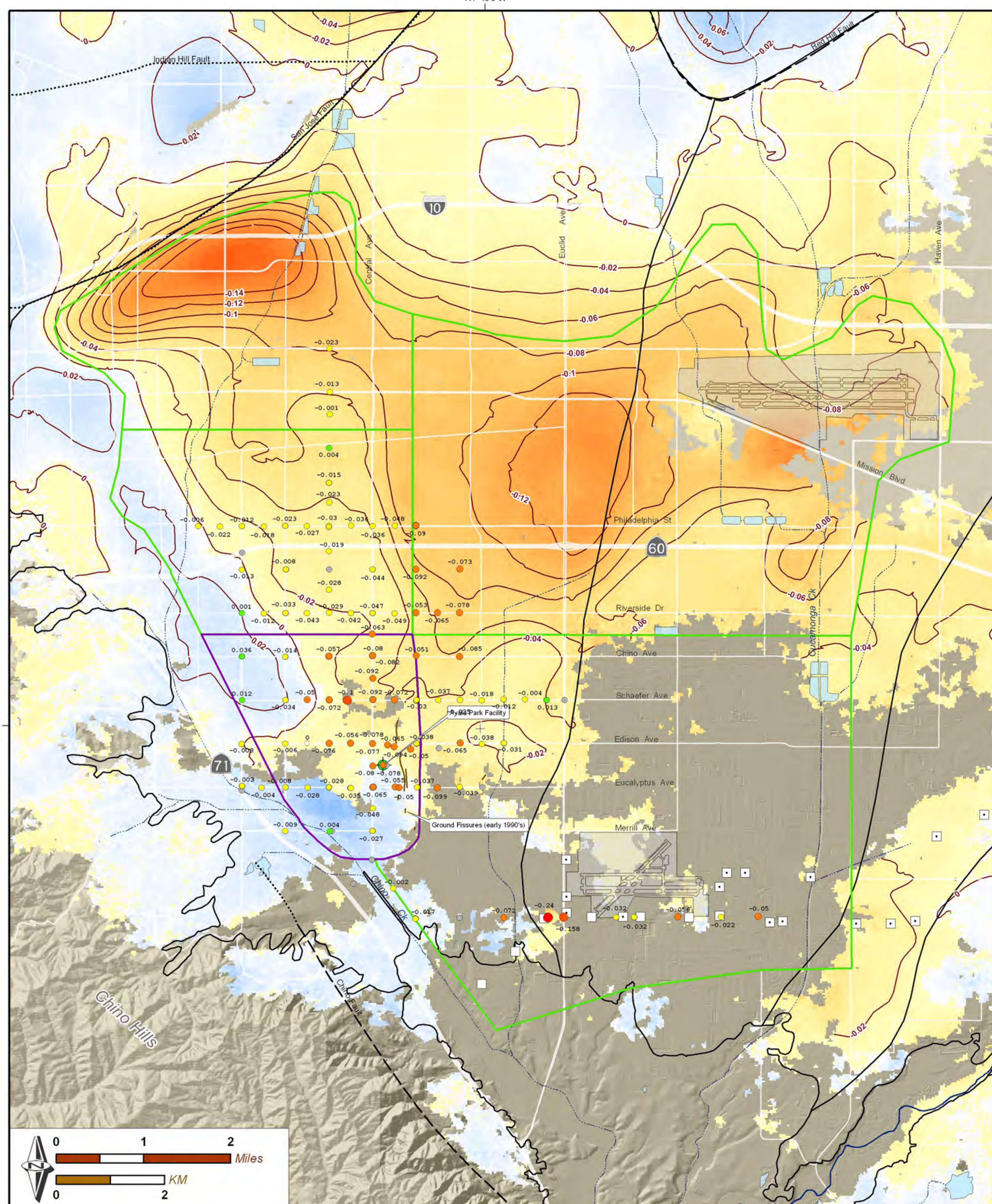

- Insufficient Data
- > 0.20
- 0.10 - 0.20
- 0.05 - 0.10
- 0.01 - 0.05
- 0.00
- -0.01 - -0.05
- -0.05 - -0.10
- -0.10 - -0.20
- < -0.20

Relative Change in Land Surface Altitude as Measured by Leveling Surveys Oct 2005 - Oct 2008 *(feet)*

Relative Change in Land Surface Altitude as Measured by InSAR June 2005 - Oct 2008 *(feet)*

+ 0.2 ft / 0 / -0.1 / - 0.2

Brown areas represent regions where InSAR data is absent (incoherent)

- Ayala Park Facility (Extensometer and Piezometers)
- Chino Basin Desalter Well (Existing)
- Proposed Chino Creek Desalter Well
- Chino Basin Management Zones
- Subsidence Areas of Interest
- MZ1 Managed Area

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Subsidence Areas of Concern in MZ 1

Figure 4-15

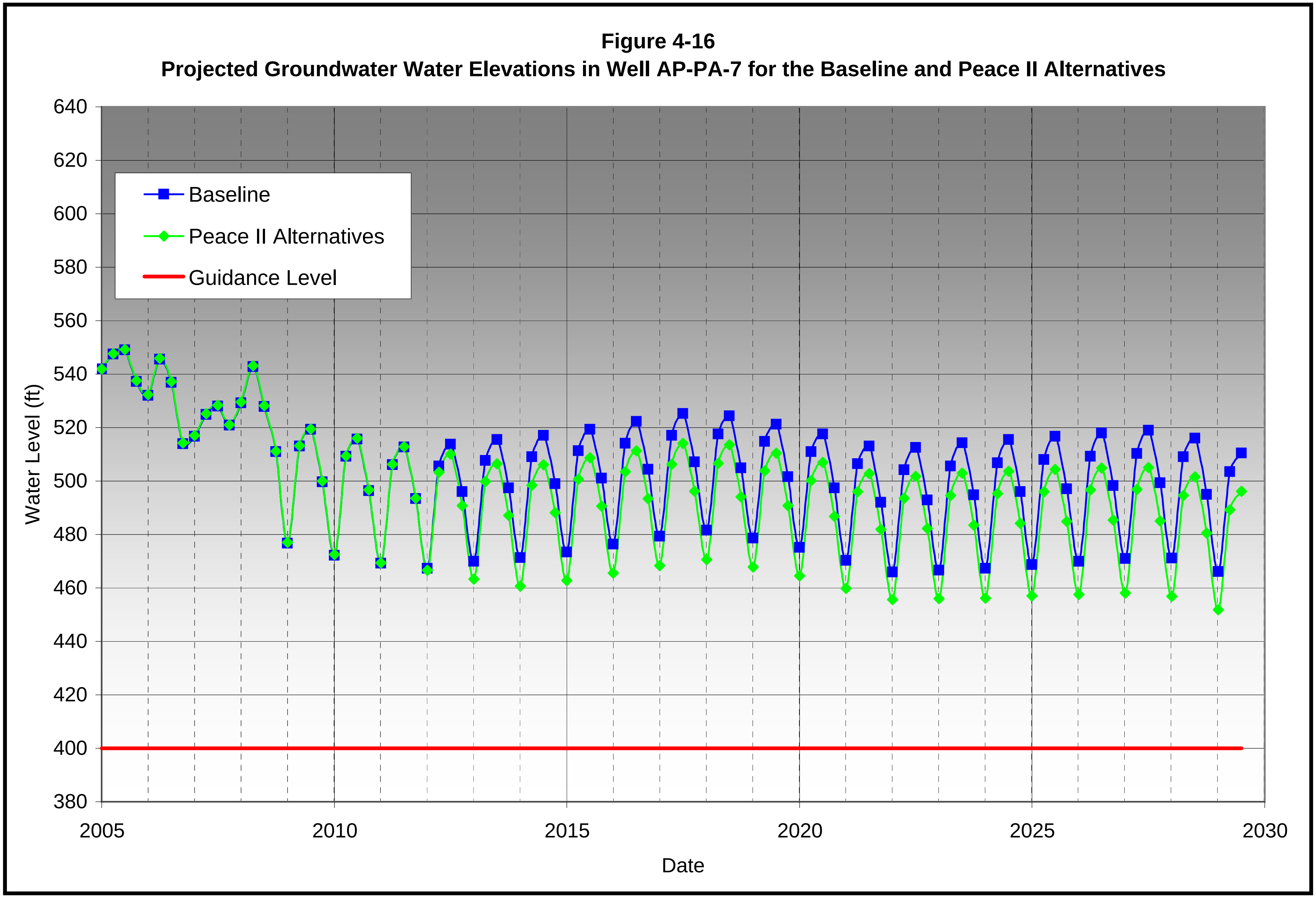

Figure 4-16 -- AP-PA-7
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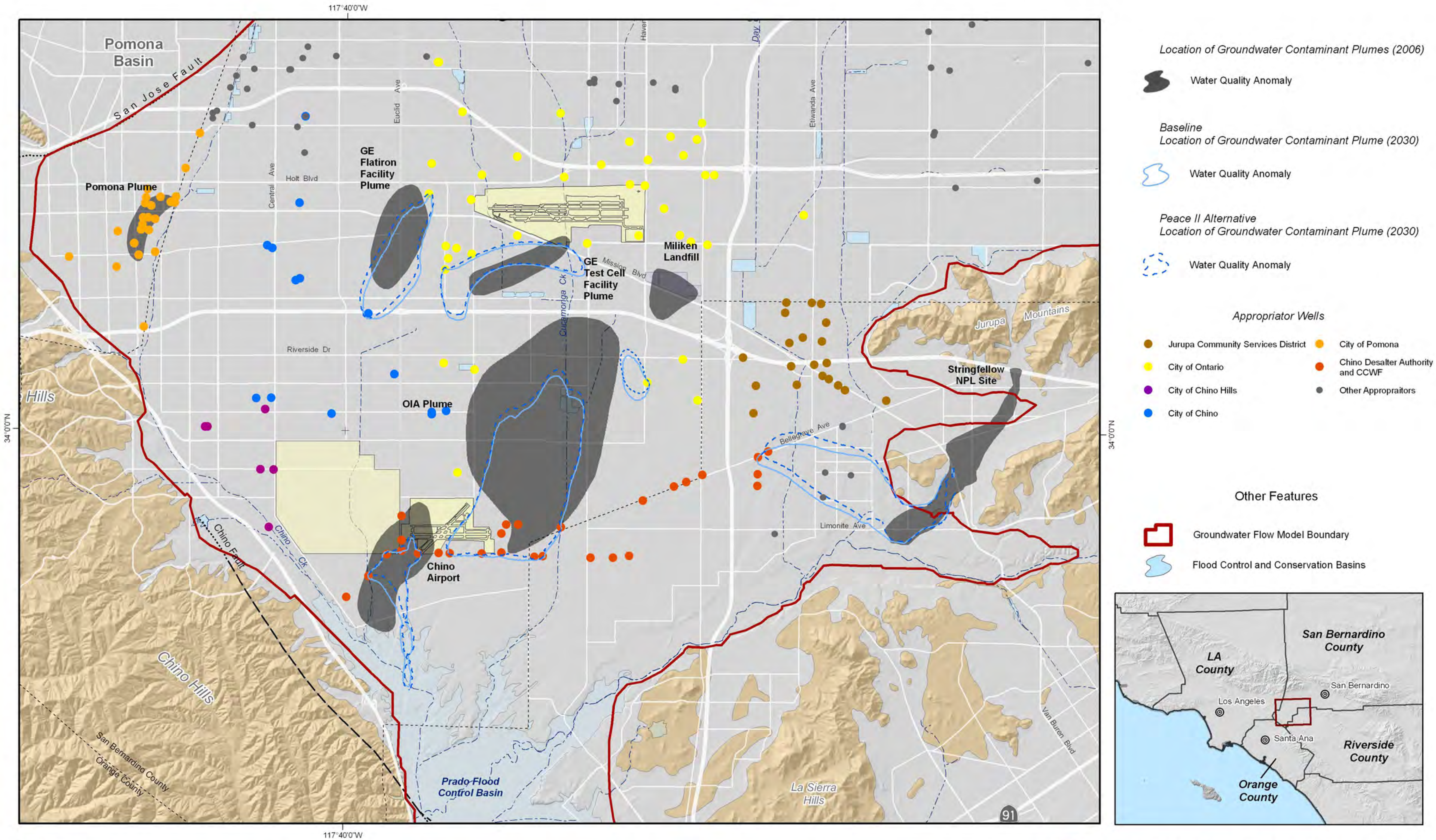

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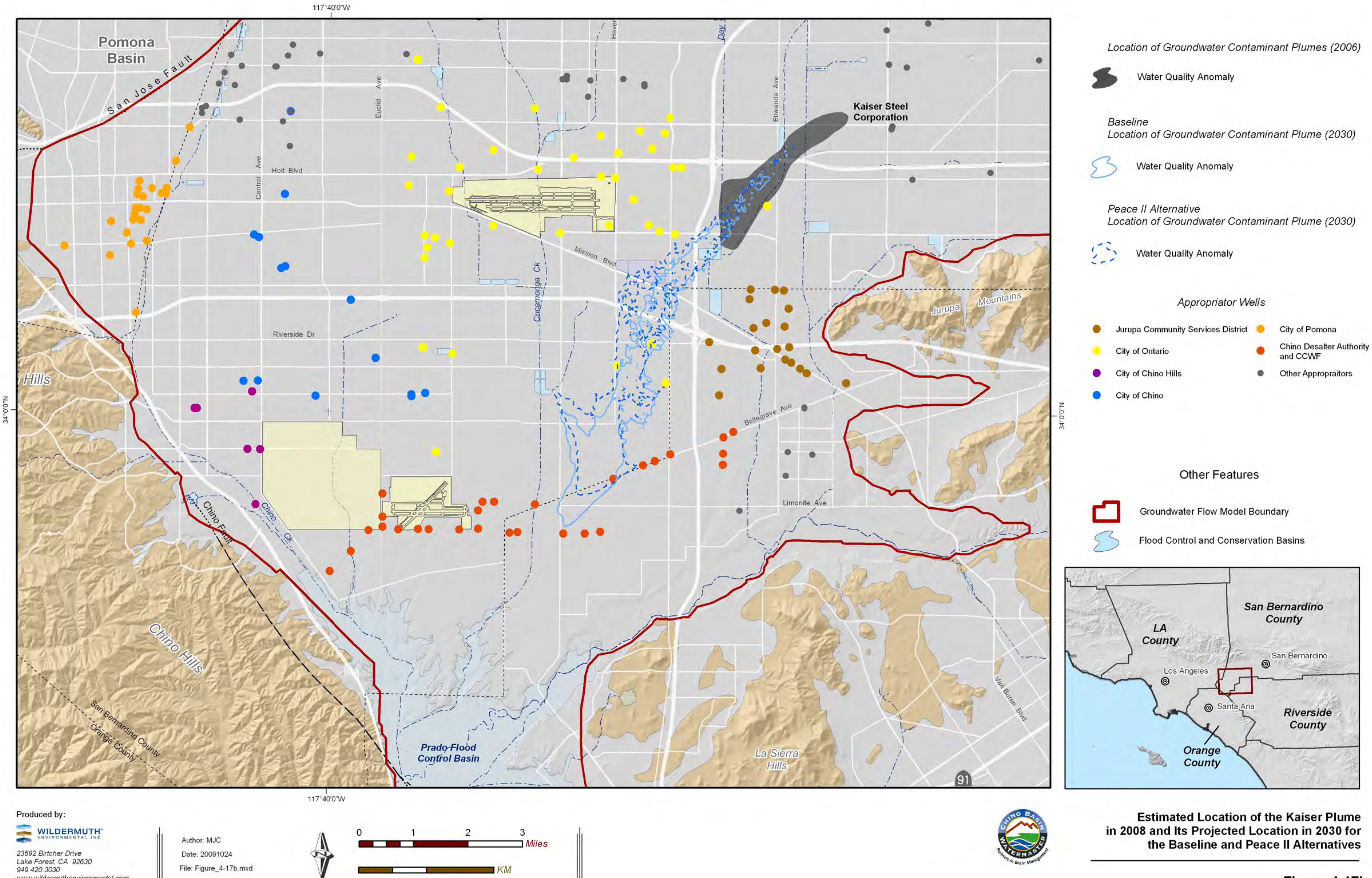
0 1 2 3 Miles
0 2 4 KM

CHINO BASIN WATERMASTER

Estimated Location of Water Quality Anomalies in 2008 and Their Projected Location in 2030 for the Baseline and Peace II Alternatives

Figure 4-17a



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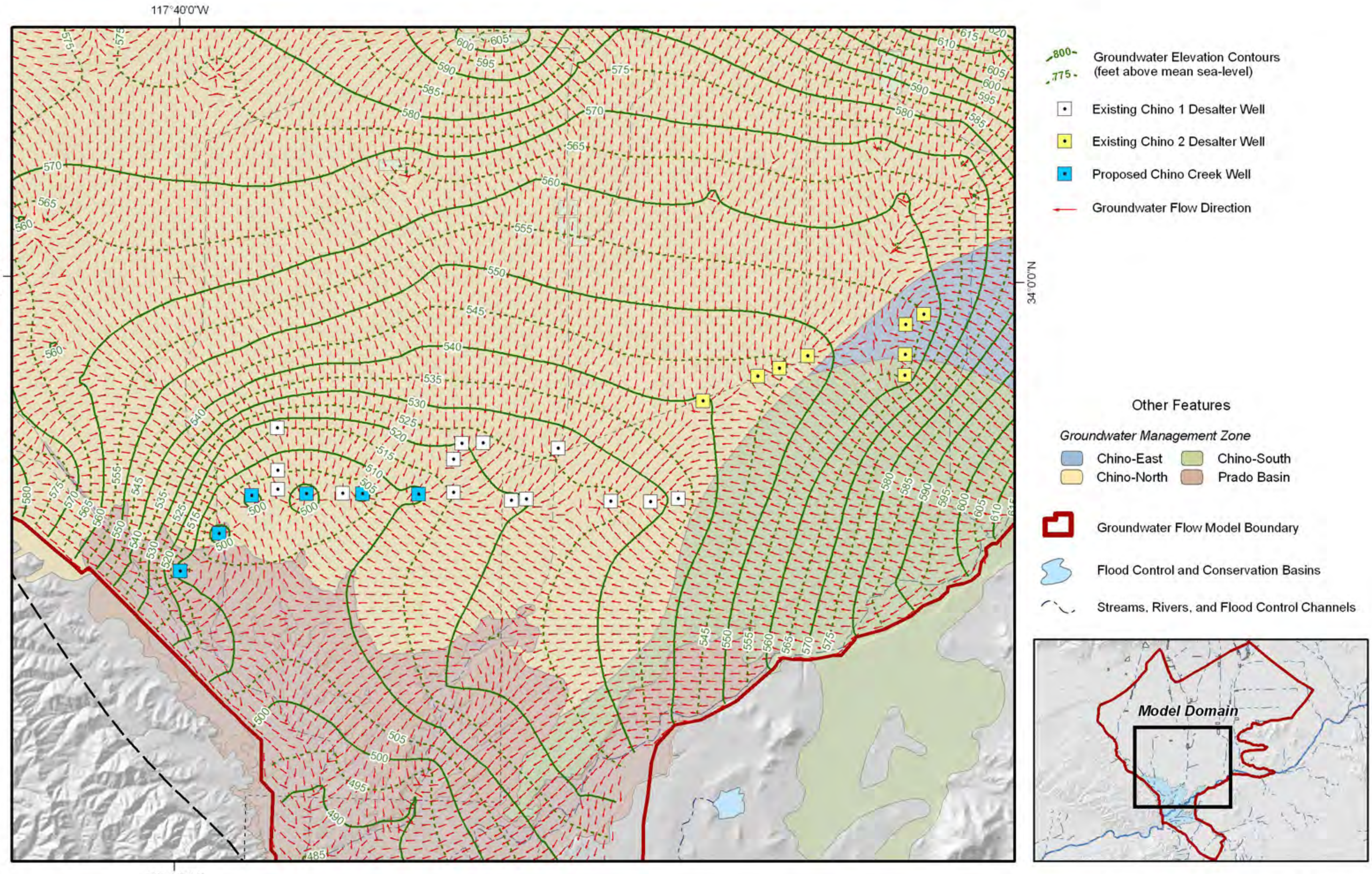
Date: 20091024
File: Figure_4-17b.mxd

Estimated Location of the Kaiser Plume in 2008 and Its Projected Location in 2030 for the Baseline and Peace II Alternatives

Figure 4-17b



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Date: 20091024

File: Figure_4-18.mxd

Layer 1 Groundwater Elevation Contours and Flow Directions in the Vicinity of the Desalters

Baseline Alternative -- 2020

Figure 4-18

Section 5 – Environmental Analysis of the Peace II Alternative

5.1 Modifications to the Baseline Alternative Required to Describe the Peace II Alternative

The Peace II Alternative is identical to the Baseline alternative except that the replenishment schedule has been modified to use re-operation water from the schedule shown in Table 2-1 and to account for new recharge from the Santa Ana River caused by re-operation The hydrologic response of the basin to the Peace II Alternative was estimated by simulating the implementation of the Peace II Alternative with the 2007 Watermaster Model. The model results were extracted and summarized pursuant to the evaluation criteria described in Section 3 and were compared Baseline Alternative.

5.2 Hydrologic Balance and Santa Ana River New Yield

The Peace II Alternative was simulated with the 2007 Watermaster Model to evaluate the hydrologic response of the Chino Basin to implementing the Peace II Alternative. The combined hydrologic water budget for the Chino North, Chino South, Chino East, and Prado Management Zones for the Peace II Alternative is shown in Table 5-1. This water budget table shows outflow from the Chino Basin, recharge from the Santa Ana River, and the change in storage. At the end of fiscal 2030, the storage in the basin is 408,000 acre-ft less than at the start of the simulation. This 408,000 acre-ft decrease includes -26,000 acre-ft of CURO and, therefore, the ending storage, adjusted for CURO, is -432,000 acre-ft. At the end of the planning period, the Peace II Alternative reduces storage in the basin by 291,000 acre-ft more in comparison to the Baseline Alternative (-432,000 minus -141,000).

Santa Ana River recharge increases by about 18,000 acre-ft/yr over the planning period, and rising groundwater to the Santa Ana River decreases by about 7,000 acre-ft/yr, netting an increase of about 25,000 acre-ft/yr. Some of the increase in Santa Ana River recharge discharges to the Temescal Basin in response to a projected chronic overdraft in that basin. The Santa Ana River recharge is projected to increase by about 6,000 acre-ft/yr over the planning period with the implementation of the Peace II Alternative (25,000 minus 19). In sum, the increased recharge into the Chino Basin from the Santa Ana River and the decrease in discharge to the Santa Ana River and evapotranspiration total about 63,000 acre-ft over the planning period.

5.3 Groundwater Levels

5.3.1 Groundwater Level Changes in Water Service Areas

Figures 4-10a and 4-10b show the estimated groundwater elevation contours for July 2005 for model layers 1 and 2, respectively. These maps show the initial groundwater elevations throughout the basin and illustrate the initial groundwater levels for the planning period. Figures 5-1a and 5-1b show the projected groundwater elevations in June 2030, the end of the planning period, for model layers 1 and 2, respectively. Figures 5-2a and 5-2b show the change in groundwater levels across the basin over the planning period for model layers 1 and 2, respectively. And, Figures 5-3a and 5-3b show the difference in groundwater elevations for 2030 conditions relative to the Baseline Alternative for model layers 1 and 2, respectively. Figures 5-2 a through 5-3b also show the appropriators' water service area boundaries.

5.3.1.1 Groundwater Level Changes in Water Service Areas

The direction of groundwater flow in the Chino Basin in 2005 and 2030 is generally the same with groundwater flowing from the northeast and north to the southwest and south. Figure 4-9 shows the locations of appropriator wells that were used in the production and replenishment optimization that was discussed in Section 4.3 and for which groundwater level projections were extracted from the Peace II Alternative simulation. Appendix B contains charts that illustrate the projected groundwater elevation time series for these 98 wells. Figures 4-13a through 4-13j illustrate projected groundwater elevations at some of these appropriator wells. And, Table 4-8 characterizes the average, maximum, and minimum changes in groundwater elevations across the water service areas of appropriators that overlie the Chino Basin for the Baseline and Peace II Alternatives from 2005 through 2030.

The groundwater elevation projections in Appendix B and in Figures 4-13a through 4-13j show that groundwater production is sustainable for the Baseline and Peace II Alternatives. At some wells, the groundwater elevation falls below constraints prescribed by the appropriators. For these cases, it was assumed that the pumps would be lowered to maintain production. It is also the case that, under 2005 and the years immediately following, the constraint established by the appropriator was violated and yet those wells were in use.

As shown in Table 4-8, the average changes in layers 1 and 2 were essentially identical in eastern half of the basin but were significantly different in the western half of the basin. In layer 1, the average change in groundwater elevation ranges from a low of -14 feet for the Pomona service area to -34 feet for the CVWD service area; in layer 2, it ranges from a low of -19 feet for the FWC service area to -52 feet for the MVWD service area. Relative to the Baseline Alternative, in 2030, the average change in groundwater elevation ranges from a low of -8 feet for the JCSD service area to -25 feet for the Pomona service area; in layer 2, it ranges from a low of -10 feet for the JCSD service area to -23 feet for the MVWD, Pomona, and Upland service areas.

In layer 1, the maximum change in groundwater elevation ranges from a low of -41 feet for the FWC service area to -71 feet for the MVWD service area; in layer 2, it ranges from a low of -41 feet for the FWC service area to -80 feet for the Chino service area. In layer 1, the minimum change in groundwater elevation ranges from a low of +1 feet for the JCSD service area to -14 feet for the Upland service area; in layer 2, it ranges from a low of zero feet for the Chino service area to -38 feet for the Pomona and MVWD service areas.

Relative to the Baseline Alternative, in 2030, the maximum change in groundwater elevation ranges from a low of -18 feet for the FWC service area to -28 feet for the Pomona, Upland, and MVWD service areas; in layer 2, it ranges from a low of -18 feet for the FWC service area to -27 feet for the Upland and MVWD service areas. In layer 1, the minimum change in groundwater elevation relative to the Baseline Alternative ranges from a low of zero feet for the Chino and the JCSD service areas to -21 feet for the Pomona service area; in layer 2, it ranges from a low of zero feet for the Chino and JCSD service areas to -20 feet for the Pomona service area.

5.3.1.2 Groundwater Level Changes in Riparian Habitat Areas

Figure 4-14a shows the Emergent Wetland, Freshwater Marsh, Riparian Forest, and Southern Willow Scrub vegetation units, grouped and mapped as riparian vegetation, and the July 2005 depth to water in the riparian vegetation area. Figure 5-4a shows the change in depth to water between 2005 and 2030 for the Peace II Alternative. North of the Santa Ana River, changes in depth to water range from zero feet for most of the riparian vegetation area to less than 3 feet. South and east of the Santa Ana River, depth to water changes are attributable to groundwater production in the Temescal Basin. Changes in groundwater elevations relative to the Baseline Alternative range form zero feet near the streams to about 1 foot over the riparian areas away from the streams.

The consumptive use by the riparian vegetation is projected to decline by a total of about 2,200 acre-ft/yr, based on the water budget for the Peace II Alternative (see Table 5-1). Compared to the Baseline Alternative, this is a 300 acre-ft/yr reduction in consumptive use that is projected to occur gradually over the planning period.

5.4 Subsidence

Figure 4-16 shows the guidance level (400 feet mean sea level) and the projected groundwater elevation time series at the PA-7 piezometer for the Peace II Alternative. The minimum projected groundwater elevation at PA-7 drops from about 480 feet in 2009 to about 460 feet in the out years and is well above the guidance level. Compared to the Baseline Alternative, the groundwater elevation in the PA-7 peizometer is about 10 feet lower.

5.5 Movement of Water Quality Anomalies

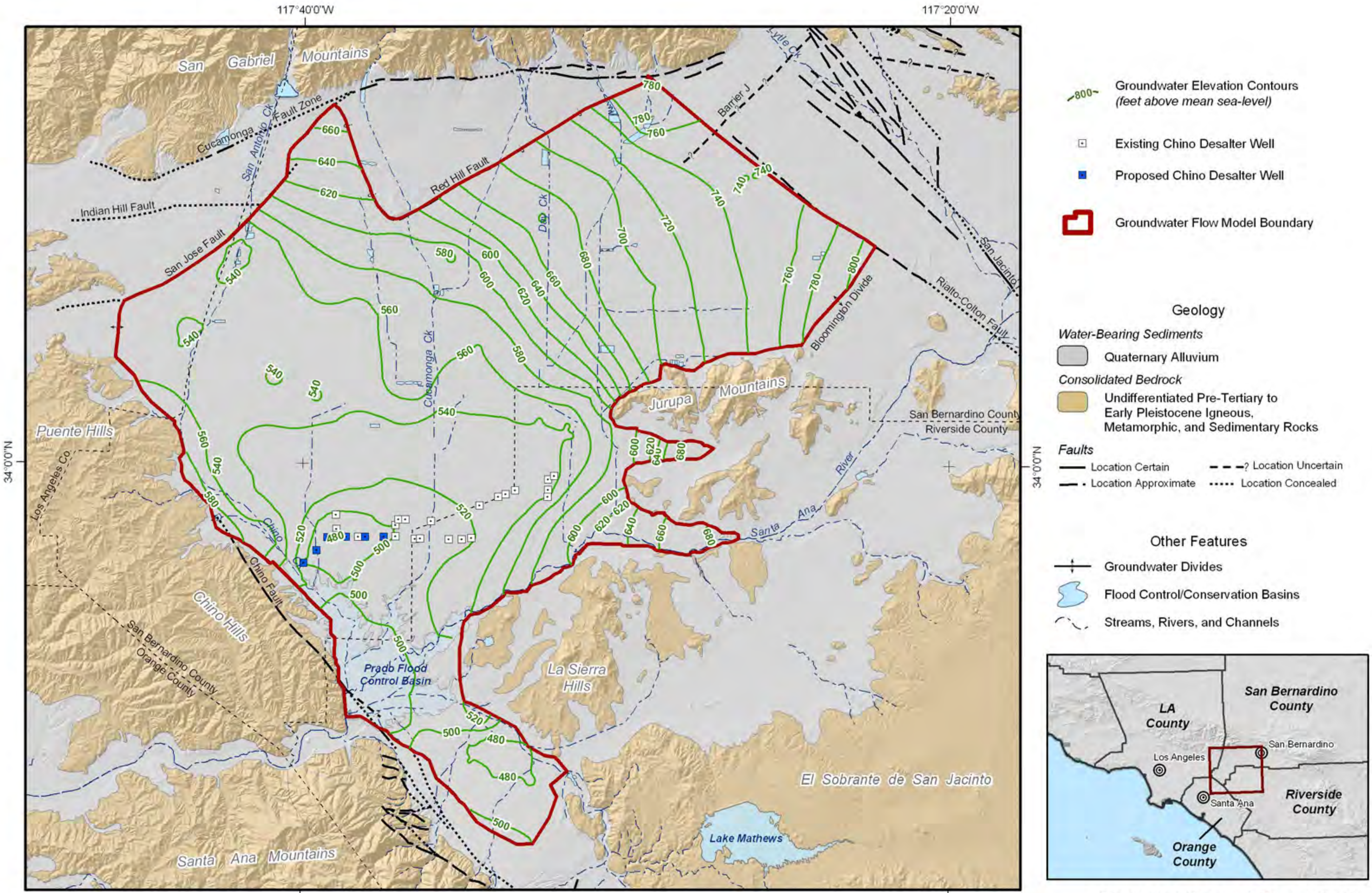
Figure 4-17a illustrates the locations of all the groundwater contaminant plumes, with the exception of the Kaiser Plume, at the beginning of the planning period and their estimated locations at the end of the planning period for the Baseline and Peace II Alternatives. Figure 4-17b is a similar map for the Kaiser Plume. The plume locations at the start of the planning period were mapped from recent data (2006). The projected plume paths, timing and geographic extent are essentially identical for the Baseline and Peace II Alternatives. That is, the implementation of the Peace II Alternative has no significant effect on the movement of these contaminant plumes.

5.6 Hydraulic Control

Hydraulic control was assessed from groundwater elevation contour maps. Hydraulic control is weakest when water levels are highest in the southern portion of the basin. During the planning period, groundwater levels are the highest in the southern part of the basin in 2020 for the Peace II Alternative. Figure 5-5 is a groundwater elevation contour map for the lower part of the Chino Basin and shows the locations of the desalter well fields, directional groundwater flow vectors for every fifth model cell, and the southern boundary of the Chino North Management Zone. This map demonstrates that groundwater flows away from the Santa Ana River upstream of the Prado Reservoir, south of the Desalter II well field, and south of the eastern part of the Desalter I well field. There is clear indication that hydraulic control is achieved by the Peace II Alternative with a maximum groundwater level depression of about 15 feet in the center of the CCWF, relative to the apparent stagnation point down-gradient of the CCWF. Relative to the Baseline Alternative, the state of hydraulic control achieved by the Peace II Alternative is much more significant and reliable.

Table 5-1
Water Budget for Chino North, Chino East, Chino South, and Prado Basin Management Zones
Peace II Alternative
(acre-ft)

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



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Date: 20091021
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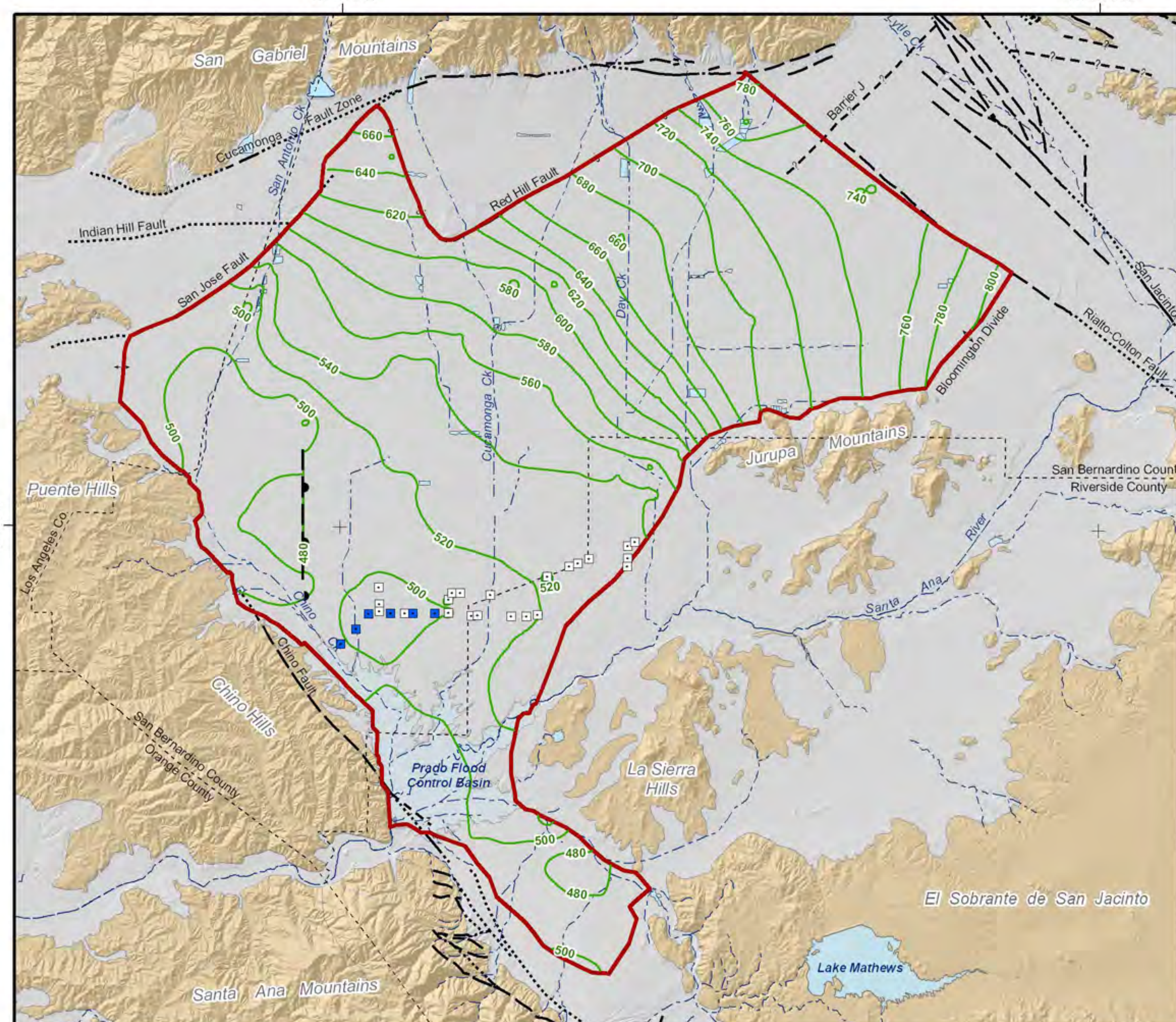
2009 Production Optimization and Evaluation of the Peace II Project Description

Projected Peace II Groundwater Elevations for Layer 1
July 2030

Figure 5-1a



Groundwater Elevation Contours (feet above mean sea-level)

Existing Chino Desalter Well

Proposed Chino Desalter Well

Groundwater Flow Model Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

Location Certain

Location Approximate

Location Concealed

Location Uncertain

Approximate Location of Groundwater Barrier

Other Features

Groundwater Divides

Flood Control/Conservation Basins

Streams, Rivers, and Channels

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0 1 2 3 4 Miles

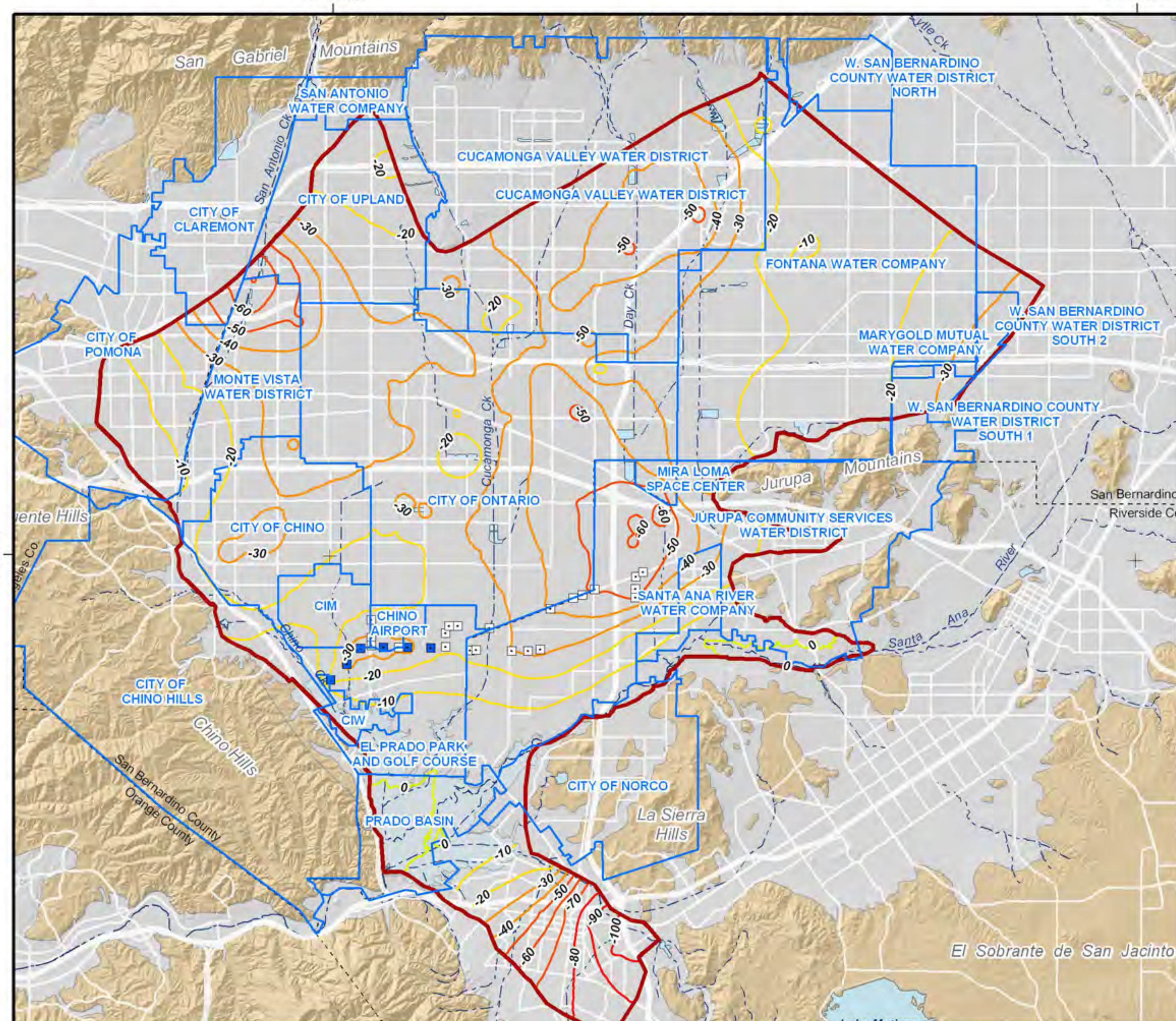
0 2 4 6 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Projected Baseline Groundwater Elevations for Layer 2

July 2030

Figure 5-1b



Main Features

50 - 75	
25 - 50	
0 - 25	
0	*Contours of Equal Groundwater Elevation Change from July 2005 to June 2030 (feet)*
0 - -25	
-25- -50	
-50 - -75	
-75 - -100	

Water Service Area Boundaries

Other Features

Existing Chino Desalter Well

Proposed Chino Desalter Well

Groundwater Flow Model Boundary

Flood Control/Conservation Basins

Streams, Rivers, and Channels

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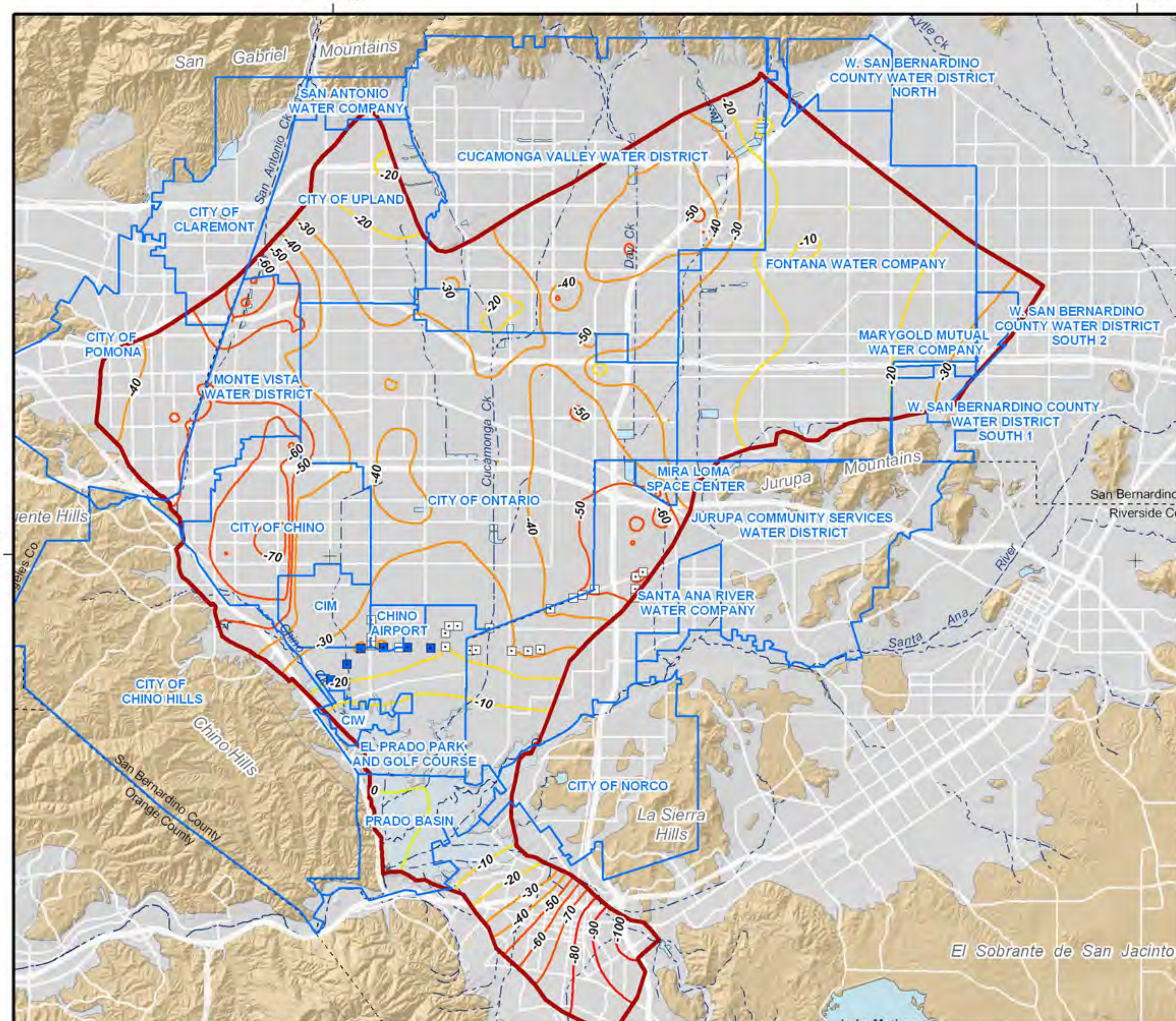
0 1 2 3 4 Miles

0 2 4 6 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Projected Peace II Groundwater Elevation Change
for Layer 1 in June 2030

Figure 5-2a



Main Features

Contours of Equal Groundwater Elevation Change from July 2005 to June 2030 (feet)

- 50 - 75
- 25 - 50
- 0 - 25
- 0
- 0 - -25
- -25 - -50
- -50 - -75
- -75 - -100

Water Service Area Boundaries

Other Features

- Existing Chino Desalter Well
- Proposed Chino Desalter Well
- Groundwater Flow Model Boundary
- Flood Control/Conservation Basins
- Streams, Rivers, and Channels

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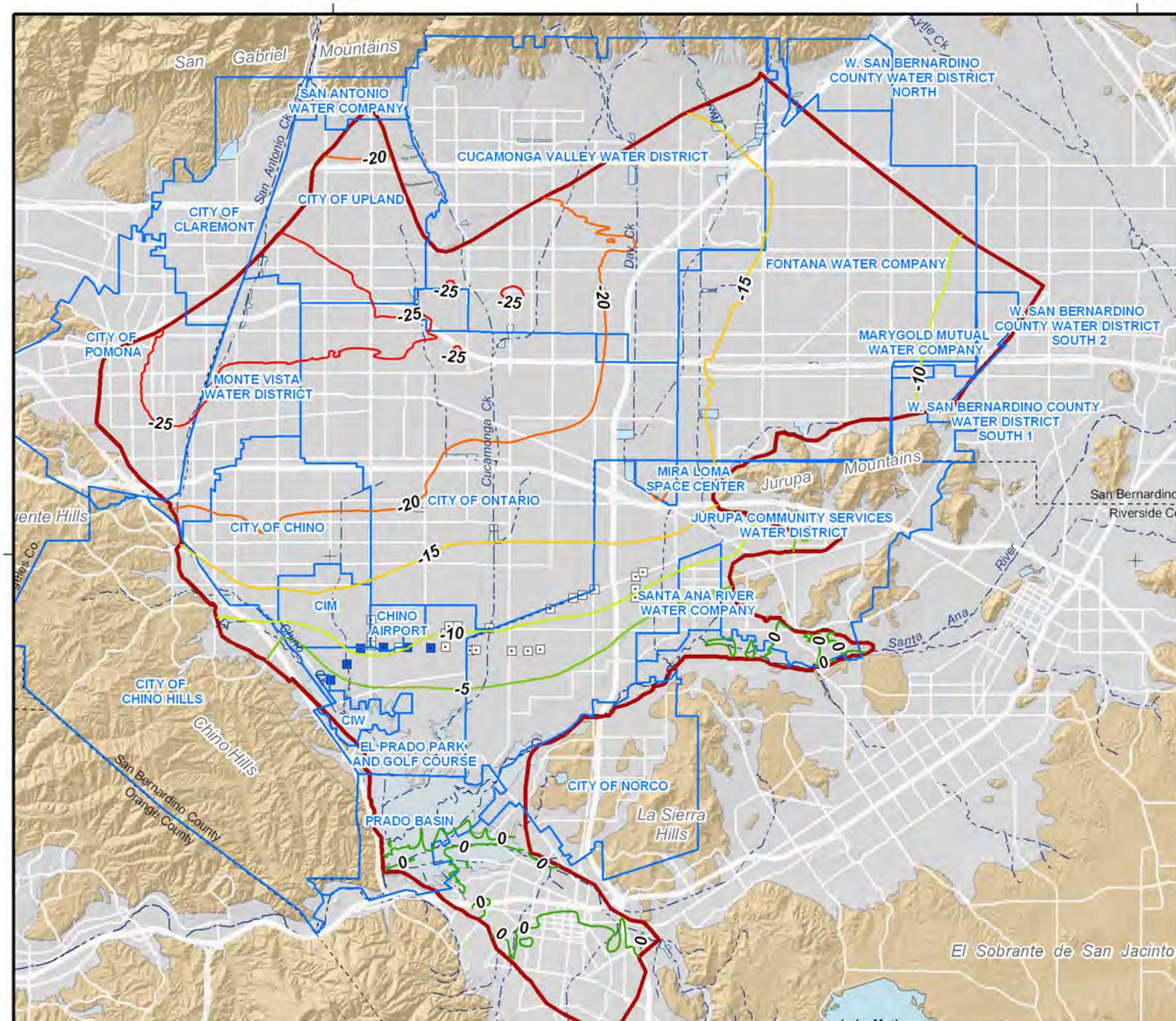
0 1 2 3 4 Miles
0 2 4 6 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Projected Peace II Groundwater Elevation Change
for Layer 2 in June 2030

Figure 5-2b



Main Features

- 0- -5
- -5 - -10
- -10 - -15
- -15 - -20
- -20 - -25
- -25- -30

Contours of Equal Groundwater Elevation Change from June 2030 (feet)

Water Service Area Boundaries

Other Features

- Existing Chino Desalter Well
- Proposed Chino Desalter Well
- Groundwater Flow Model Boundary
- Flood Control/Conservation Basins
- Streams, Rivers, and Channels

Peace II Groundwater Elevation Minus the Baseline Groundwater Elevation
for Layer 1 in June 2030

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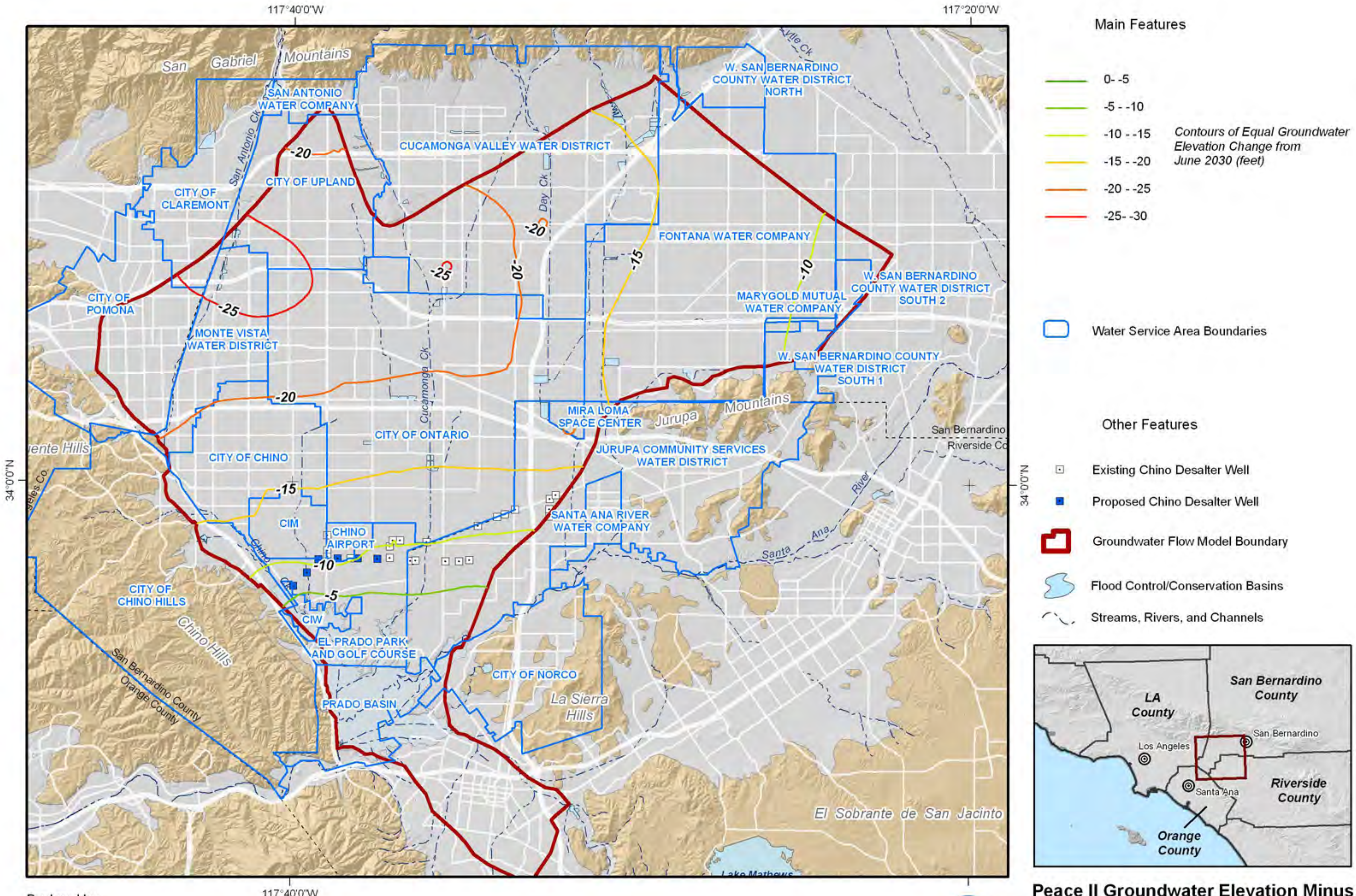
0 1 2 3 4 Miles
0 2 4 6 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Figure 5-3a



Peace II Groundwater Elevation Minus the Baseline Groundwater Elevation

for Layer 2 in June 2030

Figure 5-3b

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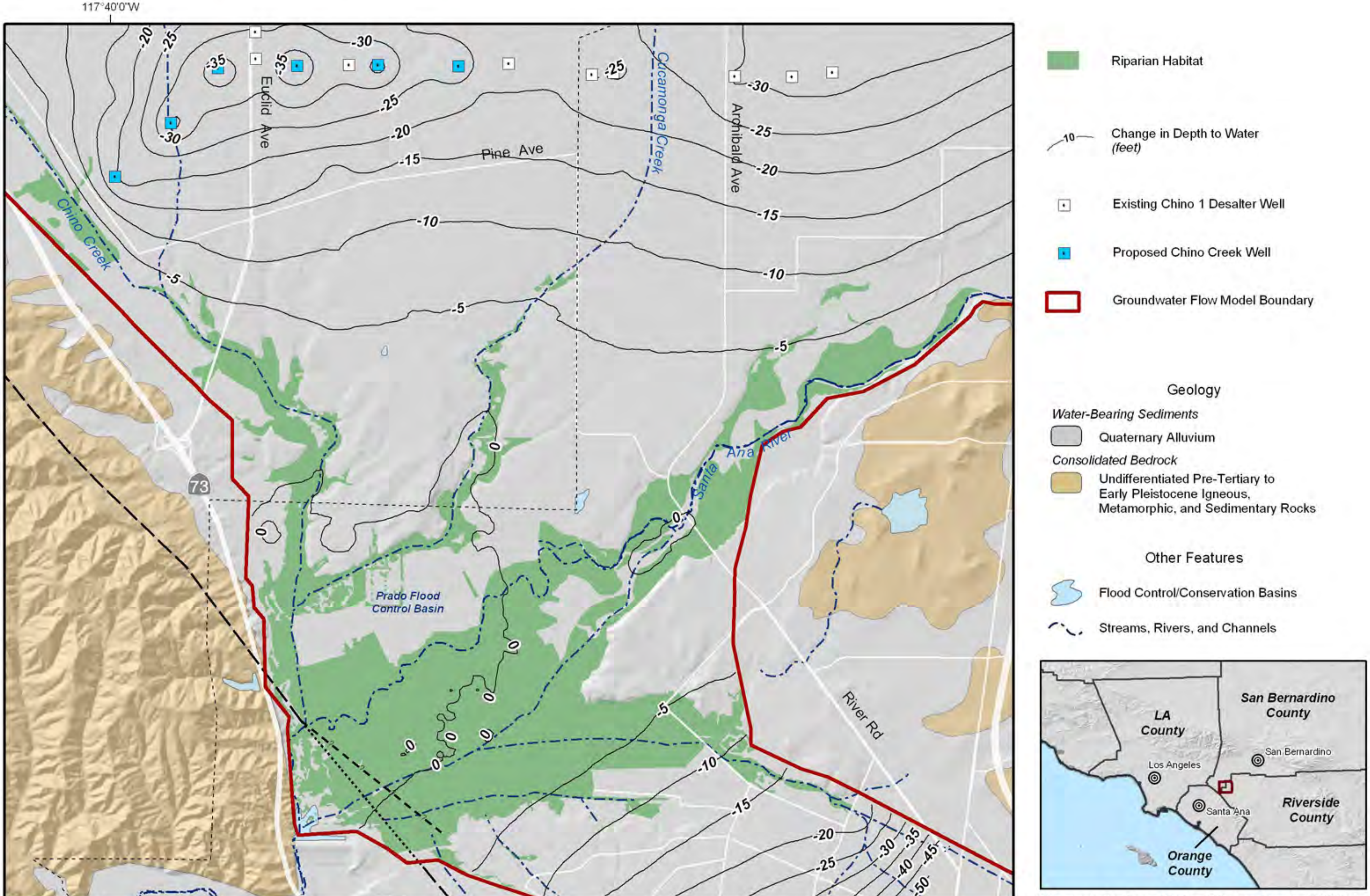

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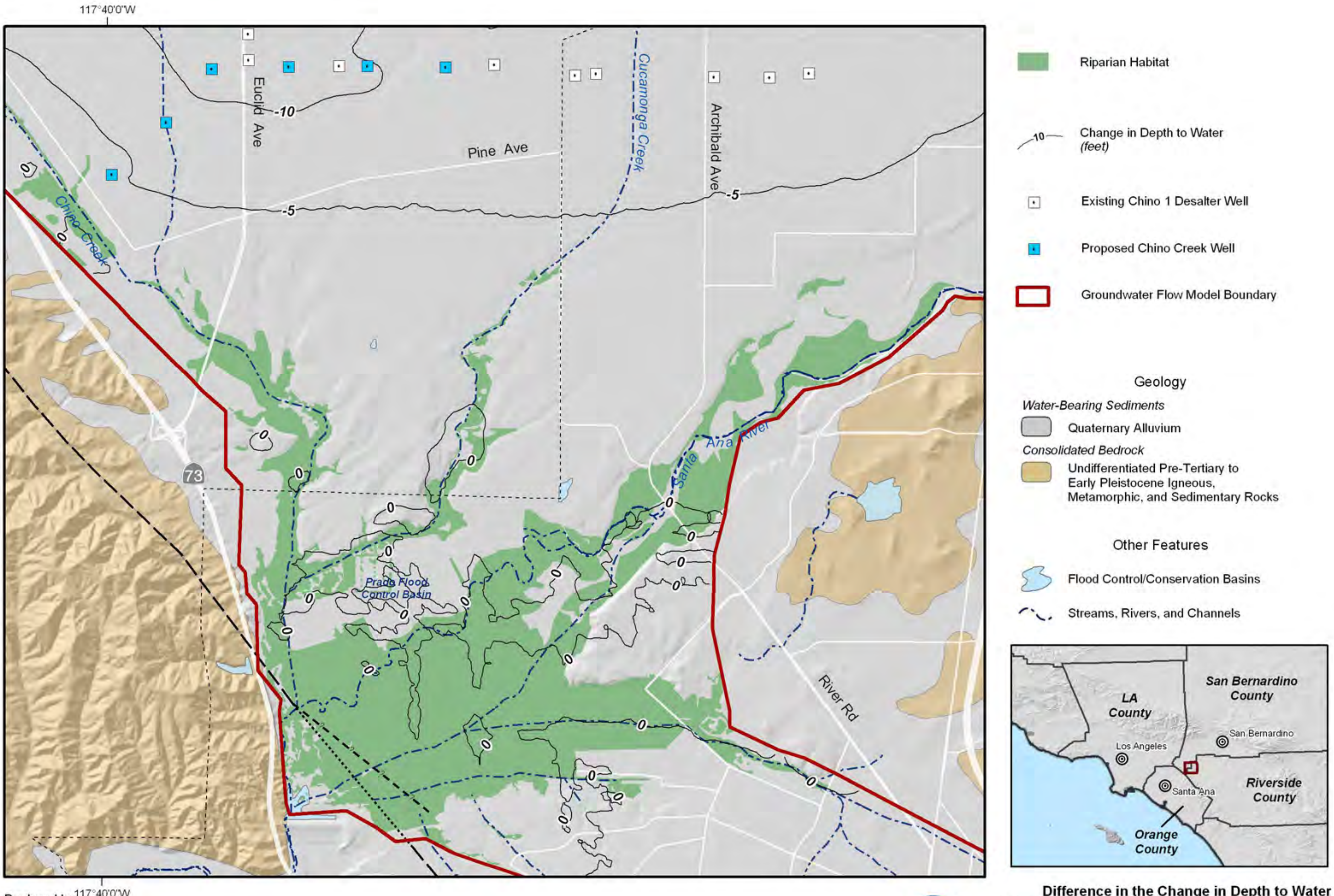
File: Figure_5-4a.mxd

2009 Production Optimization and Evaluation of the Peace II Project Description

Change in Depth to Water from 2005 to 2030 in the Riparian Vegetation Area of the Prado Dam Reservoir with the Peace II Alternative

Figure 5-4a



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Date: 20091024

File: Figure_5-4b.mxd

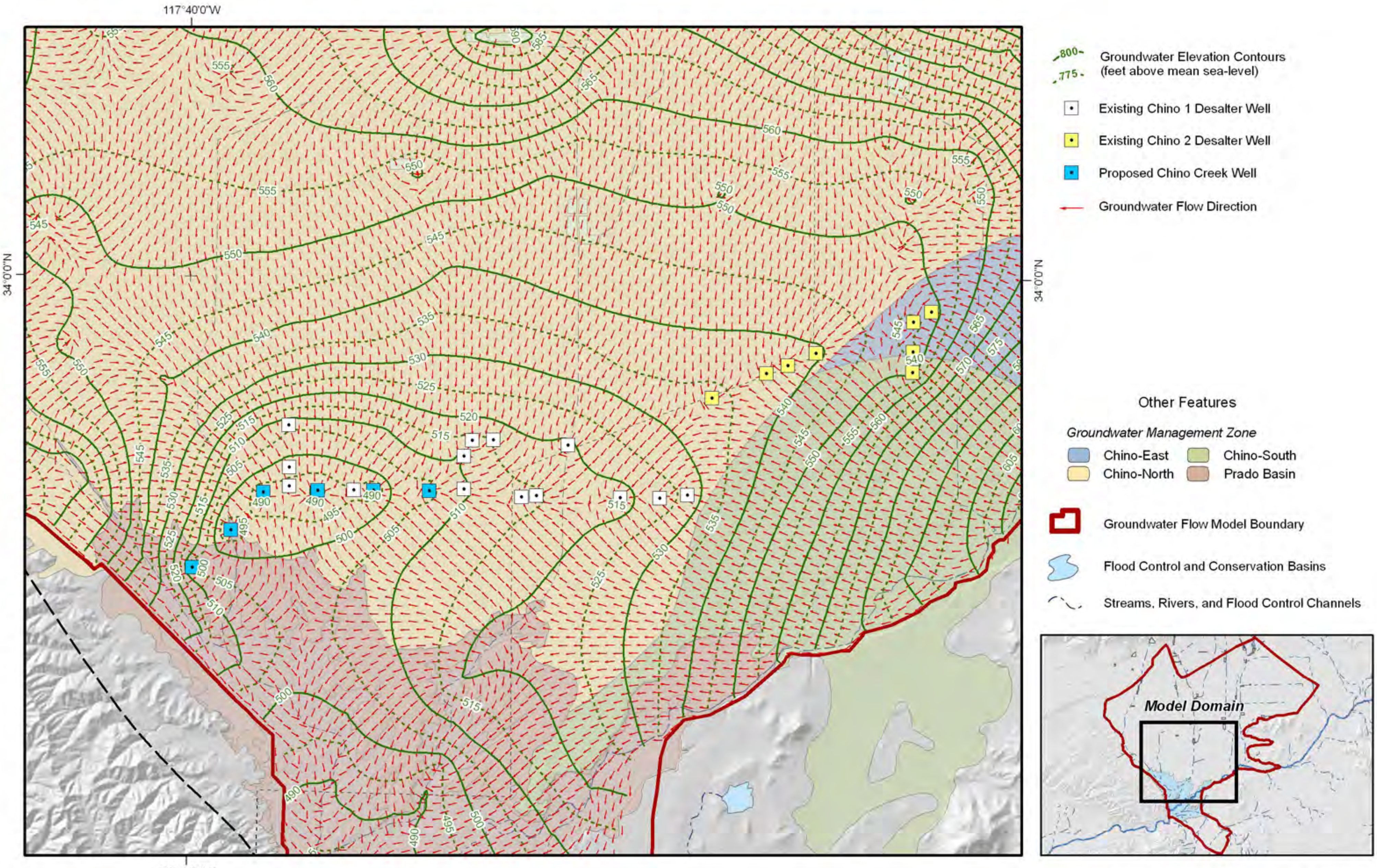
0 1 Miles

0 2 KM

2009 Production Optimization and Evaluation of the Peace II Project Description

Difference in the Change in Depth to Water from 2005 to 2030 in the Riparian Vegetation Area of the Prado Dam Reservoir, Peace II Alternative minus the Baseline Alternative

Figure 5-4b



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Date: 20091024

File: Figure_5-5.mxd

Layer 1 Groundwater Elevation Contours and Flow Directions in the Vicinity of the Desalters

Peace II Alternative -- 2020

Figure 5-5

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Appendix A

Post Optimization Production at Appropriator Wells

Appendix A
Post Optimization Production at Appropriator Wells
(acre-feet/year)

Owner	Well name	Year																								
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
City of Chino Hills	17	0	622	1,430	915	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762	1,762
	7A	168	281	74	249	542	542	542	542	542	542	542	542	542	542	542	542	542	542	542	542	542	542	542	542	542
	7B	289	465	120	342	745	745	745	745	745	745	745	745	745	745	745	745	745	745	745	745	745	745	745	745	745
	5	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
	15	0	0	0	0	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689	689
	1A	395	689	910	627	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084	1,084
City of Chino	10	0	0	0	0	356	403	403	403	403	403	403	403	403	403	403	563	738	807	807	807	807	807	807	807	807
	12	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	331	794	682	568	864	873	883	893	903	913	924	935	945	956	967	988	1,007	1,026	1,045	1,064	1,064	1,064	1,064	1,064	1,064
	6	250	973	828	765	1,094	1,106	1,119	1,131	1,144	1,156	1,170	1,184	1,198	1,211	1,225	1,251	1,275	1,299	1,323	1,347	1,347	1,347	1,347	1,347	1,347
	14	1,519	1,213	263	0	0	17	83	148	213	278	350	423	495	567	639	870	927	1,034	1,210	1,385	1,385	1,385	1,385	1,385	1,385
	5	392	288	318	631	1,497	1,514	1,531	1,548	1,565	1,582	1,601	1,620	1,639	1,658	1,677	1,712	1,745	1,778	1,811	1,844	1,844	1,844	1,844	1,844	1,844
	9	512	2,479	2,836	1,829	2,821	2,853	2,886	2,918	2,950	2,982	3,017	3,053	3,089	3,124	3,160	3,226	3,289	3,351	3,413	3,475	3,475	3,475	3,475	3,475	3,475
	11	2,012	2,052	1,416	1,482	2,188	2,213	2,238	2,263	2,288	2,312	2,340	2,368	2,395	2,423	2,450	2,502	2,550	2,599	2,647	2,695	2,695	2,695	2,695	2,695	2,695
	13	847	1,063	1,265	461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MVWD-33	0	0	0	591	1,727	1,747	1,767	1,786	1,806	1,826	1,847	1,869	1,891	1,913	1,934	1,975	2,013	2,051	2,090	2,128	2,128	2,128	2,128	2,128	2,128
	17	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
	16	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
	NEW-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	173	404	484	484	484	484	484	484	484
	NEW-3	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
	NEW-8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	381	381	381	381	381	381
Cucamonga Valley Water District	CB-4	2,298	2,230	1,572	1,568	854	1,142	0	580	580	580	580	580	1,107	605	0	0	594	2,017	2,074	2,144	2,144	2,144	1,936	2,420	2,420
	CB-30	2,027	1,464	1,156	640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CB-5	2,910	2,297	2,611	1,657	0	0	0	-464	-464	-464	-464	-464	-464	0	0	0	0	-748	-748	-748	-336	324	-748	0	0
	CB-3	1,422	1,473	781	1,399	1,347	1,347	1,347	673	673	277	673	673	673	673	1,347	673	673	673	673	673	673	673	1,347	1,347	1,347
	CB-38	3,645	3,895	3,365	2,822	2,739	2,892	3,045	2,606	2,759	2,866	2,939	3,011	2,841	3,495	4,113	3,894	3,966	3,086	3,159	3,160	3,160	3,160	3,160	4,113	4,113
	CB-39	0	1	171	3,168	3,653	3,856	4,060	3,800	4,004	4,147	4,243	4,340	4,113	4,660	5,484	5,192	5,289	4,638	4,735	4,737	4,737	4,737	4,737	5,484	5,484
	CB-40	0	0	132	1,183	0	0	0	0	0	0	0	0	335	240	0	0	0	44	704	1,364	1,613	1,613	0	683	1,783
	CB-41	0	2,788	2,140	854	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CB-42	39	2,934	2,278	1,466	0	0	0	464	464	464	464	464	464	0	0	0	0	748	748	748	748	748	748	0	0
	CB-1	2,117	1,705	1,058	907	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CB-43	0	0	0	1,613	3,226	3,226	3,226	2,111	2,207	1,613	1,613	1,613	1,613	2,741	3,226	3,054	3,111	1,613	1,613	1,613	1,668	2,108	3,226	3,226	3,226
	ASR1	0	0	0	0	0	0	2,388	2,044	2,164	2,248	2,305	2,362	2,228	2,741	3,226	3,054	3,111	2,420	2,477	2,478	2,478	2,478	2,478	3,226	3,226
	ASR2	0	0	0	0	0	0	0	2,044	2,164	2,248	2,305	2,362	2,228	2,741	3,226	3,054	3,111	2,420	2,477	2,478	2,478	2,478	2,478	3,226	3,226
	ASR3	0	0	0	0	0	0	0	0	-31	-464	-201	459	1,134	1,613	461	1,613	1,613	865	865	865	865	865	2,478	3,226	3,226
	CB-2C	0	0	0	0	1,611	1,701	1,791	1,533	1,623	1,686	1,729	1,771	1,671	2,056	2,420	2,290	2,333	1,815	1,858	1,859	1,859	1,859	1,859	2,420	2,420
	CB-46	0	0	0	1,153	3,168	3,359	2,592	143	318	-526	-469	-412	541	1,323	0	1,950	2,016	1,082	1,082	1,444	1,829	1,829	2,417	4,033	4,033
	ASR5	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
	ASR4	0	0	0	0	0	0	0	0	0	2,712	2,769	2,826	2,693	2,741	3,226	3,054	3,111	3,168	3,225	3,226	3,226	3,226	3,226	3,226	3,226
Fontana Water Company	F31A	419	858	698	743	669	469	159	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115
	F18A	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
	F35A	0	46	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F7A	1,072	1,622	1,737	729	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F30A	1,350	906	709	683	913	913	913	763	453	143	231	320	408	497	585	630	674	718	763	807	807	807	807	807	913
	F37A	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

Appendix A
Post Optimization Production at Appropriator Wells
(acre-feet/year)

Owner	Well name	Year																								
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Fontana Water Company (Cont'd)	F22A	939	1,182	905	2,197	2,391	2,324	2,257	2,208	2,208	2,141	2,176	2,208	2,208	2,208	2,208	2,208	2,208	2,208	2,208	2,208	2,208	2,208	2,208	2,208	2,247
	F17B	564	2,221	961	1,577	2,081	2,081	2,081	2,072	2,041	2,010	2,019	2,028	2,036	2,045	2,054	2,059	2,063	2,068	2,072	2,077	2,077	2,077	2,077	2,077	2,081
	F23A	2,365	1,109	2,226	1,203	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F21A	1,480	1,009	1,181	390	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F24A	508	1,335	1,316	1,737	2,016	1,891	1,766	1,642	1,517	1,460	1,460	1,464	1,500	1,535	1,571	1,589	1,606	1,624	1,642	1,660	1,660	1,660	1,660	1,660	1,749
	F26A	843	1,255	710	736	1,472	1,472	1,472	1,388	1,190	991	1,048	1,105	1,161	1,218	1,275	1,303	1,331	1,360	1,388	1,416	1,416	1,416	1,416	1,416	1,472
	F4A	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
	F2A	2,738	1,635	1,032	1,367	1,485	1,286	1,088	974	974	974	974	974	974	974	974	974	974	974	974	974	974	974	974	974	1,060
	F17C	1,305	2,189	4,297	2,433	2,363	2,363	2,363	2,354	2,318	2,282	2,292	2,303	2,313	2,323	2,333	2,338	2,343	2,348	2,354	2,359	2,359	2,359	2,359	2,359	2,363
	F44A	934	450	739	32	110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F44B	526	314	365	351	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F44C	239	124	516	395	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golden State Water Company	MARGARITE #1	438	881	599	630	329	342	356	370	384	397	402	406	410	415	419	412	405	399	392	385	385	385	385	385	385
Jurupa Community Services District	13	3,752	3,805	3,022	1,941	2,280	2,236	2,191	2,147	2,102	2,057	2,137	2,216	2,295	2,375	2,454	2,449	2,445	2,440	2,436	2,432	2,432	2,432	2,432	2,432	2,432
	17	3,122	0	633	1,896	2,449	2,401	2,354	2,306	2,258	2,210	2,295	2,380	2,465	2,551	2,636	2,631	2,626	2,621	2,616	2,612	2,612	2,612	2,612	2,612	2,612
	18	757	100	136	433	845	828	812	795	779	762	791	821	850	879	909	907	906	904	902	901	901	901	901	901	901
	6	951	1,480	807	1,388	1,858	1,822	1,785	1,749	1,713	1,676	1,741	1,806	1,870	1,935	1,999	1,996	1,992	1,989	1,985	1,981	1,981	1,981	1,981	1,981	1,981
	19	1,064	1,651	1,105	499	0	0	0	927	927	536	557	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	20	891	1,146	1,292	1,033	802	787	771	755	740	724	752	780	808	836	863	862	860	859	857	856	856	856	856	856	856
	15	147	946	134	475	0	0	0	480	465	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	14	2,490	2,814	2,032	3,086	3,145	3,089	3,075	1,823	1,803	988	1,026	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	16	530	498	605	525	0	0	0	21	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	124	807	899	1,638	2,094	1,499	1,451	1,212	1,184	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	706	646	324	164	323	161	161	161	161	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	86	525	1,428	731	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Galleano	0	0	0	0	0	0	0	-807	-807	717	776	835	893	1,759	1,818	1,814	1,811	1,001	998	994	994	994	994	1,801	1,801
	ODA	0	0	0	0	0	0	0	-807	-807	-807	-807	835	893	1,759	1,818	1,814	1,811	1,001	998	994	994	994	994	1,801	1,801
	IDI-1	0	0	0	0	0	1,656	1,623	783	750	717	776	835	893	1,759	1,818	1,814	1,811	1,001	998	994	994	994	994	1,801	1,801
	IDI-2	0	0	0	0	0	0	0	-807	-807	717	776	835	893	1,759	1,818	1,814	1,811	1,001	998	994	994	994	994	1,801	1,801
	22	0	0	0	196	1,194	218	182	-1,306	-1,342	-1,453	-1,453	-1,453	-1,453	0	0	0	0	-1,453	-1,453	-1,453	-1,453	-1,453	-1,453	0	0
	23	0	0	0	1,256	3,125	3,064	3,003	1,449	1,388	1,327	1,435	1,544	1,653	3,254	3,363	3,357	3,351	1,852	1,845	1,839	1,839	1,839	1,839	3,332	3,332
	24	156	266	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	25	0	0	0	792	1,971	1,932	1,894	1,855	1,817	1,778	1,847	1,915	1,984	2,052	2,121	2,117	2,113	2,109	2,105	2,101	2,101	2,101	2,101	2,101	2,101
City of Ontario	16	1,286	1,113	936	477	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	17	1,820	1,419	1,409	1,005	690	683	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	20	103	346	121	270	420	416	411	407	402	397	412	427	0	0	0	0	0	0	0	0	0	0	0	0	0
	24	460	595	437	277	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	25	356	903	452	652	762	754	745	737	729	720	748	775	802	829	857	0	0	0	0	0	0	0	0	0	0
	26	92	104	109	59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	27	199	252	92	491	594	588	581	-255	-255	-255	-255	-255	-255	0	0	0	0	-410	-410	-410	-410	-410	-410	0	0
	29	886	1,309	1,283	1,288	1,422	1,406	1,391	1,375	1,360	1,344	1,395	1,446	1,496	1,547	1,598	1,649	1,700	1,751	1,802	1,852	1,903	1,954	2,005	2,056	0
	31	2,079	3,636	3,234	2,642	1,595	1,577	1,560	1,542	1,525	1,507	1,564	1,621	1,678	1,735	1,792	1,849	1,906	1,963	2,020	2,078	2,135	2,192	2,249	2,306	2,363
	34	1,296	1,938	1,955	1,593	852	842	833	824	814	805	835	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	35	2,793	3,713	3,372	2,450	1,468	1,451	1,435	1,419	1,403	1,387	1,439	1,492	1,544	1,597	1,649	1,702	1,754	1,807	1,859	1,912	1,964	2,017	2,069	2,122	2,174
	36	1,077	1,764	771	953	903	893	883	873	863	853	885	917	950	0	0	0	0	0	0	0	0	0	0	0	0
	37	4,381	2,802	3,082	1,640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A
Post Optimization Production at Appropriator Wells
(acre-feet/year)

Owner	Well name	Year 2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
City of Ontario (Cont'd)	38	1,275	1,625	1,876	1,480	1,001	930	1,255	1,501	125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	39	3,137	1,229	256	88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	40	3,033	2,310	2,945	1,808	1,781	1,762	1,742	1,723	1,703	1,683	1,747	1,811	1,874	1,938	2,002	2,065	2,129	2,193	2,257	2,320	2,384	2,448	2,511	2,575	2,639
	41	2,699	1,998	1,697	922	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	45	0	0	0	567	1,354	1,340	1,325	1,310	1,295	1,280	1,328	1,377	1,425	1,474	1,522	1,570	1,619	1,667	1,716	1,764	1,813	1,861	1,910	1,958	2,006
	9	2,796	715	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	46	0	0	0	567	1,354	1,340	1,325	1,310	1,295	1,280	1,328	1,377	1,425	1,474	1,522	1,570	1,619	1,667	1,716	1,764	1,813	1,861	1,910	1,958	2,006
	47	0	0	0	2,016	4,033	4,033	4,033	4,033	4,025	1,146	1,387	2,189	2,695	3,242	2,767	2,590	1,734	1,942	2,072	958	1,092	1,260	1,428	1,597	2,960
	48	0	0	0	0	975	964	954	943	932	922	956	991	1,026	1,061	1,096	1,131	1,166	1,200	1,235	1,270	1,305	1,340	1,375	1,410	1,445
	49	0	0	474	1,272	975	964	954	943	932	922	956	991	1,026	1,061	1,096	1,131	1,166	1,200	1,235	1,270	1,305	1,340	1,375	1,410	1,445
	50	0	0	0	277	663	656	649	641	634	627	650	674	698	721	745	769	793	816	840	864	887	911	935	959	982
	51	0	0	0	0	867	857	848	467	457	447	478	509	540	943	974	1,005	1,036	469	500	531	562	593	624	1,253	1,284
	52	0	0	0	453	1,084	1,072	1,060	1,048	1,036	1,024	1,063	1,101	1,140	1,179	1,218	1,256	1,295	1,334	1,373	1,411	1,450	1,489	1,528	1,566	1,605
	42	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	43	0	0	0	1,452	2,903	2,903	2,903	2,903	2,903	2,636	2,692	2,903	2,903	2,903	2,903	2,903	2,772	2,820	2,868	2,550	2,624	2,662	2,701	2,740	2,903
	44	0	0	0	1,400	3,112	3,061	3,290	3,474	2,147	0	0	147	410	1,186	512	328	0	0	78	0	0	0	0	0	0
	100	0	0	0	0	0	0	0	0	0	4,033	4,033	4,033	4,033	4,033	4,033	4,033	4,033	4,033	4,033	4,033	4,033	4,033	4,033	4,033	4,033
	101	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,522	1,570	1,619	1,667	1,716	1,764	1,813	1,861	1,910	1,958	2,006
	103	0	0	0	0	0	0	0	0	1,295	1,280	1,328	1,377	1,425	1,474	1,522	1,570	1,619	1,667	1,716	1,764	1,813	1,861	1,910	1,958	2,006
	104	0	0	0	0	0	0	0	0	1,295	1,280	1,328	1,377	1,425	1,474	1,522	1,570	1,619	1,667	1,716	1,764	1,813	1,861	1,910	1,958	2,006
	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,619	1,667	1,716	1,764	1,813	1,861	1,910	1,958	2,006
	106	0	0	0	0	0	0	0	-581	-581	-581	-581	-581	-581	0	0	0	0	-935	-935	829	878	926	975	1,958	2,006
	109	0	0	0	0	0	0	0	-581	-581	699	748	796	845	1,474	1,522	1,570	1,619	732	781	829	878	926	975	1,958	2,006
	111	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
	119	0	0	0	0	0	0	0	-581	-581	-581	-581	-581	-581	0	0	1,570	1,619	732	781	829	878	926	975	1,958	2,006
	115	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	787
	120	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
	126	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
	134	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
	136	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
	138	0	0	0	0	0	0	0	-523	-523	-523	-523	-523	-523	0	0	0	0	-841	-841	-841	-841	-841	-841	0	0
Monte Vista Water District	10	0	111	659	550	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6	442	525	572	536	0	0	0	0	0	0	0	0	0	18	106	195	284	424	538	622	706	790	807	807	807
	19	1,487	2,395	2,447	2,472	2,401	2,431	2,461	2,491	2,521	2,551	2,596	2,641	2,686	2,728	2,760	2,791	2,823	2,847	2,866	2,885	2,904	2,923	2,943	2,962	2,981
	20	653	774	1,309	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	26	597	1,413	2,101	2,151	2,401	2,431	2,461	2,491	2,521	2,551	2,596	2,641	2,686	2,728	2,760	2,791	2,823	2,847	2,866	2,885	2,904	2,923	2,943	2,962	2,981
	27	831	1,751	1,878	2,213	2,401	2,431	2,461	2,491	2,521	2,551	2,596	2,641	2,686	2,728	2,760	2,791	2,823	2,847	2,866	2,885	2,904	2,923	2,943	2,962	2,981
	28	2,879	3,577	3,276	2,664	2,521	2,552	2,584	2,615	2,647	2,678	2,725	2,773	2,820	2,864	2,898	2,931	2,964	2,989	3,010	3,030	3,050	3,070	3,090	3,110	3,130
	MVWD-33	0	0	0	482	1,200	1,215	1,230	781	796	811	833	856	878	1,364	1,380	1,396	1,412	676	685	695	704	714	723	1,481	1,490
	32	0	0	0	0	0	0	0	-465	-465	-465	-465	-465	-465	0	0	0	0	-748	-748	-748	-748	-748	-748	0	0
	4	540	469	266	826	996	1,009	1,021	841	853	866	884	903	922	1,132	1,145	1,158	1,172	871	879	887	895	903	911	1,229	1,237
	31	0	0	0	963	2,401	2,431	2,461	2,491	2,521	2,551	2,596	2,641	2,686	2,728	2,760	2,791	2,823	2,847	2,866	2,885	2,904	2,923	2,943	2,962	2,981
	30	0	0	420	67	0	0	0	-465	-465	-465	-465	-465	-465	0	0	0	0	-748	-689	-600	-511	-422	-266	654	827
	34	0	0	0	0	0	0	0	-465	-465	-465	-465	-465	-465	0	0	0	0	-748	-748	-748	-748	-748	-748	0	0
	5	1,156	605	1,314	1,500	1,680	1,701	1,722	1,743	1,764	1,785	1,817	1,848	1,880	1,910	1,932	1,954	1,976	1,993	2,006	2,020	2,033	2,046	2,060	2,073	2,086
City Of Pomona	30	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
	6	193	92	1,025	844	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984
	5B	1,153	41	200	992	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036

Appendix A
Post Optimization Production at Appropriator Wells
(acre-feet/year)

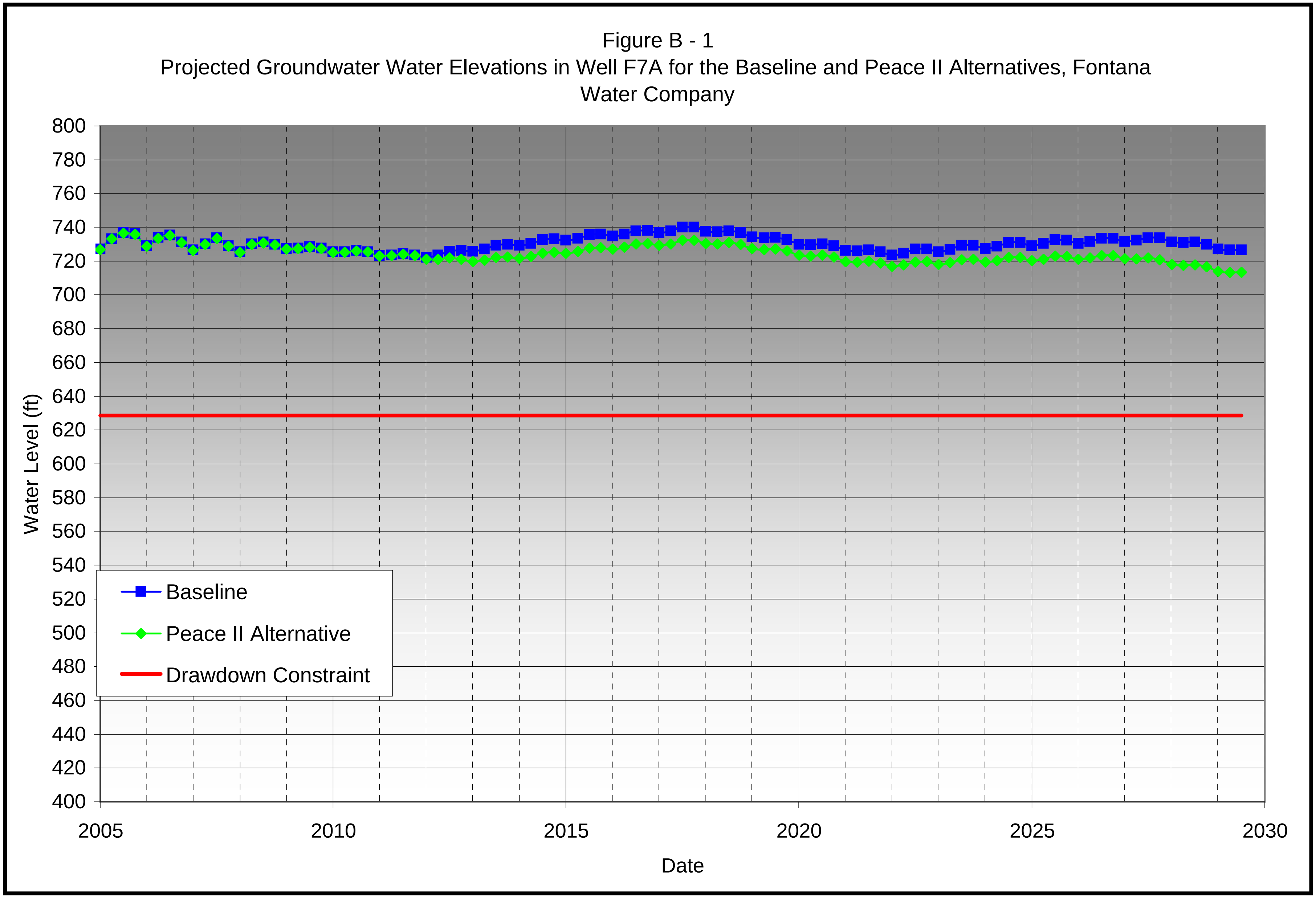
Owner	Well name	Year																								
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
City of Pomona (Cont'd)	2	447	336	332	1,328	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243	1,243
	16	564	327	1,140	911	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880
	4	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
	10	1,541	1,602	1,610	1,197	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932
	17	211	232	225	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11	16	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12	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
	18	181	143	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	14	155	231	344	325	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673	673
	15	713	611	123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	21	1,065	1,171	1,122	919	637	637	637	637	637	637	637	637	637	637	637	637	637	637	637	637	637	637	637	637	637
	26	824	1,032	1,009	999	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010
	23	30	258	322	500	925	925	925	925	925	925	925	925	925	925	925	925	925	925	925	925	925	925	925	925	925
	25	952	814	1,424	1,237	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932	932
	27	497	768	914	860	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880	880
	35	343	172	252	735	751	751	751	751	751	751	751	751	751	751	751	751	751	751	751	751	751	751	751	751	751
	34	536	1,840	1,832	1,511	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288	1,288
	24	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
	29	343	267	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	36	183	948	1,278	1,000	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829	829
San Antonio Water Company	35	0	0	0	326	853	879	904	930	956	981	995	1,008	1,022	1,035	1,048	1,045	1,041	1,037	1,033	1,030	1,030	1,030	1,030	1,030	1,030
Santa Ana River Water Company	03	0	0	0	21	37	38	40	41	43	44	45	45	46	46	47	46	45	44	44	43	43	43	43	43	43
	03A	1	0	0	30	51	53	55	57	59	61	62	63	63	64	65	64	63	62	61	60	60	60	60	60	60
	OLD 02	0	0	0	26	45	46	48	50	52	54	54	55	56	56	57	56	55	54	53	52	52	52	52	52	52
	05	0	0	0	13	22	23	24	25	26	27	27	28	28	28	28	28	27	27	27	26	26	26	26	26	26
	07	0	0	0	16	28	29	30	31	32	33	34	34	34	35	35	35	34	34	33	32	32	32	32	32	32
	01A	0	0	0	34	57	59	62	64	67	69	70	70	71	72	73	72	70	69	68	67	67	67	67	67	67
	04	0	0	0	14	24	25	26	27	28	29	29	30	30	30	31	30	30	29	29	28	28	28	28	28	28
City of Upland	8	0	0	640	381	215	244	272	301	330	358	358	358	358	358	358	358	358	358	358	358	358	358	358	358	358
	3	0	0	334	491	215	244	272	301	330	358	358	358	358	358	358	358	358	358	358	358	358	358	358	358	358
	7A	1,394	1,112	1,060	342	301	341	381	421	462	502	502	502	502	502	502	502	502	502	502	502	502	502	502	502	502
	20	0	0	0	526	215	244	272	301	330	358	358	358	358	358	358	358	358	358	358	358	358	358	358	358	358
	21A	0	0	0	219	338	383	428	473	518	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563	563
Niagara	0	167	407	497	750	657	684	712	739	767	794	803	811	820	828	837	824	810	797	783	770	770	770	770	770	770
Arrowhead Mountain Spring Water Company	0	25	0	0	153	263	274	285	296	307	318	321	325	328	332	335	330	324	319	314	308	308	308	308	308	308
San Bernardino County (Olympic Facility)	0	0	0	0	67	125	130	135	140	146	151	152	154	156	157	159	156	154	151	149	146	146	146	146	146	146
Chino Desalter Authority	CCWFA 1	0	0	0	0	0	0	0	0	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525	1,525
	CCWFA 2	0	0	0	0	0	0	0	0	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513
	CCWFA 3	0	0	0	0	0	0	0	0	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513	1,513
	CCWFA 4	0	0	0	0	0	0	0	0	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443
	CCWFA 5	0	0	0	0	0	0	0	0	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103	1,103
	CCWFA 6	0	0	0	0	0	0	0	0	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399
	CDA I 1	658	403	635	692	788	788	788	788	587	587	587	587	587	587	587	587	587	587	587	587	587	587	587	587	587
	CDA I 2	179	151	198	374	526	526	526	526	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391
	CDA I 3	789	691	808	823	788	788	788	788	587	587	587	587	587	587	587	587	587	587	587	587	587	587	587	587	587
	CDA I 4	486	441	370	428	526	526	526	526	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391	391
	CDA I 5	1,025	136	580	692	1,314	1,314	1,314	1,314	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979

Appendix A
Post Optimization Production at Appropriator Wells
(acre-feet/year)

Owner	Well name	Year																								
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Chino Desalter Authority (Cont'd)	CDA I 8	135	184	621	562	1,051	1,051	1,051	1,051	783	783	783	783	783	783	783	783	783	783	783	783	783	783	783	783	783
	CDA I 9	874	252	686	1,255	1,314	1,314	1,314	1,314	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979
	CDA I 10	1,282	1,060	1,519	1,422	1,314	1,314	1,314	1,314	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979
	CDA I 11	975	1,674	1,274	1,481	1,752	1,752	1,752	1,752	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305
	CDA I 6	6	623	465	682	963	963	963	963	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718	718
	CDA I 7	300	389	406	820	1,314	1,314	1,314	1,314	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979	979
	CDA I-EXP 13	2,748	2,610	738	2,842	2,939	2,939	2,939	2,939	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769	2,769
	CDA I-EXP 14	2,160	3,402	3,323	2,941	2,671	2,671	2,671	2,671	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517
	CDA I-EXP 15	889	1,775	1,420	2,865	2,671	2,671	2,671	2,671	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517	2,517
	CDA II 1	953	3,224	2,548	1,539	1,559	1,559	1,559	1,559	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851
	CDA II 2	728	2,957	2,804	2,273	1,559	1,559	1,559	1,559	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851
	CDA II 3	673	3,067	2,869	2,276	1,559	1,559	1,559	1,559	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851
	CDA II 4	699	2,924	1,166	934	1,559	1,559	1,559	1,559	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851
	CDA II 7	19	493	1,095	1,864	1,559	1,559	1,559	1,559	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851
	CDA-II 6	0	82	2,064	2,442	2,078	2,078	2,078	2,078	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468
	CDA-II 8	57	124	1,032	1,527	1,559	1,559	1,559	1,559	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851
	CDA-II 9	0	211	1,508	1,180	1,559	1,559	1,559	1,559	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851	1,851

Appendix B

Projected Groundwater Elevations at Select Appropriator Wells



Well Hydrographs_Appendix B_v2 -- F7A_98
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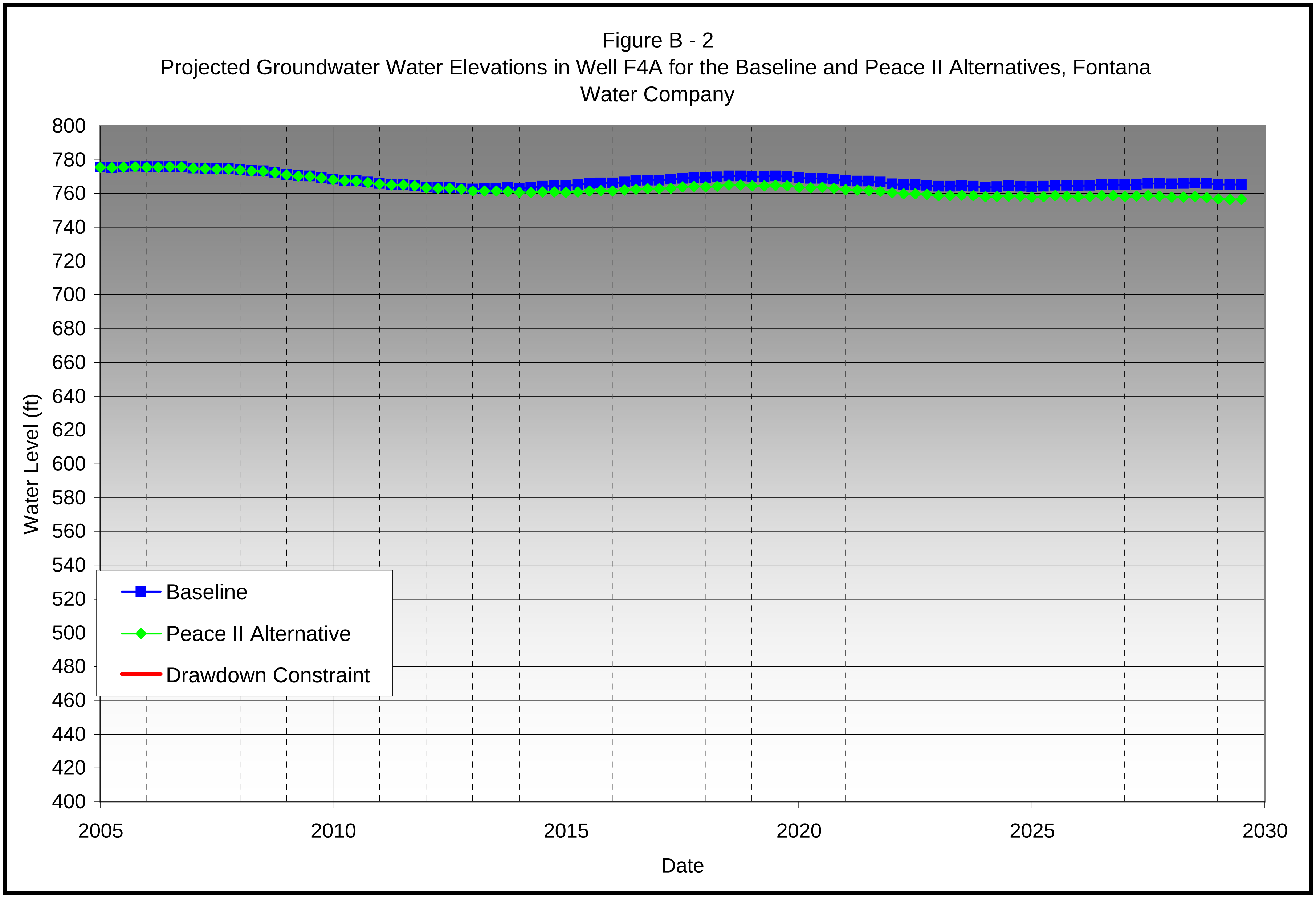
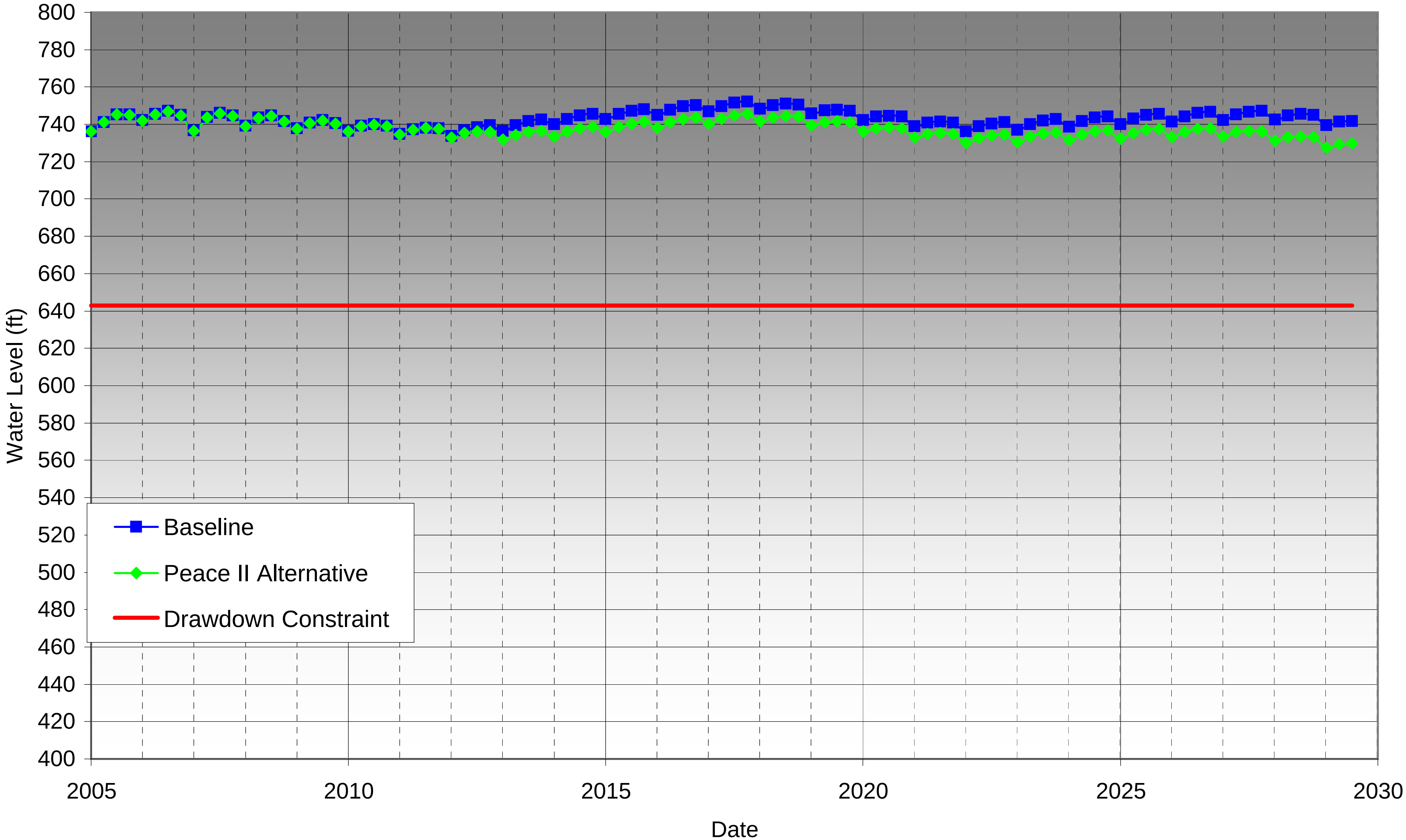
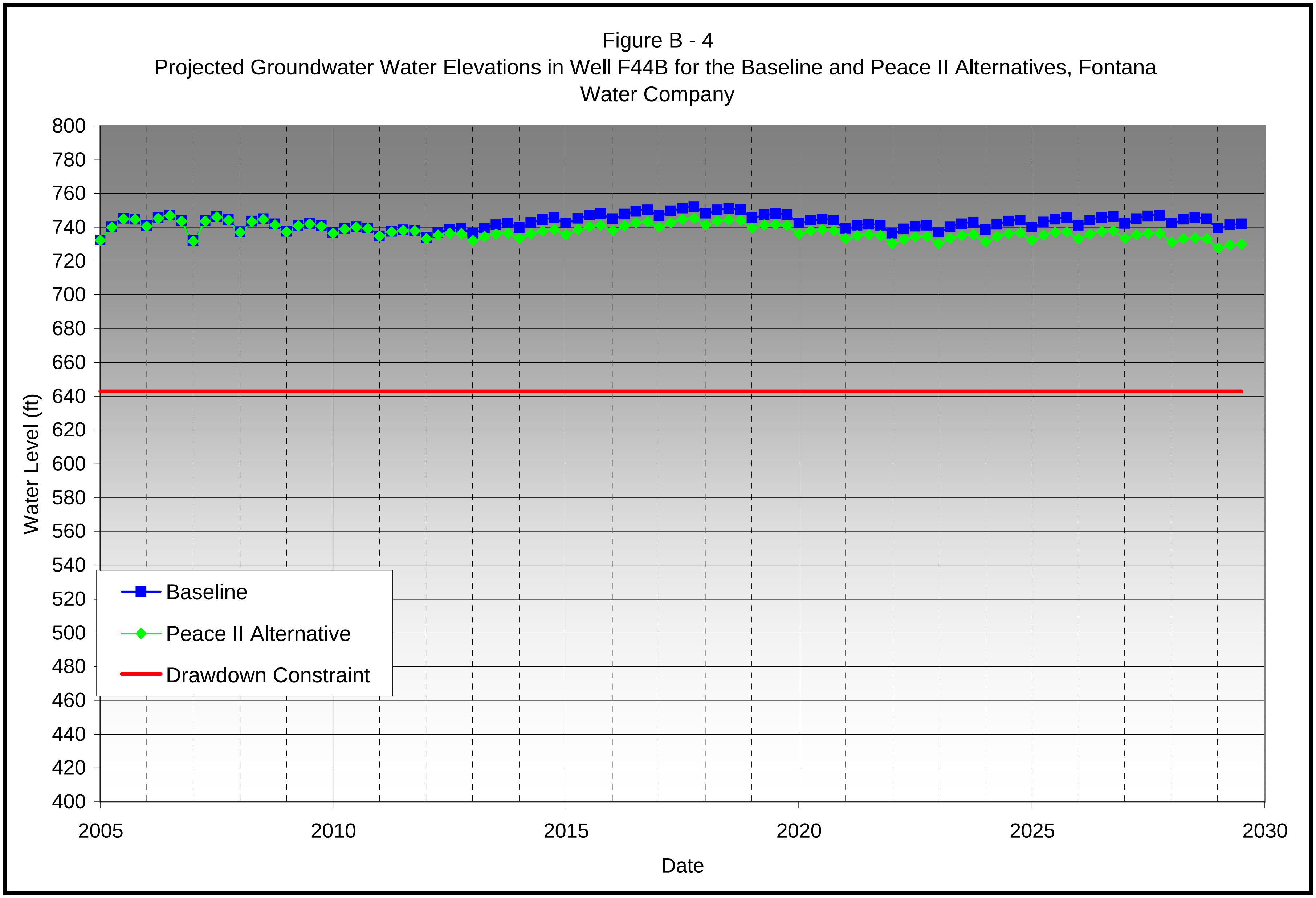
WILDERMUTH ENVIRONMENTAL INC.



Well Hydrographs_Appendix B_v2 -- F4A_97
11/3/2009 -- 4:47 PM

Figure B - 3
Projected Groundwater Water Elevations in Well F44C for the Baseline and Peace II Alternatives, Fontana Water Company





Well Hydrographs_Appendix B_v2 -- F44B_95
11/3/2009 -- 4:47 PM

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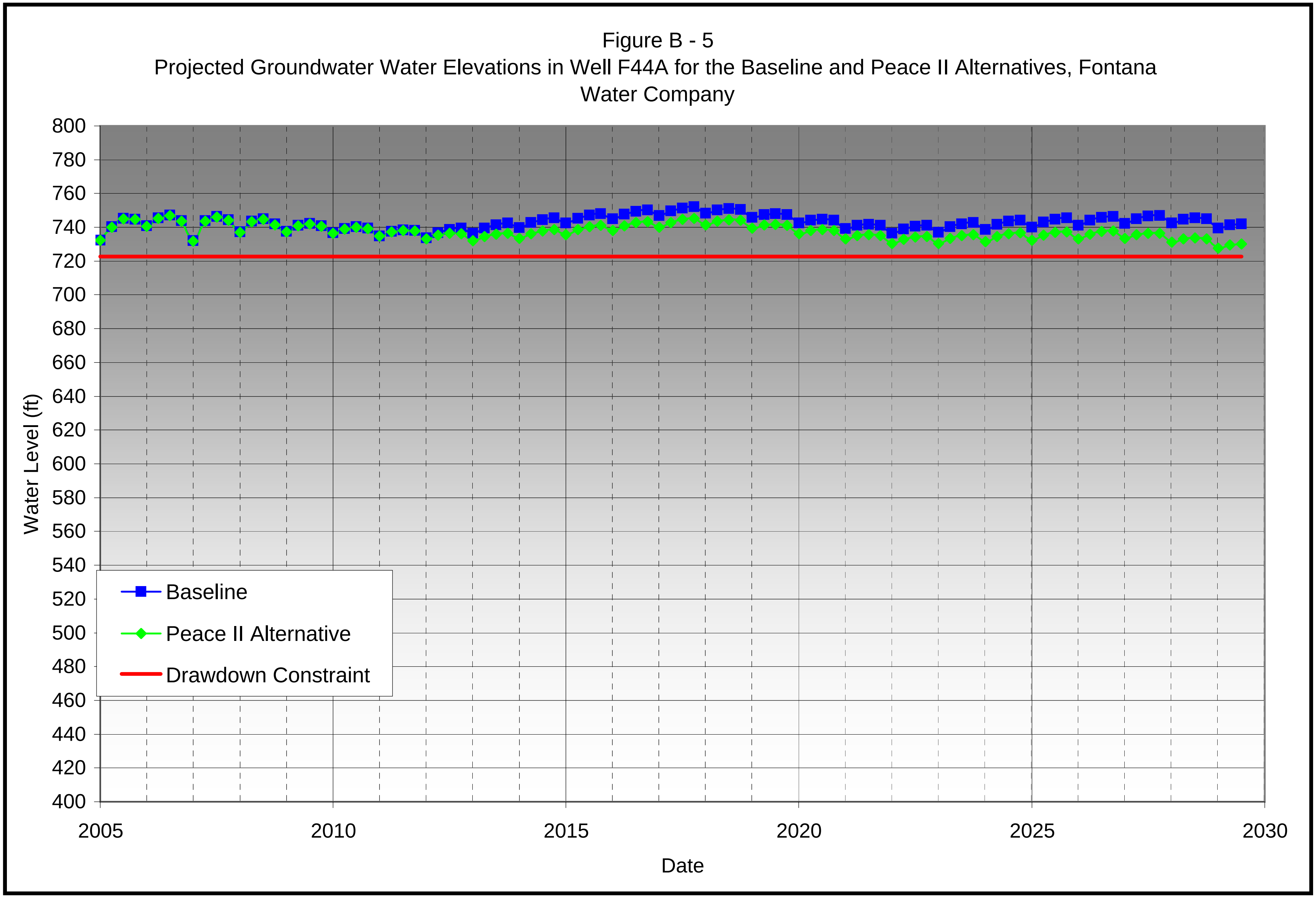
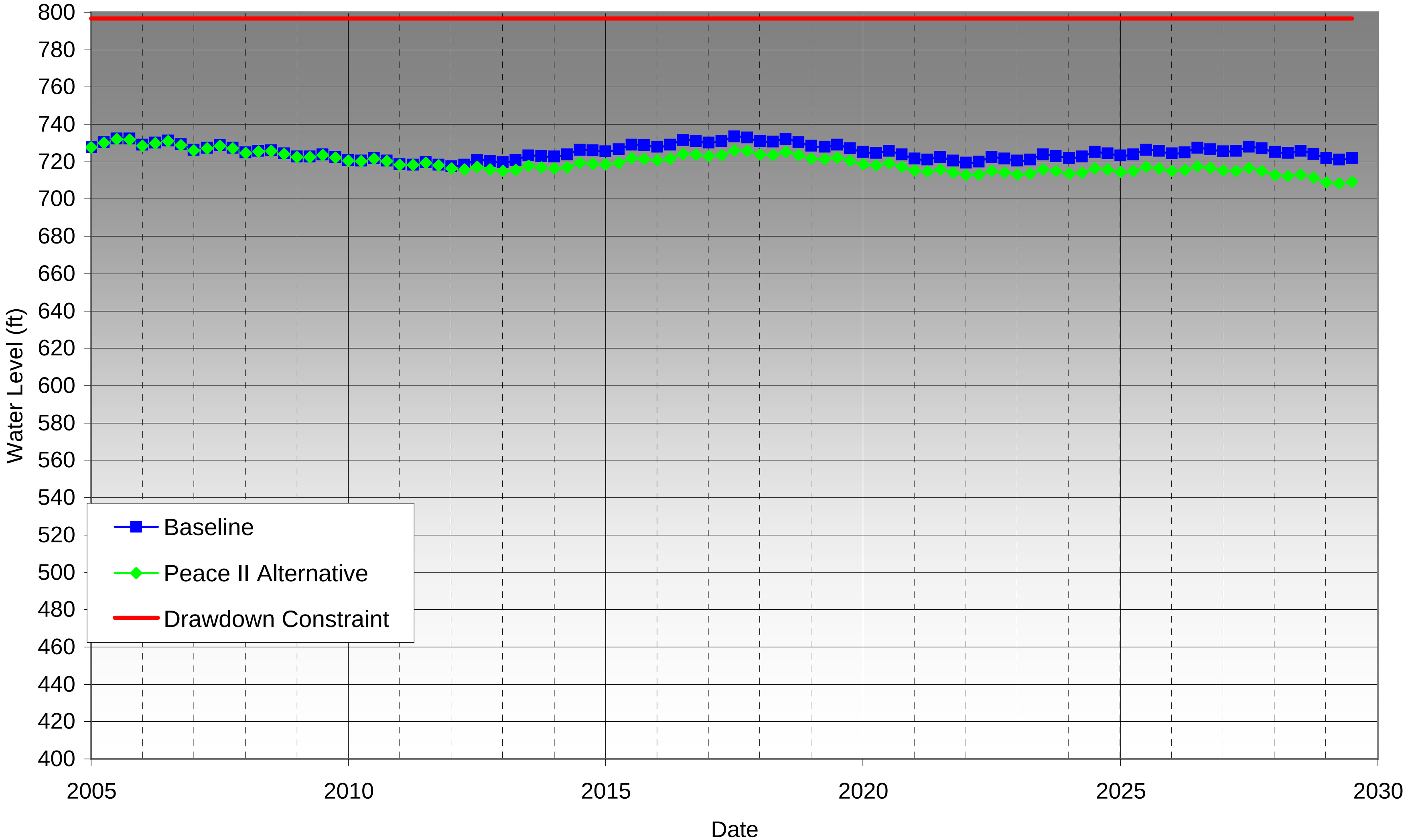


Figure B - 5
Projected Groundwater Water Elevations in Well F44A for the Baseline and Peace II Alternatives, Fontana Water Company
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

Figure B - 6
Projected Groundwater Water Elevations in Well F37A for the Baseline and Peace II Alternatives, Fontana Water Company



Well Hydrographs_Appendix B_v2 -- F37A_93
11/3/2009 -- 4:47 PM

WILDERMUTH ENVIRONMENTAL INC.

Figure B - 7
Projected Groundwater Water Elevations in Well F35A for the Baseline and Peace II Alternatives, Fontana Water Company

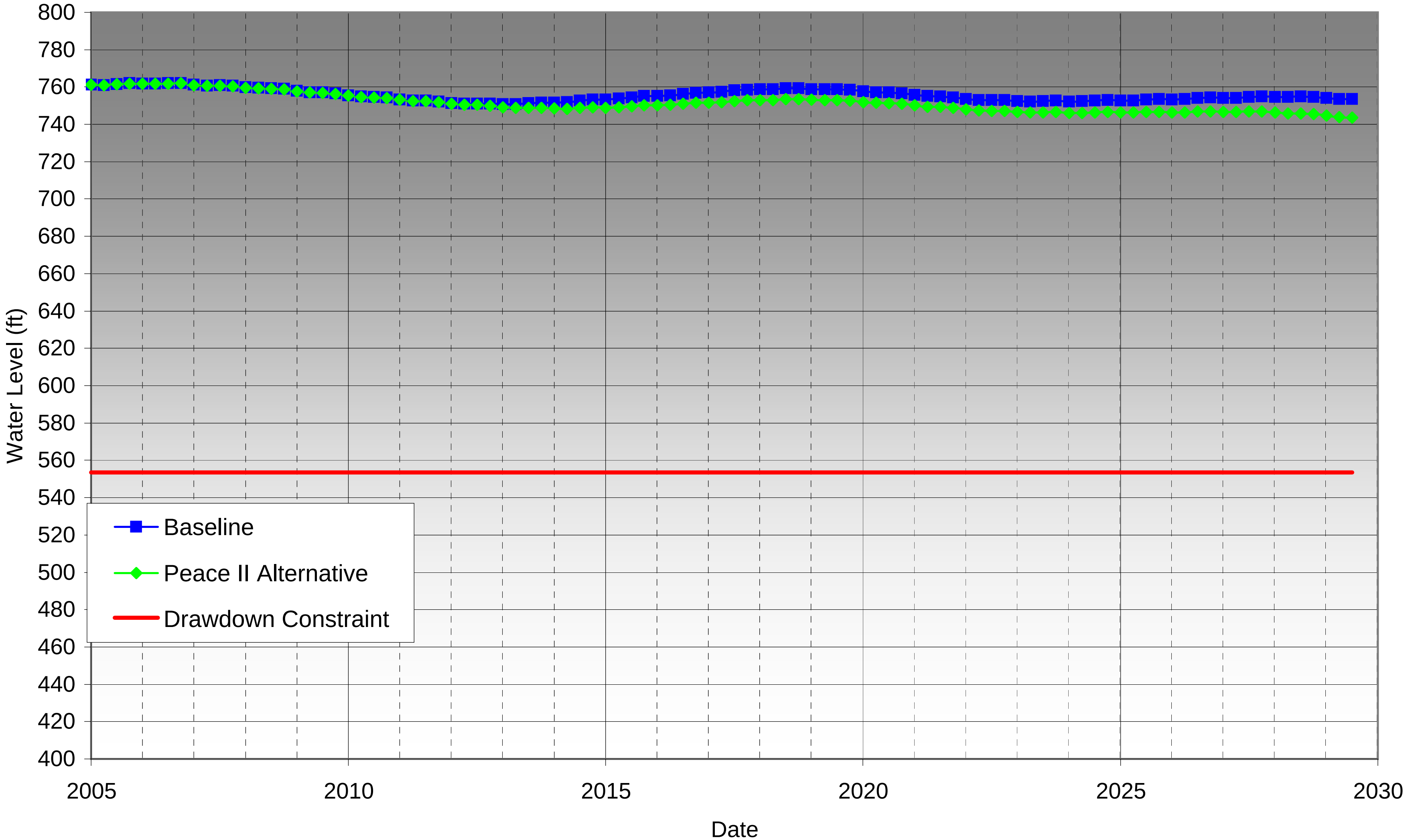


Figure B - 8
Projected Groundwater Water Elevations in Well F31A for the Baseline and Peace II Alternatives, Fontana Water Company

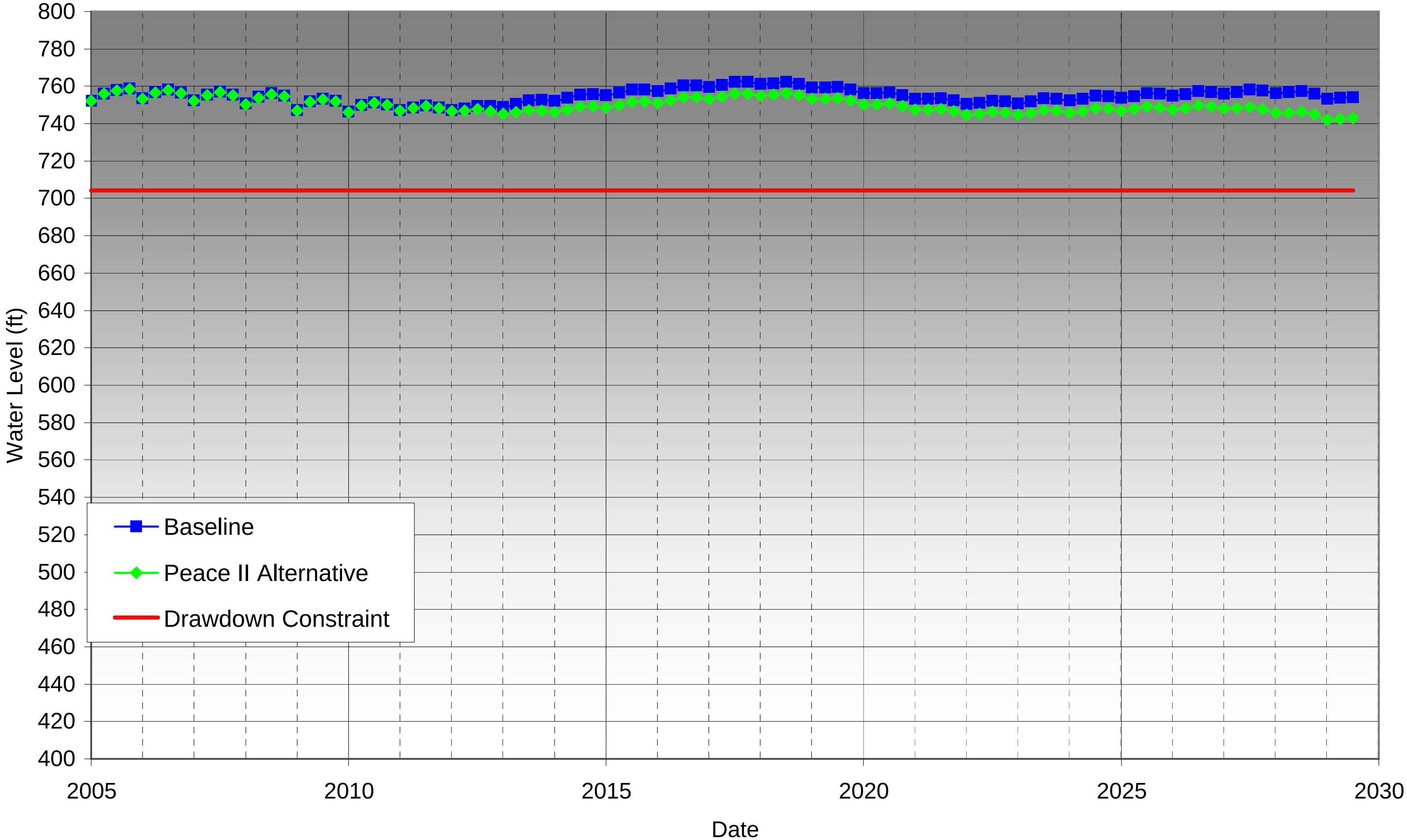


Figure B - 9
Projected Groundwater Water Elevations in Well F30A for the Baseline and Peace II Alternatives, Fontana Water Company

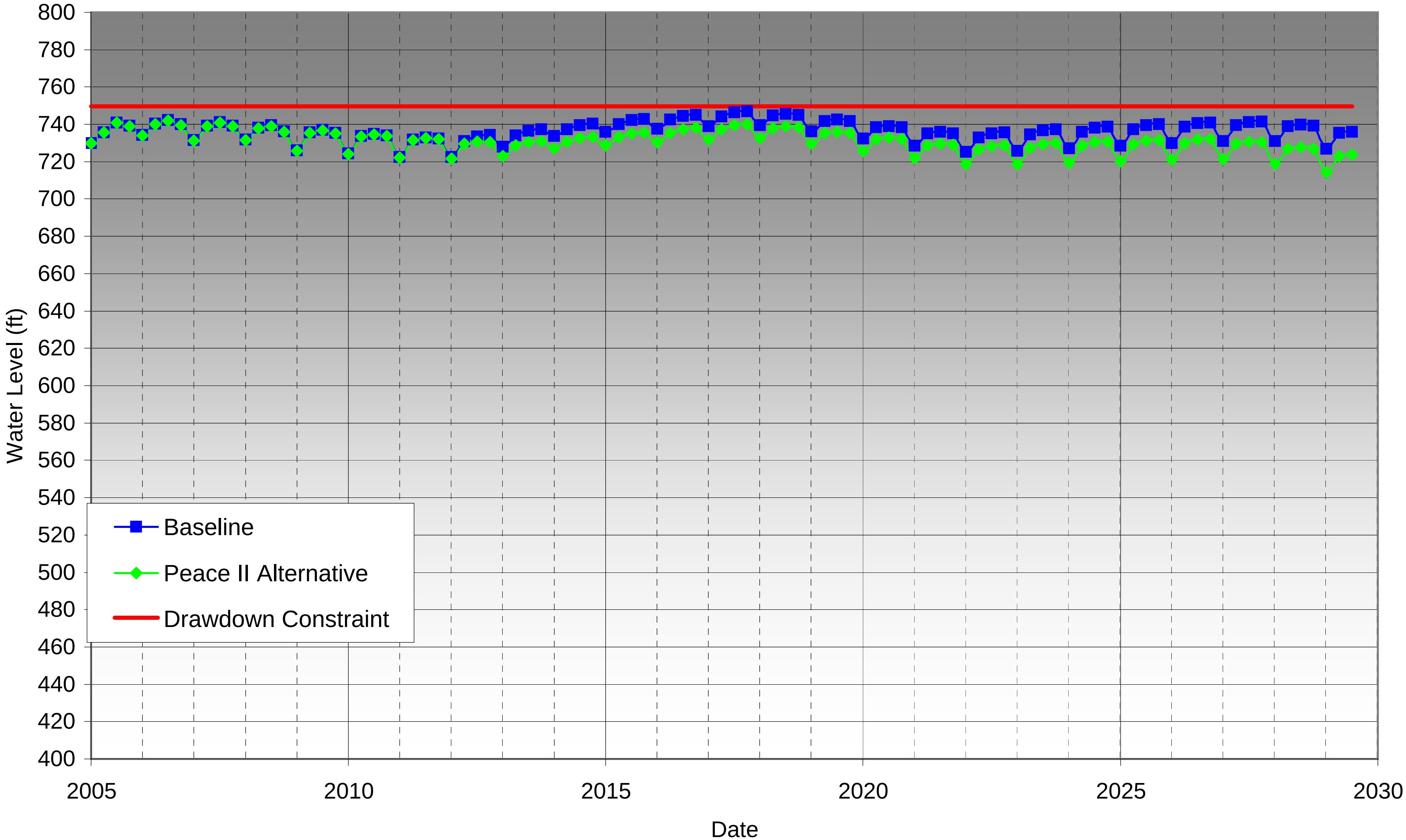


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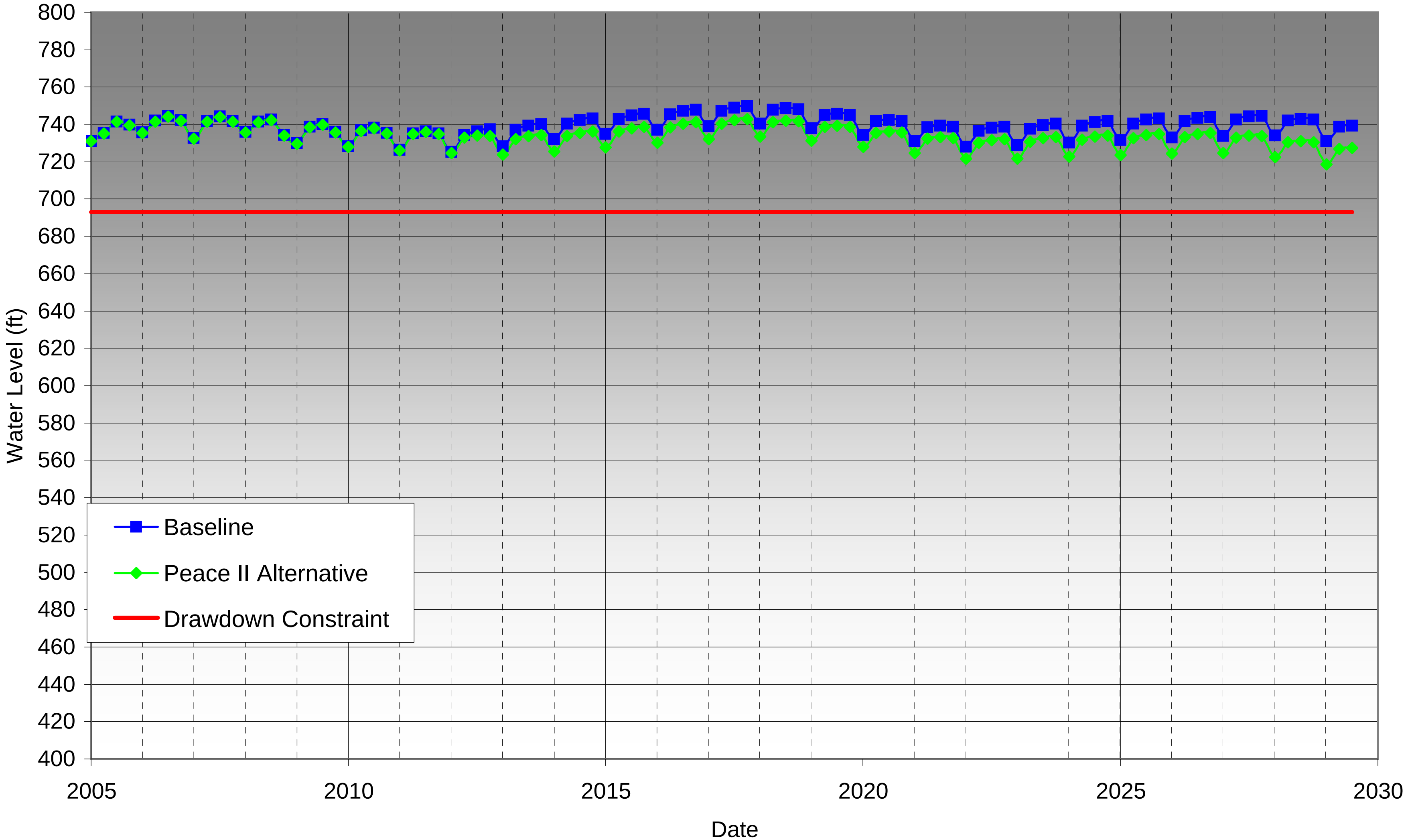
Figure B - 10
Projected Groundwater Water Elevations in Well F2A for the Baseline and Peace II Alternatives, Fontana Water Company



Well Hydrographs_Appendix B_v2 -- F2A_89
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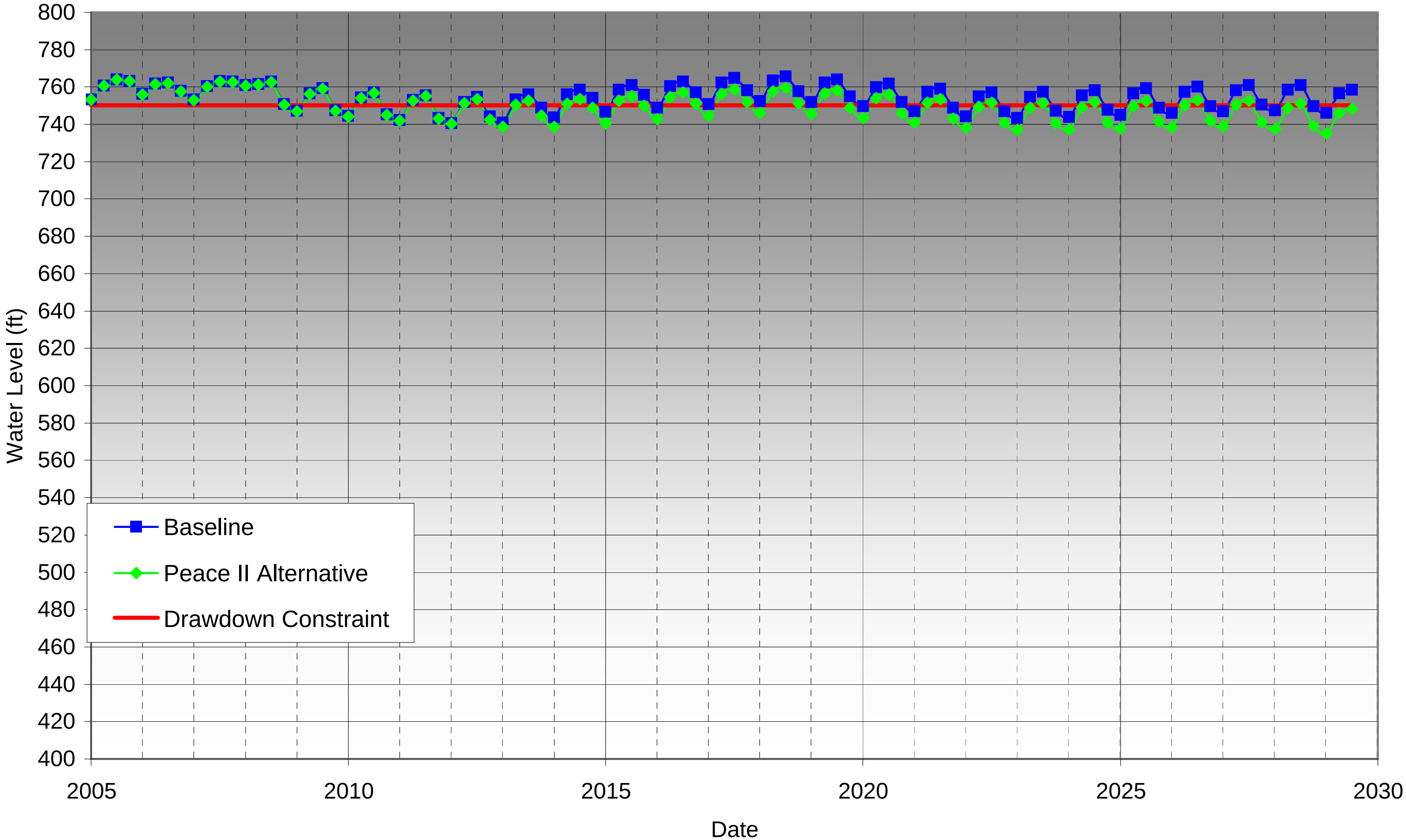
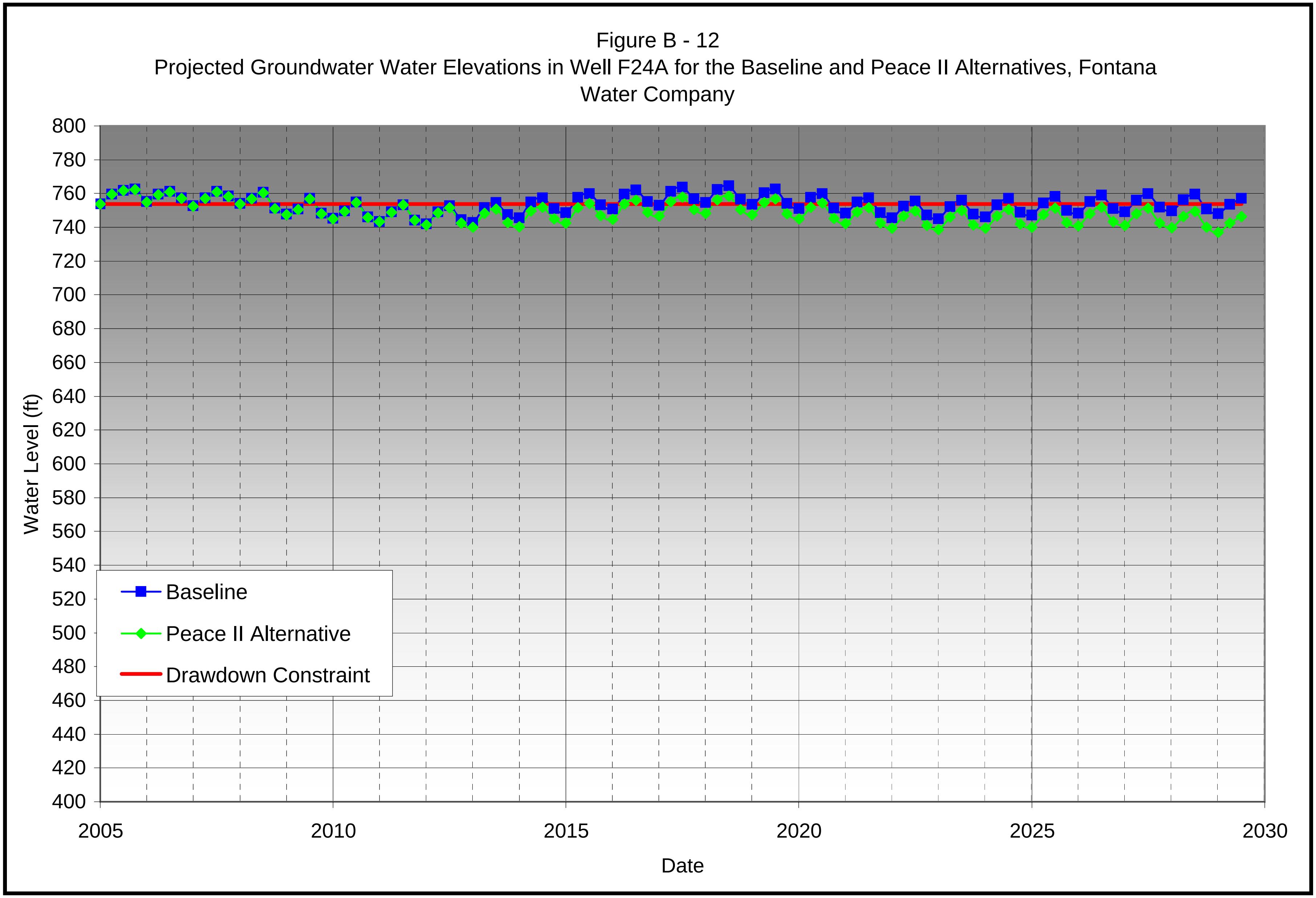
Figure B - 11
Projected Groundwater Water Elevations in Well F26A for the Baseline and Peace II Alternatives, Fontana Water Company





Well Hydrographs_Appendix B_v2 -- F24A_87
11/3/2009 -- 4:47 PM

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Figure B - 13
Projected Groundwater Water Elevations in Well F23A for the Baseline and Peace II Alternatives, Fontana Water Company

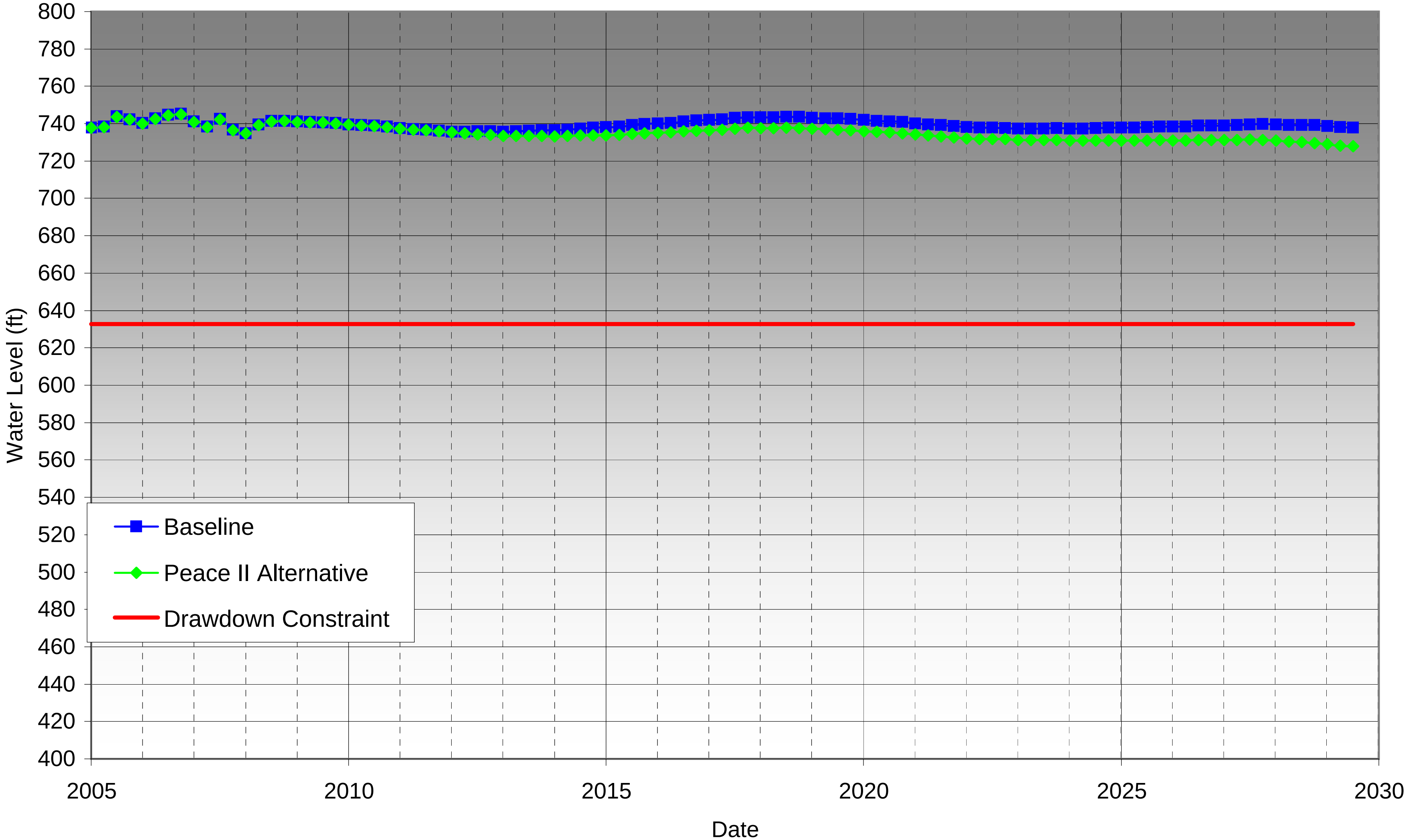

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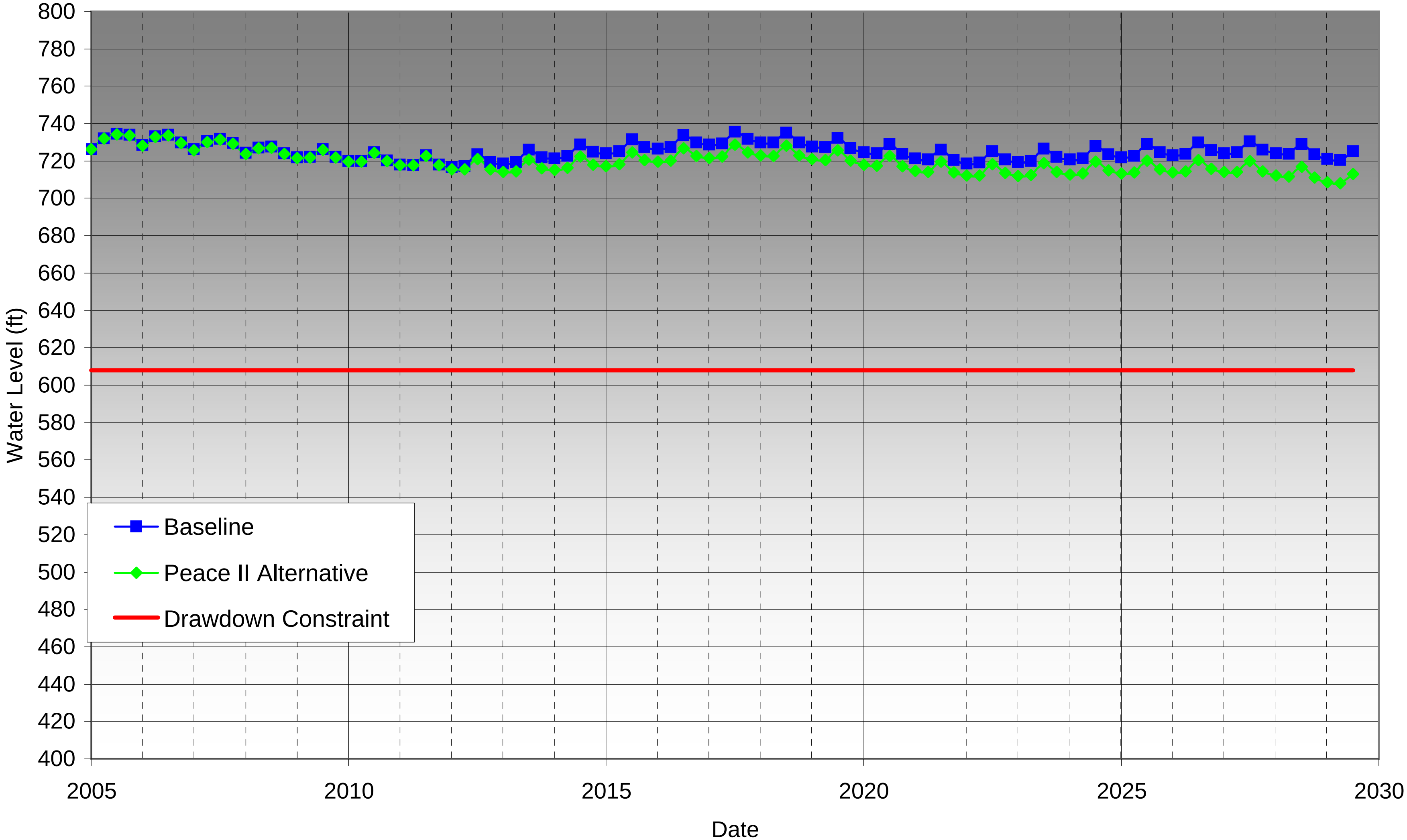
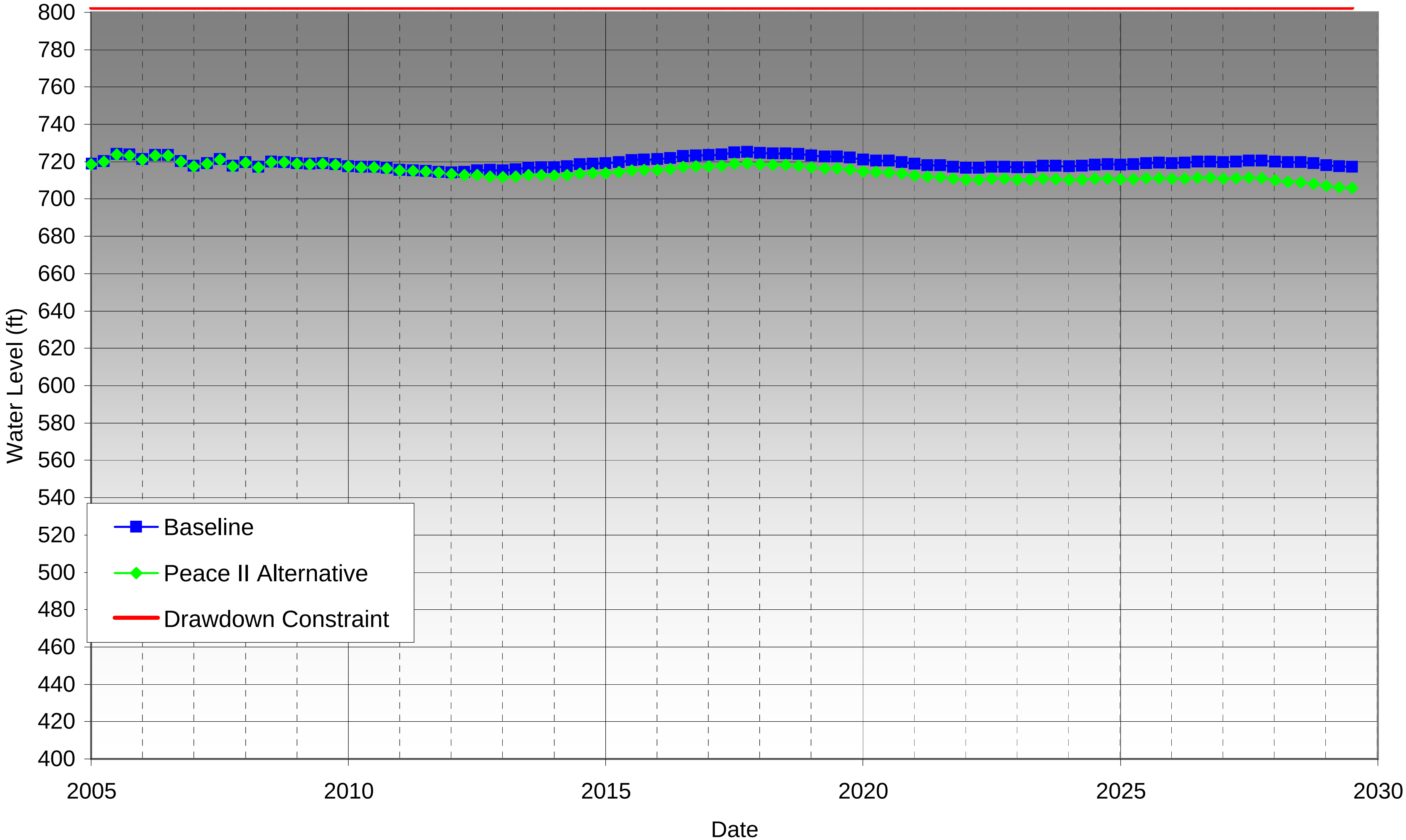
Figure B - 14
Projected Groundwater Water Elevations in Well F22A for the Baseline and Peace II Alternatives, Fontana Water Company



WILDERMUTH ENVIRONMENTAL INC.

