Volume II A

City of Chino

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1.0 INTRODUCTION

1.1 Overview

The Chino Groundwater Basin (Basin) Dry-Year Yield (DYY) Program Expansion (Program Expansion) is a comprehensive water resources management program to maximize conjunctive-use opportunities in the Basin. Program Expansion details are provided in a two-volume Project Development Report (PDR). Volume I traces the development of the original DYY Program, describes the Program Expansion, and presents the technical, financial, and institutional framework within which individual projects would move forward. Volume II consists of 10 lettered sub-volumes (A-J) defining facilities to be developed by the Program Expansion's ten participating appropriators. This Volume IIA presents conceptual development of proposed facilities for the City of Chino (Chino) to participate in the program expansion. These include ion exchange (IX) facilities with Ion Separation Exchange Process (ISEP®) and an injection well. An Opinion of Probable Cost is also presented. This Introduction Chapter provides background information on the DYY Program, the Program Expansion, and the Chino system.

1.2 Evolution of DYY Program and Program Expansion

The Program Expansion is being developed by the Chino Basin Watermaster (Watermaster) in association with the Inland Empire Utilities Agency (IEUA), Metropolitan Water District of Southern California (Metropolitan), Three Valleys Municipal Water District (TVMWD), and Western Municipal Water District (WMWD). Table 1-1 summarizes the history and evolution of the Expansion Program, which could provide an additional 17,000 acre-feet (acre-ft) of groundwater for dry-year use.

Table 1-1
Evolution of Chino Basin DYY Program Expansion*

Item	Description	Comments
Chino Basin Optimum Basin Management Program (OBMP)	Developed in response to a 1998 court ruling governing water use in the Basin (Chino Judgment). The Judgment was a continuation of a 1978 ruling providing a legal definition for the Basin and establishing a court-appointed Watermaster.	OBMP objectives are to enhance Basin water supplies, protect and enhance water quality, enhance Basin management, and provide equitable financing. Of the OBMP's nine Program Elements, three are applicable to the Expansion Program: Salt Management (7), Groundwater Storage Management (8), and Conjunctive-use (9).
DYY Program	Conjunctive-use program initiated in 2002 among Metropolitan, IEUA, Watermaster, and participating Basin appropriators. IEUA, which manages the distribution of imported water to Basin appropriators, acts as liaison between Watermaster and Metropolitan.	The Program provides for 100,000 acre-ft of water through in-lieu exchange and direct recharge of surplus Metropolitan imported supplies. Water can be "put" into and "taken" out of the Basin at a maximum rate of 25,000 acre-feet per year (afy) and 33,000 afy, respectively.
DYY Program Expansion	Expansion of 2002 DYY Program to produce up to 17,000 afy of additional groundwater for dry-year use, in-lieu of imported water.	Each of the participating appropriators would contribute a portion of the 17,000 acre-ft of additional dry-year yield or necessary "puts" into the Basin.

* Additional details are provided in PDR Volume I.

1.3 Documentation

IEUA assembled the consultant team for both the DYY Program and the Program Expansion. Both Programs have been accomplished through a series of cooperative activities working extensively with Watermaster and the Basin appropriators. From this collaboration, several reports, technical memoranda (TMs), and computer models were produced, which served as the framework of this PDR.

The PDR is organized into four volumes. Volumes I and II, prepared by Black & Veatch (B&V), provide general information on the DYY Program Expansion. Volume I presents background information on the Basin and Program operations, while Volume II presents design criteria specific to each participating agency. Volume III, the Preliminary Modeling Report prepared by Wildermuth Environmental, Inc. (WEI), presents results of a groundwater model used to evaluate the water resources impacts of the DYY Program on the Basin. Volume IV presents the California Environmental Quality Act (CEQA) documentation conducted for this project and was prepared by Tom Dodson & Associates (TDA).

1.4 Summary of Program Participants

Volume II describes the specific site requirements and design criteria for the proposed facilities required to provide the 17,000 acre-ft of additional dry-year yield. Table 1-2 lists the appropriators and the corresponding PDR volume which identifies their project-specific facilities. Construction of these facilities is required for full Program implementation.

Table 1-2
Summary of Program Participants and Facility Requirements

Agency/PDR Volume	Facility Requirements
City of Chino (II A)	▸ Regenerable Ion Exchange (IX) treatment at existing well Nos. 3 and 12 ▸ Aquifer Storage Recovery (ASR) Site at Well No. 14: Regenerable IX treatment at existing well no. 14 and replacement of existing Chino agriculture well for injection
City of Chino Hills (II B)	▸ Convert existing well No. 19 to ASR
Cucamonga Valley Water District (II C)	▸ Four new ASR wells
Jurupa Community Services District (II D)	▸ New well No. 27 ("Galleano Well") ▸ New well No. 28 ("Oda Well") ▸ New well No. 29 ("IDI Well")
Monte Vista Water District (II E)	▸ New ASR well and regenerable IX treatment ▸ Rehabilitate existing well No. 2 and regenerable IX treatment ▸ Regenerable IX treatment at existing ASR well No. 4 and well No. 27 ▸ Conveyance facilities to deliver water from Monte Vista Water District (MVWD) via Chino Hills to Walnut Valley Water District Service Area
City of Ontario (II F)	▸ Conveyance facilities to establish interconnection with Cucamonga Valley Water District (CVWD)
City of Pomona (II G)	▸ Regenerable IX treatment at existing Reservoir No. 5 site
City of Upland (II H)	▸ New well in Six Basins
Three Valleys Municipal Water District (II I)	▸ Treated water pipeline from Water Facilities Authority (WFA) water treatment plant (WTP) to Miramar WTP ▸ Turnout along Azusa-Devil Canyon Pipeline
Western Municipal Water District (II J)	▸ Conveyance facilities to establish interconnection between planned Riverside-Corona (RC) Feeder and Jurupa Community Services District (JCSD) service area ▸ Conveyance pipeline to establish interconnection between WMWD service area and Arlington Desalter Pipeline

1.5 Conceptual Design Assumptions

Facilities described in Volume II were designed based upon information available and using the following general design assumptions:

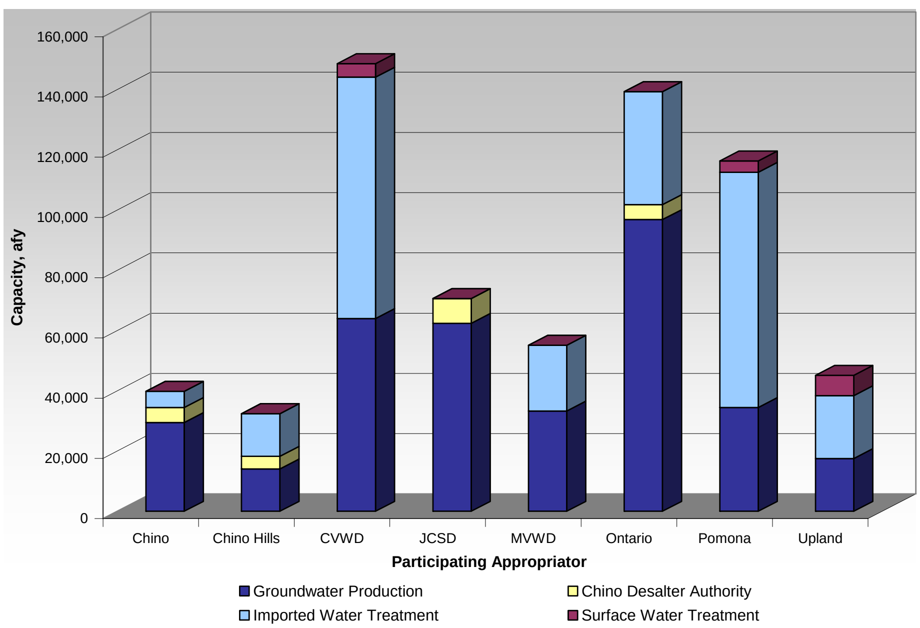
- Elevations were based upon United States Geological Survey (USGS) maps and maps obtained online from Google® Earth and are estimated to be accurate to within 10 percent of the actual elevation. Topographical surveys would be performed as part of the final design.
- Typical engineering calculations and assumptions were used to develop preliminary sizing for equipment and IX facilities. The final designs may vary slightly dependent upon results of the Title 22 water quality testing as well as detailed discussions with Calgon Carbon, Inc. (Calgon).
- Conceptual designs assumed to not have significant permitting restrictions. Investigation of potential permit requirements for each project would be carried out during final design.

- Brine discharge to the non-reclaimable waste (NRW) System was assumed to not have a significant impact on NRW System capacity. The available capacity of the NRW system would be evaluated during final design.
- Groundwater levels and flows, anticipated drawdown from well operation and location and concentration of contaminants was based upon available data provided by WEI based upon their recent modeling efforts.
- Facilities to be constructed on agency or City property were assumed to not require additional land purchase. In addition, pipelines constructed in City or County streets were assumed to be within the right-of-way limits.
- The opinion of probable cost is intended to provide a budgetary estimate of the capital and operational costs. Detailed quantity and unit cost figures for the facilities would depend on specific manufacturer equipment and prices.

1.6 Facility Requirements

An investigation ("Asset Inventory") consisting of several meetings and site visits was conducted to determine the condition of existing facilities and production capacities of each participating appropriator. The Asset Inventory presents a comprehensive list of the facilities available for each appropriator and identifies each participating appropriator's groundwater production capabilities and imported water treatment capacity. The results of the Asset Inventory are discussed in Volume I, Appendix A. Figure 1-1 summarizes Asset Inventory results.

Figure 1-1
Water Resource Capacities for Participating Appropriators(1)(2)



Notes:
(1) Participating Appropriators include current Basin appropriators interested in participating in the DYY Program Expansion. This does not include agencies outside the Basin, such as TVMWD and WMWD.
(2) Does not include recycled water deliveries provided by IEUA.

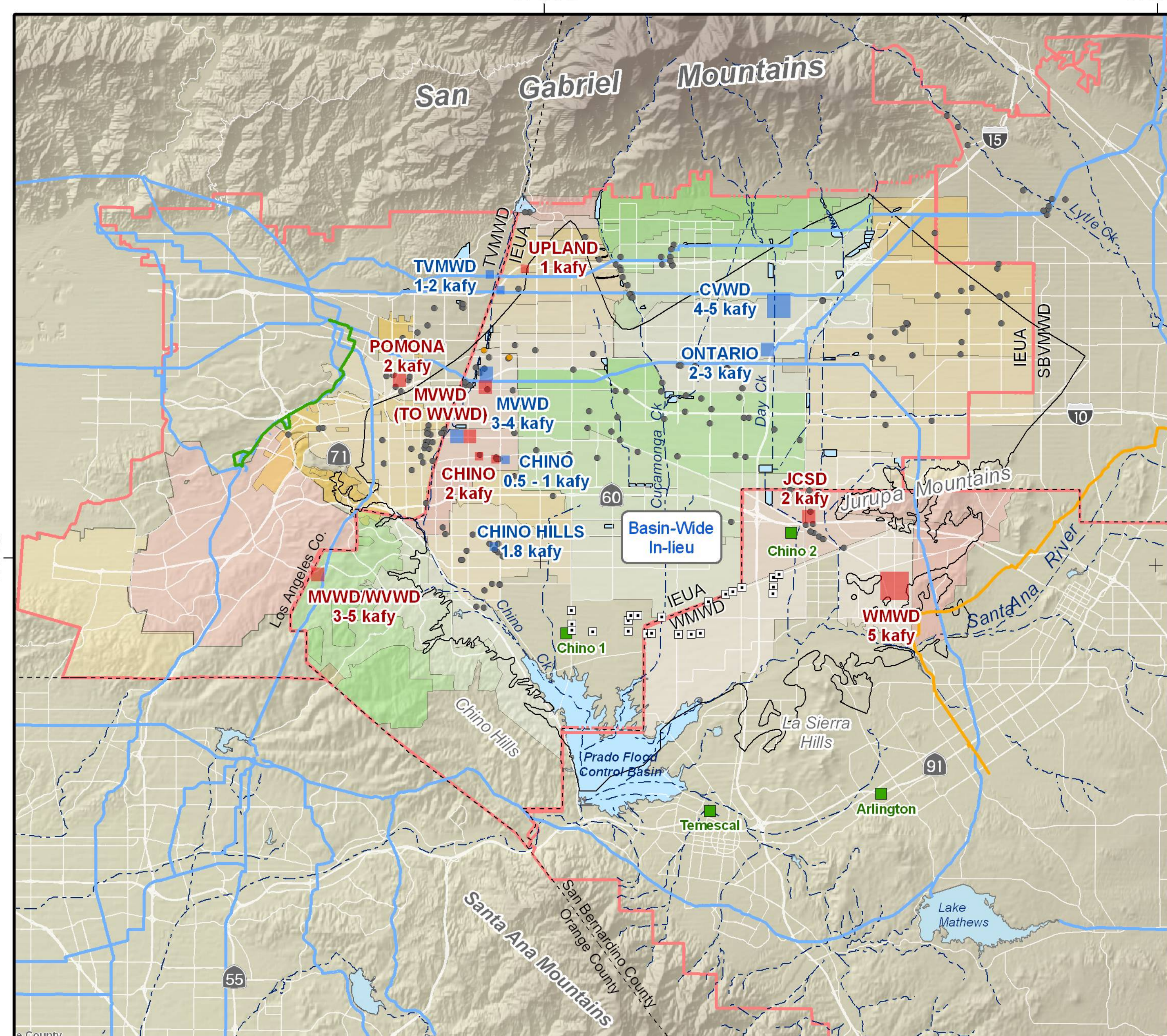
Table 1-3 lists potential Program participants and each agency's potential "put" and/or "take" contribution. The combined "take" capacity of these agencies ranges from 15,000 to 17,000 afy. The combined "put" capacity of these agencies is approximately 12,300 to 16,800 afy of direct capacity plus Basin-wide in-lieu deliveries and surface spreading contributions.

Figure 1-2 shows the locations of each agency's proposed facilities and/or locations where potential "puts" and "takes" could occur within the Basin. As the figure demonstrates, the "puts" and "takes" may be balanced on the east and west sides of the Basin. Through groundwater modeling, Program operations were evaluated to determine the potential for material physical injury to a party of the Chino Judgment or to the Chino Basin as required by the Peace Agreement (refer to Volume III, Program Modeling Report).

