10.2.2 Protests to Wastewater Change Petition WW0059

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State of California
State Water Resources Control Board
DIVISION OF WATER RIGHTS
P.O. Box 2000, Sacramento, CA 95812-2000
Info: (916) 341-5300, FAX: (916) 341-5400, Web: http://www.waterrights.ca.gov

PROTEST – (Petitions)

BASED ON ENVIRONMENTAL OR PUBLIC INTEREST CONSIDERATIONS
Protests based on Injury to Vested Rights should be completed on other side of this form

APPLICATION WW0059 **PERMIT** _____ **LICENSE** _____

I, (We,) East Valley Water District
Name of protestant

of P.O. Box 3427 San Bernardino, CA 92413 have read carefully
Post Office address of protestant

a notice relative to a petition for ◉ change or ○ extension of time.

under APPLICATION WW0059 of City of San Bernardino Municipal Water Department
State name of petitioner

to appropriate water from Rapid Infiltration and Extraction Facility
Name of source

It is desired to protest against the approval thereof because to the best of our information and belief:
my or our

the proposed change/extension will
(1) not be within the State Water Resources Control Board's (SWRCB) jurisdiction ☐
(2) not best serve the public interest ■
(3) be contrary to law ■
(4) have an adverse environmental impact ■

State facts, which support the foregoing allegations See Attachment A

Under what conditions may this protest be disregarded and dismissed? See Attachment B
State conditions that will relieve protest, or if none, so state

A true copy of this protest has been served upon the petitioner by e-mail with consent of Petitioner's counsel.
Personally or by mail

Date 7/29/2010

_____
Protestant(s) or Authorized Representative sign here

Protests MUST be filed within the time allowed by the SWRCB as stated in the notice relative to the change or ***such further time as may be allowed.***

(NOTE: Attach supplemental sheets as necessary)

PRO-PET (1-00)

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PROTEST – (Petitions)

BASED ON INJURY TO VESTED RIGHTS

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to appropriate water from Rapid Infiltration and Extraction Facility
Name of source

It is desired to protest against the approval thereof because to the best of our information and belief the
my or our

proposed change will result in injury to us as follows: See Attachment C
me or us State the injury which will result to you (see NOTE below)

Protestant claims a right to the use of water from the source from which petitioner is diverting, or proposes to divert, which right is based on: See Attachment C
Prior to application, notice posted, use begun prior to 12/19/14, riparian claim, or other right

Please provide application, permit or license numbers or statement of diversion and use numbers, which cover your use of water, or state 'none' _____. The extent of present and past use of water by protestant or his predecessors in interest from this source is as follows: See Attachment C
State approximate date first use made, amount used, time of year when diversion made, the use to which water is put

Where is YOUR DIVERSION POINT located? _____ ¼ of _____ ¼ of Section _____
Describe location with sufficient accuracy that position thereof relative to that of petitioner may be determined.

T.___, R. ____, ____ B. & M. Is this point downstream from petitioner's point of diversion? YES ○ NO ○
If Yes, explain: _____

Under what conditions may this protest be disregarded and dismissed? See Attachment B
State conditions which will relieve protest, or if none, so state.

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(NOTE: Attach supplemental sheets as necessary)

PRO-PET (1-00)

Attachments to Protest by

East Valley Water District

Against

WW0059 – Wastewater Change Petition Proposed by City of San Bernardino Municipal Water Department

Attachment A

The proposed petition to change the City of San Bernardino's discharge of treated wastewater into the Santa Ana River may not best serve the public interest for the following reasons:

On January 7, 1958, Protestant EAST VALLEY WATER DISTRICT ("EVWD") entered into a joint powers agreement with Petitioner CITY OF SAN BERNARDINO ("CITY") for the construction and operation of the City Sewage Treatment Plant. Under the terms thereof, EVWD delivers its wastewater to the City Sewage Treatment Plant for collection and secondary treatment. Approximately 26 mgd of the effluent is then sent to the Rapid Infiltration and Extraction ("RIX") Facility operated by the CITY and the City of Colton for tertiary treatment and ultimate discharge into the Santa Ana River. The CITY has engaged in various efforts to market its portion of the recycled flows from the RIX Facility to potential buyers and use the proceeds generated thereby to offset the operation, maintenance, and expansion cost of the City Sewage Treatment Plant and reduce the financial burden of EVWD in connection therewith. If the pending Petition for Change filed by the CITY reflects an intent or desire of the CITY to deviate from such plans, then said Petition will operate to interfere with the sound management of water resources within the Bunker Hill basin and impair the economic resources of EVWD and its rate-paying customers.

For these reasons, as well as the potential that the Petition could alter flows in the Santa Ana River, the Petition would also be contrary to law and the legal rights of affected parties, and have an adverse impact on the environment.

Attachment B

The protest may be withdrawn if the CITY and EVWD reach agreement on the disposal of the treated water in question, consistent with existing rights and responsibilities and agreements in place between them. EVWD is actively seeking resolution of its issues.

Attachment C

CITY's proposed change has the potential to interfere with EVWD's use and enjoyment of resources available from the Bunker Hill basin.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road, Suite 101
Carlsbad, California 92011

DMS
cc: R. Katz
C. Shumaker
D. Headrick

In Reply Refer To:
FWS-SB-10B0630-10TA0875

JUL 29 2010
RECEIVED
AUG 6 2010
S.B.M.W.D.
GENERAL MANAGER

State Water Resources Control Board
Division of Water Rights
P. O. Box 2000
Sacramento, California 95812-2000

Attention: Ms. Kathleen Groody

Subject: Protest of Revised Wastewater Change Petition WW0059, City of San Bernardino Municipal Water Department, City of San Bernardino, San Bernardino County, California

Dear Ms. Groody,

The U.S. Fish and Wildlife Service provides this letter in protest of the above-referenced petition which addresses Change of Place of Use, Change of Purpose of Use, and Reduction in Discharge Quantity by the City of San Bernardino Municipal Water Department (SBMWD). The SBMWD currently discharges wastewater into the Santa Ana River from 2 separate facilities: 1) the San Bernardino Water Reclamation Plant (SBWRP) which discharges secondary wastewater; and 2) the Rapid Infiltration and Extraction (RIX) facility which discharges tertiary wastewater and is located downstream from the SBWRP. The SBMWD proposes to reuse recycled water within its service area and to market surplus recycled water to water agencies outside of this service area.

We offer the following information in keeping with our responsibilities under the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*), and in keeping with our agency's mission to work "with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."

We base our protest on our review of the Revised Notice of Wastewater Change Petition WW0059 (Revised Petition), Environmental Information for Petitions and Attachment A (March 2010), and Petition for Change documents (April 2010). We previously reviewed the RIX Facility Recycled Water Sales Program, Program Environmental Impact Report (Vol. 1) and Technical Appendices (Vol. 2) (March 2003) and the Final RIX Facility Recycled Water Sales Program, Program Environmental Impact Report (January 2005). We have enclosed the 2003 joint letter-response from our agency and the California Department of Fish and Game regarding the Program Environmental Impact Report for your reference.

It is our understanding that SBMWD proposes the following changes to its existing recycled water program: 1) to convey secondary wastewater to various groundwater basins within its service area to allow for 290 acres of groundwater recharge; 2) to sidestream secondary wastewater for irrigation uses within its service area; and 3) to tertiary-treat remaining secondary wastewater at the RIX facility for both discharge into the Santa Ana River and conveyance to the Inland Empire Utility Agency service area. The Revised Petition states that the proposed project would result in a change in place of use and purpose of use of up to 31,500 acre-feet (ac-ft) of water annually or 28 million gallons per day (mgd) of the SBMWD's current maximum discharge limit of 44,822 ac-ft annually or 40 mgd. If read correctly, this implies that a maximum of only 13,322 ac-ft of treated wastewater would be available for discharge annually. However, there is insufficient detail in the documents for us to fully understand potential changes to actual discharge regimes; e.g., a comparison of actual discharges and proposed maximum discharge would be helpful and the proportion of secondary wastewater that would be used for irrigation and the proportion of tertiary wastewater that would be either discharged into the Santa Ana River or sold outside of the SBMWD service area were unspecified.

The federally-threatened Santa Ana sucker (*Catostomus santaanae*, "SAS") and least Bell's vireo (*Vireo bellii pusillus*, "LBV") both occur in the vicinity of the RIX facility. Habitat for both of these species is maintained by discharge from the RIX facility outside of the rainy season. During the rainy season, the SBMWD discharges secondary effluent from the SBWRP facility rather than discharging tertiary effluent from the RIX facility. The SAS in particular, is dependent upon discharges from the RIX facility to maintain suitable habitat for spawning and foraging (California Regional Water Quality Control Board 1995, Chadwick & Associates, Inc. 1992). Hence, we are particularly concerned about the potential adverse impacts to these listed species. Critical habitat for the SAS was proposed by our agency on December 9, 2009 (74 FR 65056-65087) and encompasses the reach of the Santa Ana River into which both facilities discharge. Critical habitat for the SAS is anticipated to become final in December of this year. If there is any Federal involvement in the proposed action, impacts to critical habitat as well as to federally-listed species should also be considered pursuant to § 7 the Act.

In the April 2010 Environmental Information for Petitions, the SBMWD states that the proposed actions would not adversely impact fish, wildlife, or riparian habitat (item 10); however, we could find no supporting information and note that the SBMWD states that a new environmental document would be prepared to evaluate the details of this specific project (item 4). If this document has already been prepared, we were unable to locate it. If it has not already been done, we strongly recommend that a thorough environmental review of the proposed action be provided for public comment prior to any action being taken on this Petition. The previously-circulated Program Environmental Impact Reports are outdated; the proposed action differs from the previously-evaluated project proposal and the reduction in wastewater discharge requested in the Revised Petition greatly exceeds that evaluated in the Program Environmental Impact Reports.

The proposed action would also involve the conveyance of wastewater to other off-site facilities. However, no information was provided regarding the methods of conveyance (e.g., use of existing facilities, construction of new or upgraded pipelines, pump stations). Hence, we recommend that further evaluation of this project include details regarding the conveyance of wastewater within and outside of the SBMWD's service area and potential impacts to federally-listed species and/or critical habitats, if any, of this aspect of the proposed program.

We appreciate the opportunity to respond to the Revised Petition. If you should have any comments or questions regarding this information contact Nancy Ferguson of this office at (760) 431-9440, extension 244.

Sincerely,

for Kennon A. Corey
Assistant Field Supervisor

Encl: (1)

Literature Referenced:

California Regional Water Quality Control Board, Santa Ana Region. 1995. Water Quality Control Plan, Santa Ana River Basin (8).

Chadwick & Associates, Inc. 1992. Santa Ana River Use-Attainability Analysis. Volume 2: Aquatic Biology, Habitat, and Toxicity Analysis. Prepared for the Santa Ana Watershed Project Authority, Riverside, California. pp. 111.

cc:
Stacey Aldstadt, San Bernardino Municipal Water Department, San Bernardino, California
M ark Adelson, Regional Water Quality Control Board, Santa Ana Region, Riverside, California
Jeff Brandt, California Department of Fish and Game, Ontario, California

ENCLOSURE

U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road
Carlsbad, California 92008
(760) 431-9440
FAX (760) 431-5902 + 9618

CA Dept. of Fish & Game
4775 Bird Farm Road
Chino Hills, California 91709
(909) 597-4144
FAX (909) 597-0067

In Reply Refer To:
FWS-SB-3061.3

APR 29 2003

Stacey Aldstadt, Deputy General Manager
City of San Bernardino Municipal Water Department
300 North D Street
San Bernardino, California 92418

Re: Comments on the Program Environmental Impact Report for the Regional Rapid Infiltration and Extraction Facility Recycled Water Sales Program - SCH #99101088

Dear Ms. Alstadt:

The U.S. Fish and Wildlife Service (Service) and the California Department of Fish and Game (Department), hereafter collectively referred to as the Wildlife Agencies, offer the following comments and recommendations regarding project-associated biological impacts based on our review of the Programmatic Environmental Impact Report (PEIR) for the Regional Rapid Infiltration and Extraction (RIX) Facility Recycled Water Sales Program (Program). The PEIR proposes to divert up to 25.2 cubic feet per second (cfs) [16.27 million gallons per day (mgd) or 18,000 acre feet per year (afy)] of the RIX facility's current discharge to potential users in San Bernardino, Riverside, and Orange Counties. The proposed diversion is equivalent to approximately 40 percent of maximum discharge (62 cfs) of the RIX facility and approximately 33 to 46 percent of the current discharge (55 to 76 cfs). Your agency states that the Program will ensure that the RIX Facility continues to discharge 40 cfs (25.8 mgd) or discharge a volume equivalent to the volume produced prior to the establishment of RIX Facility operations during spawning period.

The primary concern and mandate of the Service is the protection of public fish and wildlife resources and their habitats. The Service has legal responsibility for the welfare of migratory birds, anadromous fish, and endangered animals and plants occurring in the United States. The Service is also responsible for administering the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

The Department is responding as a Trustee Agency, pursuant to the California Environmental Quality Act (CEQA) Guidelines Section 15386, and as a Responsible Agency regarding any discretionary actions pursuant to CEQA Guidelines Section 15381. The Department as a Trustee Agency has jurisdiction by law over natural resources affected by a project which are held in trust for the people of the State of California. The Department, as a Responsible Agency, is required to actively participate in the CEQA process and review and use the Lead Agency's CEQA

documents when taking any discretionary action (CEQA Guidelines Sec 15096), such as the issuance of a Streambed Alteration Agreement or a California Endangered Species Act (CESA) Incidental Take Permit.

We are concerned that the reduced discharge of effluent and construction activities that may result from the proposed Program may affect the federally endangered Delhi Sands flower-loving fly (*Rhaphiomidas terminatus abdominalis*, "DSF") and the San Bernardino kangaroo rat (*Dipodomys merriami parvus*, "SBKR"), the federally threatened Santa Ana sucker (*Catostomus santaanae*, "sucker") and coastal California gnatcatcher (*Polioptila californica californica*, "gnatcatcher"), the federally and State endangered southwestern willow flycatcher (*Empidonax traillii extimus*, "flycatcher"), the federally and State threatened least Bell's vireo (*Vireo bellii pusillus*, "vireo"), and the State endangered western yellow-billed cuckoo (*Coccyzus americanus occidentalis*, "cuckoo"). The Department is also concerned that the proposed Program will also impact aquatic and sensitive riparian species. Many sensitive species that are listed by the Department as Species of Special Concern are known to occur within the Santa Ana River and may be affected by the project including the Santa Ana sucker, Santa Ana speckled dace (*Rhinichthys osculus*), arroyo chub (*Gila orcutti*), western spadefoot toad (*Scaphiopus hammondii*), southwestern pond turtle (*Clemmys marmorata pallida*), Belding's savannah sparrow (*Passerculus sandwichensis beldingi*), tri-colored blackbird (*Agelaius tricolor*), yellow-breasted chat (*Icteria virens*), white-faced ibis (*Plegadis chihi*), white-tailed kite (*Elanus leucurus*), Swainson's hawk (*Buteo swainsoni*) and ferruginous hawk (*Buteo regalis*).

The Wildlife Agencies are concerned that neither of the options for discharge under the proposed Program will provide sufficient habitat to maintain current populations of the sucker. The Santa Ana River supports habitat for the sucker for approximately 34 miles. For approximately seven to ten of these miles, 80 percent of the water is supplied by discharges from the RIX Facility. Reviewing data from Chadwick Ecological Consultants provided in the PEIR, it appears that suckers were rarely observed before 1998 between the RIX outlet and the Metropolitan Water District (MWD) pipeline in the Santa Ana River (Sites labeled SAR3, SAR4 and SAR5). Since the RIX Facility began discharging in 1996, habitat in this stretch of the Santa Ana River has improved and currently supports a significant population of the sucker. We are concerned that a 40 percent reduction in this discharge could eliminate and/or degrade significant portions of sucker habitat. As stated in the PEIR, data do not exist to determine whether the proposed discharge flow of 40 cfs would be sufficient to maintain the sucker in this stretch of the Santa Ana River. In fact, the survey data for the sucker indicate that water quality and/or discharge quantity, which ranged from 37 to 49 cfs, prior to the establishment of the RIX Facility were insufficient to support sucker populations between the RIX Facility and the downstream MWD pipeline. Maintenance of flow in this area is particularly important because the RIX Facility provides a majority of the flow during the non-rainfall season. Therefore, we recommend that you address the quality and quantity of discharge required to maintain existing habitat for the sucker in a revised PEIR or similar document.

In addition, comparison of 1990 and 2002 aerial photographs indicated that the stream has increased significantly in length during this time because of the development of "meanders" and braided conditions. Therefore, we recommend that you determine, if possible, the minimum flow

volume required to support the sucker within the Santa Ana River between the RIX Facility outlet and the MWD pipeline in a braided river configuration rather than as a straight streambed. We also suggest that you consider potential effects to sucker that may result from decreased water flow such increased parasitic infection, effects from increased water temperature such as subsequent metabolic and behavioral changes, changes in water quality, and changes in predator and prey abundance and behavior, and develop measures to offset these potential impacts.

The PEIR states that your agency will ensure that the RIX Facility continue to discharge 40 cfs during the spawning period. We note that the spawning period for the sucker appears to be variable and spawning has been detected as late as July in recent years in the Santa Ana River. Therefore, any measures designed to protect the spawning period of the sucker should be focused between March 1 and July 30. In addition, the nursery period is especially important to fish as it is often the period when they are most susceptible to injury, starvation, and death. Therefore, it is important to not only address the spawning period to enable reproductive success, it is also important to address the nursery period that occurs from March 15 through October 30 to enable recruitment success.

We are also concerned that the reduction in flow from the RIX Facility may have an adverse effect on the riparian habitat that currently exists within the Santa Ana River upon which several previously listed federally and/or State listed and sensitive species are dependent. We recommend that you provide further clarification as to how discharge from the City of Riverside, City of Corona, and the Inland Empire Utilities Agency would be sufficient to support 6,245 acres of riparian habitat downstream of the Riverside Narrows (as stated on Page 4.7-3). This clarification should provide the assumptions and method of calculation for the analysis for the water consumption needs of riparian vegetation, including: 1) the amount of water that percolates into the underlying aquifer, 2) the depth and volume of the underlying aquifer, 3) the amount of water that is being used by existing vegetation, and 4) the amount of water that is removed due to evaporation. In addition, we recommend that you provide a rationale for the water consumption values used for this analysis (i.e., what is the basis for the 5 percent downward adjustment).

We would also like a similar clarification of the assumptions and calculations used to indicate that the riparian habitat that exists between the RIX Facility and the MWD pipeline would be sustained on the proposed reduced discharges. Vireos have been detected in the vicinity of the MWD pipeline. Although flood control activity likely limits the growth of riparian habitat in some areas, the Martha Mclean Anza Narrows Park immediately upstream of the MWD pipeline supports more than 400 acres of riparian habitat that may be suitable for vireo.

We suggest that you incorporate an adaptive management strategy and long-term monitoring program for the area of the Santa Ana River between the RIX Facility and the MWD pipeline that would include periodic assessments of the amount of riparian habitat, depth of the underlying aquifer, depth of root systems for young and mature vegetation within the River, and vegetation surveys. We also encourage you to work with other water use agencies within the Santa Ana River watershed to implement a similar program downstream of the MWD pipeline.

We also request that an analysis of effects to federally and State listed species that exist within the Santa Ana River floodplain be conducted prior to approval of specific Program-related projects that include ground disturbing activities. These species include the gnatcatcher, DSF, vireo, SBKR, flycatcher, and cuckoo. Each of these species occupy habitats that are adjacent to or within the Santa Ana River and may be affected by projects proposed within or adjacent to their habitats.

The Department is concerned that the cumulative effects analysis was not adequate. On page 3-15 under "Related Projects" the PEIR refers to an application submitted by the Orange County Water District to the State Water Resources Control Board to obtain water rights to the flows of all water reaching Prado Basin. The Department recommends referencing the four pending applications for water rights within the Santa Ana Watershed submitted to the State Water Resources Control Board by the Chino Basin Watermaster, San Bernardino Municipal Water District and Western Municipal Water District, San Bernardino Valley Water Conservation District, and the City of Riverside. The Department recommends the revised PEIR discuss potential cumulative impacts to biological resources that may result from the reduction of water by all reasonably foreseeable actions in the Santa Ana River, including the current water right applications. The Department believes a significant reduction in water in the Santa Ana River will likely have a devastating effect upon existing populations of sensitive fish species.

The Wildlife Agencies are also concerned that the cumulative effect of additional water withdrawals will substantially decrease habitat that supports the sucker, vireo, and flycatcher. The Wildlife Agencies recommend that any proposed projects that will be using a portion of the RIX Facility water currently being discharged be considered in the cumulative effects analysis be included in a revised PEIR.

We encourage your agency to work with other water use agencies within the Santa Ana River watershed to assist in maintaining and restoring habitat for federally and State listed and sensitive species. We look forward to continuing our work with your agency and are available to assist you in addressing project effects to federally and State listed and sensitive species and their habitats. If you have any questions or comments regarding this letter, please contact Lucy Caskey (Service) at (760) 431-9440, extension 249 or Leslie MacNair (Department) at (949) 458-1754.

Sincerely,

for Karen A. Goebel
Assistant Field Supervisor
U. S. Fish and Wildlife Service

Leslie MacNair
Staff Environmental Scientist
Habitat Conservation Planning - Region 6
California Department of Fish and Game

cc: Regional Water Quality Control Board, Santa Ana Region
State Clearinghouse, Sacramento

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State of California
State Water Resources Control Board

DIVISION OF WATER RIGHTS

P.O. Box 2000, Sacramento, CA 95812-2000

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2010 JUN -9 AM 9:

ORIGINAL

PROTEST – APPLICATION

Based on Environmental Considerations, Public Interest, Public Trust, and Other Issues.
(Protests based on INJURY TO PRIOR RIGHTS should be completed on other side of form)

APPLICATION WW0059

1. I, (We) Lisa Belenky, Senior Attorney, Center for Biological Diversity
(Name of Protestant(s))
of 351 California Street, Suite 600, San Francisco, CA 94104, (415) 632-5307 have read carefully a copy
(Mailing address and zip code of protestant(S)) (Telephone Number)
of, or a notice relative to, Application WW0059 of City of San Bernardino Municipal Water Department
(Name of applicant)
to appropriate from change waste water place and purpose of use and reduce discharge to the
(Name of source)
at a point Santa Ana River. The Protested application is a wastewater change petition, seeking to change the place of use, purpose of use, and reduce discharge quantity of treated wastewater.

2. I, (We) protest the above application on:

☑ ENVIRONMENTAL ISSUES, ETC.:
The appropriation will not best conserve the public interest, will have an adverse environmental impact and/or will adversely affect a public trust use of a navigable waterway. *
a. Public interest protests should clearly indicate how the appropriation will affect the public.
b. Environmental protest should identify specific impacts and provide supporting recitals on issues such as: plants, animals or fish affected, erosion, pollution, aesthetics, etc.
c. Public trust protests must identify the navigable waters to be affected and how the project will impact public trust values.
Protests of a general nature (not project specific) or opposed to constitutional or legislated state policy will not be accepted. A request for information or for studies to be conducted is not a protest.

☐ OTHER ISSUES, ETC.:
The appropriation will be contrary to law, will require access rights, will not be in the State Water Resources Control Board's jurisdiction, or concerns other issues.

Facts and, if applicable, points of law which support the foregoing allegations are as follows: The Center for Biological Diversity is concerned that the proposed actions have the potential to significantly impact aquatic and riparian species and habitats including the federally-listed Santa Ana sucker. The Center reserves the right to provide specific facts and points of law to the Board regarding these issues until after environmental review has been prepared and circulated to the public for review.

3. Under what conditions may this protest be disregarded and dismissed?
(Conditions should be a nature that the applicant can address and either accept or submit mitigating measures.)
As the petition states, additional environmental review is needed to fully assess the potential impacts of the petitioned actions on the environment. At this time, the protestant does not have sufficient information to determine the conditions under which this protest could be resolved.

4. A true copy of this protest has been served upon the applicant by mail
(Personally or by mail)

* For the purpose of filing a protest, navigable waters include streams and lakes that may b e seasonally navigable in small recreational watercraft.

Date: June 7, 2010

Notes: Attach supplemental sheets as necessary. Protests must be filed within the time specified in the notice of application

Lisa T. Belenky
Protestant(s) or authorized representative sign here
Lisa Belenky, Senior Attorney, Center for Biological Diversity
Type or print name and title of representative, if applicable
351 California Street, Suite 600
Street address
San Francisco, CA 94104
City and State
(415) 632-5307
Telephone number

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State of California
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under APPLICATION WW0059 of City of San Bernardino Municipal Water Department
State name of petitioner

to appropriate water from Rapid Infiltration and Extraction Facility
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the proposed change/extension will
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Date July 29, 2010

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PRO-PET (1-00)

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PROTEST – (Petitions)

BASED ON INJURY TO VESTED RIGHTS

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my or our

proposed change will result in injury to us as follows: See attachment C
me or us State the injury which will result to you (see NOTE below)

Protestant claims a right to the use of water from the source from which petitioner is diverting, or proposes to divert, which right is based on: See attachment C
Prior to application, notice posted, use begun prior to 12/19/14, riparian claim, or other right

Please provide application, permit or license numbers or statement of diversion and use numbers, which cover your use of water, or state 'none' _____. The extent of present and past use of water by protestant or his predecessors in interest from this source is as follows: See attachment C
State approximate date first use made, amount used, time of year when diversion made, the use to which water is put

Where is YOUR DIVERSION POINT located? _____ ¼ of _____ ¼ of Section _____
Describe location with sufficient accuracy that position thereof relative to that of petitioner may be determined.

T.___, R. ____, ____ B. & M. Is this point downstream from petitioner's point of diversion? YES ○ NO ○
If Yes, explain: _____

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personally or by mail

Date: July 29, 2010

_____
Protestant(s) or Authorized Representative sign here

Protests MUST be filed within the time allowed by the SWRCB as stated in the notice relative to the change or such further time as may be allowed.

(NOTE: Attach supplemental sheets as necessary)

PRO-PET (1-00)

Attachments to Protest by

City of Riverside, San Bernardino Valley Municipal Water District and Western Municipal Water District of Riverside County

Against

WW0059 – Wastewater Change Petition Proposed by City of San Bernardino Municipal Water Department

Attachment A

The proposed petition to change the City of San Bernardino's discharge of treated wastewater into the Santa Ana River will not serve the public interest because it will interfere with the implementation of the *Orange County* Judgment and sound conjunctive management of the Riverside Basin. It will be contrary to law for the same reasons. It will have an adverse impact on the environment because it will reduce flows in the Santa Ana River.

Attachment B

Petitioner must reach an agreement with Protestants City of Riverside, San Bernardino Valley Municipal Water District and Western Municipal Water District of Riverside County to protect those agencies' respective interests. Protestants acknowledge that this Protest will need to be supplemented if those negotiations are not successful and acknowledge that the Petition may need to be modified if those negotiations are successful. Accordingly, Protestants respectfully request that this matter, the consideration of WW0059, be held in abeyance for six months to allow negotiations to be held with Petitioner.

Attachment C

Petitioner's change in the place of use of its wastewater has the potential to injure the water rights of Protestants, which include but are not limited to post-1914 appropriative rights and adjudicated rights to groundwater, and to interfere with a number of different court judgments.

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KDM / KG

State of California

Memorandum

Date: July 22, 2010

To: By Facsimile and U.S. Mail

Ms. Kathleen Groody
Environmental Scientist
Division of Water Rights
State Water Resources Control Board
P.O. Box 2000
Sacramento, CA 95812-2000

From: Mr. Jeff Brandt
Senior Environmental Scientist
Department of Fish and Game
Inland Deserts Region
3602 Inland Empire Blvd., Suite C-220
Ontario, CA 91764

Subject: **(REVISED)** Protest of Wastewater Change Petition WW0059 for the Change of Place of Use, Change of Purpose of Use, and Reduction of Discharge Quantity by the City of San Bernardino Municipal Water Department for its treated wastewater

The Department of Fish and Game ("Department") respectfully submits this protest to the above-referenced petition ("petition") and requests the State Water Resources Control Board ("Board") to accept this protest based on the information provided herein. The Department is filing this protest in its capacity as a trustee agency for the state's fish and wildlife resources under the Fish and Game Code (Fish & G. Code, § 1802) and the California Environmental Quality Act ("CEQA") (Pub. Resources Code, § 21070; Cal. Code Regs., Tit. 14, § 15386). Also, the Department could be required to act as a responsible agency under CEQA if the project will require a streambed alteration agreement under Fish and Game Code Section 1600 *et seq.* and/or take authorization under the California Endangered Species Act ("CESA") (Fish & G. Code, § 2050 *et seq.*).

Summary

The Department is protesting the petition because based on the limited information currently in its possession or control, the changes the petitioner, the City of San Bernardino Municipal Water Department ("SBMWD"), is proposing could adversely affect the fish and wildlife resources identified below. At this time, without more information regarding whether the changes proposed by SBMWD could adversely affect fish and wildlife resources, the Department is unable to determine whether there are any measures that if made conditions of approval by the Board would adequately

protect fish and wildlife resources. In order to make this determination, SBMWD should complete the studies described below as part of a study plan approved by the Department before the Board takes any action on the petition. If the SBMWD is unwilling to do so, the Board should require those studies in accordance with its authority under Water Code sections 1701.1, 1701.2, and 1701.3 and any other applicable authority. Based on the results of those studies, the information in the petition, and any documents SBMWD prepares or has prepared to comply with CEQA, the Department would be able to recommend the Board either that it deny the petition or approve it with specific conditions necessary to protect fish and wildlife resources.

Project Description

SBMWD has petitioned the Board to change the place of use, change the purpose of use, and reduce the quantity of discharge of the SBMWD's tertiary treated wastewater (also referred to as "recycled water") (collectively, "project") from its Rapid Infiltration and Extraction Facility (RIX facility) located at 1990 Agua Mansa Road, Colton, CA. At the present time, the RIX facility discharges 61.9 cfs of tertiary treated wastewater into Rialto Channel, which flows along the northeastern side of the facility and into the Santa Ana River. The changes proposed by SBMWD will reduce the amount of tertiary treated wastewater discharged into Rialto Channel and thus the Santa Ana River by 43.5 cfs (with an annual reduction in discharges of up to 31,500 acre-feet), which will reduce the total discharge from 61.9 cfs to 18.4 cfs. The 43.5 cfs of tertiary treated wastewater that is not discharged into Rialto Channel is proposed to be used for irrigation of 290 acres within the Inland Empire Utilities Agency service area, land within the SBMWD service area, and regional partners west of the RIX facility; and groundwater recharge within the Waterman Basins, East Twin Creek Basins, Devils Canyon Basins, and Sweetwater Basin.

SBMWD is proposing these changes to maximize the use of its recycled water and increase its water supply reliability while decreasing its dependence on imported water supplies.

Basis of Protest

Watershed and habitat protection are vital to the Department's management of California's diverse fish, wildlife, and plant resources.

The Santa Ana River Watershed drains approximately 3,200 square miles and provides habitat for at least 1,400 species of plants, 200 species of birds, 50 species of mammals, 13 species of reptiles, 7 species of amphibians, and 15 species of fish. Rialto Channel is a tributary to the Santa Ana River above Prado Dam. Rialto Channel originates from the San Bernardino County Flood Control District (SBCFCD) Cactus Flood Control Basins located north of North Etiwanda Avenue, east of North Cedar Avenue/North Ayala Drive, south of State Route 210, and west of North Cactus Avenue in the City of Rialto. The Rialto Channel is essentially a continuation of the Cactus

Flood Control Channel, which originates near the City of Fontana and flows south into Cactus Flood Control Basin #5. Rialto Channel flows south from Cactus Flood Control Basin #1 for approximately 5.5 miles to where it meets the Santa Ana River approximately 2 miles north of the San Bernardino County/Riverside County line. The majority of Rialto Channel is concrete-lined. However, from where Rialto Channel crosses under Agua Mansa Road and flows south along the northeastern side of the RIX facility for approximately 0.32 miles, the drainage has a soft bottom and is bounded by earthen material and concrete riprap along the upper portions of its embankments. This section of the channel is vegetated with mature riparian vegetation along both banks, which forms a dense canopy over the channel. The vegetation is dominated by native plant species, including willow (*Salix* spp.), Fremont cottonwood (*Populus fremontii*), and mule fat (*Baccharis salicifolia*). The RIX facility discharges treated wastewater into Rialto Channel immediately south of Agua Mansa Road, which provides a perennial source of water in the vegetated section of the channel extending to the Santa Ana River.

As described above, the section of Rialto Channel downstream of the discharge point to where it meets the Santa Ana River supports mature riparian habitat. This section of Rialto Channel also provides aquatic habitat. The Santa Ana River immediately downstream of the confluence with Rialto Channel supports mature riparian habitat and aquatic habitat as well. Riparian and aquatic habitats within the vegetated section of Rialto Channel, and the Santa Ana River and its tributaries downstream of the confluence with Rialto Channel support several sensitive species listed as threatened or endangered under CESA and the federal Endangered Species Act ("ESA"), and California species of special concern (SSC), including, but not limited to: arroyo chub (*Gila orcutti*), Cooper's hawk (*Accipiter cooperii*), least Bell's vireo (*Vireo bellii pusillus*), Santa Ana sucker (*Catostomus santaanae*), southwestern pond turtle (*Clemmys tigris multiscutatus*), southwestern willow flycatcher (*Empidonax traillii extimus*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), white-tailed kite (*Elanus leucurus*), yellow warbler (*Dendroica petechia*), and yellow-breasted chat (*Icteria virens*).

The streambed of Rialto Channel downstream of the RIX facility discharge point consists mostly of gravel, cobbles, and rocks. This substrate combined with the existing perennial flow in the drainage (as a result of the discharge from RIX) and riparian tree canopy, is regarded by many local experts, including the Department and other resources agencies and conservation entities, as high quality habitat for the Santa Ana sucker (SAS), a federally-listed threatened fish species and state-listed fish species of special concern. In fact, many local experts and surveying agencies consistently report the presence of SAS in Rialto Channel between the discharge point and the confluence with the Santa Ana River. It is assumed that SAS migrate from the Santa Ana River into Rialto Channel for refuge or to spawn because of the quality of habitat present in the drainage. Arroyo chub have also been identified within the aquatic habitat in Rialto Channel and the Santa Ana River downstream.

Rialto Channel below the discharge point and the Santa Ana River downstream of the confluence with Rialto Channel contain riparian habitat that supports several sensitive bird species. SBCFCD has been monitoring the nesting activity and success of least Bell's vireo (LBV) and southwestern willow flycatcher (SWFL), both state- and federally-listed endangered bird species, within the Santa Ana River between the Tippecanoe Avenue overpass in San Bernardino downstream to the San Bernardino/Riverside county line since 2001. During the past several years, SBCFCD has documented numerous LBV territories with successful nesting (i.e., LBV fledglings observed) with the riparian habitat in the Santa Ana River from its confluence with Rialto Channel downstream approximately two miles to the San Bernardino/Riverside County line. During the 2008 nesting season, SBCFCD documented eight LBV territories containing 6 nests with one successful nest yielding two fledglings within the Santa Ana River from its confluence with Rialto Channel to the county line. As of early July 2010, SBCFCD has identified eight LBV territories within the riparian habitat in the Santa Ana River from its confluence with Rialto Channel downstream approximately two miles to the San Bernardino/Riverside County line. One of the eight LBV territories was identified at the confluence of Rialto Channel and the Santa Ana River. SBCFCD has reported at least three successful nests (i.e., LBV fledglings observed) thus far within the eight territories for the 2010 nesting season. The possibility of additional successful nests for the 2010 nesting season is highly likely due to the fact that LBV do not commonly leave their territories until September. For the 2010 nesting season thus far, SBCFCD has also reported observations of two migrant SWFL within the Santa Ana River between the confluence with Rialto Channel and the county line.

The Department is concerned that SBMWD's proposal to reduce the quantity of treated wastewater discharged from the RIX facility to the Rialto Channel from 61.9 cfs to 18.4 cfs will adversely impact the riparian and aquatic habitats present in the Rialto Channel below the discharge point and the Santa Ana River immediately downstream, which consequently may adversely impact the species that are dependent upon those habitats. Specifically, the reduction in discharge quantity of treated wastewater will decrease the amount of water available to sustain both the riparian and aquatic habitats within the Rialto Channel and the Santa Ana River downstream. A reduction in water availability in the aquatic habitat in Rialto Channel and the Santa Ana River downstream may: 1) reduce the quality of the habitat for SAS and other fish that utilize these areas for spawning, rearing, and refuge; and 2) hydrologically disconnect Rialto Channel from the Santa Ana River, ultimately affecting the movement of SAS and other fish from the Santa Ana River into Rialto Channel. A reduction in water availability for the riparian habitat in Rialto Channel and the Santa Ana River downstream may: 1) provide unfavorable hydrological conditions for native plant species in these areas, ultimately reducing the density, quality, and type of riparian habitat available for nesting birds, and fish species seeking canopy cover for spawning, rearing, or refuge; and 2) disconnect the riparian corridor in the Santa Ana River from the riparian corridor in Rialto Channel, ultimately impacting the movement and nesting behaviors of birds, and the movement, spawning, rearing, and refuge behaviors of the SAS and other fish species. Overall, the Department is concerned that the proposed reduction in discharge will reduce or eliminate the riparian and aquatic habitats present within Rialto

Channel below the discharge point and in the Santa Ana River downstream, and ultimately reduce the presence and long-term viability of sensitive species such as LBV and SAS.

SBMWD's petition does not include a hydrologic study, biological report, or other information that identifies and analyzes the impacts that the proposed reduction in discharge will have on the riparian and aquatic habitats within Rialto Channel below the discharge point and the Santa Ana River downstream or the species dependent on these habitats. In addition, SBMWD's petition does not provide a habitat map or plant and animal species compendium for Rialto Channel or the Santa Ana River downstream.

Recommendations

As discussed above, the Department needs more information to determine the impacts the project could have on fish and wildlife resources in the project area. SBMWD stated the following in the *Fish and Wildlife Concerns* section of the petition: "There are no expected adverse impacts to fish, wildlife, or riparian habitat as a result of the implementation of this project". With respect to CEQA, SBMWD stated the following in its petition: "In 2003, the (District) prepared and certified a Program Environmental Impact Report titled 'RIX Facility Recycled Water Sales Program' that evaluated reducing the discharge from the RIX facility to the Santa Ana River, please see Attachment B. The project described in the PEIR is similar to the project described in this Petition for Change; however, there are differences and thus a new environmental document will be prepared to evaluate the details of this specific project." The Department has reviewed Attachment B. The reduction in discharge quantity from the RIX Facility into Rialto Channel as discussed in Attachment B, "RIX Facility Recycled Water Sales Program, Program Environmental Impact Report" dated 2003 (PEIR), is a reduction from 61.9 cfs to a minimum of 38.7 cfs, for a total reduction of 23.2 cfs. In SBMWD's petition, the proposed reduction in discharge quantity is a reduction from 61.9 cfs to 18.4 cfs, for a total reduction of 43.5 cfs. The reduction in discharge quantity proposed by SBMWD in the petition is nearly double that proposed and evaluated in the 2003 PEIR. Thus, as SBMWD stated in the petition, there are "differences" in the two proposals and "new environmental documents should be prepared to evaluate the details of this specific project." Furthermore, the Department does not concur with SBMWD's determination that "there are no expected adverse impacts to fish, wildlife, or riparian habitat as a result of the implementation of this project", as the proposal to reduce the quantity of discharge from the RIX Facility to Rialto Channel from 61.9 cfs to 18.4 cfs has not been evaluated by SBMWD under CEQA.

SBMWD has yet to determine whether the reduction in discharge quantity of tertiary treated wastewater from the RIX facility to Rialto Channel will have an adverse affect on biological resources. In short, the information on the project's potential impacts to fish and wildlife resources currently in the possession and control of the Department is very limited at this time. As a result, at this time, the Department cannot

identify specific terms and conditions to dismiss this protest. However, the Department can recommend studies SBMWD should complete (perhaps as part of its analysis of the project under CEQA) that will generate information sufficient for the Department to recommend specific terms and conditions to protect fish and wildlife resources. Further, SBMWD is or could be required to undertake those studies (described below under "Study Plan") under Water Code sections 1701.1, 1701.2, and 1701.3. In the meantime, the Board should not take any action to approve or otherwise act on SBMWD's petition.

Study Plan

Where a project could affect the hydrologic regime of a watershed, the necessary elements to successfully maintain the downstream biological diversity needs to be identified to facilitate sound management decisions. Based on the general information SBMWD provided, a site-specific study to determine appropriate flow-related terms and conditions is needed. The study plan should include, at a minimum, the following:

1. Identification of minimum flows necessary to maintain the health and perpetuation of aquatic resources in Rialto Channel below the discharge point and the Santa Ana River downstream.

2. A hydrologic study to determine if the production of the watershed is sufficient to reduce the discharge flows as proposed without having significant adverse impacts to riparian and aquatic resources of Rialto Channel and the Santa Ana River downstream.

3. A habitat-based stream needs assessment that incorporates habitat, species, and life history criteria specific to Rialto Channel and the Santa Ana River downstream.

4. A complete updated (within the last two years) assessment of the flora and fauna within, adjacent to, and downstream of Rialto Channel, with particular emphasis on identifying endangered, threatened, and sensitive species and sensitive habitats, which includes protocol surveys (United States Fish and Wildlife Service and/or Department protocols) for the presence of threatened or endangered plant and animal species and species of special concern conducted on the entire project site, places of discharge (including downstream reaches affected by the discharge), and places of use. The Department's California Natural Diversity Data Base ("CNDDB") in Sacramento should be contacted at (916) 327-5960 to obtain current information on any previously reported sensitive species and habitat, including Significant Natural Areas identified under Chapter 12 in the Fish and Game Code. (The Department notes that the CNDDB may have limited data for the project area, but any lack of data does not mean that sensitive resources do not occur in the project area.)

5. A quantification of the loss of biological resources that will occur as a result of the reduction of discharge in Rialto Channel and the Santa Ana River downstream and

an evaluation of the impacts to resources based on the proposed amount of water flow that will be present as a result of the reduction of discharge. The CEQA document should contain a thorough discussion of direct, indirect, and cumulative impacts expected to adversely affect biological resources, with specific measures to offset such impacts. Project impacts should be analyzed relative to their effects on offsite habitats. Specifically, this should include nearby rivers, streams, or lakes located downstream of the project (including the entire floodplain for the waterway), public lands, open space, mitigation sites, adjacent natural habitats, and riparian ecosystems. Impacts to and maintenance of wildlife corridor/movement areas, including access to undisturbed habitat in adjacent areas, should be fully evaluated and provided.

6. A specific proposal to provide minimum flows in Rialto Channel for maintenance of any existing riparian and aquatic habitat, fish, and wildlife resources.

7. A mitigation plan to replace lost plant, fish, and/or wildlife resources including, but not limited to, the species or habitats described above and in the CNDDB. This plan must include a survey which quantifies the loss of resources that will occur as a result of this project. It must also specify measures that will be taken to offset impacts to resources and outline specific mitigation and monitoring programs.

If after the Department receives the above-described information it can identify terms and conditions that if adopted by the Board as enforceable conditions of petition approval will mitigate any adverse impacts the project could have on habitat and fish and wildlife resources, it will recommend those to SBMWD and the Board. For example, such terms and conditions might include, but not be limited to, the following:

1. Maintain sufficient quantity and quality of flow in Rialto Channel to ensure the unimpeded passage of fish from the Santa Ana River upstream to Rialto Channel and to maintain in good condition any riparian and aquatic resources that are likely to exist in the Santa Ana River downstream under current flows.

2. Implement Department-approved mitigation plans.

3. Allow access for Department personnel to monitor compliance with Department- and Board-imposed terms and conditions.

4. Require SBMWD to notify the Department and, if necessary, obtain a streambed alteration agreement pursuant to Fish and Game Code Section 1600 *et seq.* for the proposed reduction in flow in Rialto Channel.

5. Require SBMWD to obtain take authorization under CESA if the proposed reduction in flow in Rialto Channel could result in "take" of CESA-listed species.

The Department will be serving SBMWD a copy of this protest by mailing a duplicate copy to SBMWD, in accordance with Water Code section 1703.2, subdivision (e).

If you have any questions regarding this protest, please contact Ms. Anna Milloy, Environmental Scientist, by telephone at (909) 987-8176, by email at amilloy@dfg.ca.gov, or by mail at the above letterhead address.

cc: Ms. Stacy R. Aldstadt
Deputy General Manager
City of San Bernardino Municipal Water Department
300 N. D. Street, 5th Floor
San Bernardino, CA 92418

Ms. Anna Milloy, Ontario; Mr. Jeff Brandt, Ontario
Department of Fish and Game

Ms. Nancy Ferguson
U.S. Fish and Wildlife Service, Carlsbad

Mr. Lee Reader
Santa Ana Watershed Association

Ms. Shelli Lamb
Riverside-Corona Resource Conservation District

10.2.3 Memorandum of Understanding Regarding the Resolution of Protests to Wastewater Change Petition WW0059

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Memorandum of Understanding
Regarding the Resolution of Protests to
Wastewater Change Petition WW0059

This Memorandum of Understanding ("MOU") is made and entered into on February 22, 2011 ("Effective Date"), by and between the City of San Bernardino Municipal Water Department (the "Department"), the City of Riverside, through its Public Utilities Department ("Riverside"), San Bernardino Valley Municipal Water District ("Valley District"), and Western Municipal Water District of Riverside County ("Western"). Each of the Parties to this MOU is hereinafter sometimes referred to as a "Party" and are collectively referred to as the "Parties."

Recitals

A. On April 23, 2010, the Department filed a Petition for Change regarding treated wastewater with the State Water Resources Control Board ("SWRCB") pursuant to Water Code section 1211. The SWRCB accepted and noticed the City's petition as Wastewater Change Petition WW0059 (the "Petition").

B. On or about July 29, 2010, Riverside, Valley District and Western (collectively "Protestants") filed a protest with the SWRCB alleging that the Petition infringed upon prior vested rights and was not in the public interest.

C. Department and Protestants wish to cooperate to: (1) explore and pursue potential opportunities to jointly plan, permit, design, construct, and operate the Department's proposed "Clean Water Factory – San Bernardino" (the "Project") at the earliest possible time and at the least possible cost to the public; and (2) allow for the Project to retain the greatest possible quantity of treated wastewater in the San Bernardino Basin Area ("SBBA").

D. The Parties wish to memorialize their mutual understandings and agreements in this MOU so as to provide a firm foundation for future cooperation, and to allow Protestants to withdraw their protests to the Petition.

NOW, THEREFORE, in consideration of the foregoing Recitals and the mutual covenants and conditions contained herein, the parties agree as follows:

1. It is the intent of the Parties to develop a cooperative and collaborative arrangement that will: (i) enable the Parties to jointly plan, design, permit, construct and operate the Project for water conservation purposes pursuant to the water conservation provisions of the 1969 *Orange County* Judgment; and (ii) consistent with that intent, reduce the

discharge of treated wastewater into the Santa Ana River to the greatest extent possible so as to replenish the SBBA and/or provide water for direct use.

2. The Parties shall immediately commence good faith discussions to explore and pursue potential opportunities to jointly plan, design, permit, construct and operate the Project at the earliest possible time and at the least possible cost to the public. These potential opportunities shall include, but shall not be limited to, the formation of a joint powers authority and/or development and execution of a joint exercise of powers agreement wherein the Parties would specify their respective rights, obligations, duties and liabilities related to jointly planning, designing, permitting, constructing, and operating the Project. Specifically, the Parties agree to the following framework principles:

   a. The 1969 agreement between Valley District and the Department will remain in full force and effect until and unless Valley District and all of the other Parties execute a written agreement establishing an alternative way for Valley District to meet its obligations under the 1969 *Orange County* Judgment. The Parties will immediately begin discussions aimed at developing such an alternative that will enable greater quantities of treated wastewater to be used within the SBBA or to replenish the SBBA.

   b. No wastewater treated by the Department shall be sold or delivered, directly or via an exchange/transfer, outside the boundaries of the Santa Ana River watershed, as defined in the *Orange County* Judgment.

   c. No wastewater treated by the Department shall be sold or delivered, directly or via an exchange/transfer within the boundaries of the Santa Ana River watershed as defined in the *Orange County* Judgment but outside the SBBA without the prior written consent of all of the Parties.

