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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 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 J describes proposed facilities for Western Municipal Water District (WMWD). This chapter provides background information on the DYY Program, the Program Expansion, and the WMWD system. Chapter 2 provides conceptual development of the interconnection facilities required for WMWD to participate in the Program Expansion. An opinion of probable cost is presented in chapter 3.

1.2 Evolution of DYY Program and Program Expansion

The Program Expansion is being developed by the Chino Basin Watermaster (Watermaster) in association with WMWD, the Inland Empire Utilities Agency (IEUA), Metropolitan Water District of Southern California (Metropolitan), and Three Valleys Municipal Water District (TVMWD). Table 1-1 summarizes the history and evolution of the Program Expansion, 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 ‣ Aquifer storage and recovery (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 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 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 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:

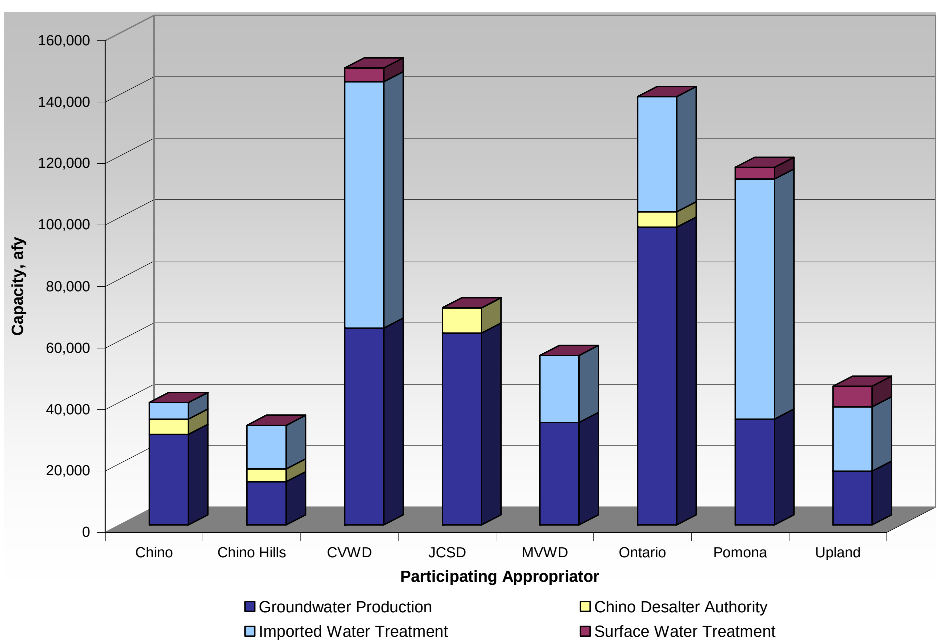
- Elevations were based upon United States Geological Survey (USGS) maps and maps obtained online from Google® Earth and are estimated to be accurate to within 10 percent of the actual elevation. Topographical surveys would be performed as part of the final design.
- Typical engineering calculations 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 assumed to not have significant permitting restrictions. Investigations 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.

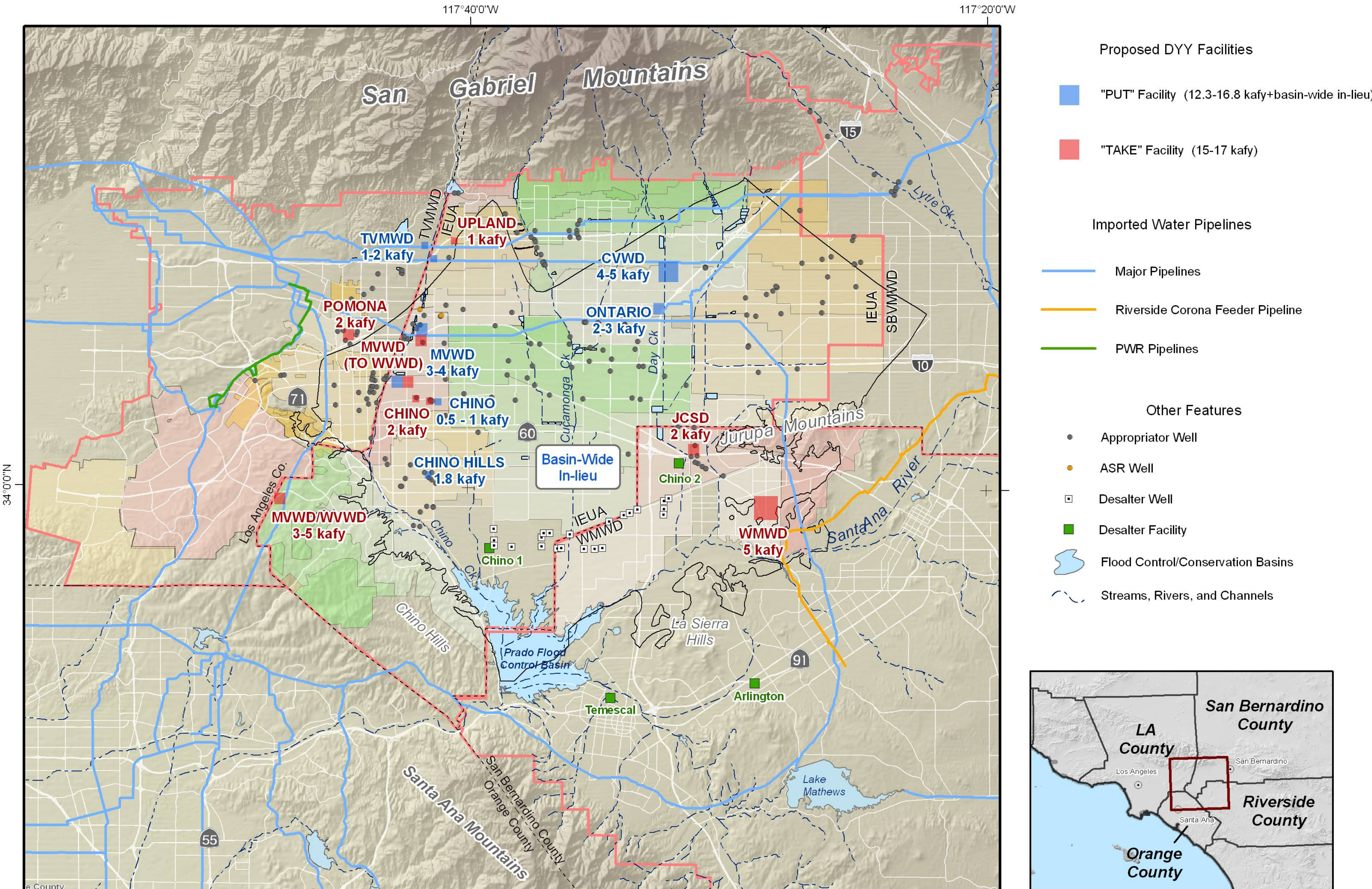
Table 1-3 lists potential Program participants and each agency's potential "put" and/or "take" contribution. The combined "take" capacity of these agencies ranges from 15,000 to 17,000 afy. The combined "put" capacity of these agencies is approximately 12,300 to 16,800 afy of direct capacity plus Basin-wide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



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Inland Empire

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 for WMWD

WMWD serves western Riverside County with water from both the Colorado River and the State Water Project (SWP). A small portion of water is also received from the City of Riverside (Riverside). WMWD provides wholesale water to the cities of Corona, Norco, and Riverside and the water agencies of Elsinore Valley and Rancho California. Water is also served to customers in the unincorporated areas of El Sobrante, Eagle Valley, Temescal Creek, Woodcrest, Lake Mathews, and March Air Force Base. WMWD sells over 90,000 acre-ft of water to its customers annually. The water is comprised of both treated and untreated water in the service area from various sources. The treated water portion accounts for about 60 percent of the total water supplied by WMWD, and the remaining amount is untreated or raw water. The treated water sources include Metropolitan SWP water and supplemental water from Riverside. WMWD has a purchase agreement with Metropolitan for an initial base demand of 65,298.5 acre-ft with an initial Tier I annual maximum of 58,768.7 acre-ft. Tier 1 represents Metropolitan's first tier rate structure with the least expensive water rates. The supplemental Riverside water is supplied by 40 domestic groundwater wells, and the WMWD agreement allows approximately 4,900 gallons per minute (gpm) to be purchased on an emergency or off-season basis.

