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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-B describes proposed facilities for the City of Chino Hills (Chino Hills). Individual chapters provide conceptual development of the aquifer storage and recovery (ASR) well required for Chino Hills to participate in the Program Expansion. An Opinion of Probable Cost is also presented. This Introduction Chapter provides background information on the DYY Program, the Program Expansion, and the Chino Hills 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 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
Chino (II A)	▸ Regenerable 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 Area
Ontario (II F)	▸ Conveyance facilities to establish interconnection with Cucamonga Valley Water District (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 Treatment Facilities (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 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:

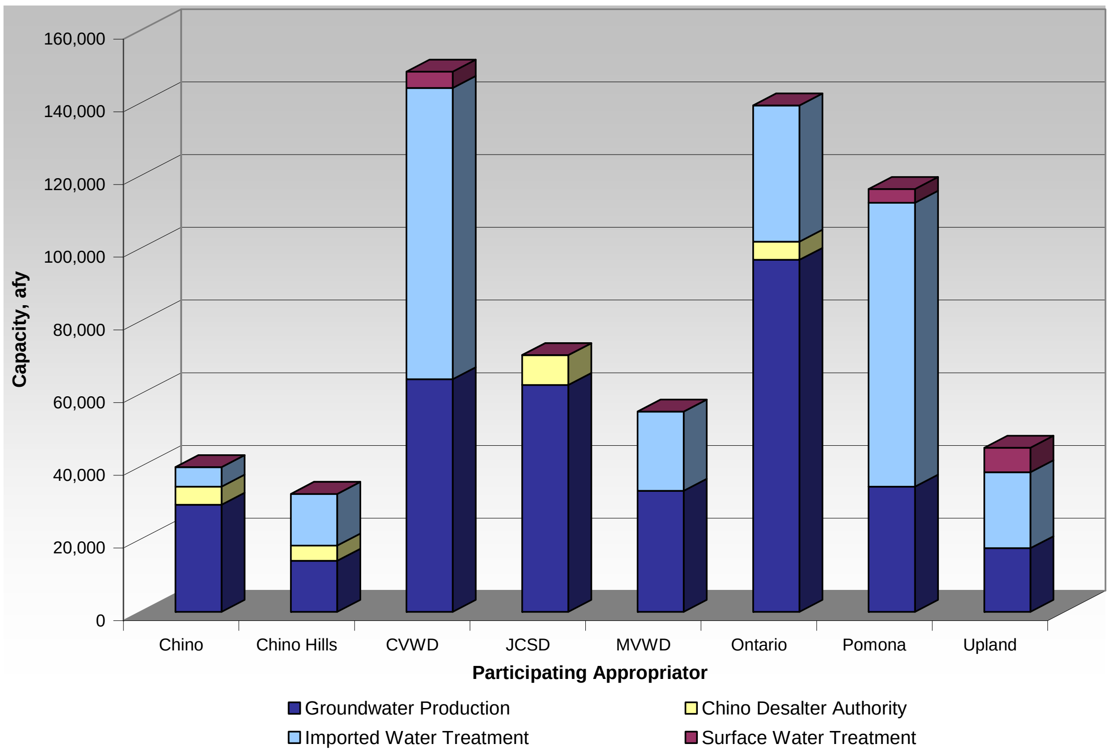
- Elevations were based upon United States Geological Survey (USGS) maps and maps obtained online from Google® Earth and are estimated to be accurate to within 10 percent of the actual elevation. Topographical surveys would be performed as part of the final design.
- Typical engineering calculations and assumptions were used to develop preliminary sizing for equipment facility. The final designs may vary slightly dependent upon results of the Title 22 water quality testing.
- 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 effots.
- 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.