3. The Parties agree to comply with the framework principles set forth above, regardless of whether the Parties are able to reach agreement on how to jointly plan, design, permit, construct and operate the Project.

4. Not later than ten business days after the effective date of this MOU, the Protestants shall file with the SWRCB a letter, in substantially the form attached hereto as Appendix __, withdrawing their respective protests to the Petition, and supporting the SWRCB's granting of the Petition.

5. This MOU shall not operate to validate or invalidate, modify or affect any Party's water rights. Each Party to this MOU reserves any and all claims and causes of action respecting its water rights claims, any and all defenses against any water rights claims made by any other entity, and any claims arising from contamination or water quality degradation. Further nothing

in this MOU is intended to modify or affect in any way any prior agreements or judgments affecting the Parties, save as expressly stated in this MOU.

IN WITNESS WHEREOF, the parties hereto have executed this MOU as of the day and year first written above.

CITY OF RIVERSIDE, a California
charter city and municipal corporation

By: _____
City Manager

Attest: _____
City Clerk

Approved as to Form:

By: _____
Deputy City Attorney

CITY OF SAN BERNARDINO MUNICIPAL
WATER DEPARTMENT

By: Toni Callicott, President
Board of Water Commissioners

in this MOU is intended to modify or affect in any way any prior agreements or judgments affecting the Parties, save as expressly stated in this MOU.

IN WITNESS WHEREOF, the parties hereto have executed this MOU as of the day and year first written above.

CITY OF RIVERSIDE, a California
charter city and municipal corporation

By: _____
City Manager

Attest: _____
City Clerk

Approved as to Form:

By: _____
Deputy City Attorney

CITY OF SAN BERNARDINO MUNICIPAL
WATER DEPARTMENT

Stacy Aldstadt for

By: Toni Callicott, President
Board of Water Commissioners

SAN BERNARDINO VALLEY MUNICIPAL
WATER DISTRICT

By: C. Patrick Milligan, President
Board of Directors

WESTERN MUNICIPAL WATER DISTRICT
OF RIVERSIDE COUNTY

By: Brenda Dennstedt, President
Board of Directors

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10.2.4 Preliminary Design Report

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CITY OF SAN BERNARDINO
MUNICIPAL WATER DEPARTMENT

Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

SUMMARY REPORT

RBF Consulting
14725 Alton Parkway
Irvine, California 92618

Black & Veatch
15615 Alton Parkway
Irvine, California 92618

July 2012

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CLEAN WATER FACTORY
RECYCLED/ADVANCED WATER CONVEYANCE SYSTEM

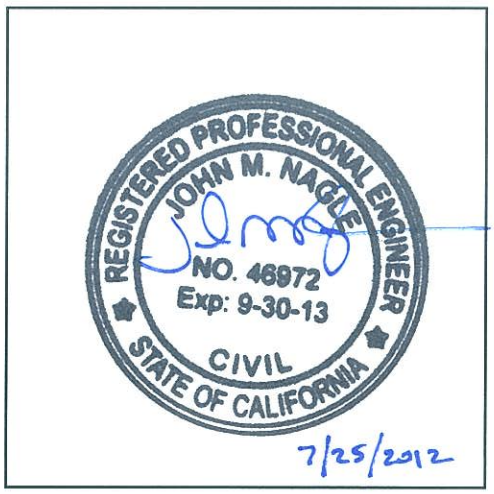
Engineering Analysis Summary Report

CITY OF SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

General Manager:	Stacey Aldstadt
Engineering Manager:	Greg Gage
Director of Water Reclamation:	John Claus
Director, Water Utility:	Matt Litchfield, P.E.

ENGINEERING TEAM

Principal Engineer:	Michael P. Rudinica, P.E., RBF Consulting
Lead Engineer:	Steven N. Foellmi, P.E., Black & Veatch
Project Engineers:	Timothy M. Smith, P.E., Black & Veatch
	John M. Nagle, P.E., RBF Consulting
	David A. Cover, P.E., Black & Veatch
	Sam V. Valdez, P.E., RBF Consulting



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EXECUTIVE SUMMARY

The City of San Bernardino Municipal Water Department (SBMWD) is evaluating the feasibility of the Clean Water Factory (CWF) Project. This Summary Report (Report) provides the basis for overall evaluation of the CWF recycled/advanced water conveyance system engineering analysis including conveyance facility requirements and potential recycled water customers. The data herein will be used in the development of the CWF Project Environmental Impact Report (EIR)/Environmental Impact Statement (EIS).

This summary gives a brief overview of the information presented in the Report.

- **Background Information (Section 1).** This section describes the findings and conclusions of a Recycled Water Planning Investigation Report (Recycled Water Report) prepared for SBMWD in 2010 and the applicability to the currently defined CWF Project. Also provided are brief descriptions of the Bunker Hill Groundwater Basin, a discussion of the on-going environmental documentation, definition of conveyance system terminology, and a list of abbreviations and acronyms used in this Report.

- **Existing Facilities (Section 2).** This section describes the major existing facilities within the area impacted by the proposed CWF Project: the San Bernardino Water Reclamation Plant (SBWRP), the Rapid Injection and Extraction Facility (RIX), and the Waterman Basins/East Twin Creek Spreading Grounds collectively known as the Recharge Basins.

- **Proposed Facilities (Section 3).** Six Conveyance Scenarios were developed to analyze possible configurations of conveyance facilities for the CWF Project. This section gives a brief description of each scenario, including pipelines, pump stations, storage reservoirs, and associated facilities required. A schematic is developed for each scenario.

- **Potential Direct Use Customers and Recycled Water Demands (Section 4).** The Recycled Water Report identified 19 potential irrigation customers. This section expands the list of potential direct use customers to 60 and calculates estimated recycled water demands. Water demand factors are presented for each land use category: golf courses, parks, schools, nursery, cemeteries, public use, and Caltrans. Maps are developed indicating potential recycled water customers in proximity to potential CWF Project facilities.

- **Preliminary Facility Sizing (Section 5).** This section presents preliminary sizing for recycled water and advanced treated water facilities including transmission pipelines, pump stations, and storage reservoirs. General criteria are described, followed by criteria for the six Conveyance Scenarios developed in Section 3.

- **Preliminary Hydraulic Analysis (Section 6).** This section presents a hydraulic analysis conducted to evaluate pressures, total head loss, and pumping requirements for the

various alignment options for the six Conveyance Scenarios. Hydraulic profiles are presented using the criteria described in Section 5.

- **Facility Requirements (Section 7).** To assist the SBMWD in determining facility space and land acquisition requirements, this section develops typical site layouts for a reservoir site, a pump station site, and a site which combines both facilities.

- **Pipeline Alignment Analysis (Section 8).** This section presents a Conveyance Facility Corridor that provides a relatively direct route from the SBWRP to the Recharge Basins. Four preferred Alignment Options are developed using criteria described in Section 5. Evaluation criteria are developed and each alignment option is rated and ranked. Cost estimates for the four Alignment Options are also presented.

- **Pump Station/Storage Reservoir Analysis (Section 9).** This section presents an analysis to evaluate seven potential Pump Station/Storage Reservoir Sites within the Conveyance Facility Corridor. Typical site requirements are identified and layouts are presented for each potential site. Facility power requirements are determined and connections to existing power lines are identified. Results are presented from an evaluation of the preferred Pump Station/Storage Reservoir Sites considering evaluation factors and rating and ranking each site. Cost estimates for the seven Pump Station/Storage Reservoir Site options are also presented.

- **Conveyance System Scenarios (Section 10).** The overall analysis of six potential Conveyance Scenarios with various configurations of pipelines and Pump Station/Storage Reservoir Sites within a Conveyance Facility Corridor between the SBWRP and the Recharge Basins is presented. Results are presented from an evaluation of the Conveyance Scenarios considering evaluation factors and rating and ranking each scenario. Cost estimates for the six Conveyance Scenarios are presented including cost per acre-foot.

- **Conclusion (Section 11).** Conclusions are presented for the comprehensive feasibility-level analysis of conveyance facilities associated with the CWF Project that will be used in the development of the project's EIR/EIS.

- **Appendix A through F.** Supporting information is presented on Potential Direct Use Areas, Conveyance Scenario Pipeline Lengths, Preliminary Hydraulic Analysis, Pump Station and Storage Reservoir Information, Cost Estimates, Distribution Pipelines, and Pipeline Separation Standards.

1.0 BACKGROUND INFORMATION

This section summarizes the findings and conclusions of the 2010 Recycled Water Report and the applicability to the currently defined CWF Project. This section also describes the location and water quality objectives of the Bunker Hill Groundwater Basin (Bunker Hill Basin), discusses environmental documentation, defines conveyance system terminology, and lists abbreviations and acronyms used herein.

1.1 PLANNING INVESTIGATION REPORT (WILDERMUTH)

In November 2010, a Recycled Water Planning Investigation Report (Recycled Water Report) was prepared by Wildermuth Environmental, Inc. (Wildermuth) for the SBMWD. This document was prepared to determine the feasibility of using recycled and advanced treated water to augment SBMWD's water supply. The overall location of the CWF and related facilities developed in the Recycled Water Report are shown on Figure 1-1 and the San Bernardino Basin Area is shown on Figure 1-2.

The SBMWD's water supply is entirely from the Bunker Hill Basin. Water availability has been affected by the extended drought in California, water supply constraints from State Water Project (SWP) facilities that are used by the San Bernardino Valley Municipal Water District (Valley District) to recharge the Bunker Hill Basin, and groundwater supply use. The SBMWD is required to reduce per capita water demands to be in compliance with Senate Bill SBX-7 (10 percent reduction in per capita water demands by 2015 and 20 percent by 2020). The SBMWD is developing solutions to meet its future water needs, including using recycled water for delivery to recycled water customers and recharging the Bunker Hill Basin with recycled and/or advanced treated water.

Addition of tertiary and advanced treatment processes at the SBMWD's existing San Bernardino Water Reclamation Plant (SBWRP) was evaluated to provide additional recycled water and/or advanced treated water.[1] The SBWRP currently treats 22 million gallons per day (mgd) to secondary treatment standards, which are conveyed via a pipeline to the Rapid Infiltration and Extraction (RIX) Facility for tertiary treatment and discharge to the Santa Ana River. The SBWRP has a rated capacity of 33 mgd with projected treatment demands of up to 35 mgd by the year 2030 requiring some expansion. Secondary treated water at the SBWRP could be treated to the tertiary level using conventional filtration and disinfection processes, including chlorination or ultraviolet (UV), and then delivered to potential recycled water customers for

[1] The terms recycled water and advanced treated water are used in this Summary Report. Recycled or tertiary treated water refers to water treated to Title 22 standards for use in non-potable application such as irrigation and industrial uses, Recycled or tertiary water is also known as disinfected secondary-2.2 recycled water or Non-Potable Reuse (NPR) water or direct use water. Advanced treated water refers to water treated using advanced treatment processes including MBR, MF, UF, NF, RO, AOP, and/or other treatment technology to produce nearly pure water meeting California Department of Public Health standards. Advanced water is also known as Indirect Potable Reuse (IPR) water that utilizes a natural environmental barrier (i.e. groundwater basin) prior to use as a drinking water source.

irrigation and uses at the SBWRP. Advanced treatment processes could include various combinations of methods, including Membrane Bioreactor (MBR), Micro Filtration/Ultrafiltration (MF/UF), Nano Filtration (NF), Reverse Osmosis (RO), and Advanced Oxidation Process (AOP). The treated water could then be delivered to recycled water customers and/or for groundwater recharge. Groundwater recharge is proposed at the existing Recharge Basins, which are owned and operated by the San Bernardino County Flood Control District (SBCFCD).

The Recycled Water Report indicated that previous studies have shown that recycled water distribution throughout the SBMWD's service area is not economically feasible. However, recycled water service could be delivered economically near the SBWRP and along a defined pipeline corridor to nearby potential recycled water customers. The SBMWD had already identified recycled water customers with up to 800 acre-feet per year (0.71 mgd) Average Day Demand (ADD) near the SBWRP and planned to provide recycled water service as part of their Master Plan. The Recycled Water Report identified up to 2.1 mgd (ADD) near the SBWRP and up to 0.7 mgd (ADD) of recycled water demand along a defined pipeline corridor. An additional 1.3 mgd (ADD) of recycled water demand along the defined pipeline corridor was defined as part of this engineering study (total of 2.0 mgd to northern customers).

Advanced treated water could be utilized to deliver water to recycled water customers and/or for groundwater recharge. The Recycled Water Report identified up to 18.2 mgd of advanced water treatment at the SBWRP with 14.2 mgd of product water (considering 92 percent recovery through MF and 85 percent recovery through RO) for groundwater recharge at the existing Recharge Basins. The capacity is limited by production of concentrated brine from the advanced water treatment process (RO or NF) at approximately 15 percent (or 2.5 mgd) which is conveyed by the Inland Empire Brine Line (IEBL) connection at the SBWRP. The SBMWD has a contractual discharge capacity of 2.5 mgd in the IEBL. Improved recovery of product water by different treatment processes could reduce the concentrated brine and/or increase product water available for recharge.

Current California Department of Public Health (CDPH) draft Groundwater Replenishment Reuse regulations (November 21, 2011) allow surface application of advanced treated water for groundwater replenishment without defined dilution. Prior draft regulations required 50 percent advanced treated water to 50 percent dilution water, but operating facilities have increased up to 75 percent advanced treated water or higher. These new regulations allow for the potential ultimate groundwater recharge of 14.2 mgd of advanced treated water at the existing Recharge Basins without dilution.

Current CDPH draft Groundwater Replenishment Reuse regulations (November 21, 2011) also allow surface application of tertiary treated water for groundwater replenishment with substantial dilution (20 percent tertiary to 80 percent dilution water), which increase the potential tertiary water use by up to 5 mgd for recharge at the existing Recharge Basins. A summary of the key parameters is provided in Table 1-1.

Table 1-1
Key Parameters

Facility	Description	Criteria
SBWRP	Existing Rated Capacity	33 mgd
	Current Treatment	Secondary
	Current Operation	22 mgd
IEBL	Existing Contractual Discharge Capacity (SBMWD)	2.5 mgd
RIX	Existing Rated Capacity	40 mgd
	Current Treatment	Tertiary
	Current Operation	36 mgd
Recycled Customers	Northern (ADD)	2.0 mgd
	At SBWRP and Southern (ADD)	2.1 mgd
Advanced Treatment*	Secondary Effluent	18.2 mgd
	Microfiltration (92% recovery)	16.7 mgd
	Reverse Osmosis (85% recovery)	14.2 mgd
	Brine Waste (to IEBL)	2.5 mgd
	Advanced Treated Water	14.2 mgd
Recharge	Recycled Water/Diluent Water	20%/80%
	Advanced Water/Diluent Water	Per CDPH Prior Standard 50%/50% Potential 100%/0%
* Criteria for MF/RO/AOP Advanced Treatment. Other treatment scenarios are being evaluated.		

1.2 BUNKER HILL GROUNDWATER BASIN

The Bunker Hill Basin is comprised of the Bunker Hill-A and Bunker Hill-B Management Zones as defined by the Regional Water Quality Control Board (RWQCB). Figure 1-3 shows the location and water quality objectives of the basins in proximity to the CWF Project as developed by the Recycled Water Report. Water quality objectives set by the Santa Ana RWQCB are listed below:

- Bunker Hill-A Management Zone – location of recycled water northern customers. Basin objectives for total dissolved solids (TDS) = 310 milligrams per liter (mg/L); Nitrate = 2.7 mg/L (basin has no assimilative capacity, existing TDS = 330 mg/L; Nitrate = 4.0 mg/L).

- Bunker Hill-B Management Zone – location of recycled water customers near SBWRP. Basin objectives for TDS = 330 mg/L; Nitrate = 7.3 mg/L (basin has assimilative capacity, existing TDS = 280 mg/L; Nitrate = 5.4 mg/L).

The CWF Project proposes tertiary and/or advanced treated water delivery to recycled water customers and groundwater recharge. The water quality objectives of the Bunker Hill-A Management Zone could limit the overall recycled water/advanced treated water use. An evaluation was included in the Recycled Water Report that demonstrated water quality objectives would be met with the flow rates proposed in the Recycled Water Report. The basin objectives were re-evaluated with the proposed flow rates presented in this Summary Report based on the new draft CDPH regulations. The addition of 2 mgd of recycled water for direct use customers and 5 mgd of recycled water for groundwater recharge combined with advanced treated water and State Project Water (SPW) dilution met the water quality objectives (Combined water TDS = 233 mg/L; Nitrate = 2.45). Storm water was not considered for dilution to meet the basin objectives since it is not new water. The dilution water low TDS and nitrate blends with the recycled water with higher TDS and nitrate to meet the basin objectives.

The water quality objectives of the Bunker Hill-B Management Zone using 2.1 mgd (ADD) are expected to be met considering the assimilative capacity of the basin. The assimilative capacity is the ability of the basin to receive groundwater recharge with water constituent (TDS and nitrate) amounts greater than the specified basin objective because the current constituent amounts in the basin are currently below the basin objectives. For the Bunker Hill-B Management Zone, it is expected that with the addition of the 2.1 mgd for direct use customers, the basin objectives will still be met. The Santa Ana River RWQCB may permit groundwater recharge at concentrations higher than the basin objectives if assimilative capacity exists.

1.3 ENVIRONMENTAL IMPACT REPORT/ENVIRONMENTAL IMPACT STUDY

RBF Consulting (RBF) is preparing an environmental document for the CWF Project. The document addresses potential environmental impacts represented by the project in accordance with Federal and State law. RBF's approach to the document is to combine the expertise of planning disciplines with engineering review to establish the best viable alternatives and to eliminate elements of the project that are technically infeasible. The approach also uses prior studies and technical reports as much as practicable to present a comprehensive, cost effective analysis.

Because a Federal nexus has been identified, RBF is preparing a combined National Environmental Policy Act (NEPA)/California Environmental Quality Act (CEQA) document for the CWF Project. The combined EIR/EIS will address potential impacts that may result from implementation of the CWF Project. Critical elements include analysis pertaining to redirection of some, or all, of the current discharge to the Santa Ana River, new conveyance and treatment systems, and the effects represented by adding substantial amounts of recycled water and advanced treated water to the upper groundwater basins. All reasonable alternatives to the project will be analyzed pursuant to NEPA requirements.

The environmental document is expected to be completed in the summer of 2013.

To provide sufficient detail on the required conveyance system for the CWF Project EIR/EIS, RBF in association with Black & Veatch is preparing supplemental information on the Conveyance System. This Report identifies conveyance system facility requirements and potential recycled water customers.

1.4 CONVEYANCE SYSTEM TERMINOLOGY

Certain terminology, defined below, is used throughout this Report. These terms were selected to facilitate the presentation of the project description.

Conveyance System – The portion of the CWF Project that includes the facilities required to transport treated water from the SBWRP to the Recharge Basins.

Conveyance Facility – An individual facility, such as a pump station, transmission pipeline or storage reservoir. The Conveyance Facilities, in aggregate, make up the Conveyance System.

Conveyance Facility Corridor – A general term used to describe the study area between the SBWRP and the Recharge Basins in which conveyance facilities will potentially be located.

Conveyance Scenarios – Several configurations (referred to as scenarios) are possible for the Conveyance System. These depend on the use of single or dual transmission pipelines, single-lift or two-lift pumping, or the remote location for the advanced water treatment facilities. Six Conveyance Scenarios are identified and analyzed in this Report.

Alignment Options – Within the Conveyance Facility Corridor, there are numerous potential alignments in which to locate transmission pipelines. Four specific Alignment Options are presented in this Report. Conveyance Scenarios and Alignment Options are independent of each other, i.e., any of the four Alignment Options can be applied to any of the six Conveyance Scenarios.

Site Options – Within the Conveyance Facility Corridor, there are numerous potential locations for siting intermediate pump stations and storage facilities. Similar to Alignment Options, specific Site Options can be applied to different Conveyance Scenarios.

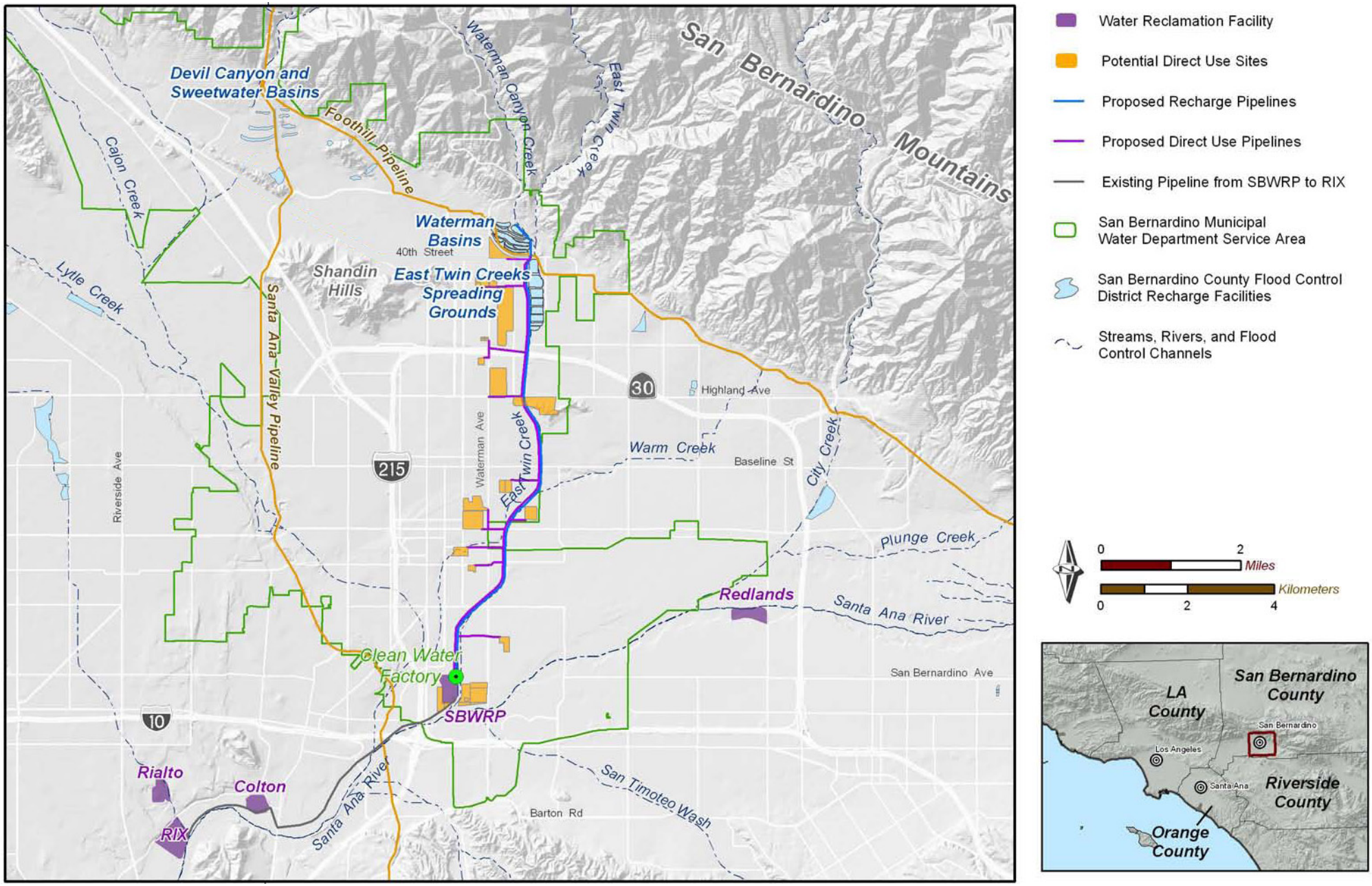
1.5 ABBREVIATIONS AND ACRONYMS

The following abbreviations and acronyms are used in this Report.

AACEI	Association for the Advancement of Cost Engineering International
ABND	abandoned
ADD	average day demand
AFY	acre-feet per year
ALT	alternative
amsl	above mean sea level
AOP	advanced oxidation processes
avg	average
AW	advanced water
AWWA	American Water Works Association
BNSF	Burlington Northern Santa Fe Railway Company
Caltrans	California Department of Transportation
CCI	Construction Cost Index
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
City	City of San Bernardino
CL, ℄	centerline
CMU	concrete masonry unit
CONC	concrete
CWF	Clean Water Factory
DW	domestic water
dwg	drawing
E	east
E/O	east of
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ELEC	electrical
ENR	Engineering News Record
EX	existing
FO	fiber optic
fps	feet per second
G	gas
gpm	gallons per minute
HDPE	high-density polyethylene

HP	high pressure
HWY	highway
IEBL	Inland Empire Brine Line
INV	invert
IPR	indirect potable reuse
L	long
LF	linear foot/feet
LN	lane
max	maximum
MBR	membrane bioreactor
MDD	maximum day demand
MF/UF	microfiltration/ultrafiltration
mg/L	milligrams per liter
mgd	million gallons per day
min	minimum
MMD	maximum month demand
N	north
N/O	north of
NEPA	National Environmental Policy Act
NF	nanofiltration
NPR	non-potable reuse
O&M	operation and maintenance
PHD	peak hour demand
PRV	pressure regulating valve
psi	pounds per square inch
R/R	railroad
R/W, RW, ROW	right-of-way
RCP	reinforced concrete pipe
RD	road
Recharge Basins	Waterman Basins and East Twin Creek Spreading Grounds
RIX	Rapid Infiltration and Extraction
RO	reverse osmosis
RW	recycled water
RWQCB	Regional Water Quality Control Board
S	south
S/O	south of
SANBAG	San Bernardino Association of Governments
SBCFCD	San Bernardino County Flood Control District
SBMWD	City of San Bernardino Municipal Water Department
SBWRP	San Bernardino Water Reclamation Plant
SCE	Southern California Edison
SD	storm drain
SPW	State Project Water

SS	sanitary sewer
ST	street
SWP	State Water Project
TDH	total dynamic head
TDS	Total Dissolved Solids
TELE	telephone
UV	ultraviolet
Valley District	San Bernardino Valley Municipal Water District
VFD	variable frequency drive
W	west
W/O	west of



SOURCE: SBMWD Recycled Water Planning Investigation Report (Wildermuth - November 2010)

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Location of Clean Water Factory and Related Facilities

Figure 1-1

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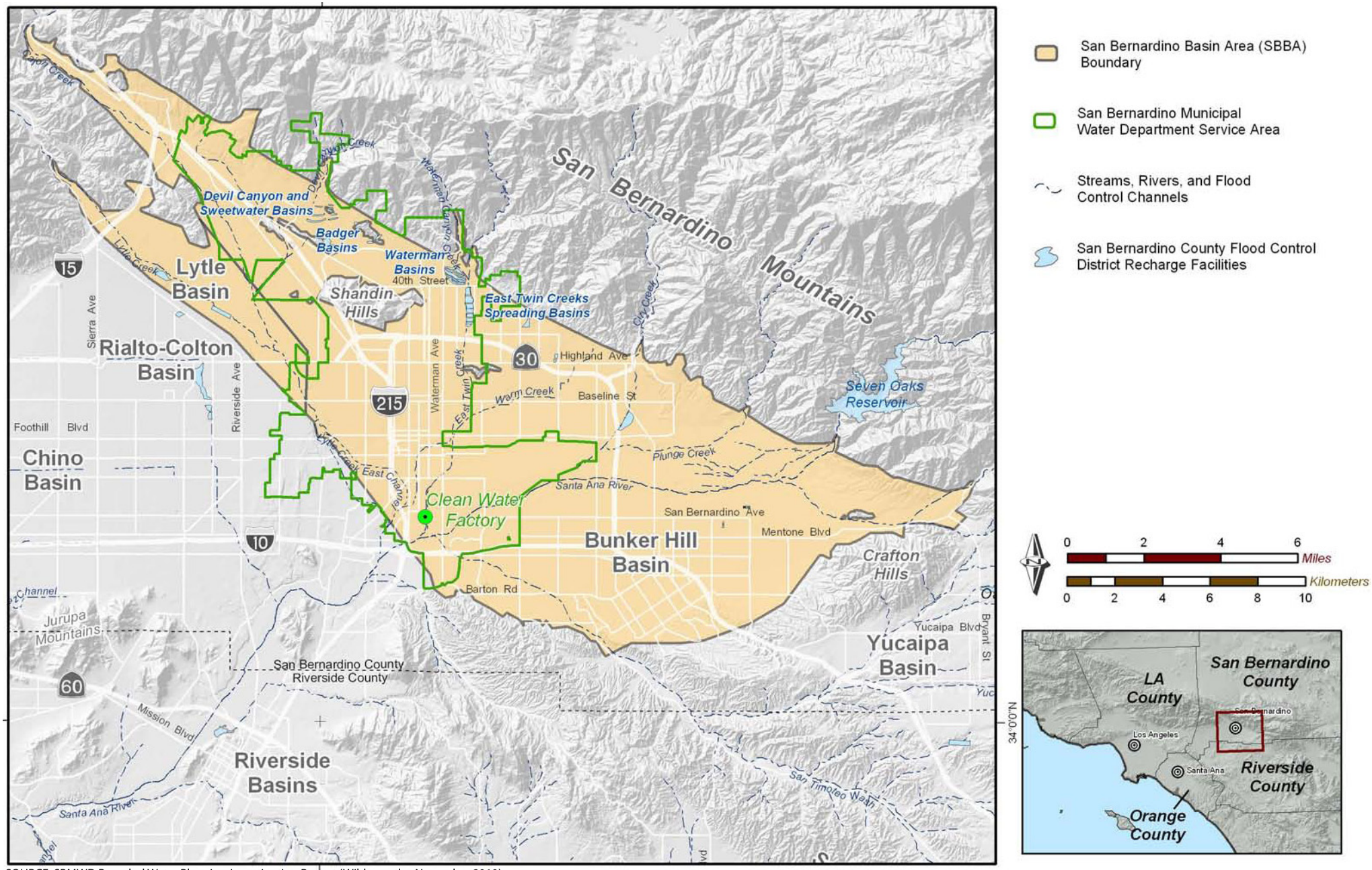

SOURCE: SBMWD Recycled Water Planning Investigation Report (Wildermuth - November 2010)

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San Bernardino Basin Area

Figure 1-2

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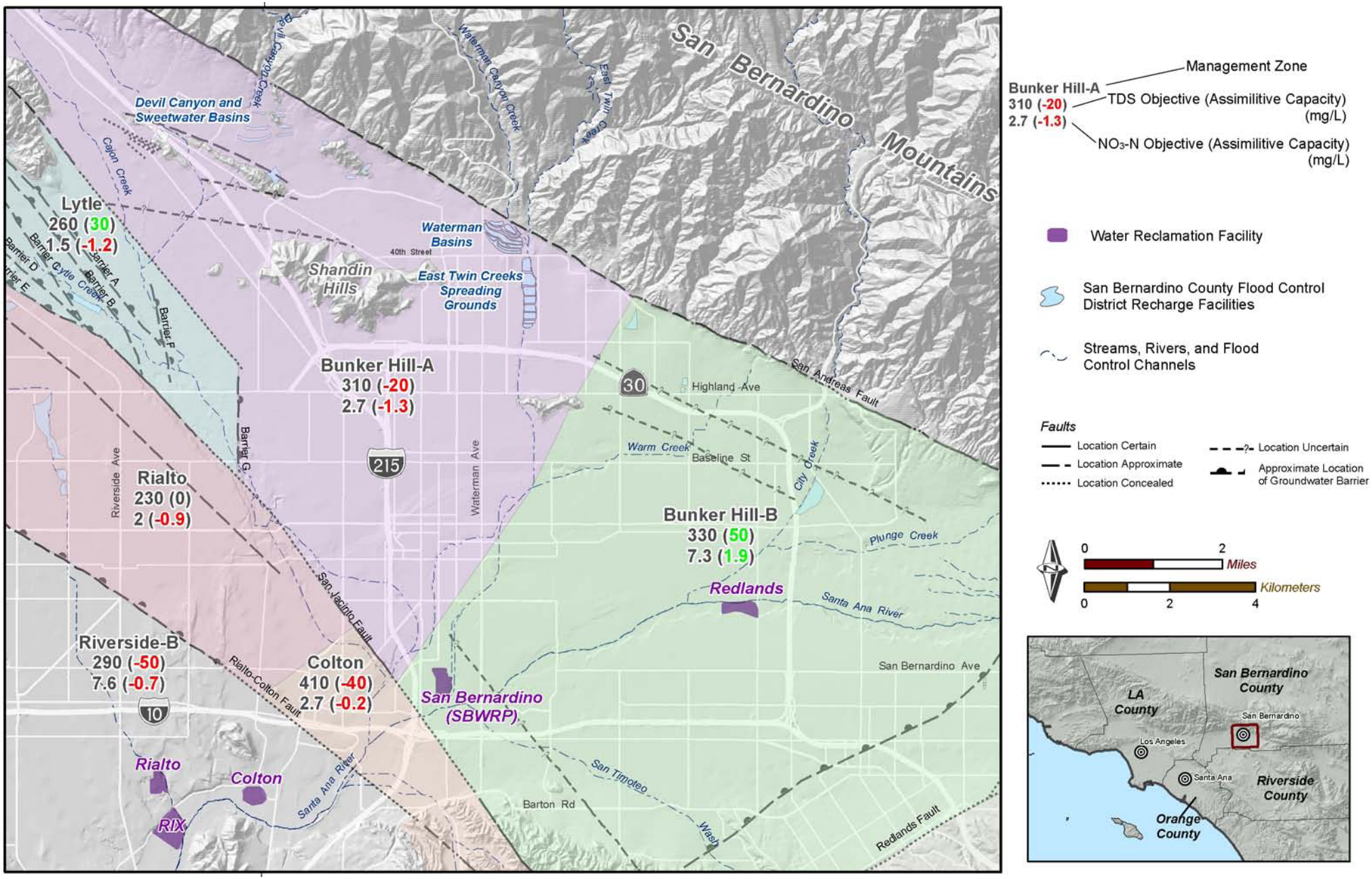

SOURCE: SBMWD Recycled Water Planning Investigation Report (Wildermuth - November 2010)

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RWQCB Basin Plan Management Zone Locations and Water Quality Objectives

Figure 1-3

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2.0 EXISTING FACILITIES

The primary existing facilities within the area impacted by the proposed CWF Project include the SBWRP, the RIX facility, and the Recharge Basins. The SBMWD does not currently have recycled water infrastructure.

2.1 SAN BERNARDINO WATER RECLAMATION PLANT

The SBWRP is located in the southern part of SBMWD's service area at 399 Chandler Place, San Bernardino, California. The SBWRP currently treats 22 mgd to secondary treatment standards using a treatment train that includes headworks, primary clarifiers, aeration systems with nitrogen removal capabilities, and secondary clarifiers. The secondary treated water is conveyed via a pipeline to the RIX Facility for tertiary treatment and discharge to the Santa Ana River. The SBWRP has a rated capacity of 33 mgd with projected treatment demands of 28 mgd by 2015, 31 mgd by 2020, and up to 35 mgd by 2030. The SBWRP will be expanded or upgraded to meet projected 2030 demands.

2.2 RAPID INJECTION AND EXTRACTION (RIX) FACILITY

The RIX tertiary treatment facility is located approximately four miles southwest of the SBWRP along the Santa River (see Figure 1-1). The SBMWD and City of Colton are members of a Joint Powers Agency that owns and operates the RIX facility. The RIX facility currently treats approximately 5 mgd of secondary-treated effluent from the City of Colton and 22 mgd from the SBWRP to the tertiary level for disposal to the Santa Ana River. Secondary effluent is applied to percolation ponds and a sand filter. Following filtration by the local soils, filtered effluent is extracted and combined with effluent from the sand filter, then disinfected with ultraviolet light and discharged to the Santa Ana River. The RIX tertiary treatment facility is permitted to treat 40 mgd of secondary treated effluent and discharge up to 64 mgd of tertiary treated recycled water. It currently receives approximately 27 mgd of secondary effluent, and currently discharges approximately 36 mgd to the Santa Ana River. The SBMWD has submitted a Petition for Change to the State Water Resources Control Board to reduce the discharge at the RIX facility to 11.9 mgd. As part of the CWF project, secondary effluent from the SBWRP to the RIX facility would be reduced to approximately 4 to 7 mgd. The balance of the secondary effluent from the SBWRP would be treated to a tertiary or advanced level and utilized for recycled water customers or groundwater recharge as part of the CWF project.

2.3 WATERMAN BASINS/EAST TWIN CREEK SPREADING GROUNDS

The Waterman Basins and East Twin Creek Spreading Grounds (collectively known as the Recharge Basins) will be used as the groundwater recharge facilities for the CWF Project. Total recharge that could be used as dilution water as required by CDPH Replenishment Recharge Reuse regulations is estimated at 22,700 acre-feet per year (20.2 mgd) as indicated below. Dilution water is also utilized to meet the Bunker Hill-A Basin water quality objectives.

- Waterman Basins – these basins capture storm water runoff and are a current recharge location for the Valley District. Estimated 10-year average storm water runoff is 2,100 acre-feet per year (1.9 mgd). Estimated Valley District recharge with State Project Water (SPW) is 10,700 acre-feet per year (9.5 mgd). The total recharge for the Waterman Basins that could be used as dilution water is 12,800 acre-feet per year (11.4 mgd).

- East Twin Creek Spreading Grounds – these spreading grounds capture storm water runoff, and serve as an overflow for the Waterman Basins. The Spreading Grounds do not currently have a turnout for Valley District recharge using State Project Water, but a turnout is planned. Estimated 10-year average storm water runoff is 3,900 acre-feet per year (3.5 mgd). Estimated Valley District recharge with State Project Water is 6,000 acre-feet per year (5.3 mgd). The total recharge for the East Twin Creek Spreading Grounds that could be used as dilution water is 9,900 acre-feet per year (8.8 mgd).

The Recharge Basins are owned and operated by the San Bernardino County Flood Control District. These basins will continue to function as flood control facilities. Recycled water and advanced treated water used for groundwater recharge may be limited prior to and during storm events. Groundwater recharge flows may need to be diverted at the SBWRP to the RIX facility and Santa Ana River during storm events. During large storm events where the flow in the Santa Ana River is greater than a 20 to 1 ratio as compared to the SBWRP discharge rate, the RWQCB allows discharge at the SBWRP of secondary effluent to the Santa Ana River without tertiary and/or advanced treatment.

3.0 PROPOSED FACILITIES

Six Conveyance Scenarios were developed to analyze possible configurations of conveyance facilities for the CWF Project. Configurations included:

- A single pipeline that would deliver advanced treated water to both recycled water customers and the Recharge Basins;
- Dual pipelines with one recycled water pipeline to customers and one advanced water pipeline to the Recharge Basins;
- A single pipeline that would deliver recycled water to both recycled water customers and to an advanced water treatment plant located at the Recharge Basins.

Pump stations and storage tanks were located to optimize system hydraulics and flexibility for delivery of recycled water and advanced treated water flow. Design criteria and sizing of facilities are described in Section 5.

Facilities will be required at the Waterman Basins and East Twin Creek Spreading Grounds to discharge recycled water and advanced treated water for infiltration into the Recharge Basins. Turnouts with isolation valves, meters, and concrete discharge structures would be installed at various locations along the edge of the Spreading Basins. Monitoring wells will also be required at various points within and adjacent to the Recharge Basins to monitor the flow of recycled water and advanced treated water within the groundwater basin.

The six Conveyance Scenarios are described below and evaluated in detail in the following sections of this report.

3.1 CONVEYANCE SCENARIOS

Descriptions of six Conveyance Scenarios are provided below and summarized in Table 3-1. The Conveyance Scenarios are also depicted in Figures 3-1 through 3-6. Facilities have been assigned designation numbers with the first number representing the Conveyance Scenario number and second number representing the facility number (i.e. Storage Tank 1-1 is Conveyance Scenario 1 and Tank 1 within this scenario).

Conveyance Scenario 1 – This scenario utilizes a single conveyance system to deliver advanced treated water to both direct use northern customers and the Recharge Basins, and a separate recycled water system to serve direct use customers near the SBWRP. A recycled water storage tank (Storage Tank 1-1) and pump station (Pump Station 1-1) would be located at the SBWRP to serve direct use customers near the SBWRP. An advanced water storage tank (Storage Tank 1-2) and pump station (Pump Station 1-2) would be located at the SBWRP and would convey water in Pipeline 1-1 to both direct use northern customers and the Recharge Basins. An advanced water storage tank (Storage Tank 1-3) at an intermediate location would serve a

portion of direct use northern customers. Brine would be discharged to the IEBL at the SBWRP. Secondary treated effluent would be conveyed through an existing pipeline to the RIX facility.

Conveyance Scenario 2 – This scenario utilizes a single conveyance system with two lifts to deliver advanced treated water to both direct use northern customers and the Recharge Basins, and a separate recycled water system to serve direct use customers near the SBWRP. A recycled water storage tank (Storage Tank 2-1) and pump station (Pump Station 2-1) would be located at the SBWRP to serve direct use customers near the SBWRP. An advanced water storage tank (Storage Tank 2-2) and pump station (Pump Station 2-2) would be located at the SBWRP and would convey water in Pipeline 2-1 to both direct use northern customers and an intermediate storage tank (Storage Tank 2-3). Advanced water would be conveyed in a second lift by an intermediate pump station (Pump Station 2-3) through Pipeline 2-2 to a portion of direct use northern customers and to the Recharge Basins. Brine would be discharge to the IEBL at the SBWRP. Secondary treated effluent would be conveyed through an existing pipeline to the RIX facility.

Conveyance Scenario 3 – This scenario utilizes dual conveyance systems with one recycled water pipeline serving direct use northern customers and one advanced water pipeline to the Recharge Basins, and a separate recycled water system to serve direct use customers near the SBWRP. A recycled water storage tank (Storage Tank 3-1) and pump station (Pump Station 3-1) would be located at the SBWRP to serve direct use customers near the SBWRP and direct use northern customers in Pipeline 3-1. A recycled water storage tank (Storage Tank 3-3) at a northern location would serve direct use northern customers. Recycled water would be conveyed in a second lift by a northern pump station (Pump Station 3-3) through Pipeline 3-2 to the Recharge Basins. An advanced water storage tank (Storage Tank 3-2) and pump station (Pump Station 3-2) would be located at the SBWRP and would convey water in Pipeline 3-3 to the Recharge Basins. Brine would be discharged to the IEBL at the SBWRP. Secondary treated effluent would be conveyed through an existing pipeline to the RIX facility.

Conveyance Scenario 4 – This scenario utilizes dual conveyance systems with one recycled water pipeline serving direct use northern customers and one advanced water pipeline with two lifts to the Recharge Basins, and a separate recycled water system to serve direct use customers near the SBWRP. A recycled water storage tank (Storage Tank 4-1) and pump station (Pump Station 4-1) would be located at the SBWRP to serve direct use customers near the SBWRP and direct use northern customers in Pipeline 4-1. A recycled water storage tank (Storage Tank 4-3) at a northern location would serve direct use northern customers. Recycled water would be conveyed in a second lift by a northern pump station (Pump Station 4-3) through Pipeline 4-2 to the Recharge Basins. An advanced water storage tank (Storage Tank 4-2) and pump station (Pump Station 4-2) would be located at the SBWRP and would convey water in Pipeline 4-3 to an intermediate storage tank (Storage Tank 4-4). Advanced water would be conveyed in a second lift by an intermediate pump station (Pump Station 4-4) through Pipeline 4-4 to the Recharge Basins. Brine would be discharged to the IEBL at the SBWRP. Secondary treated effluent would be conveyed through an existing pipeline to the RIX facility.

Conveyance Scenario 5 – This scenario utilizes a single conveyance system that would deliver recycled water to both direct use northern customers and to an advanced water treatment plant located at the Recharge Basins. A recycled water storage tank (Storage Tank 5-1) and pump station (Pump Station 5-1) would be located at the SBWRP to serve direct use customers near the SBWRP; and direct use northern customers, Recharge Basins, and an advanced treatment plant all through Pipeline 5-1. A recycled water storage tank (Storage Tank 5-2) at an intermediate location would serve a portion of direct use northern customers. A separate pipeline (Pipeline 5-2) would convey brine from an advanced treatment plant at the Recharge Basins to the SBWRP for discharge to the IEBL. Secondary treated effluent would be conveyed through an existing pipeline to the RIX facility.

Conveyance Scenario 6 – This scenario utilizes a single conveyance system with two lifts that would deliver recycled water to both direct use northern customers and to an advanced water treatment plant located at the Recharge Basins. A recycled water storage tank (Storage Tank 6-1) and pump station (Pump Station 6-1) would be located at the SBWRP to serve direct use customers near the SBWRP; and a portion of direct use northern customers through Pipeline 6-1. A recycled water storage tank (Storage Tank 6-2) at an intermediate location would serve a portion of direct use northern customers. Recycled water would be conveyed in a second lift by an intermediate pump station (Pump Station 6-2) through Pipeline 6-2 to a portion of direct use northern customers, Recharge Basins, and an advanced treatment plant. A separate pipeline (Pipeline 6-2) would convey brine from an advanced treatment plant at the Recharge Basins to the SBWRP for discharge to the IEBL. Secondary treated effluent would be conveyed through an existing pipeline to the RIX facility.