The main sources for untreated water are the Colorado River Aqueduct (CRA) and groundwater from the San Bernardino / Riverside area. The untreated water is used for various irrigation purposes throughout the area including irrigation of citrus, avocado crops, and nurseries. Additional non-potable water from the March Wastewater Reclamation Facility (MWRF) is used for irrigation purposes in the retail area at existing golf courses and cemeteries.

WMWD is undertaking the RC Feeder Project to provide supplemental potable water supply to its service area. This project will strengthen the water distribution system and make WMWD less dependent on direct delivery of water from Metropolitan. The project is currently in the preliminary design stage and will provide infrastructure for additional SWP water, when available, for purchase and delivery. The additional water would be stored in the San Bernardino area, to be extracted as needed during dry years. WMWD's water resource capabilities are presented in Table 1-4.

Table 1-4
Water Supplies for WMWD(1)

Water Resource	WMWD Capacity, afy
Local Supplies	
Groundwater	189,000
Groundwater Recovery	14,200
Recycled Water	2,900
Imported Supplies	
Metropolitan	
Full Service (Tiers I and II)	98,600
Replenishment	11,000
Interim Agricultural Water Program	21,600

Notes:
(1) Reference 2010 data from WMWD Urban Water Management Plan 2005 Report, Appendix D.

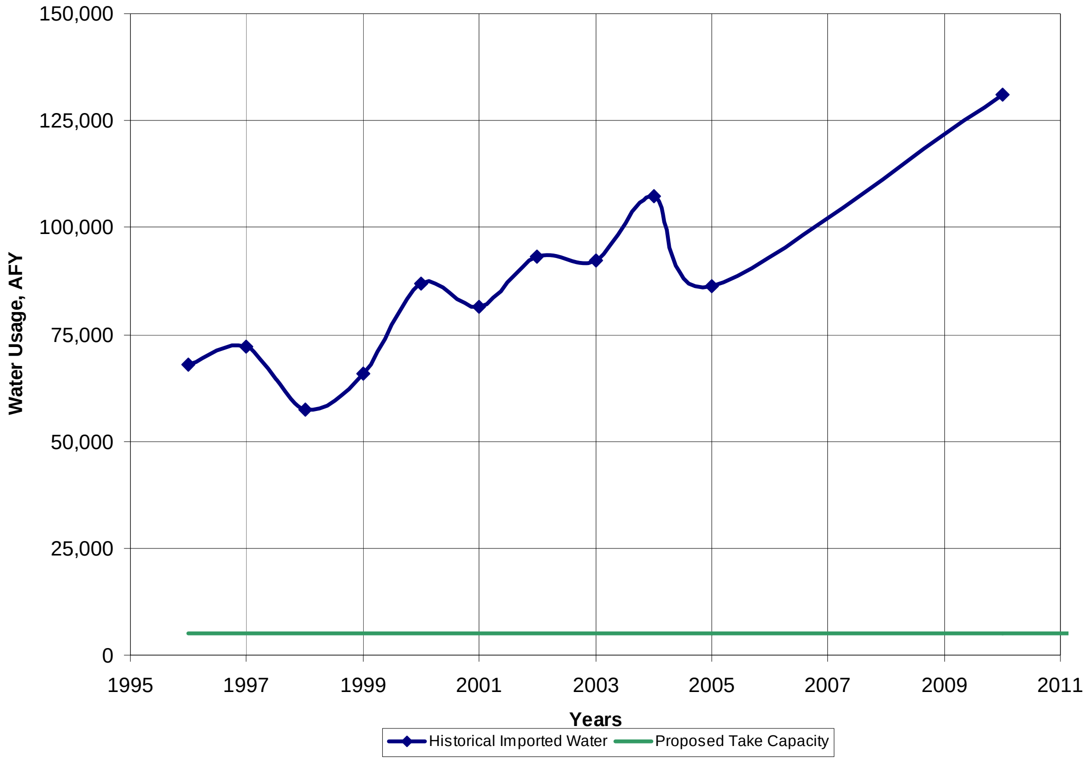
During the initial agency meetings that were conducted throughout the first several months of the project, WMWD indicated a "take" interest of 8,000-10,000 afy from the Chino Basin. This "take," or shift, from the Basin would be conducted by new interconnections between Basin Appropriators and WMWD, and using existing or new infrastructure to pump the stored groundwater out of the Basin and convey to WMWD's service area. Upon further development of potential Program Expansion participants and implementation of other regional infrastructure required to deliver water to WMWD from the Basin, the "take" was limited to the lower portion of Management Zone (MZ) 3 via JCSD's existing and newly proposed production facilities. Upon review of groundwater modeling results in this area, the maximum "take" for WMWD supported by JCSD's facilities and the lower portion of MZ3 was 5,000 afy.

However, WMWD maintains interest in increasing their "take" from the Chino Basin to 10,000 afy, and perhaps higher. This increase may be supported in subsequent programs beyond this expansion due to development of other required and substantial regional infrastructure, such as the following:

- Construction of the RC Feeder North Reach
- Construction of a new WTP from the Etiwanda Pipeline
- Construction of a new ASR wellfield in the southern portion of Fontana Water Company's service area

Figure 1-3 presents historical WMWD imported water usage compared to the 5,000 AFY take capacity. The proposed 5,000 afy take capacity represents a relatively small amount of water compared to historical imported water purchases.