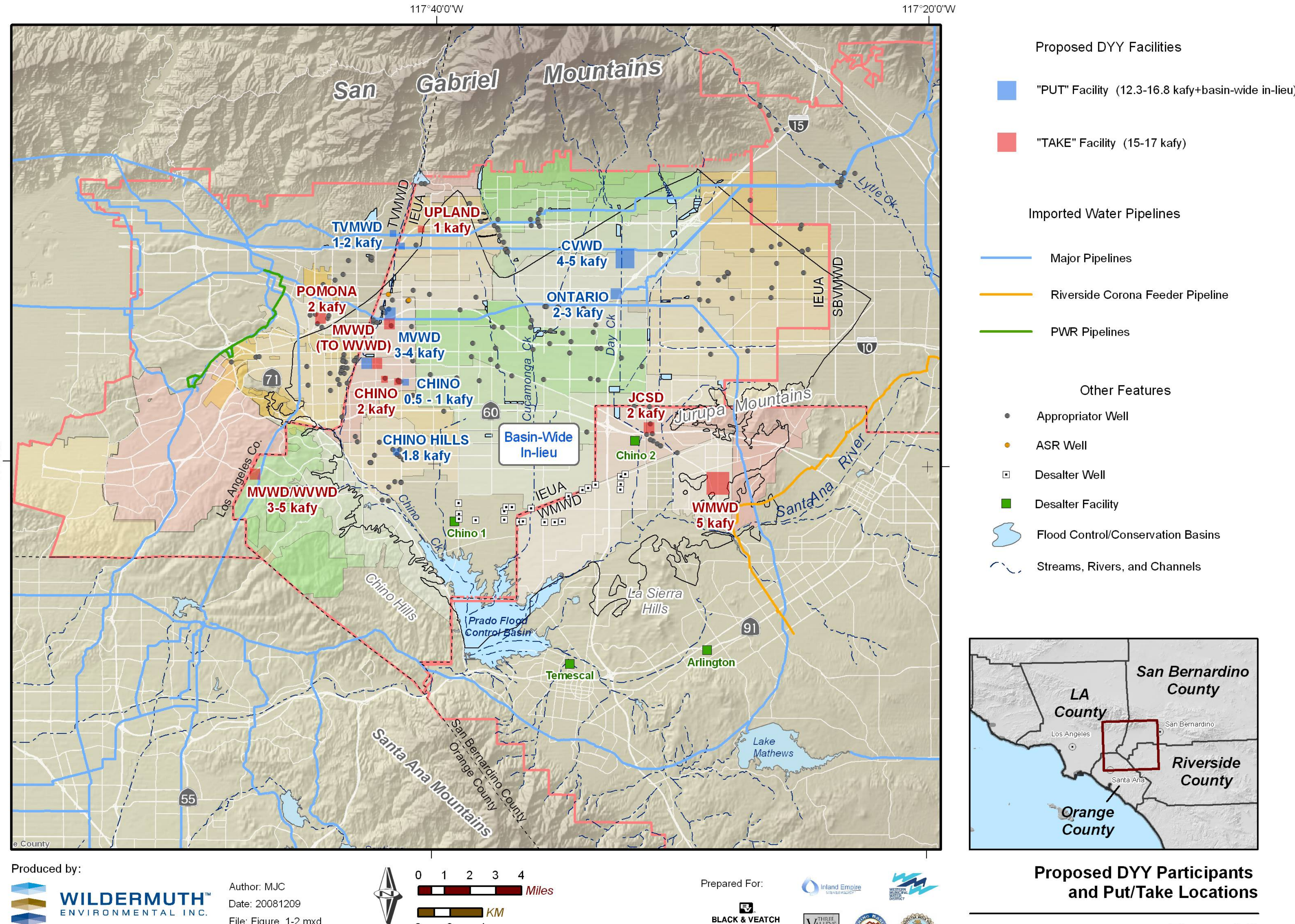
Table 1-3
Summary of Initial and Expanded DYY Program Participants and Proposed Put/Take Capacities

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



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Prepared For:

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Proposed DYY Participants and Put/Take Locations

Figure 1-2

1.6.1 Chino Hills Water Resources and Shift Obligation

The Asset Inventory data, summarizing Chino Hills' 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 Hills has an imported water treatment capacity of 18.0 million gallons per day (mgd) (20,200 afy) and groundwater production capacity of 16.2 mgd (18,200 afy). Chino Hills receives its treated imported water from the WFA.