Figure B - 15
Projected Groundwater Water Elevations in Well F21A for the Baseline and Peace II Alternatives, Fontana Water Company



Well Hydrographs_Appendix B_v2 -- F21A_84
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WILDERMUTH ENVIRONMENTAL INC.

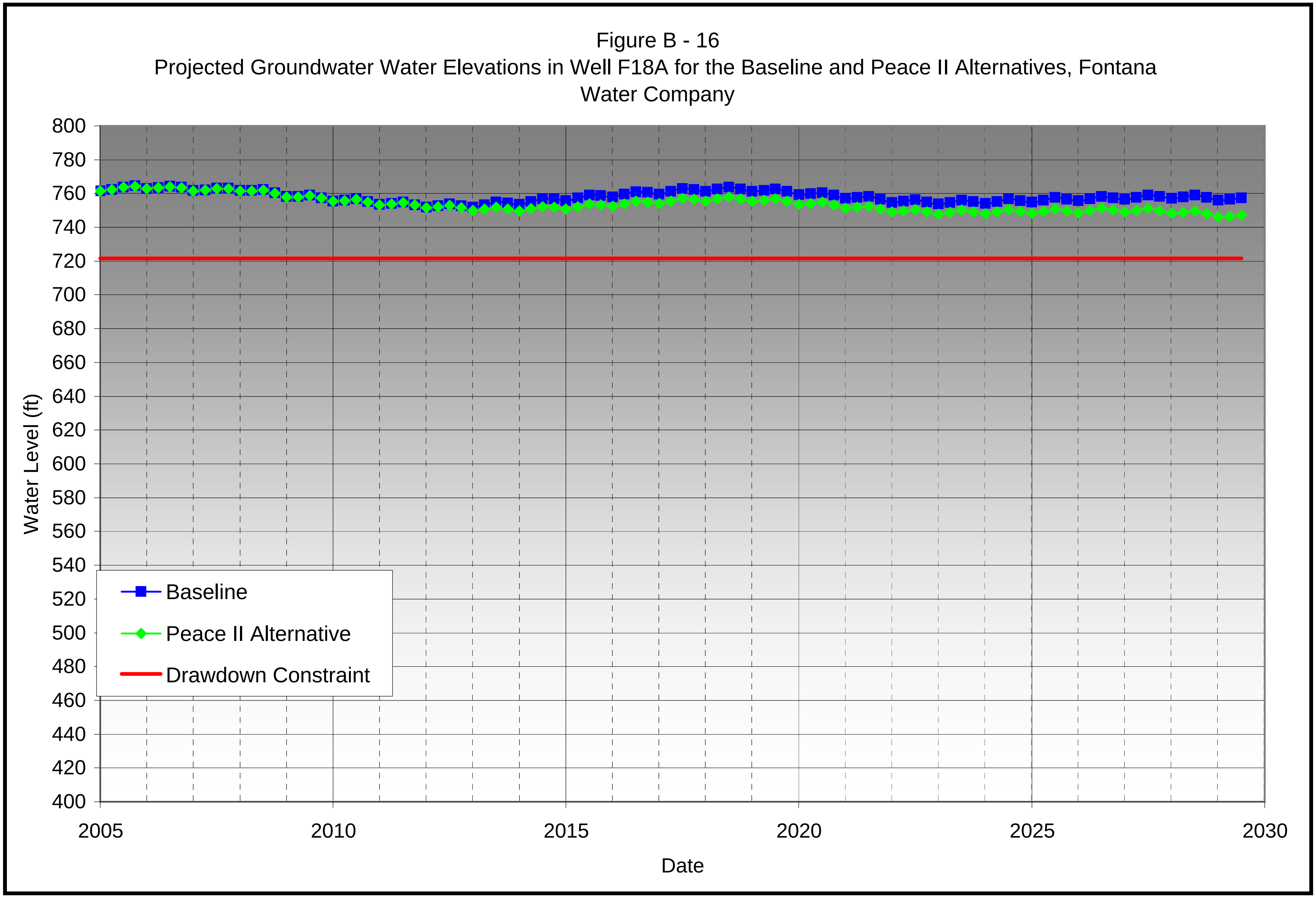


Figure B - 16
Projected Groundwater Water Elevations in Well F18A for the Baseline and Peace II Alternatives, Fontana Water Company
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

Figure B - 17
Projected Groundwater Water Elevations in Well F17C for the Baseline and Peace II Alternatives, Fontana Water Company

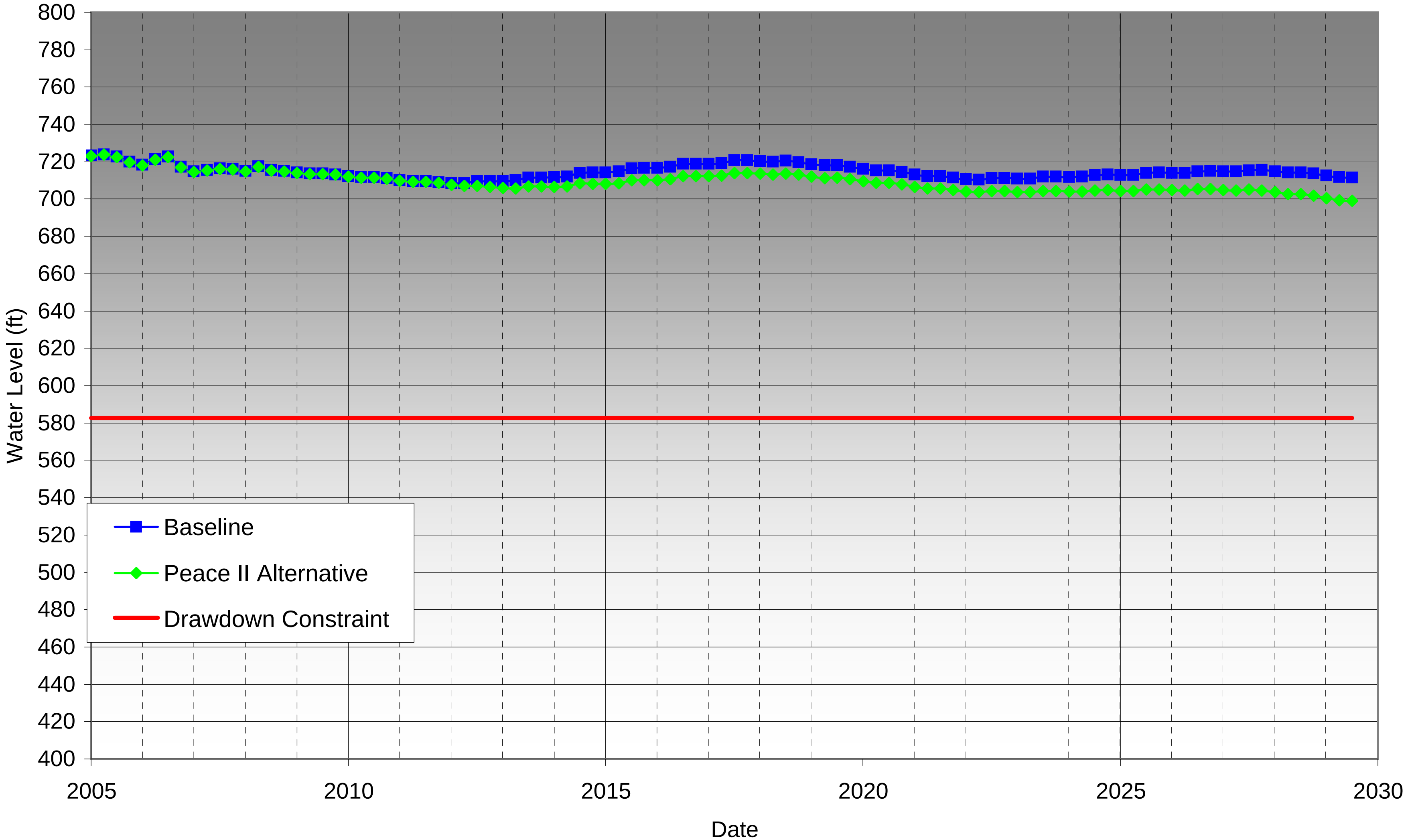


Figure B - 18
Projected Groundwater Water Elevations in Well F17B for the Baseline and Peace II Alternatives, Fontana Water Company

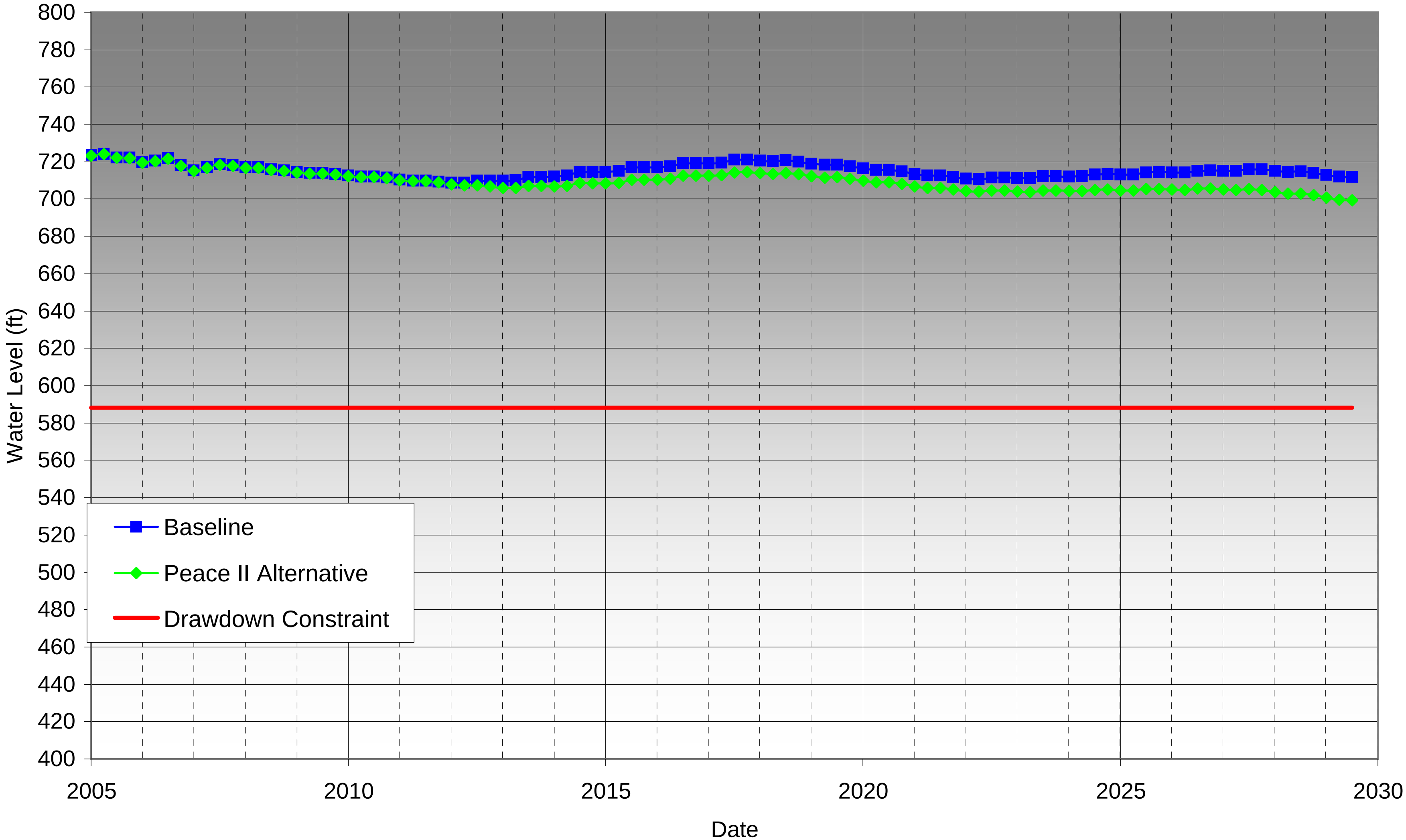
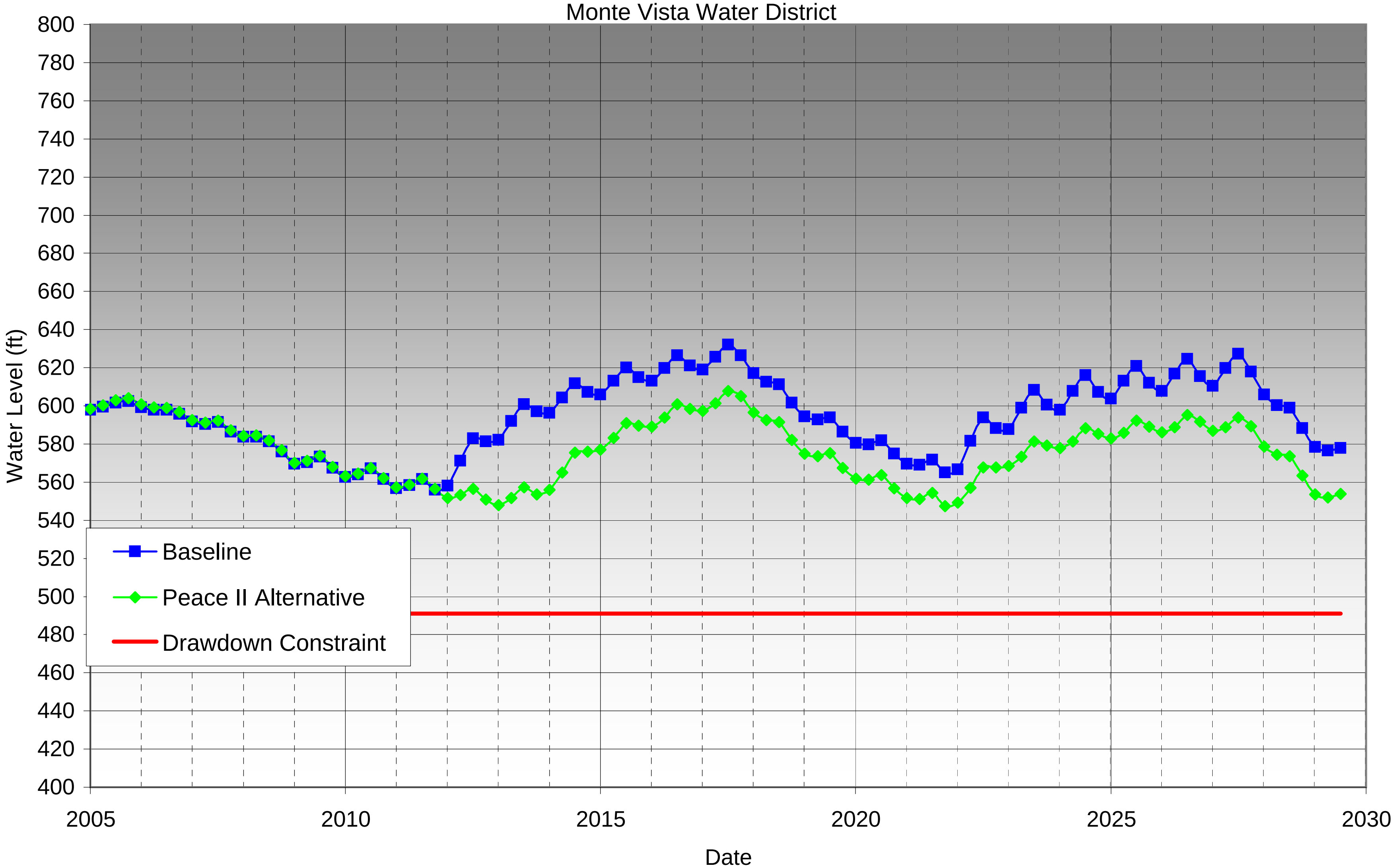
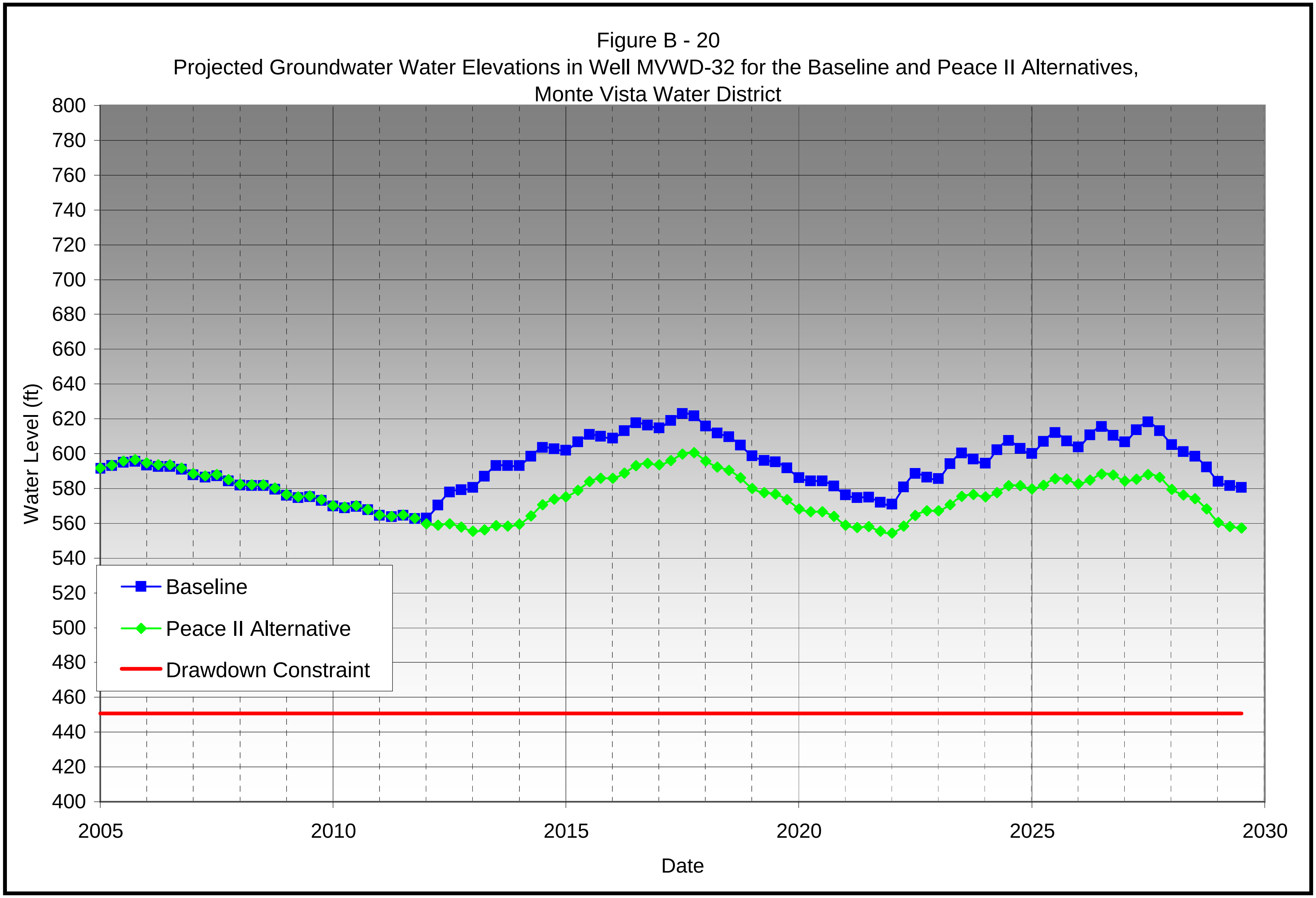


Figure B - 19
Projected Groundwater Water Elevations in Well MVWD-33 for the Baseline and Peace II Alternatives, Monte Vista Water District

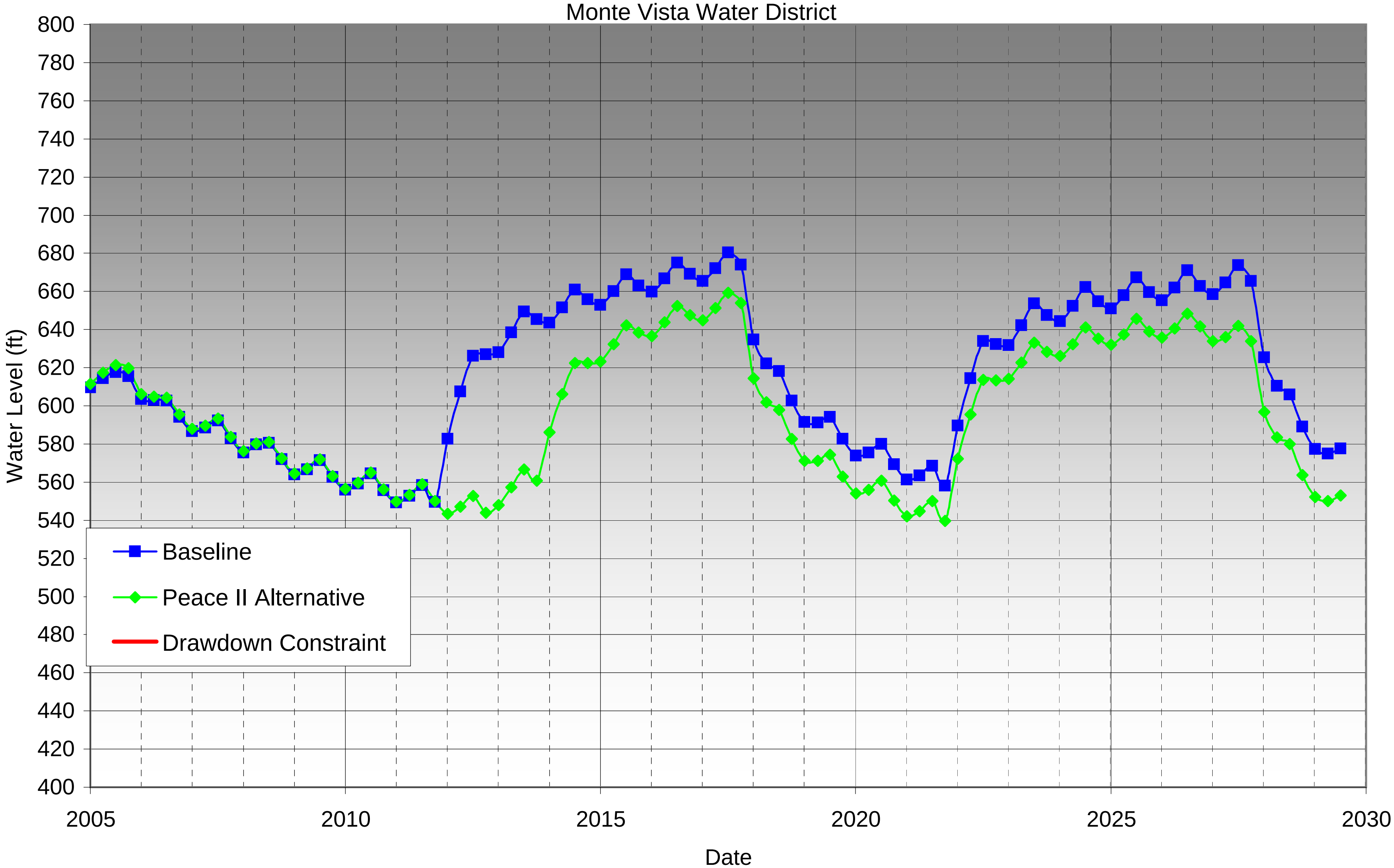




Well Hydrographs_Appendix B_v2 -- MVWD-32_79
11/3/2009 -- 4:47 PM

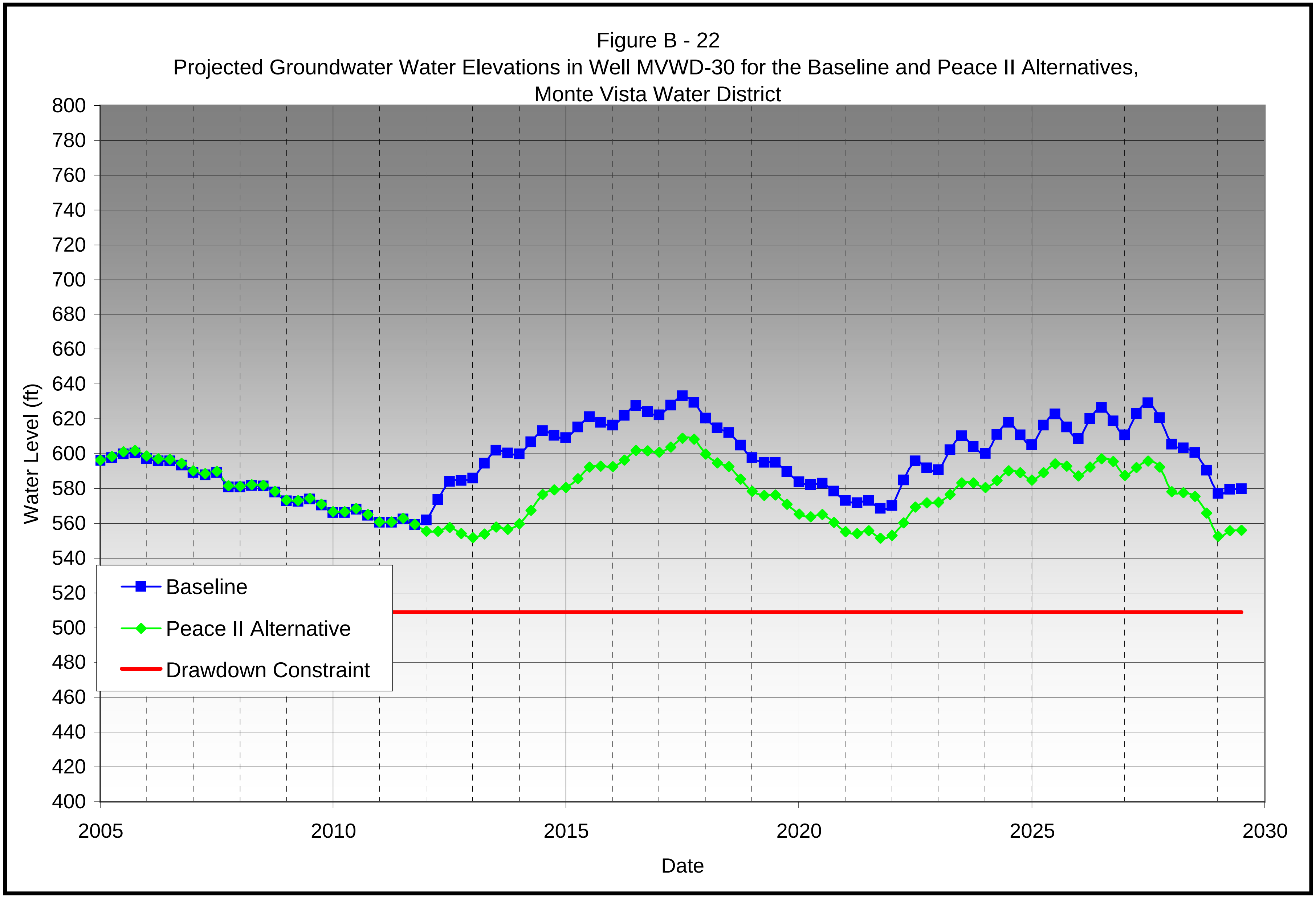
WILDERMUTH ENVIRONMENTAL INC.

Figure B - 21
Projected Groundwater Water Elevations in Well MVWD-31 for the Baseline and Peace II Alternatives,
Monte Vista Water District



Well Hydrographs_Appendix B_v2 -- MVWD-31_78
11/3/2009 -- 4:47 PM

WILDERMUTH ENVIRONMENTAL INC.



Well Hydrographs_Appendix B_v2 -- MVWD-30_77
11/3/2009 -- 4:47 PM

WILDERMUTH ENVIRONMENTAL INC.

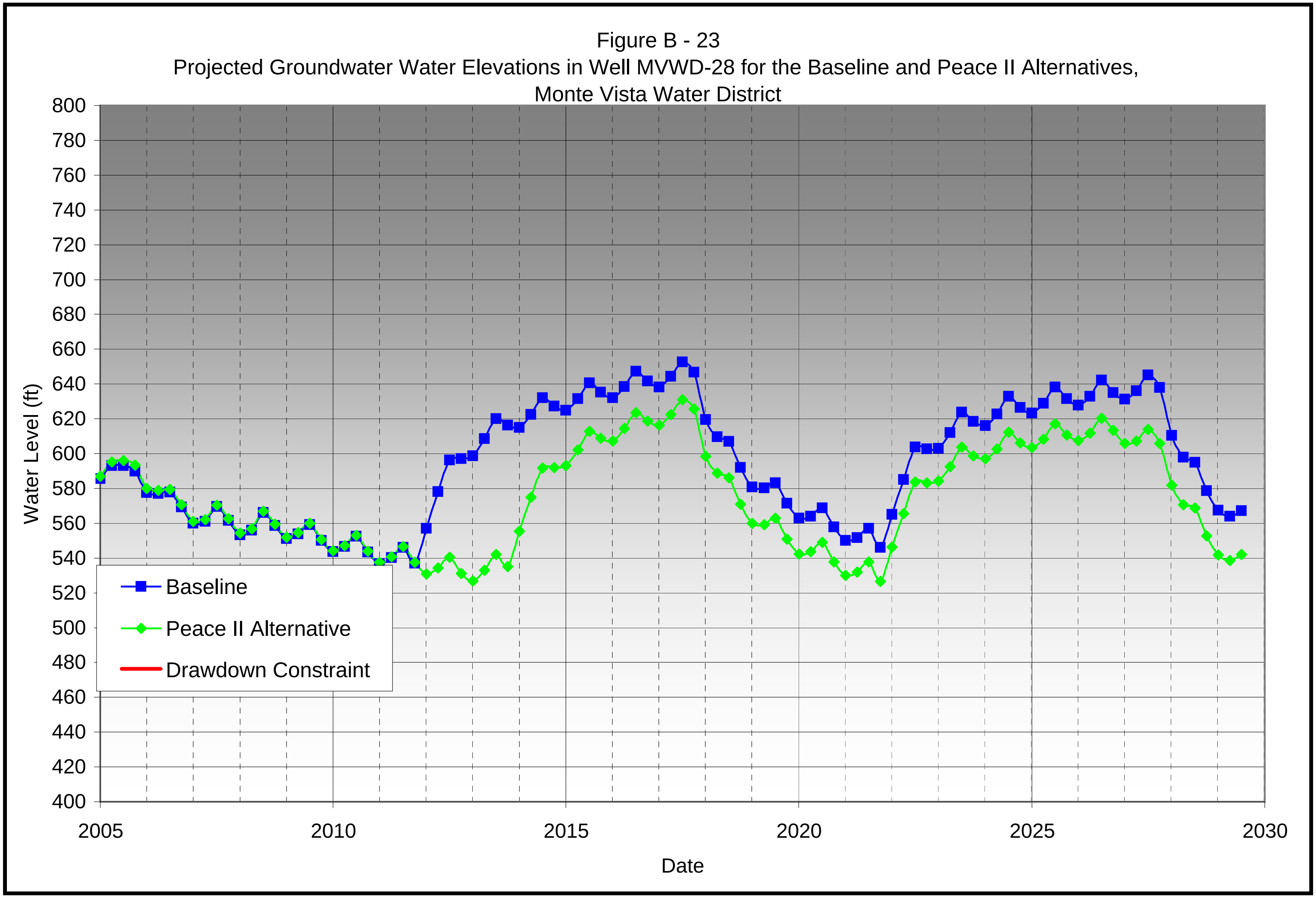


Figure B - 23
Projected Groundwater Water Elevations in Well MVWD-28 for the Baseline and Peace II Alternatives,
Monte Vista Water District
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

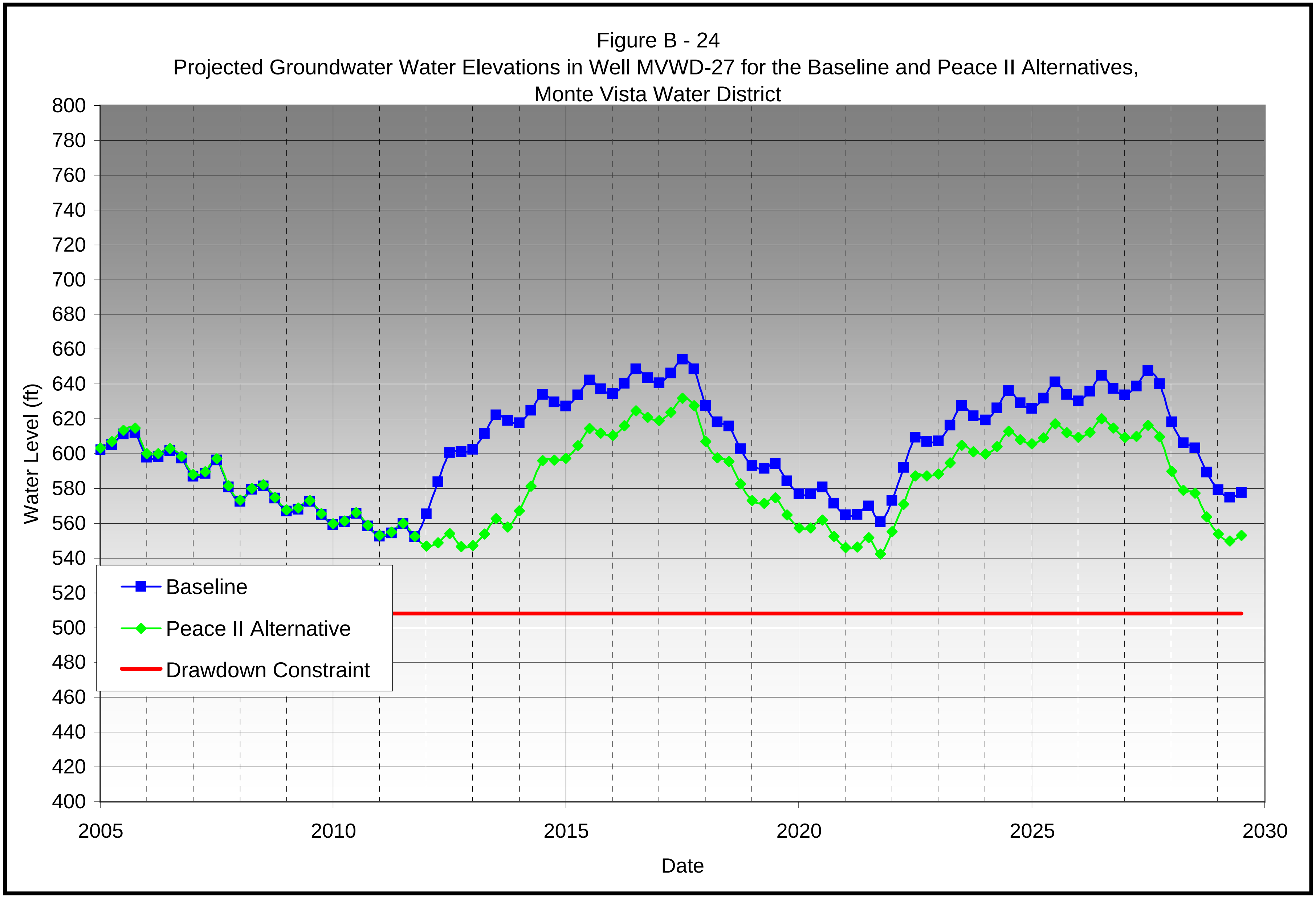


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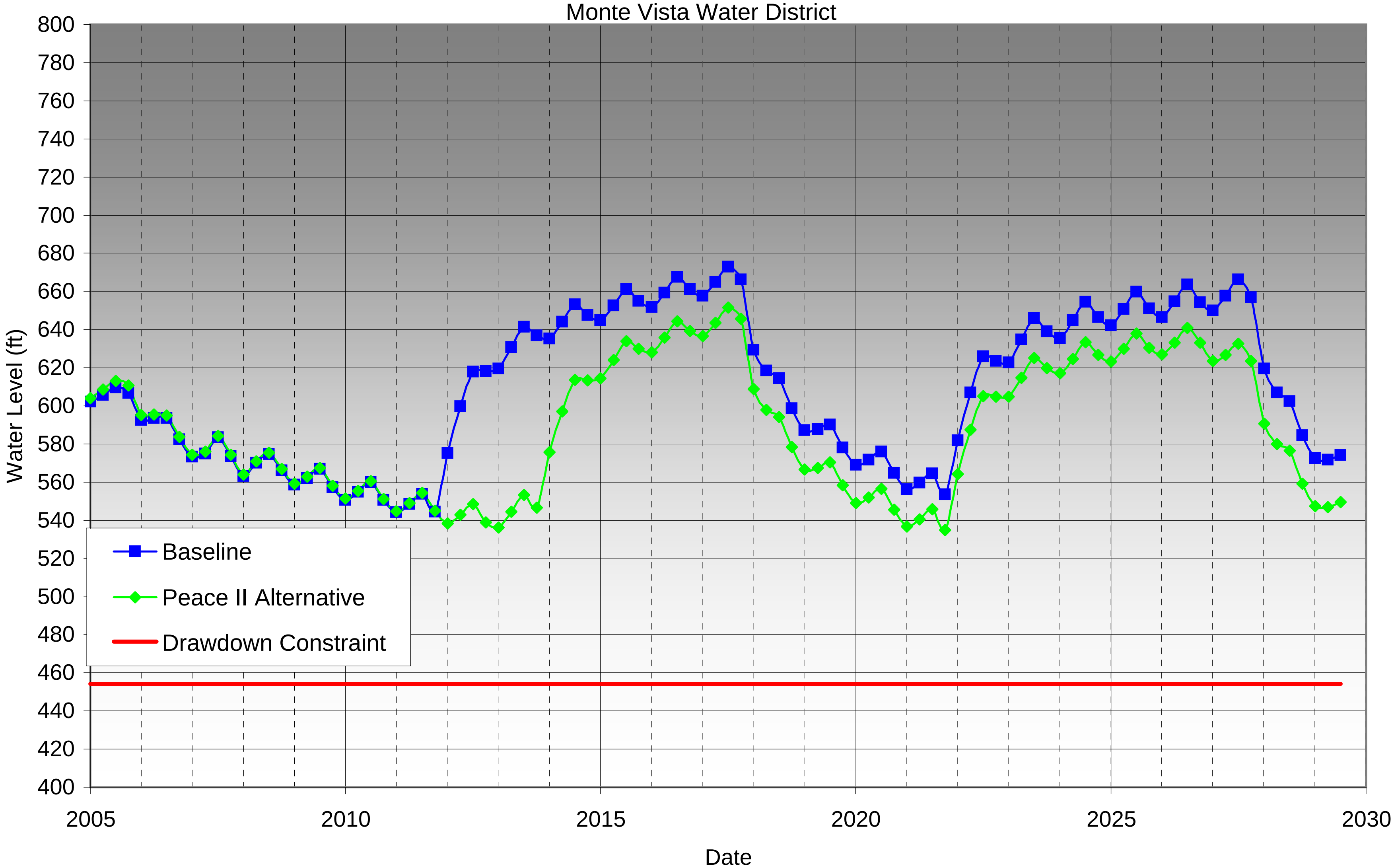
Figure B - 25
Projected Groundwater Water Elevations in Well MVWD-26 for the Baseline and Peace II Alternatives, Monte Vista Water District



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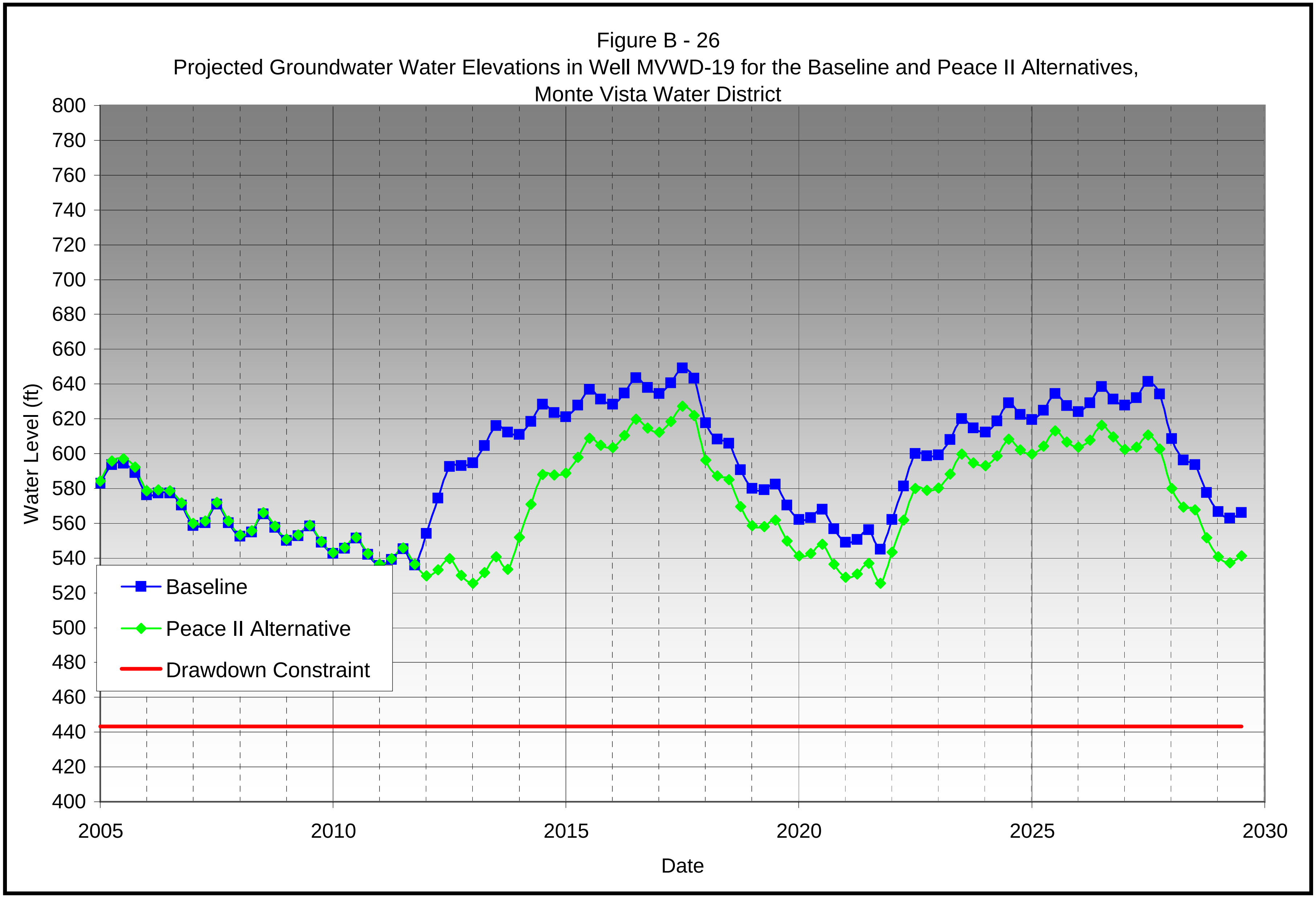

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Figure B - 27
Projected Groundwater Water Elevations in Well MVWD-10 for the Baseline and Peace II Alternatives, Monte Vista Water District

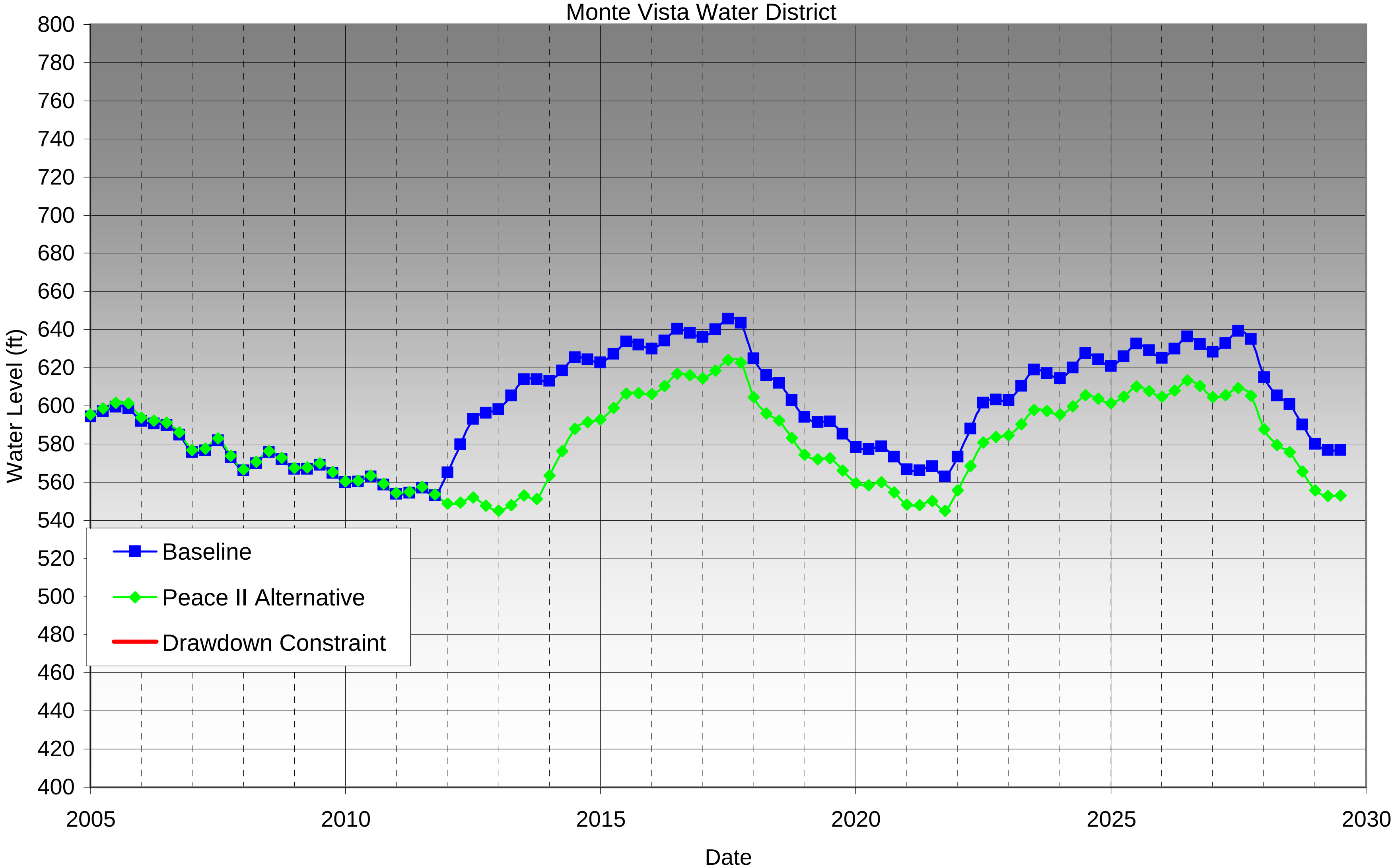
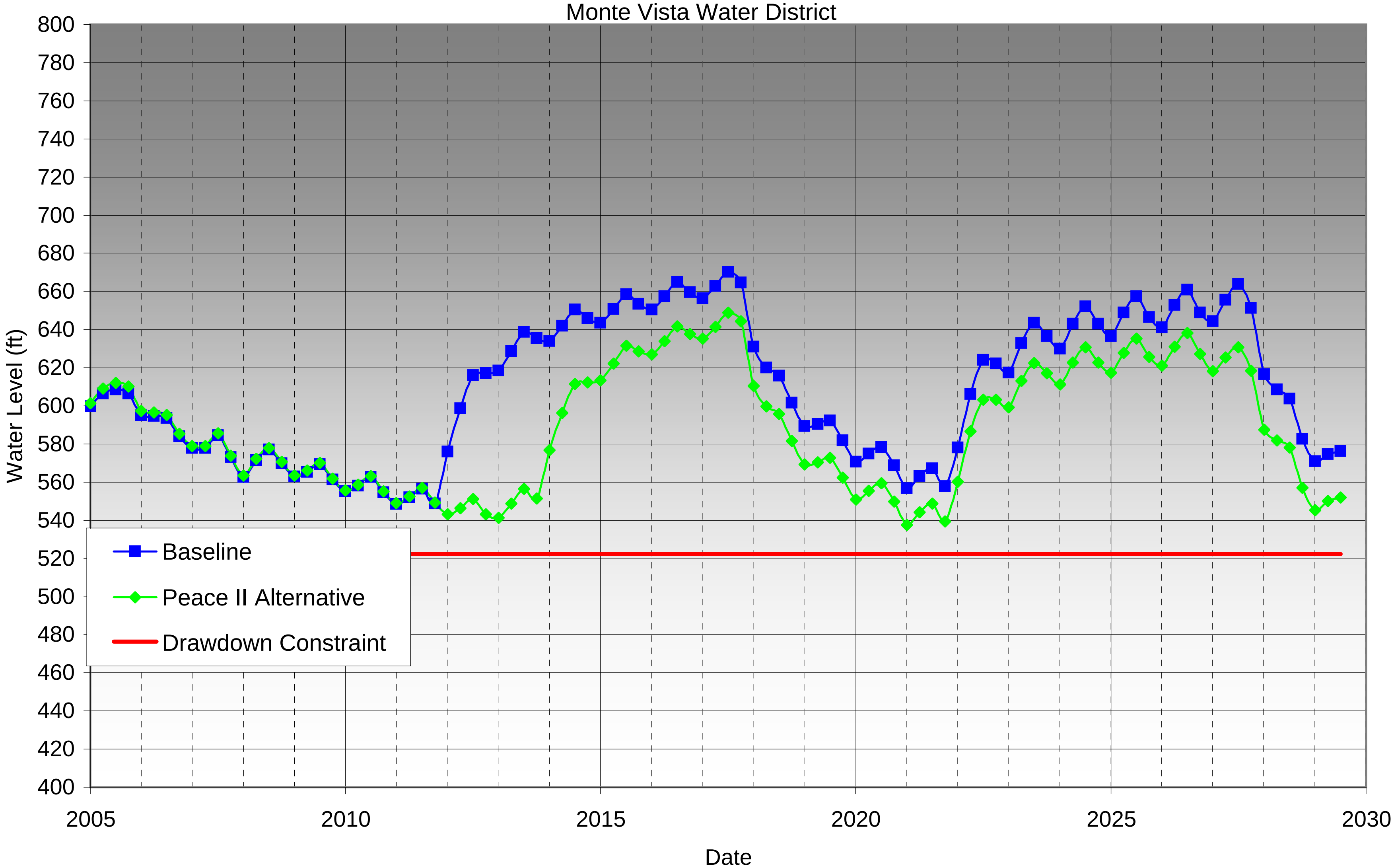


Figure B - 28
Projected Groundwater Water Elevations in Well MVWD-06 for the Baseline and Peace II Alternatives,
Monte Vista Water District



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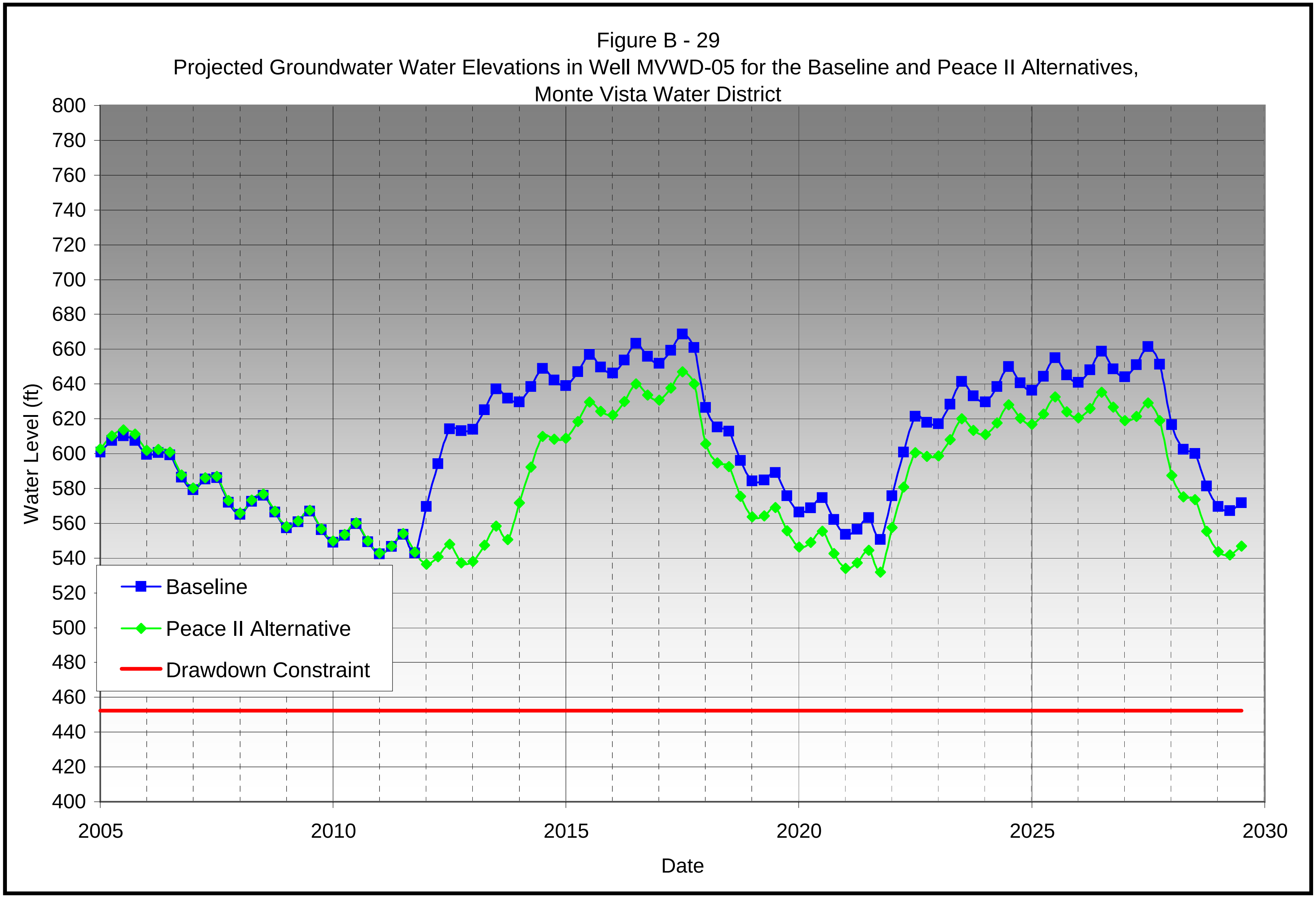
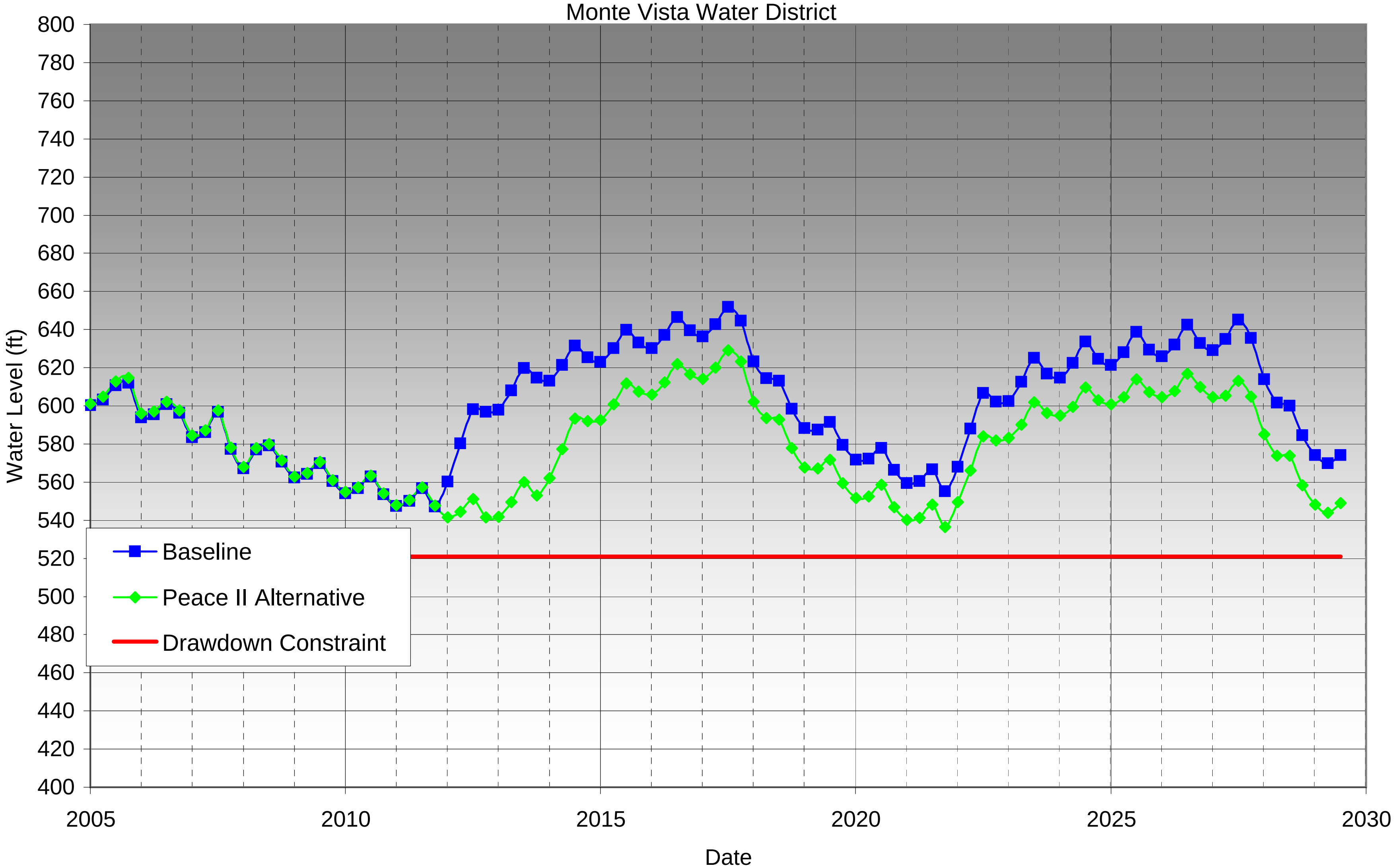


Figure B - 29
Projected Groundwater Water Elevations in Well MVWD-05 for the Baseline and Peace II Alternatives,
Monte Vista Water District
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

Figure B - 30
Projected Groundwater Water Elevations in Well MVWD-04 for the Baseline and Peace II Alternatives,
Monte Vista Water District



WILDERMUTH ENVIRONMENTAL INC.

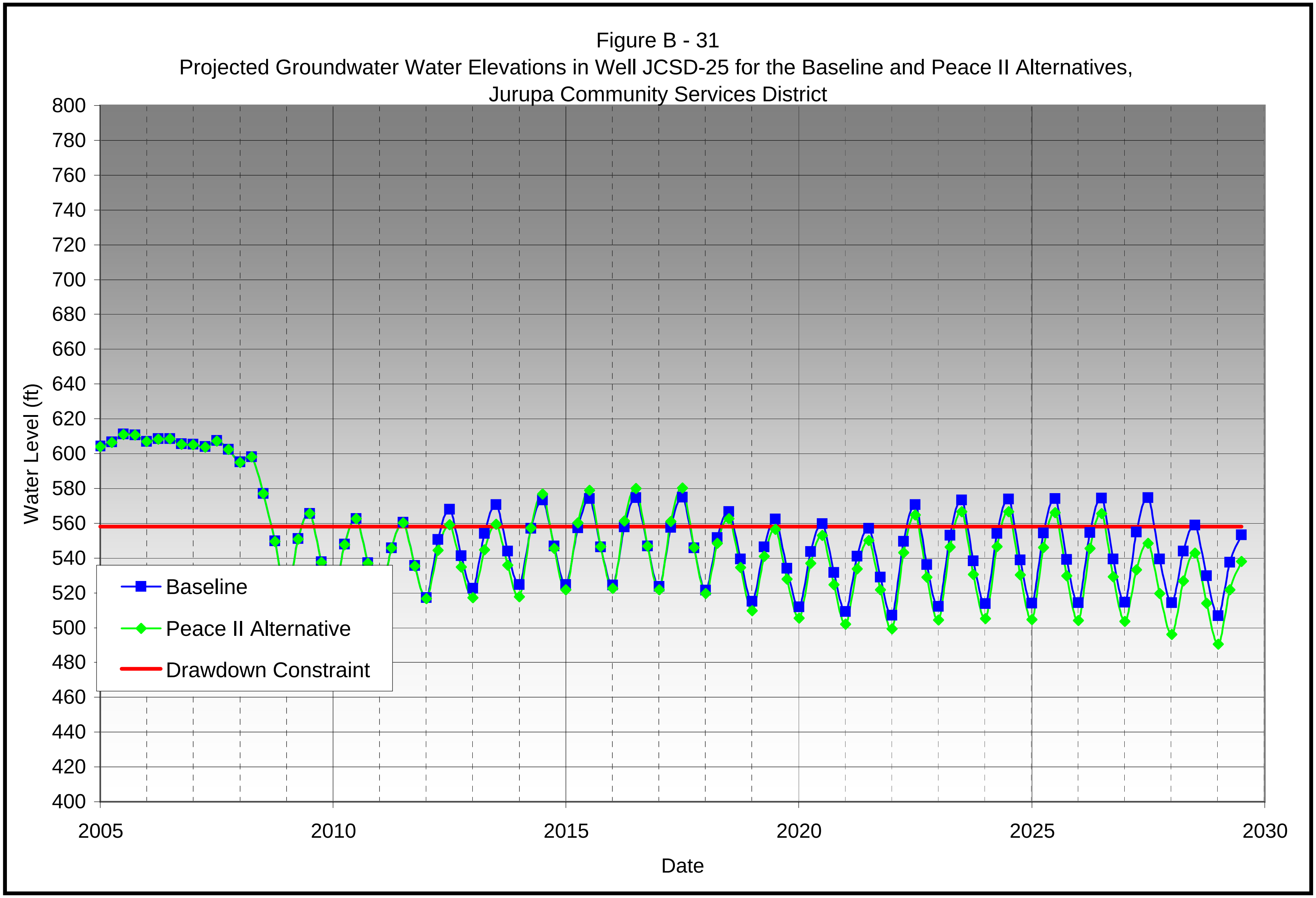
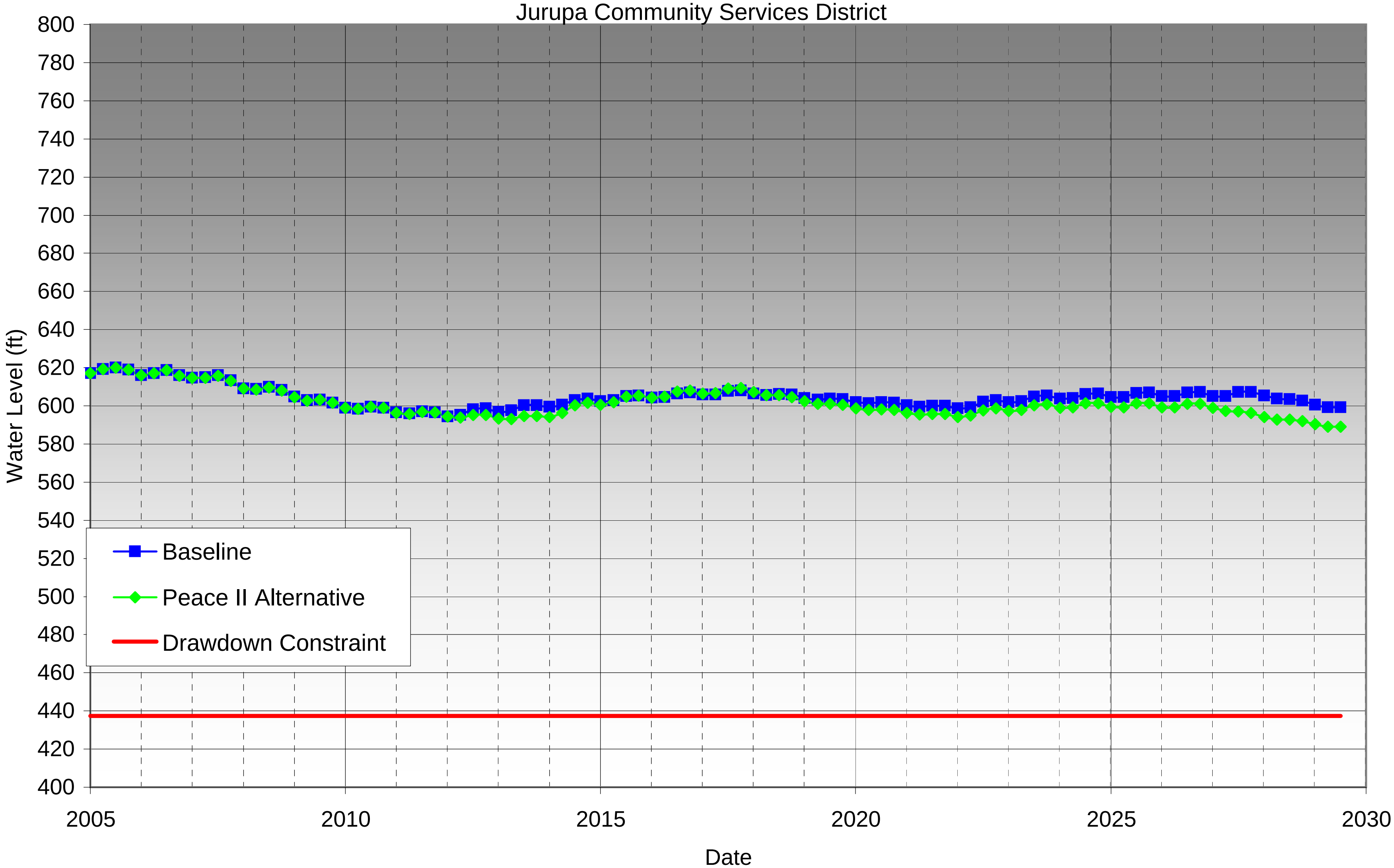


Figure B - 31
Projected Groundwater Water Elevations in Well JCSD-25 for the Baseline and Peace II Alternatives,
Jurupa Community Services District
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

Figure B - 32

Projected Groundwater Water Elevations in Well JCSD-24 for the Baseline and Peace II Alternatives, Jurupa Community Services District



Well Hydrographs_Appendix B_v2 -- JCSD-24_67
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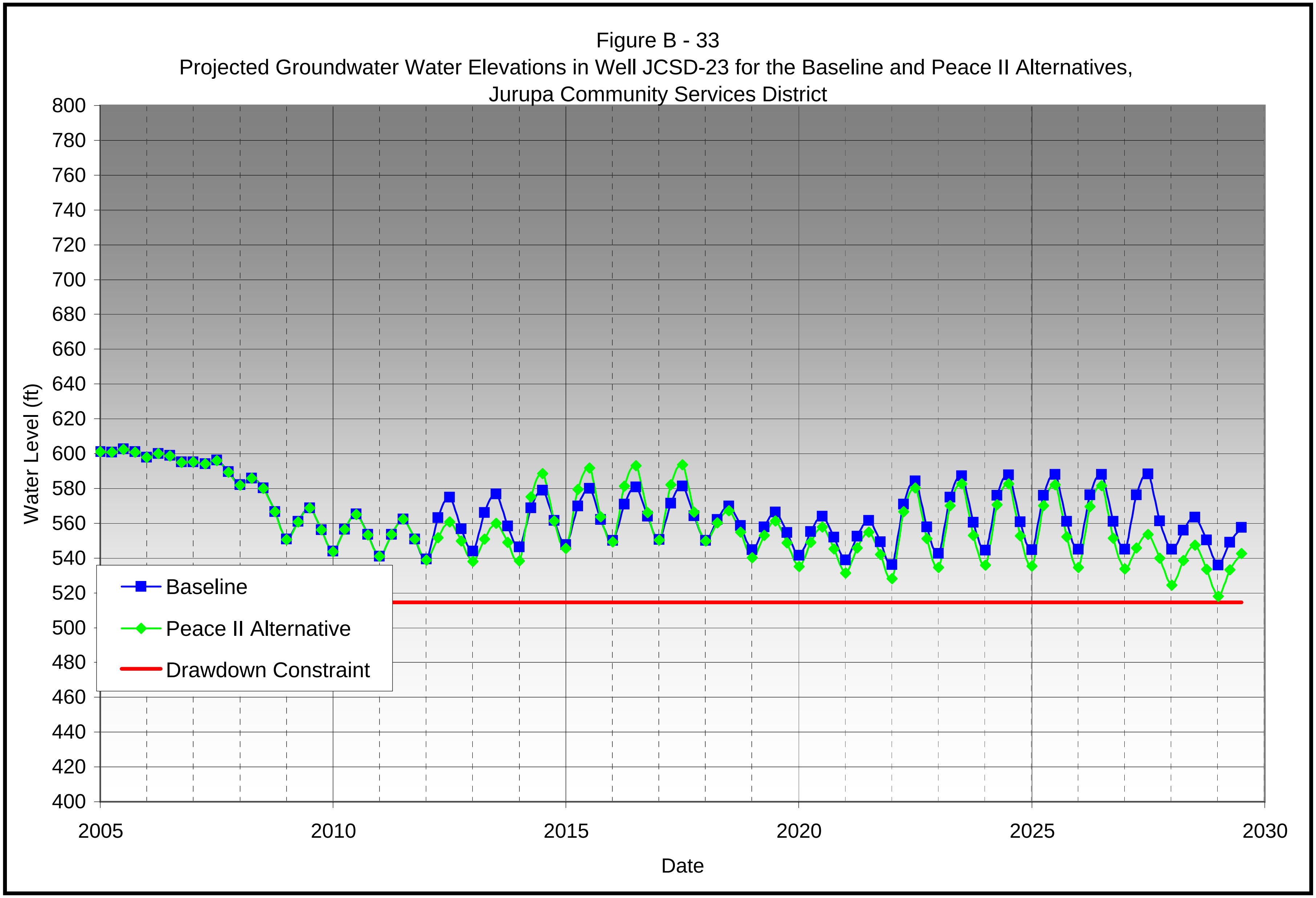

Well Hydrographs_Appendix B_v2 -- JCSD-23_66
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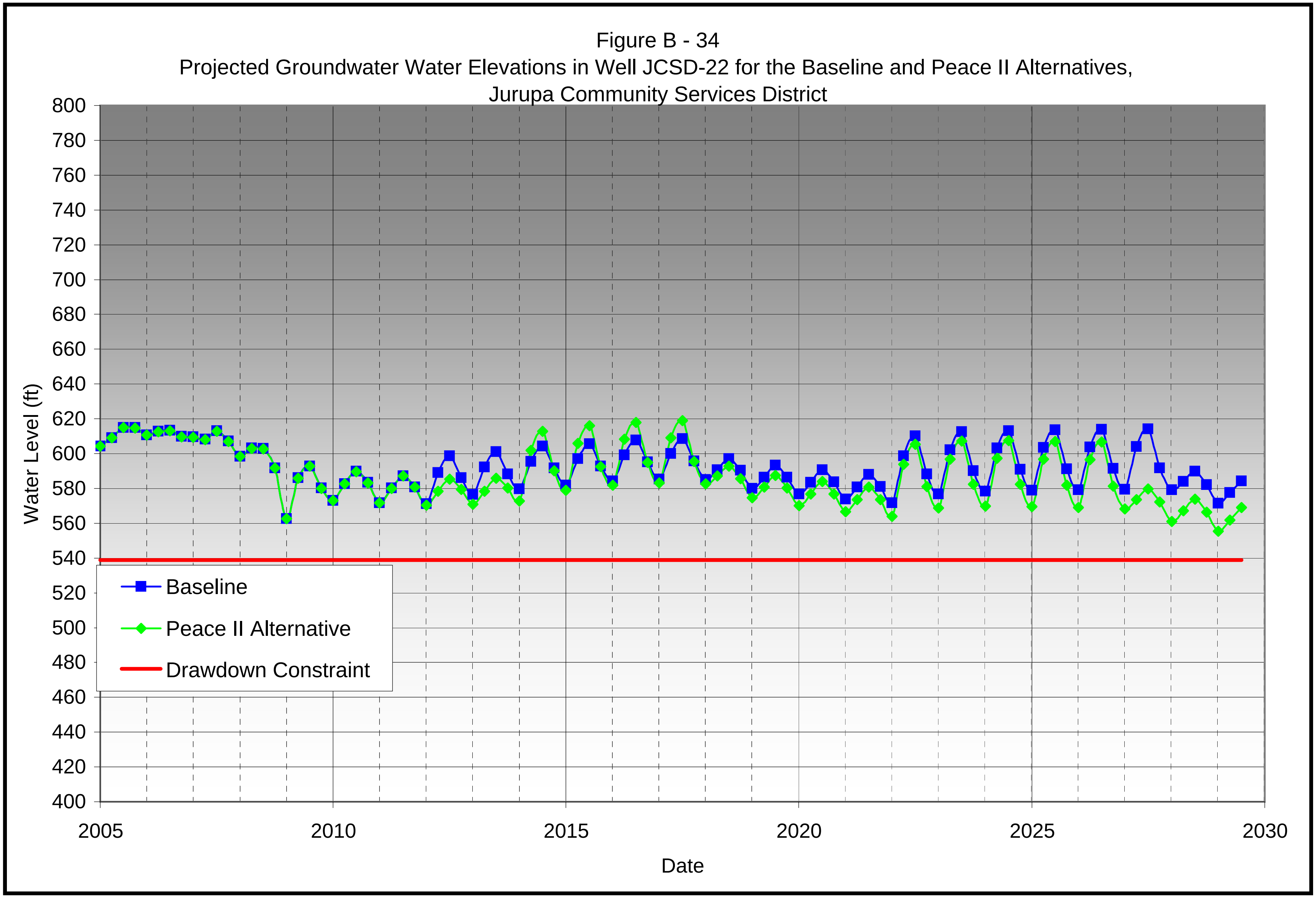
WILDERMUTH™ ENVIRONMENTAL INC.



WILDERMUTH ENVIRONMENTAL INC.

Figure B - 35
Projected Groundwater Water Elevations in Well JCSD-20 for the Baseline and Peace II Alternatives,
Jurupa Community Services District

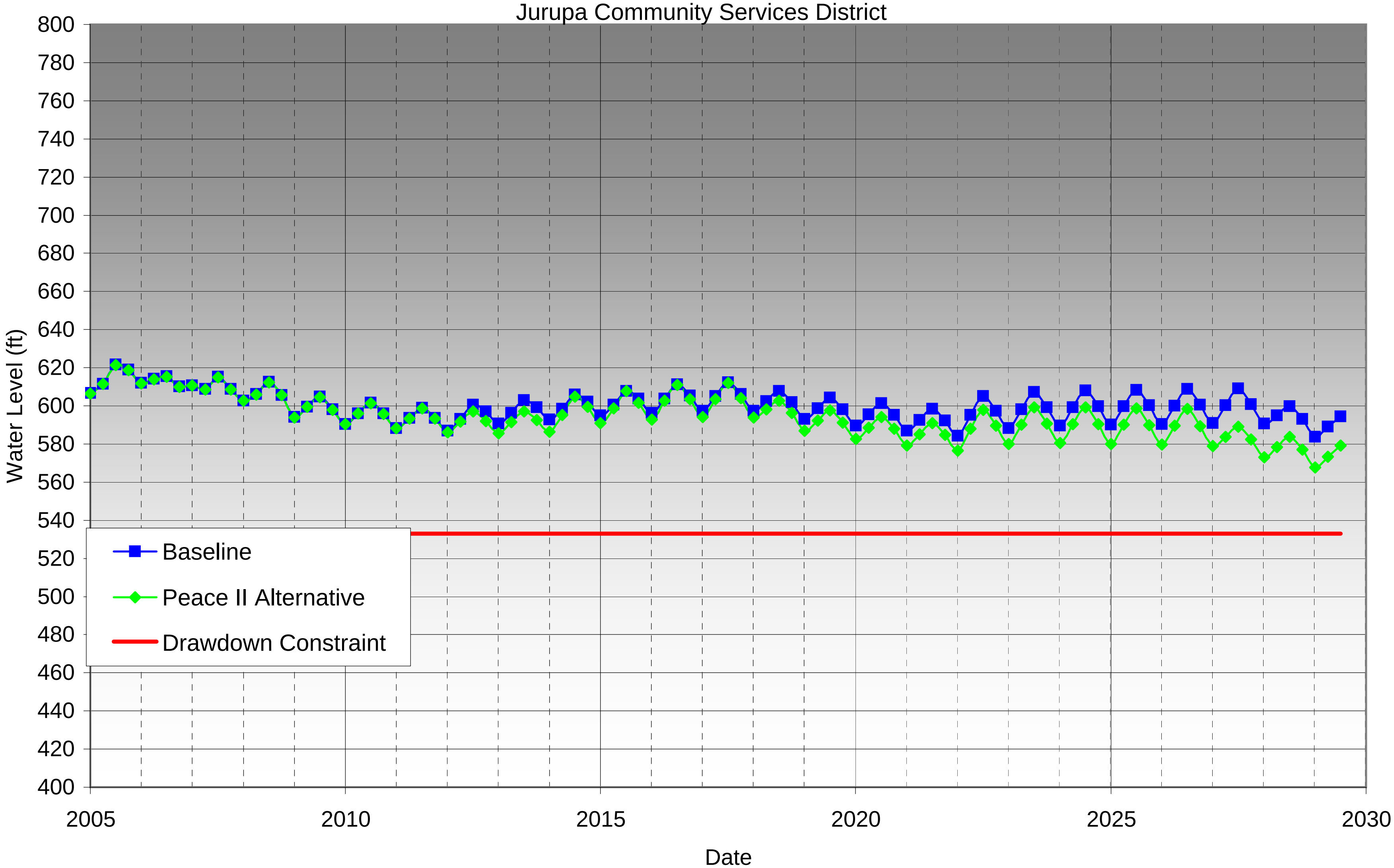


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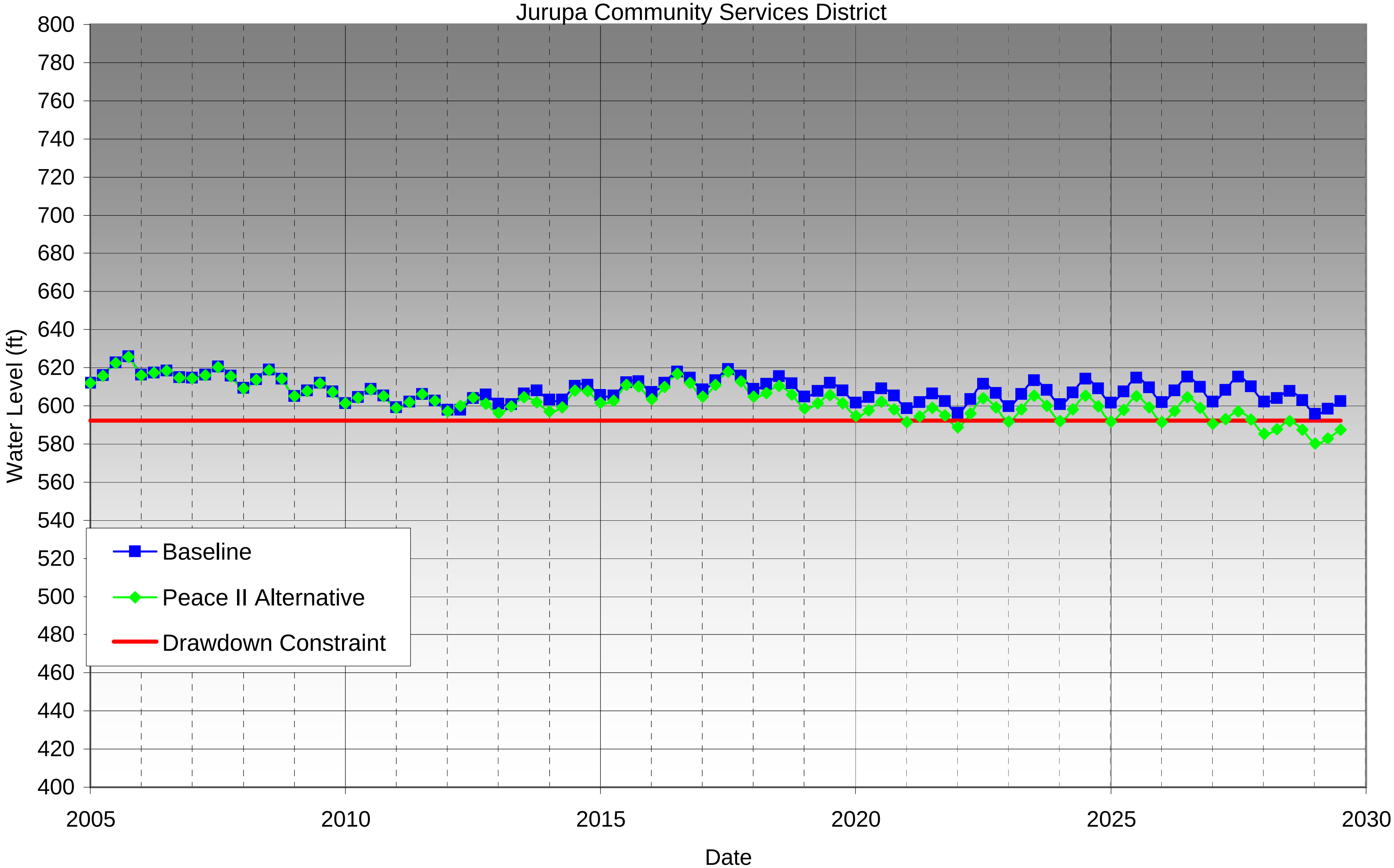
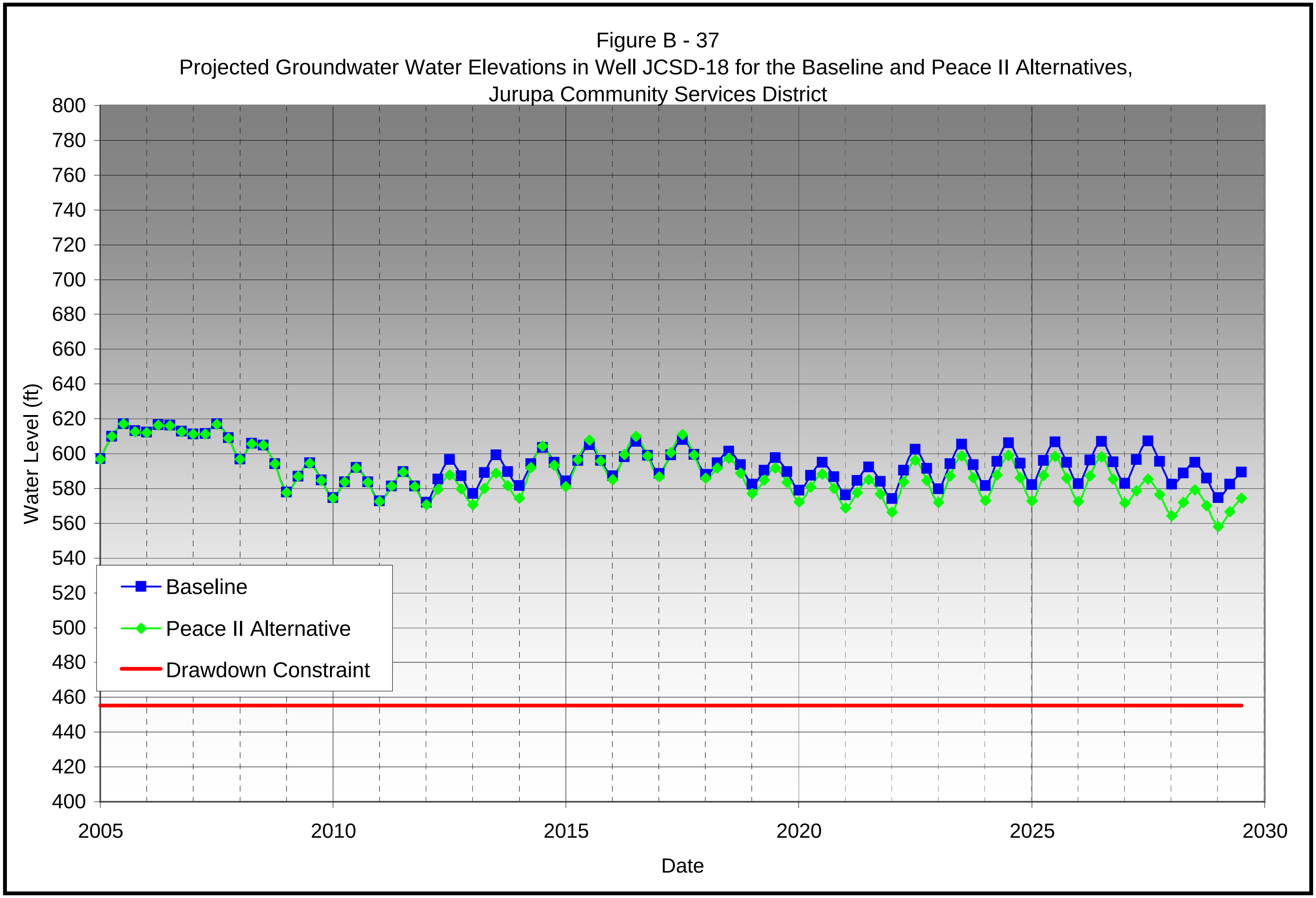
Figure B - 36

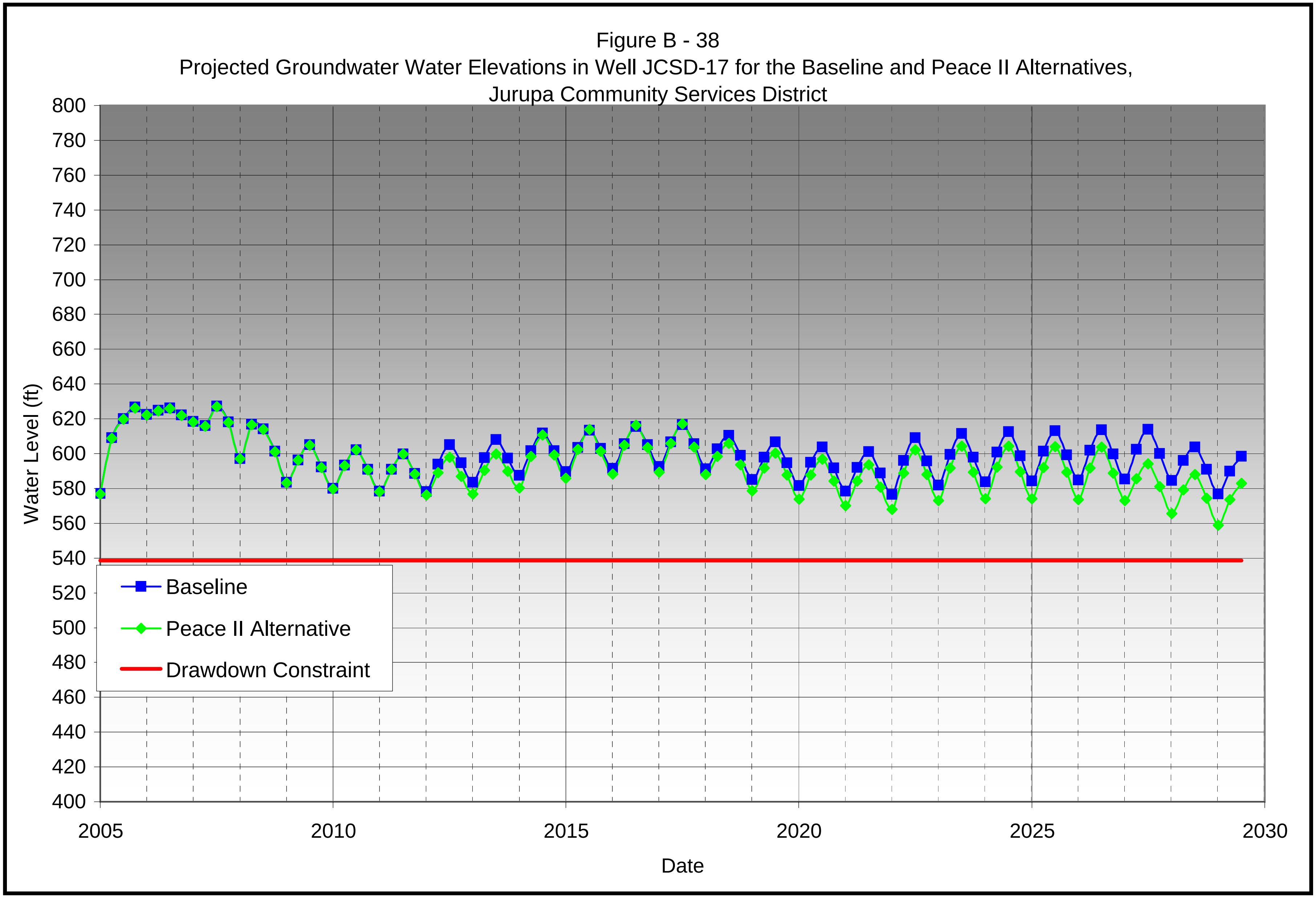
Projected Groundwater Water Elevations in Well JCSD-19 for the Baseline and Peace II Alternatives,
Jurupa Community Services District



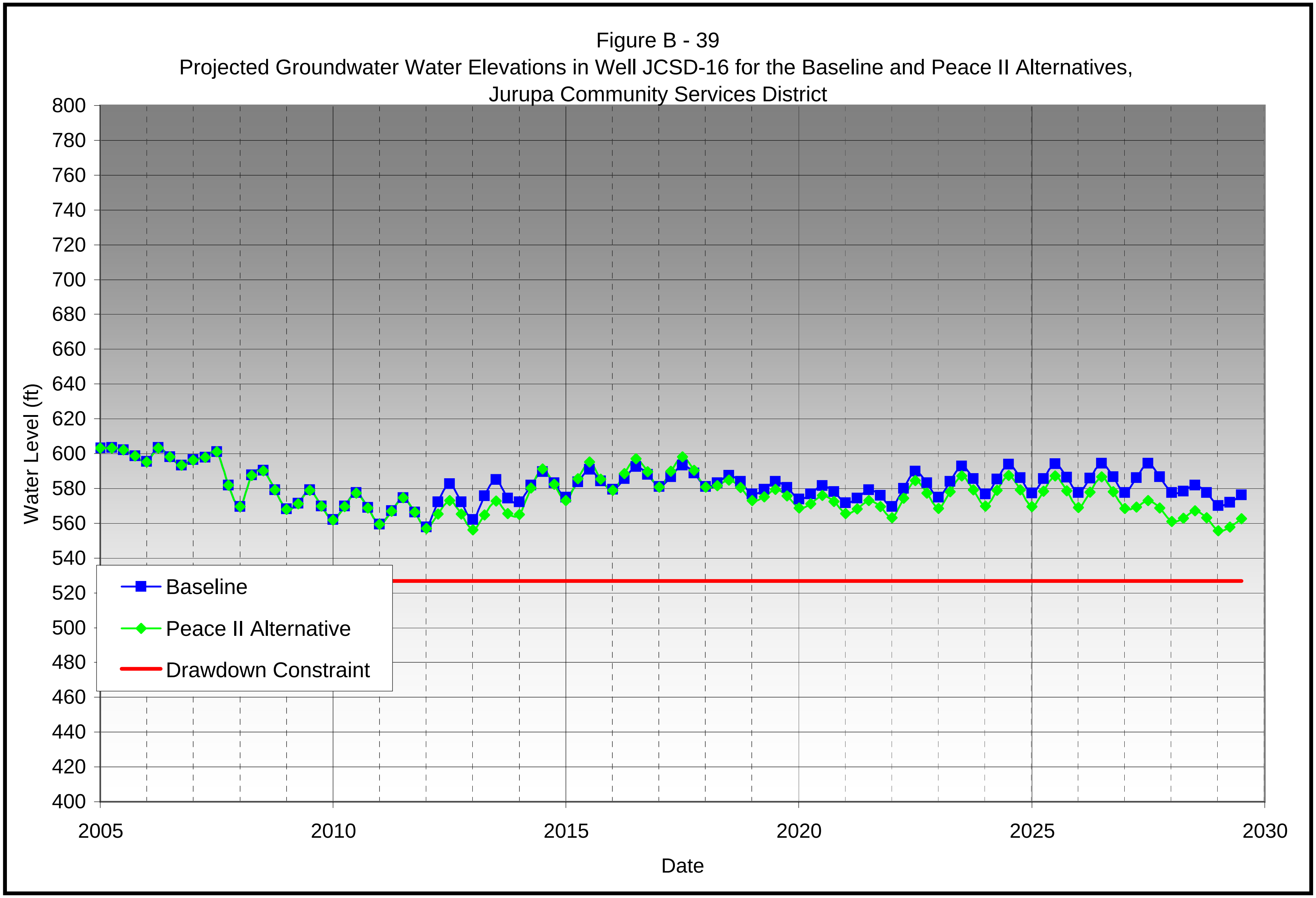
WILDERMUTH™ ENVIRONMENTAL INC.



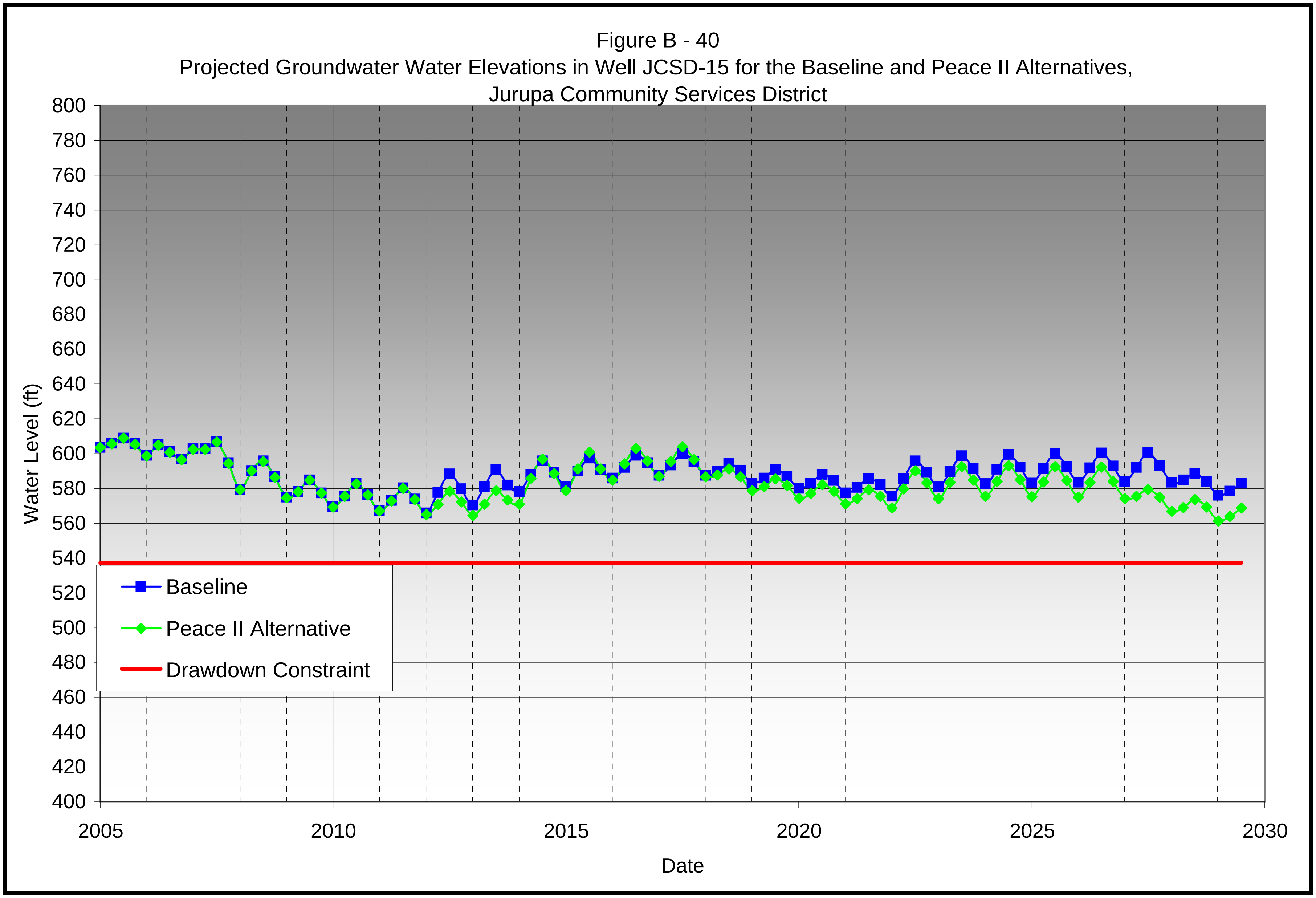
Well Hydrographs_Appendix B_v2 -- JCSD-18_62
11/3/2009 -- 4:47 PM



WILDERMUTH™ ENVIRONMENTAL INC.



Well Hydrographs_Appendix B_v2 -- JCSD-16_60
11/3/2009 -- 4:47 PM



Well Hydrographs_Appendix B_v2 -- JCSD-15_59
11/3/2009 -- 4:47 PM

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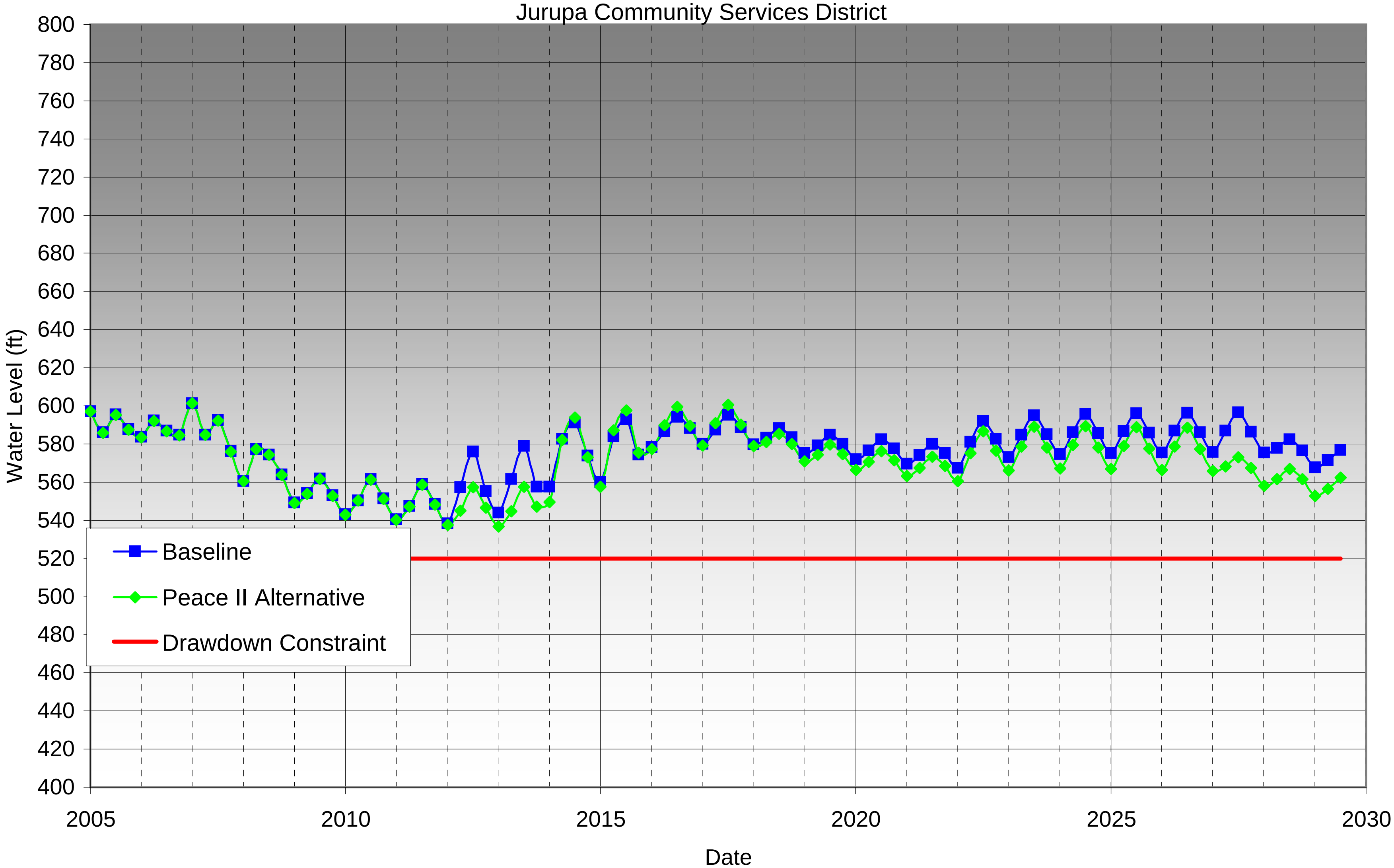
Figure B - 41
Projected Groundwater Water Elevations in Well JCSD-14 for the Baseline and Peace II Alternatives,
Jurupa Community Services District



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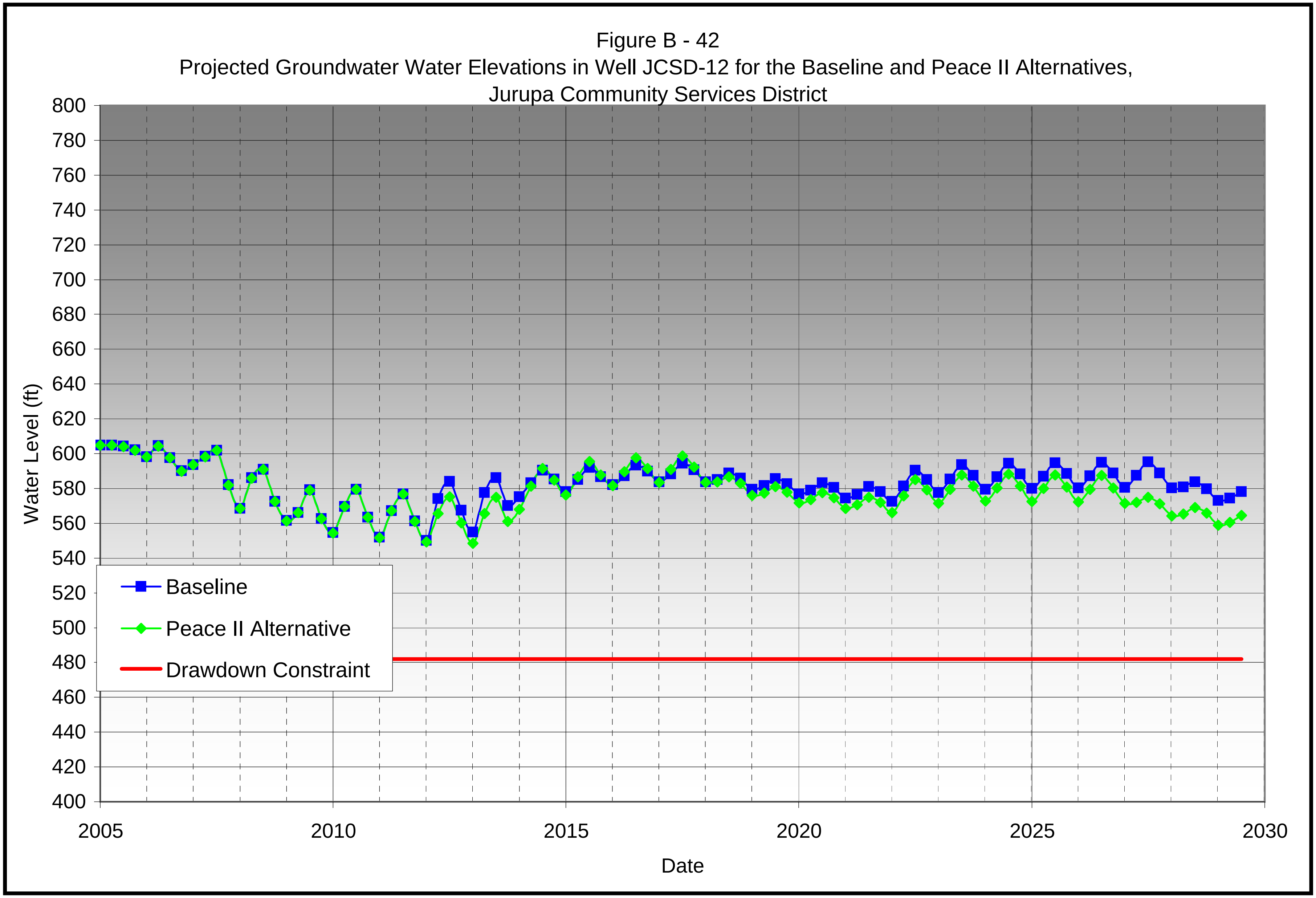
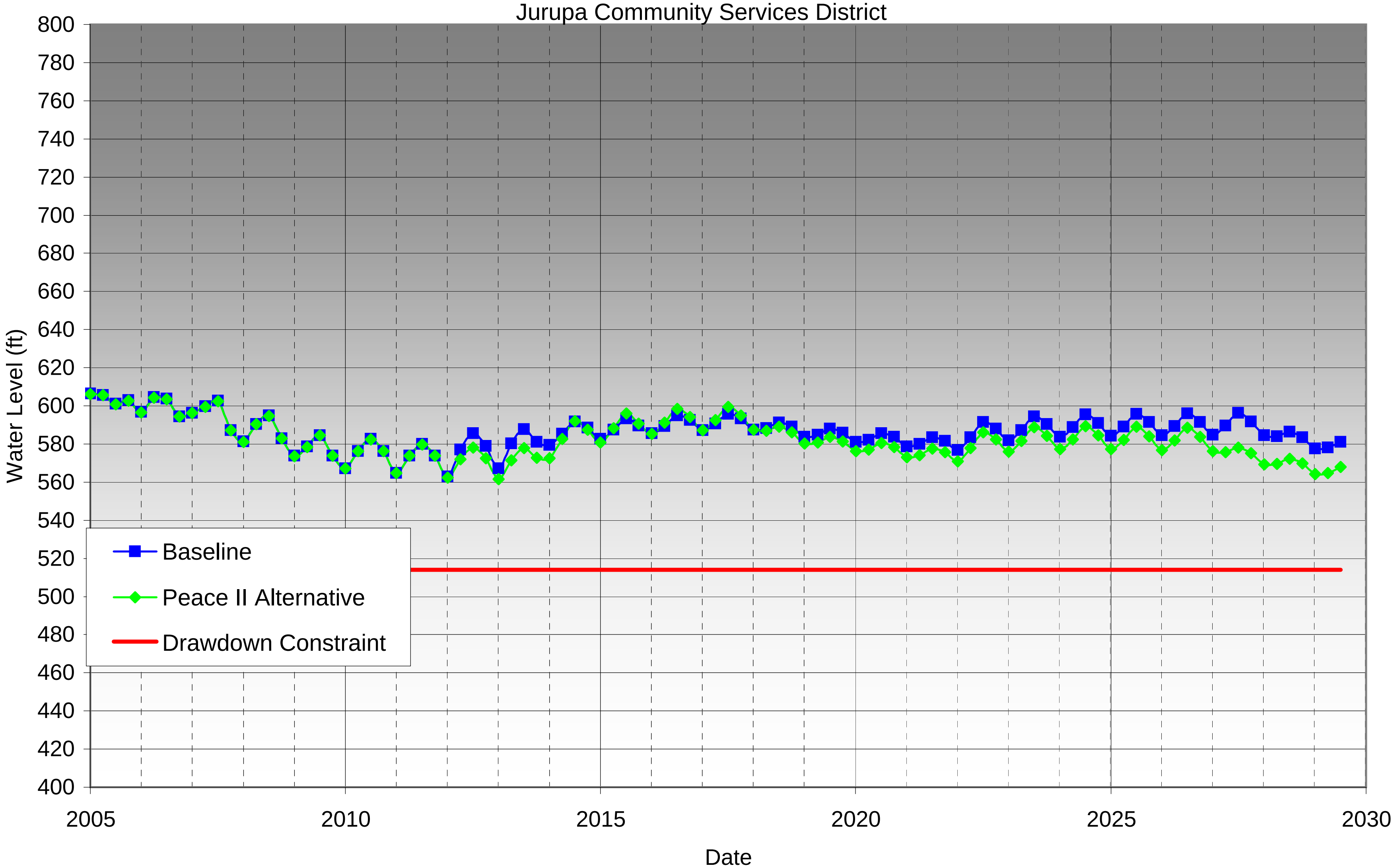
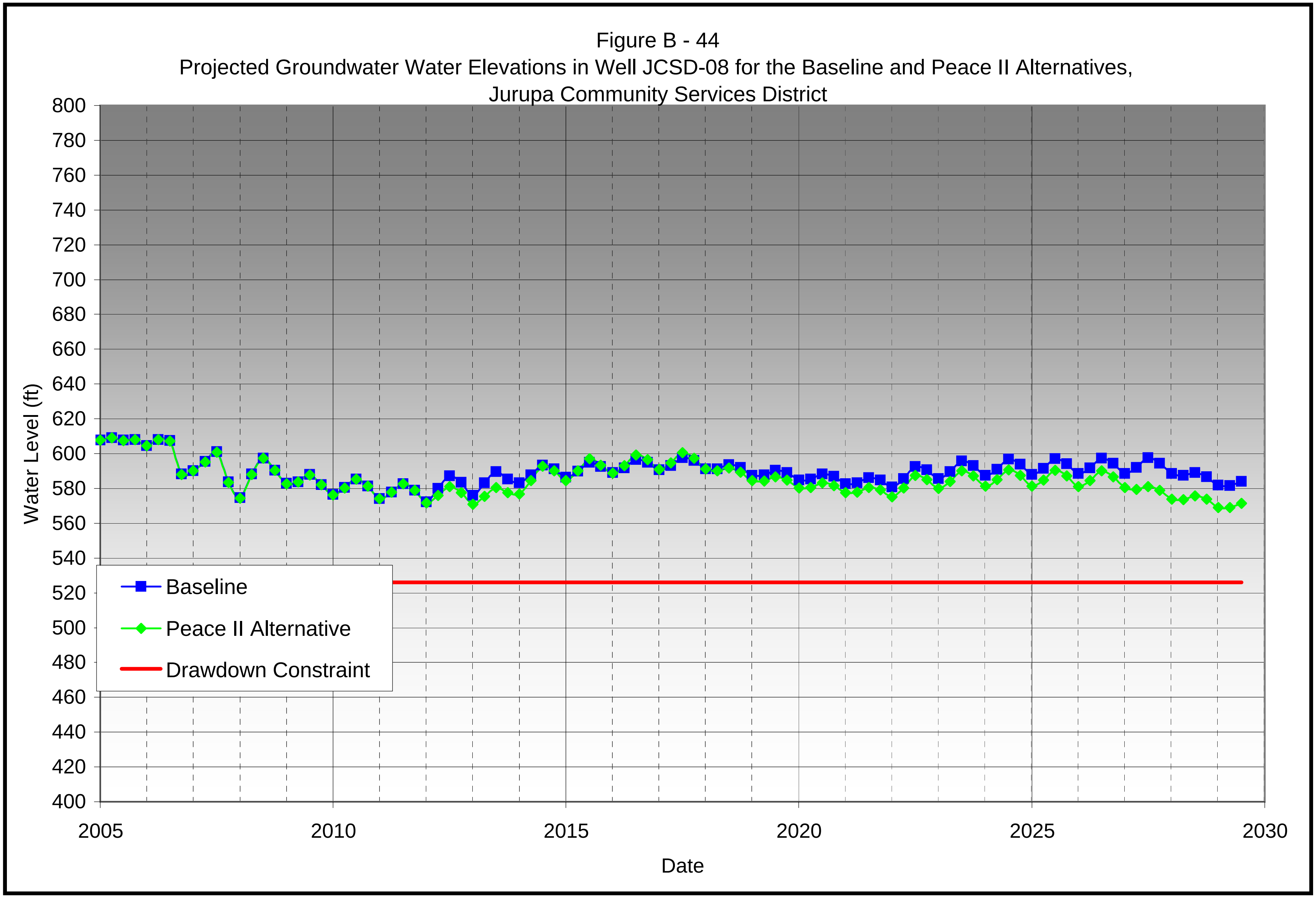
ENVIRONMENTAL INC.



WILDERMUTH™ ENVIRONMENTAL INC.

Figure B - 43
Projected Groundwater Water Elevations in Well JCSD-11 for the Baseline and Peace II Alternatives,
Jurupa Community Services District





WILDERMUTH™ ENVIRONMENTAL INC.

Figure B - 45
Projected Groundwater Water Elevations in Well JCSD-06 for the Baseline and Peace II Alternatives,
Jurupa Community Services District

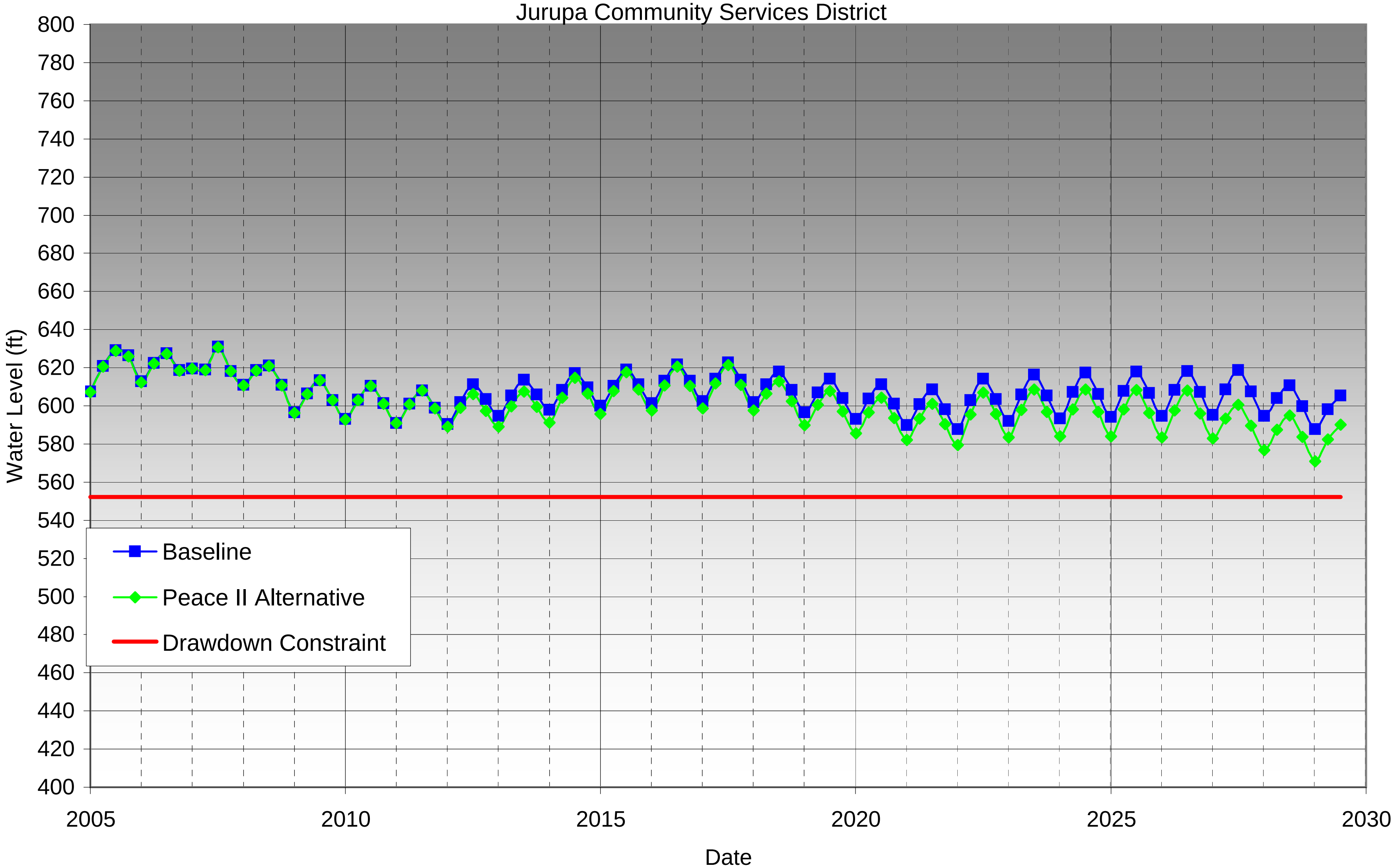


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Figure B - 46
Projected Groundwater Water Elevations in Well CB-5 for the Baseline and Peace II Alternatives,
Cucamonga Valley Water District

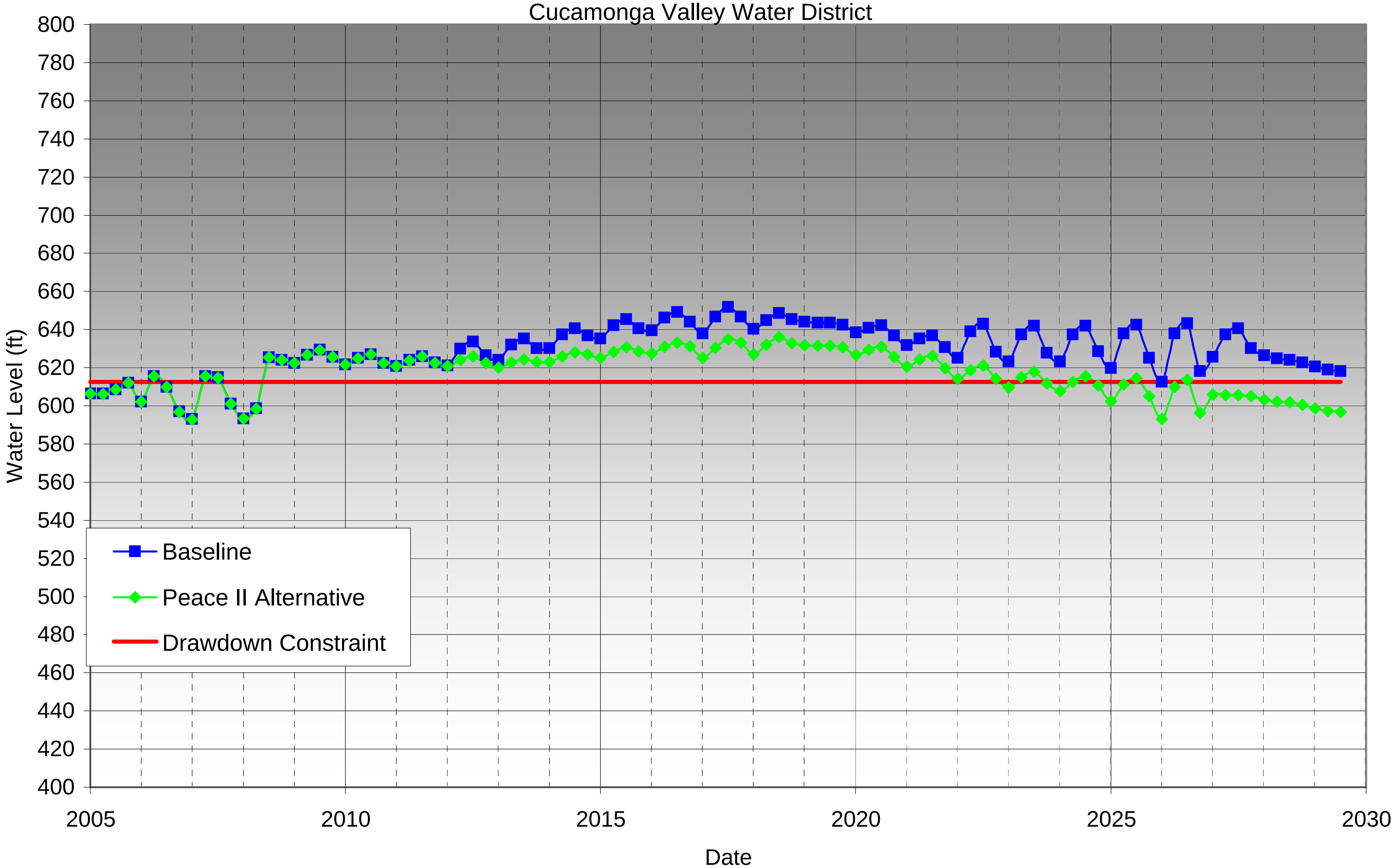


Figure B - 47
Projected Groundwater Water Elevations in Well CB-46 for the Baseline and Peace II Alternatives,
Cucamonga Valley Water District

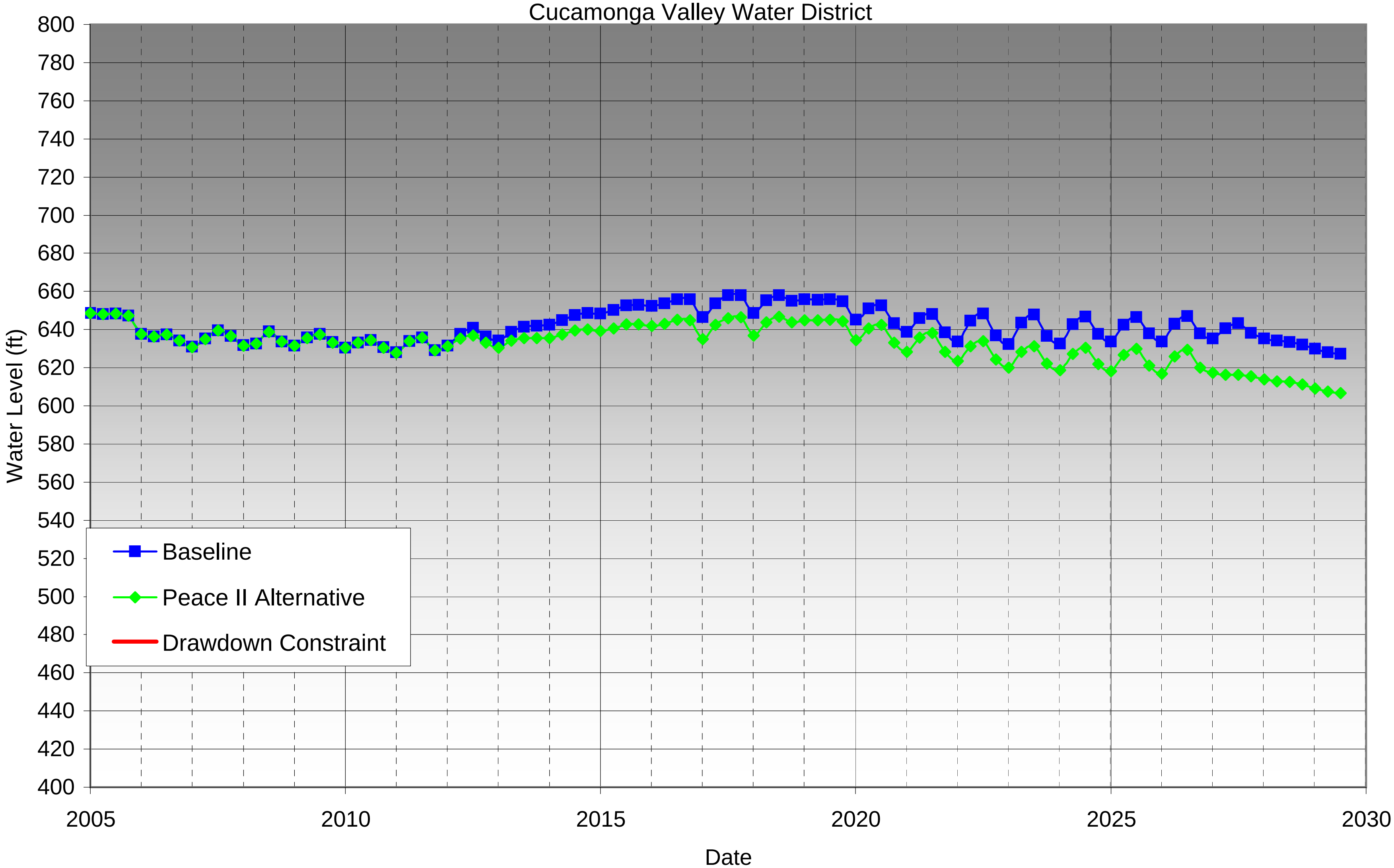


Figure B - 48
Projected Groundwater Water Elevations in Well CB-42 for the Baseline and Peace II Alternatives,
Cucamonga Valley Water District

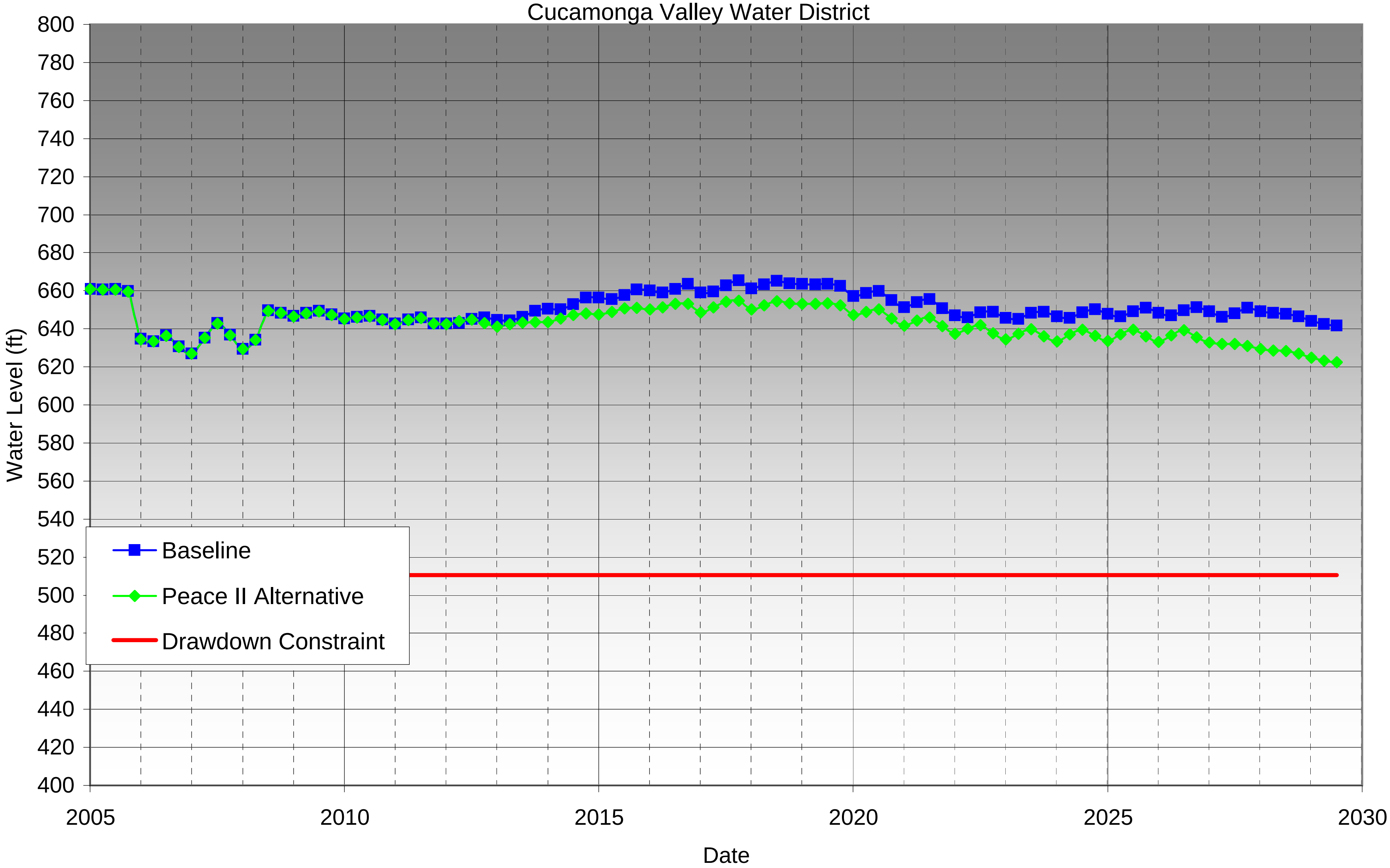
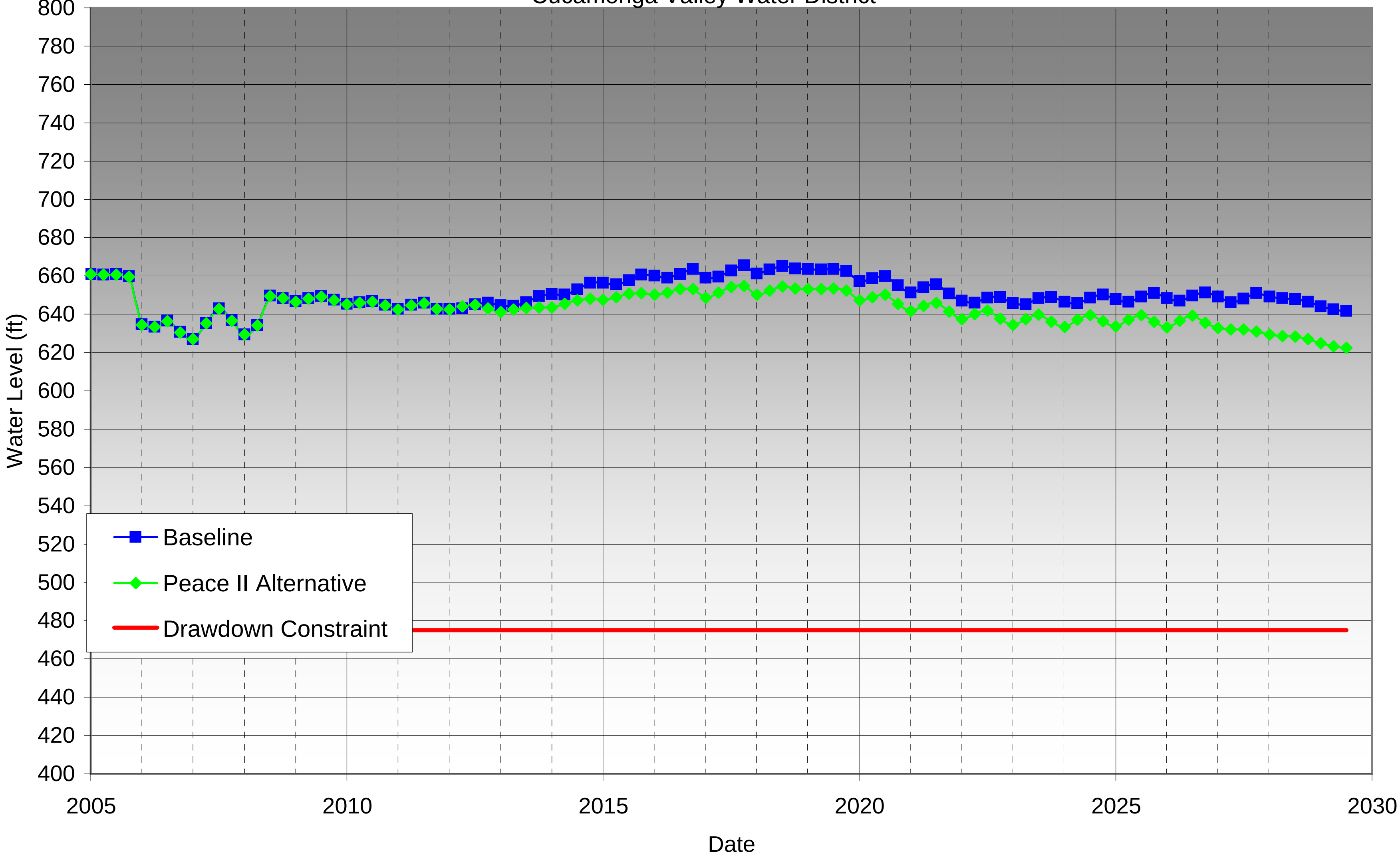
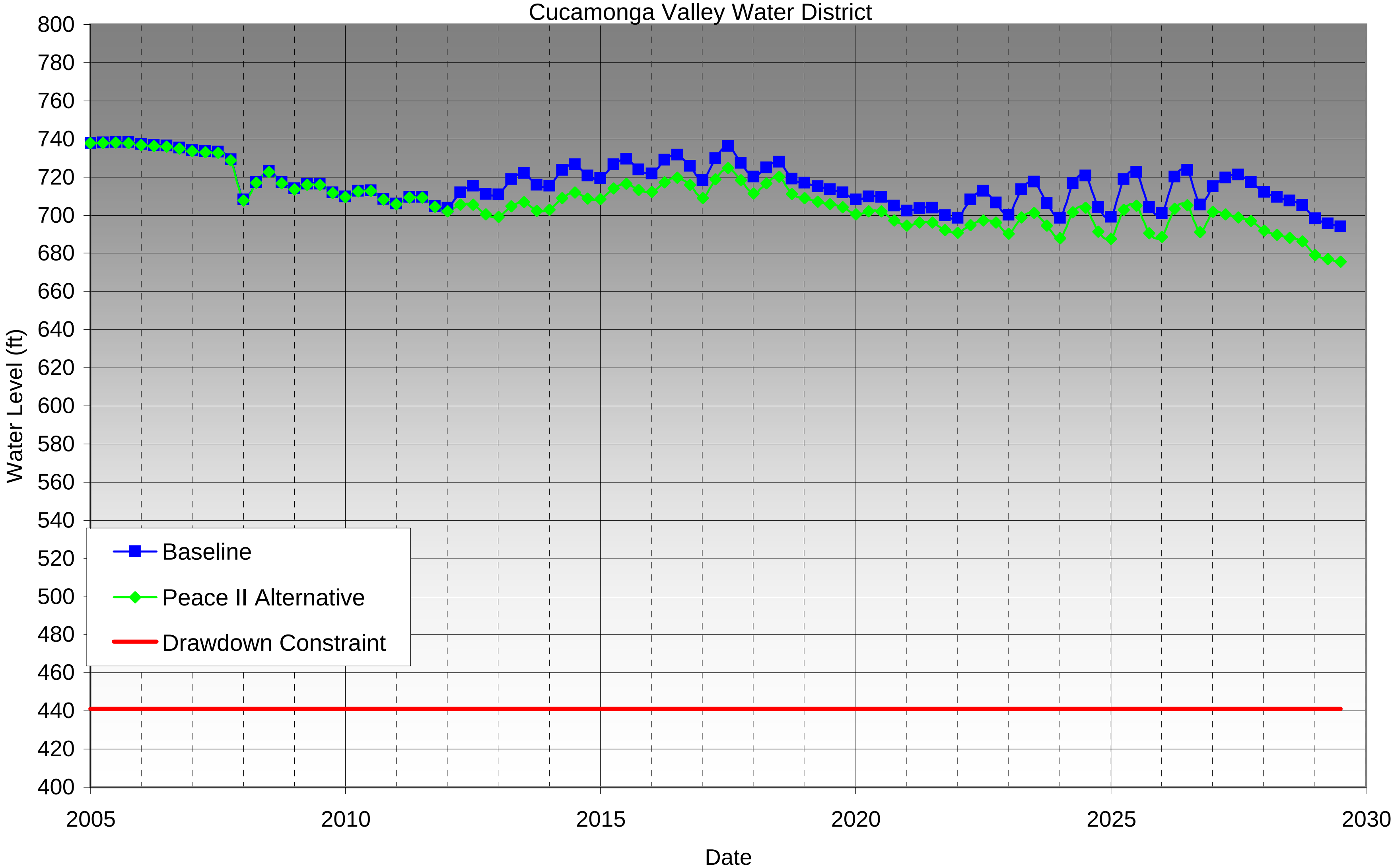


Figure B - 49
Projected Groundwater Water Elevations in Well CB-41 for the Baseline and Peace II Alternatives,
Cucamonga Valley Water District



WILDERMUTH ENVIRONMENTAL INC.

Figure B - 50
Projected Groundwater Water Elevations in Well CB-40 for the Baseline and Peace II Alternatives,
Cucamonga Valley Water District



WILDERMUTH™ ENVIRONMENTAL INC.

Figure B - 51
Projected Groundwater Water Elevations in Well CB-4 for the Baseline and Peace II Alternatives,
Cucamonga Valley Water District

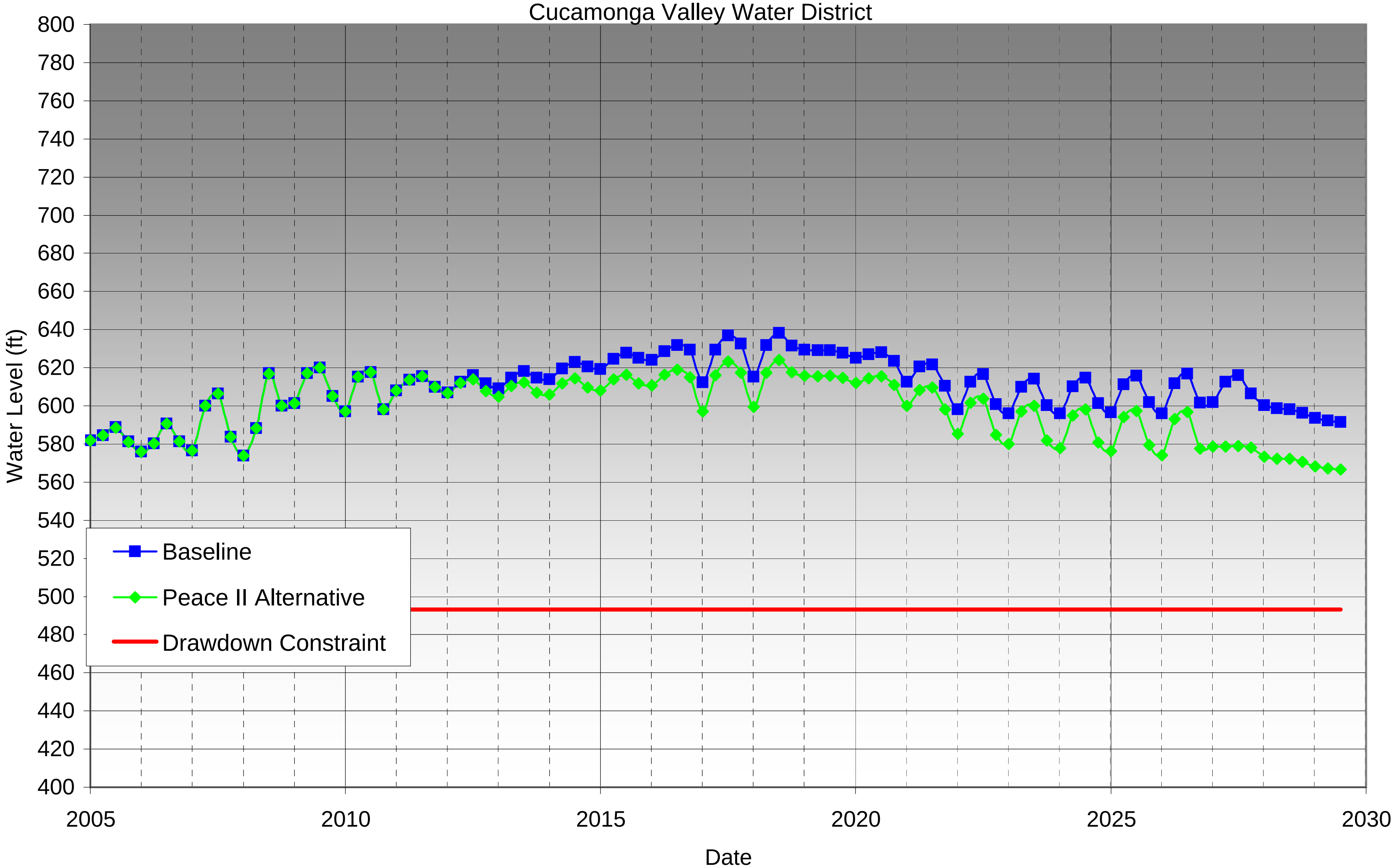
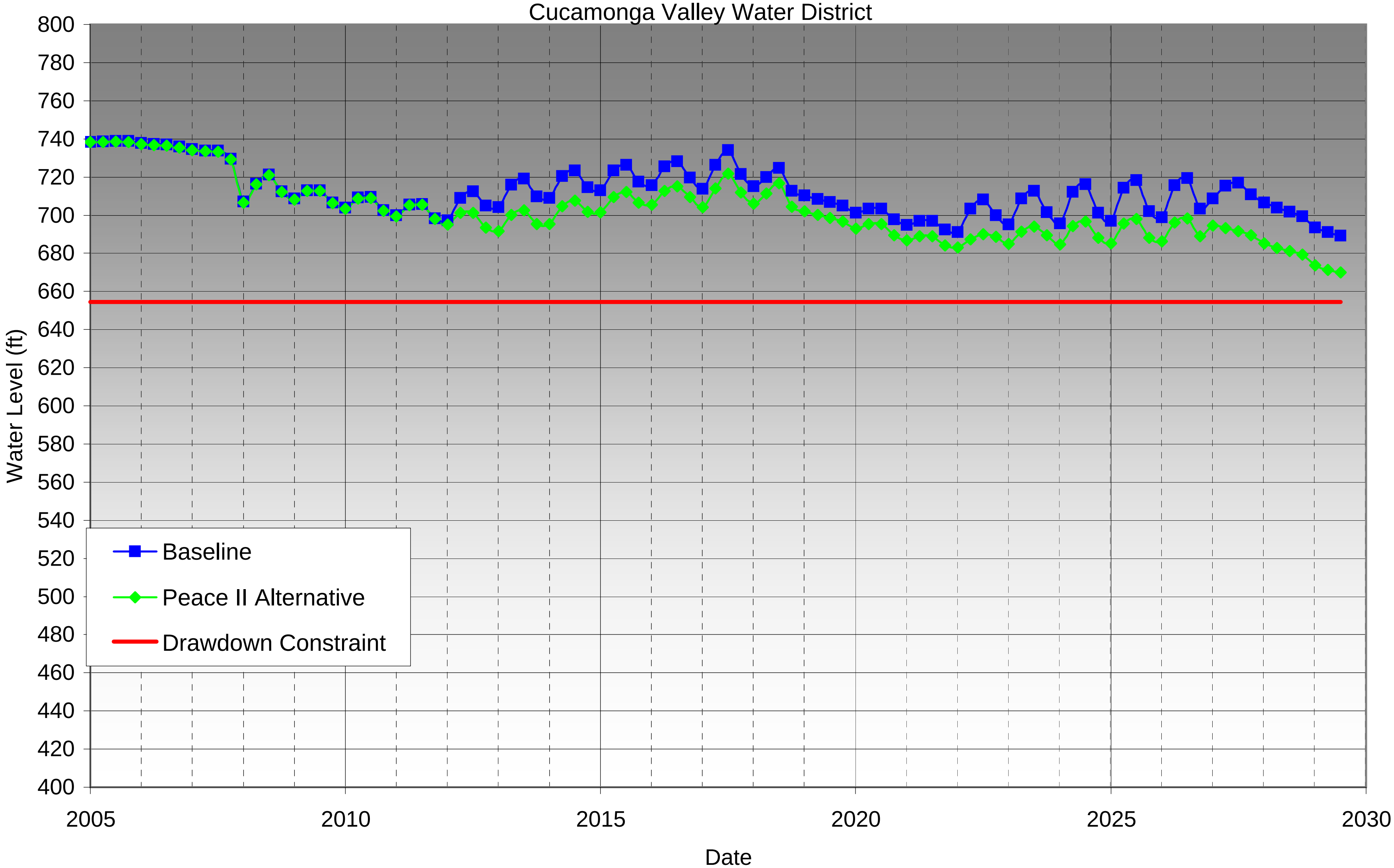


Figure B - 52
Projected Groundwater Water Elevations in Well CB-39 for the Baseline and Peace II Alternatives,
Cucamonga Valley Water District



WILDERMUTH™ ENVIRONMENTAL INC.