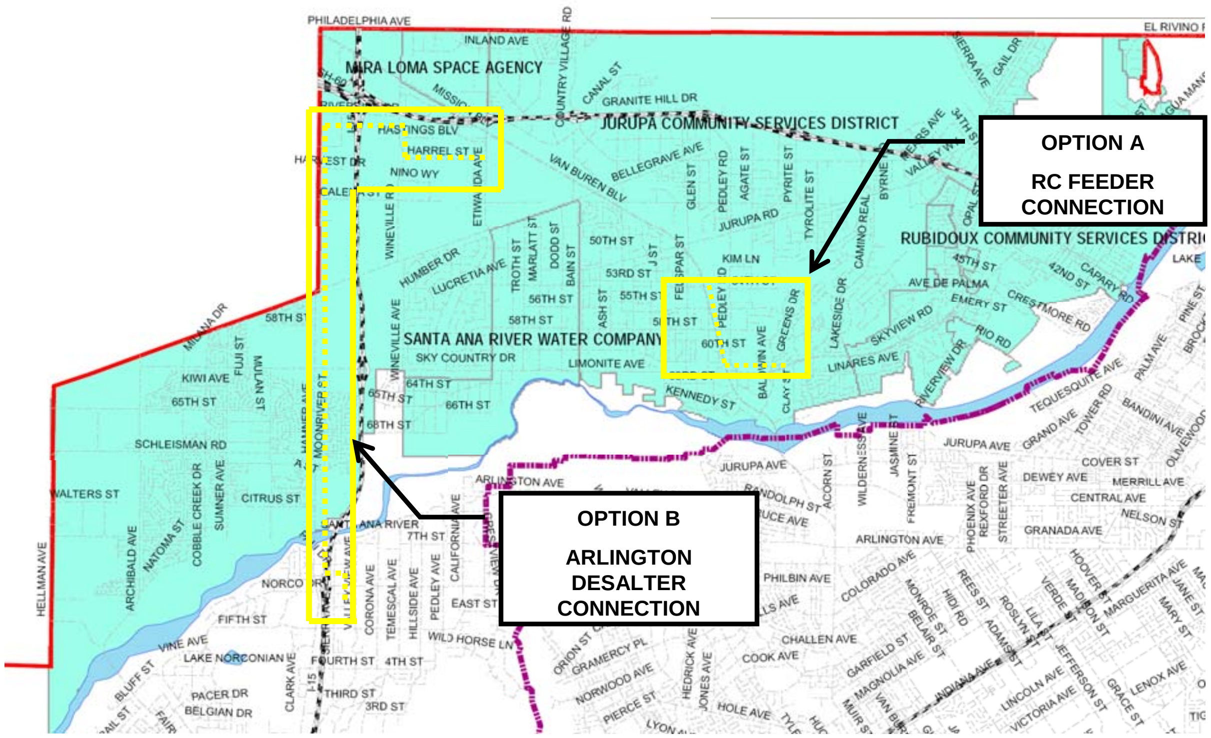
Figure 1-3
WMWD Historical Imported Water Usage



1.6.2 Program Expansion Facility Requirements

WMWD indicated an interest in participating on the "take" side of the Program Expansion. This would require a new interconnection between WMWD and one of the Chino Basin Appropriators. Two proposed WMWD interconnection facilities options were considered: 1) Option A, RC Feeder Connection, and 2) Option B, Arlington Desalter Connection. The general vicinity of the new proposed facilities are shown on Figure 1-4. As shown on the figure, Option A would be a new interconnection between WMWD and JCSD. Option B would be a new interconnection to the Chino Desalter Authority's (CDA) Chino II Expansion Project.

N



WATER SERVICE MAP KEY

- WMWD GENERAL DISTRICT BOUNDARY
- OTHERS (JURUPA COMMUNITY SERVICES DISITRCT)
- CITY OF RIVERSIDE BOUNDARY
- DYY PROJECT EXPANSION FACILITIES

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Chino Basin Dry Year Yield Program Expansion Project Western Municipal Water District – Vicinity Map	Figure 1-4

1.6.2.1 Option A - RC Feeder Connection

The interconnection would consist of a new 42-inch diameter pipeline and booster pump station conveying flow from the Chino Basin to WMWD's RC Feeder. The alignment would begin at the 56th Street tie-in location in JCSD's service area. The alignment for the new pipe would run south along Van Buren Boulevard and then turn east along Limonite Avenue until connecting to the RC Feeder pipeline at Clay Street.

The flow capacity for the JCSD and WMWD interconnection scenario is set at 5,000 afy, which is the total WMWD "take" contribution for the Program Expansion. As the 42-inch pipe is oversized to meet future master planned deliveries in and out of the Chino Basin, additional DYY water deliveries may be achieved in the future if determined feasible by JCSD, WMWD, and the Watermaster. A booster pump station would be required to meet the hydraulic pressure demand of the RC Feeder pipeline.

1.6.2.2 Option B - Arlington Desalter Connection

The facilities being considered would transfer the water from the expansion of the Chino II Desalter to the Arlington Desalter pipeline with a new 30-inch diameter pipeline. The water supply for the Chino II Expansion project is extracted groundwater supply from wells in Chino Creek Well Field, which provide overall hydraulic control of the basin.

The 10,600 afy (10.5 million gallons per day [mgd]) expansion of the Chino II Desalter would be divided equally among, WMWD, City of Ontario (Ontario), and JCSD, with each party receiving 3,533 afy. The new 30-inch pipeline would serve WMWD's 3,533 afy of desalter water along with the 5,000 afy DYY shift allocation to WMWD's service area via a connection to the exposing Arlington Desalter pipeline. The 5,000 afy would either be produced by JCSD's wells or pumped directly into the JCSD system similar to Option A or would be achieved via exchange of desalter purchases.

1.7 Abbreviations and Acronyms

The following abbreviations/acronyms are used in this report:

acre-ft	acre-feet
afy	acre-feet per year
ASR	aquifer storage and recovery
ASTM	American Society for Testing Materials
AWWA	American Water Works Association
B&V	Black & Veatch
Basin	Chino Basin
Cal-OSHA	California Occupational Safety & Heath Administration
CDA	Chino Desalter Authority
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CML&C	cement mortar lined and coated
CRA	Colorado River Aqueduct

CVWD	Cucamonga Valley Water District
d/t	diameter / thickness
DYY	Dry-Year Yield
DYY Program	initial Chino Basin Dry-Year Yield Program
DYY Program Expansion	Chino Basin Dry-Year Yield Program Expansion
fps	feet per second
gpm	gallons per minute
HDD	horizontal directional drilling
HDPE	high-density polyethylene
HGL	hydraulic grade line
HP	horsepower
I&C	instrumentation and controls
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)
mgd	million gallons per day
Metropolitan	Metropolitan Water District of Southern California
MTBM	microtunnel boring machine
MVWD	Monte Vista Water District
MWRF	March Wastewater Reclamation Facility
NSF	National Sanitation Foundation
OD	outside diameter
Ontario	City of Ontario
O&M	operation and maintenance
OBMP	Optimum Basin Management Program
pcf	pounds per cubic foot
PDR	Project Development Report
Program	DYY Program, DYY Program Expansion
Program Expansion	Chino Basin Dry-Year Yield Program Expansion
psi	pounds per square inch
PVC	polyvinyl chloride
RC	Riverside - Corona
ROW	right of way
SAR	Santa Ana River
SCE	Southern California Edison
SWP	State Water Project
TBM	tunnel boring machine
TDA	Tom Dodson & Associates
TDH	total dynamic head
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. Agency-specific references for the facilities listed in this Volume II J are shown below.

[WMWD, 2007] Western Municipal Water District, *Riverside-Corona Feeder Basis of Design Report*, Prepared by Black & Veatch, August 31, 2007

[WMWD, 2005] Western Municipal Water District, *Urban Water Management Plan*. 2005

2.0 AGENCY INTERCONNECTION FACILITIES

2.1 Overview

This chapter introduces WMWD's participation into the DYY Program Expansion with involvement in two "take" delivery scenarios from the Basin, allowing increased shift from Metropolitan's imported water supplies. The proposed WMWD interconnection facilities under consideration include Option A, RC Feeder Connection and Option B, Arlington Desalter Connection. The original level of interest for the total "take" capacity by WMWD was upwards of 10,000 afy for the DYY Program Expansion. However, based upon modeling results prepared by WEI, the total "take" estimated to be sustainable in the Basin for Western in the southern MZ3 area is approximately half the original capacity identified, or about 5,000 afy.