Table 1-3
Summary of Initial and Expanded DYY Program Participants and Proposed Put/Take Capacities

Agency	Initial DYY Program (1)		DYY Program Expansion (2)	
	Put Capacity (afy)	Take Capacity (afy)	Put Capacity (afy) (4)	Take Capacity (afy) (6)
City of Chino	(3)	1,159	500-1,000	2,000
City of Chino Hills(5)		1,448	1,800	0
Cucamonga Valley Water District		11,353	4,000-5,000	0
Jurupa Community Services District		2,000	0	2,000
Monte Vista Water District		3,963	3,000-4,000	3,000-5,000
City of Ontario		8,076	2,000-3,000	0
City of Pomona		2,000	0	2,000
City of Upland		3,001	0	1,000
Three Valleys Municipal Water District		0	1,000-2,000	0
Western Municipal Water District		0	0	5,000
Total	25,000	33,000	12,300 – 16,800	15,000 – 17,000

Notes:
(1) Initial 100,000 acre-ft DYY Program includes maximum 25,000 afy "put" over a four-year period of surplus water and a maximum 33,000 afy "take" over a three-year dry period.
(2) DYY Program Expansion includes increases in total storage, "put" capacity, and "take" capacity.
(3) "Puts" for the initial DYY Program are accomplished by a combination of direct recharge and in-lieu deliveries.
(4) Does not include basin-wide in-lieu deliveries and direct recharge.
(5) MVWD assumed Chino Hills' shift obligation of 1,448 afy per an amendment to the agreement between the agencies dated March 5, 2007.
(6) Post modeling, adjusted take capacities. See Volume III for details.



Proposed DYY Facilities

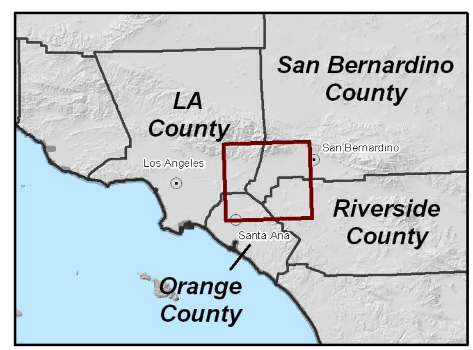
- "PUT" Facility (12.3-16.8 kafy+basin-wide in-lieu)
- "TAKE" Facility (15-17 kafy)

Imported Water Pipelines

- Major Pipelines
- Riverside Corona Feeder Pipeline
- PWR Pipelines

Other Features

- Appropriator Well
- ASR Well
- Desalter Well
- Desalter Facility
- Flood Control/Conservation Basins
- Streams, Rivers, and Channels



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Proposed DYY Participants and Put/Take Locations

Figure 1-2

Therefore, while the Basin has adequate storage capacity, any increases in groundwater production during dry years would likely require additional production capacity and/or groundwater treatment. Groundwater treatment during dry years would contribute to the long term sustainable use of the Basin. A further discussion of the Basin Operations Plan is provided in Volume I.

1.6.1 Water Resources, Historical Water Use, and Shift Obligation

The Asset Inventory data summarizing Chino's existing water resources capabilities is presented in Table 1-4. The complete Asset Inventory is provided in Appendix A of Volume I. The results of the Asset Inventory indicate that Chino has an imported water treatment capacity of 4.8 million gallons per day (mgd) (5,400 afy) and groundwater production capacity of 30.3 mgd (33,900 afy). Chino receives its treated imported water from the WFA Agua de Lejos WTP.

Table 1-4
Existing Water Resource Capacities for Chino

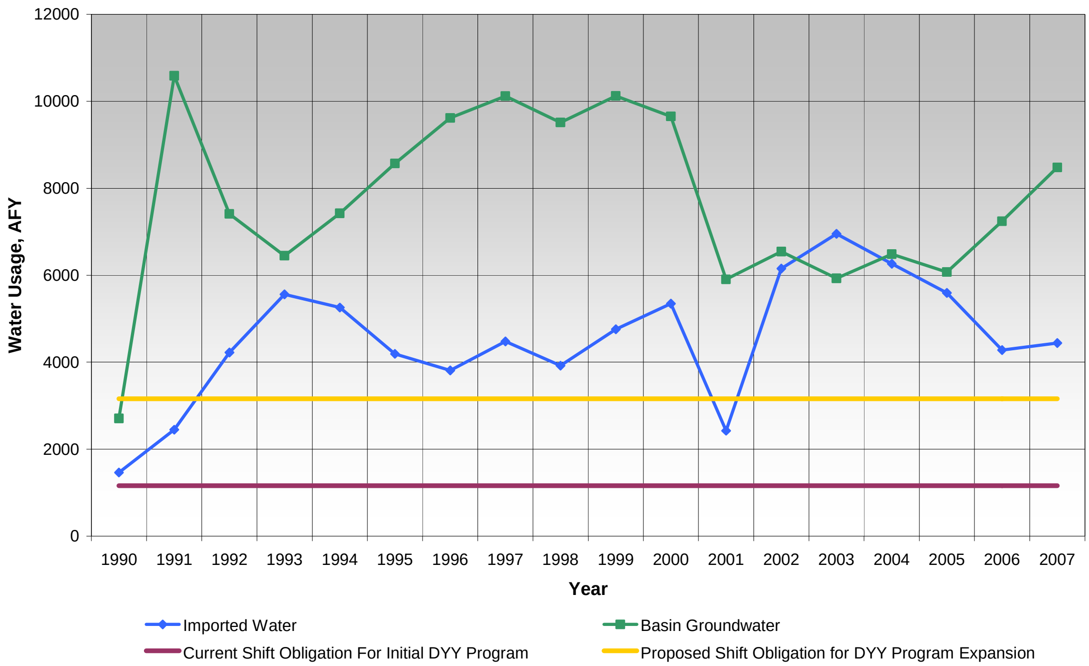
Water Resource	Chino Capacity, mgd (afy)
Local Surface and Imported Water	
Local Surface Water	
Subtotal	0 (0)
Imported Metropolitan Water	
WFA	4.8 (5,400)
Subtotal	4.8 (5,400)
Total Local Surface and Imported Water	4.8 (5,400)
Groundwater	
Chino I Desalter	4.5 (5,000)
Chino Basin Wells(1)	25.8 (28,900)
Non-Chino Basin Wells(1)	0 (0)
Total Groundwater	30.3 (33,900)
TOTAL WATER RESOURCES	**35.1 (39,300)**

Notes:
(1) Accounts for all well production capacity, regardless of water quality.

Figure 1-3 presents the historical groundwater production and imported water purchases for Chino. In 2007, approximately 66 percent of Chino's 12,922 acre-ft of water usage was Basin groundwater versus approximately 34 percent from imported water supplied by Metropolitan. Based on historical imports and on future growth projections, Chino has elected to contribute 2,000 afy toward the potential 17,000 afy Program Expansion. To achieve this potential contribution, Chino has proposed two alternative facility arrangements, Options A and B. Facilities associated with these options are discussed in Section 1.5.2

Option A would incorporate "take" facilities, and Option B would incorporate both "put" and "take" facilities. The "take" facilities would involve the use of existing wells and new IX treatment facilities. The "put" facilities would involve the use of a new injection well.

Figure 1-3
Chino Historical Imported Water and Groundwater Usage



1.6.2 Program Expansion Facilities Description

1.6.2.1 Option A Facilities

Option A would include a new IX facility. The new Well Nos. 3 and 12 IX Facility would provide treatment of the rehabilitated existing Well No. 3 and existing Well No. 12. It would provide a treated water capacity of 2,750 gallons per minute (gpm) and be located at the Well Nos. 3 and 12 site in Chino, on the southwest corner of State Street and Benson Avenue.

1.6.2.2 Option B Facilities

Option B facilities would include a new IX facility and a new injection well. An existing abandoned agricultural well would be rehabilitated (if possible) and converted into a new injection well that would provide a put capacity of 500 to 1,000 afy. (This PDR assumes replacement of the agricultural well with a new injection well.) The new Well No. 14 IX Facility would provide treatment of Well No. 14. It would provide a treated water capacity of 2,300 gpm. The new injection well and IX facilities would be located at the Well No. 14 site in the City of Montclair, on the southwest corner of Benson Avenue and State Street.

Chapters 2, 3, and 4 provide further description of the IX facilities for both Options A and B, the new injection well facility, and the preliminary opinion of probable cost, respectively.

1.7 Abbreviations and Acronyms

The following abbreviations/acronyms are used in Volume IIA of the Chino Basin Dry Year Yield Program Expansion PDR:

acre-ft	acre-feet
afy	acre-feet per year
AOPs	advanced oxidation processes
ASR	Aquifer Storage and Recovery
B&V	Black & Veatch
Basin	Chino Basin
bgs	below ground surface
ft/day	feet per day
$CaCO_3$	calcium carbonate
Calgon	Calgon Carbon, Inc.
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
Chino	City of Chino
Cl^-	chloride
Cl_2	chlorine
ClO_4^-	perchlorate
CML&C	cement mortar lined and coated
cu ft	cubic feet
CVWD	Cucamonga Valley Water District
DBCP	dibromochloropropane
DWR	California Department of Water Resources
DYY	Dry-Year Yield
DYY Program	initial Chino Basin Dry-Year Yield Program
DYY Program Expansion	Chino Basin Dry-Year Yield Program Expansion
ft	feet
FFD	fixed frequency drive
gpm	gallons per minute
gpm/ft	gallons per minute per foot
HCl	hydrochloric acid
HDPE	high-density polyethylene
HMI	human machine interface
hp	horsepower
HVAC	heating, ventilation, and air conditioning
I&C	instrumentation and controls
IEUA	Inland Empire Utilities Agency
ISEP®	Ion Separation Exchange Process
IX	ion exchange
JCSD	Jurupa Community Services District
Judgment	Chino Basin Municipal Water District vs. the City of Chino et al. (1978)
KW	kilowatts

mgd	million gallons per day
Metropolitan	Metropolitan Water District of Southern California
ug/L	microgram per liter
mg/L	milligrams per liter
MVWD	Monte Vista Water District
NaOCl	salt
NO_3^-	nitrate
NRW	non-reclaimable wastewater
OD	outside diameter
OEM	original equipment manufacturer
O&M	operation and maintenance
OBMP	Optimum Basin Management Program
PDR	project development report
PLC	programmable logic controller
Program Expansion	Chino Basin Dry-Year Yield Program Expansion
psi	pounds per square inch
pvc	polyvinyl chloride
RC	Riverside-Corona
SCE	Southern California Edison
TCE	trichloroethylene
TDA	Tom Dodson & Associates
TEFC	totally enclosed fan-cooled
TM	technical memorandum
TVMWD	Three Valleys Municipal Water District
USGS	United States Geological Survey
VFD	Variable Frequency Drive
VOCs	volatile organic compounds
Watermaster	Chino Basin Watermaster
WEI	Wildermuth Environmental, Inc.
WFA	Water Facilities Authority
WTP	water treatment plant
WVWD	Walnut Valley Water District
WMWD	Western Municipal Water District

1.8 References

General references are listed in Volume I, Section 1.9.

2.0 ION EXCHANGE (ISEP®) FACILITIES

2.1 Overview

This chapter presents a detailed description of the proposed IX treatment facilities, which would provide a portion of Chino's contribution to the DYY program obligation. Based upon conversations with Chino staff during the development of the Program Expansion, Chino prefers the proprietary ISEP® manufactured by Calgon. For this reason, ISEP® was selected over the typical counter-current regenerated IX process. This chapter reviews the raw water supply well quality, IX facility components, site requirements, electrical requirements, instrumentation and control (I&C) requirements, and conveyance piping.

Chino has proposed two options to meet its shift commitment. Option A includes an IX facility at Chino's Well Nos. 3 and 12 site. This new IX facility would be located in a residential area of Chino on the southwest corner of Central Avenue and Phillips Boulevard. Option B would include a new IX facility and new injection well at Chino's Well No. 14 site. This new IX facility and injection well would be located in an industrial area of the City of Montclair on the southwest corner of State Street and Benson Avenue. Figure 2-1 and Figure 2-2 present location maps of the new IX facilities.

2.2 Raw Water Supply

The new Well Nos. 3 and 12 IX Facility would treat groundwater from a rehabilitated Well No. 3 and Well No. 12. Well No. 3 has not been in operation for 20 years and has been vandalized and stripped of its equipment. Rehabilitation at a minimum would include a new pump, motor, electrical equipment, and clearance pumping. Well No. 12 was shut off in October 2007 due to high nitrate and perchlorate levels. This production well is in good condition and would not require rehabilitation.

The new Well No. 14 IX and injection well facilities would treat groundwater from Well No. 14 and replenish the groundwater through the new injection well. Similar to Well No. 12, Well No. 14 was shut off in October 2007 due to high nitrate and perchlorate levels. This production well is in good condition and would not require rehabilitation. Based on conversations with Chino staff, the existing agricultural well on site would require rehabilitation (if possible) or drilling of a new injection well near the same location. For the purposes of this report, it was assumed that the existing agricultural would not be rehabilitated and a new well would be used for injection. The new injection well is discussed further in Chapter 3.

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Chino Basin Dry Year Yield Program Expansion Project

City of Chino – Option A Vicinity Map

Figure

2 – 1

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Chino Basin Dry Year Yield Program Expansion Project

City of Chino – Option B Vicinity Map

Figure 2 – 2

Table 2-1 presents the historic groundwater conditions for Well Nos. 10 and 12.

Table 2-1
Historical Operating Conditions(1)

Operating Conditions	Well No. 10	Well No. 12
Production Capacity, gpm	1,087	2,225
Est. Avg. Static Groundwater Elev., ft bgs (2)	286	290
Estimated Average Drawdown, feet (3)	53	66
Approximate Specific Capacity, gpm/ft (4)	20	34

Notes:
(1) Historical operating conditions listed in table are based on actual pump test data conducted in September 2007 and provided by WEI, 2008.
(2) Feet, below ground surface (bgs).
(3) Pump test data provided by City of Chino, 2008.
(4) Gallons per minute per foot of drawdown.