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Table 3-1
Conveyance Scenarios

Scenario No.	Description	Facilities
1	Single conveyance system to deliver advanced treated water to direct use northern customers and the Recharge Basins. A separate recycled water system to serve direct use customers near SBWRP.	• Recycle water storage tank and pump station at SBWRP • Advanced water storage tank and pump station at SBWRP • Advanced water storage tank at an intermediate location
2	Single conveyance system with two lifts to deliver advanced treated water to direct use northern customers and the Recharge Basins. A separate recycled water system to serve direct use customers near the SBWRP.	• Recycle water storage tank and pump station at SBWRP • Advanced water storage tank and pump station at SBWRP • Advanced water storage tank and pump station at an intermediate location
3	Dual conveyance systems with one recycled water pipeline serving direct use northern customers and one advanced water pipeline to the Recharge Basins. A separate recycled water system to serve direct use customers near the SBWRP.	• Recycle water storage tank and pump station at SBWRP • Recycled water storage tank and pump station at a northern location • Advanced water storage tank and pump station at SBWRP
4	Dual conveyance systems with one recycled water pipeline serving direct use northern customers and one advanced water pipeline with two lifts to the Recharge Basins. A separate recycled water system to serve direct use customers near the SBWRP.	• Recycle water storage tank and pump station at SBWRP • Recycled water storage tank and pump station at a northern location • Advanced water storage tank and pump station at SBWRP • Advanced water storage tank and pump station at an intermediate location
5	Single conveyance system to deliver recycled water to both direct use northern customers and to an advanced water treatment plant located at the Recharge Basins.	• Recycle water storage tank and pump station at SBWRP • Recycled water storage tank at an intermediate location • Advanced treatment plant at Recharge Basins • Brine pipeline from Recharge Basins to SBWRP
6	Single conveyance system with two lifts to deliver recycled water to both direct use northern customers and to an advanced water treatment plant located at the Recharge Basins.	• Recycle water storage tank and pump station at SBWRP • Recycled water storage tank and pump station at an intermediate location • Advanced treatment plant at Recharge Basins • Brine pipeline from Recharge Basins to SBWRP

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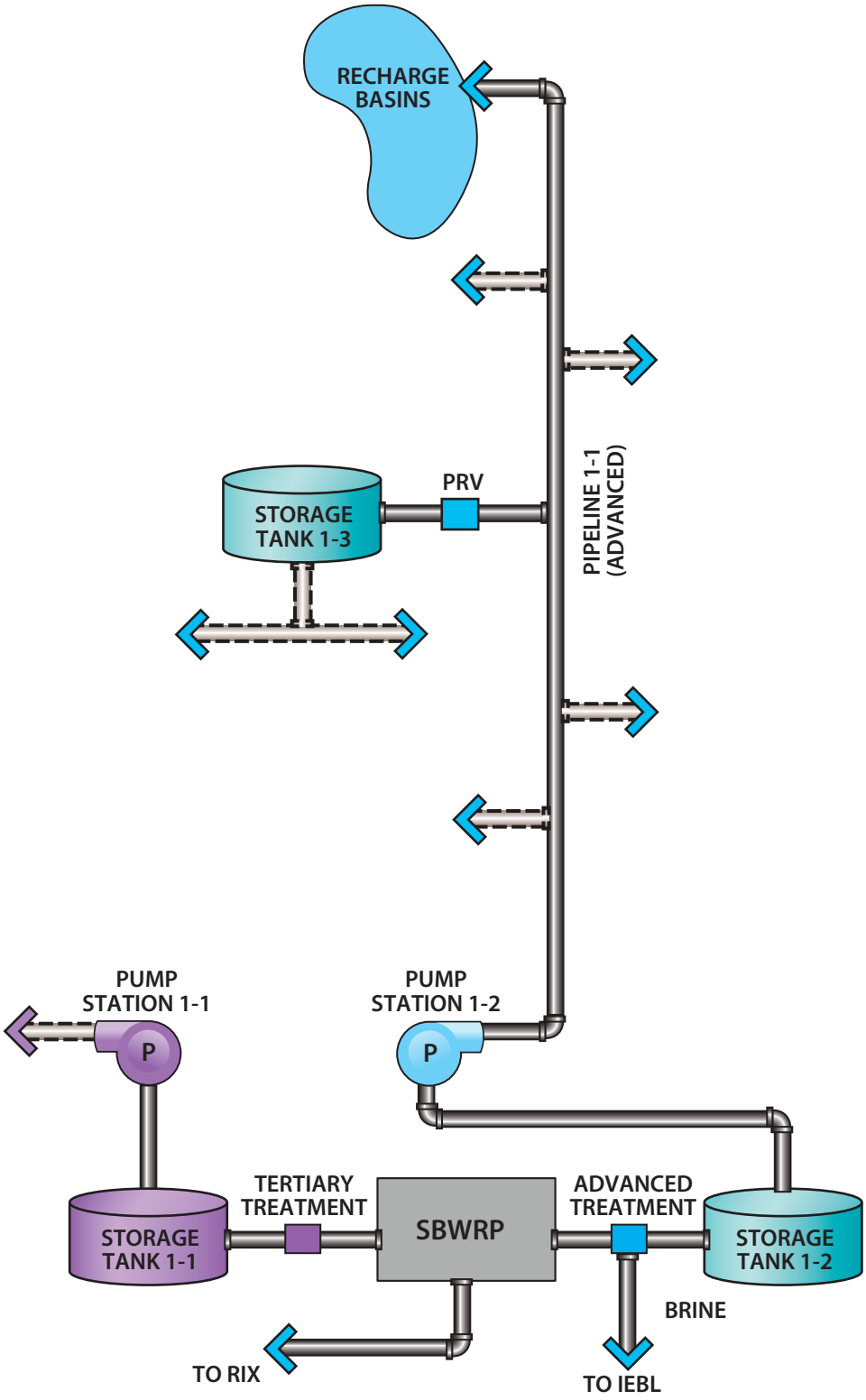

CONVEYANCE SCENARIO 1

RECYCLED WATER FACILITIES

ADVANCED WATER FACILITIES

TRANSMISSION PIPELINE

DISTRIBUTION PIPELINES TO DIRECT USE CUSTOMERS

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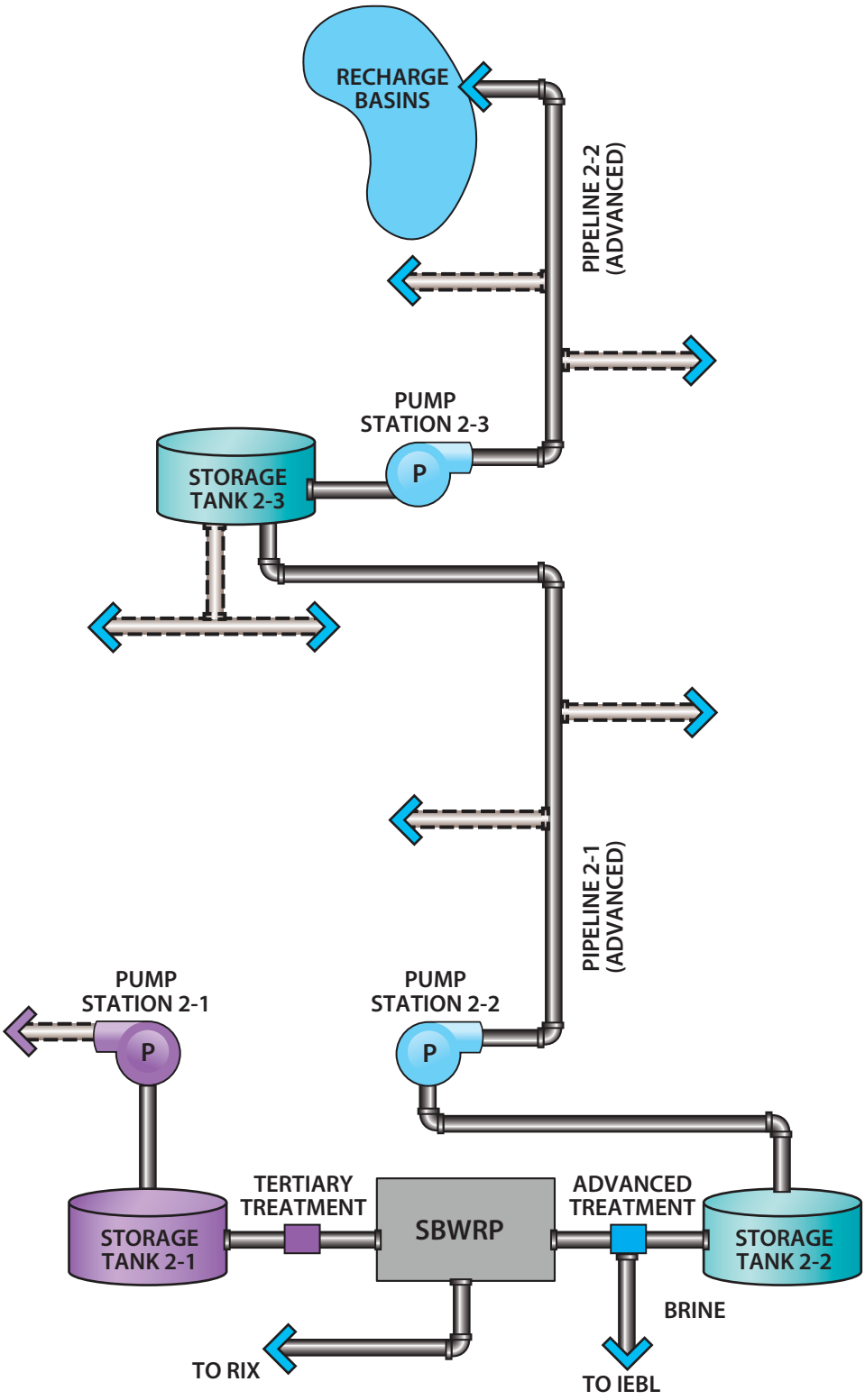
Recycled / Advanced Water Conveyance Scenarios

Figure 3-1



CONVEYANCE SCENARIO 2

- RECYCLED WATER FACILITIES
- ADVANCED WATER FACILITIES
- TRANSMISSION PIPELINE
- DISTRIBUTION PIPELINES TO DIRECT USE CUSTOMERS

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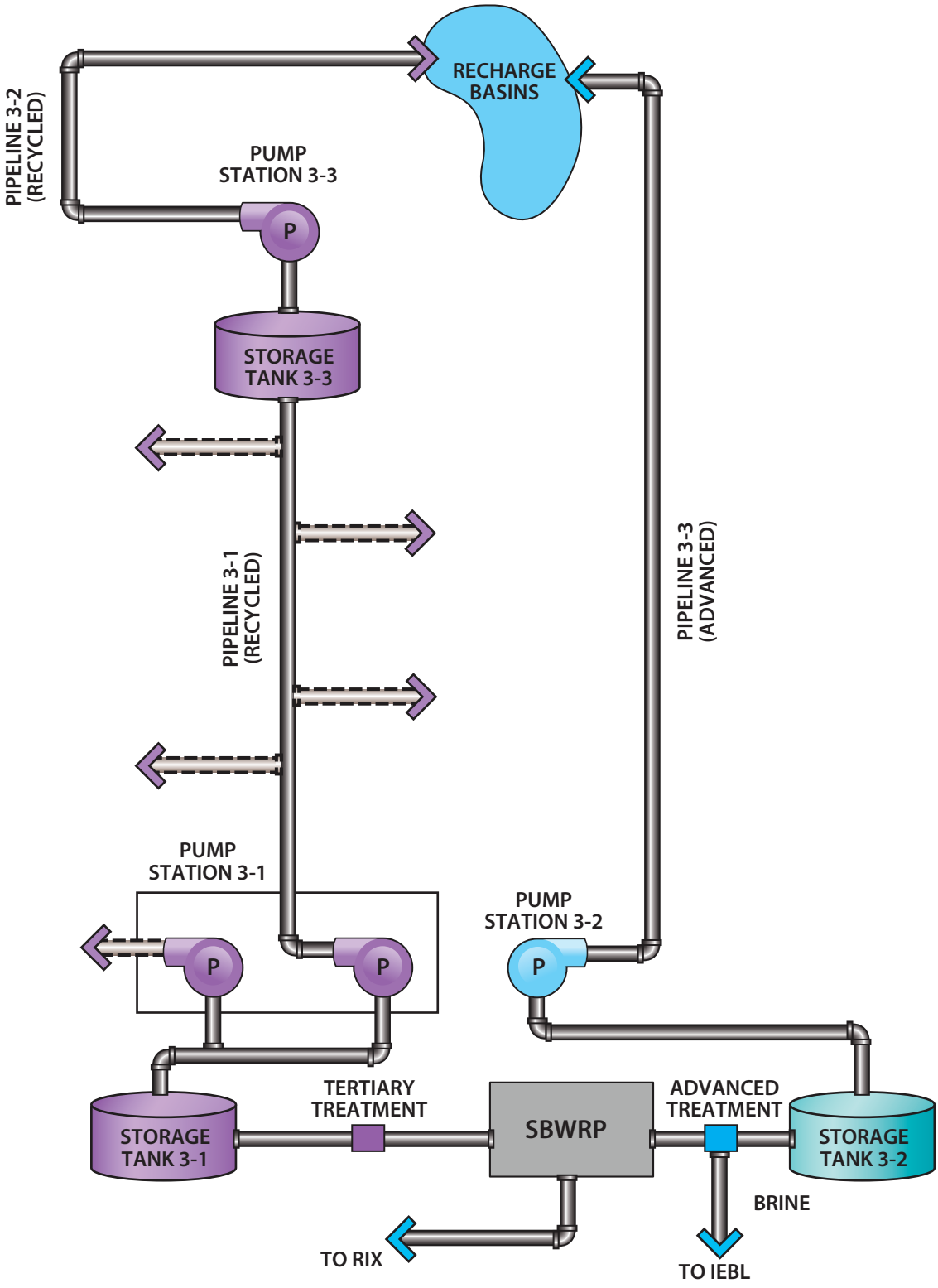
Recycled / Advanced Water Conveyance Scenarios

Figure 3-2



CONVEYANCE SCENARIO 3

RECYCLED WATER FACILITIES

ADVANCED WATER FACILITIES

TRANSMISSION PIPELINE

DISTRIBUTION PIPELINES TO DIRECT USE CUSTOMERS

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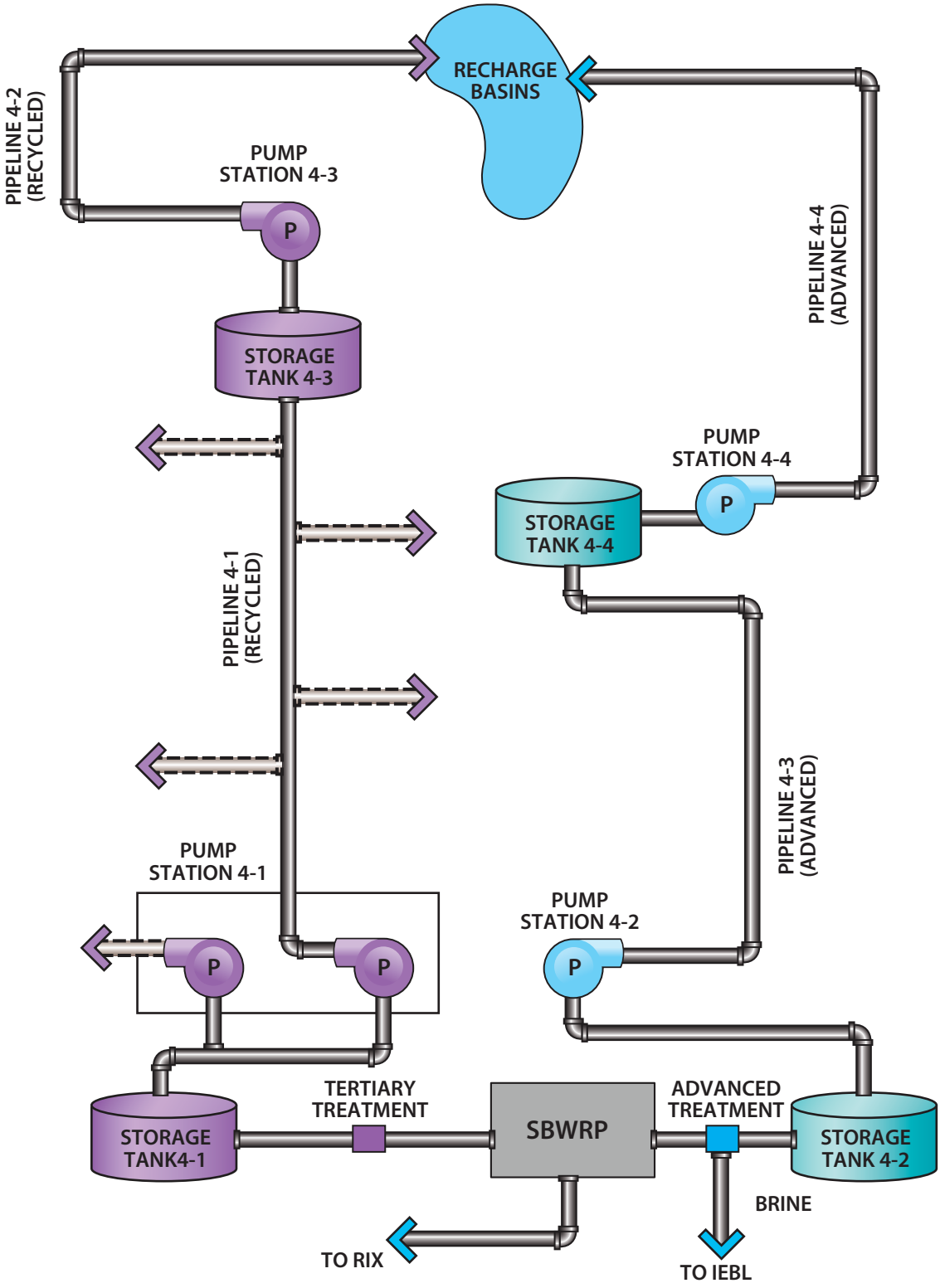
Recycled / Advanced Water Conveyance Scenarios

Figure 3-3



CONVEYANCE SCENARIO 4

- RECYCLED WATER FACILITIES
- ADVANCED WATER FACILITIES
- TRANSMISSION PIPELINE
- DISTRIBUTION PIPELINES TO DIRECT USE CUSTOMERS

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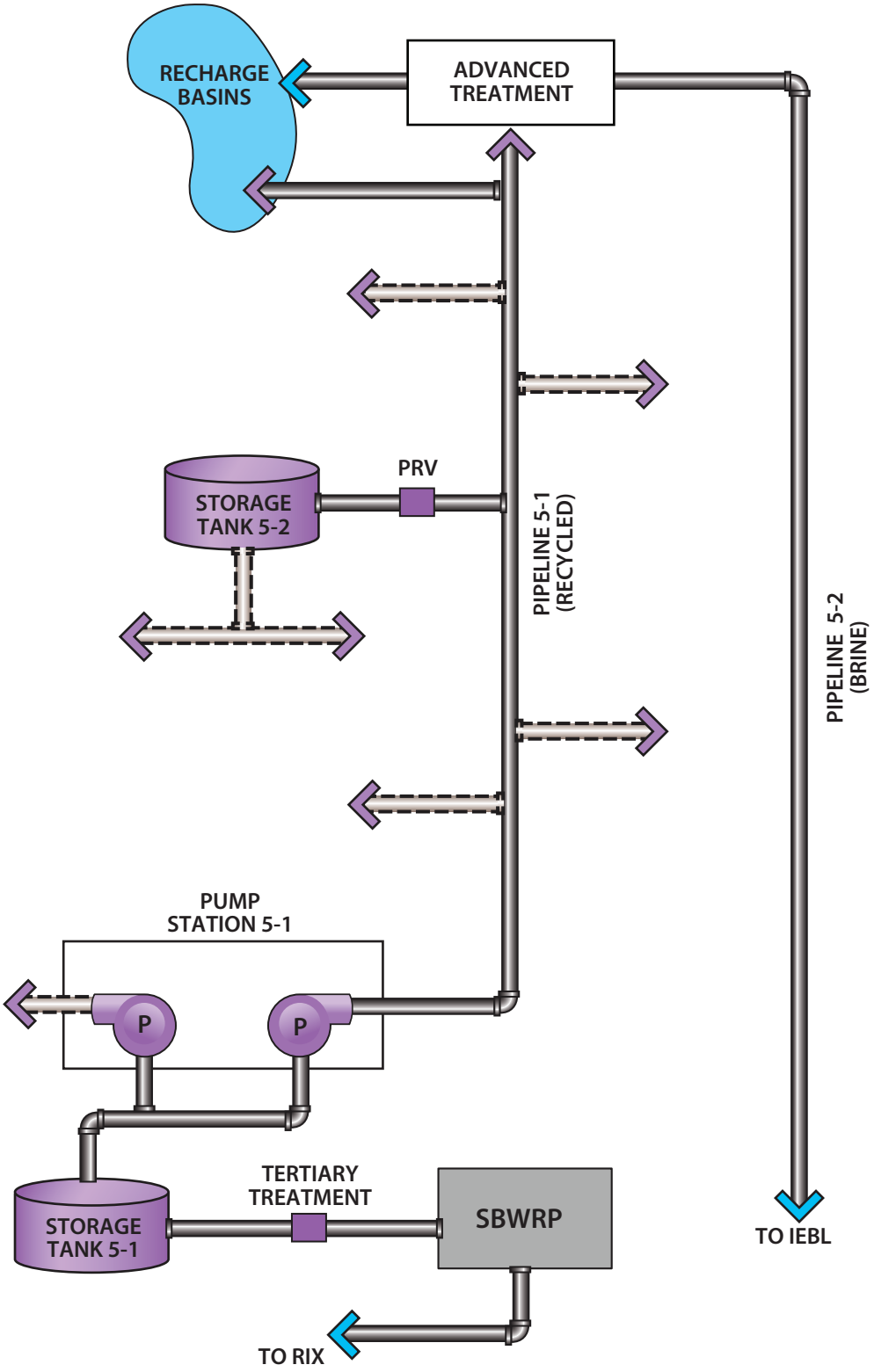
Recycled / Advanced Water Conveyance Scenarios

Figure 3-4



CONVEYANCE SCENARIO 5

- RECYCLED WATER FACILITIES
- ADVANCED WATER FACILITIES
- TRANSMISSION PIPELINE
- DISTRIBUTION PIPELINES TO DIRECT USE CUSTOMERS

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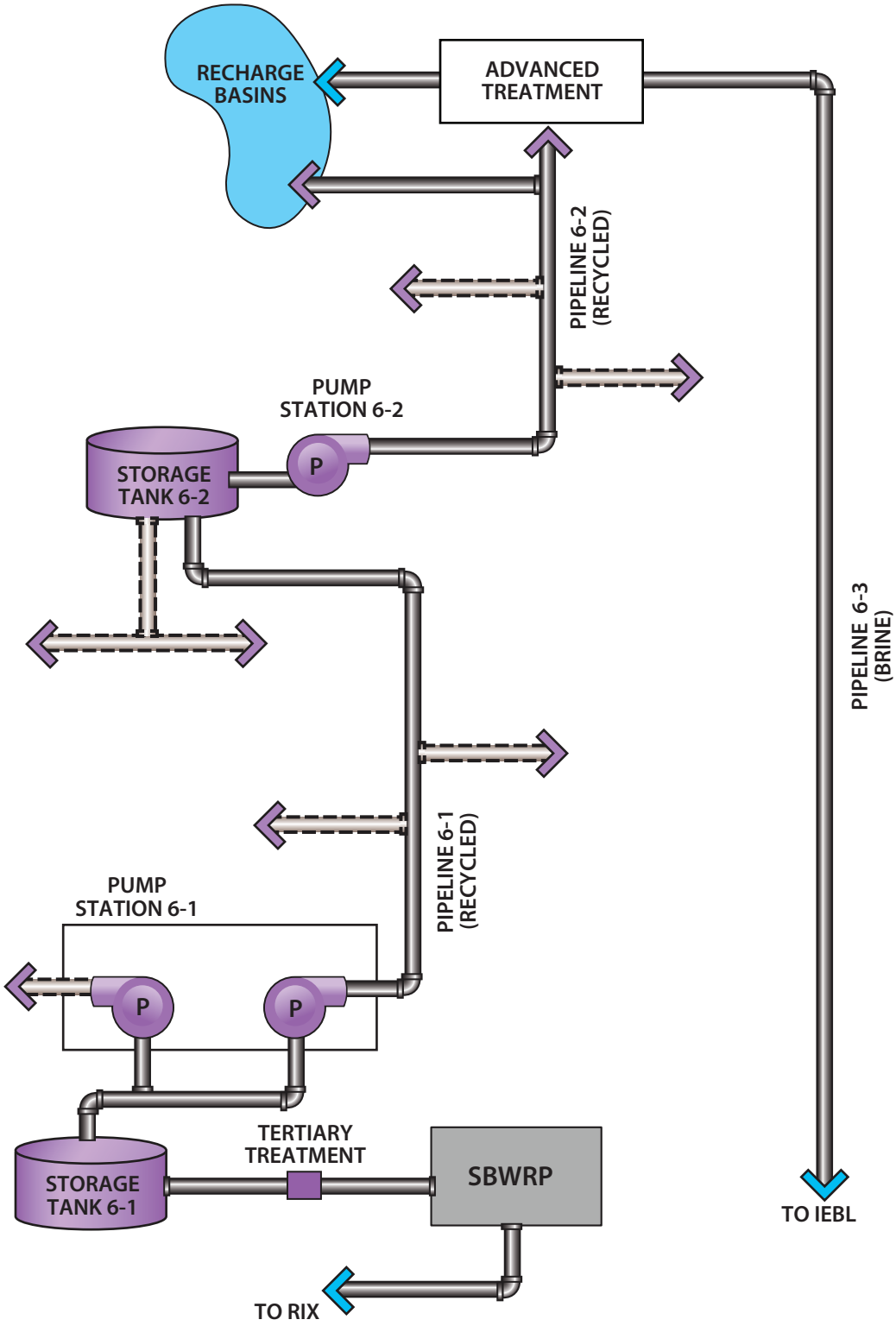
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Recycled / Advanced Water Conveyance Scenarios

Figure 3-5



CONVEYANCE SCENARIO 6

- RECYCLED WATER FACILITIES
- ADVANCED WATER FACILITIES
- TRANSMISSION PIPELINE
- DISTRIBUTION PIPELINES TO DIRECT USE CUSTOMERS

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SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Recycled / Advanced Water Conveyance Scenarios

Figure 3-6

4.0 POTENTIAL DIRECT USE CUSTOMERS AND RECYCLED WATER DEMANDS

The CWF Project will reduce SBMWD's per capita water usage in order to comply with SBX-7, although many additional benefits will be realized including, but not limited to, increasing water supply reliability. This will be accomplished in part by converting existing potable water customers, either partially or entirely, to recycled water (direct use). Some typical uses for recycled water include irrigation, cleaning, industrial cooling, industrial processes, fire flow, refilling of lakes, and other various uses. As previously mentioned, the Recycled Water Report indicated that conventional direct recycled water distribution throughout the entire SBMWD service area is not economically feasible; however, there are several specific candidates for recycled water conversion along the recycled water conveyance alignments that may be a viable option for cost-effectively reducing per capita potable water usage. This philosophy was maintained when identifying and evaluating potential direct use customers as part of this analysis as described in the following sections.

4.1 DIRECT USE CUSTOMERS

Identifying potential direct use customers began with examining the areas that were previously identified in the Recycled Water Report. Potential direct use customers in the Recycled Water Report were limited to the San Bernardino Public Golf Course; existing irrigation customers along the East Twin Creek flood control channel, including parks, schools, and golf courses; and on-site use at the SBWRP. A total of 19 irrigation customers were identified, with a total average day demand of approximately 2.8 mgd (2.1 mgd at the SBWRP and to the south and 0.7 mgd to the north). As part of this analysis, these areas were confirmed to be viable candidates for recycled water usage, and remain included in the list of potential direct use customers.

In addition to the previously identified areas, additional potential direct use customers were identified within the area proximate to the proposed conveyance pipeline alignments, generally defined as bound by I-215 Freeway to the west, the I-10 Freeway to the south, Del Rosa Drive to the east, and the Recharge Basins at the north end of the SBMWD service area totaling approximately 1.3 mgd. Presumed large users just outside of this area were also identified; however, these potential customers have been excluded from the demand calculations since their distances from the proposed conveyance pipelines may make these cost-prohibitive options. These large users are as follows:

- Montecito Memorial Park and Mortuary
- Loma Linda University
- Loma Linda Community Park
- Rancon Lake
- San Bernardino International Airport
- San Bernardino Soccer Complex

For potential customer selection, emphasis was placed on those areas presumed to have the highest irrigation demands, which would include golf courses, parks, schools, cemeteries, and nurseries. As of result of further investigation, a total of 60 potential customers were identified corresponding to a total gross area of approximately 961 acres

A comprehensive list of potential direct use customers is provided in Table A-1 in Appendix A. Their areas and proximity to the conveyance pipeline Alignment Options are shown in Figures 4-1 through 4-5. Conveyance pipeline segments and alignments are described further in Section 6.

4.2 RECYCLED WATER CRITERIA AND DEMANDS

In order to evaluate recycled water facility sizing and effectiveness of serving potential direct use customers, estimated water demands were calculated using gross parcel areas and water demand factors. Water demand factors were calculated according to land use category based on historic water demand data for the previously identified areas provided in the Recycled Water Report. A summary of this data is shown in Table 4-1 (see Appendix A for more detailed information). It should be noted that the SBWRP, the San Bernardino Public Golf Course, and irrigated areas along the I-215 Freeway currently receive groundwater from a well located at the SBWRP. There are also groundwater wells located at Wildwood Park and the Arrowhead Country Club. Usage of these groundwater wells may understate the actual amount of recycled water that would ultimately be needed.

Table 4-1
Existing Irrigation Water Demand

Irrigation Customers [1]	Total (AFY) [1]	Approx Gross Area (ac) [1]	Calculated Demand Factor (AFY/ac)
San Bernardino Water Reclamation Plant	1998	49 [2]	40.51
San Bernardino Public Golf Course	209.1	93	2.25
CalTrans (I-215)	100.2	15 [2]	6.89
Arrowhead Country Club	247.2	110	2.25
Mill Community Park	25.3	14	1.81
Meadowbrook Recreational Park	25.4	14	1.81
Meadowbrook Park	12.6	7	1.80
Secombe Lake State Recreational Area	56	31	1.81
Perris Hill Park	57.7	32	1.80
Horine Park	10.2	6	1.70
Wildwood Park	43.6	24	1.82
Palm Field	8.9	5	1.78
Community Gardens	27	15	1.80

Table 4-1 (continued)
Existing Irrigation Water Demand

Irrigation Customers [1]	Total (AFY) [1]	Approx Gross Area (ac) [1]	Calculated Demand Factor (AFY/ac)
Pioneer Memorial Cemetery	36.7	20	1.84
Mountain View Cemetery	104.6	58	1.80
Golden Valley Middle School	16.44	16 [2]	1.02
Parkside Elementary	16.44	5 [2]	3.00
Wilson Elementary	16.44	6 [2]	2.78
Sierra High School	81.23	14 [2]	5.89
Totals	**3093**	**534**	**-**

[1] Source: SBMWD Recycled Water Planning Investigation Report, Appendix B, (Wildermuth, November 2010), except as noted.

[2] Gross area based on County of San Bernardino GIS data.

The demand factors for similar land use categories were averaged to establish demand factors for golf courses, parks, schools, nurseries, cemeteries, and public use areas (e.g., libraries, governmental buildings, etc.). Where available, demand factors based on historic water use for customers identified in the Recycled Water Report were utilized. For any additional potential customers, the demand factors were increased to form more conservative planning factors to allow for some variability for future demands. These water demand factors are listed in Table 4-2.

Table 4-2
Water Demand Factors

Land Use Category	Avg Demand Factor (Historic) (AFY/ac)	Planning Demand Factor (AFY/ac) [1]
Golf Courses (GC)	2.25	2.5
Parks (PK)	1.79	2.0
Schools (SC)	2.78	4.0
Nursery (N)	1.80	2.0
Cemeteries (C)	1.82	2.0
Public Use (PB) [2]	-	3.0
Caltrans (CT) [3]	-	2.0

[1]: Note: Planning factor corresponds to gross area.

[2]: Planning factor for Public Use category is based upon a 75 percent irrigated ratio as compared to Schools.

[3]: Planning factor for Caltrans category is based upon the Parks land use category applied to the irrigated portion of Caltrans land use.

Water demand peaking factors were also established to account for the variations in demands that typically occur seasonally, daily, and hourly. Four pertinent demand conditions were considered, including average day demand (ADD), maximum month demand (MMD), maximum day demand (MDD), and peak hour demand (PHD) during a maximum day. Maximum month demand represents the month with the highest amount of water usage, typically occurring in the hottest month of the year during summer. This factor was calculated as 1.3 times the average day demand from the Recycled Water Report. Similarly, maximum day demand represents the single day of the year with the highest amount of water usage. Although the Recycled Water Report concluded that the maximum day factor was equivalent to the maximum month factor of 1.3 times the average day demand based on the premise that irrigation schedules are usually varied on a seasonal basis rather than a daily basis, this factor was increased to a more conservative value of 2.0 to allow for some variation in demand throughout the month. The peak hour demand factor was calculated as 3.0 times the maximum day demand based on an 8-hour irrigation window per 24-hours, since irrigation typically occurs during a limited period during the late night hours and early morning hours. A summary of the water demand peaking factors is provided in Table 4-3.

Table 4-3
Water Demand Peaking Factors

Demand Condition	Peaking Factor
Average Day Demand (ADD)	-
Maximum Month Demand (MMD)	1.3 x ADD
Maximum Day Demand (MDD)	2.0 x ADD
Peak Hour Demand (PHD)	3.0 X MDD

A detailed summary of potential direct use customers, land use categories, gross areas, and estimated demands is provided in Table A-1 in Appendix A. It should be noted that this analysis does not take into consideration potential future changes in land use or future projects that may need or want recycled water service.

For development of pipeline, pump station, and storage tank capacity, the direct use demands were evaluated and are summarized in Table 4-4. Direct use customers were split into two groups: (1) northern users, and (2) users at the SBWRP and southern users. The groups will have separate pipeline, pump station and storage tank facilities for service due to their location.

Table 4-4
Water Demands

Direct Users	Demand Condition	Demand
Northern	Average Day Demand (ADD)	2.0 mgd (2,219 AF/yr)
	Maximum Month Demand (MMD)	2.6 mgd (2,884 AF/yr)
	Maximum Day Demand (MDD)	4.0 mgd (4,437 AF/yr)
	Peak Hour Demand (PHD)	12.0 mgd (13,311 AF/yr)
At SBWRP and Southern	Average Day Demand (ADD)	2.1 mgd (2,307 AF/yr)
	Maximum Month Demand (MMD)	2.7 mgd (2,999 AF/yr)
	Maximum Day Demand (MDD)	4.2 mgd (4,614 AF/yr)
	Peak Hour Demand (PHD)	12.6 mgd (13,842 AF/yr)

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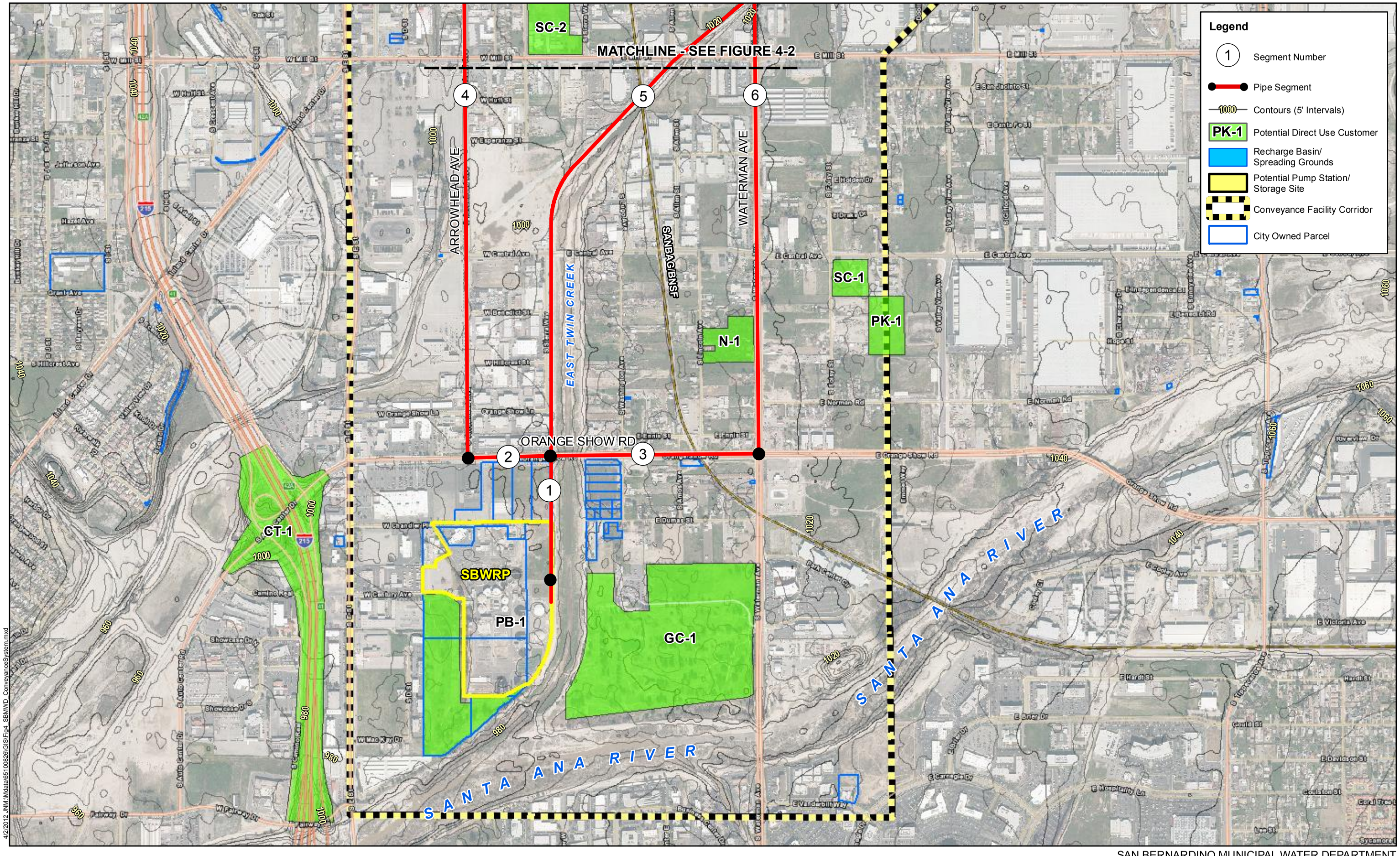

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Source: SCAG, Eagle Aerial - 2011, Esri, Intermap

SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Recycled Water System

Potential Direct Use Areas

Figure 4-1

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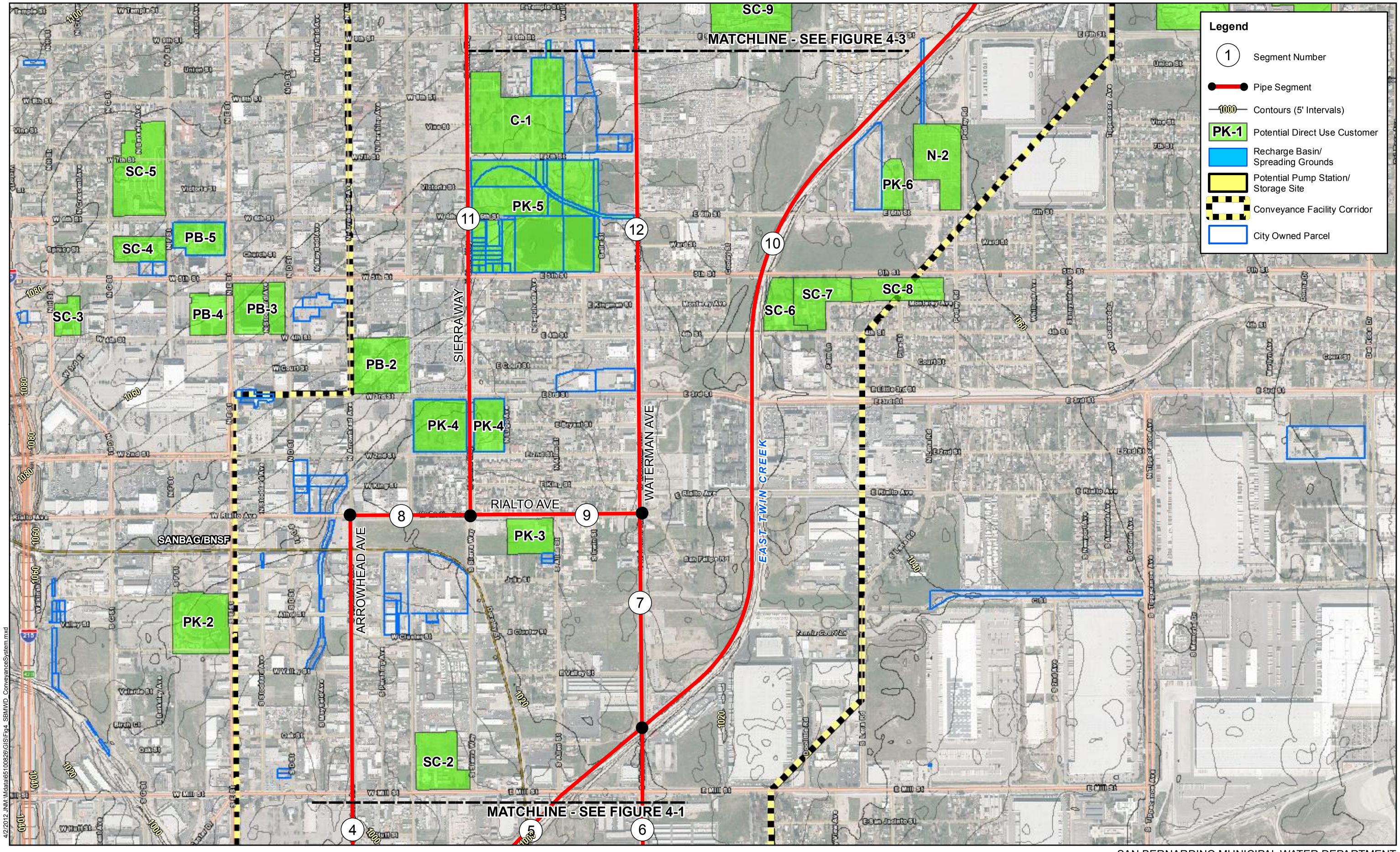

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0 500 1,000 2,000 Feet

Source: SCAG, Eagle Aerial - 2011, Esri, Intermap

SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Recycled Water System

Potential Direct Use Areas

Figure 4-2

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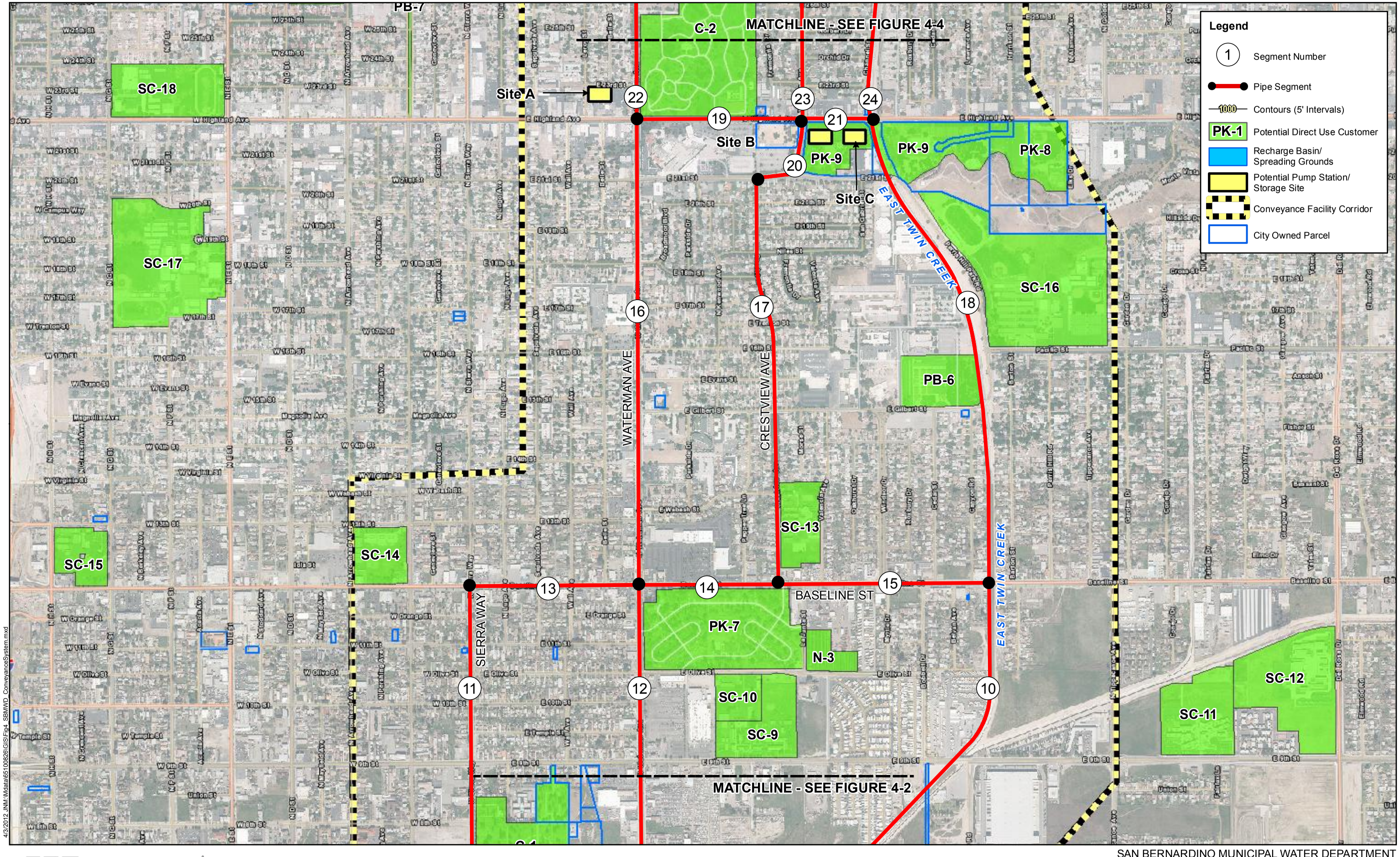

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0 500 1,000 2,000 Feet

Source: SCAG, Eagle Aerial - 2011, Esri, Intermap

SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Recycled Water System

Potential Direct Use Areas

Figure 4-3

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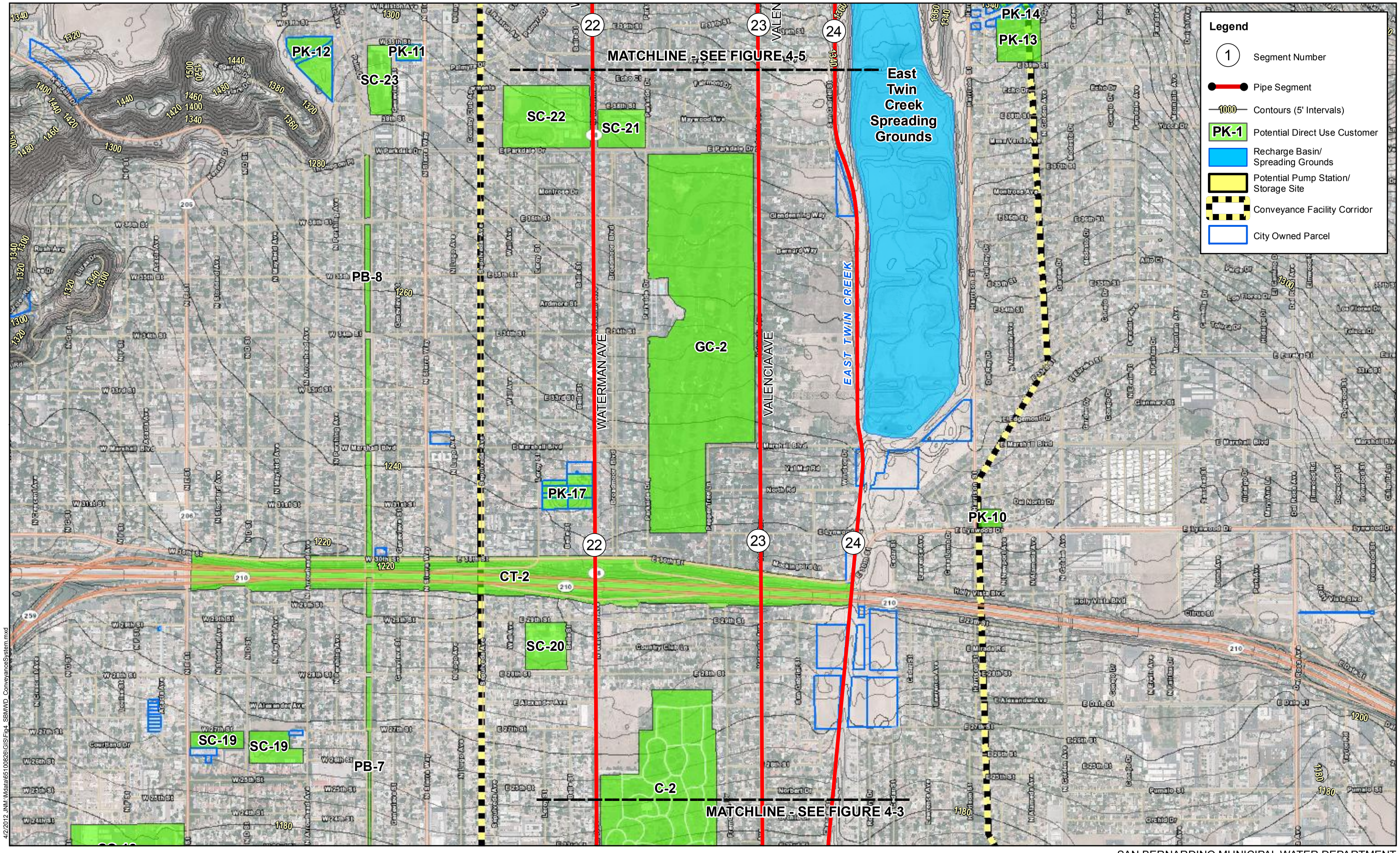

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0 500 1,000 2,000 Feet

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SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Recycled Water System

Potential Direct Use Areas

Figure 4-4

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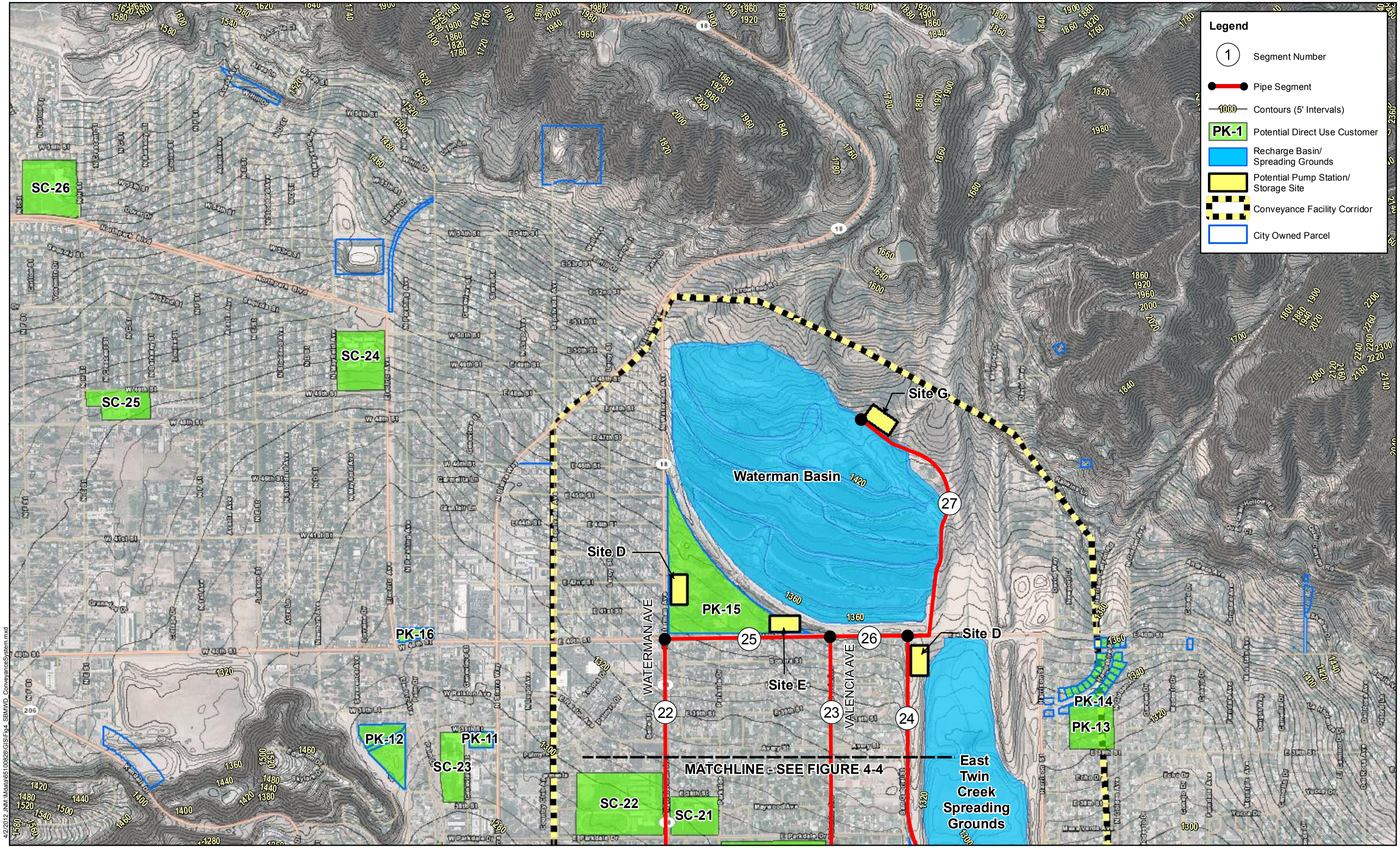

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Source: SCAG, Eagle Aerial - 2011, Esri, Intermap

SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Recycled Water System

Potential Direct Use Areas

Figure 4-5

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5.0 PRELIMINARY FACILITY SIZING

Preliminary facility sizing was developed for recycled water and advanced treated water facilities. Primary facilities included transmission pipelines, pump stations, and storage reservoirs. Design criteria were developed for each type of facility and is listed in Table 5-1.

