Volume II C

Cucamonga Valley Water District

TABLE OF CONTENTS

Page

TABLES

FIGURES

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 will 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 II C describes proposed facilities for Cucamonga Valley Water District (CVWD). Chapter 2 provides conceptual development of the aquifer storage and recovery (ASR) wells required for CVWD to participate in the Program Expansion. An Opinion of Probable Cost is presented in Chapter 3. This Introduction Chapter provides background information on the DYY Program, the Program Expansion, and the CVWD 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 will 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 Operation, 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
Chino (II A)	▸ Regenerable ion exchange (IX) treatment at existing Well Nos. 3 and 12 ▸ ASR Site at Well No. 14: Regenerable IX treatment at existing Well No. 14 and replacement of existing Chino agriculture well for injection
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 Areas
Ontario (II F)	▸ Conveyance facilities to establish interconnection with CVWD
Pomona (II G)	▸ Regenerable IX treatment at existing Reservoir No. 5 site
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 Plan (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 Chino II Desalter

1.5 Conceptual Design Assumptions

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

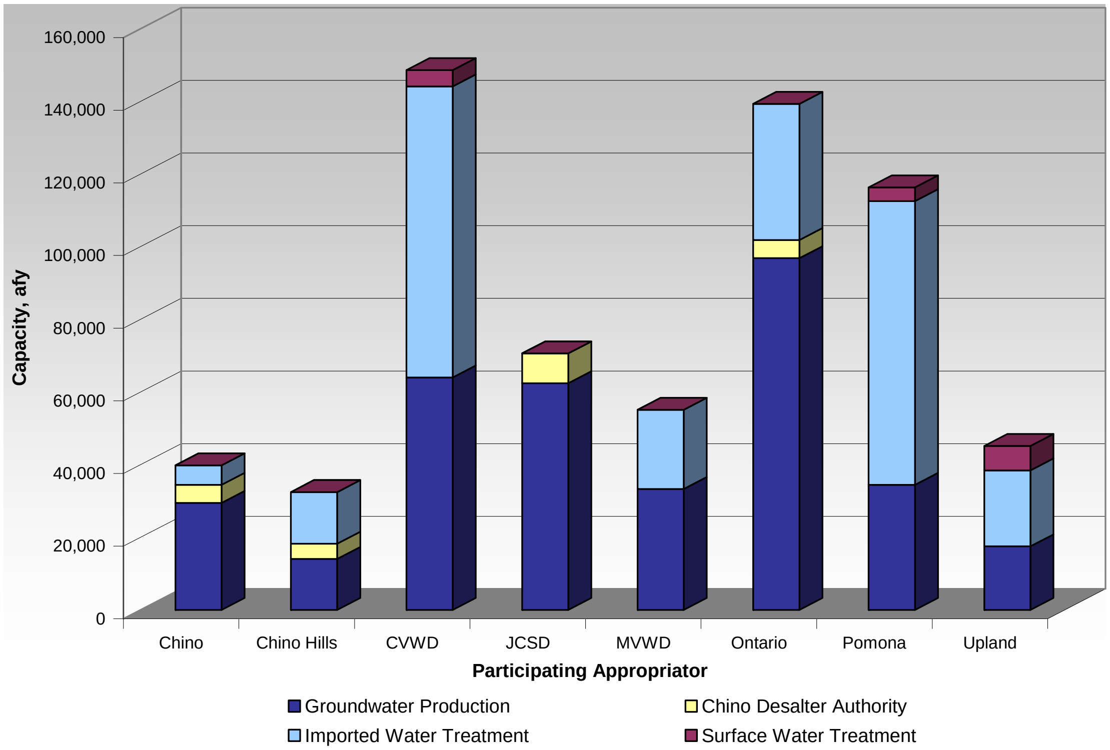
- Elevations were based upon United States Geological Survey (USGS) maps and maps obtained online from Google® Earth and are estimated to be accurate to within 10 percent of the actual elevation. Topographical surveys would be performed as part of the final design.
- Typical engineering calculations 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 IX resin manufacturers.
- Conceptual designs were 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.

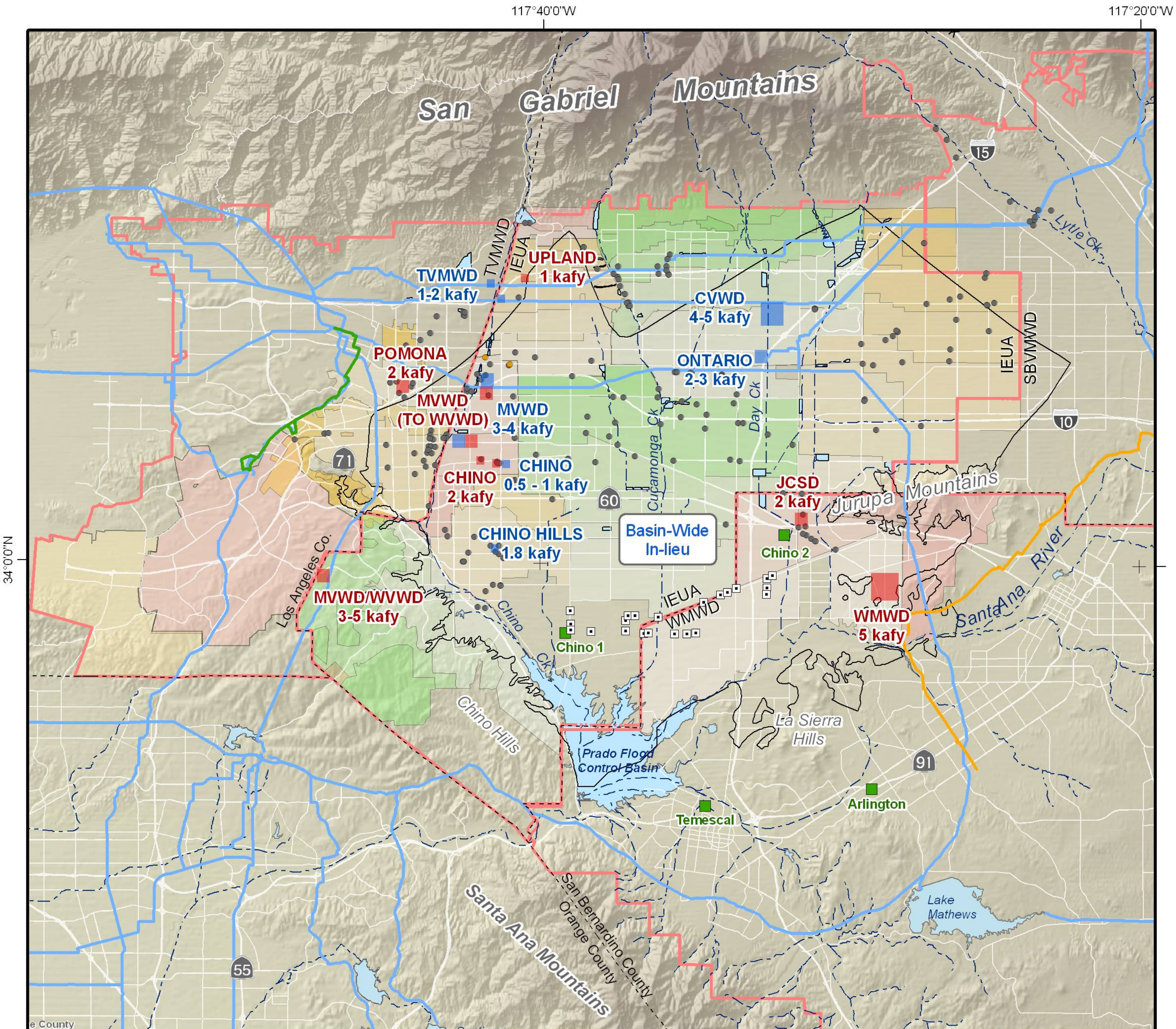
Table 1-3
Summary of Initial and Expanded DYY Program Participants and Proposed Put/Take Capacities

Agency	Initial DYY Program (1)		DYY Program Expansion (2)	
	Put Capacity (afy)	Take Capacity (afy)	Put Capacity (afy) (4)	Take Capacity (afy) (6)
Chino	(3)	1,159	500-1,000	2,000
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
Ontario		8,076	2,000-3,000	0
Pomona		2,000	0	2,000
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.