Table 2-2 presents the anticipated operating conditions and performance of the production wells. In order to approximate the operating conditions for the rehabilitated Well No. 3, data collected by WEI for nearby Well No. 10 was used as a basis. Data collected by WEI for Well No. 12 was used as a basis for approximating the operating conditions of Well No. 14. This information would be used to develop and confirm hydraulic capabilities of the wells.

Table 2-2
Anticipated Operating Conditions

Conditions	Option A		Option B
	Well No. 3	Well No. 12	Well No. 14
General Conditions			
Basis for Operating Conditions, Well No.	10	12	12
Distance from Basis Well Above, feet	260	0	4,750
Location (Intersection)	Central/ Phillips	Central/ Phillips	State/ Benson
Site Elevation, feet amsl (1)	885	885	955
Well HGL/Delivery Zone, feet amsl	909	909	984
Operating Conditions (2)			
Production Capacity, gpm	500	2,250	2,300
Est. Avg. Static Groundwater Elev., ft bgs	286	290	290
Assumed Specific Capacity, gpm/ft	20	34	34
Calculated Estimated Drawdown, feet	25	66	66

Notes:
(1) Above mean sea level (amsl).
(2) Operating conditions listed in table are based on actual pump test data conducted in September 2007 and provided by WEI, 2008.

The wellhead pump for the rehabilitated Well No. 3 would be a multistage vertical turbine with an electric motor located above ground. The drive shaft would be water lubricated, and pre-lubrication of the line shaft bearings would be provided during the pump startup. Pump performance design criteria were developed for the expected production rates and are presented in Table 2-3. The pump and motor for Well No. 3 was sized to be hydraulically capable of converging with flow from Well No. 12 and to meet the required elevation listed in Table 2-2.

Table 2-3
Assumed Pump Performance

Description	Option A		Option B
	Well No. 3	Well No. 12	Well No. 14
Pump			
Type	Deep well turbine	Deep well turbine	Deep well turbine
Capacity, gpm	500	2,250	2,300
Total Dynamic Head, feet (1)	311	356	356
No. of Stages	7	Existing Well/Pump Duty Would Remain the Same	Existing Well/Pump Duty Would Remain the Same
Pump Efficiency, percent	80		
Discharge Column Diameter, inches	6		
Motor			
Type (2)	TEFC High-Efficiency		
Nominal Motor Horsepower, HP	75		
Motor Drive (3)	FFD		
Maximum Motor Speed, rpm	1,760		

Notes:
(1) Includes frictional losses and mechanical shaft losses.
(2) Totally Enclosed Fan Cooled (TEFC)
(3) Fixed Frequency Drive (FFD)

For existing Wells Nos. 12 and 14, the hydraulic capabilities of the existing pumps and motors were verified to ensure that water could be delivered from the wells to the required elevation listed in Table 2-2.

A preliminary hydraulics investigation showed that booster pumps would be required for both options to provide sufficient lift through the IX facilities and to the on-site reservoir(s). This would need to be further evaluated during detailed design.

A more detailed discussion of the hydraulic conditions is presented in Section 2.4.9.

2.3 Raw Water Quality

The water quality data for the Chino raw water supplies was developed from the WEI database of CDPH records and cross-referenced with any water quality data received during the development of the Asset Inventory. Table 2-4 presents the estimated raw water quality data for Option A. Because water quality data for Well No. 3 is not available, the design water quality for this well was based on the water quality data from nearby Well No. 12. The maximum values for Well Nos. 3 and 12 were averaged and used as the design water quality for the Well Nos. 3 and 12 IX Facility. The constituents of concern are highlighted.

Table 2-4
Option A IX Facility Estimated Raw Water Quality

Constituent	Well No. 3		Well No. 12		Blend	
	Avg	Max	Avg	Max	Avg	Max
Pumping Capacity (gpm)	--	500	--	2,250	--	2,750
Cations (mg/L)						
Calcium	68	79	68	79	68	79
Magnesium	14	14	14	14	14	14
Sodium	16	17	16	17	16	17
Potassium	2	2	2	2	2	2
Anions (mg/L)						
Alkalinity (as CaCO3)	145	151	145	151	145	151
Sulfate	27	31	27	31	27	31
Chloride	12	16	12	16	12	16
Nitrate	66	78	66	78	66	78
Other (ug/L)						
Dibromochloropropane (DBCP)	0.01	0.02	0.01	0.02	0.01	0.02
Arsenic	0	0	0	0	0	0
Trichloroethylene (TCE)	0	0	0	0	0	0
Perchlorate	15	18	15	18	15	18
General						
Total Dissolved Solids (mg/L)	312	324	312	324	312	324
pH	8	8	8	8	8	8

Table 2-5 presents the raw water quality data for Well No. 14. The maximum values listed were used as the design water quality for the Well No. 14 IX Facility. The constituents of concern for these facilities are highlighted.

Table 2-5
Option B IX Facility Estimated Raw Water Quality

Constituent	Well No.14	
	Avg	Max
Pumping Capacity (gpm)	--	2,300
Cations (mg/L)		
Calcium	58	61
Magnesium	12	13
Sodium	24	25
Potassium	2	2
Anions (mg/L)		
Alkalinity (as CaCO3)	141	150
Sulfate	31	32
Chloride	11	15
Nitrate	66	92
Other (ug/L)		
DBCP	0.06	0.08
Arsenic	2	2
TCE	0	0
Perchlorate	11	14
General		
Total Dissolved Solids (mg/L)	303	326
pH	8	8

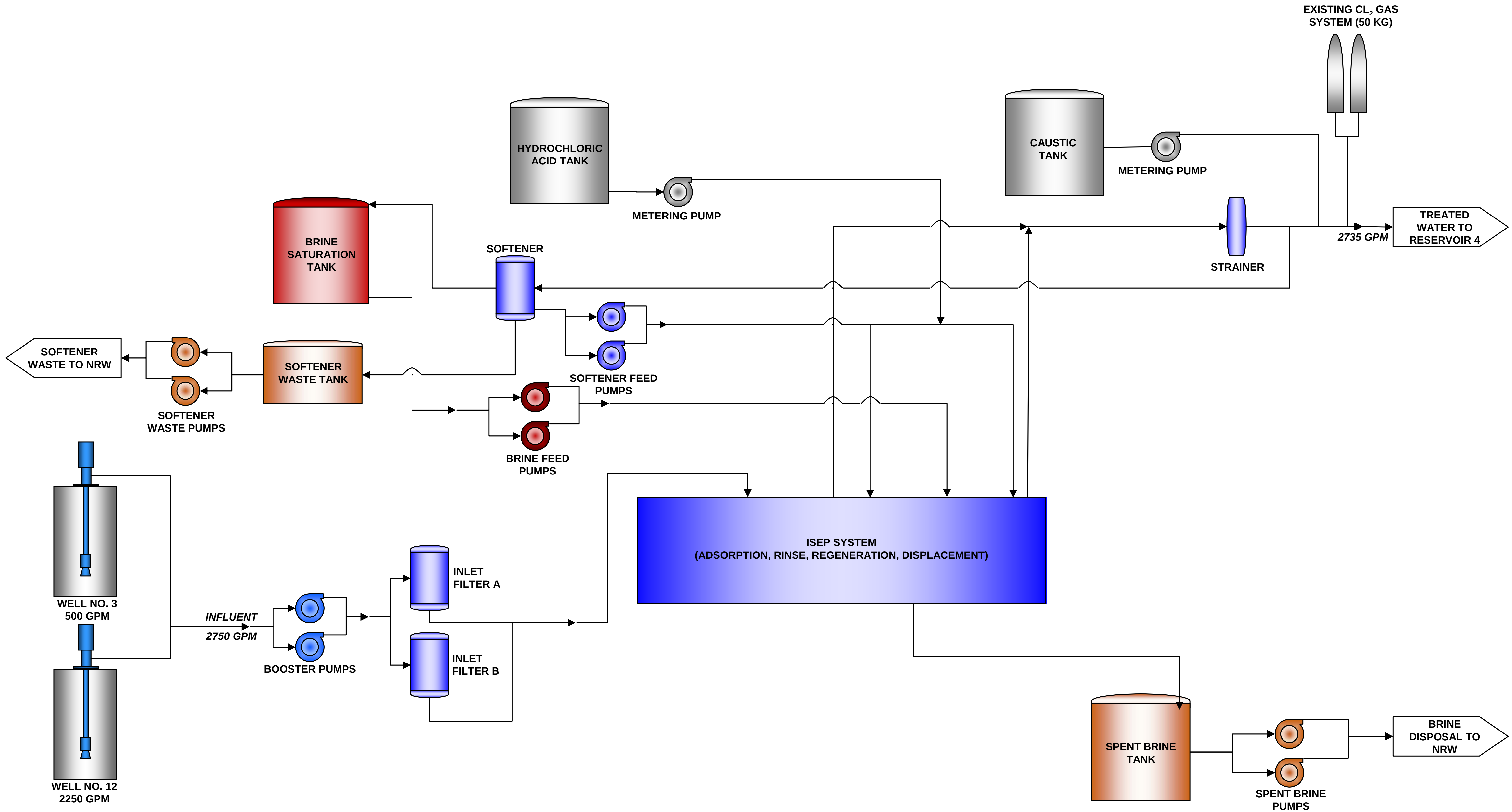
It is recommended that Chino conduct a complete Title 22 water quality analysis on the feed water wells to ensure that recent and accurate water quality data is available during the final process design.

2.4 Chino Facilities

The IX facilities would be constructed primarily on Chino property and would treat nitrate and perchlorate-impaired groundwater from rehabilitated Well No. 3, Well No. 12, and Well No. 14. Process flow diagrams for Option A and Option B are presented in Figures 2-3 and 2-4, respectively. A discussion on IX treatment and a typical IX process schematic are provided in Volume I. The sections below describe design criteria and components of the IX facilities. The calculations used to develop the information below are provided in Appendix A of this Volume IIA.

2.4.1 Design Capacity

The Well Nos. 3 and 12 IX Facility and the Well No. 14 IX facility would treat nitrate and perchlorate-laden groundwater. The design of the individual IX facilities were developed using the raw water quality data from Table 2-4 and Table 2-5 and assuming a treated water nitrate (NO_3) concentration of 9 mg/L as NO_3 and perchlorate concentration less than 4 ug/L. Table 2-6 presents the specific design capacity criteria for the two IX facilities.



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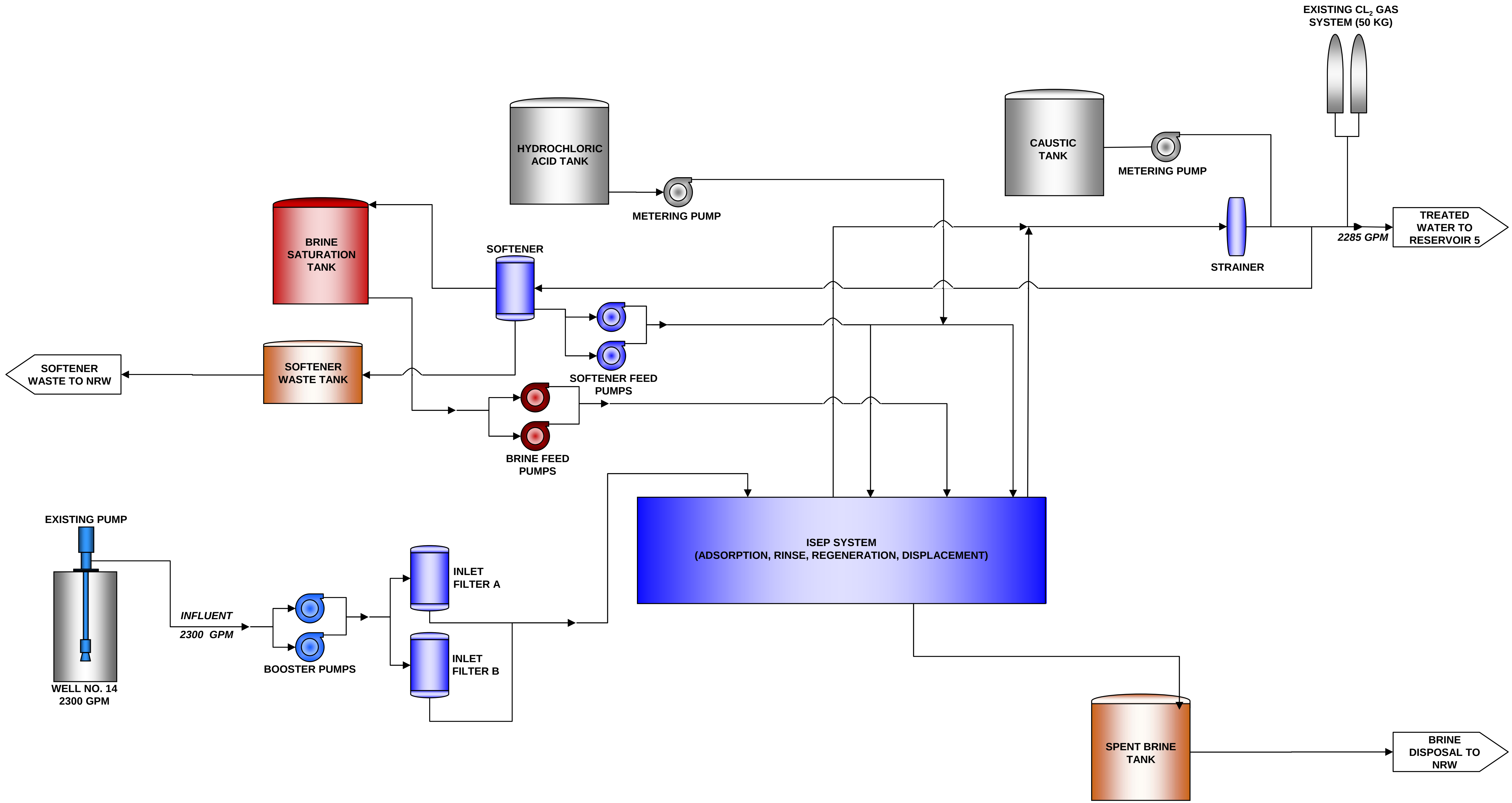
Chino Basin Dry Year Yield Program Expansion Project

City of Chino – Option A IX Facility Process Flow Diagram

Figure

2 – 3



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Chino Basin Dry Year Yield Program Expansion Project

City of Chino – Option B IX Facility Process Flow Diagram

Figure 2 – 4

Table 2-6
IX Facility Design Capacity Criteria

Parameter	Option A Well No. 3 and 12 IX Facility	Option B Well No. 14 IX Facility
Water Quality (1)		
Raw Water Nitrate, mg/L	78	92
Treated Water Nitrate, mg/L	9	9
Raw Water Perchlorate, ug/L	18	14
Treated Water Perchlorate, ug/L	<4	<4
Process Flows		
Raw Water, gpm	2,750	2,300
Feed Water, gpm	2,750	2,300
Treated/Finished Water, gpm	2,735	2,285

Notes:
(1) Values expressed as nitrate as NO_3.