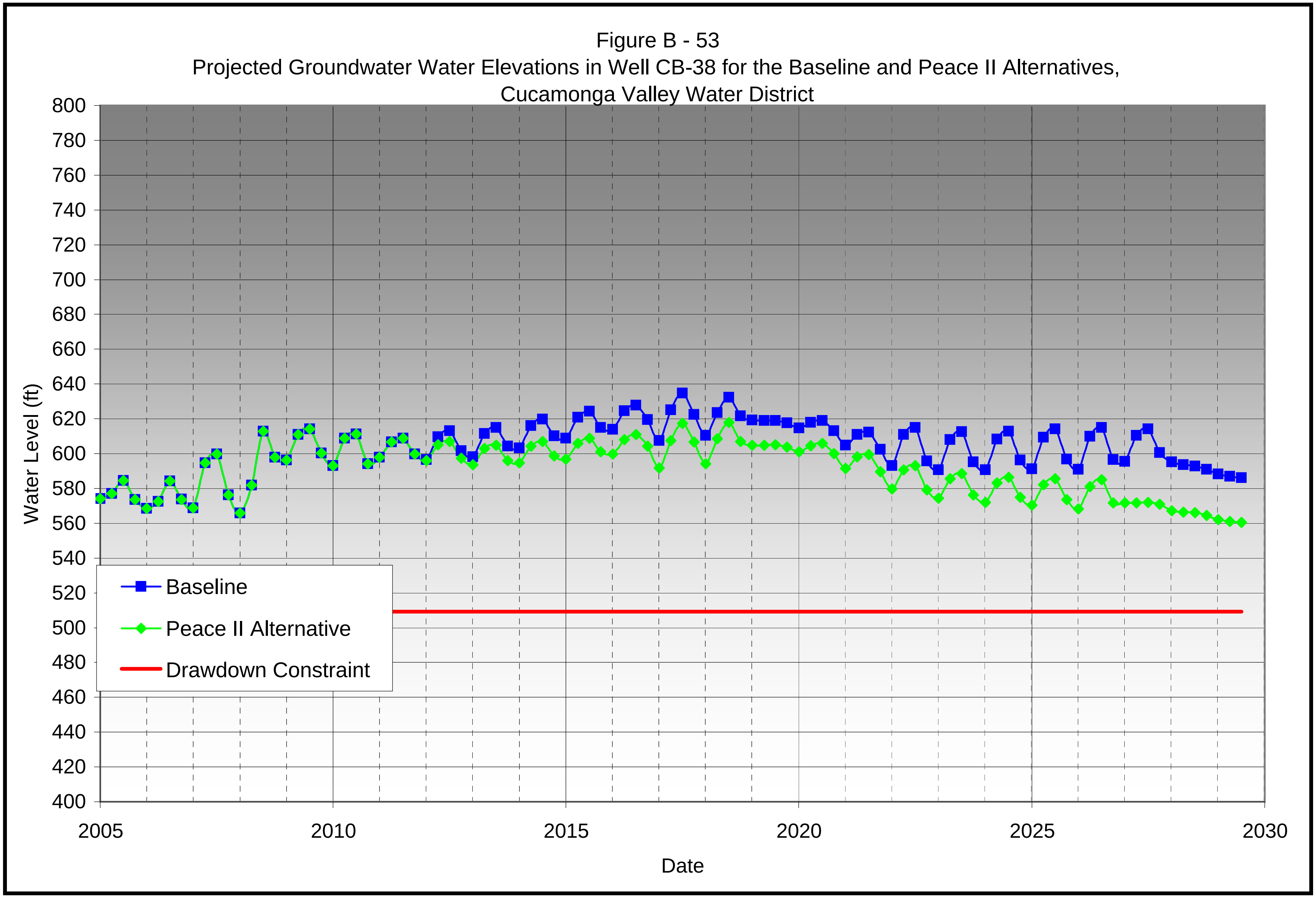


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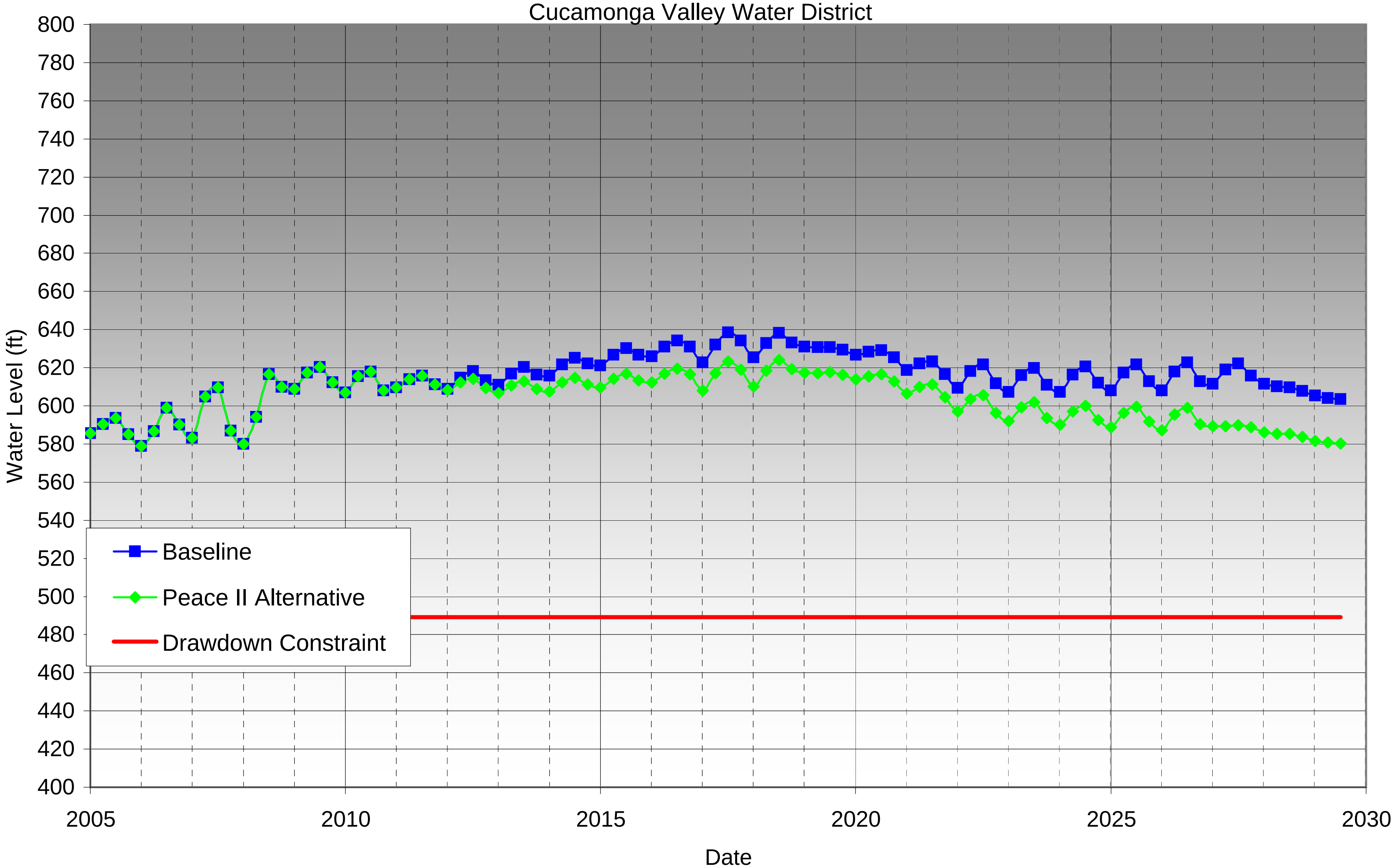
Figure B - 54
Projected Groundwater Water Elevations in Well CB-30 for the Baseline and Peace II Alternatives,
Cucamonga Valley Water District



Well Hydrographs_Appendix B_v2 -- CB-30_45
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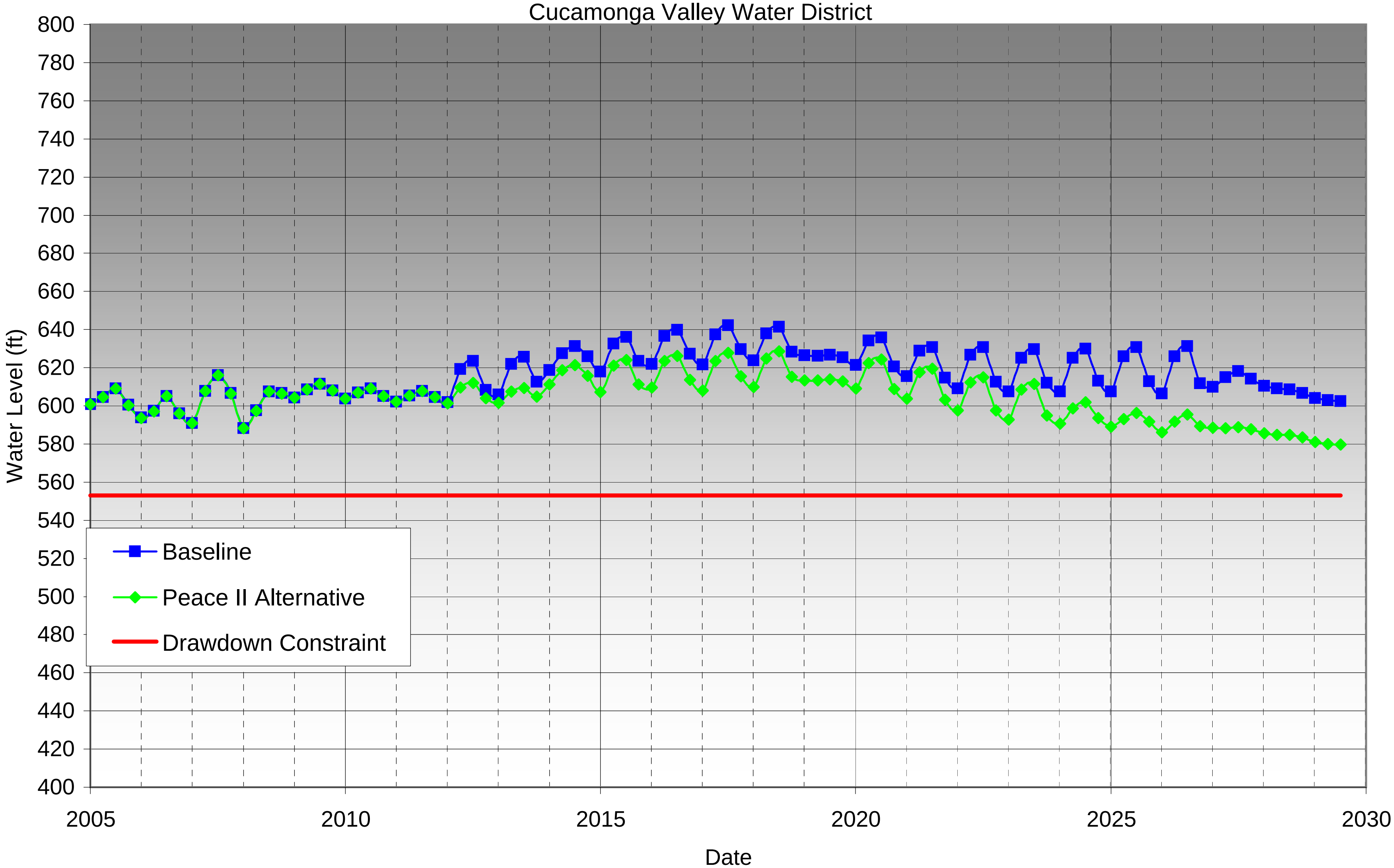
Figure B - 55
Projected Groundwater Water Elevations in Well CB-3 for the Baseline and Peace II Alternatives,
Cucamonga Valley Water District



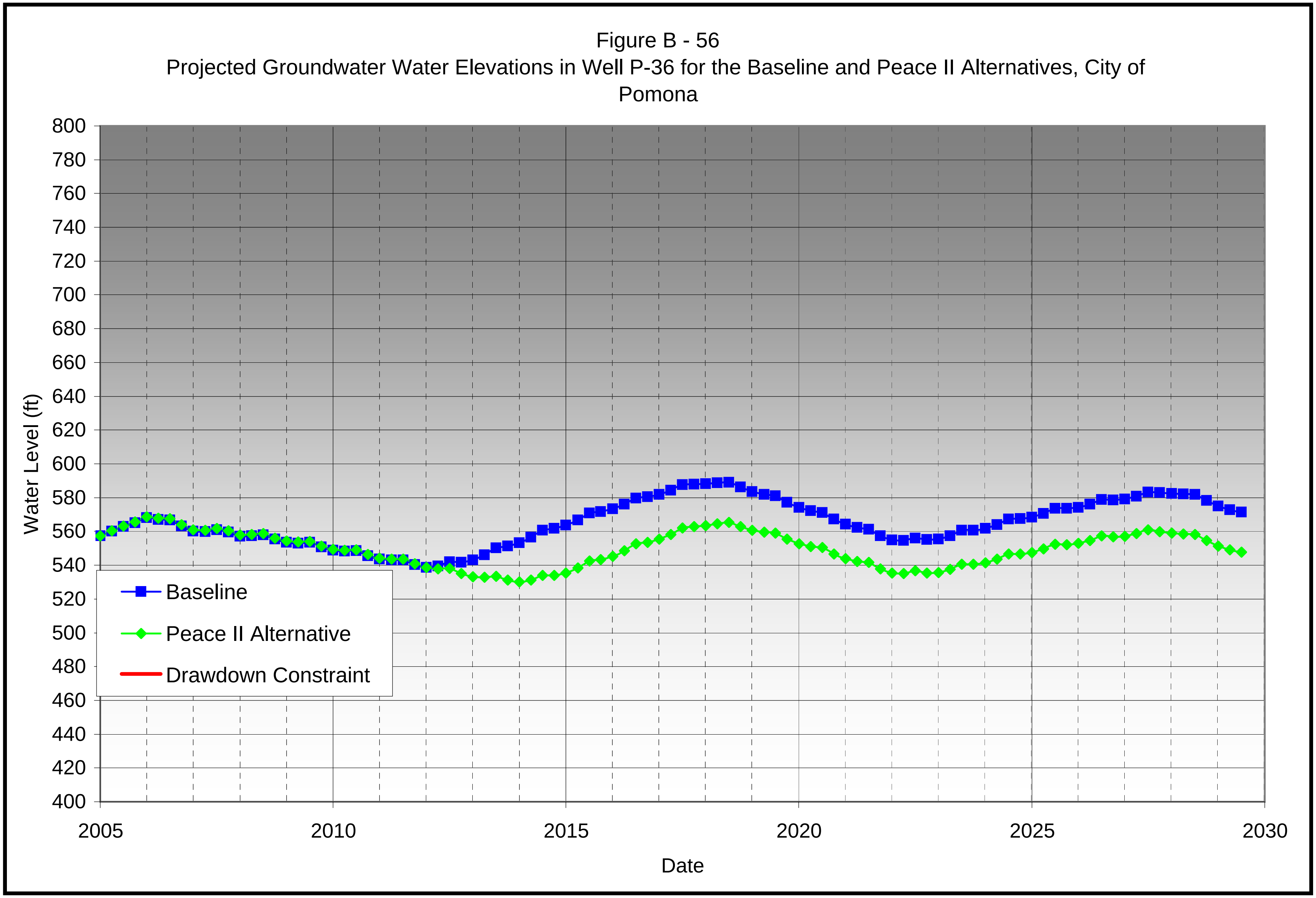


Figure B - 56
Projected Groundwater Water Elevations in Well P-36 for the Baseline and Peace II Alternatives, City of Pomona
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

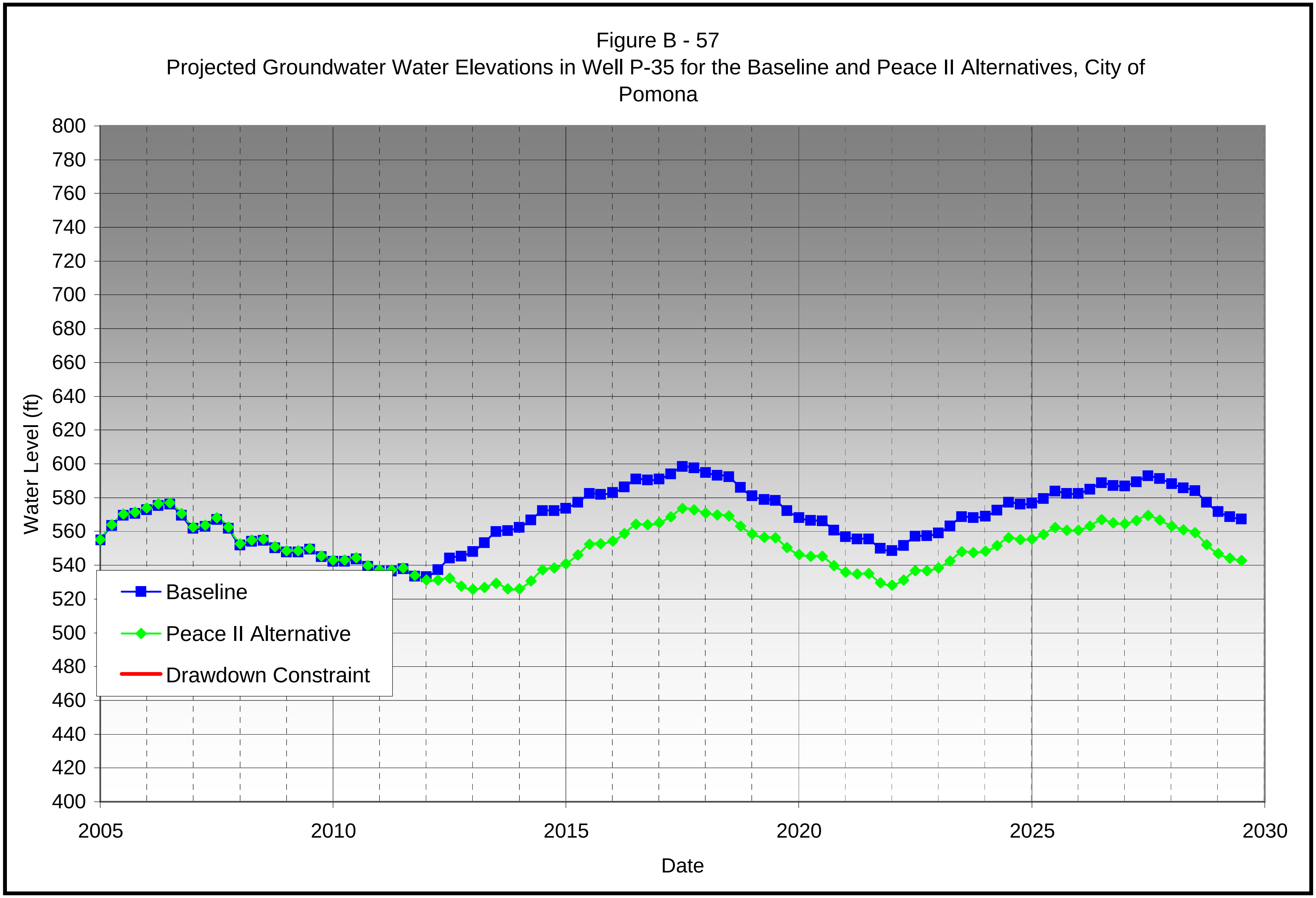


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Figure B - 58

Projected Groundwater Water Elevations in Well P-34 for the Baseline and Peace II Alternatives, City of Pomona

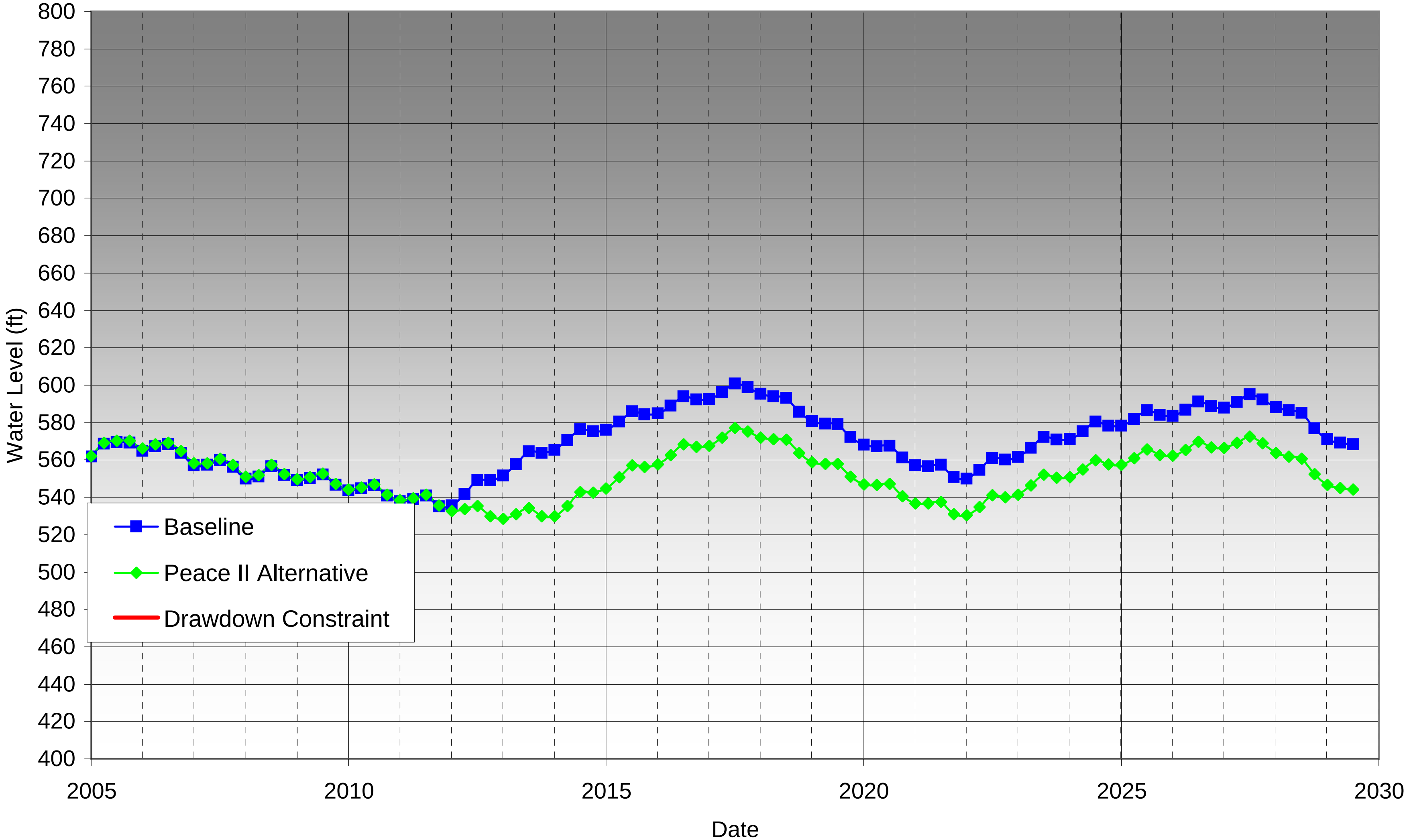
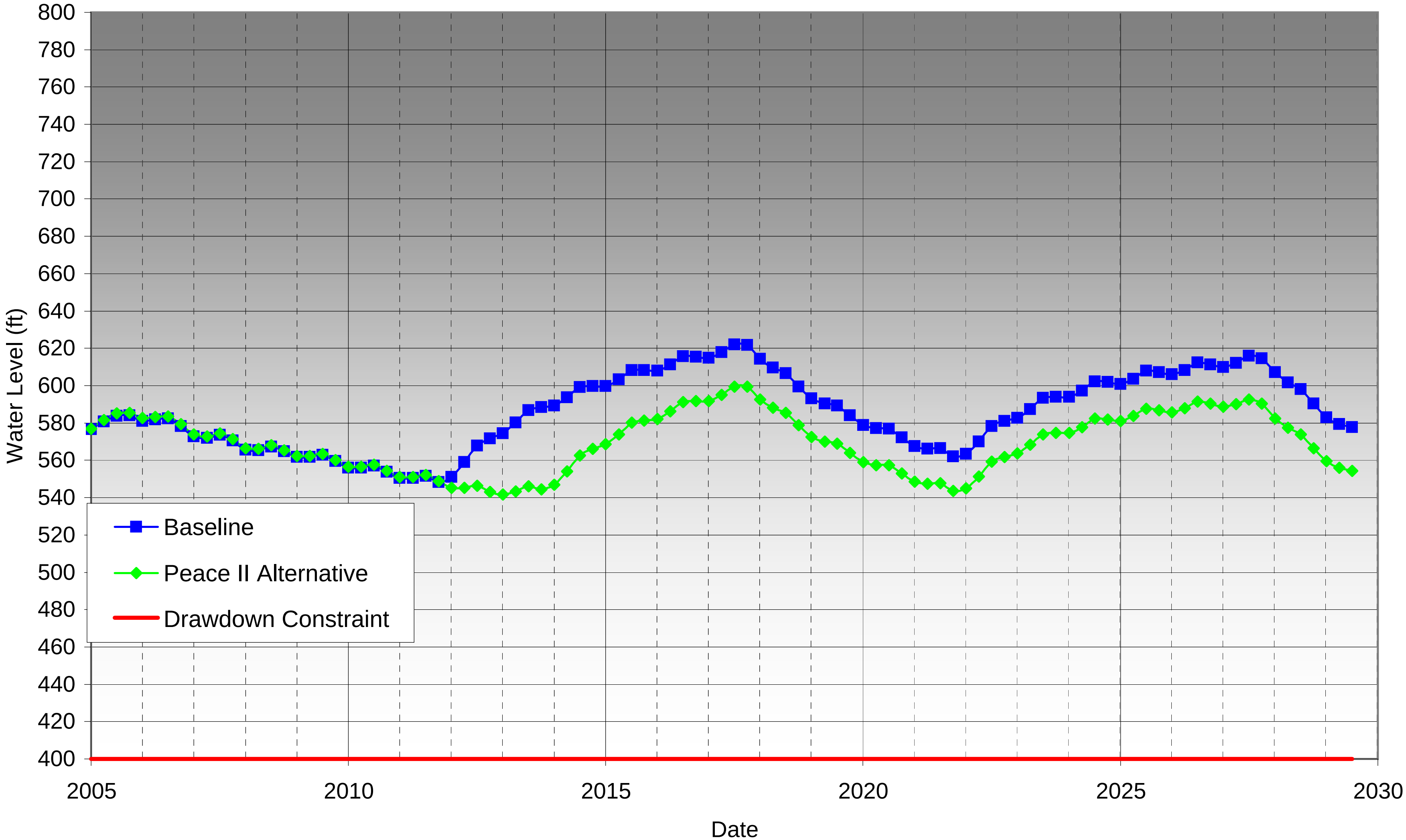


Figure B - 59
Projected Groundwater Water Elevations in Well P-30 for the Baseline and Peace II Alternatives, City of Pomona



WILDERMUTH™ ENVIRONMENTAL INC.

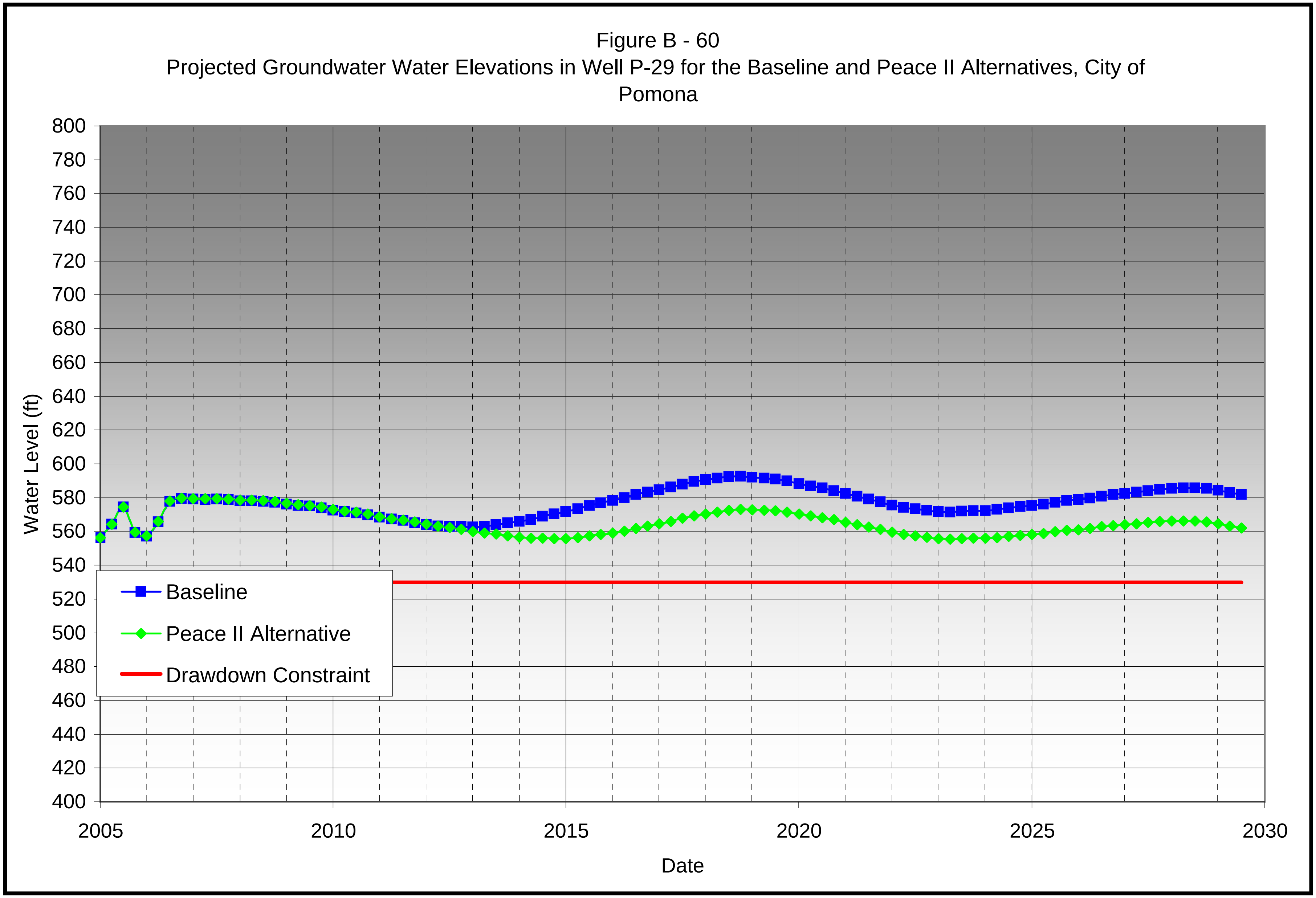


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Figure B - 61
Projected Groundwater Water Elevations in Well P-27 for the Baseline and Peace II Alternatives, City of Pomona

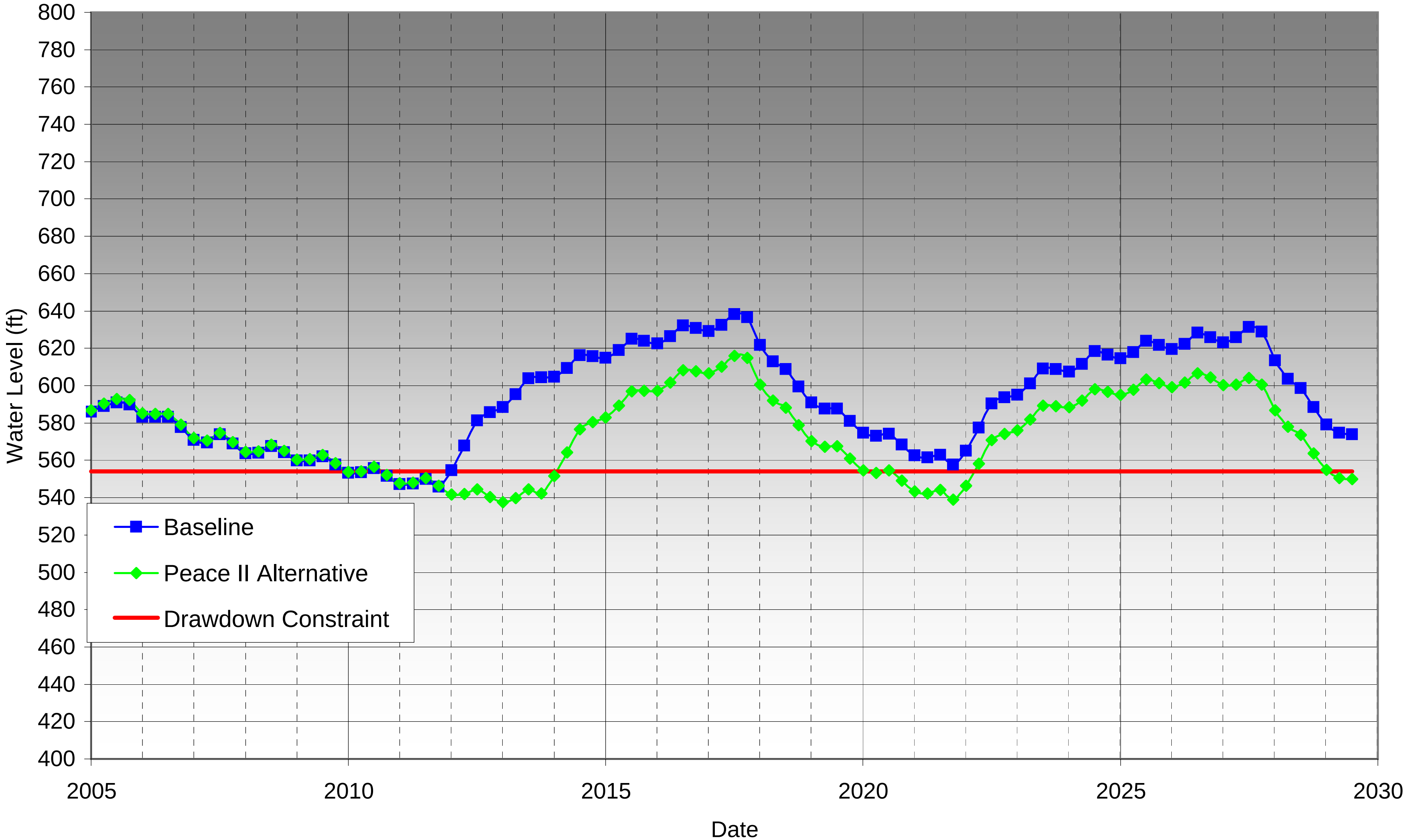
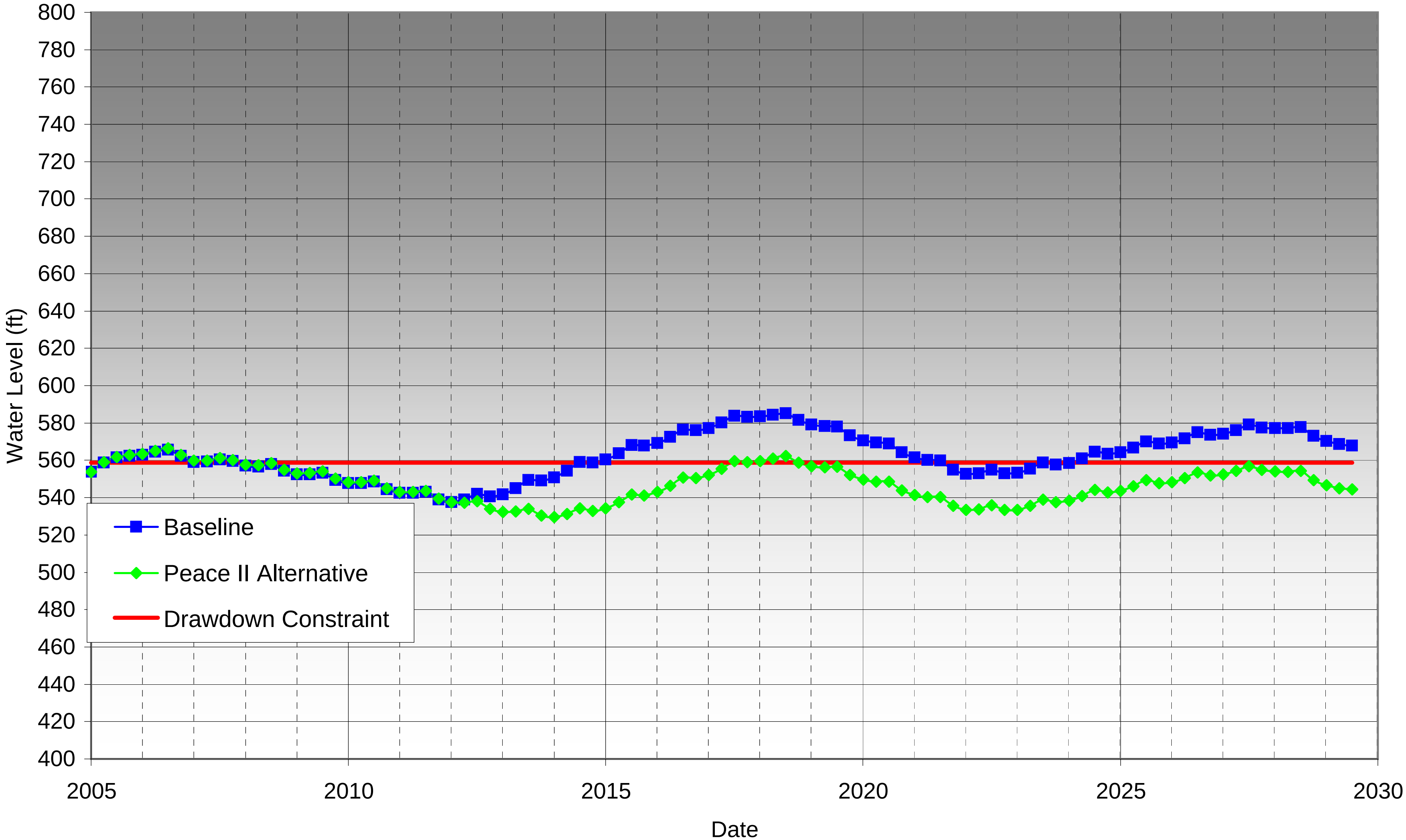
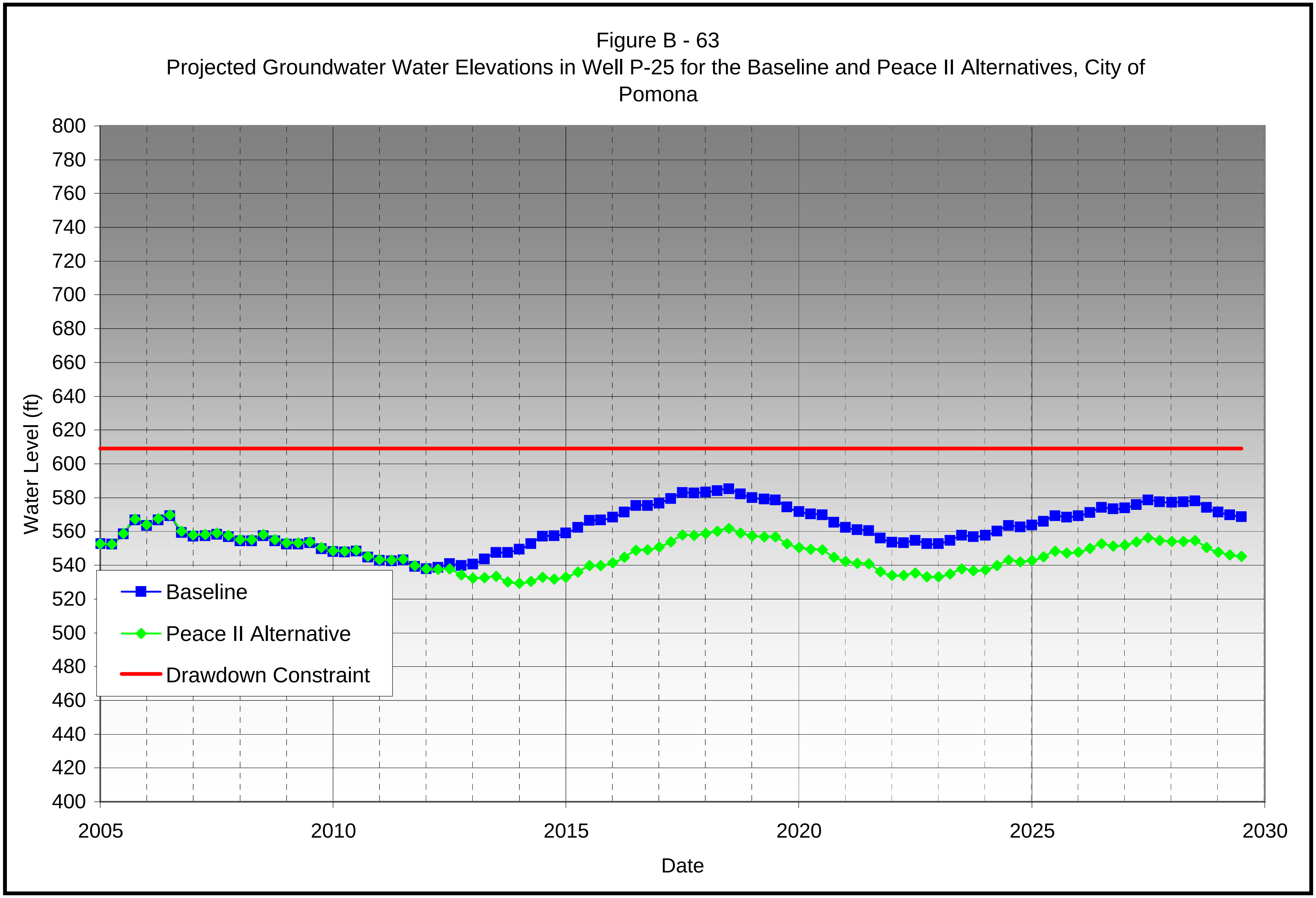


Figure B - 62
Projected Groundwater Water Elevations in Well P-26 for the Baseline and Peace II Alternatives, City of Pomona





WILDERMUTH™ ENVIRONMENTAL INC.

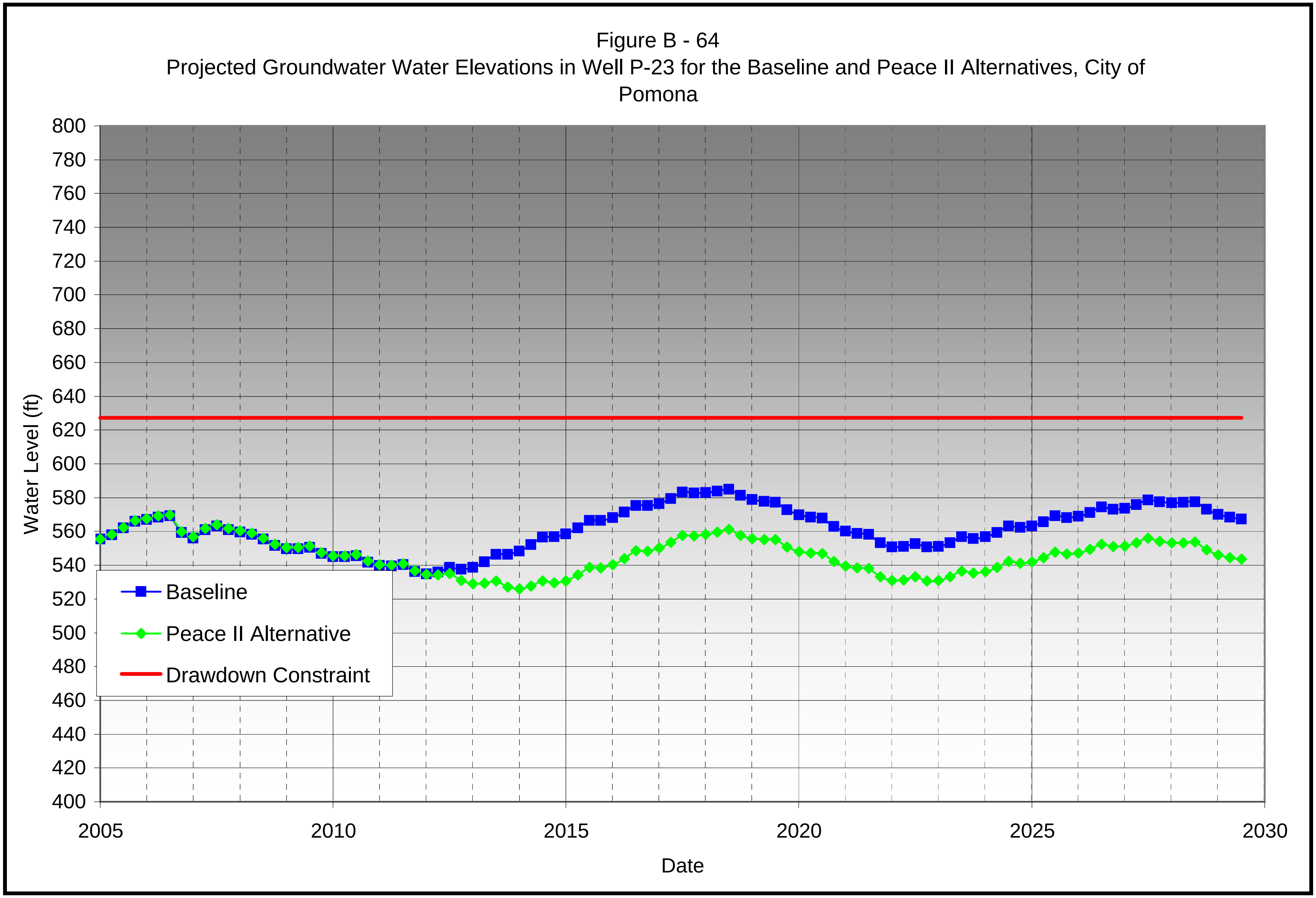
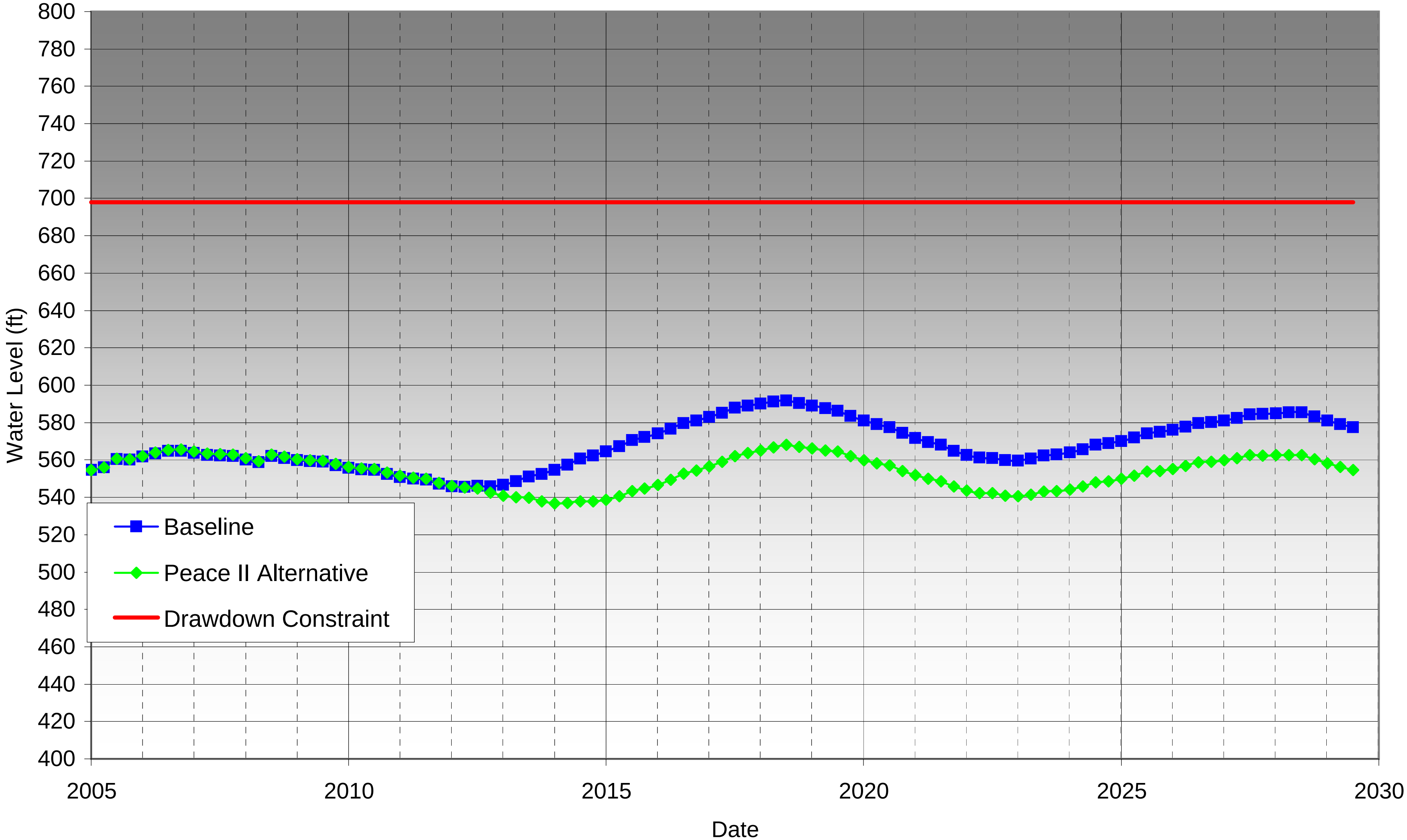
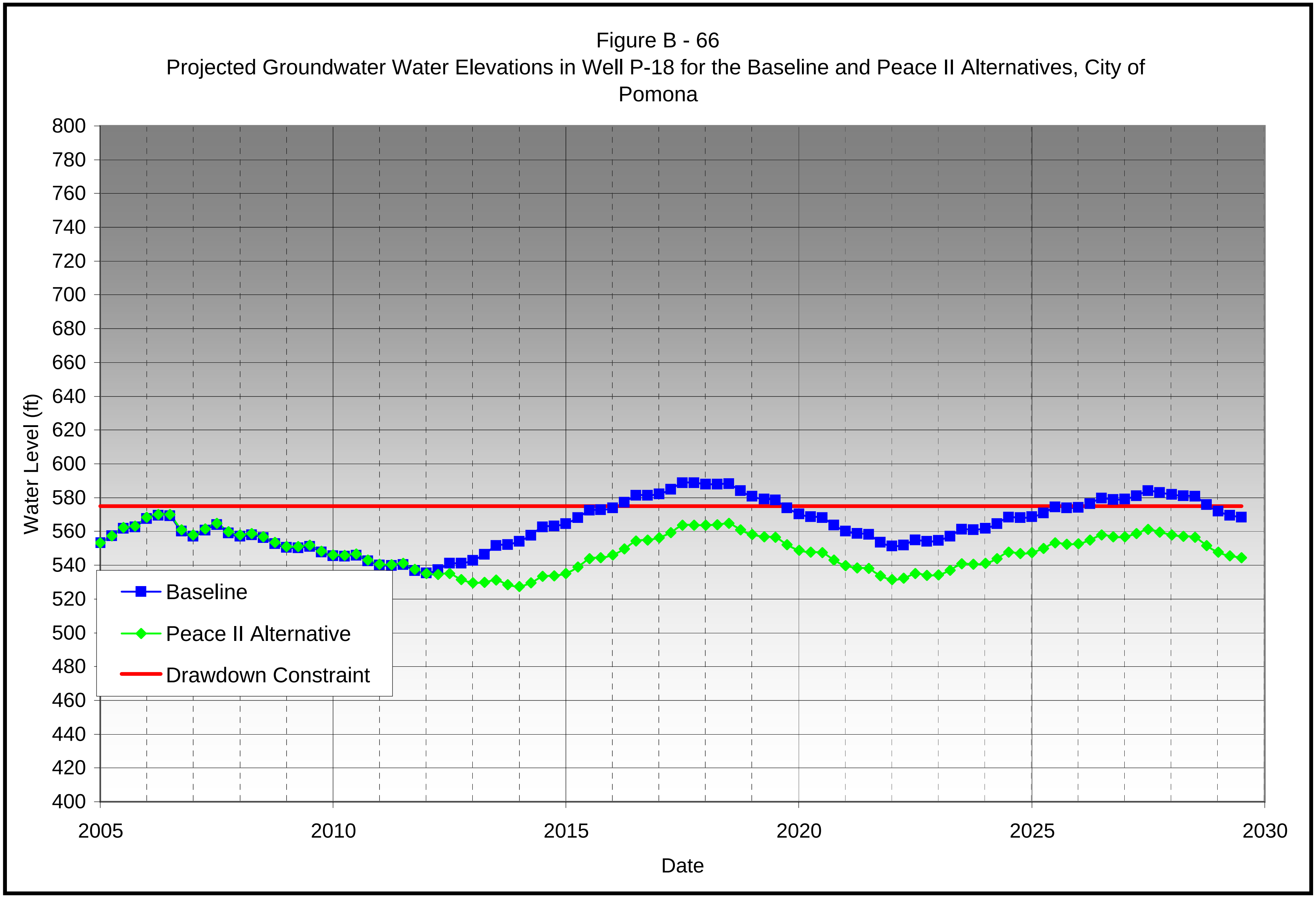


Figure B - 64
Projected Groundwater Water Elevations in Well P-23 for the Baseline and Peace II Alternatives, City of Pomona
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

Figure B - 65
Projected Groundwater Water Elevations in Well P-21 for the Baseline and Peace II Alternatives, City of Pomona



WILDERMUTH ENVIRONMENTAL INC.



WILDERMUTH ENVIRONMENTAL INC.

Figure B - 67
Projected Groundwater Water Elevations in Well P-17 for the Baseline and Peace II Alternatives, City of Pomona

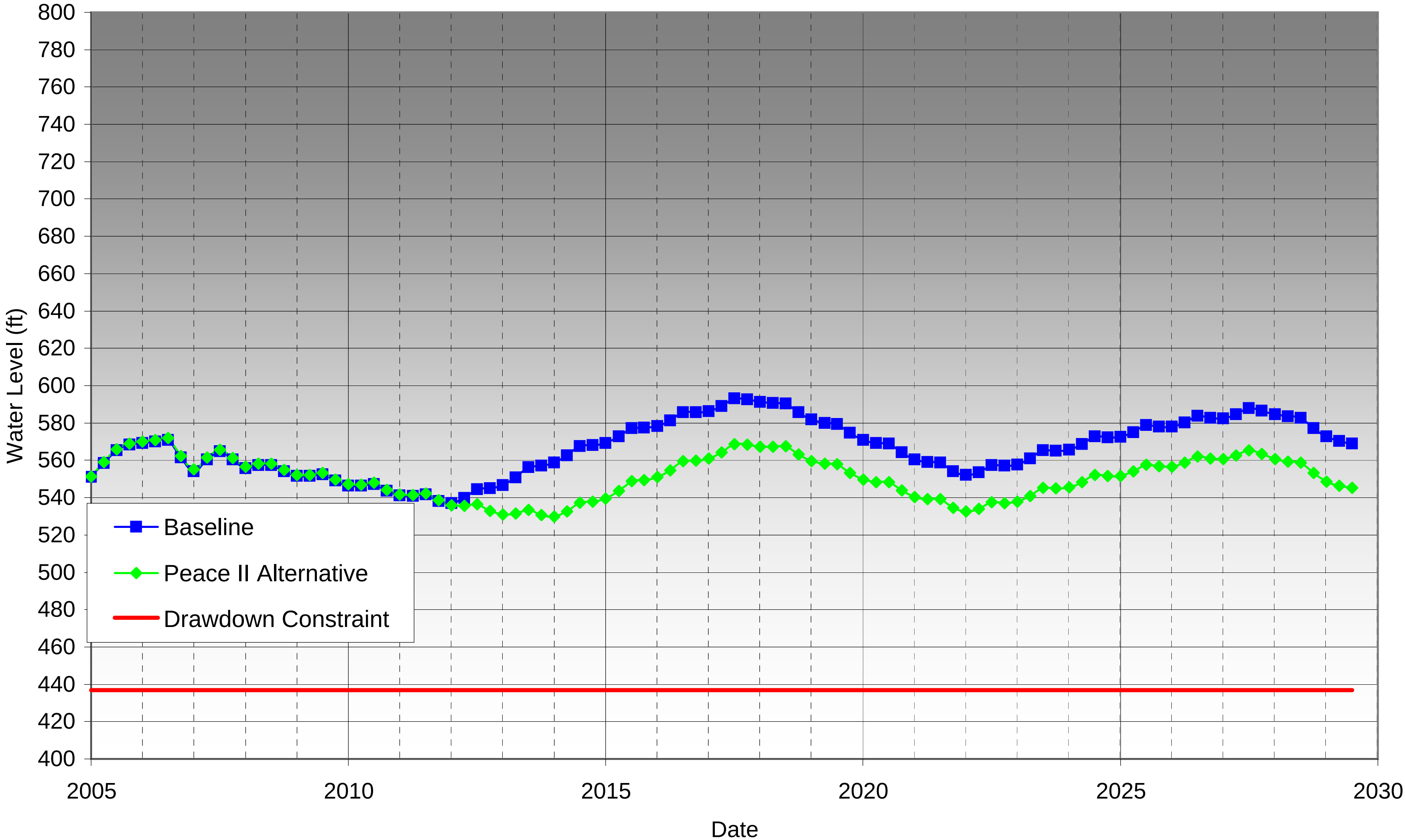
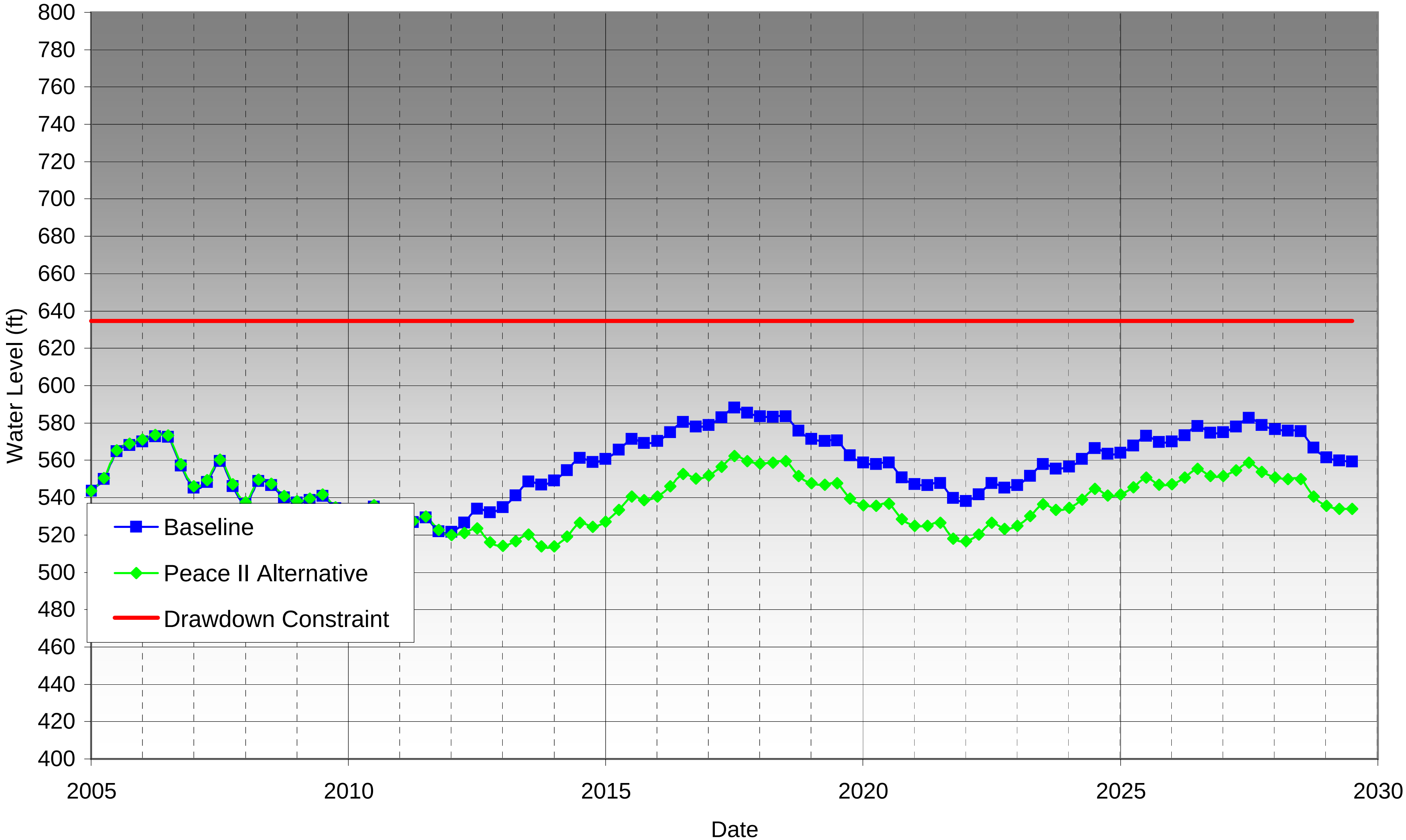


Figure B - 68
Projected Groundwater Water Elevations in Well P-16 for the Baseline and Peace II Alternatives, City of Pomona



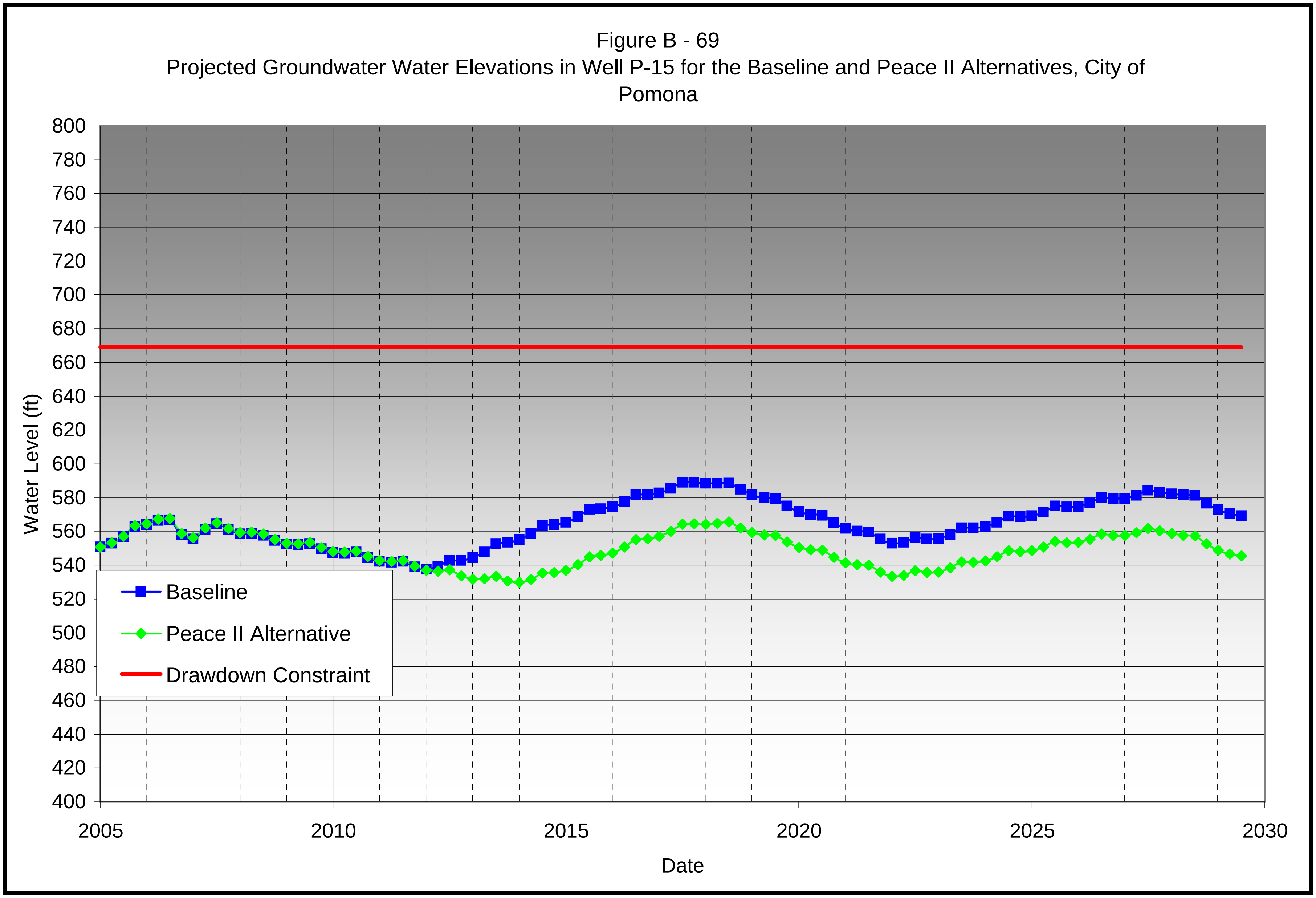


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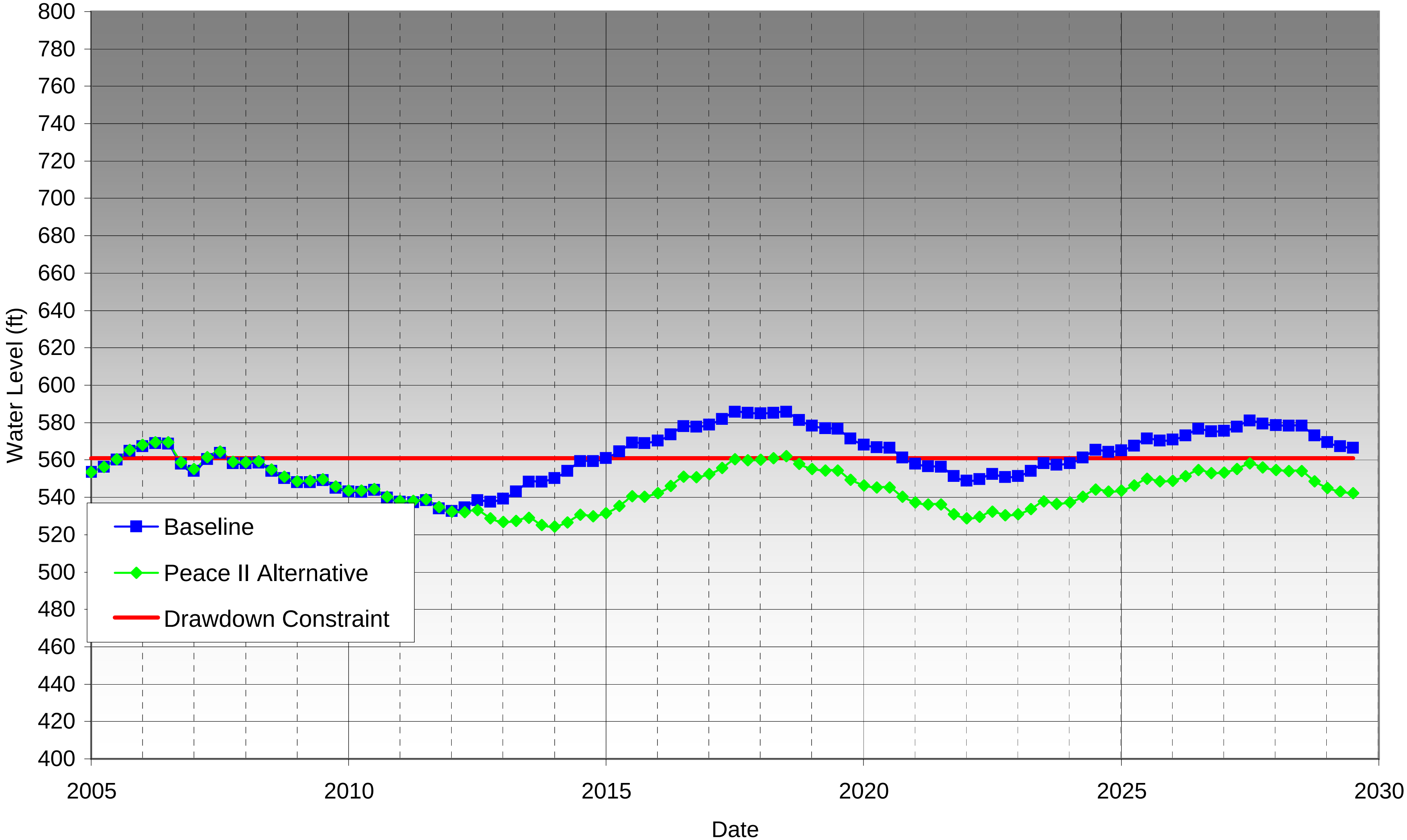
Figure B - 70
Projected Groundwater Water Elevations in Well P-14 for the Baseline and Peace II Alternatives, City of Pomona



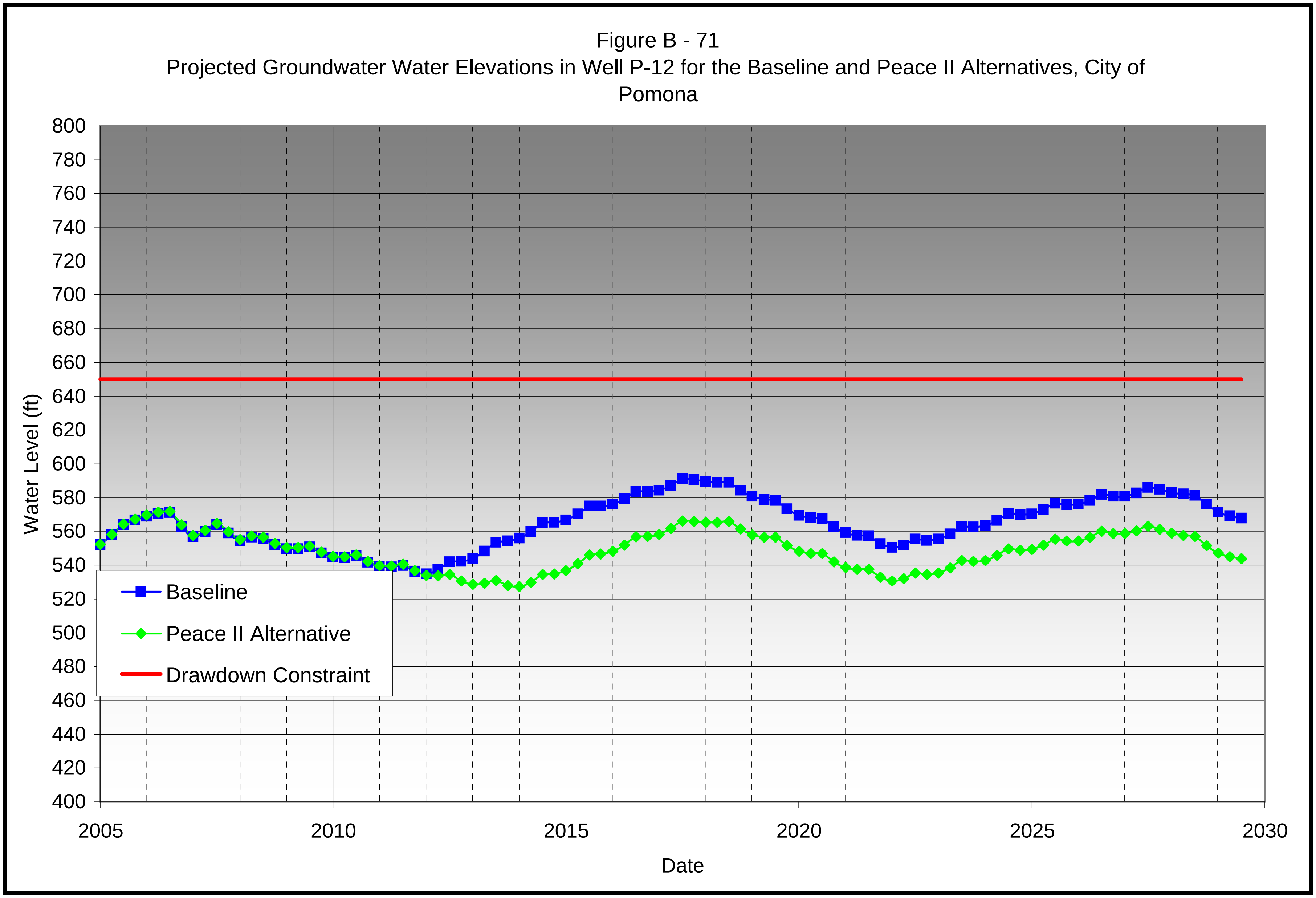
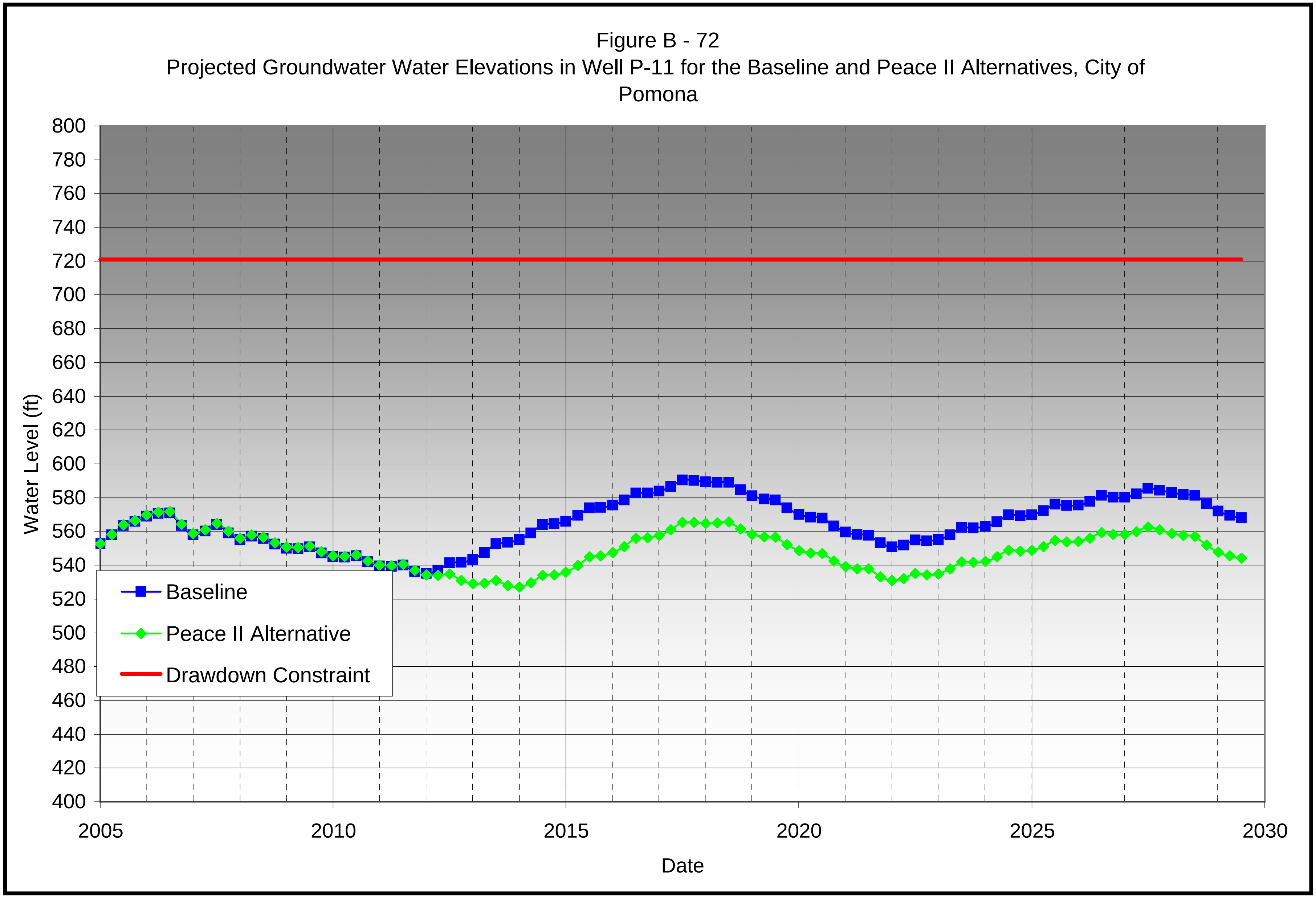


Figure B - 71
Projected Groundwater Water Elevations in Well P-12 for the Baseline and Peace II Alternatives, City of Pomona
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint



Well Hydrographs_Appendix B_v2 -- P-11_27
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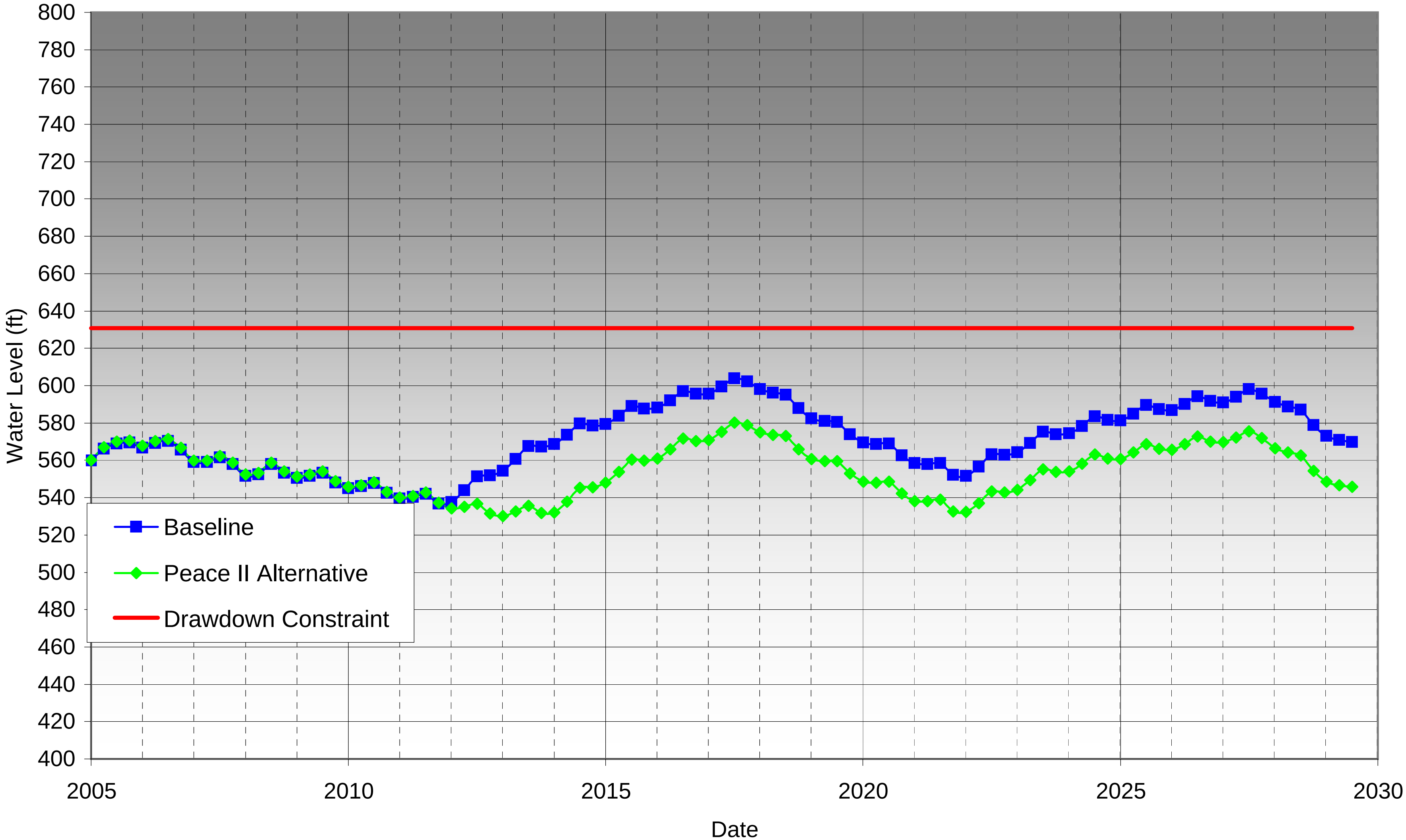
Figure B - 73
Projected Groundwater Water Elevations in Well P-10B for the Baseline and Peace II Alternatives, City of Pomona



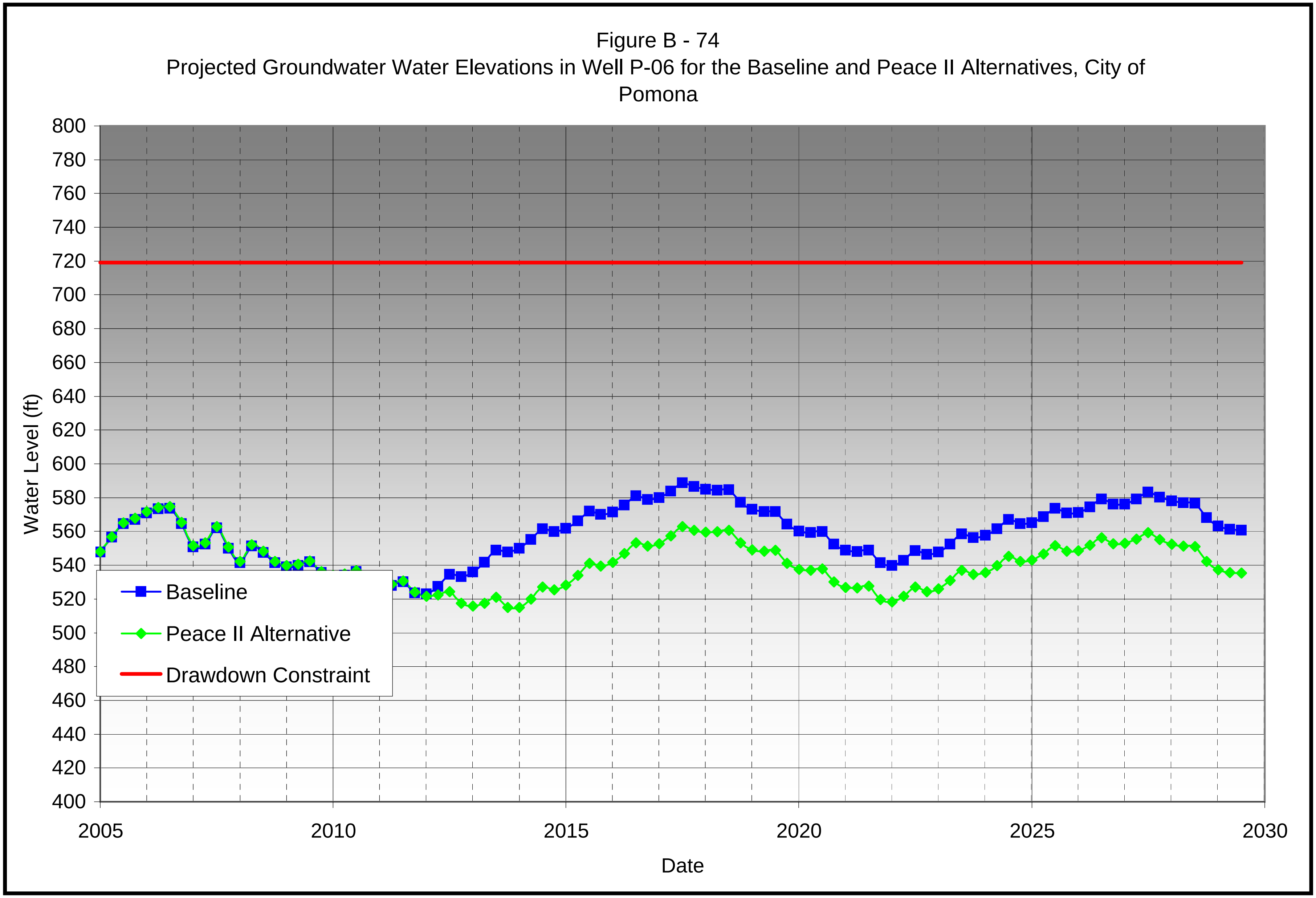


Figure B - 74
Projected Groundwater Water Elevations in Well P-06 for the Baseline and Peace II Alternatives, City of Pomona
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

Figure B - 75
Projected Groundwater Water Elevations in Well P-04 for the Baseline and Peace II Alternatives, City of Pomona

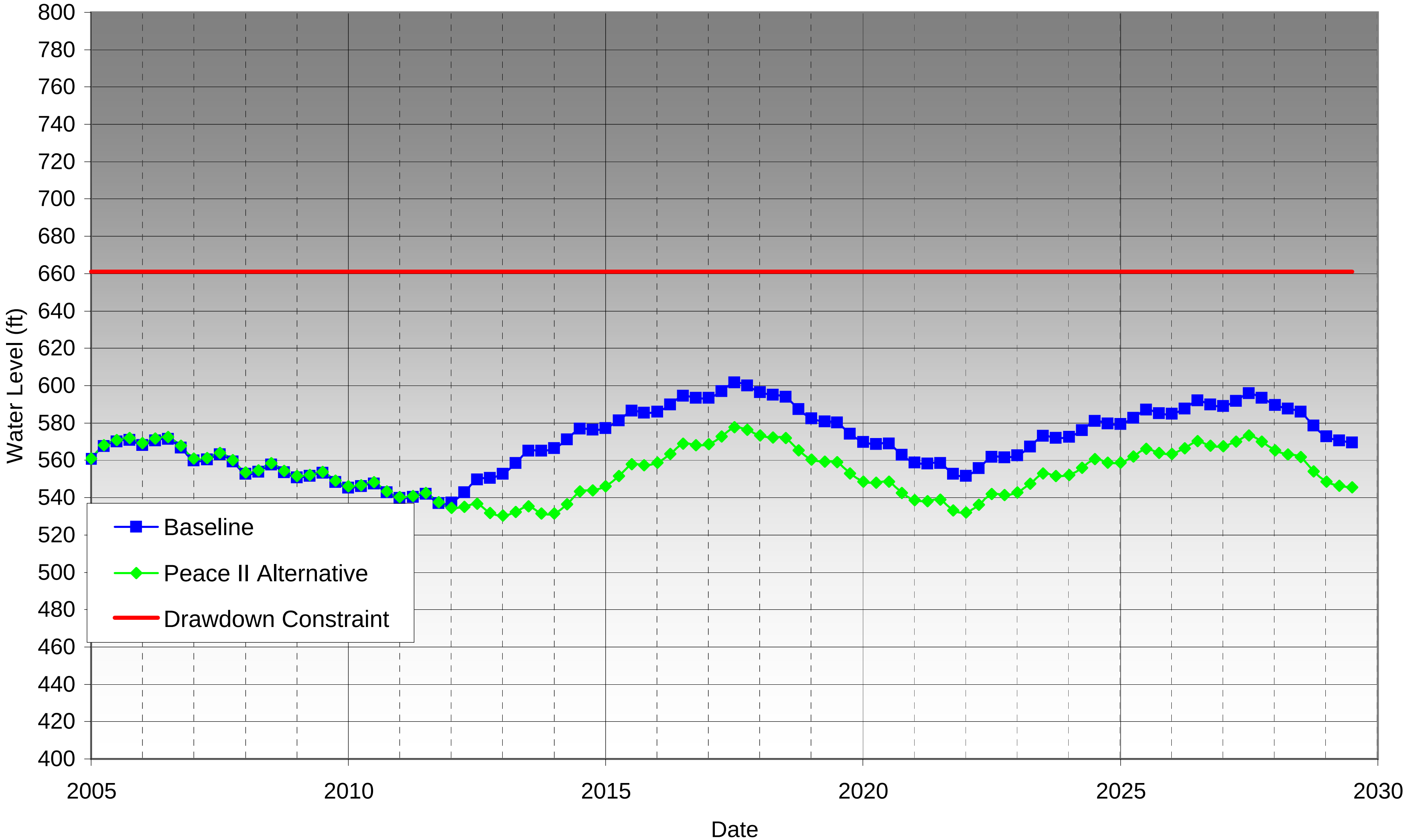


Figure B - 76
Projected Groundwater Water Elevations in Well ONT-52 for the Baseline and Peace II Alternatives, City of Ontario

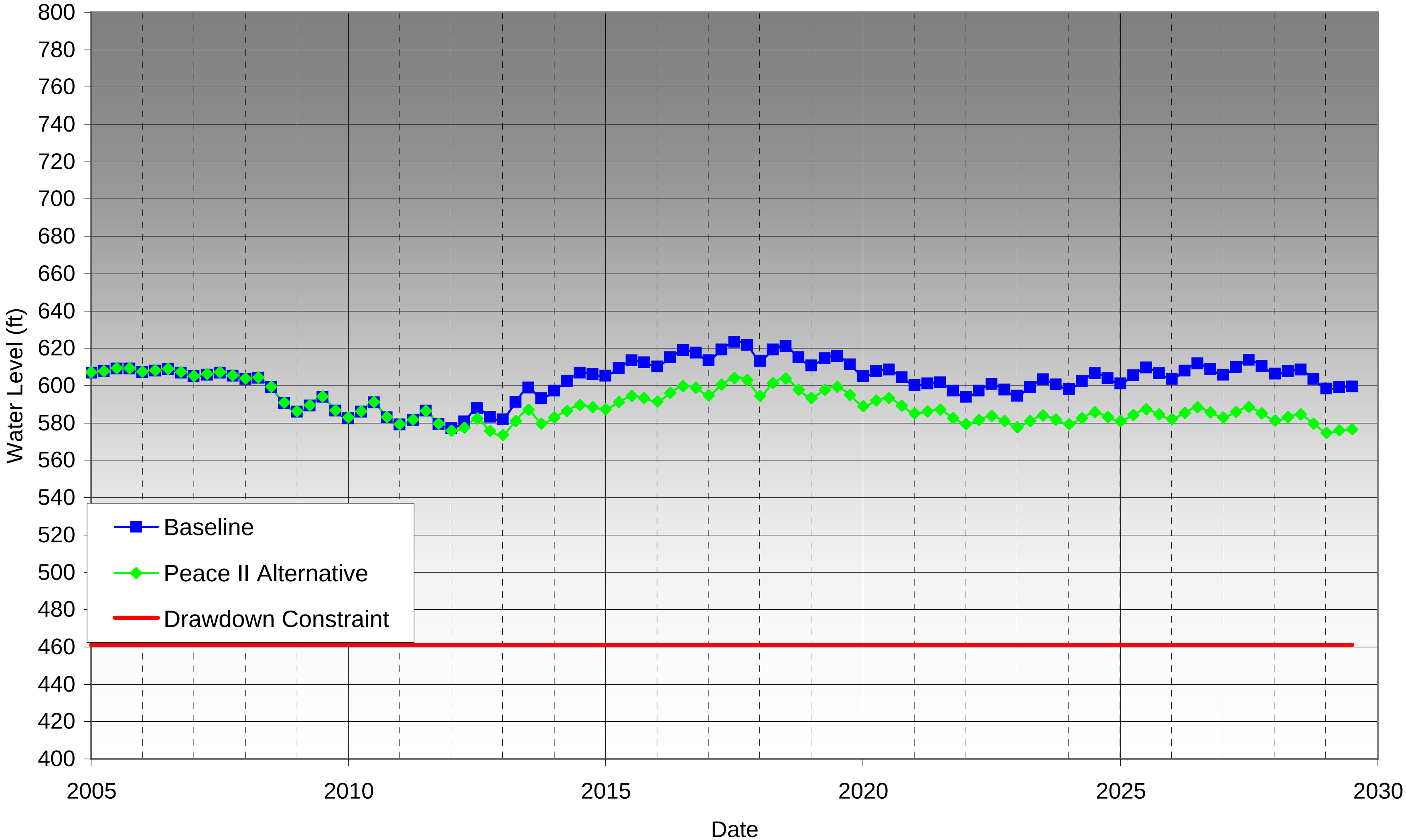


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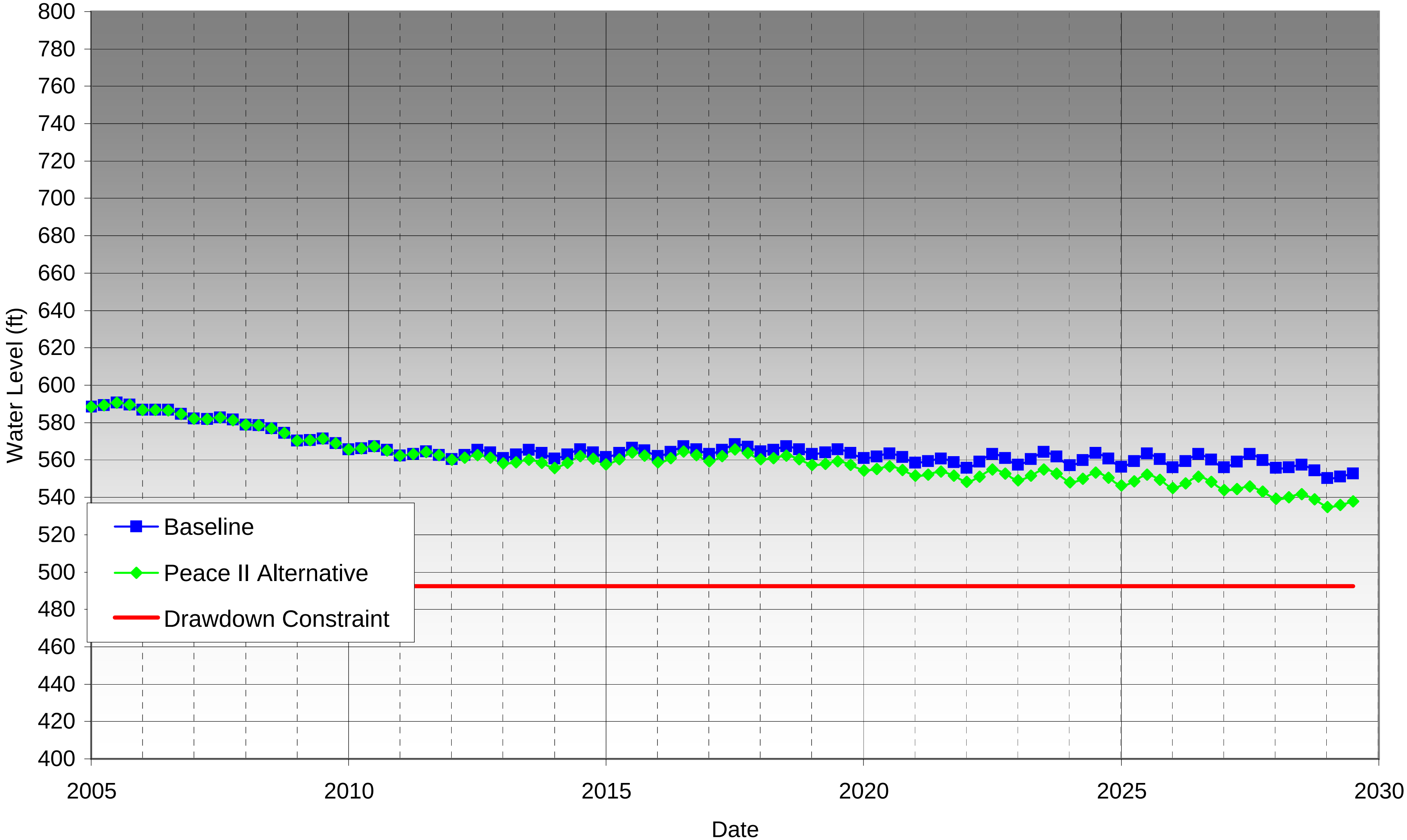
Figure B - 77
Projected Groundwater Water Elevations in Well ONT-50 for the Baseline and Peace II Alternatives, City of Ontario



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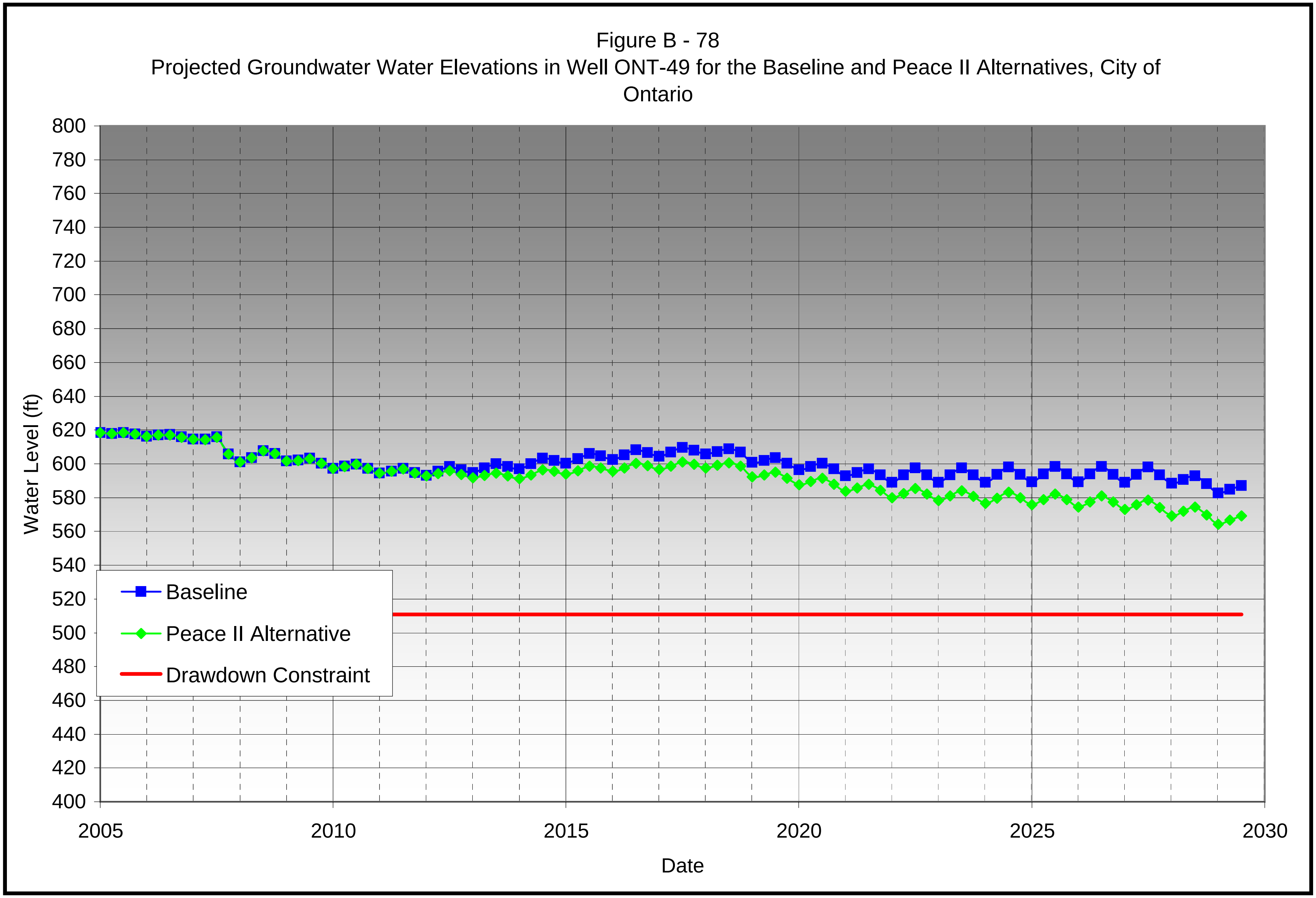

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Figure B - 79
Projected Groundwater Water Elevations in Well ONT-47 for the Baseline and Peace II Alternatives, City of Ontario

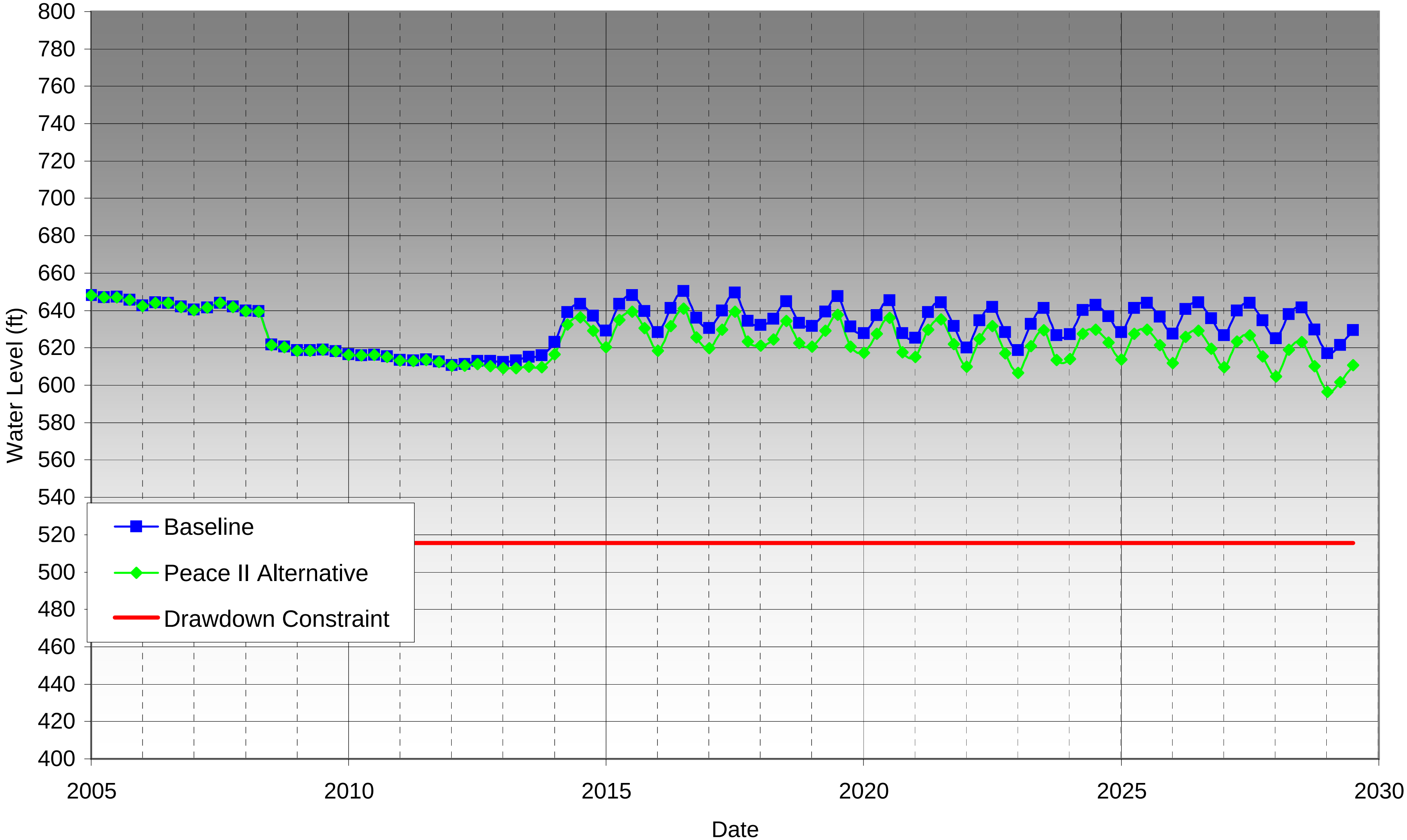


Figure B - 80
Projected Groundwater Water Elevations in Well ONT-46 for the Baseline and Peace II Alternatives, City of Ontario

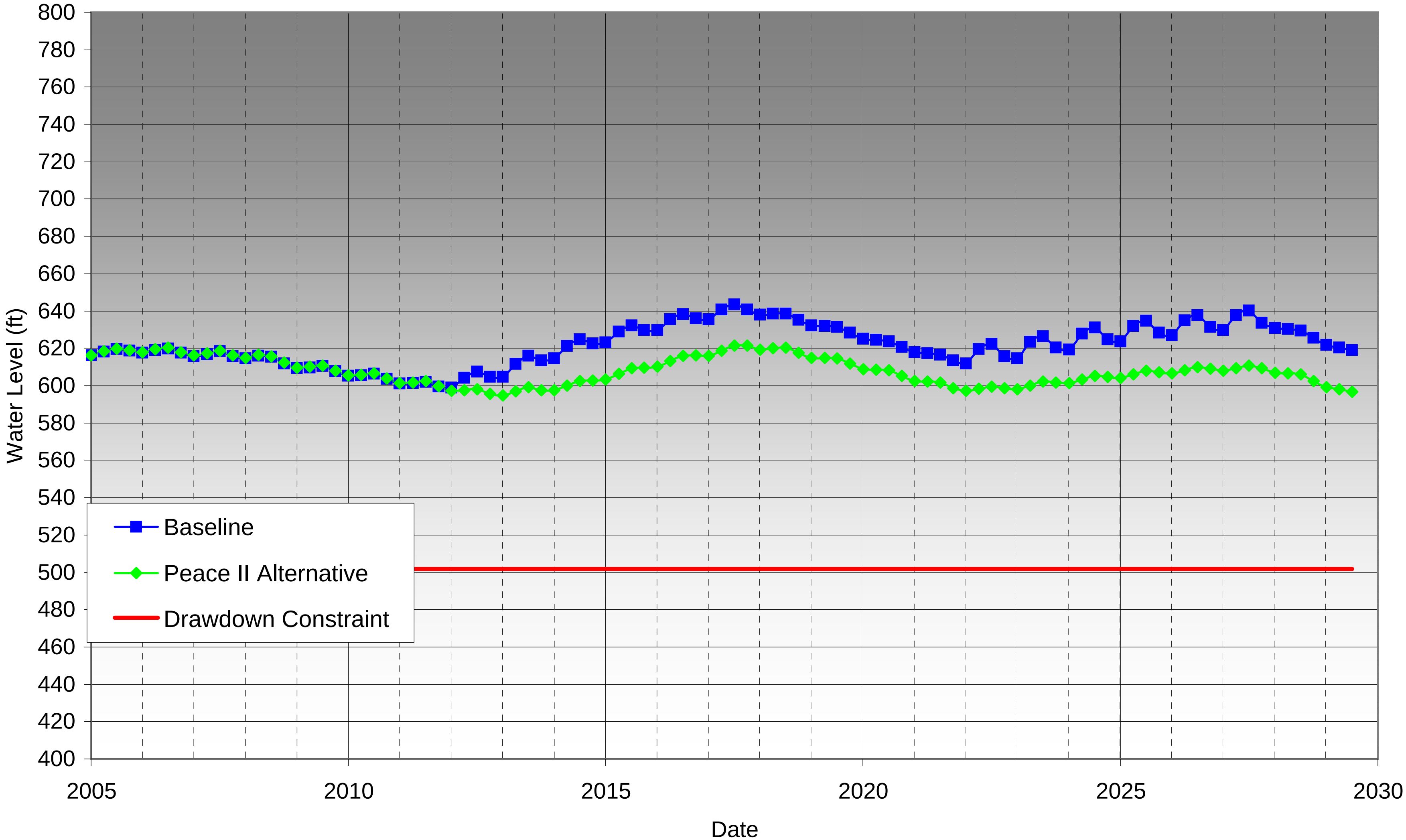
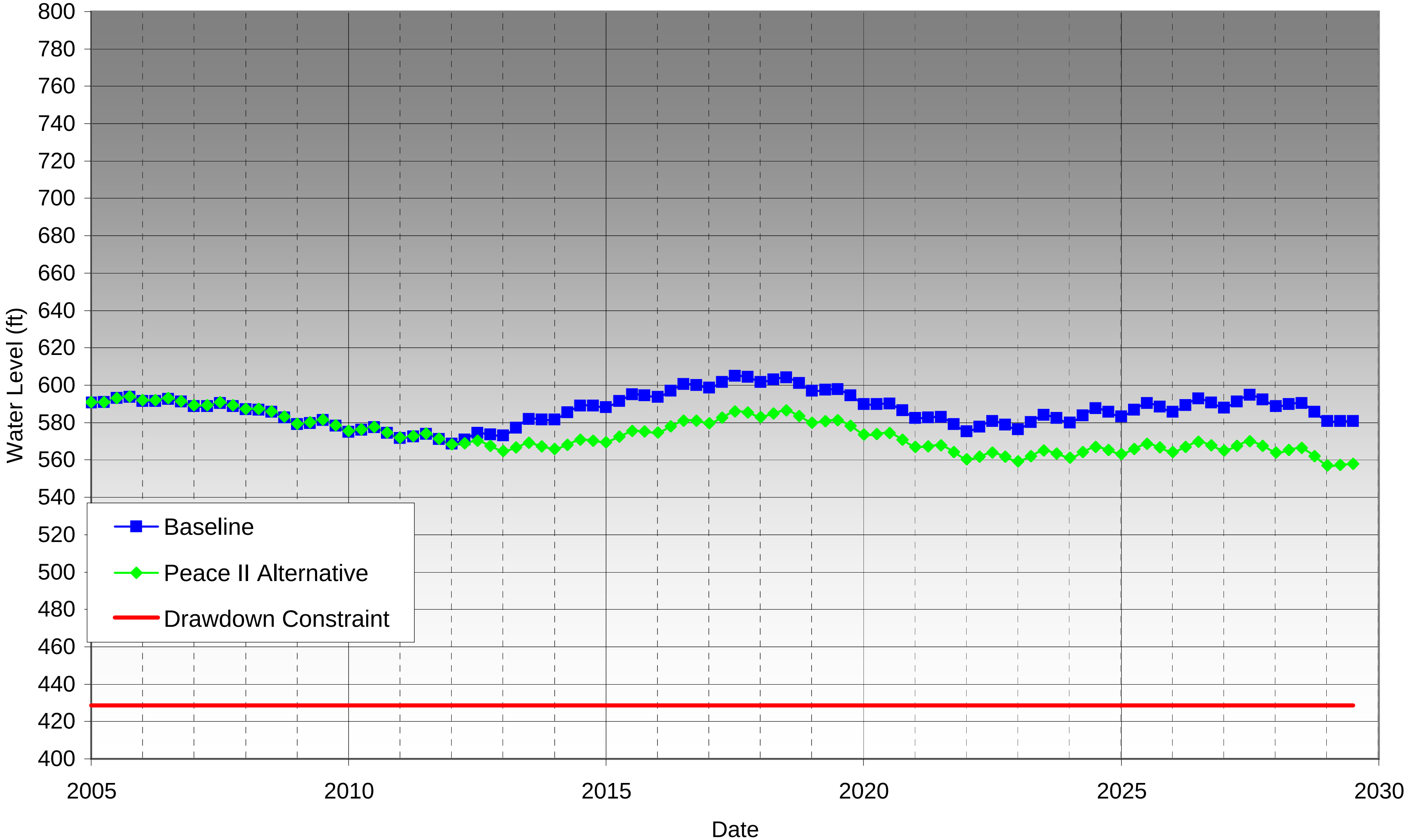


Figure B - 81
Projected Groundwater Water Elevations in Well ONT-45 for the Baseline and Peace II Alternatives, City of Ontario



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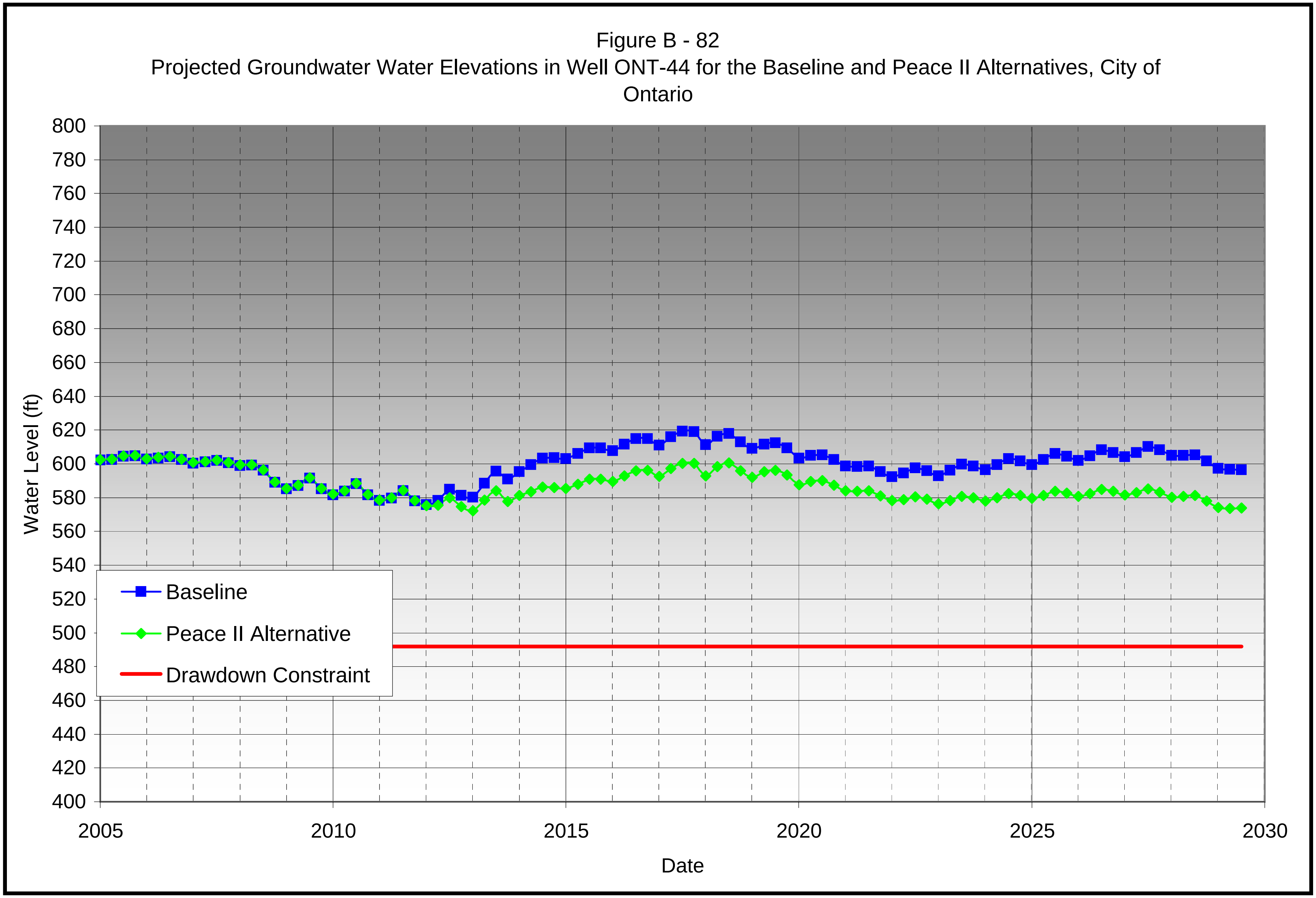

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Figure B - 83
Projected Groundwater Water Elevations in Well ONT-41 for the Baseline and Peace II Alternatives, City of Ontario

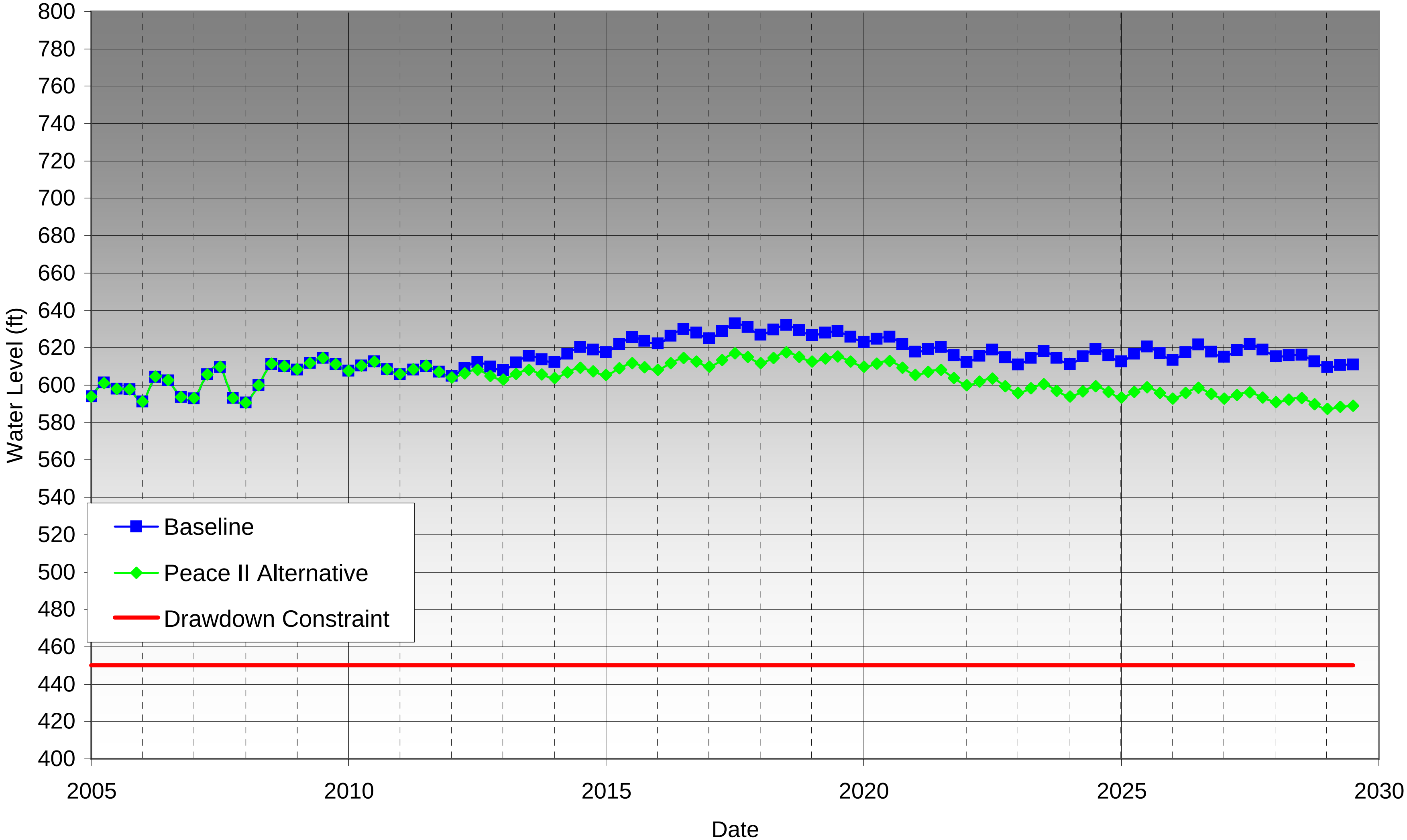

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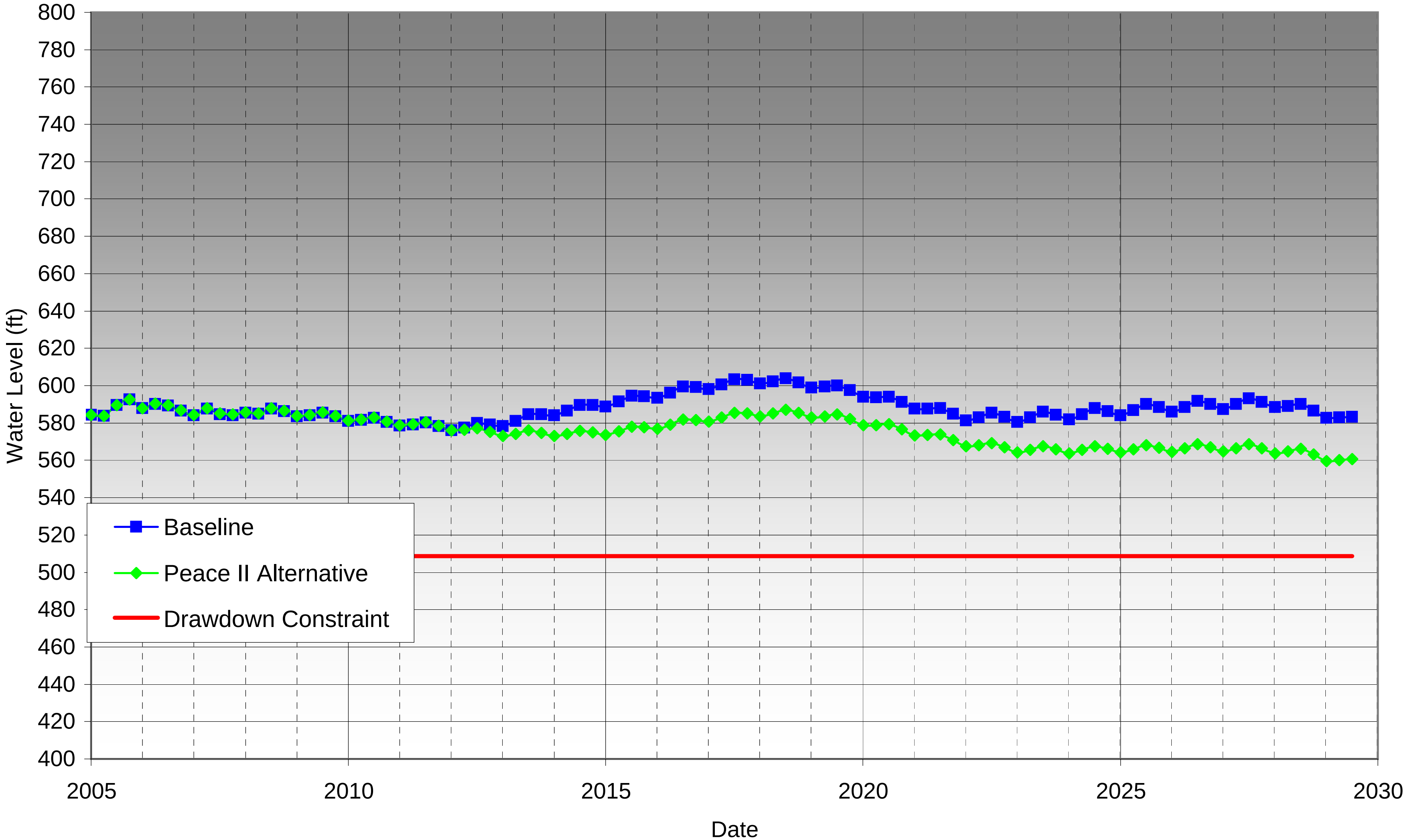
Figure B - 84
Projected Groundwater Water Elevations in Well ONT-40 for the Baseline and Peace II Alternatives, City of Ontario



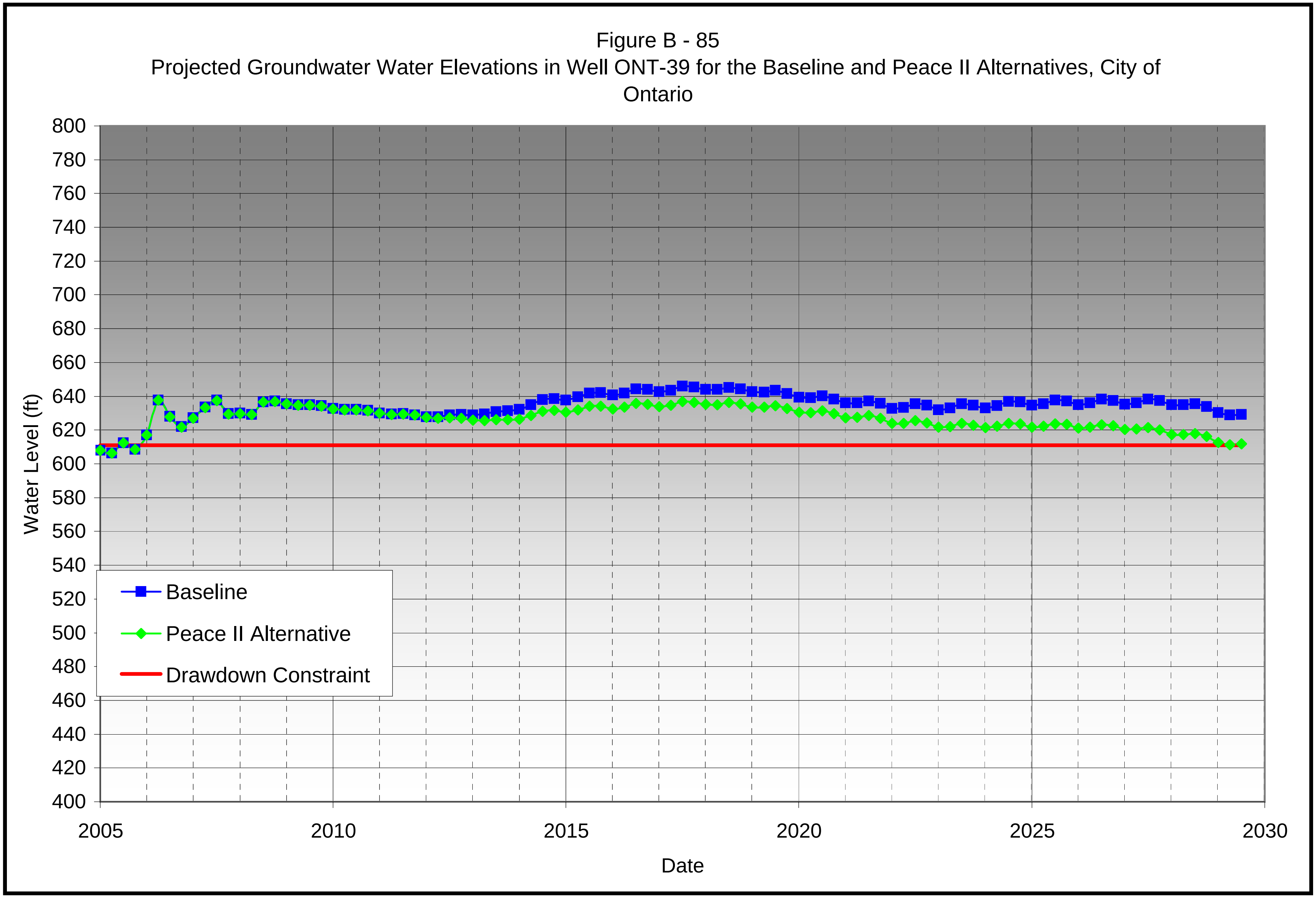


Figure B - 85
Projected Groundwater Water Elevations in Well ONT-39 for the Baseline and Peace II Alternatives, City of Ontario
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

Figure B - 86
Projected Groundwater Water Elevations in Well ONT-38 for the Baseline and Peace II Alternatives, City of Ontario

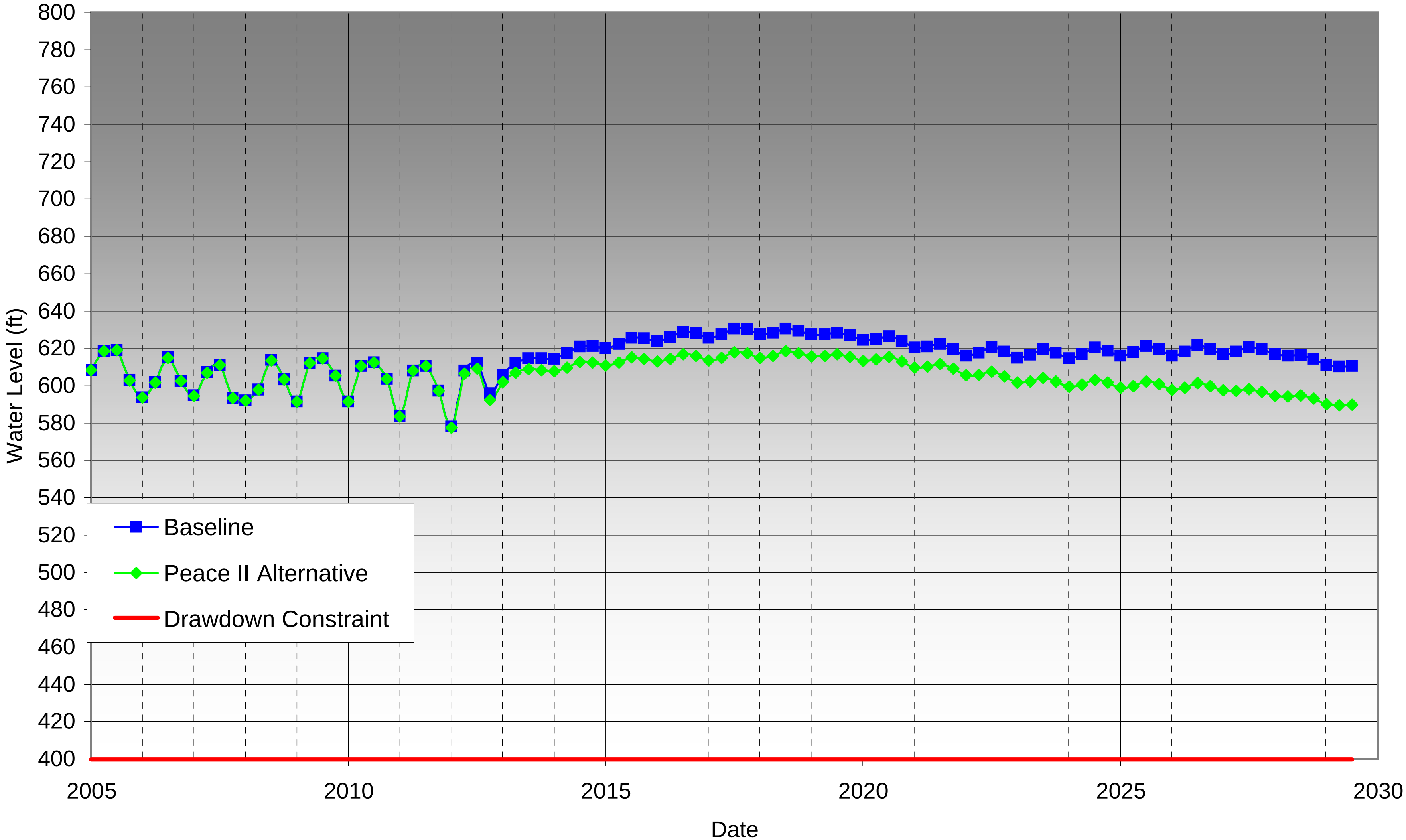


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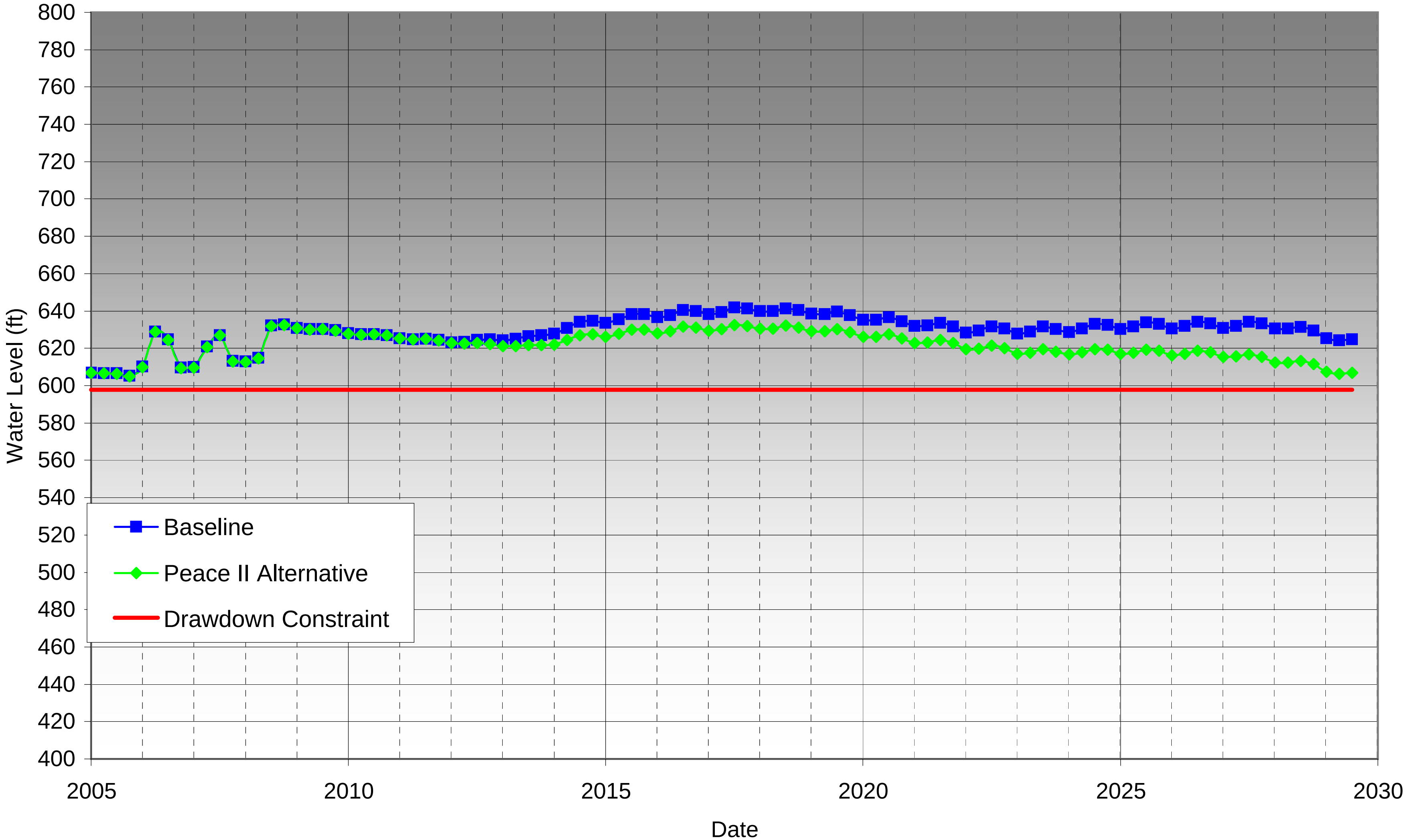
Figure B - 87
Projected Groundwater Water Elevations in Well ONT-37 for the Baseline and Peace II Alternatives, City of Ontario



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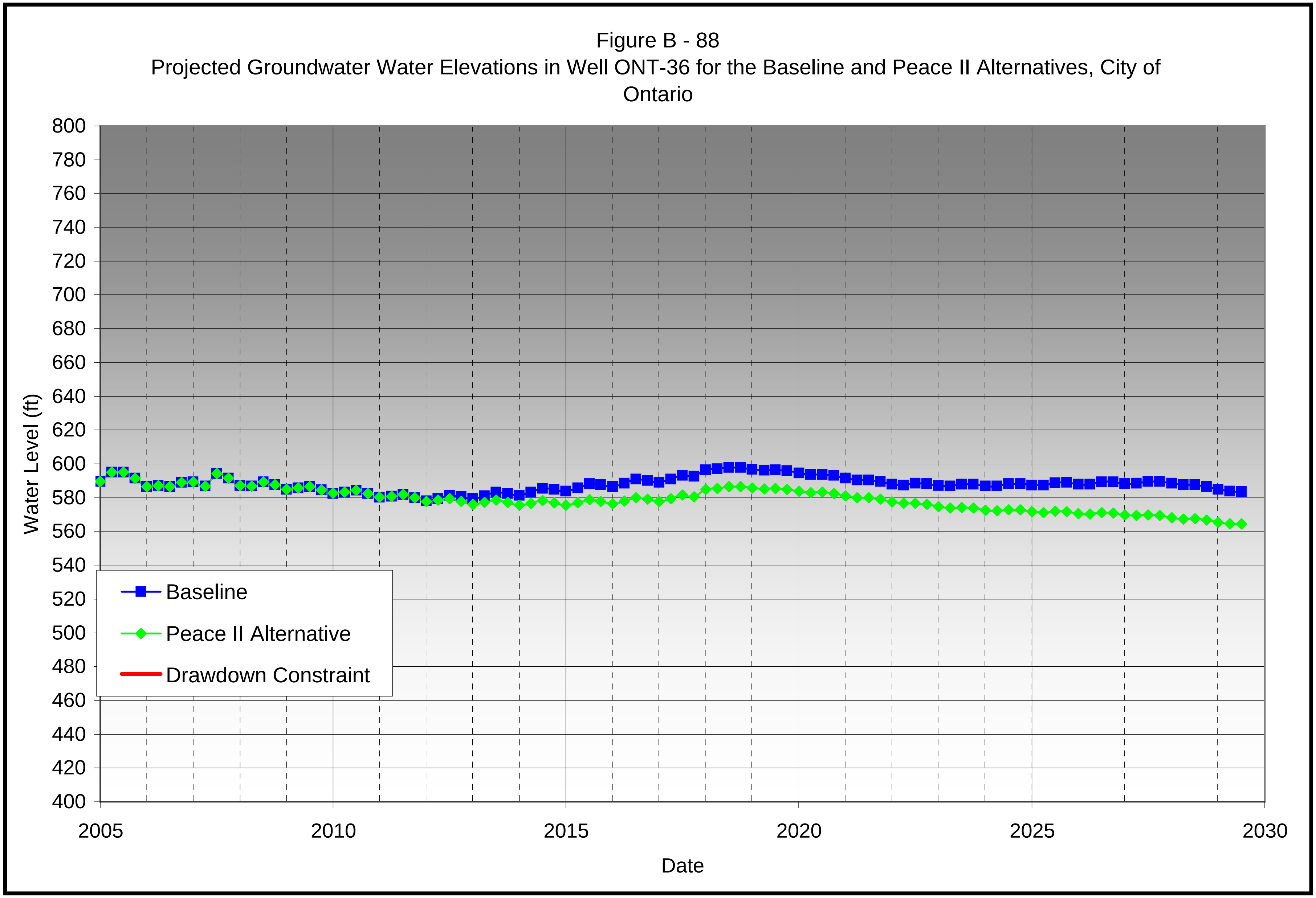


Figure B - 88
Projected Groundwater Water Elevations in Well ONT-36 for the Baseline and Peace II Alternatives, City of Ontario
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

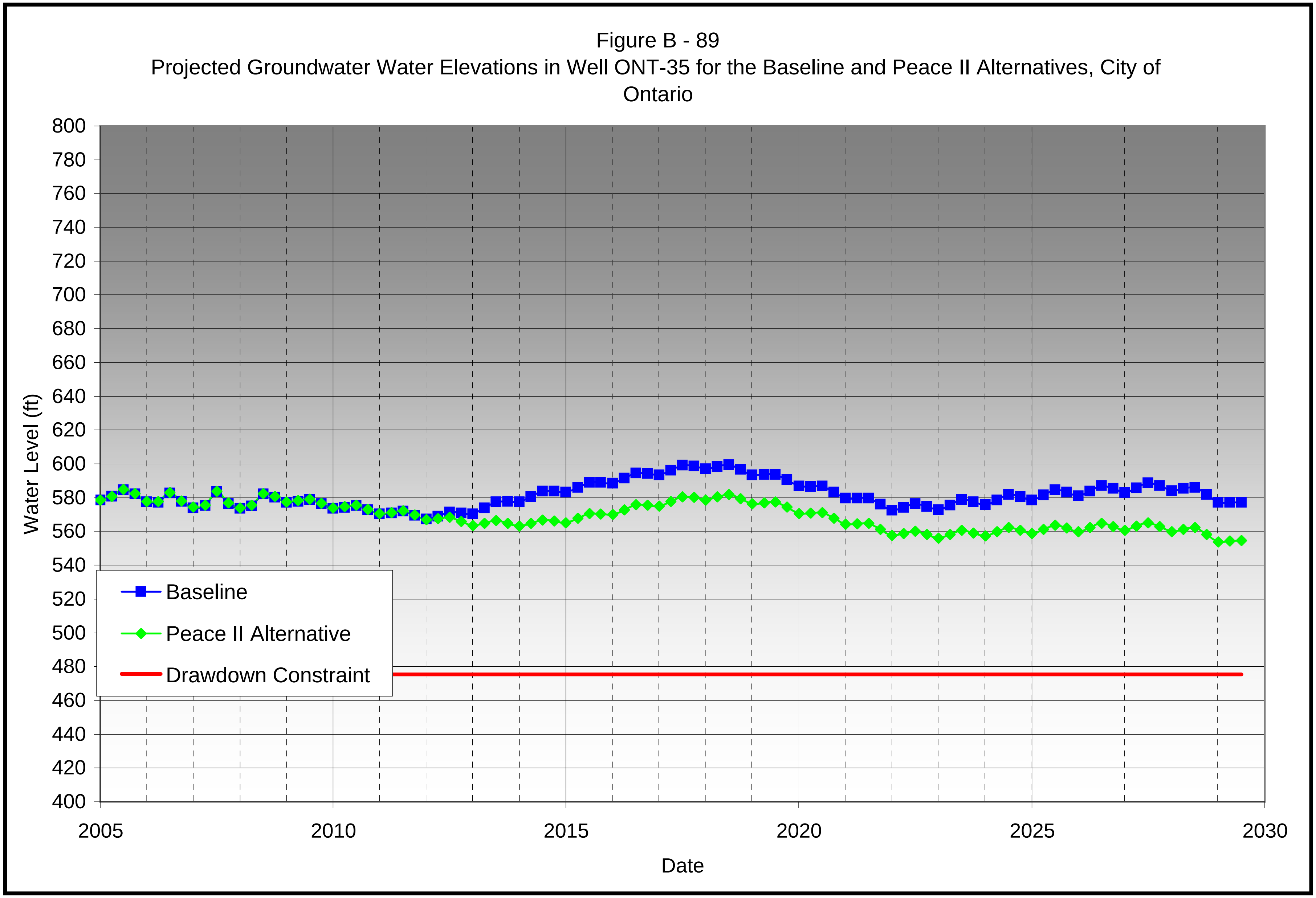


Figure B - 89
Projected Groundwater Water Elevations in Well ONT-35 for the Baseline and Peace II Alternatives, City of Ontario
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

Figure B - 90

Projected Groundwater Water Elevations in Well ONT-34 for the Baseline and Peace II Alternatives, City of Ontario

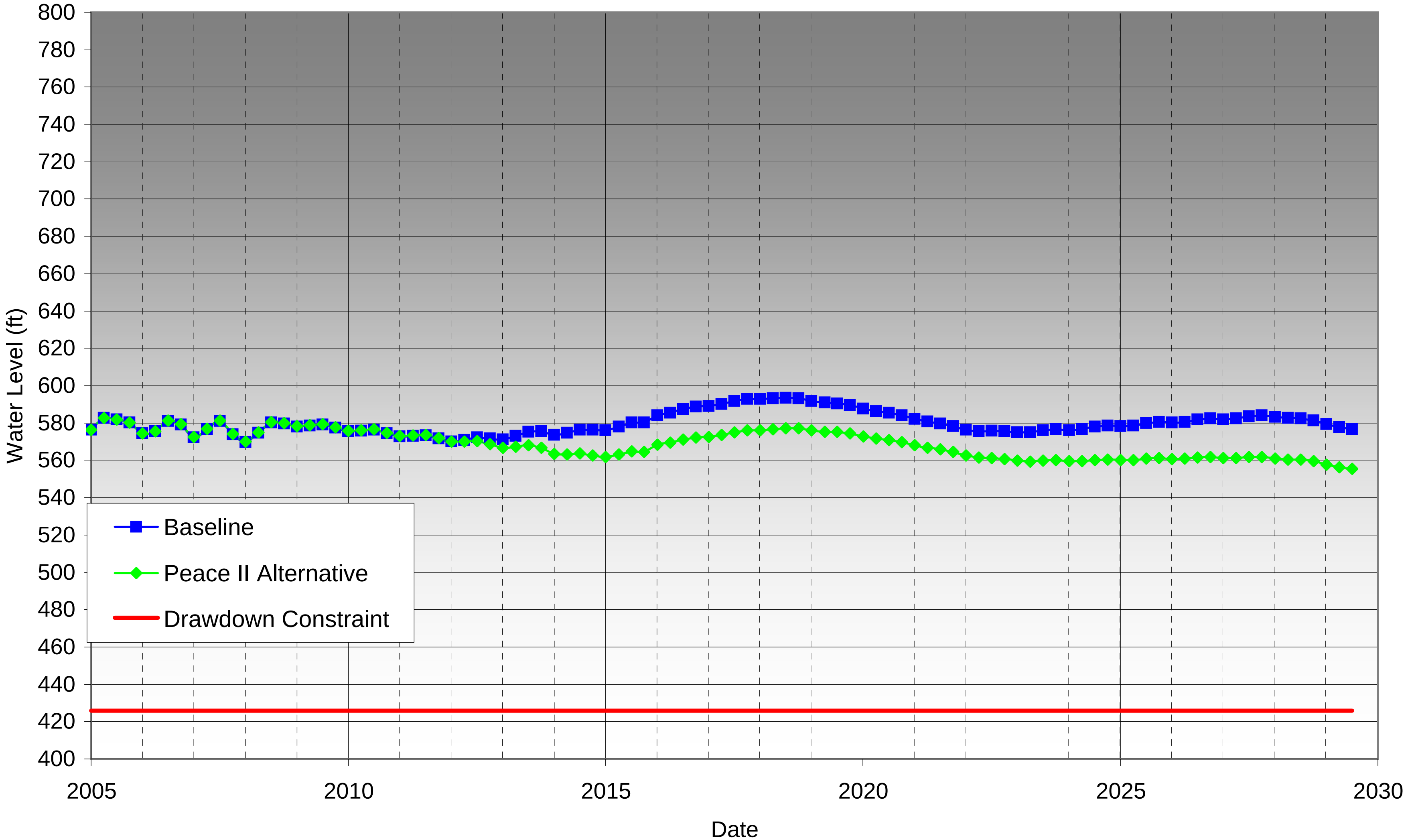
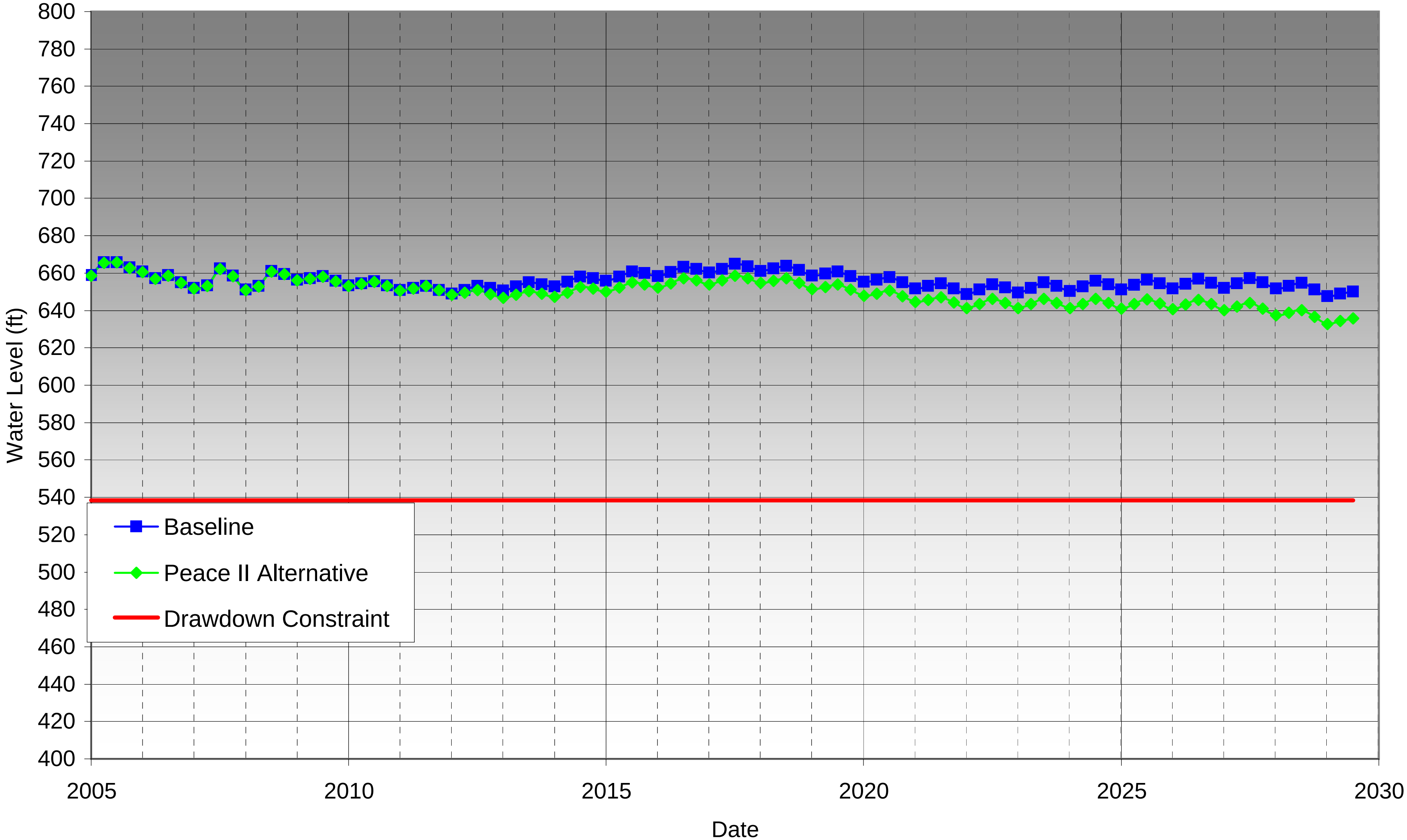


Figure B - 91
Projected Groundwater Water Elevations in Well ONT-31 for the Baseline and Peace II Alternatives, City of Ontario