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).

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 will contribute to the long term sustainable use of the Basin. A further discussion of the Basin Operations Plan is provided in Volume I.



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

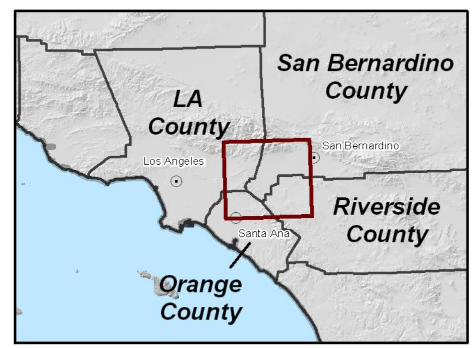
ASR Well

Desalter Well

Desalter Facility

Flood Control/Conservation Basins

Streams, Rivers, and Channels



Produced by:

WILDERMUTH™ ENVIRONMENTAL INC.

www.wildermuthenvironmental.com

Author: MJC
Date: 20081209
File: Figure_1-2.mxd

0 1 2 3 4 Miles

0 2 4 KM

Prepared For:

BLACK & VEATCH Corporation

Proposed DYY Participants and Put/Take Locations

Figure 1-2

1.6.1 Water Resources, Historical Water Use, and Shift Obligation for CVWD

The Asset Inventory data summarizing CVWD'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 CVWD has a local surface and imported water treatment capacity of 75.5 million gallons per day (mgd) (84,600 afy) and groundwater production capacity of 57.1 mgd (64,000 afy). CVWD receives its treated imported water from their own Royer-Nesbit and Lloyd Michael WTPs.

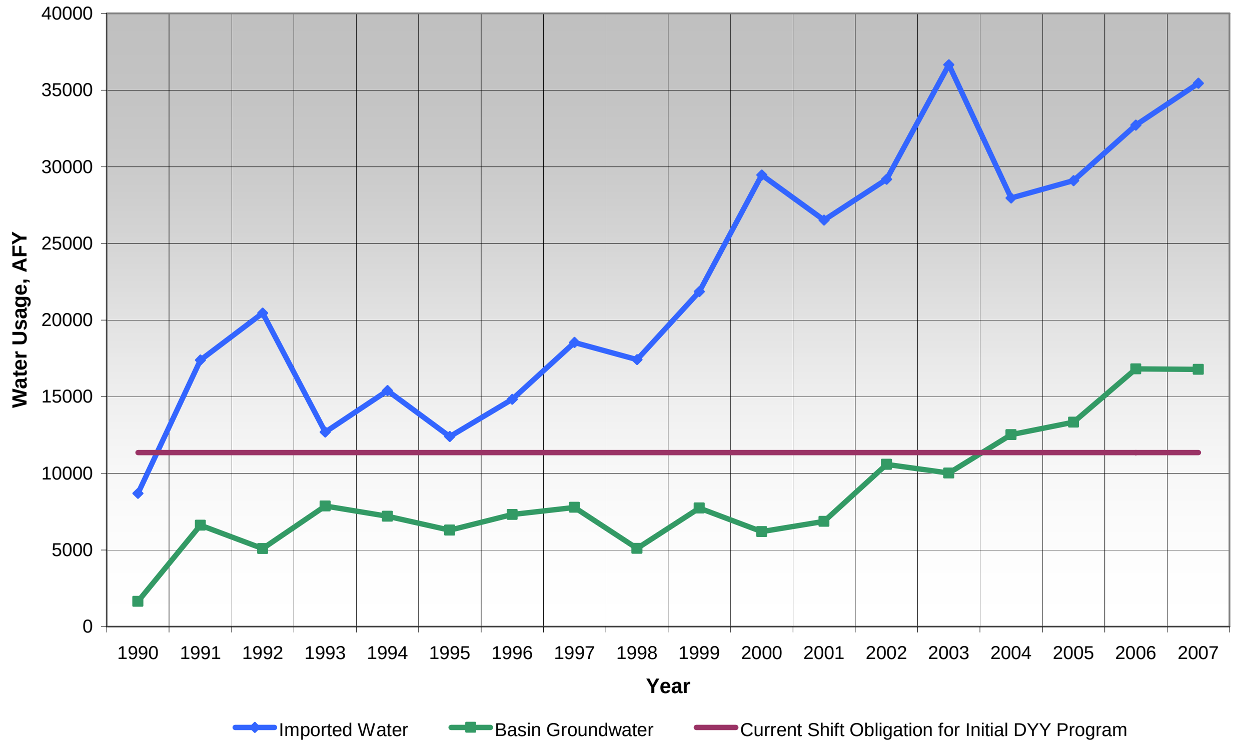
Table 1-4
Existing Water Resource Capacities for CVWD

Water Resource	CVWD Capacity, mgd (afy)
Local Surface and Imported Water	
Local Surface Water	
Arthur Bridge WTP	4.0 (4,500)
Subtotal	4.0 (4,500)
Imported Metropolitan Water	
Royer-Nesbit WTP	11.5 (12,900)
Lloyd Michael WTP	60.0 (67,200)
Subtotal	71.5 (80,100)
Total Local Surface and Imported Water	75.5 (84,600)
Groundwater	
Chino Basin Wells(1)	28.3 (31,700)
Non-Chino Basin Wells(1)	28.8 (32,300)
Total Groundwater	57.1 (64,000)
TOTAL WATER RESOURCES	**132.6 (148,600)**

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 CVWD. In 2007, approximately 35 percent of CVWD's 54,300 acre-ft of water usage was Basin groundwater versus approximately 65 percent from imported water supplied by Metropolitan. This breakdown does not account for local surface water or recycled water deliveries. Based on historical imports and on future growth projections, CVWD has elected to contribute a "put" of 4,000 – 5,000 afy toward the Program Expansion. To achieve this "put" contribution, CVWD has proposed four new ASR wells as discussed in Section 1.6.2.

Figure 1-3
CVWD Historical Imported Water and Groundwater Usage



CVWD participated on the "take" side of the original DYY Program and is interested in participating in the Program Expansion on the "put" side only. CVWD's "put" contribution will enable other agencies, such as JCSD and WMWD, to participate further on the "take" side. CVWD's "put" facilities include construction of four new ASR wells to inject treated water from Lloyd Michael WTP in the northern area of the Basin within Management Zone 3 (MZ3).

The number of new ASR wells was based on the interest of WMWD and JCSD in participating in the Program Expansion. According to WEI's model, the additional "put" accomplished by the new ASR facilities would benefit MZ3 by helping to reduce over pumping in the area. WMWD initially expressed interest in contributing up to 8,000-10,000 afy of "take", or shift, from the Basin. However, upon review of groundwater modeling results in JCSD's service area, the maximum "take" for WMWD supported by JCSD's facilities and the lower portion of MZ3 was 5,000 afy. In addition to WMWD, JCSD's potential "take" in the Program Expansion would be 2,000 afy, which would also benefit from the new ASR facilities located up gradient in the Basin. Therefore, the total new "take" from both WMWD and JCSD under the Program Expansion would be 7,000 afy.