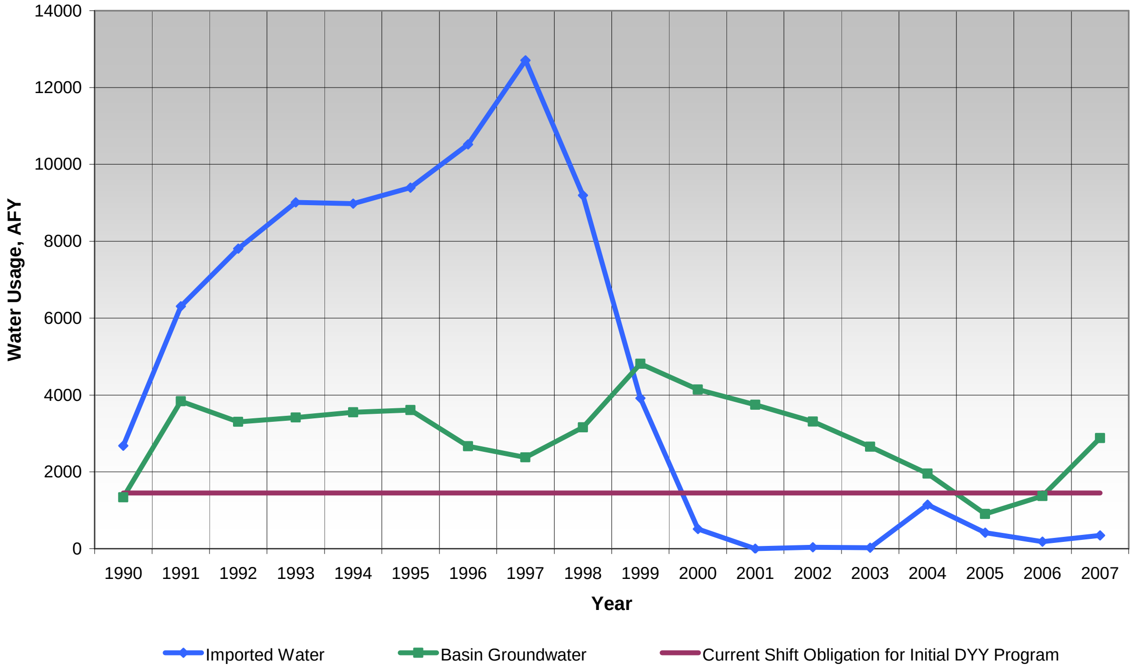
Table 1-4
Existing Water Resource Capacities for Chino Hills

Water Resource	Chino Hills Capacity, mgd (afy)
Local Surface and Imported Water	
Local Surface Water	
Subtotal	0 (0)
Imported Metropolitan Water	
WFA	18.0 (20,200)
Subtotal	18.0 (20,200)
Total Local Surface and Imported Water	18.0 (20,200)
Groundwater	
Chino Basin Wells(1)	12.5 (14,000)
Non-Chino Basin Wells(1)	3.7 (4,200)
Total Groundwater	16.2 (18,200)
TOTAL WATER RESOURCES	**34.2 (38,400)**

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 Hills. In 2007, approximately 89 percent of Chino Hills' 3,227 acre-ft of water usage was Basin groundwater versus approximately 11 percent from imported water supplied by Metropolitan. Based on historical imports and on future growth projections, Chino Hills has elected to contribute 1,448 afy toward the potential 17,000 afy Program Expansion. To achieve this potential contribution, Chino Hills has proposed to set up in place in-lieu exchange agreement(s) with Third Parties. Specific details are not currently known. Chino Hills has also proposed to convert its existing production Well No. 19 to an ASR well. Chino Hills will then accomplish its "put" via injection of treated water from the nearest service line.

Figure 1-3
Chino Hills Historical Imported Water and Groundwater Usage



1.6.2 Chino Hills Facility Requirements

It was assumed that the conversion of production Well No. 19 to an ASR well would not impact the historic production capacity of the well (i.e. 1,500 gallons per minute [gpm]). Based on this production capacity rate, it is anticipated that the maximum injection capacity of the well would be approximately 50 percent of the production rate, or 750 gpm. Chino Hills' remaining contribution would be met by in-lieu exchange agreements set between Chino Hills and Third Parties.

Although tight, the existing site is adequate in size to be converted to an ASR well, assuming that no treatment other than disinfection would be needed. The site is over 50 feet by 50 feet and is located on existing Chino Hills property.