2.2 Water Supply

The water supply for both Option A and B would be groundwater pumped by JCSD wells and conveyed through JCSD's system to the points of interconnection. Option B would also convey WMWD's portion of the Chino II expansion. These sources would provide the water for WMWD's "take" facilities. Both these facilities would be located in the southeast portion of the Basin.

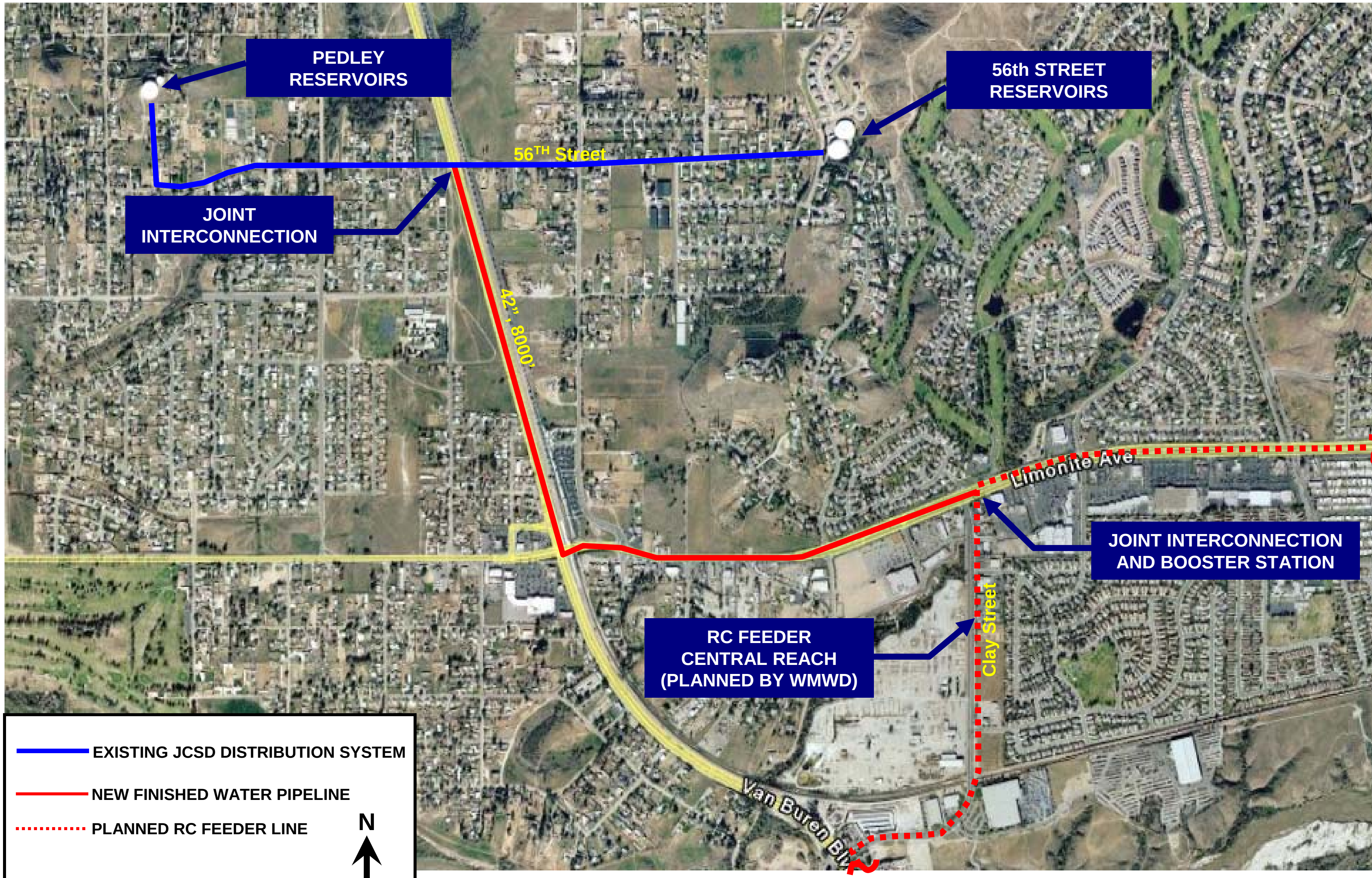
The facilities for Option A would consist of a new 42-inch diameter pipeline conveying flow in the southeast direction, beginning at the JCSD 56th Street tie-in point traveling along Van Buren Boulevard and Limonite Avenue alignments. The JCSD connection tie-in point would be located at the intersection of 56th Street and Van Buren Boulevard. This point is nearly halfway between the Pedley and 56th Street Reservoirs in the JCSD 870 pressure zone. As indicated by the JCSD Master Water Plan, both the Pedley Reservoirs and 56th Street Reservoirs are located in the JCSD 870 pressure zone.

Option B would transfer water from Chino II Expansion and the JCSD's system to the Arlington Desalter pipeline via a new 30-inch diameter pipeline along Hamner Avenue. The water supply for the Chino II Expansion project is extracted groundwater supply from wells in Chino Creek Well Field, which provide overall hydraulic control of the Basin.

2.3 Pipeline Alignments

2.3.1 Option A - RC Feeder Connection

The interconnection would consist of a new 42-inch diameter pipeline. Near the end of the new pipeline alignment a new pump station would be required to boost flow into the central reach of the RC Feeder. The RC Feeder central reach is currently under final design and is scheduled for construction completion in the year 2012 (WMWD, August 2007). Figure 2-1 shows the pipeline alignment of the RC Feeder Connection-Option A.



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Chino Basin Dry Year Yield Program Expansion Project