Table 5-1
Design Criteria

Facility	Description	Criteria
Pipelines	Capacity, Transmission	Maximum Day Demand (MDD) Consider Average Day Demand for Recharge alternating with MDD for Recycled Water
	Capacity, Distribution	Peak Hour Demand for Recycled Water
	Velocity	6 feet per second (fps)
	Roughness	Hazen-Williams C=130 (Pipe Dia. ≥ 14″) Hazen-Williams C=120 (Pipe Dia. ≤ 12″)
	Pressure, pipe	150 psi (to match valve/pipe classes) 250 psi (to match valve/pipe classes)
	Pressure, pipe class	Minimum Thickness Class 50 for Ductile Iron Pipe
	Pressure, design	Design Pressure = Operating + Surge
	Material, < 48 inch Dia.	Ductile Iron Pipe with cement mortar lining and seal coat per AWWA C-104 Bituminous coating per AWWA C-151
	Alternative Materials, < 48 inch Dia.	Steel Pipe per AWWA C-200 with cement mortar lining and coating. PVC Pipe per AWWA C900/C905 HDPE Pipe per AWWA C906
	Material, ≥ 48 inch Dia.	Steel Pipe per AWWA C-200 with cement mortar lining and coating
	Easements	25-foot minimum width
	Depth of Cover	3 feet in street 3 feet if established grade, Pipe Dia. ≤ 12″ 3.5 feet if established grade, Pipe Dia. > 12″ 5 feet for open areas (no established grade)

Table 5-1 (continued)
Design Criteria

Facility	Description	Criteria
Pump Stations	Capacity	Maximum Day Demand (MDD). Consider Average Day Demand for Recharge alternating with MDD for Recycled Water. Peak Hour Demand (PHD) for closed loop.
	Number of Pumps	For Capacity + one spare
	Backup Power	Provide access for hookup of portable emergency generator. Quick connection per SBMWD Dwg. W11.9, W11.10, W11.11.
	Operation	Simple operation desired. Consider Variable Frequency Drives (VFDs) for flexibility/optimization of capital and O&M costs
	Architecture	Blend in with neighborhood
	Access	Accommodate 30-foot long vehicles
Storage Tanks	Volume	Tank: Maximum Day Demand for Recycled Water Forebay: 20 minutes Average Day Demand for Advanced Water
	Type	Round, pre-stressed concrete (above ground)
	Alternative Types	Round, steel (above ground) Rectangular, cast-in-place (above or below ground)
	Operation	Allow for shutdowns for inspection every 3 to 5 years
	Access	Accommodate 30-foot long vehicles

Preliminary facility sizing was based on the SBWRP capacity of 33 mgd, advanced water treatment and conveyance sizing, recycled water treatment and conveyance sizing, brine disposal IEBL capacity of 2.5 mgd, and secondary treated flows to the RIX facility.

5.1 ADVANCED TREATED WATER CONVEYANCE FACILITIES OVERVIEW

Advanced treated water conveyance facilities include pipelines, pump stations, and storage tanks to provide advanced treated water to direct use northern customers and/or Recharge Basins. The various advanced water Conveyance Scenarios provide for either a single combined conveyance pipeline that would serve both direct use northern customers and

Recharge Basins, or a dual conveyance pipelines where one pipeline would be dedicated to providing advanced treated water to Recharge Basins and one pipeline would be dedicated to providing conventional recycled water to Recharge Basins and direct use customers for irrigation. In either case, the maximum capacity of the advanced water pipeline would be sized for 14.2 mgd (limited by IEBL capacity for brine disposal from advanced treatment). Pump stations are sized for pumping flow to the Recharge Basins in one lift, or to an intermediate storage tank then to the Recharge Basins in two lifts using a second pump station located near the intermediate storage tank. The maximum pump discharge pressures are approximately 250 psi for the one lift configuration, and 150 psi for the two lift configuration. Storage tanks are sized for direct use Maximum Day Demand (MDD) if recycled water customers are served using advanced treated water. For advanced water to Recharge Basins only conveyance scenario, storage tanks are sized as pump station forebays only. Where disposal of brine is required from an advanced treatment plant located at the Recharge Basins, the brine pipeline would be a gravity pipeline sized for 2.5 mgd.

5.2 RECYCLED WATER CONVEYANCE FACILITIES OVERVIEW

Recycled water conveyance facilities include pipelines, pump stations, and storage tanks to provide recycled water to direct use northern customers and/or Recharge Basins. The various conventional recycled water Conveyance Scenarios provide for either a single recycled water conveyance pipeline that would serve both direct use northern customers and Recharge Basins, or a single recycled water conveyance pipeline that would serve direct use northern customers, Recharge Basins, and an advanced treatment plant located at the Recharge Basins. The maximum capacity of the conventional recycled water pipeline segments are 7.0 mgd for combined direct use northern customers and groundwater recharge (limited by direct use customers and dilution in Recharge Basins); 5.0 mgd for groundwater recharge; and 25.2 mgd for combined to direct use northern customers, groundwater recharge, and advanced treatment. Pump stations are sized for pumping flow to the Recharge Basins in one lift, or to an intermediate storage tank then to the Recharge Basins in two lifts using a second pump station located near the intermediate storage tank. The maximum pump discharge pressures are approximately 250 psi for the one lift configuration, and 150 psi for the two lift configuration. Storage tanks are sized for direct use MDD for the appropriate segment of direct use demand.

5.3 CONVEYANCE SCENARIOS FACILITY SIZING

The following section summarizes the preliminary facility sizing for transmission pipelines, pump stations, and storage reservoirs under each conveyance scenario identified in Section 3 and are shown on Figures 5-1 through 5-6. It should be noted that a range of lengths are shown for each pipeline. This is because the actual length of each pipeline will depend on the final alignment selected for each. The potential alignments for the transmission mains are discussed in detail in Section 6, and summarized on Table A-2 in Appendix A

5.3.1 Conveyance Scenario 1

- Pipeline 1-1: Advanced water pipeline from SBWRP to Recharge Basins with capacity for combined direct reuse northern customers and groundwater recharge.
  - Capacity: 14.2 mgd [2.0 mgd (Direct Use, ADD) + 12.2 mgd (Basins)]
  - Velocity: 6 fps
  - Diameter: 30 inch
  - Length: 38,460 to 42,900 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 15 to 250 psi
- Pump Station 1-1: Recycled water pump station at SBWRP for transmission to direct reuse customers near SBWRP.
  - Capacity: 12.6 mgd (8,750 gpm) PHD
  - Pressure: 80 psi
  - Pumps: 3 pumps (2 operating + 1 spare), 4,400 gpm each, 250 HP each
- Pump Station 1-2: Advanced water pump station at SBWRP for transmission to combined direct reuse northern customers and groundwater recharge, and an intermediate storage tank (Storage Tank 1-3).
  - Capacity: 14.2 mgd (9,860 gpm)
  - Pressure: 250 psi
  - Pumps: 4 pumps (3 operating + 1 spare), 3,300 gpm each, 600 HP each
- Storage Tank 1-1: Recycled water storage tank at SBWRP with capacity for direct reuse customers near SBWRP.
  - Capacity: 4.2 million gallons (MDD)
- Storage Tank 1-2: Advanced water storage tank at SBWRP with capacity for a portion of direct reuse northern customers.
  - Capacity: 3.2 million gallons (MDD)
- Storage Tank 1-3: Advanced water storage tank at intermediate location with capacity for a portion of direct reuse northern customers.
  - Capacity: 0.8 million gallons (MDD)

5.3.2 Conveyance Scenario 2

- Pipeline 2-1: Advanced water pipeline from SBWRP to Storage Tank 2-3 with capacity for direct reuse northern customers and groundwater recharge.
  - Capacity: 14.2 mgd [2.0 mgd (Direct Use, ADD) + 12.2 mgd (Basins)]
  - Velocity: 6 fps
  - Diameter: 30 inch

- Length: 24,500 to 28,200 feet
- Material: AWWA C104 Ductile Iron Pipe
- Pressure: 30 to 100 psi

- Pipeline 2-2: Advanced water pipeline from Storage Tank 2-3 to Recharge Basins with capacity for a portion of direct reuse northern customers and groundwater recharge.
  - Capacity: 14.2 mgd [2.0 mgd (Direct Use, ADD) + 12.2 mgd (Basins)]
  - Velocity: 6 fps
  - Diameter: 30 inch
  - Length: 13,900 to 16,600 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 15 to 150 psi

- Pump Station 2-1: Recycled water pump station at SBWRP for transmission to direct reuse customers near SBWRP.
  - Capacity: 12.6 mgd (8,750 gpm) PHD
  - Pressure: 80 psi
  - Pumps: 3 pumps (2 operating + 1 spare), 4,400 gpm each, 250 HP each

- Pump Station 2-2: Advanced water pump station at SBWRP for transmission to combined direct reuse northern customers and groundwater recharge and an intermediate tank (Storage Tank 2-3).
  - Capacity: 14.2 mgd (9,860 gpm)
  - TDH: 100 psi
  - Pumps: 4 pumps (3 operating + 1 spare), 3,300 gpm each, 250 HP each

- Pump Station 2-3: Advanced water pump station at an intermediate location for transmission to a portion of direct reuse northern customers and groundwater recharge.
  - Capacity: 14.2 mgd (9,860 gpm)
  - Pressure: 150 psi
  - Pumps: 4 pumps (3 operating + 1 spare), 3,300 gpm each, 400 HP each

- Storage Tank 2-1: Recycled water storage tank at SBWRP with capacity for direct reuse customers near SBWRP.
  - Capacity: 4.2 million gallons (MDD)

- Storage Tank 2-2: Advanced water storage tank at SBWRP with capacity for a portion of direct reuse northern customers.
  - Capacity: 1.6 million gallons (MDD)

- Storage Tank 2-3: Advanced water storage tank at an intermediate location with capacity for a portion of direct reuse northern customers.
  - Capacity: 2.4 million gallons (MDD)

5.3.3 Conveyance Scenario 3

- Pipeline 3-1: Recycled water pipeline from SBWRP to Storage Tank 3-3 with capacity for direct reuse and groundwater recharge.
  - Capacity: 7.0 mgd [2.0 mgd (Direct Use, ADD) + 5.0 mgd (Basins)]
  - Velocity: 6 fps
  - Diameter: 20 inch
  - Length: 35,200 to 38,800 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 30 to 250 psi
- Pipeline 3-2: Recycled water pipeline from Storage Tank 3-3 to Recharge Basins with capacity for groundwater recharge.
  - Capacity: 5.0 mgd (Basins)
  - Velocity: 6 fps
  - Diameter: 16 inch
  - Length: 3,300 to 6,000 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 15 to 80 psi
- Pipeline 3-3: Advanced water pipeline from SBWRP to Recharge Basins with capacity for groundwater recharge.
  - Capacity: 14.2 mgd (Basins)
  - Velocity: 6 fps
  - Diameter: 30 inch
  - Length: 38,460 to 42,900 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 15 to 250 psi
- Pump Station 3-1: Recycled water pump station at SBWRP with two sets of pumps – one set for transmission to direct reuse customers near SBWRP, and one set for transmission to combined direct reuse northern customers and groundwater recharge.
  - Recycled Water Pumps (to SBWRP Direct Users):
    - Capacity: 12.6 mgd (8,750 gpm) PHD
    - Pressure: 80 psi
    - Pumps: 3 pumps (2 operating + 1 spare), 4,400 gpm each, 250 HP each
  - Recycled Water Pumps (to Northern Direct Users and Storage Tank 3-3):
    - Capacity: 7.0 mgd (4,860 gpm)
    - Pressure: 250 psi
    - Pumps: 3 pumps (2 operating + 1 spare), 2,500 gpm each, 450 HP each

- Pump Station 3-2: Advanced water pump station at SBWRP for transmission to groundwater recharge.
  - Capacity: 14.2 mgd (9,860 gpm)
  - Pressure: 250 psi
  - Pumps: 4 pumps (3 operating + 1 spare), 3,300 gpm each, 600 HP each
- Pump Station 3-3: Recycled water pump station at an intermediate location for transmission to groundwater recharge.
  - Capacity: 5.0 mgd (3,475 gpm)
  - Pressure: 80 psi
  - Pumps: 3 pumps (2 operating + 1 spare), 1,750 gpm each, 100 HP each
- Storage Tank 3-1: Recycled water storage tank at SBWRP with capacity for direct reuse customers near SBWRP.
  - Capacity: 4.3 million gallons [4.2 million gallons (MDD) + 0.1 million gallons (pumping forebay)]
- Storage Tank 3-2: Advanced water storage tank at SBWRP with capacity for use as a pumping forebay.
  - Capacity: 0.2 million gallons
- Storage Tank 3-3: Recycled water storage tank at a northern location with capacity for direct reuse northern customers.
  - Capacity: 4.0 million gallons (MDD)

5.3.4 Conveyance Scenario 4

- Pipeline 4-1: Recycled water pipeline from SBWRP to Storage Tank 4-3 with capacity for direct reuse and groundwater recharge.
  - Capacity: 7.0 mgd [2.0 mgd (Direct Use, ADD) + 5.0 mgd (Basins)]
  - Velocity: 6 fps
  - Diameter: 20 inch
  - Length: 35,200 to 38,800 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 30 to 250 psi
- Pipeline 4-2: Recycled water pipeline from Storage Tank 4-3 to Recharge Basins with capacity for groundwater recharge.
  - Capacity: 5.0 mgd (Basins)
  - Velocity: 6 fps
  - Diameter: 16 inch
  - Length: 3,300 to 6,000 feet

- Material: AWWA C104 Ductile Iron Pipe
- Pressure: 15 to 80 psi

- Pipeline 4-3: Advanced water pipeline from SBWRP to Storage Tank 4-4 with capacity for groundwater recharge.
  - Capacity: 14.2 mgd (Basins)
  - Velocity: 6 fps
  - Diameter: 30 inch
  - Length: 24,500 to 28,200 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 30 to 100 psi

- Pipeline 4-4: Advanced water pipeline from Storage Tank 4-4 to Recharge Basins with capacity for groundwater recharge.
  - Capacity: 14.2 mgd (Basins)
  - Velocity: 6 fps
  - Diameter: 30 inch
  - Length: 13,900 to 16,600 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 15 to 150 psi

- Pump Station 4-1: Recycled water pump station at SBWRP with two sets of pumps – one set for transmission to direct reuse customers near SBWRP, and one set for transmission to combined direct reuse northern customers and groundwater recharge.
  - Recycled Water Pumps (to SBWRP Direct Users):
    - Capacity: 12.6 mgd (8,750 gpm) PHD
    - Pressure: 80 psi
    - Pumps: 3 pumps (2 operating + 1 spare), 4,400 gpm each, 250 HP each
  - Recycled Water Pumps (to Northern Direct Users and Storage Tank 4-3):
    - Capacity: 7.0 mgd (4,860 gpm)
    - Pressure: 250 psi
    - Pumps: 3 pumps (2 operating + 1 spare), 2,500 gpm each, 450 HP each

- Pump Station 4-2: Advanced water pump station at SBWRP for transmission to groundwater recharge and intermediate tank (Storage Tank 4-4).
  - Capacity: 14.2 mgd (9,860 gpm)
  - Pressure: 100 psi
  - Pumps: 4 pumps (3 operating + 1 spare), 3,300 gpm each, 250 HP each

- Pump Station 4-3: Recycled water pump station at an intermediate location for transmission to groundwater recharge.
  - Capacity: 5.0 mgd (3,475 gpm)

- Pressure: 80 psi
- Pumps: 3 pumps (2 operating + 1 spare), 1,750 gpm each, 100 HP each

- Pump Station 4-4: Advanced water pump station at an intermediate location for transmission to groundwater recharge
  - Capacity: 14.2 mgd (9,860 gpm)
  - Pressure: 150 psi
  - Pumps: 4 pumps (3 operating + 1 spare), 3,300 gpm each, 400 HP each
- Storage Tank 4-1: Recycled water storage tank at SBWRP with capacity for direct reuse customers near SBWRP.
  - Capacity: 4.3 million gallons [4.2 million gallons (MDD) + 0.1 million gallons (pumping forebay)]
- Storage Tank 4-2: Advanced water storage tank at SBWRP with capacity for use as a pumping forebay.
  - Capacity: 0.2 million gallons
- Storage Tank 4-3: Recycled water storage tank at a northern location with capacity for direct reuse northern customers.
  - Capacity: 4.0 million gallons (MDD)
- Storage Tank 4-4: Advanced water storage tank at an intermediate location for use as a pumping forebay and intermediate storage for groundwater recharge.
  - Capacity: 0.2 million gallons

5.3.5 Conveyance Scenario 5

- Pipeline 5-1: Recycled water pipeline from SBWRP to Advanced Treatment at Recharge Basins with capacity for combined direct reuse northern customers and treatment for groundwater recharge.
  - Capacity: 25.2 mgd [2.0 mgd (Direct Use, ADD) + 5.0 mgd (Basins) + 18.2 mgd (Advanced Treatment Plant)]
  - Velocity: 6 fps
  - Diameter: 36 inch
  - Length: 38,460 to 42,900 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 15 to 250 psi
- Pipeline 5-2: Brine pipeline from Advanced Treatment at Recharge Basins to SBWRP (IEBL Pipeline) with capacity for waste brine.
  - Capacity: 2.5 mgd (Brine)
  - Velocity: 6 fps

- Diameter: 12 inch
- Length: 38,460 to 42,900 feet
- Material: AWWA C104 Ductile Iron Pipe
- Pressure: 5 to 15 psi (Gravity line)

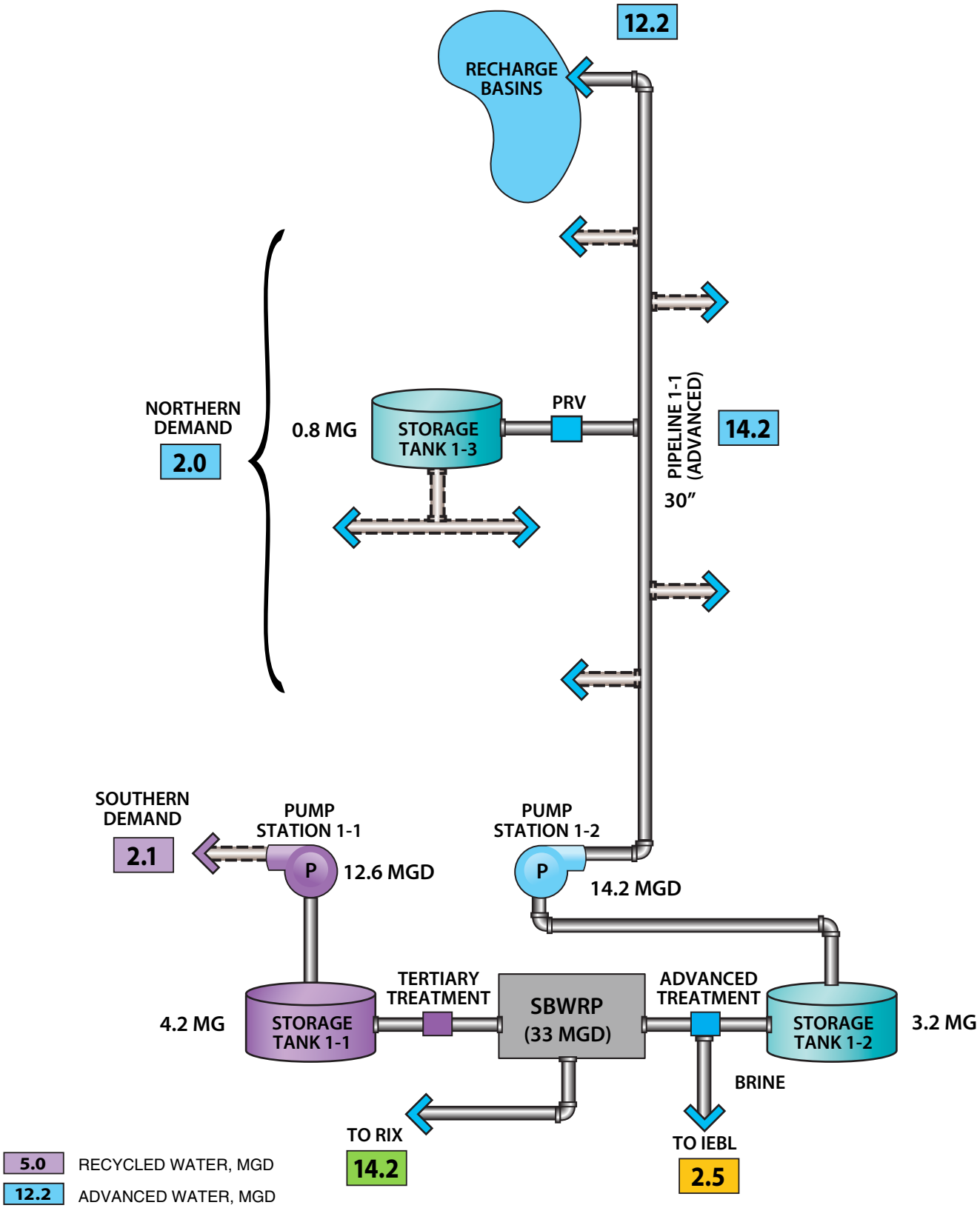
- Pump Station 5-1: Recycled water pump station at SBWRP with two sets of pumps – one set for transmission to direct reuse customers near SBWRP, and one set for transmission to combined direct reuse northern customers and advanced water treatment at Recharge Basins.
  - Recycled Water Pumps (to SBWRP Direct Users):
    - Capacity: 12.6 mgd (8,750 gpm) PHD
    - Pressure: 80 psi
    - Pumps: 3 pumps (2 operating + 1 spare), 4,400 gpm each, 250 HP each
  - Recycled Water Pumps (to Northern Direct Users, Advanced Treatment at Recharge Basins, and Storage Tank 5-2):
    - Capacity: 25.2 mgd (17,500 gpm)
    - Pressure: 250 psi
    - Pumps: 4 pumps (3 operating + 1 spare), 5,830 gpm each, 1,000 HP each
- Storage Tank 5-1: Recycled water storage tank at SBWRP with capacity for direct reuse customers near SBWRP and a portion of direct reuse northern customers.
  - Capacity: 7.4 million gallons [4.2 million gallons (MDD) + 3.2 million gallons (MDD)]
- Storage Tank 5-2: Recycled water storage tank at intermediate location with capacity for a portion of direct reuse northern customers.
  - Capacity: 0.8 million gallons (MDD)

5.3.6 Conveyance Scenario 6

- Pipeline 6-1: Recycled water pipeline from SBWRP to Storage Tank 6-2 with capacity for combined direct reuse northern customers and treatment for groundwater recharge.
  - Capacity: 25.2 mgd [2.0 mgd (Direct Use, ADD) + 5.0 mgd (Basins) + 18.2 mgd (Advanced Treatment Plant)]
  - Velocity: 6 fps
  - Diameter: 36 inch
  - Length: 24,500 to 28,200 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 30 to 100 psi

- Pipeline 6-2: Recycled water pipeline from Storage Tank 6-2 to Advanced Treatment at Recharge Basins with capacity for combined direct reuse northern customers and treatment for groundwater recharge
  - Capacity: 25.2 mgd [2.0 mgd (Direct Use, ADD) + 5.0 mgd (Basins) + 18.2 mgd (Advanced Treatment Plant)]
  - Velocity: 6 fps
  - Diameter: 36 inch
  - Length: 13,900 to 16,600 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 15 to 150 psi
- Pipeline 6-3: Brine pipeline from Advanced Treatment at Recharge Basins to SBWRP (IEBL Pipeline) with capacity for waste brine
  - Capacity: 2.5 mgd (Brine)
  - Velocity: 6 fps
  - Diameter: 12 inch
  - Length: 38,460 to 42,900 feet
  - Material: AWWA C104 Ductile Iron Pipe
  - Pressure: 5 to 15 psi (Gravity line)
- Pump Station 6-1: Recycled water pump station at SBWRP with two sets of pumps – one set for transmission to direct recycled water reuse customers near SBWRP and one set for transmission to combined direct water reuse northern customers and advanced water treatment at Recharge Basins and intermediate tank (Storage Tank 6-2).
  - Recycled Water Pumps (to SBWRP Direct Users):
    - Capacity: 12.6 mgd (8,750 gpm) PHD
    - Pressure: 80 psi
    - Pumps: 3 pumps (2 operating + 1 spare), 4,400 gpm each, 250 HP each
  - Recycled Water Pumps (to Northern Direct Users, Advanced Treatment at Recharge Basins, and Storage Tank 6-2):
    - Capacity: 25.2 mgd (17,500 gpm)
    - Pressure: 100 psi
    - Pumps: 4 pumps (3 operating + 1 spare), 5,830 gpm each, 450 HP each
- Pump Station 6-2: Recycled water pump station at an intermediate location for transmission to a portion of direct reuse northern customers and advanced water treatment at Recharge Basins.
  - Capacity: 25.2 mgd (17,500 gpm)
  - Pressure: 150 psi
  - Pumps: 4 pumps (3 operating + 1 spare), 5,830 gpm each, 600 HP each

- Storage Tank 6-1: Recycled water storage tank at SBWRP with capacity for direct reuse customers near SBWRP and a portion of direct reuse northern customers.
  - Capacity: 5.8 million gallons [4.2 million gallons (MDD) + 1.6 million gallons (MDD)]
- Storage Tank 6-2: Recycled water storage tank at an intermediate location with capacity for a portion of direct reuse northern customers.
  - Capacity: 2.4 million gallons (MDD)



CONVEYANCE SCENARIO 1

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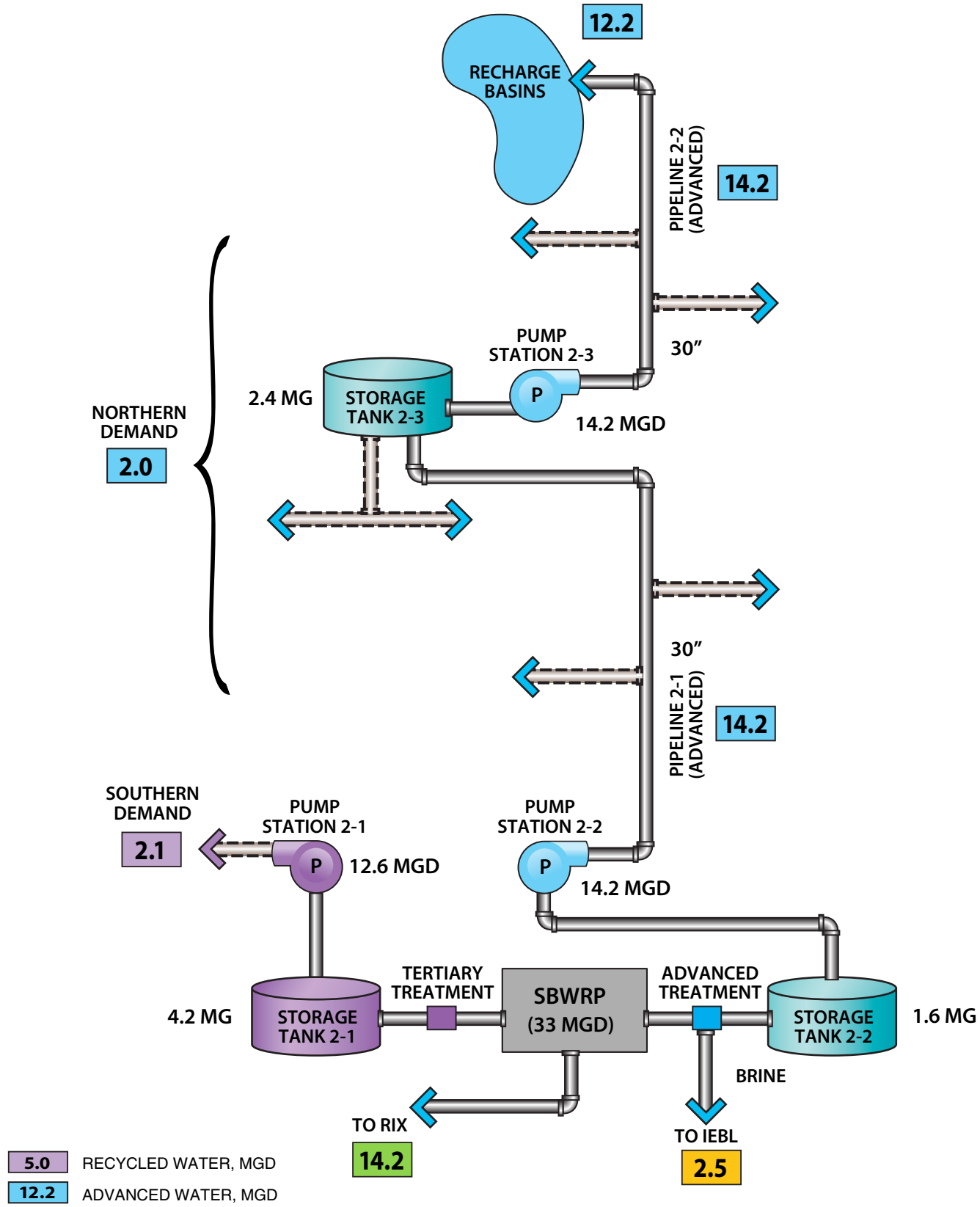
Conveyance Scenarios Facility Sizing

Figure 5-1



CONVEYANCE SCENARIO 2

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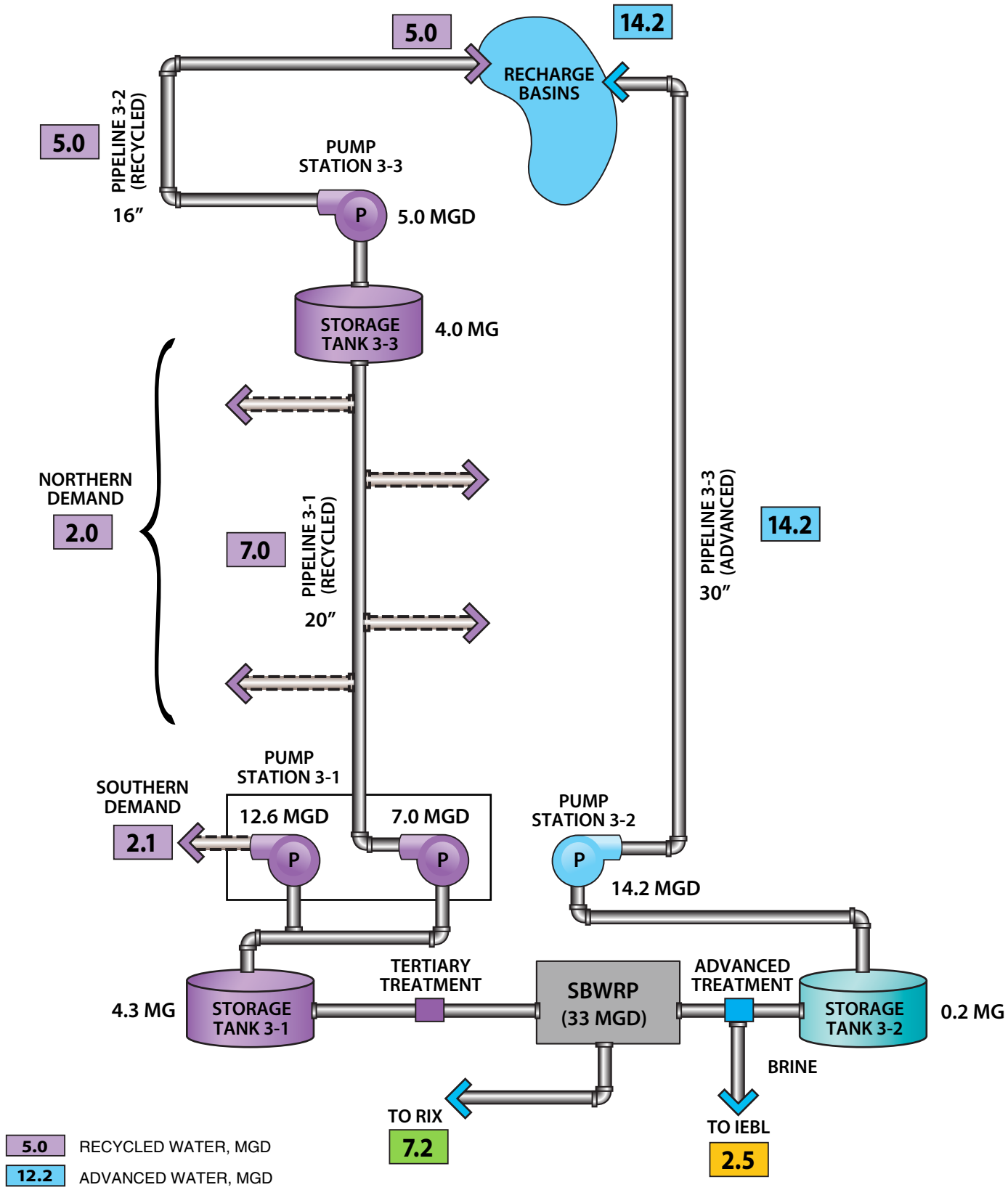
Conveyance Scenarios Facility Sizing

Figure 5-2



CONVEYANCE SCENARIO 3

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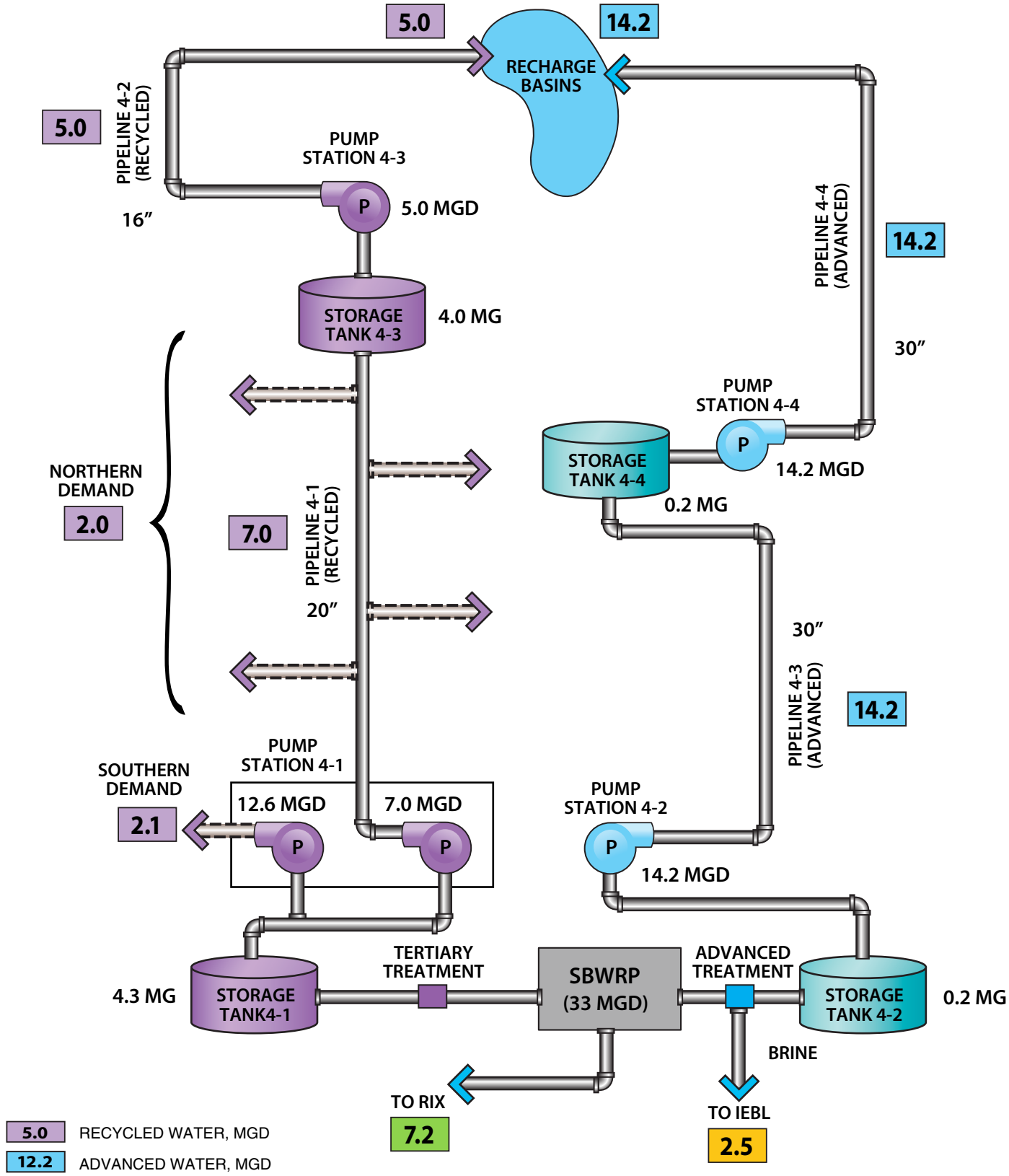
Conveyance Scenarios Facility Sizing

Figure 5-3



CONVEYANCE SCENARIO 4

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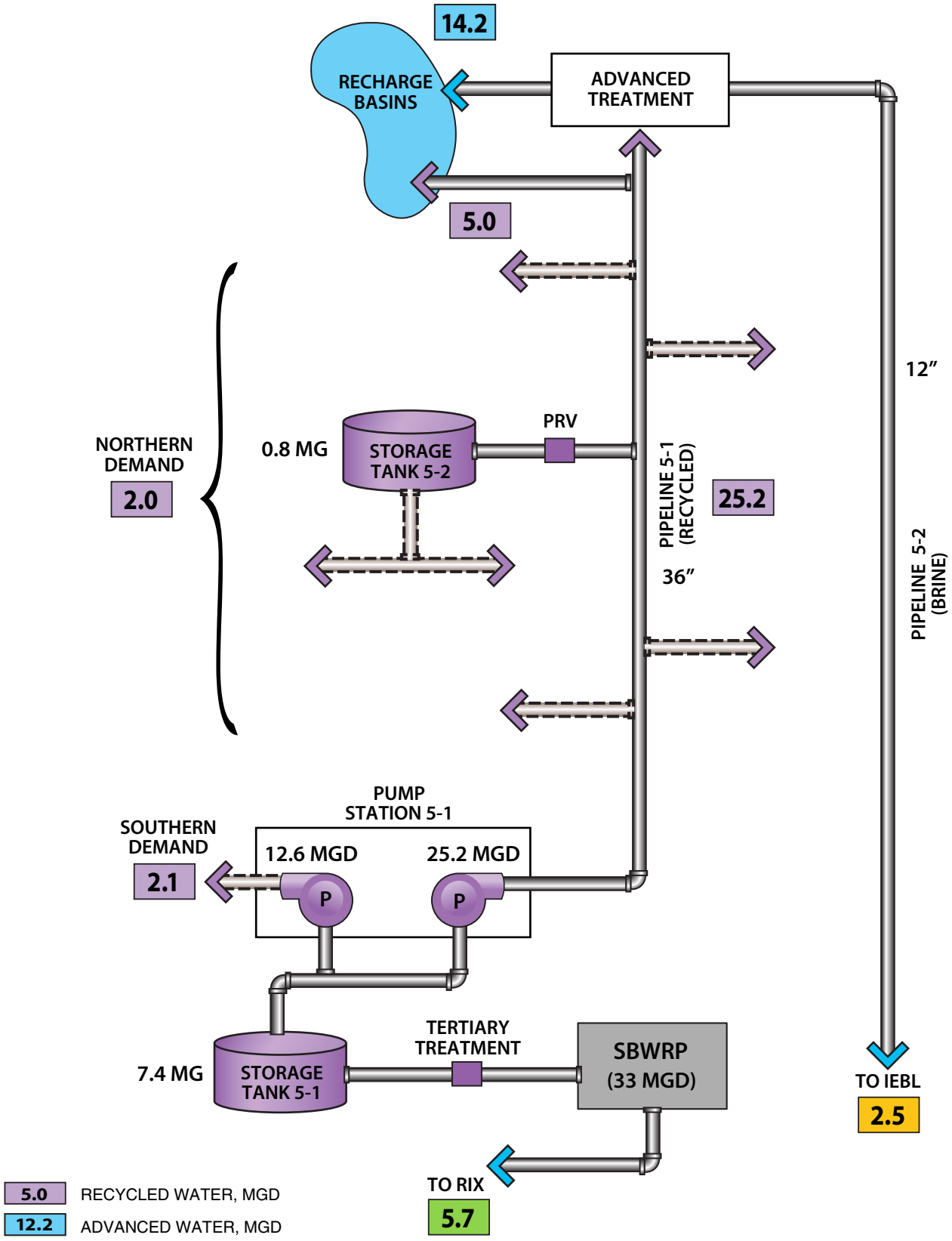
Conveyance Scenarios Facility Sizing

Figure 5-4



CONVEYANCE SCENARIO 5

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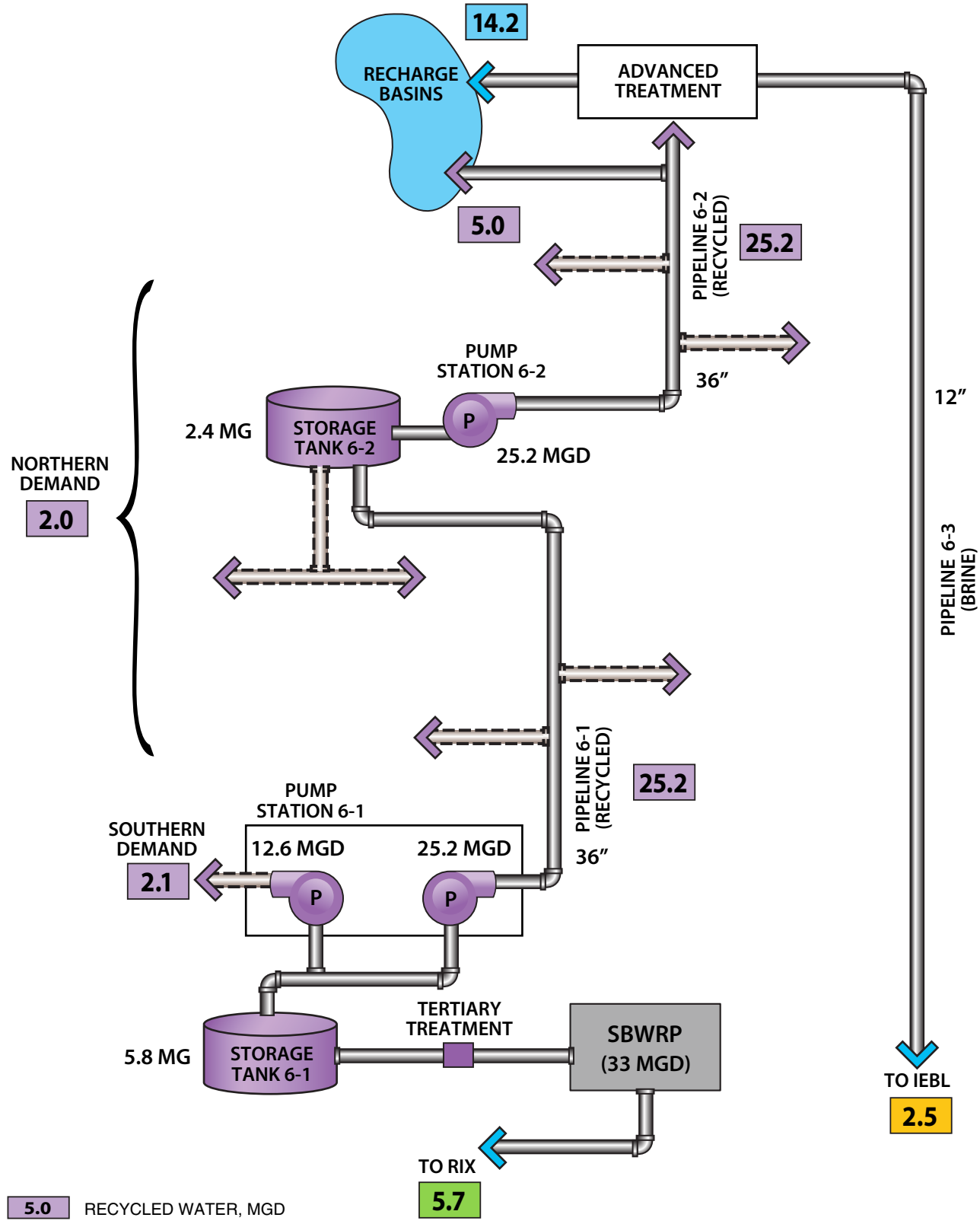
Conveyance Scenarios Facility Sizing

Figure 5-5



CONVEYANCE SCENARIO 6

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SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Conveyance Scenarios Facility Sizing

Figure 5-6

6.0 PRELIMINARY HYDRAULIC ANALYSIS

A preliminary hydraulic analysis was conducted utilizing the preliminary facility sizing criteria described in Section 5 for pipelines, pump stations, and storage tanks for each conveyance scenario. The hydraulic analysis calculations are included in Appendix B. The preliminary hydraulic analysis was conducted for the six Conveyance Scenarios and three Alignment Options. A Hazen-Williams coefficient of C=130 was utilized for pipelines with a diameter greater than 12-inches and a C=120 for pipelines with a diameter of 12-inches or less. The calculated total head loss (friction and minor losses) for delivery from the SBWRP to the spreading basins varied from approximately 90 to 100 feet. Hydraulic profiles for Conveyance Scenarios 1-6 are shown on Figures 6-1 to 6-9.