To offset this additional dry-year production from MZ3 of the Basin, it was assumed that the "put" supply for two-thirds of this water (approximately 4,000-5,000 afy) would be provided via injection and one-third (approximately 2,000-3,000 afy) would be accomplished with in-lieu deliveries between the City of Ontario (Ontario) and JCSD via a new CVWD/Ontario interconnection. Assuming surplus deliveries would be available seven out of 12 months of the year during "put" years, approximately 8,600 afy of injection capacity would be required. Based on an assessment of the average well production capacity within the same area, a production capacity of 2,000 gallons per minute (gpm) was assumed for each new ASR well. Assuming a conservative 66% injection to production capacity, four new ASR wells, each with an injection capacity of approximately 1,300 gpm, would be required to achieve a firm 5,000 acre-feet annual "put."

Four preliminary sites were selected as shown on Figure 1-4. Each ASR well site is located on existing CVWD or school District property. The sites were also chosen to be nearby existing water transmission mains with sufficient capacity to deliver this additional supply during the injection cycle.

As mentioned above, in addition to the ASR wells, in-lieu deliveries would be arranged between CVWD and Ontario. A new preliminary reservoir site was identified at the intersection of Foothill Boulevard and Rochester Avenue near the limits of CVWD and Ontario's service areas. Two 8-million gallon reservoirs at this site, while not a part of the Program Expansion, would serve as a connection between CVWD and Ontario's systems. Treated water from Lloyd Michael WTP would be conveyed through CVWD's system to this interconnection location. Ontario would then use this water in-lieu of pumping groundwater, allowing JCSD to pump this stored water during dry years to achieve their own shift or for delivery to WMWD. Additional details on this project component are described in Volume II F.

1.6.2 Program Expansion Facility Requirements

Figure 1-4 shows the general location of the new ASR well facilities. Each well would provide a maximum "put" capacity of 1,300 gpm. Each well site would be a minimum of 50 feet by 50 feet and would be located near an existing transmission main that would be used to provide water for injection via new 12-inch diameter connections to the ASR wells.

ASR Well Nos. 1 and 2 would be located on a future CVWD/Ontario interconnection site on the southeast corner of Foothill Boulevard and Rochester Avenue. Two 8 million gallon (MG) reservoirs are also planned to be constructed on this site. A 30-inch transmission main runs along Rochester Avenue, to which ASR Well Nos. 1 and 2 would be connected to receive water for injection.

ASR Well No. 3 would be located at the southeast end of the Grapeland Elementary School property near the intersection of Etiwanda Avenue and Craig Drive. ASR Well No. 3 would be connected to a 24-inch transmission main in Etiwanda Avenue.

ASR Well No. 4 would be located on CVWD's Reservoir 2C site, which is located east of Etiwanda Avenue, between Highland Avenue and Carnesi Drive. A 42-inch transmission main running along Etiwanda Avenue and through the property would provide water to ASR Well No. 4. The 42-inch line delivers water to Reservoir 2C from the Lloyd Michael WTP.

The new ASR well facilities are described in Chapter 2. The preliminary opinion of probable cost is presented in Chapter 3.

BLACK & VEATCH building a world of difference™
ENERGY WATER INFORMATION GOVERNMENT

Chino Basin Dry Year Yield Program Expansion Project

Cucamonga Valley Water District – New ASR Wells No. 1-4 Vicinity Map

Figure 1-4

1.7 Abbreviations and Acronyms

The following abbreviations/acronyms are used in this report:

acre-ft	acre-feet
AFD	adjustable frequency drive
afy	acre-feet per year
As	arsenic
ASR	aquifer storage and recovery
B&V	Black & Veatch
Basin	Chino Basin
bgs	below ground surface
ft/day	feet per day
CEQA	California Environmental Quality Act
Chino Hills	City of Chino Hills
CML&C	cement mortar lined and coated
CML&W	cement mortar lined and wrapped
CVWD	Cucamonga Valley Water District
DYY	Dry-Year Yield
DYY Program	initial Chino Basin Dry-Year Yield Program
DYY Program Expansion	Chino Basin Dry-Year Yield Program Expansion
gpm	gallons per minute
gpm/ft	gallons per minute per foot
HP	horsepower
IEUA	Inland Empire Utilities Agency
IX	Ion Exchange
JCSD	Jurupa Community Services District
Judgment	Chino Basin Municipal Water District vs. the City of Chino et al. (1978)
MG	million gallons
mgd	million gallons per day
Metropolitan	Metropolitan Water District of Southern California
mg/L	milligrams per liter
MVWD	Monte Vista Water District
MZ3	Management Zone 3
NO_3^-	nitrate
NRW	Non-Reclaimable Wastewater
O&M	operation and maintenance
OBMP	Optimum Basin Management Program
Ontario	City of Ontario
PDR	project development report
Program	DYY Program, DYY Program Expansion
Program Expansion	Chino Basin Dry-Year Yield Program Expansion
psi	pounds per square inch
RC	Riverside-Corona
TDA	Tom Dodson & Associates

TDH	total dynamic head
TDS	total dissolved solids
TEFC	totally enclosed fan-cooled
TM	technical memorandum
TVMWD	Three Valleys Municipal Water District
Upland	City of Upland
USGS	United States Geological Survey
Watermaster	Chino Basin Watermaster
WEI	Wildermuth Environmental, Inc.
WFA	Water Facilities Authority
WTP	water treatment plant
WMWD	Western Municipal Water District

1.8 References

General references are listed in Volume I, Section 1.9.

2.0 AQUIFER STORAGE AND RECOVERY WELLS

2.1 Overview

This chapter describes the location and facilities for four new CVWD ASR wells. CVWD is planning to construct the wells to inject water to provide a portion of the "put" capacity to meet the requirements of the DYY Program Expansion. Three new ASR wells would be constructed on existing CVWD property, and the fourth would be on an existing school site.

2.2 ASR Well Locations and Site Selection

The sites for the four new ASR wells were based on discussions with CVWD staff. As shown on Figure 2-1, ASR Well Nos. 1 and 2 would be located on a future CVWD/Ontario interconnection site on the southeast corner of Foothill Boulevard and Rochester Avenue. A 30-inch transmission main runs along Rochester Avenue to which ASR Well Nos. 1 and 2 would be connected to receive water for injection.

Four potential school and park sites were considered for the location of ASR Well No. 3. The Grapeland Elementary School site was selected for conceptual design due to the apparent vacant land on the south end of the property. ASR Well No. 3 would be located on the Grapeland Elementary School property as shown on Figure 2-2. The well would be connected to the 24-inch transmission main in Etiwanda Avenue.

ASR Well No. 4 would be located on CVWD's Reservoir 2C site, which is located east of Etiwanda Avenue, between Highland Avenue and Carnesi Drive as shown on Figure 2-3. A 42-inch transmission main running along Etiwanda Avenue and through the property would provide treated water to ASR Well No. 4 for injection. The 42-inch line delivers treated water to Reservoir 2C from the Lloyd Michael WTP.

The sites are good candidates to construct ASR wells due to the proximity to treated water mains which convey treated water from Lloyd Michael WTP for injection. Each of the properties would also have adequate drainage facilities where the waste flows could be conveyed into existing concrete drain boxes located in the streets.

2.3 Groundwater Supply and Water Quality

2.3.1 Historical Groundwater and Operating Conditions

Historic groundwater elevations and operating conditions were estimated from existing wells in the vicinity of the proposed well locations. The information presented in the following sections was derived from the WEI database of annual operating records from 1973 to present and from information provided by CVWD and the Watermaster.