Western Municipal Water District – Option A RC Feeder Connection

Figure 2-1

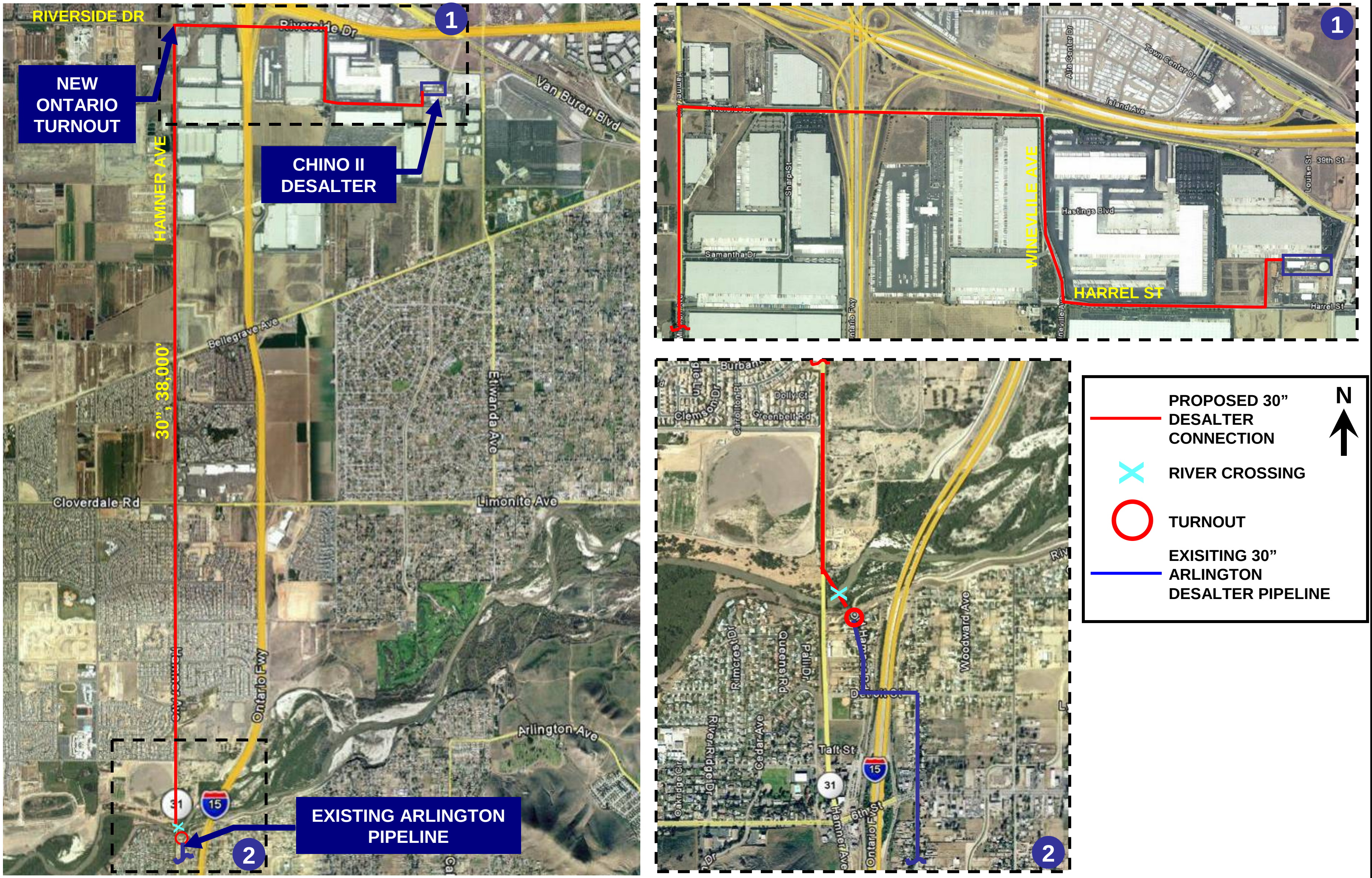
The 42-inch diameter pipeline size was selected upon discussion with WMWD staff to include provisions for future additional operational flow capacity above what is being developed under the DYY Program Expansion. The estimated flow under the current expected total shift obligation is 5,000 afy. As the 42-inch pipe is oversized to meet future, master planned deliveries in and out of the Chino Basin, additional DYY water deliveries may be achieved in the future if determined feasible by JCSD, WMWD, and Watermaster.

2.3.2 Option B - Arlington Desalter Connection

The second scenario is an interconnection between the CDA's Chino II Expansion Project and WMWD. Similar to the first scenario, the "take" interconnection would allow for the delivery of water from the southeast portion of the Basin to the WMWD service area. The 30-inch pipeline alignment would begin at the Chino II Desalter site location near the Pomona Freeway (HWY 60) and Etiwanda Avenue then continue west to the intersection of Riverside Blvd and Hamner Avenue, and then south along Hamner and across the Santa Ana River. A new 1010 Zone pump station (to be developed by others) would boost treated water from the Chino II Desalter into the new pipeline. Ontario will likely be constructing a 1010 pressure zone turnout along the alignment to allow for shared water transfer, as indicated in the Chino Desalter Phase 3 Project memorandum dated July 7, 2008. The river crossing construction methods are outlined in Section 2-5. The WVWD water connection would be via the existing 30-inch Arlington Desalter pipeline for delivery to the Norco and WMWD service areas. Figure 2-2 shows the pipeline alignment of the Arlington Desalter Connection – Option B.

2.4 Pipeline Design

The design parameters discussed in this section include general design criteria, codes and standards, hydraulic design, pipe diameter, pipe materials, load criteria, pipeline wall thickness, joints and fittings, trench design, connections, lining and coatings, corrosion control, and pipeline appurtenances. At this stage of project development, it was assumed that steel pipe would be the selected pipe material for the purposes of developing an opinion of probable cost. Alternative pipe materials, such as ductile iron, high-density polyethylene (HDPE), and polyvinyl chloride (PVC), may also be appropriate and should be investigated during the design phase in order to provide a competitive bidding scenario. A summary of the design criteria for the pipeline is presented in Table 2-1.



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Chino Basin Dry Year Yield Program Expansion Project

Western Municipal Water District – Option B Arlington Desalter Connection

Figure 2-2

Table 2-1
Summary of Pipeline Design Criteria

Design Parameter	Option A RC Feeder Connection	Option B Arlington Desalter Connection
Pipe		
Pipe Diameter, inches	42	30
Pipe Length, feet	8,200	38,300
Design Flows		
Maximum, cubic feet per second (cfs)	57.7 (1)	12.7 (3)
Average, cfs	6.9 (2)	6.9 (4)
Velocities		
Maximum, feet per second (fps)	6	2.6
Average, fps	0.7	2.4
Design Pressure		
Design Hydraulic Gradient, elevation	870 (5)	1010
Approximate Pipe Center Line, elevation	705	572
Design Pressure, psi	71	185
Pipe Wall Design		
Diameter/thickness (d/t) ratio	165	165
Minimum Thickness, inch	0.26	0.25
Pipe and Fittings Materials	Cement Mortar Lined and Coated Welded Steel	Cement Mortar Lined and Coated Welded Steel
Pipe	Steel AWWA C200	Steel AWWA C200
Lining	Plant applied cement mortar, AWWA C205	Plant applied cement mortar, AWWA C205
Coating	Cement mortar, AWWA C205	Cement mortar, AWWA C205
Pipe Trench Criteria		
Minimum Cover, feet	6	6
Allowable Nominal Deflection		
Percent of Nominal Diameter	2	2
Modulus of Soil, psi (assumed)	1400	1400
Pipe Joints	Gasketed, single or double welded, or butt strap, as required by WMWD	Gasketed, single or double welded, or butt strap, as required by WMWD
River Crossings	No	Yes – Santa Ana River
Crossing Technologies	-	Above Ground - Bridge Supported, Horizontal Directional Drilling (HDD), Microtunneling

<u>Notes:</u>
(1) Flow based upon maximum recommended pipeline velocity sizing criteria of 6 fps.
(2) Flow based upon current expected total shift obligation of 5,000 afy.
(3) Based upon delivery limitations from available pumping head at the 1010 Chino Desalter Pump Station.
(4)Based upon combined flow capacity deliveries to WMWD listed in the Chino Desalter Phase 3 Project (7/17/2008)
(5)Based upon pipeline hydraulics conditions prior to booster pump station location.

2.4.1 Applicable Codes and Standards

The following codes and standards are applicable to the design and construction of the pipeline:

- American Society for Testing Materials (ASTM)
- American Water Works Association (AWWA) Codes and Standards
- AWWA Manual M11 (Steel Pipe – A Guide for Design & Installation)
- AWWA Manual M51 (Air Release, Air/Vacuum, and Combination Air Valves)
- B&V Design Procedures
- California Code of Regulations
- Division of Occupational Safety and Health (Cal-OSHA)
- CDPH
- WMWD and JCSD Standards

2.4.2 Hydraulic Design

Pipeline hydraulic design and requirements are based on information obtained from JCSD, the CDA, and WMWD. The hydraulic design of the RC Feeder interconnection indicates a booster pump station would be required to increase the hydraulic grade to match the operating levels of the RC Feeder pipeline along the central reach. The Arlington interconnection hydraulic design includes a 1010 zone pump station (by others) to convey flow to the point of connection at the Arlington pipeline. The plan and hydraulic profiles for the RC Feeder and Arlington interconnection facilities are provided on Figures 2-3 and 2-4.