The ASR facility is presented in Chapter 2 of this volume. A plan and section of a typical ASR well is presented in Chapter 8 of Volume I.

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
AWWA	American Water Works Association
bgs	below ground surface
B&V	Black & Veatch
Basin	Chino Basin
ft/day	feet per day
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
Chino Hills	City of Chino Hills
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/sqft	gallon per minute per square foot
HP	Horsepower
IEUA	Inland Empire Utilities Agency
in	inches
JCSD	Jurupa Community Services District
Judgment	Chino Basin Municipal Water District vs. the City of Chino et al. (1978)
MCL	Maximum Contaminant Level
mgd	million gallons per day
Metropolitan	Metropolitan Water District of Southern California
mg/L	milligrams per liter
MVWD	Monte Vista Water District
NO_3^-	nitrate
O&M	operation and maintenance
OBMP	Optimum Basin Management Program
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
RO	reverse osmosis
TBD	To Be Determined
TDA	Tom Dodson & Associates
TM	technical memorandum
TVMWD	Three Valleys Municipal Water District
ug/L	micrograms per liter
USGS	U.S. 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

Existing Well No. 19 is located in the City of Chino Hills, north of Anderson Street. The well pump/motor is located behind the acoustical paneling.

This chapter describes the location and facilities for converting existing production Well No. 19 to an ASR well. Chino Hills is planning to convert the production well to inject and extract water when needed to meet its proposed "put" year contribution under the Program Expansion. The extraction mode for the well would be ultimately used as a backup to Chino Hills' existing production wells. The existing well to be converted to an ASR well is located on existing Chino Hills property as shown on Figure 2-1. The site is located in Chino Hills, north of Anderson Street. This site has space constraints due to existing facility piping located above and below grade. The site is a candidate to convert the existing Well No. 19 to an ASR well due to the availability of treated water from a nearby transmission main in Anderson Street. The existing well has a chlorine disinfection system and electrical switchgear that could be reused. The requirements to convert Well No. 19 to an ASR well are as shown on Figure 2-2.

2.2 Groundwater Supply and Water Quality

2.2.1 Historical Groundwater and Operating Conditions

Historic groundwater elevations and operating conditions of Well No. 19 were investigated. The information presented in the following sections was derived from the WEI database of annual operating records from about 2003 to 2007 and from information provided by the Watermaster. From records provided by WEI, the existing production Well No. 19 was last recorded to be active in October 2007. It was assumed that the well was shut down due to high arsenic concentrations in the raw water. Historic production rate of the well was approximately 1,500 gpm.

Table 2-1 presents the historic groundwater elevations for existing Chino Hills Well No. 19. Based on the data presented in the table, the static groundwater levels for the proposed ASR well would be approximately 126 feet (ft) below ground surface (bgs). Dynamic groundwater levels would be approximately 295 ft. Available data from pump tests was reviewed to estimate the production rate, specific capacity, and screened interval for the proposed new well. The data in Table 2-1 was used to develop the anticipated ASR well operating conditions listed in Table 2-2.