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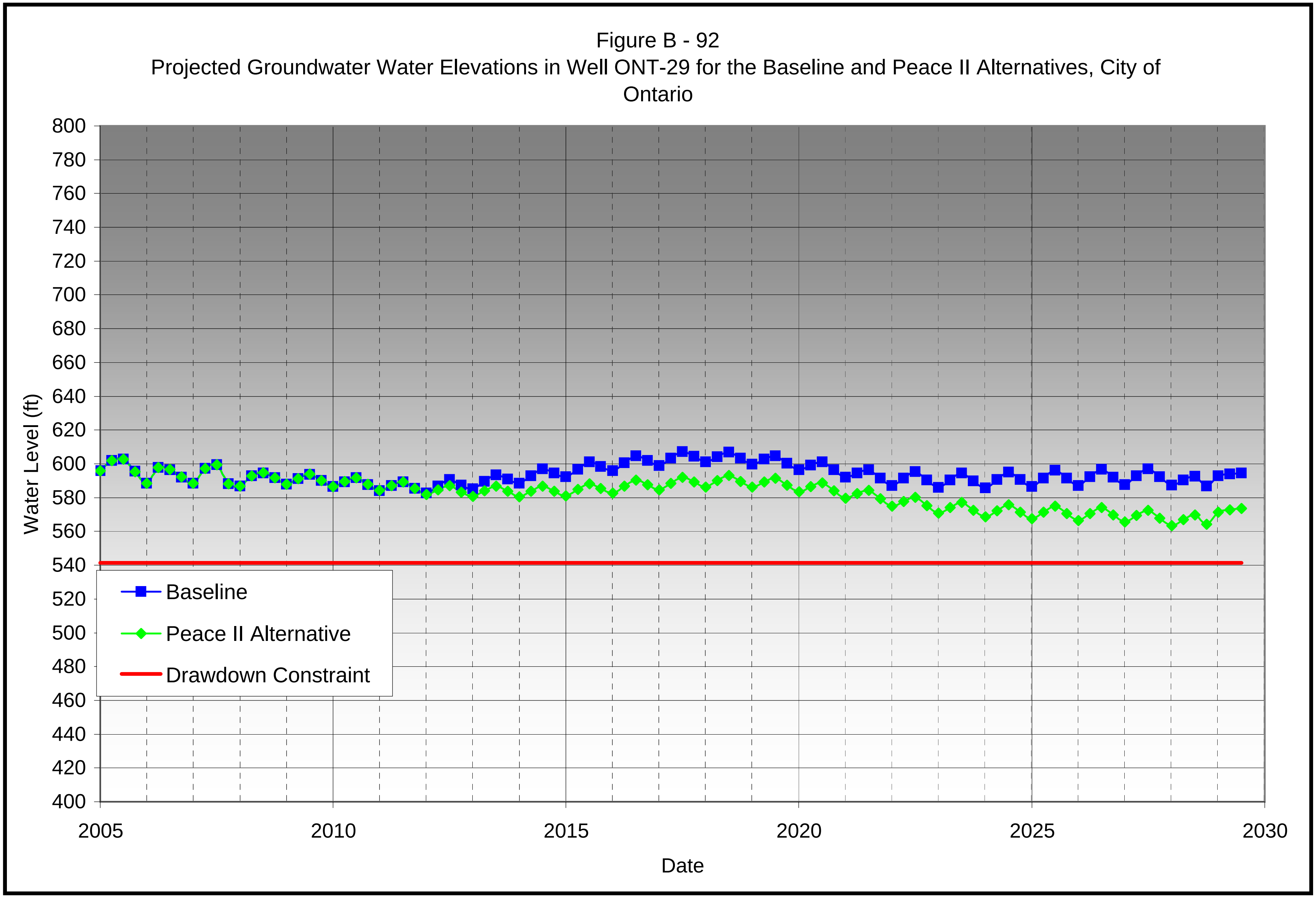

Figure B - 92
Projected Groundwater Water Elevations in Well ONT-29 for the Baseline and Peace II Alternatives, City of Ontario
Water Level (ft)
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
2005
2010
2015
2020
2025
2030
Date
Baseline
Peace II Alternative
Drawdown Constraint

Figure B - 93
Projected Groundwater Water Elevations in Well ONT-27 for the Baseline and Peace II Alternatives, City of Ontario

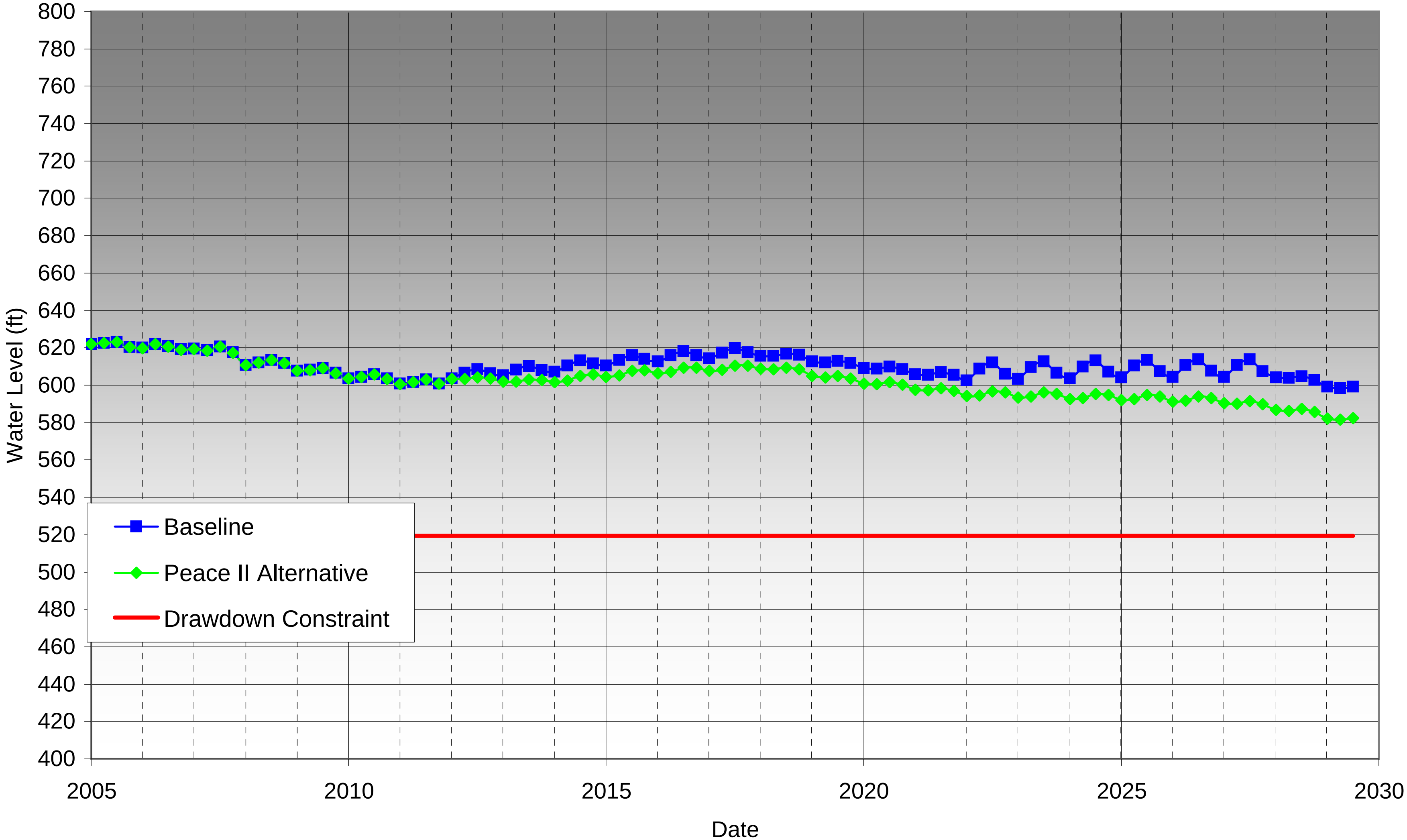

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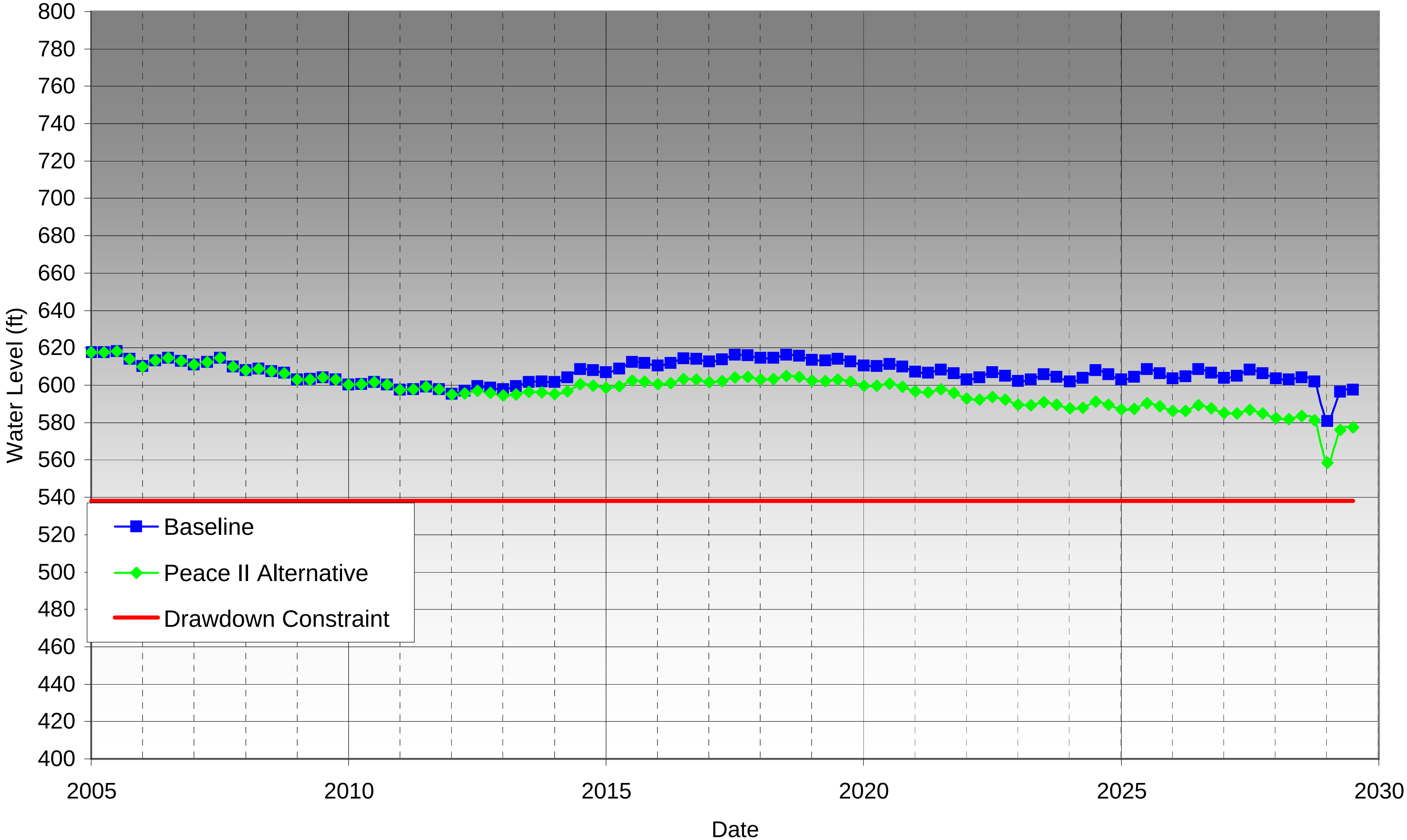
Figure B - 94
Projected Groundwater Water Elevations in Well ONT-26 for the Baseline and Peace II Alternatives, City of Ontario



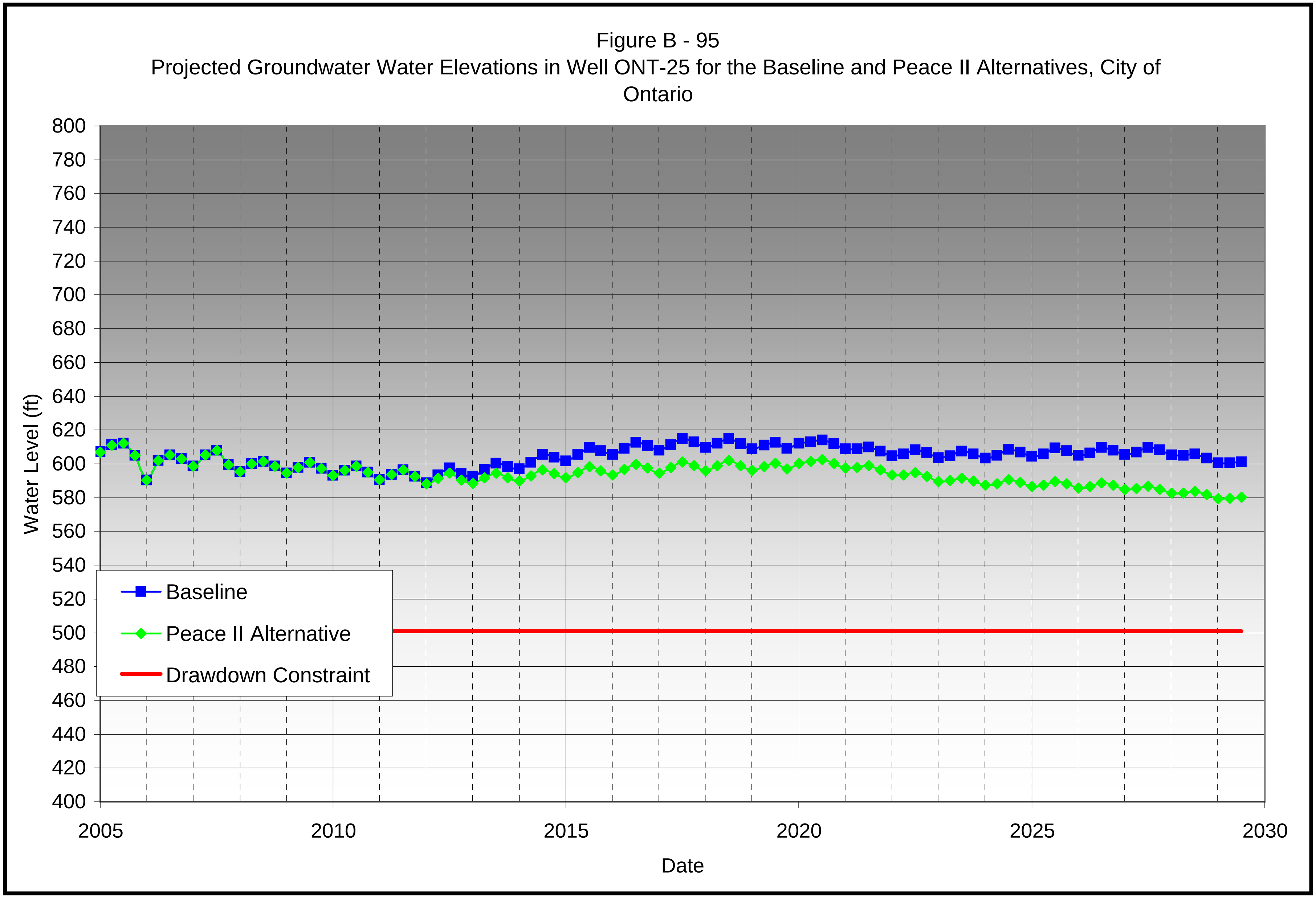


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Figure B - 96
Projected Groundwater Water Elevations in Well ONT-24 for the Baseline and Peace II Alternatives, City of Ontario

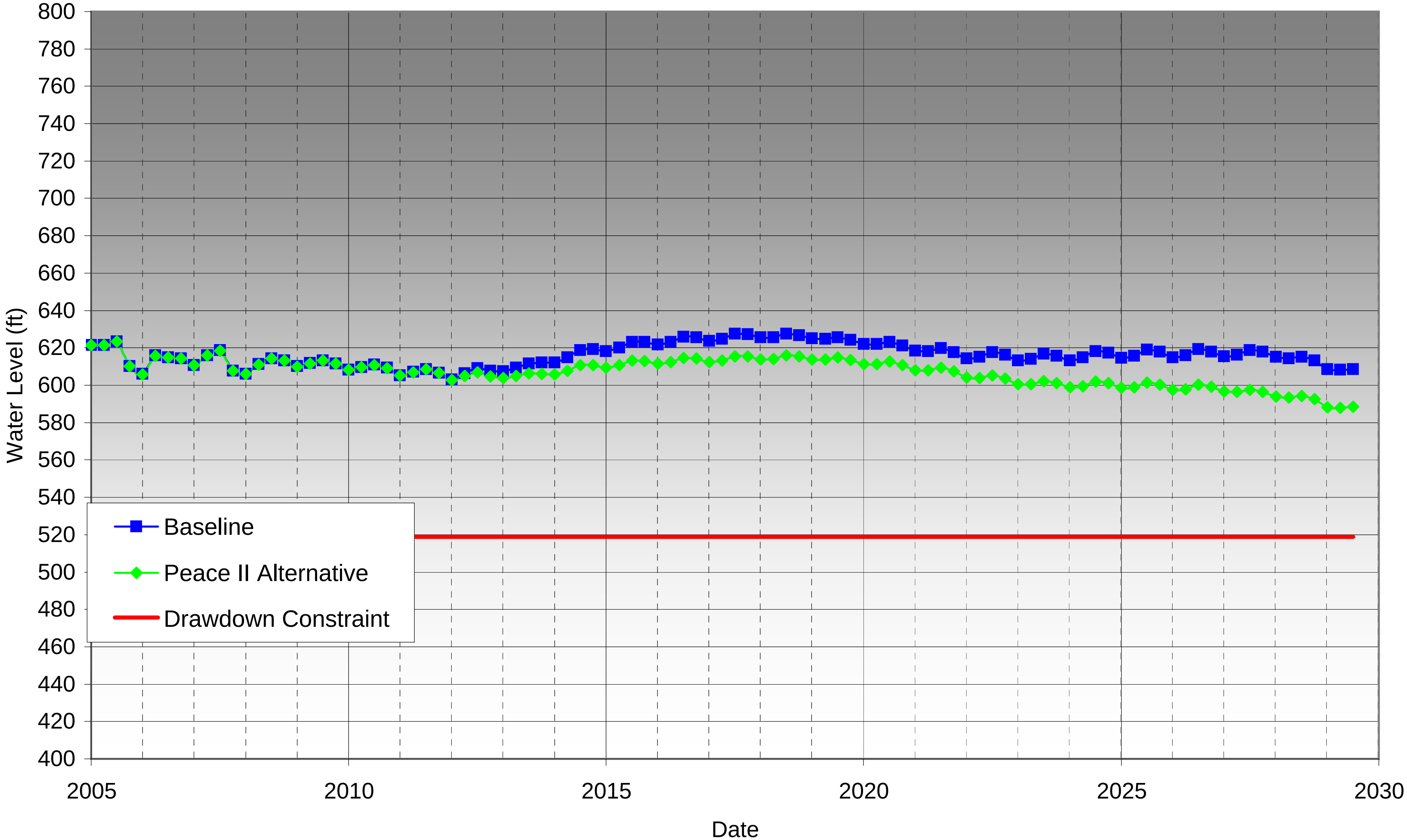
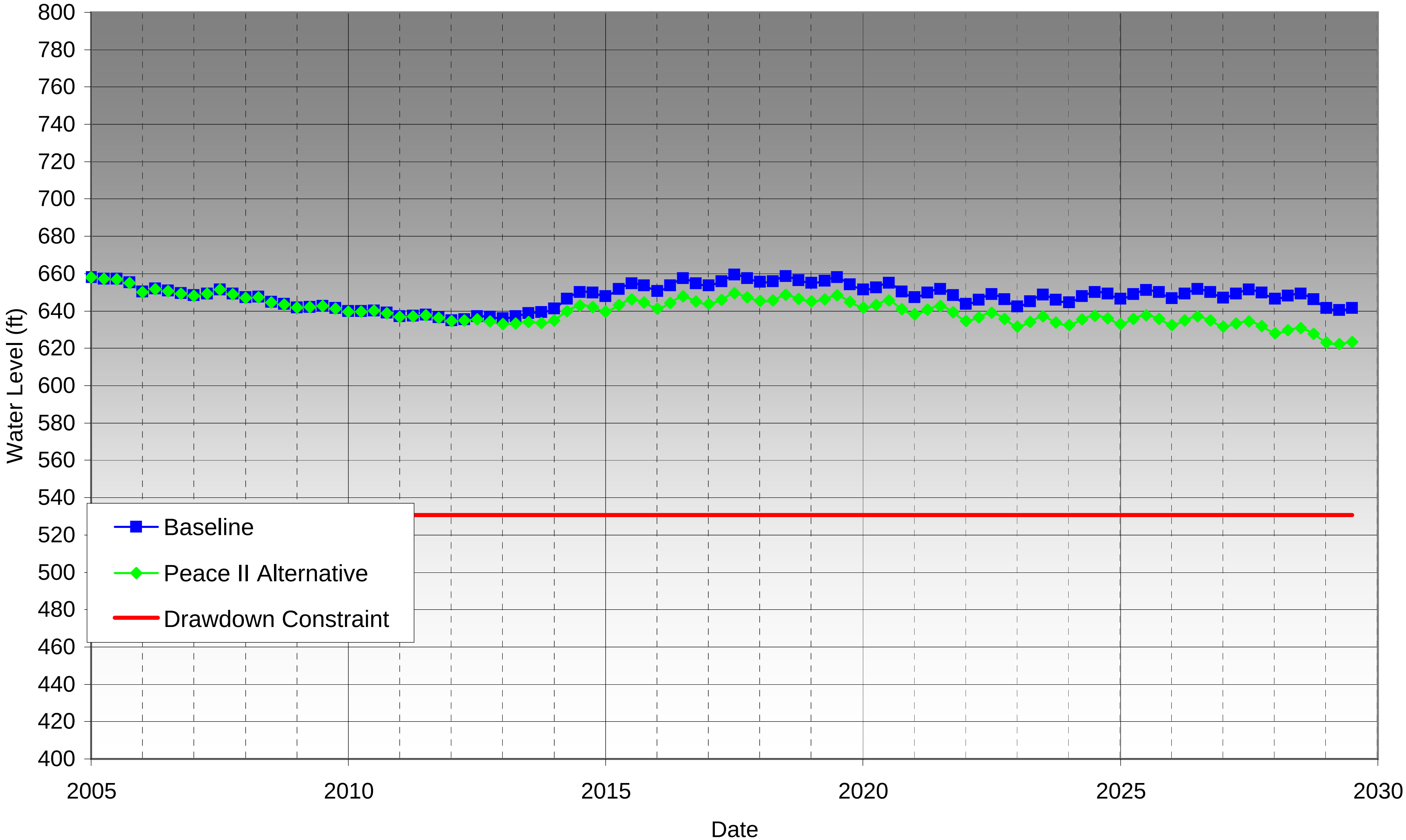


Figure B - 97
Projected Groundwater Water Elevations in Well ONT-20 for the Baseline and Peace II Alternatives, City of Ontario



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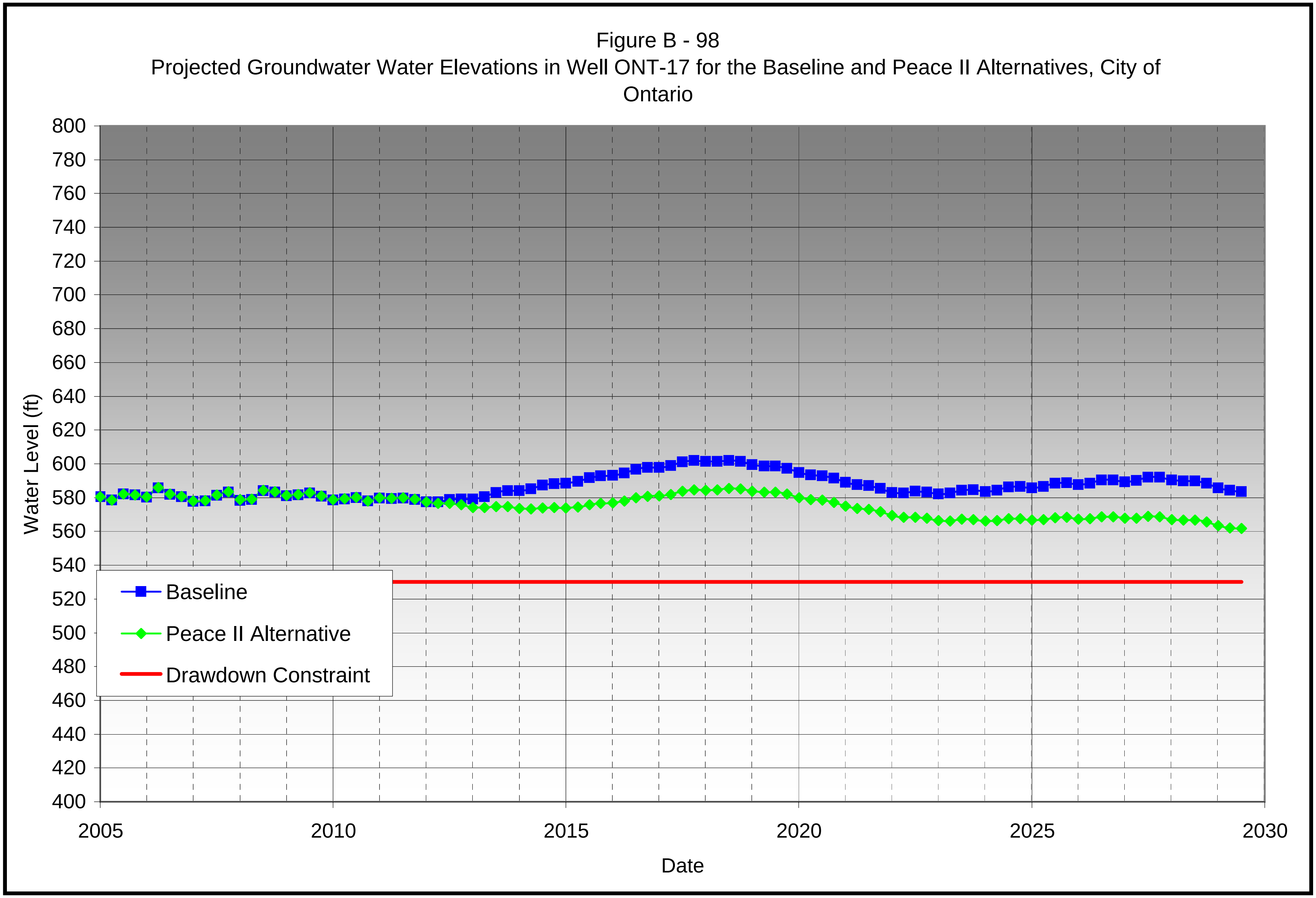

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APPENDIX 3

STATE OF THE BASIN REPORT

Chino Basin
Optimum Basin Management Program
2008 State of the Basin Report

Final Report

Prepared for

Chino Basin Watermaster

Prepared by

WILDERMUTH ENVIRONMENTAL INC.

NOVEMBER 2009

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Acronyms, Abbreviations, and Initialisms

μg/L	micrograms per liter
1,1,1-TCA	1,1,1-trichloroethane
1,1-DCE	1,1-dichloroethene
1,2,3-TCP	1,2,3-trichloropropane
1,2-DCA	1,2-dichloroethane
AF	acre-feet
AFY	acre-feet per year
B&V	Black & Veatch, Inc.
Basin Plan	Water Quality Control Plan for the Santa Ana River Basin
CAO	Cleanup and Abatement Order
CBWM ID	Chino Basin Watermaster Well Identification
CDA	Chino Desalter Authority
CDFM	cumulative departure from mean precipitation
CDPH	California Department of Public Health (formerly the Department of Health Services)
CIM	California Institution for Men
cis-1,2-DCE	cis-1,2-dichloroethene
COPC	Constituents of Potential Concern
CVWD	Cucamonga Valley Water District
DLR	detection limit for reporting
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EMP	Evaluation Monitoring Program
EPA	US Environmental Protection Agency
ft	feet
ft-bgs	feet below ground surface
ft-brp	feet below reference point (*e.g.* static surveyed measurement point)
GE	General Electric
GIS	Geographic Information System
GRCC	Groundwater Recharge Coordination Committee
HCMP	Hydraulic Control Monitoring Program
IEUA	Inland Empire Utilities Agency

Acronyms, Abbreviations, and Initialisms

InSAR	Synthetic Aperture Radar Interferometry
ISOB	Initial State of the Basin
JCSD	Jurupa Community Services District
M&RP	Monitoring and Reporting Program
MCL	maximum contaminant level
mg/L	milligrams per liter
MSL	Milliken Sanitary Landfill
MVSL	Mid-Valley Sanitary Landfill
MVWD	Monte Vista Water District
MWDSC	Metropolitan Water District of Southern California
MZ	Management Zone
NDMA	N-nitrosodimethylamine
NO_3 - N	Nitrate expressed as nitrogen
NPL	National Priorities List
OBMP	Optimum Basin Management Program
OIA	Ontario International Airport
PBMZ	Prado Basin Management Zone
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
ROD	Records of Decision
RP	Regional Plant
RWQCB	Regional Water Quality Control Board
SARWC	Santa Ana River Water Company
SOB	State of the Basin
SWP	State Water Project
SWQIS	State Water Quality Information System
TCE	trichloroethene
TDS	total dissolved solids
TOC	total organic carbon
US EPA	US Environmental Protection Agency
USGS	US Geological Survey
USL	Upland Sanitary Landfill

Acronyms, Abbreviations, and Initialisms

VOC	volatile organic chemical
Watermaster	Chino Basin Watermaster
WEI	Wildermuth Environmental, Inc.
WQS	water quality standard

ES-1 Summary and Background

The baseline for the ISOB was on or about July 1, 2000—the point in time that represents the start of Optimum Basin Management Program (OBMP) implementation. The State of the Basin (SOB) reports serve as a metric for measuring OBMP implementation progress. This current SOB report contains water level, water quality, ground-level, and other data through 2007/08 and describes Watermaster activity through fall 2008.

The intent of this report is twofold:

- During Watermaster fiscal year 2000/01, several OBMP-spawned investigations and initiatives commenced, encompassing groundwater level and quality, ground level, annual recharge assessment, recharge master planning, hydraulic control, desalter planning and engineering, and meter installation. This report describes the progress made in these activities through the fall of 2008.
- This report also describes the general state of the basin with respect to groundwater levels, groundwater quality, subsidence, recharge, and hydraulic control.

ES-2 Section 2 – General Hydrologic Condition

The Chino Basin covers about 220 square miles. Figure 2-1 shows the location of the Chino Basin within the context of the Santa Ana River watershed. The watershed of the Chino Basin is almost identical to the Santa Ana River at Prado, the exception being the addition of the Temescal Creek watershed that enters the Prado Dam reservoir just upstream of the dam and for practical purposes contributes negligible inflow to the Chino Basin. In total, the watershed area for streams crossing the Chino Basin is about 1490 square miles.

The Chino Basin has a semi-arid Mediterranean climate. Precipitation is a major source of local groundwater recharge for the Basin and thus, the availability of this recharge can be understood by analyzing long-term precipitation records.

The hydrologic regime in the Chino Basin has important implications for water supply and groundwater management. The occurrence of long dry periods, characteristic of the region's climate, limit the recharge of precipitation and storm water recharge for years at a time and requires management strategies that conserve precipitation and storm water recharge whenever available. The amount of stormwater produced per unit of precipitation has increased over time due to urbanization and will continue to increase in the future as the remaining undeveloped and agricultural land uses are converted to developed uses.

ES-3 Section 3 – Basin Operations and Groundwater Monitoring

Future re-determinations of safe yield for the Chino Basin will be based largely on accurate estimations of groundwater production, artificial recharge, and basin storage changes over time. Watermaster is actively improving its programs to track production, recharge, and groundwater levels (storage). A meter installation program has improved production estimates in the agricultural areas. Watermaster continues to implement comprehensive, high-frequency, groundwater-level monitoring programs across the basin to support various OBMP-related activities. Since 2003, Watermaster has been installing pressure transducers/data loggers in many of the wells it monitors for water levels to improve data quality. In addition, nine (9) nested sets of monitoring wells have been installed in the southern Chino Basin for the HCMP and provide highly detailed, depth-specific piezometric (and water quality) data. It is likely that additional monitoring wells will need to be constructed in southern Chino Basin as private wells (that are currently being used for monitoring by Watermaster) are destroyed as agricultural land uses convert to urban.

The following are the general trends in groundwater production:

- There was a basin-wide increase in the number of wells producing over 1,000 AFY between 1978 and 2008. 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 just north of the Santa Ana River has decreased. This is consistent with the conversion of land use from agricultural to urban that has been occurring in the area.
- Since the implementation of the OBMP in 2000, desalter pumping has commenced and has progressively increased; in 2007/08, desalter pumping reached a historical high of 26,972 AF.
- Since the implementation of the OBMP in 2000, the number of wells that produce over 1,000 AFY on the west side of Chino Basin (west of Euclid Avenue) has decreased. This is consistent with (1) the implementation of the MZ1 Interim Management Plan, which reduced pumping by up to 3,000 AFY in the Chino area, and (2) the reduced pumping by the City of Pomona, the Monte Vista Water District, and the City of Chino Hills from 2003 to 2008 as these agencies have been participating in in-lieu recharge for the Dry Year Yield program.
- Agricultural Pool pumping continues to decline. In 2007/08, total production for the Agricultural Pool fell to 30,910 AF, the lowest production on record for the pool. 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.

As required by the Peace Agreement and summarized in the OBMP Recharge Master Plan, Watermaster initiated the Chino Basin Groundwater Recharge Program. This is a comprehensive program to enhance water supply reliability and improve the groundwater quality of local drinking water wells throughout the Chino Basin by increasing the recharge of storm water, imported water, and recycled water.

There are 21 Chino Basin recharge facilities described in the OBMP Recharge Master Plan, Phase II Report (WEI, 2001).

The following are the general trends in groundwater recharge:

- Since 2000, total storm water recharge has averaged approximately 4,600 AFY. During 2006/07 and 2007/08, total storm water recharge in the Chino Basin was approximately 4,600 and 9,900 AF, respectively.

- Since 2000, the total supplemental water recharge—consisting of imported and recycled waters—has averaged approximately 11,500 AFY. During 2006/07 and 2007/08, total supplemental water recharge in the Chino Basin was approximately 6,350 and 2,400 AF, respectively.

The Chino Basin groundwater level analysis for fall 2008 revealed notable pumping depressions in the groundwater level surface that interrupt the general flow pattern surrounding the Chino I & Chino II Desalter well fields. There are also discernible groundwater level depressions in the northern portion of MZ1 (Montclair and Pomona areas) and directly southwest of the Jurupa Hills due to local groundwater production.

Watermaster has developed a Geographic Information System model to estimate groundwater storage changes from groundwater level contour maps. This model was utilized to estimate storage changes during the period following OBMP implementation. During the 2006 to 08 period, storage changed by about -54,000 AF. The total change in storage since implementation of the OBMP (2000-08) is approximately -62,000 AF.

With regard to hydraulic control, since 2000, pumping at the Chino I Desalter well field has generally flattened the regional hydraulic gradient within the shallow aquifer system around the western half of the Chino I Desalter well field and has created a capture zone surrounding the eastern half of the well field. Piezometric data suggest a significant reduction in the southward component of the hydraulic gradient around the western half of the Chino I Desalter well field but do not indicate a gradient reversal (northward component) and, hence, do not yet provide compelling evidence for complete hydraulic control at the Chino I Desalter well field. The ultimate fate of groundwater that flows past the Chino I Desalter well field is continued flow southward toward Prado Basin where groundwater rises to become surface water in the tributaries of Prado Basin.

ES-4 Section 4 – Groundwater Quality

Watermaster continues to monitor water quality in the basin and stores these data in a relational database, which also includes all of the historical data that Watermaster has been able to acquire for wells in the region. Watermaster has instituted a cooperative process whereby water quality data are acquired on a routine basis from the appropriators. This alleviates some of the data quality control issues with downloading data from the state water quality database.

Groundwater quality in Chino Basin is generally very good with better groundwater quality found in the northern portion of Chino Basin where recharge occurs. Salinity (TDS) and nitrate-nitrogen concentrations increase in the southern portion of Chino Basin. Between July 2003 and June 2008, 32 percent of the wells south of Highway 60 had TDS concentrations below the secondary MCL, an improvement from the 20 percent reported in the 2006 State of the Basin Report (period of July 2001 through June 2006). In some places, wells with low TDS concentrations are proximate to wells with higher TDS concentrations, suggesting a vertical stratification of water quality. Between July 2003 and June 2008, about 69 percent of the wells sampled south of Highway 60 had nitrate-nitrogen concentrations greater than the MCL, an improvement from the 80 percent reported in the 2006 State of the Basin Report (period of July 2001 through June 2006). However, please note that these statistical improvements may be an artifact of sampling occurrence and frequency.

Other constituents that impact groundwater quality from a regulatory or Basin Plan standpoint include certain VOCs, arsenic, and perchlorate. As discussed in Section 4.3.4, there are a number of point source releases of VOCs in the Chino Basin that are in various stages of investigation or cleanup. There are also known point source releases of perchlorate (Milliken Valley Sanitary Landfill, Stringfellow, etc.), and non-point source related perchlorate contamination appears to have resulted from natural and anthropogenic sources. Arsenic at levels above the WQS appears to be limited to the deeper aquifer zone near the City of Chino Hills. Hexavalent chromium, while not currently a groundwater quality issue in the Chino Basin, may become so, depending on the promulgation of future standards.

The Initial State of the Basin and subsequent State of the Basin Reports discussed the need for future long-term monitoring. Due to commercial and residential development in the Chino Basin area; many of the private agricultural wells south of State Route 60 that have been used for monitoring activities are being destroyed as land is developed. In response to the loss of historically utilized wells, Watermaster developed a water quality key well program. This program designates a series of wells across a wide areal distribution for long-term monitoring activities. This key well monitoring program provides a good representation of the areal groundwater quality in this portion of the basin. Watermaster's program relies on municipal producers, government agencies, and private consultants to supply their groundwater quality data on a cooperative basis. Watermaster supplements these data with data obtained through its own sampling and analysis program of private wells in the area generally south of State Route 60. As with past water quality monitoring, the results will be added to the Watermaster database.

Point sources of concern are critical to the overall quality of Chino Basin groundwater. To ensure that Chino Basin groundwater remains a sustainable resource, it is of the utmost importance that Watermaster closely monitor point sources and emerging contaminates. It is recommended that Watermaster continue to work closely with the RWQCB and potentially responsible parties within the Chino Basin. This will allow for up-to-date understanding of groundwater quality, investigations, remediation activities, and potential mutually beneficial remedial options through Chino Basin desalting facilities.

ES-5 Section 5 – Ground-Level Monitoring

Implementation of the MZ1 Plan began in 2008. The MZ1 Plan calls for (1) the continued scope and frequency of monitoring implemented during the IMP within the MZ1 Managed Area and (2) expanded monitoring of the aquifer system and land subsidence in other areas of the Chino Basin where the Interim Management Plan (IMP) indicated concern for future subsidence and ground fissuring. The expanded monitoring efforts outside of the MZ1 Managed Area are consistent with the requirements of PE1.

Watermaster's current ground-level monitoring program includes:

- *Piezometric Levels.* Piezometric levels are an important part of the ground-level monitoring program because piezometric changes are the mechanism for aquifer-system deformation and land subsidence.
- *Aquifer-System Deformation.* Watermaster records aquifer-system deformation at the Ayala Park Extensometer facility where two extensometers record the vertical component of aquifer-system compression and/or expansion once every 15 minutes.
- *Vertical Ground-Surface Deformation.* Watermaster monitors vertical ground-surface deformation via the ground-level surveying and remote sensing (InSAR) techniques established during the IMP.
- *Horizontal Ground-Surface Deformation.* Watermaster monitors horizontal ground-surface displacement across the eastern side of the subsidence trough and the adjacent area east of the barrier/fissure zone. These data, obtained by electronic distance measurements (EDMs), are used to characterize the horizontal component of land surface displacement caused by groundwater production on either side of the fissure zone.

The conclusions and recommendations for Watermaster's basin-wide ground-level monitoring program are provided below:

- Land subsidence does not appear to be a concern in the eastern and northernmost portions of Chino Basin. In these areas, the underlying aquifer system is composed primarily of coarse-grained sediments that are not prone to compaction.

- Land subsidence and the potential for ground fissuring are major concerns in the western and southern portions of the Chino Basin. In these areas, the underlying aquifer system consists of interbedded, fine-grained sediment layers (aquitards) that can drain and compact when groundwater levels decline in the adjacent coarse-grained aquifers. Ground fissuring has occurred in the past where land subsidence was differential (i.e. steep gradient of subsidence). Ground fissuring is the main subsidence-related threat to infrastructure.

- Land subsidence has been persistent across most of the western and southern portions of the Chino Basin since, at least, 1987 when land subsidence monitoring began. In many of these areas, land subsidence continues even during periods of groundwater level recovery, indicating that thick, slowly-draining aquitards are compacting in response to the large historical drawdowns of 1935 to 1978.

- Pumping-induced drawdown has caused accelerated occurrences of land subsidence in the recent past, including subsidence in the City of Chino during the early 1990s and, currently, in the vicinity of the Chino I Desalter well field. Watermaster should anticipate similar occurrences of land subsidence in areas (1) that are prone to subsidence and (2) where drawdown will occur in the future.

- Watermaster will continue its basin-wide ground-level monitoring program, using InSAR and ground-level surveys. Watermaster will consider expanding the ground-level surveys to cover the area of the proposed Chino Creek Desalter Well Field. This is an area that is prone to subsidence, where drawdown is planned near where ground fissuring has occurred in the past, and where InSAR data is not currently available. Watermaster will also consider expanding the ground-level surveys to cover the Pomona and Ontario Areas. In general, InSAR data coverage is continuous and of high quality throughout both areas, so ground-level surveys would primarily provide supporting and confirmation data for the InSAR and would occur at a frequency of once every three to five years.

- Watermaster will consider installing low-cost piezometer/extensometer facilities at appropriate locations in all Areas of Subsidence Concern. This type of facility has been successfully constructed and tested at Ayala Park in Chino. Such facilities record the requisite data (1) to monitor land subsidence and groundwater levels at high resolution and accuracy, (2) to provide the information necessary to characterize the elastic and/or inelastic nature of any land subsidence occurring in an area, and (3) to provide the information necessary to characterize aquifer and aquitard properties that could be used in a predictive computer-simulation model of subsidence.

- Watermaster will consider building and calibrating predictive computer-simulation models of subsidence across all Areas of Subsidence Concern in the Chino Basin. These models would provide information on the rates and ultimate magnitude of land subsidence that could be associated with various basin management planning scenarios (i.e. pumping and recharge patterns). This information would be valuable to affected Watermaster parties.

- Because ground fissuring caused by differential land subsidence is the main threat to infrastructure, Watermaster will periodically inspect for signs of ground fissuring in areas that are experiencing differential land subsidence. In addition, Watermaster will consider monitoring the horizontal strain across these zones of potential ground fissuring in an effort to better understand and manage ground fissuring.

1.1 Background

The Chino Basin Watermaster (Watermaster) completed the *Initial State of the Basin* (ISOB) Report in October 2002. The baseline for the ISOB was on or about July 1, 2000—the point in time that represents the start of Optimum Basin Management Program (OBMP) implementation. The ISOB and subsequent State of the Basin (SOB) reports serve as a metric for measuring OBMP implementation progress. This current SOB report contains water level, water quality, ground-level, and other data through 2007/08 and describes Watermaster activity through fall 2008.

The OBMP was developed for the Chino Basin (see Figure 1-1 for the location of Chino Basin and its management zones) pursuant to the Judgment (Chino Basin Municipal Water District v. City of Chino, et al.) and the February 19, 1998 ruling (WEI, 1999). Pursuant to the OBMP Phase 1 Report, the Peace Agreement and associated Implementation Plan, and the November 15, 2001 Court Order, Watermaster staff has prepared this State of the Basin (SOB) Report. The intent of this report is twofold:

- During Watermaster fiscal year 2000/01, several OBMP-spawned investigations and initiatives commenced, encompassing groundwater level and quality, ground level, annual recharge assessment, recharge master planning, hydraulic control, desalter planning and engineering, and meter installation. This report describes the progress made in these activities through the fall of 2008.
- This report also describes the general state of the basin with respect to groundwater levels, groundwater quality, ground surface levels (subsidence), recharge, and hydraulic control.

1.2 Report Organization

Executive Summary: The Executive Summary provides a brief overview of the OBMP and its results.

Section 1 – Introduction: This section describes the project background, summarizes the project objectives, and provides an outline.

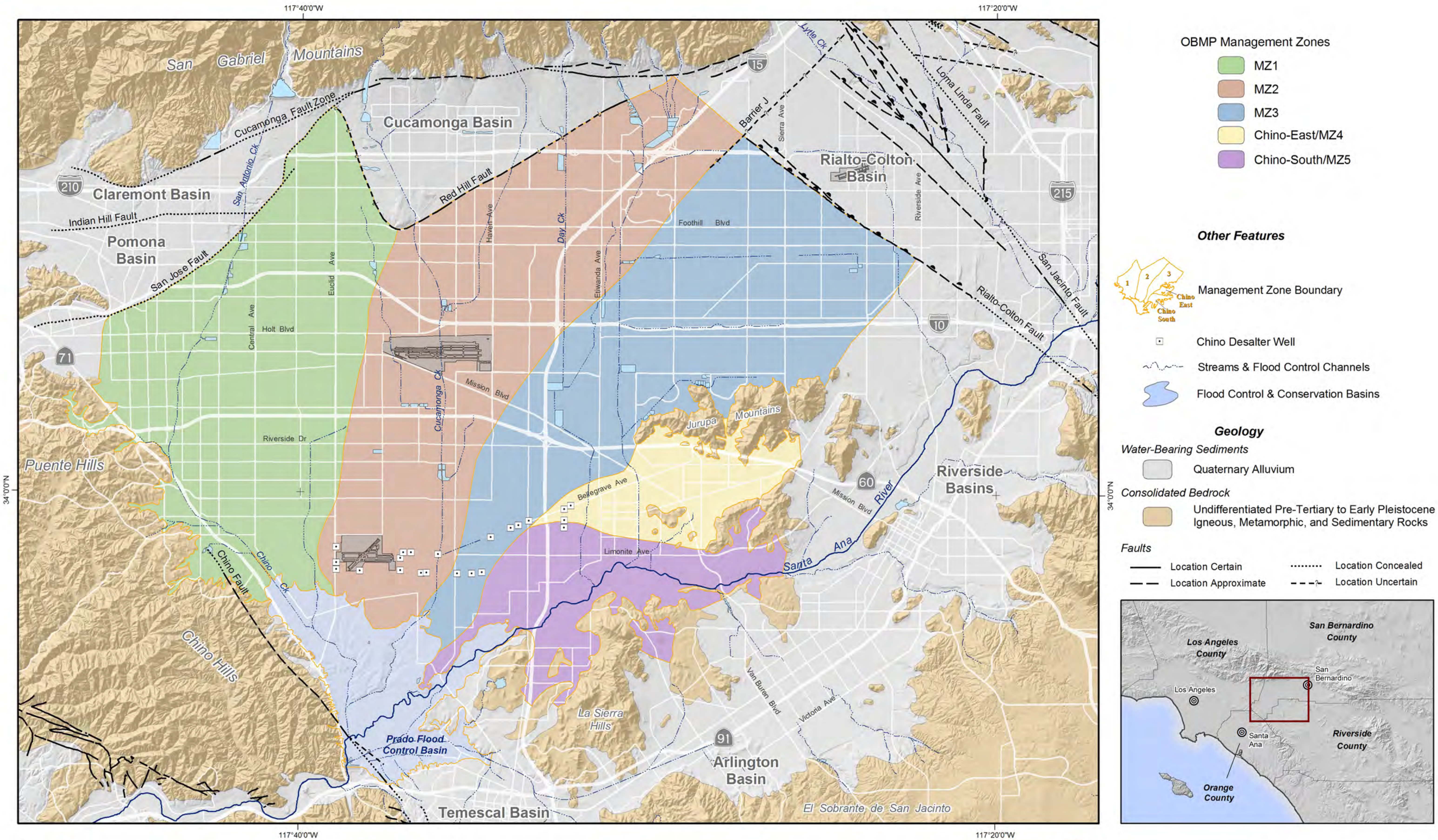
Section 2 – General Hydrologic Condition: Section 2 describes the general hydrologic condition of the Chino Basin.

Section 3 – Basin Operations and Groundwater Level Monitoring: Section 3 describes Basin operations, including groundwater level, groundwater quality, groundwater production, recharge, and ground surface monitoring efforts.

Section 4 – Groundwater Quality: Section 4 describes historical and current groundwater quality and lists and describes point sources of concern.

Section 5 – Ground Level Monitoring: Section 5 describes ground surface monitoring in the Basin using InSAR and traditional leveling surveys, describes areas of subsidence concern, and presents the results of the subsidence analyses.

Section 6 – References: Section 6 contains the references consulted in this investigation.



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2008 State of the Basin Report
Introduction

Chino Groundwater Basin
Management Zones

Figure 1-1

The Chino Basin covers about 220 square miles. Figure 2-1 shows the location of the Chino Basin within the context of the Santa Ana River watershed. The watershed of the Chino Basin is almost identical to the Santa Ana River at Prado, the exception being the addition of the Temescal Creek watershed that enters the Prado Dam reservoir just upstream of the dam and for practical purposes contributes negligible inflow to the Chino Basin. The Santa Ana River watershed area tributary to the Chino Basin at the MWD Crossing is about 852 square miles. The area tributary to the Chino Basin down stream of the MWD Crossing is about 414 square miles and includes the watershed areas of San Antonio and Chino Creeks, Cucamonga Creek, Day Creek, the East Etiwanda and San Sevaine Creeks, and small drainages from the Riverside and Arlington areas south of the Santa Ana River. In total, the watershed area for streams crossing the Chino Basin is about 1490 square miles. The time of concentration[1] for the Santa Ana River at the MWD Crossing is estimated to be between one to two days. By contrast the time of concentrations for streams discharging from north to south over the Chino Basin is a few hours.

2.1 Precipitation

The Chino Basin has a semi-arid Mediterranean climate. Precipitation is a major source of local groundwater recharge for the Basin and thus, the availability of this recharge can be understood by analyzing long-term precipitation records. Four precipitation stations in the Basin were used to characterize the long-term precipitation patterns in the Basin. The location of the precipitation station used herein to construct the Claremont/Montclair hybrid (combined records of 1034 and 1137)[2] station and the Ontario hybrid (combined records of 1017 and 1075) station records are shown in Figure 2-1. A third station of historical prominence in the Santa Ana watershed, the San Bernardino Hospital station, was used to characterize the historical precipitation upstream of the Chino Basin. The location of the San Bernardino Hospital station (2146) is shown in Figure 2-1. Table 2-1 lists annual statistics for the stations utilized in this characterization.

Figure 2-2 illustrates the annual precipitation time series and the cumulative departure from the mean (CDFM) precipitation for the 1900 to 2008 period at the Claremont/Montclair hybrid precipitation station. During this period, four series of dry-wet cycles are apparent: prior to 1904 through 1922; 1922 through 1946; 1946 through 1983, and 1983 through 1998. A fifth cycle appears to have started in 1998 and continues through present. The records of the Ontario hybrid and San Bernardino Hospital stations also show the same patterns of dry-wet cycles as the Claremont/Montclair hybrid station during the historic period (see Figures 2-3 and 2-4).

The long-term average annual precipitation for these stations are 17.8 inches at the Claremont/Montclair hybrid station (1900 through 2008), 15.4 inches at the Ontario hybrid

[1] The time of concentration is the time it takes for runoff from the most distant upstream part of the watershed to reach a specified point of interest.

[2] These two precipitation stations are close to each other, their overlapping records are highly correlated, and their records have been combined to produce a hybrid record of over 100 years duration.

station (1914 through 2008) and 16.4 inches at the and San Bernardino Hospital station (1900 through 2008). The ratio of dry years to wet years is about three to two. That is, for every ten years about six years will have below average precipitation and four years will have greater than average precipitation.

The safe yield of the Chino Basin is based on the hydrology during 1965 through 1974, a period of ten years (base period). This base period contains two wet years in 1965 and 1969 with annual precipitation depths of 24 and 26 inches, respectively, at the Claremont/Montclair hybrid station, and 19.8 and 25.6 inches, respectively at the Ontario hybrid station. This base period falls within the longest dry period on record (1946 to 1976). The average annual precipitation for the base period at the Claremont/Montclair hybrid station was 16.3 inches, or 1.5 inches less than the long-term annual average. The average annual precipitation for the base period at the Ontario hybrid station was 14.7 inches, or 0.6 inches less than the long-term annual average. The base period was preceded by a 20-year dry period that was punctuated with a few wet years (1952, 1954, 1957 and 1958).

The Peace Agreement period runs from 2000 to the present, an eight-year period. The Peace Agreement period contains three wet years in 2001, 2004, and 2005 with 19.7, 22.1, and 29.2 inches, respectively, as measured at the Claremont/Montclair hybrid station. The Peace Agreement period lies within a dry period that appears to have started in 1998 and continues to the present. The average annual precipitation for the Peace Agreement period at the Claremont/Montclair hybrid station was 16.6 inches, or 1.2 inches less than the long-term annual average.

2.2 Surface Water Discharge

The principal surface water features of the Chino Basin include the Santa Ana River and its tributaries in the reach between the MWD Crossing and Prado Dam. The main tributaries in this reach of the river include the San Antonio/Chino Creeks, Cucamonga Creek, Day Creek, and East Etiwanda/San Sevaine Creeks. Figure 2 1 shows the locations of these surface water features for the Chino Basin. Figure 2-1 shows the locations of two USGS discharge monitoring stations, one located at the MWD Upper Feeder Crossing of the Santa Ana River (11066460) that measures the discharge into the Chino Basin, and one located just downstream of Prado Dam (11074000) that measures the discharge exiting the watershed at the downstream end of the from the Chino and Temescal Basins.

Figure 2-5 shows the annual time history of storm flow for the Santa Ana River at below Prado Dam from water year 1919/20 to 2007/08 (October to September). Figure 2-5 also has a plot of the CDFM for precipitation at the Ontario hybrid station. Figure 2-5 demonstrates that that the relationship of precipitation to stormwater runoff changed significantly around water year 1977/78, such that more runoff per unit of precipitation was produced after 1977/78. To see this, note the positive slope of the CDFM (indicative of a wet period) during the 1936/37 to 1944/45 period. During this period, about 49 inches of precipitation occurred above the mean precipitation of 15.4 inches per year. From 1977/78 to 1982/83, another wet period, there was about 51 inches of precipitation above the mean but there was much more storm water discharge than occurred between 1937 and 1945. A similar observation can be made about the 1991/92 to 1997/98 period.

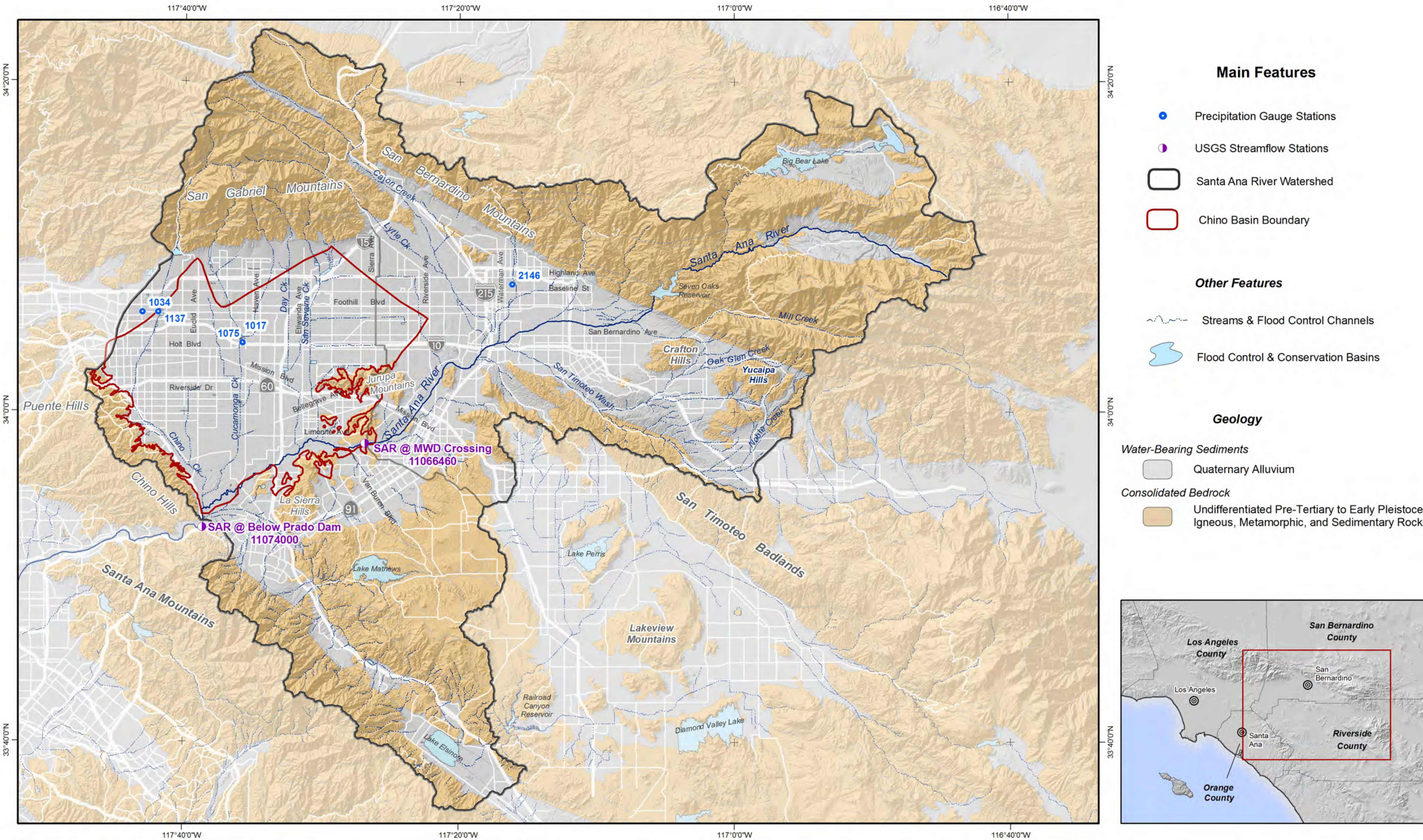
To further illustrate the change in rainfall-runoff relationship, a double mass analysis can be used. A double mass analysis is an arithmetic plot of the accumulated values of observations for two related variables that are paired in time and thought to be related. As long as the relationship between the two variables remains constant, the double mass curve will appear as a straight line (constant slope). A change in slope indicates that the relationship has changed where the break in slope denotes the timing of that change. Figure 2-6 is a double mass curve plot of precipitation at the Claremont/Montclair hybrid, Ontario, and San Bernardino Hospital precipitation stations versus storm water discharge at below Prado Dam for the 1919/20 through 2007/08 period. Note that the slope of the double mass curve after water year 1976/77 is much steeper than prior to 1976/77. The change in curvature denotes that a significant change occurred in the rainfall–runoff relationship. Figure 2-7 is a double mass curve plot of precipitation at the Claremont/Montclair hybrid station and Ontario precipitation stations versus storm water discharge generated in the watershed between the MWD Crossing and Prado Dam. The relationship of storm water discharge and precipitation in Figure 2-7 is similar to that shown in Figure 2-6 with Chino Basin producing about 75 percent of the storm water between the MWD Crossing and Prado Dam. Two observations can be regarding the time history of surface water discharge of the Santa Ana River: 1) there is a steady increase in the baseflow of the river starting around the 1970s and 2) there is an increase in the magnitude of storm water discharge starting in the late 1970s. These changes in discharge have occurred due to urbanization of the watershed. The increase in non-stormwater discharge is due to primarily to increases in recycled water discharges to the Santa Ana River. The increase in stormwater discharge is due to the modification of the land surface caused by the conversion from agricultural to urban uses, lining of stream channels, and other associated improvements in drainage systems.

2.3 Summary/Characterization of Current Hydrologic Regime

The hydrologic regime in the Chino Basin has important implications for water supply and groundwater management. The occurrence of long dry periods, characteristic of the region's climate, limit the recharge of precipitation and storm water recharge for years at a time and requires management strategies that conserve precipitation and storm water recharge whenever available. The amount of stormwater produced per unit of precipitation has increased over time due to urbanization and will continue to increase in the future as the remaining undeveloped and agricultural land uses are converted to developed uses.

Table 2-1
Annual Statistics of Long-Term Records at Precipitation Stations in the Chino Basin
(inches)

Area	Montclair/Claremont	S B Hospital	Ontario
Period of Record	1900 to 2008	1900 to 2008	1914 to 2008
Annual Average	17.78	16.36	15.38
Maximum	37.58	35.65	37.41
Minimum	5.39	5.95	3.84
Standard Deviation	7.66	6.83	7.05
Mean + 1 Standard Deviation	25.44	23.19	22.43
Coefficient of variation	43%	42%	46%



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2008 State of the Basin Report
General Hydrologic Condition

Santa Ana River Watershed Tributary to the Chino Basin

Figure 2-1

Figure 2-2
Annual Precipitation in the Claremont/Montclair Area

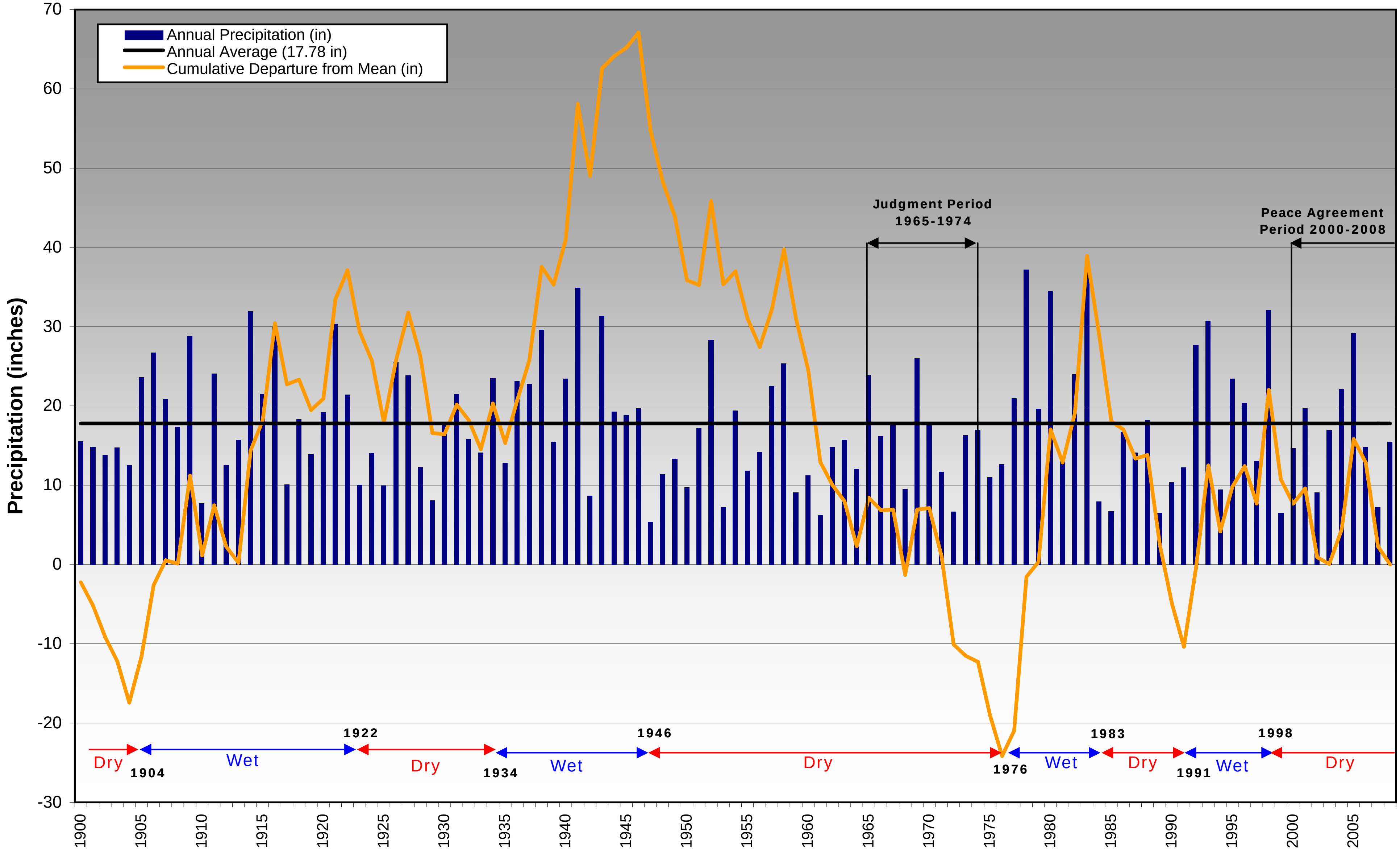

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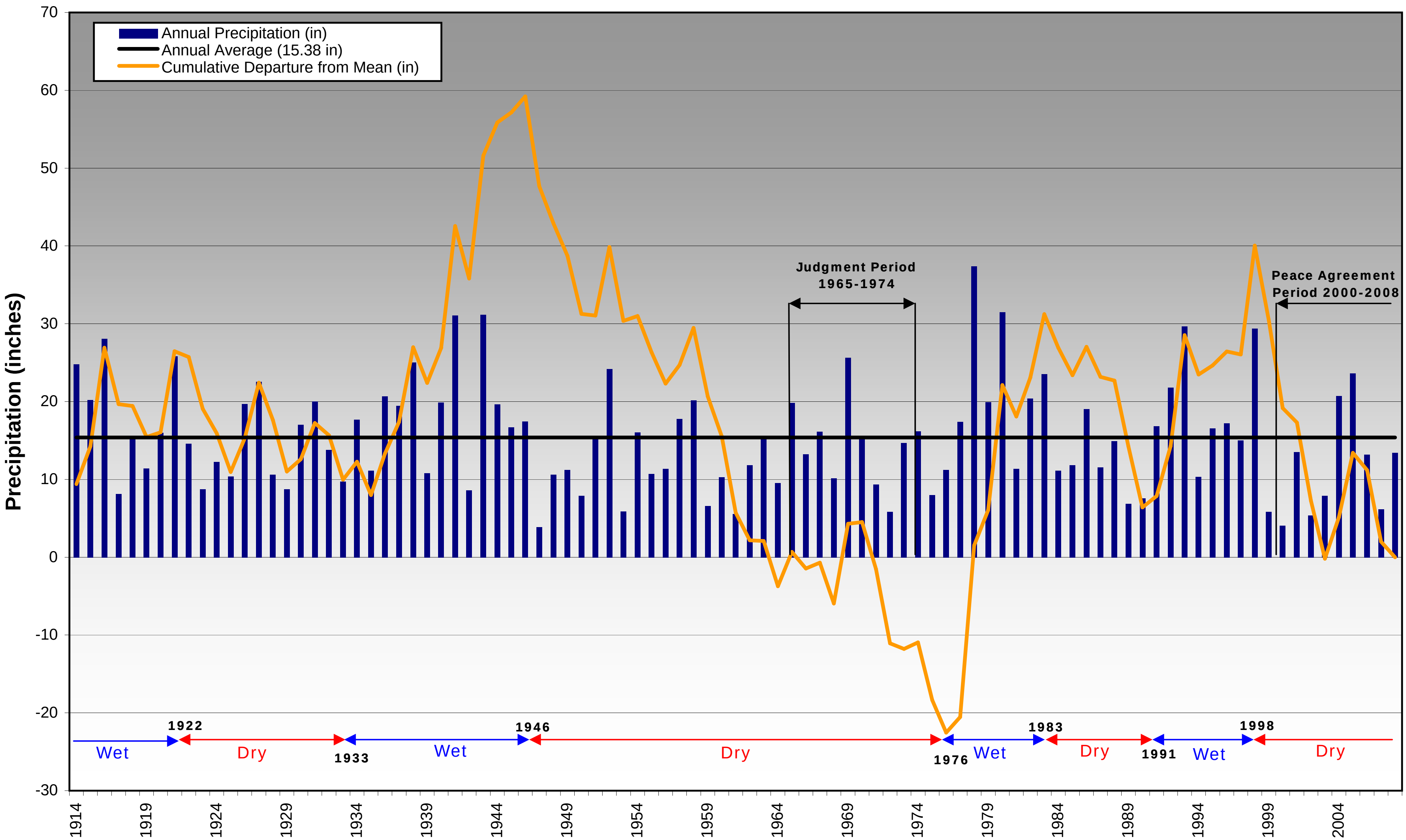
Figure 2-3
Annual Precipitation in the Ontario Area



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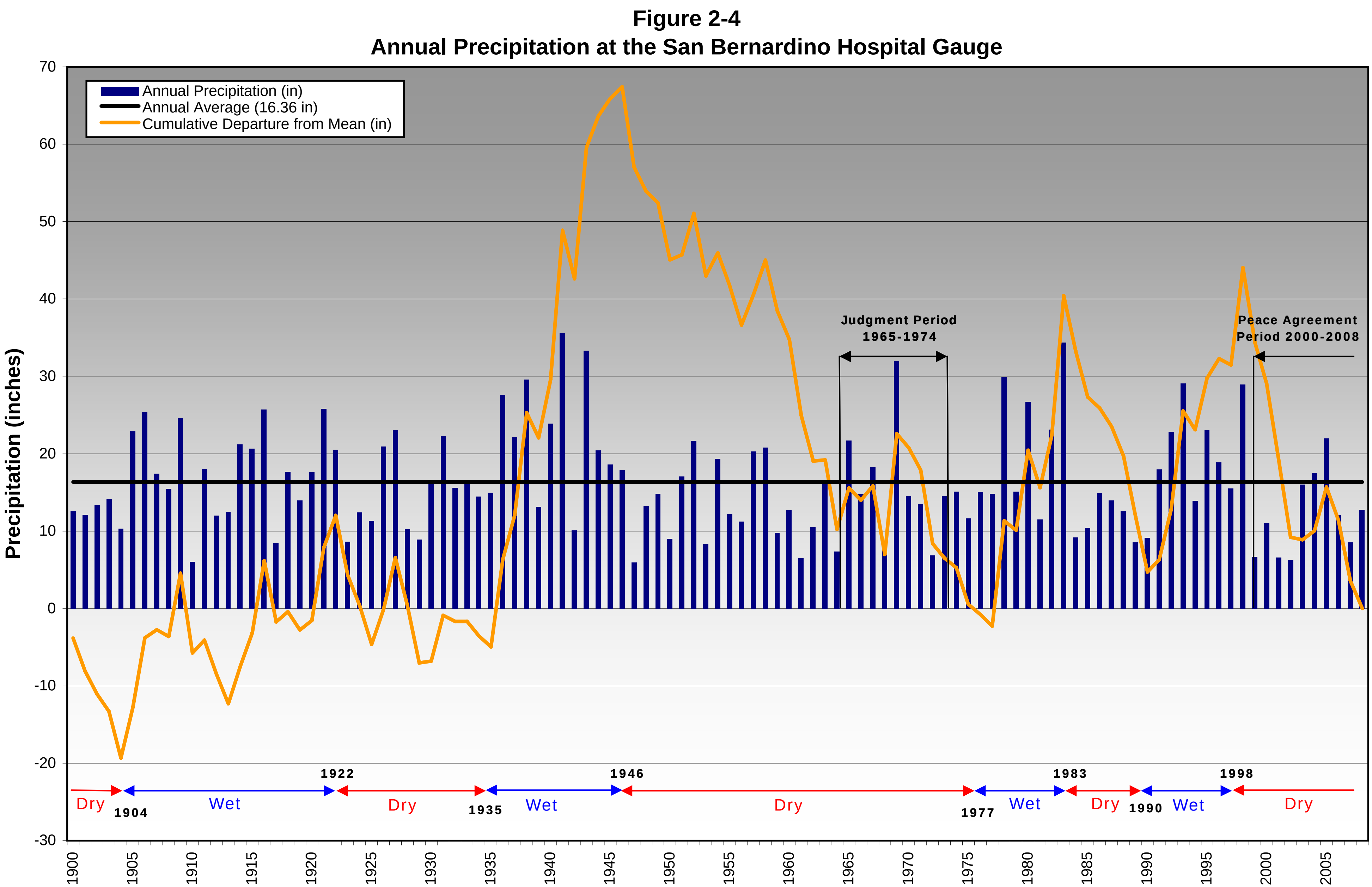

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Figure 2-5
Annual Stormflow Measured at below Prado Dam
Water Year 1919/20 - 2007/08

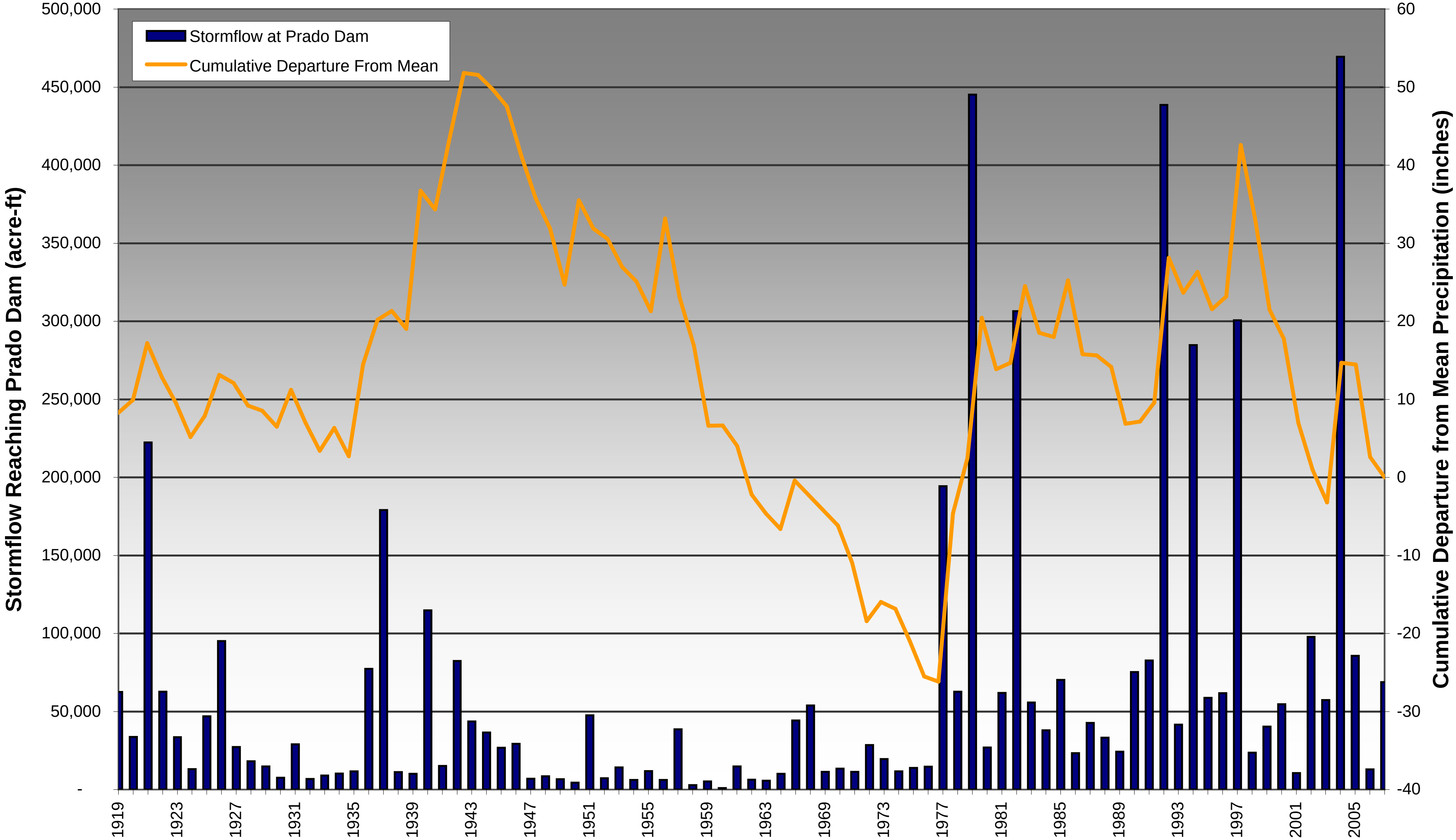

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Figure 2-6
Double Mass Curve of Precipitation
vs Storm Flow Measured at below Prado Dam
Water Years 1919/20 through 2007/08

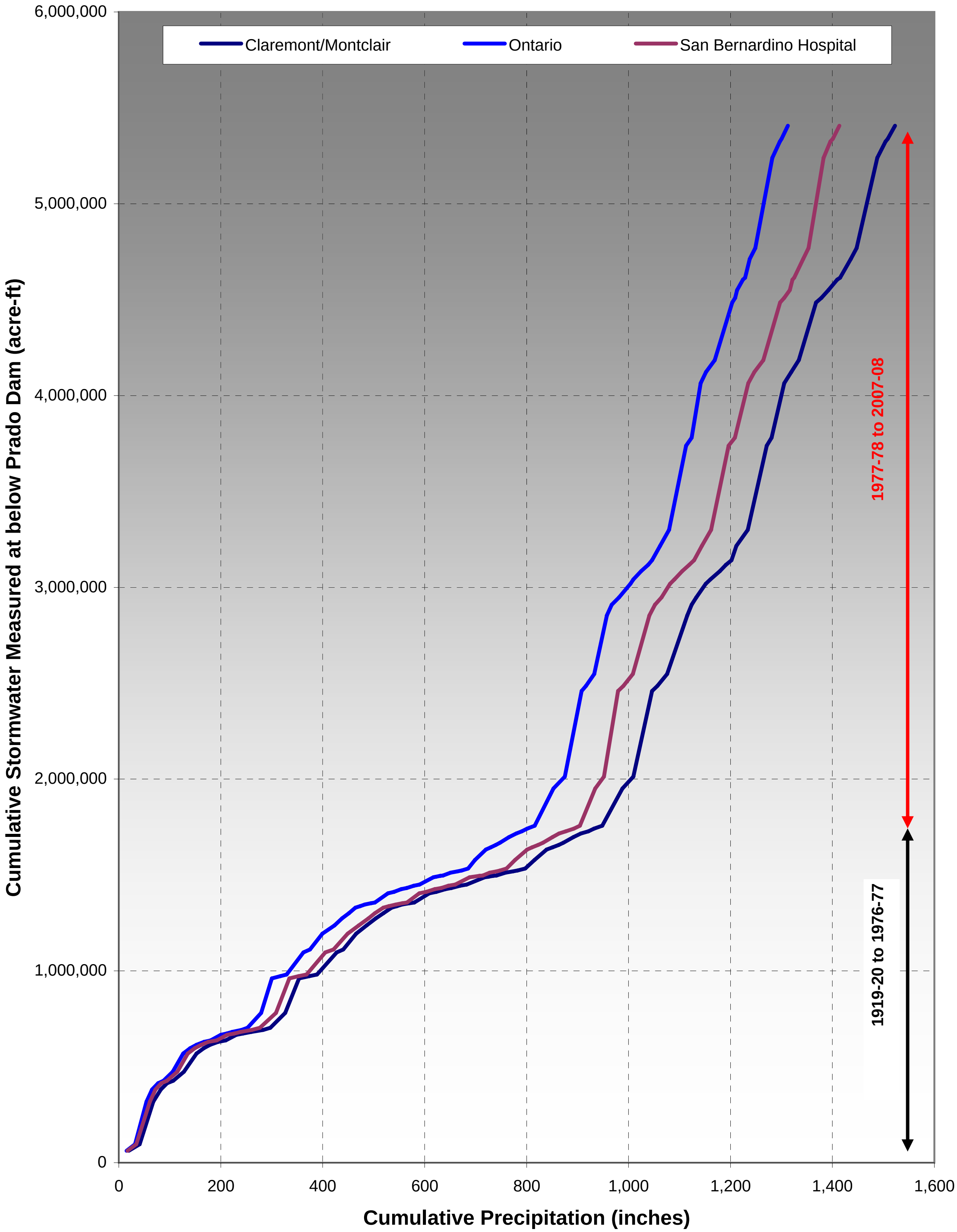

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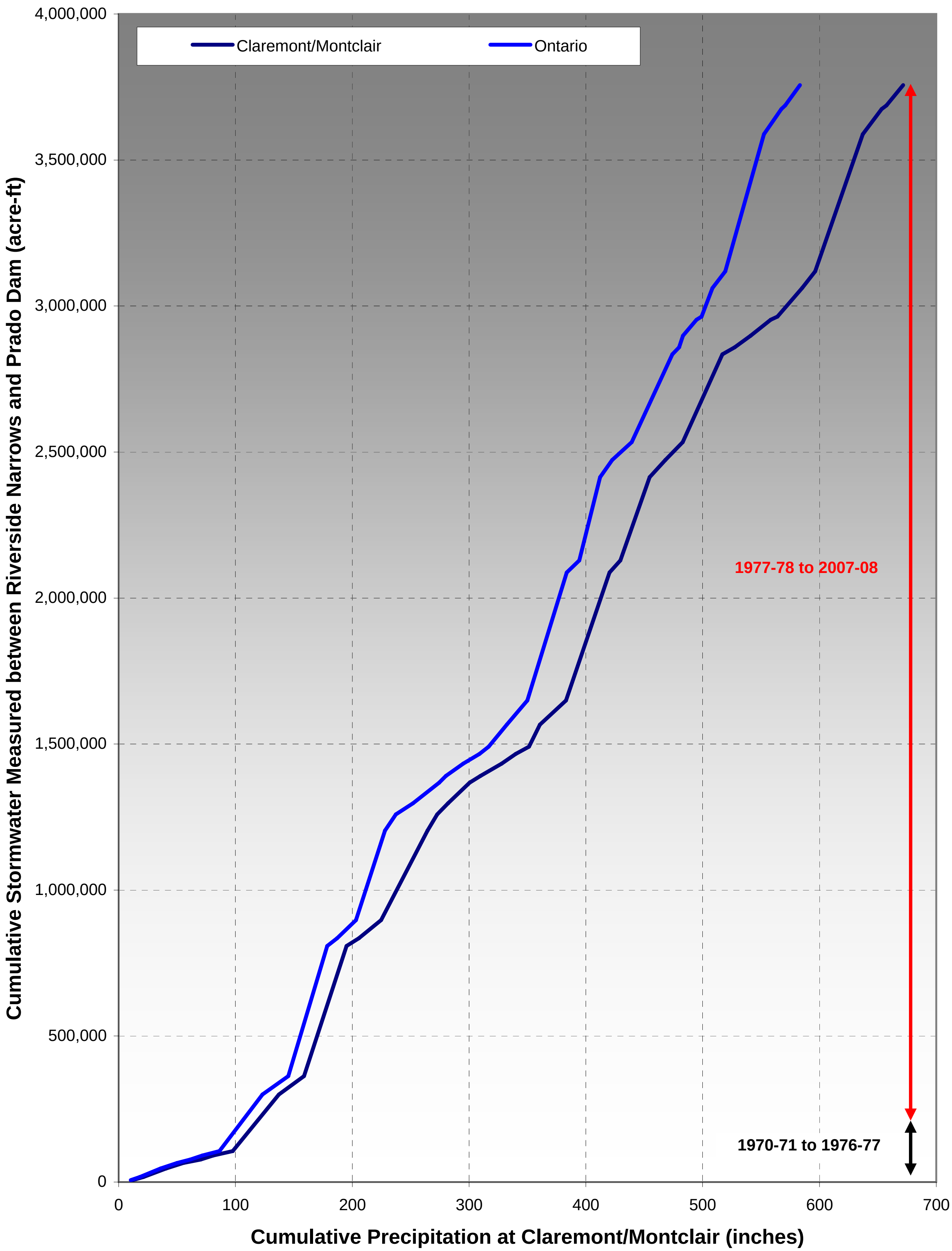
Figure 2-7
Double Mass Curve of Precipitation in Chino Basin vs Storm Flow Generated between Riverside Narrows and Prado Dam Water Years 1970/71 through 2007/08



Section 3 – Basin Operations and Groundwater Monitoring

3.1 Background

The OBMP states that the re-determination of safe yield and the estimation of losses from groundwater storage programs require comprehensive groundwater-level mapping across the basin, analyses of groundwater level time histories at wells, and accurate estimations of groundwater production and artificial recharge activities. Pursuant to the Peace Agreement, Watermaster will re-determine safe yield and establish loss rates from storage in 2010.

The monitoring of basin activities—such as groundwater production and artificial recharge—and potential responses to those activities—such as changes in groundwater levels and storage—is a major component of *OBMP Program Element 1 – Develop and Implement a Comprehensive Monitoring Program*. Program Element 1 was developed, in part, to address the first impediment to *OBMP Goal 1 – Enhance Basin Water Supplies*: "Unless certain actions are taken, safe yield of the Basin will be reduced […] due to groundwater outflow from the southern part of the Basin." (WEI, 1999) This impediment speaks to the possibility of increased groundwater outflow to the Santa Ana River as a result of (1) reduced groundwater production in the southern part of the basin as agricultural land is converted to urban uses and (2) increased groundwater storage due to other management activities, such as artificial recharge and storage and recovery programs. That is, increased groundwater levels in the southern Chino Basin (via reduced groundwater production and/or increased groundwater storage) may result in increased groundwater discharge to the Santa Ana River (i.e. loss of basin yield). This potential loss of safe yield needs to be computed periodically and used in the administration of the Judgment; otherwise, the Chino Basin could be overdrafted.

This section describes the physical state of the Chino Basin with respect to groundwater pumping, artificial recharge, groundwater levels, and groundwater storage. Special attention is given to changes that have occurred since the implementation of the OBMP (2000) and since the last State of the Basin Report (2006).

3.2 Groundwater Flow System

The physical nature of groundwater occurrence and movement with regard to basin boundaries, recharge, groundwater flow, and discharge is described below.

3.2.1 Groundwater Recharge, Flow, and Discharge

While considered one basin from geologic and legal perspectives, the Chino Basin can be hydrologically subdivided into at least five flow systems that act as separate and distinct hydrologic units. Each flow system can be considered a management zone, and the management zones delineated in the OBMP were determined based on these hydrologic units (WEI, 1999), as shown in Figure 1-1. Each management zone has a unique hydrology, and water resource management activities that occur in one management zone have limited impacts on the other management zones.

The predominant sources of recharge to Chino Basin groundwater reservoirs are percolation of direct precipitation and returns from applied water. The following is a list of other potential sources of recharge:

- Infiltration of flow within unlined stream channels overlying the basin
- Underflow from fractures within the bounding mountains and hills
- Artificial recharge of urban runoff, storm water, imported water, and recycled water at recharge basins
- Underflow from seepage across the bounding faults, including the Red Hill Fault (from Cucamonga basin), the San Jose Fault (from the Claremont Heights and Pomona basins), and the Rialto-Colton Fault (from the Rialto-Colton Basin)
- Deep percolation of precipitation and returns from use
- Intermittent underflow from the Temescal Basin

In general, groundwater flow mimics surface drainage patterns: groundwater flows from the forebay areas of high elevation (areas in the north and east flanking the San Gabriel and Jurupa Mountains) towards areas of discharge near the Santa Ana River within the Prado Flood Control Basin.

In detail, groundwater discharge throughout Chino Basin primarily occurs via:

- Groundwater production
- Rising water within Prado Basin (and potentially other locations along the Santa Ana River, depending on climate and season)
- Evapotranspiration within Prado Basin (and potentially other locations along the Santa Ana River, depending on climate and season) where groundwater is near or at the ground surface
- Intermittent underflow to the Temescal Basin

3.3 Monitoring Programs

3.3.1 Groundwater Pumping Monitoring

Since its establishment in 1978, Watermaster has collected information to develop groundwater production estimates. Appropriative Pool and Overlying Non-Agricultural Pool estimates are based on flow meter data that are provided by producers on a quarterly basis. Agricultural Pool estimates are based on water duty methods and meter data. The Watermaster Rules and Regulations require groundwater producers that produce in excess of 10 acre-feet per year (AFY) to install and maintain meters on their well(s). In 2000, Watermaster initiated a meter installation program for Agricultural Pool wells and a meter-reading program that required at least one reading per year.

In the OBMP Phase I Report (WEI, 1999), it was estimated that up to 600 private wells would need to be equipped with meters. Watermaster staff completed meter installation on the majority of these wells and began reading meters in 2003. Some agricultural wells were not metered due to the anticipated conversion of land from agricultural to urban uses. As of

December 2008, Watermaster had installed or repaired meters at 326 active agricultural wells. Watermaster records production data from these meters on a quarterly basis. These data are then entered into Watermaster's database. Figure 3-1 shows the locations of all active wells in fiscal 2007/08 by pool.

3.3.2 Artificial Recharge Monitoring

Figure 3-2 shows the locations of the basins used for artificial recharge in the Chino Basin. There are four types of water recharged within Chino Basin: imported water from the State Water Project (SWP), storm water, urban runoff, and recycled water. Deliveries of SWP water are monitored using water delivery records supplied by the Metropolitan Water District of Southern California (MWDSC) and the IEUA. Historically, the recharge of storm water and urban runoff was incidental to flood control operations, and many opportunities to measure and record this recharge were missed. Since the implementation of the OBMP, water level data sensors have been installed in each recharge basin. Recorded changes in recharge basin water levels during storm events coupled with elevation-area-volume curves and elevation-outflow relationships allow for the calculation of storm water and urban runoff recharge. Recycled water is recharged at seventeen of the recharge sites, most of which have multiple basins. The IEUA monitors and reports recycled water quality and recharge volumes. Groundwater quality within the vicinity of the recycled water recharge basins is measured and reported quarterly by the IEUA.

3.3.3 Groundwater Level Monitoring

Groundwater level monitoring was inadequate prior to OBMP implementation. Problems with historical groundwater level monitoring included an inadequate areal distribution of wells in monitoring programs, short time histories, questionable data quality, and insufficient resources to develop and conduct a comprehensive program.

The OBMP defined a new, comprehensive groundwater level monitoring program. The program start-up occurred in two steps: an initial survey from 1998 to 2001, followed by long-term monitoring at a set of key wells.

Watermaster has three active groundwater level monitoring programs operating in the Chino Basin: (1) a semiannual basin-wide well monitoring program, (2) a key well monitoring program that is associated with the Chino I/II Desalter well fields and the HCMP, and (3) a piezometric monitoring program that is associated with land subsidence and ground fissuring in Management Zone 1 (MZ1). Monitoring frequency varies with each program. Figure 3-3 shows the locations and measurement frequencies of all the wells that are currently used in Watermaster's groundwater level monitoring programs. In addition to its field programs, Watermaster collects groundwater level data from municipal producers, government agencies, and private entities. All collected water level measurements are entered into Watermaster's relational database.

3.3.3.1 Basin-wide Groundwater Level Monitoring Program

The objective of the basin-wide groundwater level monitoring program is to collect groundwater level data from all wells in the Chino Basin that can be reliably monitored. These wells are shown in Figure 3-2, symbolized by their measurement frequencies. Wells in the other groundwater level monitoring programs (see Sections 3.3.3.2 and 3.3.3.3 below) are, by definition, also part of the basin-wide monitoring program. In total, the basin-wide program consists of about 900 wells. Watermaster staff measures water levels at about 450 private wells at least twice per year (spring and fall). At the remaining wells, water levels are measured by other agencies, including:

- California Department of Toxic Substances and Control (Stringfellow Superfund Site)
- Orange County Water District (Prado Basin)
- Santa Ana Regional Water Quality Control Board (various remediation sites)
- USGS (special investigations)
- County of San Bernardino (landfill monitoring)
- Private Consultants (various remediation sites)

Watermaster collects data for these wells twice per year; though, for some of these wells, data are collected more frequently as part of other monitoring programs (see below).

3.3.3.2 Key Well Water Level Program

Watermaster developed and implemented a key well monitoring program in the southern portion of the Chino Basin. The objective of this program is to increase measurement frequency and data quality at a reduced but representative network of wells. This network of wells and the monitoring program must satisfy the requirements for monitoring desalter impacts to local producers and for determining hydraulic control (see Section 3.6.4 for a description of the HCMP).

In the Chino Basin, development has led to the conversion of land from agricultural to urban uses and has resulted in the destruction of wells that were previously included in Watermaster's key well water level monitoring program. As key wells are lost to development, nearby wells are evaluated for suitability as key well replacements. Currently, there are 159 wells in the key well water level monitoring program. Manual water levels measurements are done monthly at 95 of these wells. The remaining 64 wells contain pressure transducers/data loggers that automatically record water levels once every 15 minutes.

3.3.3.3 MZ1 Monitoring Program

The MZ1 monitoring program is an intensive aquifer-system monitoring program that was implemented beginning in Watermaster fiscal year 2001/02 to provide information that could be used by Watermaster to determine the causes of subsidence in MZ1 and develop a long-term subsidence management plan for MZ1. In fiscal 2002/03, an aquifer system monitoring facility was constructed at Ayala Park in the City of Chino. This facility includes multi-depth piezometers that record depth-specific head once every 15 minutes. In addition, about 30 production and monitoring wells that surround this facility are equipped with pressure transducers that record water levels once every 15 minutes. All of these data are uploaded to Watermaster's water level database. Several of these wells are also included in the key well water level monitoring program.

3.4 Groundwater Pumping

3.4.1 Historical Groundwater Pumping

Table 3-1 lists Watermaster's records of Chino Basin production by pool for the period fiscal 1977/78 through fiscal 2007/08. Figure 3-4 depicts the distribution of production by pool. Over this period, annual groundwater production has ranged from a high of about 198,000 AF (fiscal 2006/07) to a low of about 123,000 AF (fiscal 1982/83) and has averaged about 154,000 AFY since fiscal 1977/78. The distribution of production by pool has shifted since 1977. Agricultural Pool production, which is mainly concentrated in the southern portion of the basin, dropped from about 54 percent of total production in 1977-78 to about 19 percent in 2007/08. During the same period, Appropriative Pool production, which is mainly concentrated in the northern half of the basin, increased from about 40 percent of total production in 1977-78 to about 79 percent in 2007/08 (sum of production for the appropriative pool and the Chino Desalter Authority [CDA]). Increases in Appropriative Pool production have approximately kept pace with declines in agricultural production. Production in the Overlying Non-Agricultural Pool declined from about 5 percent of total production in fiscal 1977/78 to about 2 percent in the mid-1980s, rose to about 4 percent through the 1990s, and recently decreased to about 2 percent in 2003-04 where it remained through fiscal 2007/08.

Figures 3-5 through 3-9 illustrate the location and magnitude of groundwater production at wells in the Chino Basin for fiscal years 1977/78, 1999/2000, 2005/06, 2006/07, and 2007/08, respectively. A close review of these figures indicates:

- There was a basin-wide increase in the number of wells producing over 1,000 AFY between 1978 and 2008. 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 just north of the Santa Ana River has decreased. This is consistent with the land use transition from agricultural to urban that has been occurring in the area.
- Since the implementation of the OBMP in 2000, desalter pumping has commenced and progressively increased; in fiscal 2007/08, desalter pumping reached a historical high of 26,972 AFY.
- Since the implementation of the OBMP in 2000, the number of wells that produce over 1,000 AFY on the west side of Chino Basin (west of Euclid Avenue) has decreased. This is consistent with (1) the implementation of the MZ1 Interim Management Plan, which reduced pumping by up to 3,000 AFY in the Chino area, and (2) reduced pumping by the City of Pomona, the Monte Vista Water District, and the City of Chino Hills from 2003 to 2008, as these agencies have been participating in in-lieu recharge for the Dry-Year Yield Program.

3.4.2 Agricultural Pool Pumping

Agricultural Pool pumping has declined steadily since 1978 (see Figure 3-1). In fiscal 2007/08, total production for the Agricultural Pool fell to 30,910 AF—the Agricultural Pool's lowest production on record. Since OBMP implementation in 2000, Agricultural Pool production has decreased from about 40,000 AF in fiscal 2000/01 (24 percent of total basin production) to about 31,000 AF in fiscal 2007/08 (19 percent of total basin production).

3.4.3 Overlying Non-Agricultural Pool Pumping

Since OBMP implementation in 2000, Overlying Non-Agricultural Pool production has accounted for less than 5 percent of total basin production, ranging from about 2,300 AF (1 percent of total production in fiscal 2004/05) to 8,000 AF (5 percent of total production in fiscal 2000/01). In fiscal 2007/08, Overlying Non-Agricultural production of about 3,400 AF accounted for 2 percent of total basin production.

3.4.4 Appropriative Pool Pumping

Since OBMP implementation in 2000, average production by the Appropriative Pool, excluding desalter production, has been about 122,000 AFY, which accounts for about 70 percent of total basin production.

The CDA operates two desalter facilities (Chino I and Chino II) that are supplied with raw groundwater from 22 wells. The desalter facilities belong to the Appropriative Pool. In fiscal 2007/08, the CDA desalters produced more water than in any previous year (26,972 AF). Since the CDA began pumping in 2000, its production has accounted for about 16 percent of total Appropriative Pool production and about 8 percent of total basin production. During 2005/06, the Chino II Desalter facility became operational, and as a result, CDA groundwater production increased by about 60 percent from the previous year. Average annual production by the CDA since 2000 has been about 14,800 AFY.

Since OBMP implementation in 2000, average annual production by the Appropriative Pool, including desalter production, has been about 137,000 AFY. Approximately 130,000 AF were produced in fiscal 2007/08. As a percent of total basin production, Appropriative Pool production increased from about 72 percent in fiscal 2000/01 to about 79 percent in fiscal 2007/08.

3.5 Artificial Recharge

Watermaster initiated the Chino Basin Groundwater Recharge Program as required by the Peace Agreement. This program is an integral part of Watermaster's OBMP and is summarized in the OBMP Recharge Master Plan. This comprehensive program aims to enhance water supply reliability and improve the groundwater quality of local drinking water wells throughout the Chino Basin by increasing the recharge of storm water, imported water, and recycled water.

Below, the physical volumes of water percolated at recharge basins in the Chino Basin are discussed. Specific source waters include storm water and supplemental water, which consists of State Water Project (SWP) water and recycled water.

3.5.1 Recharge Facilities

There are 21 recharge facilities described in the OBMP Recharge Master Plan, Phase II Report (B&V & WEI, 2001). Table 3-2 lists the operable recharge facilities in the Chino Basin and summarizes annual wet water recharge (by type) for the period of July 1, 2000 through June 30, 2008. Figure 3-2 shows the locations of the groundwater recharge facilities. Detailed descriptions of these facilities and their operating characteristics can be found in *Chino Basin Recharge Facilities Operating Procedures* (GRCC, 2006).

3.5.2 Regulatory Requirements for Recharge in the Chino Basin

The general recharge requirements for the Chino Basin are outlined in Section 5.1 of the Chino Basin Peace Agreement – Recharge and Replenishment. The requirements of the Peace Agreement are further discussed and expanded on in the OBMP Recharge Master Plan (WEI, 2001).

The Recycled Water Groundwater Recharge Program, which is being implemented by the IEUA and Watermaster, is subject to the following requirements:

- California Regional Water Quality Control Board, Santa Ana Region. Monitoring and Reporting Program (M&RP) No. R8-2005-0033 for IEUA and Chino Basin Watermaster. Phase 1 Chino Basin Recycled Water Groundwater Recharge Project, San Bernardino County. April 15, 2005.
- California Regional Water Quality Control Board, Santa Ana Region. Order No. R8-2007-0039. Water Recycling Requirements for Inland Empire Utilities Agency and Chino Basin Watermaster, Chino Basin Recycled Groundwater Recharge Program, Phase I and Phase II Projects, San Bernardino County. June 29, 2007.

3.5.3 Historical Recharge

3.5.3.1 Storm Water Recharge

Storm Water recharge is monitored by the IEUA pursuant to the Chino Basin Recharge Facilities Operating Procedures (GRCC, 2006). Transducers have been installed in each recharge basin that receives storm water. The percolation rate in each basin is measured directly and used in conjunction with established elevation-storage-area tables to calculate recharge.

Since 2000, total storm water recharge has averaged approximately 4,600 AFY. During fiscal years 2006/07 and 2007/08, total storm water recharge in Chino Basin was approximately 4,600 and 9,900 AF, respectively (see Table 3-2).

3.5.3.2 Supplemental Water Recharge

SWP water for artificial recharge is currently available to the region from the MWDSC. The MWDSC delivers SWP water into the Chino Basin from the Foothill Feeder, which flows from east to west across the northern half of the Chino Basin. During fiscal 2006/07, total SWP water recharge in Chino Basin was approximately 6,500 AF. During fiscal 2007/08, there was no SWP water recharge in the Chino Basin. The aggregate average SWP water recharge that has occurred since the OBMP was implemented is about 10,100 AFY.

During fiscal 2007/08, the Banana, Hickory, 7th and 8th Street, and Ely Basins were used to recharge recycled water. During fiscal years 2006/07 and 2007/08, total recycled water recharge in Chino Basin was approximately 3,000 and 2,400 AF, respectively. The aggregate average recycled water recharge that has occurred since the OBMP was implemented is about 1,000 AFY.

During fiscal years 2006/07 and 2007/08, supplemental water recharge—consisting of imported and recycled waters—was approximately 6,350 and 2,400 AF, respectively. The aggregate average supplemental water recharge that has occurred since the OBMP was implemented is about 11,500 AFY.

3.6 Groundwater Levels

This subsection analyzes groundwater levels at wells in the various management zones (MZs) throughout the Chino Basin and discusses changes in groundwater storage since the implementation of the OBMP in 2000 and since the 2006 State of the Basin report.

3.6.1 Historical Groundwater Level Trends

Figure 3-10 shows the locations of wells with groundwater level time histories discussed herein and the Chino Basin management zone boundaries. Wells were selected based on length of record, density of data points, quality of data, geographical distribution, and aquifer system. Wells are identified by their local name (usually owner abbreviation and well number) or their Watermaster ID (CBWM ID) if privately owned.

Figures 3-11 through 3-15 are groundwater level time history charts for the wells shown in Figure 3-10. Some of the short-term groundwater level fluctuations shown in these figures result from the inclusion of static and dynamic observations. Below, by management zone, the behavior of groundwater levels at specific wells is compared to climate, groundwater production, wet water recharge activities, and other factors as appropriate.

To compare groundwater levels to climate, a cumulative departure from mean precipitation (CDFM) curve has been plotted on the groundwater level time history charts. Positive sloping lines on the CDFM curve show wet years or wet periods. Negatively sloping lines show dry years or dry periods. For example, the period from 1978 to 1983 was an extremely wet period, and it is represented by a positively sloping line. To compare groundwater levels to pumping and recharge activities, bar charts that show groundwater production and wet water recharge by management zone have been superimposed on the groundwater level time history charts.

3.6.1.1 Management Zone 1

MZ1 is an elongate region, running generally north-south, and comprises the westernmost area of the Chino Basin. It is bounded by MZ2 to the east, various basin-boundary faults to the north, and sedimentary bedrock outcrops to the west and south.

Figure 3-11 shows groundwater level time histories for the following wells: Monte Vista Water District Well 10 (MVWD-10), City of Pomona Well 11 (P-11), City of Chino Well 10 (C-10), and Chino Hills Wells 15A and 16 (CH-15A and CH-16). The Montclair, College Heights, Upland, and Brooks Street Basins are located in the northern portion of MZ1 and are the primary sites for artificial recharge.

Wells MVWD-10 and P-11 exhibit representative groundwater levels for the northern portion of MZ1. An analysis of static groundwater levels at these wells shows a decline from 1995 to 2001, a period of increased groundwater production in MZ1. Since 2001, water levels have risen by about 100 feet at MVWD-10 and by about 45 feet at P-11. This increase is most likely attributed to a decrease in local production and an increase in wet water recharge in MZ1 since 2001.

Well C-10 is located in central MZ1. Water levels at C-10 peak in the mid-1990s but decline by about 20 feet from 1995 to 2000, which is likely due to increased groundwater production in MZ1. Unlike other wells in MZ1 that experienced significant water level recovery from 2000 to 2006, C-10's water levels remained essentially unchanged. Since 2006, water levels have risen by approximately 20 feet. This increase is due to a decrease in local production and an increase in wet water recharge.

Water levels measured at CH-15A are representative of the shallow aquifer system in the southern portion of MZ1. The recent land subsidence investigation (Section 5) has shown that in southern MZ1, the aquifer system is hydrologically stratified. The shallow aquifer system is unconfined to semi-confined while the deep aquifer system is confined. Water levels in CH-15A have historically been stable at around 80-90 ft-bgs and have experienced small variations in response to nearby pumping. Though, since 2000, water levels have risen by about 10 feet. This is primarily due to the decrease in local production associated with the MZ1 Interim Management Plan.

CH-16 is perforated in the confined deep aquifer system, which is characterized by large changes in piezometric pressure due to nearby pumping. In 2003 and 2004, during a series of pumping tests conducted by Watermaster in southern MZ1, water levels in CH-16 dropped by approximately 100 feet, and the period of recovery lasted several months. These tests demonstrated that piezometric levels in CH-16 (and the deep aquifer system in general) are heavily influenced by changes in pumping from local wells screened within the deep aquifer system. The static water levels at CH-16 declined by about 100 feet from 1995 to 2000 and subsequently recovered by about 140 feet from 2000 to 2006. At the end of 2008, static water levels had declined by about 30 feet from the 2006 highs with a maximum drawdown of about 60 feet observed in the summer of 2008.

3.6.1.2 Management Zone 2

Management Zone 2 (MZ2) is a large, central, elongate area of the Chino Basin (see Figure 3-10). Figure 3-12 shows groundwater level time histories for Cucamonga Valley Water District (CVWD) Wells CB-3 and CB-5 (CVWD CB-3 and CVWD CB-5), City of Ontario Well 16 (O-16), CBWM ID 600394, and Hydraulic Control Monitoring Program Wells 2/1 and 2/2 (HCMP-2/1, and HCMP-2/2). These wells are aligned north to south, approximately along a groundwater flow line. The San Sevaine, Etiwanda, Lower Day, Victoria, Turner, and Ely Basins are located in the northern and central regions of MZ2 and are the primary sites for artificial recharge.

The groundwater level time histories for the northernmost wells—CVWD CB-3 and CB-5 and O-16—show a general water level increase following 1978, which is likely due to a combination of the 1978 to 1983 wet period, the reduction in overdraft following the implementation of the Chino Basin Judgment, and the start of artificial replenishment with imported water in the San Sevaine and Etiwanda Basins. Following the early 1990s, water levels at these wells began to decrease and have continued to decrease to present. The static water levels at CB-3 and CB-5 decreased by approximately 30 feet between 2003 and 2006. Long-term water level decreases in this area of MZ2 are likely due to decreased wet water recharge from 1996 to 2003 and increased groundwater production from 1995 to present.

Well CBWM ID 600394 is located in the central portion of MZ2, north of the Chino I Desalter well field. Water levels at this well have decreased by about 15 feet since 2000.

Wells HCMP 2/1 and HCMP 2/2 are located at the southern end of MZ2 near the Chino I Desalter well field. These wells were completed and the first measurements were recorded in early 2005. HCMP 2/1 is perforated in the shallow aquifer system, and HCMP 2/2 is perforated in the deep aquifer system. Contrary to that of of MZ1, the deeper aquifer in this MZ behaves much more like the shallow, unconfined aquifer, which is indicative of a greater degree of hydraulic communication between the two aquifer systems. Both wells exhibited similar groundwater level increases (15-20 feet) from 2005 to 2006. It is likely that this was due to changes in local production—especially at some of the nearby Chino I Desalter wells, which experienced a production decrease in 2005 and 2006. Since 2006, water levels have decreased by 5-10 feet in both wells.

3.6.1.3 Management Zone 3

Management Zone 3 (MZ3) consists of the area along the eastern boundary of the Chino Basin. It is bounded by MZ2 to the west, Chino-East (MZ4) and Chino-South (MZ5) to the south, and the Rialto-Colton Fault to the east (see Figure 3-10). Figure 3-13 shows water level time histories for Fontana Water Company Wells F30A and F35A (F30A and F35A), Milliken Landfill Well M-3 (M-3), County of San Bernardino MIL M-06B, CBWM ID 3602468, and HCMP Well 7/1 (HCMP 7/1). These wells are aligned northeast to southwest, approximately along a groundwater flow line. The RP-3 and Declez Basins are located in the central region of MZ3 and are the primary sites for artificial recharge.

Wells F30A and F35A are located in the northeastern portion of MZ3. The groundwater level time histories of these two wells show relatively stable water levels from 1978 until the late

1990s. From 2000 to 2006, the wells experienced a progressive decline in water levels of about 25 feet. This decline is likely due to increased production in MZ3. Their lack of responsiveness to climate is likely due to the absence of significant sources of recharge. Since 2006, water levels at F35A have remained relatively unchanged, and water levels at F30A have fluctuated ±5 to 10 feet.

Wells M-3/M-06B and CBWM ID 3602468 are located in the central portion of MZ3. From 2000 to 2006, a groundwater decline of about 30 feet was observed at these wells.

The southernmost well, HCMP-7/1, experienced a groundwater level decline of about 20 feet from 2005 to the end of 2008. Similar water level declines can be observed in most wells throughout MZ3. This regional drawdown in MZ3 is likely due to the steady increase in production within MZ3 over the past 30 years and a lack of artificial recharge.

3.6.1.4 Management Zone 4

MZ4 – also known as Chino-East – is bounded by the Jurupa Hills to the north, the Pedley Hills to the east, MZ5 to the south, and MZ3 to the west (see Figure 3-10). Figure 3-14 shows groundwater level time histories for HCMP Well 9/1 (HCMP-9/1), Jurupa Community Services District Well 10 (JCSD-10), and CBWM ID 3300718. There are no major recharge basins in MZ4, and very little groundwater production occurs in this area.

Groundwater levels at these wells decreased by about 30 feet between 2000 and 2008. These declines are likely due to groundwater production at nearby wells, including the Chino II desalter well field, which is located near the western boundary of the MZ.

3.6.1.5 Management Zone 5

MZ5 – also known as Chino-South – is bounded by MZ4 to the north, MZ3 to the west, the Riverside Narrows to the east, and various unnamed hills to the south (see Figure 3-10). Figure 3-15 shows groundwater level time histories for USGS Well Archibald-1, HCMP Well 8/1 (HCMP 8/1), and Santa Ana River Water Company Well 07 (SARWC-07). There are no groundwater recharge basins in MZ5, but the Santa Ana River is a major source of groundwater recharge.

These wells exhibit very little groundwater level variation due to the stabilizing effects of the Santa Ana River. Production in MZ5 decreased steadily from 1978 to 2008 due to the destruction of many private agricultural wells. Current production is approximately 3,000 AFY (see Figure 3-15). Groundwater levels in HCMP-8/1 and SARWC-07 have declined about 10-15 feet since 2006. This decline is likely due to the onset of pumping at nearby Chino II Desalter wells.

3.6.2 Current Groundwater Levels

The groundwater level data collected from the various monitoring programs described in Section 3.3 were used to create groundwater level elevation contour maps of the Chino Basin for fall 2000 (Figure 3-16), fall 2003 (Figure 3-17), fall 2006 (Figure 3-18), and fall 2008 (Figure 3-19). Appendix A is an E-sized water level map that includes the point data used to contour the fall 2008 groundwater levels. The following procedures were used in the creation of these maps:

- Extract the entire time history of groundwater level data from Watermaster's groundwater level database for all wells in the Chino Basin.
- Plot and explore groundwater elevation time histories for all wells.
- Choose one "static" groundwater level elevation data point per well that is representative of the fall 2008 period.
- Plot groundwater level elevation data on maps with background geologic/hydrologic features.
- Contour and digitize groundwater elevation data.

The groundwater elevation contours for fall 2008 (Figure 3-19) are generally consistent with past groundwater elevation contour maps (see, for example, Figures 3-16, 3-17, and 3-18). These maps show that groundwater generally flows in a south-southwest direction from the primary areas of recharge in the northern parts of the basin toward the Prado Flood Control Basin in the south. There are notable pumping depressions in the groundwater level surface that interrupt the general flow patterns in the northern portion of MZ1 (Montclair and Pomona areas) and directly southwest of the Jurupa Hills. There is a discernible depression in groundwater levels surrounding the Chino I & Chino II Desalter well fields.

Close inspection of the groundwater level data used to construct these maps suggests the existence of hydraulically distinct aquifer systems—primarily in MZ1 and the western parts of MZ2. Previous investigations have concluded that two distinct aquifer systems exist in these areas: a shallow unconfined to semi-confined aquifer and deeper confined aquifer. The groundwater levels shown in these maps correspond to the shallow aquifer system and do not reflect the piezometric levels of the deeper aquifers.

3.6.3 Changes in Groundwater Storage

Watermaster developed a GIS model to estimate groundwater storage changes from the groundwater level contour maps discussed above. In preparing this model, Watermaster compiled a comprehensive library of well driller's logs for wells in the Chino Basin. Lithologic descriptions of borehole cuttings and associated depth intervals were digitized and added to Watermaster's database. All lithologic descriptions were then assigned a value of specific yield based on USGS investigations (Johnson, 1967). These data were then used to estimate the average specific yield across each hydrostratigraphic layer in the Chino Basin (see Section 2 of this report for additional details).

The storage change model and the procedures for estimating storage change include:

- Create groundwater elevation contour maps of the Chino Basin for the beginning and ending of the period for which a storage change will be estimated (e.g. fall 2000, fall 2003, and fall 2006).
- Create three-dimensional raster surfaces (ESRI grids) of the groundwater elevation contour maps.

- Create a 400-meter by 400-meter grid (polygon shapefile) of the Chino Basin.
- Assign attributes to each grid cell for (1) surface area, (2) overlying management zone, (3) beginning groundwater elevation surface (e.g. fall 2003), (4) ending groundwater elevation surface (e.g. fall 2006), (5) top and bottom elevations for the model layers, and (6) the specific yield of sediments for each model layer.
- Export the attribute table of the 400-meter grid to spreadsheet format to calculate the volumetric storage change.

Figure 3-20 shows the 400x400-meter grid, symbolized by the storage change between fall 2000 and fall 2003. Basin-wide, the groundwater storage model estimates a change in storage of about -93,400 AF over this three-year period. Based on this figure, the following sub-areas experienced a decrease in storage:

- In the northwest near Pomona and Montclair
- In the northeast near Fontana and eastern Ontario and Rancho Cucamonga
- Near the Chino I Desalter well field, which began producing groundwater in 2000

And, the following sub-areas experienced an increase in storage:

- In the southwest within the City of Chino where pumping decreased in association with the land subsidence investigation and the Forbearance Agreement
- In the south, just north of the Santa Ana River, where many agricultural wells are being destroyed as land use transitions from agricultural to urban

Figure 3-21 shows the 400x400-meter grid, symbolized by the storage change between fall 2003 and fall 2006. Basin-wide, the groundwater storage model estimates a change in storage of about +46,500 AF over this three-year period. Based on this figure, the following sub-areas experienced a decrease in storage:

- In the northeast near Fontana as well as in eastern Ontario and Rancho Cucamonga in MZ2 and MZ3
- In the area directly west of the Jurupa Mountains in MZ3
- In the area immediately surrounding the eastern portions of the Chino I Desalter well field (During this period, increased production in this area was mainly due to the onset of pumping at the Chino I Desalter expansion wells.)

And, the following sub-areas experienced an increase in storage:

- In the northwest near Pomona and Montclair in MZ1 where pumping decreased in association with in-lieu recharge for the Dry-Year Yield program
- In the southwest within the City of Chino where pumping decreased in association with the land subsidence investigation and the Forbearance Agreement
- In the southern region of MZ2 on the west side of the Chino I Desalter well field
- In the south, just north of the Santa Ana River, where many agricultural wells are being destroyed as land use transitions from agricultural to urban

Figure 3-22 shows the 400x400-meter grid, symbolized by the storage change between fall 2006 and fall 2008. Basin-wide, the groundwater storage model estimates a change in storage of about -53,600 AF over this two-year period. Based on this figure, the following sub-areas experienced a decrease in storage:

- In the area directly west and southwest of the Jurupa Mountains in MZ3 (This area is influenced by groundwater production at wells owned by the Jurupa Community Services District.)
- In the area immediately surrounding the eastern portion of the Chino I Desalter well field (During this period, increased production in this area was mainly due to the continued pumping at the Chino I Desalter expansion wells.)
- In the area immediately surrounding the Chino II Desalter well field (During this period, increased production in this area was due to increased pumping at the Chino II Desalter wells.)

And, the following sub-areas experienced an increase in storage:

- In the northwest near Pomona and Montclair in MZ1 where pumping decreased in association with in-lieu recharge for the Dry-Year Yield program
- In the southwest where pumping decreased in association with the land subsidence investigation and the Forbearance Agreement
- In the south, just north of the Santa Ana River, where many agricultural wells are being destroyed as land use transitions from agricultural to urban

The total change in storage since implementation of the OBMP (2000-08) is approximately -62,000 AF.

3.6.4 Assessment of Hydraulic Control

The hydrologic conceptual model of Chino Basin describes an aquifer system where groundwater flows from areas of recharge in the Chino-North MZ (a grouping of the northern portions of MZs 1, 2, and 3) toward areas of historical surface discharge in the south near the Prado Basin and the Santa Ana River (WEI, 2006a). One of the intended purposes of the Chino Desalter well fields is to intercept (capture) groundwater originating in the Chino-North MZ before discharges to the Prado Basin or the Santa Ana River as surface water.

Piezometric data collected from monitoring and production wells in the southern portion of the Chino Basin during the period of 1997 through 2008 were analyzed to determine the state of hydraulic control. For a full discussion of hydraulic control, see the *Chino Basin Maximum Benefit Monitoring Program 2008 Annual Report* (WEI, 2009). Figure 3-23 shows groundwater elevation contours and data for the shallow aquifer system in spring 2000—prior to any significant pumping by the Chino I Desalter wells. The contours depict regional groundwater flow from the northeast to the southwest. Figure 3-24 shows groundwater elevation contours and data for the shallow aquifer system in spring 2006—after six years of pumping from the Chino I Desalter wells but prior to any significant pumping from the Chino II Desalter wells. Note that desalter pumping in 2006 interrupts the regional flow pattern of 2000. Specifically, the contours to the north and southeast of the desalter well field swing in towards the eastern half of the well field where the desalter wells are perforated primarily within the shallow aquifer system. Figure 3-26 shows groundwater elevation contours and data for the shallow aquifer system in spring 2008, approximately eight years after the commencement of Chino I Desalter pumping and two years after the commencement of Chino II Desalter pumping. The Chino II Desalter well field began producing groundwater in mid-2006, causing the contours to swing in toward the well field from the north and the southeast. The data continue to suggest a reduction in the southward component of the hydraulic gradient around the western half of the Chino I Desalter well field; however, the contours do not indicate a gradient reversal and, hence, do not provide compelling evidence for hydraulic control in this region.

Since 2000, pumping at the Chino I Desalter well field has generally flattened the regional hydraulic gradient within the shallow aquifer system around the western half of the Chino I Desalter well field and has created a capture zone surrounding the eastern half of the well field. Around the western half of the Chino I Desalter well field, piezometric data suggest a significant reduction in the southward component of the hydraulic gradient but do not indicate a gradient reversal (northward component) and, hence, do not yet provide compelling evidence for complete hydraulic control at the Chino I Desalter well field. Pumping at the Chino II Desalter well field, where all wells are perforated within the shallow and deep aquifer systems, began in mid-2006. A depression continues to develop in the piezometric surface. The ultimate fate of groundwater that flows past the western portion of the Chino I Desalter well field is continued flow southward toward the Prado Basin where groundwater rises to become surface water in the tributaries of the Prado Basin.

Table 3-1
Summary of Recharge and Discharge
(acre-ft)

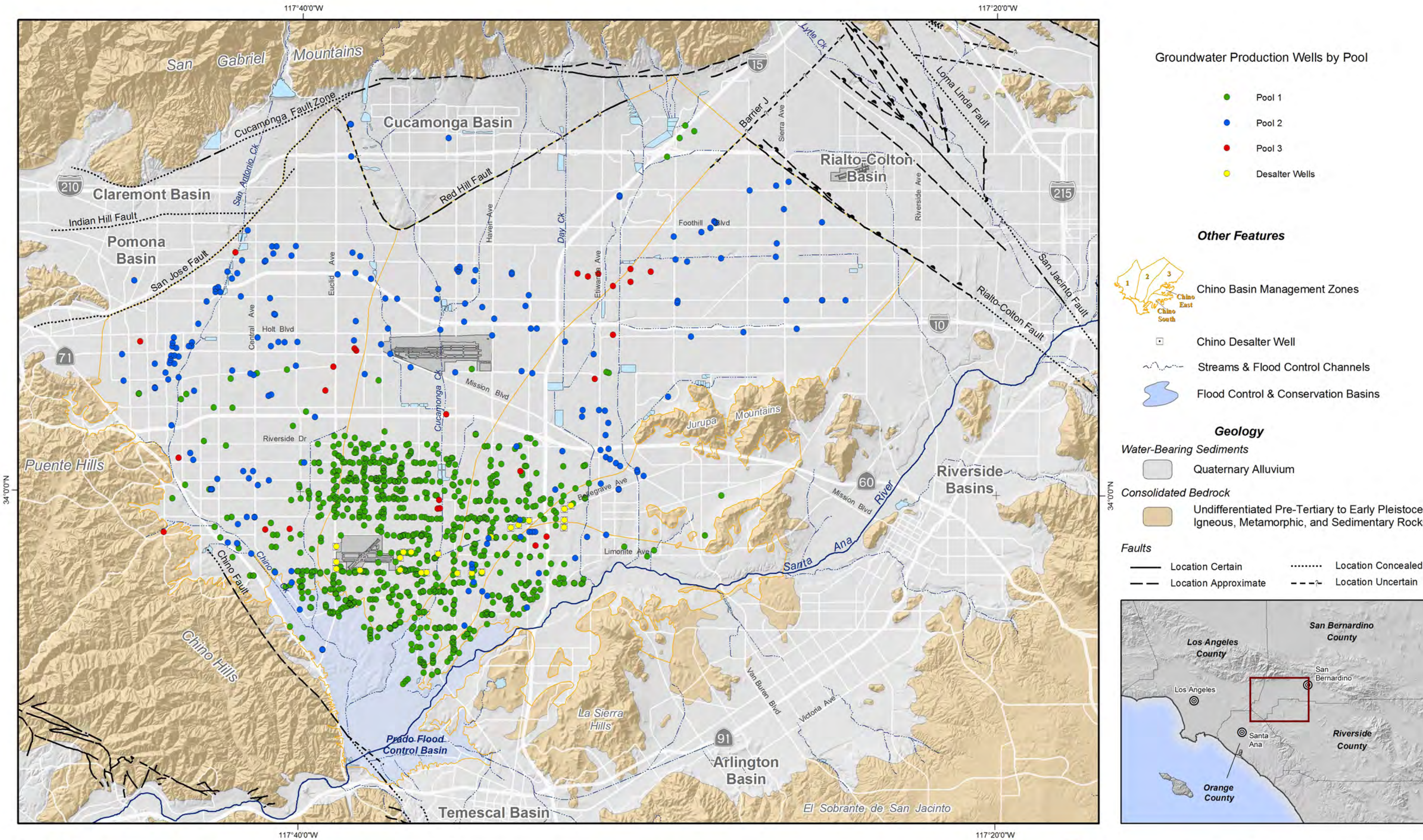
Fiscal Year	Wet Water Recharge to the Chino Basin										Discharge[7]										
	Safe Yield	Wet Water Recharge[1]							Total Inflow	Pumping						Pumping Distribution (% of Total)				
		Replenish	Cyclic or Conj Use	MZ1 Program	Recycled	New Storm Water[5]	Desalter Induced SAR Inflow[6]	Total		Appropriative Pool less CDA Desalters[2, 3, 4]	Chino Desalter Authority	Total Appropriative Pool	Agricultural Pool	Overlying Non-Ag Pool	Total	Appropriative Pool less CDA Desalters[2, 3, 4]	Chino Desalter Authority	Total Appropriative Pool	Agricultural Pool	Overlying Non-Ag Pool
1977 - 1978	140,000	10,680	0	0	0	0	0	10,680	150,680	60,659	0	60,659	83,934	10,082	154,675	39%	0%	39%	54%	7%
1978 - 1979	140,000	12,638	15,757	0	0	0	0	28,395	168,395	60,597	0	60,597	73,688	7,127	141,412	43%	0%	43%	52%	5%
1979 - 1980	140,000	2,507	14,243	0	0	0	0	16,751	156,751	63,834	0	63,834	69,369	7,363	140,566	45%	0%	45%	49%	5%
1980 - 1981	140,000	12,228	8,662	0	0	0	0	20,890	160,890	70,726	0	70,726	68,040	5,650	144,416	49%	0%	49%	47%	4%
1981 - 1982	140,000	16,609	5,047	0	0	0	0	21,656	161,656	66,731	0	66,731	65,117	5,684	137,532	49%	0%	49%	47%	4%
1982 - 1983	140,000	13,188	15,501	0	0	0	0	28,689	168,689	63,481	0	63,481	56,759	2,395	122,635	52%	0%	52%	46%	2%
1983 - 1984	140,000	13,777	7,960	0	0	0	0	21,737	161,737	70,558	0	70,558	59,033	3,208	132,799	53%	0%	53%	44%	2%
1984 - 1985	140,000	12,188	8,709	0	0	0	0	20,897	160,897	76,912	0	76,912	55,543	2,415	134,870	57%	0%	57%	41%	2%
1985 - 1986	140,000	16,332	2,095	0	0	0	0	18,427	158,427	80,859	0	80,859	52,061	3,193	136,113	59%	0%	59%	38%	2%
1986 - 1987	140,000	10,086	9,921	0	0	0	0	20,007	160,007	84,662	0	84,662	59,847	2,559	147,068	58%	0%	58%	41%	2%
1987 - 1988	140,000	2,494	0	0	0	0	0	2,494	142,494	91,579	0	91,579	57,865	2,958	152,402	60%	0%	60%	38%	2%
1988 - 1989	140,000	7,407	0	0	0	0	0	7,407	147,407	93,617	0	93,617	46,762	3,619	143,998	65%	0%	65%	32%	3%
1989 - 1990	140,000	0	0	0	0	0	0	0	140,000	101,344	0	101,344	48,420	4,856	154,620	66%	0%	66%	31%	3%
1990 - 1991	140,000	3,291	503	0	0	0	0	3,793	143,793	86,658	0	86,658	48,085	5,407	140,150	62%	0%	62%	34%	4%
1991 - 1992	140,000	3,790	1,761	0	0	0	0	5,551	145,551	91,982	0	91,982	44,682	5,240	141,904	65%	0%	65%	31%	4%
1992 - 1993	140,000	12,535	1,677	0	0	9,041	0	23,253	163,253	86,367	0	86,367	44,092	5,464	135,923	64%	0%	64%	32%	4%
1993 - 1994	140,000	8,859	7,634	0	0	0	0	16,493	156,493	80,798	0	80,798	44,298	4,586	129,682	62%	0%	62%	34%	4%
1994 - 1995	140,000	0	10,300	0	0	0	0	10,300	150,300	93,419	0	93,419	55,022	4,327	152,768	61%	0%	61%	36%	3%
1995 - 1996	140,000	82	0	0	0	0	0	82	140,082	101,606	0	101,606	43,639	5,424	150,669	67%	0%	67%	29%	4%
1996 - 1997	140,000	0	17	0	0	0	0	17	140,017	110,163	0	110,163	44,809	6,309	161,281	68%	0%	68%	28%	4%
1997 - 1998	140,000	8,323	0	0	0	0	0	8,323	148,323	97,435	0	97,435	43,344	4,955	145,734	67%	0%	67%	30%	3%
1998 - 1999	140,000	5,697	0	0	0	0	0	5,697	145,697	107,723	0	107,723	47,538	7,006	162,267	66%	0%	66%	29%	4%
1999 - 2000	140,000	1,001	0	0	507	0	0	1,508	141,508	126,645	0	126,645	44,401	7,774	178,820	71%	0%	71%	25%	4%
2000 - 2001	140,000	30	0	6,500	500	0	3,995	7,030	147,030	113,437	7,989	121,426	39,954	8,084	169,464	67%	5%	72%	24%	5%
2001 - 2002	140,000	0	0	6,500	505	0	4,729	7,005	147,005	121,489	9,458	130,947	39,494	5,548	175,989	69%	5%	74%	22%	3%
2002 - 2003	140,000	0	0	6,499	185	0	5,220	6,684	146,684	120,557	10,439	130,996	38,487	4,853	174,336	69%	6%	75%	22%	3%
2003 - 2004	140,000	4,020	2,463	3,558	48	0	5,303	10,089	150,089	136,834	10,605	147,439	41,978	2,915	192,332	71%	6%	77%	22%	2%
2004 - 2005	140,000	4,380	0	7,877	158	12,500	4,927	24,915	164,915	127,811	9,854	137,665	34,450	2,327	174,441	73%	6%	79%	20%	1%
2005 - 2006	140,000	33,756	0	1,554	1,304	12,999	4,944	49,613	189,613	124,315	16,479	140,794	33,900	3,026	177,720	70%	9%	79%	19%	2%
2006 - 2007	140,000	32,991	0	0	2,989	4,770	7,907	40,750	180,750	130,826	26,356	157,182	37,295	3,369	197,846	66%	13%	79%	19%	2%
2007 - 2008	140,000	0	0	0	2,340	10,243	8,092	12,583	152,583	103,078	26,972	130,050	30,910	3,440	164,400	63%	16%	79%	19%	2%
Totals	4,340,000	248,888	112,249	32,489	8,536	49,553	45,114	451,715	4,791,715	2,946,702	118,152	3,064,853	1,552,816	151,162	4,768,832					
Average	140,000	8,029	3,621	1,048	275	1,598	1,455	14,571	154,571	95,055	14,769	98,866	50,091	4,876	153,833	59%	8%	63%	35%	3%
Max	140,000	33,756	15,757	7,877	2,989	12,999	8,092	49,613	189,613	136,834	26,972	157,182	83,934	10,082	197,846	73%	16%	79%	55%	7%
Min	140,000	0	0	0	0	0	0	0	140,000	60,597	0	60,597	33,900	2,327	122,635	39%	0%	39%	19%	1%

[1] Includes only water actually spread
[2] Includes only actual water produced and does not include MWD exchanges
[3] Includes adjustment for Ontario production of 633 AF in FY 2001-02
[4] Includes adjustment for Jurupa, Niagara, and Chino production correction of 1,030 AF in FY 2002-03
[5] Includes 9,041 acre-ft of surface water recharge in the Chino Basin that would otherwise have recharged the Claremont Heights Basin in FY 1992-93; and CBFIP stormwater capture of 12,500 acre-ft/yr beginning in FY 2004-05.
[6] Watermaster has assumed that half of the desalter pumping has been replenished by induced recharge in the Santa Ana River through FY 2004-05 and that 30 percent of the desalter pumping has been replenished by induced recharge in the Santa Ana River in FY 2005-06
[7] The only discharge considered herein is pumping, the other discharges are assumed netted out in the safe yield

Table 3-2
Summary of Annual Wet Water Recharge in the Chino Basin

Basin Name	2000/2001				2001/2002				2002/2003				2003/2004			
	Storm Water	Imported Water	Recycled Water	Total Recharge	Storm Water	Imported Water	Recycled Water	Total Recharge	Storm Water	Imported Water	Recycled Water	Total Recharge	Storm Water	Imported Water	Recycled Water	Total Recharge
Banana Basin	390	0	0	390	184	0	0	184	366	0	0	366	188	0	0	188
Declez Basin	--	0	0	0	--	0	0	0	--	0	0	0	--	0	0	0
Etiwanda Conservation Ponds	--	0	0	0	--	0	0	0	--	0	0	0	--	0	0	0
Hickory Basin	37	0	0	37	105	0	0	105	551	0	0	551	224	0	0	224
Jurupa Basin	--	0	0	0	--	0	0	0	--	0	0	0	--	0	0	0
RP-3 Basins	--	0	0	0	--	0	0	0	--	0	0	0	--	0	0	0
Turner Basin	167	0	0	167	100	0	0	100	192	0	0	192	0	0	0	0
7^{th} and 8^{th} Street Basins	--	0	0	0	--	0	0	0	--	0	0	0	--	0	0	0
Brooks Street Basin	0	0	0	0	104	0	0	104	676	0	0	676	--	0	0	0
College Heights Basins	--	0	0	0	--	0	0	0	--	0	0	0	--	0	0	0
Ely Basins	--	0	500	500	--	0	505	505	--	0	185	185	--	0	48	48
Etiwanda Spreading Basins	--	0	0	0	--	0	0	0	--	0	0	0	--	2,812	0	2,812
Lower Day Basin	--	0	0	0	--	0	0	0	--	0	0	0	--	0	0	0
Montclair Basins	2,890	6,530	0	9,420	773	6,500	0	7,273	1,328	6,499	0	7,827	--	3,558	0	3,558
San Sevaine	--	0	0	0	--	0	0	0	--	0	0	0	--	1,211	0	1,211
Upland Basin	--	0	0	0	--	0	0	0	--	0	0	0	--	0	0	0
Victoria Basin	--	0	0	0	--	0	0	0	--	0	0	0	--	0	0	0
Totals:	3,484	6,530	500	10,514	1,266	6,500	505	8,271	3,113	6,499	185	9,797	412	7,582	48	8,042

Basin Name	2004/2005				2005/2006				2006/2007				2007/2008			
	Storm Water	Imported Water	Recycled Water	Total Recharge	Storm Water	Imported Water	Recycled Water	Total Recharge	Storm Water	Imported Water	Recycled Water	Total Recharge	Storm Water	Imported Water	Recycled Water	Total Recharge
Banana Basin	459	0	0	459	221	206	529	956	226	783	643	1,652	278	0	157	435
Declez Basin	--	0	0	0	737	0	0	737	0	0	0	0	730	0	0	730
Etiwanda Conservation Ponds	--	197	0	197	--	0	0	0	0	0	0	0	0	0	0	0
Hickory Basin	653	0	0	653	517	623	586	1,726	536	212	646	1,394	949	0	625	1,574
Jurupa Basin	--	0	0	0	--	0	0	0	0	0	0	0	0	0	0	0
RP-3 Basins	--	0	0	0	767	0	0	767	802	0	0	802	511	0	0	511
Turner Basin	297	310	0	607	2,575	346	0	2,921	406	313	1237	1,956	1542	0	0	1,542
7^{th} and 8^{th} Street Basins	--	0	0	0	1,271	0	0	1,271	640	0	0	640	959	0	1,054	2,013
Brooks Street Basin	--	0	0	0	524	2033	0	2,557	205	1604	0	1,809	475	0	0	475
College Heights Basins	--	0	0	0	108	5,432	0	5,540	1	3,125	0	3,126	172	0	0	172
Ely Basins	--	0	158	158	1,531	0	188	1,719	631	0	466	1,097	1,603	0	562	2,165
Etiwanda Spreading Basins	--	2,137	0	2,137	20	2,488	0	2,508	0	1,160	0	1,160	10	0	0	10
Lower Day Basin	--	107	0	107	624	2,810	0	3,434	78	2,266	0	2,344	303	0	0	303
Montclair Basins	--	7,887	0	7,887	1,296	5,536	0	6,832	355	10,681	0	11,036	859	0	0	859
San Sevaine	--	1,621	0	1,621	2,072	9,172	0	11,244	244	5,749	0	5,993	749	0	0	749
Upland Basin	--	0	0	0	214	5,922	0	6,136	195	7068	0	7,263	312	0	0	312
Victoria Basin	--	0	0	0	330	0	0	330	260	0	0	260	427	0	0	427
Totals:	1,409	12,258	158	13,825	12,807	34,568	1,303	48,678	4,579	32,961	2,992	40,532	9,879	0	2,398	12,277



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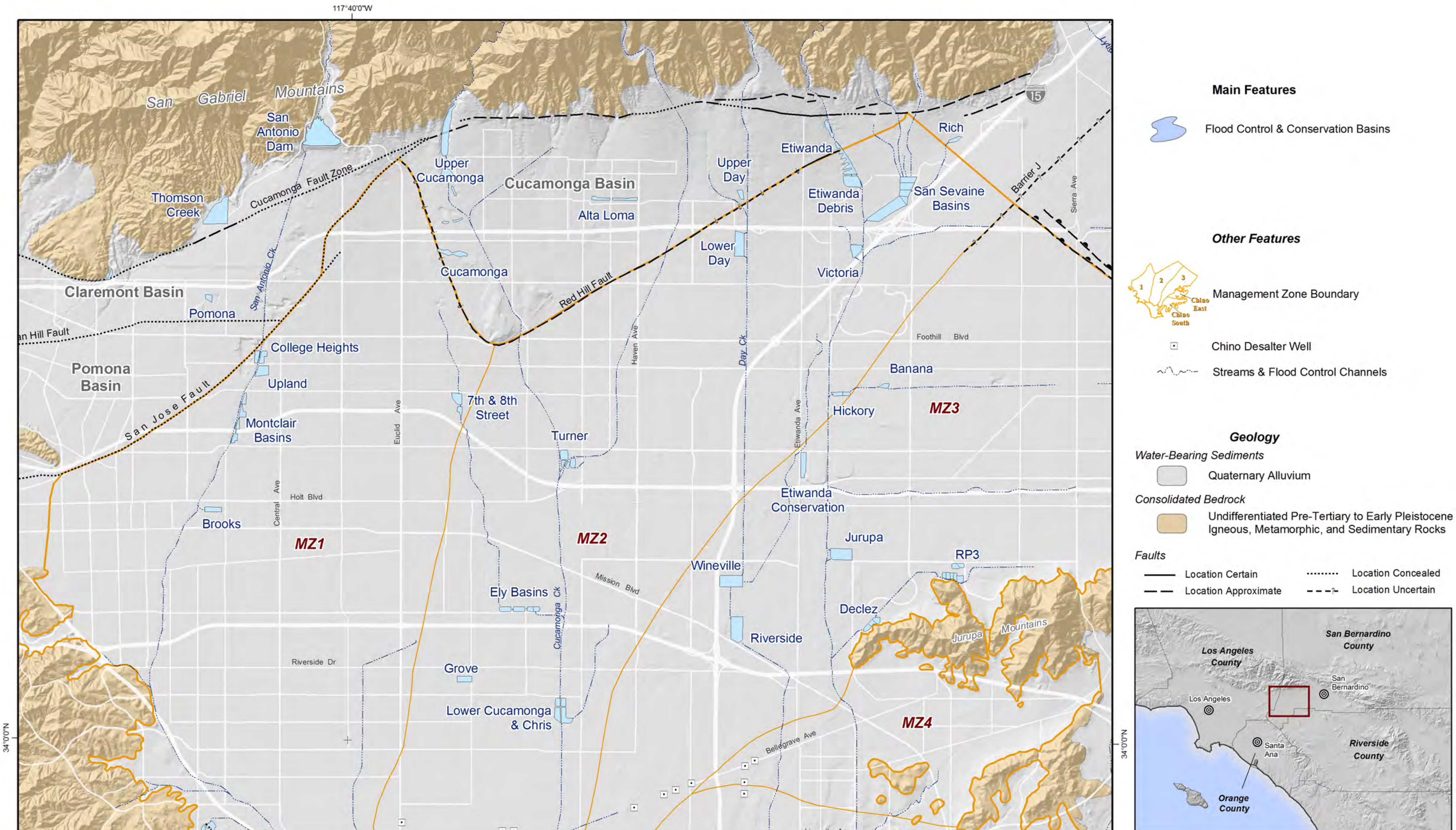
2008 State of the Basin Report
Basin Operations and Groundwater Level Monitoring

Active Production Wells by Pool

Production Wells as of Fiscal Year 2007-08

Figure 3-1



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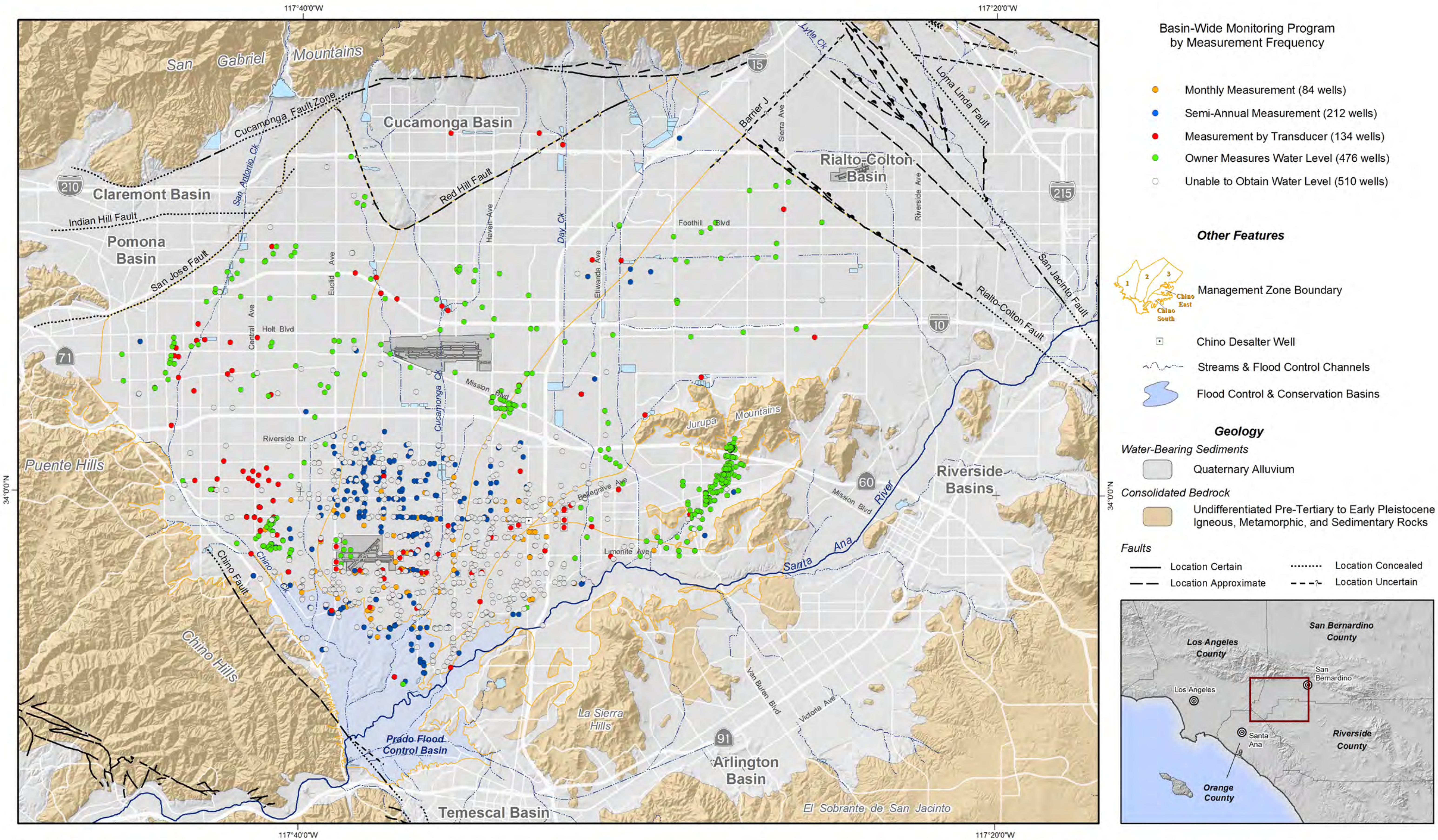
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Basin Operations and Groundwater Level Monitoring

Recharge Basin Locations

Figure 3-2



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2008 State of the Basin Report
Basic Operations and Groundwater Level Monitoring

Groundwater Level Monitoring Network
Well Locations and Measurement Frequency

Figure 3-3

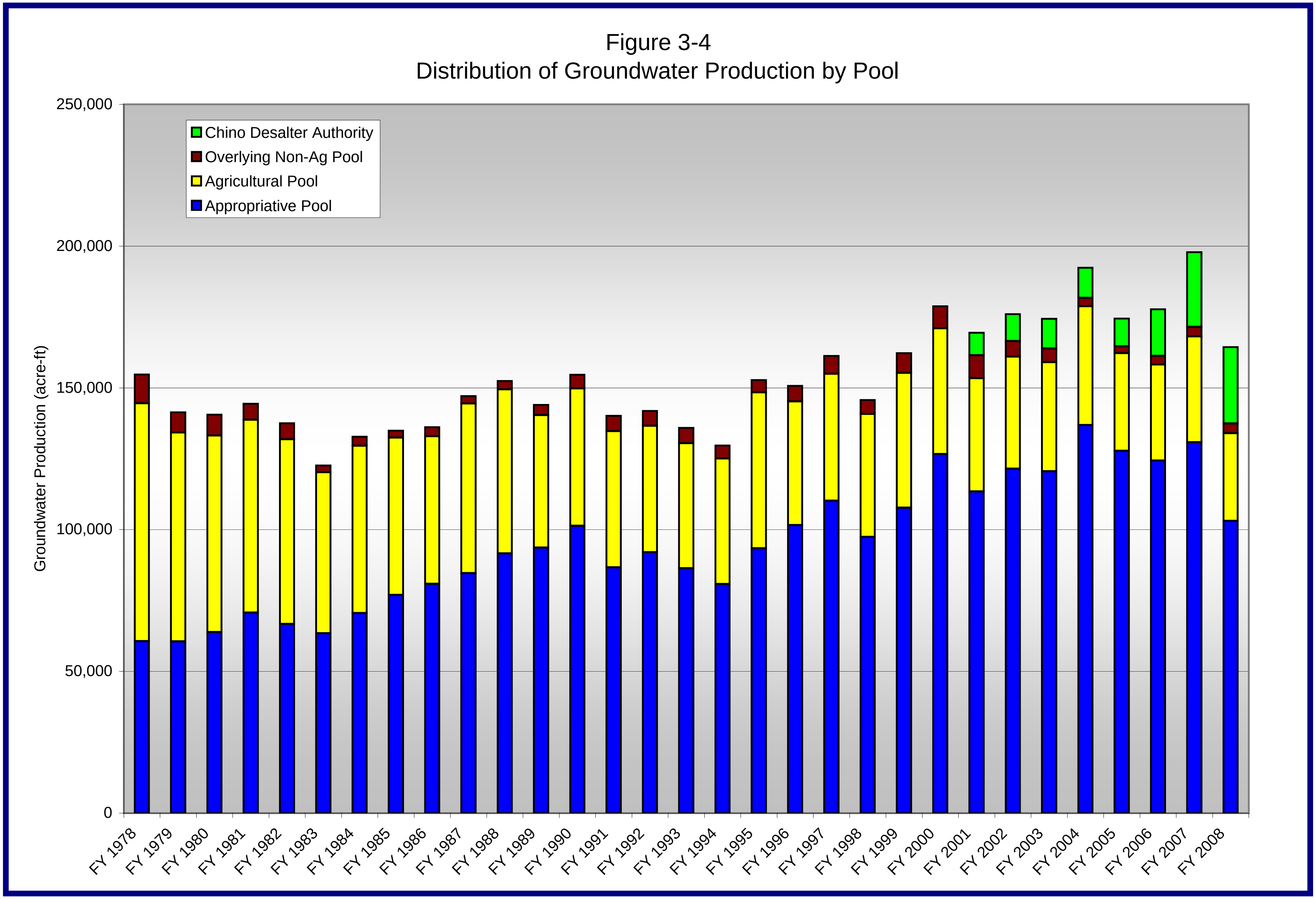

Figure_3-4.xlsFigure 3-4

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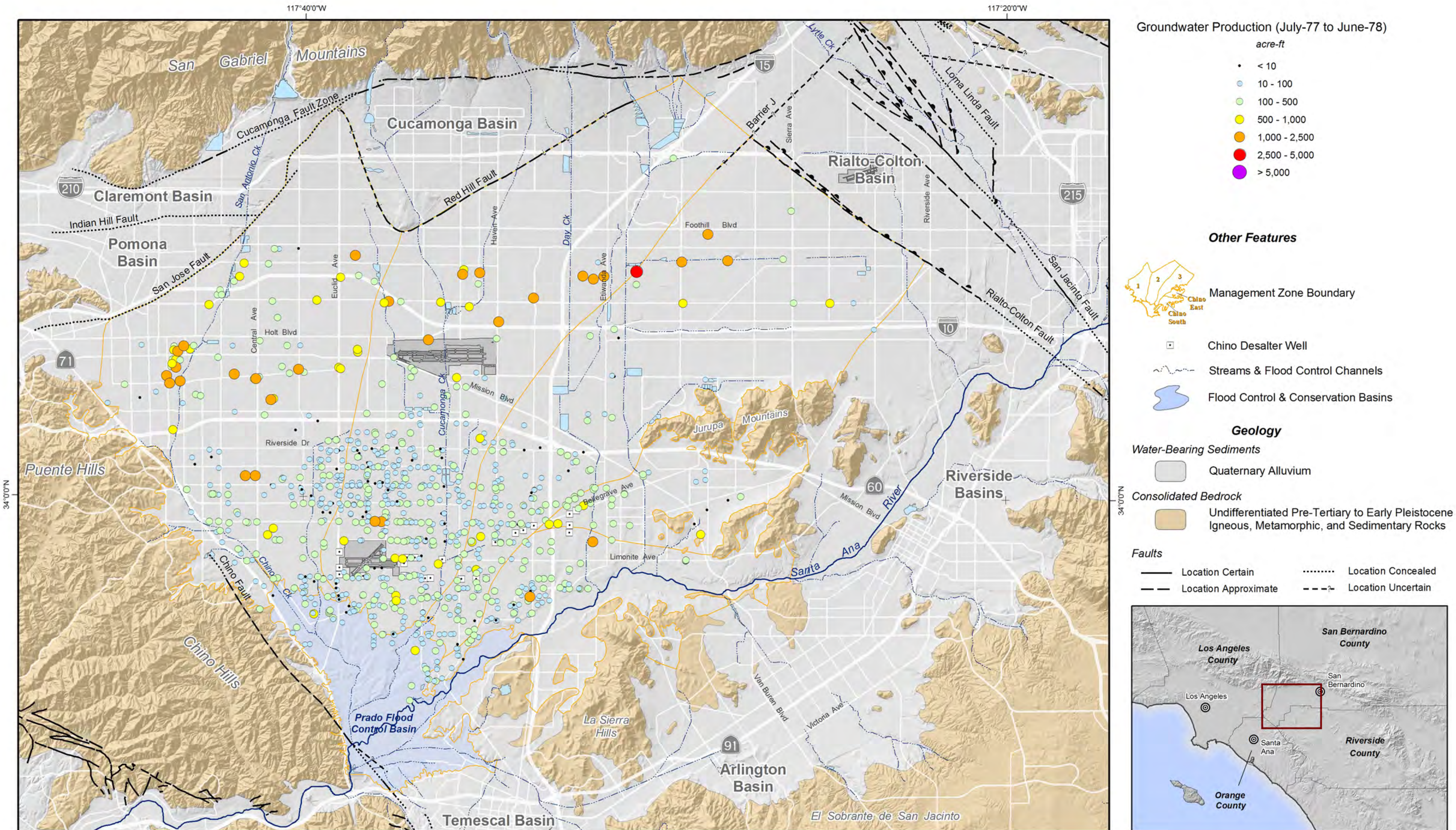