Table 2-2 summarizes the hydraulic parameters for each interconnection scenario at both the maximum flow and average flow determined by the DYY shift.

Table 2-2
Summary of Hydraulic Parameters

Hydraulic Design Parameters	RC Feeder Connection	Arlington Desalter Connection
Maximum flow, cfs		
Maximum Hydraulic Losses, feet	23.6	38.8
Average flow, cfs		
Average Hydraulic Losses, feet	0.5	29.8
Booster Pump Station Horsepower, hp Average Flow	520	Not Required

2.4.3 Pipe Diameter

The RC Feeder connection would utilize a 42-inch diameter pipeline. The pipeline size was selected upon discussion with WMWD staff to include provisions for future additional operational flow capacity above what is being developed under the DYY Program Expansion. The Arlington Pipeline interconnection would utilize a 30-inch diameter pipeline.

2.4.4 Pipe Materials

Pipeline materials would be selected to meet ductility and joint design guidelines for superior seismic performance. Steel pipe was selected for the basis of this conceptual project development; however, alternative pipe materials could be evaluated during final design. The pipeline would be cement mortar lined and coated steel pipe conforming to AWWA C200. The pressure class would be allowed to vary along the pipe. The required pipeline wall thickness would be determined for the pipeline and indicated on the plan and profile drawings.

2.4.5 Pipe Sections

Typical pipe sections are available in alternative lengths from 40 to 60 feet, depending on the pipe manufacturer's mill capabilities. Total approximate lengths of 42-inch and 30-inch pipe would be 8,200 feet and 38,300 feet, respectively.

2.4.6 Load Criteria

Internal and external loads must be considered to ensure appropriate pipeline design.

2.4.6.1 Internal Load

Design for internal loading would be based on the design hydraulic grade line (HGL). Design pressures would be based on the considerations of normal operating conditions, transient surge conditions, hydrostatic test pressures, and other conditions if warranted.

2.4.6.2 External Load

Design of the pipe for external loading would consider the depth of earth cover, live loads, and construction loads. A maximum deflection of two percent nominal pipe diameter would be allowed. This maximum allowable design deflection for the 30-inch and 42-inch diameter pipes is 0.15 and 0.24 inches, respectively. Based on a modulus of elasticity of 1,400 psi for soil, the minimum cover over the pipeline would be 6 feet and the maximum cover 20 feet. Concrete slurry would be required for deeper installation. In areas where utility crossings may occur, pipe cover would range from 6 to 10 feet or be governed by the geotechnical engineer's recommendations.

2.4.7 Pipeline Wall Thickness

Minimum pipe wall thickness is an important consideration for handling and installation and for protection against collapse or buckling due to internal vacuum. Hydraulic requirements often dictate that the pipe wall thickness be increased for internal pressure. The minimum wall thickness and internal pressure were calculated to determine the governing criteria for wall thickness.

2.4.7.1 Minimum Wall Thickness

The d/t ratio provides the minimum steel thickness for safe transport of the pipe. A d/t of 165 is recommended for this pipeline, resulting in a minimum wall thickness for a 42-inch and 30-inch pipeline of 0.26-inch and 0.18-inch, respectively. When the pipeline would be buried in streets and/or areas where future construction may expose the pipe, a minimum wall thickness of 0.25-inch is recommended.

The steel thickness necessary to withstand the internal pressure was also calculated to ensure the minimum thickness is adequate. Based upon preliminary calculations, the internal pressure considered is negligible when considering a thickness of 0.25-inch. The pipe wall thickness would vary along the alignment based on the test HGL and the actual centerline of the installed pipe. These thicknesses would be determined during final design, although the required pipe wall thickness would be 0.25-inch at a minimum.

Based upon this preliminary investigation, a wall thickness of 0.26-inch is recommended for the connection to the RC Feeder pipeline. The wall thickness for the connection to the Arlington Desalter pipeline shall be set at the minimum allowed thickness of 0.25-inch.

2.4.8 Pipe Deflection

Steel pipe is a flexible conduit, and the maximum cover depth is dependent on the allowable deflection caused by external loads. Maximum allowable deflection resulting from external loading conditions is limited to two percent of the pipe diameter for pipe with shop applied cement mortar coating. The maximum allowable design deflection of two percent for the 30-inch and 42-inch diameter pipe would be 0.15 inches and 0.24 inches, respectively.

Deflections using the minimum pipe wall thicknesses were calculated assuming a soil unit weight of 120 pounds per cubic foot (pcf) and assuming Class B bedding as summarized in Table 2-3.

Table 2-3
Pipe Deflection [(1)]

Design Parameters	Option A RC Feeder Connection	Option B Arlington Desalter Connection
Pipe Diameter, inches	42	30
Deflection, inches	0.24	0.15
Max. Cover Depth, feet	20	23

Notes:
(1) Assumes w = 120 pcf and Class B bedding.

2.4.9 Joints and Fittings

Pipe installation would use rubber gasket joints, or single or double welded joints to join pipe sections, depending upon WMWD standards.

2.4.10 Trench Design

Excavation for pipe installation would be in accordance with the requirements established by Cal-OSHA and by the applicable agencies. Shoring may be required due to space constraints and possibly soil considerations. Shoring design would be specified to be the responsibility of the contractor. Trench depth should be generally selected based on minimum cover to protect the pipe safely from transient loads. Depth of trench in city streets may be governed by existing utilities or other conditions. If the sides of the trench remain vertical after excavation, and if bedding and backfill were consolidated by hydraulic methods, then the minimum trench width at the top of the pipe would be pipe outside diameter (OD) plus 20 inches on each side of the pipe. If the pipe-zone bedding and backfill require densification by compaction, then the width of the trench at the bottom of the pipe should be determined by the space required for the proper and effective use of tamping equipment, but it should never be less than pipe OD plus 20 inches on each side. Flat bottom trenches should be excavated to a depth of a minimum of four inches below the established grade line of the outside bottom of the pipe. Specified building material should be used to fill the excess excavation. Loose subgrade material should be graded uniformly to the established grade line for the full length of the pipe.

Three options are available: open trench with flared sidewalls, open trench with shoring, jack and bore method.

2.4.10.1 Open Trench with Flared Sidewalls

This method would require more construction area than other methods because of the type of equipment used. However, open trenching with flared sidewalls is the least expensive form of excavation for pipelines. This method would generally be used in open terrain and would not likely be used in the installations considered in this chapter. An open trench would demand the width of two lanes, essentially halting one direction of traffic flow.

2.4.10.2 Open Trench with Shoring

Shored open trench construction would be required for the majority if not all of the pipeline and would be used for confined construction areas and restricted rights-of-way (ROW). Pipe placement along the street would require this method because of space confinement. The majority of the pipeline would be constructed within the ROW for existing public streets.