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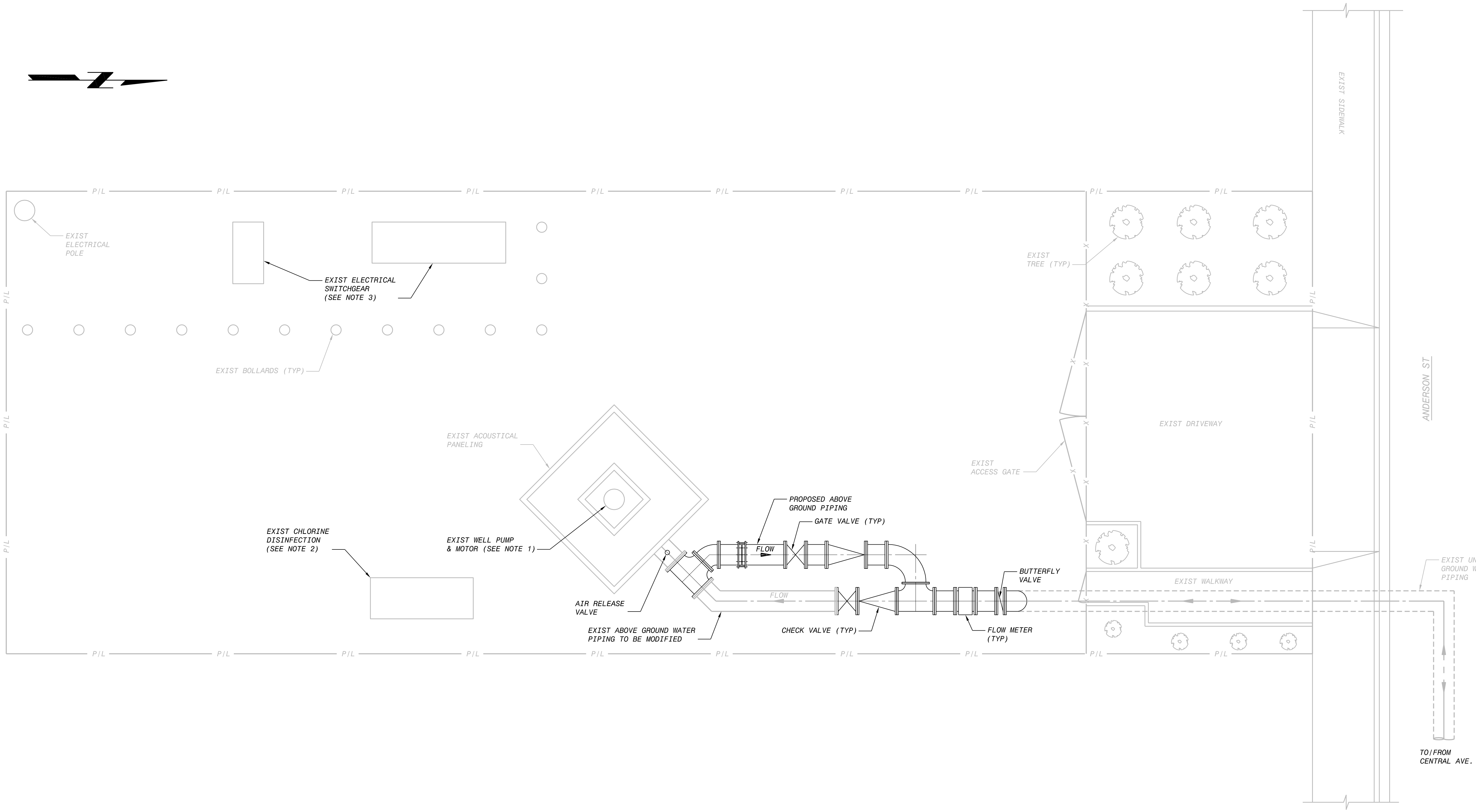
Chino Basin DYY Expansion Program

City of Chino Hills – Well No. 19 Site

Figure 2-1



SITE PLAN

10' 0 10' 20'
1"=10'

NOTES:
1. REMOVE EXISTING EQUIPMENT, CLEAN SCREEN AND RESTORE CAPACITY OF EXISTING WELL. MODIFY AND REINFORCE EXISTING STEEL CASING. PROVIDE AND INSTALL NEW PUMP AND MOTOR. PROVIDE AND INSTALL NEW VALVING SYSTEM TO INCLUDE AIR VALVES, CHECK VALVES, GATE VALVES AND FITTINGS.
2. EXISTING CHLORINE DISINFECTION TO BE REUSED AS-IS. PROVISION OF HALOGEN AUTOMATIC SENSOR AND VALVE CLOSURE SYSTEM IS REQUIRED.
3. EXISTING ELECTRICAL SWITCHGEAR TO BE REUSED AS-IS.
4. EXISTING WASTE LINE TO BE RE-USED.

CONCEPTUAL - NOT FOR CONSTRUCTION

REVISIONS AND RECORD OF ISSUE

DATE	NO.	BY	CK	APP

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USER:GLA36511 DWG VER:1.10

BLACK & VEATCH
Black & Veatch Corporation
Irvine, California

CHINO BASIN DYY PROGRAM EXPANSION PROJECT
PROJECT DEVELOPMENT REPORT

CITY OF CHINO HILLS
WELL NO. 19 ASR SITE AND YARD PIPING PLAN

DESIGNED: BF
DETAILED: JEG
CHECKED:
APPROVED:
DATE:

PROJECT NO.
160374

FIGURE 2-2

FD160374
D160374

Table 2-1
Historical Operating Conditions [1]

Operating Conditions	Well No. 19
Production Capacity, gpm	1,500
Est. Avg. Static Groundwater Elev., ft bgs [2]	126
Estimated Average Drawdown, feet [3]	150
Approximate Specific Capacity, gpm/ft [4]	9

Notes:
(1) Estimated groundwater and drawdown water level data 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.