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0 1 2 3 4 5 Miles

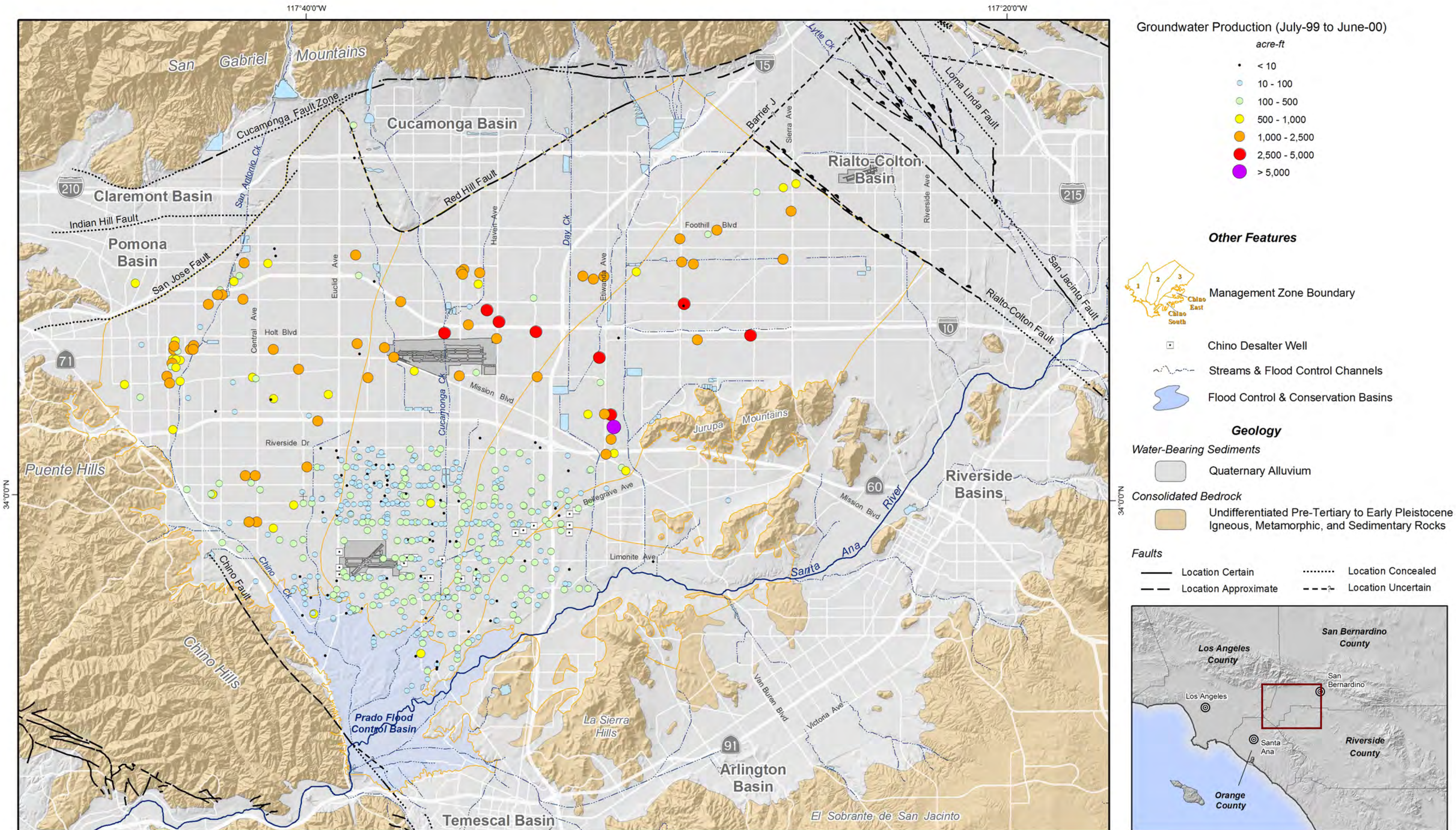
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Pumping

Groundwater Production by Well

Fiscal Year 1977-1978

Figure 3-5



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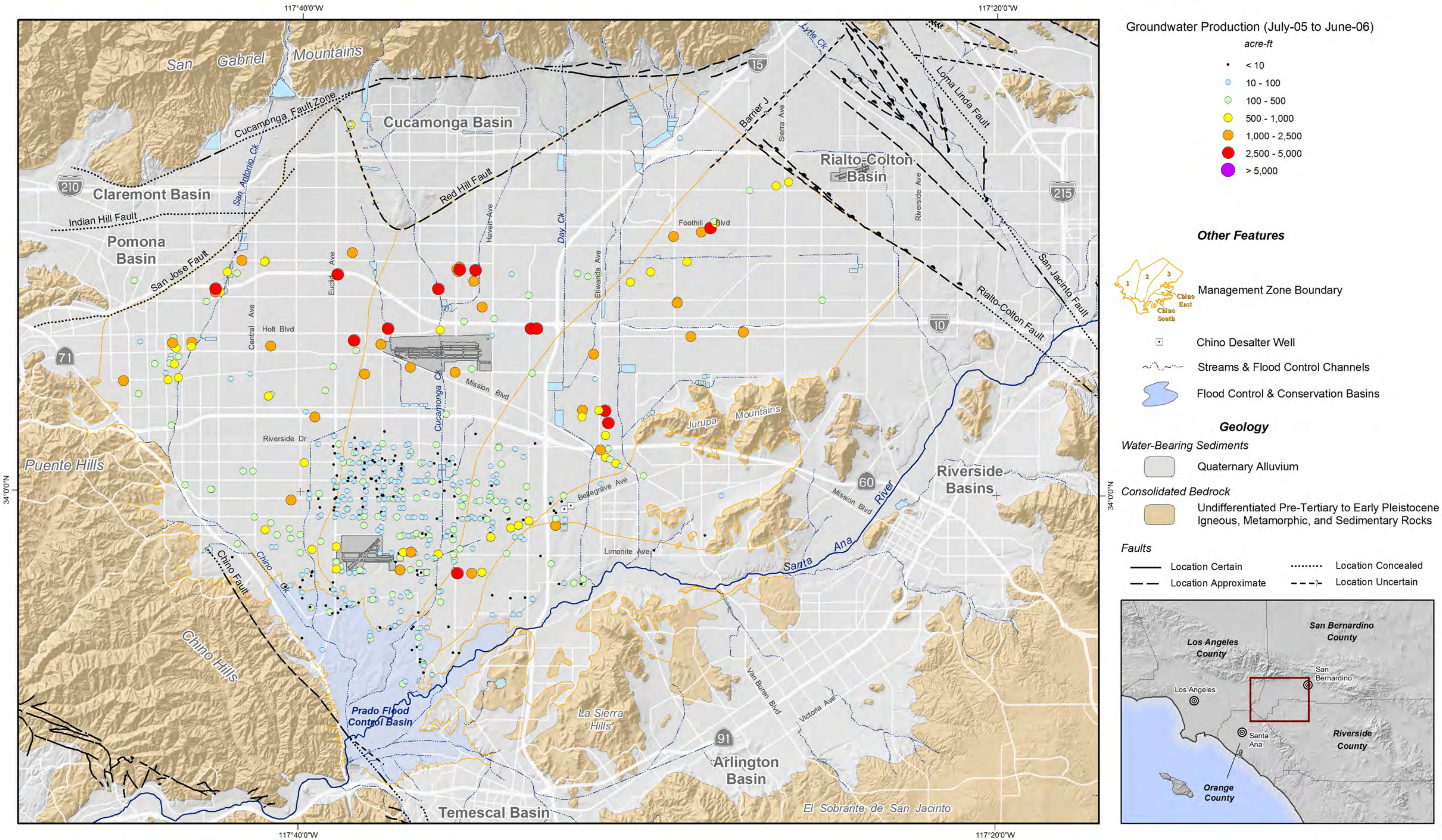
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Pumping

Groundwater Production by Well

Fiscal Year 1999-2000

Figure 3-6



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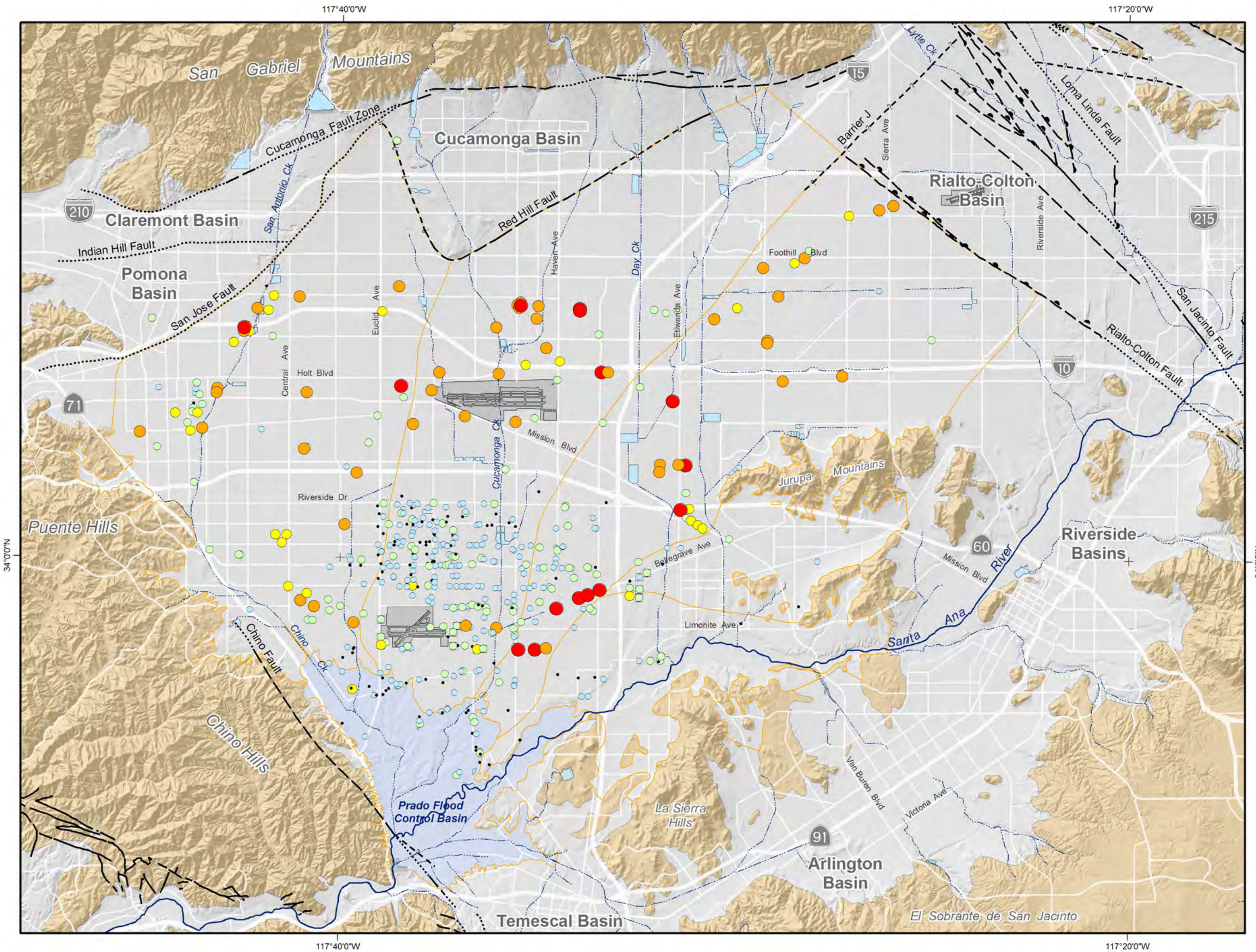
2008 State of the Basin Report
Groundwater Pumping

Groundwater Production by Well

Fiscal Year 2005-2006

Figure 3-7



Groundwater Production (July-06 to June-07)

acre-ft

- < 10
- 10 - 100
- 100 - 500
- 500 - 1,000
- 1,000 - 2,500
- 2,500 - 5,000
- > 5,000

Other Features

- Management Zone Boundary (1, 2, 3, Chino East, Chino South)
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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0 1 2 3 4 5 Miles

0 2 4 6 8 KM

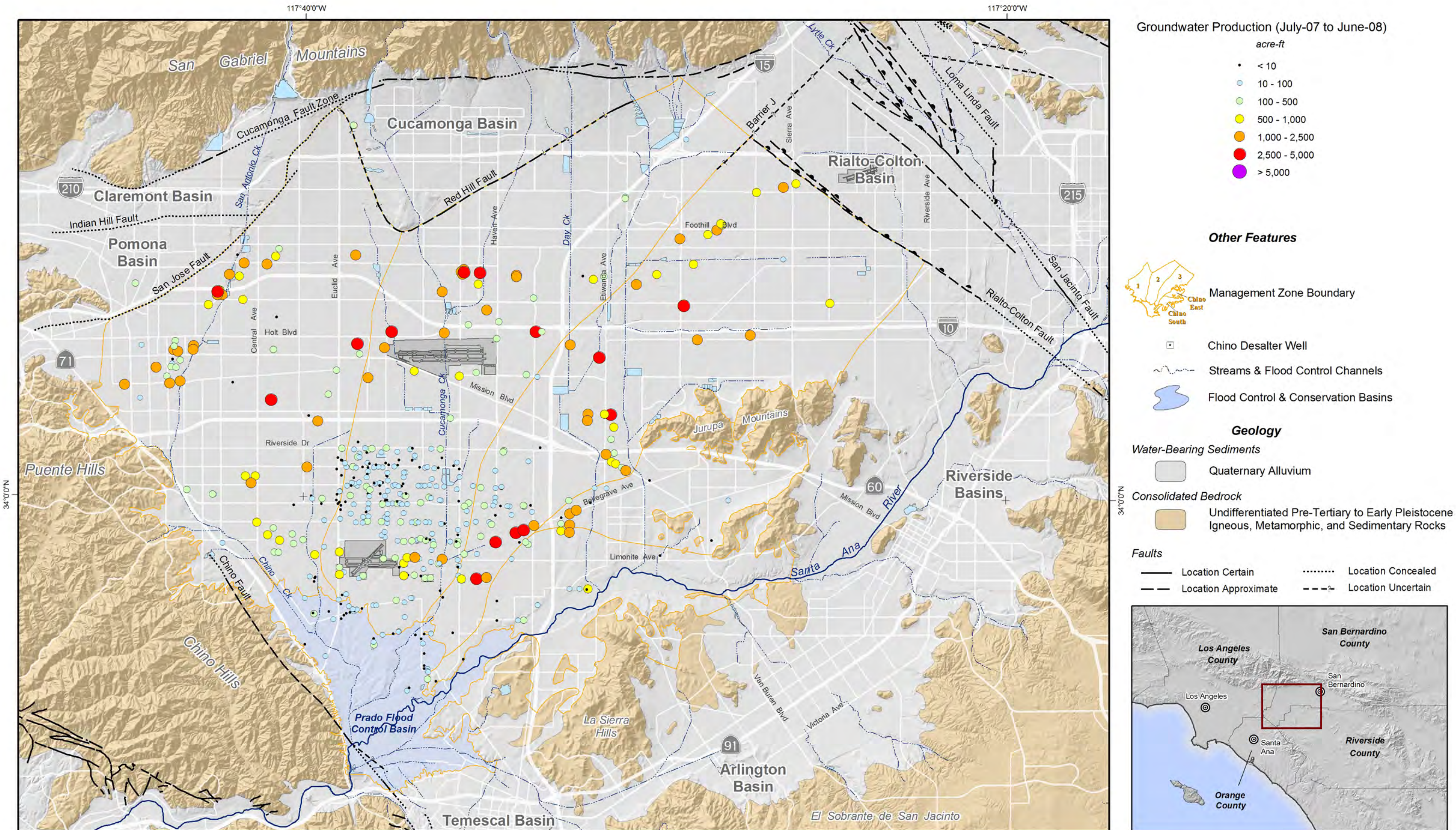
2008 State of the Basin Report

Groundwater Pumping

Groundwater Production by Well

Fiscal Year 2006-2007

Figure 3-8



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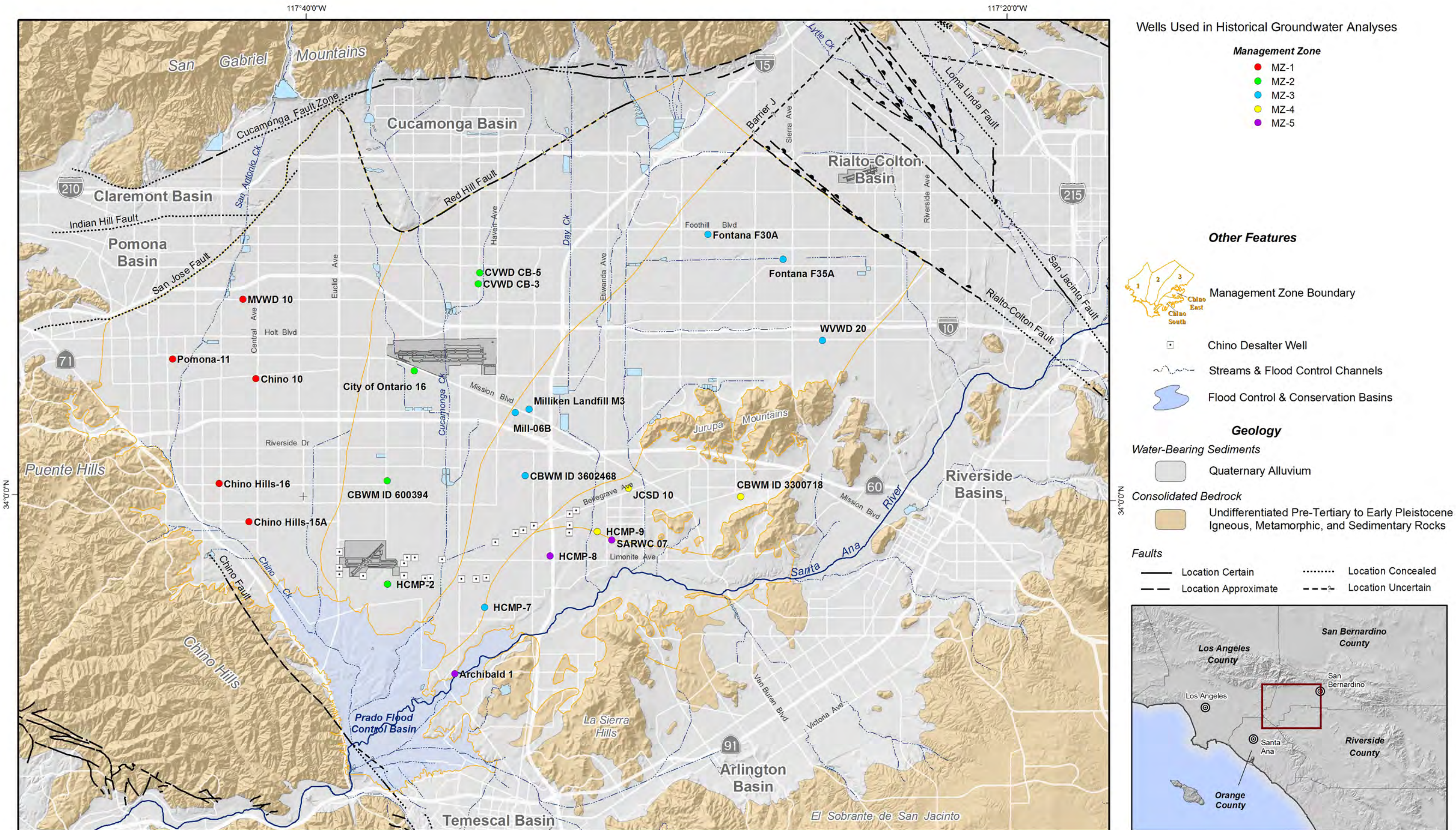
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Pumping

Groundwater Production by Well
Fiscal Year 2007-2008

Figure 3-9



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0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Levels

Historical Groundwater Level Trends
Well Location Map
Wells Used in Historical Groundwater Level Analyses

Figure 3-10

Figure 3-11 - Time History of Production, Recharge, and Groundwater Levels in MZ1

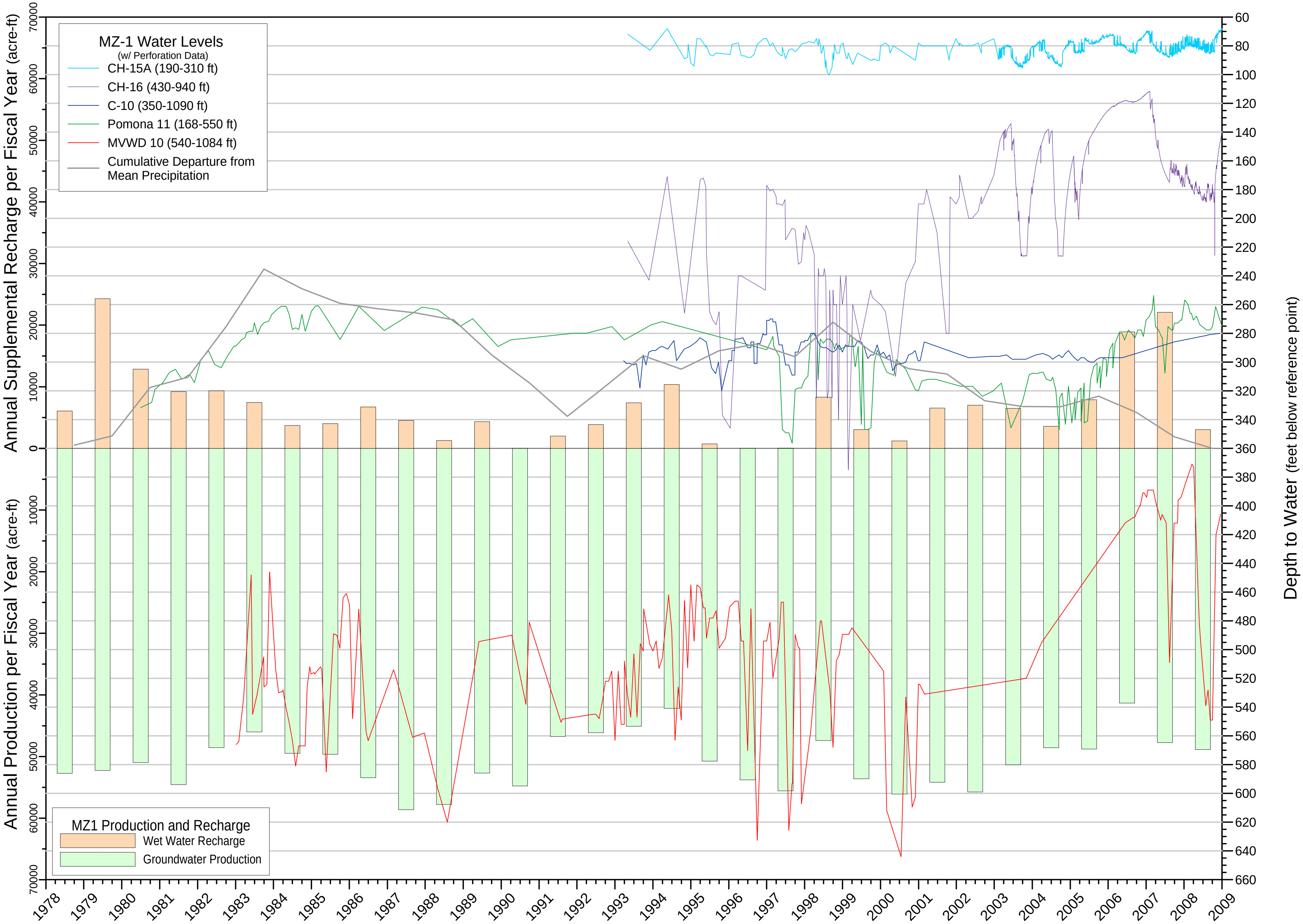

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Figure 3-12 - Time History of Production, Recharge, and Groundwater Levels in MZ2

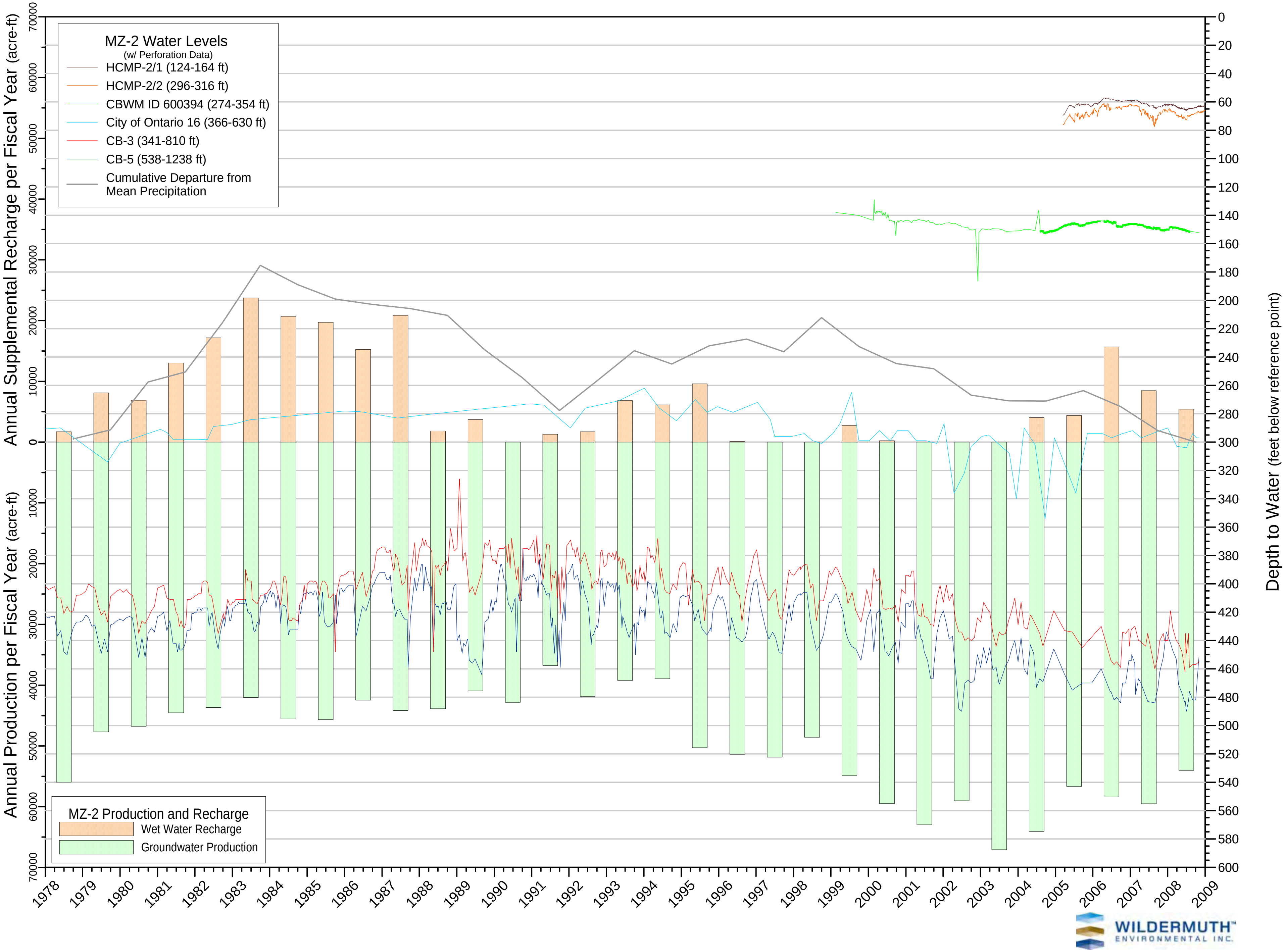


Figure 3-13 - Time History of Production, Recharge, and Groundwater Levels in MZ3

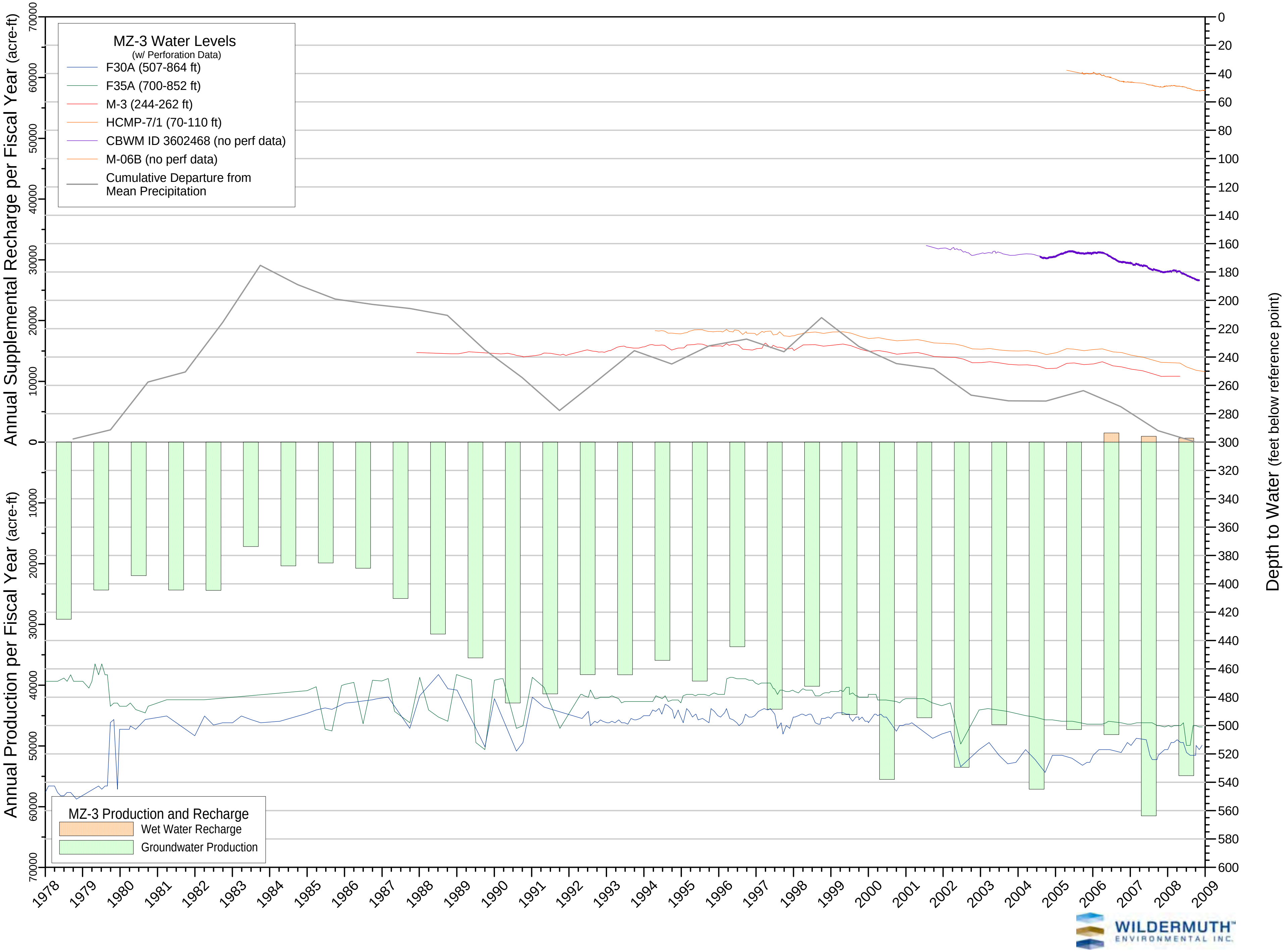


Figure 3-14 - Time History of Production, Recharge, and Groundwater Levels in Chino-East MZ

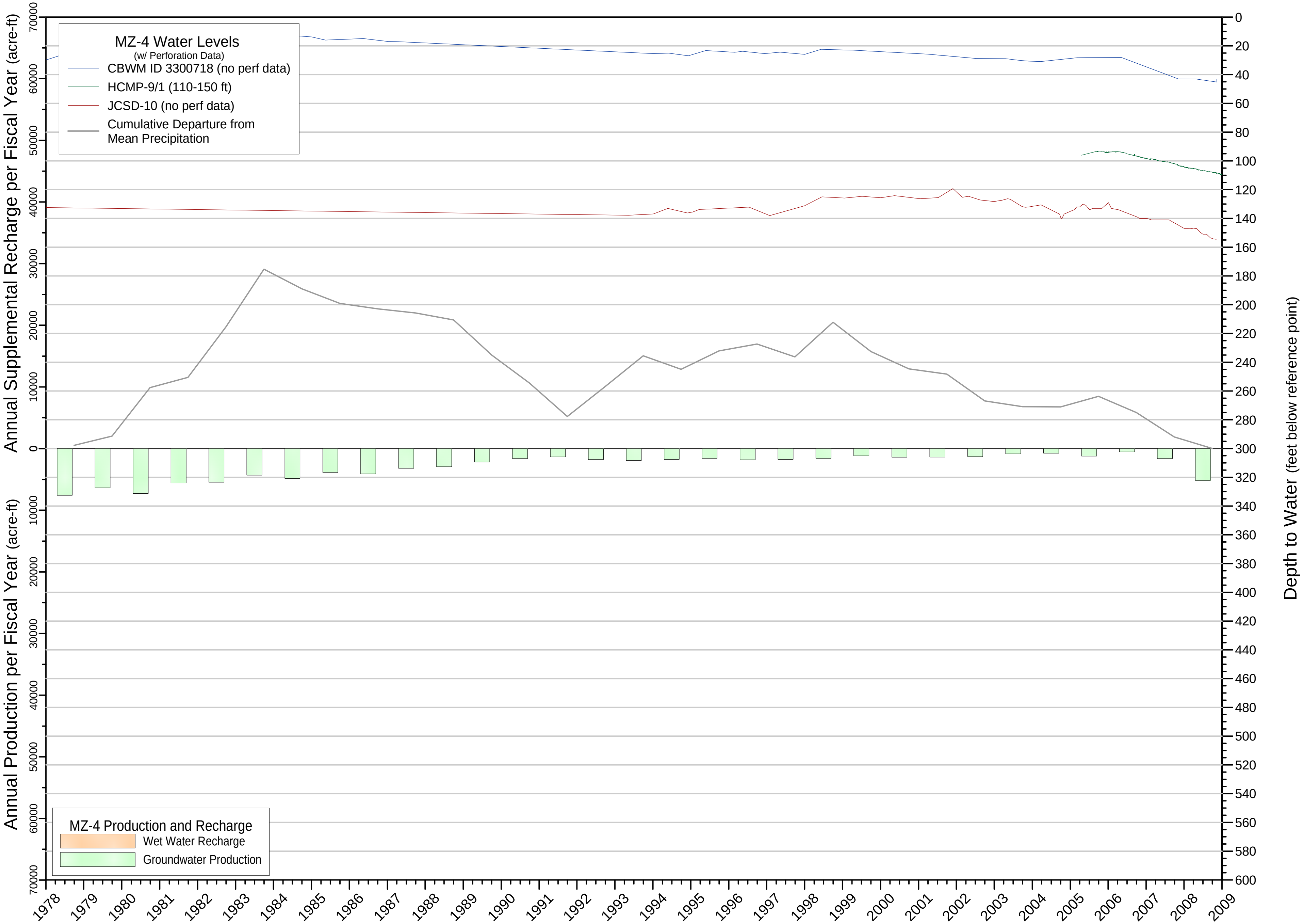
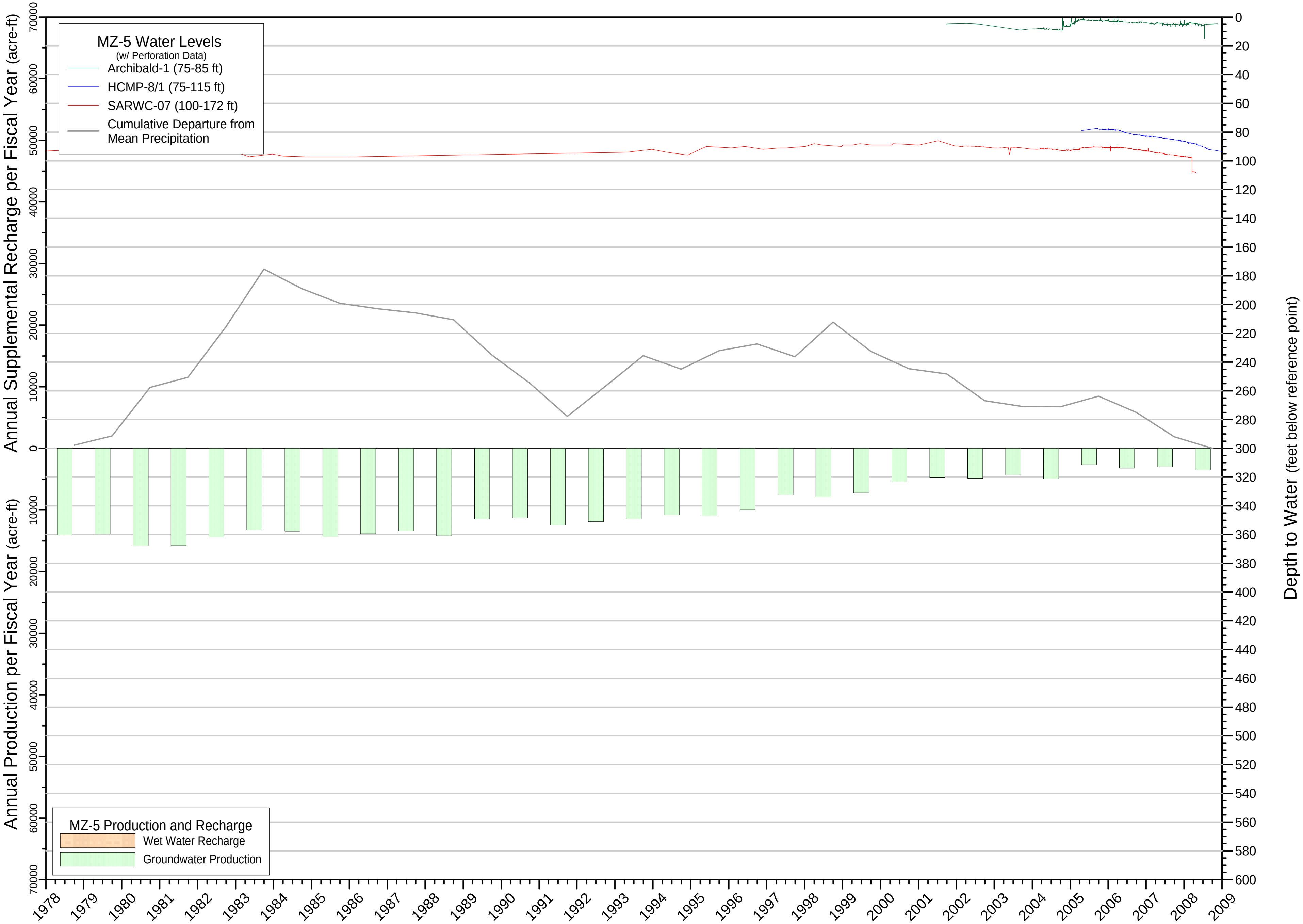
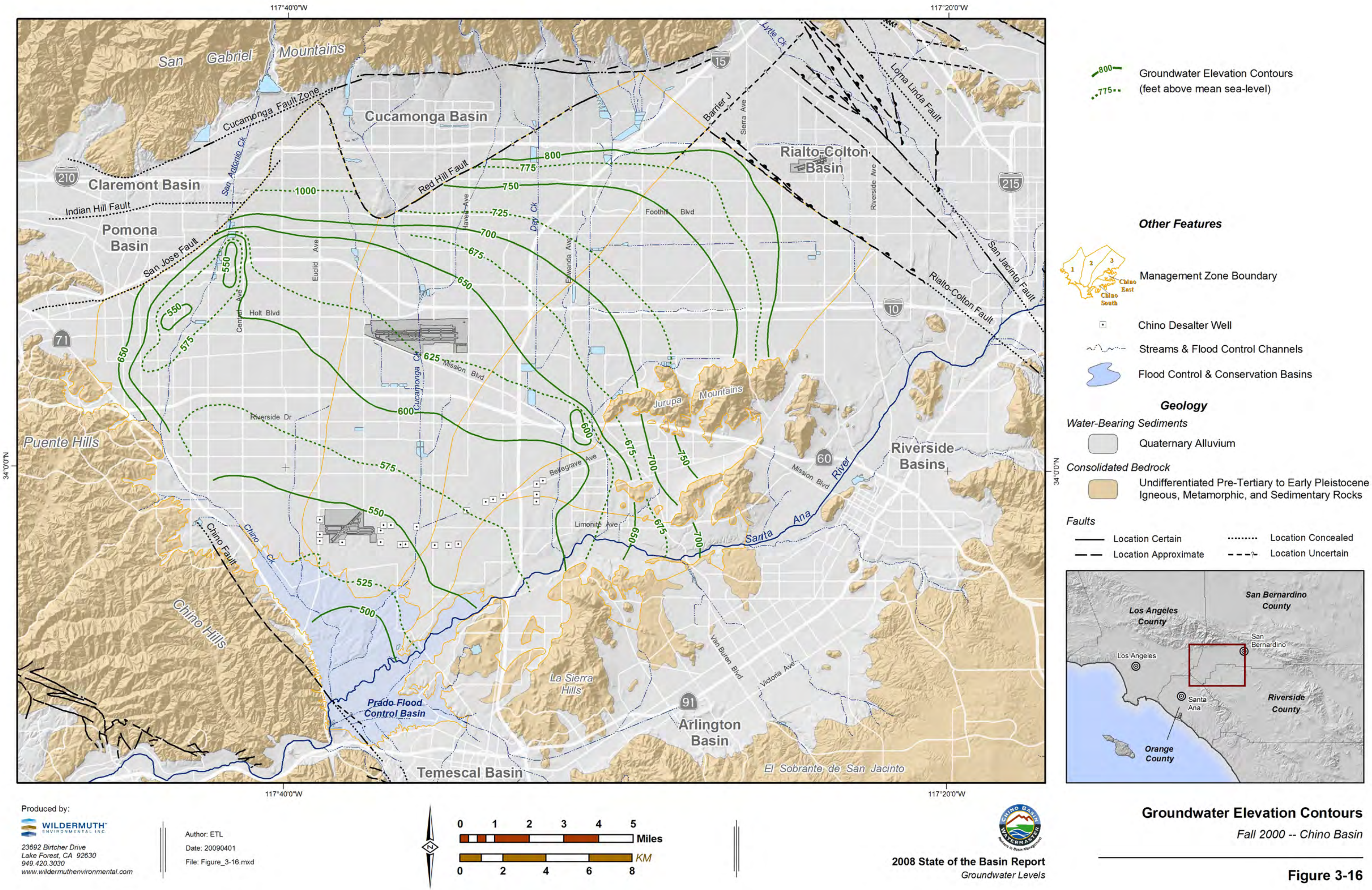


Figure 3-15 - Time History of Production, Recharge, and Groundwater Levels in Chino-South MZ





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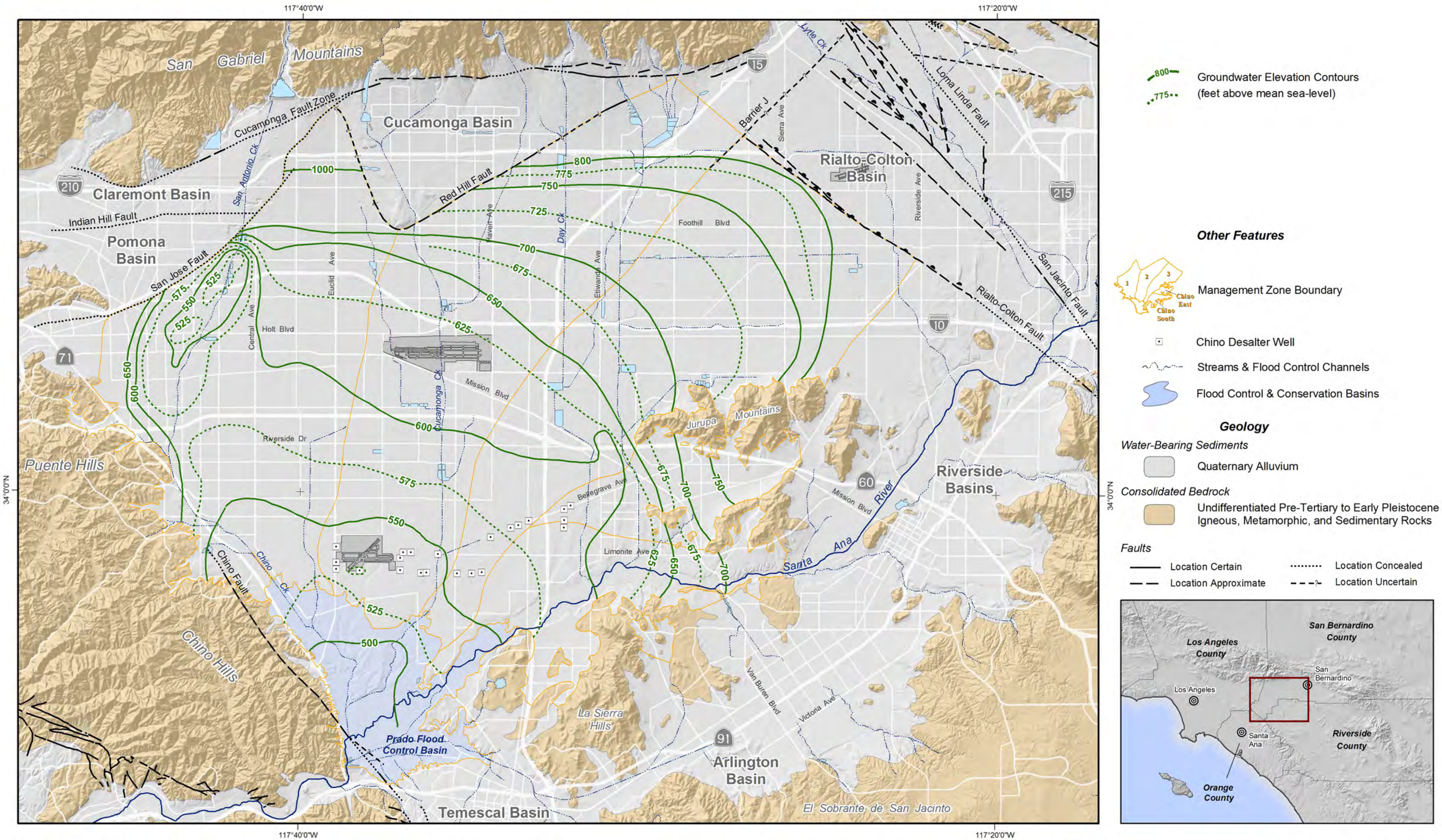
2008 State of the Basin Report
Groundwater Levels

Groundwater Elevation Contours
Fall 2000 -- Chino Basin

Figure 3-16



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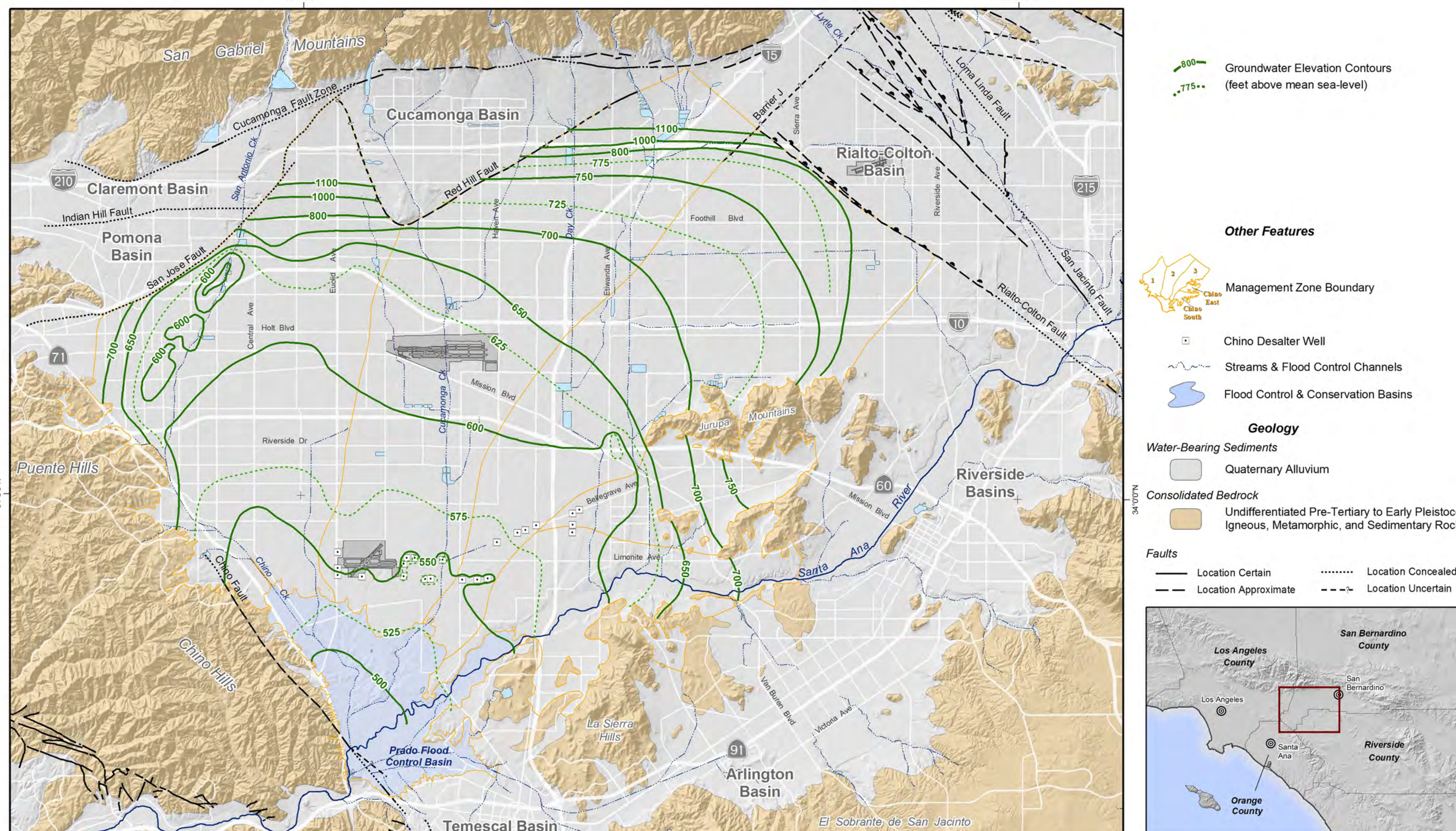
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Levels

Groundwater Elevation Contours

Fall 2003 -- Chino Basin

Figure 3-17



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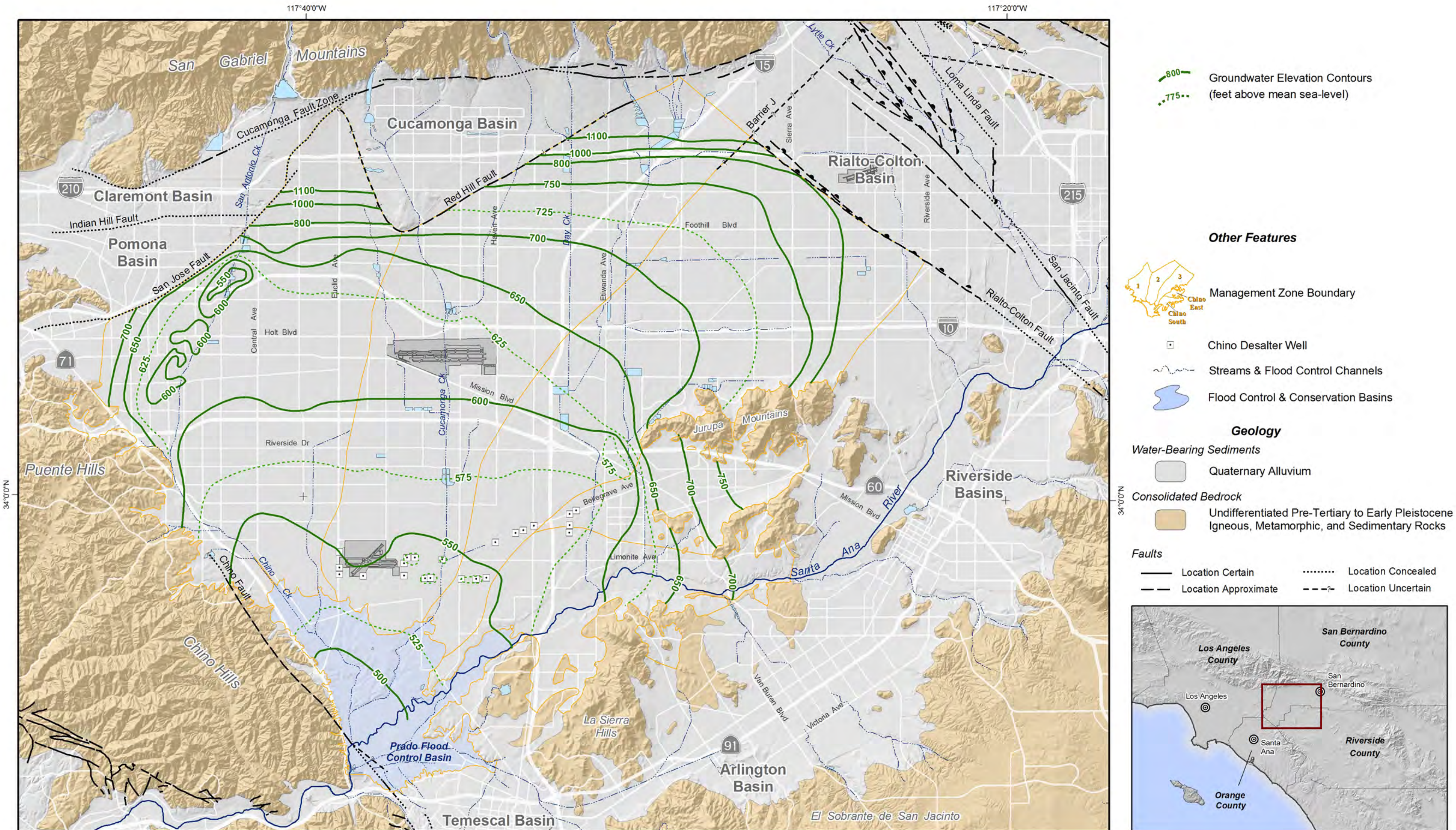
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Levels

Groundwater Elevation Contours
Fall 2006 -- Chino Basin

Figure 3-18



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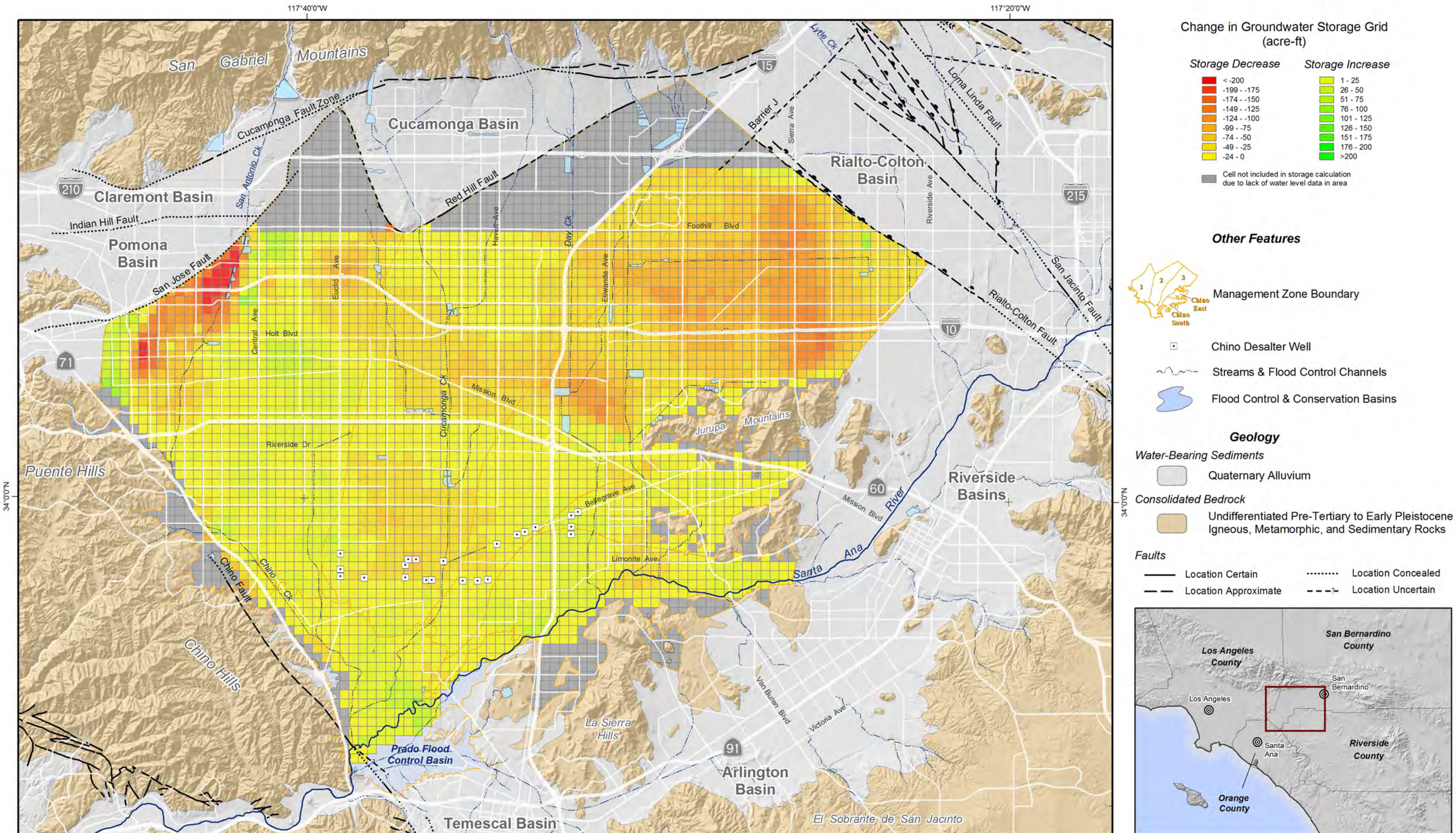
2008 State of the Basin Report
Groundwater Levels

Groundwater Elevation Contours

Fall 2008 -- Chino Basin

Figure 3-19



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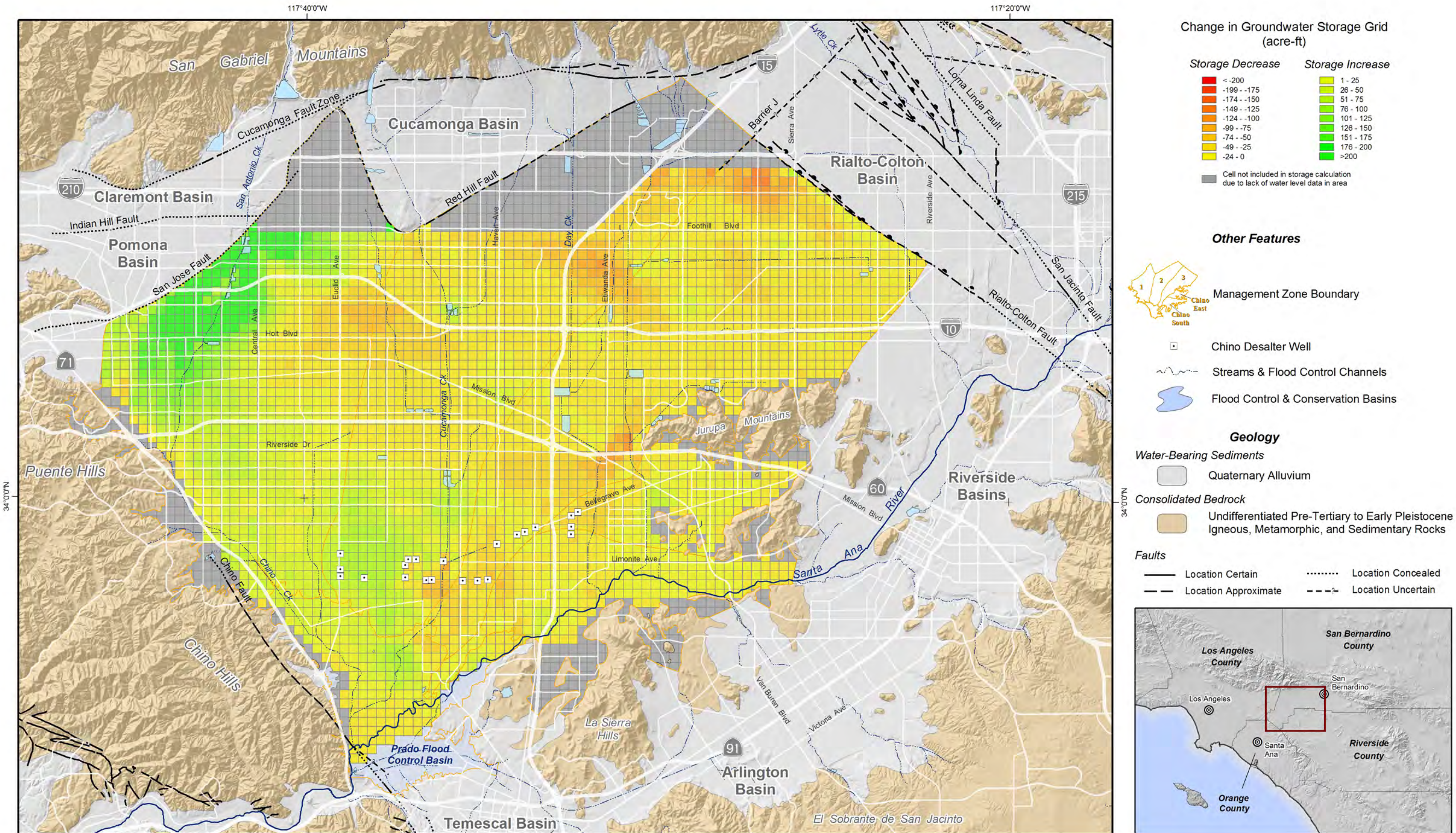
2008 State of the Basin Report
Changes in Groundwater Storage

Change in Groundwater Storage
Fall 2000 to Fall 2003

Figure 3-20



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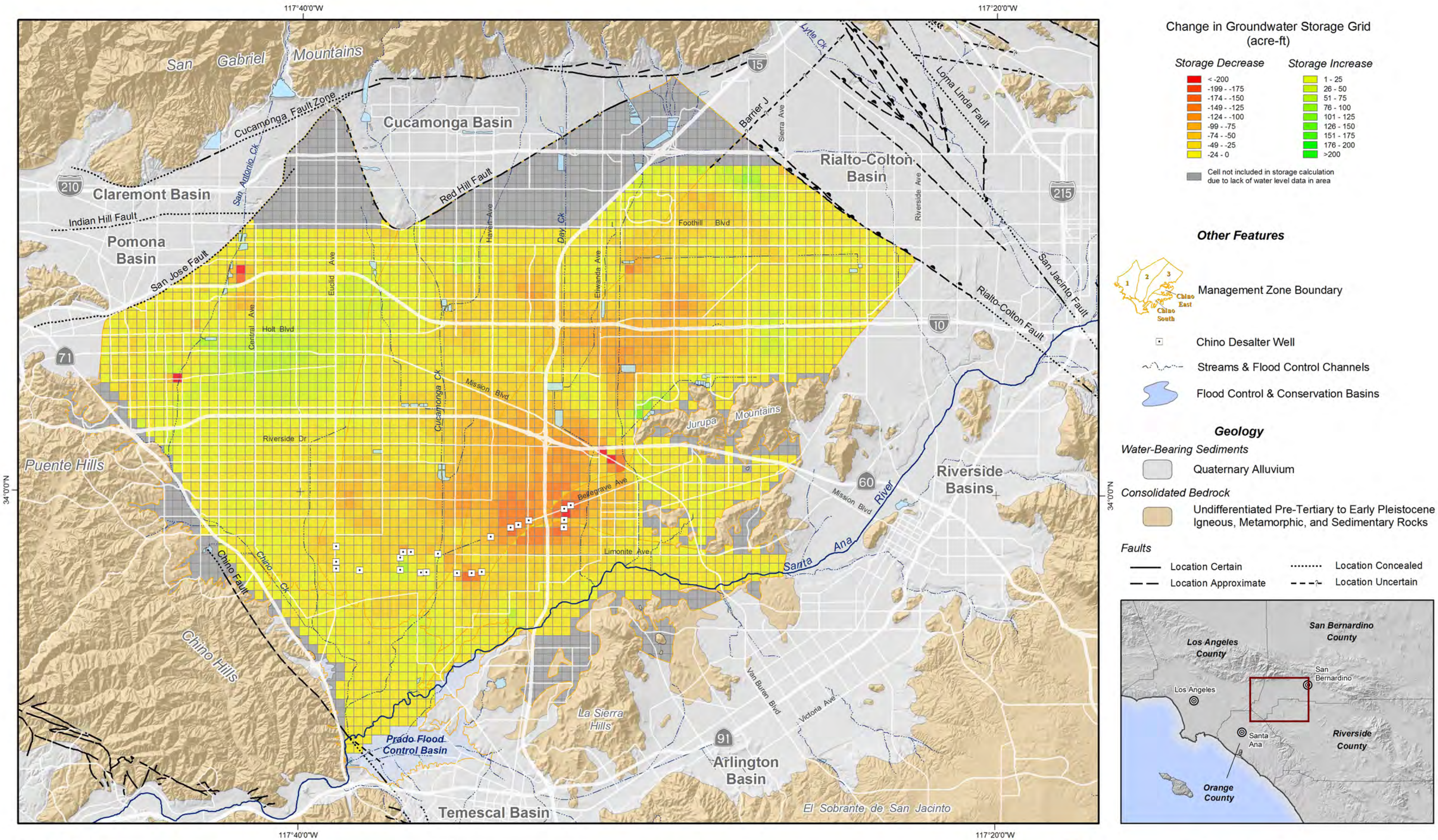
2008 State of the Basin Report
Changes in Groundwater Storage

Change in Groundwater Storage
Fall 2003 to Fall 2006

Figure 3-21



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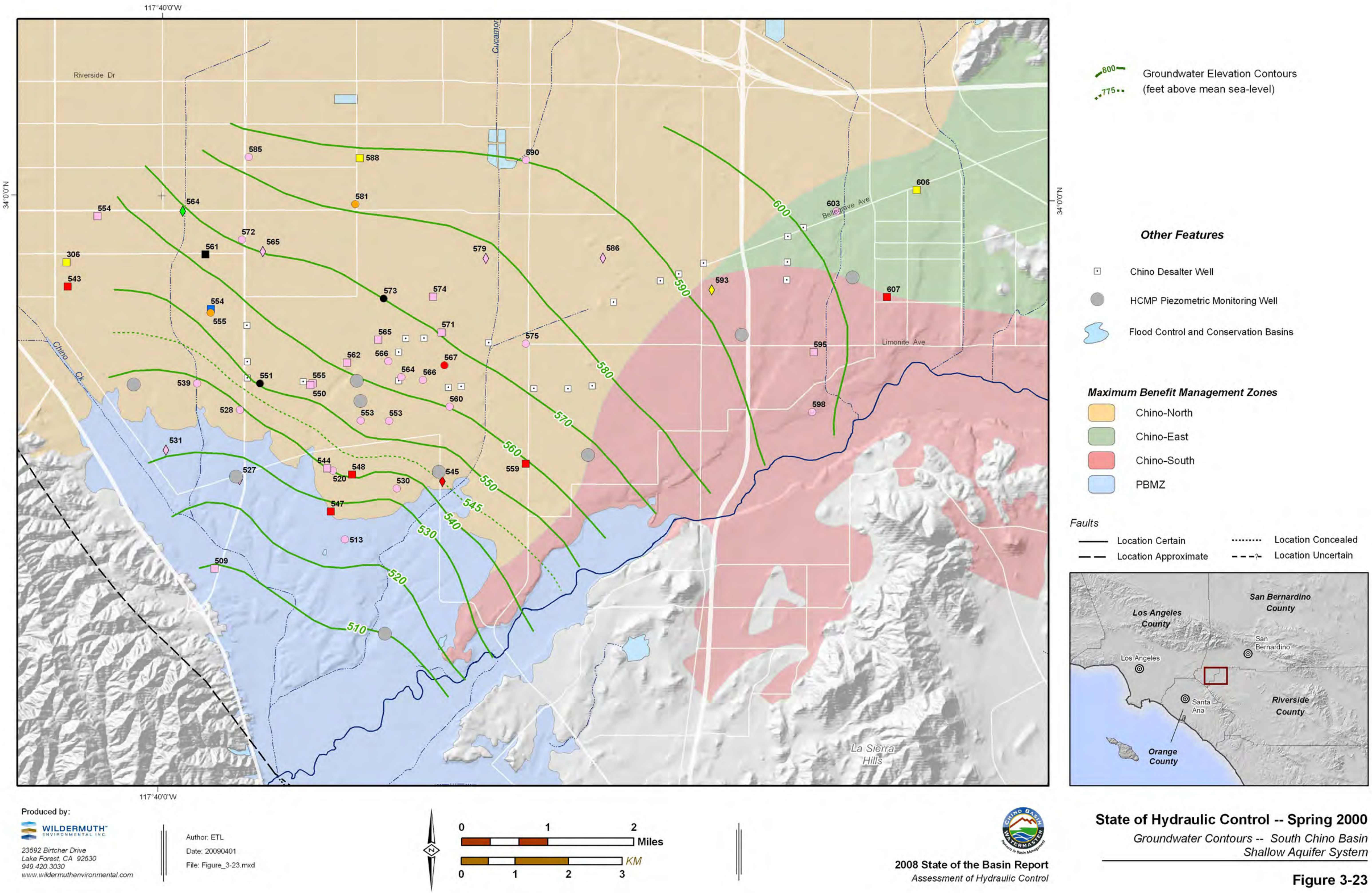
2008 State of the Basin Report
Changes in Groundwater Storage

Change in Groundwater Storage
Fall 2006 to Fall 2008

Figure 3-22



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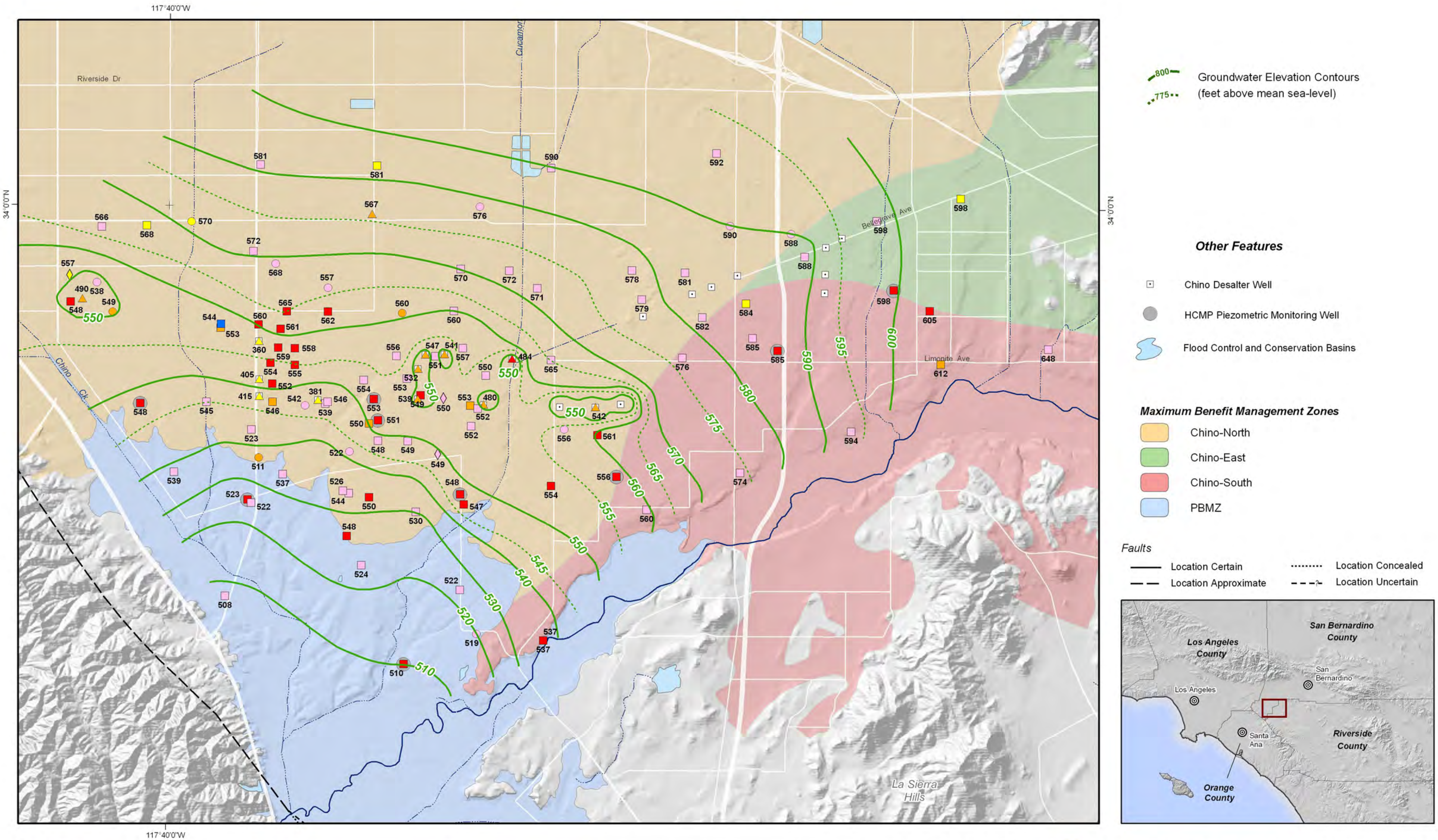
2008 State of the Basin Report
Assessment of Hydraulic Control

State of Hydraulic Control -- Spring 2000

Groundwater Contours -- South Chino Basin Shallow Aquifer System

Figure 3-23



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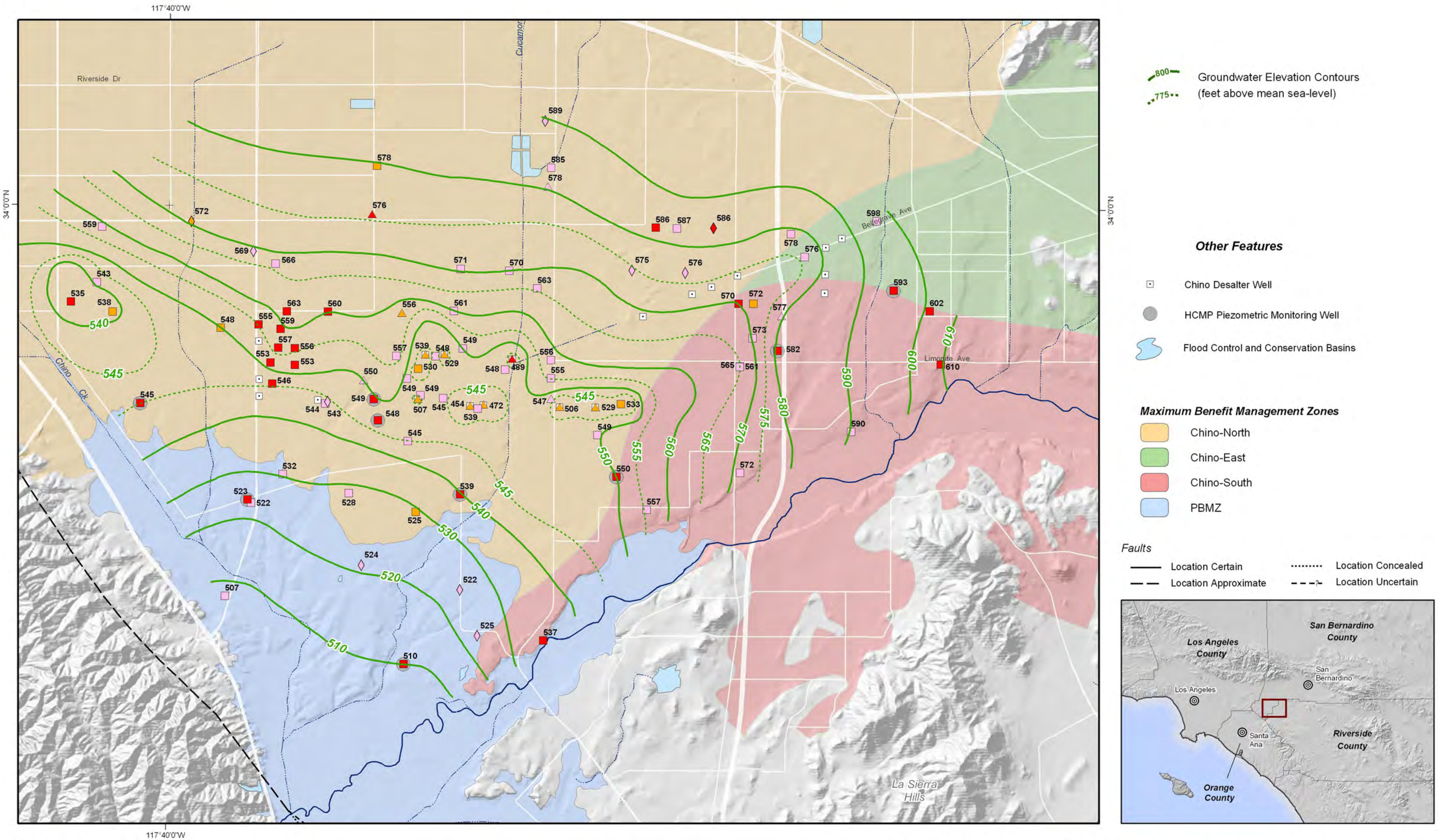
0 1 2 Miles
0 1 2 3 KM

2008 State of the Basin Report
Assessment of Hydraulic Control

State of Hydraulic Control -- Spring 2006
Groundwater Contours -- South Chino Basin Shallow Aquifer System

Figure 3-24



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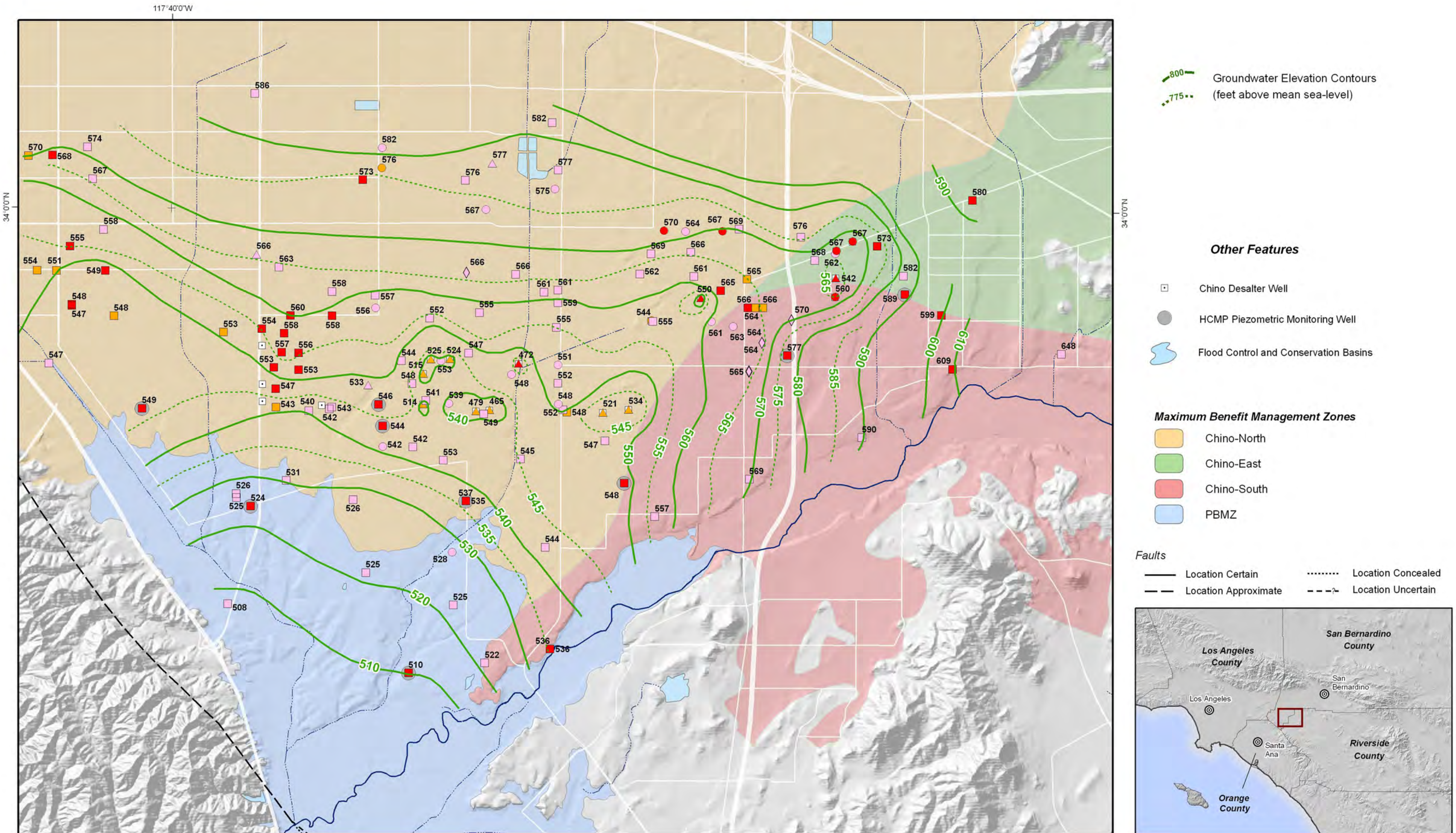
2008 State of the Basin Report
Assessment of Hydraulic Control

State of Hydraulic Control -- Spring 2007

Groundwater Contours -- South Chino Basin Shallow Aquifer System

Figure 3-25



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0 1 2 Miles

0 1 2 3 KM

2008 State of the Basin Report

Assessment of Hydraulic Control

State of Hydraulic Control -- Spring 2008

Groundwater Contours -- South Chino Basin Shallow Aquifer System

Figure 3-26

4.1 Background

Chino Basin groundwater is not only a critical resource to overlying water producers; it is a critical resource to the entire Santa Ana Watershed. From a regulatory perspective, the use of Chino Basin groundwater to serve potable demands is limited by drinking water standards, groundwater basin water quality objectives, and Santa Ana River water quality objectives. In August 1999, Phase 1 of the OBMP established that groundwater monitoring must be conducted in order to obtain current water quality and water level data in Chino Basin (WEI, 1999). These data are necessary for defining and evaluating specific strategies and locations for the mitigation of nitrate, TDS, and other Constituents of Potential Concern (COPCs); new recharge sites; and pumping patterns that result from the implementation of the OBMP.

In the past, various entities have collected groundwater quality data. Municipal and agricultural water supply entities have collected groundwater quality data to comply with the Department of Health Services' requirements in the California Code of Regulations, Title 22, or for programs that range from irregular study-oriented measurements to long-term periodic measurements. Groundwater quality observations have been made by the DWR, by participants in the 1969 Judgment on the Santa Ana River (Orange County Water District vs. City of Chino et al.), by dischargers under orders from the RWQCB, and by the County of San Bernardino. The DWR and the San Bernardino County Flood Control District were very active in collecting groundwater quality data in the Chino Basin prior to the adjudication of the Chino Basin. After the Judgment was entered in 1978, monitoring south of State Route 60 stopped almost completely with the exception of that conducted by the Cities of Chino, Chino Hills, and Norco; the Jurupa Community Services District (JCSD); and the Santa Ana River Water Company. Most of the pre-1978 measurements were digitized by the DWR. In 1986, the MWDSC conducted the first comprehensive survey of groundwater quality, covering all constituents regulated under Title 22.

Watermaster initiated a regular monitoring program for Chino Basin in 1989. Groundwater quality data has been obtained periodically since 1990.

4.2 Water Quality Monitoring Programs

Watermaster began conducting a more robust monitoring program as part of the initial OBMP implementation. Watermaster's program relies on municipal producers, government agencies, and private consultants to supply their groundwater quality data on a cooperative basis. Watermaster supplements these data with data obtained through its own sampling and analysis program of private wells in the area generally south of State Route 60. Water quality data are also obtained from special studies and monitoring programs that take place under the orders of the RWQCB, the California Department of Toxic Substances Control (DTSC), and others. Watermaster has combined previously digitized groundwater quality data from all known sources into a comprehensive database.

4.2.1 Water Quality Monitoring Programs for Wells Owned by Municipal Water Suppliers

Water quality samples are collected from Appropriative Pool wells and some overlying Non-Agricultural Pool wells as part of formalized monitoring programs. Constituents include (i) those regulated for drinking water purposes in the California Code of Regulations, Title 22; (ii) those regulated in the 1995 Water Quality Control Plan for the Santa Ana River Basin (Basin Plan); or (iii) those that are of special interest to the pumper.

4.2.2 Water Quality Monitoring Programs for Private Water Supply Wells

Historically, private wells were sampled less methodically and less frequently than wells owned by members of the Appropriative Pool. As a result, there is little historical (pre-1999) groundwater quality information for most of the 600 private wells in the southern part of the Chino Basin. As mentioned above, the MWDSC conducted an assessment of water quality and water levels in the private wells south of State Route 60 in 1986. This assessment was a component of the Chino Basin groundwater storage program Environmental Impact Report (MWDSC et al., 1988). Nevertheless, the historical quality of groundwater produced at the majority of the wells in the southern Chino Basin is unknown.

In 1999, the Comprehensive Monitoring Program initiated the systematic sampling of private wells south of State Route 60 in the Chino Basin. Over a three-year period, Watermaster sampled all available wells at least twice to develop a robust baseline data set. This program has since been reduced to approximately 110 private key wells, and about half of these wells are sampled every other year. Groundwater quality samples are analyzed for general minerals, physical properties, and for regional COPCs (e.g. perchlorate, and volatile organic chemicals [VOCs] in the vicinity of known VOC plumes). This key well monitoring program provides a good representation of the areal groundwater quality in this portion of the basin.

4.2.3 Water Quality Monitoring Programs Conducted Pursuant to Regulatory Orders

Groundwater monitoring is conducted by private and public entities as part of regulatory orders and voluntary cleanups. These programs consist of networks of monitoring wells designed specifically to delineate and characterize the extent of the responsible party's contamination. These monitoring programs may include monthly, quarterly, and/or annual sampling frequencies. The following is a summary of all the regulatory and voluntary contamination monitoring in Chino Basin:

- **Plume:** Alumax Aluminum Recycling Facility
  Constituent of Concern: TDS, sulfate, nitrate, chloride
  Order: RWQCB Cleanup and Abatement Order 99-38
- **Plume:** Chino Airport
  Constituent of Concern: VOCs
  Order: RWQCB Cleanup and Abatement Order 90-134

- **Plume:** California Institute for Men
  Constituent of Concern: VOCs
  Order: Voluntary Cleanup Monitoring
- **Plume:** Crown Coach International Facility
  Constituent of Concern: VOCs and Solvents
  Order: Voluntary Cleanup Monitoring
- **Plume:** General Electric Flatiron Facility
  Constituent of Concern: VOCs
  Order: Voluntary Cleanup Monitoring
- **Plume:** General Electric Test Cell Facility
  Constituent of Concern: VOCs
  Order: Voluntary Cleanup Monitoring
- **Plume:** Kaiser Steel Fontana Site
  Constituent of Concern: TDS/total organic carbon (TOC)
  Order: See discussion in Section 4.36.7.
- **Plume:** Milliken Sanitary Landfill
  Constituent of Concern: VOCs
  Order: RWQCB Order No. 81-003
- **Plume:** Upland Sanitary Landfill
  Constituent of Concern: VOCs
  Order RWQCB Order No 98-99-07
- **Plume:** Ontario International Airport (VOC Plume – South of Ontario Airport)
  Constituent of Concern: VOC
  Order: This plume is currently being voluntarily investigated by a group of potentially responsible parties.
- **Plume:** Stringfellow National Priorities List (NPL) Site
  Constituent of Concern: VOCs, perchlorate, N-nitrosodimethylamine (NDMA), heavy metals
  Order: The Stringfellow Site is the subject of US Environmental Protection Agency (EPA) Records of Decision (RODs): EPA/ROD/R09-84/007, EPA/ROD/R09-83/005, EPA/ROD/R09-87/016, and EPA/ROD/R09-90/048.

4.2.4 Other Water Quality Monitoring Programs

In a letter dated July 13, 2000, the RWQCB expressed their concern to the IEUA that the historical recharge of recycled water at IEUA Regional Plant No. 3 (RP3) may have caused groundwater contamination at down-gradient wells. Other sources of groundwater contamination in the area include the Kaiser Steel Mill, Alumax, other industries, and historical agricultural activities, including citrus groves and hog feed lots. Several municipal wells have been shut down in MZ3 due to perchlorate and nitrate in groundwater. MZ3 includes areas that underlie all or part of the Fontana Water Company, the Marygold Mutual Water Company, the CVWD, and the City of Ontario. MZ3 groundwater is tributary to wells owned by the JCSD.

To characterize groundwater levels and quality in MZ3, Watermaster and the IEUA performed an investigation. The objectives of this investigation were to develop a groundwater sampling program, install two sentry wells at the distal end of the Kaiser plume, and perform further characterization of groundwater quality. Sampling was conducted at twenty-two selected key wells from late 2005 to 2007. Where possible, four quarterly samples and one annual sample were collected. In 2007, two triple-nested wells (MZ3-1 and MZ3-2) were installed down gradient of the Kaiser plume. These wells were sampled quarterly for one year. The sampling results provided data to further characterize the water quality patterns for contaminants of concern in the study area, including TDS, nitrate, sulfate, chloride, and perchlorate. And, the results from well MZ3-1/3 redefined the extent of the Kaiser plume.

4.2.5 Information Management

As with groundwater level and production data, Watermaster manages groundwater quality data in order to perform the requisite scientific and engineering analyses required to ensure that the goals of the OBMP are being met. Watermaster's relational database contains well location, construction, lithology, specific capacity, groundwater level, and water quality data. Historical water quality data for the period prior to the mid-1980s were obtained from the DWR and supplemented with data from producers in the Appropriative and Overlying Non-Agricultural Pools and others. For the period from the mid-1980s forward, Watermaster has QA/QC'd and uploaded water quality data from its own sampling programs, the State of California Department of Public Health (CDPH, formerly the Department of Health Services) database, and other cooperating parties to its relational database. Occasionally, problems have been found with CDPH data, usually occurring in the form of incorrect constituent identification. In 2003, Watermaster launched the Chino Basin Relational Database effort to collect water quality data directly from each member agency and thereby circumvent past data problems. Cooperating parties provide all data (including geologic, geophysical, water levels, water quality, production, and recharge) to Watermaster on a routine basis. These data are delivered in electronic format directly from the laboratory or from the cooperating party.

4.3 Groundwater Quality in Chino Basin

Figure 4-1 shows all wells with groundwater quality monitoring results for the 5-year period of July 2003 to June 2008.

Inorganic and organic constituents detected in groundwater samples from wells in the Chino Basin through June 2008 were analyzed synoptically. This analysis included all available data from production and monitoring wells. Hence, the data do not represent a programmatic investigation of potential sources nor do they represent a randomized study that was designed to ascertain the water quality status of the Chino Basin. These data do, however, represent the most comprehensive information available to date.

Monitoring wells targeted at potential sources tend to have greater concentrations than municipal or agricultural production wells. Wells with constituent concentrations greater than one-half of the MCL represent areas that warrant concern and inclusion in a long-term monitoring program. In addition, groundwater in the vicinity of wells with samples greater than the MCL may be impaired from a beneficial use standpoint.

Numerous water quality standards have been put in place by federal and state agencies. Primary MCLs are enforceable criteria that are set due to health effects. Secondary standards are related to the aesthetic qualities of the water, such as taste and odor. For some chemicals, there are "Notification Level" criteria that are set by the CDPH. When notification levels are exceeded, the CDPH recommends that the utility inform its customers and consumers about the presence of the contaminant and any health concerns associated with exposure. The level at which the CDPH recommends the drinking water system remove the affected drinking water source from service is the "Response Level." These levels range from 10 to 100 times the notification level, depending on the chemical. The following constituents exceeded at least one water quality criteria in more than 10 wells within the Chino Basin for the period of July 2003 through June 2008:

Analyte Group/Constituent		Wells with Exceedance
Inorganic Constituents		
	Total Dissolved Solids	221
	Nitrate-Nitrogen	395
	Aluminum	153
	Arsenic	24
	Chloride	25
	Chromium	30
	Iron	185
	Manganese	58
	Perchlorate	188
	Sulfate	41
	Vanadium	25
General Physical		
	Color	21
	Odor	28
	pH	14
	Specific Conductance	121
	Turbidity	78
Chlorinated VOCs		
	1,1-Dichloroethane	11
	1,1-Dichloroethene	31
	1,2,3-Trichloropropane	23
	1,2-Dichloroethane	17
	cis-1,2-Dichloroethene	10
	Tetrachloroethene (PCE)	37
	Trichloroethene (TCE)	115

For all figures (Section 4 and Appendix B) that depict water quality distributions in the Chino Basin, the following convention is typically followed in setting class intervals in the legend (where WQS is the applicable water quality standard [see table below]). Variations of this convention may be employed to highlight certain aspects of the data.

Symbol	Class Interval
⚪	Not Detected
🔵	<0.5x WQS, but detected
🟢	0.5x WQS to WQS
🟡	WQS to 2x WQS
🟠	2x WQS to 4x WQS
🔴	> 4x WQS

4.3.1 Total Dissolved Solids

In Title 22, TDS is regulated as a secondary contaminant. The California secondary drinking water MCL for TDS is 500 mg/L. Figure 4-2 shows the distribution of the maximum TDS concentrations in Chino Basin from July 2003 through June 2008. During this period, maximum TDS concentrations ranged from 48 mg/L to 4,790 mg/L with average and median concentrations of approximately 550 mg/L and 380 mg/L, respectively. The highest concentrations are located south of State Route 60 where the impacts from agriculture are greatest, which is consistent with the data reported in the 2006 State of the Basin Report.

The impacts of agriculture on TDS in groundwater are primarily caused by dairy waste disposal, consumptive use, and fertilizer use on crops. As irrigation efficiency increases, the impact of consumptive use on TDS in groundwater also increases. For example, if source water has a TDS concentration of 250 mg/L and the irrigation efficiency is about fifty percent (flood irrigation), the resulting TDS concentration in returns to groundwater would be 500 mg/L, which is exclusive of the mineral increments from fertilizer. If irrigation efficiency is increased to seventy-five percent, the resulting TDS concentration in the returns to groundwater would be 1,000 mg/L, which is also exclusive of the mineral increments from fertilizer. For modern irrigated agriculture, the TDS impacts of consumptive use are more significant than mineral increments from fertilizers.

Wells with low TDS concentrations in close proximity to wells with higher TDS concentrations suggests a vertical stratification of water quality. However, there is a paucity of information concerning well construction/perforation intervals; Thus, the vertical differences in water quality are currently unverifiable.

4.3.2 Nitrate-Nitrogen

In Title 22, the primary MCL for nitrate as nitrogen (NO3-N) in drinking water is 10 mg/L. By convention, all nitrate values are expressed in this report as NO3-N. Figure 4-3 displays the distribution of maximum NO3-N concentrations in the Chino Basin from July 2003 through June 2008.

Areas with significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation were formerly or are currently overlain by:

- Citrus (the northern parts of the Chino-North MZ)
- Dairy and irrigated agriculture (the southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the Prado Basin MZ [PBMZ])

Nitrate concentrations in groundwater have increased slightly or remained relatively constant in the northern parts of the Chino-North MZ from 1960 to present. These areas were formerly occupied by citrus groves and vineyards. The nitrate concentrations underlying these areas rarely exceed 10 mg/L (as nitrogen). Over the same period, nitrate concentrations increased significantly in the southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the PBMZ. In these areas, land use was progressively converted from irrigated/non-irrigated agricultural land to dairies, and nitrate concentrations typically exceed the 10 mg/L MCL and frequently exceed 40 mg/L.

4.3.3 Other Constituents of Potential Concern

Section 4.3.3 discusses the constituents with water quality standards that were exceeded in ten or more wells in Chino Basin with the exception of nitrate and TDS. The details of these exceedances are displayed graphically in Figures 4-4 through 4-17, and in Appendix B.

A query was developed to analyze water quality data in the Chino Basin from July 2003 through June 2008 that is in exceedance of any water quality standard. The results of this query are provided in a summary table in Appendix C, including:

- Chemical Constituents (listed alphabetically)
- Reporting Units
- Water Quality Standards (detailed explanations are provided in the table's footnote):
  - EPA Primary MCL
  - EPA Secondary MCL
  - California Primary MCL
  - California Secondary MCL
  - California Notification Level
- Minimum – the minimum concentration of the given constituent for the given time period. Non-detect values were assigned a value of zero.
- Lower or First Quartile – the first value that divides the items of a frequency distribution or ordered data set into four classes with each containing one fourth of the total population.
- Median or Second Quartile – the second value that divides the items of a frequency distribution or ordered data set into four classes with each containing one fourth of the total population.
- Upper or Third Quartile – the third value that divides the items of a frequency distribution or ordered data set into four classes with each containing one fourth of the total population.

- Maximum – the maximum concentration of the given constituent for the given time period. Non-detect values were assigned a value of zero.
- Average – the average concentration of the given constituent for the given time period. Non-detect values were assigned a value of zero.
- Number of Samples – the total number of samples for the given constituent for the given time period.
- Number of Wells Sampled – the number of wells sampled in the given time period, not the number of samples collected.
- Number of Wells with Detects – the number of wells in the period wherein the constituent was detected at any concentration.
- Number of Wells with Exceedances – the number of wells in the given time period with any value that exceeded any of the five water quality standards.

4.3.3.1 VOCs

The following seven VOCs were detected at or above their MCL in more than 10 wells in the Chino Basin:

- 1,1-dichloroethane (1,1-DCA)
- 1,1-dichloroethene (1,1-DCE)
- 1,2,3-trichloropropane (1,2,3-TCP)
- 1,2-dichloroethane (1,2-DCA)
- *cis*-1,2-dichloroethene (cis-1,2-DCE)
- tetrachloroethene (PCE)
- trichloroethene (TCE)

4.3.3.1.1 Trichloroethene and Tetrachloroethene

Trichloroethene (TCE) and tetrachloroethene (PCE) were/are widely used industrial solvents. Both PCE and TCE are used as metal degreasers in the automotive and other metal working industries. PCE is commonly used in the dry-cleaning industry. TCE was commonly used as a food extractant. The areal distributions of TCE and PCE are shown in Figures 4-4 and 4-5, respectively. In general, PCE is below the detection limit for wells in the Chino Basin. Wells with detectable levels tend to occur in clusters, such as those around the Milliken Landfill, south and west of the Ontario Airport, and along the margins of the Chino Hills. The spatial distribution of TCE resembles that of PCE. TCE was not detectable in most of the wells in the basin, and similar clusters of wells occur around the Milliken Landfill, south and west of Ontario International Airport (OIA), south of Chino Airport, and in the Stringfellow plume.

Figure 4-19 shows the ratio of TCE, PCE, and their breakdown products in monitoring wells associated with the VOC plumes in the southern Chino Basin. The unique characteristics of these plumes can be seen by comparing TCE and PCE concentrations and dispersion. For example, the Milliken Landfill plume and the GE plumes near Ontario Airport have significant concentrations of both TCE and PCE while the Chino Airport and Stingfellow plumes have significant concentrations of TCE and only minor detections of PCE, and the OIA plume is characterized solely by TCE. These unique characteristics allow for differentiation between the plumes and determining the intermingling of plumes.

4.3.3.1.2 1,1-Dichloroethene, 1,2-Dichloroethane, and cis-1,2-Dichloroethene

1,1-Dichloroethene (1,1-DCE), 1,2-Dichloroethane (1,2-DCA), and cis-1,2-Dichloroethene (cis-1,2-DCE) are degradation by-products of PCE and TCE (Dragun, 1988) that are formed by reductive dehalogenation. The areal distributions of 1,1-DCE, 1,2-DCA, and cis-1,2-DCE are shown in Figures 4-6 through 4-8, respectively. 1,1-DCE, 1,2-DCA, and cis-1,2-DCE have not been detected in the majority of wells in the Chino Basin. 1,1-DCE is found near the Milliken Landfill, south and west of OIA, at the former Crown Coach Facility, and at the head of the Stringfellow plume. 1,2-DCA and cis-1,2-DCE are found in the same general locations.

4.3.3.1.3 1,1-Dichloroethane

1,1,-Dichloroethane (1,1-DCA) is a colorless oily liquid that is used as a solvent for plastics, as a degreaser, as a halon in fire extinguishers, and in the cementing of rubber, and is a degradation by-product of 1,1,1-TCA. Figure 4-9 shows the areal distribution of 1,1-DCA in the Chino Basin. Eleven wells were in exceedance of the primary CA MCL of 5 μg/L for 1,1-DCA for the period of July 2003 through June 2008. The majority of these wells are monitoring wells at the former Crown Coach Facility.

4.3.3.1.4 1,2,3-Trichloropropane

1,2,3-TCP is a colorless liquid that is used primarily as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, and in the synthesis of hexafluoropropylene and as a cross linking agent in the synthesis of polysulfides. It has been used as a solvent, an extractive agent, a paint and varnish remover, and a cleaning and degreasing agent, and it has been formulated with dichloropropene in the manufacturing of soil fumigants, such as D-D.

The current California State Notification Level for 1,2,3-TCP is 0.005 μg/L. The adoption of the Unregulated Chemicals Monitoring Requirements regulations occurred before a method capable of achieving the required detection limit for reporting (DLR) was available. According to the CDPH, some utilities moved ahead with monitoring, and samples were analyzed using higher DLRs. Unfortunately, findings of non-detect with a DLR higher than 0.005 μg/L do not provide the CDPH with the information needed for setting a standard. New methodologies with a DLR of 0.005 μg/L have since been developed, and the CDPH has requested that any utility with 1,2,3-TCP findings of non-detect with reporting levels of 0.01 μg/L or higher do follow-up sampling using a DLR of 0.005 μg/L. Because 1,2,3-TCP may be a basin-wide water quality issue, private and public wells are continuing to be retested at the lower detection limit (0.005 μg/L).

Figure 4-10 shows the distribution of 1,2,3-TCP in Chino Basin, based on the data limitations discussed above. High 1,2,3-TCP values are associated with the Chino Airport Plume. Of particular note, there is a cluster of wells with 1,2,3-TCP concentrations greater than the Notification Level in the Jurupa region and a scattering of wells that exceed the Notification

Level on the western margins of the basin. Watermaster will continue to monitor and investigate this constituent.

4.3.3.2 Iron, Arsenic, and Vanadium

Iron, arsenic, and vanadium concentrations depend on mineral solubility, ion exchange reactions, surface complexations, and soluble ligands. These speciation and mineralization reactions, in turn, depend on pH, oxidation-reduction potential, and temperature.

4.3.3.2.1 Iron

In general, iron is not detected across the Chino Basin, but there are some scattered detectable concentrations that are above regulatory limits (see Appendix B). Iron concentrations are elevated in the vicinity of the Stringfellow Plume. Outside of the Stringfellow Plume, there were 85 wells with iron concentrations that exceed the MCL. Nevertheless, these exceedances may be an artifact of sampling methodology; relatively high concentrations of iron and trace metals are often the result of the dissolution of aluminosilicate particulate matter and colloids, which is caused by the acid preservative in unfiltered samples.

4.3.3.2.2 Arsenic

The US EPA implemented a new primary MCL for arsenic in 2006, decreasing the MCL from 50 µg/L to 10 µg/L. In November 2008, the Primary CA MCL was also changed from 50 µg/L to 10 µg/L. Figure 4-11 shows the distribution of arsenic in the Chino Basin. Eleven wells in the basin had arsenic concentrations that exceeded the MCL. Of these wells, three are associated with the Stringfellow Plume, and three are associated with Chino Airport Plume. Higher concentrations of arsenic are found in the Chino/Chino Hills area in the lower aquifer at depths greater than about 350 ft-bgs.

4.3.3.2.3 Vanadium

In the Chino Basin, vanadium has been detected above regulatory limits in some scattered wells. In groundwater, vanadium can result from mining and industrial activities or be of natural occurrence. While elemental vanadium does not occur in nature, vanadium compounds are found in fossil fuels and exist in over 60 different mineral ores. The primary industrial use of vanadium is in the steel industry where it is used to strengthen steel. Figure 4-12 shows the areal distribution of vanadium in the Chino Basin. The majority of the 25 wells in exceedance of the California Notification Level (0.05 mg/L) are associated with the Stringfellow Plume. Other exceedances are found near the Milliken Landfill, in deep wells in the Chino/Chino Hills area, and in one well near the Jurupa Mountains.

4.3.3.3 Perchlorate

Perchlorate has recently been detected in several wells in the Chino Basin (Figure 4-13), in other basins in California, and in other states in the west. The most probable reason why perchlorate was not detected in groundwater until recently is that analytical methodologies that could attain a low enough detection limit did not previously exist. Prior to 1996, the method detection limit for perchlorate was 400 μg/L. In March 1997, an ion chromatographic method was developed with a detection limit of 1 μg/L and a reporting limit of 4 μg/L.

As an environmental contaminant, perchlorate (ClO_4^-) originates from the solid salts of ammonium perchlorate (NH_4ClO_4), potassium perchlorate ($KClO_4$), or sodium perchlorate ($NaClO_4$). Perchlorate salts are quite soluble in water. The perchlorate anion (ClO_4^-) is exceedingly mobile in soil and groundwater environments. Because of its resistance to react with other available constituents, it can persist for many decades under typical groundwater and surface water conditions. Perchlorate is a kinetically stable ion, which means that reduction of the chlorine atom from a +7 oxidation state in perchlorate to a -1 oxidation state as a chloride ion requires activation energy or the presence of a catalyst to facilitate the reaction. Since perchlorate is chemically stable in the environment, natural chemical reduction is not expected to be significant.

Possible sources of perchlorate contamination are synthetic (ammonium perchlorate used in the manufacturing of solid propellant used for rockets, missiles, and fireworks) and natural (perchlorate derived from Chilean caliche that was used for fertilizer).

Fertilizers derived from Chilean caliche are currently used in small quantities on specialized crops, including tobacco, cotton, fruits, and vegetables (Renner, 1999). However, evidence suggests that usage may have been widespread for citrus crops in Southern California from the late 1800s through the 1930s.

The current CDPH Notification Level for perchlorate is 6 μg/L, which was established on March 11, 2004.

Perchlorate has been detected in 188 wells in the Chino Basin at levels greater than 6 μg/L. Perchlorate Notification Level exceedances occur in the following areas of the Chino Basin (Figure 4-13):

- Rialto-Colton Basin (There is a significant perchlorate plume in the Rialto-Colton Basin. The RWQCB is investigating the source of this plume, which appears to be near the Mid-Valley Sanitary Landfill. According to the RWQCB, several companies—including B.F. Goodrich, Kwikset Locks, American Promotional Events, and Denova Environmental—operated nearby and used or produced perchlorate. These companies were located on a 160-acre parcel at T1N R5W S21 SW1/4. Denova Environmental also operated on a 10-acre lot at T1N R5W S20 S1/2 (along the boundary between Sections 20 and 29). Perchlorate in the Fontana area of Chino Basin may be the result of (i) the Rialto-Colton perchlorate plume migrating across the Rialto-Colton fault, (ii) other point sources in Chino Basin, and/or (iii) the non-point application of Chilean nitrate fertilizer in citrus groves.)
- Downgradient of the Stringfellow Superfund Site (Concentrations have exceeded 600,000 μg/L at onsite observation wells. The plume has likely reached the Pedley Hills and may extend as far as Limonite Avenue.)
- City of Pomona well field (source[s] unknown)
- Wells in the City of Ontario water service area, south of OIA (source[s] unknown)
- Scattered wells in the Monte Vista water service area (source[s] unknown)

- Scattered wells in the City of Chino water service area (source[s] unknown)

A forensic isotope study was conducted to determine the source of perchlorate in Chino Basin groundwater. This forensic technique was developed using comprehensive stable isotope analyses (37Cl/35Cl and 18O/17O/16O) of perchlorate to determine the origin of the perchlorate (synthetic vs. naturally occurring). Stable isotope analyses of perchlorate from known man-made (e.g. samples derived from electrochemically synthesized ammonium- and potassium-perchlorate salts) and natural (e.g. samples from the nitrate salt deposits of the Atacama Desert in Chile) sources reveal systematic differences in isotopic characteristics that are related to the formation mechanisms (Bao & Gu, 2004; Böhlke et al., 2005; Sturchio et al., 2006). There is considerable anecdotal evidence that large quantities of Chilean nitrate fertilizer were imported into the Chino Basin in the early 1900s for the citrus industry, which covered the north, west and central portions of the basin.

The perchlorate isotope study consisted of 10 groundwater samples that were collected throughout the Chino Basin. The sampling points included private wells and municipal production wells. Samples were collected using a flow-through column with a highly perchlorate-selective anion-exchange resin. The exchange resin concentrates low levels of perchlorate in groundwater such that a sufficient amount can be acquired and for isotopic analysis. Results confirmed that most of the perchlorate in the west and central portions of the Chino Basin was derived from Chilean nitrate fertilizer. One sample collected south of the OIA is a potential mixture of natural and synthetic sources.

4.3.3.4 Total Chromium and Hexavalent Chromium

Figure 4-14 shows the areal distribution of total chromium in the Chino Basin. Thirty wells were found to be in exceedance of the CA MCL of 50 μg/L. The majority of these wells are associated with the Milliken Sanitary Landfill, the Stringfellow Plume, and the GE Test Cell Plume. The remaining wells include isolated wells near the Jurupa Mountains and in the southern Chino Basin and City of Pomona wells. Chromium in groundwater results from natural and anthropogenic sources.

Hexavalent chromium is currently regulated under the MCL for total chromium. In 1999, the CDPH identified that hexavalent chromium needed an individual MCL, and concerns over its carcinogenicity grew. Subsequently, the CDPH included it on the list of unregulated chemicals that require monitoring. California Health and Safety Codes (§116365.5 and §1163659a) compelled the adoption of a hexavalent chromium MCL by January 1, 2004, and required it to be close to the public health goals (PHG) established by the Cal/EPA Office of Environmental Health Hazard Assessment (OEHHA). At present, the PHG has not been established, and the CDPH cannot proceed with the MCL process. Figure 4-15 shows the areal distribution of hexavalent chromium in the Chino Basin. Only three wells in the Chino Basin were in exceedence of the CA MCL for total chromium. In the near future hexavalent chromium may become a more significant contaminant of concern in the Chino Basin when a lower MCL is determined by CDPH, and more wells are sampled for hexavalent chromium.

4.3.3.5 Chloride and Sulfate

Chloride and sulfate both exceeded secondary MCLs. As discussed previously, secondary MCLs apply to chemicals in drinking water that adversely affect its aesthetic qualities and are not based on the direct health effects associated with the chemical. Chloride and sulfate are major anions associated with TDS. All wells in the basin had detectable levels of sulfate (Figure 4-16), but most had concentrations that were less then 125 mg/L (one-half the water quality standard). A total of 41 wells had concentrations at or above the sulfate secondary MCL. In general, these wells are distributed in the southern portion of the basin, in the Stringfellow plume, and along the margins of the Chino Hills. All wells had detectable levels of chloride (Figure 4-17), but most had concentrations that were less 125 mg/L (one-half the MCL). The secondary MCL for chloride was exceeded in 25 wells; almost all of which are located in the southern portion of the basin.

4.3.3.6 Color, Odor, and Turbidity

In the last 5 years, color, odor, and turbidity have been detected above their secondary MCLs in more than 10 wells within the Chino Basin (see Appendix B). These parameters are monitored purely for aesthetic reasons and should not substantially impair water quality in the Chino Basin.

4.3.4 Point Sources of Concern

The water quality discussion above described water quality conditions across the entire basin. The discussion below describes the water quality plumes associated with known point source discharges to groundwater. Figure 4-18 shows the locations of various point sources and associated areas of water quality degradation. Figure 4-19 shows the VOC plumes and features pie charts that display the relative percent of TCE, PCE, and other VOCs detected at groundwater wells within plume impacted areas. The pie charts demonstrate the chemical differentiation between the VOC plumes in the southern portion of Chino Basin.

4.3.4.1 Alumax Aluminum Recycling Facility

Between 1957 and 1982, an 18-acre aluminum recovery facility was operated in the City of Fontana. The byproducts of aluminum recycling are aluminum oxide wastes and brine water. During this 25-year period, solid wastes were stockpiled onsite. Process water containing sodium and potassium chloride salts was discharged onsite and allowed to percolate into native soil and groundwater. Discharge ceased in 1982, and the solid wastes were removed in 1992. Onsite groundwater monitoring was initiated in 1993 by then owner Alumax, Inc. The site was subsequently capped to prevent the future mobilization of salts offsite. Alcoa Davenport Works (Alcoa) purchased Alumax in 1998.

Currently, there are two onsite monitoring wells: MW-1 is located in the northeast corner of the property, and MW-2 is located in the southwest corner. These wells have steel casings and have experienced chloride corrosion and extensive accumulation of iron hydroxide scale. Rehabilitation efforts in 2001 failed to adequately clear the well screens. Both wells subsequently experienced partial casing constrictions or screen collapses. In 2007, it was discovered that over ten feet of iron oxide scale and sediment had accumulated in the bottom of MW-1. MW-2 was abandoned and replaced in 2008 as it could no longer be sampled.

Offsite monitoring began with the construction of four monitoring wells (AOS-1, AOS-2, AOS-3, and AOS-4) between 1999 and 2000. These wells are all located downgradient of the site and were constructed of PVC in an effort to avoid the scale and corrosion experienced at the onsite wells. In April 2008, the RWQCB stated that Alcoa would no longer be required to monitor offsite monitoring wells AOS-1, AOS-2, and AOS-3 unless elevated levels of salts were detected at upgradient well AOS-4 (RWQCB, 2008). Alcoa is currently evaluating the ownership transfer of wells AOS-1, AOS-2, and AOS-3 to Watermaster to allow for continued monitoring.

The plume emanating from the Alumax site is characterized by elevated concentrations of sulfate, nitrate, chloride, potassium, and sodium. Consequently, the TDS concentrations at the onsite wells are high, ranging from about 500 mg/L to over 2,000 mg/L. Offsite monitoring has yielded observed TDS concentrations that range from about 100 mg/L to 700 mg/L. Note that these TDS values are higher than those observed at up-gradient wells, which typically range from 200 to 300 mg/L.

4.3.4.2 Chino Airport

The Chino Airport is located approximately four miles east of the City of Chino and six miles south of the OIA and occupies about 895 acres. From the early 1940s until 1948, the airport was owned by the federal government and used for flight training and aircraft storage. The County of San Bernardino acquired the airport in 1948 and has operated and/or leased portions of the facility ever since. Since 1948, businesses and activities at the airport have included: the modification of military aircraft; crop-dusting; aircraft-engine repair; aircraft painting, stripping, and washing; dispensing of fire-retardant chemicals to fight forest fires; and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes has been widespread throughout the airport's history. From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of the Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells downgradient of the Chino Airport. The most common VOC detected above its MCL is TCE, as shown in Figure 4-19. TCE concentrations in the contaminated wells ranged from 6 to 75 μg/L.

In 1990, Cleanup and Abatement Order (CAO) No. 90-134 was issued to address groundwater contamination emanating from the Chino Airport. During 2003, five groundwater monitoring wells were installed onsite; and in 2005, an additional four groundwater monitoring wells were installed onsite for further characterization. During June and July of 2006, Watermaster conducted a focused sampling event of 25 wells within the vicinity of the Chino Airport plume. In 2007, the San Bernardino County Department of Airports began to focus their investigation on offsite characterization of the plume. In 2008, the RWQCB issued a CAO (No. R-8 2008-0064) to the San Bernardino County Department of Airports in order to define the lateral and vertical extent of the VOCs in groundwater and to prepare a remedial action plan. In late 2008, nine offsite monitoring wells were completed in three locations. Initial sampling of these wells was done in August 2009.

Figure 4-18 shows the approximate areal extent of TCE in groundwater at concentrations in exceedance of the MCL in the vicinity of the Chino Airport as of 2008. The plume is elongate in shape, up to 3,600 feet wide, and extends approximately 12,100 feet from the airport's northern boundary in a south to southwestern direction. From July 2003 to June 2008, the maximum TCE concentration detected at an individual well within the Chino Airport plume was 910 μg/L.

4.3.4.3 California Institute for Men

The California Institution for Men (CIM) is a state correctional facility located in the City of Chino and has been in existence since 1939. The property occupies approximately 1,500 acres, and is bounded by Eucalyptus Avenue to the north, Euclid Avenue to the east, Kimball Avenue to the south, and Central Avenue to the west. Site use includes agricultural operations, inmate housing, and correctional facilities. The Heman G. Stark Youth Correctional Facility occupies the eastern portion of the property (Geomatrix Consultants, 2005).

In 1990, PCE was detected at a concentration of 26 μg/L at CIM drinking water supply Well 1. Analytical results have indicated that the most common VOCs detected in groundwater underlying CIM are PCE and TCE. The maximum PCE concentration in groundwater detected at an individual monitoring well (MW-7) was 1990 μg/L, and the maximum TCE concentration in groundwater detected at an individual monitoring well (MW-6) was 160 μg/L (Geomatrix Consultants, 2007). Other detected VOCs include 1,2-DCE, bromodichloromethane, 1,1,1-TCA, carbon tetrachloride, chloroform, and toluene.

In 1992, construction began on a groundwater monitoring network of approximately 40 wells. These wells were sampled intermittently through 2007. An Interim Remedial Measure (IRM) was implemented to resume production at Well 1, treat extracted water to reduce VOC concentrations, and use that water as part of the CIM potable water distribution system. Since the implementation of the IRM, the concentrations of PCE and TCE in groundwater have decreased considerably. Of the 39 wells sampled in 2007, 6 wells in the shallow aquifer had PCE concentrations in exceedance of the MCL, and TCE was detected at one shallow monitoring well (Geomatrix Consultants, 2007). CIM submitted a Request for No Further Action (NFA) for groundwater PCE remediation to the RWQCB.

Figure 4-18 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding their MCLs as of 2008. The plume is up to 2,900 feet wide and extends about 5,800 feet from north to south. As Figure 4-19 illustrates, the CIM plume is primarily characterized by PCE. From July 2003 to June 2008, the maximum PCE and TCE concentrations in groundwater detected at an individual well within the CIM plume were 57 μg/L and 26 μg/L, respectively.

4.3.4.4 Crown Coach

The former Crown Coach site, located at 13799 Monte Vista Ave in the City of Chino, was used by the General Electric Corporation (GE) for the manufacturing and maintenance of semi-tractors and buses from the early 1970s onward. In 1987, it was discovered that twelve underground storage tanks were leaking lube oils, diesel, antifreeze, waste oil, and waste solvents. All 12 tanks were removed by 1988, and the release of spent solvents in the underlying soil and groundwater was reported (Rosengarten Smith & Associates, 1992). Since 1988, sampling at 22 monitoring wells has determined the concentration and areal extent of the VOC plume. Contaminated soil and groundwater are contained onsite. The most common VOCs detected are TCE, PCE, and 1,1-DCE, as shown in Figure 4-19.

Concurrent with groundwater monitoring, a series of remediation activities have occurred on the property. Starting in June 1990, extracted groundwater was discharged to an onsite sewer connection, operating under an industrial wastewater discharge permit. A soil-vapor extraction system was brought onsite in 1992 to address vadose zone contamination. Starting in 2005, a Dual Phase Extraction Treatment System (DPETS) was used to remediate groundwater and soil. In May 2008, Duke Reality began redevelopment activities on the property. During construction, DPETS operations ceased, and Edible Oil Solution (EOS) was injected into ten monitoring and extraction wells as a remediation replacement.

Figure 4-18 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding their MCLs near the Crown Coach Facility as of 2008. The plume is approximately 500 feet in length and 250 feet wide. The last monitoring event in 2008 indicated that the lateral boundaries of the plume are decreasing, and PCE, TCE, and 1,1 DCE were not detected in deep aquifer wells (Rosengarten Smith & Associates, 2008). From July 2003 to June 2008, the maximum PCE and TCE concentrations detected at an individual well within the Crown Coach VOC plume were 182 μg/L and 125 μg/L, respectively.

In June 2009, GE submitted a report to the Regional Board evaluating the effectiveness of the EOS injections and the need for additional remedial measures. In this report GE concluded that the hydrogeologic conditions beneath the site are sufficient to protect the beneficial uses of groundwater in the regional aquifer and that no further monitoring and remediation activity is warranted at this site. A response from the Regional Board on this report is pending.

4.3.4.5 General Electric Flatiron Facility

The General Electric Flatiron Facility (Flatiron Facility) occupied the site at 234 East Main Street, Ontario, California from the early 1900s to 1982. Its operations primarily consisted of manufacturing clothes irons. Currently, the site is occupied by an industrial park. The RWQCB issued an investigative order to GE in 1987 after an inactive well in the City of Ontario was found to contain TCE and chromium above drinking water standards. Analytical results from groundwater sampling have indicated that VOCs and total chromium are the major groundwater contaminants. The most common VOC detected at levels significantly above its MCL is TCE, as shown in Figure 4-19. TCE has reached a measured maximum concentration of 5,620 μg/L. Other VOCs—including PCE, toluene, and total xylenes—are periodically detected but commonly below their MCLs (Geomatrix Consultants, 1997).

The facility's eighteen monitoring wells are part of a quarterly monitoring program that began in 1991. Remediation activities began in 1995 with RWQCB Waster Discharge Requirement Order No. 95-62 for the pump and treat of groundwater at two extraction wells, EW-01 and EW-02. The operation of the extraction wells and remediation system is also referred to as the Final Remediation Measures (FRM). Groundwater from EW-01 is treated for VOCs, and groundwater from EW-02 is treated for VOCs and chromium. The two sources of treated water join, are pipelined to the West Cucamonga Channel and ultimately to the Ely Basins, where it percolates into the Chino Basin Aquifer. In late 2009 or early 2010, an injection well and pipeline will be completed, and treated groundwater will be injected into the Chino Basin. In addition to the remediation measures discussed above, a Soil Vapor Extraction (SVE) system has been in operation since 2003 to remove VOCs from impacted soil.

Figure 4-18 shows the approximate areal extent of TCE in groundwater at concentrations exceeding the MCL as of 2008. The plume is up to 3,400 feet wide and extends about 9,000 feet south-southwest (hydraulically downgradient) from the southern border of the site. From July 2003 to June 2008, the maximum TCE concentration detected at an individual well within the Flatiron Facility plume was 5,620 μg/L, and the maximum total chromium concentration detected at an individual well was 485 μg/L.

4.3.4.6 General Electric Test Cell Facility

The GE Engine Maintenance Center Test Cell Facility (Test Cell Facility) is located at 1923 East Avion, Ontario, California. From 1956 to present, primary operations at the Test Cell Facility have included the testing and maintenance of commercial and military aircraft engines. Historically, hazardous waste was disposed of in dry wells. In 1987, results of a preliminary investigation indicated the presence of VOCs in soils near the dry wells. In 1991, a soil and groundwater investigation and subsequent quarterly groundwater quality monitoring showed the presence of VOCs in the soil and groundwater beneath the Test Cell Facility and that the VOCs had migrated offsite (Dames & Moore, 1996). Subsequent investigations indicated that the most common and abundant VOC detected in groundwater beneath the site was TCE. The historical maximum TCE concentration measured at an onsite monitoring well (directly beneath the Test Cell Facility) was 1,240 μg/L. The historical maximum TCE concentration measured at an offsite monitoring well (downgradient) was 190 μg/L (BDM International, 1997). Other detected VOCs include PCE, cis-1,2-DCE, 1,2-dicholoropropane, 1,1-DCE, 1,1-DCA, and chloroform, among others.

A Consent Order between General Electric and CDPH was signed September 28, 1988 for groundwater and soil remediation (Docket No. 88/89-009CO). The groundwater investigation and cleanup is under the oversight of the RWQCB. Vapor extraction treatment system operations began in 1996 (Docket No. HAS 97/98-014). Quarterly monitoring and operations status reports have been submitted to the DTSC and the RWQCB since remediation commenced. Recently a study was conducted to evaluate the effectiveness of the soil remediation program. The results of this study were submitted to the DTSC in October 2008 (Geosyntec Consultants, 2008). In some regions of the facility, shallow soils have reached acceptable closure levels; however, remediation activities will continue until sufficient data can be evaluated.

Figure 4-18 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding federal MCLs as of 2008. The plume is elongate in shape, up to 2,400 feet wide, and extends approximately 10,300 feet from the Test Cell Facility in a southwesterly direction. As Figure 4-19 illustrates, the GE Test Cell Facility plume is characterized primarily by TCE, PCE, cis-1,2-DCE, and 1,1-DCE. From July 2003 to June 2008, the maximum TCE and PCE concentrations in groundwater detected at an individual well within the Test Cell Facility plume were 900 μg/L and 16 μg/L, respectively.

4.3.4.7 Kaiser Steel Fontana Steel Site

Between 1943 and 1983, the Kaiser Steel Corporation (Kaiser) operated an integrated steel manufacturing facility in Fontana. During the first 30 years of operations (1945-1974), a portion of the Kaiser brine wastewater was discharged to surface impoundments and allowed to percolate into the soil. In the early 1970s, the surface impoundments were lined to eliminate percolation to groundwater (Wildermuth, 1991). In July of 1983, Kaiser initiated a groundwater investigation that revealed the presence of a plume of degraded groundwater beneath the facility. In August 1987, the RWQCB issued CAO Number 87-121, requiring additional groundwater investigations and remediation activities. The results of those investigations showed that the major constituents of release to groundwater were inorganic dissolved solids and low molecular weight organic compounds. The wells sampled during the groundwater investigations had TDS concentrations ranging from 500 to 1,200 mg/L and TOC concentrations ranging from 1 to 70 mg/L. By November 1991, the plume had migrated almost entirely off the Kaiser site.

In 1993, Kaiser and the RWQCB entered into a settlement agreement; Kaiser was required to mitigate any adverse impacts caused by its plume at existing and otherwise useable municipal wells. Pursuant to the settlement, the RWQCB rescinded its earlier order 91-40, and Kaiser was granted capacity in the Chino II Desalter to intercept and remediate the Kaiser plume within the Chino Basin. In an effort to further characterize the plume, during 2005, a network of 22 public and private supply wells were selected for quarterly groundwater sampling for one year and annual sampling thereafter. In addition, two triple nested monitoring wells, MZ3-1 and MZ3-2, were installed between the distal edge of the plume and municipal supply wells in 2007. Well MZ3-1/3 was found to have elevated concentrations of TDS, sulfate, and TOC. Based on this finding, the Kaiser plume was extended to include this well.

Figure 4-18 shows the approximate areal extent of the TDS/TOC groundwater plume as of 2008. Based on a limited number of wells, including Kaiser monitoring wells MP-2 and KOSF, City of Ontario Wells 27 and 30, and monitoring wells MZ3-1 and MZ3-2, the plume is up to 7,000 feet wide and extends about 18,500 feet from the northeast to the southwest.

4.3.4.8 Milliken Sanitary Landfill

The Milliken Sanitary Landfill (MSL) is an inactive Class III Municipal Solid Waste Management Unit, located near the intersections of Milliken Avenue and Mission Boulevard in the City of Ontario. This facility is owned by the County of San Bernardino and managed by the County's Waste System Division. The facility operated from 1958 to 1999. Groundwater monitoring at the MSL began in 1987 with five monitoring wells as part of a Solid Waste Assessment Test (SWAT) investigation (IT, 1989). The results of this investigation indicated that the MSL had released organic and inorganic compounds to underlying groundwater. Based on this finding, the MSL conducted an Evaluation Monitoring Program (EMP) investigation. At the completion of the EMP, a total of 29 monitoring wells were drilled to evaluate the nature and extent of the groundwater impacts identified in the vicinity of the MSL (GeoLogic Associates, 1998). Analytical results have indicated that VOCs are the major constituents of release. The most commonly detected VOCs are TCE, PCE, and dichlorodifluoromethane. Other VOCs that have been detected above MCLs include vinyl chloride, benzene, 1,1-dichloroethane, and 1,2-dichloropropane. Historically, the maximum total VOC concentration in an individual monitoring well was 159.6 μg/L (GeoLogic Associates, 1998).

Figure 4-18 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of 2008. The plume is up to 1,800 feet wide and extends about 2,100 feet south of the MSL's southern border. As Figure 4-19 illustrates, the MSL plume is characterized by a mixture of PCE, TCE, and their degradation products. From July 2003 to June 2008, the maximum TCE and PCE concentrations detected at an individual well within the MSL plume were 12 μg/L and 8.4 μg/L, respectively.

4.3.4.9 Municipal Wastewater Disposal Ponds

Historically, treated municipal wastewater was disposed of in ponds located near the current IEUA Regional Plant 1 (RP1), located in south Ontario, and the former Regional Plant 3 (RP3) disposal ponds, located in south Fontana. The ponds located just east of RP1, commonly referred to as the Cucamonga ponds, were used to dispose of untreated effluent collected by the Cucamonga County Water District (now the CVWD) and the IEUA. The RP3 disposal ponds are located on the southwest corner of Beech and Jurupa Avenues in the City of Fontana. The discharge of treated wastewater to the Cucamonga ponds and the RP3 ponds ceased between the early 1970s and the mid-1980s. The contaminant plumes emanating from these ponds have never been characterized.

4.3.4.10 Upland Sanitary Landfill

The Upland Sanitary Landfill (USL) is located on the site of a former gravel quarry at the southeastern corner of 15th Street and Campus Avenue in the City of Upland. The facility operated from 1950 to 1979 as an unlined Class II and Class III municipal solid waste disposal site. In 1982, the entire USL disposal site was covered with a 10-inch thick, low permeability layer of sandy silt (GeoLogic Associates, 1997). Groundwater monitoring began at the USL in 1988, and there are now three onsite monitoring wells: an upgradient well, a cross-gradient well, and a downgradient well (City of Upland, 1998). Monitoring results indicate that the USL has released organic and inorganic compounds to underlying groundwater (GeoLogic Associates, 1997). Groundwater samples from the downgradient monitoring well consistently contain higher concentrations of organic and inorganic compounds than samples from the upgradient and cross-gradient wells. Historical groundwater samples have indicated that VOCs are the major constituents of release, and all three monitoring wells have shown detectable levels of VOCs. The most common VOCs detected above MCLs are dichlorodifluoromethane, PCE, TCE, and vinyl chloride. Other VOCs that have been periodically detected above MCLs include methylene chloride, cis-1,2-DCE, 1,1-DCA, and benzene. For the 1990 to 1995 period, the average total VOC concentration at the downgradient monitoring well was 125 μg/L (GeoLogic Associates, 1997). And, for the July 2003 to June 2008 period, the maximum TCE and PCE concentrations detected at USL monitoring wells were 0.6 μg/L and 3.5 μg/L, respectively.

Figure 4-18 shows the approximate areal extent of VOCs at concentrations exceeding MCLs as of 2008. Please note that this plume is only defined by three onsite monitoring wells. The extent of the plume may be greater than currently depicted in Figure 4-18.

4.3.4.11 VOC Plume – South of the OIA

A VOC plume, containing TCE, exists south of the OIA. This plume extends approximately from State Route 60 on the north and Haven Avenue on the east to Cloverdale Road on the south and South Grove Avenue on the west. It is up to 11,300 feet wide and 20,500 feet long. By the late 1980s, the RWQCB determined TCE was present in numerous private wells in the area south of the OIA, and identified past activities at the airport as a likely source of TCE (RWQCB, 2005b). By 2005, TCE in exceedance of the CA MCL (5μg/L) was detected in 92 of the 167 private wells in the area. In July 2005, Draft CAOs were issued by the RWQCB to six parties identified as former TCE dischargers on the OIA property: Aerojet, the Boeing Company (Boeing), the Department of Defense, the Lockheed Martin Corporation (Lockheed), and the Northrop Grumman Corporation (Northrop). On a voluntary basis, Lockheed, GE, Boeing, and Aerojet are funding current investigative work on the extent and source of the TCE plume. Three triple nested monitoring wells were constructed in 2008 between the OIA and the VOC plume. A fourth well will be completed in 2009.

Final CAOs will likely be issued in the future. Watermaster has been working closely with the RWQCB and the identified parties, providing any available information to assist in the investigation. Remediation of the plume will likely be achieved using the CDA's Chino Basin Desalter I facilities . Watermaster is currently seeking a settlement with the companies to recover treatment costs associated with the VOC plume.

Figure 4-18 shows the approximate areal extent of the plume as of 2008. As Figure 4-19 illustrates, the OIA plume is characterized solely by TCE. During the July 2003 to June 2008 period, the maximum TCE concentration detected at an individual well within this plume was 38 μg/L.

4.3.4.12 Stringfellow NPL Site

One facility in the Chino Basin, the Stringfellow site, is on the current NPL of Superfund Sites. This site is located in Pyrite Canyon north of Highway 60 near the community of Glen Avon in Riverside County (see Figure 4-18). From 1956 until 1972, this 17-acre site was operated as a hazardous waste disposal facility. More than 34-million gallons of industrial waste—primarily from metal finishing, electroplating, and pesticide production—were deposited at the site (US EPA, 2001). A groundwater plume of site-related contaminants exists underneath portions of the Glen Avon area. Groundwater at the site contains various VOCs, perchlorate, NDMA, and trace metals, such as cadmium, nickel, chromium, and manganese. In the original disposal area, soil is contaminated with pesticides, polychlorinated biphenyls (PCBs), sulfates, perchlorate, and trace metals. The original disposal area is covered by a clay cap, fenced, and guarded by security services.

Contamination at the Stringfellow site has been addressed by cleanup remedies described in four EPA RODs. Since 1986, cleanup actions have focused on controlling the source of contamination, installing an onsite pretreatment plant, the cleanup of the lower part of Pyrite Canyon, and the cleanup of the community groundwater area below Highway 60. In 1996, the DTSC assumed responsibility for the maintenance of the Stringfellow Superfund Site through a Cooperative Agreement with the USEPA. In December 2007, the DTSC submitted the Draft Final Supplemental Feasibility Study (SFS), which identified and evaluated the final remedial alternatives for cleanup. The 2007 Draft SFS is a revised version of an earlier 2000 draft; reconsideration was required after perchlorate and other new contaminates were discovered in 2001. Once finalized, the SFS will be used by the US EPA to select a final remedial strategy and prepare a draft ROD. The draft ROD is anticipated in December 2009.

Figure 4-18 shows the approximate areal extent of the Stringfellow VOC plume as of 2008. The VOC plume is elongate in shape, up to 1,500 feet wide, and extends approximately 14,500 feet from the original disposal area in a southwesterly direction. The most common VOC detected at levels above the MCL is TCE. There are approximately 70 extraction wells throughout the length of the plume, which have been effective in stopping plume migration and removing TCE contamination. South of Highway 60, there are only a few isolated areas where TCE exceeds 5 μg/L (DTSC, 2008). During the 2003 to 2008 period, the maximum TCE concentration detected in the Stringfellow plume was 170 μg/L.

High levels of perchlorate associated with the Stringfellow site were detected in community groundwater south of Highway 60 in 2001. Residents connected to the JCSD water service were provided bottled water, and the DTSC contracted to install water mains and hook ups at each residence. Concurrent with the SFS, the DTSC is conducting a Remedial Investigation and Feasibility Study of remedial alternatives for perchlorate in the downgradient community area. As with TCE, the operation of the groundwater treatment system has resulted in a reduction of perchlorate. Since the discovery in 2001, perchlorate concentrations have been reduced by 30% to 50% throughout the monitored area (DTSC, 2008). Figure 4-18 shows the approximate areal extent of perchlorate concentrations exceeding the Notification Level (6 μg/L) as of 2008. The perchlorate plume is elongated in shape, up to 2,000 feet wide, and extends approximately 25,000 feet to the southwest from the original disposal area. During the 2003 to 2008 period, the maximum perchlorate concentration detected in the Stringfellow plume was 870 μg/L.

4.3.5 Water Quality by Management Zone

Figure 4-20 shows the locations of wells with groundwater quality time histories discussed herein and the five Chino Basin management zone boundaries. Wells were selected based on length of record, completeness of record, quality of data, and geographical distribution. Wells are identified by their local name (usually owner abbreviation and well number) or their X Reference ID (X Ref ID) if privately owned. The HCMP wells were selected because they are sampled at multiple depths and have a consistent water quality record for the past four years. Figures 4-21 through 4-28 are TDS and NO3-N time histories for the wells shown in Figure 4-20 from 1970 to 2008. These time histories illustrate water quality variation and trends within each management zone and the current state of water quality compared to historical trends.

4.3.5.1 Management Zone 1

MZ1 is an elongate region in the westernmost part of the Chino Basin. Figures 4-21 and 4-22 show TDS and NO3-N time histories for three wells representative of the northern portion of MZ1 (City of Upland well 8 [Upland 08], Monte Vista Water District well 5 [MVWD 05], and City of Upland well 20 [Upland 20]), two wells representative of the central region (City of Chino 5 [Chino 05] and City of Pomona well 23 [Pomona 23]), and two wells representative of the southern portion (Chino Institution for Men well 13 [CIM 13] and HCMP 3). In the northern portion of MZ1, NO3-N and TDS values have remained steady or decreased slightly over the time period depicted. Upland 08 exhibits NO3-N concentrations above the MCL (10 mg/L); however, slightly towards the west, near the Upland, Montclair, and College Heights Recharge Basins, NO3-N values drop below the MCL, as demonstrated by MVWD 05. TDS levels also decrease near the recharge basins. In the central region of MZ1, TDS and NO3-N concentrations have increased slightly over the last 30 years, but they are still below the MCLs. In the southern portion, NO3-N and TDS concentrations have increased significantly since 1990 and are above the MCLs, which is the trend seen in the majority of wells south of Highway 60. Quarterly sampling at HCMP 3 shows that TDS and NO3-N concentrations have remained stable over the past four years. HCMP 3 also shows the variation of water quality from the shallow to deeper aquifers. Overall, NO3-N and TDS concentrations in MZ1 escalate from north to south but have not increased over the last five years.

4.3.5.2 Management Zone 2

MZ2 is an elongate region in the center part of the Chino Basin. Figures 4-23 and 4-24 show TDS and NO3-N time histories for two wells representative of the northern portion of MZ2 (CVWD Well 5 [CVWD 05] and City of Ontario well 24 [ONT 24]), one well representative of the central region (City of Ontario well 17 [ONT 17]), and three wells representative of the southern portion (X Ref 29, HCMP 1, and X Ref 5333). Similar to MZ1, NO3-N and TDS values increase from north to south. Over the time period depicted, NO3-N and TDS concentrations have remained stable in the northern portion of MZ2, increased slightly in the central region, and increased considerably in the southern portion. At X Ref 5333 and HCMP 1, in the southern portion of MZ2, TDS concentrations are currently greater than twice the MCL (500 mg/L), and NO3-N concentrations are twice the MCL (10mg/L) or greater. In addition, HCMP 1 exemplifies the variation of high TDS and NO3-N levels in the shallow aquifer and low levels in the deeper aquifer. Overall, NO3-N and TDS concentrations have not increased over the last five years with the exception well X Ref 5333.

4.3.5.3 Management Zone 3

MZ3 is an elongate region that borders the majority of the Chino Basin's eastern boundary. Figures 4-25 and 4-26 show TDS and NO3-N time histories for one well representative of the northern portion (City of Fontana 37A [F37A]), one well representative of the central region (City of Ontario well 31 [ONT 31]), and two wells representative of the southern portion (Jurupa Community Service District well 16 [JCSD 16], and X Ref 5736). Similar to MZ1 and

MZ2, NO3-N and TDS values increase from north to south. In the northern and central areas of MZ3, TDS values have slightly increased since 1980 but still remain below the MCL (500 mg/L). Over the time period depicted, NO3-N concentrations increase in all regions of MZ3. Well F37A, in the northern region, exhibits NO3-N concentrations slightly above the MCL (10 mg/L). In the southern portion of MZ3, current TDS and NO3-N concentrations are near double the MCLs. At JCSD 16, NO3-N and TDS concentrations have increased significantly since 1990. In general, NO3-N and TDS concentrations have not increased over the last five years.

4.3.5.4 Management Zone 4

MZ4 – also known as Chino-East – is a wedge shaped region, bounded by the Jurupa Hills to the northeast, the Pedley Hills to the southeast, Management Zone 5 to the south, and Management Zone 3 to the west. Figures 4-27 and 4-28 show TDS and NO3-N time-histories for one well representative of the western region (HCMP-9), one well representative of the northern region (Jurupa Community Service District Well 24 [JCSD 24]), and one well representative of the eastern region (CDPH Stringfellow monitoring well [CTP-TW1]). In the western portion of MZ4, at HCMP-9, TDS and NO3-N concentrations are above the MCLs in the shallow aquifer but quite low in the deeper aquifer. The TDS and NO3 concentrations at JCSD 24 are slightly lower than those in the western portion, but they are slightly below or equal to the MCLs. In the eastern portion, at CTP-TW1, TDS and NO3-N concentrations are significantly above the MCLs. High TDS and NO3-N concentrations in the eastern portion of MZ4 are predominantly associated with the Stringfellow plume. Pre-1990 water quality data was not available for wells in this region. Since 1990, MZ4 TDS and NO3-N levels have remained relatively stable and decreased slightly over the last few years.

4.3.5.5 Management Zone 5

MZ5 – also known as Chino-South – is a small region towards the southeastern boundary of the Chino Basin. It is bordered by MZ4 to the north and MZ3 to the east. Figures 4-27 and 4-28 show TDS and NO3-N time histories for three wells representative of the northern portion of MZ5 (San Ana River Water Company Well 1A [SARWC 01A], JCSD 01, and HCMP-8). None of the wells in the southern region of MZ5 have sampling records that are complete enough to be considered representative. At JCSD 01 and SARWC 01A, TDS concentrations have historically been above the MCL (500 mg/L) and began to notably increase in 1990. Starting in 1995, NO3-N concentrations at JCSD 01 and SARWC 01A began to increase slightly above the MCL. Water quality sampling at these two wells ceased around 2005; however, HCMP-8 shows that TDS and NO3-N concentrations have decreased significantly since then.

4.3.6 Current State of Groundwater Quality in Chino Basin

The groundwater quality in Chino Basin is generally very good with better groundwater quality found in the north where recharge occurs. In the southern portion of the basin, TDS and NO3-N concentrations increase. Between July 2003 and June 2008, 32 percent of the wells sampled south of Highway 60 had TDS concentrations below the secondary MCL, an improvement from the 20 percent reported in the 2006 State of the Basin Report (period of July 2001 through June 2006). In some places, wells with low TDS concentrations are proximate to wells with higher TDS concentrations, suggesting a vertical stratification of water quality. Between July 2003 and June 2008, about 69 percent of the wells sampled south of Highway 60 had NO3-N concentrations greater than the MCL, an improvement from the 80 percent reported in the 2006 State of the Basin Report (period of July 2001 through June 2006). However, please note that these statistical improvements may be an artifact of sampling occurrence and frequency.