2.4.10.3 Jack and Bore Method

The jack and bore method may be utilized if issues exist which would not allow sections of the street to be opened, such as a congested intersection. The contractor shall install a prefabricated pipe through the ground from a jacking pit to a receiving pit. The pipe would be propelled by jacks located in the jacking pit. As the pipe installation progresses, the spoils would be transported out of the pipe either manually or by mechanical methods. The casing pipe material would be steel pipe welded at each joint. The casing pipe would need to accommodate the carrier pipe plus the skids, or pipe spacers, to support the carrier pipe. The contractor would need space for the jacking pit (approximately 20 by 40 feet), equipment (e.g. excavator, crane, generator, small equipment, storage containers), materials, temporary spoils piles, and delivery equipment. The jacking and receiving pits would be supported in a manner similar to open trench excavation with shoring. The contractor would require space around the boring pit for the excavator, crane, and the other equipment.

2.4.11 Pipeline Connections

Each connection point to existing pipelines would require insulating joints and necessary isolation valves. Vaults may be recommended for placement of the isolation valves to allow for access for maintenance rather than direct burial approach. Special consideration for thrust restraint should also be considered at each of the pipeline connection locations.

2.4.12 Lining and Coatings

All buried steel pipe would be coated and lined. The pipe coating would be a cement mortar coating in accordance with AWWA C205. The lining would also be cement mortar. The lining and coating would be used to protect the pipeline from wear during installation and operation, as well as from corrosion.

2.4.13 Corrosion Control

The water being conveyed is potable water and is not known to be corrosive. Cement mortar lining on the inside of the steel pipe would provide the primary corrosion protection for the steel shell.

If cathodic protection is desired, cathodic test stations would be included in the pipeline design. Installation of wire jumpers at joints, harness assemblies, and couplings would be provided for continuity along the pipeline. Insulating flanges would be provided to isolate pipeline segments. Where cement mortar coatings are not provided on the pipeline, the pipe would be coated with a high performance protective coating, coated with mastic, and wrapped with polyethylene sheeting.

2.4.14 Construction Requirements

The majority alignment was assumed to lie within the public ROW. Encroachments through public streets would be handled by the city or county. The contractor would have to work within a restricted construction zone along the road, either on the shoulder or within an identified lane, where the trench would be located using a shored trench. A detailed evaluation of the construction zone requirements versus available width would be required during design.

2.4.15 Pipeline Appurtenances

Water conveyance facilities include appurtenant structures for operation and protection against damaging hydraulic transients. Facilities to permit periodic maintenance would also be provided. Specific appurtenances would include couplings, isolation valves, air and vacuum relief, blow-off facilities, access manways, and marker posts.

2.4.15.1 Couplings

Sleeve couplings provide tightness and strength with flexibility. The flexible sleeve coupling would be able to handle acceptable pipe axial movement. If greater displacement were needed, a harness assembly could be installed with each flexible coupling according to AWWA M11.

2.4.15.2 Isolation Valves

The pipeline would be designed to resist damage from earthquakes. In addition, valves may be provided to isolate portions of the pipeline should damage occur. Isolation valves would be the same size as the pipeline and would be manually operated. The location of these valves, if desired, would be determined after the completion of the geotechnical report during final design.

2.4.15.3 Air Release/Vacuum Relief

Air release/vacuum relief valves allow entrained air to vent out of the pipeline during fill, allow air back into the pipeline when it is being drained, and protect the pipeline from collapse due to negative pressures. The air release/vacuum relief valves would be installed at every summit along the pipeline; the valves would prevent accumulation of air pockets at high points, which might impair the pipe’s flow capacity. Air release/vacuum relief valves would be designed to meet all the criteria in AWWA M11 and M51.

2.4.15.4 Blowoff Facilities

Blowoff facilities would be located at the low points and upstream of line valves located on a slope of the pipeline. Blowoff facilities would be used to drain pipe sections and to allow for relief of pipe pressure for inspection and maintenance purposes. The blow off facilities would consist of a short length of pipe connected to the bottom of the main pipe and carried away from the main to a gate valve, where the operating nut must be accessible from the surface. The blowoff facility would be designed and set with the stem vertical and just beyond the side of the pipeline.

2.4.15.5 Access Manway

Access to the pipeline would be provided from the top of the pipe with a tee in the pipeline with a blind flange. The manholes would typically be 30-inch flanged tees, either buried or contained within a concrete structure, and located at about 2,000 foot spacings. Access manholes would be located close to valves and low points, as well as intermediate locations along the pipeline.

2.4.15.6 Utility Research

An investigation of existing facilities should be performed to identify approximate locations of crossing or parallel utilities in relation to that of the pipeline. Potholing is also expected in some locations along the pipeline alignment during final design to determine unknown or verify as-built utility locations.

2.5 Arlington Desalter Pipeline – Santa Ana River Crossing

In general, the proposed pipelines would be constructed by open trench methods. However the alignment of Option B along Hamner Avenue involves a crossing of the Santa Ana River (SAR). This section describes the available construction alternatives for river crossings. The river crossing construction alternatives discussed include suspending the pipeline along a bridge and three trenchless construction methods: HDD, microtunneling, and conventional tunneling.

2.5.1 Pipeline Bridge Suspension

This river crossing option includes suspending the pipeline by an existing bridge. The Arlington Desalter Pipeline interconnection will cross the SAR at the Hamner Avenue bridge. The pipe alignment would travel underneath or along the side of the existing Hanmer Avenue bridge structure and would be supported through a series of pipe supports over a approximate total span of 660 feet. An evaluation of the structural integrity of the bridge to support the pipe is beyond the scope of this investigation. If the pipe suspension option is chosen for further development, this analysis should be conducted. Also, the development of the SAR crossing would require coordination with several municipal and regulatory agencies. Figure 2-5 provides an aerial view of the Hamner Avenue bridge crossing over the SAR looking southwest.

Figure 2-5
Aerial View of the Hamner Avenue Bridge

2.5.1.1 Design Considerations

The design for a suspended pipeline would include additional emphasis for the following items:

- security issues
- traffic planning
- structural pipeline supports
- joints, fittings, and couplings
- air release valves
- corrosion control
- protective coatings

2.5.2 Horizontal Directional Drilling

HDD is a proven method where pipes are installed in the following sequence:

- Setup – A drill rig is set up on one side of the crossing;
- Pilot Bore – The rig drills into the ground at an 8 to 16 degree angle from the ground surface. The rig then transforms the drilling curve from a straight line tangentially into a vertical curve with a large radius. After passing beneath the surface obstacle (e.g., river, highway, existing structure, etc.), the rig then transforms the drilling curve into a tangential line rising to the ground surface at an angle of 5 to 10 degrees.
- Ream – Once the pilot bore is completed, the bore is reamed by one or more passes to a diameter that is 120 to 150 percent of the carrier pipe outside diameter. Some drillers overcut 6 inches for pipes larger than 24 inches in diameter. The overcut would be necessary to reduce friction and pullback force during installation of the carrier pipe.
- Pipe Installation – After the ream process, the carrier pipe is welded into a single string of pipe and then connected to a swivel and pulled into the borehole along the drilling curve from the drill rig exit side to the entry side. The slurry is used in the annular space between the borehole and pipe wall to lubricate.