2.4.2 Process Requirements

The ISEP® system is a continuous counter-current IX process that involves several exchange vessels that are continually in adsorption, rinse, regeneration, or displacement mode as illustrated on Figure 2-5. The new Chino ISEP® facilities would reduce the nitrate concentration to 9 mg/L and the perchlorate concentration to less than 4 ug/L. Each facility would consist of 30 exchange vessels. Each exchange vessel would have a Type II Strong Base Anionic Resin and would be approximately three feet in diameter with a sidewall depth of six feet. The selection of the resin type is discussed in Volume I. Resin volume within each exchange vessel would be approximately 25 cubic feet.

Figure 2-5
Typical ISEP® Arrangement of IX Vessels

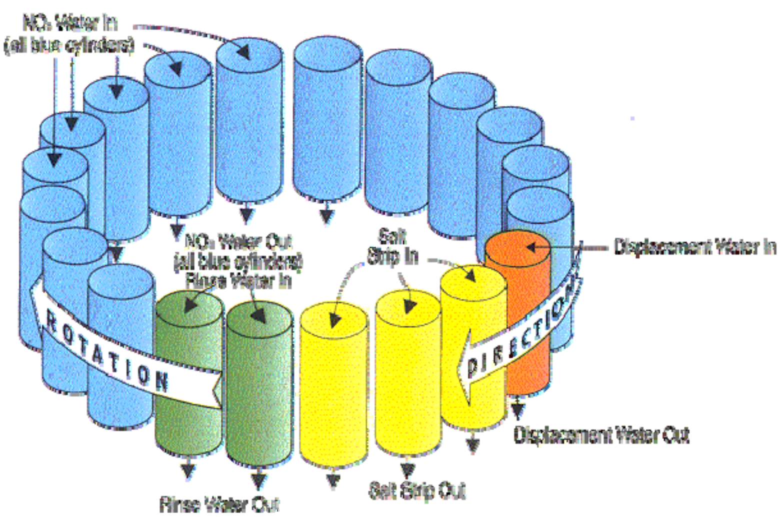


Table 2-7 presents the process requirements for the ISEP® facilities. The ISEP® system manufacturer (Calgon) would furnish all process equipment within the IX treatment system "black box." This would include all IX vessels, cartridge filters, process piping, valves and other appurtenances, brine saturators, chemical tanks, and waste tanks.

Table 2-7
ISEP® Facilities Process Requirements

Parameter	Option A Well Nos. 3 and 12 IX Facility	Option B Well No. 14 IX Facility
No. of IX Vessels	30	30
Adsorption	24	23
Rinse	2	2
Regeneration	3	4
Displacement/Backwash	1	1
Hydraulic Loading, gpm/square foot	16.2	14.2
Bed Volumes Treated per Hour, BV/hour	36.9	35.3
IX Vessel capacity, each, gpm	115	100
IX Vessel Dimensions		
Diameter, feet	3	3
Sidewall Depth, feet	6	6
IX Resin		
Type	Type II Strong Base Anionic	Type II Strong Base Anionic
Depth, feet	3.5	3.3
Volume per Vessel, cubic feet	25	23

2.4.3 Regeneration System

Countercurrent regeneration is recommended for use in order to minimize nitrate leakage through the IX vessels within the ISEP® facility and to buffer the potential impacts of variations in raw water nitrate and perchlorate concentrations. For countercurrent regeneration, the regenerate solution (brine) is introduced in an upflow mode at the bottom of the IX vessel; the resin at the bottom of the vessel is therefore essentially completely regenerated and free of nitrate. The IX resin would be regenerated using a 7 percent salt solution (0.58 lbs salt per gallon). The salt solution would be prepared and stored as concentrated 26 percent brine before dilution to the 7 percent solution. Effluent water from the rinse process of the ISEP® system would be used for dilution. An automated brine production system, which incorporates bulk salt storage and brine preparation/storage facilities within a single tank, would be provided.

The system would typically be regenerated in "nitrate mode regeneration" with the brine solution being fed at approximately 12 gpm, at a rate of 7.50 pounds of salt per cubic foot of resin. The system would occasionally be operated in "perchlorate mode regeneration" once the effluent perchlorate concentration reaches a certain level. In this case, the brine solution would be fed at approximately 22 gpm, at a rate of 28.50 pounds of salt per cubic foot of resin. The existing Chino ISEP® Facility currently operates in "perchlorate mode regeneration" about once a week.

2.4.4 Water Softener System

An on-site water softener system would soften IX treated water and be used for the displacement, brine saturation, and rinsing processes of the ISEP® system. Approximately 25 gpm of softened water would be required: 10 gpm for the displacement/backwash process before regeneration of the resin, 5 gpm for the brine saturators, and 10 gpm for the softened water rinse following regeneration of the resin.

To prevent scaling, hydrochloric acid (HCl) would be added to the softened water before entering the displacement/backwash process of the ISEP® system. Approximately 100 gallons per day of HCl would be required. HCl would be stored on-site in one 8.5 foot diameter by 10 foot high fiber reinforced plastic tank. On-site delivery of HCl would occur approximately once every 30 days by tanker trucks.

2.4.5 Waste Disposal

The ISEP® system produces two streams of waste: the resin waste regenerate brine and the water softener waste regenerate brine. It is not recommended that the streams be combined into one waste line en route to the non-reclaimable wastewater (NRW) line due to scaling issues. The calcium and magnesium from the water softener waste brine combined with the bicarbonate from the resin waste brine may form calcium carbonate or magnesium carbonate, potentially causing scaling in the pipes. These two waste streams would require separate 6-inch pipelines for conveyance to the NRW line. To minimize connection points to the NRW, the two lines would be combined into one shortly before connecting to the NRW. Table 2-8 summarizes the waste production and discharge of the IX facilities.

Table 2-8
IX Facility Waste Production and Discharge

	Option A Well Nos. 3 and 12 IX Facility	Option B Well No. 14 IX Facility
Brine Waste		
Average Waste Flow from ISEP®, gpm	9.7	9.3
Storage Tank Volume, gallons	8,500	8,500
Storage Tank Drain System		
Type	Pumped	Gravity
Average Drain Rate, gpm	10	10
Maximum Drain Rate, gpm	20	20
Delivery Pressure, psi	25	20
Water Softening Brine Waste		
Average Waste Flow, gpm	2	2
Storage Tank Volume, gallons	8,500	8,500
Storage Tank Drain System		
Type	Pumped	Gravity
Maximum Drain Rate, gpm	10	10
Delivery Pressure, psi	25	20
Total Max Waste Flow to NRW Line, gpm	30	30

2.4.6 Salt Brine Storage and Feed System

Salt storage facilities would be provided on site for the brine generation process. Salt for the preparation of brine would be delivered to the site dry in bulk tanker trucks. The salt delivery trucks would have a maximum capacity of approximately 20 tons (40,000 pounds), and the salt would be unloaded pneumatically into the bulk salt storage tanks on site. The total salt stored on site would range from approximately 50 to 150 tons, which would provide a sufficient salt stock for 7-21 days of brine production. The salt would be stored in three tanks approximately 14 feet in diameter and 14 feet tall. Each storage tank would be equipped with a water feed connection to prepare a 26 percent salt brine solution within the tank. The IX facilities would require approximately 2.5 to 9.5 gpm of 26 percent brine for the resin regeneration cycle. Brine pumps would transfer the brine from the storage tank to the ISEP® regeneration lines for IX resin regeneration. Two salt brine pumps with variable frequency drives would be provided, one duty and one stand-by.

Table 2-9 presents the specific design criteria of the brine storage and feed system.

Table 2-9
Salt Brine Storage and Feed Systems

Parameter	Option A Well No. 3 and 12 IX Facility	Option B Well No. 14 IX Facility
Chemical	Salt (NaOCl)	Salt (NaOCl)
Product Form	Delivered in bulk	Delivered in bulk
Brine Pumps		
Type	Centrifugal	Centrifugal
Number	2	2
Rated Capacity, gpm	15	15
Salt Application Rate (1), lbs. NaOCl/cu. ft. resin	7.5	7.5
Salt Application Rate (2), lbs. NaOCl/cu. ft. resin	28.5	28.5
Salt Brine Solution Concentration, percent by weight	26	26
Required 26% Brine (1), gpm	2.5	2.4
Required 26% Brine (2), gpm	9.6	9.2
Feed Brine Solution Concentration, percent salt by weight	7	7
Salt Usage per Day (1), ton	4.7	4.5
Salt Usage per Day (2), ton	17.9	17.1
Approximate Weekly Salt Usage, ton	50	50
Bulk Brine Storage Tanks (Saturators)		
Dimensions, diameter x sidewall height	14 ft x 14 ft	14 ft x 14 ft
No. of tanks	3	3
Total Salt Storage Capacity, tons	150	150
Materials of Construction	Fiberglass Reinforced Plastic	Fiberglass Reinforced Plastic
Salt Delivery Quantity, tons	50	50
Storage Duration, days	21	21

Notes:
(1) Typical "Nitrate Mode Regeneration"
(2) Typical "Perchlorate Mode Regeneration"

2.4.7 pH Adjustment

Since IX also removes hardness ions, pH adjustment of the IX treated water would be required as part of the treatment process. Sodium hydroxide (caustic) would be added to the treated water for pH adjustment before entering the reservoir. The caustic would be stored outside in a fiber reinforced plastic tank and would be delivered monthly by tanker truck. Further investigation of the anticipated treated water quality would be required to define the caustic storage and feed system.

It is possible that pH adjustment might not be needed if it is determined that the pH is suitable, as is the case at the City of Chino's existing ISEP® plant. The need for pH adjustment was assumed for the purposes of this PDR.

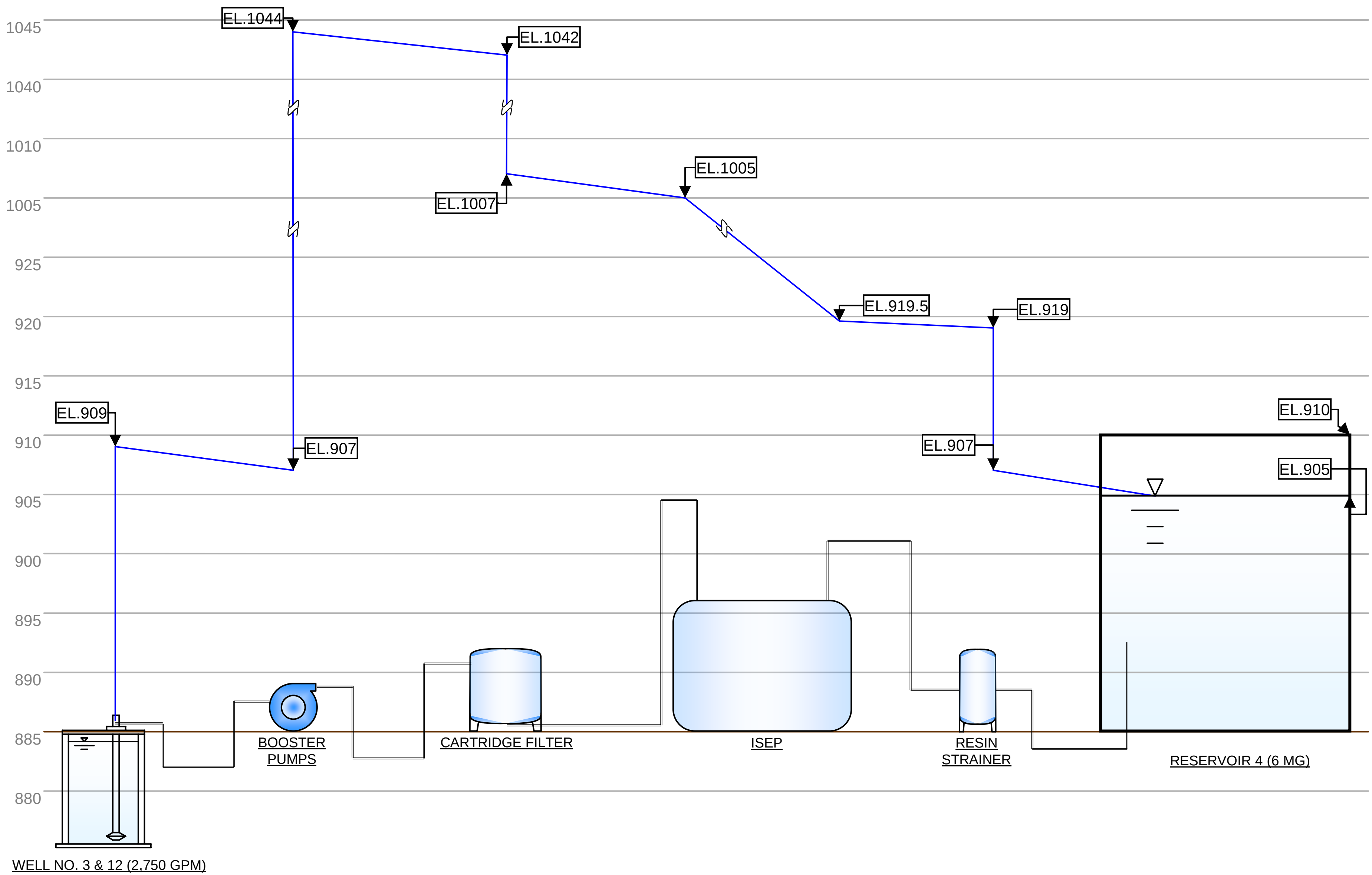
2.4.8 Disinfection Facilities

Disinfection would be required to satisfy chlorine demand and residual. Based on discussions with Chino staff, Chino would prefer the use of chlorine gas for disinfection. The Well Nos. 3 and 12 Facility would require a new chlorine gas facility. The existing Well No. 14 site contains a chlorine gas feed system that would be utilized as part of the Well No. 14 IX Facility.