BLACK & VEATCH
building a world of difference™
ENERGY WATER INFORMATION GOVERNMENT

Chino Basin Dry Year Yield Program Expansion Project

Cucamonga Valley Water District – New ASR Well Nos. 1 and 2 Vicinity Map

Figure 2-1

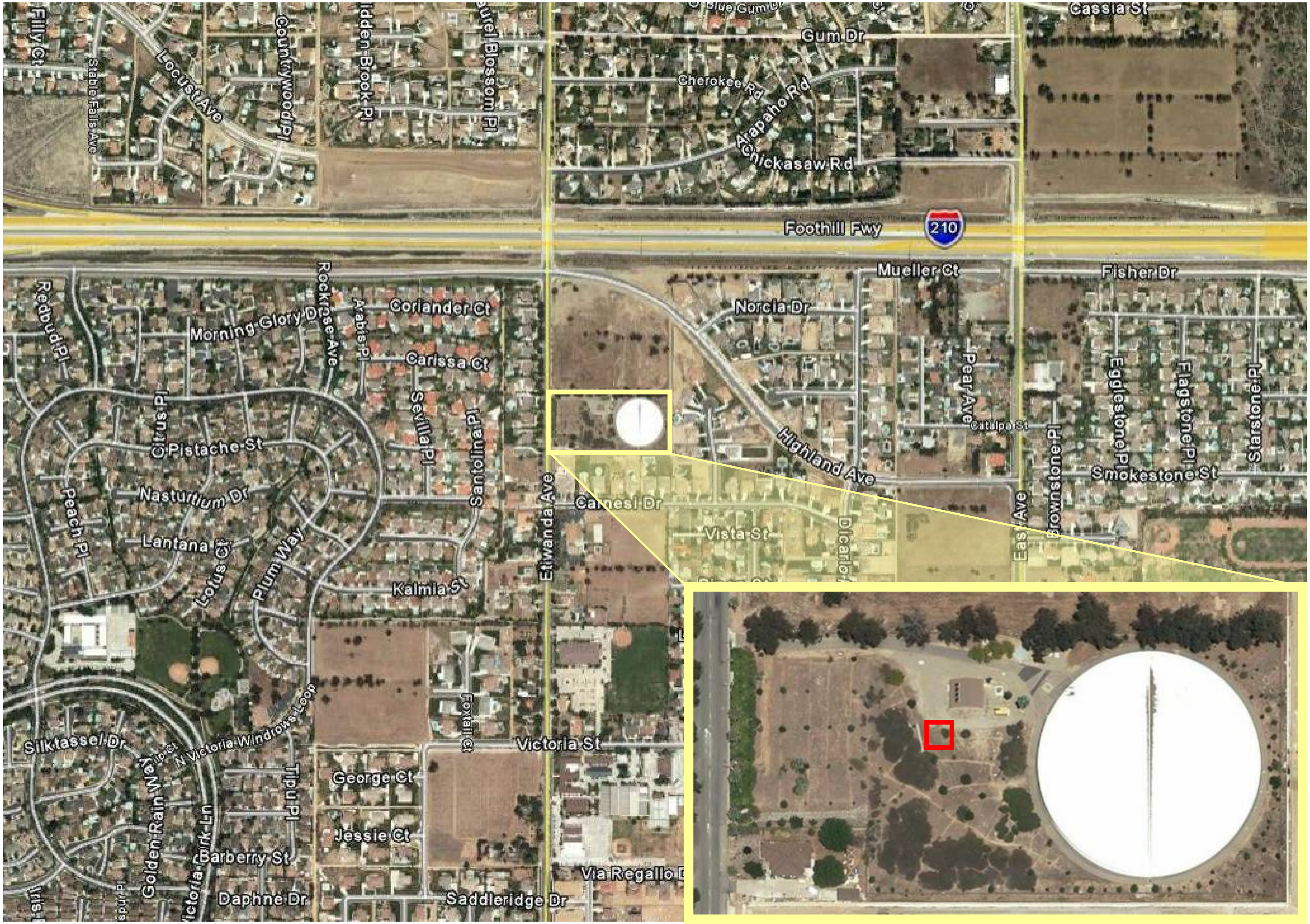
BLACK & VEATCH
building a world of difference™
ENERGY WATER INFORMATION GOVERNMENT

Chino Basin Dry Year Yield Program Expansion Project

Cucamonga Valley Water District – New ASR Well No. 3 Vicinity Map

Figure

2-2



ENERGY WATER INFORMATION GOVERNMENT

Chino Basin Dry Year Yield Program Expansion Project

Cucamonga Valley Water District – New ASR Well No. 4 Vicinity Map

Figure 2-3

Table 2-1 presents the historic groundwater elevations for two existing CVWD wells, CC-28 and 40, which are located in the vicinity of the new ASR well sites. Based on the data presented in the table, the static groundwater levels for the proposed ASR wells would be approximately 450 to 700 feet below ground surface. The dynamic groundwater levels in Table 2-1 are based on a pumping rate of 1,500 gpm. To provide an injection capacity of 1,300 gpm, the pumping rate for the new ASR wells would be 2,000 gpm, resulting in greater drawdown than the results shown in Table 2-1. The assumptions that resulted in the injection and pumping rate values are discussed in Chapter 1 of this volume. The specific capacity of the new wells was assumed to be that of existing Wells 28 and 40, which is 30 gpm/ft. Based on this specific capacity, the drawdown for the new ASR wells would be 67 feet, resulting in dynamic groundwater levels of approximately 550 to 770 feet below ground surface. The specific capacity and drawdown assumed for each new well should be verified with existing and/or new test wells. The data in Table 2-1 was used to develop the anticipated operating conditions.

Table 2-1
Historical Operating Conditions [1]

Operating Conditions	Well No. 28	Well No. 40
Site Elevation, feet amsl [2]	1,529	1,280
Production Capacity, gpm	1,500	1,500
Est. Avg. Static Groundwater Elev., ft bgs [3]	440	570
Estimated Average Drawdown, feet [4]	50	50
Approximate Specific Capacity, gpm/ft [5]	30	30

Notes:
(1) Estimated groundwater and drawdown water level data provided by WEI, 2008.
(2) Above mean sea level (amsl).
(3) Feet, below ground surface (bgs).
(4) Drawdown is the difference between static and dynamic groundwater elevations.
(5) Gallons per minute per foot of drawdown.

2.4 Expected Operating Conditions and Well Performance

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, Chapter 6. The anticipated production capacities of the wells are 2,000 gpm. Assuming a conservative 66% injection to production capacity based on the location of the wells relatively high in MZ3 of the Basin, the estimated injection capacity of each well is approximately 1,300 gpm. The ASR well also would be intended to inject higher quality water into an aquifer of lesser quality. Imported water, which is low in nitrates, would gradually dilute and displace high nitrate plumes. Additionally, injection would create localized zones of good quality water at the well site and down gradient of the ASR well. Thus, the well could operate to create a zone, or "bubble," of better quality water to be recovered at a later time. Table 2-2 provides the anticipated operating conditions for CVWD's new ASR wells based on the information shown in Table 2-1.

Table 2-2
Anticipated Operating Conditions

Conditions	Well No. 1	Well No. 2	Well No. 3	Well No. 4
General Conditions				
Basis for Operating Conditions, Well No.	40	40	40	40
Distance from Basis Well Above, feet	10,200	10,200	2,700	5,700
Location (Intersection)	Foothill/ Rochester	Foothill/ Rochester	Etiwanda/ Baseline	Etiwanda/ Highland
Site Elevation, feet amsl (1)	1,190	1,190	1,308	1,407
Well HGL/Delivery Zone, feet amsl	1,299/ Zone 2	1,299/ Zone 2	1,421/ Zone 3	1,421/ Zone 3
Operating Conditions(2)				
Production Capacity, gpm	2,000	2,000	2,000	2,000
Maximum Injection Capacity, gpm	1,300	1,300	1,300	1,300
Est. Avg. Static Groundwater Elev., ft bgs(3)	480	480	598	697
Est. Avg. Injection Head, feet (4)	679	679	683	584
Assumed Specific Capacity, gpm/ft	30	30	30	30
Calculated Estimated Drawdown, feet	67	67	67	67

Notes:
(1) Above mean sea level (amsl).
(2) Operating conditions should be field verified and validated with field borings
(3) New ASR Well sites are at different elevations than Well 40, which resulted in different depths to static groundwater.
(4) Addition of static lift and system pressure in delivery zone.