6.1 ADVANCED TREATED WATER CONVEYANCE FACILITIES

Conveyance Scenarios 1 through 4 include advanced treated water facilities. Operations for each conveyance scenario for advanced treated water were considered to develop the hydraulic analysis and are described below.

Conveyance Scenario 1 – Advanced treated water will be produced at the SBWRP with brine concentrate discharged to the IEBL and product water delivered to a finished water storage tank on site (Storage Tank 1-2). The finished water storage tank was sized for distribution of MDD to direct use northern customers. Peak hour direct use demands can be met with the storage volume. Seasonal direct use demands will fluctuate and can be addressed by adjusting flows to Recharge Basins. The pump station (Pump Station 1-2) will be located on site and will use Storage Tank 1-2 as the forebay and will pump to direct use northern customers, Storage Tank 1-3, and to the Recharge Basins. The delivery to multiple locations allows flexibility to serve varying direct use demands and overall annual input to the Recharge Basins. Pressure to Storage Tank 1-3 will be reduced with a pressure regulating valve (PRV). Storage Tank 1-3 will serve a selected group of direct users in an intermediate location along the alignment.

Conveyance Scenario 2 – Advanced treated water will be produced at the SBWRP with brine concentrate discharged to the IEBL and product water delivered to a finished water storage tank on site (Storage Tank 2-2). The finished water storage tank was sized for distribution of MDD to a portion of direct use northern customers. Peak hour direct use demands can be met with the storage volume. The pump station (Pump Station 2-2) will be located on site and will use Storage Tank 2-2 as the forebay and will pump to a portion direct use northern customers and Storage Tank 2-3. Storage Tank 2-3 will be located at an intermediate location along the alignment and will serve a selected group of direct users. Pump Station 2-3 will be located at the same intermediate location and will use Storage Tank 2-3 as a forebay and will pump to a portion of direct use northern customers and to the Recharge Basins. Seasonal direct use demands will fluctuate and can be addressed by adjusting overall flows to the Recharge Basins.

Conveyance Scenario 3 – Advanced treated water will be produced at the SBWRP with brine concentrate discharged to the IEBL and product water delivered to a finished water storage tank on site (Storage Tank 3-2). The finished water storage tank was sized as a forebay only for Pump Station 3-2. The pump station (Pump Station 3-2) will be located on site and will use Storage Tank 3-2 as the forebay and will pump to the Recharge Basins.

Conveyance Scenario 4 – Advanced treated water will be produced at the SBWRP with brine concentrate discharged to the IEBL and product water delivered to a finished water storage tank on site (Storage Tank 4-2). The finished water storage tank was sized as a forebay only for Pump Station 4-2. The pump station (Pump Station 4-2) will be located on site and will use Storage Tank 4-2 as the forebay and will pump to Storage Tank 4-4. Storage Tank 4-4 will be located at an intermediate location along the alignment and will allow two head lifts of advanced treated water to reduce pipeline pressures. Pump Station 4-4 will be located at the same intermediate location and will use Storage Tank 4-4 as a forebay and will pump to the Recharge Basins.

6.2 RECYCLED WATER CONVEYANCE FACILITIES

Conveyance Scenarios 1 through 6 include recycled water facilities. Operations for each conveyance scenario were considered for recycled water to develop the hydraulic analysis and are described below.

Conveyance Scenarios 1 and 2 – Recycled water will be produced at the SBWRP with product water delivered to a finished water storage tank on site (Storage Tank 1-1 or 2-1). The finished water storage tank was sized for distribution of MDD to direct use customers near the SBWRP. Peak hour direct use demands can be met with varying pumping rate. Seasonal direct use demands will fluctuate and can be addressed by varying the tertiary water produced at the treatment plant, releasing excess tertiary water to the RIX facility and Santa Ana River, or providing a large seasonal storage tank. The pump station (Pump Station 1-1 or 2-1) will be located on site and will use the finished water storage tank as the forebay and will pump to direct use customers near the SBWRP.

Conveyance Scenario 3 and 4 – Recycled water will be produced at the SBWRP with product water delivered to a finished water storage tank on site (Storage Tank 3-1 or 4-1). The finished water storage tank was sized for distribution of MDD to direct use customers near the SBWRP and as a forebay for pumping to northern direct use customers. Peak hour direct use demands can be met with varying pumping rate. The pump station (Pump Station 3-1 or 4-1) will be located on site and will use the finished water storage tank as the forebay and one set of pumps will pump to direct use customers near the SBWRP, and another set of pumps will pump to direct use northern customers and a northern storage tank (Storage Tank 3-3 or 4-3). Peak hour direct use northern customer demands will be met with Storage Tank 3-3 or 4-3. Storage Tank 3-3 or 4-3 will be located at a northern location along the alignment and will serve direct use northern customers. Pump Station 3-3 or 4-3 will be located at the same northern location and

will use northern storage tank (Storage Tank 3-3 or 4-3) as a forebay and will pump to the Recharge Basins. Seasonal direct use demands will fluctuate and can be addressed by adjusting overall flows to the Recharge Basins.

Conveyance Scenario 5 – Recycled water will be produced at the SBWRP with product water delivered to a finished water storage tank on site (Storage Tank 5-1). The finished water storage tank was sized for distribution of MDD to direct use customers near the SBWRP. Peak hour direct use demands can be met with varying pumping rate. The pump station (Pump Station 5-1) will be located on site and will use the finished water storage tank as the forebay and one set of pumps will pump to direct use customers near the SBWRP, and another set of pumps will pump to direct use northern customers, Storage Tank 5-2, the Recharge Basins, and to advanced treatment at the Recharge Basins. The delivery to multiple locations allows flexibility to serve varying direct use demands and overall annual input to the Recharge Basins. Pressure to Storage Tank 5-2 will be reduced with a pressure regulating valve (PRV). Storage Tank 5-2 will serve a selected group of direct users in an intermediate location along the alignment. Seasonal direct use demands will fluctuate and can be addressed by adjusting overall flows to the Recharge Basins. A pipeline will be required to convey brine from the advanced treatment at the Recharge Basins to the SBWRP and IEBL.

Conveyance Scenario 6 – Recycled water will be produced at the SBWRP with product water delivered to a finished water storage tank on site (Storage Tank 6-1). The finished water storage tank was sized for distribution of MDD to direct use customers near the SBWRP. Peak hour direct use demands can be met with varying pumping rate. The pump station (Pump Station 6-1) will be located on site and will use the finished water storage tank as the forebay and one set of pumps will pump to direct use customers near the SBWRP, and another set of pumps will pump to direct use northern customers and Storage Tank 6-2. Storage Tank 6-2 will serve a selected group of direct users in an intermediate location along the alignment. Pump Station 6-2 will be located at the same intermediate location and will use Storage Tank 6-2 as a forebay and will pump to a portion of direct use northern customers, to the Recharge Basins, and to advanced treatment at the Recharge Basins. Seasonal direct use demands will fluctuate and can be addressed by adjusting overall flows to the Recharge Basins. A pipeline will be required to convey brine from the advanced treatment at the Recharge Basins to the SBWRP and IEBL.

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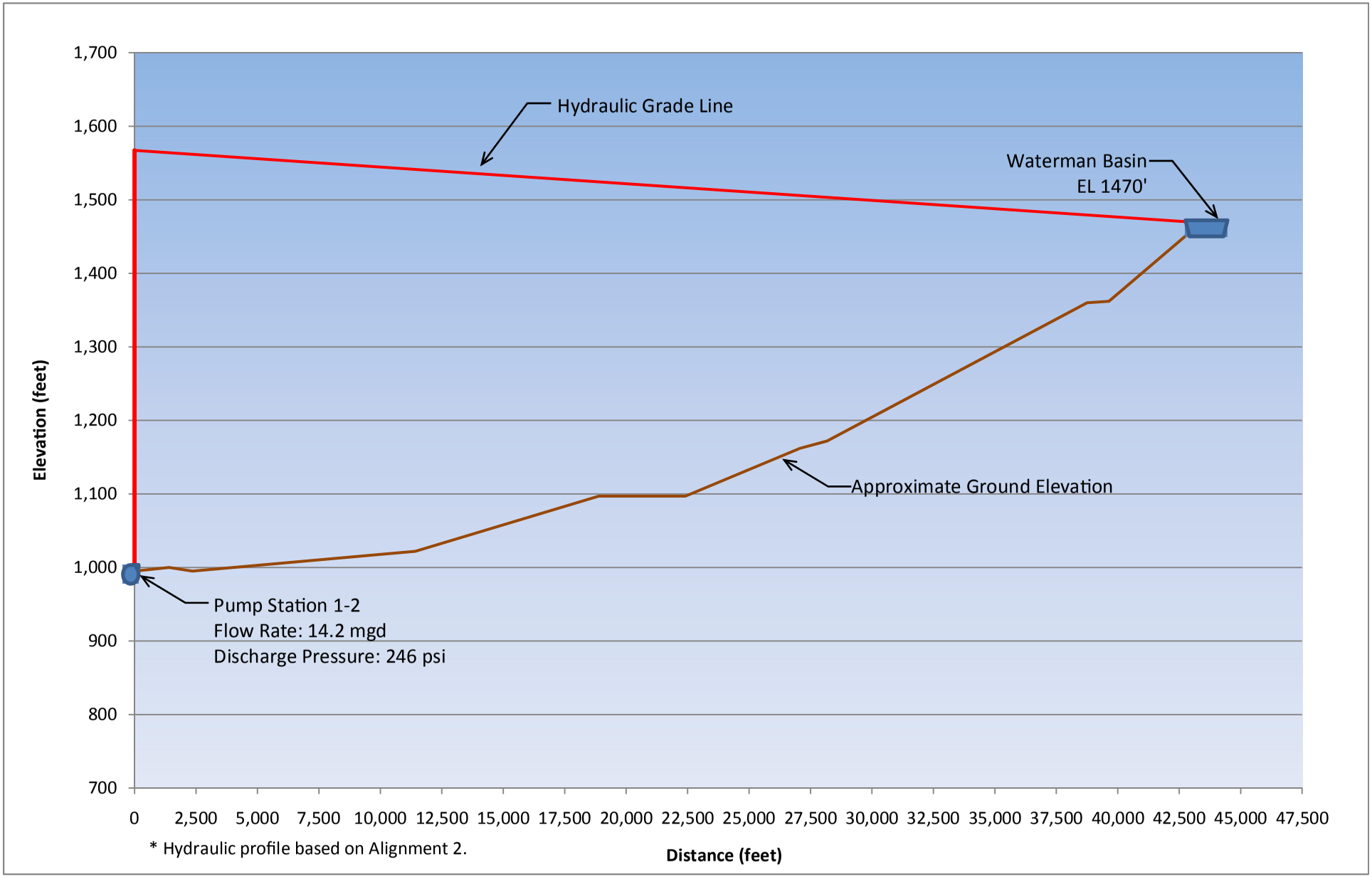

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Hydraulic Profile
Pipeline 1-1: Advanced Treated Water

Figure 6-1

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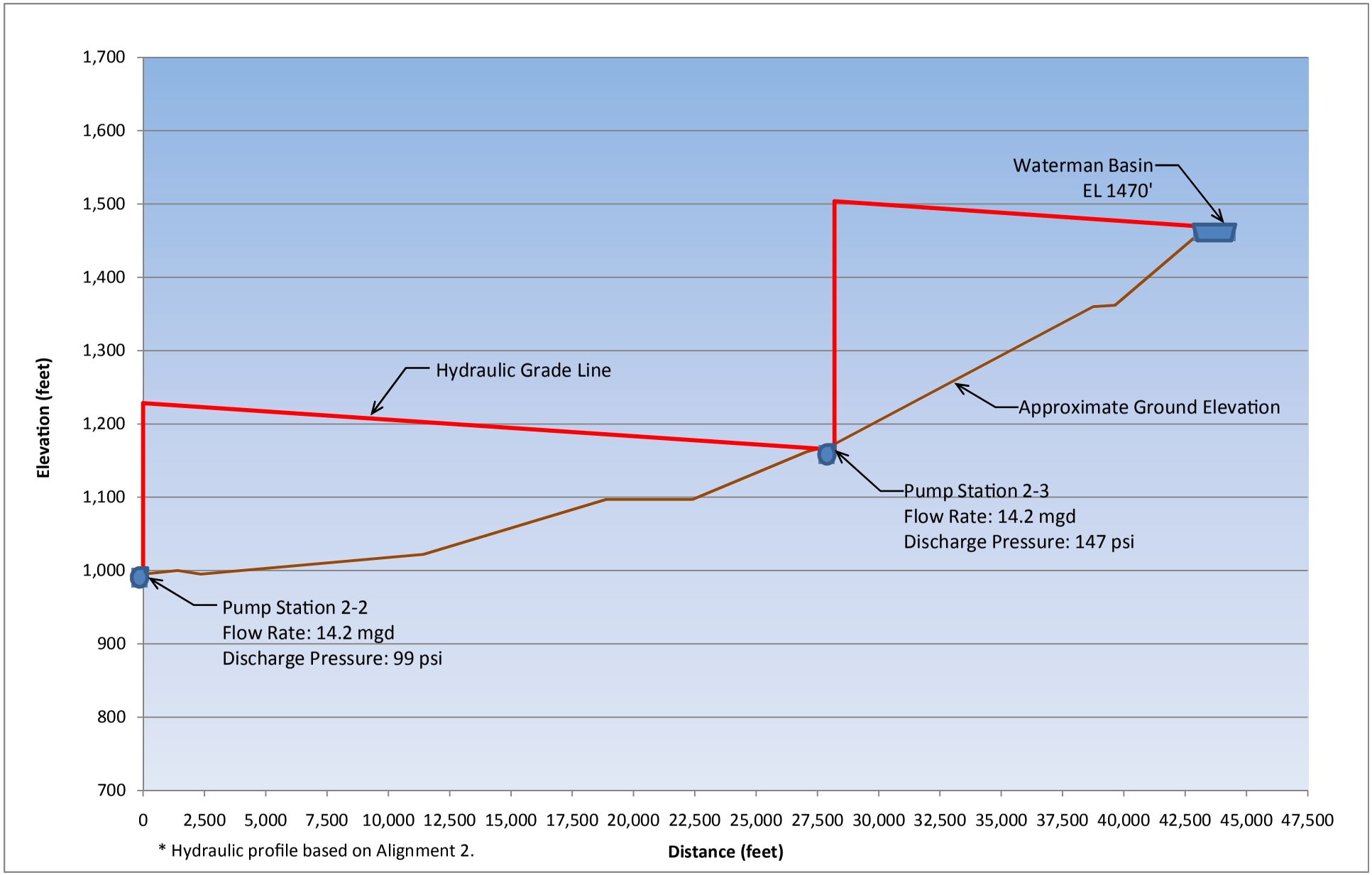

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SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Hydraulic Profile
Pipelines 2-1 & 2-2: Advanced Treated Water

Figure 6-2

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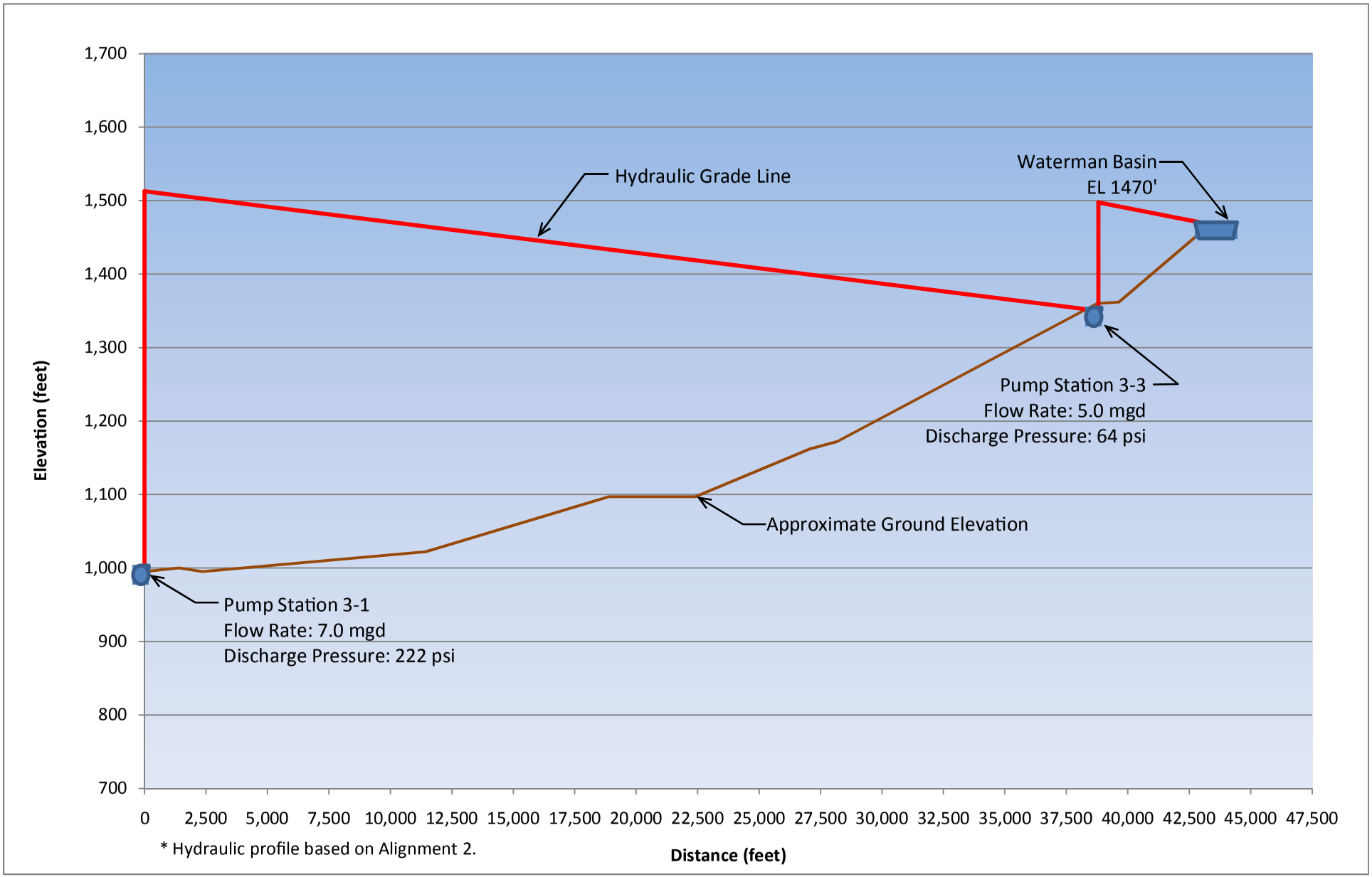

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Hydraulic Profile
Pipelines 3-1 and 3-2: Recycled Water

Figure 6-3

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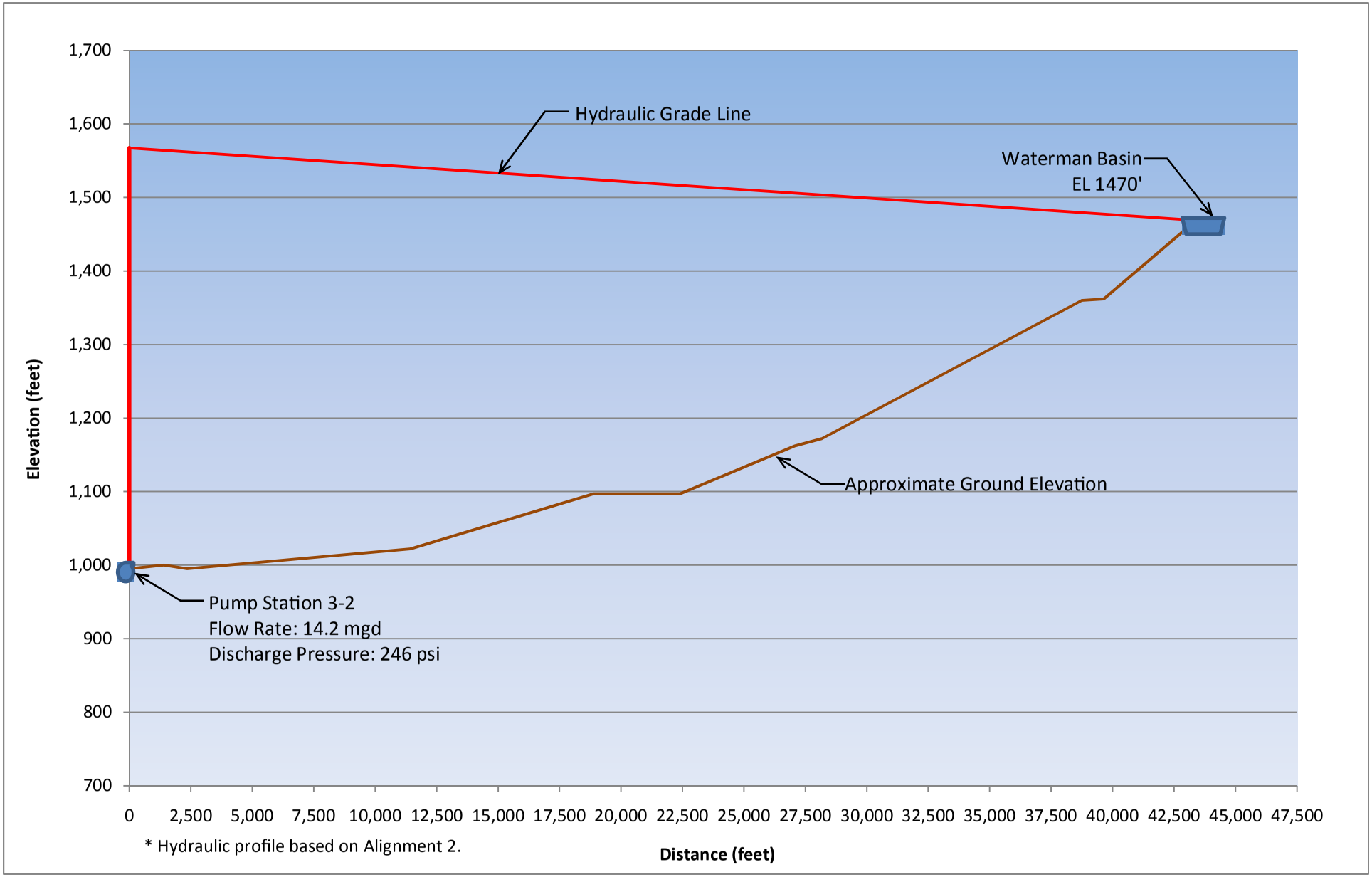

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SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Hydraulic Profile
Pipeline 3-3: Advanced Treated Water

Figure 6-4

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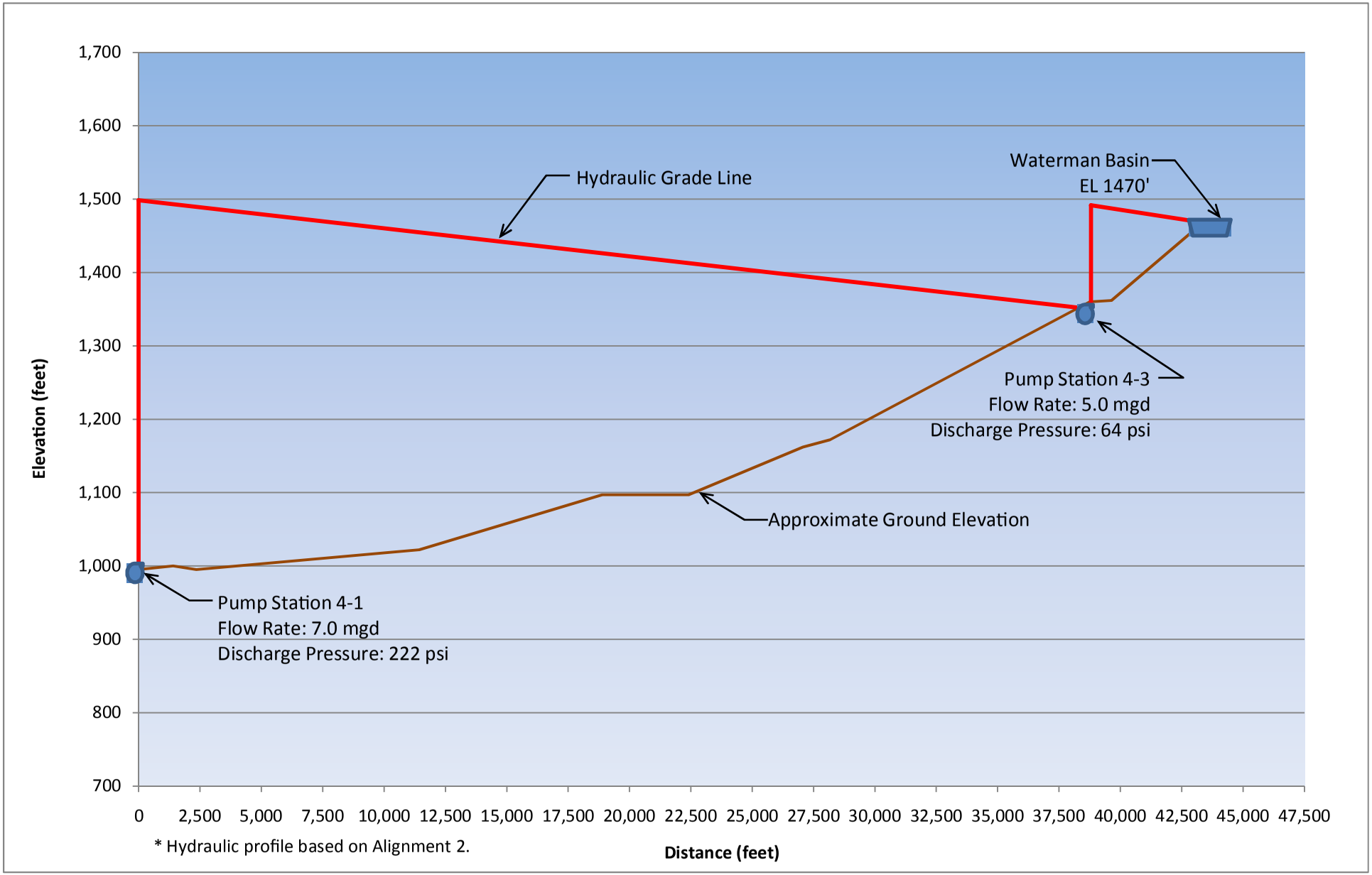

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SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Hydraulic Profile
Pipelines 4-1 & 4-2: Recycled Water

Figure 6-5

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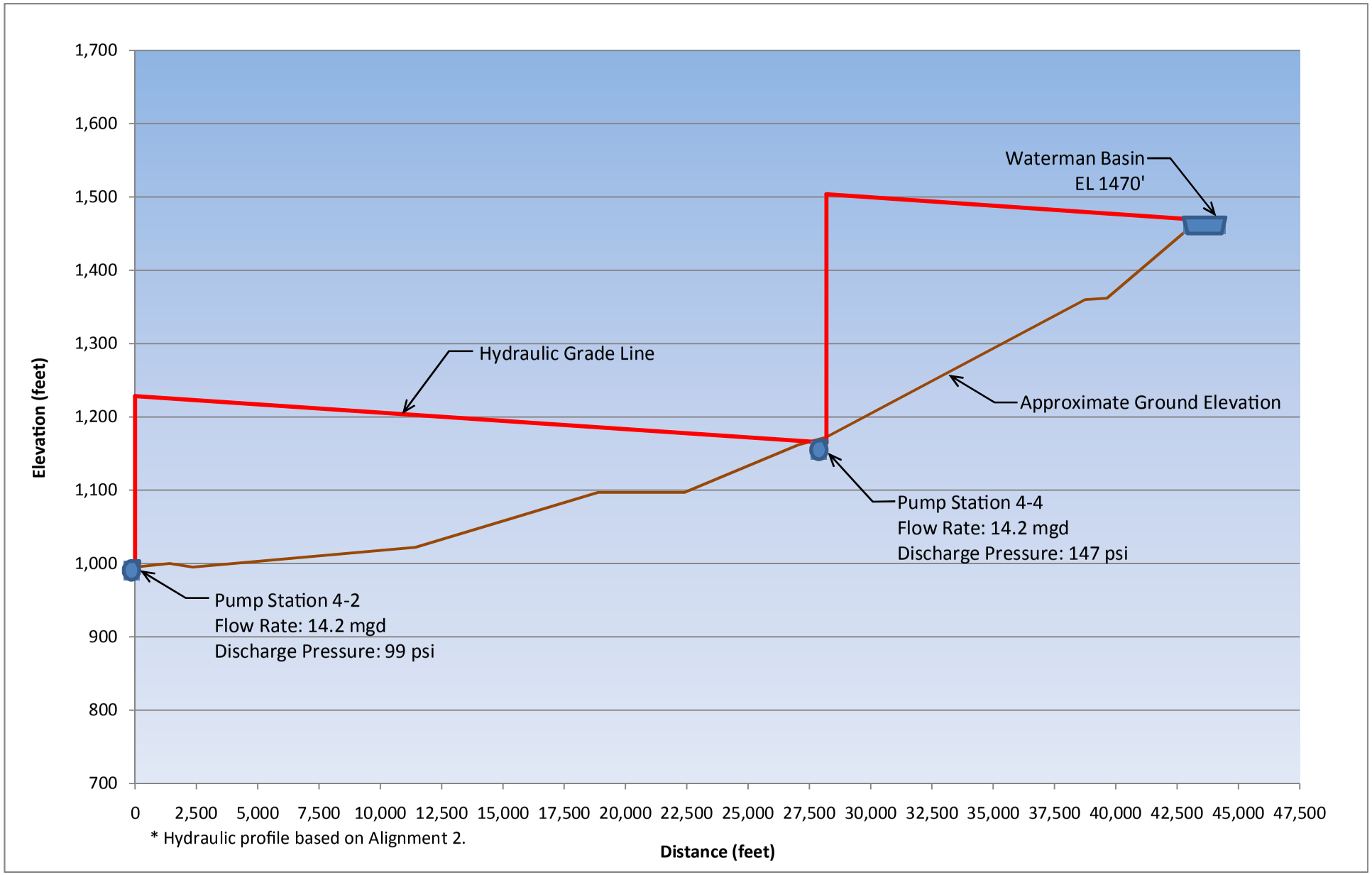

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SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Hydraulic Profile
Pipelines 4-3 & 4-4: Advanced Treated Water

Figure 6-6

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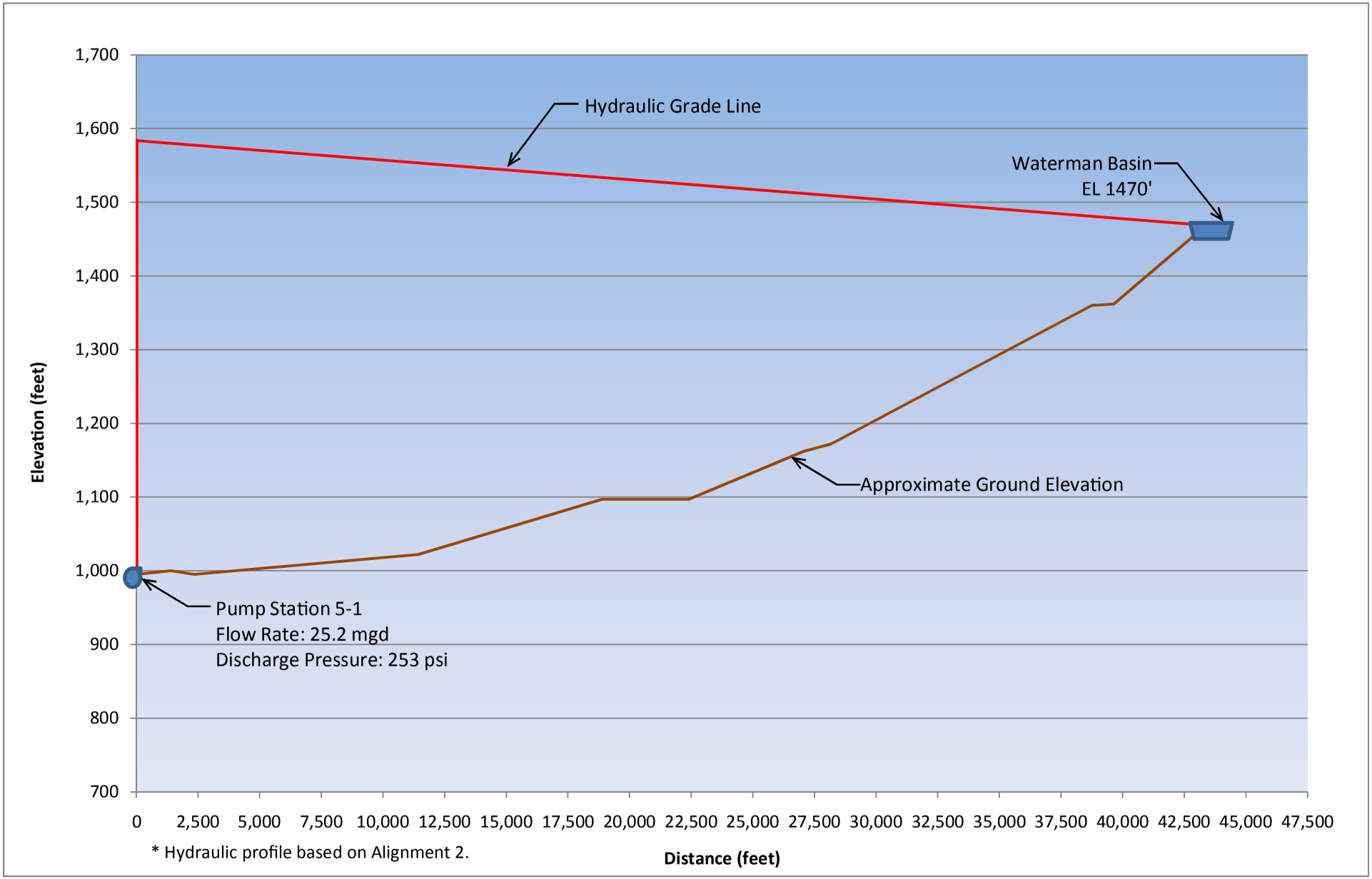

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SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Hydraulic Profile
Pipeline 5-1: Recycled Water

Figure 6-7

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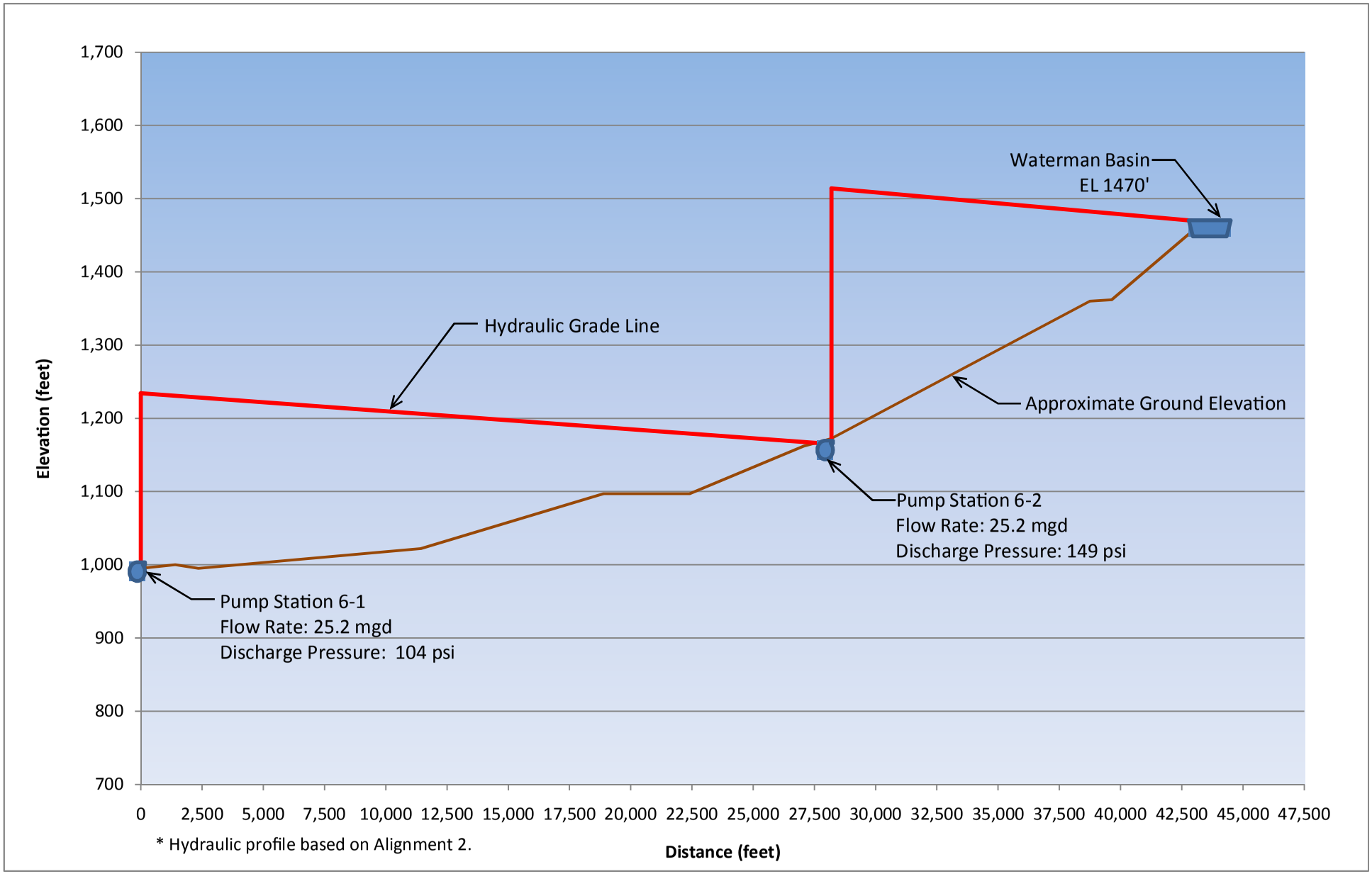

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SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Hydraulic Profile
Pipelines 6-1 & 6-2: Recycled Water

Figure 6-8

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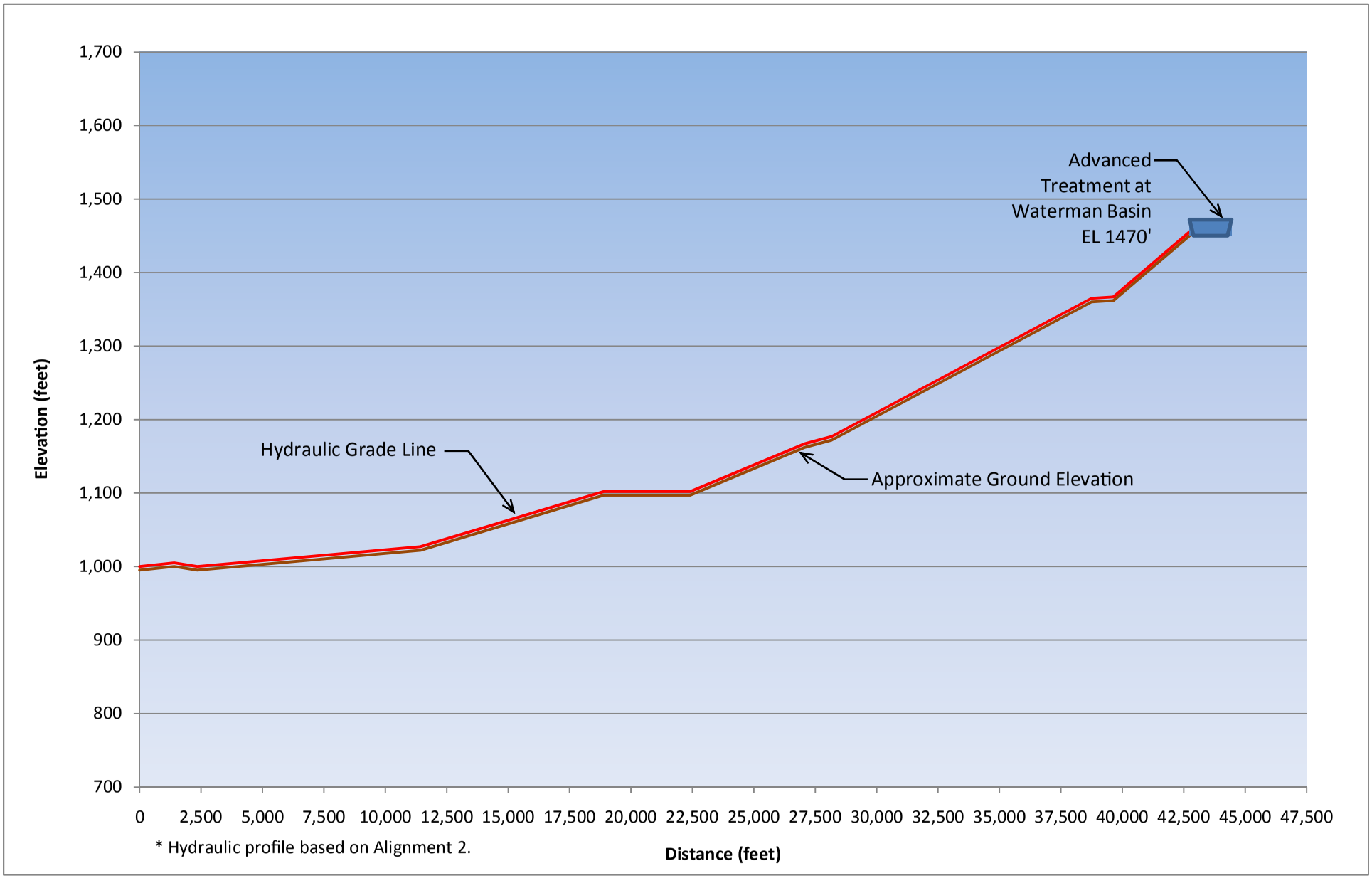

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Hydraulic Profile
Pipeline 5-1 & 6-1: Brine Water

Figure 6-9

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7.0 FACILITY REQUIREMENTS

As discussed in the preceding sections, there will be pumping facilities located at the SBWRP and, depending on the conveyance scenario that is selected, there may be intermediate pump station and reservoir sites between the SBWRP and the Recharge Basins. To assist the SBMWD in determining the facility space and land acquisition requirements, we have developed typical site layouts for a reservoir site, a pumping station site, and a site which combines both facilities.

7.1 TYPICAL STORAGE RESERVOIR SITE

It is assumed that an individual storage reservoir site would include one circular reservoir constructed of either welded steel or prestressed concrete. In order to determine typical site requirements, we have assumed the following:

- Minimum 25-foot clear drivable access around entire reservoir.
- One side of reservoir to have 45-foot clear space to ensure space for yard piping, valve vaults, electrical equipment and vehicle access.
- Landscaping buffer 10 feet wide on all sides.
- 30-foot-wide driveway access and 20-foot wide gate.
- Fencing on property lines and right-of-way line.

The minimum amount of land required will be dependent on the size of storage reservoir, as shown on Figure 7-1. For example, a 100-foot diameter reservoir will require a parcel with minimum dimensions of 170 feet x 190 feet, or approximately 0.75 acres.

7.2 TYPICAL PUMPING STATION SITE

It is assumed that an individual pumping station site would include a simple rectangular building of concrete masonry unit (CMU) block construction. It is anticipated that the building will house pumps and electrical equipment. In order to determine typical site requirements, we have assumed the following:

- Minimum 25-foot clear drivable access around entire building.
- 50-foot clear space from the building on two sides to ensure space for yard piping, valve vaults, flow meter, surge tank, electrical equipment, and space provisions for connecting a portable backup generator.
- Landscaping buffer 10 feet wide on all sides.
- 30-foot-wide driveway access and 20-foot wide gate.
- Fencing on property lines and right-of-way line.

The minimum amount of land required will be dependent on the size of the building, as shown on Figure 7-1. For example, a 20 foot x 40 foot building will require a parcel with minimum dimensions of 115 feet x 135 feet, or approximately 0.36 acres.

7.3 TYPICAL COMBINED STORAGE RESERVOIR/PUMPING STATION SITE

Two optional configurations have been developed for a site that combines a storage reservoir and pump station. It is assumed that the site would accommodate one circular reservoir constructed of either welded steel or prestressed concrete, and one rectangular CMU block pump building. The difference between the options is the orientation of the pump building as shown on Figure 7-2. In order to determine typical site requirements, we have assumed the following:

Option A

- Minimum 25-foot clear drivable access around entire reservoir and building footprints.
- A minimum of 40 feet clear between the reservoir and pump building.
- A 50-foot clear area immediately in front of the access driveway to ensure space for yard piping, valve vaults, flow meter, surge tank, electrical equipment, and space provisions for connecting a portable backup generator.
- Landscaping buffer 10 feet wide on all sides.
- 30-foot-wide driveway access and 20-foot wide gate.
- Fencing on property lines and right-of-way line.

The minimum amount of land required will be dependent on the sizes of the reservoir and building, as shown on Figure 7-2. For example, a 100 foot diameter reservoir and a 20 foot x 40 foot building will require a parcel with minimum dimensions of 170 feet x 250 feet, or approximately 0.98 acres.

Option B

- Minimum 25-foot clear drivable access around entire reservoir and building footprints.
- A minimum of 40 feet clear between the reservoir and pump building.
- A 50-foot clear area immediately in front of the access driveway to ensure space for yard piping, valve vaults, flow meter, surge tank, electrical equipment, and space provisions for connecting a portable backup generator.
- Landscaping buffer 10 feet wide on all sides.
- 20-foot-wide driveway access centered between the reservoir and pump building.
- Fencing on property lines and right-of-way line.

The minimum amount of land required will be dependent on the sizes of the reservoir and building, as shown on Figure 7-2. For example, a 100 foot diameter reservoir and a 20 foot x 40 foot building will require a parcel with minimum dimensions of 170 feet x 240 feet, or approximately 0.94 acres.