Chlorine gas has chemical handling hazards that would require a monitoring and alarm system. Halogen chlorine gas sensors in the chlorination shed would be required to shut the system down if a chlorine gas leak is detected. Chlorine gas tanks would be delivered on site and be stored in a chlorination shed. Decisions on the disinfection methodology would ultimately require re-examination during the final design stage.

2.4.9 Hydraulics

A preliminary investigation of the hydraulics for the new IX facilities determined that additional pumping would be required to provide sufficient pressure for the ISEP® system and conveyance to the storage reservoir. Hydraulic profiles of the Well Nos. 3 and 12 Facility and the Well No. 14 Facility are presented on Figures 2-6 and 2-7, respectively. Each site would require two 150-hp booster pumps (1 duty and 1 stand-by) upstream of the IX facilities. The pumps would have variable frequency drives to allow capacity and head adjustments if needed. Booster pump requirements for each site are presented in Table 2-10.



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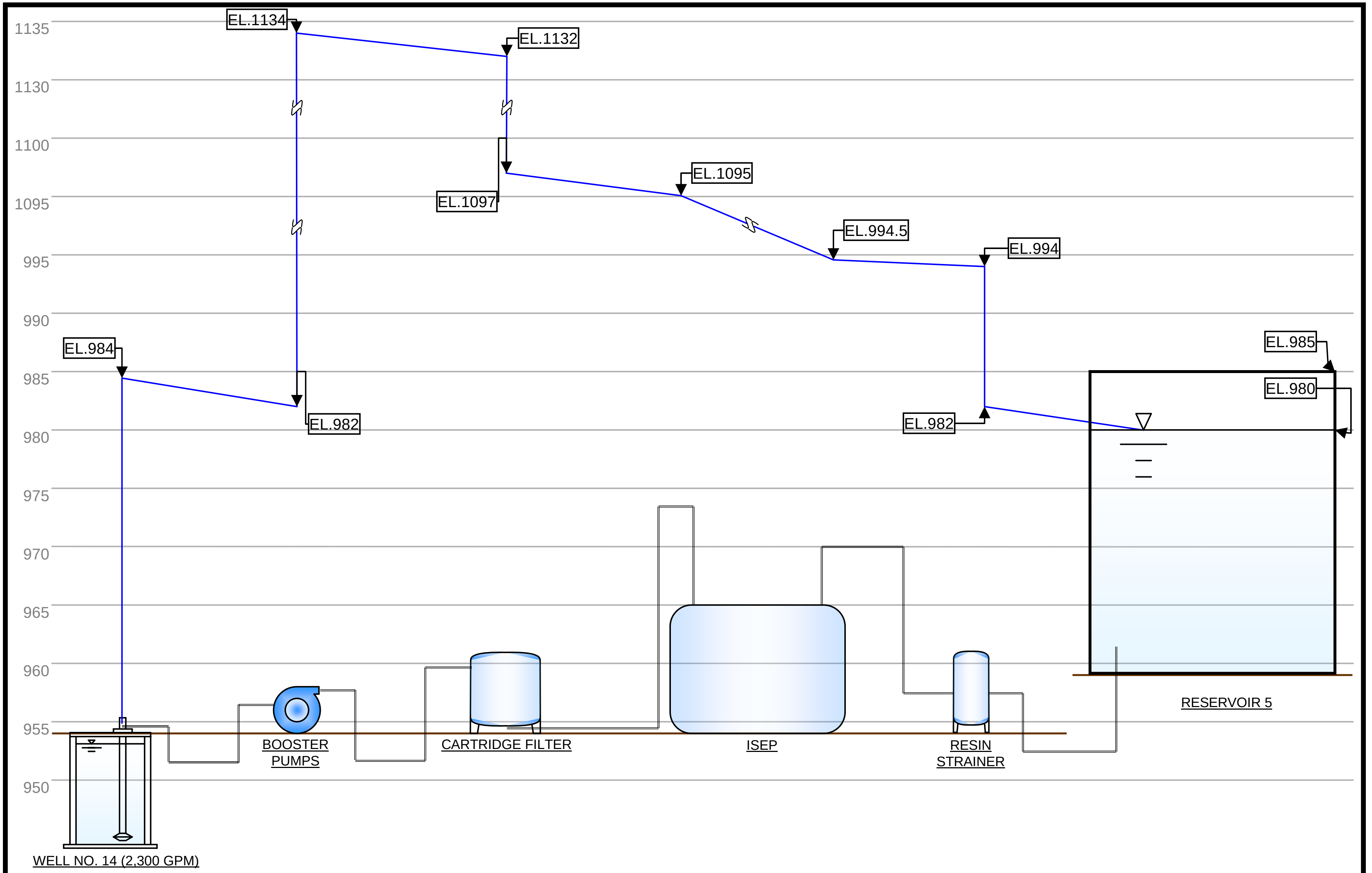
Chino Basin Dry Year Yield Program Expansion Project

City of Chino – Option A Preliminary Hydraulic Profile

Figure 2 – 6



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Chino Basin Dry Year Yield Program Expansion Project

City of Chino – Option B Preliminary Hydraulic Profile

Figure 2 – 7

Table 2-10
Booster Pump Requirements

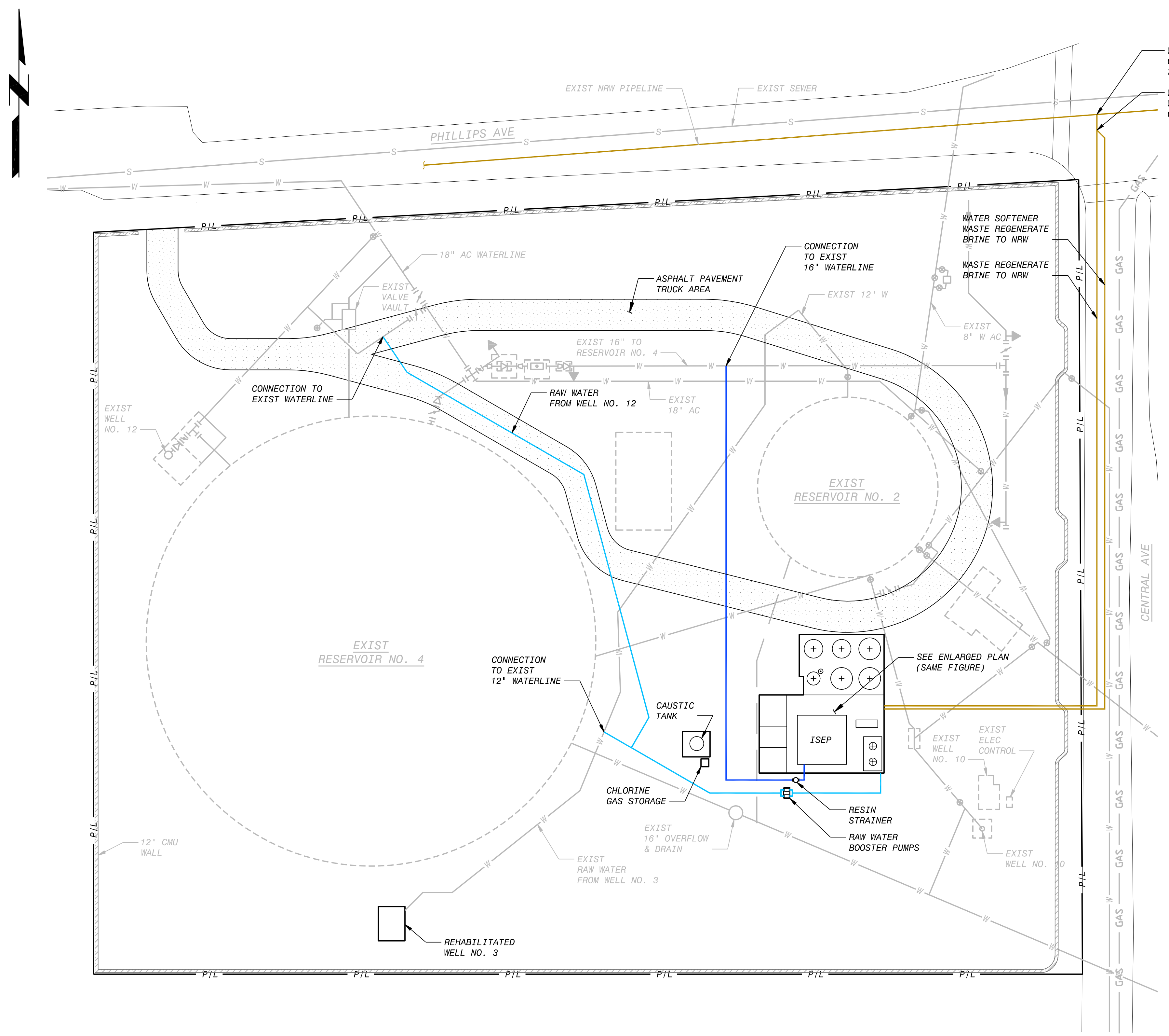
Parameter	Option A Well Nos. 3 and 12 IX Facility	Option B Well No. 14 IX Facility
Flow, gpm	2,750	2,300
Lift Requirement, feet (psi)	140 (61)	155 (68)
Required Energy, hp (kw)	122 (900)	113 (85)
Pump		
Type	Horizontal Split Case	Horizontal Split Case
Capacity, gpm	2,750	2,300
Pump Efficiency, percent	80	80
Motor		
Nominal Motor Horsepower, hp	150	150
Motor Drive (1)	VFD	VFD
Maximum Motor Speed, rpm	1,185	1,185

Notes:
(1) Variable Frequency Drive (VFD)

2.4.10 Site Requirements

The Well Nos. 3 and 12 IX Facility would be located on Chino property in Chino, on the southwest corner of Central Avenue and Phillips Avenue. The site contains existing Chino Reservoirs Nos. 2 and 4, Chino Wells Nos. 3, 12, and 10, and a booster pump station. The new IX facilities would be constructed in the southeast corner of the site. A conceptual layout of the new Well Nos. 3 and 12 IX Facility is presented on Figure 2-8.

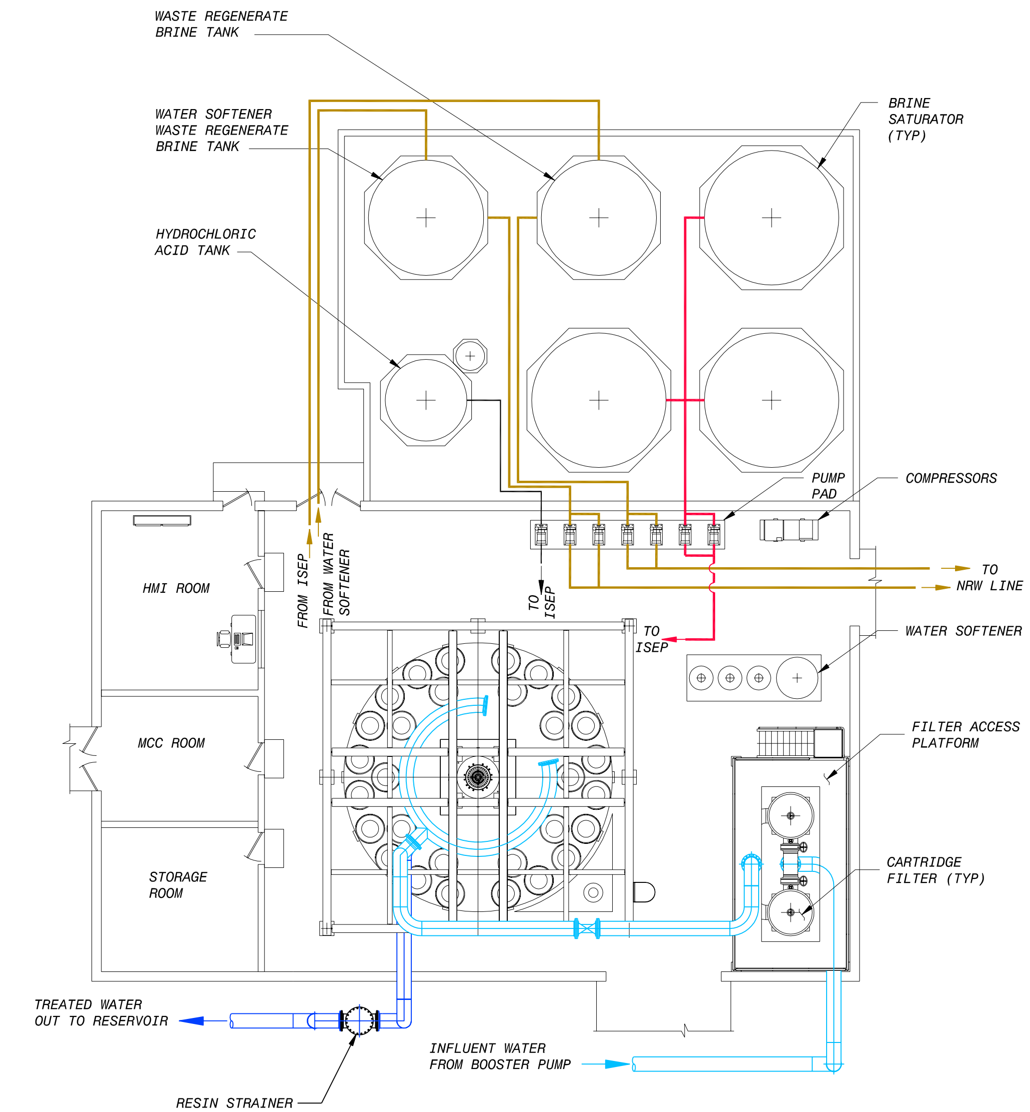
The Well No. 14 IX Facility would be located on Chino property in the City of Montclair, on the southeast corner of Benson Avenue and State Street. The site contains existing Well No. 14 facilities, Reservoir No. 5, a WFA turnout and an abandoned agricultural well. The new IX facilities would be constructed at the south end of the site and would allow room for a future reservoir. As described in Chapter 3, a new injection well would take the place of the abandoned agricultural well at the north end of the site. A conceptual layout of the new Well No. 14 IX Facility is presented in Figure 2-9.