Table 2-2
Anticipated Operating Conditions

Conditions	Well No. 19
General Conditions	
Basis for Operating Conditions, Well No.	19
Distance from Basis Well Above, feet	0
Location (Intersection)	Anderson/ Central
Site Elevation, feet amsl [1]	682
Well HGL/Delivery Zone, feet amsl	775
Operating Conditions	
Production Capacity, gpm	1,500
Maximum Injection Capacity, gpm	750
Est. Avg. Static Groundwater Elev., ft bgs	126
Est. Avg. Injection Head, feet [2]	218
Assumed Specific Capacity, gpm/ft	10
Calculated Estimated Drawdown, feet	150

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

2.3 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.

Based on the historical production rate of Well No. 19 and assuming a conservative 50 percent injection to production ratio, the anticipated production and injection capacities of the ASR Well No. 19 would be 1,500 gpm and 750 gpm, respectively. Many factors affect the production and injection capacities of any ASR well. These factors would need to be assessed during detailed design.

New ASR Well No. 19 would inject treated drinking water into the aquifer. The stored water would displace the water naturally present in the aquifer, creating a 'bubble' around the well. Theoretically, the 'bubble' would be confined or semi-confined by overlying and underlying geologic formations composed of impermeable materials. When recovered from storage, the water usually requires only disinfection before being sent out to the water distribution system. However, it is possible that the aquifer of existing Well No. 19 is unconfined, in which case a more in-depth study would be required to determine its implications on the quality and quantity of the water that would be recovered from storage.

Table 2-2 provides the anticipated operating conditions for Chino Hills' converted ASR Well No. 19 based on the information shown in Table 2-1.

2.3.1 Anticipated Water Quality

The raw water quality of Well No. 19 has deteriorated over time, leading eventually to the well being shut down in October 2007. Based on the water quality data available in the Asset Inventory, the recorded nitrate (NO_3^-) and arsenic (As) concentrations were 21 milligrams per liter (mg/L) and 25 micrograms per liter (ug/L), respectively. The arsenic concentration exceeds the State of California Maximum Contaminant Level (MCL), set at 5 ug/L.

The proposed conversion of production Well No. 19 to an ASR well could have the dual benefit of improving the water quality of the aquifer as well as enhancing replenishment capacity. As treated water is injected into the aquifer for storage, some mixing occurs between the native and the injected water, leading to an overall improvement of the water quality. However, it is hard to predict the value of the arsenic concentration after recovery. Nevertheless, it has been empirically proven that, although a new ASR well initially produces water of a lesser quality than the quality of water injected, the quality of the recovered water improves dramatically over successive cycles of 'put' and 'take'. After conversion of Well No.19 and prior to switching the ASR well to production mode, some monitoring would be conducted to confirm the levels of contaminants in the recovered water.

Therefore, at this stage it is not proposed that wellhead treatment be provided. It is anticipated that the recovered water would receive disinfection only.

A detailed study would be required to confirm the geology of the underlying aquifer and the suitability of Well No. 19 as an ASR well.

2.3.2 Injection Cycle

At the beginning of an injection cycle, water would be 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.

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 an existing transmission main located near the well site.

2.3.3 Extraction Cycle

The extraction cycle for an ASR well would 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 via disinfection or further treatment depending on requirements.

Under normal operating conditions, extraction of groundwater would take place during the summer months (May through September).

2.3.4 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 only wells if 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.

2.4 New Well Facilities and Wellhead Equipment

Conversion of Well No. 19 to an ASR well would consist of the restoration of the existing well casing and screen, modification of the wellhead piping, and installation of a new wellhead pump and motor. In addition, a flow control valve would be required to regulate the pressure and amount of water injected. A minor control/valve upgrade of the chlorine gas system would likely be required in order to comply with current fire regulations.