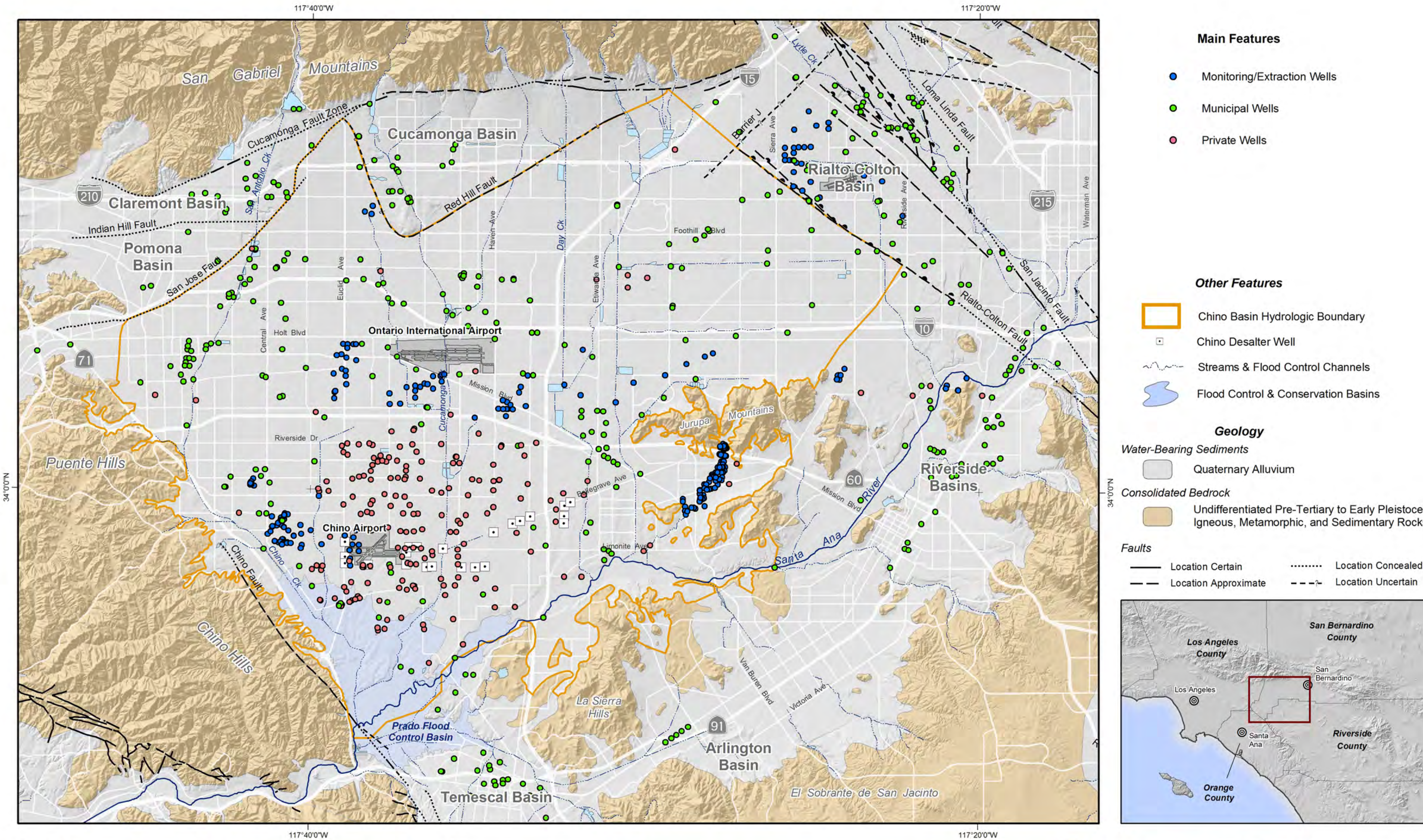
Other constituents that impact groundwater quality from a regulatory or Basin Plan standpoint include certain VOCs, arsenic, and perchlorate. As discussed in Section 4.3.4, there are a number of point source releases of VOCs in the Chino Basin that are in various stages of investigation or cleanup. There are also known point source releases of perchlorate (MVSL area, Stringfellow, etc.), and non-point source related perchlorate contamination appears to have resulted from natural and anthropogenic sources. Arsenic at levels above the WQS appears to be limited to the deeper aquifer zone near the City of Chino Hills. Hexavalent chromium, while not currently a groundwater quality issue in the Chino Basin, may become so, depending on the promulgation of future standards.

4.4 Conclusions and Recommendations

The Initial State of the Basin, and the 2004 and 2006 State of the Basin Reports discussed the need for future, long-term monitoring. Due to commercial and residential development in the Chino Basin area; many of the private agricultural wells that have been used for monitoring activities are destroyed as land is developed.

In response to the loss of historically utilized wells, Watermaster developed a water quality key well program. This program designates a series of wells across a wide areal distribution for long-term monitoring activities. To establish the well network, a grid was overlain the basin, and, where possible, at least one well was chosen per grid cell. Wells that are part of the water level monitoring program and/or on property that is not likely to be developed were preferentially chosen. Details of the Key Well Groundwater Quality Monitoring Program are available in the 2008 Chino Basin Maximum Benefit Annual Report and in Section 4.2.2 of this report. Key well sampling began in fall 2005 and runs in two-year cycles. Sampling results are added to the Watermaster database.

Point sources of concern are critical to the overall quality of Chino Basin groundwater. To ensure that Chino Basin groundwater remains a sustainable resource, it is of the utmost importance that Watermaster closely monitor point sources and emerging contaminates. It is recommended that Watermaster continue to work closely with the RWQCB and potentially responsible parties within the Chino Basin. This will allow for up-to-date understanding of groundwater quality, investigations, remediation activities, and potential mutually beneficial remedial options through Chino Basin desalting facilities.



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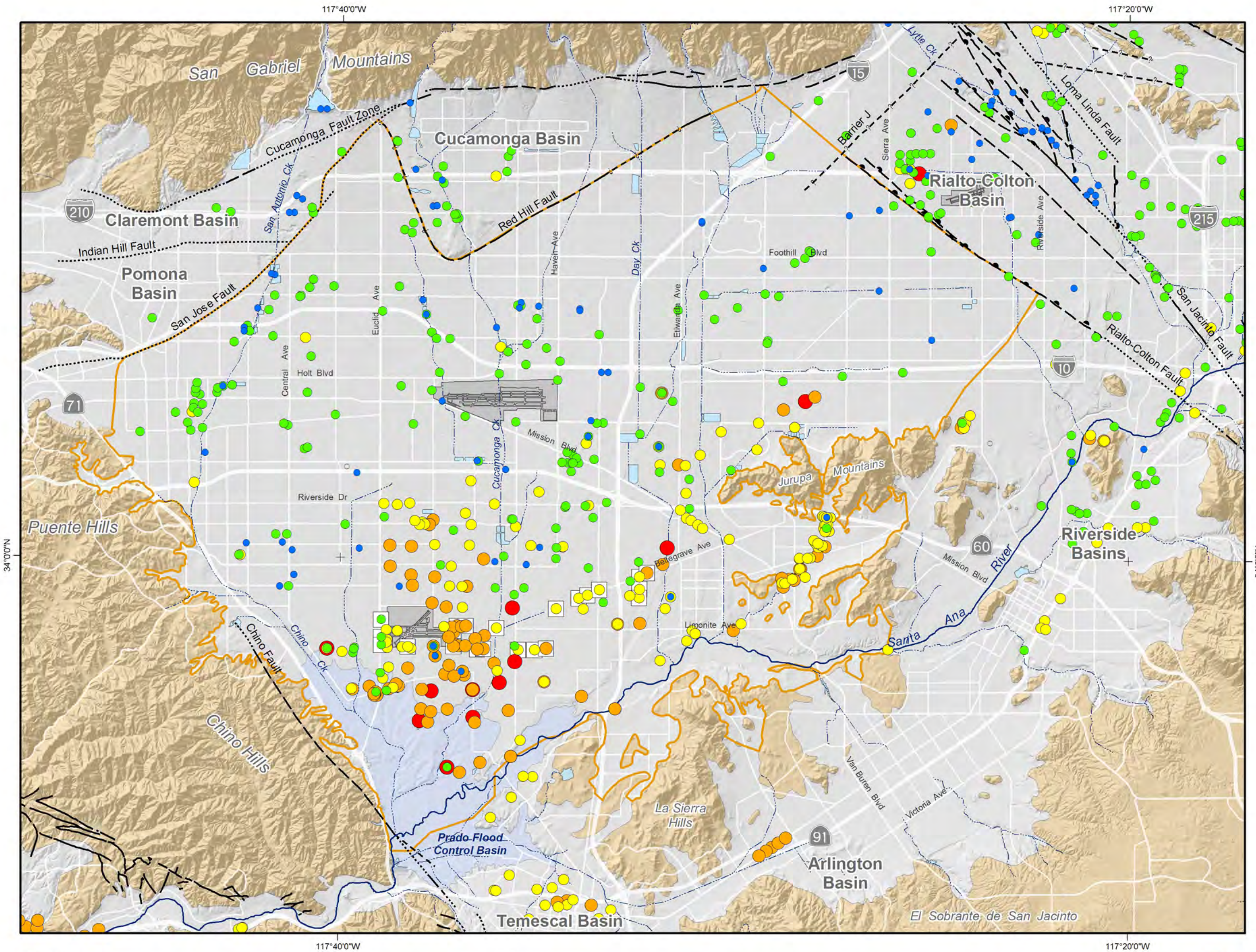
2008 State of the Basin Report

Groundwater Quality

Groundwater Wells with Water Quality Data

July 2003 - June 2008

Figure 4-1



Main Features

Total Dissolved Solids Concentration (mg/L)

- < 125
- 125 - 250
- 250 - 500
- 500 - 1,000
- 1,000 - 2,000
- > 2,000

Secondary US EPA MCL = 500 mg/L

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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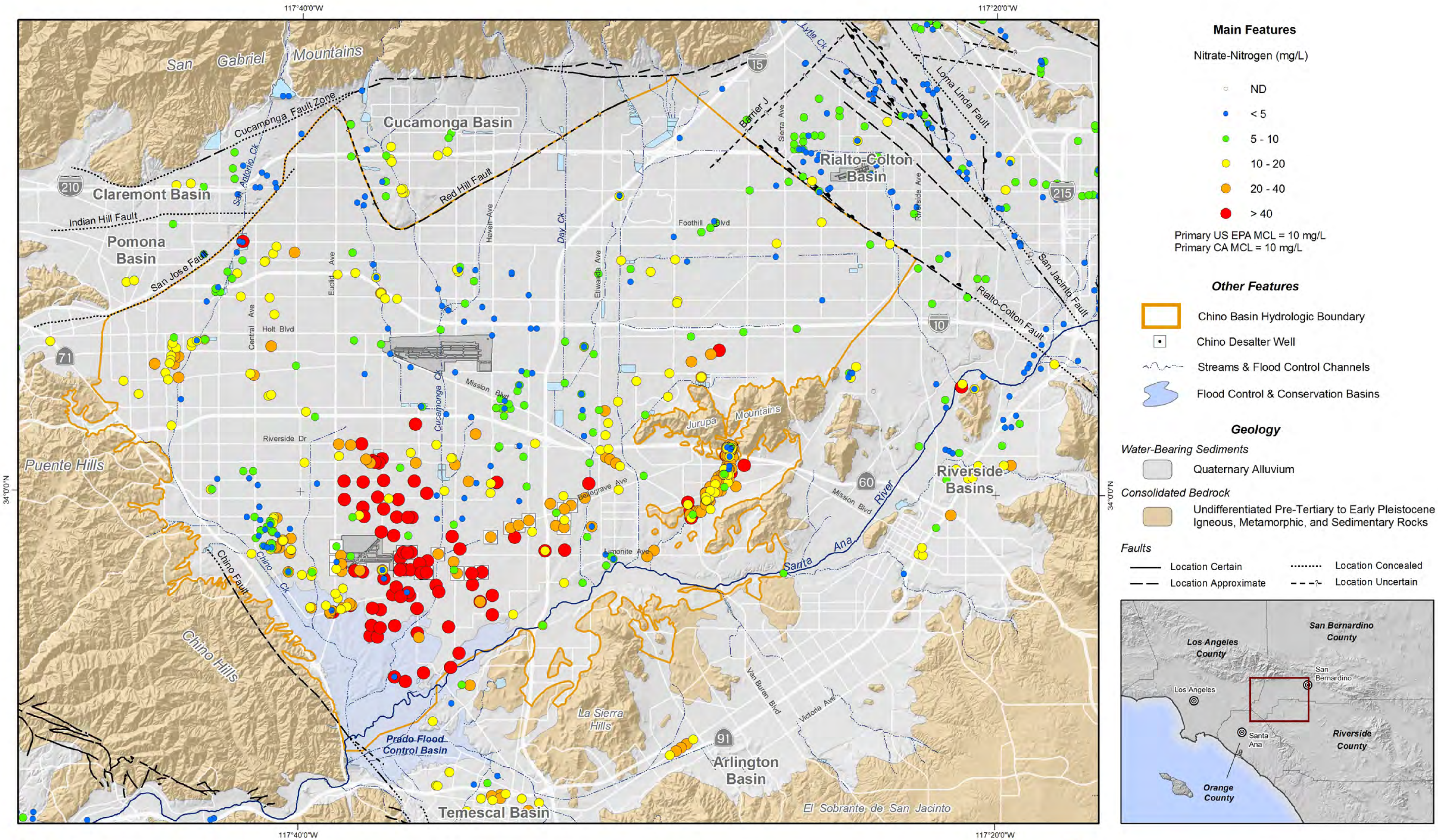
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

Total Dissolved Solids in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-2



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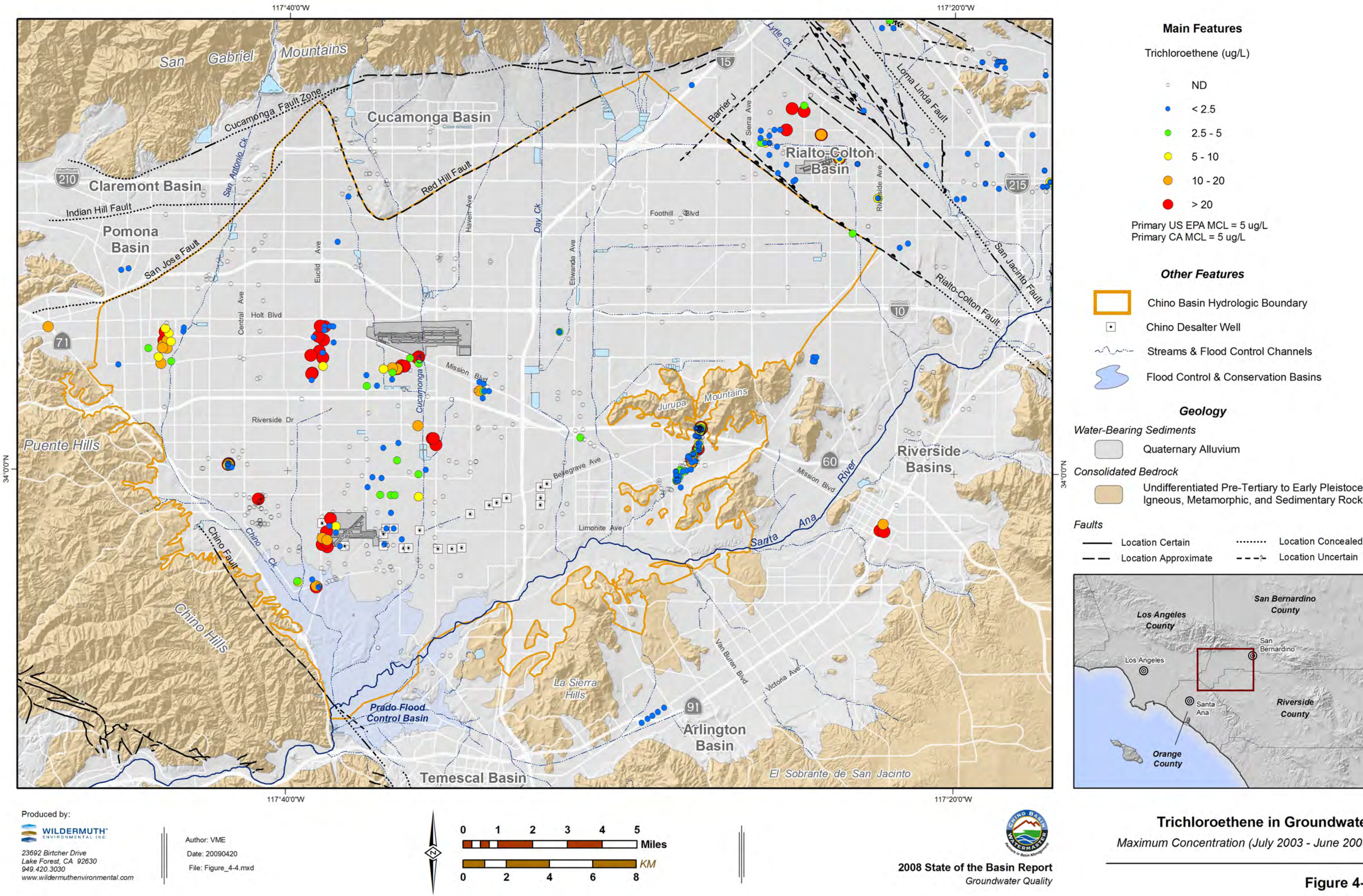
0 1 2 3 4 5 Miles

0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

Nitrate as Nitrogen in Groundwater
Maximum Concentration (July 2003 - June 2008)

Figure 4-3



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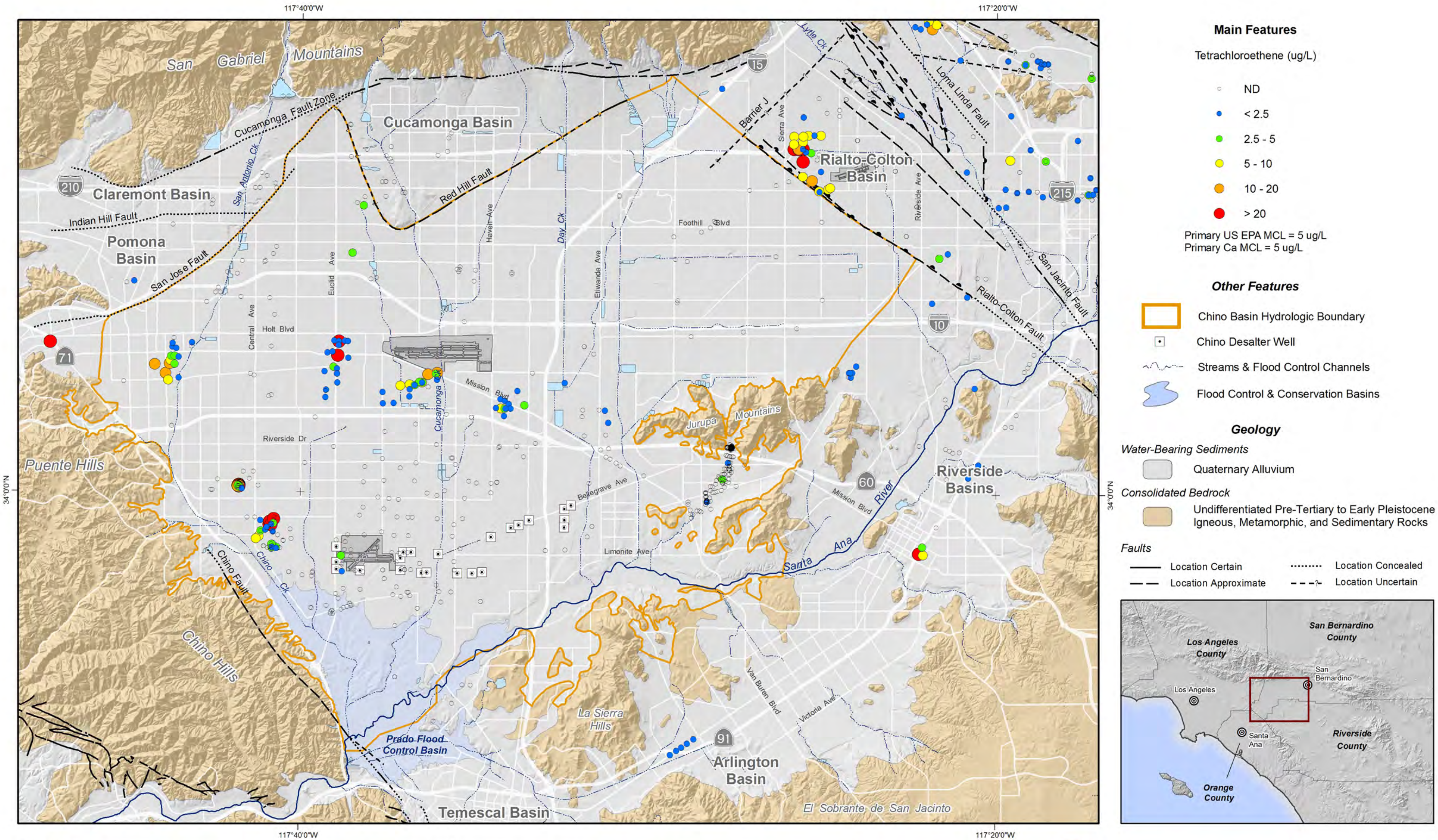
2008 State of the Basin Report
Groundwater Quality

Trichloroethene in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-4



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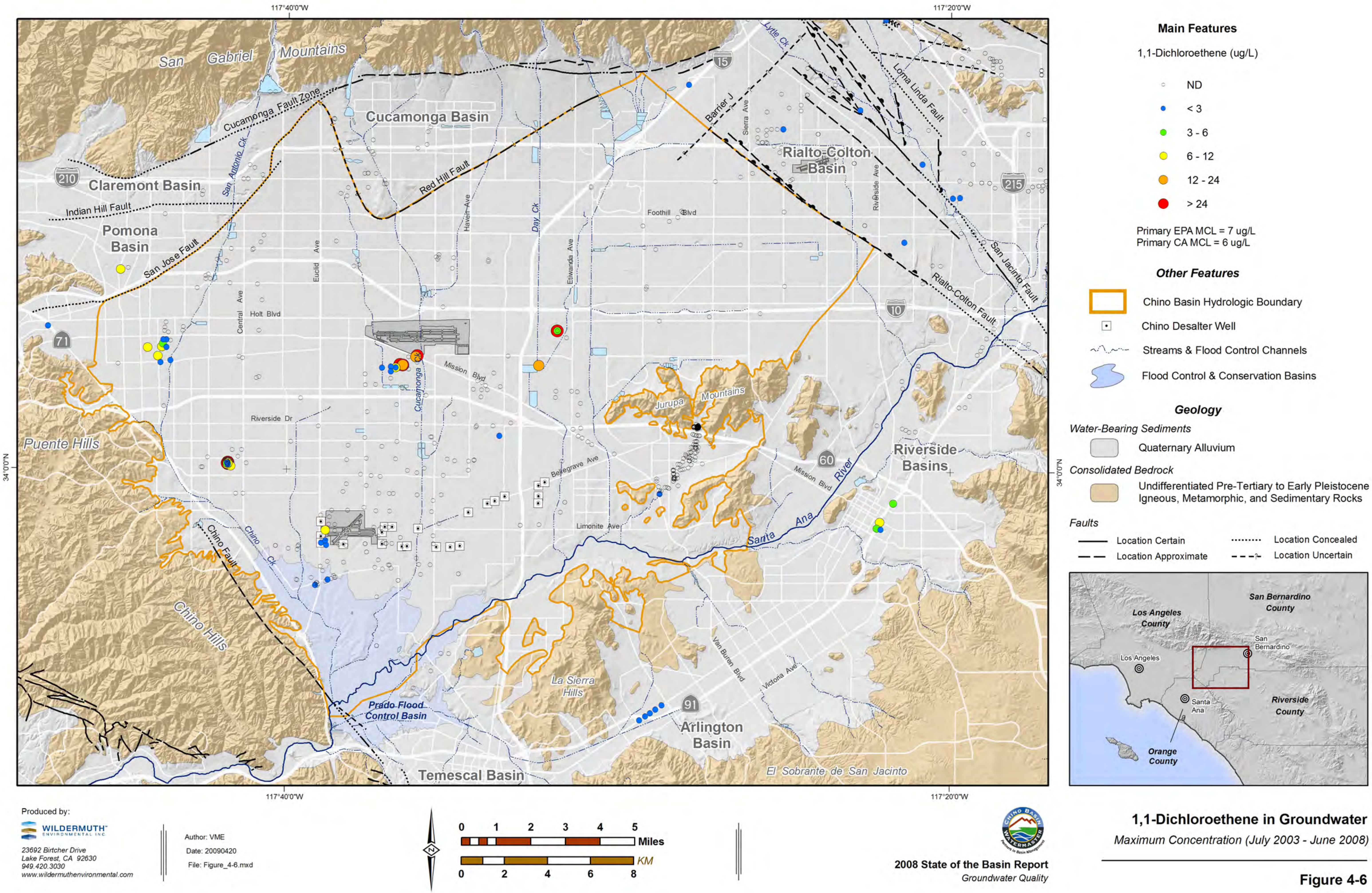
2008 State of the Basin Report
Groundwater Quality

Tetrachloroethene in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-5



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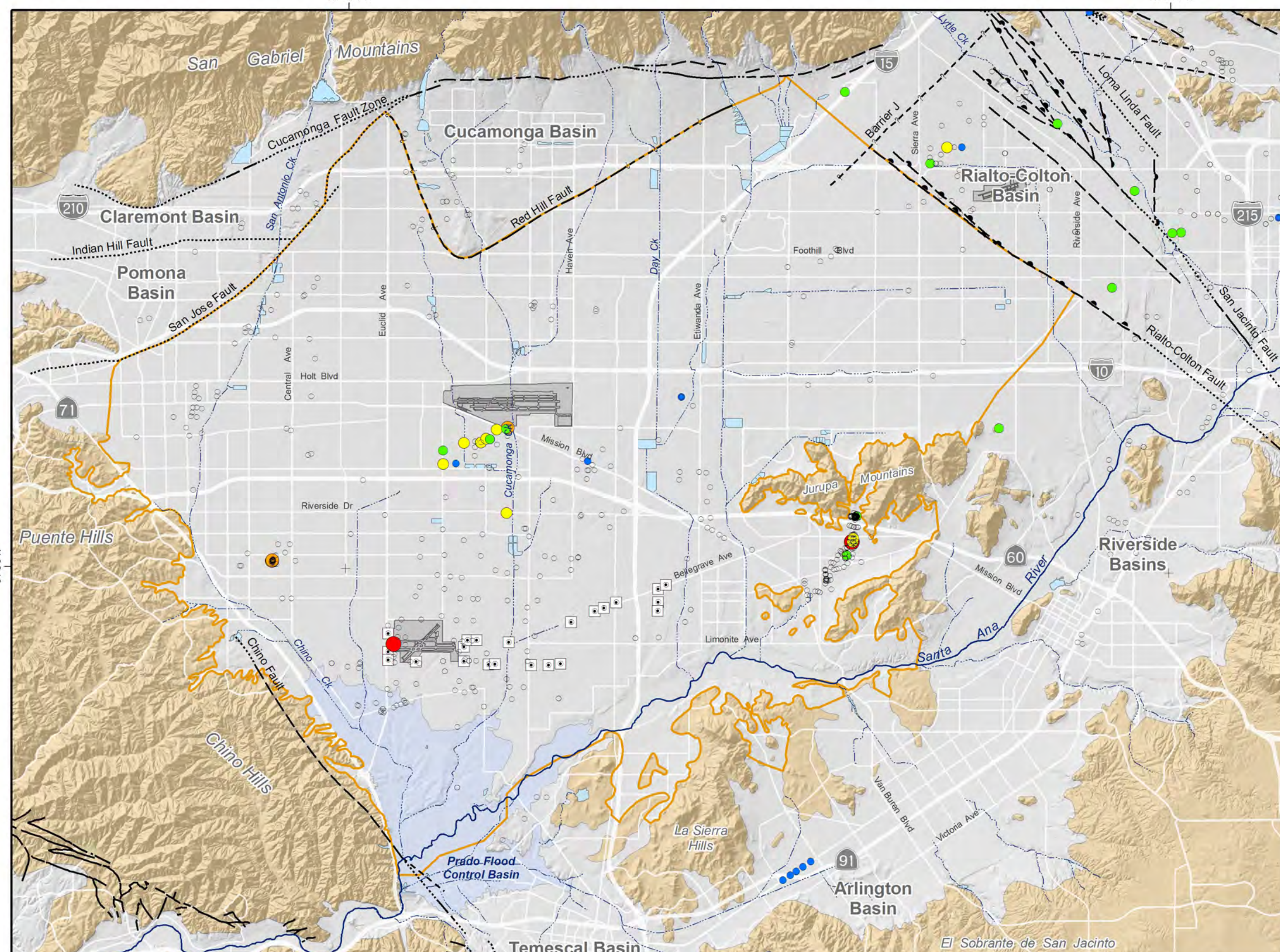
2008 State of the Basin Report
Groundwater Quality

1,1-Dichloroethene in Groundwater
Maximum Concentration (July 2003 - June 2008)

Figure 4-6



Main Features

1,2-Dichloroethane (ug/L)

- ND
- < 0.25
- 0.25 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- > 2.0

Primary EPA MCL = 5 ug/L
Primary CA MCL = 0.5 ug/L

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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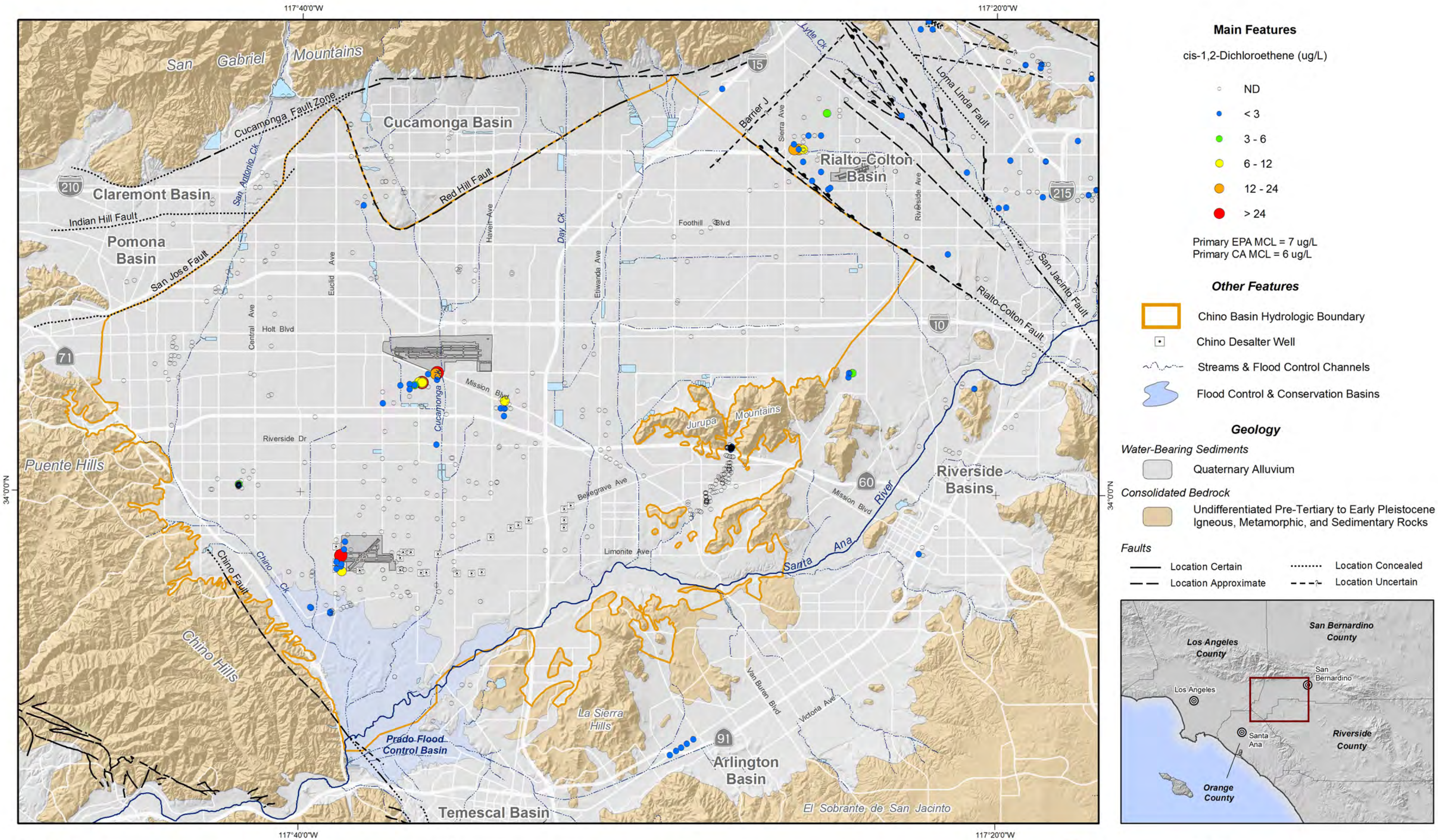
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

1,2-Dichloroethane in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-7



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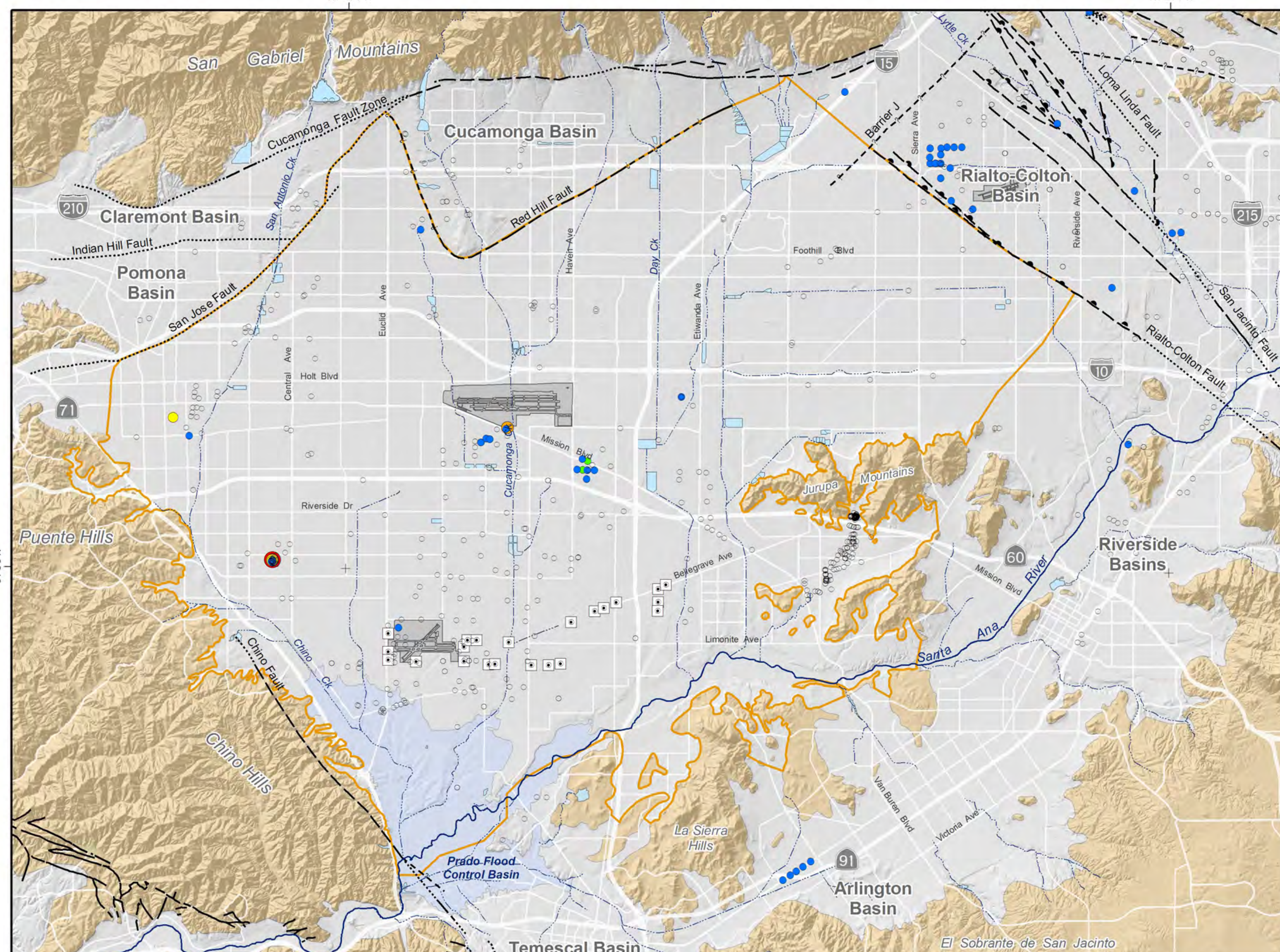
2008 State of the Basin Report
Groundwater Quality

cis-1,2-Dichloroethene in Groundwater
Maximum Concentration (July 2003 - June 2008)

Figure 4-8



Main Features

1,1-Dichloroethane (ug/L)

- ND
- < 2.5
- 2.5 - 5
- 5 - 10
- 10 - 20
- > 20

Primary CA MCL = 5 ug/L

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

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Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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0 1 2 3 4 5 Miles

0 2 4 6 8 KM

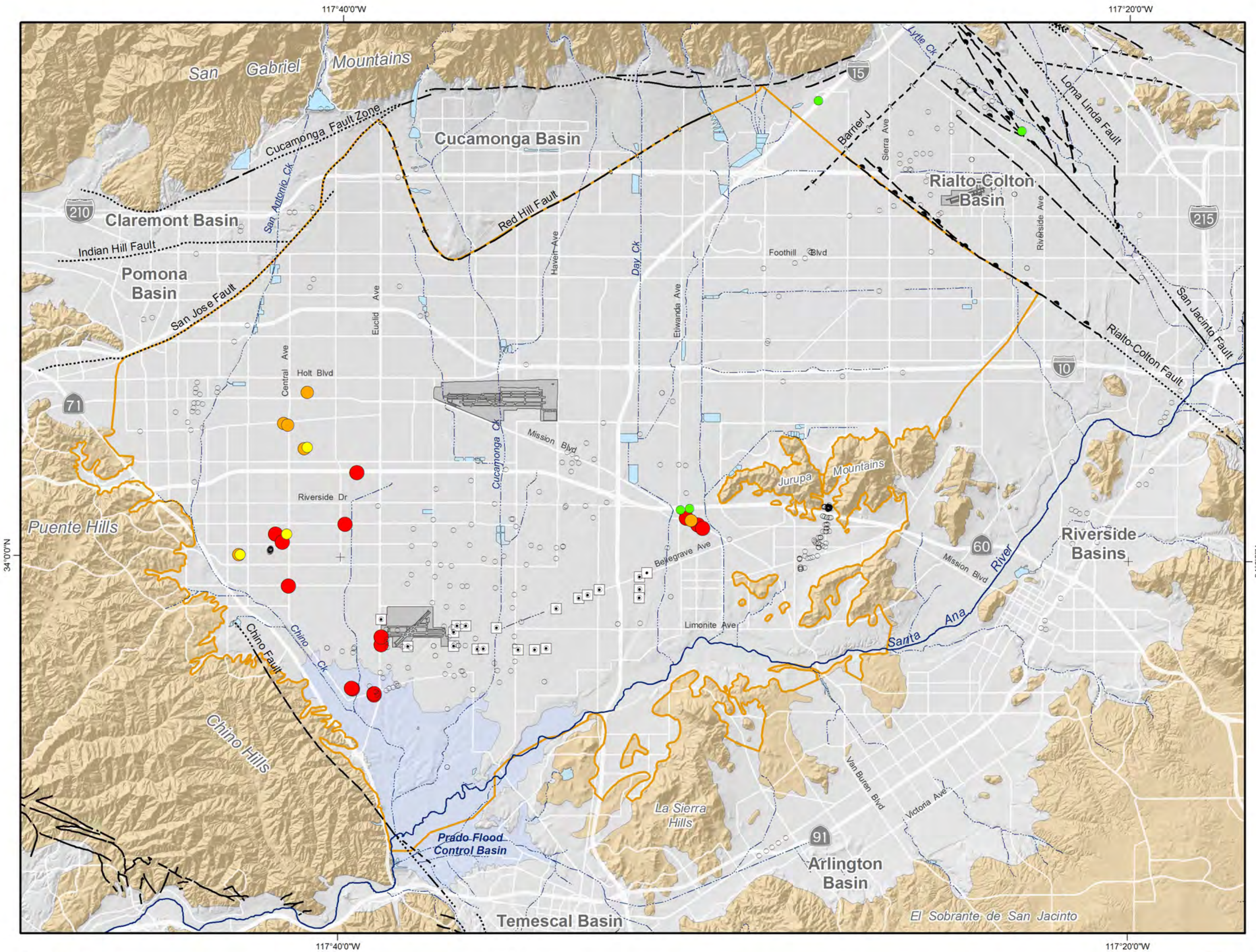
2008 State of the Basin Report

Groundwater Quality

1,1-Dichloroethane in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-9



Main Features

1,2,3-Trichloropropane (ug/L)

- ND
- < 0.0025
- 0.0025 - 0.005
- 0.005 - 0.01
- 0.01 - 0.02
- > 0.02

CA Notification Level = 0.005 ug/L

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

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Faults

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- Location Approximate
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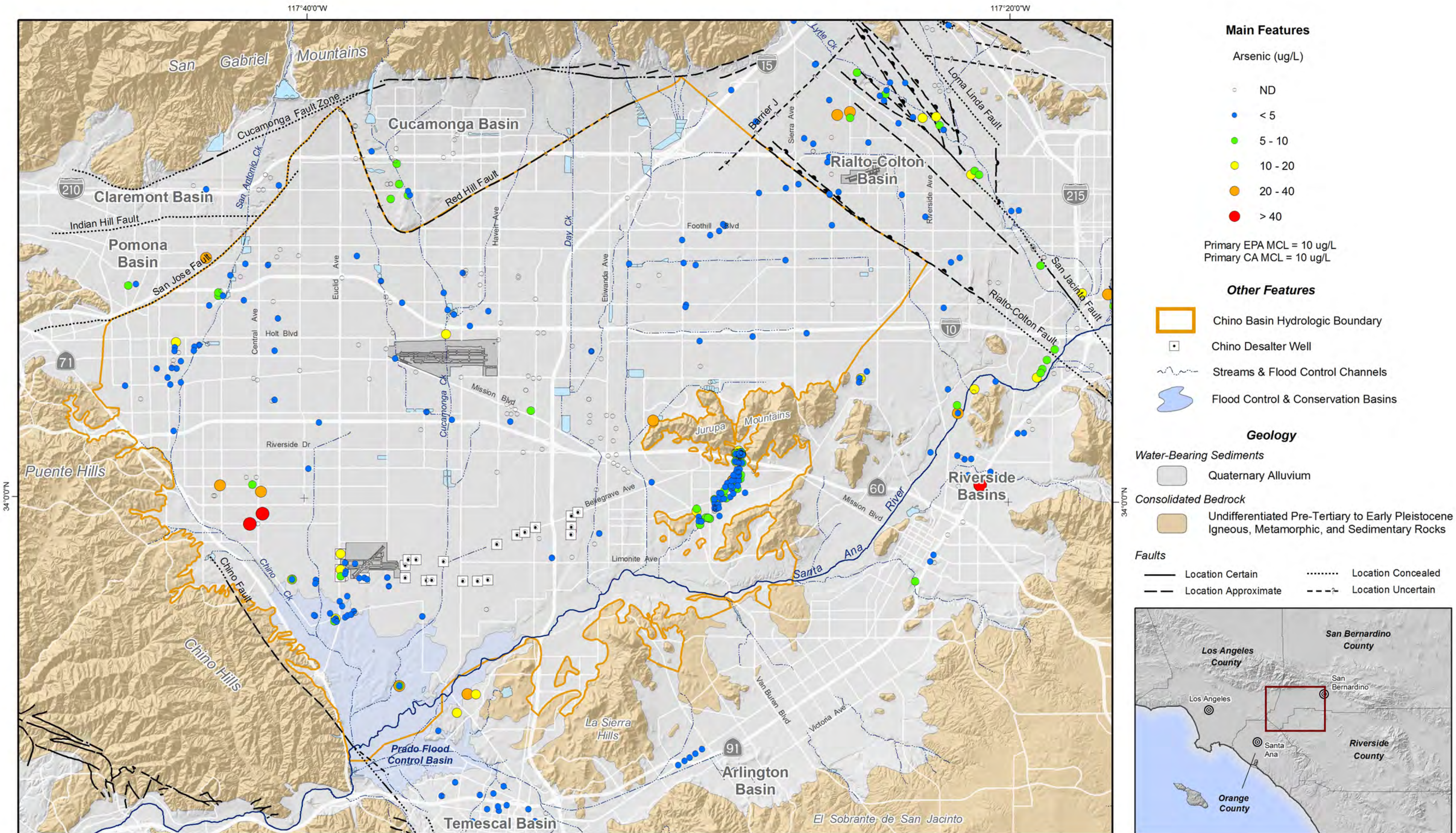
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

1,2,3-Trichloropropane in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-10



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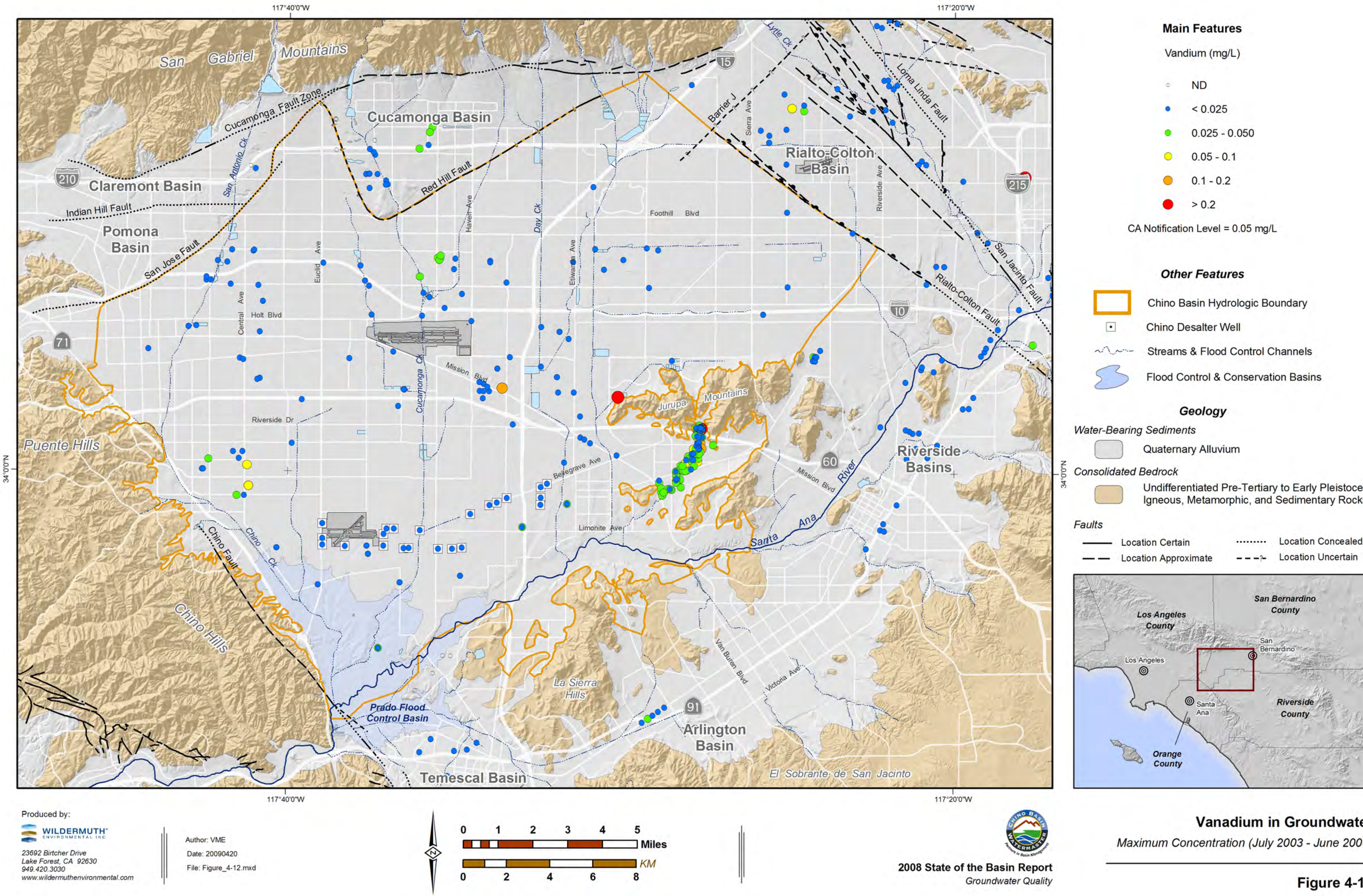
2008 State of the Basin Report
Groundwater Quality

Arsenic in Groundwater
Maximum Concentration (July 2003 - June 2008)

Figure 4-11



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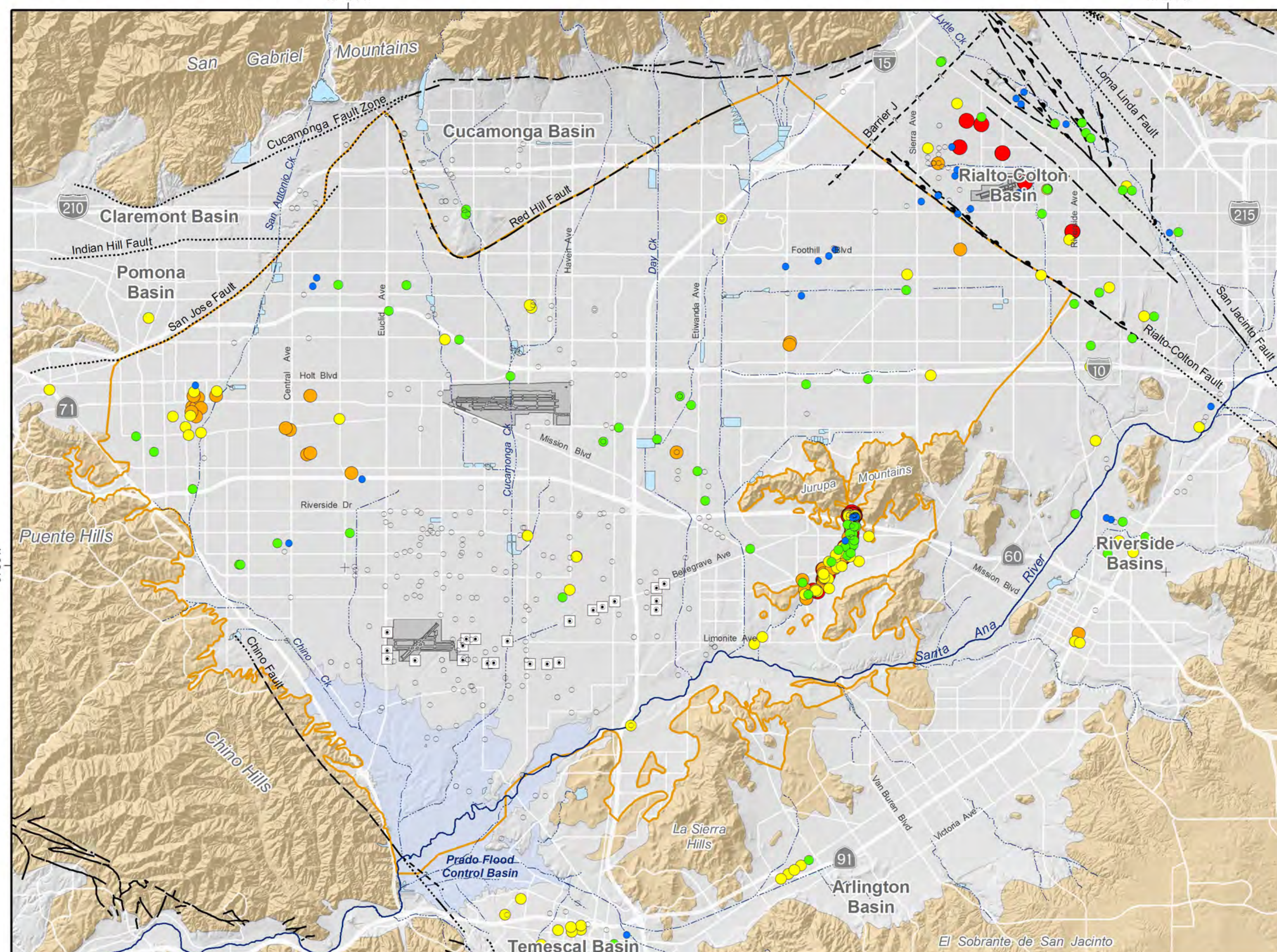
2008 State of the Basin Report
Groundwater Quality

Vanadium in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-12



Main Features

Perchlorate (ug/L)

- ND
- < 3
- 3 - 6
- 6 - 12
- 12 - 24
- > 24

CA Notification Level = 6 ug/L

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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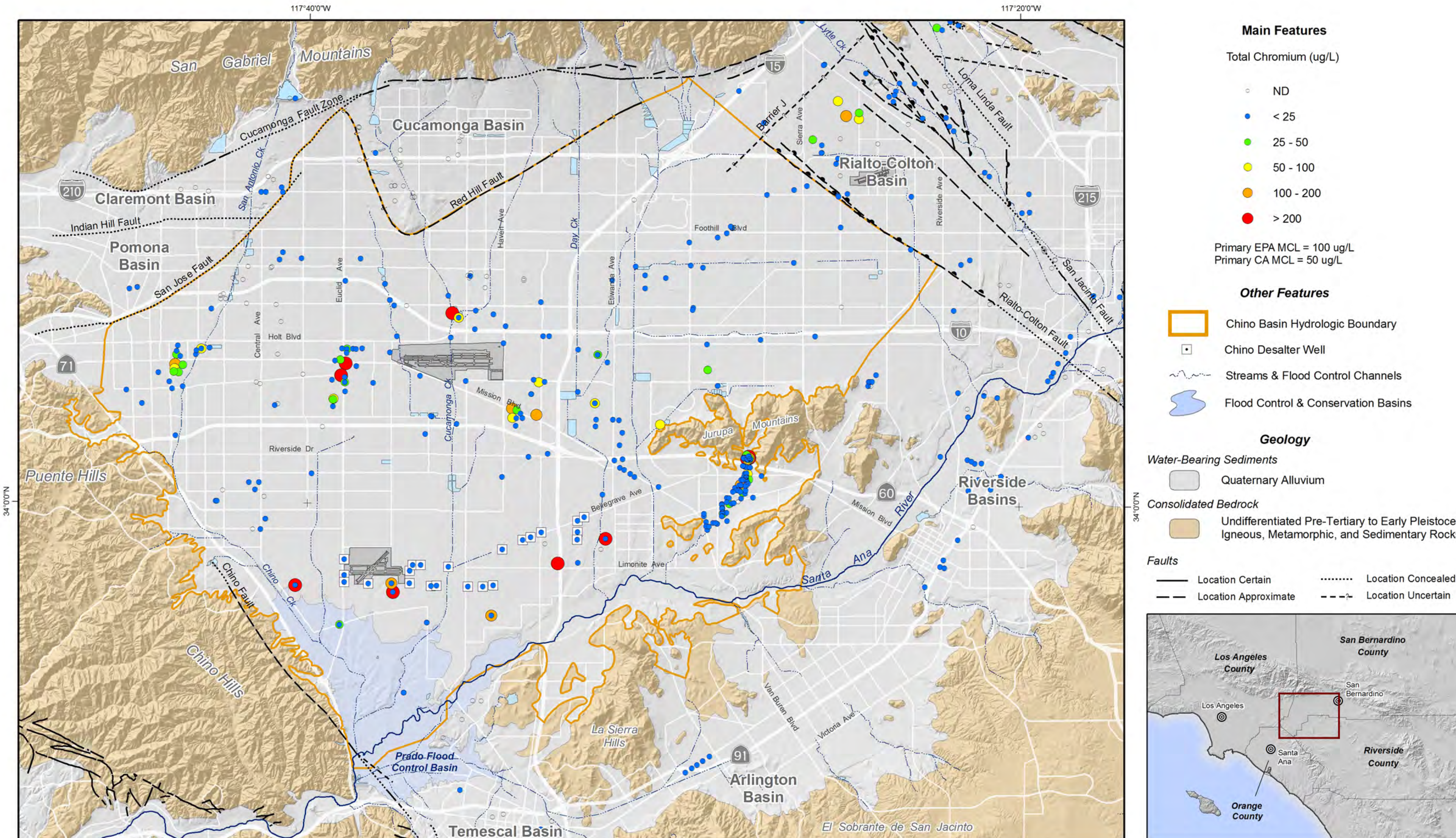
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

Perchlorate in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-13



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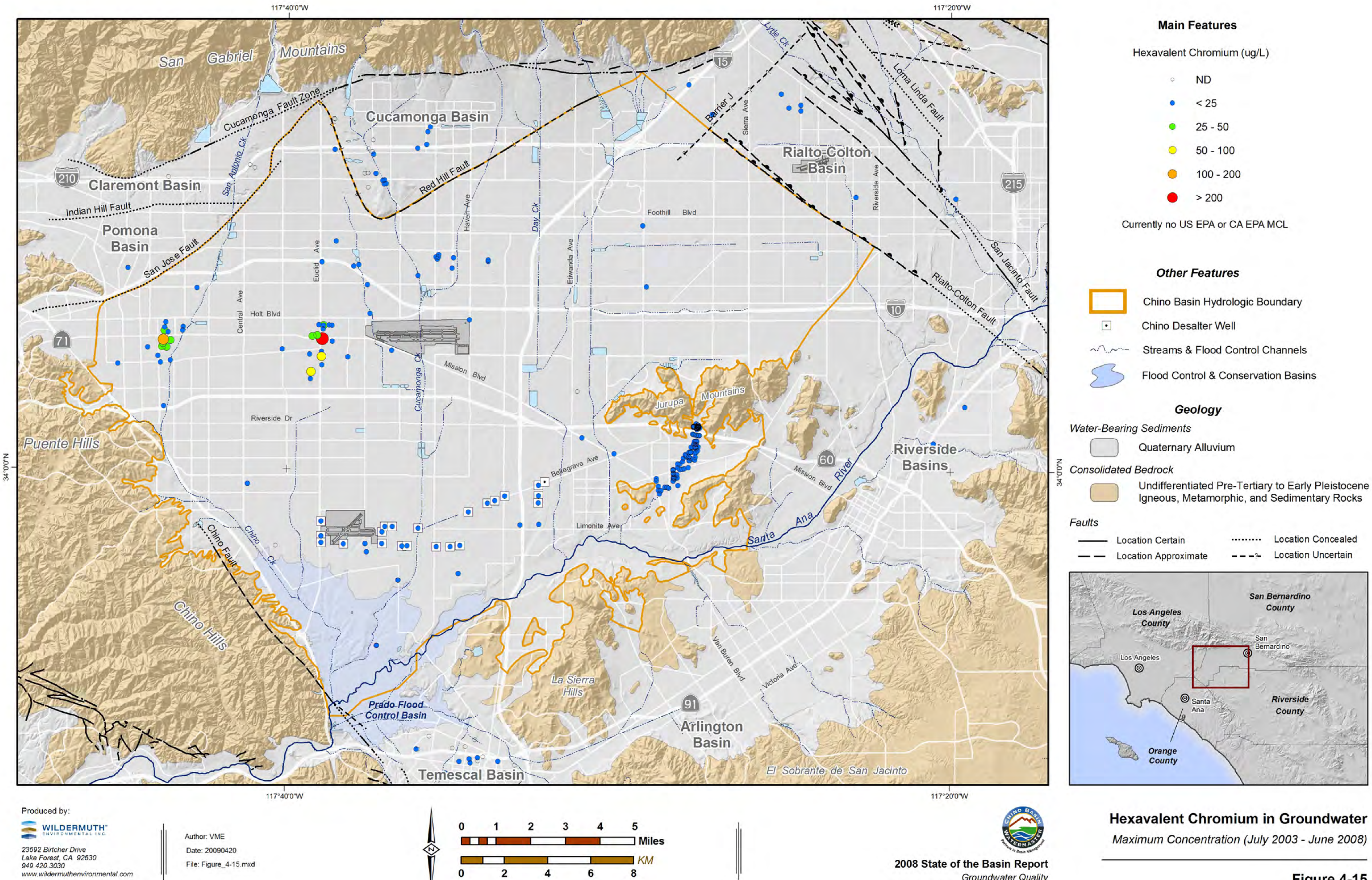
2008 State of the Basin Report
Groundwater Quality

Total Chromium in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-14



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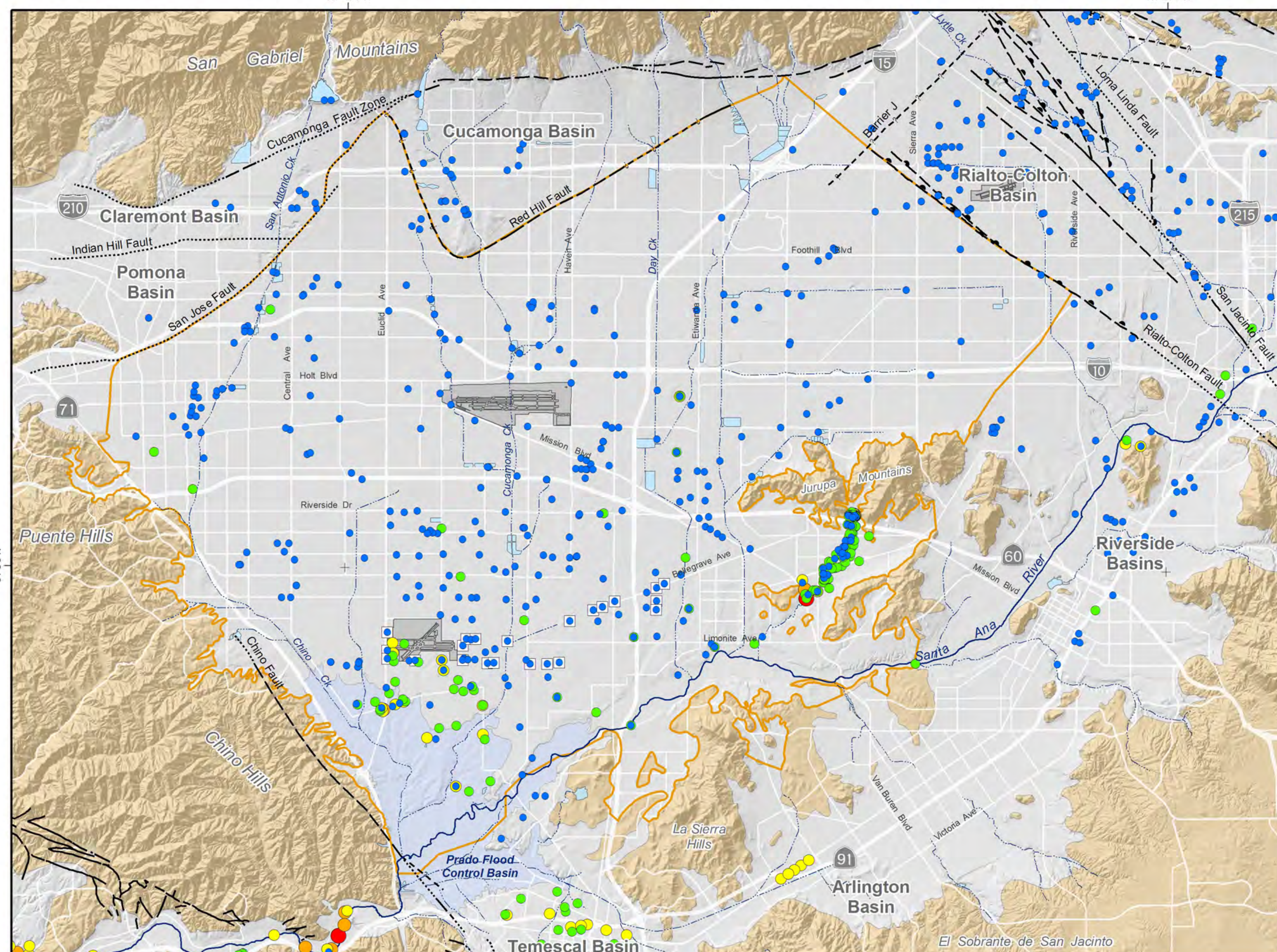
2008 State of the Basin Report
Groundwater Quality

Hexavalent Chromium in Groundwater
Maximum Concentration (July 2003 - June 2008)

Figure 4-15



Main Features

Sulfate (mg/L)

- ND
- < 125
- 125 - 250
- 250 - 500
- 500 - 1,000
- > 1,000

Secondary EPA MCL = 250 mg/L
Secondary CA MCL = 250 mg/L

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

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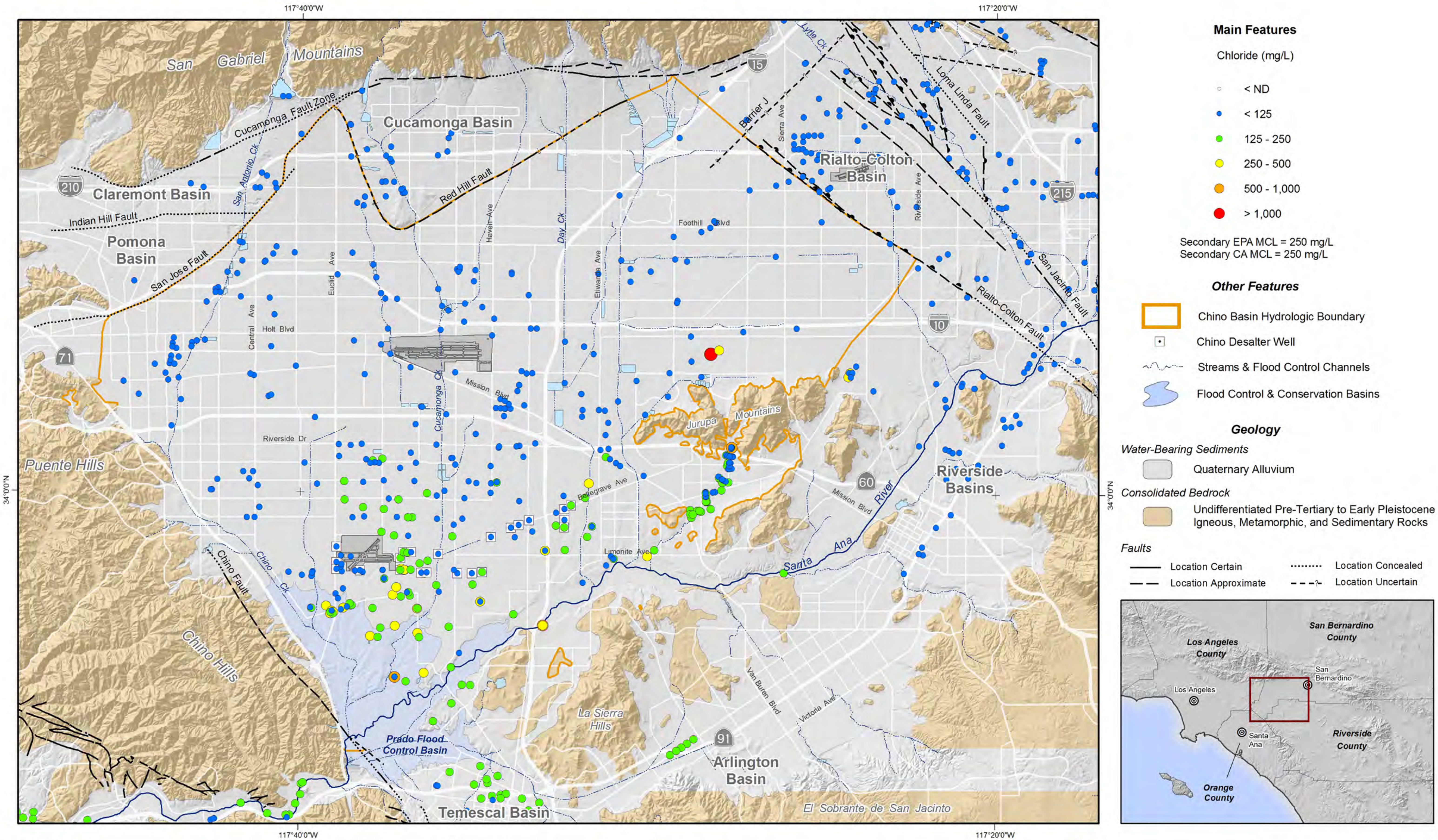
2008 State of the Basin Report
Groundwater Quality

Sulfate in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-16



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0 1 2 3 4 5 Miles

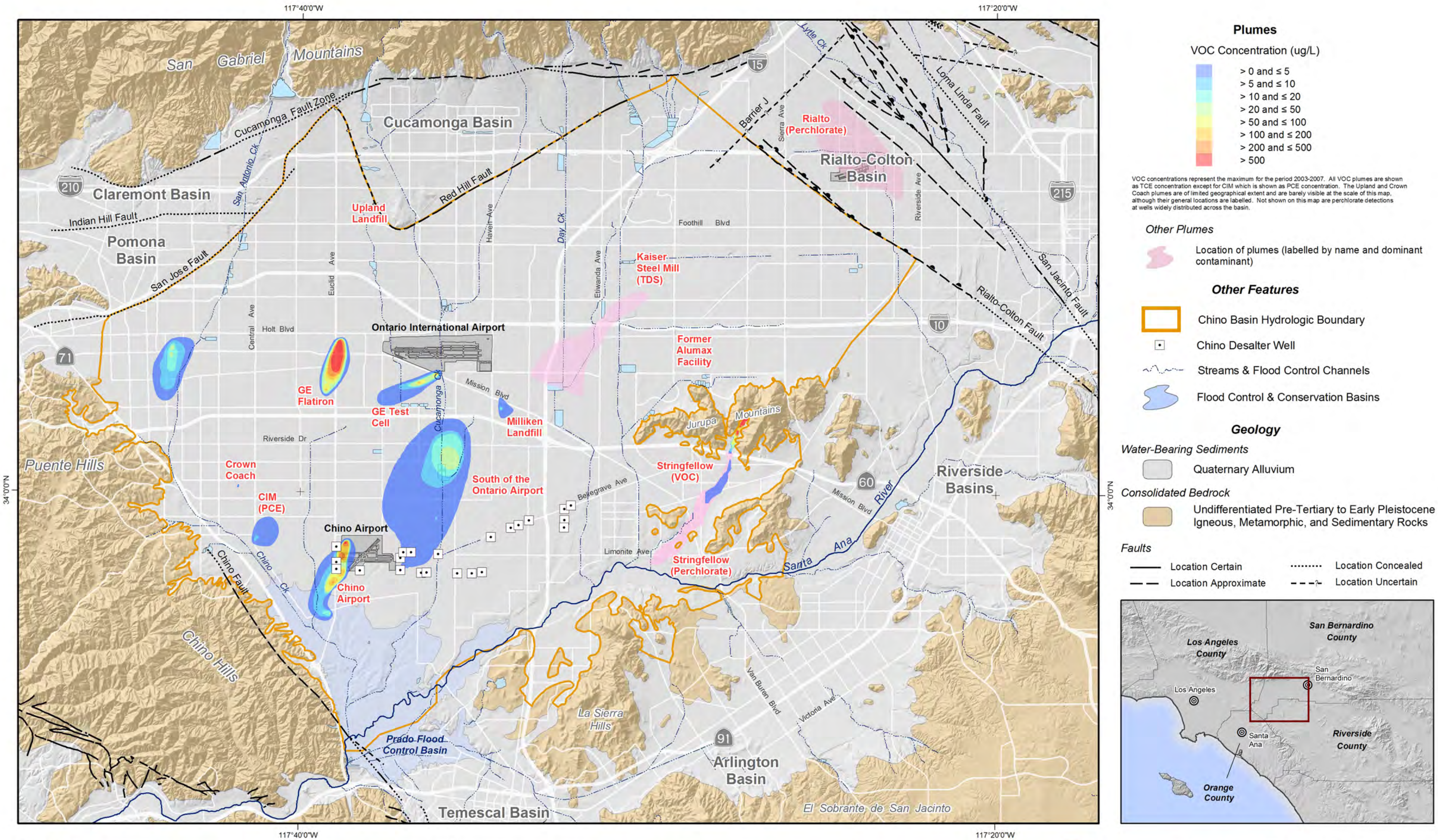
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

Chloride in Groundwater

Maximum Concentration (July 2003 - June 2008)

Figure 4-17



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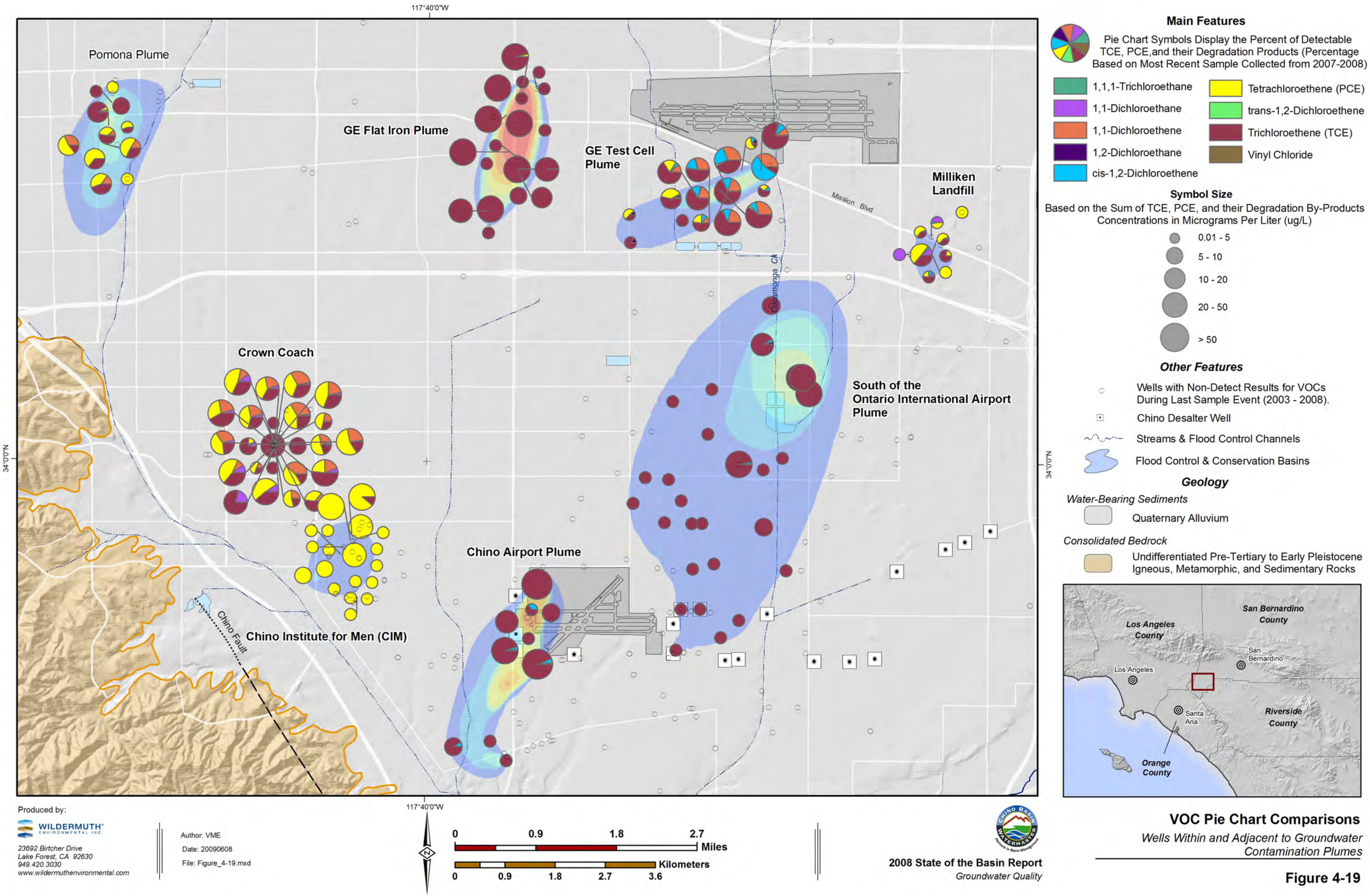
2008 State of the Basin Report
Groundwater Quality

Groundwater Contamination Plumes

Chino Basin Area (Updated June 2008)

Figure 4-18



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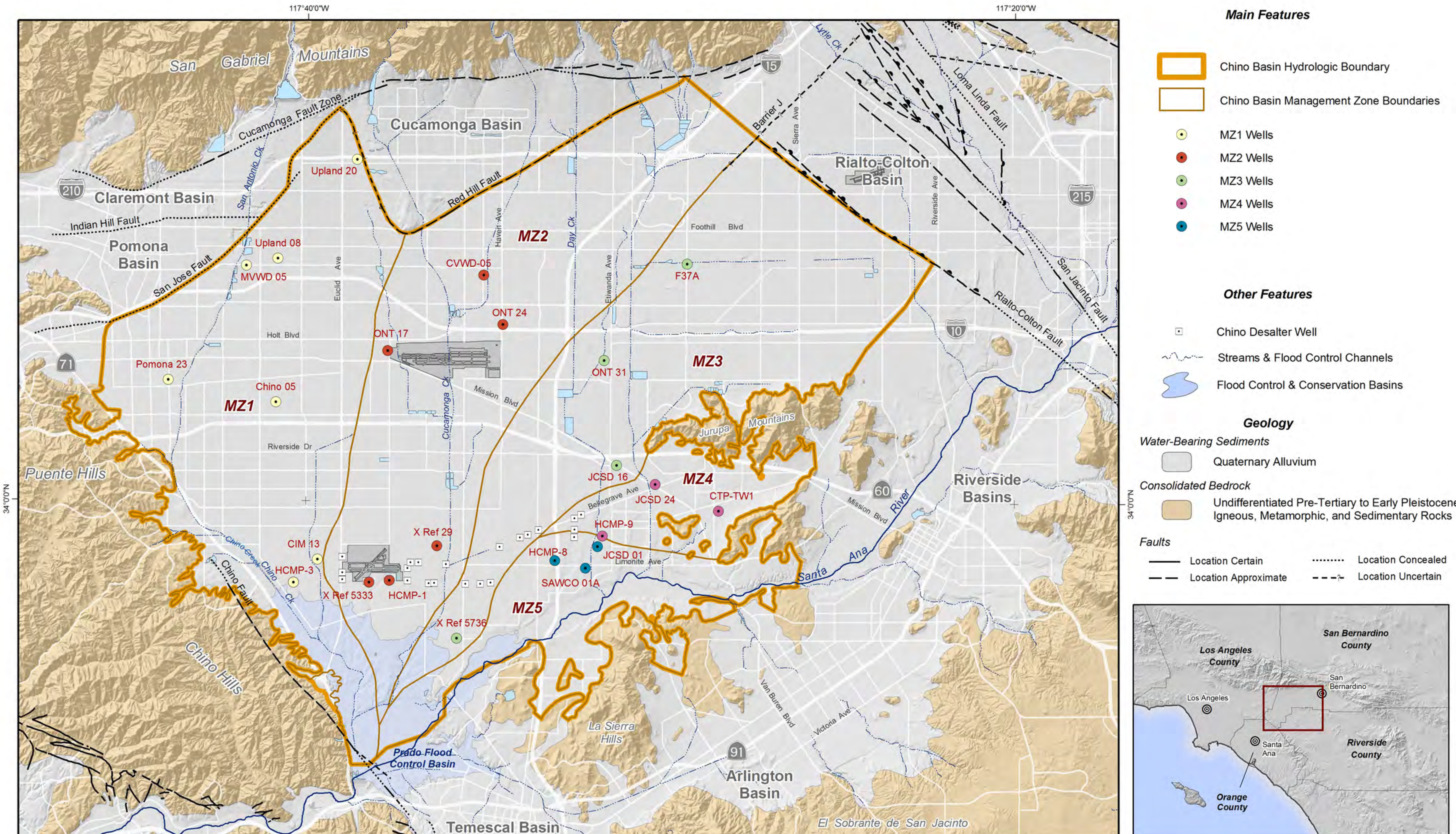
2008 State of the Basin Report
Groundwater Quality

VOC Pie Chart Comparisons

Wells Within and Adjacent to Groundwater Contamination Plumes

Figure 4-19



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File: Figure4-20.mxd

0 1 2 3 4 5 Miles

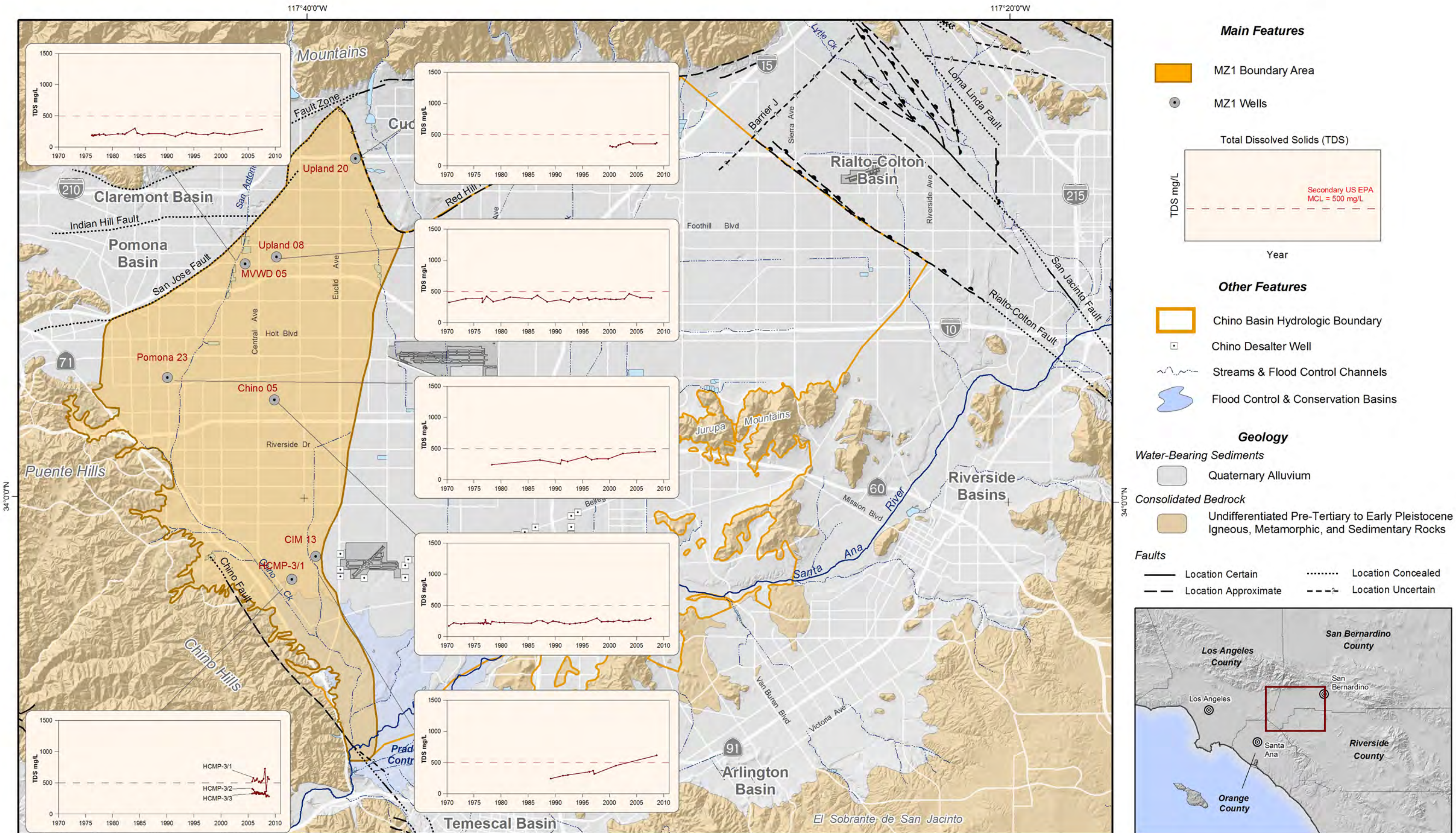
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

Well Locations

Wells Used in Management Zone Water Quality Analyses

Figure 4-20



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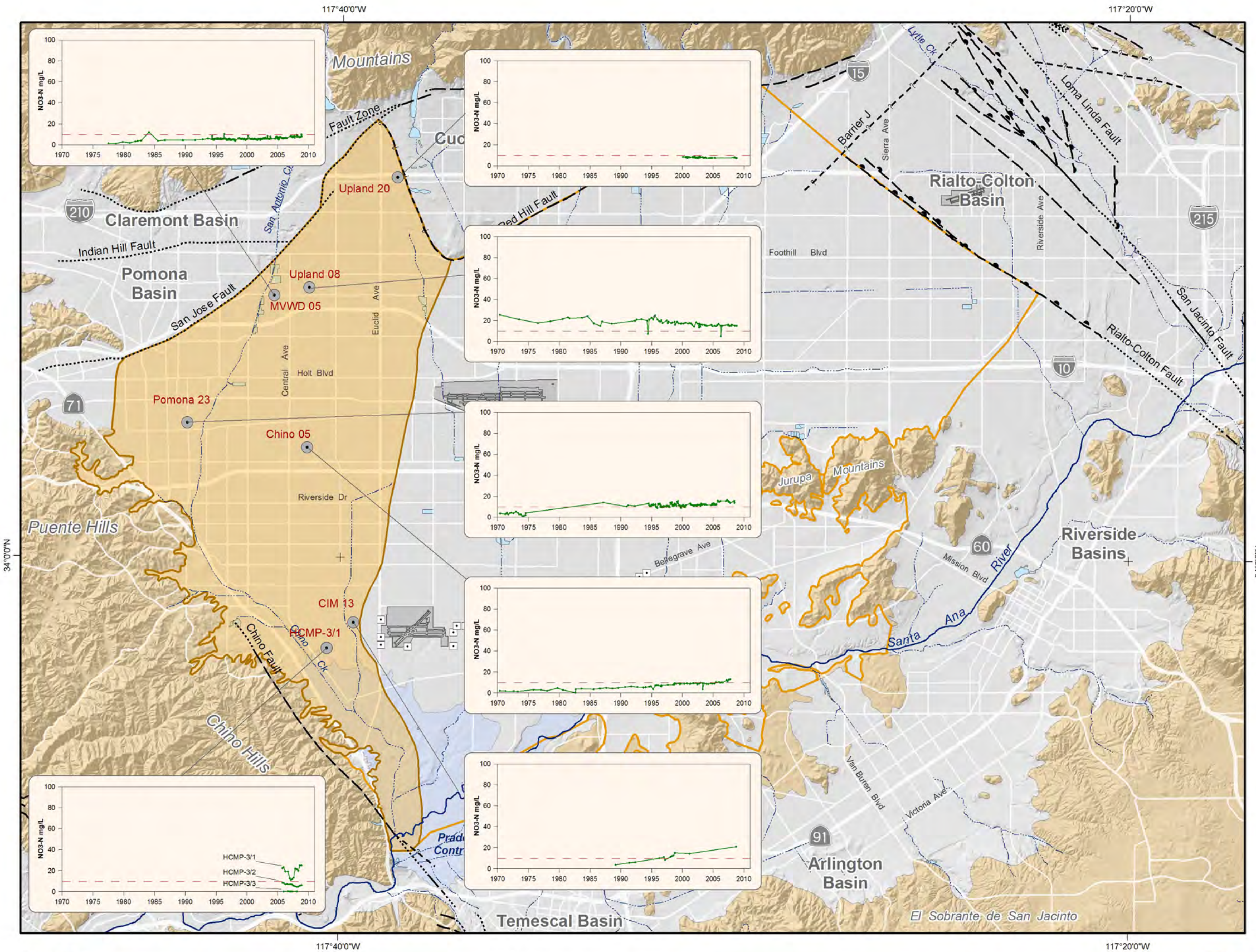
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

Chino Basin Management Zone 1
Historical and Current Total Dissolved Solids Concentration

Figure 4-21



Main Features

MZ1 Boundary Area

MZ1 Wells

Nitrate-Nitrogen Concentration

NO3-N mg/L

Primary US EPA MCL = 10 mg/L

Year

Other Features

Chino Basin Hydrologic Boundary

Chino Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

Location Certain — Location Concealed

Location Approximate — Location Uncertain

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0 1 2 3 4 5 Miles

0 2 4 6 8 KM

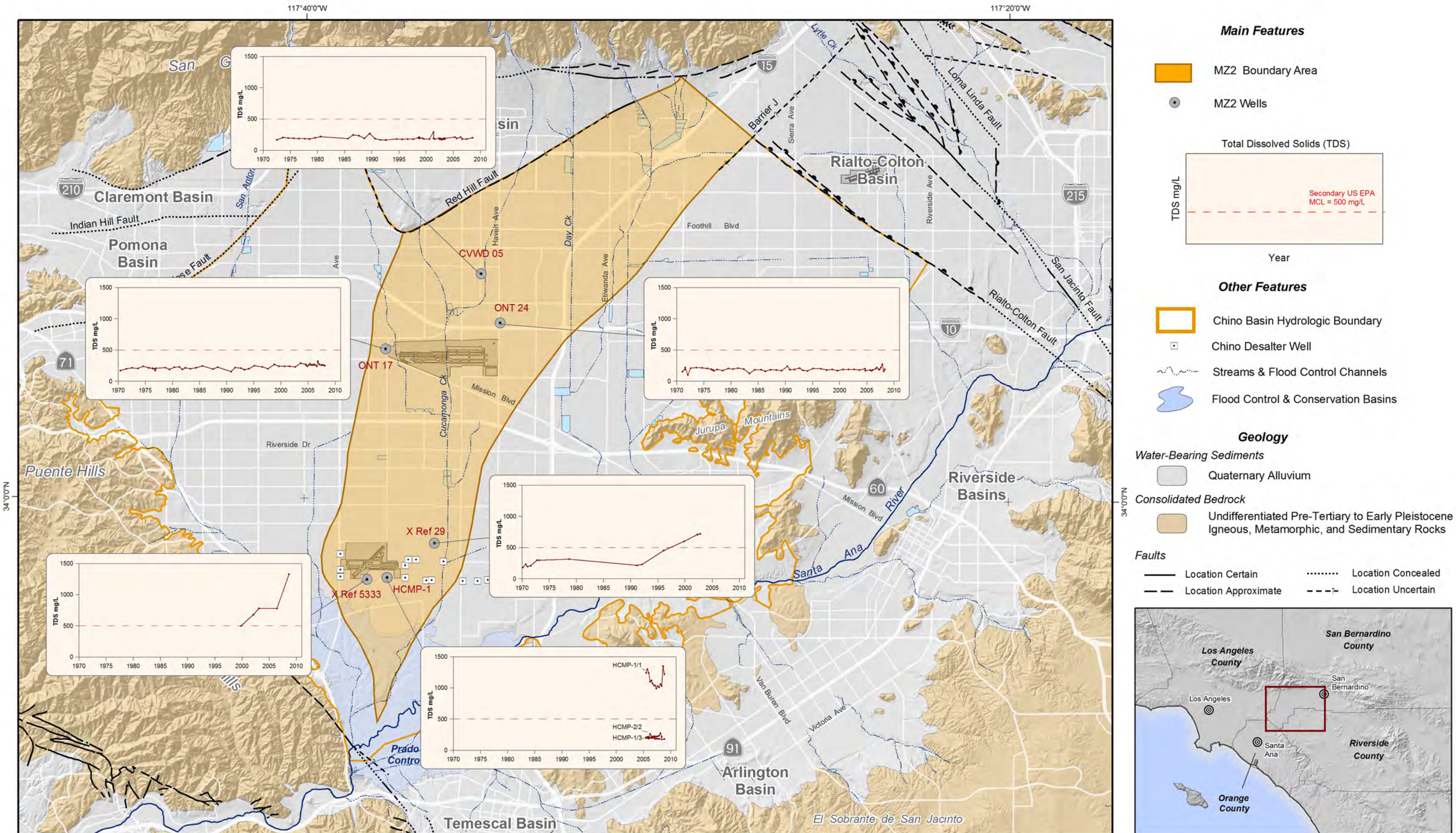
2008 State of the Basin Report

Groundwater Quality

Chino Basin Management Zone 1

Historical and Current Nitrate-Nitrogen Concentrations

Figure 4-22



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File: Figure_4-23.mxd

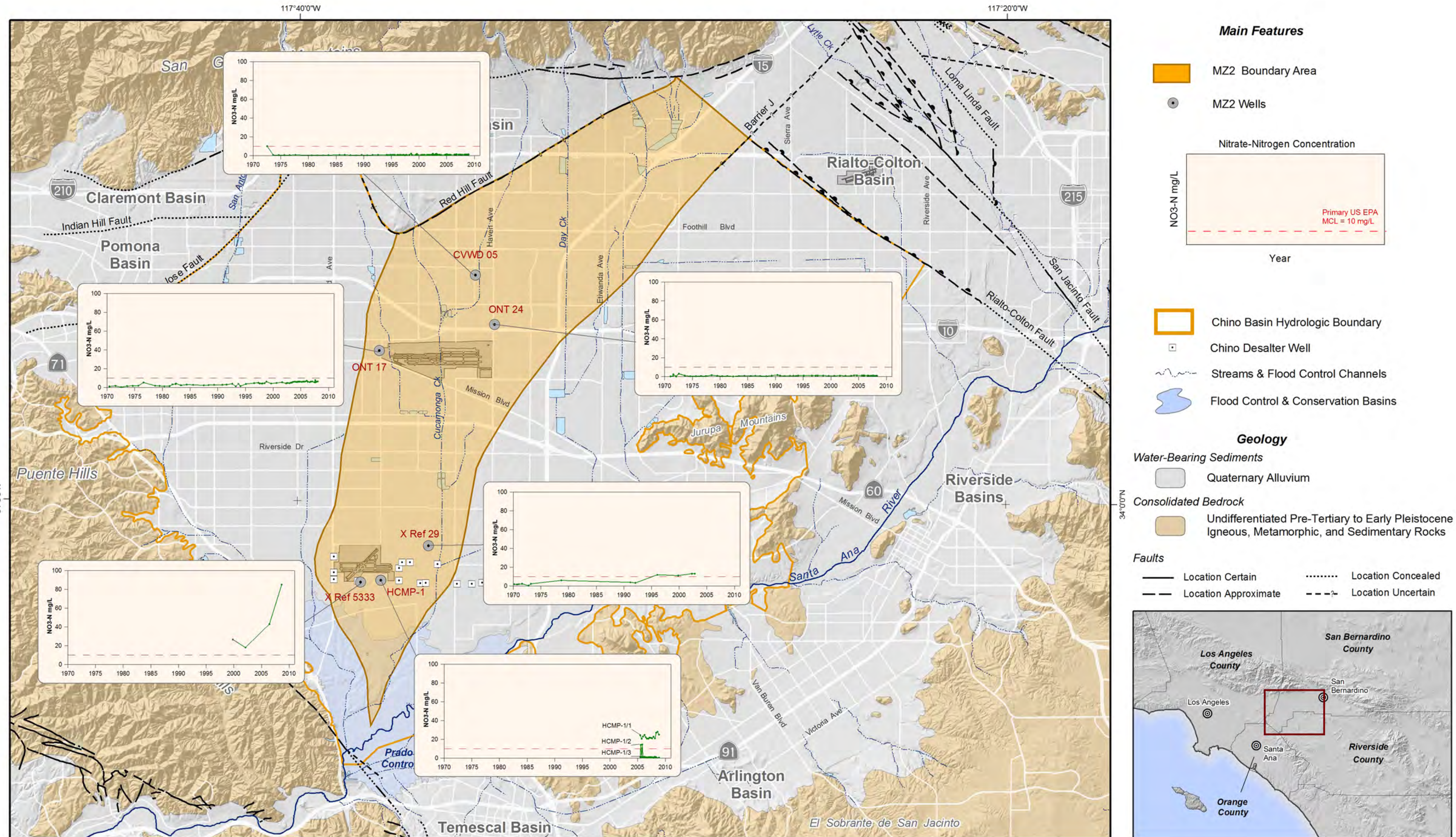
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

Chino Basin Management Zone 2

Historical and Current Total Dissolved Solids Concentration

Figure 4-23



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File: Figure_4-24.mxd

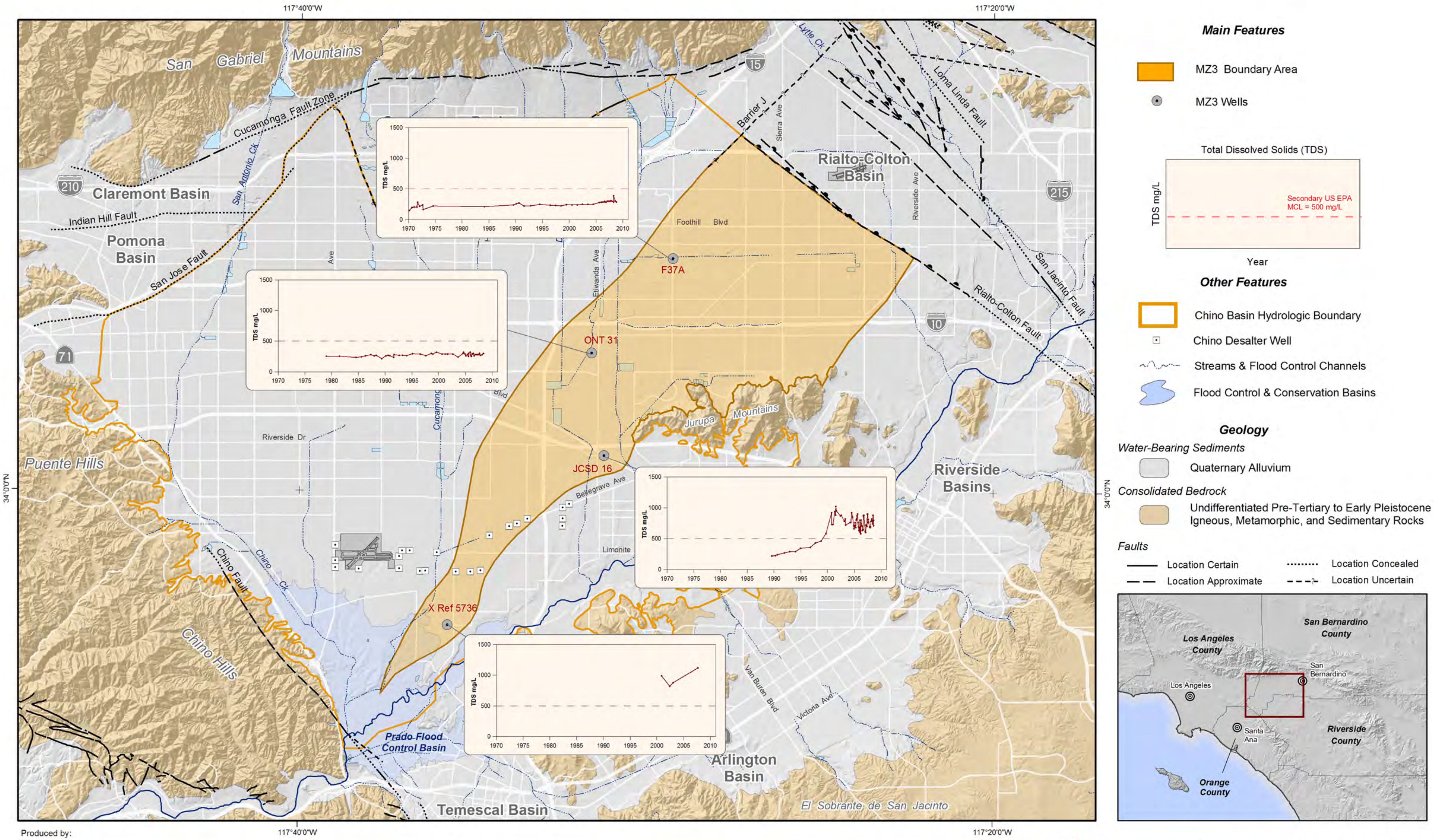
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

Chino Basin Management Zone 2

Historical and Current Nitrate-Nitrogen Concentration

Figure 4-24



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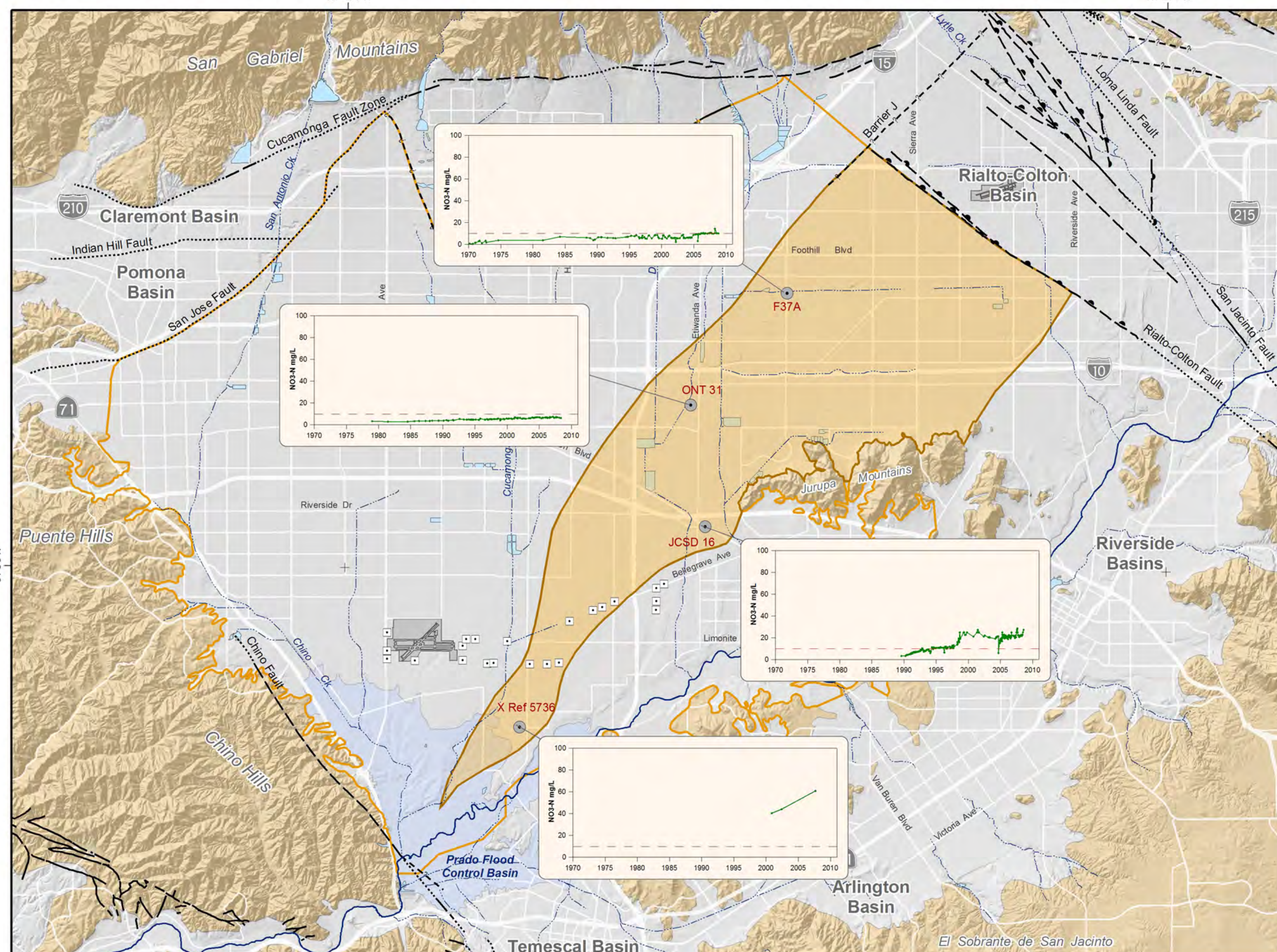
2008 State of the Basin Report
Groundwater Quality

Chino Basin Management Zone 3

Historical and Current Total Dissolved Solids Concentration

Figure 4-25



Main Features

MZ3 Boundary Area

MZ3 Wells

Nitrate-Nitrogen Concentration

NO3-N mg/L

Primary US EPA MCL = 10 mg/L

Year

Other Features

Chino Basin Hydrologic Boundary

Chino Desalter Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

Location Certain — Location Concealed

Location Approximate — Location Uncertain

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0 1 2 3 4 5 Miles

0 2 4 6 8 KM

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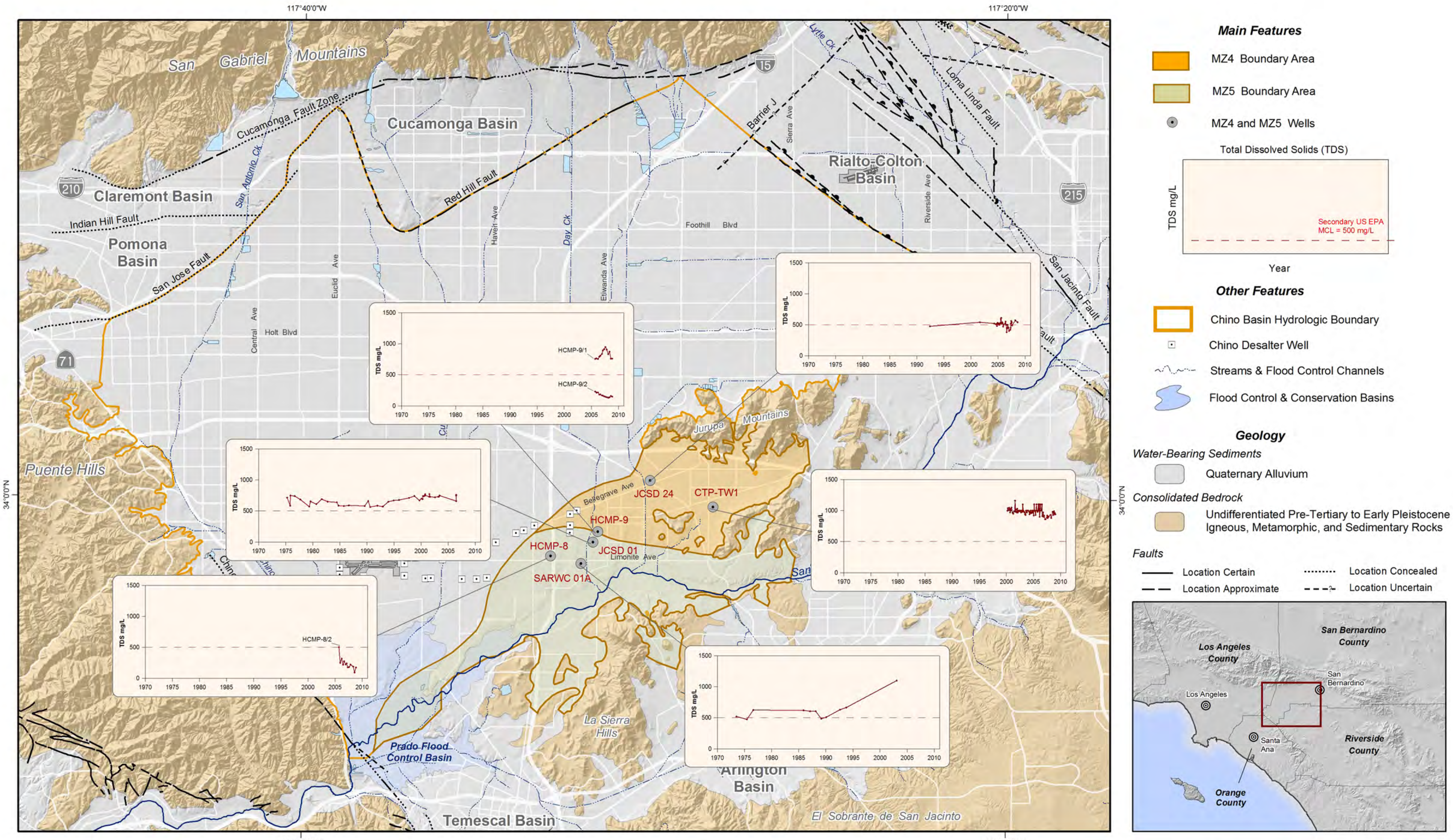
Groundwater Quality

Chino Basin Management Zone 3

Historical and Current Nitrate-Nitrogen Concentration

Figure 4-26



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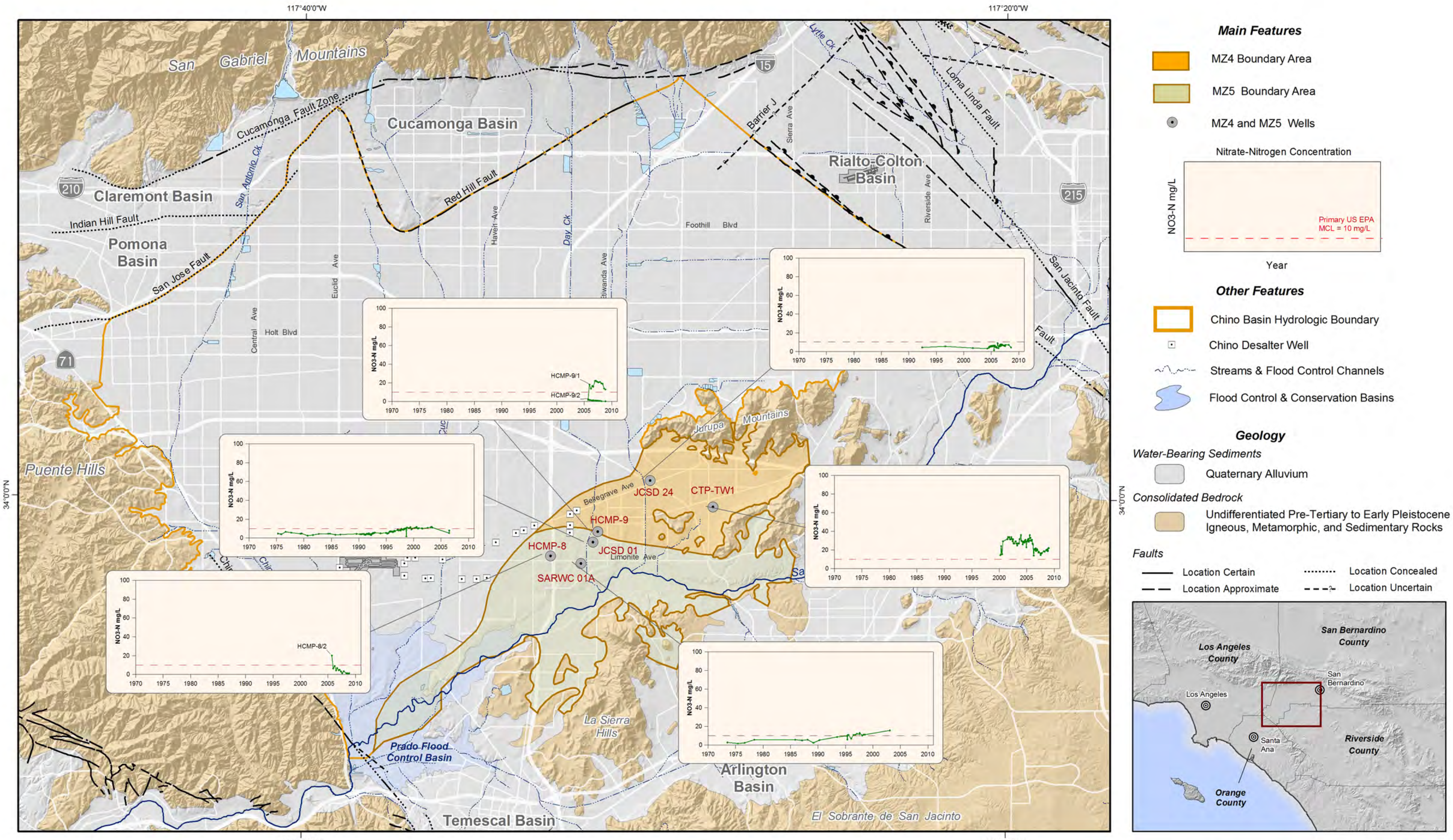
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Groundwater Quality

Chino Basin Management Zone 4 and Zone 5

Historical and Current Total Dissolved Solids Concentration

Figure 4-27



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2008 State of the Basin Report
Groundwater Quality

Chino Basin Management Zone 4 and Zone 5

Historical and Current Nitrate-Nitrogen Concentration

Figure 4-28

5.1 Background

One of the earliest indications of land subsidence in Chino Basin was the appearance of ground fissures in the City of Chino. These fissures appeared as early as 1973, but an accelerated occurrence of ground fissuring ensued after 1991 and resulted in damage to existing infrastructure (see Figure 5-1). The scientific studies that followed attributed the fissuring phenomenon to differential land subsidence caused by pumping of the underlying aquifer system and the consequent drainage and compaction of aquitard sediments.

5.1.1 OBMP Program Element 4

In 1999, the OBMP Phase I Report (WEI, 1999) identified pumping-induced drawdown and subsequent aquifer-system compaction as the most likely cause of land subsidence and ground fissuring observed in MZ1. Program Element 4 of the OBMP, *Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1*, called for the development and implementation of an interim management plan for MZ1 that would:

- Minimize subsidence and fissuring in the short-term.
- Collect the information necessary to understand the extent, rate, and mechanisms of subsidence and fissuring.
- Formulate a management plan to abate future subsidence and fissuring or reduce it to tolerable levels.

In 2000, the Implementation Plan in the Peace Agreement called for an aquifer-system and land subsidence investigation in the southwestern region of MZ1 to support the development of a management plan for MZ1 (second and third bullets above). This investigation was titled the MZ1 Interim Monitoring Program (IMP). From 2001-2005, Watermaster developed, coordinated, and conducted the IMP under the guidance of the MZ1 Technical Committee, which is composed of representatives from all major MZ1 producers and their technical consultants. Specifically, the producers represented on the MZ1 Technical Committee include: the Agricultural Pool, the Cities of Chino, Chino Hills, Ontario, Pomona, and Upland; the Monte Vista Water District; the Southern California Water Company; and the State of California (CIM).

The main conclusions derived from the IMP were:

1. Groundwater production from the deep confined aquifer system in this area causes the greatest stress to the aquifer system. In other words, pumping of the deep aquifer system causes water level drawdowns that are much greater in magnitude and lateral extent than drawdowns caused by pumping of the shallow aquifer system.
2. Water level drawdowns due to pumping of the deep aquifer system can cause inelastic (permanent) compaction of the aquifer-system sediments, which results in permanent land subsidence. The initiation of inelastic compaction within the aquifer system was identified during this investigation when water levels fell below

a depth of about 250 feet in the PA-7 piezometer at Ayala Park.

3. The current state of aquifer-system deformation in south MZ1 (in the vicinity of Ayala Park) is essentially elastic. Very little inelastic (permanent) compaction is now occurring in this area, which is in contrast to the recent past when about 2.2 feet of land subsidence, accompanied by ground fissuring, occurred from about 1987 to 1995.
4. During this study, a previously undetected barrier to groundwater flow was identified. This barrier is located within the deep aquifer system and is aligned with the historical zone of ground fissuring. Pumping from the deep aquifer system is limited to the area west of the barrier, and the resulting drawdowns do not propagate eastward across the barrier. Thus, compaction occurs within the deep system on the west side of the barrier but not on the east side, which causes concentrated differential subsidence across the barrier and creates the potential for ground fissuring.
5. InSAR and ground level survey data indicate that permanent subsidence in the central region of MZ1 (north of Ayala Park) has occurred in the past and continues to occur today. The InSAR data also suggest that the groundwater barrier extends northward into central MZ1. These observations suggest that the conditions that very likely caused ground fissuring near Ayala Park in the 1990s are also present in central MZ1 and should be studied in more detail.

The investigation methods, results, and conclusions (listed above) are described in detail in the MZ1 Summary Report (WEI, 2006b). The investigation provided enough information for Watermaster to develop Guidance Criteria for the MZ1 producers in the investigation area that, if followed, would minimize the potential for subsidence and fissuring during the completion of the MZ1 Subsidence Management Plan (MZ1 Plan). The Guidance Criteria formed the basis for the MZ1 Plan, which was developed by the MZ1 Technical Committee and approved by Watermaster in October 2007. In November 2007, the California Superior Court, which retains continuing jurisdiction over the Chino Basin Adjudication, approved the MZ1 Plan and ordered its implementation.

The MZ1 Plan includes a listing of Managed Wells subject to the plan, a map of the so-called Managed Area in southern MZ1, an initial threshold water level (Guidance Level) at an index well in the Managed Area (245 feet below the top of the PA-7 well casing at Ayala Park in Chino [ft-brp]), and a plan for ongoing monitoring and annual reporting.

5.1.2 OBMP Program Element 1

The OBMP Phase I Report also noted that land subsidence was occurring in other parts of the basin besides Chino. Program Element 1 (PE1) of the OBMP and the Implementation Plan, *Develop and Implement a Comprehensive Monitoring Program*, called for basin-wide analysis of land subsidence via ground-level surveys and InSAR and ongoing monitoring based on the analysis of the subsidence data. Through 2008, basin-wide monitoring has been based on the ground-level survey data and InSAR data collected as part of the IMP and the MZ1 Plan implementation.

5.2 Ground-Level Monitoring Program

Implementation of the MZ1 Plan began in 2008. The MZ1 Plan calls for (1) the continued scope and frequency of monitoring implemented during the IMP within the MZ1 Managed Area and (2) expanded monitoring of the aquifer system and land subsidence in other areas of the Chino Basin where the IMP indicated concern for future subsidence and ground fissuring. The expanded monitoring efforts outside of the MZ1 Managed Area are consistent with the requirements PE1.

Watermaster's current ground-level monitoring program includes:

- *Piezometric Levels*. Piezometric levels are an important part of the ground-level monitoring program because piezometric changes are the mechanism for aquifer-system deformation and land subsidence. Watermaster monitors piezometric levels at about 33 wells in MZ1. Currently, a pressure-transducer/data-logger is installed at each of these wells and records one water level reading every 15 minutes. And, Watermaster records depth-specific water levels at the piezometers located at the Ayala Park Extensometer facility every 15 minutes.
- *Aquifer-System Deformation*. Watermaster records aquifer-system deformation at the Ayala Park Extensometer facility (see Figure 5-1). At this facility, two extensometers, completed at 550 ft-bgs and 1,400 ft-bgs, record the vertical component of aquifer-system compression and/or expansion once every 15 minutes (synchronized with the piezometric measurements).
- *Vertical Ground-Surface Deformation*. Watermaster monitors vertical ground-surface deformation via the ground-level surveying and remote sensing (InSAR) techniques established during the IMP. Currently, ground-level surveys are being conducted in the MZ1 Managed Area once per year. InSAR is the only monitoring technique being employed outside the MZ1 Managed Area, and InSAR data is analyzed once per year.
- *Horizontal Ground-Surface Deformation*. Watermaster monitors horizontal ground-surface displacement across the eastern side of the subsidence trough and the adjacent area east of the barrier/fissure zone. These data, obtained by electronic distance measurements (EDMs), are used to characterize the horizontal component of land surface displacement caused by groundwater production on either side of the fissure zone. Currently, Watermaster is collecting EDMs at a semiannual frequency (Spring/Fall) between east/west aligned benchmarks on Eucalyptus, Edison, Schaefer, and Philadelphia Avenues.

5.3 Results of Ground-Level Monitoring Program

At the conclusion of each fiscal year, the MZ1 Plan requires that Watermaster produce an MZ1 Annual Report that includes the results of the past year's monitoring. The 2008 MZ1 Annual Report (currently in preparation) will be the first such report published by Watermaster and will focus primarily on the intensive monitoring being conducted in the MZ1 Managed Area.

The ground-level monitoring results described below will focus primarily on the ground-level survey and InSAR monitoring being conducted across the entire Chino Basin (PE1).

5.3.1 InSAR

Figure 5-2 is a map of the Chino Basin that shows InSAR results for 2005-2008. The InSAR data are generally coherent and useful in the northern urbanized areas of the basin but are generally incoherent and not as useful in the southern agricultural areas (light brown areas in Figure 5-2). This pattern of "coherence" relative to land use is typical of InSAR data.

Figure 5-2 shows that ground motion during 2005-2008 was relatively minor (less than about -0.02 ft of subsidence) in the northeastern parts of the basin, such as Fontana and Rancho Cucamonga. However, in northwestern parts of the basin, land subsidence of over -0.14 ft and -0.12 ft have been measured by InSAR in Pomona and Ontario, respectively.

Figure 5-2 also shows that ground motion is influenced by geologic faults that cut through the aquifer system and act as barriers to groundwater flow. For instance, the land surface elevation has increased (uplift) in the southern portion of the Cucamonga Basin—just north of the Red Hill Fault. The San Jose Fault is clearly influencing the pattern of ground motion in the Claremont, Pomona, and Chino Basins. Of most concern, with respect to the potential for ground fissuring, is the differential ground motion across the San Jose Fault between the Pomona and Chino Basins.

Historically, the City of Chino has experienced the most land subsidence (e.g. over -2.0 ft of subsidence within the MZ1 Managed Area during 1987-1999), but for 2005-2008, the InSAR data indicate that land subsidence was relatively minor in this area (less than about -0.04 ft).

5.3.2 Ground-Level Surveys

Figure 5-3 is a map of the western half of Chino Basin that shows both the InSAR and ground-level survey results for 2005-2008. The ground-level survey data generally corroborate the patterns and magnitude of ground motion shown in the InSAR data with a few exceptions:

- The ground-level survey data indicate a greater magnitude of land subsidence in the MZ1 Managed Area (maximum subsidence = -0.10 ft) than the InSAR data (maximum subsidence = -0.05 ft).
- In some areas, the ground-level survey data indicate minor subsidence while the InSAR data indicate minor uplift. In these instances, the difference between the ground-level survey and InSAR data is generally less than about 0.05 ft.

One advantage of the ground-level survey data is that it can provide information on ground motion in areas where InSAR data is absent. See, for example, the area shown on Figure 5-3 near at the intersection of Euclid Avenue and Kimball Avenue where the Chino I Desalter wells pump groundwater from the deep aquifer system. The survey data indicated maximum land subsidence of -0.24 ft in this area during 2005-2008.

5.4 Analysis of Ground Surface Displacement

Historical ground motion data (shown in Figure 5-1) and recent ground motion data (shown in Figures 5-2 and 5-3) indicate that land subsidence concerns in the Chino Basin are confined to certain portions of MZ1 and MZ2. These "areas of subsidence concern" are delineated and labeled in Figures 5-2 and 5-3. Besides the MZ1 Managed Area, Watermaster has designated four additional areas of subsidence concern: the Central MZ1 Area, the Pomona Area, the Ontario Area, and the Southeast Area.

The recent land subsidence that has been occurring in each of these areas is mainly controlled by recent and/or historical changes in groundwater levels, which, in turn, are mainly controlled by pumping and recharge.

Below, the relationships between groundwater pumping, aquifer recharge, groundwater levels, and ground motion, which help to reveal cause and effect; the current state of ground motion; and the nature of current land subsidence (i.e. elastic and/or inelastic, differential, etc.), are discussed by area of concern.

5.4.1 MZ1 Managed Area

Within the MZ1 Managed Area, pumping of the deep confined aquifer system causes water level drawdowns that are much greater in magnitude and lateral extent than drawdowns caused by pumping of the shallow aquifer system. Artificial recharge in the northern portions of MZ1 appears to have no immediate impact on groundwater levels in the deep aquifer system in the MZ1 Managed Area. These conclusions were established during the IMP (WEI, 2006b) and are shown graphically in Figure 5-4.

Figures 5-4 and 5-5 also show vertical ground motion at the Deep Extensometer at Ayala Park and at a benchmark monument (137/53) at the corner of Schaefer Avenue and Central Avenue. About -2.5 ft of subsidence occurred in portions of the MZ1 Managed Area from 1987-2000, but very little inelastic subsidence has occurred since 2000, and no additional ground fissuring has been observed.

Another conclusion of the IMP was that groundwater-level drawdowns due to pumping of the deep aquifer system can cause inelastic (permanent) compaction of the aquifer-system sediments, which results in permanent land subsidence. The initiation of inelastic compaction within the aquifer system was identified during the IMP when water levels fell below a depth of about 250 feet in the PA-7 piezometer at Ayala Park. From 2005 to 2008, water levels at PA-7 did not decline below 250 ft-brp , and very little, if any, inelastic compaction was recorded in the MZ1 Managed Area. Data from the MZ1 Managed Area are further analyzed in the 2008 MZ1 Annual Report (in preparation).

The IMP also identified a previously undetected barrier to groundwater flow on the east side of the MZ1 Managed Area. This barrier is located within the deep aquifer system and is aligned with the historical zone of ground fissuring (see Figure 5-3). Pumping from the deep aquifer system has been limited to the area west of the barrier, and the resulting drawdowns have not propagated eastward across the barrier. Thus, historical compaction occurred within the deep system on the west side of the barrier but not on the east side. Concentrated differential subsidence across the barrier is the most likely cause of the ground fissuring observed in the early 1990s. The rate of land subsidence decreased to almost zero in the MZ1 Managed Area in the mid-1990s, and no additional ground fissuring has been observed.

5.4.2 Central MZ1 Area

The Central MZ1 Area is located directly north of the MZ1 Managed Area (see Figure 5-3). Figures 5-6 and 5-7 display time histories of groundwater pumping, aquifer recharge, groundwater levels, and ground motion in the Central MZ1 Area.

The ground motion time histories for Central MZ1 is similar to that of the MZ1 Managed Area—as much as -2.2 ft of inelastic subsidence occurred at the corner of Philadelphia and Monte Vista Avenue from 1987-2000, but very little inelastic subsidence has occurred since 2000. This similarity suggests a relationship to the causes of land subsidence in the MZ1 Managed Area; however, there is very little historical groundwater level data in this area to confirm this relationship.

Most of the wells with historical groundwater level records are in the northern part of Central MZ1 (see Figure 5-3) where historical subsidence was not as pronounced. From about 1935 to 1978, groundwater levels in these wells declined by about 150 ft. Groundwater levels increase by about 50 ft during the 1980s and remained relatively stable until 2005. Since 2005, groundwater levels have increased by about 25 ft, which is likely due to decreased pumping and increased recharge in MZ1.

5.4.3 Pomona Area

The Pomona Area is located directly north of the Central MZ1 Area (see Figure 5-3). Figures 5-8 and 5-9 display time histories of groundwater pumping, aquifer recharge, groundwater levels, and ground motion in the Pomona Area.

The ground motion time histories of the Pomona Area is based solely on InSAR data from 1992 to 1995, 1995 to 2000, and 2005 to 2008. These data indicate that land subsidence has occurred continuously in this area, generally at a rate of about 0.07 ft/yr. The rate of subsidence appears to be decreasing gradually with time.

From about 1935 to 1978, groundwater levels in the Pomona Area declined by about 175 ft or more. Groundwater levels increased by about 50 to 100 ft during the 1980s. From about 1990 to 2004, groundwater levels declined again by about 25 to 50 ft. And from 2004 to 2008, groundwater levels increased by about 25 to 50 ft. The groundwater level changes from 1990 to 2008 appear to be closely related to pumping and recharge in MZ1.

The observed, continuous land subsidence cannot be explained entirely by the corresponding changes in groundwater levels during this time (1992-2008). A plausible explanation for the subsidence is that thick, slowly-draining aquitards are compacting in response to the historical drawdowns that occurred from 1935 to 1978 (see Figure 5-9).

Lastly, the InSAR data in Figure 5-3 shows a steep gradient of subsidence across the San Jose Fault, indicating the potential for the accumulation of horizontal strain in the shallow sediments and the possibility of ground fissuring. Ground fissuring is the main subsidence-related threat to infrastructure.

5.4.4 Ontario Area

The Ontario Area is located east of the Central MZ1 and the Pomona Areas (see Figure 5-3). Figures 5-10 and 5-11 display time histories of groundwater pumping, aquifer recharge, groundwater levels, and ground motion in the Ontario Area.

The ground motion time histories of the Ontario Area is based solely on InSAR data from 1992 to 1995, 1995 to 2000, and 2005 to 2008. These data indicate that land subsidence has occurred continuously in this area, generally at a rate of about 0.06 ft/yr. The rate of subsidence appears to be decreasing gradually with time.

From about 1935 to 1978, groundwater levels in the Ontario Area declined by about 125 ft. Groundwater levels increased by about 10 to 20 ft during the early 1980s and have remained relatively stable since then.

The observed continuous land subsidence from 1992 to 2008 is not explained by the relatively stable groundwater levels. A plausible explanation for the subsidence is that thick, slowly-draining aquitards are compacting in response to the historical drawdowns that occurred from 1935 to 1978 (see Figure 5-11).

5.4.5 Southeast Area

The Southeast Area is located east of the MZ1 Managed Area (see Figure 5-3). Figures 5-12 and 5-13 display time histories of groundwater pumping, aquifer recharge, groundwater levels, and ground motion in the Southeast Area.

The ground motion time histories of the Southeast Area is based solely on ground-level surveys performed from 1987to 2008. These data indicate that land subsidence has occurred continuously and slowly in this area, generally at a rate of about 0.02 ft/yr. However, the data also indicate that from 2005 to 2008 about -0.24 ft of subsidence occurred near the western portion of the Chino I Desalter well field where these wells are pumping from and causing drawdown within the deep confined aquifer system.

There is very little historical groundwater level data for this area prior to about 1990. The data since 1990 indicate relatively stable groundwater levels.

The observed slow but continuous land subsidence from 1987 to 2008 is not explained by the relatively stable groundwater levels. A plausible explanation for the subsidence is that thick, slowly-draining aquitards are compacting in response to the historical drawdowns that likely occurred prior to 1990.

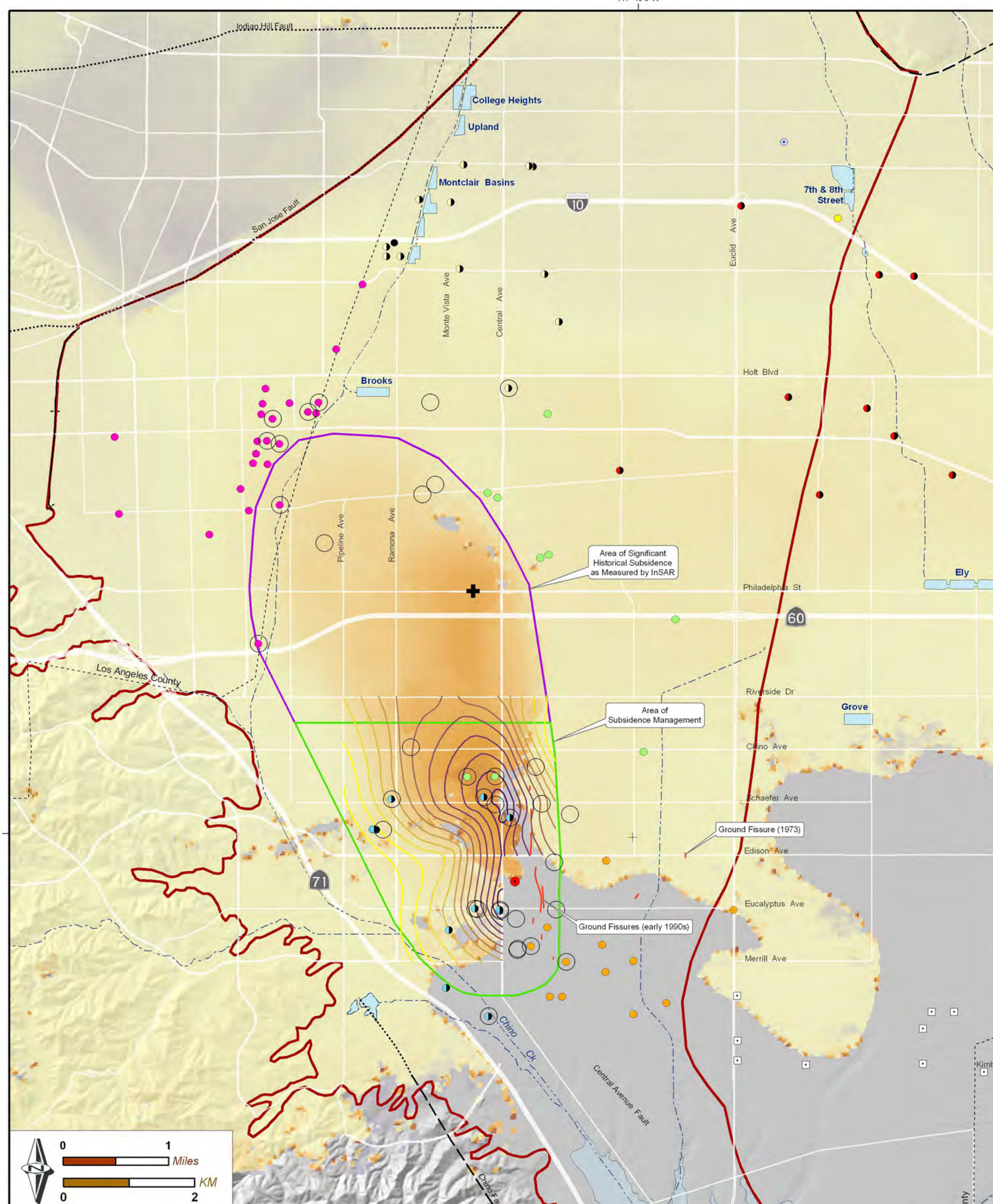
Lastly, the first ground fissures ever documented in the Chino Basin occurred in the Southeast Area in the early 1970s, but ground fissuring has not been observed in the Southeast Area since then.

5.5 Conclusions and Recommendations

The conclusions and recommendations for Watermaster's basin-wide ground-level monitoring program are provided below.

- Land subsidence does not appear to be a concern in the eastern and northernmost portions of Chino Basin. In these areas, the underlying aquifer system is composed primarily of coarse-grained sediments that are not prone to compaction.
- Land subsidence and the potential for ground fissuring are major concerns in the western and southern portions of the Chino Basin. In these areas, the underlying aquifer system consists of interbedded, fine-grained sediment layers (aquitards) that can drain and compact when groundwater levels decline in the adjacent coarse-grained aquifers. Ground fissuring has occurred in the past where land subsidence was differential (i.e. steep gradient of subsidence). Ground fissuring is the main subsidence-related threat to infrastructure.
- Land subsidence has been persistent across most of the western and southern portions of the Chino Basin since, at least, 1987 when land subsidence monitoring began. In many of these areas, land subsidence continues even during periods of groundwater level recovery, indicating that thick, slowly-draining aquitards are compacting in response to the large historical drawdowns of 1935 to 1978.
- Pumping-induced drawdown has caused accelerated occurrences of land subsidence in the recent past, including subsidence in the City of Chino during the early 1990s and, currently, in the vicinity of the Chino I Desalter well field. Watermaster should anticipate similar occurrences of land subsidence in areas (1) that are prone to subsidence and (2) where drawdown will occur in the future.
- Watermaster will continue its basin-wide ground-level monitoring program, using InSAR and ground-level surveys. Watermaster will consider expanding the ground-level surveys to cover the area of the proposed Chino Creek Desalter Well Field. This is an area that is prone to subsidence, where drawdown may occur near where ground fissuring has occurred in the past, and where InSAR data is not currently available. Watermaster will also consider expanding the ground-level surveys to cover the Pomona and Ontario Areas. In general, InSAR data coverage is continuous and of high quality throughout both areas, so ground-level surveys would primarily provide supporting and confirmation data for the InSAR and would occur at a frequency of once every three to five years.
- Watermaster will consider installing low-cost piezometer/extensometer facilities at appropriate locations in all Areas of Subsidence Concern. This type of facility has been successfully constructed and tested at Ayala Park in Chino. Such facilities record the requisite data (1) to monitor land subsidence and groundwater levels at high resolution and accuracy, (2) to provide the information necessary to characterize the elastic and/or inelastic nature of any land subsidence occurring in an area, (3) to provide the information necessary to develop criteria to manage subsidence, and (4) to provide the information necessary to characterize aquifer and aquitard properties that could be used in a predictive computer-simulation model of subsidence.

- Watermaster will consider building and calibrating predictive computer-simulation models of subsidence across all Areas of Subsidence Concern in the Chino Basin. These models would provide information on the rates and ultimate magnitude of land subsidence that could be associated with various basin management planning scenarios (i.e. pumping and recharge patterns). This information would be valuable to affected Watermaster parties.
- Because ground fissuring caused by differential land subsidence is the main threat to infrastructure, Watermaster will periodically inspect for signs of ground fissuring in areas that are experiencing differential land subsidence. In addition, Watermaster will consider monitoring the horizontal strain across these zones of potential ground fissuring in an effort to better understand and manage ground fissuring.