SITE PLAN

40' 20' 0 40' 80'

1"=80'



ISEP FACILITY PLAN

10' 0 10' 20'

1"=20'

LEGEND:

- RAW WATER
- ISEP TREATED EFFLUENT
- BRINE SOLUTION
- WASTE FLOW TO NRW SYSTEM

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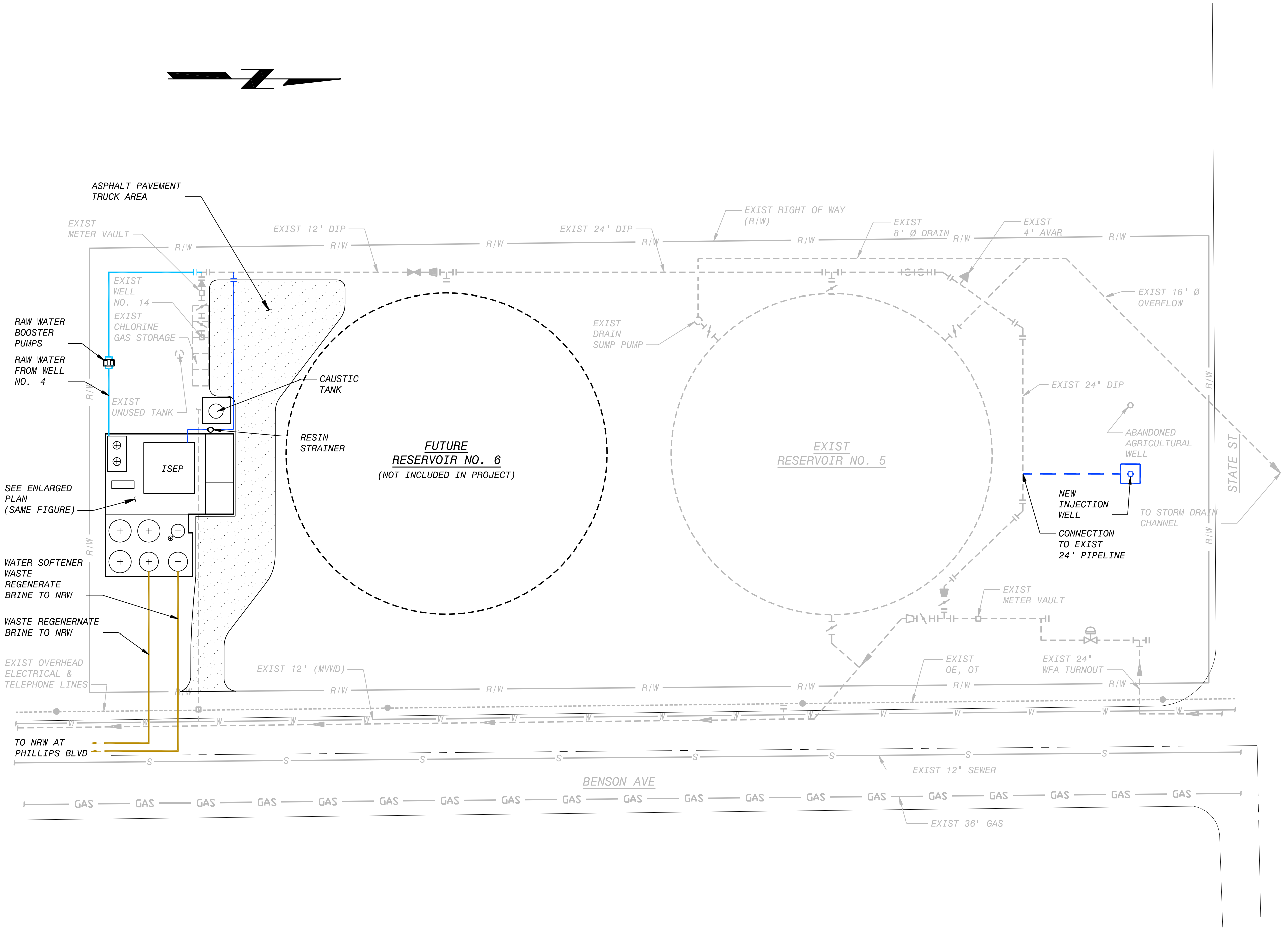
CHINO BASIN DYY PROGRAM EXPANSION PROJECT
PROJECT DEVELOPMENT REPORT

CITY OF CHINO
OPTION A - WELL NOS. 3 & 12 IX FACILITY
SITE AND YARD PIPING PLAN

DESIGNED: MJG
DETAILED: JEG
CHECKED:
APPROVED:
DATE:

PROJECT NO.
160374

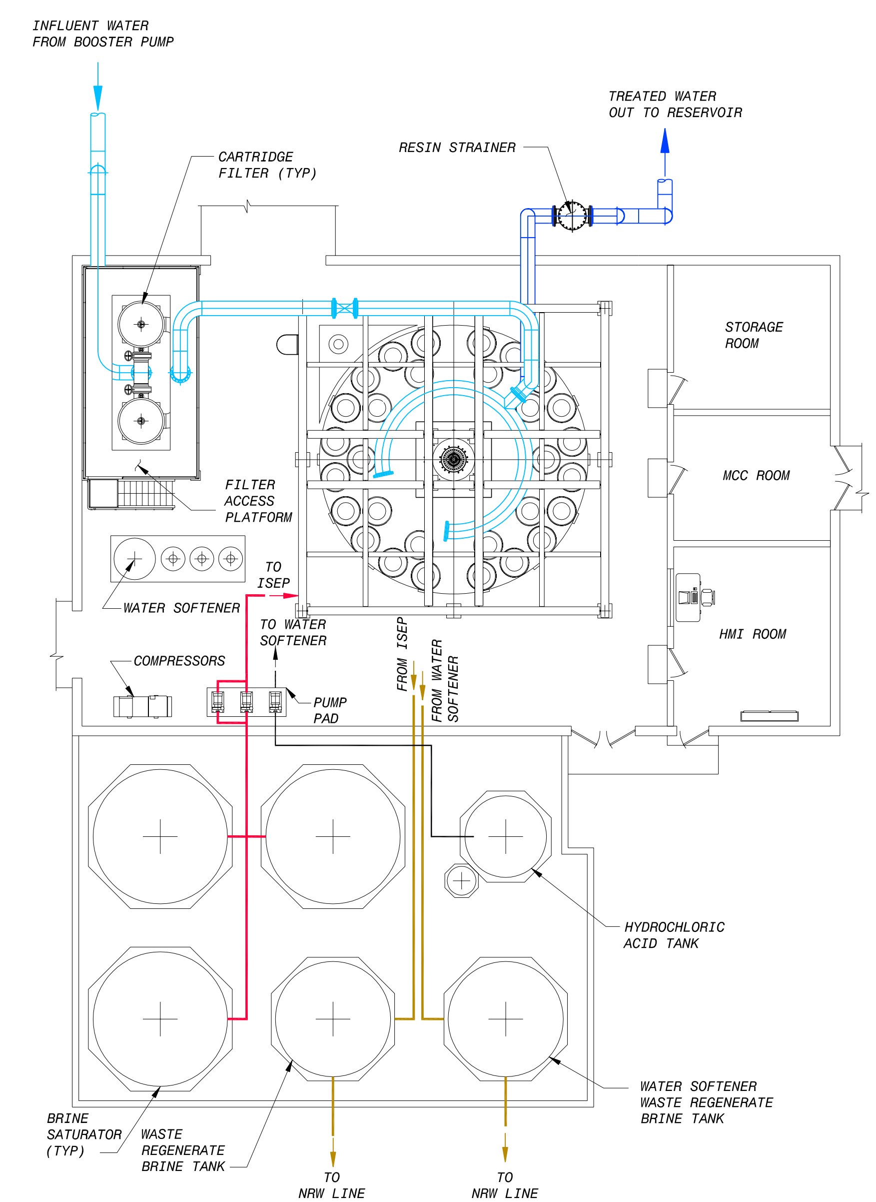
FIGURE 2-8



SITE PLAN

40' 20' 0 40' 80'

1"=80'



ISEP FACILITY PLAN

10' 0 10' 20'

1"=20'

LEGEND:

- RAW WATER
- ISEP TREATED EFFLUENT
- BRINE SOLUTION
- WASTE FLOW TO NRW SYSTEM
- TREATED WATER FOR INJECTION

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CHINO BASIN DYY PROGRAM EXPANSION PROJECT
PROJECT DEVELOPMENT REPORT

CITY OF CHINO
OPTION B - WELL NO. 14 IX FACILITY
SITE AND YARD PIPING PLAN

DESIGNED: MJG
DETAILED: JEG
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APPROVED:
DATE:

PROJECT NO.
160374

FIGURE 2-9

The IX Facilities would require site space for the new major components listed in Table 2-11.

Table 2-11
Major IX Facility Components

Components	Option A Well No. 3 and 12 IX Facility	Option B Well No. 14 IX Facility
ISEP® System Building	1	1
Salt Saturator Tank	3	3
Water Softener Tank	3	3
Waste Tank	2	2
Booster Pump Station	1	1
Caustic Tank	1	1
New Chlorine Shed	1	0
HCl Tank	1	1

Demolition of existing facilities is not anticipated for the construction of the new IX Facilities. Existing Well No. 3 equipment, such as the housing, pump equipment, and electrical equipment, would be removed and replaced at the Well Nos. 3 and 12 IX Facility site. The abandoned agricultural well at the Well No. 14 site would be cleaned out if possible and be converted into a new injection well as discussed in Chapter 3.

Driveway access and site vehicle access would be required for maintenance vehicle access, bulk salt deliveries, and bulk chemical deliveries. Existing site entrances for both IX facilities would remain in service. Asphalt pavement would be required as indicated on Figures 2-8 and 2-9 for proper vehicle access within the site. Where access is provided from paved roads, storm drainage would be provided. The surface contours on the sites are relatively flat and would not require major grading.

2.4.11 Electrical Requirements

Power upgrades for the IX facilities may be required to support the additional power demand of ISEP® building/facilities and the booster pumps. The electrical loads would include well pumping panels, site lighting, chemical feed equipment, mixing, and heating, ventilation, and air conditioning (HVAC), etc.

Southern California Edison (SCE) requires that each site utilize one transformer to handle individual site needs. If the current on-site transformer is not capable of supporting the new IX facilities, a larger transformer would be required to handle current and additional power needs.

Available on site power would need further investigation to determine the required power upgrades.

2.4.12 Instrumentation & Control Requirements

Given the size and requirements of the proposed IX systems, the IX system controls packages would likely be furnished by a qualified original equipment manufacturer (OEM) under the general contractor. This would provide the opportunity for the controls packages to be specified using Chino standard programmable logic controller (PLC) hardware and human/machine interface (HMI) software.

Monitoring equipment (including analyzers) would be provided in the final design in conformance with CDPH requirements. Additional process monitoring equipment (including analyzers, flow meters, and pressure transducers) would be required for operators to control operations and gauge system performance.

2.5 Conveyance Piping

Conveyance piping would include on-site raw water piping, on-site finished water piping, and the waste piping from the IX facility to the NRW pipeline. The general yard piping layouts are presented on the site plans (Figures 2-8 and 2-9).

2.5.1 Raw Water Piping

Well Nos. 3 and 12 IX Facility
Approximately 500 feet of 16-inch diameter raw water piping would convey groundwater from Well Nos. 3 and 12 to the new booster pumps to the IX treatment facility. All new piping would be on-site.

Well No. 14 IX Facility
Approximately 160 feet of 16-inch diameter raw water piping would convey groundwater from Well No. 14 to the new booster pumps to the IX treatment facility. All new piping would be on-site.

Any new raw water piping would either be cement mortar lined and coated (CML&C) or cement mortar lined and wrapped (CML&W) steel. Buried piping would have polyethylene wrap and may be concrete encased in specific areas.

2.5.2 Finished Water Piping

Well Nos. 3 and 12 IX Facility
Approximately 300 feet of 16-inch diameter finished water piping would convey treated water and connect to an existing on-site 16-inch pipeline. The existing 16-inch pipeline currently conveys WFA water to Reservoir No. 4.

Well No. 14 IX Facility
Approximately 130 feet of 16-inch diameter finished water piping would convey treated water and connect to an existing on-site 12-inch pipeline. The existing 12-inch line currently conveys Well No. 14 water to Reservoir No. 5.

Similar to the raw water piping, new finished water piping would either be CML&C or CML&W steel. Buried piping would have polyethylene wrap and may be concrete encased in specific areas.

2.5.3 Waste Regenerate Piping

Well Nos. 3 and 12 IX Facility

Two parallel 6-inch diameter pipelines would be installed in a single trench from the waste tanks of the Well Nos. 3 and 12 Facility north along Central Avenue to the NRW pipeline on Phillips Boulevard. The piping is assumed to be on existing Chino property and in public right-of-way. Figure 2-10 shows the waste regenerate pipelines plan and profile.