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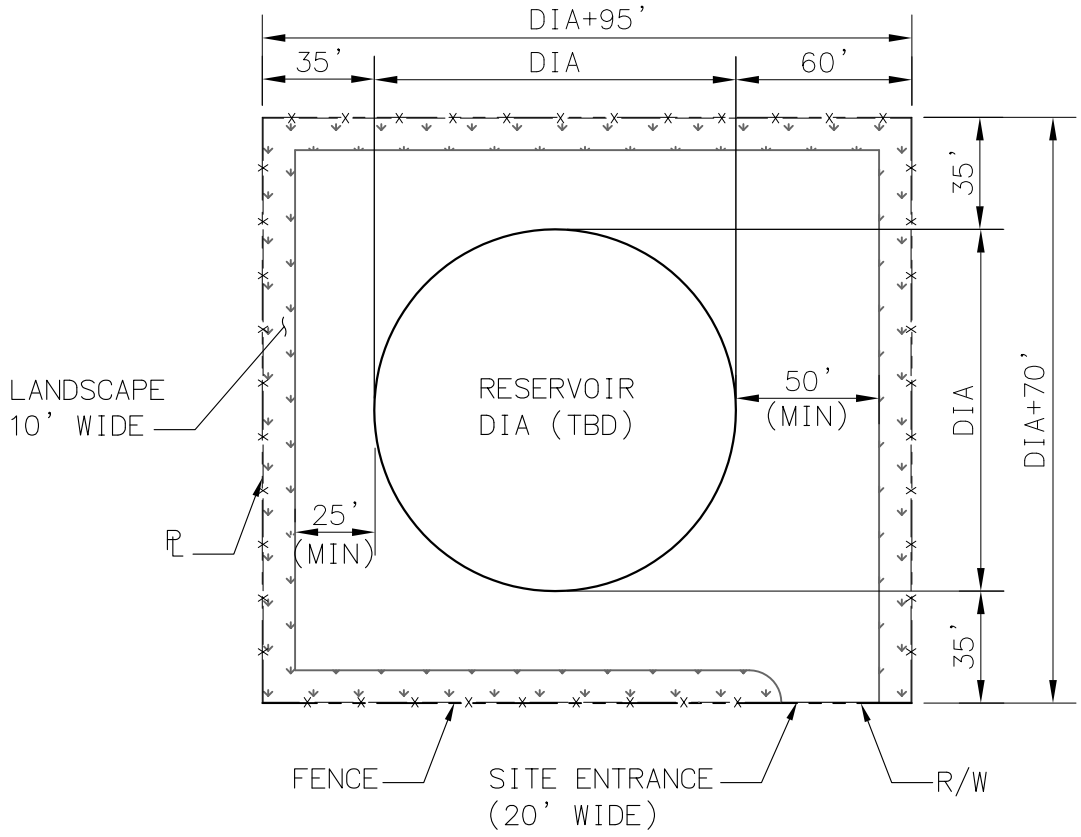
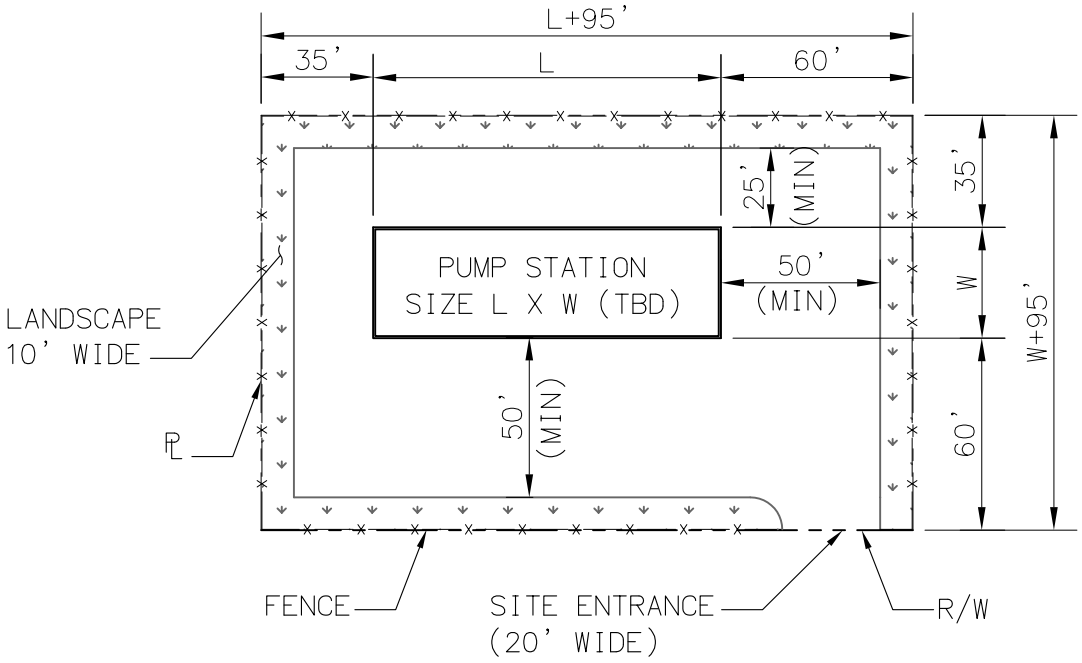


RESERVOIR SITE PLAN
NTS



PUMP STATION SITE PLAN
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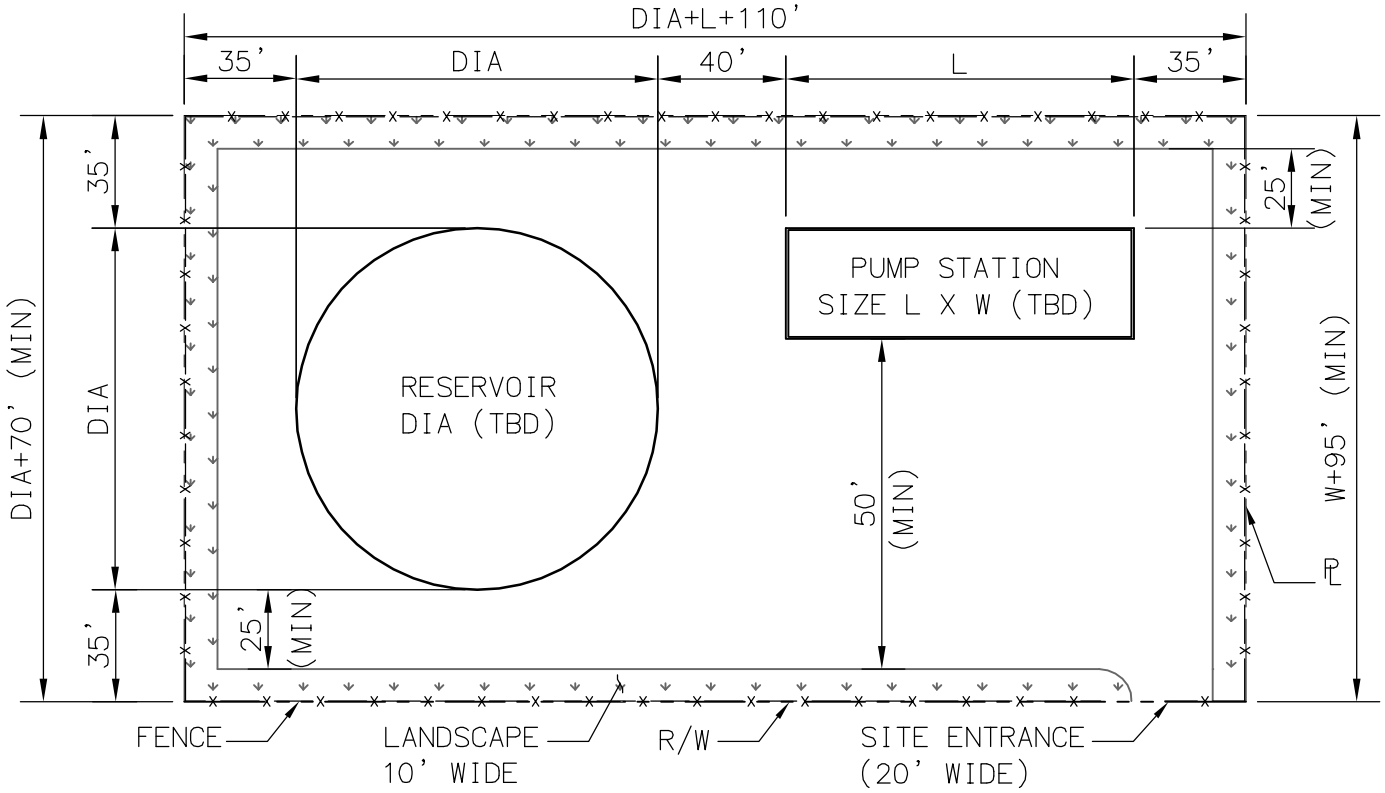
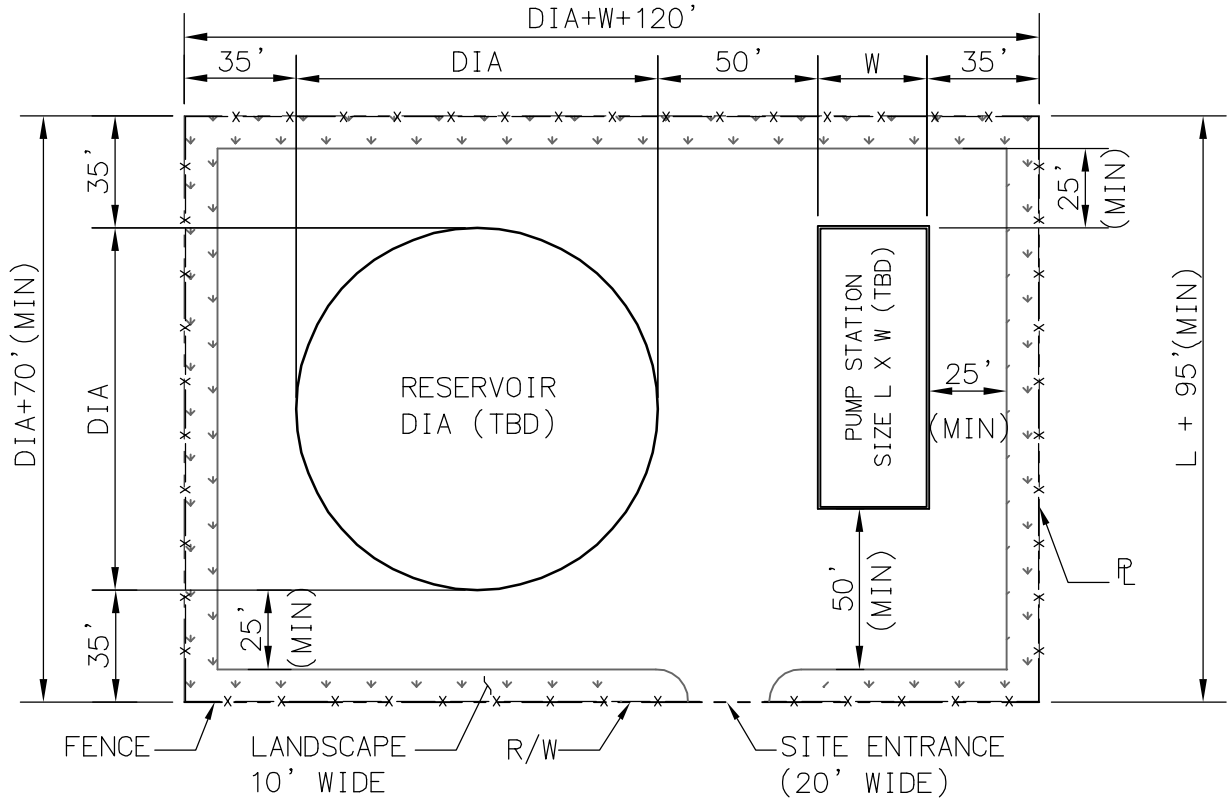
Separate Reservoir and Pump Station Sites

Figure 7-1



RESERVOIR/ PUMP STATION SITE PLAN (OPTION A)

NTS



RESERVOIR/ PUMP STATION SITE PLAN (OPTION B)

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Combined Reservoir and Pump Station Sites

Figure 7-2

8.0 PIPELINE ALIGNMENT ANALYSIS

8.1 OVERVIEW

An alignment analysis was conducted to evaluate potential transmission pipeline alignments between the SBWRP and the Recharge Basins, located approximately seven miles north. As part of this study, a Conveyance Facility Corridor was identified that provides a relatively direct route from the SBWRP to the Recharge Basins. To develop general pipeline alignment options within the Corridor, a total of 27 segments were identified in public streets and along the San Bernardino County Flood Control District right-of-way (shown on Figures 4-1 to 4-5).

The SBMWD then identified four preferred Alignment Options, which were analyzed in further detail and subsequently refined. This analysis included identifying agency and regulatory requirements associated with the transmission pipeline facilities, reviewing existing record information, identifying existing utilities for each alignment, and developing cross-sections to depict critical crossings. The refined Alignment Options are shown on Figures 8-1 and 8-2, and their lengths are summarized on Table A-2 in Appendix A. An evaluation of the preferred Alignment Options, based on the evaluation factors and rating of each alignment, is presented in this Section.

8.2 POTENTIAL CORRIDORS/SEGMENTS

There are four preferred alignments for the various transmission pipeline segments. For Conveyance Scenarios with two pipelines (Scenarios 3 through 6), Alignment Options are described below. For Conveyance Scenarios with one combined pipeline (Scenarios 1 and 2), only one pipeline would be constructed in Alignment Option 1, 2, or 3.

1. Alignment Option 1 - Two pipelines (recycled water and advanced water) in one trench along Twin Creek channel.
2. Alignment Option 2 - Two pipelines (recycled water and advanced water) along public streets. Streets include Arrowhead Avenue, Sierra Way, Crestview Avenue, and Valencia Avenue.
3. Alignment Option 3 - Two pipelines (recycled and advanced) along public streets. Streets include Arrowhead Avenue, Sierra Way, and Waterman Avenue.
4. Alignment Option 4 - Consists of Alignment Option 1 for the advanced pipeline and Alignment Option 2 for recycled pipeline.

Additional distribution pipelines are required to deliver recycled water to direct reuse customers. These distribution pipelines would connect to the transmission pipeline and each direct reuse customer.

Pump station and storage tanks would be located within the Conveyance Facility Corridor near the pipeline alignment. Conveyance Scenarios include pump stations and/or storage tanks at intermediate and/or northern locations. Potential pump station/storage tank sites are discussed in Section 9.

8.3 AGENCY REQUIREMENTS

Agency requirements associated with the transmission and distribution pipelines primarily include SBMWD and SBCFCD requirements. Pipeline design criteria for the SBMWD are discussed in Section 5. Where the alignment crosses another agency's facility, such as Caltrans or a railroad, these agencies also have specific requirements for construction of the pipeline.

- SBMWD – The criteria for design and location of pipelines are defined in SBMWD's Design Standards. These standards indicate that pipelines should be located no closer than 3 feet horizontally from gas mains, should have a horizontal separation of 10 feet between potable and non-potable water lines, and should have a vertical separation of 12 inches between potable and non-potable water lines. The SBMWD Water and Sewer Separation Standards are shown on SBMWD Drawing Number W6.14, included in Appendix F.

- SBCFCD – The SBCFCD only allows installation of other agency pipelines within their right of way or property through a license agreement. The location of pipelines should be as close to property lines and as far away from drainage features or flood control channels as possible. It is advised that pipelines crossing a drainage feature consider sediment transport analysis to determine depth of cover. For pipelines that cross a fixed flood control channel, the pipeline is typically mounted on a bridge, but is required to be above the 100-year flood design flow level of the channel with no obstructions.

- Caltrans – Caltrans has very specific requirements for submittal of proposed pipeline crossings of its freeway right of way. Requirements include: (1) the pipeline must cross perpendicular to the freeway right-of-way at no more than 15 degree skew from perpendicular, (2) the pipeline must be within a steel casing pipeline, and (3) the top of the steel casing pipeline must be at least 15 feet below any part of the freeway (freeway road base or bridge abutment). The proposed CWF Project pipeline alignments cross Caltrans Highway 210. Alignment Option 1 would cross Highway 210 near a bridge abutment of the Highway 210 crossing of East Twin Creek Channel and the pipeline would need to meet Caltrans guidelines for separation from bridge abutments. Alignment Option 2 would cross Highway 210 near the Valencia Avenue bridge and further coordination would be required to evaluate whether one or both pipelines could

be installed within spare bridge cells designated for future pipelines. Alignment Option 3 would cross Highway 210 near the Waterman Avenue bridge and further coordination would be required to evaluate whether one or both pipelines could be installed within spare bridge cells designated for future pipelines.

- Railroad – Each pipeline alignment option has one railroad crossing. This railroad is currently owned by the San Bernardino Association of Governments (SANBAG) and operated by Burlington Northern Santa Fe Railway Company (BNSF). It is utilized as a regional rail line for freight delivery (designated as Southern California Regional Rail - A). There are specific requirements for submittal of proposed pipeline crossings of railroads. Design of pipeline crossings of railroads are generally determined by the utility agency with review by the railroad, but typically require bore and jack crossings to minimize service interruption and compliance with standards of practice.

8.4 REGULATORY REQUIREMENTS

Regulatory requirements associated with the transmission and distribution pipeline primarily include the CDPH. There are specific requirements for recycled water distribution and use.

- CDPH – The location of the pipeline alignments require specific separation distances between recycled water pipelines and potable water pipelines (Title 22 California Code of Regulations, Water Main Installation, Section 64630 and Water Main Separation, Section 64572). These requirements require that new potable water mains be installed at least 10 feet horizontally and 1 foot vertically above any parallel pipeline conveying recycled water and 4 feet horizontally and 1 foot vertically above any parallel pipeline conveying advanced treated water. At crossings, new potable water mains shall be installed at least one foot above a recycled or advanced treated water pipeline with no joints within 8 feet. These conditions can be applied for separation when installing new recycled or advanced treated water pipelines. Alternative criteria are permitted for special situations that allow installation in closer proximity by utilizing special pipe material, using a continuous sleeve, or requiring no joints within a specified distance. The SBMWD has adopted these separation requirements as shown on SBMWD Drawing Number W6.14 in Appendix F.

8.5 ALIGNMENT EVALUATION CRITERIA

Critical evaluation factors relative to the construction and operation of the transmission pipeline alignments were developed to evaluate the advantages and disadvantages of each pipeline alignment option. Each factor was evaluated and rated using an established rating system. Pipeline Alignment Options with advantages were rated higher and those with disadvantages were rated lower. Eleven critical evaluation factors were developed for the Alignment Options: right of way, agency coordination/permitting, community impacts/duration, traffic, utilities,

special crossings, constructability, land development, direct use customers, construction costs, and operations and maintenance (O&M) costs.

8.5.1 Right of Way

This criterion was used to evaluate the available right of way width for construction and maintenance of the various pipeline options. For dual pipelines in the same trench or two separate pipe trenches, an estimated 25 feet right of way width would allow for shored construction with space for equipment adjacent to the trench (an additional 10 feet would allow for passing equipment). Right of way width for short segments of pipeline could utilize a minimum right of way width of 20 feet. In roadways, sufficient width is typically available with consideration of overall roadway width and potential lane closures. Within the East Twin Creek Flood Control Channel, sufficient width was evaluated within the existing right of way. Alignment Options with wider available right of way width were rated higher than those with restricted right of way width.

8.5.2 Agency Coordination/Permitting

The location of pipeline alignment may require coordination with other agencies for right of way acquisition (i.e. a license agreement with the SBCFCD). The location of the pipeline may require other special permitting such as crossing a highway or railroad. Alignment Options without significant agency coordination and permitting requirement were rated higher than those with significant requirements.

8.5.3 Direct Use Customers

This criterion was used to evaluate the proximity for the Alignment Options to potential direct use customers. Alignment Options located closer to direct use customers were rated higher than Alignment Options that would require additional distribution piping to direct use customers.

8.5.4 Community Impacts/Duration

This criterion was used to evaluate potential impacts to the community considering residential, commercial, parks, golf course, schools, churches, and other land uses in relation to the pipeline construction and maintenance. The estimated duration of construction was considered for the impacts to community uses such as streets, parks, and businesses. Alignment Options with fewer community impacts and shorter construction duration were rated higher than those with more community impacts or longer duration.

8.5.5 Traffic

The potential impacts to traffic were evaluated considering average daily traffic counts for each street along a pipeline segment. The traffic impacts at intersections were also considered for pipeline alignments. Alignment Options with fewer traffic impacts were rated higher than those with more traffic impacts.

8.5.6 Utilities

A number of utilities were identified to exist in the Conveyance Facility Corridor including overhead utilities (power, phone, and cable), storm drains, water lines, sewer lines, underground electrical lines, petroleum fuel lines, high pressure gas lines, and buried communication lines. The utility information was obtained through utility research and investigation by contacting multiple agencies and visual observance. The number, location, size, and type of crossing or parallel utility impact the construction and maintenance of the proposed pipeline. Most of the utility crossings were considered to be minor and not expected to result in difficult construction or relocation of the proposed pipeline alignment or utility. However, if significant or multiple parallel utilities would require a relocation of a utility or proposed pipeline alignment, the segment was assigned a lower rating.

8.5.7 Special Crossings

Special crossing were defined as pipeline crossings of major drainage facilities, storm water channels, wetlands, high pressure gas pipelines, petroleum pipelines, freeways, and railroads. These special crossings were identified for each pipeline segment and were evaluated for level of impact. Tunneling or trenchless technology would be required for any major highway crossing, major storm drain crossing, or railroad crossing and in areas requiring deep excavations. Alignment Options with fewer special crossings were rated higher than those with a greater number of special crossings.

8.5.8 Constructability

The overall constructability of the pipeline segment was evaluated considering access for equipment, staging areas, material storage, slope of construction, cross slopes, and work hour restrictions (i.e. schools, traffic, etc.). Areas with limited space for construction access, equipment, and material storage would result in a more difficult working environment and could require specialty construction equipment and/or additional time to construct. Such areas were rated less favorably.

8.5.9 Land Condition

This factor represents the type of use of land and developments on the land in the location of the pipeline segment. Land conditions include open grade (dirt or grass surface), vegetated,

sensitive habitat, asphalt paved road, concrete road, and buildings/structures. Each Alignment Option was evaluated based on the land condition with a higher rating for Alignment Options with open country and lower rating for impacts to roadways, buildings/structures, and sensitive habitat.

8.5.10 Construction Costs

The estimated construction cost of pipeline segments was evaluated. Alignment Options were rated based on their relative estimated construction costs.

8.5.11 Operation and Maintenance Costs

The estimated O&M cost of pipeline segments was evaluated. Alignment Options were rated based on their relative estimated construction costs.

8.6 ALIGNMENT SEGMENT SCREENING

A total of 27 pipeline segments were initially identified as possible alignment routes from the SBWRP to the Recharge Basins. Some pipeline segments were determined to have distinct disadvantages when compared to similar pipeline segments in the same vicinity. Based on input from SBMWD and various stakeholders, four preferred Pipeline Alignment Options were identified for further consideration in the Report.

8.7 ALIGNMENT DESCRIPTIONS

8.7.1 Pipeline Alignment Option 1

Pipeline Alignment Option 1 would consist of two pipelines (recycled water and advanced water) in one trench along Twin Creek channel (for Conveyance Scenarios 3 or 4). For Conveyance Scenarios 5 or 6, the two pipelines would be a recycled water pipeline and a brine pipeline in one trench along Twin Creek channel. For Conveyance Scenarios 1 or 2, this option would consist of one pipeline along Twin Creek channel (advanced water). A brief summary of the estimated length and description by segment for Pipeline Alignment Option 1 is shown in Table 8-1.

Table 8-1
Pipeline Alignment Option 1

Segment No.	Length (ft)	Description
1	1,400	Twin Creek Channel
5	6,410	Twin Creek Channel, Twin Creek Channel Crossings, Street Crossings, Railroad Crossing
10	11,320	Twin Creek Channel, Street Crossings
18	5,600	Twin Creek Channel, Street Crossings, Perris Hill Park
24	11,290	Twin Creek Channel, Street Crossings, Highway 210 Crossing, East Twin Creek Spreading Grounds
27	3,260	Waterman Basins
TOTAL	39,280	

8.7.2 Pipeline Alignment Option 2

Pipeline Alignment Option 2 would consist of two pipelines (recycled water and advanced water) along public streets including Arrowhead Avenue, Sierra Way, Crestview Avenue, and Valencia Avenue (for Conveyance Scenarios 3 or 4). For Conveyance Scenarios 5 or 6, the two pipelines would be a recycled water pipeline and a brine pipeline. For Conveyance Scenarios 1 or 2, this option would consist of one pipeline (advanced water) along the same public streets. A brief summary of the estimated length and description by segment for Pipeline Alignment Option 2 is shown in Table 8-2.

Table 8-2
Pipeline Alignment Option 2

Segment No.	Length (ft)	Description
1	1,400	Twin Creek Channel
2	950	West Orange Show Road
4	7,710	Arrowhead Avenue, Railway Crossing
8	1,370	West Rialto Avenue
11	7,460	Sierra Way
13	1,930	East Baseline Street
14	1,590	East Baseline Street

Table 8-2 (continued)
Pipeline Alignment Option 2

Segment No.	Length (ft)	Description
17	4,660	Crestview Avenue
20	1,100	East 21st Street and Valencia Avenue
23	10,580	Valencia Avenue, Bridge over Highway 210
26	890	East 40th Street
27	3,260	Waterman Basins
TOTAL	42,900	

8.7.3 Pipeline Alignment Option 3

Pipeline Alignment Option 3 would consist of two pipelines (recycled water and advanced water) along public streets including Arrowhead Avenue, Sierra Way, and Waterman Avenue (for Conveyance Scenarios 3 or 4). For Conveyance Scenarios 5 or 6, the two pipelines would be a recycled water pipeline and a brine pipeline. For Conveyance Scenarios 1 or 2, this option would consist of one pipeline (advanced water) along the same public streets. A brief summary of the estimated length and description by segment for Pipeline Alignment Option 3 is shown in Table 8-3.

Table 8-3
Pipeline Alignment Option 3

Segment No.	Length (ft)	Description
1	1,400	Twin Creek Channel
2	950	West Orange Show Road
4	7,710	Arrowhead Avenue, Railway Crossing
8	1,370	West Rialto Avenue
11	7,460	Sierra Way
13	1,930	East Baseline Street
16	5,310	Waterman Avenue
22	10,570	Waterman Avenue, Bridge over Highway 210
25	1,890	East 40th Street
26	890	East 40th Street

Table 8-3 (continued)
Pipeline Alignment Option 3

Segment No.	Length (ft)	Description
27	3,260	Waterman Basins
TOTAL	42,740	

8.7.4 Pipeline Alignment Option 4

Pipeline Alignment Option 4 would consist of two pipelines using the alignment from Pipeline Alignment Option 1 for the advanced water pipeline and the alignment from Pipeline Alignment Option 2 for the recycled water pipeline (for Conveyance Scenarios 3 or 4). Pipeline Alignment Option 4 does not apply for Conveyance Scenarios 1, 2, 5, or 6.

8.7.5 Distribution Pipeline System

The proposed distribution pipeline systems that would be required to serve the potential direct use customers from the main transmission pipelines were developed for each Alignment Option. The distribution pipeline systems were optimized to minimize the distribution pipeline lengths and diameters, as well as to limit the number of special crossings required. Distribution pipeline diameters were sized based on a maximum allowable velocity of 6 feet per second under peak hour demands. An absolute minimum diameter criterion of 8-inches was utilized per SBMWD requirements. It should be noted that since Alignment Options 2 and 4 share the same recycled water Alignment Option, they also share the same distribution pipeline system. A summary of the distribution pipeline diameters and lengths required for each Alignment Option is presented in Table 8-4. The distribution pipeline systems are shown on Figures 8-3 through 8-8.

Table 8-4
Distribution Pipeline Summary

Alignment Option 1		Alignment Options 2 & 4		Alignment Option 3	
Diameter (in)	Length (ft)	Diameter (in)	Length (ft)	Diameter (in)	Length (ft)
8	93,400	8	80,400	8	74,000
10	14,300	10	9,500	10	11,100
Total	**107,700**	**Total**	**89,900**	**Total**	**85,100**

8.8 ALIGNMENT CROSS-SECTIONS

Detailed cross-sections were prepared for the anticipated most-critical areas along each pipeline alignment option to identify existing utilities and verify that adequate space would be available for construction of one or two proposed pipelines within the alignment corridor. Cross-section cuts are shown on Figures 8-1 and 8-2 and are labeled with the pipeline alignment option number and section cut letter (i.e. Section 2E is a section E of Pipeline Alignment Option 2). Cross-sections are shown on Figures 8-9 to 8-35.

Based on the evaluation of the alignment cross-sections, the following findings were made:

- Alignment Option 1 has adequate space for construction of two pipelines in a common trench for the length of the alignment. Due to an existing 78-inch storm drain along the north/west side of the Twin Creek Channel near Mill Street, the proposed alignment crosses to the east/south of the channel just south of Central Avenue, and then crosses back over just east of Waterman Avenue. Also, one area near E. Highland Avenue shown on Figure 8-15 (Section 1G) has a narrow width with an existing power pole that would likely require relocation.

- Alignment Option 2 has adequate space for construction of two pipelines in a common trench for the length of the alignment.

- Alignment Option 3 has limited space in at least one section of the pipeline alignment that would require the relocation of a 12-inch waterline in Waterman Avenue between Gilbert Street and Wabash Street as shown on Figure 8-31 (Section 3G) in order to construct two pipelines in a common trench for the length of the alignment. Insufficient separation is available to construct the pipelines in separate trenches.

- Alignment Option 4 has adequate space for construction of the advanced water pipeline along the alignment for Alignment Option 1 and adequate space for construction of the recycled water pipeline along the alignment for Alignment Option 2.

8.9 SPECIAL CROSSINGS

Several special crossings were identified that may require special construction methods or have strict agency construction restrictions. Special crossings include major drainage facilities, storm drain channels, high pressure gas pipelines, freeways, and railroads, as described below.

- Major Drainage Facilities – In areas where the pipeline crosses an open drainage channel, design should consider sediment transport analysis to determine depth of cover over the pipeline.

- Storm Drain Channels – In areas where the pipeline crosses a storm drain channel, the pipeline will likely be deep and have limited access. In these areas, it is recommended that the pipeline be placed in a casing to protect the pipe and allow easier access for maintenance.

- High Pressure Gas Pipelines – These crossings are a safety concern and require identification and protection during construction. Mark-out and support of high pressure gas pipelines are crucial during construction of the new crossing pipeline.

- Freeway – all of the Alignment Options cross Highway 210. Plan view exhibits were developed to indicate a preliminary crossing methodology using an 84-inch steel casing pipe with both the advanced water and recycled water pipelines within the steel casing (See Caltrans Crossing 1I, 2I, and 3H on Figures 8-17, 8-29, and 8-32). Alternatively, one or both of the proposed pipelines may be able to be constructed within the existing bridge cells at the Valencia Ave. and Waterman Ave bridge crossings of Highway 210. Caltrans agency requirements are described in Section 8.3.

- Railroad - All of the Alignment Options cross the railroad, which is owned by the SANBAG and operated by BNSF. Cross-sections were developed to indicate a preliminary crossing methodology using a steel casing pipe with the advanced water and recycled water pipeline within the steel casing (See Cross-Sections 1B, 2D, and 3D on Figures 8-10, and 8-24). Railroad agency requirements are described in Section 8.3.

8.10 ALIGNMENT EVALUATION RATING

Criterium Decision Plus, a Windows based software program, was used to assist in the evaluation process. Decision Plus is a decision management tool that helps organize, complete, and communicate complex decision-making tasks. *Criterium Decision Plus* was used to list the decision criteria developed with input from the SBMWD. The decision criteria were then applied to the Alignment Options. Evaluation factors and their weighting factors were determined in a workshop format with the SBMWD, and scores for the various options were identified. Evaluation criteria are presented in Section 8.5. This section presents the rating system used in the evaluation of the different criteria for Alignment Options.

Each pipeline alignment option was rated based upon its ability to satisfy the project objectives. The options were rated using a scale of 1 to 5 as shown in Table 8-5 with a higher rating indicating a more favorable scenario or option.

Table 8-5
Definition of Rating System

Definition	Rating
Satisfies project objectives with significant noted advantages	5
Satisfies project objectives with noted advantages	4
Satisfies project objectives	3
Satisfies project objectives with noted disadvantages	2
Satisfies project objectives with significant noted disadvantages	1

Each evaluation criteria was then assigned a weight representing the importance of the criterion on a scale of 1 to 5. A higher weight represents more important criteria as shown in Table 8-6.

Table 8-6
Definition of Weighting System

Definition	Rating
Critical Importance	5
Significant Importance	4
Important	3
Low Importance	2
Least Importance	1

Evaluation criteria weightings for Pipeline Alignment Options are shown in Table 8-7.

Table 8-7
Pipeline Alignment Options Criteria Weighting

Evaluation Criteria	Weight
Right of Way	3
Agency Coordination/Permitting	3
Community Impacts/Duration	4
Traffic	3
Utilities	2
Special Crossings	2
Constructability	4
Land Development	2
Direct Use Customers	3
Construction Costs	5
O&M Costs	5

A score for each evaluation criterion was calculated by multiplying the rating and the weight. A higher score indicated a more favorable option. The overall scores were compared for each option. The overall score is a good indication as to which options are the best match for meeting the project objectives.

Since the overall score may not add up to 100, a weighted score was calculated for each option. The overall scores were converted to percentages; therefore the ideal score would have value of 100 percent. The higher the weighted score of the option, the closer that option would come to meeting all the project objectives considering the criteria impacting the decision.

Utilizing *Criterium Decision Plus*, a decision score was calculated with an ideal score of 1.00. The higher the decision score of the option, the closer that option would come to meeting all the project objectives considering the criteria impacting the decision. Weighted scores and decision scores were similar, but since *Criterium Decision Plus* utilizes a more complex integrated rating and ranking system, the decision score was considered in evaluating the rank.

The highest decision score is considered the highest ranked or preferred option. Ranks were then assigned to the remaining options in the order of highest score to lowest score.

Each of the four potential Pipeline Alignment Options was evaluated, rated, and ranked. Ranking results are listed in Table 8-8 and depicted graphically in Figure 8-36, and discussed briefly below.

Table 8-8
Pipeline Alignment Options Evaluation and Ranking

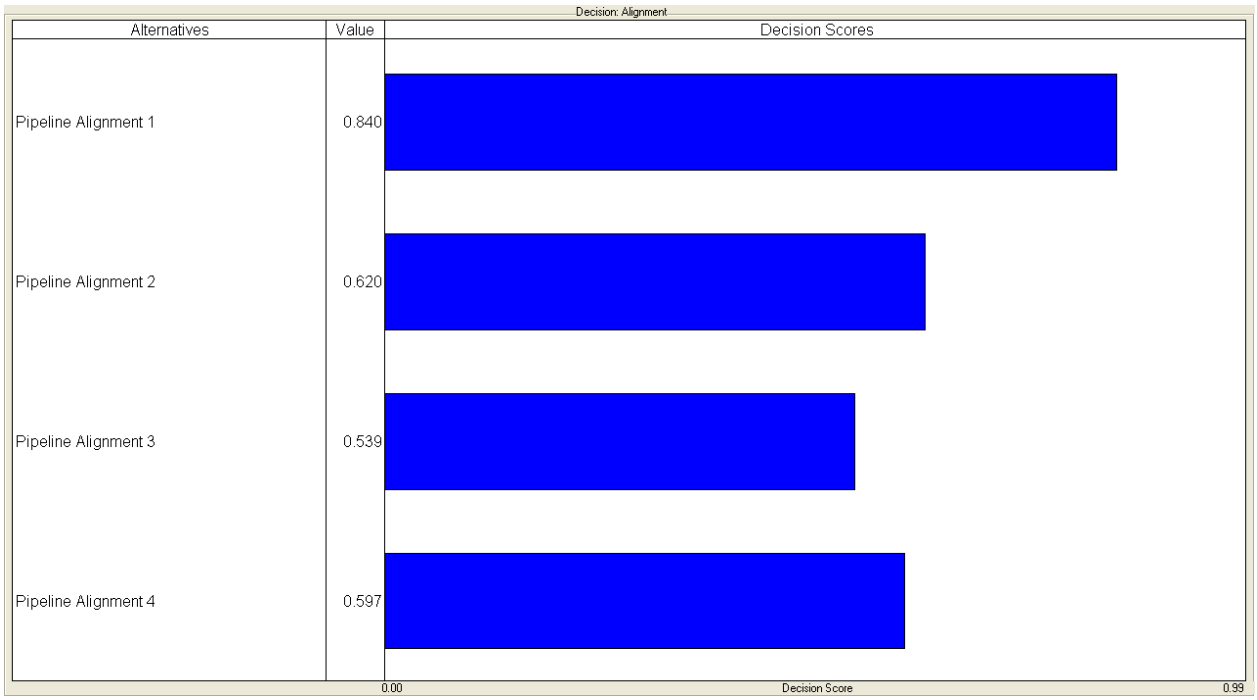
Evaluation Factor	Pipeline Alignment 1	Pipeline Alignment 2	Pipeline Alignment 3	Pipeline Alignment 4
Right of Way Weight = 3	East Twin Creek Flood Control Channel; Some limited width Rating = 3	Mostly wider streets; Some lane closure restrictions Rating = 4	Mostly wider streets; Some lane closure restrictions Rating = 4	Combined Channel and streets Rating = 2
	Score = 9	Score = 12	Score = 12	Score = 6
Agency Coordination/ Permitting Weight = 3	Requires License Agreement with SBCFCD Rating = 3	Within City streets Rating = 4	Within City streets Rating = 4	Combined License Agreement and City streets Rating = 2
	Score = 9	Score = 12	Score = 12	Score = 6
Direct Use Customers Weight = 3	Located at east edge of Corridor; longer distribution piping Rating = 2	Located in middle of Corridor; shorter distribution piping Rating = 4	Located at west edge of Corridor; shortest distribution piping Rating = 5	Located in middle of Corridor; shorter distribution piping Rating = 4
	Score = 6	Score = 12	Score = 15	Score = 12
Community Impacts/ Duration Weight = 4	Minimal impacts; within Flood Channel Rating = 5	Impacts to community; adjacent to roads Rating = 3	Impacts to community; adjacent to roads Rating = 3	Impacts to both Flood Channel and community near roads Rating = 2
	Score = 20	Score = 12	Score = 12	Score = 8
Traffic Weight = 3	Minimal impacts; within Flood Channel Rating = 5	Impacts along multiple streets with medium traffic Rating = 3	Impact along multiple streets with high traffic Rating = 1	Impacts at Flood Channel crossing and along streets with medium traffic Rating = 3
	Score = 15	Score = 9	Score = 3	Score = 9
Utilities Weight = 2	Some crossings and parallel utilities Rating = 4	Multiple crossing and parallel utilities Rating = 3	Multiple crossing and parallel utilities; utility relocations Rating = 1	Crossing at Flood Channel and multiple crossing and parallel utilities in roads Rating = 2
	Score = 8	Score = 6	Score = 2	Score = 4
Special Crossings Weight = 2	Railroad, Highway 210 Rating = 4	Railroad, Highway 210 Rating = 3	Railroad, Highway 210 Rating = 3	Two Railroad and Two Highway 210 Rating = 3
	Score = 8	Score = 6	Score = 6	Score = 6
Constructability Weight = 4	Limited space; standard work hours Rating = 4	Limited space; limited work hours Rating = 3	Limited space, limited work hours Rating = 3	Limited space; limited work hours Rating = 3
	Score = 16	Score = 12	Score =12	Score =12
Land Condition Weight = 2	Open land Rating = 5	Paved Rating = 3	Paved Rating = 3	Open land and paved Rating = 3

Table 8-8 (continued)
Pipeline Alignment Options Evaluation and Ranking

Evaluation Factor	Pipeline Alignment 1	Pipeline Alignment 2	Pipeline Alignment 3	Pipeline Alignment 4
Construction Costs* Weight = 5	Score = 10 $ 93.1 M Rating = 5	Score = 6 $ 118.0 M Rating = 2	Score = 6 $ 116.5 M Rating = 2	Score = 6 $ 101.4 M Rating = 4
O &M Costs* Weight = 5	Score = 25 $ 0.9 M/yr Rating = 5	Score = 10 $ 1.1 M/yr Rating = 3	Score = 10 $ 1.2 M/yr Rating = 2	Score = 20 $ 1.0 M/yr Rating = 4
TOTAL (Weight = 36)	Score = 25 Overall Score 151	Score = 15 Overall Score 112	Score = 10 Overall Score 100	Score = 20 Overall Score 109
Weighted SCORE	84%	62%	56%	61%
DECISION SCORE	0.840	0.620	0.539	0.597
RANK	**1st**	**2nd**	**4th**	**3rd**

*Construction and O&M costs are based on Pipeline Alignments for either Conveyance Scenario 3 or 4.

Figure 8-36
Pipeline Alignment Options Evaluation



8.10.1 Alignment Option 1

This alignment had the highest score and ranked first. Primary factors for the evaluation and ranking of Alignment Option 1 were the minimal community impacts, traffic impacts, and conflicting utilities and land condition. This alignment also had the lowest capital and O&M costs.

8.10.2 Alignment Option 2

This alignment had the second highest score and ranked second. Primary factors for the evaluation and ranking of Alignment Option 2 were an overall average satisfactory ability to meet project objectives with some noted advantages in reduced agency coordination and central location for connecting distribution pipelines to direct use customers. However, this alignment had high overall construction and O&M costs.

8.10.3 Alignment Option 3

This alignment had the lowest score and ranked forth. Primary factors for the evaluation and ranking of Alignment Option 3 were an overall average satisfactory ability to meet project objectives with some noted disadvantages in increased traffic impacts and utility conflicts. This alignment also had high overall construction and O&M costs.

8.10.4 Alignment Option 4

This alignment had the third highest score and ranked third. Primary factors for the evaluation and ranking of Alignment Option 4 were the combined advantages of using Alignment Option 1 for the advanced pipeline (reduced community impacts, traffic impacts, conflicting utilizes and land condition) and benefit of the central location for connecting distribution pipelines to direct use customers for Alignment Option 2 for the recycled pipeline. This alignment also had the second lowest capital costs.

8.11 SUMMARY

Based on the evaluation, all of the four Pipeline Alignment Options would be feasible for the CWF Project. There are noted advantages for Alignment Option 1, which ranked the highest in the evaluation. Concurrence with the SBCFCD and compliance with their requirements will be imperative in further development and selection of Alignment Option 1 as the preferred alignment. Preliminary meetings with SBCFCD have indicated that pipeline(s) aligned within the SBCFCD Twin Creek Flood Channel would be compatible under a license agreement.

8.12 COST ESTIMATES

Feasibility-level cost estimates were prepared for the four preferred Pipeline Alignment Options based on feasibility-level planning data collected and developed as part of this analysis. Due to the preliminary status of the project, the current unpredictable bidding climate, and estimated project schedule, opinions of probable costs should be updated regularly as the project is better defined. A contingency of 30 percent was applied to the estimated construction costs to account for the preliminary nature of the project. An additional allocation of 30 percent was made for administrative, legal, design, and construction management costs in order to define overall project costs. Utilizing a Class 4 Estimate for feasibility-level estimates as defined by the Association for the Advancement of Cost Engineering International (AACEI), an estimated range of -15 percent to +30 percent can be expected and an additional contingency of 15 percent was applied to the overall project costs. Finally, with the estimated mid-point of construction in three years (March 2015), an escalation cost due to projected inflation at an annual rate of 4 percent was applied (total inflation for three years equal to 12.5 percent).

Based on the current understanding of the project's criteria and general assumptions made regarding facility locations and configurations, this opinion is intended to provide a feasibility-level overall cost. Unit pipeline costs were based on historical cost data compiled from multiple similar pipeline projects and the experience of RBF and Black & Veatch. This estimate was compiled in March 2012 with an Engineering News Record (ENR) – Construction Cost Index (CCI) (Los Angeles) of 10,283.55. Therefore, the costs can be updated once the schedule has been further defined. Table 8-9 summarizes the feasibility-level costs for each preferred pipeline option. More detailed cost information for each preferred pipeline option is included in Appendix D-1.