Subsidence Features

0.0

Contours of Relative Change in Land Surface Altitude as Measured by Leveling Surveys 1987 - 1999 (feet)

-2.2

+ 1.0

0.0

- 1.0

Relative Change in Land Surface Altitude as Measured by InSAR Oct 1993 - Dec 1995 (feet)

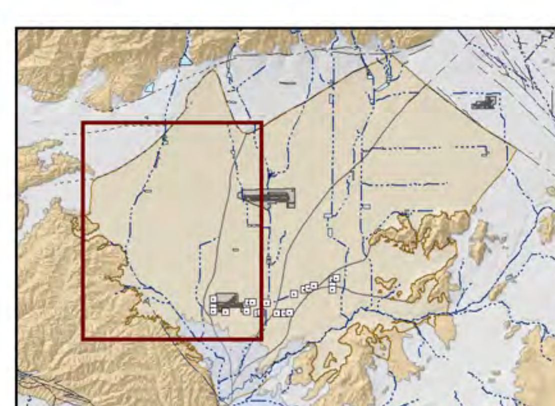
No InSAR Data

Active Production Wells in MZ-1 by Owner

- Ontario
- Pomona
- SAWC
- Upland
- SCWC
- CIM
- Chino Hills
- Chino
- MVWD

Other Features

- Well Used in MZ-1 Monitoring Program
- Ayala Park Extensometer Facility
- Proposed Central MZ-1 Piezometer
- Chino Basin Desalter Well (Existing)
- Management Zone 1 Boundary



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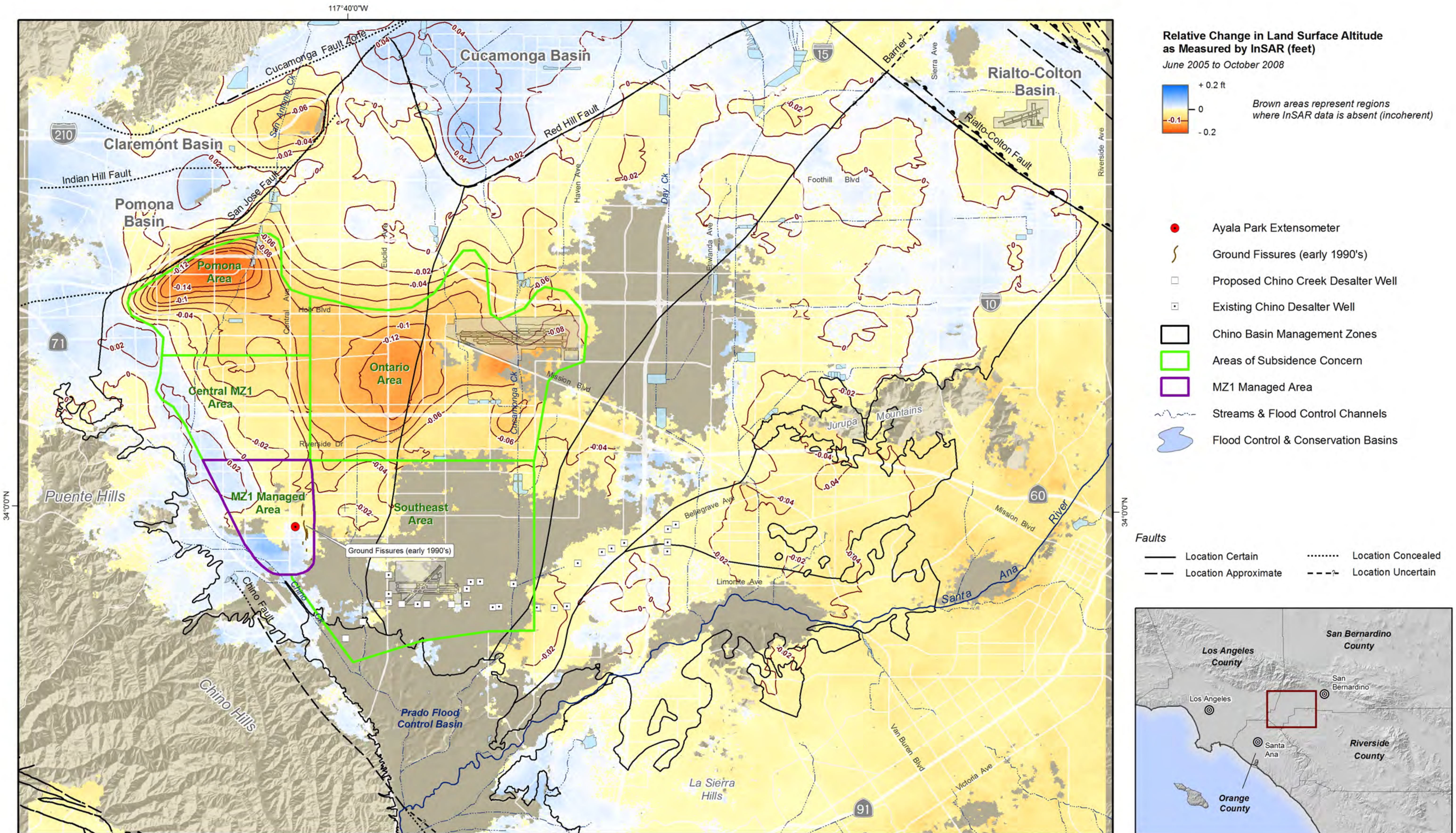
Date: 20090621
File: Figure_5-1.mxd

Historical Land Surface Deformation in Management Zone 1

Leveling Surveys (1987-99) and InSAR (1993-95)

Figure 5-1



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File: Figure_5-2.mxd

0 1 2 3 4 5 Miles
0 1 2 3 4 5 6 7 KM

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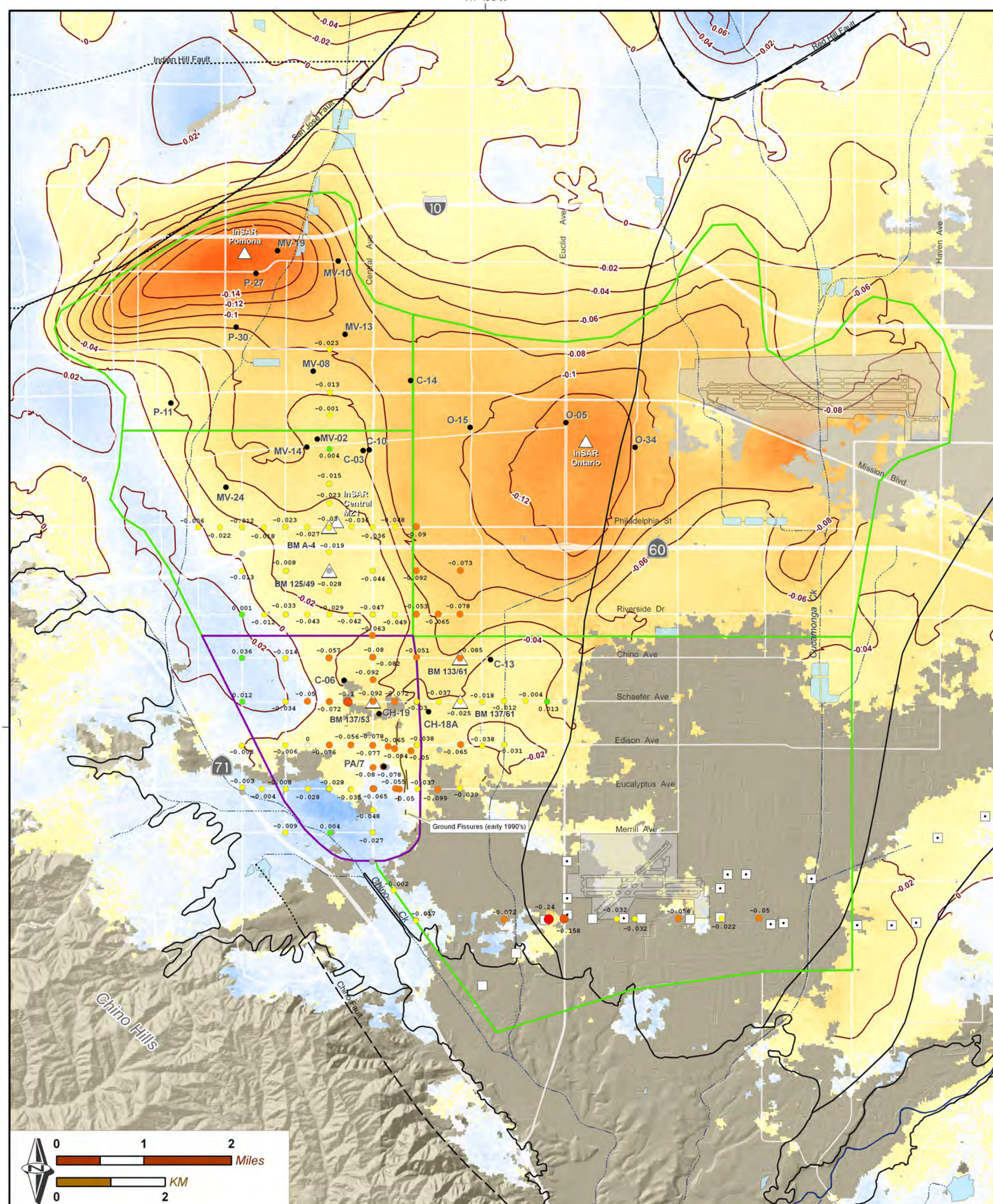
Vertical Ground Motion (2005-2008)
as Measured by InSAR in the Chino Basin Area

Figure 5-2



- Insufficient Data
- > 0.20
- 0.10 - 0.20
- 0.05 - 0.10
- 0.01 - 0.05
- 0.00
- -0.01 - -0.05
- -0.05 - -0.10
- -0.10 - -0.20
- < -0.20

Relative Change in Land Surface Altitude as Measured by Leveling Surveys Oct 2005 - Oct 2008 *(feet)*

Relative Change in Land Surface Altitude as Measured by InSAR June 2005 - Oct 2008 *(feet)*

+ 0.2 ft | 0 | -0.1 | - 0.2

Brown areas represent regions where InSAR data is absent (incoherent)

- Water Level Wells (in Figures 5-4 to 5-13)
- Chino Basin Desalter Well (Existing)
- Proposed Chino Creek Desalter Well
- Survey and InSAR Measurement Points (in Figures 5-4 to 5-13)
- Chino Basin Management Zones
- Subsidence Areas of Interest
- MZ1 Managed Area

Vertical Ground Motion (2005-2008)

Leveling Surveys and InSAR in Western Chino Basin

Figure 5-3

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Figure 5-4
Groundwater Levels versus Ground Levels in the MZ1 Managed Area - 1993 to 2009

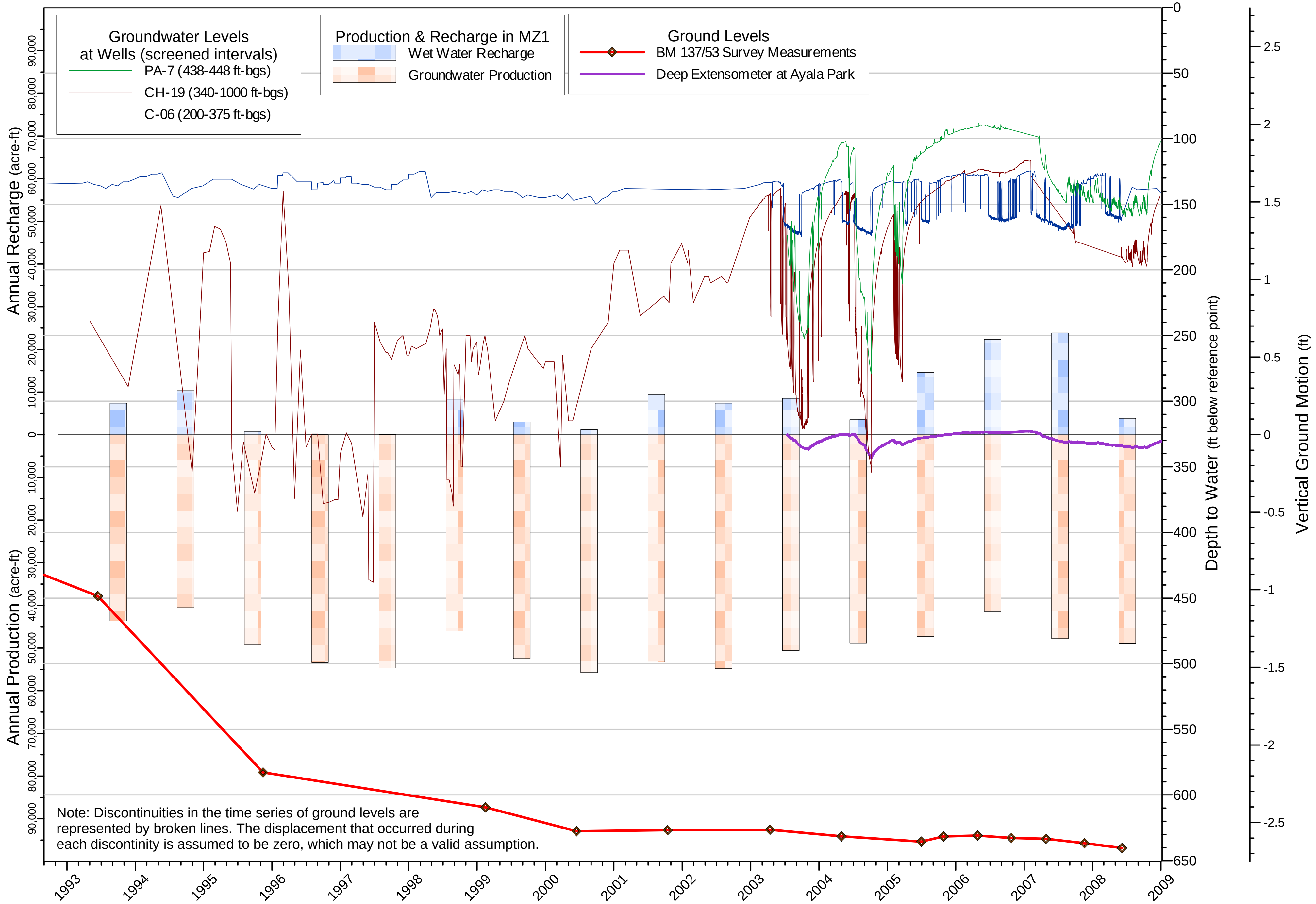


Figure 5-5
Groundwater Levels versus Ground Levels in the MZ1 Managed Area - 1935 to 2009

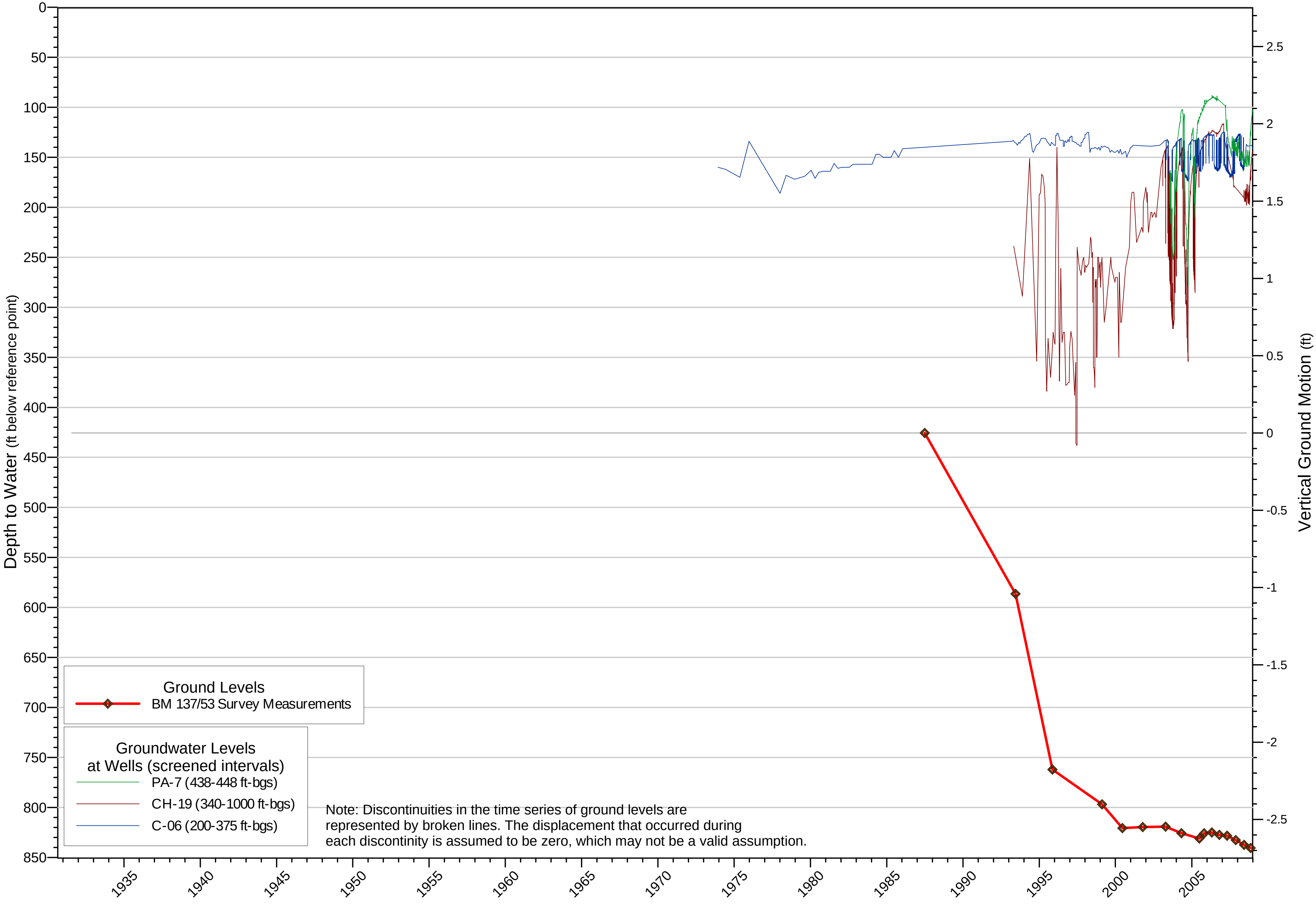


Figure 5-6
Groundwater Levels versus Ground Levels in the Central MZ1 Area - 1993 to 2009

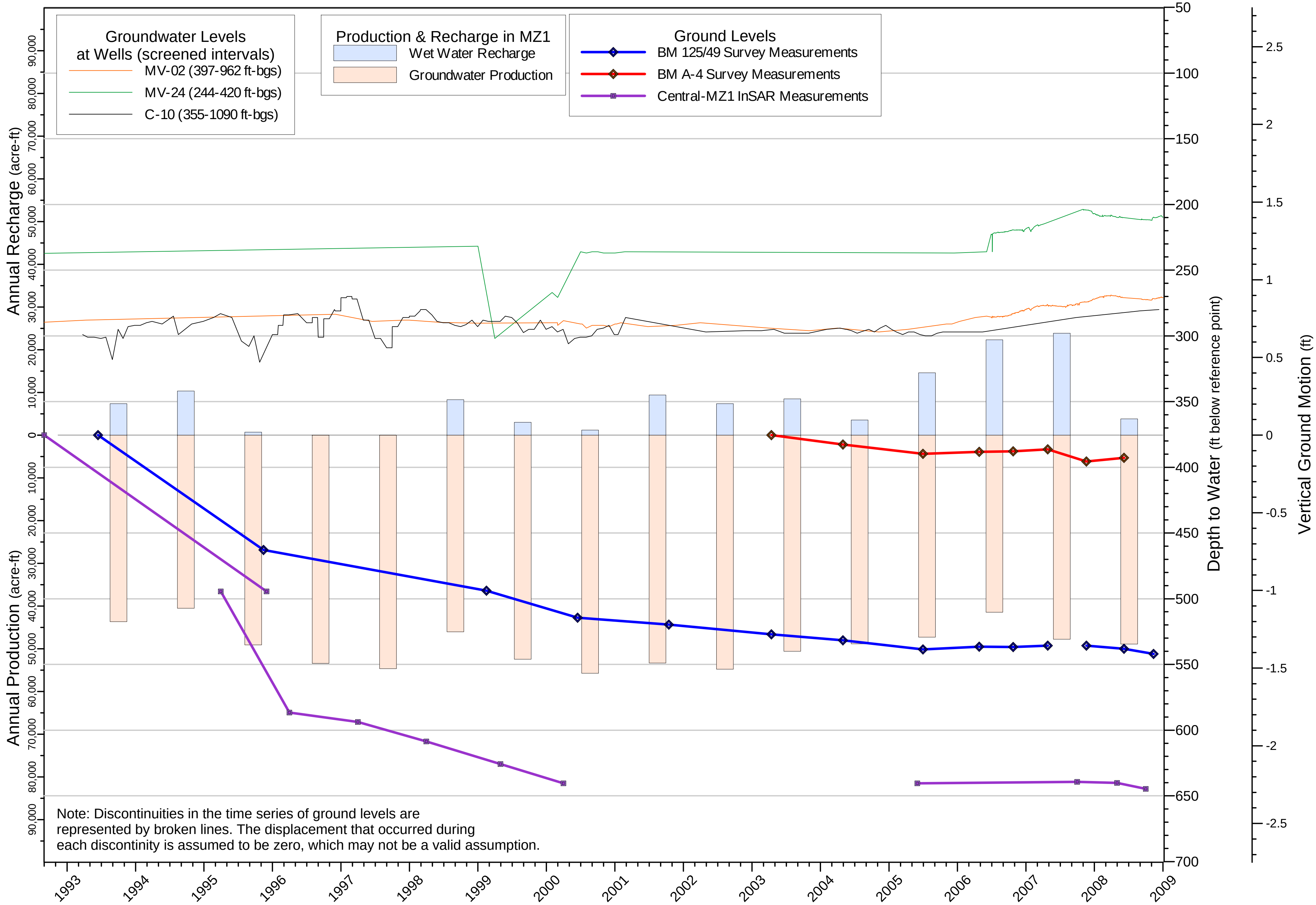


Figure 5-7
Groundwater Levels versus Ground Levels in the Central MZ1 Area - 1935 to 2009

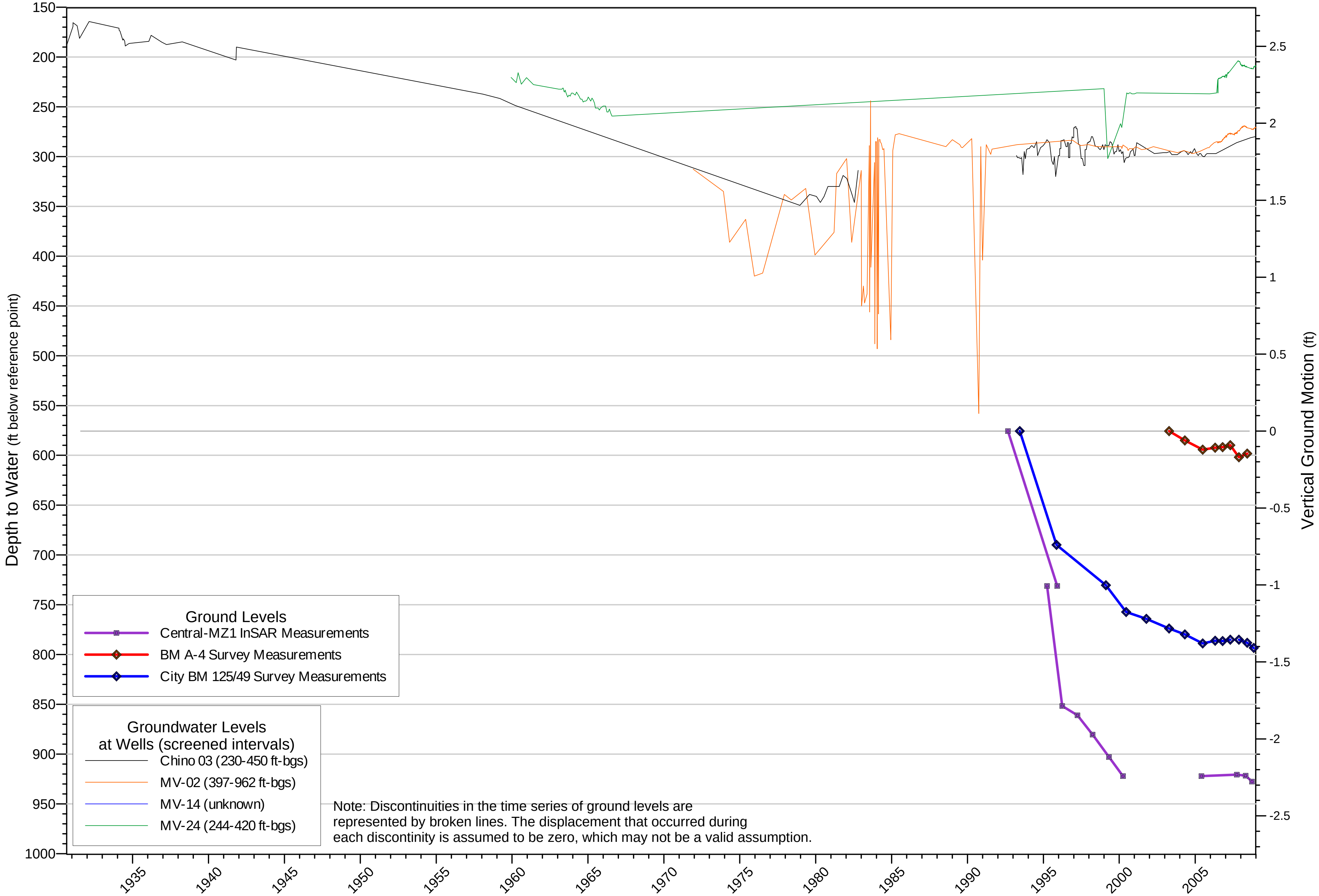


Figure 5-8
Groundwater Levels versus Ground Levels in the Pomona Area - 1993 to 2009

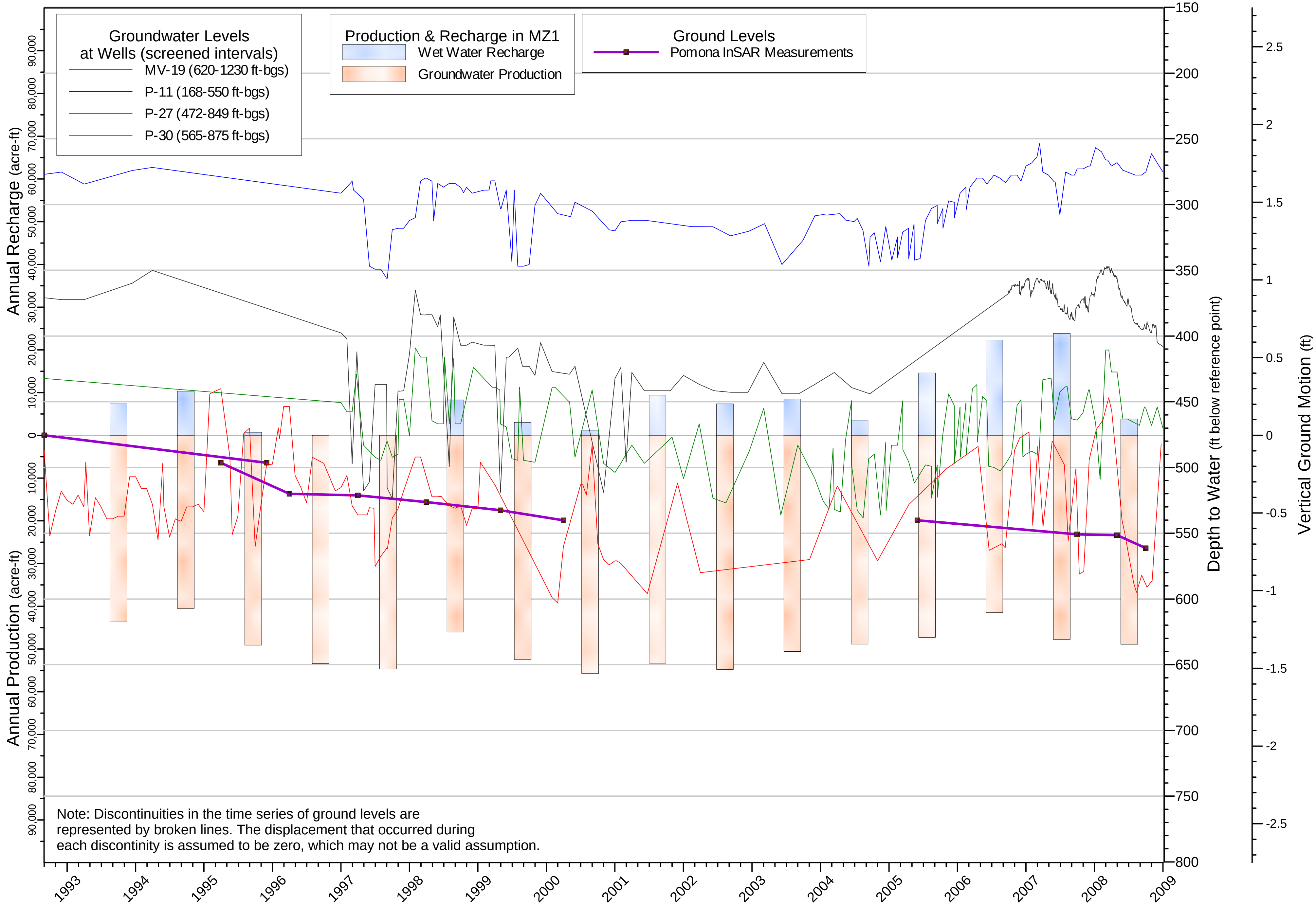


Figure 5-9
Groundwater Levels versus Ground Levels in the Pomona Area - 1935 to 2009

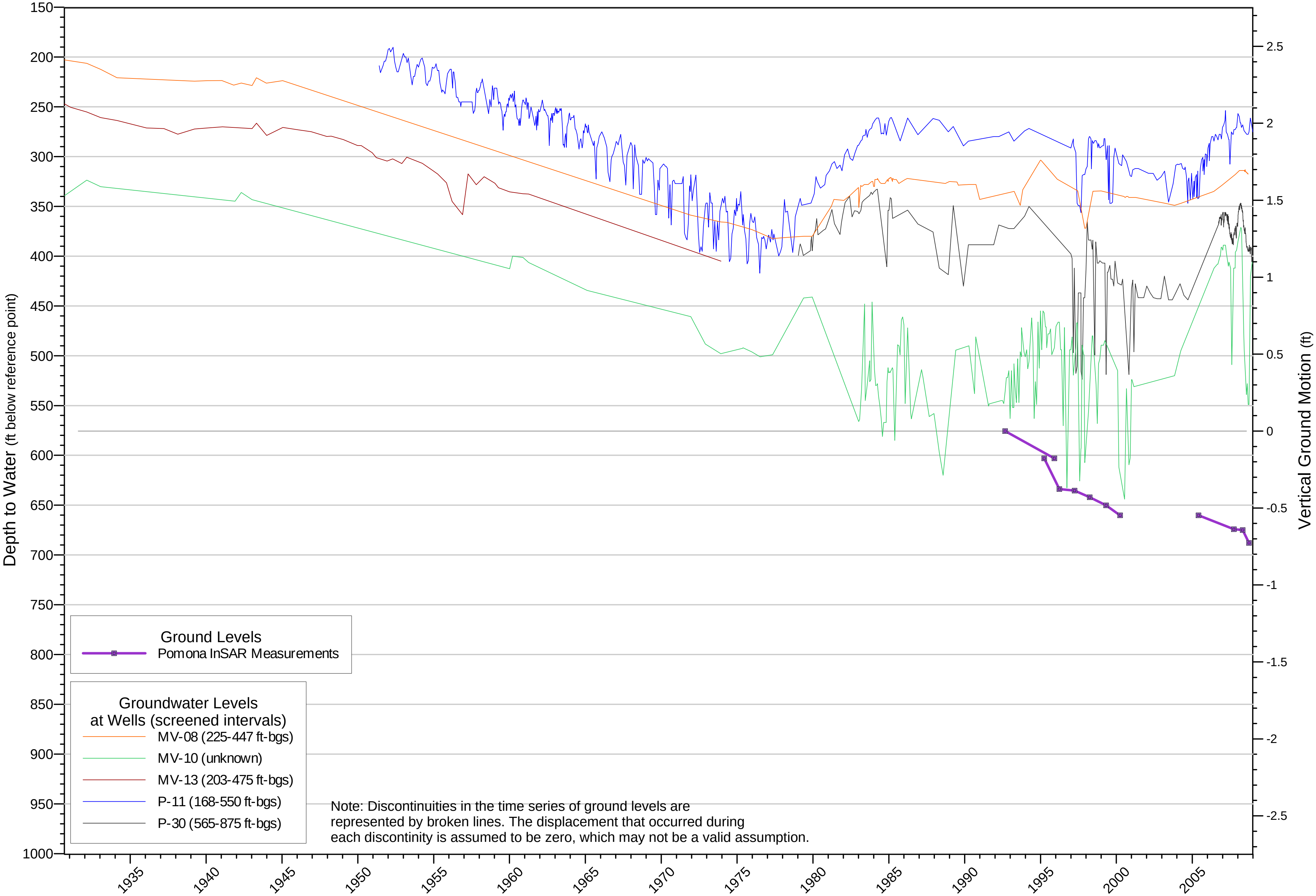


Figure 5-10

Groundwater Levels versus Ground Levels in the Ontario Area - 1993 to 2009

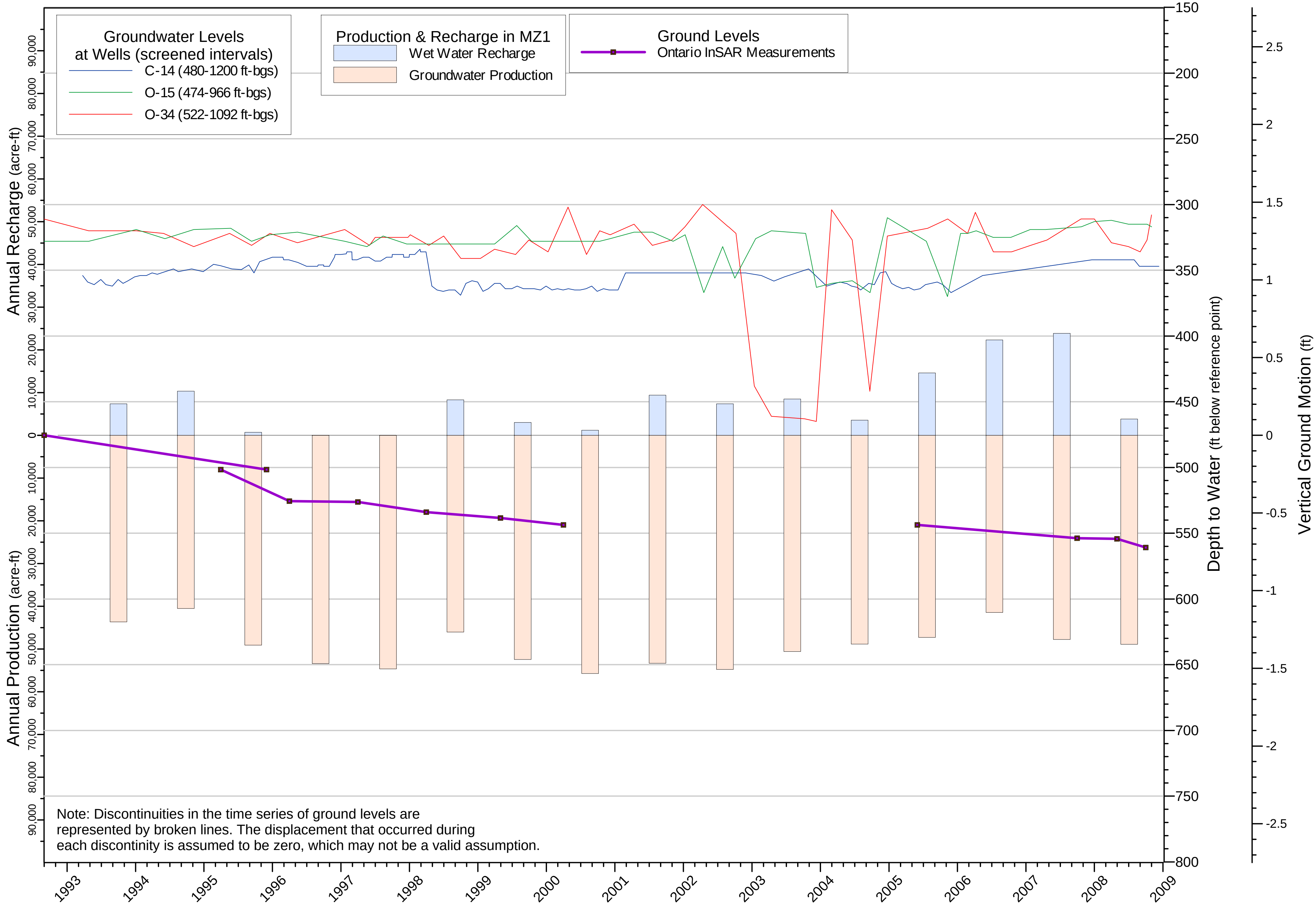


Figure 5-11
Groundwater Levels versus Ground Levels in the Ontario Area - 1930 to 2009

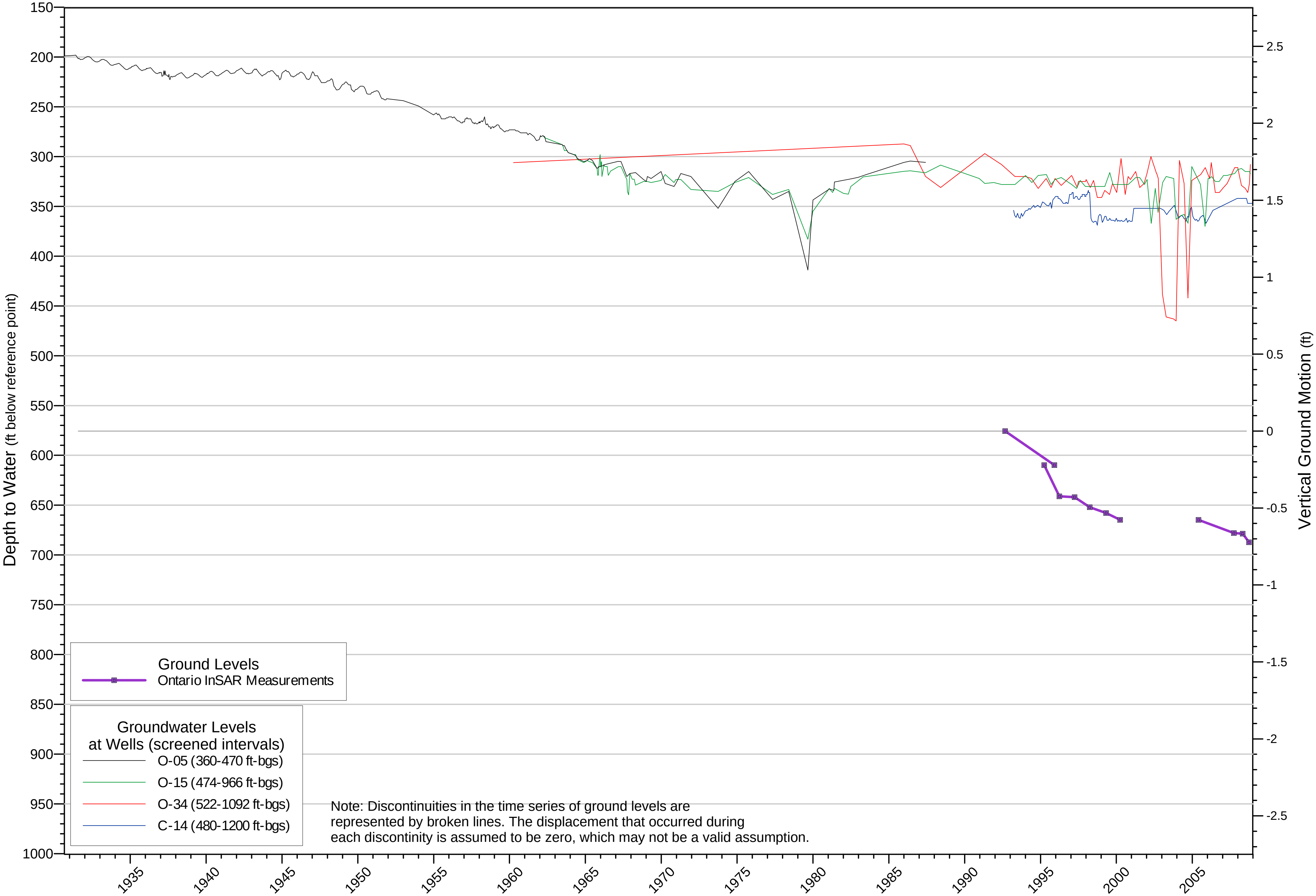


Figure 5-12
Groundwater Levels versus Ground Levels in the Southeast Area - 1993 to 2009

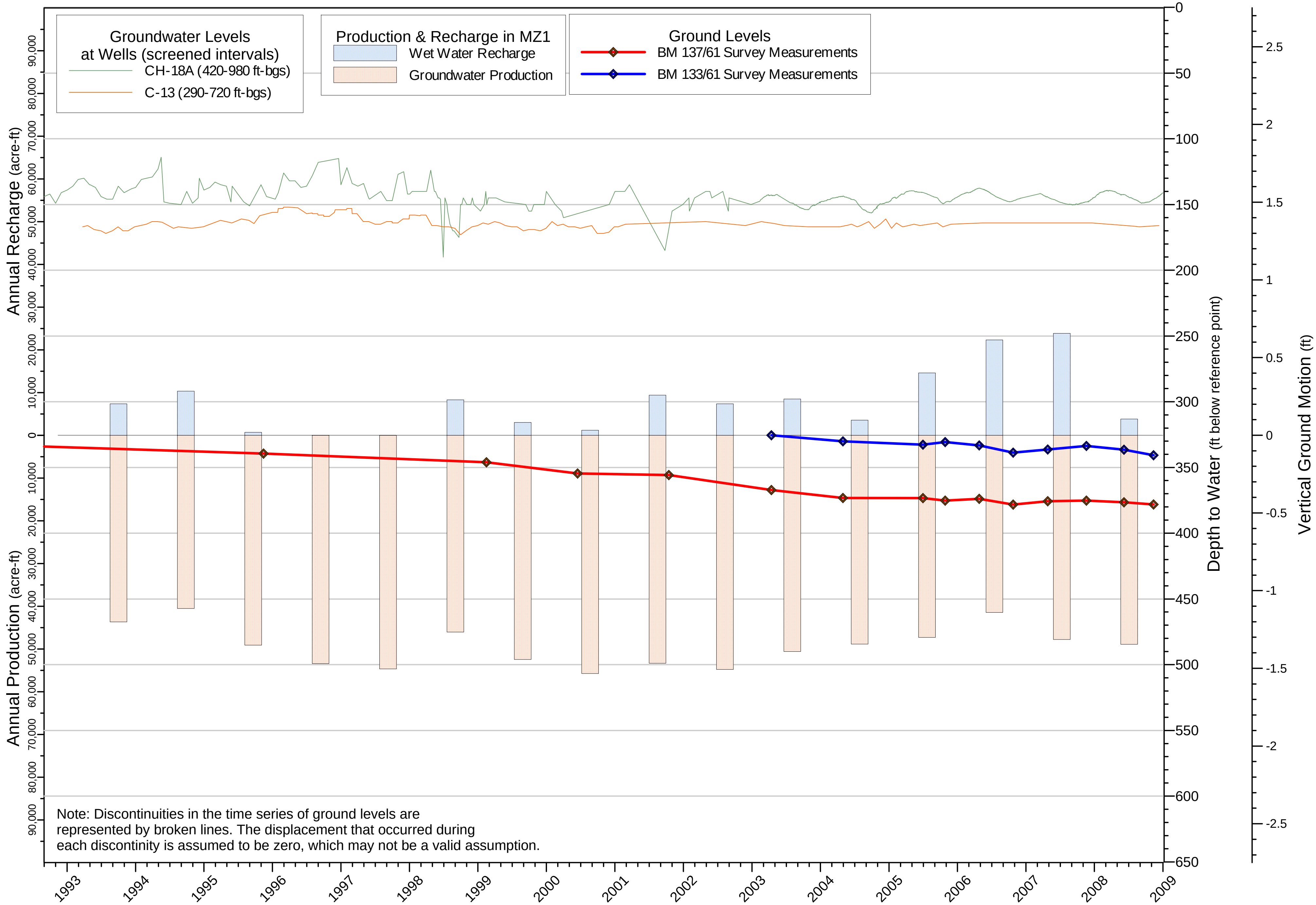
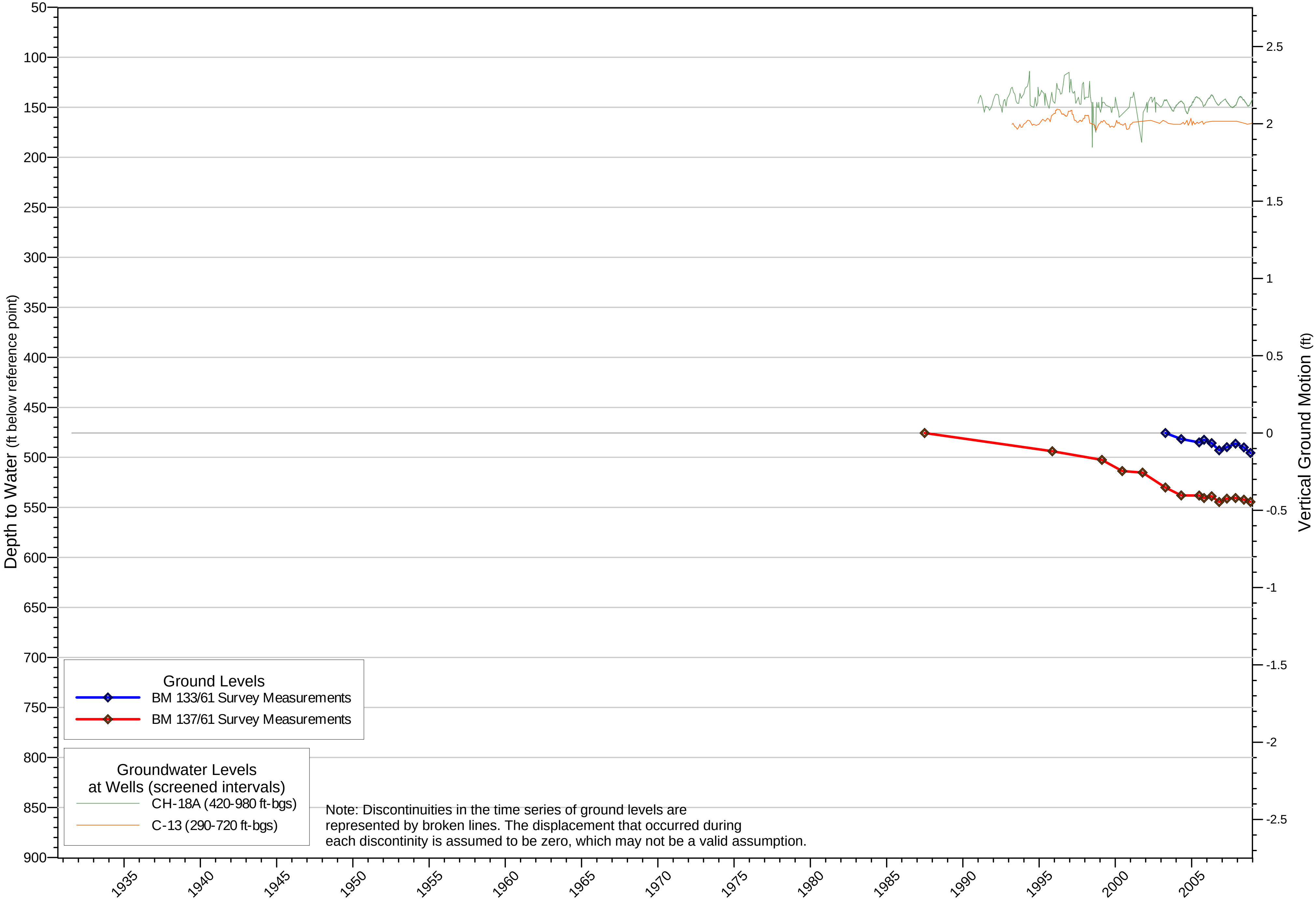


Figure 5-13
Groundwater Levels versus Ground Levels in the Southeast Area - 1930 to 2009



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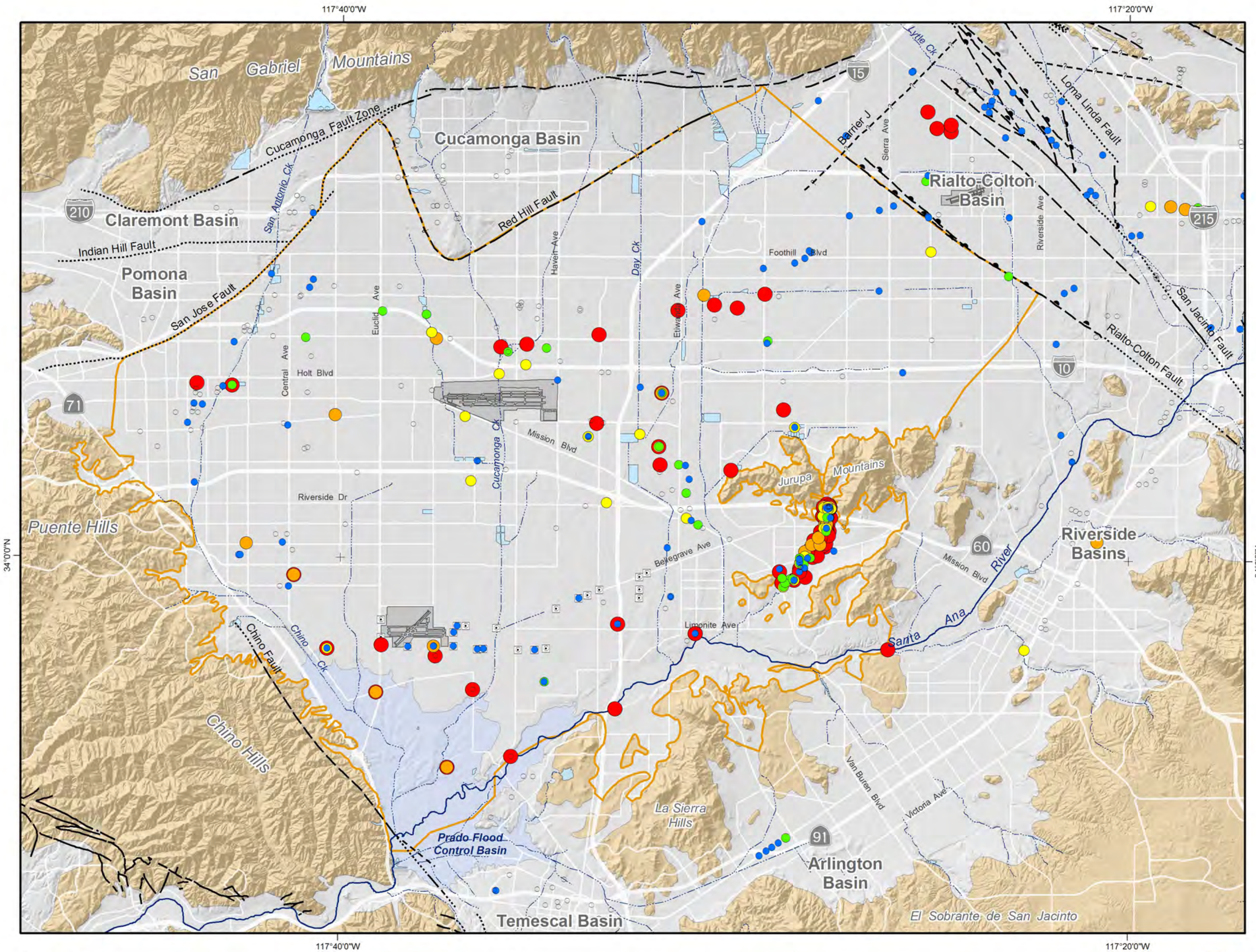
Appendix A

Groundwater Level Map

Appendix B

Groundwater Quality Maps



Main Features

Aluminum (mg/L)

- ND
- < 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.80
- > 0.80

Secondary EPA MCL = 2 mg/L
Primary CA MCL = 1 mg/L
Secondary CA MCL = 0.2 mg/L

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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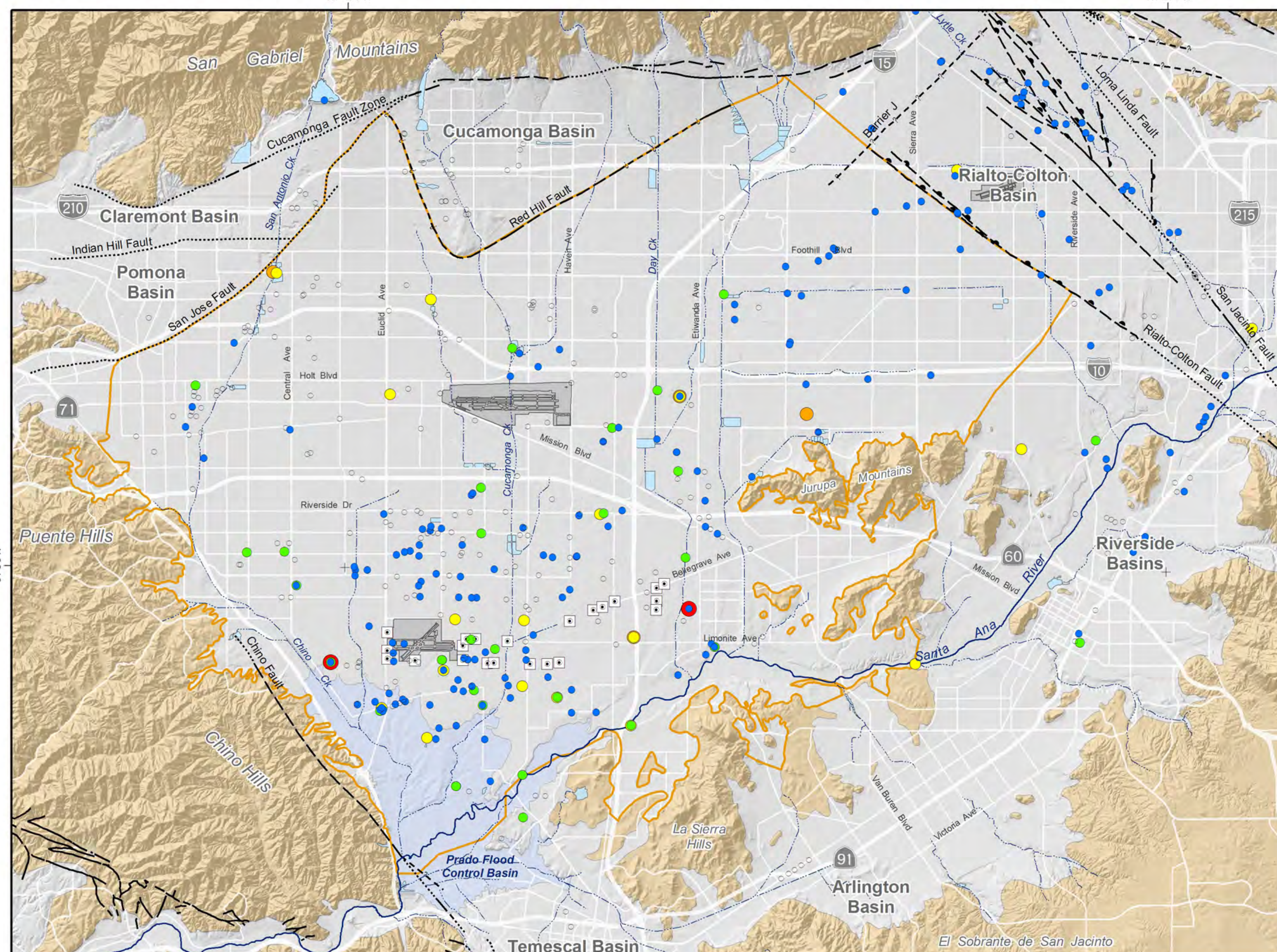
File: Appendix_B_Aluminum.mxd

0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Appendix B

Aluminum in Groundwater
Maximum Concentration (July 2003 - June 2008)

Appendix B



Main Features

Color (Color Units)

- ND
- < 7.5
- 7.5 - 15
- 15 - 30
- 30 - 60
- > 60

Secondary EPA MCL = 15 Color Units
Secondary CA MCL = 15 Color Units

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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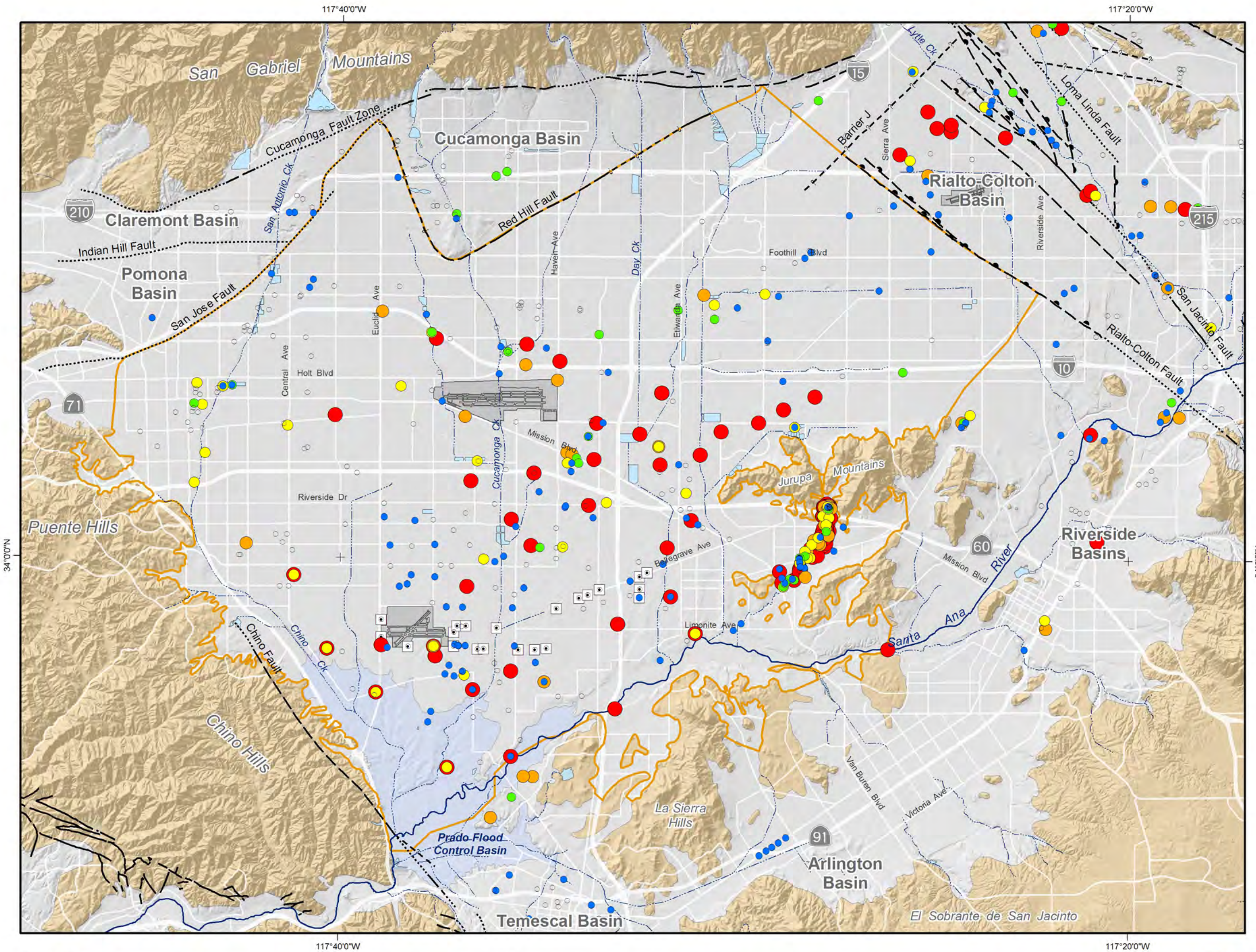
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Appendix B

Color in Groundwater

Maximum Concentration (July 2003 - June 2008)

Appendix B



Main Features

Iron (mg/L)

- ND
- < 0.15
- 0.15 - 0.30
- 0.30 - 0.60
- 0.60 - 1.2
- > 1.2

Secondary EPA MCL = 0.3 mg/L
Secondary CA MCL = 0.3 mg/L

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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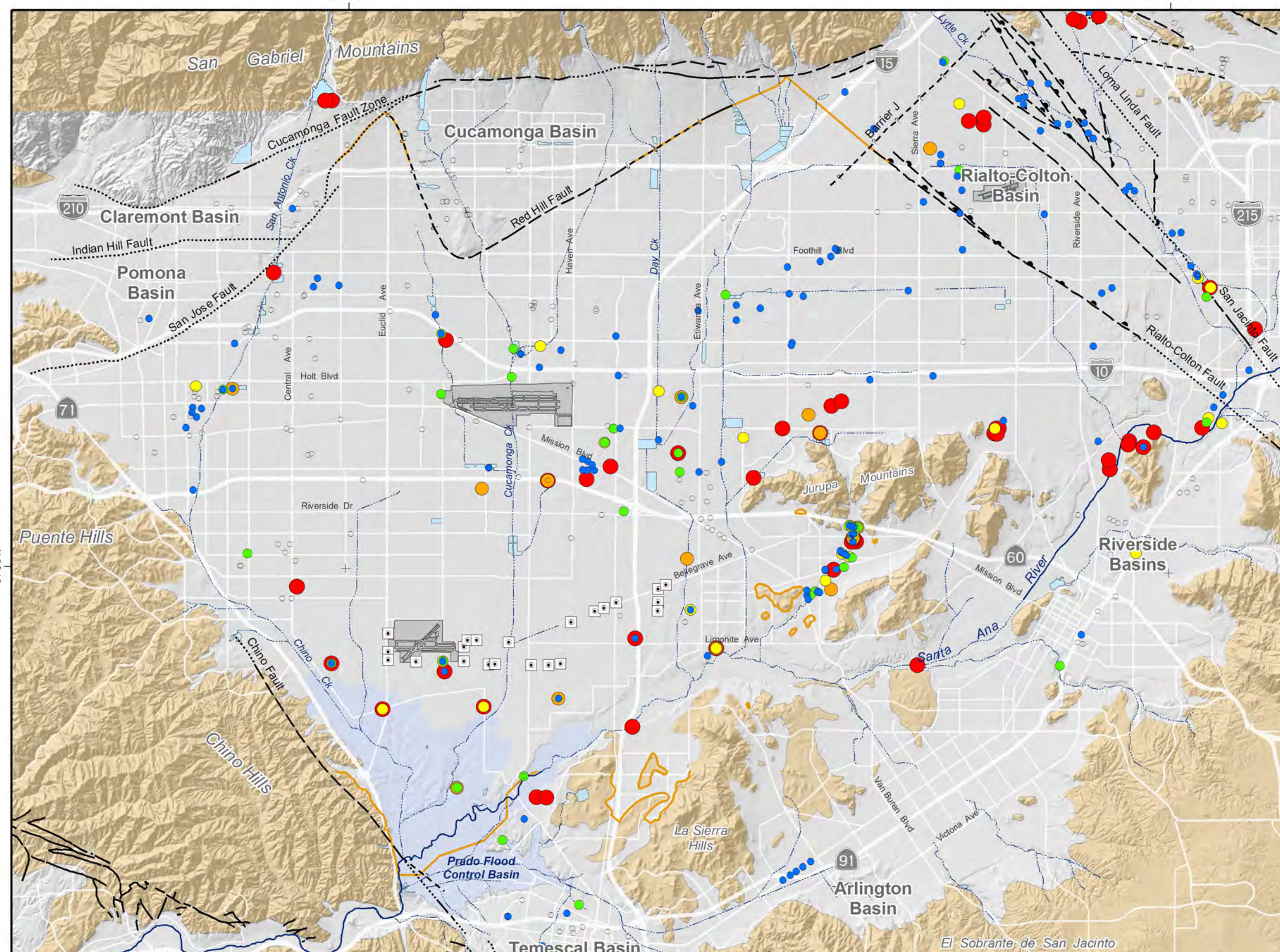
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Appendix B

Iron in Groundwater

Maximum Concentration (July 2003 - June 2008)

Appendix B



Main Features

Manganese (mg/L)

- ND
- < 0.025
- 0.025 - 0.050
- 0.050 - 0.10
- 0.10 - 0.20
- > 0.20

Secondary EPA MCL = 0.05 mg/L
Secondary CA MCL = 0.05 mg/L

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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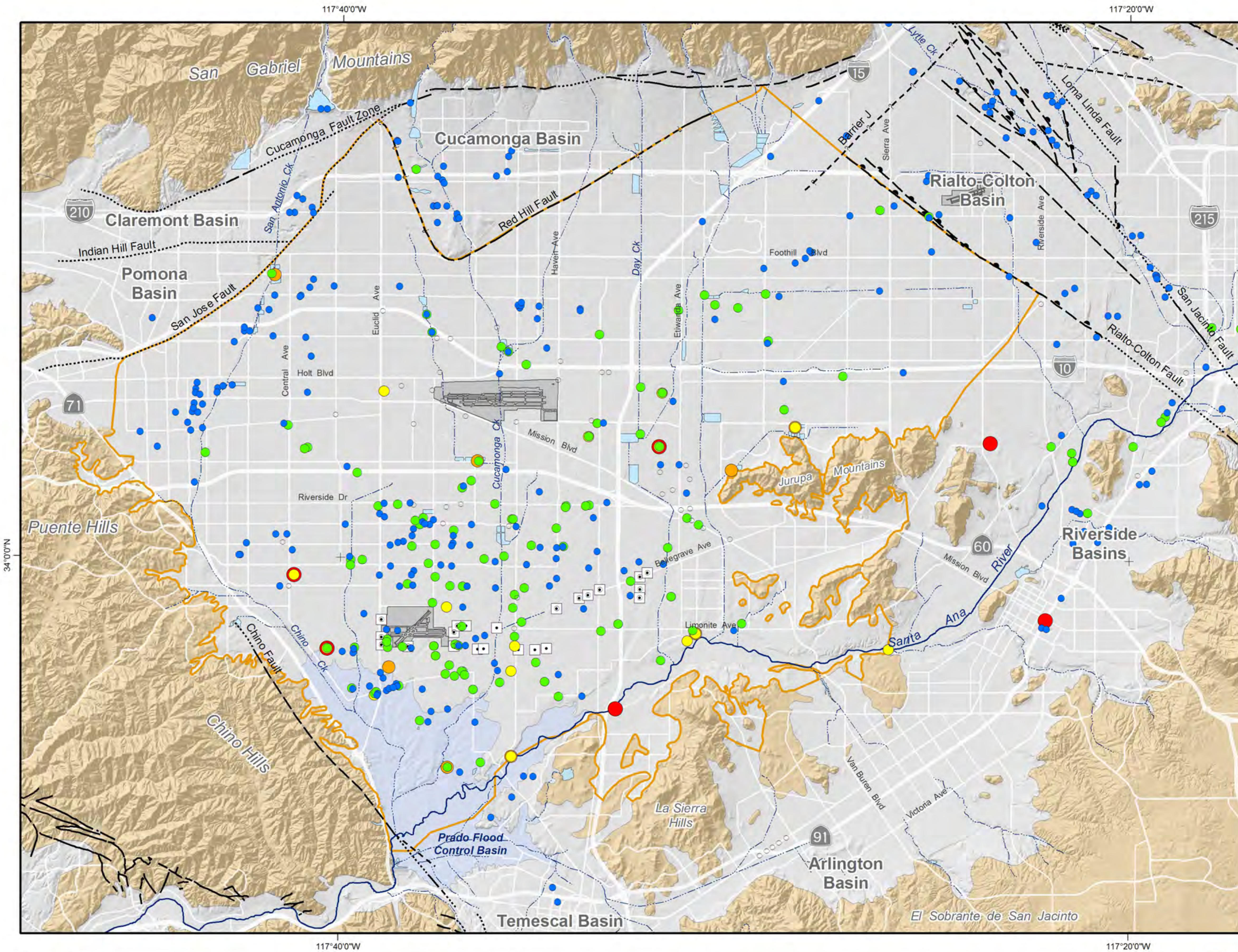
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Appendix B

Manganese in Groundwater

Maximum Concentration (July 2003 - June 2008)

Appendix B



Main Features

Odor (TON)

- ND
- < 1.5
- 1.5 - 3
- 3 - 6
- 6 - 12
- > 12

Secondary EPA MCL = 3 TON
Secondary CA MCL = 3 TON

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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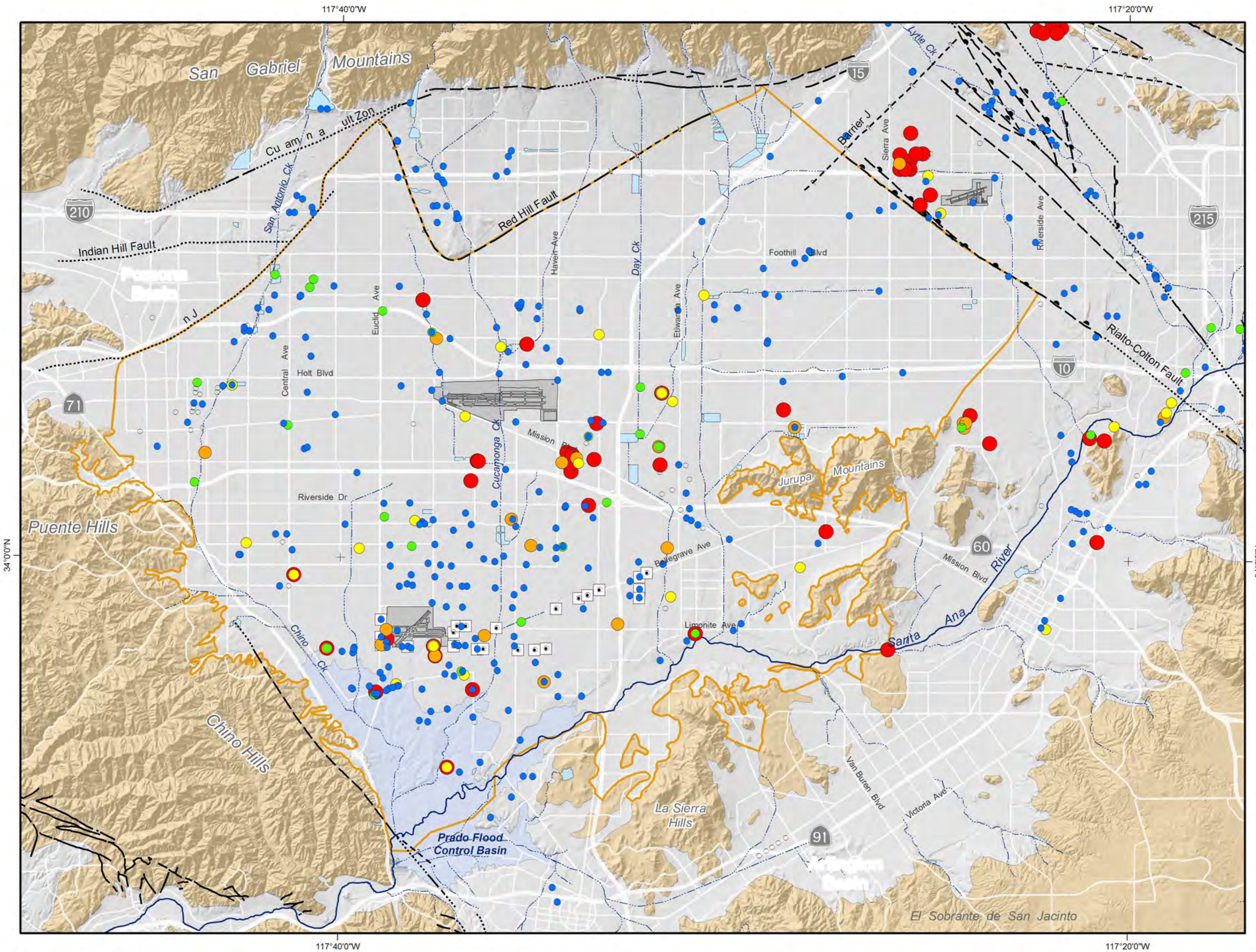
0 1 2 3 4 5 Miles
0 2 4 6 8 KM

2008 State of the Basin Report
Appendix B

Odor in Groundwater

Maximum Concentration (July 2003 - June 2008)

Appendix B



Main Features

Turbidity (NTU)

- ND
- < 2.5
- 2.5 - 5
- 5 - 10
- 10 - 20
- > 20

Secondary EPA MCL = 5 NTU
Secondary CA MCL = 5 NTU

Other Features

- Chino Basin Hydrologic Boundary
- Chino Desalter Well
- Streams & Flood Control Channels
- Flood Control & Conservation Basins

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain

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0 1 2 3 4 5 Miles
0 2 4 6 8 KM

Turbidity in Groundwater

Maximum Concentration (July 2003 - June 2008)

Appendix B

Appendix C

Groundwater Quality Exceedance Report

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
1,1,1-Trichloroethane			**ug/L**	**200**		**n/a**	**200**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.46	0.7	1.02	1.36	4.46	1.446	2641	499	5	0
1,1,2,2-Tetrachloroethane			**ug/L**	**n/a**		**n/a**	**1**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						2313	477	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane			**ug/L**	**n/a**		**n/a**	**1200**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.5	0.63	1.1	6.5	185	32.488	1694	396	6	0
1,1,2-Trichloroethane			**ug/L**	**5**		**n/a**	**5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.11	0.45	0.81	2.3	3.8	1.293	2625	499	5	0
1,1-Dichloroethane			**ug/L**	**n/a**		**n/a**	**5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.1	0.56	1.3	3.4	6013	23.667	2730	509	39	11
1,1-Dichloroethene			**ug/L**	**7**		**n/a**	**6**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.19	1.94	5.4	11.8	190	13.667	2709	507	56	31
1,2,3-Trichloropropane			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**0.005**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0.012	0.13	0.94	3.1	0.491	1192	375	25	23
1,2,4-Trichlorobenzene			**ug/L**	**70**		**n/a**	**5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.5	0.5	0.5		0.5	0.5	1008	285	1	0
1,2,4-Trimethylbenzene			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**330**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						2062	440	0	0
1,2-Dibromo-3-chloropropane			**ug/L**	**0.2**		**n/a**	**0.2**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.01	0.11	0.16	0.24	0.639	0.185	880	301	16	4

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
1,2-Dichlorobenzene			**ug/L**	**600**		**n/a**	**600**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1200	292	0	0
1,2-Dichloroethane			**ug/L**	**5**		**n/a**	**0.5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.1	0.34	0.45	0.6	3.1	0.611	2714	508	27	17
1,2-Dichloropropane			**ug/L**	**5**		**n/a**	**5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.12	0.36	0.5	1.1	3.6	0.933	2607	502	25	0
1,3,5-Trimethylbenzene			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**330**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1538	373	0	0
1,3-Dichloropropene			**ug/L**	**n/a**		**n/a**	**0.5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
94	94	94		96.5	95.25	790	238	2	2
1,4-Dichlorobenzene			**ug/L**	**75**		**n/a**	**5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.13	0.15	0.17	0.21	0.57	0.215	1271	295	1	0
1,4-Dioxane			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**3**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.1	0.29	0.5	0.99	46	1.289	577	63	10	3
2,3,7,8-Tetrachlorodibenzo-p-dioxin			**ug/L**	**3E-05**		**n/a**	**3E-05**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0	0		0	0	192	98	1	0
2,4-Dichlorophenoxyacetic acid			**ug/L**	**70**		**n/a**	**70**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						227	118	0	0
2-Chlorotoluene			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**140**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1531	364	0	0

Water Quality Exceedance Report

WILDERMUTH ENVIRONMENTAL INC.

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
4-Chlorotoluene			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**140**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1532	365	0	0
Alachlor			**ug/L**	**2**		**n/a**	**2**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						262	129	0	0
Aluminum			**mg/L**	**n/a**		**2**	**1**	**0.2**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.005	0.058	0.2	1.1	240	3.145	1437	355	250	153
Antimony			**ug/L**	**6**		**n/a**	**6**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.159	0.6	0.8	1.1	8.3	1.066	1341	350	46	1
Arsenic			**mg/L**	**0.01**		**n/a**	**0.05**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0.002	0.003	0.005	0.14	0.005	1565	381	247	24
Asbestos			**MFL**	**7**		**n/a**	**7**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.26	0.26	0.26		0.26	0.26	153	100	1	0
Atrazine			**ug/L**	**3**		**n/a**	**1**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.06	0.06	0.08	0.1	1.04	0.32	303	142	3	1
Barium			**mg/L**	**2**		**n/a**	**1**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0.042	0.07	0.13	160	0.629	1396	354	291	10
Bentazon			**ug/L**	**n/a**		**n/a**	**18**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						221	112	0	0
Benzene			**ug/L**	**5**		**n/a**	**1**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.11	0.14	0.16	0.52	1.5	0.4	2674	508	6	1

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Benzo(a)pyrene			**ug/L**	**0.2**		**n/a**	**0.2**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.02	0.02	0.02		0.02	0.02	265	131	1	0
Beryllium			**mg/L**	**0.004**		**n/a**	**0.004**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0	0	0.001	0.008	0.001	1346	350	52	2
Boron			**mg/L**	**n/a**		**n/a**	**n/a**	**n/a**	**1**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
-0.004	0.1	0.161	0.3	2.5	0.228	1260	299	105	3
Bromate			**mg/L**	**0.01**		**n/a**	**0.01**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						2	1	0	0
Cadmium			**mg/L**	**0.005**		**n/a**	**0.005**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0	0	0	0.009	0	1355	351	140	1
Carbofuran			**ug/L**	**40**		**n/a**	**18**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						210	116	0	0
Carbon Disulfide			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**160**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.28	0.3	0.54	6.6	15.7	3.862	1102	272	8	0
Carbon Tetrachloride			**ug/L**	**5**		**n/a**	**0.5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.16	0.16	0.9	1.2	1.2	0.753	2323	477	3	2
Chlorate			**mg/L**	**n/a**		**n/a**	**n/a**	**n/a**	**0.8**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.021	0.021	0.061	0.063	0.063	0.048	3	2	2	0
Chlordane			**ug/L**	**2**		**n/a**	**0.1**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						227	118	0	0

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Chloride			**mg/L**	**n/a**		**250**	**n/a**	**250**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
2.3	12	30	95	2700	68.323	2361	428	428	25
Chlorine			**mg/L**	**4**		**n/a**	**4**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
4.1	50	73	130	486	97.758	110	96	95	95
Chlorine Dioxide			**mg/L**	**0.8**		**n/a**	**0.8**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1	1	0	0
Chlorite			**mg/L**	**1**		**n/a**	**1**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						4	3	0	0
Chlorobenzene			**ug/L**	**100**		**n/a**	**70**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.28	0.6	0.79	1.4	1.7	0.962	2337	478	4	0
Chromium			**ug/L**	**100**		**n/a**	**50**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	3.5	6.5	13	1500	23.765	1762	372	329	30
Cis-1,2-Dichloroethene			**ug/L**	**70**		**n/a**	**6**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.1	0.7	2.4	6.3	71	6.832	2690	509	43	10
Color			**Assessment**	**n/a**		**15**	**n/a**	**15**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
1	3	5	5	100	6.707	1483	377	182	21
Copper			**mg/L**	**1.3**		**1**	**1.3**	**1**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0.001	0.002	0.004	150	0.504	1768	370	277	8
Cyanide			**ug/L**	**200**		**n/a**	**150**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
8.46	8.46	8.46		8.46	8.46	450	173	1	0

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Dalapon			**ug/L**	**200**		**n/a**	**200**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						227	118	0	0
Di(2-ethylhexyl)adipate			**ug/L**	**400**		**n/a**	**400**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						260	128	0	0
Di(2-ethylhexyl)phthalate			**ug/L**	**6**		**n/a**	**4**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.77	1.3	3.3	8.3	440	36.405	261	124	9	4
Dichlorodifluoromethane			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**1000**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.17	0.5	0.8	2.5	29	3.07	2323	476	17	0
Dichloromethane			**ug/L**	**5**		**n/a**	**5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.15	0.17	0.25	0.9	3	0.589	2468	482	53	0
Dinoseb			**ug/L**	**7**		**n/a**	**7**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						227	118	0	0
Diquat			**ug/L**	**20**		**n/a**	**20**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						198	108	0	0
Endothall			**ug/L**	**100**		**n/a**	**100**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						215	109	0	0
Endrin			**ug/L**	**2**		**n/a**	**2**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						231	122	0	0
Ethylbenzene			**ug/L**	**700**		**n/a**	**300**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.5	0.6	0.8	1.3	1.7	1.025	2380	481	8	0

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Ethylene Dibromide			**ug/L**	**0.05**		**n/a**	**0.05**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.02	0.02	0.02	0.02	0.02	0.02	1227	360	1	0
Fluoride			**mg/L**	**4**		**2**	**2**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.05	0.2	0.3	0.7	7.6	0.538	1553	271	265	4
Foaming Agents			**mg/L**	**n/a**		**0.5**	**n/a**	**0.5**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.005	0.06	0.08	0.14	18	0.237	1140	226	76	2
Glyphosate			**ug/L**	**700**		**n/a**	**700**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						196	109	0	0
Gross Alpha			**pci/L**	**15**		**n/a**	**15**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	1.6	2.91	4.94	42	4.283	440	127	93	7
Haloacetic Acids 5 (HAA5)			**ug/L**	**60**		**n/a**	**60**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
1.5	8.9	11.8	13.6	90	14.747	24	7	4	1
Heptachlor			**ug/L**	**0.4**		**n/a**	**0.01**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						232	122	0	0
Heptachlor Epoxide			**ug/L**	**0.2**		**n/a**	**0.01**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						231	122	0	0
Hexachlorobenzene			**ug/L**	**1**		**n/a**	**1**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						271	137	0	0
Hexachlorocyclopentadiene			**ug/L**	**50**		**n/a**	**50**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						265	131	0	0

Water Quality Exceedance Report

WILDERMUTH ENVIRONMENTAL INC.

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL	Min	1st Quartile	Median	3rd Quartile	Maximum	Average	# of Samples	# of Wells Sampled	# of Wells with Detects	# of Wells with Exceedances
Iron	mg/L	n/a	0.3	n/a	0.3	n/a	0.001	0.063	0.231	1.19	1714	7.298	2174	451	299	185
Isopropylbenzene	ug/L	n/a	n/a	n/a	n/a	770							2015	438	0	0
Lead	mg/L	0.015	n/a	0.015	n/a	n/a	0	0	0.001	0.002	0.087	0.002	1365	353	189	7
Lindane	ug/L	0.2	n/a	0.2	n/a	n/a							231	122	0	0
Manganese	mg/L	n/a	0.05	n/a	0.05	0.5	0	0.006	0.022	0.065	140	0.499	1752	281	167	58
Mercury	mg/L	0.002	n/a	0.002	n/a	n/a	0	0	0	0	0.002	0	1067	327	55	0
Methoxychlor	ug/L	40	n/a	30	n/a	n/a							227	120	0	0
Methyl Isobutyl Ketone	ug/L	n/a	n/a	n/a	n/a	120	5.3	5.3	5.3		5.3	5.3	2233	440	1	0
Methyl Tert-Butyl Ether	ug/L	n/a	n/a	13	5	n/a	0.3	11	41	93	5800	136.23	2364	488	11	3
Molinate	ug/L	n/a	n/a	20	n/a	n/a							298	133	0	0

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
n-Butylbenzene	**ug/L**	**n/a**	**n/a**	**n/a**	**n/a**	**260**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1531	364	0	0

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
N-Nitrosodimethylamine	**ug/L**	**n/a**	**n/a**	**n/a**	**n/a**	**0.01**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.006	0.006	0.006		0.006	0.006	68	34	1	0

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
N-Nitrosodipropylamine	**ug/L**	**n/a**	**n/a**	**n/a**	**n/a**	**0.01**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						3	1	0	0

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
n-Propylbenzene	**ug/L**	**n/a**	**n/a**	**n/a**	**n/a**	**260**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1532	365	0	0

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Naphthalene	**ug/L**	**n/a**	**n/a**	**n/a**	**n/a**	**17**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.6	0.6	0.6	0.7	0.7	0.633	987	259	3	0

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Nickel	**mg/L**	**n/a**	**n/a**	**0.1**	**n/a**	**n/a**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0.002	0.003	0.007	0.66	0.013	1340	349	253	7

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Nitrate-Nitrogen	**mg/L**	**10**	**n/a**	**10**	**n/a**	**n/a**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.009	3.388	7.677	15.806	200	12.759	8891	594	588	395

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Nitrite-Nitrogen	**mg/L**	**1**	**n/a**	**1**	**n/a**	**n/a**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0.05	0.1	0.15	35	1.759	1827	402	124	6

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Odor	**TON**	**n/a**	**3**	**n/a**	**3**	**n/a**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
1	1	1	2	40	1.69	1371	366	315	28

Chemical	Unit	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Oxamyl	**ug/L**	**200**	**n/a**	**50**	**n/a**	**n/a**

Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						210	116	0	0

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Pentachlorophenol			**ug/L**	**1**		**n/a**	**1**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						234	123	0	0
Perchlorate			**ug/L**	**n/a**		**n/a**	**6**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.81	6	11	20	870	21.406	2260	513	252	188
pH			**pH**	**n/a**		**8.5**	**n/a**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	7.3	7.64	7.9	770	7.921	2319	394	394	14
Picloram			**ug/L**	**500**		**n/a**	**500**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						227	118	0	0
Polychlorinated Biphenyls			**ug/L**	**0.5**		**n/a**	**0.5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						225	117	0	0
Propachlor			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**90**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						183	85	0	0
Ra 226 + Ra 228			**pci/L**	**5**		**n/a**	**5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.16	0.5	0.5	0.57	0.8	0.513	20	15	6	0
Sec-Butylbenzene			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**260**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1518	364	0	0
Selenium			**mg/L**	**0.05**		**n/a**	**0.05**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0.002	0.004	0.006	0.045	0.005	1333	350	196	0
Silver			**mg/L**	**n/a**		**0.1**	**n/a**	**0.1**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0	0	0	0.014	0	1369	350	80	0

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Silvex			**ug/L**	**50**		**n/a**	**50**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						227	118	0	0
Simazine			**ug/L**	**4**		**n/a**	**4**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.05	0.05	0.2	0.4	0.92	0.274	311	148	6	0
Specific Conductance (lab)			**umhos/cm**	**n/a**		**n/a**	**n/a**	**900**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
60	375	540	1100	1600000	3016.663	2124	335	335	121
Strontium-90			**pci/L**	**n/a**		**n/a**	**8**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
-0.35	0	0.103	0.3	1.2	0.217	63	19	18	0
Styrene			**ug/L**	**100**		**n/a**	**100**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						2291	478	0	0
Sulfate			**mg/L**	**n/a**		**250**	**n/a**	**250**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
2.4	17	50	120	1200	82.22	2913	527	527	41
TDS			**mg/L**	**n/a**		**500**	**n/a**	**500**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
48	260	380	760	4790	553.745	3945	425	425	221
Tert-Butyl Alcohol			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**12**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
2	2.1	9.7	22	150	37.16	968	232	3	1
Tert-Butylbenzene			**ug/L**	**n/a**		**n/a**	**n/a**	**n/a**	**260**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1530	365	0	0
Tetrachloroethene			**ug/L**	**5**		**n/a**	**5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.14	1	1.8	5.7	182	7.975	3357	568	114	37

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Thallium			**ug/L**	**2**		**n/a**	**2**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
-2.406	0.14	0.19	0.38	30.72	1.933	1260	349	41	6
Thiobencarb			**ug/L**	**n/a**		**n/a**	**70**	**1**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						407	159	0	0
Toluene			**ug/L**	**1000**		**n/a**	**150**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.11	0.5	0.71	2	9.8	1.694	2591	490	31	0
Total Xylene			**ug/L**	**10000**		**n/a**	**1750**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						1543	392	0	0
Toxaphene			**ug/L**	**3**		**n/a**	**3**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						227	118	0	0
Trans-1,2-Dichloroethene			**ug/L**	**100**		**n/a**	**10**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.2	0.28	0.72	1.7	7.73	1.313	2703	509	12	0
Trichloroethene			**ug/L**	**5**		**n/a**	**5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.13	1.8	3.8	18	5620	64.883	3412	569	241	115
Trichlorofluoromethane			**ug/L**	**n/a**		**n/a**	**150**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.07	0.3	0.42	0.62	19	1.663	2042	420	18	0
Trihalomethanes			**ug/L**	**80**		**n/a**	**80**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.5	1.6	4.8	64.5	87.3	28.432	618	215	23	2
Tritium			**pci/L**	**n/a**		**n/a**	**20000**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
-199	-12.6	25.7	287	596	118.69	65	18	18	0

Water Quality Exceedance Report

Sampling Period: 7/1/2003 **to** 6/30/2008

Chemical			Unit	Primary EPA MCL		Secondary EPA MCL	Primary CA MCL	Secondary CA MCL	CA NL
Turbidity			**NTU**	**5**		**n/a**	**n/a**	**5**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0	0.21	0.52	2.6	2880	21.599	1699	360	320	78
Uranium			**pci/L**	**n/a**		**n/a**	**20**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.48	1.58	2.77	5.48	20.5	4.319	175	54	53	1
Vanadium			**mg/L**	**n/a**		**n/a**	**n/a**	**n/a**	**0.05**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.001	0.009	0.013	0.025	0.31	0.02	817	290	286	25
Vinyl Chloride			**ug/L**	**2**		**n/a**	**0.5**	**n/a**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
						2389	483	0	0
Zinc			**mg/L**	**n/a**		**5**	**n/a**	**5**	**n/a**
Min	*1st Quartile*	*Median*	*3rd Quartile*	*Maximum*	*Average*	*# of Samples*	*# of Wells Sampled*	*# of Wells with Detects*	*# of Wells with Exceedances*
0.001	0.003	0.006	0.014	9.853	0.061	1804	369	264	1

Primary EPA MCL — **Primary EPA MCLs are federally enforceable limits for chemicals in drinking water and are set as close as feasible to the corresponding EPA MCLG.**

Secondary EPA — **Secondary EPA MCLs apply to chemicals in drinking water that adversely affect its odor, taste, or appearance Secondary EPA MCLs are not based on direct health effects associated with the chemical. Secondary MCLs are consdered desireable goals and are not federally enforceable**

Primary CA MCL — **Primary CA MCLs are analogous to Primary EPA MCLs and are enforceable at the state level . If the California DHS has adopted a more stringent primary MCL than the EPA MCL, the primary CA MCL sould be enforceable.**

Secondary CA — **Secondary CA MCLs are analogous to Secondary EPA MCLs and are applicable at the state level. If the California DHS has adopted a more stringent secondary MCL than the EPA MCL, the secondary CA MCL would be applied.**

CA NL — **California Notification Levels are health -based criteria similar to US EPA Health Advisories. CA NLs are not enforceable, but are levels at which the California Department of Health Services strongly urges water purveyors to take corrective actions.**

Appendix D

Compact Disk

APPENDIX 5

BIOLOGICAL ASSESSMENT FOR SANTA ANA RIVER INTERCEPTOR (SARI)

BIOLOGICAL ASSESSMENT FOR THE SANTA ANA REGIONAL INTERCEPTOR (SARI) PIPELINE REPAIR PROJECT

Located in the Prado Dam area of Riverside and San Bernardino Counties
USGS – Corona North and Prado Dam Quadrangles,
unsectioned portions of Township 3 South, Range 7 West

Prepared for:

RBF Consulting
3300 East Guasti Road, Suite 100
Ontario, California 91761

Prepared by:

Tom Dodson & Associates
2150 North Arrowhead Avenue
San Bernardino, California 92405

CERTIFICATION: I hereby certify that the statements furnished herein and in the attached exhibits present the data and information required for this biological evaluation, and that the facts, statements, and information presented are true and correct to the best of my knowledge and belief. Fieldwork conducted for this assessment was performed by me or under my direct supervision. I have not signed a non-disclosure or consultant confidentiality agreement with the project applicant or applicant's representative and that I have no financial interest in the project. Fieldwork was performed by Shay Lawrey and Lisa Tollstrup

Shay E. Lawrey

Updated and Revised January 12, 2010

Summary of Findings, Conclusions and Determinations

The Santa Ana Watershed Project Authority (SAWPA) owns approximately 92 miles of the Santa Ana Regional Interceptor (SARI) pipeline, which runs through Orange, Riverside, and San Bernardino Counties. SAWPA owns the SARI pipeline upstream of the Prado Dam and is responsible for its operation and maintenance in both Riverside and San Bernardino Counties. The SARI functions as a critical salt management mechanism designed to remove and collect salt from the watershed and transport it to treatment facilities located in Huntington Beach. Over a two-decade period the pipeline was constructed in a series of reaches or sections. SAWPA owns and operates Reaches IV-A, IV-B, IV-D, IV-E, and V.

Previous surveys of the interior of the pipelines have identified evidence of decay and bio-growth, which inhibit the flow of water through the pipe, and a number of the joints within the pipeline have been found to leak. The areas proposed for repairs (Reach IV-A and IV-B) have shown signs of deterioration. This has prompted the SAWPA to rehabilitate the pipeline in Reaches IV-A and IV-B in order to prevent an environmental disaster and to extend the service life of the pipeline.

The proposed project is located within the unincorporated area of the County of Riverside, which is within the Sphere of Influence of the City of Corona. The proposed project site is located east of State Route (SR) 71 and north of SR 91; north and east of the Prado Dam; west of the Corona Airport, and west of Hamner Road. The project area is mapped within un-sectioned portions of Township 3 South, Range 7 West on the USGS – Corona North and Prado Dam quadrangles, 7.5 Minute Series topographic maps (Figures 1, 2a-11a).

The proposed action area of Reach IV-B and the southern half of Reach IV-A traverses vacant, public land designated as flood control, water conservation and open space. Patches of agricultural, industrial and commercial land uses flank Reach IV-A, north of the Prado Dam inundation area. The primary plant community of concern in the project area is riparian, however, in addition to riparian habitat there are freshwater marsh, eucalyptus groves, coastal sage scrub (Riversidean sage scrub), riverine (sandy river wash), grassland, and ruderal habitats found within the project area.

Construction of the proposed pipeline will result in impacts to sensitive habitat, critical habitat, listed species and sensitive species. The project area is located within the critical habitat designated for the (LBVI) [*Vireo bellii pusillus*]. There are current records of Santa Ana sucker (SASU) [*Catostomus santaanae*], Southwestern willow flycatcher (SWWF) [*Empidonax traillii extimus*], and LBVI in the vicinity of the project area. There are records of Western yellow-billed cuckoo (YBCU) [*Coccyzus americanus occidentalis*] outside of the project area but within the riparian habitat of Prado Basin. There is no current published data showing YBCU occurring in the vicinity of the project area in Prado Basin. The background research for this project found that the most recent, verifiable sighting of YBCU in Prado was reported in 2000. Based the most up to date data, SASU, LBVI, and SWWF are considered present within the vicinity of the project area and other sensitive species, such as the YBCU, were determined to have a potential of occurring in the riparian habitat located in the project area based on the botanical components, percent vegetative cover, and habitat structure.

The project site is located within the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP) area. The MSHCP requires consistency with all plan policies. In addition to a MSHCP Consistency Analysis, a Determination of Biologically Equivalent or Superior Preservation (DBESP) document will be required. The MSHCP provides a mechanism which would authorize permittees of the Plan lawful take of listed species. To address the issues related to the MSHCP a separate consistency analysis document has been prepared for this project. In addition to MSHCP compliance, the project will also be required to comply with laws and regulations regarding streambed alteration and Waters of the U.S. The project will result in temporary impacts to the Santa Ana River in the vicinity of Prado Dam. The Santa Ana River is tributary to the Pacific Ocean and as such falls under the jurisdictions of the U.S. Army Corps of Engineers (ACOE), Regional Water Quality Control Board (RWQCB), and the California Department of Fish and Game (CDFG).

In this Biological Assessment, impacts have been calculated to reflect a worst case scenario. SAWPA will strive to minimize these worst case scenario impacts and, in some cases, SAWPA may be able to eliminate certain impacts completely. Under the assumption of worst case, however, the project will create a total of approximately 53 acres of land and water disturbance. Within the construction action area, calculated impacts to sensitive habitats and protected species include a 20-foot access road, land disturbances at the manholes, pipeline bypass areas, and dewatering areas. Based on the engineering data provided, field review and background information, the project has the potential to produce a maximum of 2.90 acres of temporary impacts to suitable SASU habitat. The potentially suitable SASU habitat is located below 505 feet elevation. The total calculated temporary impacts to riparian/riverine habitat and LBVI critical habitat are 13.77 acres (12.85 acres in Riverside County and 0.92 acre in San Bernardino County), ten (10) of which occur at or below 505 feet elevation.

The project area located within the upper reaches of Reach IV-A, in San Bernardino County, will not impact LBVI critical habitat, suitable or occupied LBVI or SWWF habitat, LBVI individuals or SWWF individuals. This specific portion of the project will impact bare ground and ruderal vegetation only and will avoid all impacts to riparian vegetation existing in this reach. The project proposes to avoid impacts to LBVI, SWWF and other sensitive migratory birds in the upper reaches of Reach IV-A, by constructing outside of their migratory nesting season between March 15 and September 15. Therefore, it is determined that the Project area within San Bernardino County (only) will not adversely affect critical habitat or listed species.

The project area within Riverside County that encompasses lower Reach IV-A and Reach IV-B will result in impacts that may affect critical habitat and listed species. The SARI line improvements are located within an area that is forecast to experience temporal loss of habitat due to inundation of habitat based on future changes in water management activities to support Prado Basin Water Conservation operations (U. S. Army Corps of Engineers, Los Angeles District Prado Basin Water Conservation Feasibility Study, February 2005).

Compensation for the temporal loss of habitat has already been provided for most of the same area (that area below 505 feet in elevation) that will be temporally impacted by the proposed project. The proposed project is a construction project that will remove vegetation and cause habitat loss due to discrete construction activities over a specific period of time.

In an attempt to balance mitigation and prevent double mitigation for the same habitat affected by both the proposed project and the water conservation project, SAWPA proposes to mitigate the temporal loss of habitat along the pipeline alignment in the following manner: 1) minimize, to the extent feasible, the area of LBVI critical habitat impact (13.77 acres); 2) implement a post-construction monitoring program to ensure that natural restoration of the habitat within the construction area is progressing without invasion of exotic species; 3) compensate for 50% of the temporal habitat loss of habitat below elevation 505' AMSL and 100% above elevation 505' AMSL by funding an equivalent amount of acreage of invasive plant removal (primarily arundo) or acquisition of additional comparable habitat acreage within the Prado Basin; and 4) possibly implement a pepper weed eradication program offsite near the Corps trailers.

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Chapter 1. Introduction

The purpose of this biological assessment is to provide technical information and to review the proposed project in sufficient detail to determine to what extent the proposed project may affect threatened, endangered, or proposed species. The biological assessment is prepared in accordance with Section 7 (a)(2) of the Endangered Species Act (16 U.S. C 1536(c)) The document presents technical information upon which later decisions regarding project impacts are developed.

The proposed project is located within Riverside and San Bernardino Counties. The proposed project site is located east of State Route (SR) 71; north of the SR 91; north and east of the Prado Dam; west of the Corona Airport, and west of Hamner Road. The project area is mapped within unsectioned portions of Township 3 South, Range 7 West on the USGS – Corona North and Prado Dam quadrangles, 7.5 Minute Series topographic maps.

The upper portion of Reach IV-A begins at the junction with Reach IV-D at manhole 4A-0180 and continues north to manhole 4A-0680, a distance of approximately 24,669 linear feet (4.7 miles). This section of pipe is 27 inches in diameter and is located beyond the limits of the Prado Dam wetland area, mostly within city streets and previously disturbed areas.

The lower portion of Reach IV-A begins at Prado Dam at manhole 4A-0000 and extends north to the junction of Reach IV-D at manhole 4A-0180, a distance of approximately 16,814 linear feet (3.2 miles). This section of pipe is 42 inches in diameter and is mostly located within the water conservation pool impact area.

The section of Reach IV-B included as part of the project also begins at Prado Dam at manhole 4B-0010 and extends east to manhole 4B-0150, a distance of approximately 16,188 linear feet (3.1 miles). This section of pipe is 36 inches in diameter, and manholes 4B-0010 through 4B-0070 are within the water conservation pool impact area (Figures 1, 2a-11a).

1.1. Project History

The Santa Ana Watershed Project Authority (SAWPA) is Joint Powers Authority composed of the following member agencies: Eastern Municipal Water District (EMWD), Inland Empire Utilities Agency (IEUA), Orange County Water District (OCWD), San Bernardino Valley Municipal Water District (SBVMWD), and Western Municipal Water District (WMWD). SAWPA owns approximately 72 miles of the Santa Ana Regional Interceptor (SARI), within Riverside, and San Bernardino Counties and owns capacity rights in approximately 21 miles of the SARI within Orange County. The SAWPA owns the SARI pipeline upstream of the Prado Dam and is responsible for its operation and maintenance in Riverside and San Bernardino Counties. SAWPA is also responsible for the maintenance, improvement, protection, viability, and sustainability of the SARI. The SARI was built, in part, to remove salt from the upper watershed and export it to the Pacific Ocean via the Orange County

Sanitation District (OCSD) wastewater treatment facilities in Huntington Beach. The SARI functions as a critical salt management mechanism that will allow the watershed to reach a salt balance; achieving this balance is a key watershed goal.

Nearly forty years ago, the SARI system was designed as a way to remove salt from the watershed and to collect and transport non-reclaimable industrial brine that could not be effectively treated at local treatment facilities. Depending on cost and durability factors, a number of different materials were used for the pipeline construction. Over a two-decade period the pipeline was constructed in a series of reaches or sections. The upstream reaches of the SARI (specifically IV-A through IV-E) range in pipeline size from 16" to 42". Pipeline materials used within reaches IV-A and IV-B include unlined RCP. Other materials used in various sections of the SARI include polyvinyl chloride (PVC) pipe, RCP with PVC lining, vitrified clay (VCP) pipe, high-density polyethylene (HDPE) pipe, PVC lined reinforced concrete pressure pipe (RCPP), concrete encased steel pipe, and cement mortar lined and coated (CMLC) steel pipe.

SAWPA owns and operates Reaches IV and V. Most of the upper SARI System above the Riverside County line is less than 35 years old but there are several sections of older pipe in the vicinity of the Prado Dam. When the line was constructed it was typically buried under more than thirty feet of earth, fill and channel. Over the course of the last several years significant erosion has degraded and reduced the amount of cover over some areas of the pipe to only 18 inches in the reaches downstream of Prado Dam. There is real concern that with only a thin layer of cover, significant rainfall could cause line exposure and subsequent breach.

The SARI System is currently used for: 1) the disposal of high Total Dissolved Solids (TDS) brine from desalter operations within the region; 2) the disposal of industrial wastewater that is unacceptable for discharge into local facilities, usually because of high concentrations of TDS, from commercial and industrial facilities; and 3) the disposal of domestic or industrial wastewater that is managed by public agencies and which meets standards of local treatment facilities. The primary function of the SARI is to remove salt from the watershed and prevent water quality degradation in the watershed. However, in recent years, the SARI has also become a critical component in developing local water supply by making it possible to operate brackish groundwater desalters and supporting the increased use of recycled water.

A recent project completed by the Army Corps of Engineers (Corps) has raised the height of Prado Dam by 28 feet and raised the spillway elevation by 20 feet. The new water conservation pool will support an aquifer recharge and groundwater augmentation program to be implemented by the Orange County Water District (OCWD). The conservation pool behind the dam will be set at an elevation 505 feet above mean sea level (msl), which will periodically inundate the SARI pipelines near the dam by approximately 30 feet of water. The Corps will adjust the pool elevation seasonally to provide flood protection during the winter months and groundwater recharge during the summer. Over the next 30 years, the sediment deposition behind the dam is expected to rise 20 feet. This will result in inundation of greater lengths of pipeline for longer periods of time, which will restrict access to the pipeline for all or most of the year. Increased sedimentation will also restrict access to the pipeline by covering the existing manholes. As a result of the Corps Prado Dam improvements, further inundation and sedimentation pose increased risks of pipeline failure due to increased stress on the pipe. Since the SARI line carries both wastewater and brine, a breach in the SARI line would pose a serious threat to the Prado Basin, resulting in salt and bacterial contaminant pollution of the river channel, ground water, and ocean. An initial feasibility study was prepared by SAWPA to evaluate options to repair/replace and/or relocate portions of this section of the SARI line (completed in June 2008).

1.2. Project Description

The SARI line carries primarily saline, non-domestic wastewater from industrial discharge, power plants, and municipal desalter facilities. Previous surveys of the interior pipelines have identified evidence of decay and bio-growth which inhibits the flow of water through the pipe. A number of the joints within the pipeline have been found to leak. The project proposes to rehabilitate segments of the existing pipeline to extend the service life of the Reach IV-A and Reach IV-B pipelines and meet the new loading conditions created by raising the height of the Prado Dam. SAWPA staff considered a number of factors during the planning process for rehabilitation of the pipeline. These factors included the environmental impact, operational conflicts with Prado Dam, right-of way acquisition, risk, construction cost, mitigation and permitting requirements, structural capacity, hydraulics, and operation and maintenance cost. Based consideration of these factors, SAWPA proposes to repair the existing pipeline in place using slip-line and cured in place pipe (CIPP) methods.

Repair-in-place options consist of pipeline repair techniques that do not require new or additional trenching to replace existing pipelines. Repair-in-place techniques repair existing pipelines within the same alignment. Once the repairs are complete, the pipeline would remain underground and no long-term recurring impacts are anticipated.

Live Stream Slip-Line of the Existing Pipeline (Segmental Pipe Liner)

This method proposes to insert a slip-line into the pipe without interrupting the service of the existing pipeline or installing any external bypass pumping requirements. At specific intervals along the pipeline, an access opening will be cut into the top of the pipe. The new pipe would be inserted into the existing pipeline followed by additional pipe segments. As each new segment is installed, the pipe will be pushed downstream to make room for the next pipe segment. Depending on the existing pipeline’s horizontal and vertical alignments, insertion points can be spaced up to 2,000 linear feet apart. Each insertion point will require approximately 0.5 acre of disturbance to allow for construction equipment to access the insertion pit. The new pipe would be structurally designed to withstand anticipated sediment and external water level loading conditions. The pipeline’s corrosion resistant and structural properties would provide an expected 50-year service life.

Cured-in-Place Pipe (CIPP) Liner of the Existing Pipeline

Under this alternative, a liner coated with a vinyl ester epoxy resin is inserted into the existing pipeline. The liner tube will be inserted into the pipeline at each manhole and pushed into place using water pressure. Once in place, the water in the tube is heated to activate the resin. This process creates a firm corrosion-resistant pipe that closely matches the internal diameter of the existing pipeline. The pipeline's corrosion resistant and structural properties would provide an expected 50-year service life. This process cannot be completed with the existing pipeline in service. The proposed segments for rehabilitation using CIPP are located within existing roads. A bypass pumping system is required to divert flow around the individual work area.

The majority of the pipeline of Upper Reach IV-A is located outside of the dam inundation area. The pipeline is located within existing right-of-way, and in most places within city streets or existing maintenance roads. The existing manholes are not covered with sediment and wetland vegetation and habitat disturbance is not required for access. As a result, the CIPP option will be used for Upper Reach IV-A.

1.3. Project Characteristics

Most of the impacts associated with the project would occur during the project construction phase. The slip-lining repair method will require a 20-foot temporary access road to be constructed adjacent to the existing pipeline for construction vehicles and pipeline supply trucks. In most places along the pipeline, there is an existing, previously established 10-foot wide access road. Of the 20 feet needed for the temporary access road, 10 feet will be allowed to naturally restore back to its previous natural condition, and 10 feet (mostly the existing access roads) will remain. The 10-foot access road will remain for service personnel to access the pipeline for maintenance and inspections. Additionally, clearing around each manhole with an approximate 50-foot radius will be required. These impacts will be temporary as the impacts are limited to the construction phase only. The-repair-in-place techniques proposed for this project do not include horizontal directional drillings. All repairs will take place within the existing pipelines and occurrences such as "frac-outs," which take place when pressurized slurry mixtures are forced up through the ground surface, are not a concern with the proposed project. The CIPP repair method requires access to the pipeline through existing manholes. Considering that most of the pipeline proposed for CIPP repair is located in existing right-of-ways, no vegetation removal will be required.

Live Stream Slip-Line of the Existing Pipeline (Segmental Pipe Liner)

For each insertion point for the live stream slip-lining a 0.5-acre construction staging area will be required at each insertion pit. For purposes of identifying impacts, the construction staging areas are assumed to be in a 150 feet by 150 feet (0.5 acre) configuration. The exact dimensions of each work area, however, are not limited to a 150 x 150-foot configuration and can be modified to minimize or possibly avoid impacts to a particular resource. Regardless of the dimensions used, the construction staging areas will not exceed 0.5 acre. Clearing around each manhole with an approximate 50-foot radius will be required for access into the pipeline.

The live stream slip-lining process is completed as follows:

1. A shored and lined construction pit is excavated around the existing pipeline. The top half of the pipeline is cut out to expose the flow and provide access into the existing pipeline. A slip-liner rig, consisting of a pipe elevator and hydraulic jack, is then installed within the pit.
2. A section of slip-liner pipe is then installed on the pipe elevator and lowered into position.
3. The liner is mated with the adjacent pipe joint and pushed into the existing pipeline with a hydraulic jack on the slip-liner rig.
4. This process continues until the receiving pit is reached. Push-lengths of up to 5,000 feet have been successful and are dependent upon the pipeline slope, horizontal and vertical curves within the alignment, and the total overall weight to be pushed and the friction to be overcome within the host pipe.
5. The annular or remaining space between the liner pipe and the existing pipe is filled with a pressure grout.
6. The construction pit is dewatered and is typically reconstructed as a manhole.

The slip-liner rig will be powered by a 50-horsepower diesel generator. The generator will run for approximately 10 hours per day when the slip-lining activity is in progress. Other construction equipment will consist of: construction vehicles that will clear and remove vegetation, a pipe cleaner truck (for the existing pipeline), semi-trucks that will bring pipe supplies to the job site, a fork lift to unload supplies from the truck, a water truck, a fuel truck for the generator (approximately one every two days) and a daily construction crew of approximately ten personnel.

Cured-in-Place Pipe (CIPP) Liner of the Existing Pipeline

The CIPP process will be conducted at each manhole, within SAWPA's existing pipeline easements. Clearing around the manholes, within these easements may be required for access to the manhole; excavation may be required if the manhole is covered with silt. The CIPP process requires a flow bypass system to be in place prior to installation of the CIPP liner as described for the non-live stream continuous pipe repair.

The typical CIPP process for a sanitary sewer installation is as follows:

1. The felt tube liner is cut at the factory into specific lengths corresponding to the length of each pipe reach (manhole to manhole) to be lined.
2. The felt tube is impregnated with resin designed to meet the specific conditions of the waste stream and the structural requirements of the project.
3. The liner is then trucked to the job site where it is inserted into the manhole and pushed through the host pipe with water pressure. The host sewer pipe must be

thoroughly cleaned prior to the insertion and all existing flow, and flow from connecting laterals, must be diverted around the pipe reach being lined.

4. The felt tube expands into the host pipe conforming to the interior walls of the pipe and is designed to extend between two adjacent manholes.

5. Once the tube is fully inserted, the water inside the tube is heated to activate the resin. The resin cures to create a felt-reinforced, corrosion-resistant liner.

6. The final step is to use a remote controlled lateral cutting device to reopen all lateral service connections and install a lateral “top hat” which is a short stub that fits into the lateral pipeline while the brim of the top hat is secured to the inner wall of the new liner.

For the CIPP process, one supply truck for each manhole segment will be required to provide the liner and resins. Depending on the outside temperature, a refrigeration truck may be required to prevent the heat-activated resins from activating prematurely. A fork lift will also be required to unload supplies off of the truck. Other construction equipment will consist of construction vehicles that will clear and remove vegetation, a pipe cleaner truck (for the existing pipeline), a water truck, a fuel truck for the generators (approximately one every two days) and a daily construction crew of approximately ten personnel.

Chapter 2. Biological and Regulatory Background

2.1. Listed and Sensitive Species Potentially in the Biological Study Area

Background information was gathered prior to visiting the proposed project alignment in order to determine which species could be expected to occur in the project area. This background check included a search of the CDFG's Natural Diversity Database (CNDDB) and a review of data gathered from various biological surveys previously conducted in the vicinity of the project site. The primary bodies of literature used for background information include the following sources: 2008 Least Bell's Vireo Survey Data provided by the Orange County Water District; August 2008, Initial Study for the Santa Ana Regional Interceptor Pipeline Reach IV-B, Prepared RBF, Consulting; November 2001, Supplemental Final EIR/EIS for the Prado Basin and Vicinity, Including Reach 9 and Stablilization of the Bluff Toe at Norco Bluffs, ACOE.; August 2008, Fish Protection Activities at Prado Dam, Corona, CA, prepared by San Marino Environmental Associates.

A general biological resources assessment was conducted for the entire project alignment by TDA Biologists, Shay Lawrey and Lisa Tollstrup on October 11th & 20th, 2008 and November 2nd, 2008. Additional surveys for burrowing owl were conducted between November 15 and 22, 2009. The evaluations determined that there is a potential for several sensitive species to occur in reach IV-B and in portions of reach IV-A. An impact analysis to biological resources is detailed in the sections below.

According to the CNDDB, 38 sensitive species and 3 sensitive habitat communities have been documented to occur in the Prado Dam and Corona North - USGS 7.5-minute series quadrangles (Appendix A). Of the 38 species identified to have potential to occur within the vicinity of the project area, six (6) species are considered present: long-eared owl [*Asio otus*], Santa Ana sucker (SASU) [*Catostomus santaanae*], yellow warbler [*Dendroica petechia brewsteri*], southwestern willow flycatcher (SWWF) [*Empidonax traillii extimus*], yellow-breasted chat [*Icteria virens*] and least Bell's vireo (LBVI) [*Vireo bellii pusillus*].

Seven (7) species have a moderate to high occurrence potential: southwestern pond turtle [*Actinemys marmorata pallida*], orange-throated whiptail [*Aspidoscelis hyperythra*], burrowing owl (BUOW) [*Athene cunicularia*], tricolored blackbird [*Agelaius tricolor*], western yellow-billed cuckoo (YBCU) [*Coccyzus americanus occidentalis*], arroyo chub [*Gila orcuttii*] and white rabbit-tobacco [*Pseudognaphalium leucocephalum*].

There is marginally suitable habitat along the alignment capable of supporting eight (8) other sensitive species: southern California rufus-crowned sparrow [*Aimophila ruficeps canescens*], grasshopper sparrow [*Ammodramus savannarum*], Bell's sage sparrow [*Amphispiza belli belli*], golden eagle [*Aquila chrysaetos*], Santa Ana River woollystar

[*Eristrum densifolium* var *santorum*], western mastiff bat [*Eumops perotis californicus*], western yellow bat [*Lasiurus xanthinus*], coastal California gnatcatcher [*Polioptila californica californica*].

The three sensitive habitat types within or in the vicinity of the project area are the Southern California Arroyo Chub/Santa Ana Sucker Stream, Southern Cottonwood Willow Riparian Forest, Southern Willow.

The project alignment is located within the critical habitat designated for the LBVI (Appendix B).

2.2. Regulatory Framework and Requirements

The project site is located within the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP requires consistency with all plan policies. The policies relevant to this project include the Riverine/Riparian/Vernal Pools Policy and the Urban/Wildland Interface Policy. Since this project proposes impacts to riverine-riparian areas, a Determination of Biologically Equivalent or Superior Preservation (DBESP) document and an MSHCP Consistency Analysis have been prepared.

The project will result in temporary impacts to the Santa Ana River at Prado Dam. The Santa Ana River is tributary to the Pacific Ocean and falls under the jurisdictions of the Corps, Regional Water Quality Control Board (RWQCB), and the California Department of Fish and Game (CDFG).

U.S. Fish and Wildlife Service

As indicated in the preceding detailed discussion of individual species, the project site is located within the broad area designated by the U.S. Fish and Wildlife Service (USFWS) as critical habitat for the LBVI. Furthermore, the site is occupied by LBVI as well as the SWWF and SASU. The USFWS determined the endangered status for the LBVI (1986), and SWWF (1995), and threatened status of the SASU pursuant to the provisions of the Endangered Species Act of 1973, as amended (Act). These species are highly specialized animals that have evolved in dynamic riverine regimes, where seasonal and annual rainfall fluctuations, flooding, and drought are common.

Federal Endangered Species Act

The USFWS administers the federal Endangered Species Act (ESA) of 1973. The ESA provides a legal mechanism for listing species as either threatened or endangered, and a process of protection for those species listed. Section 9 of the ESA prohibits "take" of threatened or endangered species. The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct. "Take" can include adverse modification of habitats used by a threatened or endangered species during any portion of its life history. Under the regulations of the ESA, the USFWS may authorize "take" when it is incidental to, but not the purpose of, an otherwise lawful act. Take authorization can be obtained under Section 7 or Section 10 of the ESA.

The ESA requires Federal agencies to insure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species, or destroy or adversely modify its critical habitat, if any is designated. Activities requiring Federal involvement (such as a Section 404 permit under the Clean Water Act) that may affect an endangered species on federal or private land must be reviewed by the USFWS who will determine whether or not the continued existence of the listed species is jeopardized.

Migratory Bird Treaty Act

The USWFS also affords protection to migratory birds through the Migratory Bird Treaty Act (MBTA). The MBTA protects all resident and migratory wild birds found in the United States, except the house sparrow, starling, feral pigeon, and resident game birds. Resident game birds are managed separately by each state. The MBTA makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import or export any migratory bird including feathers, parts, nests or eggs.

Army Corps of Engineers

The Corps regulates discharges of dredged or fill material into *waters of the United States*. These *waters* include wetlands and non-wetland bodies of water that meet specific criteria. The Corps regulatory jurisdiction pursuant to Section 404 of the Federal Clean Water Act (CWA) is founded on a connection, or *nexus,* between the water body in question and interstate commerce. This connection may be direct, through a tributary system linking a stream channel with traditional navigable waters used in interstate or foreign commerce, or may be indirect, through a nexus identified in the Corps regulations.

Regional Water Quality Control Board

The RWQCB's regulatory jurisdiction is pursuant to Section 401 of the Federal CWA. The RWQCB typically regulates discharges of dredged or fill material into *waters of the United States*, however they also have regulatory authority over waste discharges into Waters of the State, which may be isolated, under the Porter-Cologne Water Quality Control Act issued by the State Water Resources Board. In the absence of a nexus with the Corps, the Regional Board requires the submittal of a Waste Discharge Requirement (WDR) application, which must include a copy of the project Stormwater Pollution Prevention Plan (SWPPP) and a copy of the project Water Quality Management Plan (WQMP), otherwise called a Standard Urban Stormwater Management Plan (SUSMP). The Regional Board's role is to ensure that disturbances in the stream channel do not cause water quality degradation. As in the case with the CDFG, the Regional Board will not begin processing the WDR application until after the California Environmental Quality Act (CEQA) document is approved.

California Department of Fish and Game

Unlike the Corps, CDFG regulates not only the discharge of dredged or fill material, but all activities that alter streams and lakes and their associated habitat. The CDFG, through provisions of the California Fish and Game Code (Sections 1601-1603), is empowered to issue agreements for any alteration of a river, stream, or lake where fish or wildlife resources may be adversely affected. Streams (and rivers) are defined by the presence of a channel bed and bank, and at least an intermittent flow of water. The CDFG typically extends the limits of their jurisdiction laterally beyond the channel banks for streams that support riparian vegetation. In these situations the outer edge of the riparian vegetation is generally used as the lateral extent of the stream and CDFG jurisdiction. CDFG regulates wetland areas only to the extent that those wetlands are a part of a river, stream, or lake as defined by CDFG. While seasonal ponds are within the CDFG definition of wetlands, they are not part of a river, stream, or lake, and may, or may not, be subject to the jurisdiction of the CDFG under Sections 1601-1603 of the Fish and Game Code.

The California Department of Fish and Game (CDFG) administers the California Endangered Species Act. The State of California considers an endangered species one whose prospects of survival and reproduction are in immediate jeopardy. A threatened species is likely to become an endangered species in the near future in the absence of special protection or management, and a rare species is one that may become endangered if its present environment worsens. Rare species applies to California native plants. Species that are fully protected by California include those protected by special legislation for various reasons, such as the California condor. There is no incidental take allowed for fully protected species. Species of Special Concern is an informal designation used by CDFG for some declining wildlife species that are not proposed for listing as threatened or endangered, such as the burrowing owl. This designation does not provide legal protection, but signifies that these species are recognized as sensitive by CDFG.

In coordination with the USFWS the CDFG also administers the MBTA which provides protections for nesting birds that are both residents and migrants, whether or not they are considered sensitive by resource agencies. The CDFG code 3503 makes it illegal to destroy any birds' nest or any birds' eggs. Code 3503.5 further protects all birds in the orders Falconiformes and Strigiformes (Birds of Prey, such as hawks and owls) and their eggs and nests from any form of take.

2.3. Studies Performed

The Prado Basin is surveyed on an annual basis by the OCWD. Biologists from the OCWD conducted focused/protocol LBVI and SWWF surveys within the project area in the Spring of 2008. As part of the Prado Dam reconstruction being conducted by the Corps, fish relocation was necessary. In 2008 a team of qualified and authorized biologists surveyed for, and relocated, SASU that lived near the dam inlet and outlets. Data from these survey efforts show that the project area and nearby vicinity are occupied by LBVI, SWWF and SASU. Furthermore, results from recent surveys, as confirmed by the CNDDB, show that long-eared owl, yellow warbler, yellow-breasted chat and southwest pond turtle also occur in the project area and near vicinity. Historically, YBCU have been observed, in low numbers in Prado Basin, but not since 2000.

2.4. Professional Contacts

TDA Biologist Shay Lawrey requested information regarding biological resources known in the Prado Dam area from the following professional contacts:

Nancy Ferguson, U.S. Fish & Wildlife Service
Christine Medack, U.S. Fish & Wildlife Service
Leslie MacNair, Department of Fish and Game
Jeff Brandt, California Department of Fish and Game
Raul Rodriguez, California Department of Fish and Game
Dick Zembal, Orange County Water District
Garr Abs, U.S. Forest Service
Jonathan Baskin, San Marino Environmental Associates
Gerald Braden, San Bernardino County Museum of Natural History

Chapter 3. Environmental Setting

3.1. Regional Setting

The proposed project is located in Prado Basin within the floodplain of the Santa Ana River. The Santa Ana River is the largest stream system in southern California, beginning in the San Bernardino Mountains, reaching elevations exceeding 10,000 feet and flowing approximately 100 miles to the Pacific Ocean near Huntington Beach. The Santa Ana River floodplain contains, among other habitat types, riparian forest habitat, which is a regionally significant habitat type confined to river and creek floodplains.

A healthy riparian habitat community occurs throughout the Santa Ana River floodplain along the valley floor, where the water table is high and/or there is year-round water flow. The Santa Ana River drains southwest towards the Prado Dam. Several natural and channelized drainage courses connect with the Santa Ana River. In addition to their fundamental water related functions, these watercourses provide corridors through developed land and link open spaces together.

The riparian habitat within the Santa Ana River floodplain is a dynamic community that is dependent upon periodic flooding. Winter flows create areas of scour and sedimentation that cycle the community back to earlier successional stages. Periodic floods of large magnitude, and migration of the river channel, lay down fresh alluvial deposits where seeds can germinate and propagules can take root. The riparian plants are able to spread by seed and rhizomes, rapidly invading exposed sand or gravel bars. In the absence of flooding for 15 to 20 years, willow woodland will eventually emerge. Further back in the floodplain, at slightly higher elevations, dense riparian forests can develop with an overstory averaging 70 feet in height. The roots of the riparian trees that have been established within the Santa Ana River system, have tapped into the permanent water table. The deep tap roots enable these trees to compensate for dry summers. The canopy structure of this riparian forest has a complex architecture and its understory consists of layers of shrubs, herbs and vines. In the absence of flooding, high levels of moisture in the soil promote the survival of the young trees through their first year and as these seedlings mature the river continues to deposit sediment on the floodplain. This sediment deposition builds the river terraces and, as they are elevated, other plant species colonize resulting in further diversification in the floodplain community.

The dynamic hydrologic regime contributes to the habitat's structural diversity and high wildlife value. More species of birds nest in riparian forest than in any other California plant community. In addition to this, 25% of California's land mammals depend on the riparian habitat.

3.2. Habitat Communities in the Project Area

The proposed action area of Reach IV-B and the southern half of Reach IV-A traverse vacant, public land designated as flood control, water conservation and open space. Patches of agricultural, industrial and commercial land uses flank Reach IV-A, north of the Prado Dam inundation area.

Prado Basin is dominated by flood plain riparian plant communities, with upland habitats primarily restricted to the perimeter of the Basin. The hydrological conditions in the project area promote the establishment of riparian vegetation. A freshwater marsh habitat component is also present in the project area because standing water is seasonally abundant in the Prado Basin upstream of the Prado Dam.

The present biological condition of Prado Basin was created by the construction of Prado Dam in 1941. Prado Dam was built where Chino Creek, Cucamonga Creek (also known as Mill Creek, south of Pine Avenue) and Temescal Wash have their confluence with the Santa Ana River. Due to a combination of the high groundwater table, storm flow accumulation held in the reservoir, sewage treatment plant effluent and irrigation runoff, a resultant perennial river flow exists that has created and sustains the extensive wetland habitat in the Basin. Presently, the riparian woodlands in the Basin comprise the largest single stand of this habitat in southern California. Prado Basin supports a myriad of habitat types, including but not exclusive to cottonwood/willow riparian forest, riparian scrubland, herbaceous riparian, freshwater ponds, freshwater marsh, riverine, sandy wash, fallow fields, agricultural land, ruderal, coastal sage scrub, and oak woodland.

The riparian habitat within the project area is in various seral stages and generally consists of tall, multilayered, open, canopy riparian forests. The dominant vegetative species within this riparian forest include: Eucalyptus, Freemont cottonwood (*Populus fremontii),* black cottonwood, (*P. tremuloides*) and several tree willows (*Salix* spp). Characteristic species, in addition to the eucalyptus and cottonwood, include black willow (*S. goodingii*) narrow-leved willow (*S. exigua*), arroyo willow (*S. lasiolepis*), red willow (*S. laevigata*), sandbar willow (*S. hindsiana*), mulefat (*Baccharis salicifolia*) Sycamore (*Platanus recemosa)* and elderberry *(Sambucus mexicana).*

In addition to the riparian community, there are also freshwater marsh, eucalyptus groves, coastal sage scrub, riverine, grassland, and ruderal communities found within the project area. Cattails and reeds are the dominant species within the freshwater marsh habitat. Also within reach IV-B, stands of eucalyptus, intermixed with the riparian woodland, extend between manholes 4B-0020 and 4B-0090, east of the dam spillway to the Corona airstrip. Patches of coastal sage scrub are located along Reach IV-A between manholes 4A-0010 and 4A-0120, along the embankment between Highway 71 and the western edge of the reservoir. Manholes 4A-0000 and 4B-0010 are located in Riverine habitat. Grassland, bare ground, and ruderal habitat is found in Reach IV-A between manholes 4A-0010 and 4A-0610. For Reach IV-B these habitats are found between manholes 4B-0100 and 4B-0220. These particular sections of the pipe alignments are located along disturbed roadsides. The ruderal vegetation in these areas include barley *(Hordeum* spp.) fescue *(Vulpia myuros)* short-podded mustard, horehound *(Marrubium vulgare),* filaree *(Erodium* spp.), and doveweed *(Eremocarpus serigerus).* Please refer to Appendix C for site photos.

3.3. Physical Conditions

The site is essentially flat with a slope to the southwest at about a 1.5-percent slope. The elevation at the project area averages about 515 feet above mean sea level. The local climate is characterized by hot summers, mild winters and rainfall, which occurs almost entirely in the winter and early spring months. The average annual rainfall is about 19 inches. The climate is somewhat affected by the moderating effects of the Pacific Ocean. Average temperatures range from a minimum of 39 degrees Fahrenheit in January to an average of 91 degrees Fahrenheit in July. Winds occur from all directions, and onshore winds from the west/southwest occur during the day. At night, wind patterns reverse with an offshore flow generally coming from the east/northeast.

3.4. General Wildlife Resources in the Project Area

The riparian forest in the Prado Basin is noted for its very high bird species diversity and abundance. Neotropical migrants depend on the deciduous trees and shrubs for foraging during migration. The mature trees provide numerous cavities for cavity-dependent wildlife and the tall trees are used by nesting raptors. The emergent vegetation rooted at the water's edge provides escape cover, shade and food for fish.

The wildlife resources in Prado Basin are important due, in part, to their high diversity and the large numbers of certain wetland species that occur there. The extensive and continuous riparian woodland, unique for southern California, supports a number of rare and declining species, particularly birds. A robust raptor population occurs within the project area. The raptors have a wealth of resources to draw on for foraging and nesting. They use the tall eucalyptus for nesting, roosting and perching. There are records of eleven raptor species breeding successfully in Prado Basin, including the white-tailed kite *(Elanus leucurus)*, Cooper's hawk, golden eagle *(Aquila chrysaetos),* western screech-owl *(Otus asio),* and long-eared owl *(Asio otus*). A moderate number of raptor species from other regions winter in Prado Basin along with the resident raptors. Two of the rarer wintering raptor species include the peregrine falcon *(Falco peregrinus)* and merlin *(Falco columbarius).*

The double-crested cormorant *(Phalacrocorax auritus),* great blue heron *(Ardea herodias),* and blackcrowned night-heron *(Nycticorax nycticorax)* are conspicuous breeders among the larger water birds. The tree swallow *(Tachycinera bicolor)* is abundant locally, especially in the vicinity of dead trees with cavities where it nests. The red-winged blackbird *(Agelaius phoeniceus)* and marsh wren *(Cistothorus palustris)* are locally abundant nesters, as is piedbilled grebe *(Podilymbus podiceps),* ruddy duck *(Oxyura jamaicensis),* and American coot *(Fulica americana).* The mallard *(Anas platyrhynchos)* and cinnamon teal *(Anas cyanoptera)* are more widely scattered. Shorebirds known to nest in the Basin include: the killdeer *(Charadrius voci/erus),* American avocet *(Recurvirostra americana),* black-necked stilt *(Himantopus mexicanus),* and spotted sandpiper *(Actitis macularia).* Marsh-nesting birds include: the American bittern *(Botaurus lentiginosus),* Virginia rail *(Rallus limicola),* common moorhen *(Gallinula chloropus),* common yellowthroat, song sparrow, and tricolored blackbird *(Agelaius tricolor).*

Species that nest in the eucalyptus groves include: the Anna's hummingbird *(Calypte anna),* northern flicker *(Colaples auratus),* Cassin's kingbird *(Tyrannus vociferans),* American crow, European starling, Bullock's oriole *(Icterus bullockii),* and house finch. Nests of the red-tailed hawk *(Buteo jamaicensis)* and red-shouldered hawk are regularly found in the eucalyptus trees as well, probably because they are often the tallest trees available. Oriole and kingbird nests are locally concentrated in eucalyptus trees. The commonly encountered winter visitors in the riparian forests are the ruby-crowned kinglet *(Regulus calendula),*white-crowned sparrow *(Zonotrichia leucophrys),* American pipit *(Anthus rubescens)* and savannah sparrow *(Passerculus sandwichensis)*.

Winter concentrations of waterfowl in the Prado Basin are at least as large as those on any of the southern California coastal lagoons, and the Basin may hold the largest wintering populations of some species. The wintering waterfowl resources in the Basin are vast and are exploited by several waterfowl hunt club operators. Sixteen species of waterfowl have been found in the Basin, many numbering in the thousands. The most abundant are green-winged teal *(Anas clecca),* mallard, cinnamon teal, Northern shoveler *(Anas clypeata),* American wigeon *(Anas americana),* ring-necked duck *(Aythya collaris), a*nd ruddy duck.

Twenty-three species of mammals including three non-native species have been observed in the Prado Basin. Six species of mammals found in the Basin are listed in the California Hunting Regulations with seasons and limits set by the State Fish and Game Commission. The mule deer is a big game animal, the Audubon cottontail and black-tailed jackrabbit *(Lepus califomicus)* are resident small game animals, the gray fox *(Urocyon cinereoargenteus)* and raccoon are fur-bearing mammals, and the bobcat is a regulated non-game mammal.

There are seven amphibians species known to occur in the Prado Basin and surrounding areas (Glaser 1970, Robertson and Shipman 1974, and Zembal *et al.* 1985). The bullfrog *(Rana catesbeiana),* and African clawed frog *(Xenopus laevis)* are two invasive, non-native species commonly observed in the basin. There are 13 reptile species documented in the basin. The western fence lizard is the most frequently encountered reptile within the Basin. The side-blotched lizard is concentrated in upland areas. The western whiptail *(Cnemidophorus tigris)* is also found primarily in upland scrubland habitats around the perimeter of the Basin. The western skink *(Eumeces skiltonianus)* inhabits remnant scrublands. The gopher snake *(Piruophis melanoleucus)* is the snake most frequently observed in the Basin and is found in both uplands and in drier riparian habitats.

At least 15 species of fish have been found in the Prado Basin within the Santa Ana River. Most of these occur in the affected area, at least seasonally. Two, the SASU and arroyo chub, are native to southern California; the rest are non-native introductions. According to Cam Swift, the most abundant species in the Basin are the flathead minnow and mosquitofish. These two, along with the carp *(Cyprinus carpio),* comprise about 95 percent of all fish species in the Basin (Swift unpubl. data).

Common wildlife in the project area include coyote (*Canis latrans*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), rattlesnake (*Crotalus* sp), western fence lizard (*Sceloporus occidentalis*), desert wood rat (*Neotoma lepida*), and deer mouse (*Peromyscus maniculatus*).

3.5. Species of Concern Present in the Project area.

All of the sensitive species identified as occurring within the Corona North and Prado Dam Quadrangles in the CNDDB are evaluated in Table 1 in Section VI Results. Further discussion of the state and/or federal threatened or endangered species or species of special concern identified as potentially occurring on the site is provided below. Critical habitat for all species identified as occurring within these two quadrangles is also discussed.

Of the 38 species identified to have potential to occur within the vicinity of the project area six (6) species are considered present, including: the long-eared owl, SASU, yellow warbler, SWWF, yellow-breasted chat and LBVI.

The **Long-eared Owl** is a medium-sized woodland Owl. They have prominent ear tufts that appear to sit in the middle of the head and are usually held erect. Plumage is brown and buff, with heavy mottling and barring over most of the body. The eyes are golden yellow, facial disk pale ochraceous-tawny to rufous. The bill is black. The forehead and lores are mottled grey and white and there is a white chin patch. The legs and feet are heavily feathered. Body feathers are tipped with greyish white.

This owl is nocturnal, with activity normally beginning at dusk. They appear slim and slouch forward when perched. Long-eared Owls are buoyant fliers, appearing to glide noiselessly even when their wings are flapping. They are very maneuverable and can fly through fairly dense brush. They fly moth-like, often hovering and fluttering while looking for prey. When roosting, a Long-eared Owl will stretch its body to make itself appear like a tree branch. The main advertisement call of the male is a low "*hoo, hoo, hoo, hoo*, ...", repeated 10 to 200 times, with one note every 2 to 3 seconds. The female responds with a raspy buzz call, and often duets with the male. When alarmed, Long-eared Owls bark "*whek-WHEK-whek*" or shriek like a cat. Both males and females hiss during exchange of prey or when alarmed. Long-eared Owls hunt mainly by ranging over open rangeland, clearings, and fallow fields. They rarely hunt in woodlands where they roost and nest. Long-eared Owls sometimes eat insects, frogs, and snakes.

Long-eared owls nest almost exclusively in old stick nests of crows, ravens, hawks, or herons. Nests are almost always located in wooded sites, often screened by shrubbery, vines, or branches and are commonly 5 to 10 meters (16 to 33 feet) above ground. Long-eared Owls have an impressive nest defense display - the female spreads her wings out widely facing the intruder, flares her flight feathers, and lowers her head. This display makes her appear 2 to 3 times as large as she really is. They will occasionally attack viciously, aiming the talons at the face and throat of the intruder.

Long-eared Owls inhabit open woodlands, forest edges, riparian strips along rivers, hedgerows, juniper thickets, woodlots, and wooded ravines and gullies. Breeding habitat must include thickly wooded areas for nesting and roosting with nearby open spaces for hunting. Roosting sites are usually in the heaviest forest cover available. Unlike most other owls, during winter they may roost communally (7 to 50 owls) in dense thickets and range over very large undefended foraging areas. Communal roost sites are often used year after year, probably by the same birds. Long-eared Owls are widely distributed in North America, Eurasia and northern Africa.

Santa Ana sucker is a sucker found only in a handful of rivers in southern California. They are closely related to mountain suckers, and quite similar in appearance. Color is dark grey above and silvery-white below; the sides have a faint pattern of darker blotches and stripes. There are distinct notches where the upper and lower lips meet, and the lower lip is narrower in the middle, with only 3 or 4 rows of papillae at that point. The dorsal fins have 9 to 11 rays, while the pelvic fins have 8 to 10 rays. The caudal peduncle is somewhat longish. In contrast to the mountain sucker, the membrane between the rays of the tail fin is pigmented. Length has been recorded up to 25 cm, but less than 16 cm is more typical.

Also like mountain suckers, they feed on diatoms, other kinds of algae, and detritus, which they get by scraping surfaces such as rocks. They also eat the occasional insect larva, with larger fish observed to consume insects more frequently. These suckers live in smaller (under 7 m wide) permanent streams, with depths from a few cm to over a meter. The water must be cool, but the flow may be variable; they seem to prefer clear water, but tolerate turbidity. Not surprisingly given their feeding method, they prefer gravel, rubble, and boulder substrates.

Their range is extremely restricted; they are native only to the Los Angeles, San Gabriel, Santa Ana, and Santa Clara River systems in southern California. Populations have been lost from several parts of the rivers, so that they now only live in the upper portion of the Los Angeles and San Gabriel drainages, and the lower part of the Santa Ana River, especially areas with additional water effluent from sewage treatment plants. Although some stretches of the referenced rivers are protected by being in the Angeles National Forest, the coincidence of this fish's range with the Los Angeles metropolitan area means that it is vulnerable to extinction. Critical habitat designations for this species were proposed and published January 4, 2005 (70 FR 426).

The **southwestern willow flycatcher** is a small passerine bird measuring approximately 5.7 inches in length. It has a grayish-green back and wings, whitish throat, a light gray-olive breast, and pale yellowish belly. It has two visible white wing bars and a faint or absent eye ring. The call consists of a repeated “whit” and their song is a sneezy “fitz-bew.” (60 FR 10694). The southwestern willow flycatcher is currently one of the four recognized subspecies of the willow flycatcher. This flycatcher is a neotropical migrant that breeds in the southwestern United States from mid-April to early-September. In the fall, it migrates south to its wintering grounds in portions of South America, Central America and Mexico. (60 FR 10694)

A rapid decrease in the numbers of southwestern willow flycatchers in California and other southwestern states prompted the USFWS to designate it as a Category 1 candidate species in 1991. One year later in 1992, the California Fish and Game Commission listed the species as endangered, under the California Endangered Species Act (CESA) of 1970. On July 23, 1993 the southwestern willow flycatcher was proposed for listing as endangered by the USFWS and was then listed as Federally endangered on February 27, 1995, under the Endangered Species Act (ESA) of 1973 (60 FR 10694). The USFWS designated critical habitat for the species on July 22, 1997. This habitat includes 18 units with a total of 599 miles of river in California, New Mexico, and Arizona. In California, critical habitat was designated along portions of the Santa Ana River, San Luis Rey River, San Diego River, Santa Margarita River, Tijuana River, and south fork of the Kern River (62 FR 39129). On May 11, 2001, the critical habitat designation from 1997 was struck down by the U.S. 10th Circuit Court of Appeals who required further economic analysis. A recovery plan was finalized by USFWS in March of 2003. Critical habitat designations for this species were re-proposed and finalized in June 2004 (USFWS, 2003c).

The southwestern willow flycatcher breeds in dense riparian habitats along rivers, streams, and other wetlands. They have been documented to establish territories in elevations ranging from sea level to 8,500 feet (Sogge 1997). Plant species closely associated with the flycatcher include willows (*Salix* spp.), boxelder (*Acer negungo*), seepwillow *(Baccharis* spp.), with an overstory of cottonwood (*Populus fremontii*) (62 FR 39129). Occupied habitat is generally dominated by shrubs and trees 13 to 23 feet or more in height, which provide dense lower and mid-story vegetation approximately 13 feet aboveground. This dense vegetation is often interspersed with open water, small openings, or sparse vegetation, creating a mosaic that is not uniformly dense (62 FR 39129).

The **yellow warbler** occurs in riparian areas throughout Alaska, Canada, the United States, and parts of Mexico. A tropical subspecies occurs in Central and South America. The yellow warbler prefers wetlands and mature riparian woodlands dominated by cottonwoods, alders, and willows. It also uses well-watered, second growth woodlands and gardens. The yellow warbler winters south to the Bahamas, Central America and South America to Peru, Bolivia, and Brazil. The species breeds throughout the United States and Canada. The population is fluctuating in North America: declining in some areas and increasing in others. It was once a common to locally abundant summer resident in riparian areas throughout California. The yellow warbler has declined significantly as a breeding bird in the coastal lowlands of southern California and is believed to be extirpated from the Colorado River. Destruction of riparian habitats and cowbird parasitism are the major causes of the decline.

The yellow warbler typically arrives from their wintering areas from late March to May. It tends to nest in locations of intermediate height and shrub density. The nest is built in an upright fork or crotch of a large tree, or sometimes a sapling or bush, generally 6 to 8 feet above the ground. The nest is a well-formed cup of interwoven plant fibers and down, fine grasses, lichens, mosses, spider's silk, hairs, etc. Usually 4 to 5 eggs are laid in spring or early summer. Incubation is 11 days, and the young leave the nest at 9 to 12 days old. The yellow warbler feeds on caterpillars, cankerworms, moth larvae, bark beetles, borers, weevils, small moths, aphids, grasshoppers, and spiders, and occasionally feeds on a few species of berries.

The **yellow-breasted chat** Grinnell and Miller (1944) reported that chats bred over the entire length and breadth of the state exclusive of higher mountains and coastal islands, and were more numerous toward the interior. Breeders arrive from April to early May. Departure from breeding grounds occurs from August – September (after complete prebasic molt); some may leave in July, some stragglers into October. Spring migration: March - May. Fall migration: July - October. Poorly documented due to the species' secretive nature; it goes largely undetected once singing ceases in mid-July (Dunn and Garrett 1997). Delacour (1959) reported the capture of an adult chat in Los Angeles on 5 December 1958. Dunn and Garrett (1997) report that western birds appear to move south during fall migration on a broad front, although migrants are generally scarcer near the coast.

In California, chats require dense riparian thickets of willows, vine tangles, and dense brush associated with streams, swampy ground and the borders of small ponds (Small 1994). Chat nests frequently host Brown-headed Cowbird (*Molothrus ater*) and rarely hosts the Bronzed Cowbird (*Molothrus aeneus*). Flood control and river channelization eliminates early successional riparian habitat (willow/alder shrub habitats with a dense understory) that chats (and many other riparian focal species) use for breeding. Hunter et al. (1988) found that chats will use the exotic saltcedar (*Tamarix chinensis*), and they suggest that chats may use the saltcedar preferentially to native habitat. The authors do not report the frequency of nest placement in saltcedar, but Brown and Trosset (1989) report that chats nest in tamarisk and native shrubs in proportion to the occurrence of the different types of vegetation.

The **least Bell's vireo (LBVI)** is a small, olive-gray migratory songbird that nests and forages almost exclusively in riparian woodland habitats. Bell's vireos as a group are highly territorial and are almost exclusively insectivorous. Least Bell's vireo nesting habitat typically consists of well developed overstory, understory, and low densities of aquatic and herbaceous cover. The understory frequently contains dense sub-shrub or shrub thickets. These thickets are often dominated by plants such as narrow-leaf willow, mulefat, young individuals of other willow species such as arroyo willow or black willow, and one or more herbaceous species. LBVI generally begin to arrive from their wintering range in southern Baja California and establish breeding territories by mid-March to late-March. A large majority of breeding vireos apparently depart their breeding grounds by the third week of September and only a very few have been found wintering in the United States.

The explanations for the drastic decline of this species are various; however the two prevailing factors are habitat loss and brown-headed cowbird (*Molothrus ater*) brood parasitism (Kus 1998; Sogge et al. 1997). This small passerine species constructs open cup nests low in the riparian canopy, which may cause them be more vulnerable to brood parasitism compared to larger passerines that nest higher in the canopy. The loss of and degradation of riparian habitats have both occurred due to urban and agricultural development, fire, water diversion and impoundment, channelization, livestock grazing, off-road vehicle use and recreation, replacement of native habitats by introduced plant species, and hydrological changes resulting from these and other land uses. *V. bellii pusillus* was first proposed for listing as endangered by the USFWS on May 3, 1985, (50 FR 18968) and was subsequently listed as federally endangered on May 2, 1986 (60 FR 10694). Critical habitat units were designated by the USFWS on February 2, 1994 (59 FR 4845) and included reaches of ten streams in six counties in southern California and the surrounding approximately 38,000 acres. The critical habitat units exist in the Santa Ynez River, Santa Clara River, Santa Ana River, Santa Margarita River, San Luis Rey River, Sweetwater River, San Diego River, Tijuana River, Coyote Creek, and Jumul-Dulzura Creek.

LBVI typically inhabit riparian forests with well-developed overstories and understories. The understory often contains dense subscrub or thickets above the ground. These thickets are usually dominated by sandbar willow, mulefat, blackberry (*Rubus ursinus*), and young trees of other willow species such as black willow and arroyo willow. The overstory usually contains black willow, cottonwood and Sycamore. Although LBVI use a variety of riparian plant species for nesting, it appears that the structure of the vegetation is more important than other factors such as species composition or the age of the stand. Vireos forage in riparian and adjacent chaparral habitats up to 984 feet from the nest, and use both high and low scrub layers as foraging substrate.

LBVI begin to arrive at their breeding grounds in southern California riparian areas from mid-March to early April. Upon arrival, males establish breeding territories that range in size from 0.5 to 7.4 acres, with an average size of approximately 2 acres. After pair formation, vireos construct a hanging cup nest made up of dried plant material. Nests are usually placed in forks of branches between 2 and 5 feet from the ground. Females lay two to five eggs with both parents incubating the clutch for approximately 14 days and the young fledging after 10 to 12 days. The fledglings will remain in the parental territory for up to a month. LBVI leave the breeding grounds and migrate south mid- to late-September. Their diet consists of a wide variety of insects including wasps, bees, ants, beetles, caterpillars, and butterflies. Adults glean insects from leaves and other vegetation, hover and pick insects off stationary objects and by aerial pursuit.

3.6. Species of Concern Likely to Occur in the Project area.

Seven (7) species have a moderate to high occurrence potential. They are the southwestern pond turtle, orange-throated whiptail, BUOW, YBCU, white rabbit-tobacco, tricolored blackbird, and arroyo chub.

Southwestern pond turtle. These turtles are 3.5 - 8.5 inches in shell length (Stebbins 2003). It is a small to medium-sized drab dark brown, olive-brown, or blackish turtle with a low unkeeled carapace and usually with a pattern of lines or spots radiating from the centers of the scutes. The plastron lacks hinges, and has 6 pairs of shelds which can be cream or yellowish in color with large dark brown markings, or unmarked. The legs have black speckling and may show cream to yellowish coloring. The head usually has a black network or spots may show cream to yellowish coloring. Males usually have a light throat with no markings, a low-domed carapace, and a concave plastron. Females usually have a throat with dark markings, a high-domed carapace, and a flat or convex plastron which tends to be more heavily patterned than the male's. They are diurnal and thoroughly aquatic. This turtle is often seen basking above the water, but will quickly slide into the water when it feels threatened. Southwestern pond turtle is active from around February to November, hibernates underwater, often in the muddy bottom of a pool, and estivates during summer droughts by burying itself in soft bottom mud.

They eat aquatic plants, invertebrates, worms, frog and salamander eggs and larvae, crayfish, carrion, and occasionally frogs and fish. Pond turtles mate in April and May. They are found from the San Francisco Bay south, along the coast ranges into northern Baja California. Isolated populations occur along the Mojave River at Camp Cody and Afton Canyon from sea level to over 5,900 ft in elevation. This turtle is found in ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches, with abundant vegetation, and either rocky or muddy bottoms, in woodland, forest, and grassland. In streams, it prefers pools to shallower areas. Logs, rocks, cattail mats, and exposed banks are required for basking.

Orange-throated Whiptail is slim-bodied with a long slender tail, a thin snout, and large symmetrical head plates. The back is unspotted and black, dark brown, or grayish with 6 or fewer pale yellow or whitish stripes. The throat and often the chest are orange, turning brighter orange during breeding season. Habitat types include chaparral, non-native grassland, (Riversidian) coastal sage scrub, juniper woodland and oak woodland. Associations include alluvial fan scrub and riparian areas. The current range includes southwestern California and Baja California. They range from the southern edges of Orange (Corona del Mar) and San Bernardino (near Colton).

Tricolored blackbird The CDFG maintains a biodiversity database for tricolors. This database includes records for breeding and non-breeding tricolors during the breeding season and a winter distribution database. The recent breeding records were compiled by U.C. Davis and are included in annual reports to USFWS and CDFG. Since 1980, breeding has occurred in 46 California counties (Beedy and Hamilton 1999). With the exception of a few peripheral sites, the geographic distribution has not declined perceptively. Unlike most species when tricolors settle at high densities, as in flooded willows, territories may be vertically stacked. Arrival date on breeding grounds is mid-March through mid-July. Tricolored Blackbirds are at as high a risk as any of the narrowly endemic North American bird species and are at far greater risk than Swainson's Hawks, Burrowing Owls and other relatively widely distributed California species. But because they are a flocking species, and are in some places abundant, they do not command management attention.

Burrowing owl is a small ground-dwelling Owl with a round head and no ear tufts. They have white eyebrows, yellow eyes, and long legs. The Owl is sandy colored on the head, back, and upperparts of the wings and white-to-cream with barring on the breast and belly and a prominent white chin stripe. They have a rounded head, and yellow eyes with white eyebrows. The young are brown on the head, back, and wings with a white belly and chest. They molt into an adult-like plumage during their first summer. Burrowing Owls are comparatively easy to see because they are often active in daylight, and are surprisingly bold and approachable.

The burrowing owl occurs in shortgrass prairies, grasslands, lowland scrub, agricultural lands (particularly rangelands), prairies, coastal dunes, desert floors, and some artificial, open areas as a year-long resident (Haug, et al. 1993). They require large open expanses of sparsely vegetated areas on gently rolling or level terrain with an abundance of active small mammal burrows. As a critical habitat feature need, they require the use of rodent or other burrows for roosting and nesting cover. They may also dig their own burrow in soft, friable soil (as found in Florida) and may also use pipes, culverts, and nest boxes where burrows are scarce (Robertson 1929). The mammal burrows are modified and enlarged. One burrow is typically selected for use as the nest, however, satellite burrows are usually found within the immediate vicinity of the nest burrow within the defended territory of the owl.

The **yellow-billed cuckoo** is dependent on the combination of a dense willow understory for nesting, a cottonwood overstory for foraging and large patches of habitat in excess of 20 ha. (Laymon and Halterman 1991). It is also not known to utilize non-native vegetation in the majority of its range (Hunter et al. 1984). It is a medium sized bird. Its profile is long and slim. Its legs are short and bluish-gray. Its long tail is gray-brown above and black below with three striking pairs of large white dots visible in flight. Its body is brown above with white under parts. The undersides of its pointed wings are rufous. Adult birds have a long curved bill which is blue-black above and yellow at the base of the mandibles. Juveniles have a completely blue-black bill. While they have been known to take beetles, cicadas, bugs, wasps, flies, katydids, dragonflies, damselflies, praying mantids, lacewings, mosquito hawks, cankerworms, fall webworms (*Platyprepia virginalis*), and even tree frogs (Beal 1898, Green 1978, Laymon 1980, Ryser 1985, Dillinger 1989), more than three fourths of the yellow-billed cuckoo diet is made up of grasshoppers and caterpillars (Beal 1898). The yellow-billed cuckoo is an "incipient brood parasite," its eggs have been found in the nests of black-billed cuckoos, American robins, black-throated sparrows, mourning doves, house finches and red-winged blackbirds (Ryser 1985). Black-billed cuckoos have also been known to occasionally parasitize yellow-billed cuckoos.

Though they will occupy a variety of marginal habitats, particularly at the edges of their range, yellow-billed cuckoos in the West are overwhelmingly associated with relatively expansive stands of mature cottonwood willow forests. Canopy height ranged from 5-25 m, canopy cover from 20-90%, and understory cover from 30-90%. Willows and open water are required and the habitat will vary from dense willow-cottonwood forests to marshy bottomlands with scattered willow thickets. The cuckoo was once common in riparian habitat throughout the western United States. In California the yellow-billed cuckoo has declined from a "fairly common breeding species" throughout most of the state to a current population of less than 50 pairs (Gaines and Laymon 1984; Laymon and Halterman 1991). In 1971 it was listed by the California Department of Fish and Game as Rare. By 1977 it had become "one of the rarest birds" in the state. A 1977 survey of historical sites and suitable habitat at six widely scattered rivers turned up 54 birds in the Sacramento Valley (Tehama, Putte, Glenn, Colusa, and Sutter counties), 9 on the South Fork of the Kern River near Weldon, 3 along the Santa Ana River, Riverside County, 4 in Owens Valley, Inyo County, 6 on the Armargosa River south of Tecopa, Inyo and San Bernardino County, and 65 on both sides of the Colorado River from the Nevada state line to the Mexican border (Gaines 1977).

By 1986 the entire breeding population in California had dropped to 31-42 pairs (Laymon and Halterman 1987). The yellow-billed cuckoo is listed as endangered in the state of California.

Today, five of the remaining eight populations in California are in immediate danger of extinction, including 2 sites in Owens Valley, the Armargosa River near Tecopa, the Mojave River and the Santa Ana River. These populations only harbor 1-2 individuals in some years and none in others, making them highly vulnerable to extirpation from both stochastic and systemic processes. According to the California Department of Fish and Game (1980), remnant patches of suitable habitat in sizes sufficient to support breeding yellow-billed cuckoos are scarce. They cite both the outright loss and the fragmentation of riparian forests as the primary cause of cuckoo population declines in California. The Santa Ana River at the Prado Flood Control Basin is one of only two extensive continuous canopy cottonwood-willow forests in southern California. It has consistently supported one or two single cuckoos in recent years.

The **Arroyo chub** is a cyprinid fish found only in the coastal streams of southern California, United States. The shape of the arroyo chub is somewhat chunky, with a deep body and thick caudal peduncle. The eyes are larger than average for cyprinids. Coloration ranges from silver to gray to olive green above, shading to white below, usually with a dull gray band along each side. This is a small fish, with most adults in the 7-10 cm length range, and a maximum of 12 cm. Omnivorous, their diet includes algae, insects, and crustaceans. Arroyo chub habitat is primarily the warm streams of the Los Angeles Plain, which are typically muddy torrents during the winter, and clear quiet brooks in the summer, possibly drying up in places. They are found both in slow-moving and fast-moving sections, but generally deeper than 40 cm.

They are native to Los Angeles, Santa Margarita, San Gabriel, San Luis Rey, and Santa Ana Rivers, as well as to Malibu and San Juan Creeks. Many of the original populations have been extirpated, but it has recently been reestablished in the Arroyo Seco (Los Angeles County), a tributary of the Los Angeles River. The species also has been successfully introduced in a number of other rivers in the area, and can be found as far north as Chorro Creek in San Luis Obispo County, and as far east as the Mojave River. The Mojave and Cuyama River populations extend into the ranges of related fishes, and hybridize with Mojave chub and California roach, respectively.

White rabbit-tobacco *(Pseudognaphalium leucocephalum*) Biennial or short-lived perennial, 30–60 cm; taprooted. Stems are densely and persistently white-tomentose, usually with stipitate-glandular hairs protruding through tomentum. Leaf blades (crowded, internodes mostly 1–3, sometimes to 10 mm) are linear-lanceolate, 3–7 cm × 1–5(–6) mm, bases subclasping, not decurrent, margins strongly revolute, faces bicolor, abaxial densely white-tomentose, adaxial green, densely stipitate-glandular. Heads grow in corymbiform arrays and involucres broadly campanulate, 5–6 mm. Phyllaries are in 5–7 series, are bright white (opaque, dull) and oblong to oblong-ovate, glabrous. Pistillate are in florets of 66–85 and bisexual florets are (6–14, California) are 29–44. Cypselae are ridged and smooth, 2n = 28. Flowering season is Jul–Aug and Nov–Dec. White rabbit-tobacco are grow on/near sandy or gravelly slopes, stream bottoms, arroyos, areas of oak-sycamore, oak-pine, to pine woodlands, commonly in riparian vegetation; 50–2100 m; Ariz., Calif., N.Mex.; Mexico (Baja California, Baja California Sur, Chihuahua, Durango, Sinaloa, Sonora).

3.7. Species of Concern with Some Potential to Occur in the Project Area.

There is marginally suitable habitat on site capable of supporting eight other sensitive species, which are: southern California rufous-crowned sparrow, grasshopper sparrow, Bell's sage sparrow, golden eagle, Santa Ana River woollystar, western mastiff bat, western yellow bat, and CAGN.

Santa Ana River woollystar is a low shrubby perennial which can grow to one meter (3.3 feet) tall, with gray-green stems and leaves. This species blooms from June to August and produces bright blue flowers that are up to 1.4 inches long that occur in flower heads with about 20 blossoms each. There are three primary pollinators: long-tongued digger bee, giant flower-loving fly and hummingbirds. This species is associated with early- to moderate-successional alluvial scrub, and thus requires periodic flooding and silting for the creation of new habitats and colonization. The Santa Ana River woollystar is found only within open washes and early-successional alluvial fan scrub on open slopes above main watercourses on fluvial deposits where flooding and scouring occur at a frequency that allows the persistence of open shrublands. Suitable habitat is comprised of a patchy distribution of gravelly soils, sandy soils, rock mounds and boulder fields (Zembal and Kramer 1984; Zembal and Kramer 1985; U.S. Fish and Wildlife Service 1986). The Santa Ana River woolly-star occurs along the Santa Ana River and Lytle and Cajon Creek flood plains from the base of the San Bernardino Mountains in San Bernardino County southwest along the Santa Ana River through Riverside County into the Santa Ana Canyon of northeastern Orange County from about 150 to 580 meters (Munz 1974; Patterson 1993; Roberts 1998; Zembal and Kramer 1985; Patterson and Tanowitz 1989).

Southern California rufous-crowned sparrow is from a family of seed-eating, small to moderately large passerine birds that have strong, stubby beaks, which, in some species can be quite large. They have a bouncing flight, alternating flapping with gliding on closed wings. Rufous-crowned sparrows are found on grass-covered hillsides, coastal sage scrub, and chaparral and often occur near the edges of the denser scrub and chaparral associations. This species is typically found at an altitude range of 0 to 1,412 meters (0 to 4,633 feet). Rufous-crowned sparrows are relatively secretive, seeking cover in shrubs, rocks, and grass and forb patches, concealing their nest on the ground at the base of a grass tussock or shrub or about 1 to 3 feet above the ground. The nest is cuplike and made of twigs, bark strips, grasses. It breeds from mid-March to mid-June with a peak in May. Incubation is by the female only, but the altricial young are tended by both parents (Harrison 1978). The species is not migratory.