Well No. 14 IX Facility

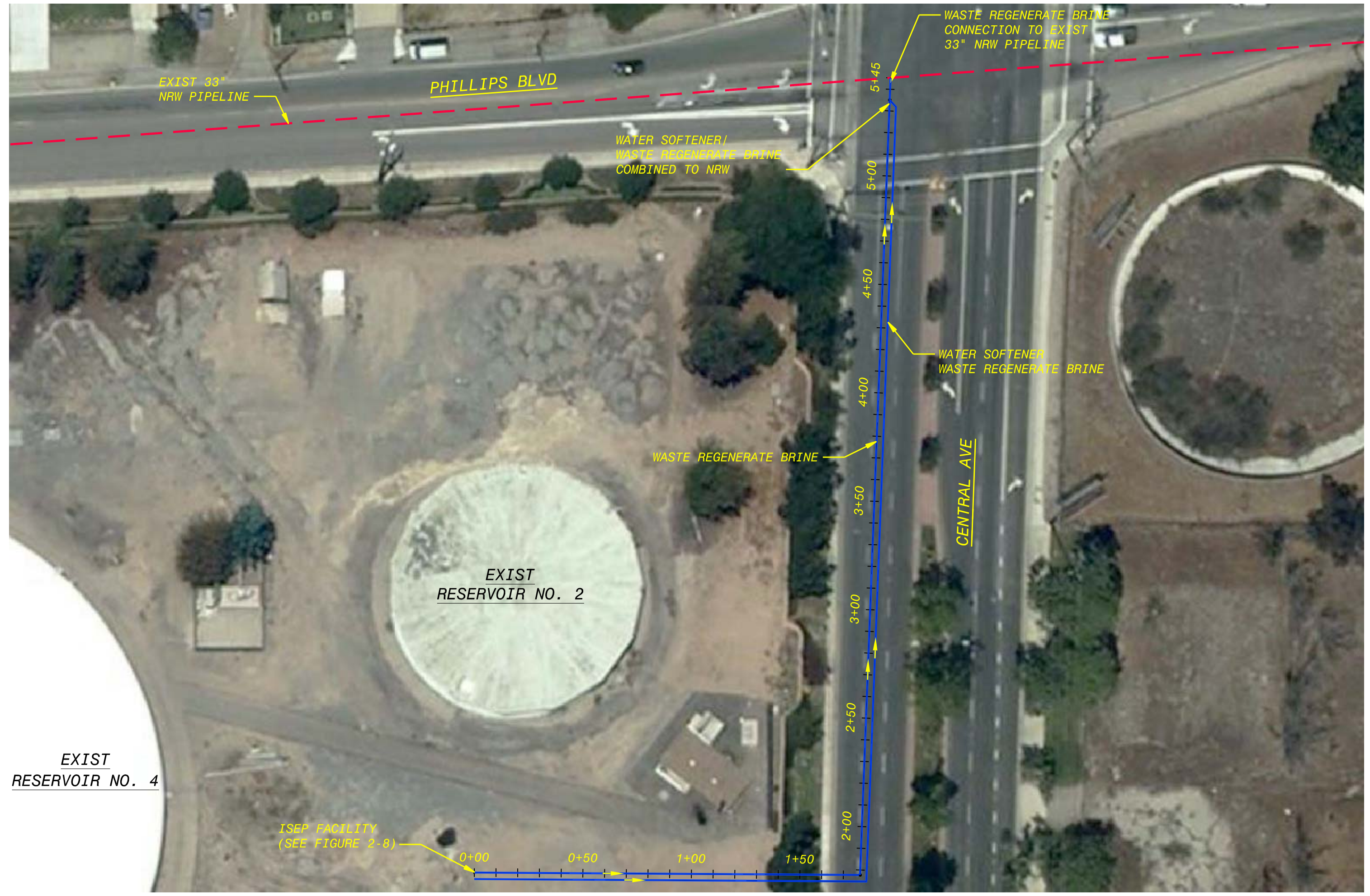
Two parallel 6-inch diameter pipelines would be installed in a single trench from the waste tanks of the Well No. 14 Facility south along Benson Avenue to the NRW pipeline on Phillips Boulevard. Most of the piping would be in public right-of-way with only a short length being installed on existing Chino property. Figure 2-11 shows the waste regenerate pipelines plan and profile.

The slight elevation increase from the Well Nos. 3 and 12 Facility to the NRW tie-in point would require that the waste from the IX plant be pumped to the NRW system. Since there is adequate elevation difference between the Well No. 14 IX Facility site and the NRW tie-in point, the waste pipelines are assumed to be able to operate under gravity from the IX plant to the NRW system. The hydraulic conditions of the pipelines are summarized in Table 2-12.

Table 2-12
Brine Waste Pipeline Hydraulic Conditions

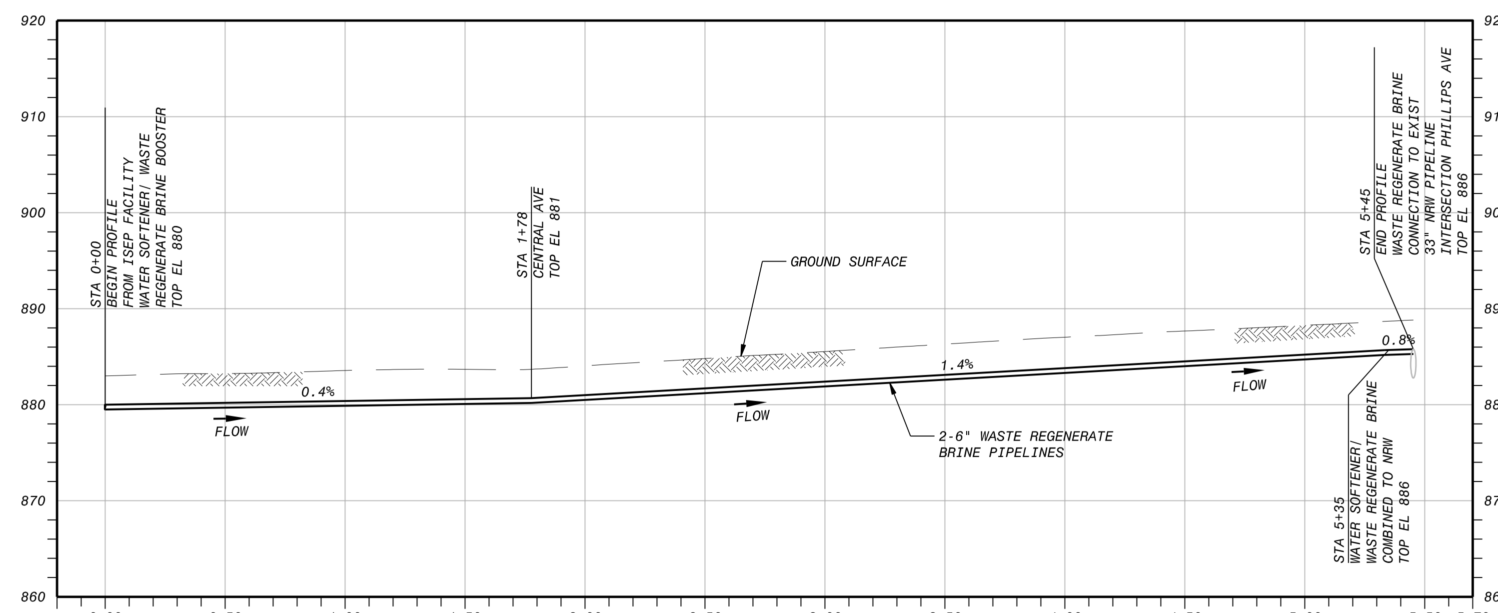
Criteria	Option A Well No. 3 and 12 IX Facility	Option B Well No. 14 IX Facility
IX Facility		
Location	Central Ave & Phillips Blvd	Benson Ave & State St
Site Elevation, feet	883	960
NRW Line		
Location	Central Ave & Phillips Blvd	Benson Ave & Phillips Blvd
Connection Invert Elevation, feet	885	905
Hydraulic Conditions		
Elevation Difference, feet	2	-55
Minimum Slope	0.004	-0.010
Pipeline Diameter, inches	6	6
Total Pipeline Length, feet	1,090	7,130
Trench Length, feet	545	3,565

The proposed pipe material for the water softener and regenerate brine waste pipelines is polyvinyl chloride (PVC) sewer pipe. An alternative pipe material is high-density polyethylene (HDPE). Pipe materials used at major crossings would be selected based on the type of construction as well as design requirements of the permitting agency.



PLAN STA 0+00 TO STA 5+45

HORIZ - 1" = 80'



PROFILE STA 0+00 TO STA 5+45

HORIZ - 1" = 80'
VERT - 1" = 20'

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CHINO BASIN DYY PROGRAM EXPANSION PROJECT
PROJECT DEVELOPMENT REPORT

CITY OF CHINO OPTION A - WELL NOS. 3 & 12
IX FACILITY WASTE REGENERATE BRINE
PIPELINES PLAN AND PROFILE

DESIGNED: MJG
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FIGURE 2-10

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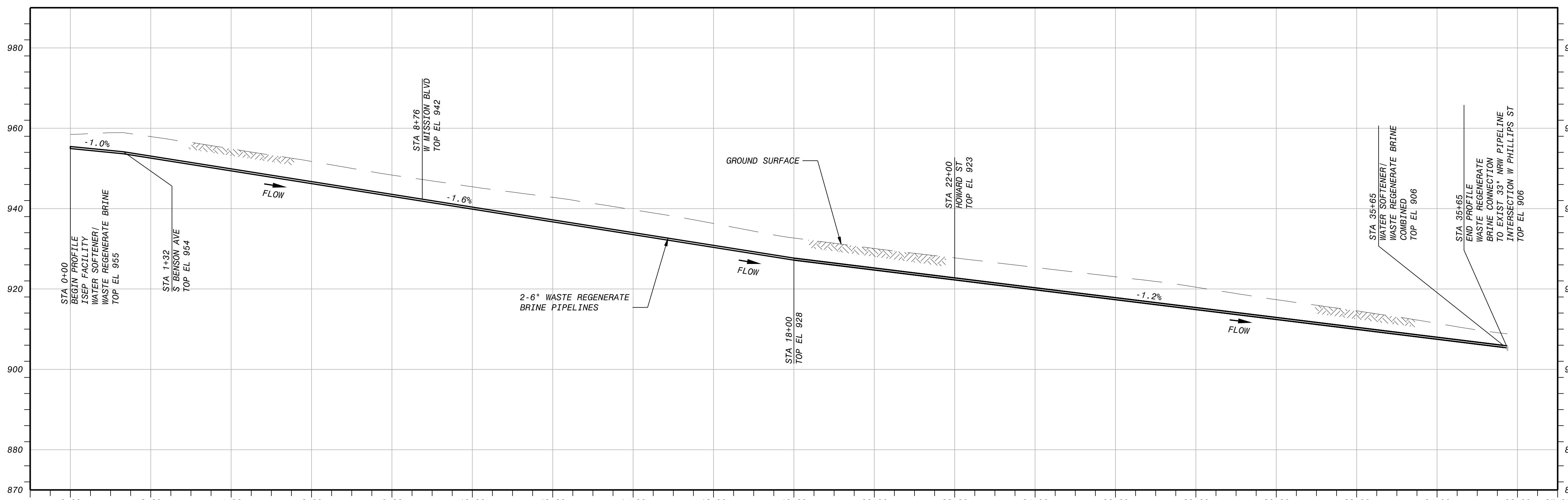
PLAN STA 0+00 TO STA 35+65

HORIZ - 1" = 300'



PROFILE STA 0+00 TO STA 35+65

HORIZ - 1" = 300'

VERT - 1" = 30'

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CHINO BASIN DYY PROGRAM EXPANSION PROJECT

PROJECT DEVELOPMENT REPORT

CITY OF CHINO OPTION B - WELL NO. 14
IX FACILITY WASTE REGENERATE BRINE
PIPELINES PLAN AND PROFILE

DESIGNED: MJG
DETAILED: JEG
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DATE:

PROJECT NO.
160374

FIGURE 2-11

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D160374

3.0 GROUNDWATER INJECTION WELL

3.1 Overview

This chapter describes the location and facilities for a new groundwater injection well. Chino is planning to construct the well to inject water when needed, to meet the additional "put" contribution under this Program Expansion. The proposed location for the injection well is on Chino's existing Reservoir 5 site, at the corner of State Street and Benson Avenue as shown on Figure 3-1. Chino initially proposed to convert an existing, disused agricultural well for down-hole injection of treated water only. However, upon further evaluation, it was determined that use of the existing well was not possible. The site is a candidate to construct an injection well due to the availability of imported water from the WFA Agua de Lejos WTP for injection. The property would also have adequate drainage facilities with the waste flows conveyed into an existing storm drain located on State Street.

3.2 Historical Groundwater and Operating Conditions

Information is unavailable for the agricultural well. A logo on the well cover indicates that it may have been drilled by Layne Western (now part of Layne Christensen), but records are not available to indicate its construction or operation. However, historic groundwater elevations and operating conditions are available for an existing Chino production well.

Table 3-1 presents the historic groundwater elevations for existing Chino Well No. 12, which is located approximately 4,750 feet from the new injection well and has a production capacity of 2,225 gpm. Due to water quality issues, Well No. 12 was shut down in October 2007.

Table 3-1
Historical Operating Conditions(1)

Operating Conditions	Well No. 12
Production Capacity, gpm	2,225
Est. Avg. Static Groundwater Elev., ft bgs (2)	290
Estimated Average Drawdown, feet(3)	66
Approximate Specific Gravity, gpm/ft (4)	34

Notes:
(1) Historical operating conditions listed in table are based on actual pump test data conducted in September 2007 and provided by WEI, 2008.
(2) Feet, below ground surface (bgs).
(3) Drawdown is the difference between static and dynamic groundwater elevations.
(4) Gallons per minute per foot of drawdown.

Based on the data presented in the table, the static groundwater levels for the proposed injection well would be approximately 290 feet below ground surface. Due to its proximity, there would potentially be some drawdown as a result of pumping from Well No. 14. The data in Table 3-1 and anticipated operating conditions for Well No. 14 were used to develop the anticipated injection well operating conditions provided in Section 3.3.

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Chino Basin Dry Year Yield Program Expansion Project

City of Chino – Injection Well Vicinity Map

Figure

3 – 1

3.3 Expected Operating Conditions and Well Performance

Aquifer Storage and Recovery (ASR) wells are intended to operate as injection wells until the required amount of water is stored in the aquifer. When additional supplies are needed, ASR wells can reverse operations and extract groundwater from the aquifer as a typical production well. A more in-depth discussion of ASR wells and drawings are provided in Volume I.