2.4.1 Anticipated Water Quality

Because the new ASR wells have not been drilled, water quality data specific to that well site is not available. However, based on discussions with staff it is anticipated that there are no known contaminants requiring treatment.

2.4.2 Injection Cycle

At the beginning of an injection cycle, water would be pumped 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, the flow rate would automatically be monitored, and a flow control valve would be used to adjust and maintain a given flow rate.

Under typical operations, treated imported water would be injected when available over the seven month period from October to April using the new ASR well. Treated imported water would be obtained from existing transmission mains located in streets adjacent to the well sites.

2.4.3 Production/Extraction Cycle

The production/extraction cycle for an ASR well will essentially be the same as the production cycle for a typical municipal production well. Typical operation of the well would include starting the well pump and motor, pumping to waste for five to ten minutes, and then pumping to the distribution system.

Under normal operating conditions, extraction of groundwater would take place during the summer months (May through September) when the ASR facility would reverse operations from the winter and be used as a production well.

2.4.4 Rehabilitation

Periodic rehabilitation is another important aspect in the operations of ASR wells. Rehabilitation typically occurs on a three-to-five year cycle in which the equipment is removed and the casing 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 if a pump has not been installed. The frequency of the backflush would be determined on a site-specific basis and may be as often as 20 minutes every two weeks. The need to backflush would be determined by a decline in injection performance, i.e., lower injection flow rate and increased injection pressure readings.

2.5 Well Drilling and Development

The new ASR wells would be drilled in the locations shown on Figures 2-4, 2-5, and 2-6. It is anticipated that these wells would be 700 to 800 feet deep and would have injection and production capacities of 1,300 and 2,000 gpm, respectively. A general methodology for well construction is mentioned below.

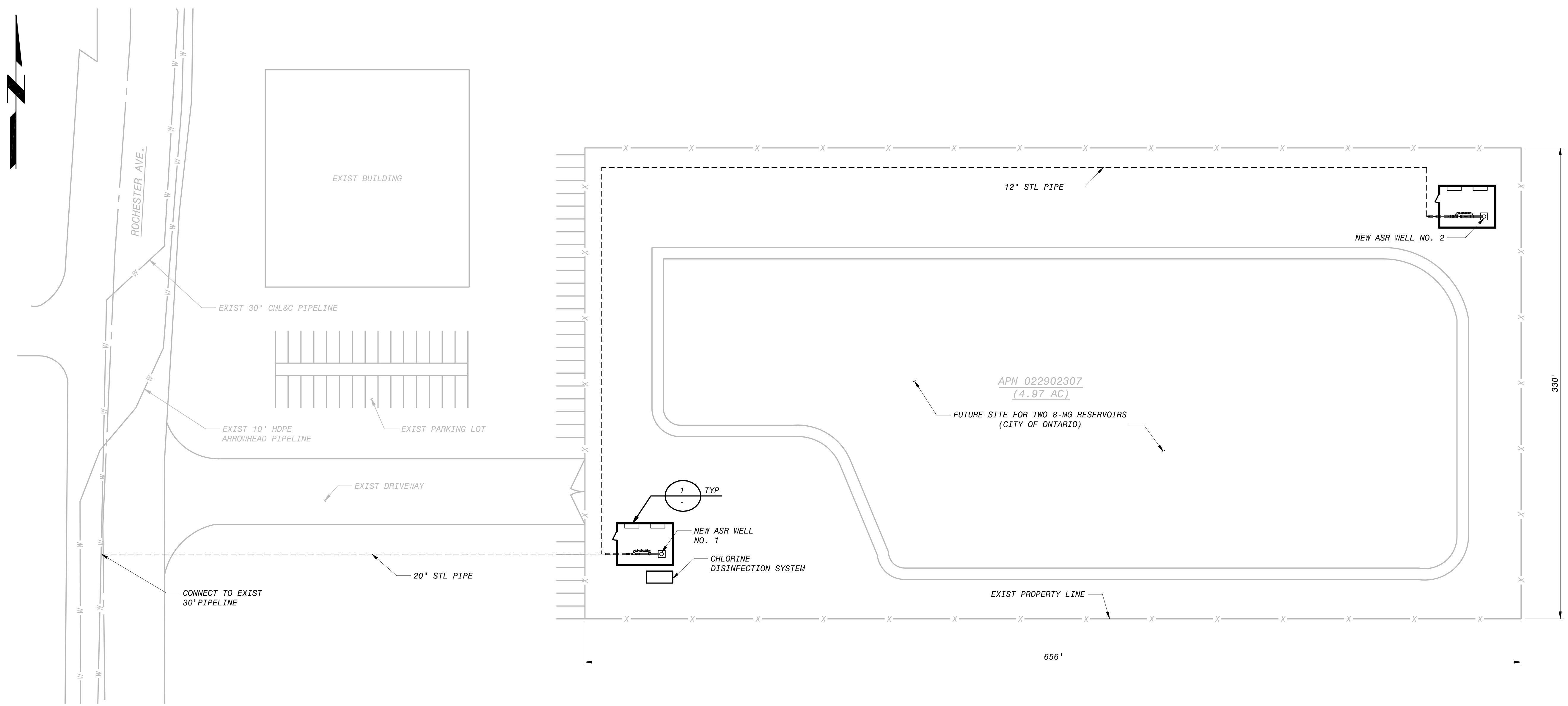
A pilot bore hole would be drilled and then reamed to the specified diameter. Selection of screening elevation and seal depths would be determined during final design and the drilling operation.

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 entire length of 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.

2.6 Well Facilities and Wellhead Equipment

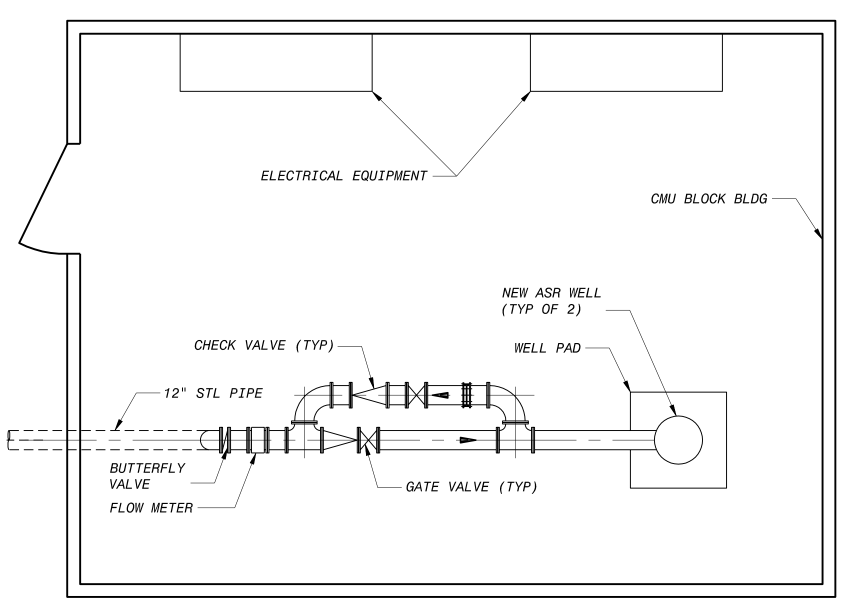
Wellhead facilities would consist of supply pipelines to and from the system, a wellhead pump and motor, and pump to waste and inject to waste pipelines. In addition, a flow control valve would be required to regulate the pressure and amount of water injected. Detailed site plans for each new ASR well are shown on Figures 2-4, 2-5, and 2-6.