2.4.1 Conversion of Well No. 19 to ASR Well No. 19

The primary task in converting Well No. 19 would be to clean the well screen and restore its capacity. The existing equipment would be dismantled and removed and the gravel pack and the steel casing checked. The well would be cleaned using a combination of chemicals and a mechanical cleaning system (such as an airbrush system) to dissolve the encrusted bacteria and slime. At the end of the downhole cleaning stage, a pump test would be required to check that the pump capacity has been restored and to remove all the chemicals from the aquifer.

When the pump test is satisfactorily completed, the casing would be modified to adjust the location of the perforations (slots in the casing that allow the water in and out of the ASR well) and reinforce the steel casing if it is in poor condition.

On completion of the steel casing modifications, the new pump, motor and piping would be installed.

2.4.2 Flow Control Valve

A flow control valve would 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.

2.4.3 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 production as presented in Table 2-3.

Table 2-3
Assumed Pump Performance

Description	ASR Well No. 19
Pump	
Type	Deep Well Turbine
Capacity, gpm	1,500
Total Dynamic Head, feet (1) (2)	449
Pump Efficiency, percent	80
Discharge Column Diameter, in	12
Motor	
Type	TEFC High-Efficiency
Nominal Motor Horsepower (HP)	250
Motor Drive	AFD

Notes:
(1) Includes frictional losses and mechanical shaft losses.
(2) Based on assumption that system residual pressure is 40 psi

2.4.4 Discharge and Blow-Off Piping

The wellhead piping would include 12-inch diameter pipes, one for injection down the well and one for production up the well; an 8-inch diameter blow-off pipe; two control valves; a check valve; vacuum air release valve; a combination air valve; a bi-direction flow meter, and other miscellaneous valves and fittings.

The blow-off piping would be utilized for discharge to waste piping drainage during startup.

2.5 Disinfection Facilities

Following a visual inspection, it was concluded that the existing disinfection facility at Well No. 19 is reusable. The existing equipment is believed to be a chlorine gas system. During the final design, a physical examination of the existing equipment would be required to assess its condition.

As the existing site is un-manned and surrounded by a residential community, it is recommended that a halogen automatic sensor and valve closure system be installed on the chlorine cylinders to comply with the current fire regulations. The advantage of an automatic valve closure device is that the source of the leak can be isolated, stopping the leak before it becomes a reportable incident.

2.6 Conveyance Piping

It was assumed that the existing conveyance piping connecting Well No. 19 to the main existing water line on Central Avenue is in a good condition and that it could be reused during operation of the new ASR well. During detailed design, a survey of the existing conveyance piping would be carried out to assess the suitability of the existing piping.

3.0 OPINION OF PROBABLE COST

3.1 Overview

This chapter presents the opinion of probable cost for the facilities described in this Volume IIB 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 City'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 $2,154,000 and $139,000, respectively.

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

Component	Costs
Capital Cost	
Construction Cost	$1,632,000
Contingency (1)	$326,000
Engineering/Administration/CM (2)	$196,000
Total Capital Cost	**$2,154,000**
Midpoint of Construction Cost (3)	$2,354,000
Annual Cost	
Annual O&M Cost	$139,000
Annualized Capital Cost (4)	$184,000
Total Annual Cost	**$323,000**

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 City's facilities. As shown, the total estimated capital cost for the new facilities would be $2,154,000. 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): ASR Conversion of Well No. 19	
Drilling/casing/cap	$500,000
Equipping	$1,100,000
General Costs	
General Requirements (2)	$32,000
Total Construction Cost	$1,632,000
Contingency (3)	$326,000
Engineering/Administration/CM (4)	$196,000
Total Capital Cost	**$2,154,000**
Total Midpoint of Construction Cost (5)	$2,354,000

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 City's facilities. As shown, the total estimated annual O&M cost for the new facilities would be $139,000.

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

Component/Facility Detail	Cost
Well Facilities (1): ASR Conversion of Well No. 19 (250 HP)	
Power	$114,000
Miscellaneous maintenance	$25,000
Total Annual O&M Cost	**$139,000**
Annualized Capital Cost (2)	$184,000
Total Annual Cost	$323,000

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.