Table 8-9
Pipeline Alignment Options Feasibility-Level Cost Estimates

Conveyance Scenario	Pipeline Alignment 1	Pipeline Alignment 2	Pipeline Alignment 3	Pipeline Alignment 4
Conveyance Scenario 1 or 2	$68.1 million	$79.7 million	$78.6 million	N/A
Conveyance Scenario 3 or 4	$94.3 million	$117.0 million	$115.9 million	$100.5 million
Conveyance Scenario 5 or 6	$91.2 million	$112.9 million	$111.1 million	N/A

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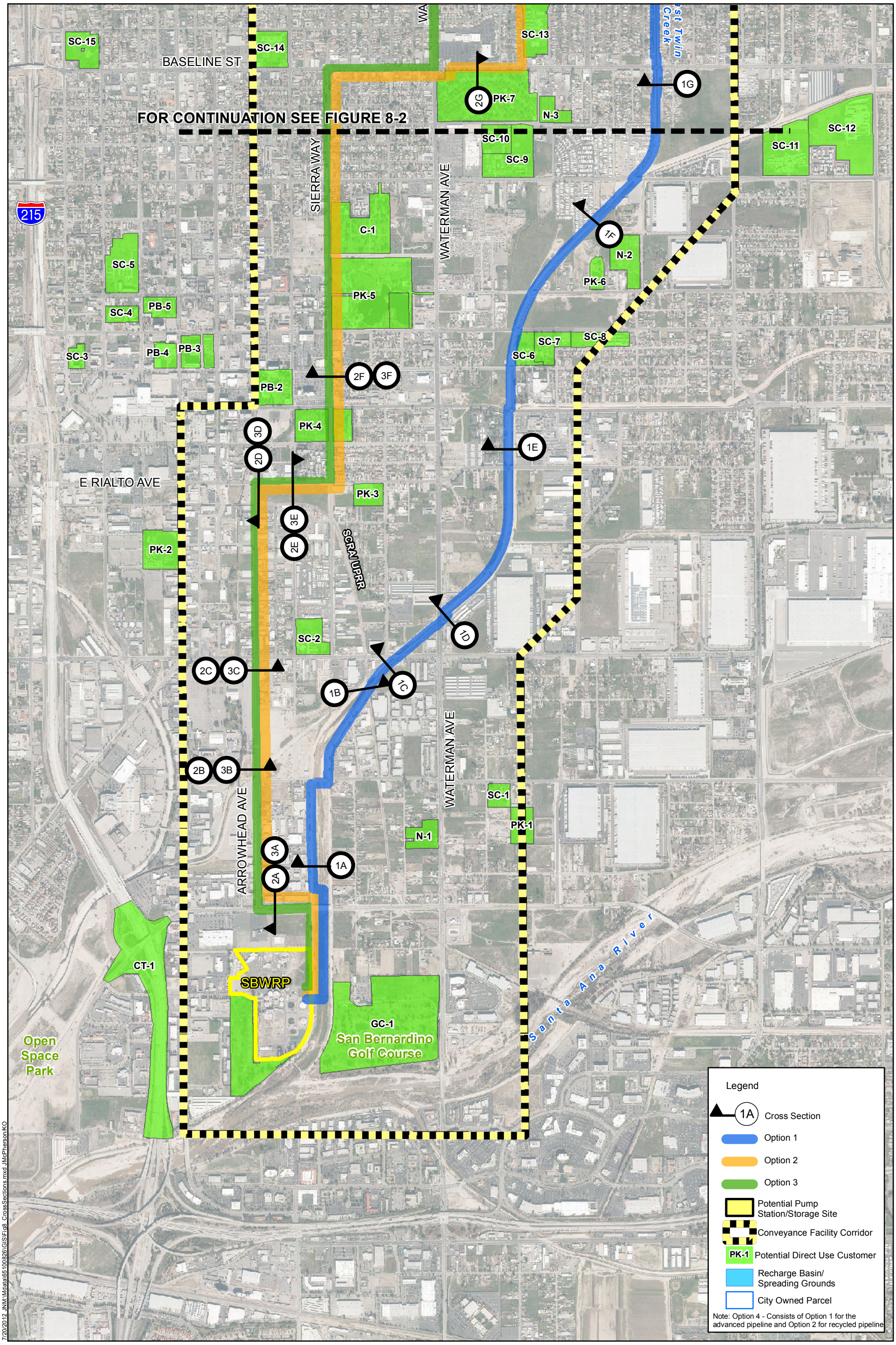

0 800 1,600 3,200 Feet

Source: Eagle Aerial - 2011, Intermap Technologies, SCAG

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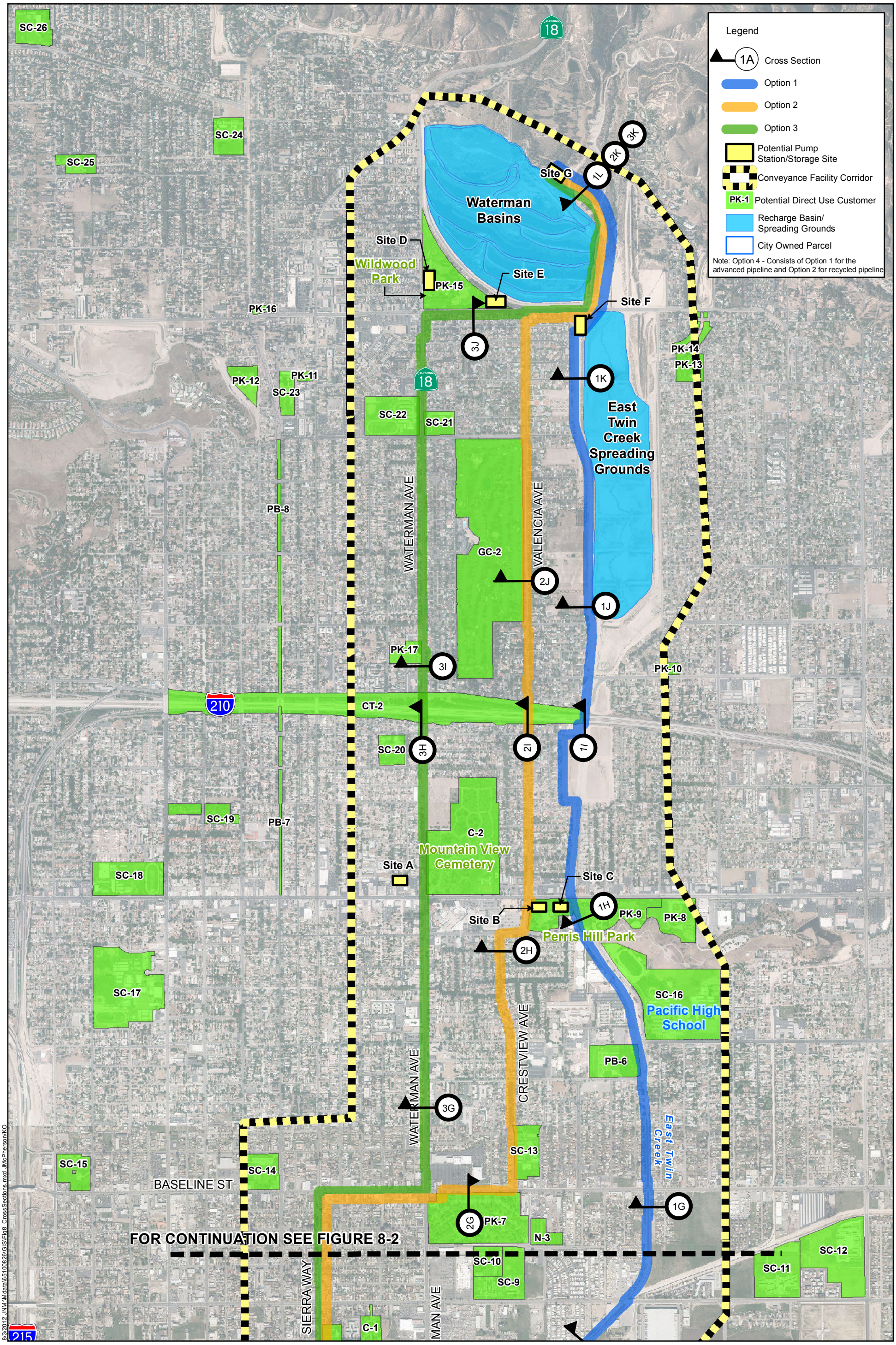
Alignment Options

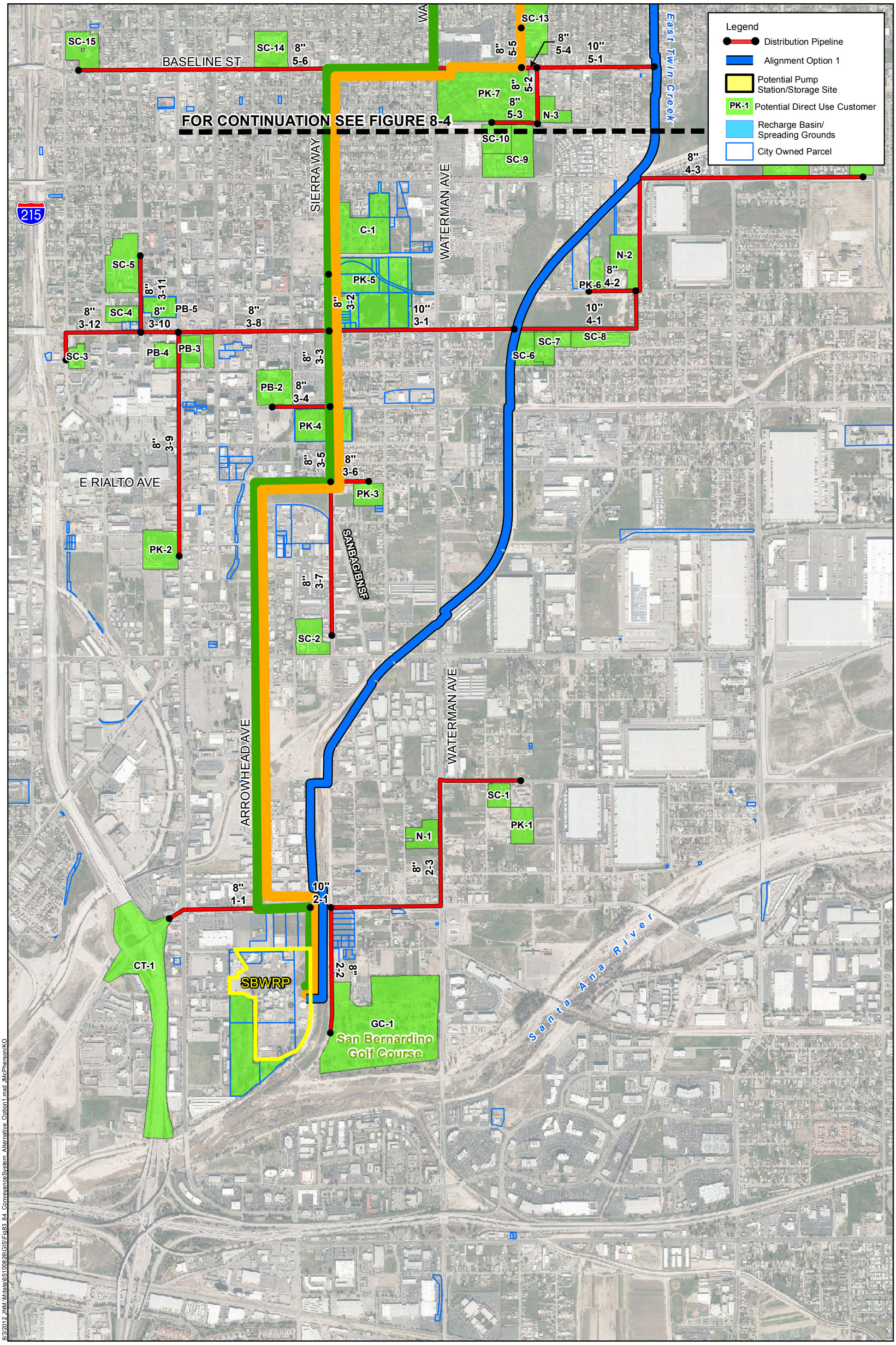
Figure 8-1



SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Alignment Options

Figure 8-2



8/3/2012 JNM-M:\data\651\00826\GIS\Fig83_84_ConveyanceSystem_Alternative_Option1.mxd JMcPherson/KO

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0 800 1,600 3,200 Feet

Source: County of San Bernardino, Eagle Aerial - 2011, Esri Online

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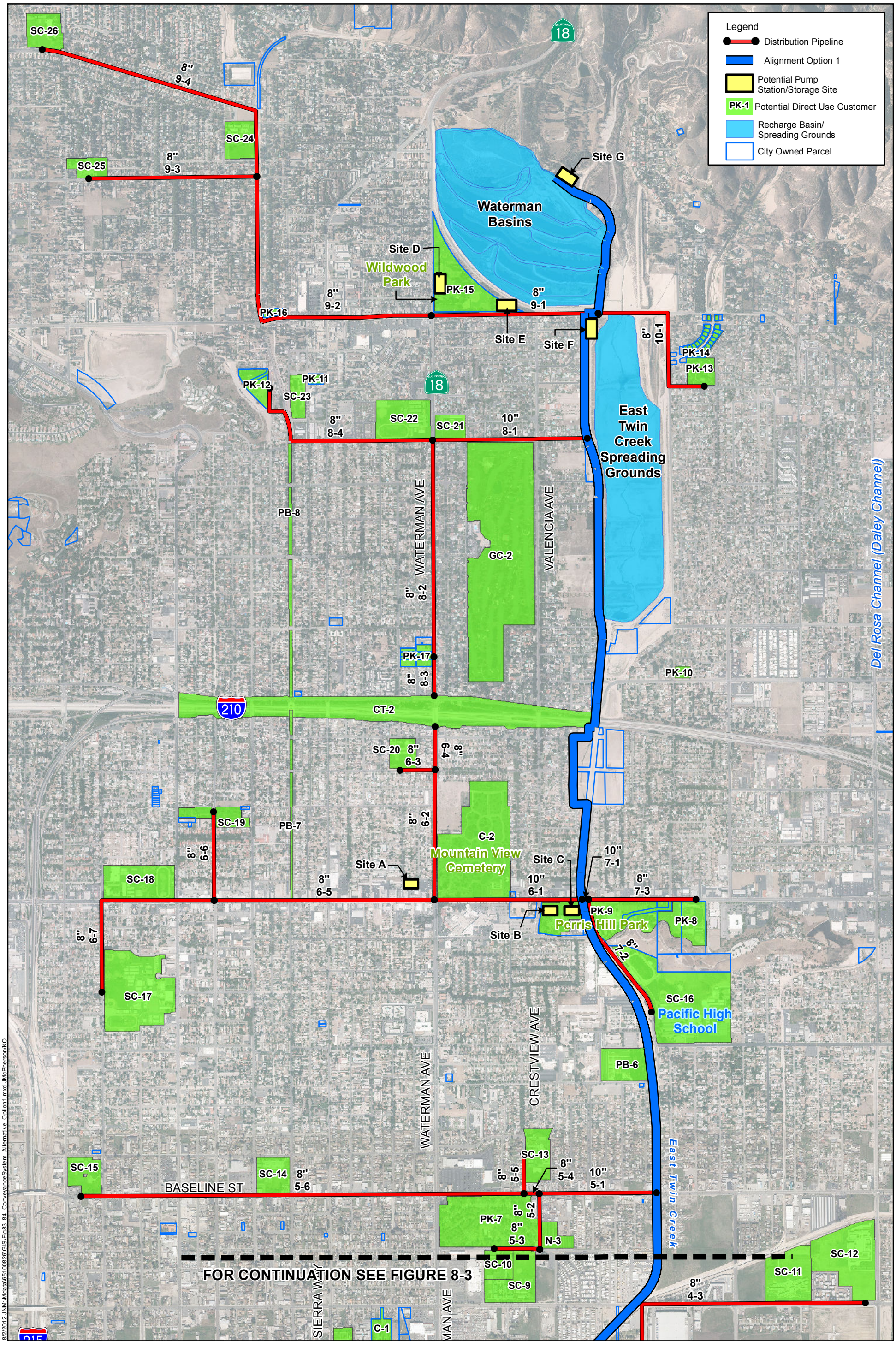
Alignment Option 1 - Distribution Pipelines

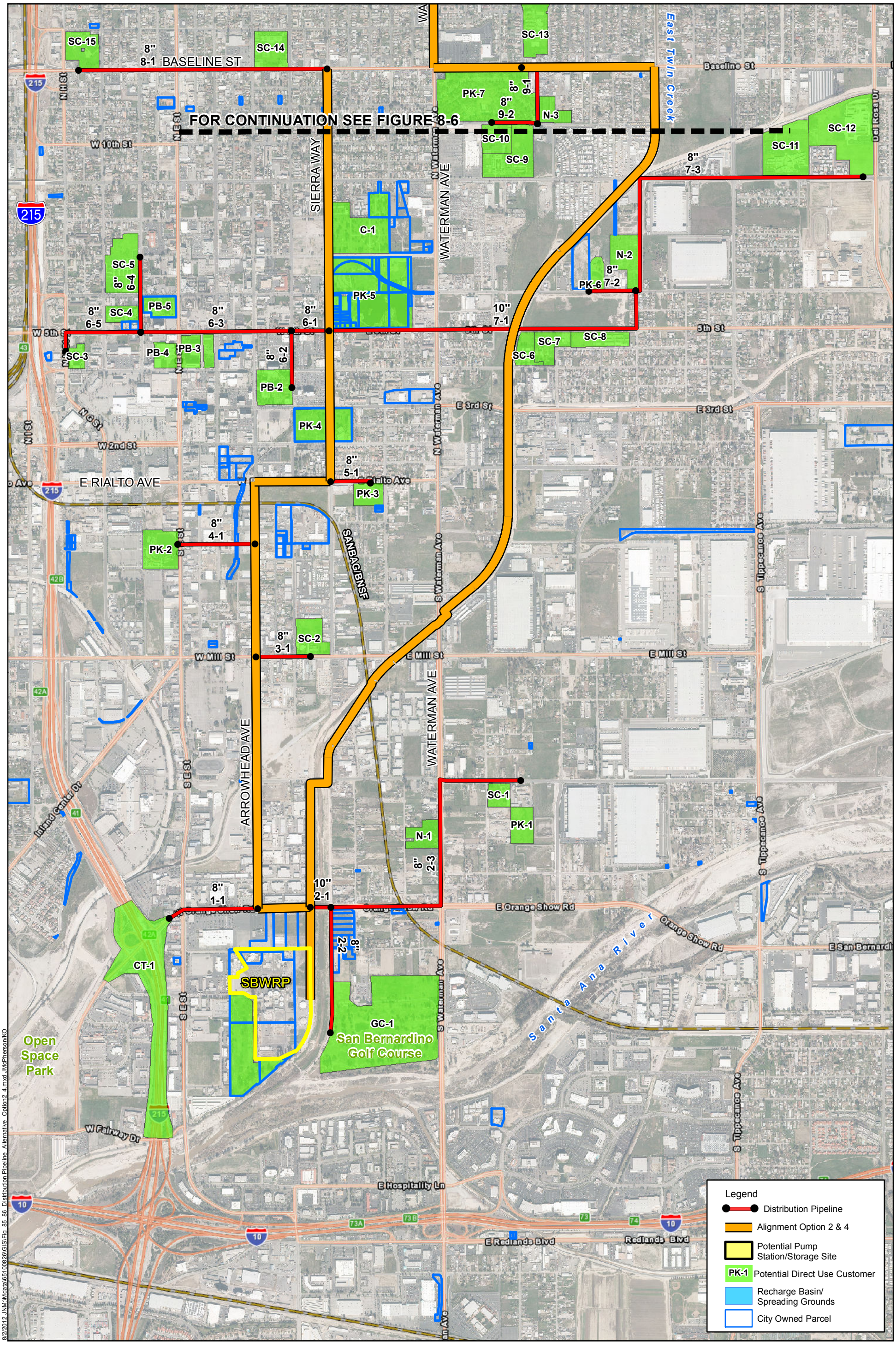
Figure 8-3



SAN BERNARDINO MUNICIPAL WATER DEPARTMENT

Alignment Option 1 - Distribution Pipelines

Figure 8-4



8/2/2012 J:\NM:\Mdata\6510026\GIS\Fig_85_86_Distribution_Pipeline_Alternative_Option2_4.mxd JMcPherson/KO

0 800 1,600 3,200 Feet

Source: County of San Bernardino, Eagle Aerial - 2011, Esri Online

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Alignment Option 2&4-Distribution Pipelines

Figure 8-5

Legend
- Distribution Pipeline
- Alignment Option 2 & 4
- Potential Pump Station/Storage Site
- PK-1 Potential Direct Use Customer
- Recharge Basin/ Spreading Grounds
- City Owned Parcel

SC-26
8" 15-4
SC-24
SC-25
8" 15-3
Site G
Waterman Basins
Site D
Wildwood Park
PK-15
8" 15-2
8" 15-1
PK-16
Site E
Site F
8" 16-1
PK-14
PK-13
PK-12
PK-11
SC-23
8" 14-2
SC-22
SC-21
8" 14-1
East Twin Creek Spreading Grounds
PB-8
GC-2
PK-17
8" 13-2
8" 13-1
PK-10
CT-2
SC-20
8" 11-3
8" 11-4
SC-19
PB-7
8" 11-6
8" 11-2
C-2
Mountain View Cemetery
Site A
Site C
SC-18
8" 11-7
8" 11-5
10" 11-1
10" 12-1
8" 12-3
PK-9
PK-8
Perris Hill Park
Site B
8" 12-2
SC-17
SC-16
Pacific High School
8" 10-1
PB-6
SC-15
8" 8-1 BASELINE ST
SC-14
SC-13
PK-7
8" 9-2
8" 9-1
N-3
SC-10
SC-9
SC-11
SC-12
8" 7-3
C-1
FOR CONTINUATION SEE FIGURE 8-5

N Sierra Way
N Waterman Ave
WATERMAN AVE
VALENCIA AVE
CRESTVIEW AVE
SIERRA WAY
N E St
N H St
W 40th St
W 30th St
E 30th St
E Lynwood Dr
Baseline St
W 10th St
Harrison St
Del Rosa Channel (Daley Channel)
East Twin Creek
Del Rosa Ave
Del Rosa Dr
Randall Dr
18
206
259
210
215

0 800 1,600 3,200 Feet

Source: County of San Bernardino, Eagle Aerial - 2011, Esri Online

4/3/2012 JNM:\Mdata\65\100826\GIS\Fig_8-5_86_Distribution Pipeline_Alternative_Option2_4.mxd JMcPherson/KO

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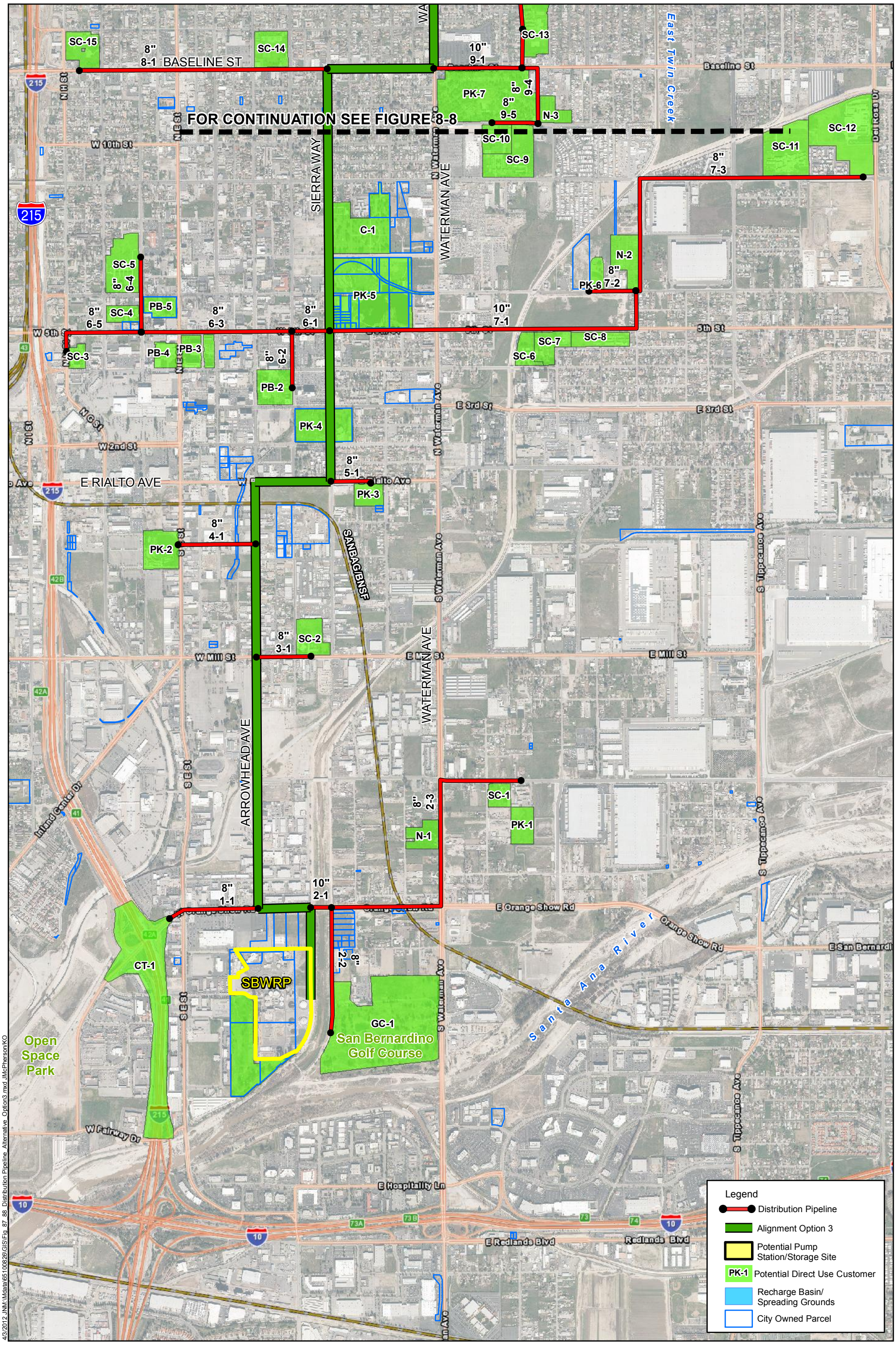
Alignment Option 2&4-Distribution Pipelines

Figure 8-6



4/3/2012 JNM:\Mdata\651\10826\GIS\Fig_87_88_Distribution Pipeline_Alternative_Option3.mxd JMcPherson/KO

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0 800 1,600 3,200 Feet

Source: County of San Bernardino, Eagle Aerial - 2011, Esri Online

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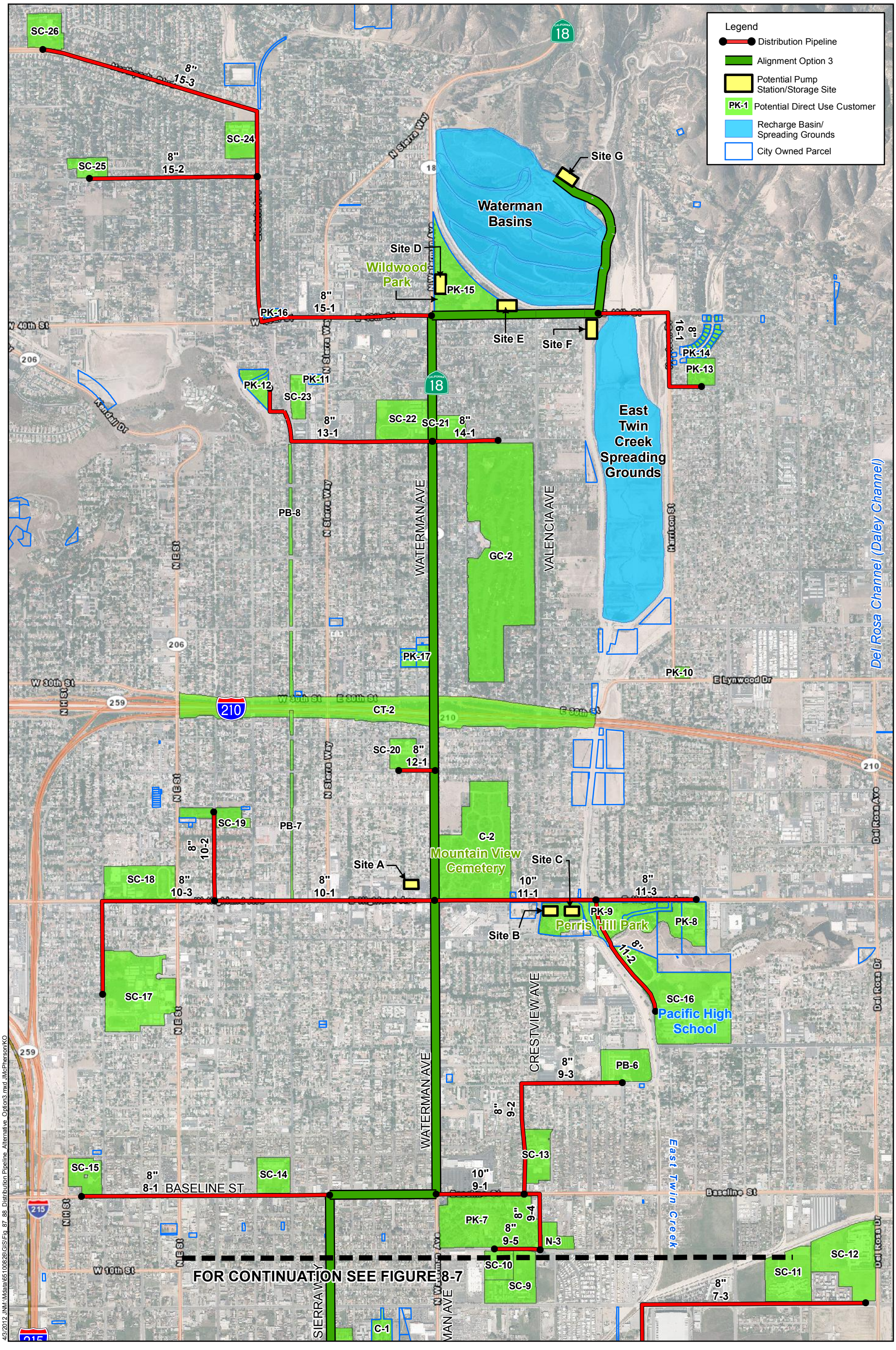
Alignment Option 3 - Distribution Pipelines

Figure 8-7



4/3/2012 JNM:\Mdata\65100826\GIS\Fig 87_88 Distribution Pipeline Alternative Option3.mxd JMcPherson/KO

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Source: County of San Bernardino, Eagle Aerial - 2011, Esri Online

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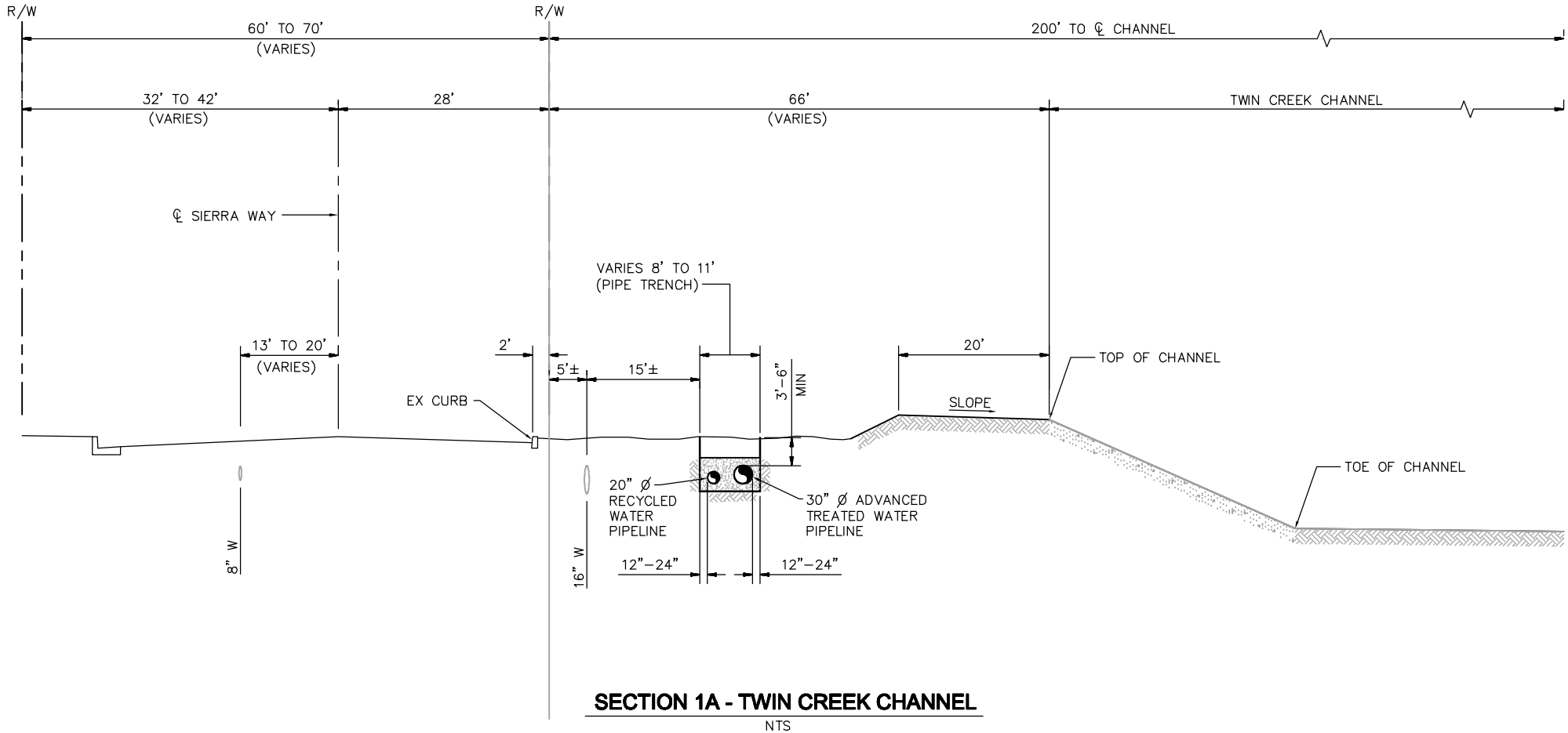
Alignment Option 3 - Distribution Pipelines

Figure 8-8



SECTION 1A - TWIN CREEK CHANNEL

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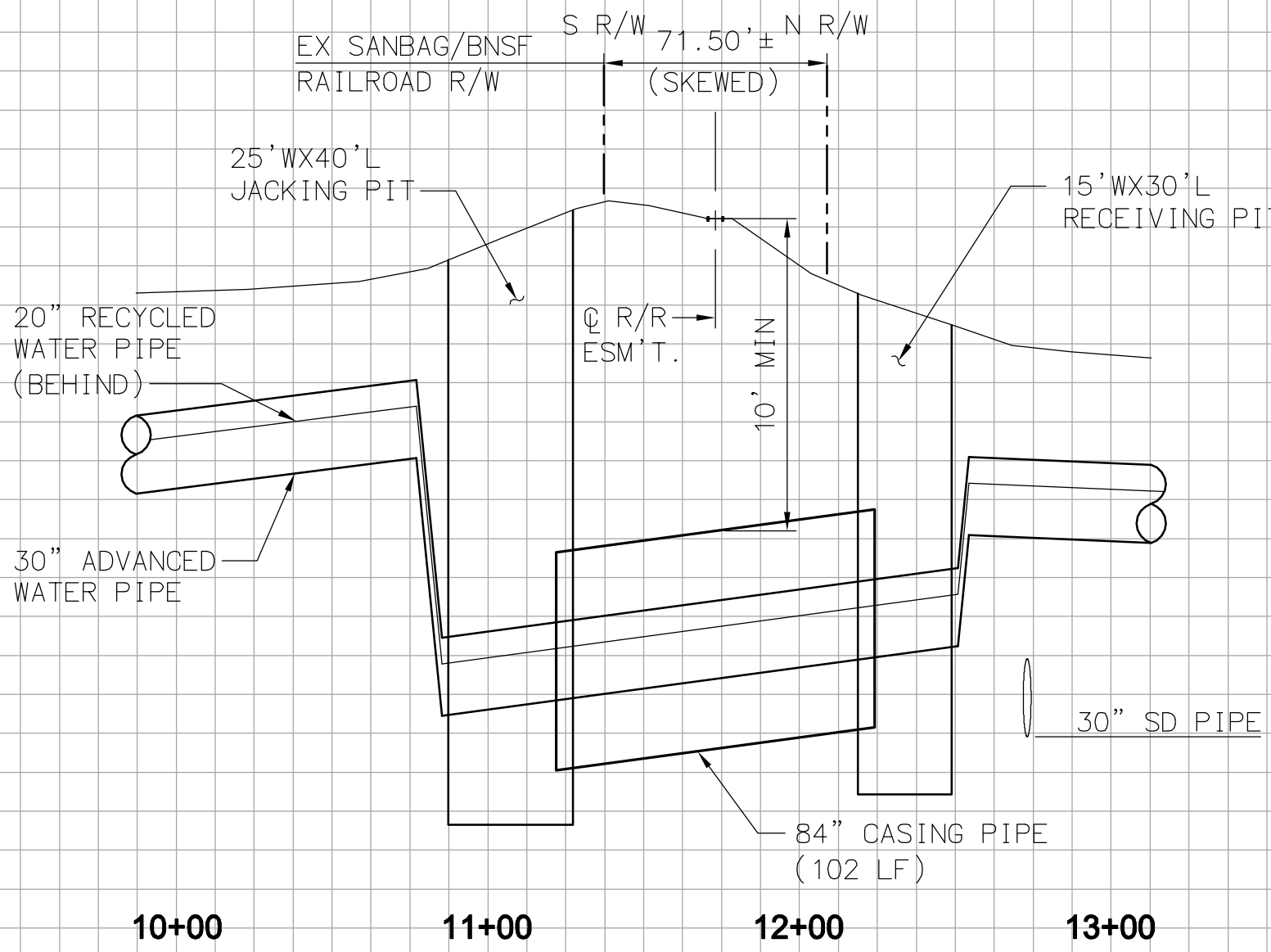
SECTION 1A – TWIN CREEK CHANNEL
SOUTH OF CENTRAL AVE

FIGURE
8-9



SECTION 1B - SANBAG/ BNSF R/R CROSSING

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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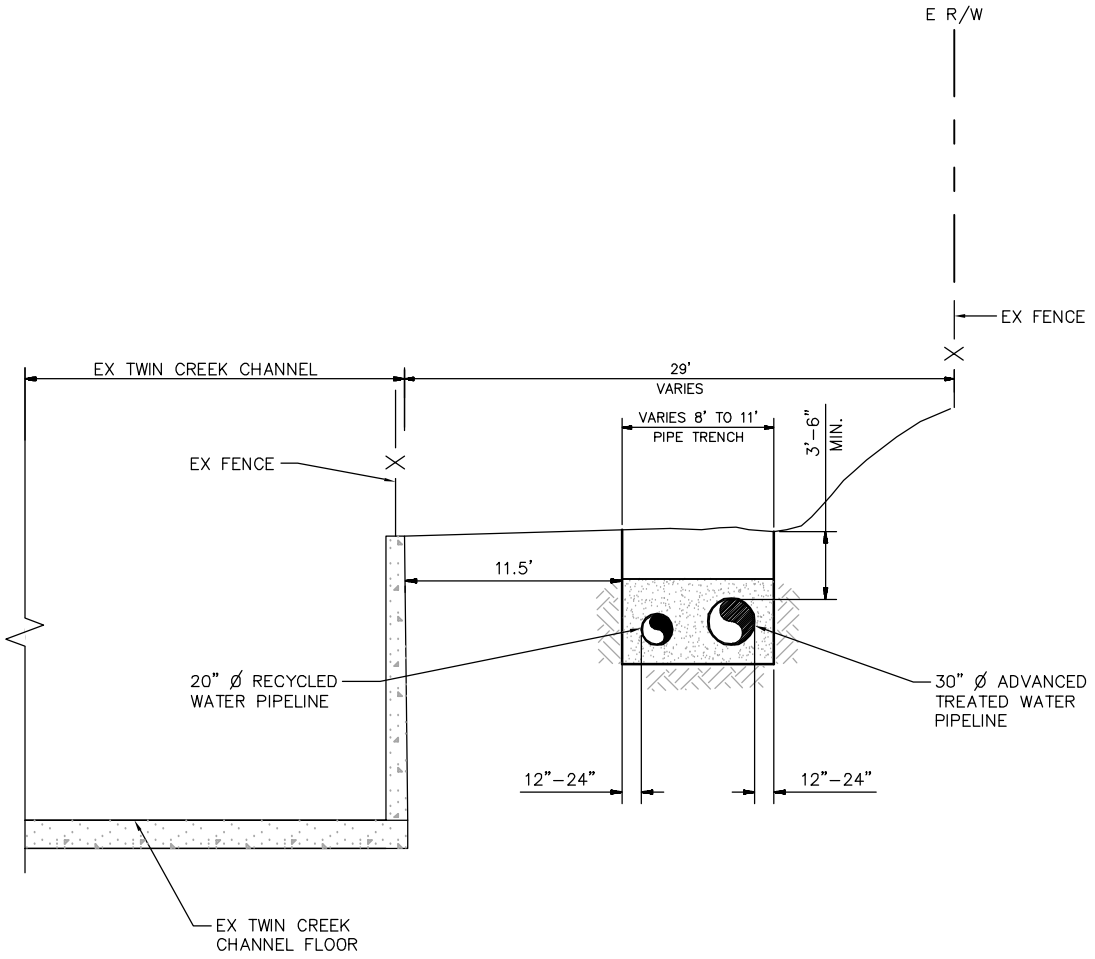
SECTION 1B - SANBAG/ BNSF RAILROAD CROSSING BETWEEN E MILL ST AND CENTRAL AVE

FIGURE 8-10



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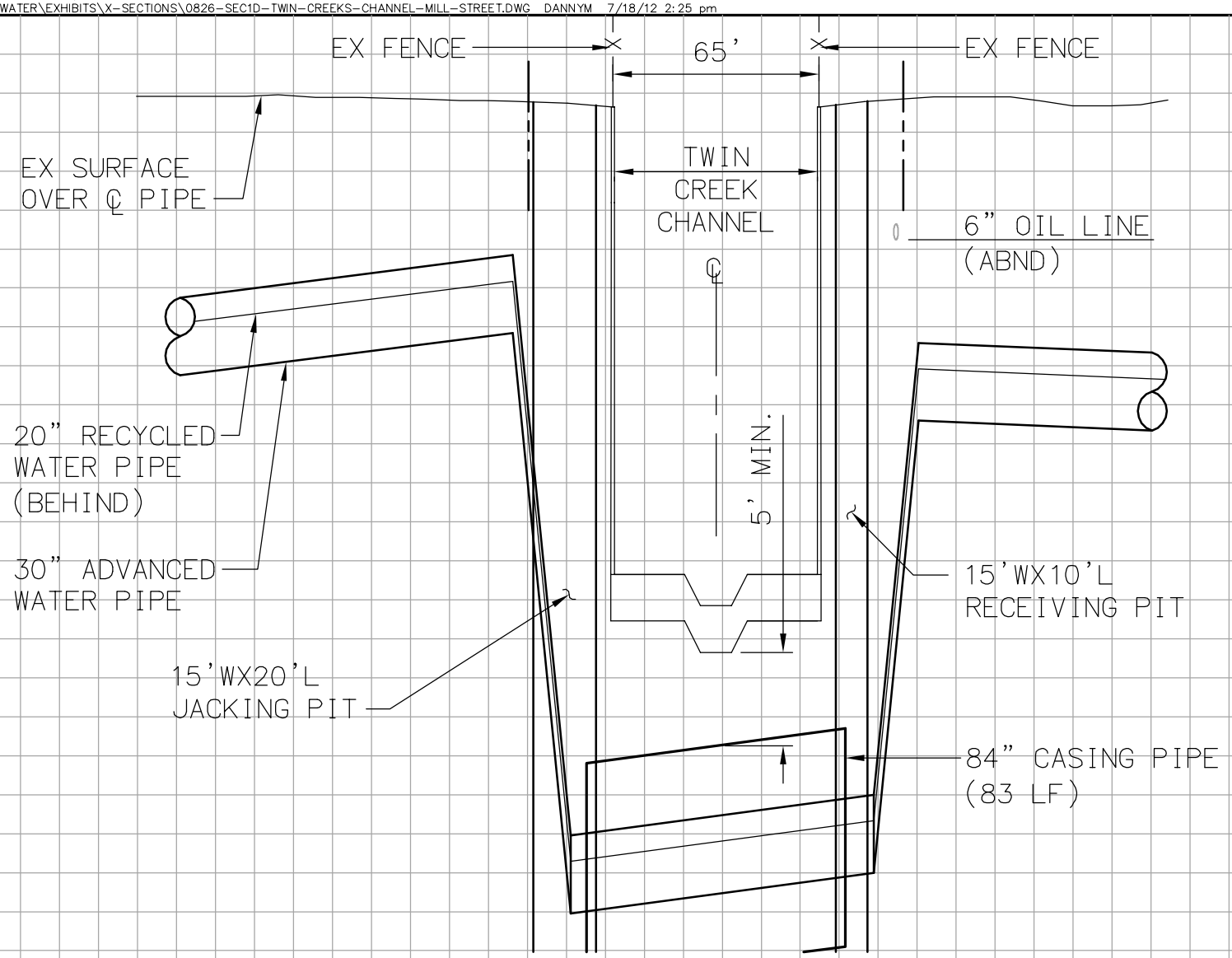
SECTION 1C – TWIN CREEK CHANNEL
200± SOUTH OF MILL ST.