SITE PLAN

20' 10' 0' 20' 40'

1" = 40'-0"



(TYP FOR WELL NOS. 1 & 2)

NEW ASR WELL ENLARGED PLAN 1

5' 0' 5' 10'

1" = 10'-0"

NOTES:

1. ELEVATIONS AND DIMENSIONS ARE APPROXIMATE.

CONCEPTUAL - NOT FOR CONSTRUCTION

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

CYGNET ID: 160374-2000-WTUP-C-N00013Q6S | XREF1:ASR Well Site @ Interconnection.jpg
WF:Figure 2-4.dwg | XREF2:
SAVED:GLA36511, 12/7/2008 2:29:34 PM | XREF3:
PLOTTED:HOL45472, 11/13/2008 4:40:21 PM | XREF4:
USER:GLA36511 | DWG VER:1.9 | XREF5:

BLACK & VEATCH
Black & Veatch Corporation
Irvine, California

CHINO BASIN DYY PROGRAM EXPANSION PROJECT
PROJECT DEVELOPMENT REPORT

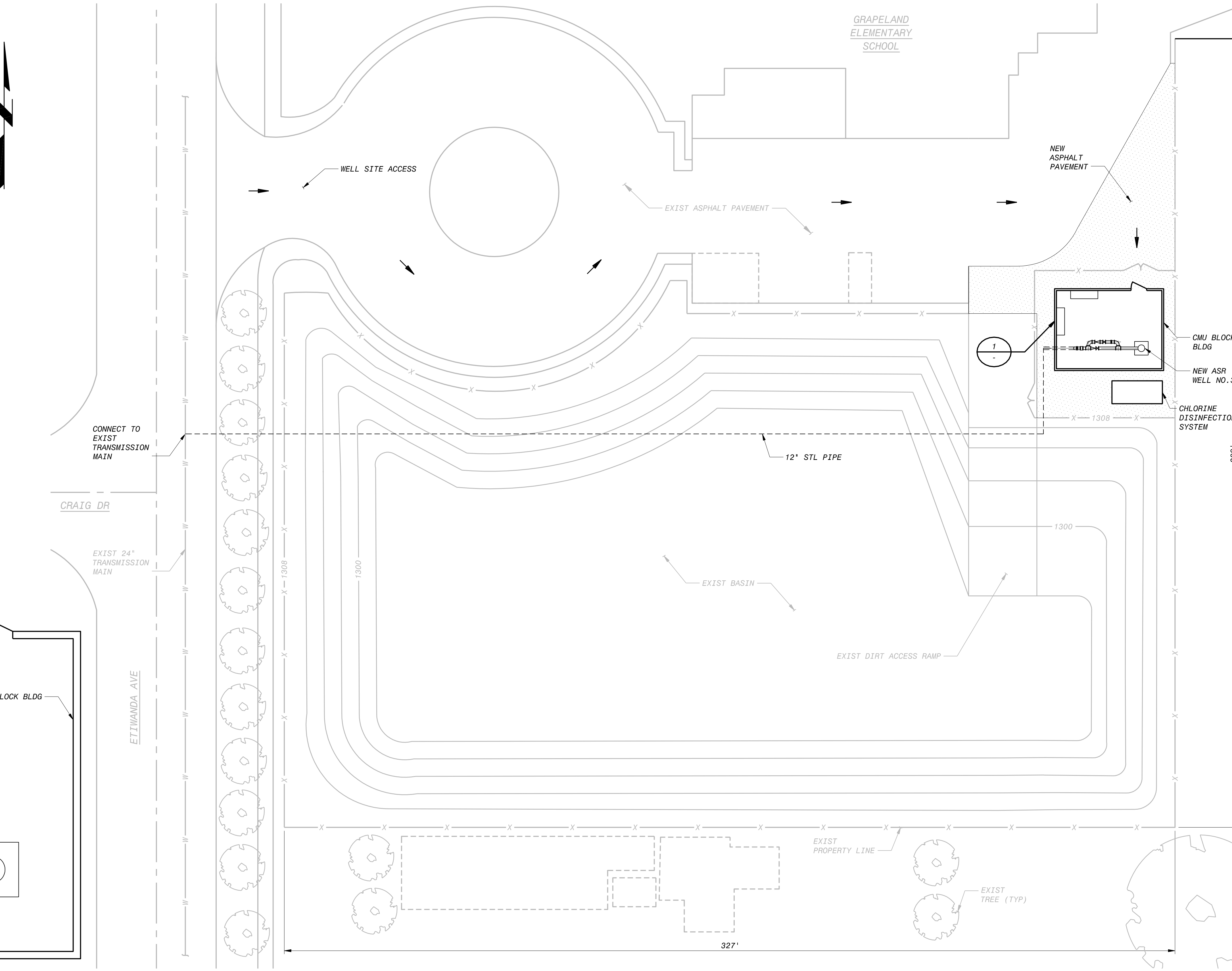
CUCAMONGA VALLEY WATER DISTRICT
ASR WELL NOS. 1 AND 2
SITE AND YARD PIPING PLAN

DESIGNED: JSH
DETAILED: JEG
CHECKED:
APPROVED:
DATE:

PROJECT NO.
160374

FIGURE 2-4

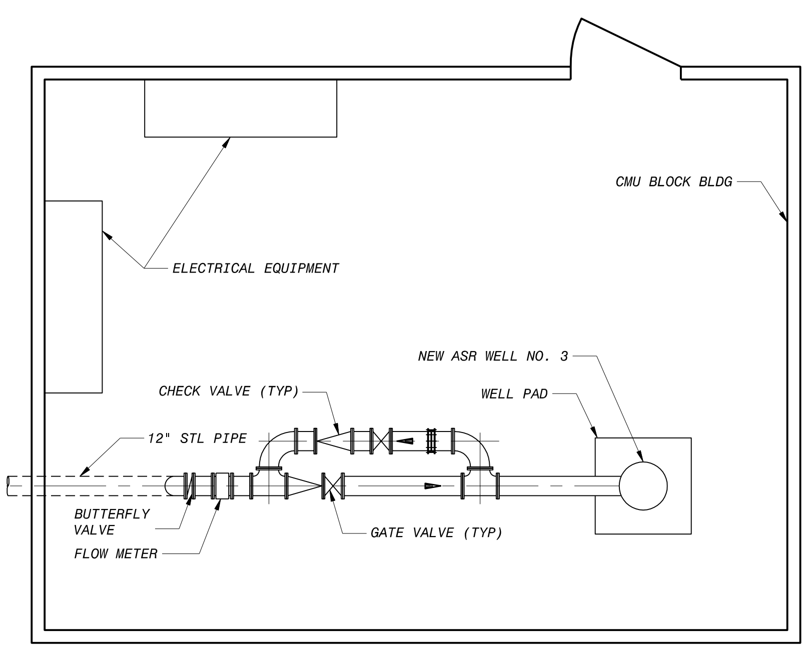
FD160374
D160374



SITE PLAN

20' 10' 0' 20' 40'

1" = 40'-0"



WELL NO. 3
NEW ASR WELL ENLARGED PLAN (1/-)

5' 0' 5' 10'

1" = 10'-0"

NOTES:

1. ELEVATIONS AND DIMENSIONS ARE APPROXIMATE.

CONCEPTUAL - NOT FOR CONSTRUCTION

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

CYGNET ID: 160374-2000-WTUP-C-N00013Q6R
XREF1:ASR Well Site @ Grapeland.jpg
WF:Figure 2-5.dwg
SAVED:GLA36511, 12/7/2008 2:40:11 PM
PLOTTED:GLA36511, 12/7/2008 2:39:35 PM
USER:GLA36511 DWG VER:1.9
XREF2: XREF3: XREF4: XREF5:

BLACK & VEATCH
Black & Veatch Corporation
Irvine, California

CHINO BASIN DYY PROGRAM EXPANSION PROJECT
PROJECT DEVELOPMENT REPORT

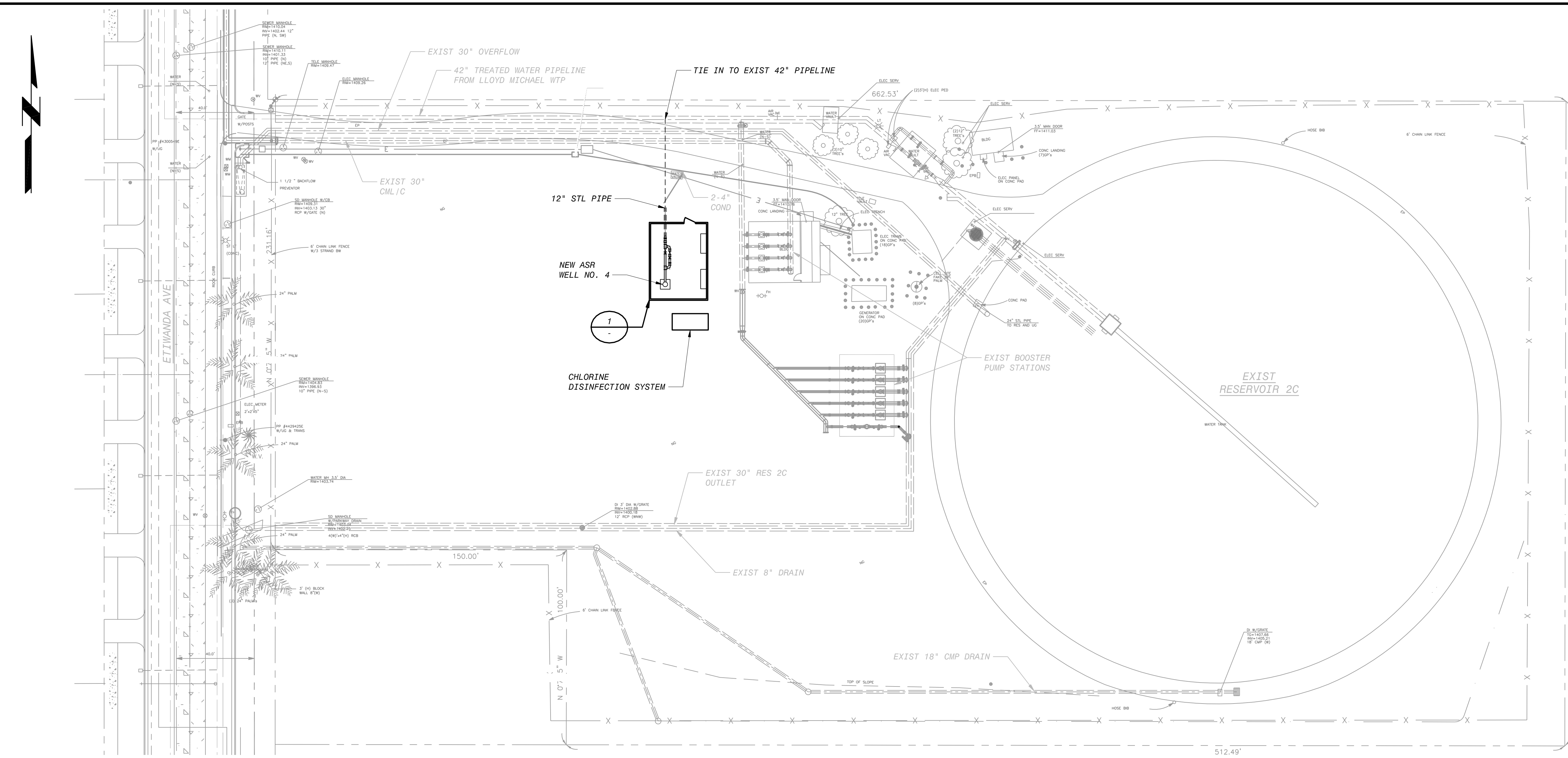
CUCAMONGA VALLEY WATER DISTRICT
ASR WELL NO. 3
SITE AND YARD PIPING PLAN

DESIGNED: JSH
DETAILED: JEG
CHECKED:
APPROVED:
DATE:

PROJECT NO.
160374

FIGURE 2-5

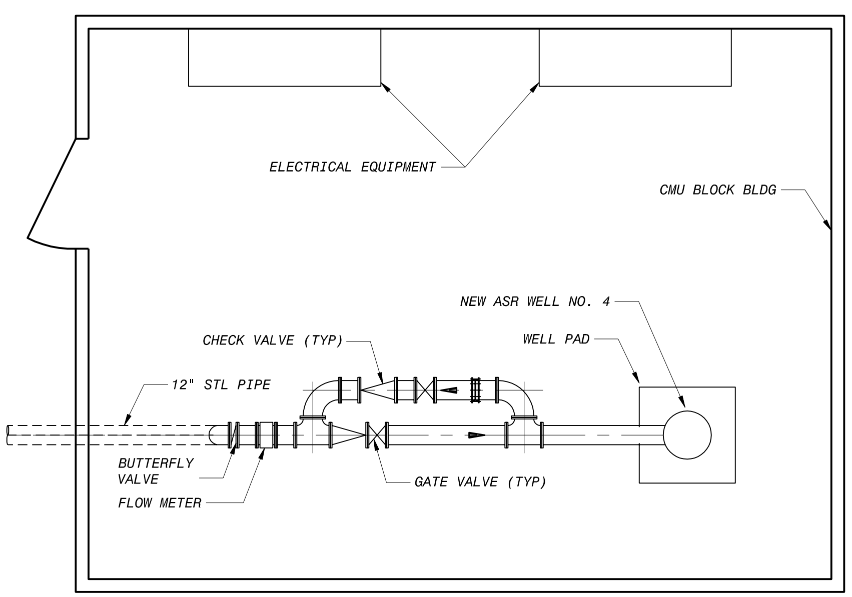
FD160374
D160374



SITE PLAN

30' 15' 0' 30' 60'

1" = 60'-0"



WELL NO. 4

NEW ASR WELL ENLARGED PLAN (1)

5' 0' 5' 10'

1" = 10'-0"

FD160374
D160374

CONCEPTUAL - NOT FOR CONSTRUCTION

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

CYGNET ID: 160374-2000-WTUP-C-N00013Q6T
WF: Figure 2-6.dwg
SAVED: GLA36511, 12/10/2008 9:13:17 AM
PLOTTED: GLA36511, 12/10/2008 9:13:18 AM
USER: GLA36511 DWG VER: 1.11
XREF1: res_2C_PS_mechanical.dwg
XREF2: res_2C_PS_piping.dwg
XREF3: ae_res_2_c.dwg
XREF4: res_2C_piping.dwg
XREF5:

BLACK & VEATCH
Black & Veatch Corporation
Irvine, California

CHINO BASIN DYY PROGRAM EXPANSION PROJECT
PROJECT DEVELOPMENT REPORT

CUCAMONGA VALLEY WATER DISTRICT
ASR WELL NO. 4
SITE AND YARD PIPING PLAN

DESIGNED: JSH
DETAILED: JEG
CHECKED:
APPROVED:
DATE:

PROJECT NO.
160374

FIGURE 2-6

2.6.1 Flow Control Valve

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

2.6.2 Well Pump and Motor

The wellhead pump 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. To proceed with conceptual design, pump performance design criteria were developed for the expected well production as presented in Table 2-3. Adjustments may be required during detailed design based on actual groundwater elevation results.