While injection would be carried out at Chino's new well, extraction would take place at Chino Well No. 14 and other existing Chino wells as part of their put-take contribution to the Program Expansion. Well No. 14 is to have wellhead IX treatment installed to treat known water quality contaminants, namely nitrate and perchlorate.

In an attempt to convert an existing agricultural well to an injection well, Chino has performed soundings in the existing agricultural well. However, the failure of these surveys indicates that the well has collapsed. The injection well at this site would therefore be a new well constructed in the vicinity of the collapsed well.

For an ASR well, the injection capacity is initially assumed to be between 30 percent and 50 percent of the production capacity of the same well. Assuming that similar performance and production would be achieved in a new injection well as in the existing Well No. 14, the injection capacity of the well would conservatively be estimated at 700 gpm.

The injection process would involve WFA water from the Agua de Lejos WTP. An existing turnout at the Reservoir No. 5 site would be utilized to provide the WFA water to the new injection well. The evidence for ASR wells indicates that good quality, imported water injected into a confined aquifer would gradually dilute local contaminant plumes over successive 'put' and 'take' cycles. The injection well, if there is any dilution effect, would potentially benefit Well No. 14 as long as that well is at a lower hydraulic gradient in the aquifer. Once the IX plant is commissioned, the resumption of production pumping from Well No. 14 should result in a localized flow of water towards it.

Table 3-2 provides the anticipated operating condition for Chino's new injection well based on the information shown in Table 3-1 and anticipated Well No. 14 operating conditions.

Table 3-2
Anticipated Operating Conditions

Conditions	New Injection Well	Well No. 14
General Conditions		
Basis for Operating Conditions, Well No.	12	12
Distance from Basis Well Above, feet	4,750	4,750
Location (Intersection)	West State/ S. Benson	West State/ S. Benson
Site Elevation, feet amsl (1)	955	955
Operating Conditions		
Injection/Production Capacity, gpm	700	2,300
Est. Avg. Static Groundwater Elev., ft bgs	290	290
Est. Avg. Injection Head, feet (2)	376	N/A

Notes:
(1) Above mean sea level (amsl).
(2) Addition of static lift and assumed system pressure of 40 psi.

It should be emphasized that assumptions about the site and its suitability for down-well injection would have to be confirmed during detailed design and by extensive testing during well drilling and development.

3.3.1 Anticipated Water Quality

Because the new injection well would be for injection only and not production, water quality is not of particular concern in regards to potential process treatment at the site. Existing Well No. 14 is currently non-operational due to unacceptable concentrations of nitrate and perchlorate, for which wellhead treatment is proposed as part of the expanded Program. The injection of treated water into the aquifer may have a beneficial, diluting effect on those contaminants.

3.3.2 Injection Cycle

At the beginning of an injection cycle, water would be allowed to run to waste for five to ten minutes to clear the supply pipeline of any unwanted debris or sediments that may have accumulated in the pipe over time. Following the waste cycle, a motor operated valve would open to allow the casing pipe to fill. During the injection process, flow rate would automatically be monitored, and a flow control valve would be used to adjust and maintain a given flow rate.

It is proposed that water for injection be obtained directly off the Benson Avenue Feeder via an existing turnout. This can be further evaluated as part of the detailed design; treated water Reservoir No. 5 or a number of other treated water pipelines along Benson Avenue can alternatively provide water for injection.

Under typical operations, treated imported water would be injected when available over the seven month period from October to April.

3.3.3 Rehabilitation

Periodic rehabilitation is another important aspect in the operations of injection and ASR wells. Rehabilitation typically occurs on a three-to-five year cycle in which any equipment is removed and the casing is cleaned. The time between rehabilitations would be extended by backflushing with a pump or by airlifting the well (injecting high pressure air at the bottom of the well to scour the casing). Airlifting is more typical on injection wells where a pump has not been installed. The frequency of the backflush or airlift would be determined on a site-specific basis and would be determined by a decline in injection performance, i.e. lower injection flow rate and increased injection pressure readings.

3.4 Well Drilling and Development

The new injection well would be drilled in the northern part of the site, near the old agricultural well. Assuming a construction similar to Chino 14 nearby, it is anticipated that this well would be 700 - 750 ft deep and would have an injection capacity of 500 to 1,000 gpm. A general methodology for well construction is presented below.

Geotechnical investigation would be carried out to establish the preferred drilling method. Based on the findings and hydrogeological recommendations, a pilot bore hole would be drilled and then reamed to the specified diameter and depth. Selection of screening elevation and seal depths would be determined based on the geophysical surveying of the pilot hole.

A copper-bearing steel casing would be installed the full length of the well, with a minimum wall thickness of 5/16-inch. Total length of louvered casing (i.e., screening) and the depth interval where it would be installed would be determined during final design. Gravel pack would be installed along the entire length of the screening depth interval. A cement grout seal would be installed from ground level to a minimum specified depth.

Requirements for a sounding pipe, permanent gravel feed line, or air vent tube would be evaluated during final design.

3.5 Well Facilities and Wellhead Equipment

Wellhead facilities would consist of a supply pipeline from the WFA turnout to the wellhead and a waste pipeline to the existing waste system. In addition, a flow control valve would be required to regulate the pressure and amount of water injected.

3.5.1 Flow Control Valve

A flow control valve can be located either on the surface or below the ground in the well. A surface-mounted control valve would have the advantage of ease of maintenance and removal. The below ground control valve (down-hole control valve) has automatic controls located on the surface, but the valve is located in the well. A down-hole valve would minimize air fouling, bio-fouling, and calcite formation in the well by eliminating air entrainment.

3.5.2 Discharge and Blow-Off Piping

The wellhead piping would include a 10-inch diameter injection pipe, an 8-inch diameter waste pipe, two control valves, a check valve, air release valve, flow meter, and other miscellaneous valves and fittings.

The waste piping would be utilized for discharge to the site waste pipeline during startup.

3.6 Conveyance Piping

Conveyance piping would include on-site piping from the existing 24-inch WFA turnout to the wellhead. The sections below provide a brief summary of the facilities discussed in detail in Chapter 2.

Approximately 60 feet of 10-inch diameter raw water piping would convey treated water from an adjacent WFA turnout to the new injection well. All new piping would be on-site and would be either CML&C steel or CML&W steel. Buried piping would have polyethylene wrap and would be concrete encased where necessary.

3.6.1 Operations and Hydraulic Conditions

Treated water for injection would be obtained from the existing WFA turnout that currently conveys WFA treated water to Chino Reservoir No. 5. This would give a maximum available head for injection of 385 feet, based on the anticipated static water level in the injection well and the top water level in the reservoir.

4.0 OPINION OF PROBABLE COST

4.1 Overview

This chapter presents the Opinion of Probable cost for the facilities described in this Volume IIA of the PDR. General cost assumptions and the Opinion of Probable Capital and Annual Operations and Maintenance (O&M) Costs are presented below.

The Opinion of Probable Cost was based on conceptual-level unit cost criteria intended to provide a budgetary estimate of each facility's capital and annual O&M costs. Table 4-1 summarizes the estimated capital and annual O&M costs for the City's proposed facilities. As shown in the table, the total Opinion of Probable Capital and Annual O&M costs for Option A facilities would be $9,207,000 and $823,000, respectively. The Total Opinion of Probable Capital and Annual O&M Costs for Option B facilities would be $7,854,000 and $686,000, respectively.

Table 4-1
Summary of Opinion of Probable Capital and Annual O&M Costs

Component	Option A	Option B
Capital Cost		
Construction Cost	$6,975,000	$5,950,000
Contingency (1)	$1,395,000	$1,190,000
Engineering/Administration/CM (2)	$837,000	$714,000
Total Capital Cost	**$9,207,000**	**$7,854,000**
Midpoint of Construction Cost (3)	$10,061,000	$8,582,000
Annual Cost		
Annual O&M Cost	$823,000	$686,000
Annualized Capital Cost (4)	$787,000	$671,000
Total Annual Cost	**$1,610,000**	**$1,357,000**

Notes:
(1) Based on 20 percent contingency.
(2) Based on 12 percent engineering/administration/construction management (CM).
(3) Assumes midpoint of construction in year 2012 at 3 percent escalation rate.
(4) Assumes amortization period of 25 years at a discount rate of 6 percent.

4.2 General Cost Assumptions

The conceptual-level Opinion of Probable Capital and O&M Costs developed in this PDR were derived from quotes received from equipment manufacturers, a survey of bid pricing from participating agency facilities previously or currently under construction, and bid results or construction cost estimates from similar and recent B&V projects. Volume I, Chapter 9, presents a summary of the basis for the unit costs used in this PDR.

Volume I, Chapter 9, also presents the construction, annual O&M, general, and financing unit cost criteria used to develop the cost estimates provided in this chapter.

4.3 Capital Cost

Table 4-2 presents the Opinion of Probable Capital Cost for construction of the City's Option A facilities. As shown, the total estimated capital cost for the new Option A facilities would be $9,207,000. Midpoint of construction costs are also provided and indicate the construction costs in year 2012 using a 3 percent escalation rate.

Table 4-2
Summary of Opinion of Probable Capital Cost – Option A Facilities

Component/Facility Detail	Option A Cost
Well Facilities [1]	
Equipping: Well No. 3 Rehabilitation	$1,000,000
Disinfection System: for Well Nos. 3 and 12 IX Facility	$200,000
Treatment Facilities: 2,750 gpm ISEP® IX System	
IX	$3,366,000
Pre-engineered Building	$200,000
Conveyance Facilities	
Brine Pipeline: 3,500 feet @ Dual 6" Diameter	$315,000
Pump station: 300 HP Plant Booster Station	$750,000
SARI/NRWS Facilities	
Initial Capacity Charge	$300,000
General Costs	
Mechanical [2]	$123,000
Electrical [2]	$412,000
Site Work [2]	$206,000
General Requirements [3]	$103,000
Total Construction Cost	$6,975,000
Contingency [4]	$1,395,000
Engineering/Administration/CM [5]	$837,000
Total Capital Cost	**$9,207,000**
Total Midpoint of Construction Cost [6]	$10,061,000

Notes:
(1) Includes any new production, ASR, and injection wells and well conversion/rehabilitation costs.
(2) Includes general costs for all treatment and booster station facilities.
(3) Includes general requirements costs for all facilities (except land and SARI/NRWS).
(4) Based on 20 percent contingency.
(5) Based on 12 percent engineering/administration/CM.
(6) Assumes midpoint of construction in year 2012 at 3 percent escalation rate.

Table 4-3 presents the opinion of probable capital cost for construction of the City's Option B facilities. As shown, the total estimated capital cost for the new Option B facilities would be $7,584,000.

Table 4-3
Summary of Opinion of Probable Capital Cost – Option B Facilities

Component/Facility Detail	Option B Cost
Well Facilities [1]: New Injection Well	
Drilling/casing/cap	$900,000
Equipping	$200,000
Treatment Facilities: 2,300 gpm ISEP® IX System	
IX	$2,815,000
Pre-engineered Building	$200,000
Conveyance Facilities	
Brine Pipeline: 400 feet @ Dual 6" Diameter	$36,000
Pump station: 300 HP Plant Booster Station	$750,000
SARI/NRWS Facilities	
Initial Capacity Charge	$300,000
General Costs	
Mechanical [2]	$107,000
Electrical [2]	$357,000
Site Work [2]	$178,000
General Requirements [3]	$107,000
Total Construction Cost	$5,950,000
Contingency [4]	$1,190,000
Engineering/Administration/CM [5]	$714,000
Total Capital Cost	**$7,854,000**
Total Midpoint of Construction Cost [6]	$8,582,000

Notes:
(1) Includes any new production and injection wells and well conversion/rehabilitation costs.
(2) Includes general costs for all treatment and booster station facilities.
(3) Includes general requirements costs for all facilities (except land and SARI/NRWS).
(4) Based on 20 percent contingency.
(5) Based on 12 percent engineering/administration/CM.
(6) Assumes midpoint of construction in year 2012 at 3 percent escalation rate.

4.4 Annual O&M Cost

Table 4-4 presents the opinion of probable annual O&M cost for the City's Option A facilities. As shown, the total estimated annual O&M cost for the new Option A facilities would be $823,000.

Table 4-4
Summary of Opinion of Probable Annual O&M Cost – Option A Facilities

Component/Facility Detail	Option A Cost
Well Facilities [1]: Well No. 3 Rehabilitation (75 HP)	
Power	$62,000
Miscellaneous Maintenance	$25,000
Treatment Facilities: 2,750 gpm ISEP® IX System	
General	$434,000
Resin Replacement	$15,000
Conveyance Facilities	
General Pipeline Maintenance: Brine Pipeline	$3,000
Pump Station Power: 300 HP Plant Booster Station	$247,000
Pump Station General Maintenance	$15,000
SARI/NRWS Facilities	
Capacity Charge	$6,000
Volumetric Charge	$14,000
CIP Charge	$2,000
Total Annual O&M Cost	**$823,000**
Annualized Capital Cost [2]	$787,000
Total Annual Cost	$1,610,000

Notes:
(1) Includes any new production, ASR, and injection wells and well conversion/rehabilitation costs.
(2) Assumes amortization period of 25 years and discount rate of 6 percent.

Table 4-5 presents the opinion of probable annual O&M cost for the City's Option B facilities. As shown, the total estimated annual O&M cost for the new Option B facilities would be $686,000.

Table 4-5
Summary of Opinion of Probable Annual O&M Cost – Option B Facilities

Component/Facility Detail	Option B Cost
Well Facilities [1]: New Injection Well	
Miscellaneous Maintenance	$25,000
Treatment Facilities: 2,300 gpm ISEP® IX System	
General	$363,000
Resin Replacement	$14,000
Conveyance Facilities: 300 HP Plant Booster Station	
Pump Station Power	$247,000
Pump Station General Maintenance	$15,000
SARI/NRWS Facilities	
Capacity Charge	$6,000
Volumetric Charge	$14,000
CIP Charge	$2,000
Total Annual O&M Cost	**$686,000**
Annualized Capital Cost [2]	$671,000
Total Annual Cost	$1,357,000

Notes:
(1) Includes any new production, ASR, and injection wells and well conversion/rehabilitation costs.
(2) Assumes amortization period of 25 years and discount rate of 6 percent.