Grasshopper sparrow a small, chunky grassland sparrow with clear buff breast and scaly-looking, dark rufous upperparts and a pale central stripe on crown; short, pointed tail. Apparently it can survive in areas where the introduced plants are combined with the native plants and the livestock grazing is not too intensive. It is found in open grassy and weedy meadows, pastures, and plains. This sparrow breeds from British Columbia, Manitoba, and New Hampshire south to Florida (rare), West Indies, and Mexico but winters north to California, Texas, and North Carolina. This elusive sparrow is named for its buzzy song. As soon as a weedy field becomes overgrown or trees have filled in an abandoned pasture, the Grasshopper Sparrow no longer uses the site for breeding. Less of a seed-eater than our other grass sparrows, it feeds largely on insects. When flushed, this sparrow flies a short distance and drops out of sight, into tall grass.

Bell's sage sparrow has been listed as a Species of Special Concern in California. Garrett and Dunn, describe their distribution in southern CA as abundant in western Riverside County and in the vicinity of El Cajon, San Diego County. *A. b. belli* is generally non-migratory, although northernmost CA populations are reported to be migratory and other populations move down-slope to lower elevations in winter. Bell's sage sparrow is a ground-foraging omnivore during breeding season and a ground gleaning granivore during non-breeding season. It generally "prefers semi-open habitats with evenly spaced shrubs 1-2 m high" (Martin and Carlson 1998). Nests have been parasitized by Brown-headed Cowbirds (*Molothrus ater*) in Idaho and California, especially in disturbed areas. Disturbances that reduce shrub cover, such as frequent fire, mechanical disruption, livestock grazing, and off-highway vehicle use appear to have negative effects on Sage Sparrows. Like other open cut nesters, Sage Sparrows are extremely vulnerable to nest predation. Sage Sparrows in coastal shrublands, as well as in the Great Basin, are highly sensitive to habitat fragmentation. They are seldom found in small habitat patches that are near developed edges.

The Golden eagle is a large, all-dark eagle with a pale golden nape with its bill being smaller and darker than that of Bald Eagle. Juvenile golden eagles have white at the base of the tail and white patches on the undersides of the wings. This eagle is found in mountain forests and open grasslands during breeding and in any habitat during migration. It has a high-pitched kee-kee-kee; also a high scream or squeal, but usually silent. This eagle is common in much of the West. These eagles prey mainly on jackrabbits and large rodents but will also feed on carrion. In some parts of their range Golden eagles are not migratory but remain in their territories all year. The Golden eagle has probably never been numerous in eastern North America; after long persecution, only a very few breeding pairs now survive. In recent years a few nests have been found, and some have produced young, but it is unlikely that the species will ever be more than a rarity in the eastern part of its range.

Western Mastiff Bat is the biggest North American bat, with a body length of 5 ½ to 7 ½" and a wingspan of over 22". Fur is dark brown, kind of thin, hairs white at base. Has huge ears, joined at base and extending out over forehead like a bonnet. They occur in two populations. One population is from the southwestern United States to central Mexico and the second is located in the central and northern portions of South America (Harvey and other 1999). Western mastiff bat is found in desert scrub, chaparral, mixed conifer forest, giant sequoia forests, and montane meadows (Philpott 1997). In the southwestern United States, day roosts are generally found in areas with rugged, rocky canyons and cliffs (Best and others 1996). Crevices in granitic rocks and consolidated sandstone are a common roosting substrate (Best and others 1996). These bats will also roost in building crevices—as nearly as many day roosts are known in buildings as in natural crevices (Barbour and Davis 1969). Western mastiff bats are insectivorous and feed primarily on moths (Philpott 1997). They forage in broad open areas including dry desert washes, flood plains, chaparral, oak woodland, open ponderosa pine forest, grassland, montane meadows, and agricultural areas.

Western yellow bat can be distinguished from other bat species by the combination of yellow coloration, size (forearm = 42-50 mm), and short ears. *Lasiurus xanthinus* occurs in northern Mexico, western Arizona, southern California, southern Nevada, and southwestern New Mexico. Western yellow bats are associated with dry, thorny vegetation on the Mexican Plateau, and are found in desert regions of the southwestern United States, where they show a particular association with palms and other desert riparian habitats. They are known to occur in a number of palm oases, but are also believed to be expanding their range with the increased usage of ornamental palms in landscaping. Yellow bats are suspected to be non-colonial. Individuals usually roost in trees, hanging from the underside of a leaf. They are commonly found in the southwestern U.S. roosting in the skirt of dead fronds in both native and non-native palm trees, and have also been documented roosting in cottonwood trees. At least some individuals or populations may be migratory, although some individuals appear to be present year-round, even in the northernmost portion of their range. Yellow bats are insectivorous. Probably one of the primary threats in the U.S., however, is the cosmetic trimming of palm fronds. The use of pesticides in date-palm and other orchards may also constitute a threat to both roosting bats and the insects upon which they forage.

Coast (San Diego) horned lizard (adults are 2.5 - 4.5 inches long from snout to vent (6.3 - 11.4 cm). A flat-bodied lizard with a wide oval-shaped body that is characterized by scattered enlarged pointed scales on the upper body and tail, and a large crown of horns or spines on the head. The two center horns are the longest. The sides of the body have two rows of pointed fringe scales. (Compare with the Desert Horned Lizard which only has one row of fringed scales on the sides.) Color is reddish, brown, yellow, or gray, with dark blotches on the back and large dark spots on the sides of the neck. They are found in a wide variety of vegetation types including coastal sage scrub, annual grassland, chaparral, oak woodland, riparian woodland and coniferous forest (Stebbins, 1954). In inland areas, this species is restricted to areas with pockets of open microhabitat, created by disturbance (e.g., floods, fire, roads, grazed areas, fire breaks) (Jennings and Hayes, 1994). It seems to have disappeared from about 45% of its former range in southern California, in particular on the coastal plain where it was once common and in riparian and coastal sage scrub habitats on the old alluvial fans of southern California. This taxon is unable to survive in habitats altered by development, agriculture, off-road vehicle use, or flood control structures (Goldberg, 1983).

Coastal California gnatcatcher (*Polioptila californica californica*) is a small blue-gray songbird. It has dark blue-gray feathers on its back and grayish-white feathers on its underside. The wings have a brownish wash to them. Its long tail is mostly black with white outer tail feathers. They have a thin, small bill. The males have a black cap during the summer which is absent during the winter. The gnatcatcher typically occurs in or near sage scrub habitat, which includes the following plant communities as classified by Holland (1986): Venturan coastal sage scrub, Diegan coastal sage scrub, maritime succulent scrub, Riversidean sage scrub, Riversidean alluvial fan sage scrub, southern coastal bluff scrub, and coastal sage-chaparral scrub. Ninety-nine percent of all gnatcatcher locality records occur at or below an elevation of 984 feet (Atwood 1990). Gnatcatchers also use chaparral, grassland, and riparian habitats where they occur adjacent to sage scrub (Bontrager 1991). These non-sage scrub habitats are used for dispersal (Bowler 1995; Campbell et al. 1995). Gnatcatchers are persistent nest builders and often attempt multiple broods, which is suggestive of a high reproductive potential.

Historically, gnatcatchers occurred from southern Ventura County southward through Los Angeles, Orange, Riverside, San Bernardino, and San Diego counties, and into Baja California, Mexico (Atwood 1990). The amount of coastal sage scrub available to gnatcatchers has continued to decrease during the period after the listing of the species. It is estimated that up to 90 percent of coastal sage scrub vegetation has been lost as a result of development and land conversion (Barbour and Major 1977).

3.8. Designated Critical Habitat in the Project area.

Critical Habitat is designated by USFWS for some threatened and endangered species. The project area is located within designated critical habitat (59 FR 4845; February 2, 1994) for the state and federally listed as endangered LBVI.

No portion of the project area is located within designated critical habitat for CAGN. Revised Critical Habitat for the CAGN Final Rule was issued on December 18, 2007 (FR Doc. 07–6003.)

No portion of the project area is located within designated critical habitat for SWWF. Revised Critical Habitat for the SWWF was issued October 19, 2005 (70 FR 60885 61009.) The Santa Ana Management Unit includes large portions of the Santa Ana River, but the designated critical habitat is mapped northeast and outside of the project area.

No portion of the project area is located within designated critical habitat for SASU. Critical Habitat for the SASU Final Rule was published January 4, 2005 (70 FR 426).

Chapter 4. Discussion of Impacts

The proposed action area of Reach IV-B and the southern half of Reach IV-A traverses vacant, public land designated as flood control, water conservation and open space. Patches of agricultural, industrial and commercial land uses flank Reach IV-A, north of the Prado Dam inundation area. The primary plant community of concern in the project area is riparian. However, in addition to riparian habitat, there are freshwater marsh, eucalyptus groves, Riversidean Alluvial Fan Sage Scrub, riverine or sandy river wash, grassland, and ruderal habitats found within the project area (Figures 2b-11b). Special status species are also discussed in the following sections. Overall maximum impact areas for different components of the construction activities are summarized in Table 1 below.

Table 1. Impact Area Calculations

Reach	Habitat Type	Temporary Impacts (acres)	Permanent Impacts (acres)
Lower IV-A	Riparian	3.15	.005
Lower IV-A	Riversidean Alluvial Fan Sage Scrub	0.18	-
Lower IV-A	Ruderal	2.69	.02
Lower IV-A	Sandy River Wash	1.15	.002
IV-B	Riparian	4.41	-
IV-B	Riversidean Alluvial Fan Sage Scrub	-	-
IV-B	Ruderal	2.39	-
IV-B	Sandy River Wash	1.12	-

The project proposes to minimize construction areas and to locate in areas that will avoid or reduce potential impacts to sensitive biological resources. The impact analysis in the following discussion provides a total impact area for each reach. Impacts associated with 10 feet of widening of the existing access road, manhole clearing, and clearing for slip-line insertion points and staging areas are considered temporary impacts. Please note that a previously permitted project re-established the existing 10 foot wide access road. The impacts for the permanent re-establishment of this access road have been mitigated and are not included in this analysis. This project will require the existing 10-foot wide access road be widened an additional 10 feet for construction. The impact of the additional access road widening by 10 feet is temporary. Once the pipeline repair is completed, the temporarily disturbed areas will be restored back to their natural condition. Mitigation requirements will be applied at the respective ratios based on the habitat type.

4.1. Natural Communities of Special Concern

The Natural Communities of Special Concern that are located within the project area are designated critical habitat for LBVI and Riparian riverine habitat.

4.1.1. LEAST BELL'S VIREO (LBVI) CRITICAL HABITAT

The project area is located within designated critical habitat (59 FR 4845; February 2, 1994) for the state and federally listed as endangered LBVI. Critical habitat for LBVI is mapped throughout Prado Basin, including the inundation area of the Dam. Therefore, a majority of the project area is located within designated critical habitat for LBVI. Total calculated impacts to LBVI critical habitat are 9.83 acres (all within Riverside County.)

Reach IV-A

In this reach of the SARI pipeline, LBVI critical habitat is found from manholes 4A-0000 to 4A-0510. A majority of the upper portion of this reach will not have any direct impacts to LBVI critical habitat. The potential impacts will occur where there is removal of vegetation to accommodate the access road and the pipeline work at the manholes. Much of the project within Reach IV-A requires just tree trimming or bare ground disturbance. No whole sale vegetation clearing is required within this reach. The locations within this reach identified as having potential impacts to LBVI critical habitat are between manholes 4A-0030 and 4A-0100. Maximum impacts in this reach to LBVI critical habitat totals 4.30 acres. Please note that the vast majority of disturbance caused by the project between these manholes falls within the 505 foot contour.

*The project area located within the upper reaches of Reach IV-A, in San Bernardino County, will not impact LBVI critical habitat. The project will impact bare ground and ruderal vegetation only and will avoid all impacts to riparian vegetation existing in this reach.

Reach IV-B

All of Reach IV-B is mapped within LBVI critical habitat and the habitat is considered highly suitable for this species. Possible impacts to LBVI critical habitat have been identified between manholes 4B-0020, through 4B-0110. Maximum impacts to LBVI critical habitat in this reach total 5.53 acres. These impacts take into account all impacts associated with the access road establishment, pipeline work at the manholes, and additional cleared areas required for the pipeline work. Manholes 4B-0020 through 4B-0070 are located within the 505 foot contour. Maximum impact area between manholes 4B-0020 and 4B-0070 is 3.7 acres.

Please note that these impacts were calculated based on existing field conditions and prior to the implementation of the Reach IV-B Joint Repair Project. Regulatory permits have recently been secured for the Reach IV-B Joint Repair Project which required mitigation for 1.18 acres of wetland habitat.

The calculations do not account for areas of Reaches IV-A and IV-B that are mapped in LBVI critical habitat, but occur in areas, devoid of wetland/riparian vegetation, which are required by this obligate riparian species.

4.1.1.1. COMPENSATORY MITIGATION

In general mitigation for adverse impacts to biological resources encompasses a range of management options. The available measures include: avoidance; minimization of impacts; offsetting impacts through repair, rehabilitation or restoration; reducing or offsetting impacts over time by preservation and maintenance operations over the life of an action; and, finally, compensation for impacts by replacing or providing substitute resources or environments. The proposed project's impacts on biological resources consist of construction impacts (disturbance of existing high quality habitat) that will result in temporary loss of habitat value within the construction area of potential effect (APE). Once the construction is completed, the ground surface can be returned to its current condition.

Based on a review of the construction plans for this project, TDA biologists conclude that habitat values should begin returning to normal after two years; thus, the temporal loss in habitat value within the areas where LBVI critical habitat that contains riparian vegetation encompasses a total of 9.83 acres.

The SARI line improvements are located within an area that is forecast to experience temporal loss of habitat due to inundation of habitat based on future changes in water management activities to support Prado Basin Water Conservation operations (U. S. Army Corps of Engineers, Los Angeles District Prado Basin Water Conservation Feasibility Study, February 2005). Based on the temporal loss of habitat impacts identified in the referenced study, the participating agencies (Corps of Engineers and Orange County) concluded that compensation for loss of habitat should be provided based on approximately 56% of the affected habitat.

As a result, compensation for the temporal loss of habitat has already been provided for most of the same area (that area below 505 feet in elevation) that will be temporally impacted by the proposed project. However, the nature of this temporal impact is different than that related to water conservation inundation impacts. The inundation impacts are a result of natural phenomena (rainfall) that do not have a discrete time frame for occurrence. The proposed project is a construction project that will remove vegetation and cause habitat loss due to discrete construction activities over a specific period of time.

In an attempt to balance mitigation and prevent double mitigation for the same habitat affected by both the proposed project and the water conservation project, SAWPA proposes to mitigate the temporal loss of habitat along the pipeline alignment in the following manner: 1) minimize, to the extent feasible, the area of LBVI critical habitat impact (9.83 acres); 2) implement a post-construction monitoring program to ensure that natural restoration of the habitat within the construction area is progressing without invasion of exotic species; 3) compensate for 50% of the temporal habitat loss of habitat below elevation 505' AMSL and 100% above elevation 505' AMSL by funding an equivalent amount of acreage of invasive plant removal (primarily arundo) or acquisition of additional comparable habitat acreage within the Prado Basin; and 4) possibly implement a pepper weed eradication program offsite near the Corps trailers.

SAWPA finds that implementation of the above mitigation measures is adequate to reduce the project impacts due to temporal loss of riverine/riparian habitat in the Prado Basin, and the species it supports, to a less than significant impact level.

Proposed mitigation

Vegetation Type	Area below 505' (0.5:1 mitigation ratio)	Area outside 505' (1:1 mitigation ratio)	TOTAL AREA PROPOSED FOR MITIGATION
Riparian	4.54	3.22	5.49
Sandy River Wash	2.12	0.16	1.22
Ruderal	0.98	4.10	0[1]
Riverside Sage Scrub	0.03	0.15	0[1]
TOTAL	7.67	7.63	**6.71**

[1]No mitigation required for ruderal and/or riverside sage scrub habitat

4.1.1.2. CUMULATIVE IMPACTS

LBVI habitat has been severely diminished and fragmented by residential, commercial, and industrial development in the San Bernardino Valley. This development heavily impacts the habitats by direct removal and subsequent degradation of adjacent habitat. Although the main cause of the decline LBVI habitat is habitat loss, other important factors are; urban development, fire, water diversion and impoundment, channelization, off-road vehicle use and recreation, displacement of native plants by introduced species, and hydrological changes resulting from these and other land uses. Overall, the project will result in temporary construction impacts that are not considered cumulatively significant.

4.1.2. RIPARIAN NATURAL COMMUNITY

Riparian forests are among the most productive of natural ecosystems. An intact riparian zone acts as a filter between streams and the adjacent environment. The riparian zone attenuates agricultural fertilizer and animal wastes from seeping into streams and ground water. It reduces sedimentation in stream beds, thus protecting spawning beds. Stream bank vegetation lessens erosion and controls the release of nutrients to the aquatic environment. Overhanging canopies prevent water from heating and thereby losing its dissolved oxygen. Riparian vegetation also provides habitat for invertebrates that are a source of food for aquatic and terrestrial life. A healthy riparian cover is the starting point of sound watershed management. In southern California, only 3 to 5% of the pre-settlement riparian forest remains, the rest having been converted primarily to farming or urban uses.

4.1.2.1. Avoidance and Minimization Efforts

Please refer to the preceding section in that the riparian habitat on site falls within LBVI critical habitat. The discussion above also applies to this issue.

4.1.2.2. Project Impacts

Please refer to the preceding section in that the riparian habitat on site falls within LBVI critical habitat. The discussion above also applies to this issue.

4.1.2.3. Compensatory Mitigation

Please refer to the preceding section in that the riparian habitat on site falls within LBVI critical habitat. The discussion above also applies to this issue.

4.1.2.4. Cumulative Impacts

Please refer to the preceding section in that the riparian habitat on site falls within LBVI critical habitat. The discussion above also applies to this issue.

4.2. Listed Species Known or Assumed Present

4.2.1. SASU

The SASU is a fish endemic to the Santa Ana River drainage. It is extremely rare and is listed by the Federal Government as Threatened. SASU are found in the project area as evidenced by the fish relocation activities conducted as part of the ACOE Prado Dam improvement/reconstruction project. In June 2008, San Marino Environmental Associates relocated approximately 800 SASU that were found in the approach channel, upstream of the dam inlet. These findings suggest that SASU are likely present in any flowing water found in the project area. For the purposes of this analysis SASU is assumed present in any wetted area of the project site.

4.2.1.1. Project Impacts

Reach IV-A

The vast majority of this reach will not have any direct impacts to suitable SASU habitat in that the work will occur outside of the wetted area, on dry land. The two locations within this reach identified as having potential impacts to suitable SASU habitat are at manholes 4A-0000 and 4A-0010. These two work areas may require dewatering as there is existing water or high ground water levels.

Reach IV-B

There are wetted portions within Reach IV-B, where SASU likely occur. Possible impacts to SASU have been identified between manholes 4B-0010, through 4B-0080. During the general survey a number of tributary streams with fish were noted. Dewatering will likely be required to at the insertion pits and to do the pipeline work around some of the manholes with in this reach, particularly in the project area between manholes 4B-0010 and 4B-0070. All stream crossings will be made with the addition of steel bridges.

The project has the potential to produce a maximum of 2.90 acre of temporary impacts (Reach IV-A = 1.76 acre and Reach IV-B 1.14 acres) to suitable SASU habitat. Habitat that is considered suitable for SASU contains a primary constituent element which is water. These calculated impacts take into account the action areas associated with the access road, dewatering, and pipeline work at the manholes that are located in potentially wetted areas. The calculations do not account for the areas of Reaches IV-A and IV-B that occur in uplands, devoid of water or high ground water.

4.2.1.2. AVOIDANCE AND MINIMIZATION EFFORTS

The intent of the SAWPA is to design and construct this project in such a way that there will be no project related impacts to SASU or SASU habitat. SAWPA will consider a variety of methods that will allow them to avoid impacts to SASU and SASU habitat. Some of these methods may include constructing in the dry season, when there are no wetted areas in the project footprint, bridging wetted areas, moving insertion points to areas well outside of wetted areas, and inserting pipeline in locations outside of wetted areas in both directions.

However, until the engineering designs are final and the project limits are surveyed in and staked it is the obligation of this biological assessment to relay potential impacts in a worst case scenario.

The suitable habitat for SASU located in the project area occurs below 505 feet in elevation. The following measures will be put in place to minimize and avoid impacts to SASU individuals. In areas where dewatering is necessary and fish are found, fish relocation operations will be employed. This relocation is a form of take by way of harassment and will require take authorization from the USFWS. Qualified and authorized fisheries biologists, familiar with SASU, will be contracted to do the relocation. A qualified and authorized biologist will provide all construction workers with an environmental awareness training class and will be onsite during all aspects of dewatering. Metal plates or similar barriers will be placed over smaller streams to so equipment can pass over them and not through them. The relocation of the fish should prevent any take of SASU and therefore, no take of this listed species is anticipated.

4.2.1.3. COMPENSATORY MITIGATION

No compensatory mitigation is proposed for SASU. There will be no permanent impacts or loss of suitable habitat for SASU as a result of this project. Following construction, the existing dirt access road will remain, but will be reduced back to its 10-foot width. This access/maintenance road was originally constructed when the pipe was installed. In 2008, as part of a separate project the access road in Reach IV-B was re-established and cleared of vegetation in 2009, prior to implementation of this project.

Based on a worst case scenario, SAWPA proposes to mitigate the temporary impacts to high quality suitable SASU habitat (wetted areas) by restoration of the temporary impact areas. The restoration effort will restore the habitat to its native pre-project condition. The suitable habitat for SASU located in the project area occurs below 505 feet in elevation. The impact area in Reach IV-B is addressed above in Section 4.1.1.3. and the impact area within IV-A (1.76 acres) would be mitigated by compensation at 50% of the impact area.

4.2.1.4. CUMULATIVE IMPACTS

Important factors impacting habitat for the SASU include urban development, fire, water diversion and impoundment, channelization, off-road vehicle use and recreation, displacement of native plants by introduced species, and hydrological changes resulting from these and other land uses. The project will result in temporary construction impacts. It will not remove the SASU habitat and is therefore not considered cumulatively significant. The loss of the SASU individuals is not anticipated as part of this project, but harassment by way of handling for relocating is anticipated. Project impacts to wetted areas are considered temporary and are not cumulatively significant relative to the SASU.

4.2.2. LBVI and SWWF

Based on the 2008 avian surveys conducted by the OCWD, LBVI occur throughout the entire project site. During the 2008 surveys one SWWF was found in the interior of the inundation area, but well outside of the project area. The habitat on site is highly suitable for these two species. Habitat that is considered suitable for these two species contains a mosaic of cottonwood, willow, and other riparian vegetative associations that is densely structured in a two or three-story canopy. The habitat onsite displays these characteristics, therefore, LBVI and SWWF are assumed present.

4.2.2.1. PROJECT IMPACTS

The project will not result in the direct take of LBVI or SWWF. The project however, does have the potential to cause indirect impacts to these species. Indirect impacts may include affects from construction noise and vibration and affects from habitat modification (vegetation removal and trimming).

4.2.2.2. AVOIDANCE AND MINIMIZATION EFFORTS

Upper Reach IV-A

*The project area located within the upper reaches of Reach IV-A, in San Bernardino County, will not impact LBVI or SWWF. The project will impact bare ground and ruderal vegetation only and will avoid all impacts to riparian vegetation existing in this reach. The project proposes to avoid impacts to these species by constructing in the upper reaches of Reach IV-A, in San Bernardino County, outside of their migratory nesting season between April 15 and July 31.

Lower Reach IV-A

The locations within this reach identified as having potential impacts to LBVI and SWWF are between manholes 4A-0030 and 4A-0100.

Reach IV-B

The entirety of this reach is identified as having potential impacts to LBVI and SWWF.

SAWPA proposes to conduct all required clearing, prior to construction, outside of the nesting season in order to avoid direct take of nesting birds, particularly LBVI and SWWF. The timing of construction, however, within Lower Reach IV-A and Reach IV-B will not be able to avoid the migratory nesting season, between March 15 and September 15. Therefore, an authorized biologist will provide all construction workers with an environmental awareness training class and will be onsite during all aspects of work within the riparian habitat. The site biologist will conduct the appropriate level of survey, as directed by the resource agencies, to identify and flag LBVI and/or SWWF breeding territories. A 300 to 500 foot buffer or "no work zone" will be placed around each territory near the project foot print. If approved by the resource agencies, sound barriers may be erected in the work area to allow construction to proceed within a buffer zone.

4.2.2.3. COMPENSATORY MITIGATION

No compensatory mitigation is proposed for these species. Please refer to LBVI critical habitat discussion above.

4.2.2.4. CUMULATIVE IMPACTS

Take of LBVI or SWWF individuals, in the form of harassment, may result from implementation of this project within the upper portions of Reach IV-A and within the entirety of Reach IV-B. The timing of construction within Lower Reach IV-A and Reach IV-B will not be able to avoid the migratory nesting season, between April 15 and July 31. Therefore, the project will require incidental take permits for LBVI and SWWF, either through formal consultation with the USFWS under Section 7 and consultation with the CDFG under California Fish and Game Code Section 2081 or through the Western Riverside County's Multiple Species Habitat Conservation Plan (MSHCP) process.

Pursuant to the provisions in the Western Riverside County's MSHCP, Section 7.3.9, the SAWPA may seek Participating Special Entity (PSE) status from the Regional Conservation Authority (RCA) for impacts to riparian/riverine resources associated with this project, outside of Federal lands. The MSHCP requires that offsetting measures for permanent and temporary impacts to riparian/riverine resources be identified and addressed in a Determination of Biologically Equivalent or Superior Preservation (DBESP) document. This document will be prepared per MSHCP requirements under separate cover.

Construction related impacts of this Project are considered temporary and should not pose a cumulative impact to these species. Periodic maintenance of the existing access road will avoid the migratory nesting season, between April 15 and July 31.

4.3. Special Status Species Assumed to be Present

4.3.1. Long-eared owl, yellow warbler, yellow-breasted chat

Recent records show that the long-eared owl, yellow warbler and yellow-breasted chat occur in the riparian habitat in Prado Basin. These three species are considered California species of special concern. At this time there are no particular permit requirements to address impacts to these species.

4.3.1.1. PROJECT IMPACTS

No direct impacts to these species are proposed as part of this project.

4.3.1.2. AVOIDANCE AND MINIMIZATION EFFORTS

The project proposes to avoid impacts to neotropical migrant species by constructing outside of the migratory nesting season between April 15 and July 31. A qualified and authorized biologist will provide all construction workers with an environmental awareness training class and will be onsite during all aspects of work within the riparian habitat. All work will be conducted during daylight hours, thus reducing impacts to nocturnal owl species.

4.3.1.3. COMPENSATORY MITIGATION

No compensatory mitigation is proposed for these species.

4.3.1.4. CUMULATIVE EFFECTS

This project will not contribute to cumulative impacts on long-eared owl, yellow warbler, or yellow-breasted chat.

4.4. Wildlife

Each habitat type within the project area is capable of supporting a huge suite of wildlife, inclusive of rare and sensitive species. Prado Basin is also considered a wildlife corridor that links a number of open, native habitats.

4.4.1. Wildlife

The proposed project has no potential to interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites. All infrastructure associated with the project will be subsurface after construction and all impacts are temporary**.**

4.4.1.1. PROJECT IMPACTS

No direct impacts to wildlife are proposed as part of this project.

4.4.1.2. Avoidance and Minimization Efforts

All work will be conducted during daylight hours. All equipment will be equipped with noise reducing fixtures. There will be a biologist on site during ground disturbing activities and all construction workers will be provided with an environmental awareness class. The project action area will be clearly marked and a visual barrier will be installed to prevent accidental intrusion by construction staff into sensitive or off-limits areas.

4.4.1.3. Compensatroy mitigaion

No compensatory mitigation is proposed for wildlife.

4.4.1.4. Cumulative Effects

This project will not contribute to cumulative impacts on wildlife.

Chapter 5. Conclusions and Determination

5.1. Conclusions

Construction of the proposed pipeline will result in impacts to sensitive habitat, critical habitat, listed species and sensitive species. The project area is located within the critical habitat designated for the LBVI. There are current records of SASU, LBVI, and SWWF in the vicinity of the project area. These and other sensitive species were determined to have a potential of occurring in the riparian habitat located in the project area based on the botanical components, percent vegetative cover, habitat structure and breeding territory establishment. Therefore, these species are assumed to be present within the project area. In addition to these species other sensitive species were determined to have a potential of occurring in the riparian habitat located in the project area based on the botanical components, percent vegetative cover, habitat structure.

As stated previously, impacts have been calculated to reflect a worst case scenario. Under this assumption, the project will create a total of approximately 15.3 acres of land disturbance. Within the construction action area, calculated impacts to sensitive habitats and protected species include 10-foot widening of the existing 10-foot wide access road, land disturbances at the manholes, pipeline bypass areas, and dewatering areas. Based on the engineering data provided, field review and background information, the project has the potential to produce a maximum of 2.90 acres of temporary impacts to suitable SASU habitat. Total calculated impacts to riparian/riverine habitat and suitable LBVI critical habitat are 9.83 acres.

5.2. Determination

* The project area located within the upper reaches of Reach IV-A, in San Bernardino County, will not impact LBVI critical habitat, suitable or occupied LBVI or SWWF habitat, LBVI individuals or SWWF individuals. This specific portion of the project will impact bare ground and ruderal vegetation only and will avoid all impacts to riparian vegetation existing in this reach. The project proposes to avoid impacts to LBVI, SWWF and other sensitive migratory birds in the upper reaches of Reach IV-A, by constructing outside of their migratory nesting season between April 15 and July 31. Therefore, it is determined that the Project area within San Bernardino County (only) will not adversely affect critical habitat or listed species.

The project area within Riverside County that encompasses lower Reach IV-A and Reach IV-B will result in impacts that may affect critical habitat and listed species. Due to the confirmed occupation of the project site by LBVI, SASU, and SWWF consultation with the USFWS will be required through the U.S. Army Corps of Engineers to address the impacts to occupied and critical habitat. As a federal Agency, the U.S. Army Corps of Engineers may not take an action (i.e. issue a permit) if that action has the potential to "affect" a federally listed species or the designated critical habitat of a listed species. If a proposed project has the potential to affect a listed species or the critical habitat of that species, the Corps must consult with the USFWS under Section 7 of the federal Endangered Species Act.

The timing of construction within Lower Reach IV-A and Reach IV-B will not be able to avoid the migratory nesting season, between April 15 and July 31. Therefore, the project will require incidental take permits for LBVI and SWWF, either through formal consultation with the USFWS under Section 7 and consultation with the CDFG under California Fish and Game Code Section 2081 or through the Western Riverside MSHCP process. Regardless of the regulatory process used to obtain take authority, the CDFG will also need to be consulted to address potential impacts to the YBCU, should they enter the site during construction.

The following mitigation will be provided to address the impacts identified above.

1. An approved fisheries biologist will be contracted to develop a fish relocation plan and implement it, in the event work must occur in a wetted area, containing fish.
2. An authorized and qualified biologist will provide all contractors an approved awareness training class prior to work.
3. An authorized and qualified biologist will be onsite during all aspects of construction within the riparian habitat to ensure compliance with permit requirements.
4. The site biologist will conduct the appropriate level of survey, as directed by the resource agencies, to identify and flag LBVI and/or SWWF breeding territories.
5. A 300 to 500 foot buffer or “no work zone” will be placed around each territory near the project foot print.
6. If approved by the resource agencies, sound barriers may be erected in the work area to allow construction to proceed within a buffer zone.
7. If SAWPA processes this project through the MSHCP as a PSE, they will compensate for the temporally loss of habitat in fee.
8. If SAWPA processes this project outside of the MSHCP through formal consultation under Section 7 with the USFWS and through Section 2081 under the State FGC with the CDFG, SAWPA proposes to mitigate impacts to listed species and critical habitat in a 1:1 ratio for impact areas above 505 feet elevation and a ½:1 ratio for areas below 505 feet elevation, by funding an equivalent amount of acreage of invasive plant removal (primarily arundo) or acquisition of additional comparable habitat acreage within the Prado Basin
9. Since the habitat will naturally restore itself very rapidly, SAWPA proposes to implement a monitoring program to ensure that exotic species do not take a hold and invade the disturbed areas.
10. SAWPA is also looking into the possibility of developing a plan to eradicate a patch of pepper weed located offsite near the Corps trailers. If this option is chosen,a qualified biologist will implement the eradication program that will include a native habitat restoration component. A 5-year monitoring and

maintenance plan will be developed as part this plan to ensure that the eradication/restoration area is self-sustaining.

Based on the data collected and analyzed, it was determined that project will result in the discharge of fill material into waters that technically meet the parameters for waters of the United States. Therefore, a permit from the Corps and RWQCB is required. Further, this project will also require a CDFG streambed alteration agreement. CDFG regulates all activities that alter streams and lakes and their associated habitat. A CDFG 1602 Agreement is required for all activities resulting in impacts to streambeds and their associated riparian/wetland habitats.

In order to comply with the MBTA, which prohibits the take of active bird nests, any grubbing, brushing or tree removal will be conducted outside of the State identified bird nesting season of February 15 through September 1. Otherwise, an authorized biologist will need to conduct nesting bird surveys to identify any active nests. A no work buffer zone of 300 feet will be placed around active nests. Sound shields may also be used in order to possibly modify the buffer zone to less than 300 ft. These proposed measures will need to be coordinated and authorized by CDFG and the USFWS.

The project site is located within the MSHCP and as such, the MSHCP requires consistency with all plan policies. The policies relevant to this project include the Riverine/Riparian/Vernal Pools Policy and the Urban/Wildland Interface Policy. A consistency analysis document addressing MSHCP issues has been prepared for this project under separate cover.

Chapter 6. References

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Appendix A CNDDB Species Occurrence Table

SCIENTIFIC NAME	COMMON NAME	STATUS FED /STATE		GENERAL HABITAT CHARACTERISTICS	MICROHABITAT CHARACTERISTICS
Abronia villosa var. aurita	chaparral sand-verbena	None		CHAPARRAL, COASTAL SCRUB	SANDY AREAS. 80-1600M.
Actinemys marmorata pallida	southwestern pond turtle	None	SC	INHABITS PERMANENT OR NEARLY PERMANENT BODIES OF WATER IN MANY HABITAT TYPES; BELOW 6000 FT ELEV.	REQUIRE BASKING SITES SUCH AS PARTIALLY SUBMERGED LOGS, VEGETATION MATS, OR OPEN MUD BANKS. NEED SUITABLE NESTING SITES.
Agelaius tricolor	tricolored blackbird	None	SC	HIGHLY COLONIAL SPECIES, MOST NUMBEROUS IN CENTRAL VALLEY & VICINITY. LARGELY ENDEMIC TO CALIFORNIA.	REQUIRES OPEN WATER, PROTECTED NESTING SUBSTRATE, & FORAGING AREA WITH INSECT PREY WITHIN A FEW KM OF THE COLONY.
Aimophila ruficeps canescens	southern California rufous-crowned sparrow	None	SC	RESIDENT IN SOUTHERN CALIFORNIA COASTAL SAGE SCRUB AND SPARSE MIXED CHAPARRAL.	FREQUENTS RELATIVELY STEEP, OFTEN ROCKY HILLSIDES WITH GRASS & FORB PATCHES.
Ammodramus savannarum	grasshopper sparrow	None		DENSE GRASSLANDS ON ROLLING HILLS, LOWLAND PLAINS, IN VALLEYS & ON HILLSIDES ON LOWER MOUNTAIN SLOPES.	FAVORS NATIVE GRASSLANDS WITH A MIX OF GRASSES, FORBS & SCATTERED SHRUBS. LOOSELY COLONIAL WHEN NESTING.
Amphispiza belli belli	Bell's sage sparrow	None	SC	NESTS IN CHAPARRAL DOMINATED BY FAIRLY DENSE STANDS OF CHAMISE. FOUND IN COASTAL SAGE SCRUB IN SOUTH OF RANGE.	NEST LOCATED ON THE GROUND BENEATH A SHRUB OR IN A SHRUB 6-18 INCHES ABOVE GROUND. TERRITORIES ABOUT 50 YDS APART.
Aquila chrysaetos	golden eagle	None	SC	ROLLING FOOTHILLS, MOUNTAIN AREAS, SAGE-JUNIPER FLATS, & DESERT.	CLIFF-WALLED CANYONS PROVIDE NESTING HABITAT IN MOST PARTS OF RANGE; ALSO, LARGE TREES IN OPEN AREAS.
Asio otus	long-eared owl	None	SC	RIPARIAN BOTTOMLANDS GROWN TO TALL WILLOWS & COTTONWOODS; ALSO, BELTS OF LIVE OAK PARALLELING STREAM COURSES.	REQUIRE ADJACENT OPEN LAND PRODUCTIVE OF MICE AND THE PRESENCE OF OLD NESTS OF CROWS, HAWKS, OR MAGPIES FOR BREEDING.
Aspidoscelis hyperythra	orange-throated whiptail	None	SC	INHABITS LOW-ELEVATION COASTAL SCRUB, CHAPARRAL, AND VALLEY-FOOTHILL HARDWOOD HABITATS.	PREFERS WASHES & OTHER SANDY AREAS WITH PATCHES OF BRUSH & ROCKS. PERENNIAL PLANTS NECESSARY FOR ITS MAJOR FOOD-TERMITES

SCIENTIFIC NAME	COMMON NAME	STATUS FED /STATE		GENERAL HABITAT CHARACTERISTICS	MICROHABITAT CHARACTERISTICS
Athene cunicularia	burrowing owl	None	SC	OPEN, DRY ANNUAL OR PERENIAL GRASSLANDS, DESERTS & SCRUBLANDS CHARACTERIZED BY LOW-GROWING VEGETATION.	SUBTERRANEAN NESTER, DEPENDENT UPON BURROWING MAMMALS, MOST NOTABLY, THE CALIFORNIA GROUND SQUIRREL.
Atriplex coulteri	Coulter's saltbush	None		COASTAL BLUFF SCRUB, COASTAL DUNES, COASTAL SCRUB, VALLEY AND FOOTHILL GRASSLAND.	OCEAN BLUFFS, RIDGETOPS, AS WELL AS ALKALINE LOW PLACES. 10-440M.
California Walnut Woodland	California Walnut Woodland	None			
Calochortus weedii var. intermedius	intermediate mariposa-lily	None		COASTAL SCRUB, CHAPARRAL, VALLEY AND FOOTHILL GRASSLAND.	DRY, ROCKY OPEN SLOPES AND ROCK OUTCROPS. 120-850M.
Catostomus santaanae	Santa Ana sucker	T/None	SC	ENDEMIC TO LOS ANGELES BASIN SOUTH COASTAL STREAMS.	HABITAT GENERALISTS, BUT PREFER SAND-RUBBLE-BOULDER BOTTOMS, COOL, CLEAR WATER, & ALGAE.
Chorizanthe parryi var. parryi	Parry's spineflower	None		COASTAL SCRUB, CHAPARRAL.	DRY SLOPES AND FLATS; SOMETIMES AT INTERFACE OF 2 VEG TYPES, SUCH AS CHAP AND OAK WDLAND; DRY, SANDY SOILS. 40-1705M.
Coccyzus americanus occidentalis	western yellow-billed cuckoo	Candidate/ Endangered		RIPARIAN FOREST NESTER, ALONG THE BROAD, LOWER FLOOD-BOTTOMS OF LARGER RIVER SYSTEMS.	NESTS IN RIPARIAN JUNGLES OF WILLOW, OFTEN MIXED WITH COTTONWOODS, W/ LOWER STORY OF BLACKBERRY, NETTLES, OR WILD GRAPE.
Coleonyx variegatus abbotti	San Diego banded gecko	None		COASTAL & CISMONTANE SOUTHERN CALIFORNIA.	FOUND IN GRANITE OR ROCKY OUTCROPS IN COASTAL SCRUB & CHAPARRAL HABITATS.
Crotalus ruber ruber	northern red-diamond rattlesnake	None	SC	CHAPARRRAL, WOODLAND, GRASSLAND, & DESERT AREAS FROM COASTAL SAN DIEGO COUNTY TO THE EASTERN SLOPES OF THE MOUNTAINS.	OCCURS IN ROCKY AREAS & DENSE VEGETATION. NEEDS RODENT BURROWS, CRACKS IN ROCKS OR SURFACE COVER OBJECTS.
Dendroica petechia brewsteri	yellow warbler	None	SC	RIPARIAN PLANT ASSOCIATIONS. PREFERS WILLOWS, COTTONWOODS, ASPENS, SYCAMORES, & ALDERS FOR NESTING & FORAGING.	ALSO NESTS IN MONTANE SHRUBBERY IN OPEN CONIFER FORESTS.

SCIENTIFIC NAME	COMMON NAME	STATUS FED /STATE		GENERAL HABITAT CHARACTERISTICS	MICROHABITAT CHARACTERISTICS
Dipodomys stephensi	Stephens' kangaroo rat	E/T		PRIMARILY ANNUAL & PERENNIAL GRASSLANDS, BUT ALSO OCCURS IN COASTAL SCRUB & SAGEBRUSH WITH SPARSE CANOPY COVER.	PREFERS BUCKWHEAT, CHAMISE, BROME GRASS & FILAREE. WILL BURROW INTO FIRM SOIL.
Dudleya multicaulis	many-stemmed dudleya	None		CHAPARRAL, COASTAL SCRUB, VALLEY AND FOOTHILL GRASSLAND.	IN HEAVY, OFTEN CLAYEY SOILS OR GRASSY SLOPES. 0-790M.
Empidonax traillii extimus	southwestern willow flycatcher	E/E		RIPARIAN WOODLANDS IN SOUTHERN CALIFORNIA.	
Eriastrum densifolium ssp. sanctorum	Santa Ana River woollystar	E/E		COASTAL SCRUB, CHAPARRAL.	IN SANDY SOILS ON RIVER FLOODPLAINS OR TERRACED FLUVIAL DEPOSITS. 150-610M.
Eumops perotis californicus	western mastiff bat	None	SC	MANY OPEN, SEMI-ARID TO ARID HABITATS, INCLUDING CONIFER & DECIDUOUS WOODLANDS, COASTAL SCRUB, GRASSLANDS, CHAPARRAL ETC	ROOSTS IN CREVICES IN CLIFF FACES, HIGH BUILDINGS, TREES & TUNNELS.
Gila orcuttii	arroyo chub	None	SC	LOS ANGELES BASIN SOUTH COASTAL STREAMS.	SLOW WATER STREAM SECTIONS WITH MUD OR SAND BOTTOMS. FEEDS HEAVILY ON AQUATIC VEGETATION & ASSOCIATED INVERTEBRATES.
Icteria virens	yellow-breasted chat	None	SC	SUMMER RESIDENT; INHABITS RIPARIAN THICKETS OF WILLOW & OTHER BRUSHY TANGLES NEAR WATERCOURSES.	NESTS IN LOW, DENSE RIPARIAN, CONSISTING OF WILLOW, BLACKBERRY, WILD GRAPE; FORAGES AND NESTS WITHIN 10 FT OF GROUND.
Lasiurus xanthinus	western yellow bat	None		FOUND IN VALLEY FOOTHILL RIPARIAN, DESERT RIPARIAN, DESERT WASH, AND PALM OASIS HABITATS.	ROOSTS IN TREES, PARTICULARLY PALMS. FORAGES OVER WATER AND AMONG TREES.
Nolina cismontana	chaparral nolina	None		CHAPARRAL, COASTAL SCRUB.	PRIMARILY ON SANDSTONE AND SHALE SUBSTRATES; ALSO KNOWN FROM GABBRO. 140-1275M.
Nyctinomops femorosaccus	pocketed free-tailed bat	None	SC	VARIETY OF ARID AREAS IN SOUTHERN CALIFORNIA; PINE-JUNIPER WOODLANDS, DESERT SCRUB, PALM OASIS, DESERT WASH, DESERT RIPA	ROCKY AREAS WITH HIGH CLIFFS.

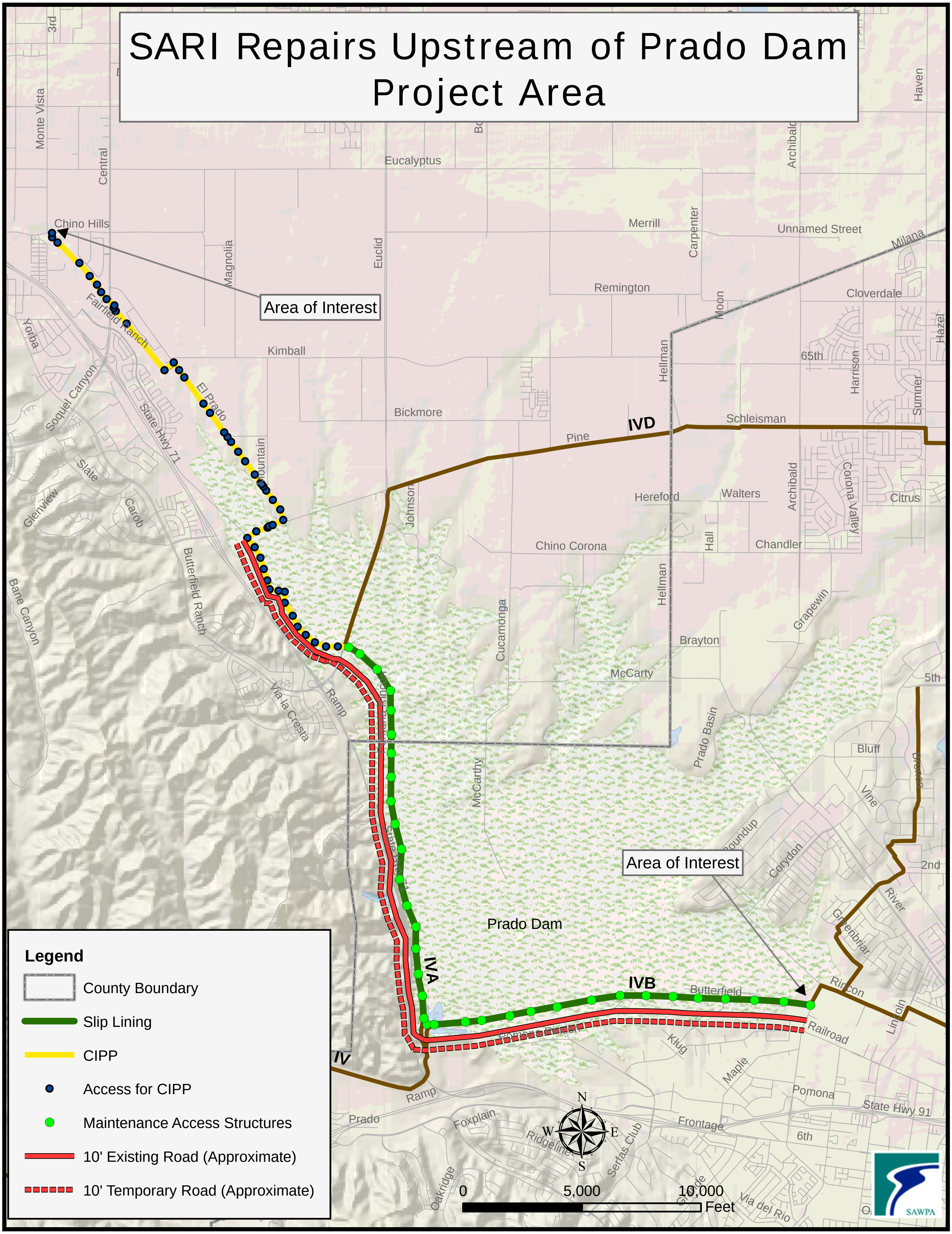
SCIENTIFIC NAME	COMMON NAME	STATUS FED /STATE		GENERAL HABITAT CHARACTERISTICS	MICROHABITAT CHARACTERISTICS
Phrynosoma coronatum (blainvillii population)	coast (San Diego) horned lizard	None	SC	INHABITS COASTAL SAGE SCRUB AND CHAPARRAL IN ARID AND SEMI-ARID CLIMATE CONDIT	PREFERS FRIABLE, ROCKY, OR SHALLOW SANDY SOILS.
Polioptila californica californica	coastal California gnatcatcher	T/None	SC	OBLIGATE, PERMANENT RESIDENT OF COASTAL SAGE SCRUB BELOW 2500 FT IN SOUTHERN CALIFORNIA.	LOW, COASTAL SAGE SCRUB IN ARID WASHES, ON MESAS & SLOPES. NOT ALL AREAS CLASSIFIED AS COASTAL SAGE SCRUB ARE OCCUPIED.
Pseudognaphalium leucocephalum	white rabbit-tobacco	None		RIPARIAN WOODLAND, CISMONTANE WOODLAND, COASTAL SCRUB, CHAPARRAL.	SANDY, GRAVELLY SITES. 0-2100M.
Rhaphiomidas terminatus abdominalis	Delhi Sands flower-loving fly	E/None		FOUND ONLY IN AREAS OF THE DELHI SANDS FORMATION IN SOUTHWESTERN SAN BERNARDINO & NORTHWESTERN RIVERSIDE COUNTIES.	REQUIRES FINE, SANDY SOILS, OFTEN WITH WHOLLY OR PARTLY CONSOLIDATED DUNES & SPARSE VEGETATION. OVIPOSITION REQ. SHADE.
Senecio aphanactis	chaparral ragwort	None		CISMONTANE WOODLAND, COASTAL SCRUB.	DRYING ALKALINE FLATS. 20-575M.
Sidalcea neomexicana	Salt Spring checkerbloom	None		ALKALI PLAYAS, BRACKISH MARSHES, CHAPARRAL, COASTAL SCRUB, LOWER MONTANE CONIFEROUS FOREST, MOJAVEAN DESERT SCRUB.	ALKALI SPRINGS AND MARSHES. 0-1500M.
Southern California Arroyo Chub/Santa Ana Sucker Stream	Southern California Arroyo Chub/Santa Ana Sucker Stream				
Southern Cottonwood Willow Riparian Forest	Southern Cottonwood Willow Riparian Forest				
Southern Sycamore Alder Riparian Woodland	Southern Sycamore Alder Riparian Woodland				
Southern Willow Scrub	Southern Willow Scrub				
Vireo bellii pusillus	least Bell's vireo	E/E		SUMMER RESIDENT OF SOUTHERN CALIFORNIA IN LOW RIPARIAN IN VICINITY OF WATER OR IN DRY RIVER BOTTOMS; BELOW 2000 FT.	NESTS PLACED ALONG MARGINS OF BUSHES OR ON TWIGS PROJECTING INTO PATHWAYS, USUALLY WILLOW, BACCHARIS, MESQUITE.

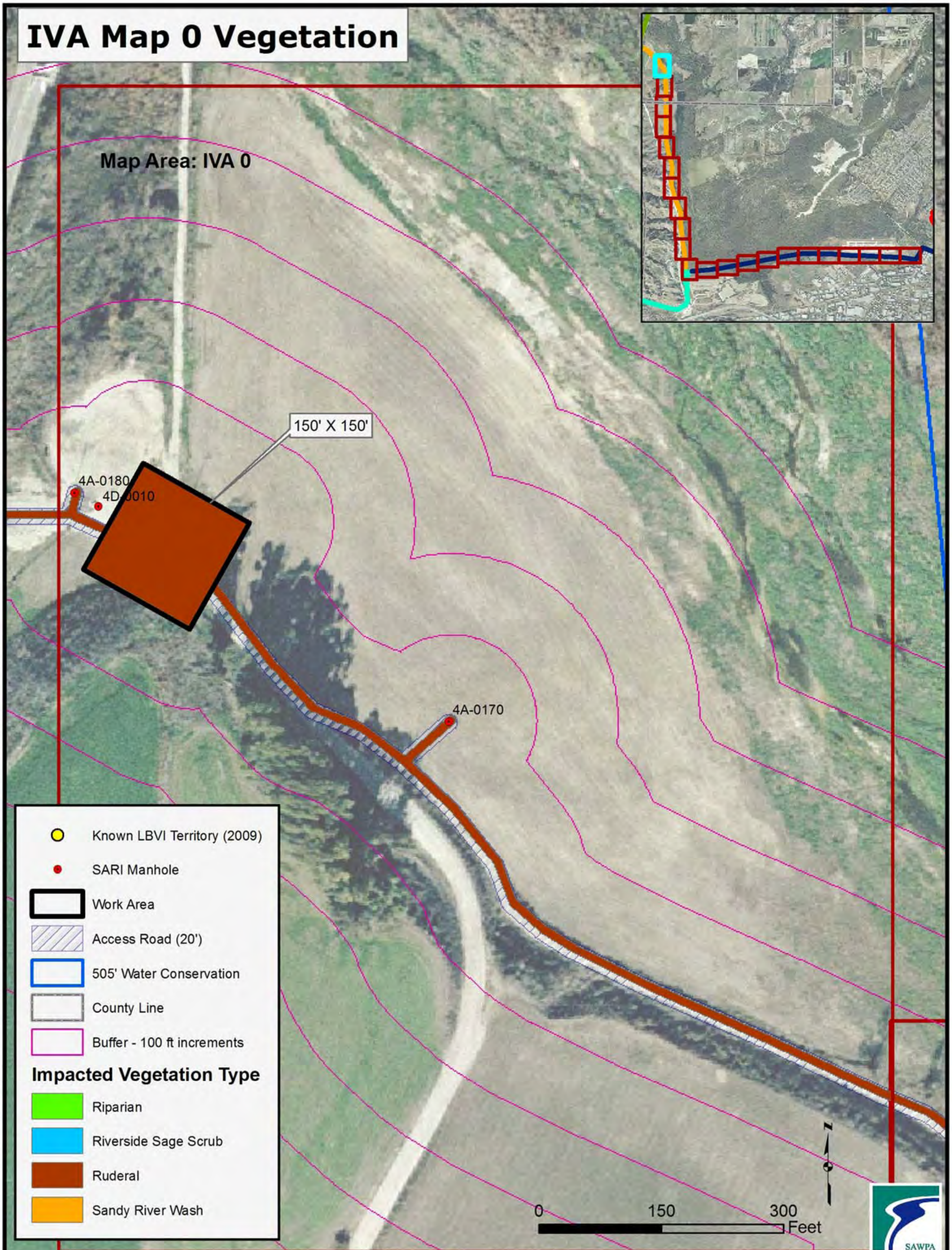
SCIENTIFIC NAME	COMMON NAME	STATUS FED /STATE		GENERAL HABITAT CHARACTERISTICS	MICROHABITAT CHARACTERISTICS

	SPECIES IS ASSUMED PRESENT WITH RECENT RECORDS IN PROJECT AREA
	APPROPRIATE HABITAT EXIST ON SITE AND OCCURRENCE POTENTIAL IS MODERATE TO HIGH
	SMALL PATCHES OF SUTIABLE HABITAT EXIST AND THERE IS A LOW POTENTIAL OF OCCURRENCE

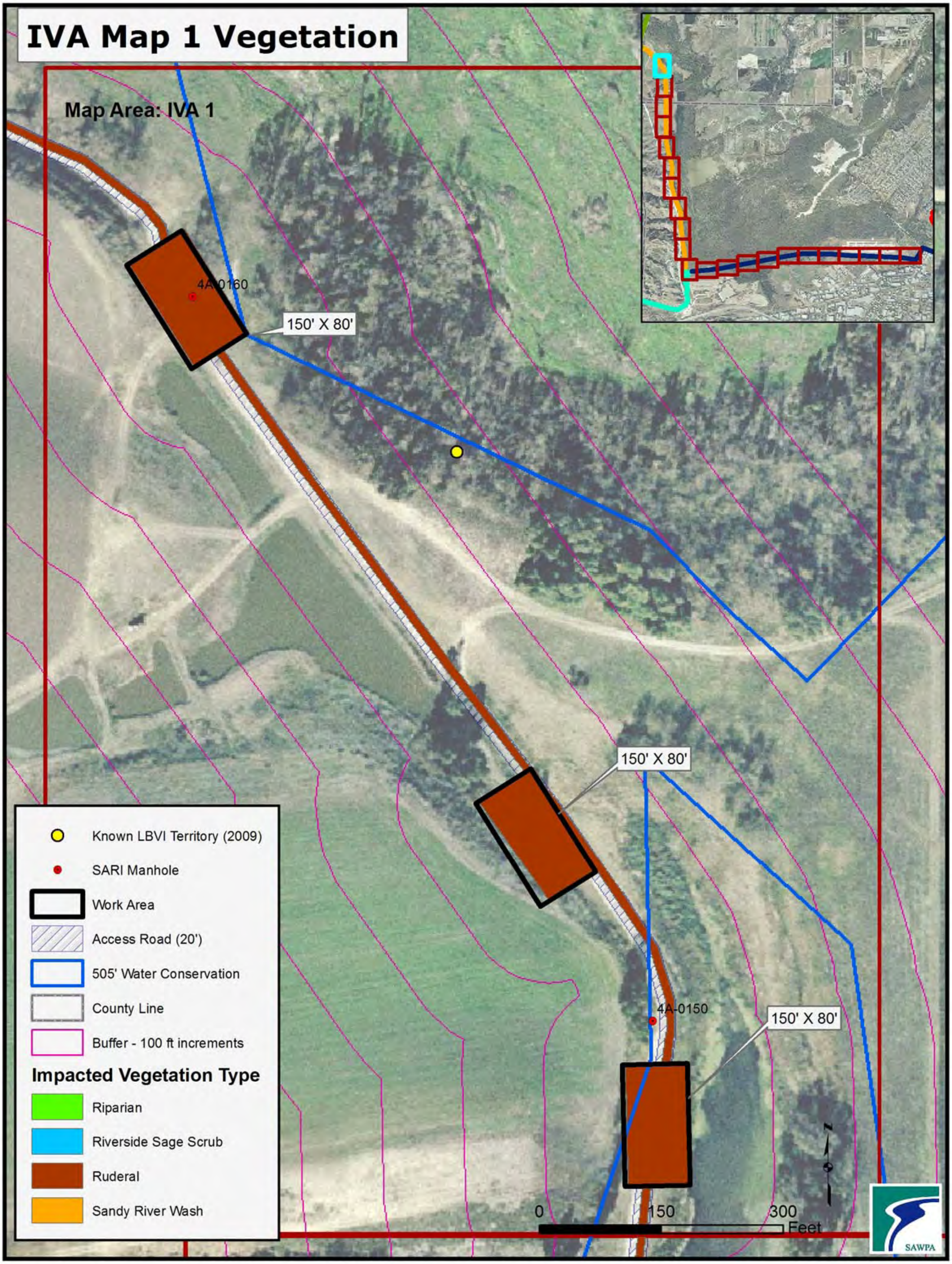
Appendix B   Figures

SARI Repairs Upstream of Prado Dam Project Area




IVA Map 0 Vegetation
Map Area: IVA 0
150' X 150'
4A-0180
4D-0010
4A-0170
Known LBVI Territory (2009)
SARI Manhole
Work Area
Access Road (20')
505' Water Conservation
County Line
Buffer - 100 ft increments
Impacted Vegetation Type
Riparian
Riverside Sage Scrub
Ruderal
Sandy River Wash
0
150
300
Feet
N
SAWPA

IVA Map 1 Vegetation



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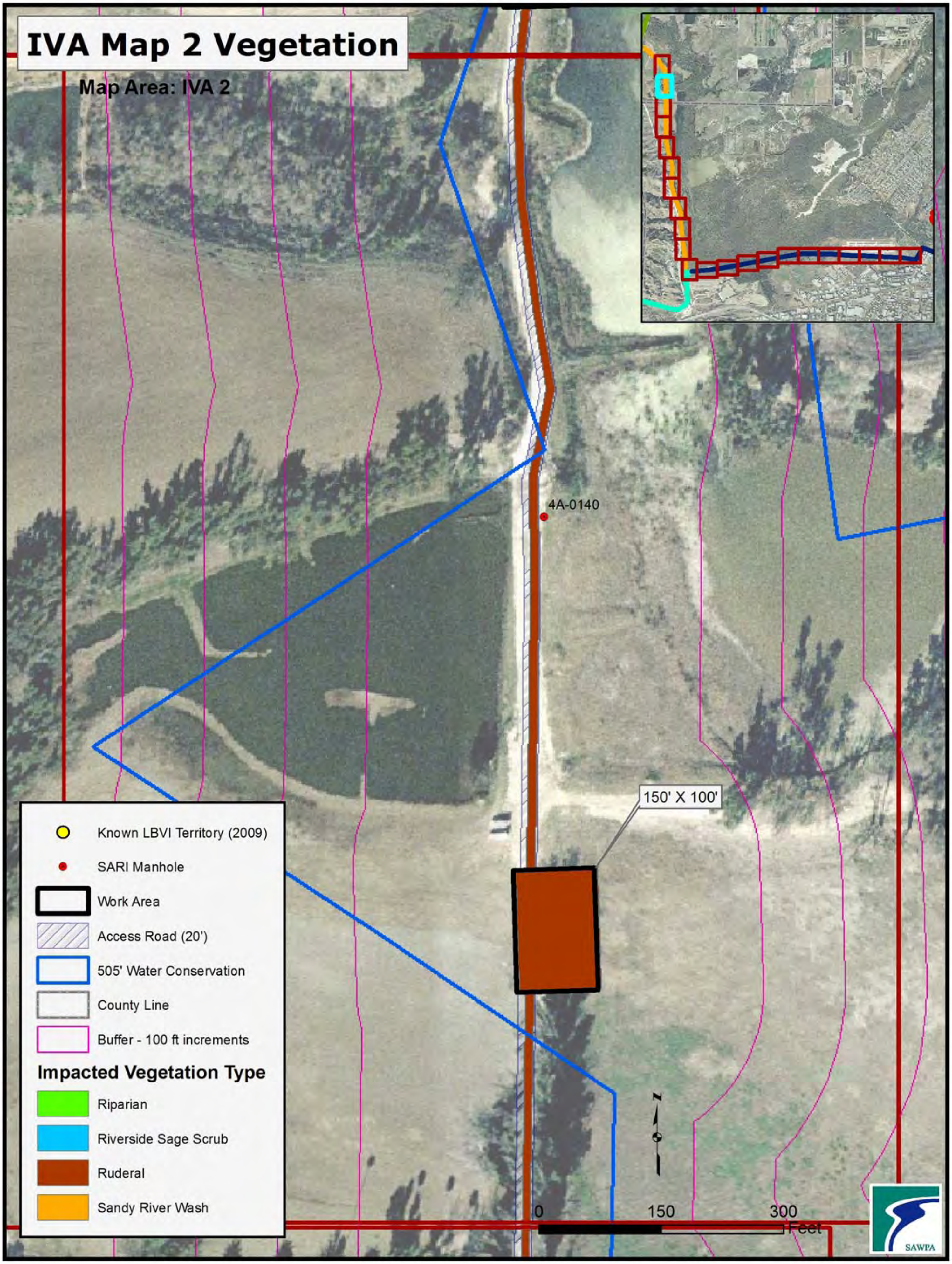

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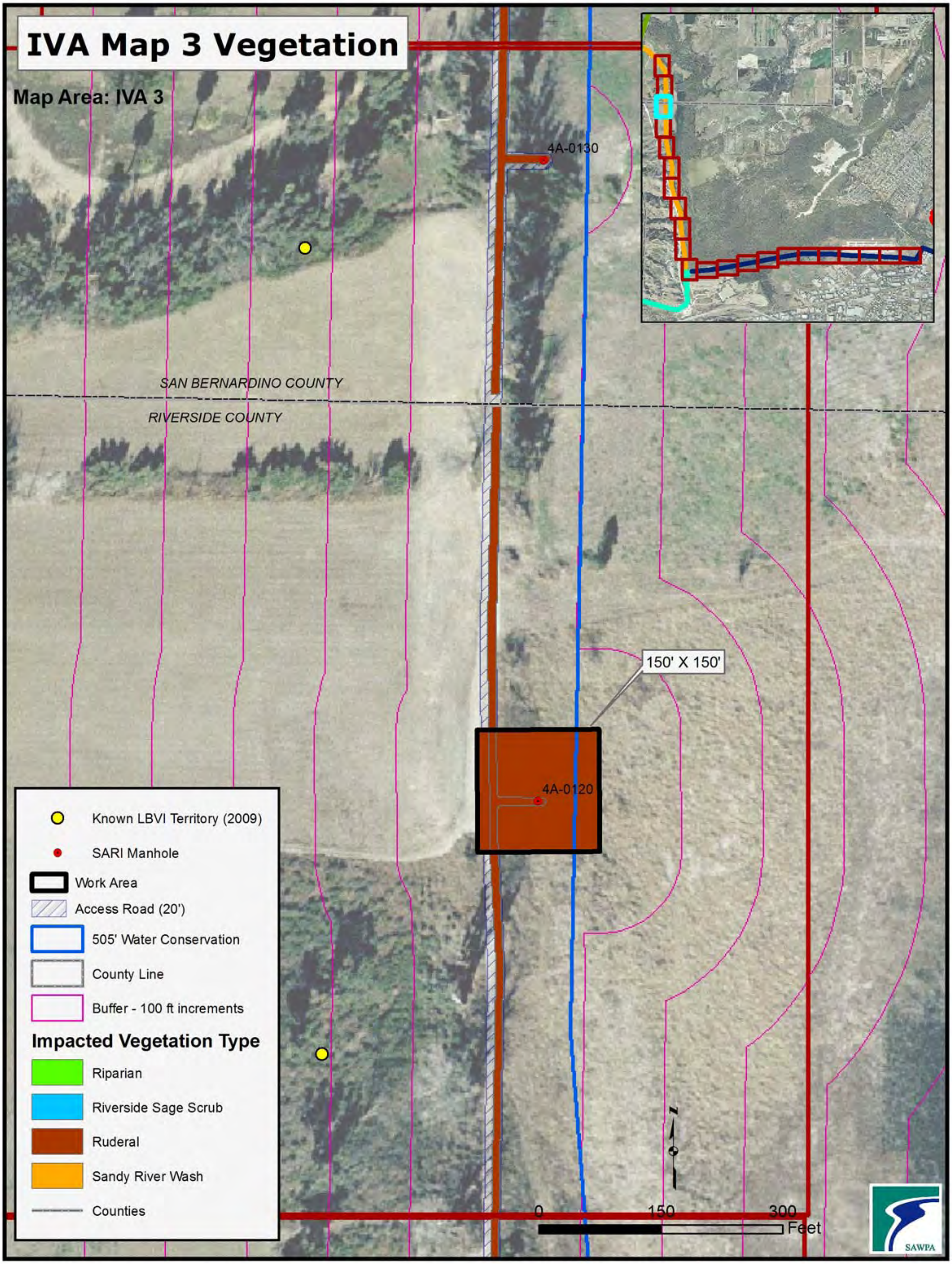

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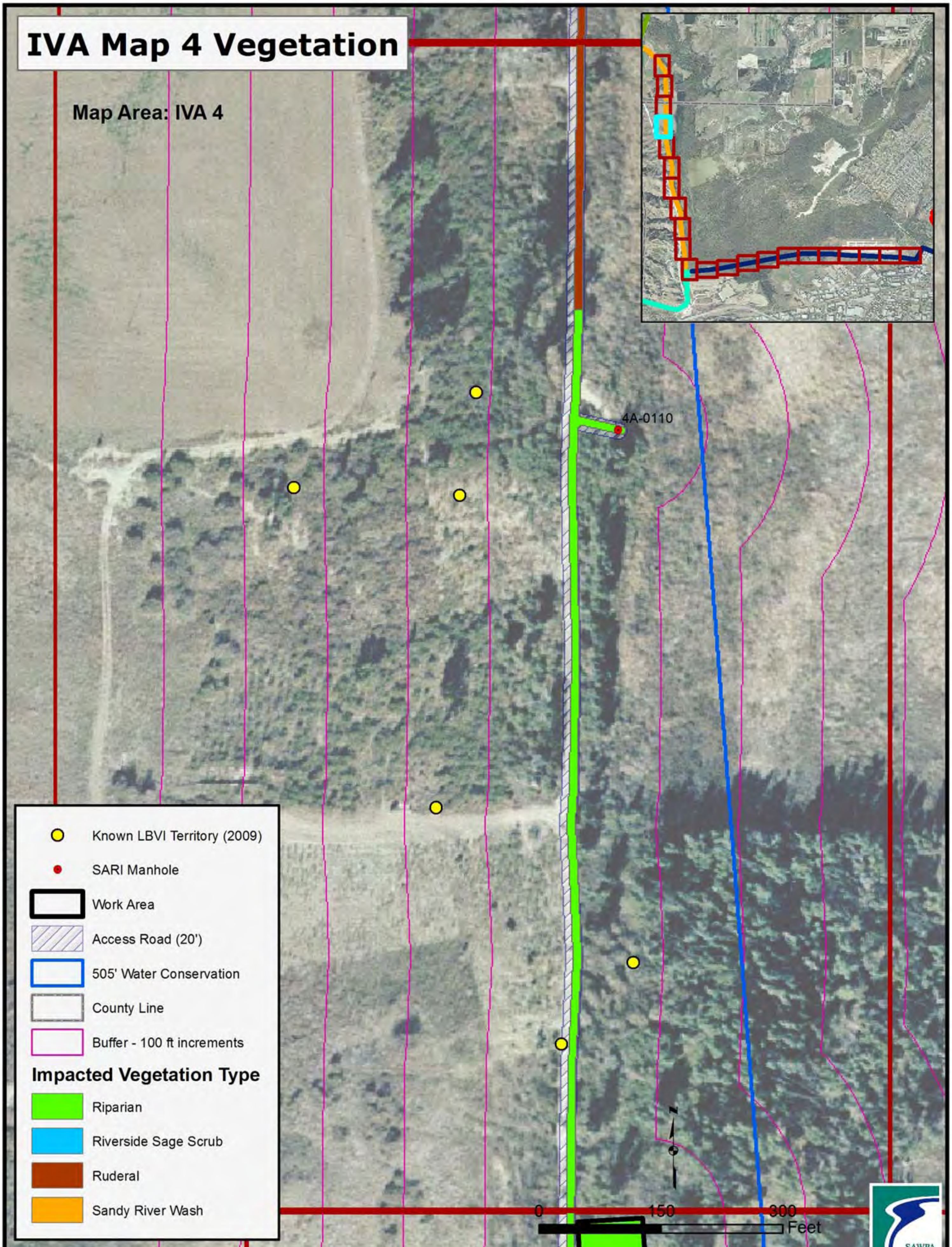

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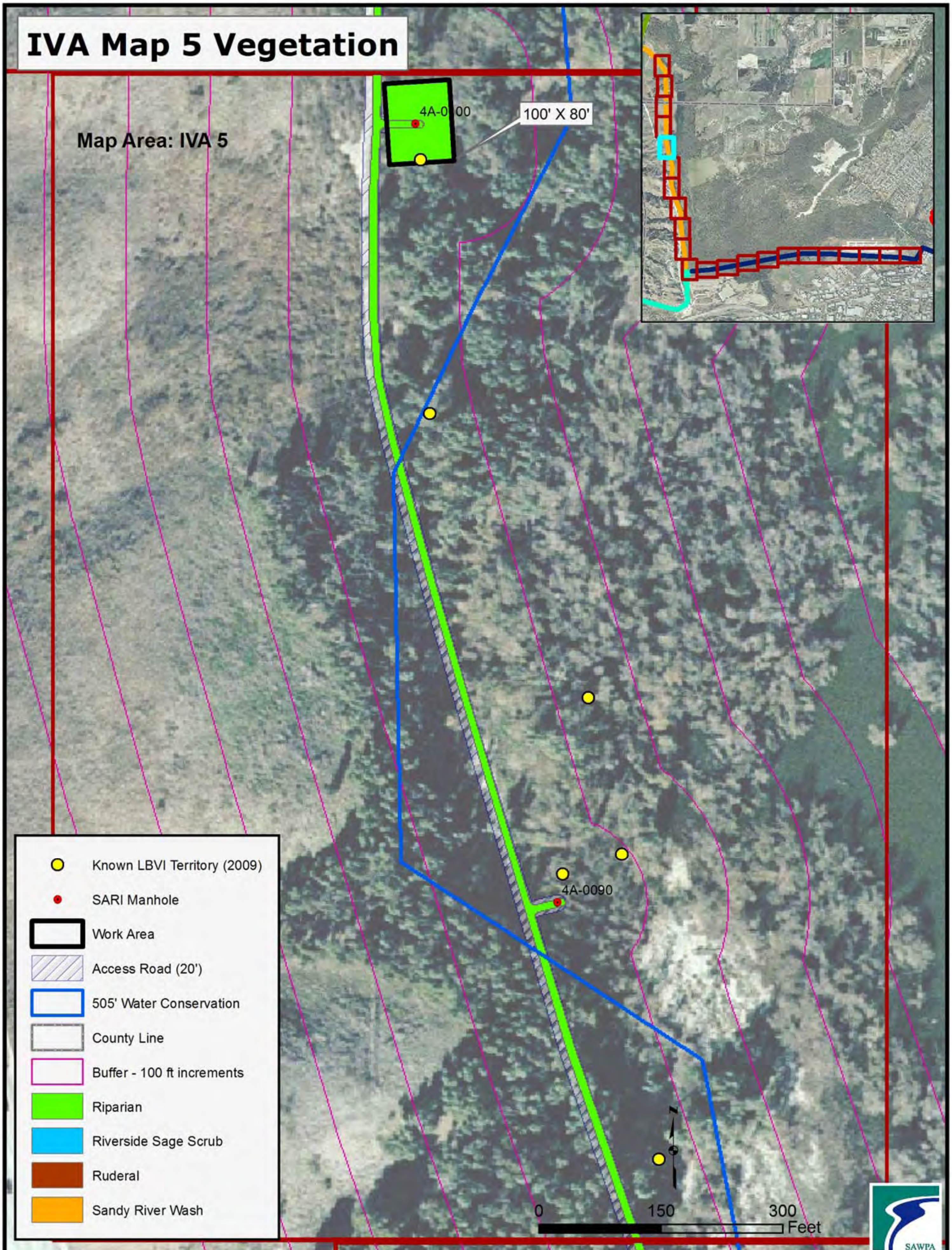
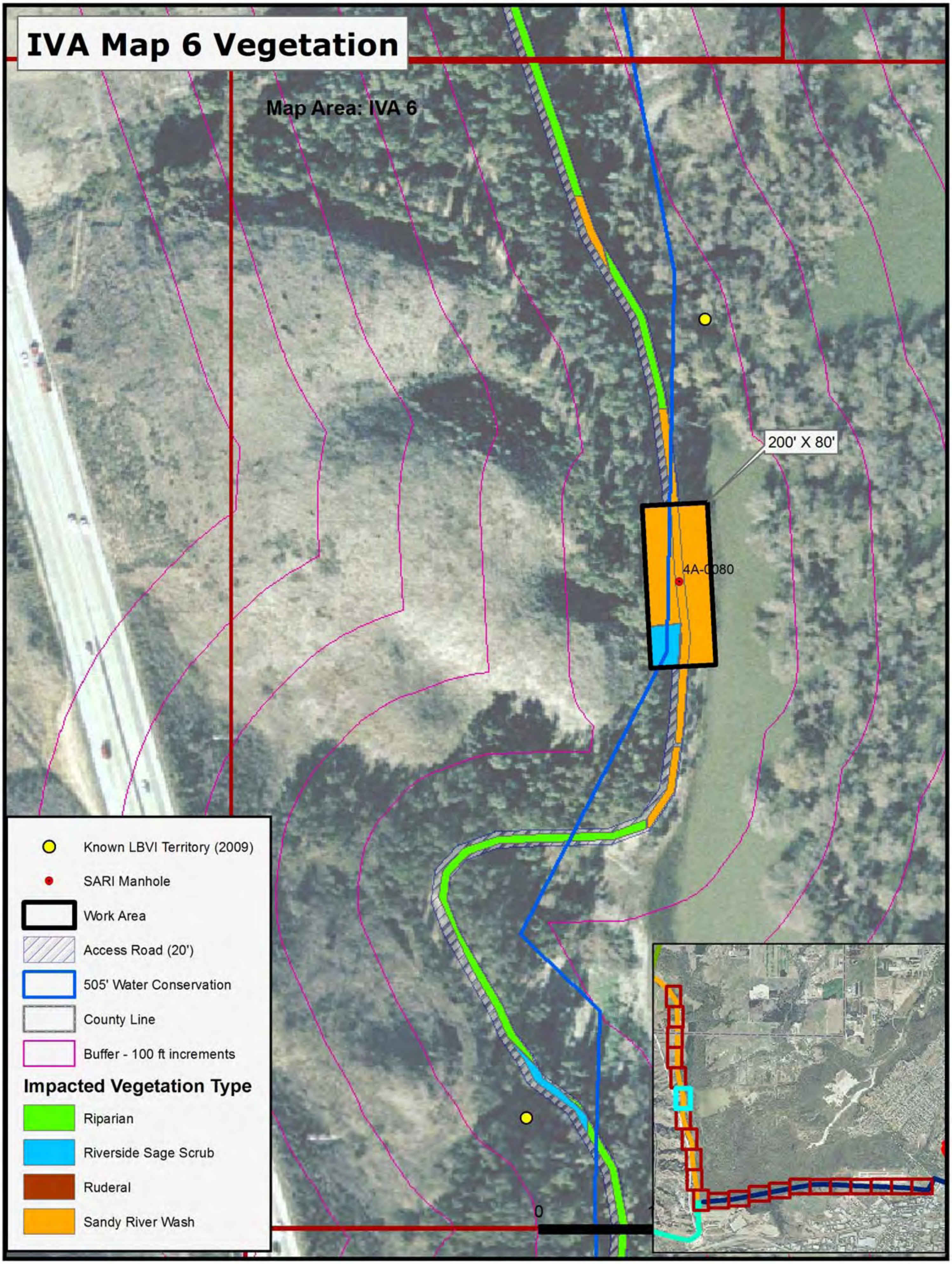

IVA Map 5 Vegetation
Map Area: IVA 5
4A-0
00
100' X 80'
4A-0090
Known LBVI Territory (2009)
SARI Manhole
Work Area
Access Road (20')
505' Water Conservation
County Line
Buffer - 100 ft increments
Riparian
Riverside Sage Scrub
Ruderal
Sandy River Wash
0
150
300
Feet
SAWPA



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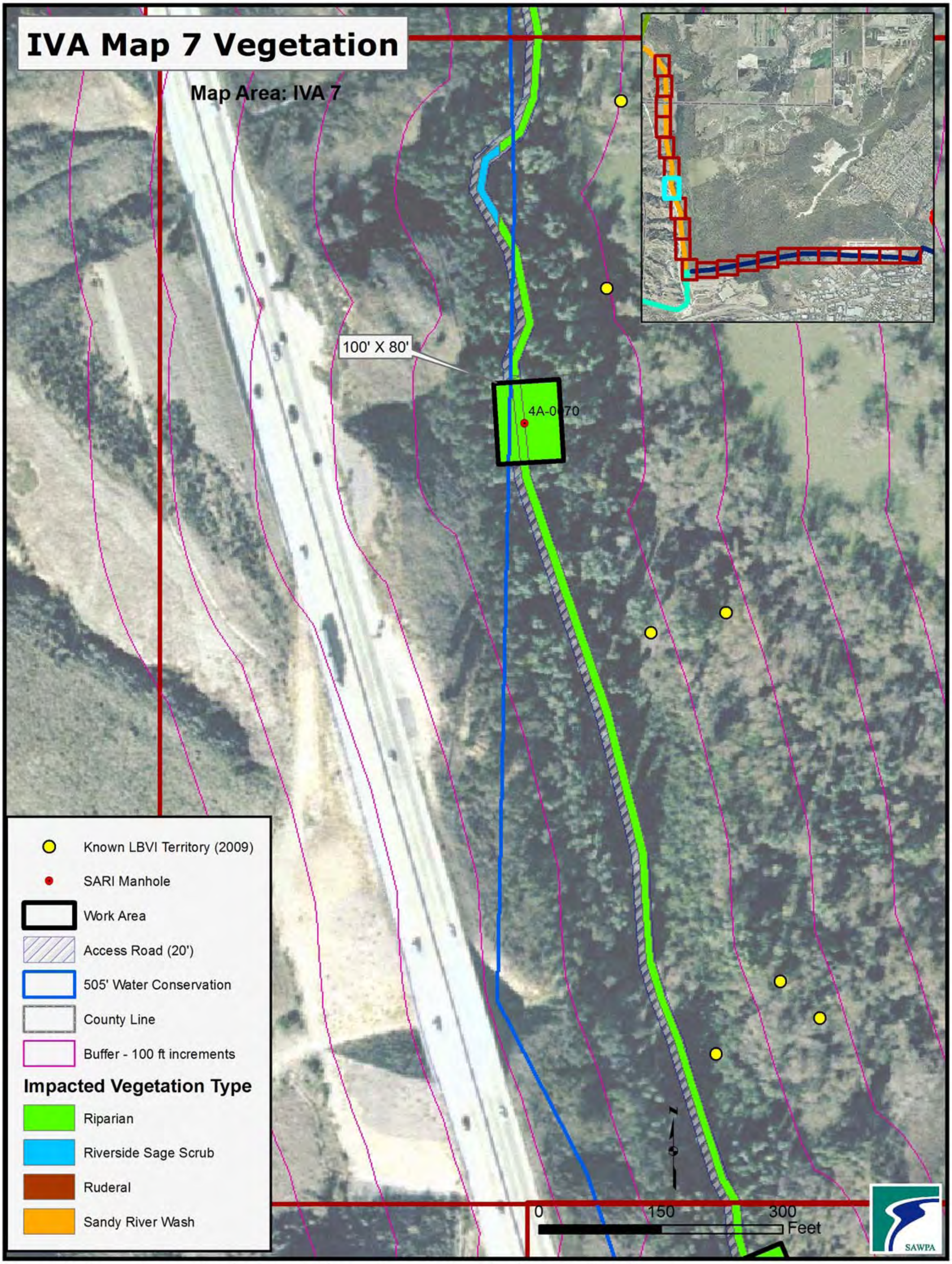

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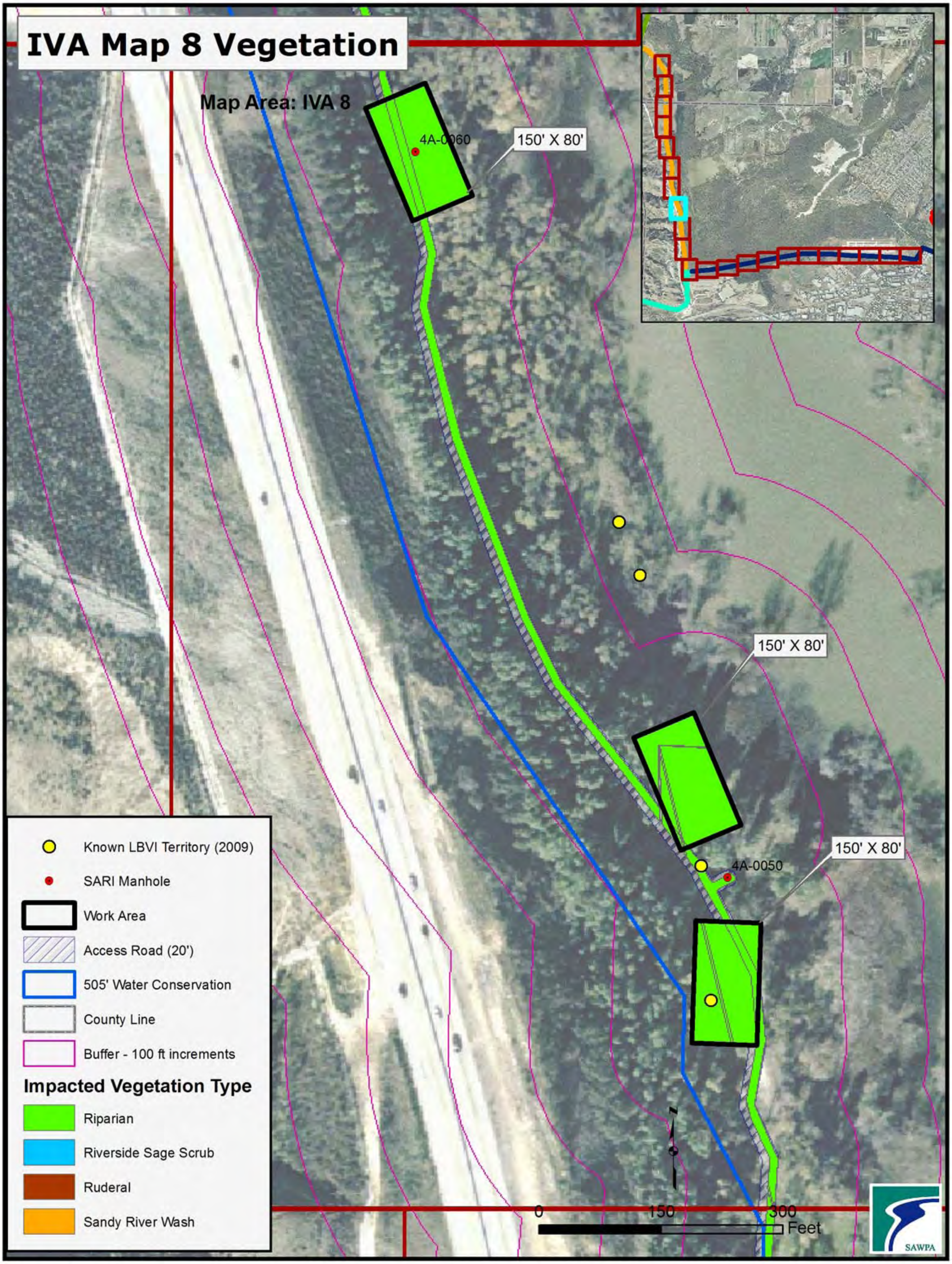

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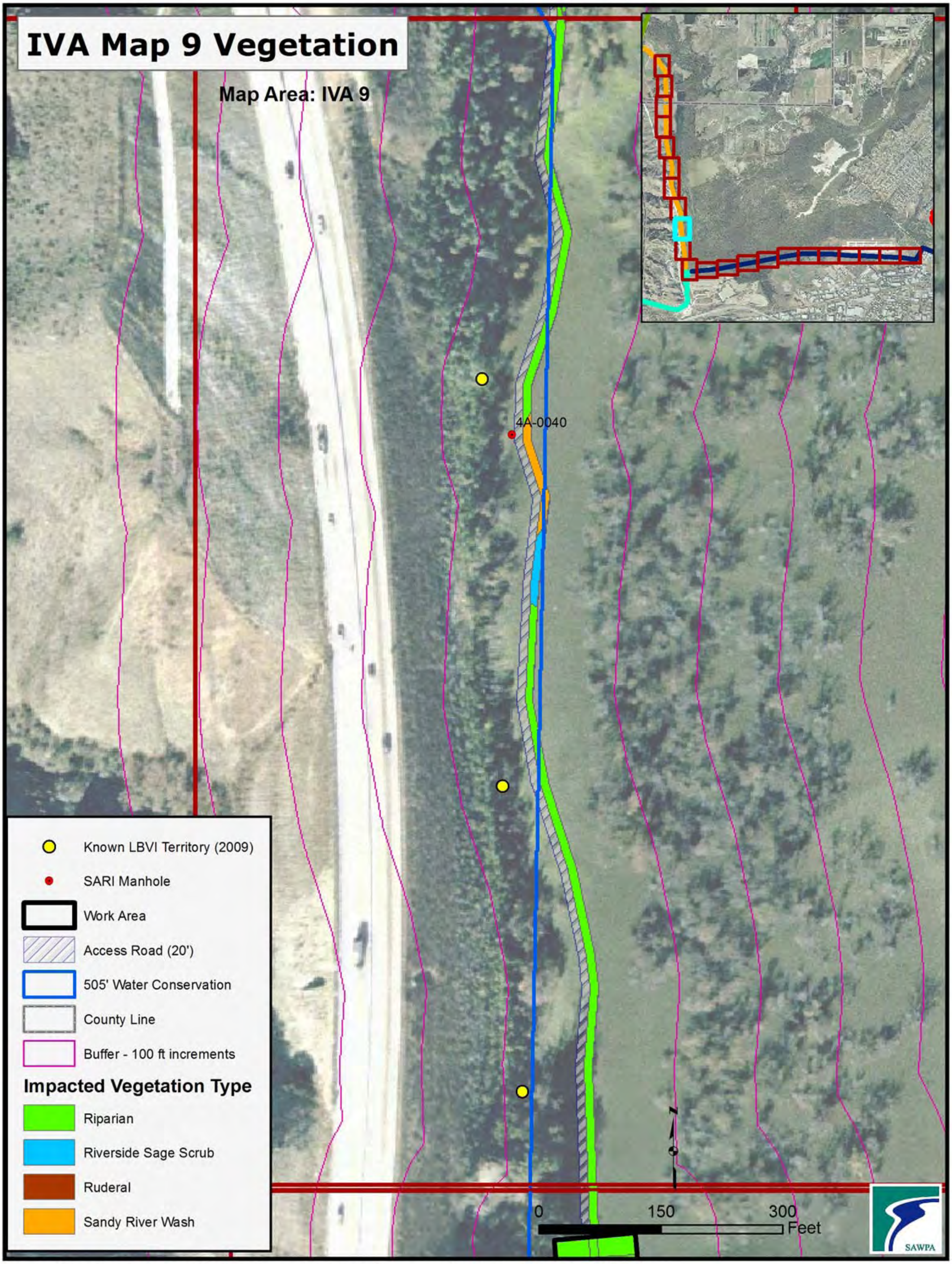

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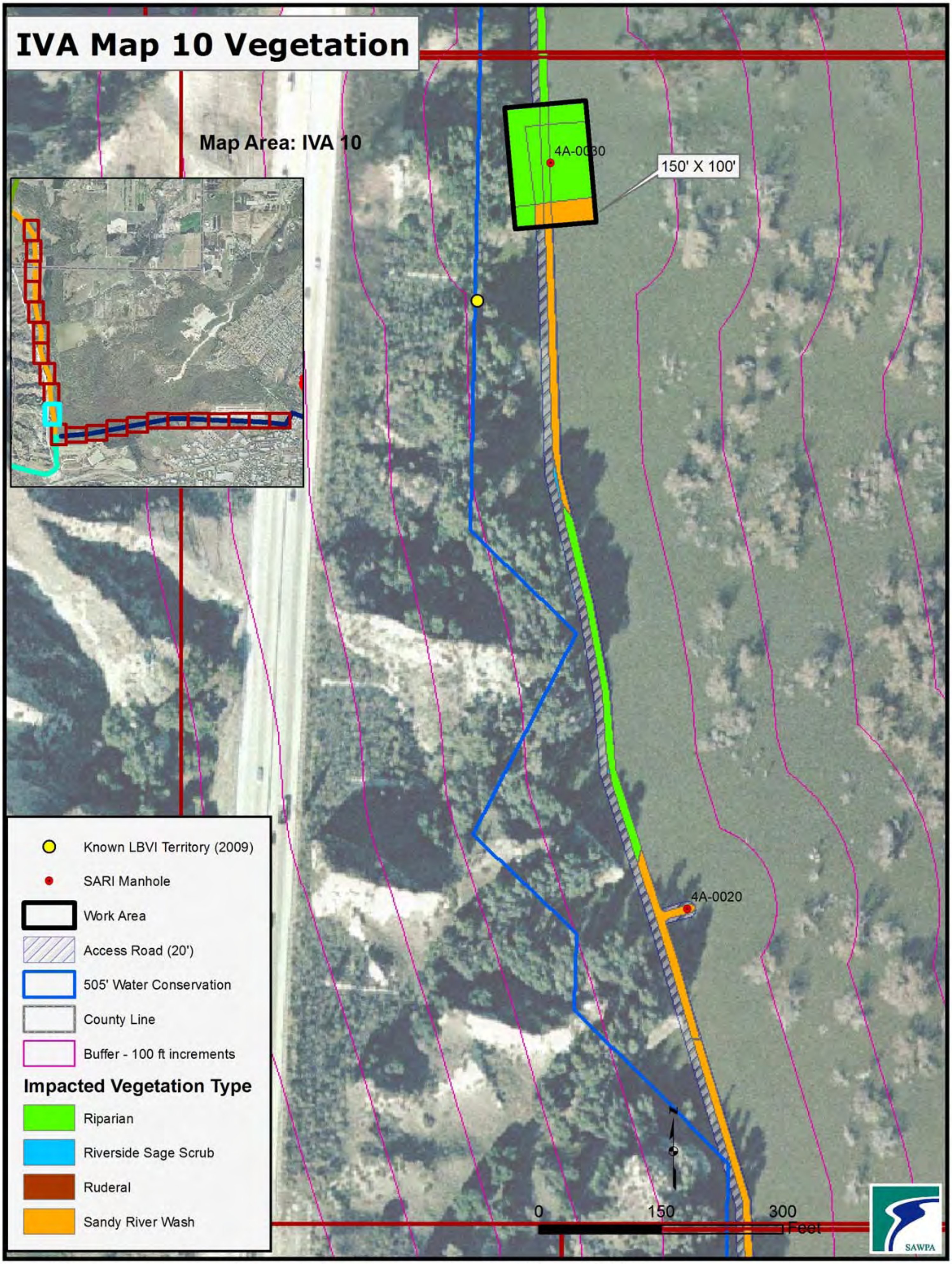

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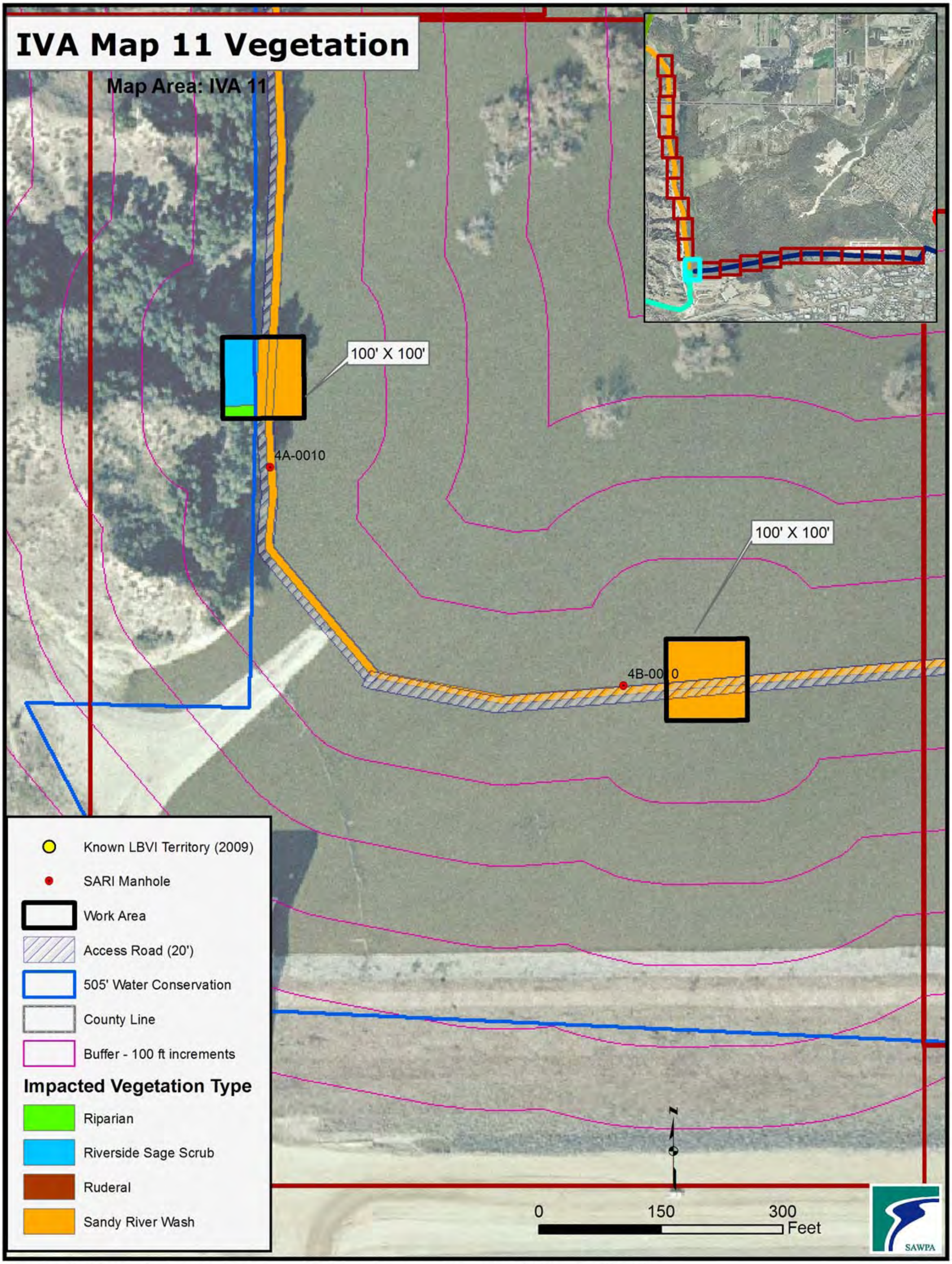
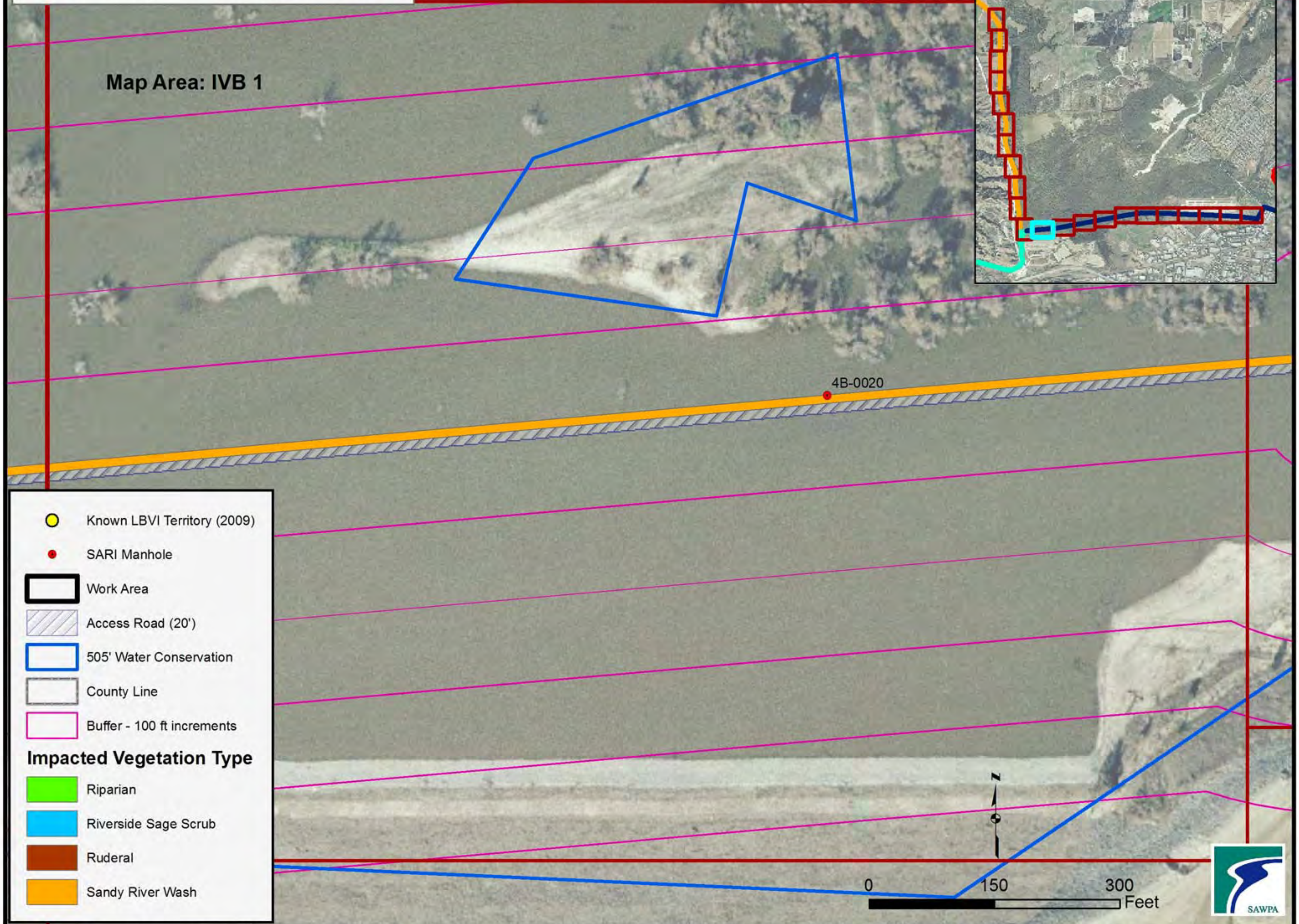

IVA Map 11 Vegetation
Map Area: IVA 11
100' X 100'
4A-0010
100' X 100'
Known LBVI Territory (2009)
SARI Manhole
Work Area
Access Road (20')
505' Water Conservation
County Line
Buffer - 100 ft increments
Impacted Vegetation Type
Riparian
Riverside Sage Scrub
Ruderal
Sandy River Wash
0
150
300
Feet
N
SAWPA

IVB Map 1 Vegetation



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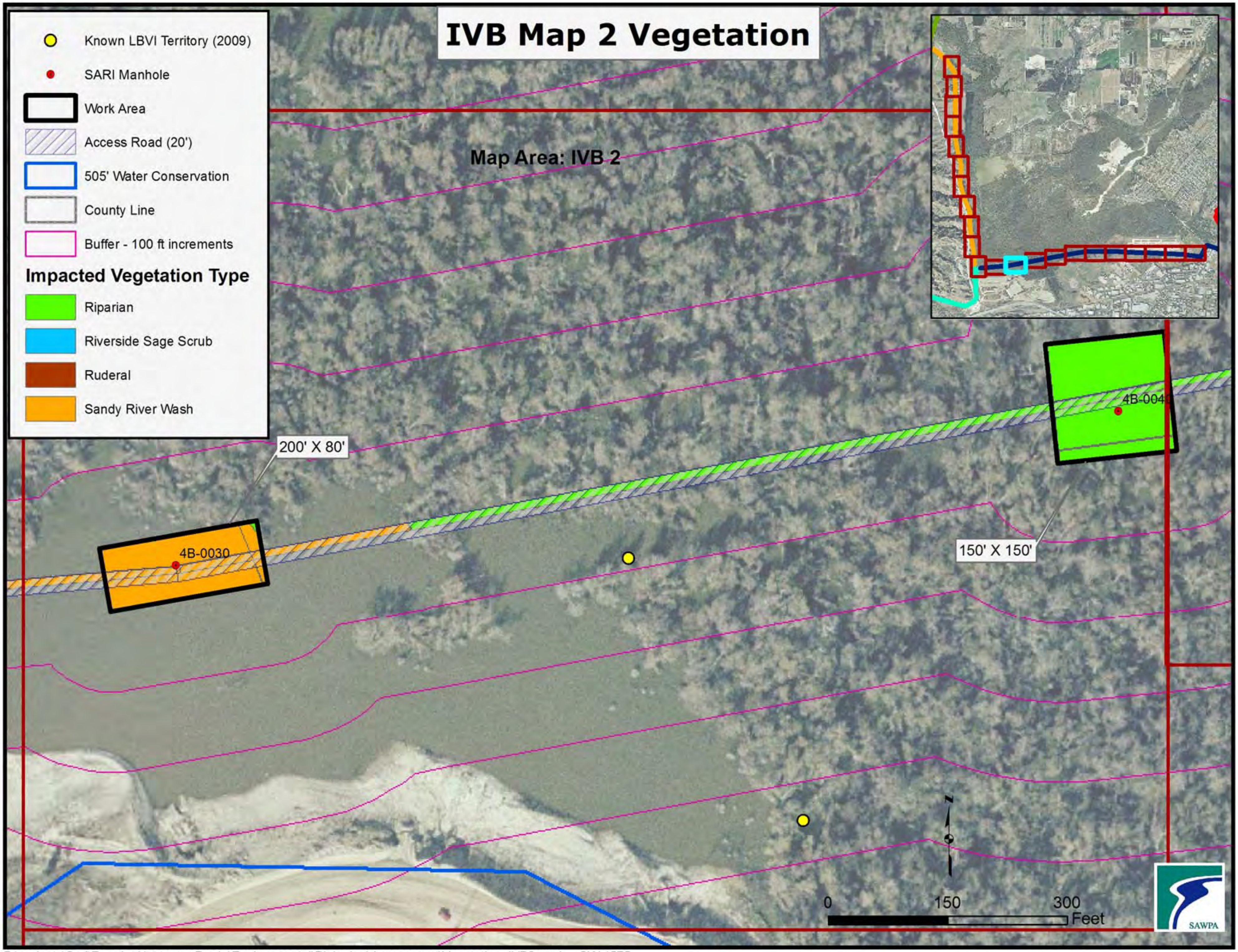

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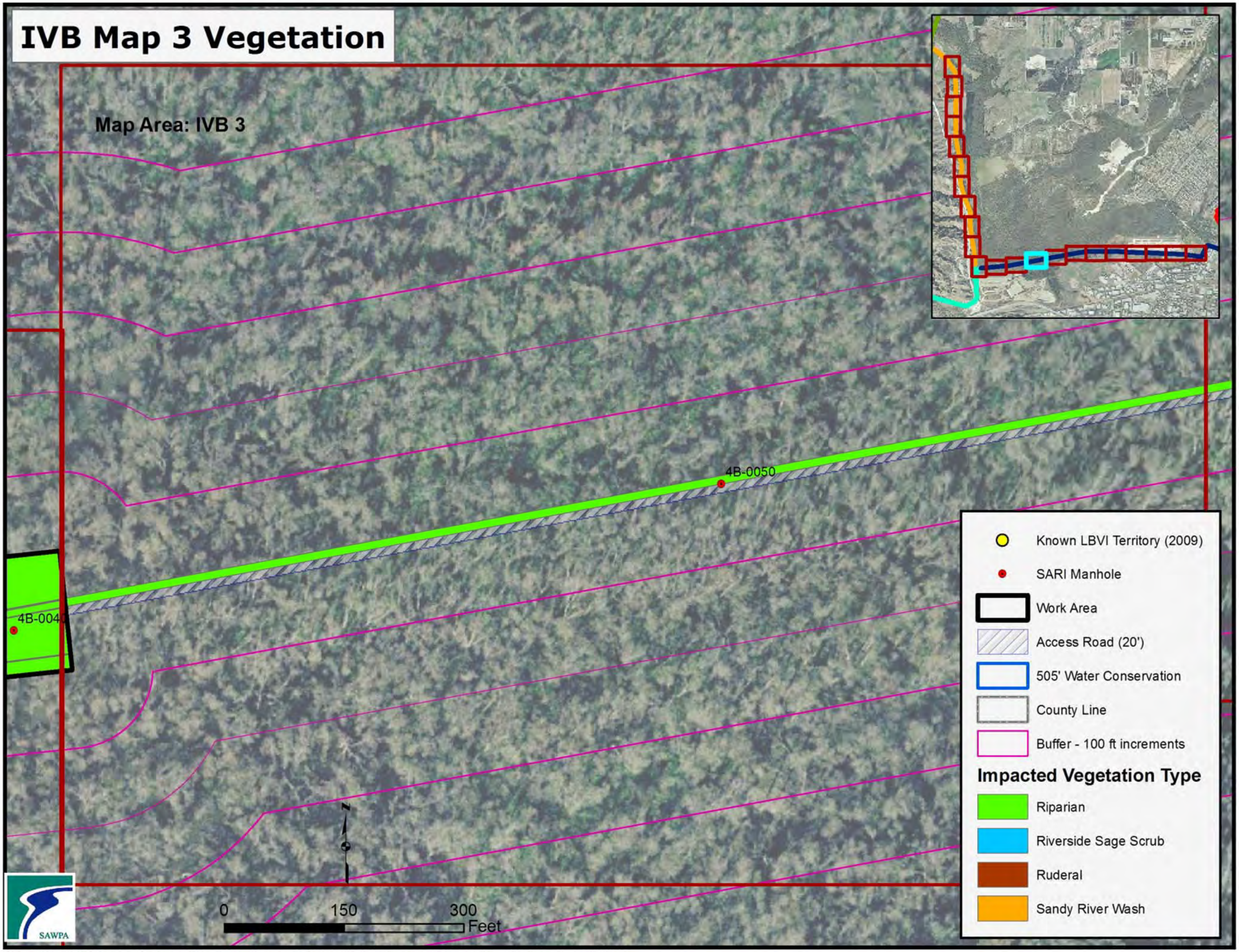

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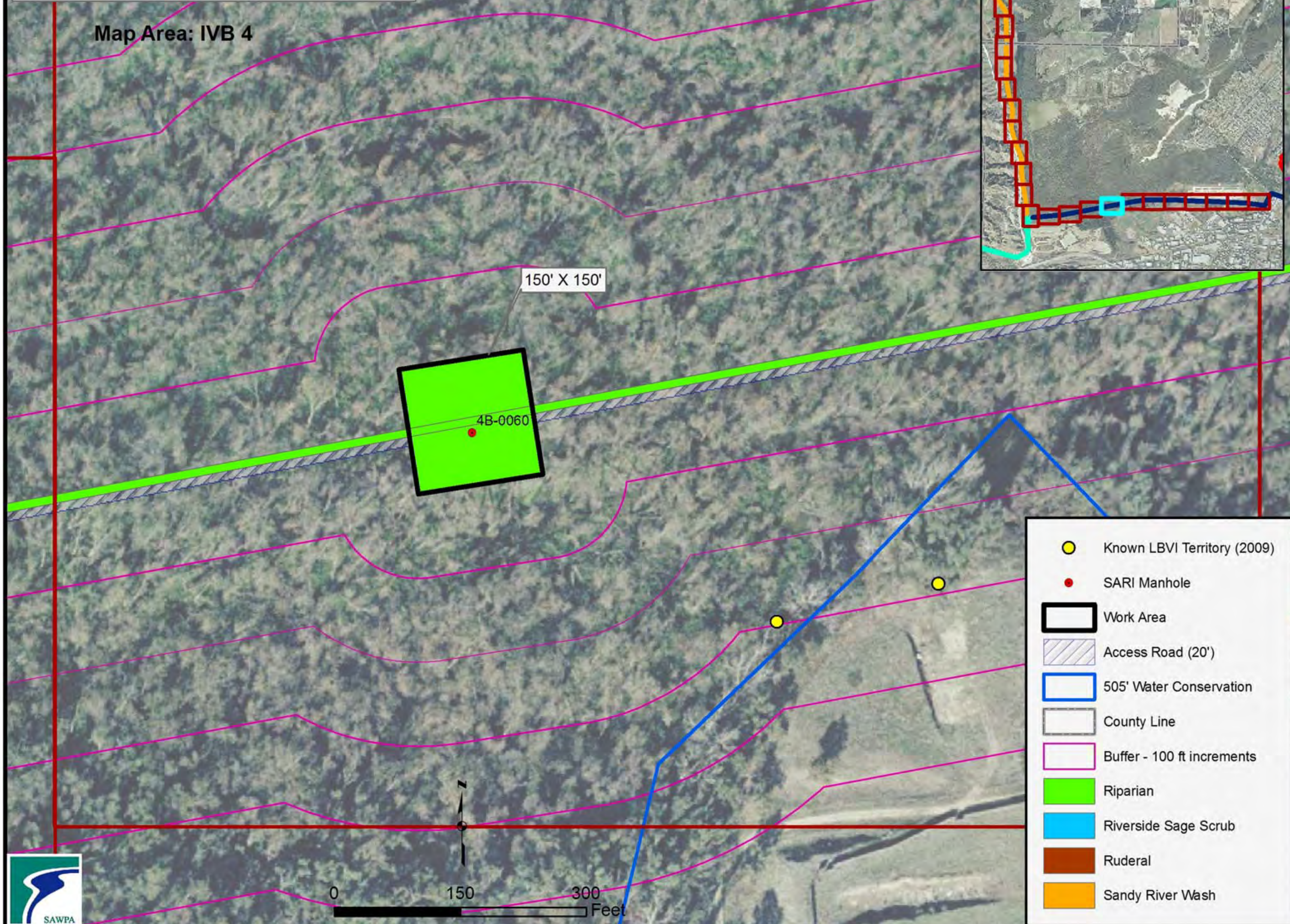
IVB Map 4 Vegetation



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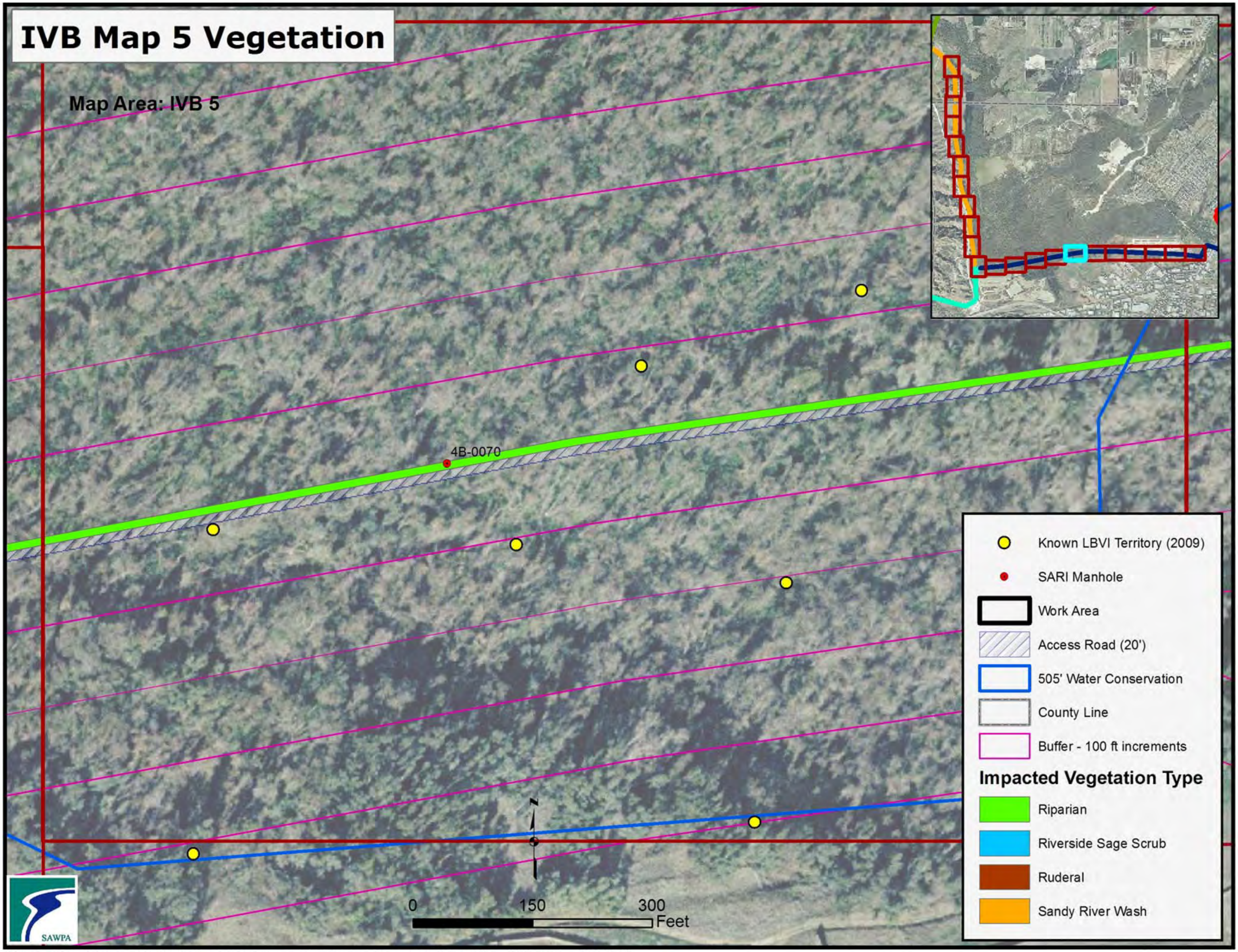

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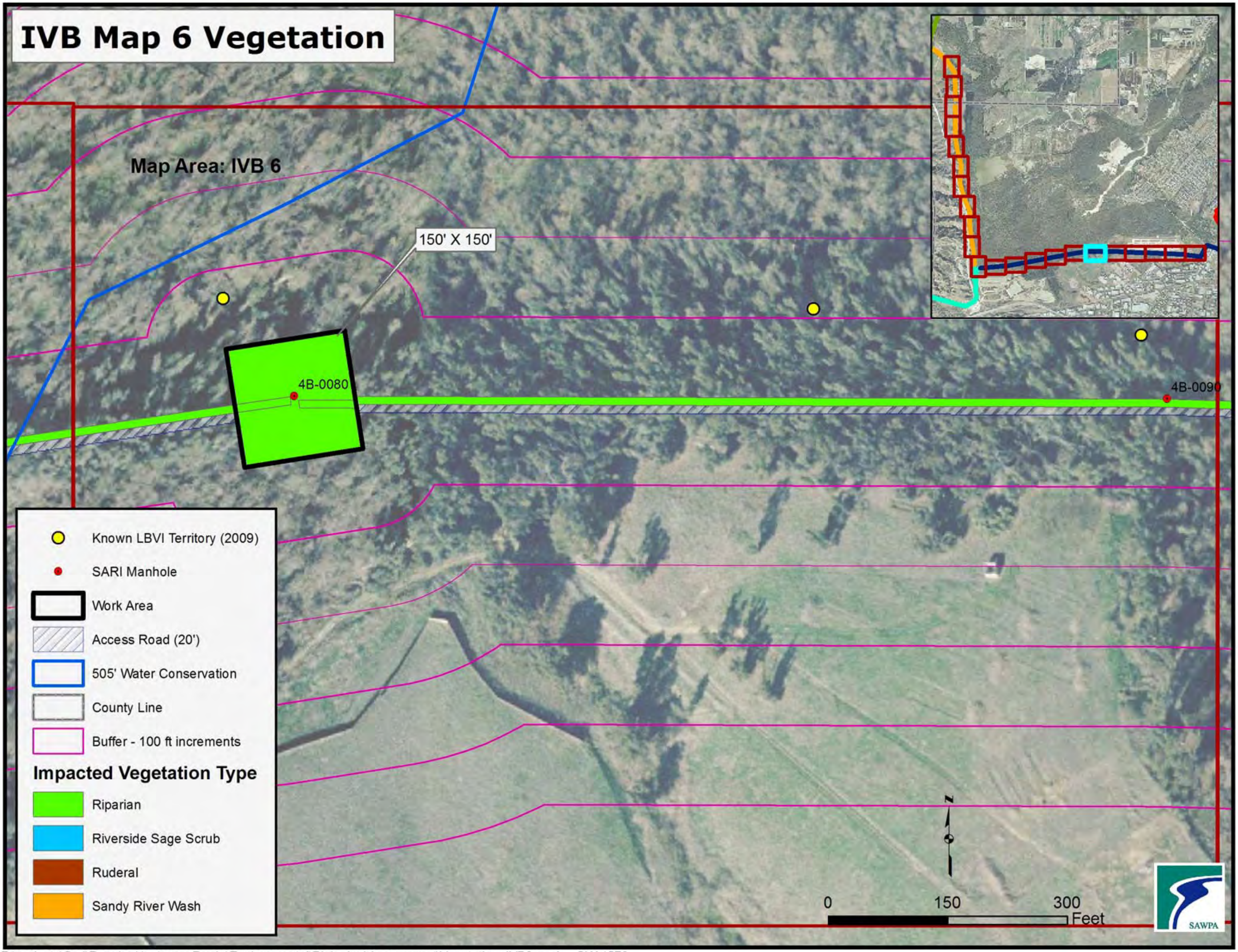

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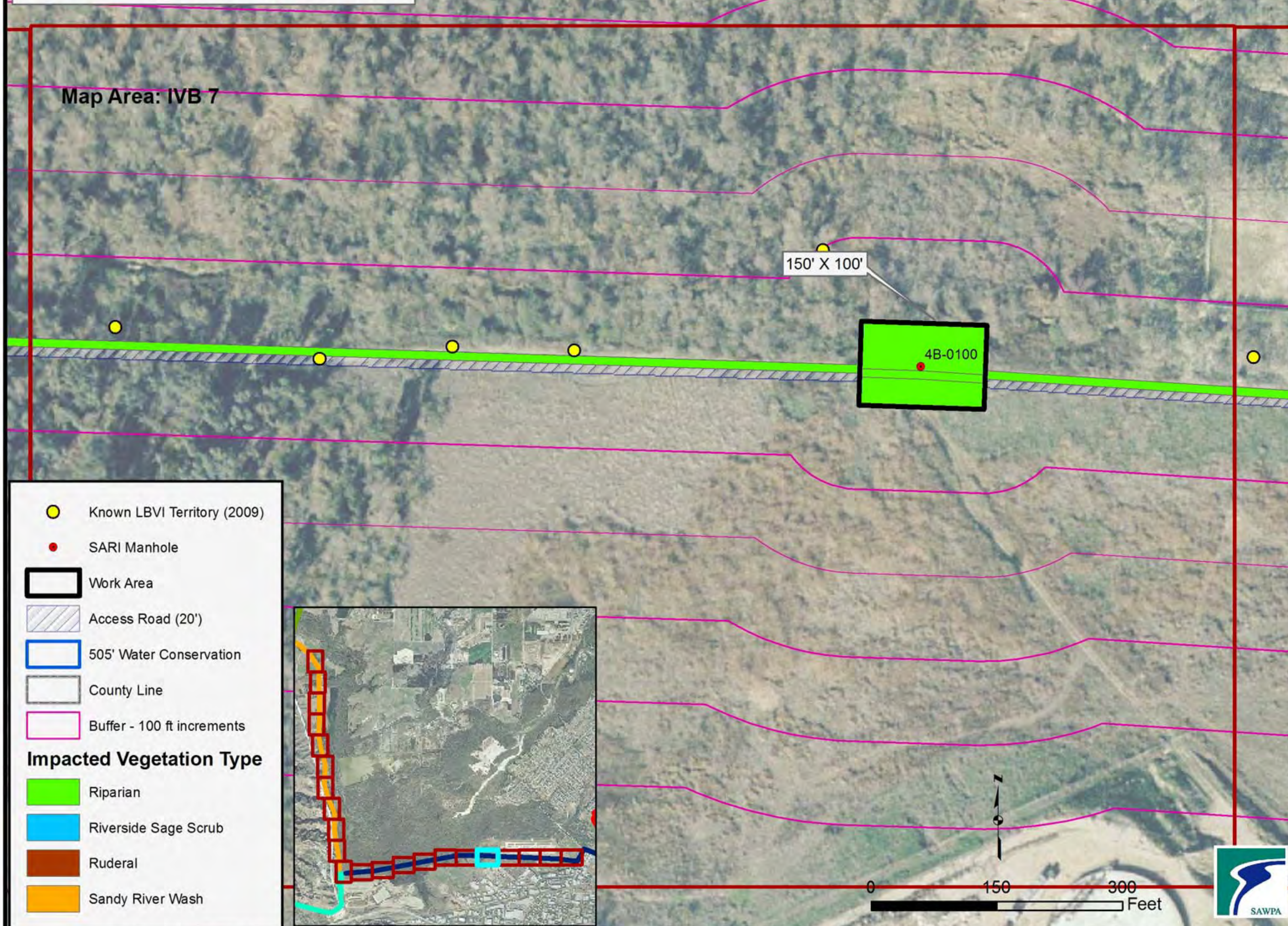
IVB Map 7 Vegetation



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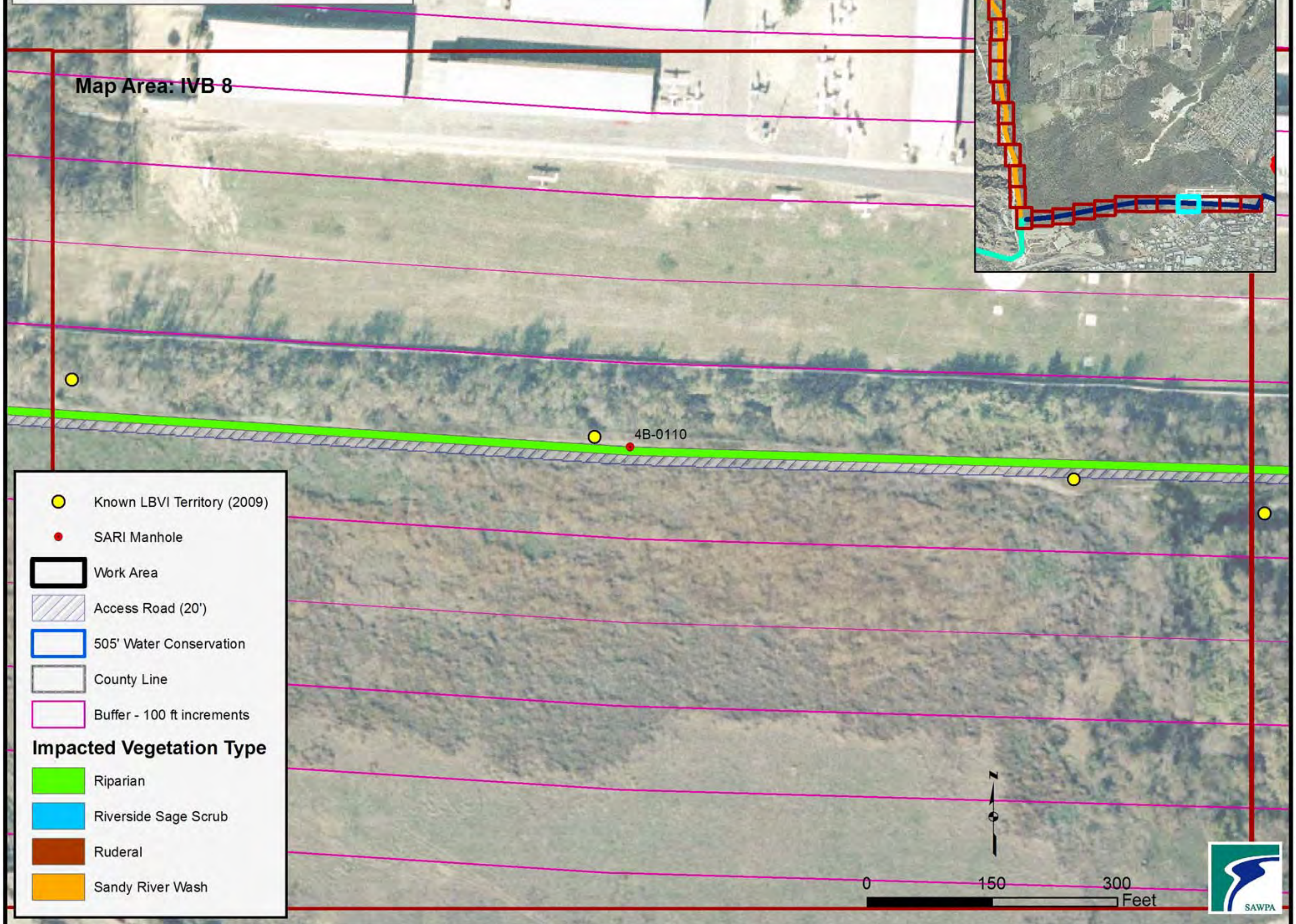
IVB Map 8 Vegetation



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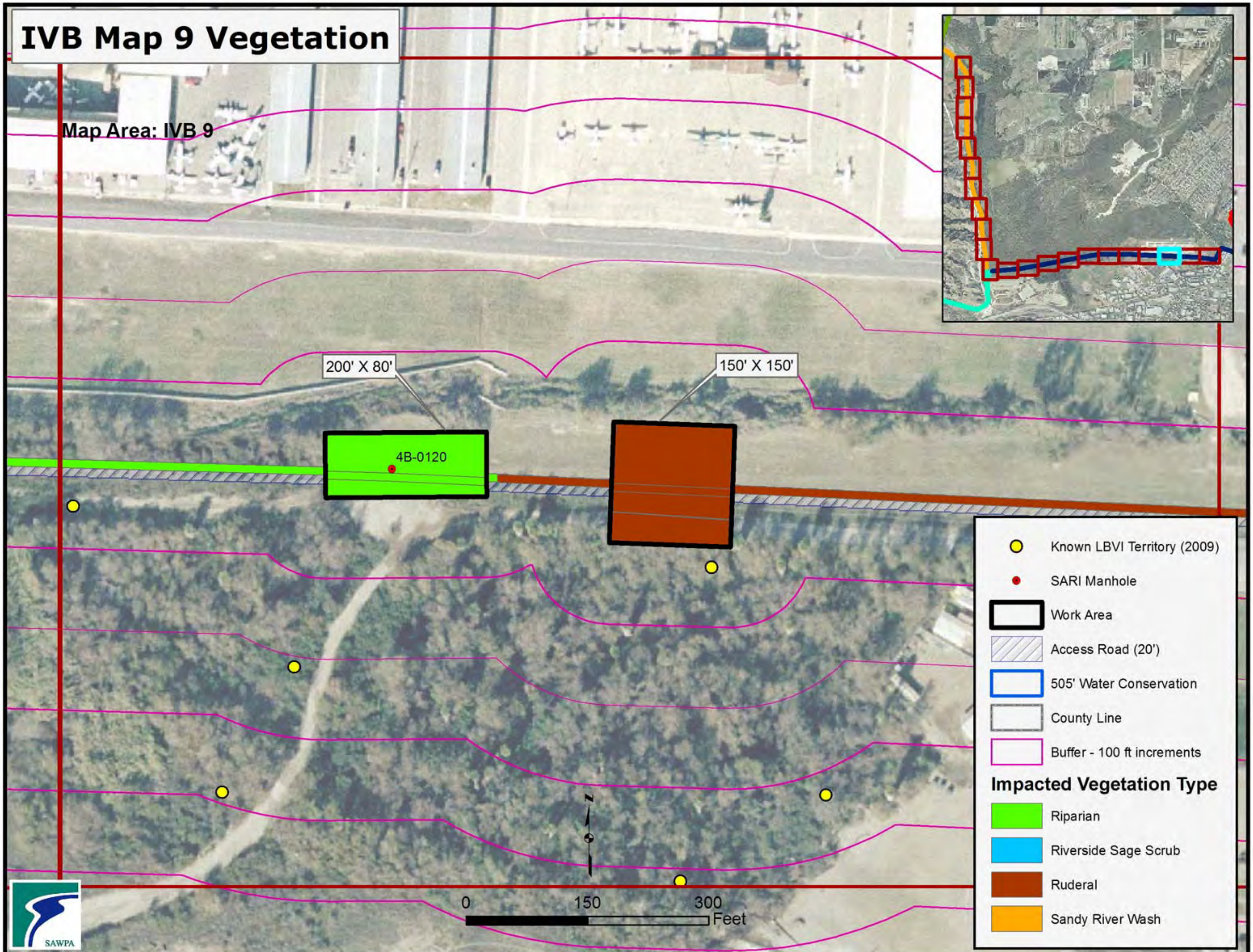

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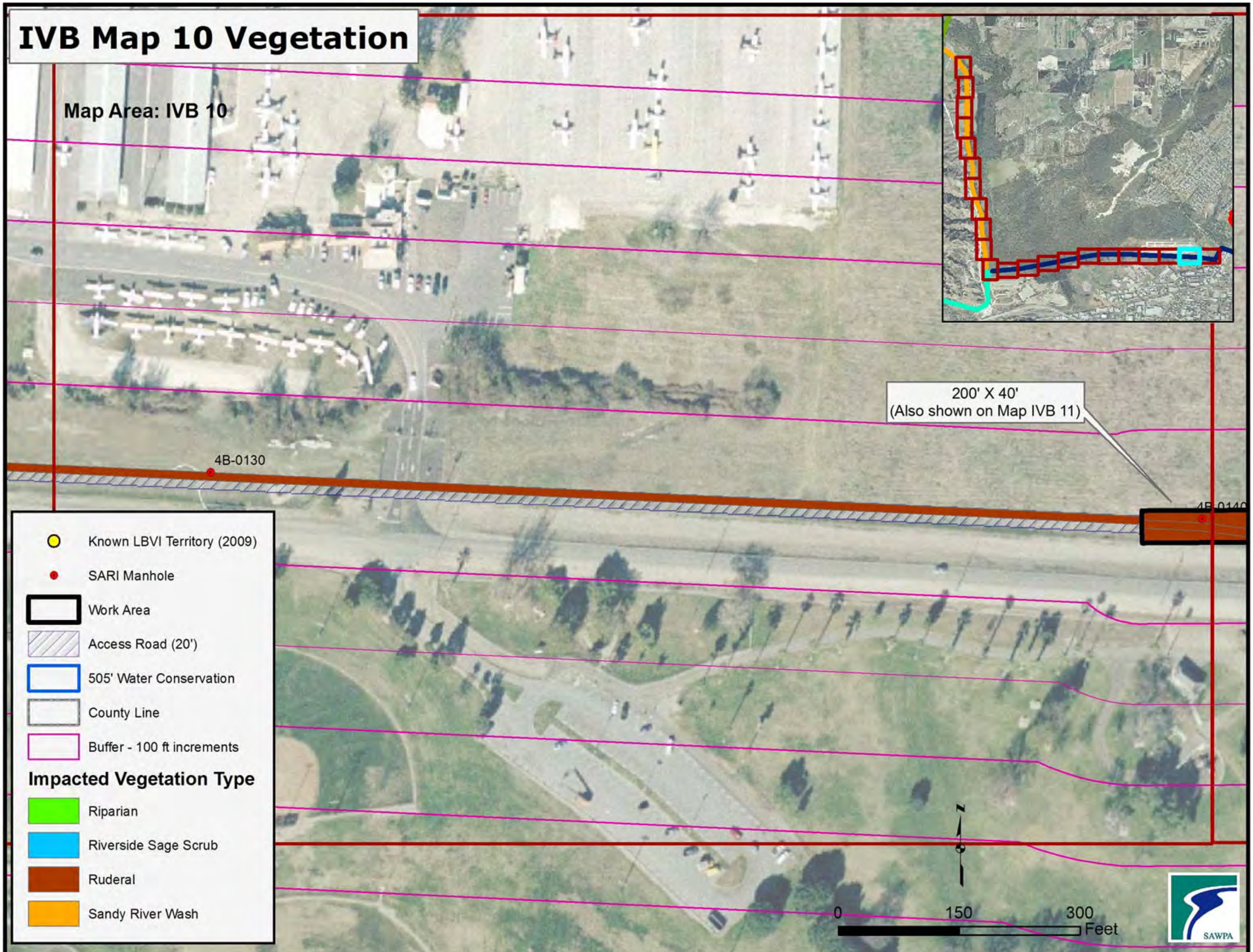
IVB Map 10 Vegetation



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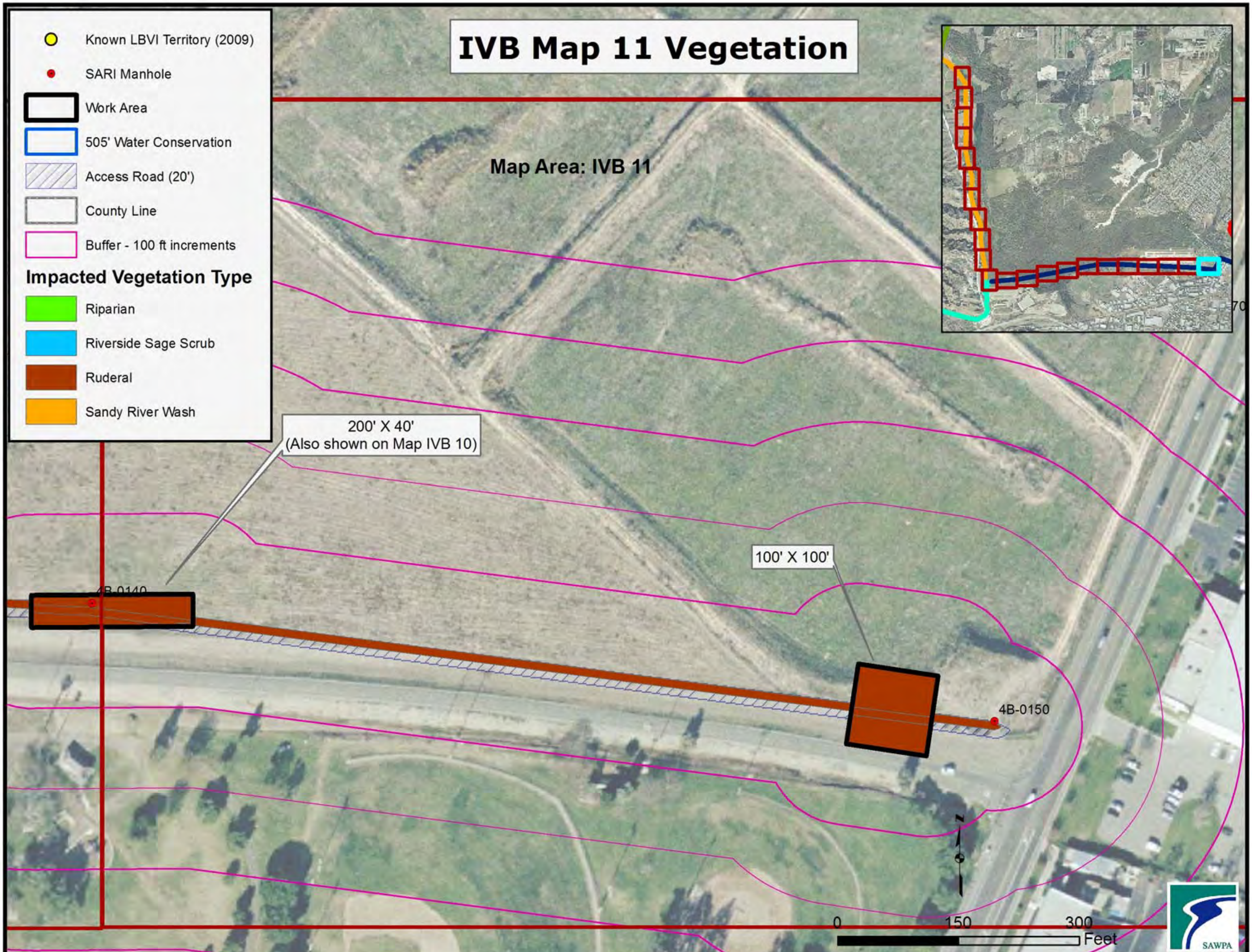
IVB Map 11 Vegetation



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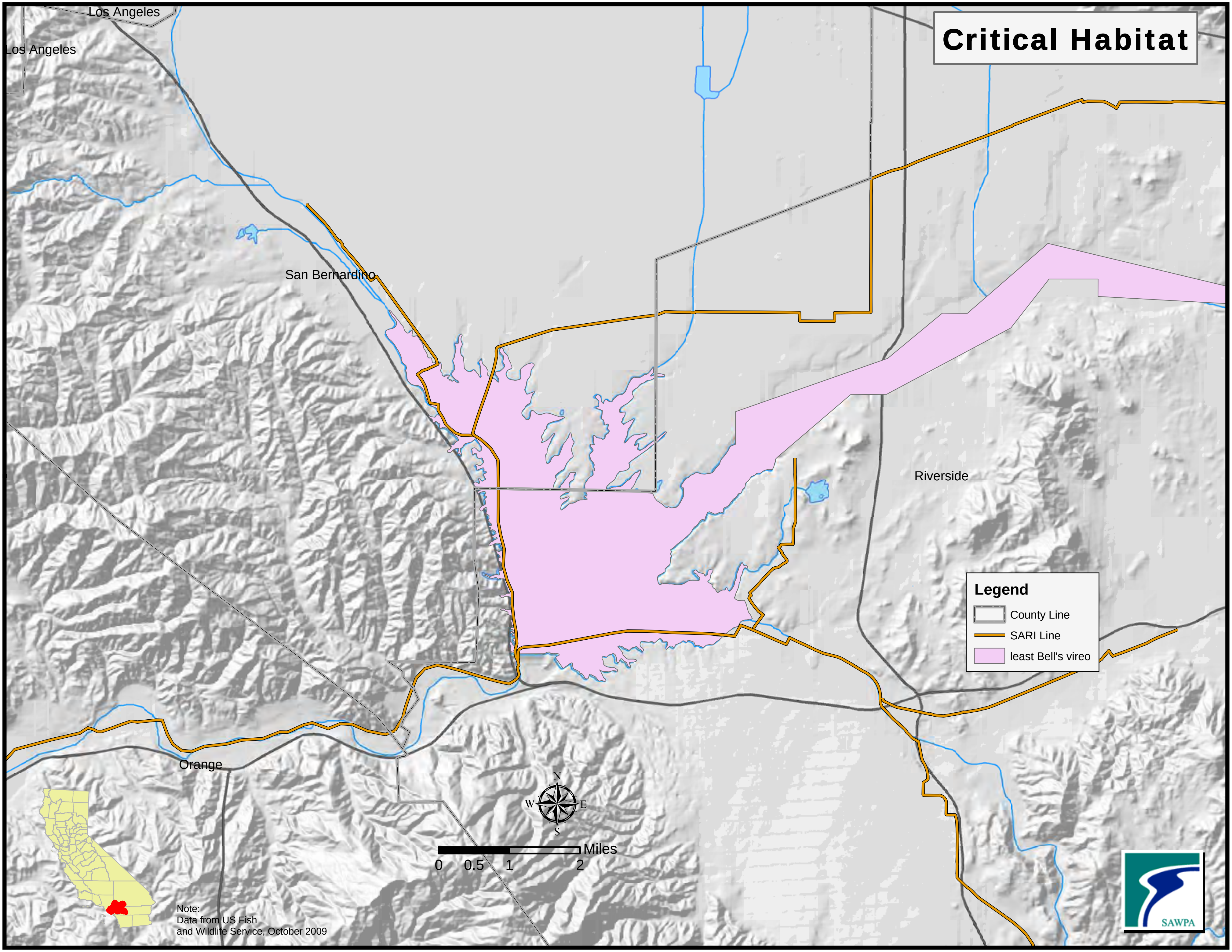
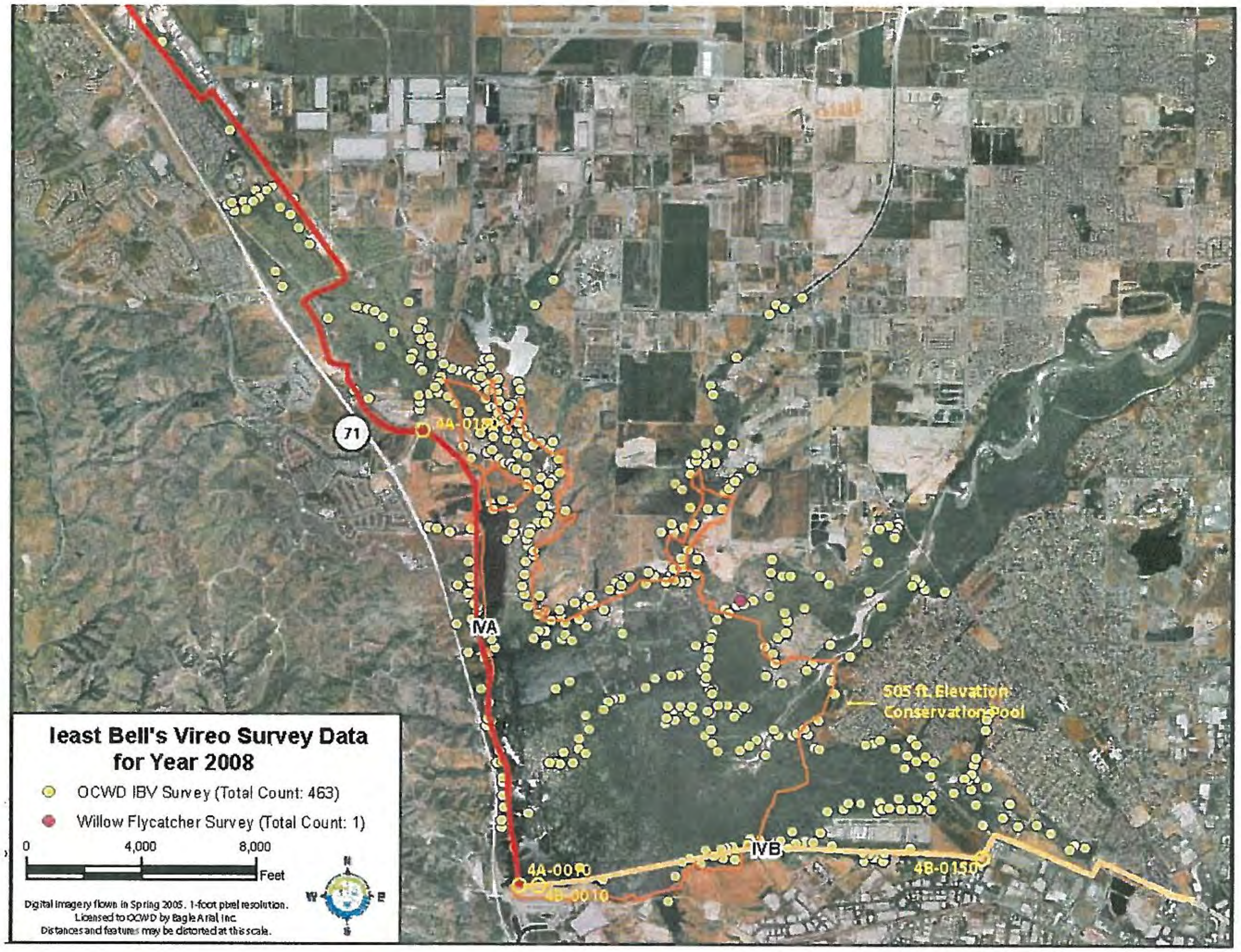


Critical Habitat
Los Angeles
Los Angeles
San Bernardino
Riverside
Orange
Legend
County Line
SARI Line
least Bell's vireo
N
W
E
S
Miles
0
0.5
1
2
SAWPA
Note:
Data from US Fish
and Wildlife Service, October 2009

FIGURE 15. 2008 LBVI AND SWWF LOCATIONS IN PRADO BASIN



Appendix C Site Photos

Photo 1. Looking at manhole 4A-0000 near dam inlet within inundation area.

Photo 2. Looking northwest towards lower portion of Reach IV-A.

Photo 3. Near manhole 4A-0000 and 4B-0010.

Photo 4. Suitable SASU critical habitat within project area near manhole 4A-0000.

Photo 5. Looking north along lower portion of Reach IV-A.

Photo 6. Looking northeast at wetted area adjacent to IV-B.

Photo 7. Looking east along western quarter of Reach IV-B

Photo 8. Looking toward manhole 4B-0040.

Photo 9. Wetted habitat located between man holes 4B-0030 and 4B-0040

Photo 10. Occupied SASU critical habitat adjacent to, and possibly within, the construction work area between man holes 4B-0040 and 4B-0050.

Photo 11. Typical view of eucalyptus component in Reach IV-B.

Photo 12. Typical view of grassland component adjacent to riparian habitat. Photo taken south of manhole 4B-0070.

Photo 13. Typical view of a maintained portion of the pre-established maintenance road within Reach IV-B.

Photo 14. View of stream crossing at an overgrown section of the access road in Reach IV-B.

Photo 16. Typical riparian habitat within Reach IV-B.

Photo 16. Suitable habitat structure for LBVI, SWWF and yellow-billed cuckoo.

Photo 17. Panned out view of riparian forest within Reach IV-B.

Photo 18. Typical view of conditions along the upper section of Reach IV-A.

Photo 19. Grassland habitat within Reach IV-A.

Photo 20. Riparian components within the upper portion of Reach IV-A.

Photo 21. Looking at manhole 4A 0110

Photo 22. Looking at manhole 4A-0090.