Table 2-3
Assumed Pump Performance

Description	ASR Well No. 1	ASR Well No. 2	ASR Well No. 3	ASR Well No. 4
Pump				
Type	Deep Well Vertical Turbine	Deep Well Vertical Turbine	Deep Well Vertical Turbine	Deep Well Vertical Turbine
Injection Capacity, gpm	1,300	1,300	1,300	1,300
Production Capacity, gpm	2,000	2,000	2,000	2,000
Total Dynamic Head, feet (1)	667	691	789	780
Pump Efficiency, percent	80	80	80	80
Motor Efficiency, percent	90	90	90	90
Discharge Column Diameter, in	12	12	12	12
Motor				
Type	TEFC High-Efficiency(2)	TEFC High-Efficiency(2)	TEFC High-Efficiency(2)	TEFC High-Efficiency(2)
Nominal Motor Horsepower (HP)	500	500	600	600
Motor Drive	AFD	AFD	AFD	AFD

Notes:
(1) TDH – Total Dynamic Head. Includes frictional losses and mechanical shaft losses.
(2) TEFC – Totally enclosed fan-cooled

The new ASR wells and associated piping would each be sized to allow 1,300 gpm of water delivered from adjacent transmission mains to be injected into the groundwater and then pumped at a rate of 2,000 gpm back into the distribution system when needed. The residual head from the existing distribution system would be adequate to inject the water into the ground. The TDH needed to pump the groundwater to the ground surface and to the required CVWD Pressure Zone would include the groundwater depth, maximum anticipated drawdown, and losses due to pipe friction and specials (bends, valves, flowmeters, etc.).

The pressure zone for Well Nos. 1 and 2 would be CVWD-2 which operates at 1,299 feet. Assuming a static groundwater level of 480 feet bgs and 67 foot drawdown, the TDH required for Well No. 1 and 2 would be 667 feet and 691 feet, respectively. A 500 HP well motor would be required to meet the TDH requirements for Well No.1 and Well No. 2.

The pressure zone for Well No. 3 would be CVWD-3, which operates at 1,421 feet. Assuming a static groundwater level of 598 feet bgs and 67 foot drawdown the TDH required for Well No. 3 would be 789 feet. A 600 HP well motor would be required to meet the TDH requirements.

The pressure zone for Well No. 4 would be CVWD-3, which operates at 1,421 feet. Assuming a static groundwater level of 697 feet bgs and 67 foot drawdown the TDH required for Well No. 4 would be 780 feet. A 600 HP well motor would be required to meet the TDH requirements.

2.6.3 Discharge and Blow-Off Piping

The wellhead piping would include a 12-inch diameter discharge pipe, an 8-inch diameter blow-off pipe, two control valves, a check valve, air release valve, flow meter, and other miscellaneous valves and fittings.

The blow-off piping would be utilized for discharge to local storm water drainage during startup and would also allow the future installation of a sand-trap if required.

2.7 Disinfection Facilities

The new ASR wells would require new disinfection facilities to satisfy chlorine demand and residual. It was assumed that CVWD would prefer to install a sodium hypochlorite feed system at each site. Sodium hypochlorite has minimal chemical handling hazards (i.e., scrubbers are not required). Totes can be easily removed from the site during periods when the well facilities are not in use. For the purposes of this study and preparing cost estimates, sodium hypochlorite delivered in totes is the recommended disinfection system for the new ASR wells. However, decisions on the disinfection methodology will ultimately require re-examination during the final design stage.

2.8 Conveyance Piping

Conveyance piping would include on-site piping to provide water for injection and convey pumped groundwater to distribution. The sections below provide a summary of the facilities.

2.8.1 Description of Existing Facilities

Each site appears to have adequate space available for the new ASR wells and piping. The ASR Well Nos. 1 and 2 site at Foothill and Rochester has been graded and currently has no existing above grade facilities. As previously mentioned, this site is planned to be the future location for two 8 MG reservoirs and appurtenances. It appears that existing electrical, sewer, and water facilities are present underground along the proposed alignment of the conveyance pipeline from the property line to the existing transmission main.

New ASR Wells Nos. 1 and 2 would be located at opposite ends of the proposed Foothill/Rochester reservoir site.

The New ASR Well No. 3 discharge piping would be routed adjacent to the basin.

The ASR Well No. 3 site, located on the edge of Grapeland Elementary School, appears to be adjacent to a shallow detention basin for storm water or other flows. The site contains some vegetation, but no visible existing above ground facilities. The well would be located on the southern edge of the school property, near a residential area.

The ASR Well No. 4 site is located at CVWD's Reservoir 2C site. The site contains a large above-grade reservoir, two pump stations, electrical facilities, and two buildings. Based upon site visits, there would be adequate space to install a new ASR well to the west of the existing reservoir and pump station.

New ASR Well No. 4 would be located on CVWD's Reservoir 2C Site.

2.8.2 Raw Water Piping

Each ASR well would be connected to an existing transmission main in the adjacent street via a 12-inch diameter pipe. All new piping would be either cement mortar lined and coated (CML&C) steel or cement mortar lined and wrapped (CML&W) steel. Buried piping would have polyethylene wrap and would be concrete encased underneath roadways, as required. The new pipe required for ASR Well Nos. 1, 2, 3, and 4 would be approximately 400 feet, 1,300 feet, 400 feet, and 90 feet, respectively.

3.0 OPINION OF PROBABLE COST

3.1 Overview

This chapter presents the opinion of probable cost for the facilities described in this Volume IIC 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 3-1 summarizes the estimated capital and annual O&M costs for the District's proposed facilities. As shown in the table, the total opinion of probable capital and annual O&M costs for the new facilities would be $15,410,000 and $1,108,000, respectively.

Table 3-1
Summary of Opinion of Probable Capital and Annual O&M Costs

Component	Cost
Capital Cost	
Construction Cost	$11,674,000
Contingency (1)	$2,335,000
Engineering/Administration/CM(2)	$1,401,000
Total Capital Cost	**$15,410,000**
Midpoint of Construction Cost (3)	$16,839,000
Annual Cost	
Annual O&M Cost	$1,108,000
Annualized Capital Cost (4)	$1,317,000
Total Annual Cost	**$2,425,000**

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 and discount rate of 6 percent.

3.2 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.

3.3 Capital Cost

Table 3-2 presents the opinion of probable capital cost for construction of the District's new facilities. As shown, the total estimated capital cost for the facilities would be $15,410,000. Midpoint of construction costs are also provided and indicate the constructions costs in year 2012 using a 3 percent escalation rate.

Table 3-2
Summary of Opinion of Probable Capital Cost

Component/Facility Detail	Cost
Well Facilities [(1)]: 4 New ASR Wells	
Drilling/Casing/Cap	$5,000,000
Equipping	$4,400,000
Disinfection System	$600,000
Pumphouse/Electrical Building	$1,000,000
Land	$50,000
Conveyance Facilities	
Pipeline: 2,200 feet at 12" diameter	$396,000
General Costs	
General Requirements [(2)]	$228,000
Total Construction Cost	$11,674,000
Contingency [(3)]	$2,335,000
Engineering/Administration/CM[(4)]	$1,401,000
Total Capital Cost	**$15,410,000**
Total Midpoint of Construction Cost [(5)]	$16,839,000

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

3.4 Annual O&M Cost

Table 3-3 presents the opinion of probable annual O&M cost for the District's new facilities. As shown, the total estimated annual O&M cost for the facilities would be $1,108,000.

Table 3-3
Summary of Opinion of Probable Annual O&M Cost

Component/Facility Detail	Cost
Well Facilities (1): 4 New ASR Wells (2 @ 500 HP; 2 @ 600 HP)	
Power	$1,006,000
Miscellaneous Maintenance	$100,000
Conveyance Facilities	
General Pipeline Maintenance: Distribution Pipeline	$2,000
Total Annual O&M Cost	$1,108,000
Annualized Capital Cost (2)	$1,317,000
Total Annual Cost	**$2,425,000**

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.