2.5.2.1 Design Considerations

Design considerations of HDD are listed in Table 2-4:

Table 2-4
HDD Design Considerations

Item	Comments
Pipe Diameter	30-inch diameter is within viable size range (up to 48 inches) for HDD construction
Pipe Material	Preferred material welded steel pipe w/ exterior polymer concrete coating and fusion bonded epoxy liner; other suitable flexible materials include HPDE
Cobbles, Boulders and Gravelly Soils	Geotechnical investigation would be required to determine risk of blocking drill path and damage to drill rig and pipe
Geometry	HDD would require smooth drill path
River Bed Scour and Erosion	Mitigate risk by allowing for sufficient depth of cover
Staging Area	HDD requires sufficient space for drill rig entry side (approx 20,000 sf) and pipe exit side (approx 15,000 sf)

2.5.3 MicroTunneling

Microtunneling is a special type of pipe jacking where a remotely controlled Microtunnel Boring Machine (MTBM) is used to construct the tunnel. The microtunnel method has been used to construct tunnels from 10 to 128 inches in diameter. The microtunnel process can be described as follows:

- Construct MTBM launching shaft and receiving shaft;
- Install pipe jacking frame and other equipment;
- Launch MTBM and start microtunneling. A crane loads the MTBM onto the jacking frame. Hydraulic jacks provide axial force to push the MTBM forward. The MTBM progresses forward by cutting soils in front of its cutter head and ingesting the cuttings into its crushing chamber. The cuttings are then transported out of the tunnel with the circulating drilling fluid. After the MTBM is jacked into the soil, the hydraulic jacks retract, and a section of pipe can be loaded onto the jacking frame. The hydraulic jacks then push the pipe and MTBM forward. The jacking process repeats, and pipe is jacked into the tunnel section by section. Pipe joints are welded before the pipes are jacked into the tunnel to ensure pipeline integrity. Once the MTBM reaches the receiving shaft, a crane will remove the MTBM, and the pipe will be ready for use after cleaning.

Design considerations for microtunneling are indicated in Table 2-5:

Table 2-5
Microtunneling Design Considerations

Item	Comments
Groundwater	Shallow groundwater level may be problematic due to instability of entry/exit shafts and water infiltration
Cobbles and Boulders	Geotechnical investigation would be required to determine risk of cobbles / boulders blocking the infiltration MTBM path
River Bed Scour and Erosion	Mitigate risk by allowing for sufficient depth of cover
Shaft Design and Staging Area	Microtunneling requires less staging area than HDD

2.5.4 Conventional Tunneling

A tunnel shield or Tunnel Boring Machine (TBM) is used in conventional tunneling. Launching and receiving shafts are constructed first. The tunnel shield or TBM is then jacked into the soil by hydraulic jacks. Initial support bracing is installed in the excavated bore behind the tail of the TBM to provide support to the surrounding soils. Initial support is then lined with watertight material to prevent groundwater infiltration. Once the TBM progresses beyond the reach of the hydraulic jacks, the hydraulic jacks will be retracted onto the initial support to provide the axial force to advance the tunnel shield or TBM further. Spoils are removed from the tunnel to allow excavation to continue as the TBM advances itself. Once the tunnel shield or the TBM reaches the receiving shaft, the carrier pipe can be installed inside the tunnel. Conventional tunneling methods are generally used for larger diameter pipe.

2.5.4.1 Design Considerations

Design considerations for conventional tunneling listed in Table 2-6:

Table 2-6
Conventional Tunneling Design Considerations

Item	Comments
Groundwater	High groundwater may lead to hydrostatic pressures at launching and receiving shafts
Cobbles and Boulders	Geotechnical investigation would be required to determine risk of blocking bore path
River Bed Scour and Erosion	Mitigate risk by allowing for sufficient depth of cover
Shaft Design and Staging Area	Conventional tunneling requires less staging than HDD

3.0 OPINION OF PROBABLE COST

3.1 Overview

This chapter presents the opinion of probable cost for the facilities described in this Volume II J 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 Option A facilities would be $12,124,000 and $560,000, respectively. The total opinion of probable capital and annual O&M costs for Option B facilities would be $24,038,000 and $29,000, respectively.

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

Component	Option A	Option B
Capital Cost		
Construction Cost	$9,185,000	$18,211,000
Contingency (1)	$1,837,000	$3,642,000
Engineering/Administration/CM (2)	$1,102,000	$2,185,000
Total Capital Cost	**$12,124,000**	**$24,038,000**
Midpoint of Construction Cost (3)	$13,248,000	$26,267,000
Annual Cost		
Annual O&M Cost	$560,000	$29,000
Annualized Capital Cost (4)	$1,036,000	$2,055,000
Total Annual Cost	**$1,596,000**	**$2,084,000**

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 Option A facilities. As shown, the total estimated capital cost for the new Option A facilities would be $12,124,000. 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--Option A Facilities

Component/Facility Detail	Option A Cost
Conveyance Facilities	
Distribution Pipeline: 8,200 feet @ 42" Diameter	$5,166,000
Pump Station: 600 HP Booster Station	$3,000,000
Land	$75,000
Railroad Crossing	$200,000
Misc. Valves and Flowmeters	$25,000
General Costs	
Mechanical (1)	$90,000
Electrical (1)	$300,000
Site Work (1)	$150,000
General Requirements (2)	$179,000
Total Construction Cost	$9,185,000
Contingency (3)	$1,837,000
Engineering/Administration/CM (4)	$1,102,000
Total Capital Cost	**$12,124,000**
Total Midpoint of Construction Cost (5)	$13,248,000

Notes:
(1) Includes general costs for major treatment and booster station facilities.
(2) Includes general requirements costs for major 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.

Table 3-3 presents the opinion of probable capital cost for construction of the District's Option B facilities. As shown, the total estimated capital cost for the new Option B facilities would be $24,038,000.

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

Component/Facility Detail	Option B Cost
Conveyance Facilities	
Pipeline: 38,300 feet @ 30" Diameter	$17,235,000
SAR River Crossing (bridge supported)	$594,000
Misc. Valves and Flowmeters	$25,000
General Costs	
General Requirements (1)	$357,000
Total Construction Cost	$18,211,000
Contingency (2)	$3,642,000
Engineering/Administration/CM (3)	$2,185,000
Total Capital Cost	**$24,038,000**
Total Midpoint of Construction Cost (4)	$26,267,000

Notes:
(1) Includes general requirements costs for all facilities (except land and SARI/NRWS).
(2) Based on 20 percent contingency.
(3) Based on 12 percent engineering/administration/CM.
(4) Assumes midpoint of construction in year 2012 at 3 percent escalation rate.

3.4 Annual O&M Cost

Table 3-4 presents the opinion of probable annual O&M cost for the District's Option A facilities. As shown, the total estimated annual O&M cost for the new Option A facilities would be $560,000.

Table 3-4
Summary of Opinion of Probable Annual O&M Cost--Option A Facilities

Component/Facility Detail	Option A Cost
Conveyance Facilities	
General Pipeline Maintenance: Distribution	$6,000
Pump Station Power: 600 HP Booster Station	$494,000
Pump Station General Maintenance	$60,000
Total Annual O&M Cost	**$560,000**
Annualized Capital Cost (1)	$1,036,000
Total Annual Cost	$1,596,000

Notes:
(1) Assumes amortization period of 25 years and discount rate of 6 percent.

Table 3-5 presents the opinion of probable annual O&M cost for the District's Option B facilities. As shown, the total estimated annual O&M cost for the new Option B facilities would be $29,000.

Table 3-5
Summary of Opinion of Probable Annual O&M Cost--Option B Facilities

Component/Facility Detail	Option B Cost
Conveyance Facilities	
General Pipeline Maintenance: Distribution	$29,000
Total Annual O&M Cost	**$29,000**
Annualized Capital Cost (1)	$2,055,000
Total Annual Cost	$2,084,000

Notes:
(1) Assumes amortization period of 25 years and discount rate of 6 percent.