FIGURE
8-11



SECTION 1D -TWIN CREEK CHANNEL N/O MILL STREET CROSSING

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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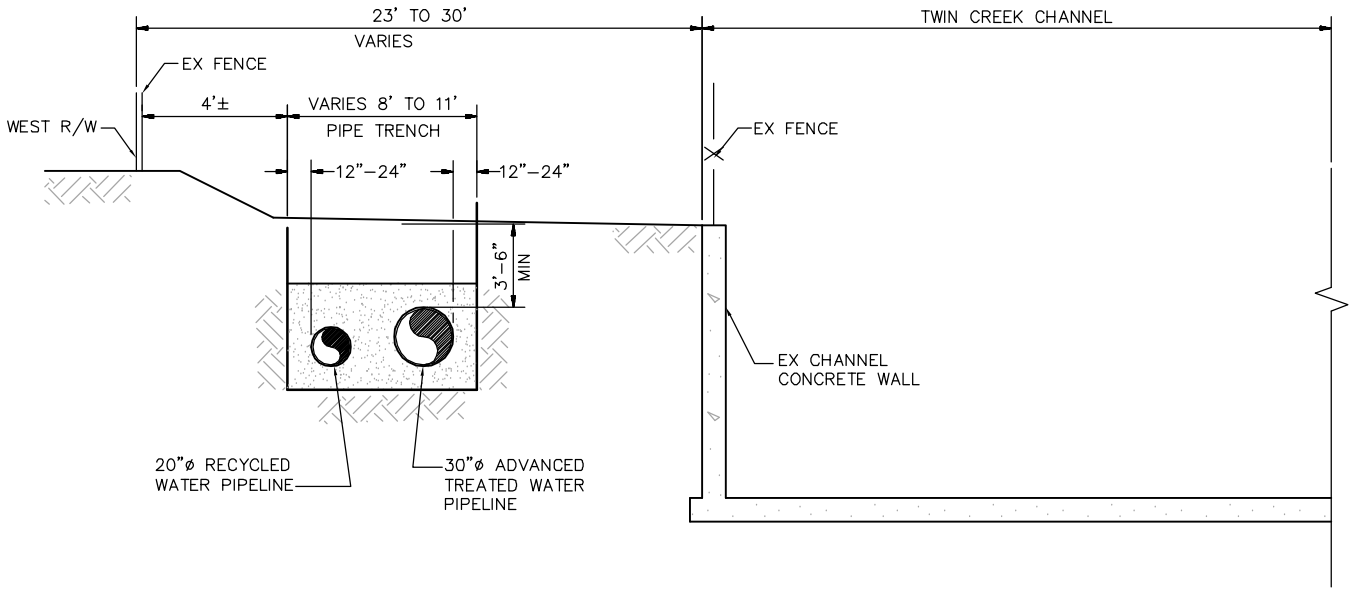
SECTION 1D TWIN CREEK CHANNEL
N/O MILL STREET CROSSING

FIGURE
8-12



SECTION 1E - TWIN CREEK CHANNEL

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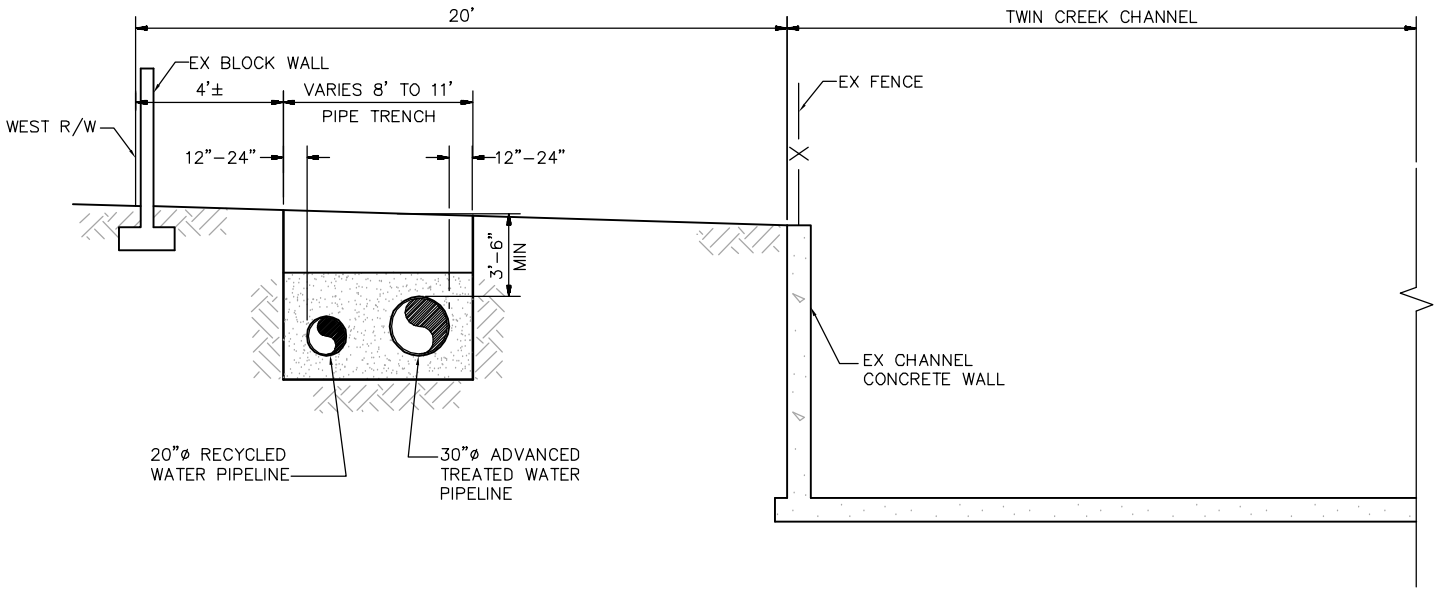
SECTION 1E – TWIN CREEK CHANNEL
BETWEEN 3rd ST AND RIALTO AVE

FIGURE
8-13



SECTION 1F - TWIN CREEK CHANNEL

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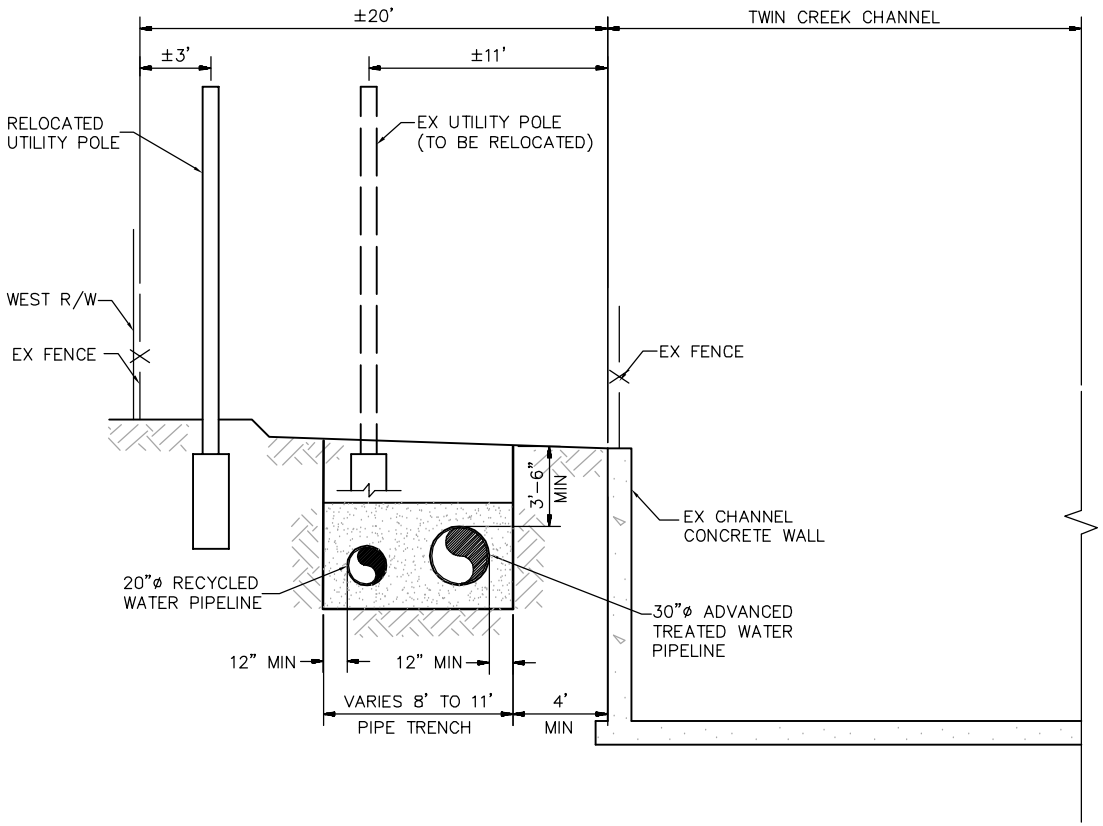
SECTION 1F – TWIN CREEK CHANNEL
BETWEEN 6TH ST AND 9TH ST

FIGURE
8-14



SECTION 1G - TWIN CREEK CHANNEL

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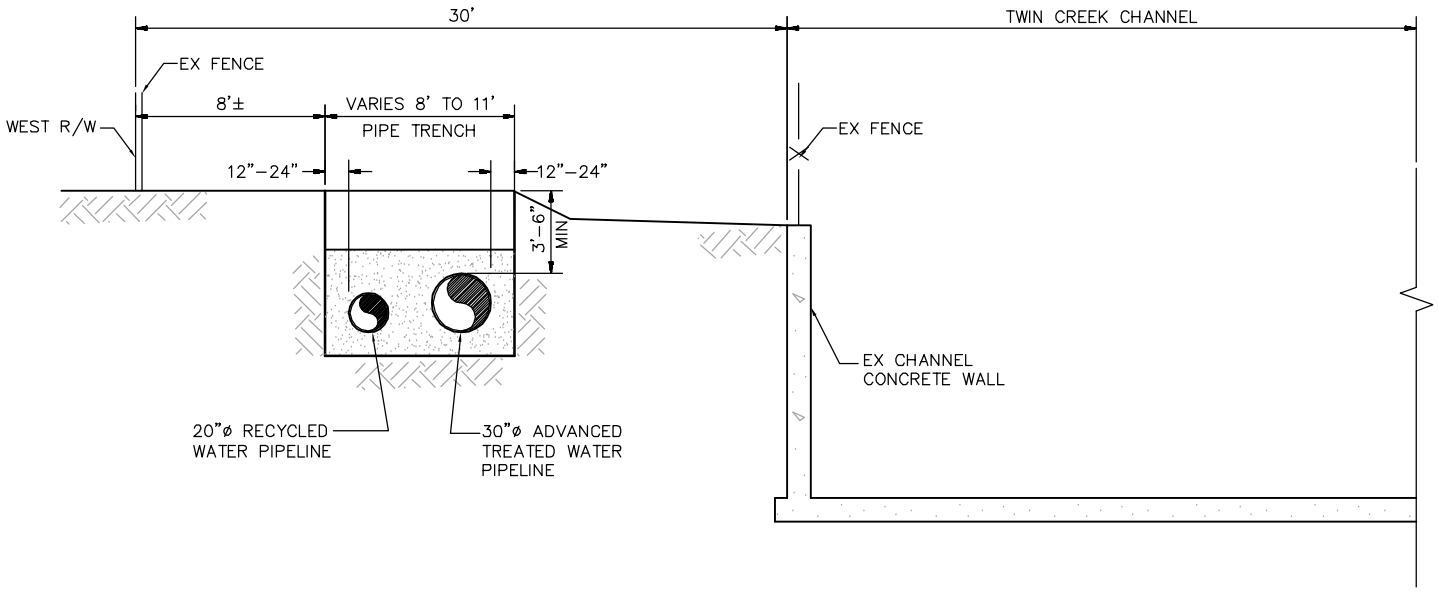
SECTION 1G – TWIN CREEK CHANNEL
SOUTH OF BASELINE RD

FIGURE
8-15



SECTION 1H - TWIN CREEK CHANNEL

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SECTION 1H – TWIN CREEK CHANNEL BETWEEN 21ST ST AND HIGHLAND AVE

FIGURE 8-16

60 30 0 60 120 180

SCALE: 1"=60'

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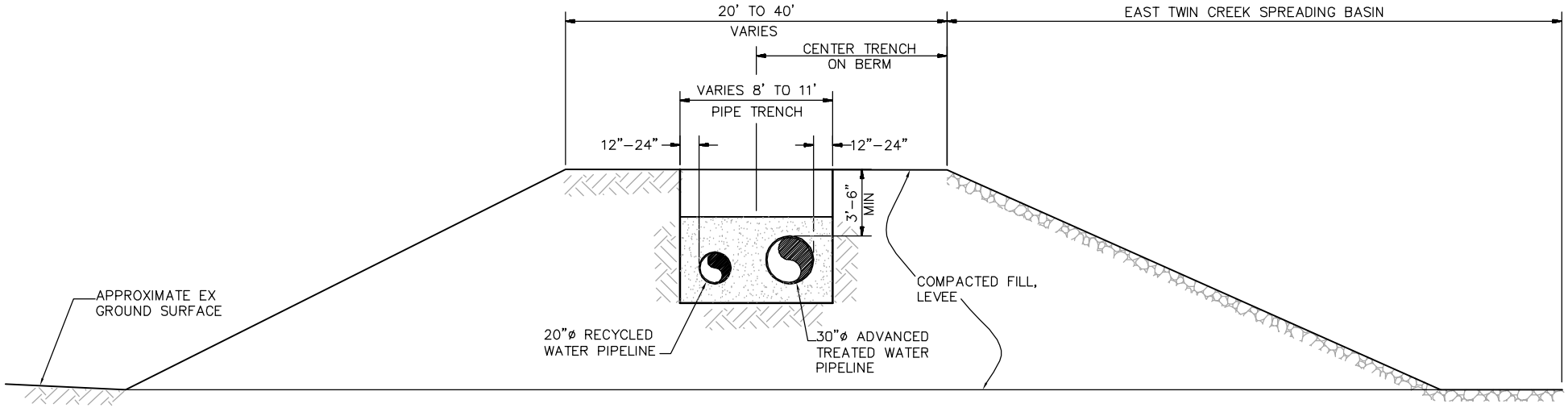
CALTRANS CROSSING 11

FIGURE
8-17

H:\PDATA\65100826\CADD\WATER\EXHIBITS\CALTRANS-CROSSING\0826-SEC11-CALTRANS.DWG DANNYM 7/17/12 4:40 pm



SECTION 1J - TWIN CREEK CHANNEL

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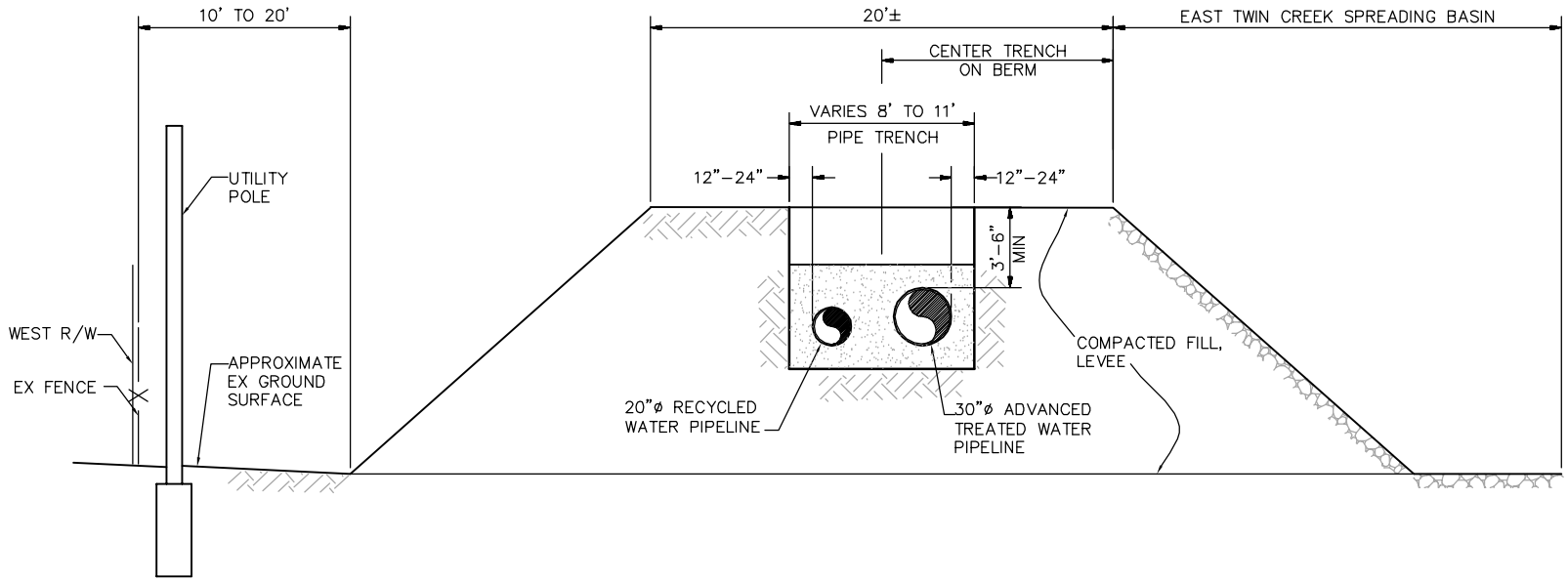
SECTION 1J – TWIN CREEK CHANNEL
NORTH OF MARSHALL BLVD

FIGURE
8-18



SECTION 1K - TWIN CREEK CHANNEL

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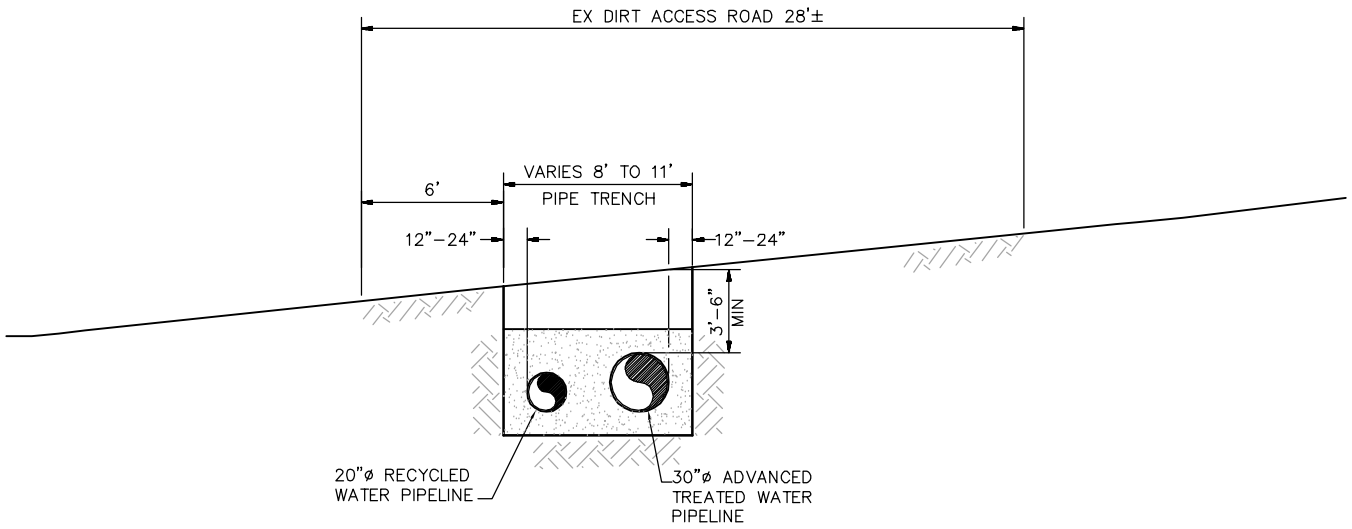
SECTION 1K – TWIN CREEK CHANNEL
NORTH OF AVERY STREET

FIGURE
8-19



SECTION 1L, 2K & 3K

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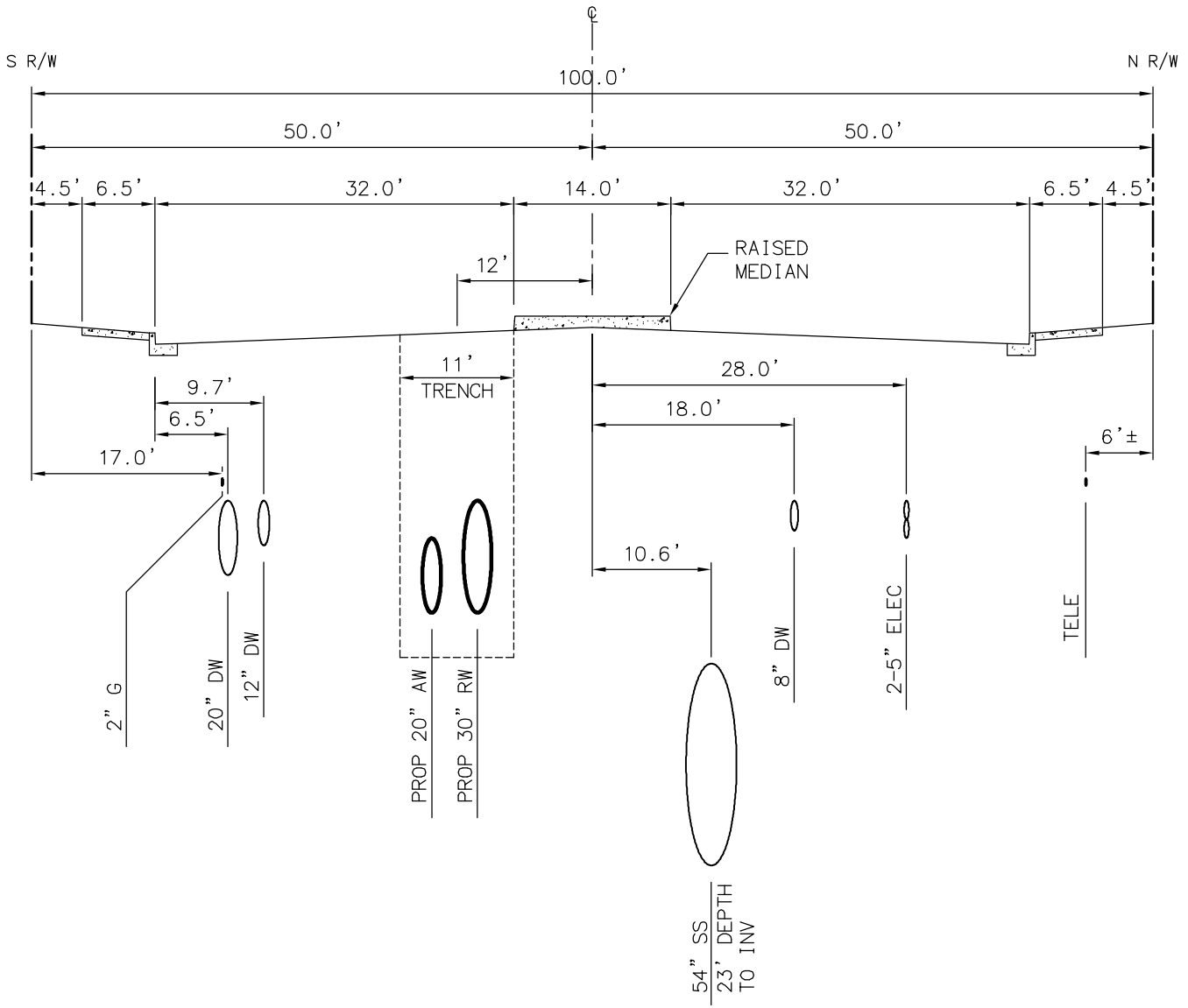
SECTION 1L, 2K & 3K – NORTH OF WATERMAN BASINS

FIGURE 8-20



SECTION 2A & 3A - ORANGE SHOW RD

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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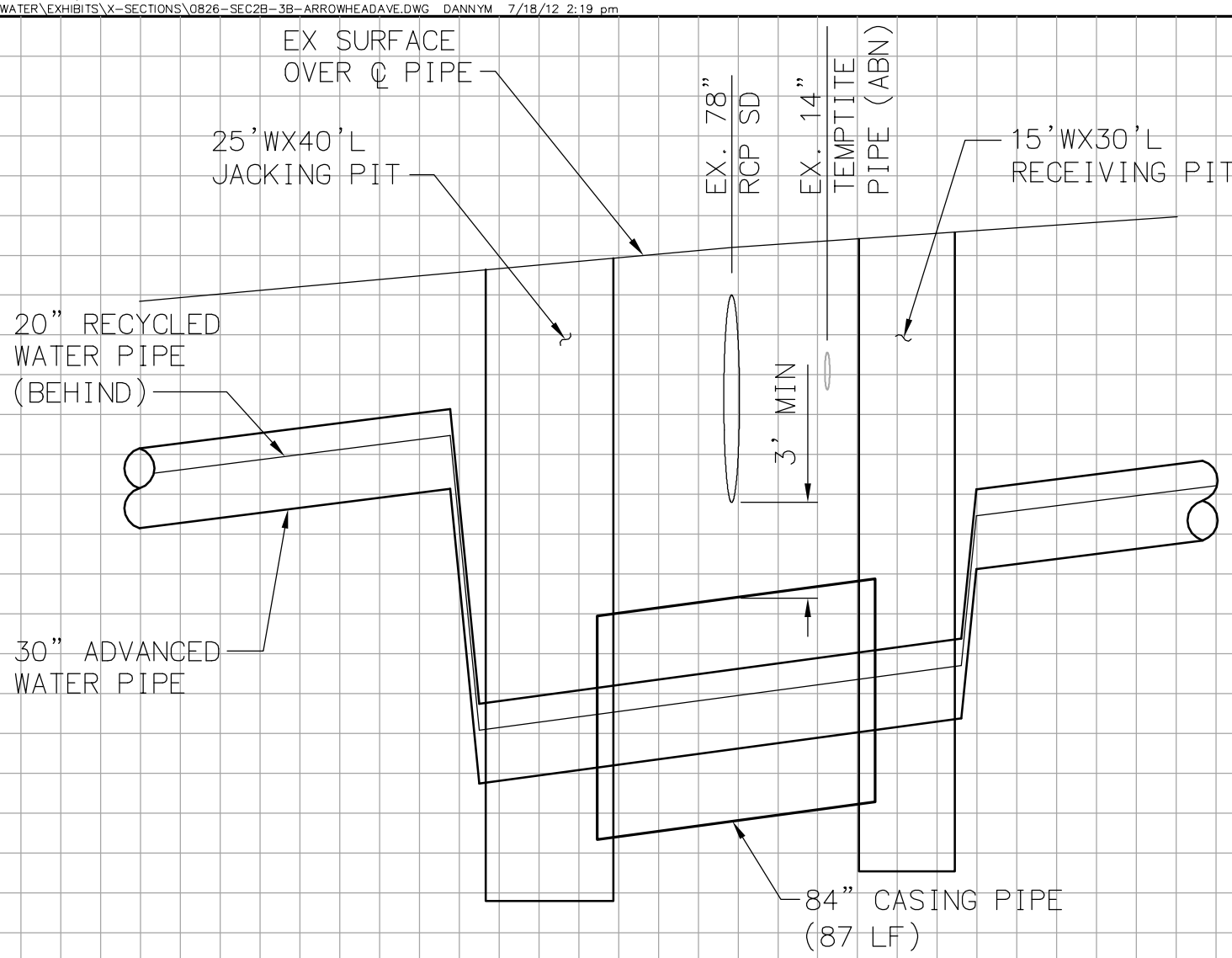
SECTION 2A & 3A - ORANGE SHOW ROAD BETWEEN EAST TWIN CREEK AND ARROWHEAD AVENUE

FIGURE 8-21



PROFILE 2B & 3B - ARROWHEAD AVE. CROSSING

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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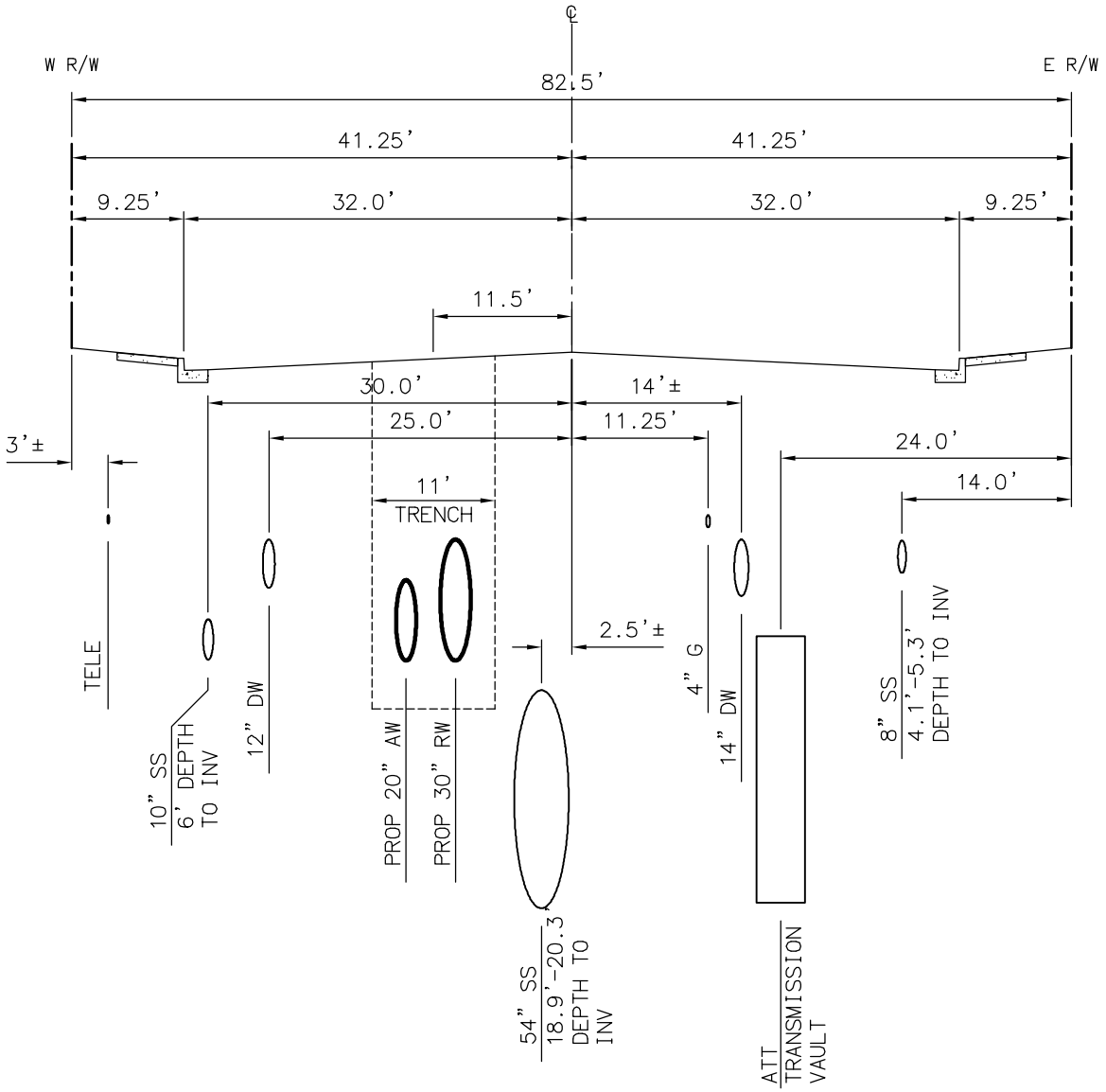
PROFILE 2B & 3B - 78" SD CROSSING
ARROWHEAD AVE

FIGURE
8-22



SECTION 2C & 3C - ARROWHEAD AVE

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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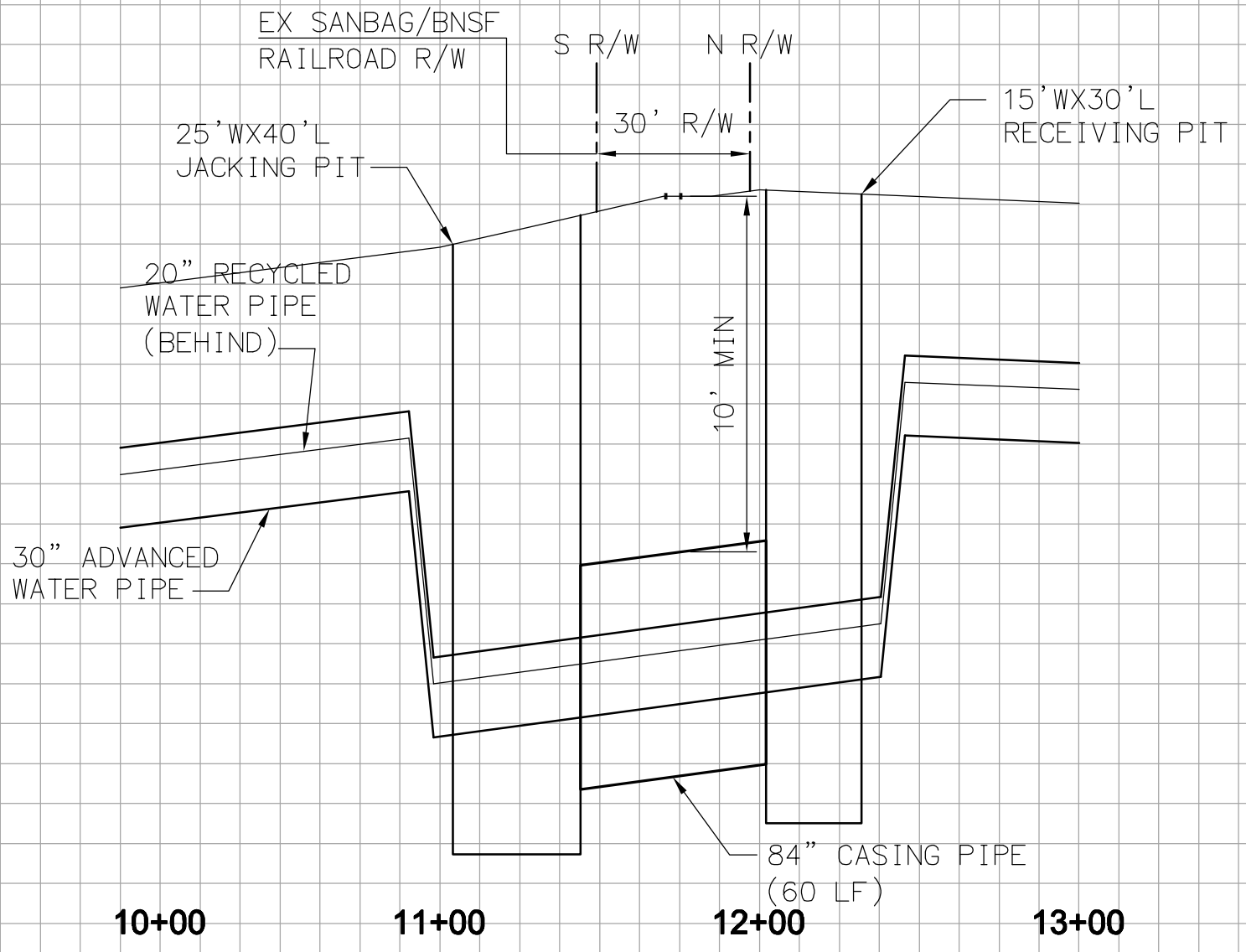
SECTION 2C & 3C - ARROWHEAD AVE
BETWEEN MILL ST AND HUFF ST

FIGURE
8-23



SECTION 2D & 3D - ARROWHEAD AVE

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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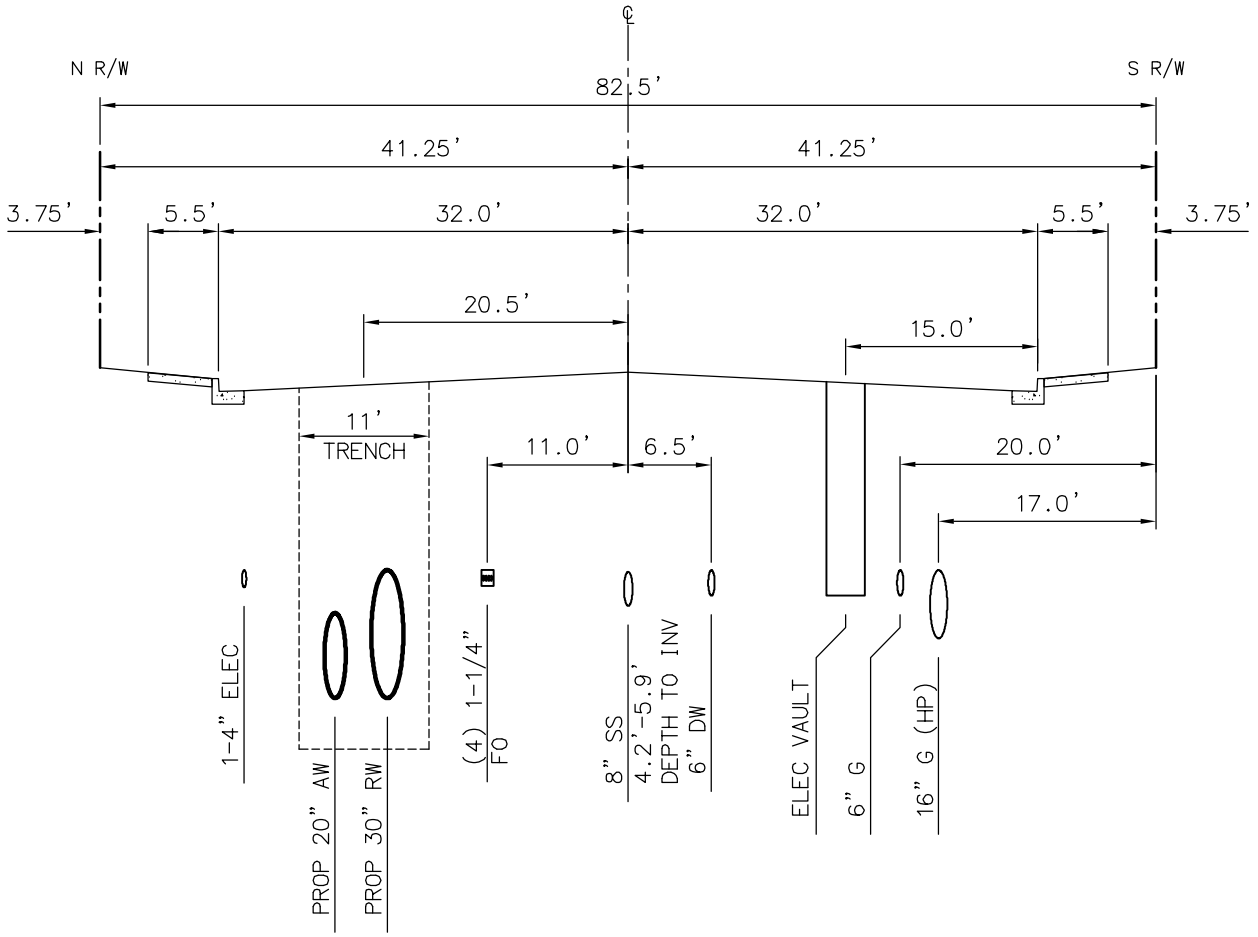
SECTION 2D & 3D - ARROWHEAD AVE
BETWEEN RIALTO AVE AND HILDA ST

FIGURE
8-24



SECTION 2E & 3E - RIALTO AVE

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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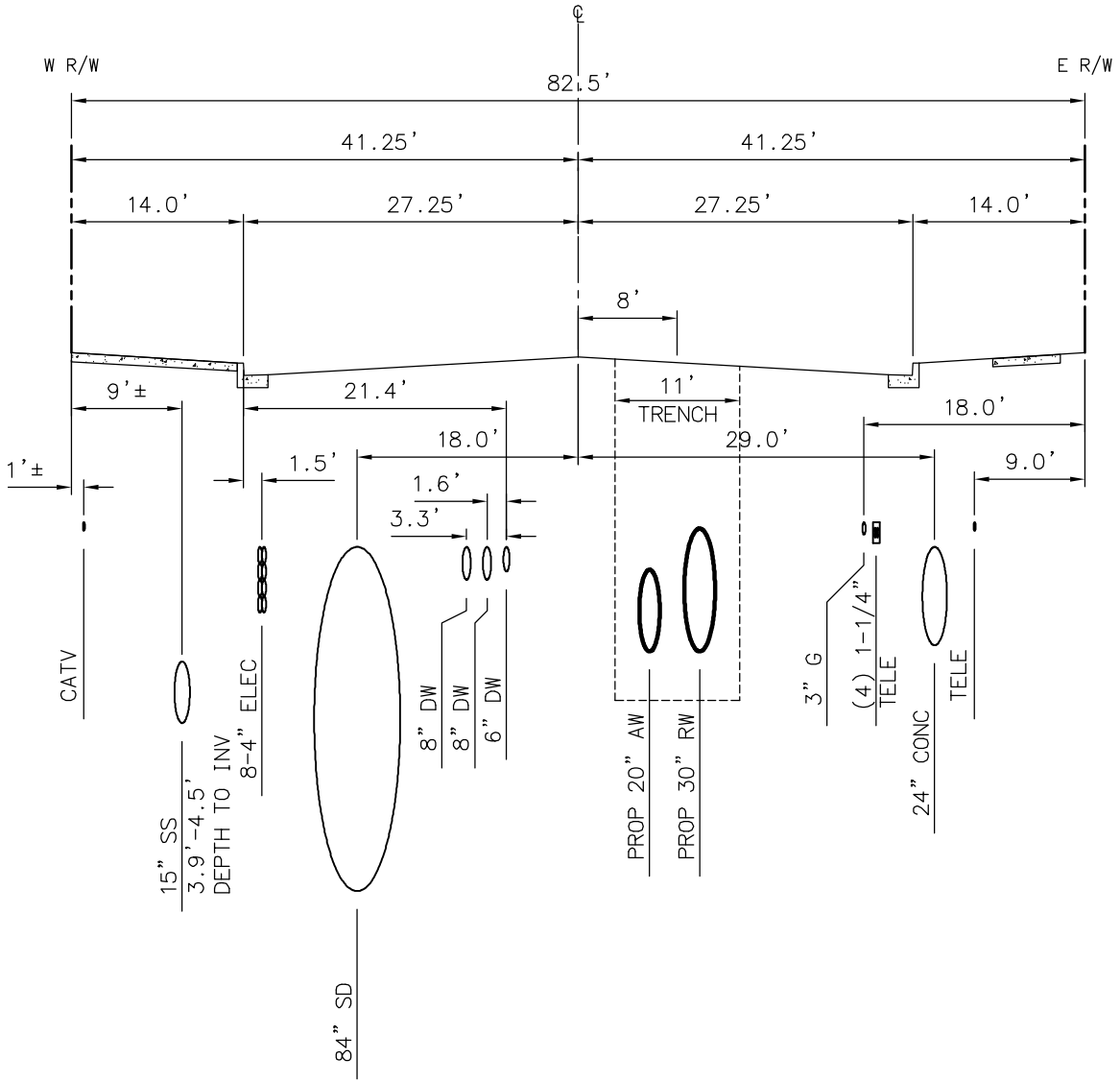
SECTION 2E & 3E - RIALTO AVE BETWEEN ARROWHEAD AVENUE AND SIERRA WAY

FIGURE
8-25



SECTION 2F & 3F - SIERRA WAY

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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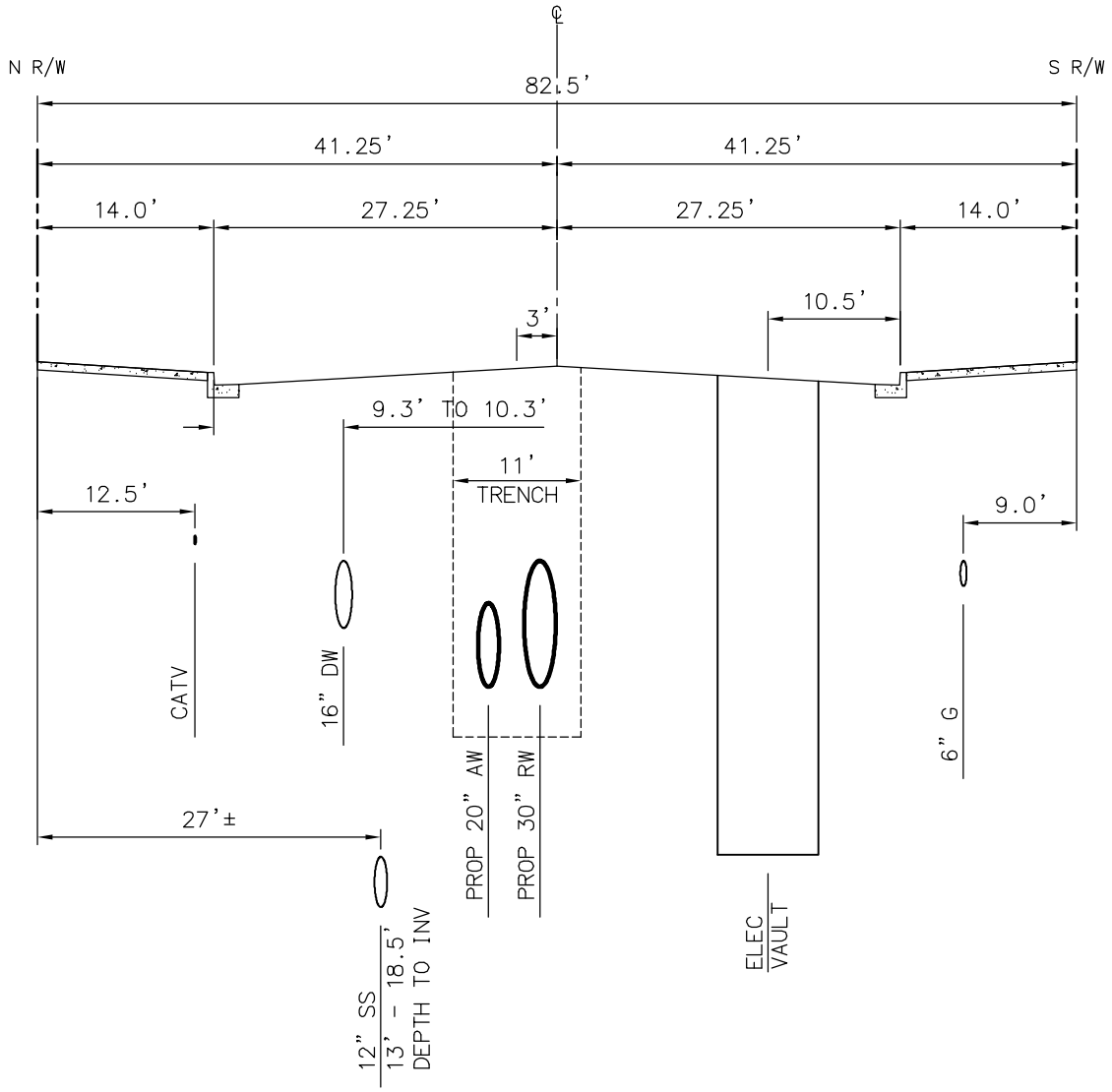
SECTION 2F & 3F - SIERRA WAY BETWEEN 4TH ST AND COURT ST

FIGURE
8-26



SECTION 2G - BASELINE ST

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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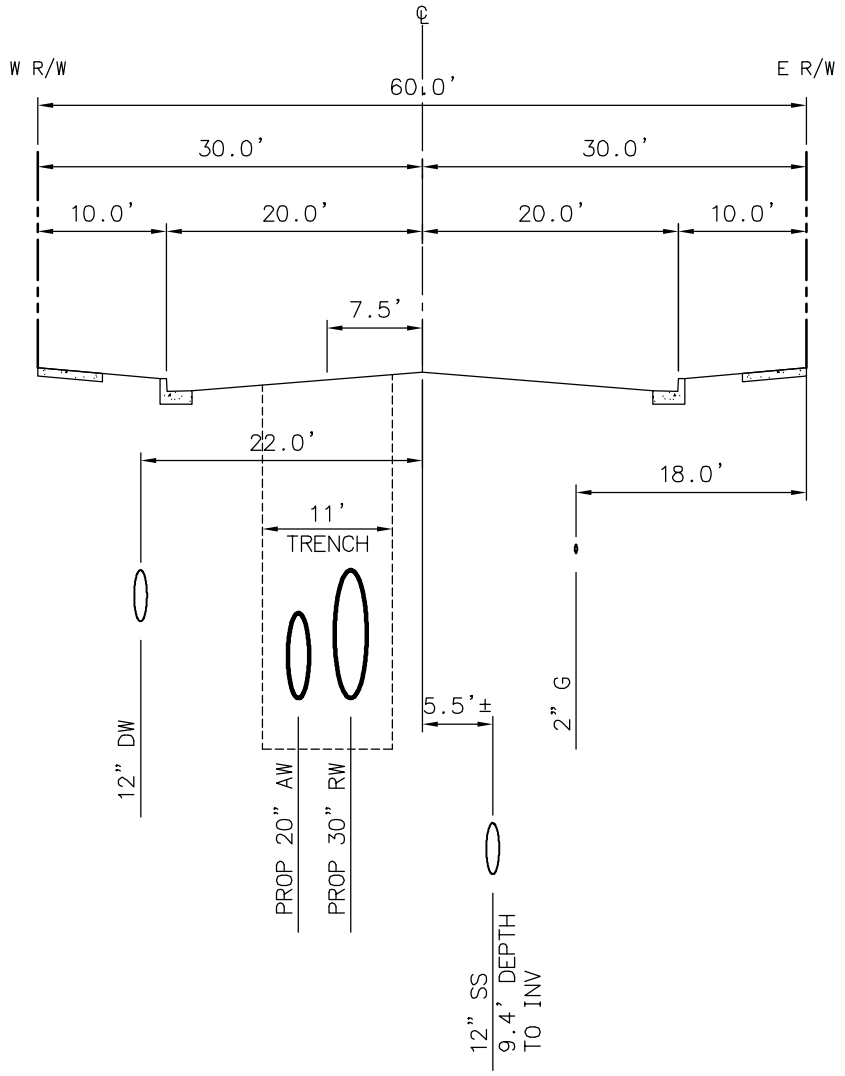
SECTION 2G - BASELINE ST BETWEEN WATERMAN AVE AND CRESTVIEW AVE

FIGURE
8-27



SECTION 2H - CRESTVIEW AVE

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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SECTION 2H - CRESTVIEW AVE
BETWEEN 21ST ST AND 19TH ST

FIGURE
8-28

60 30 0 60 120 180

SCALE: 1"=60'

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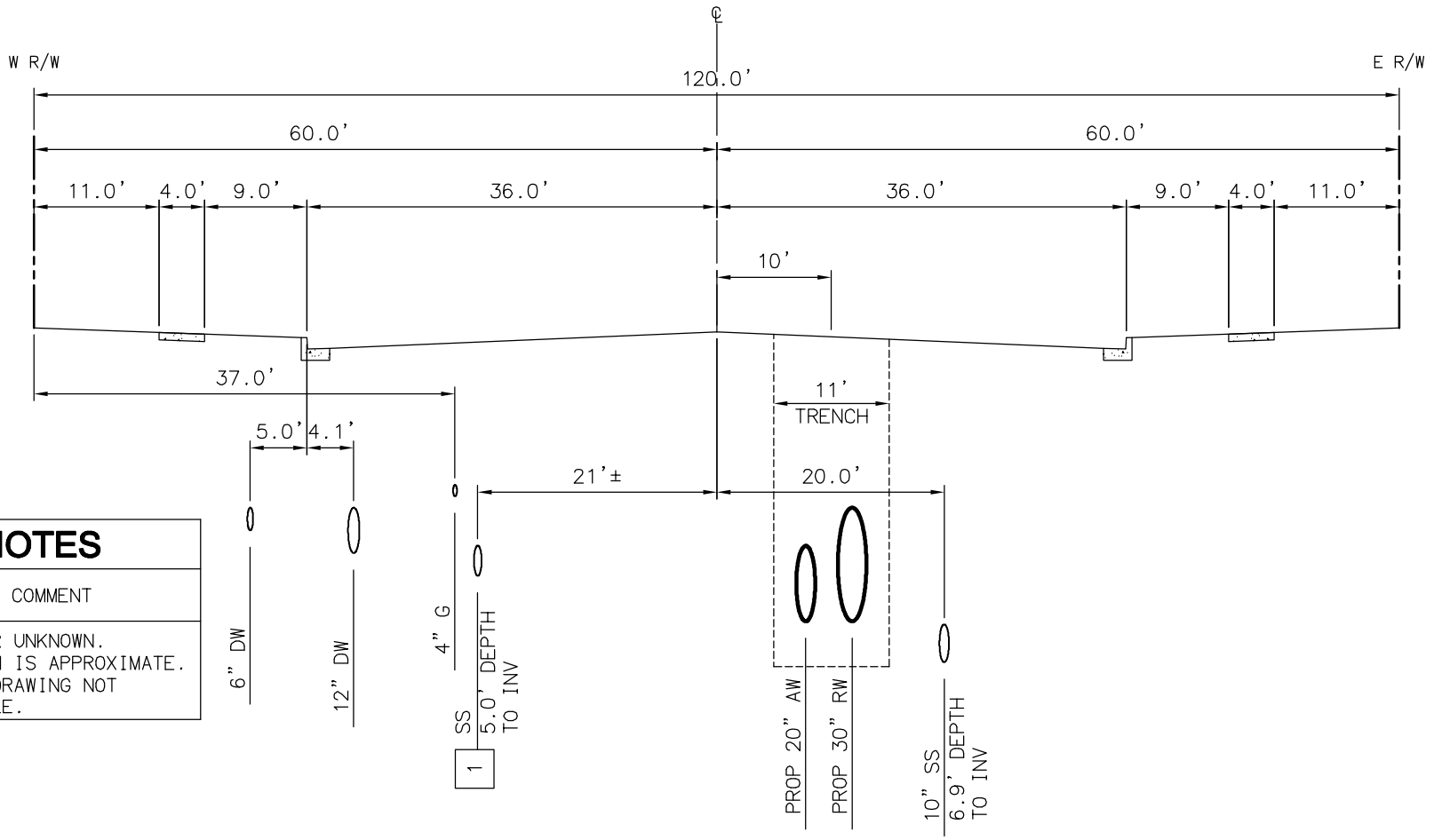
CALTRANS CROSSING 2I

FIGURE
8-29

H:\PDATA\65100826\CADD\WATER\EXHIBITS\CALTRANS-CROSSING\0826-SEC2I-CALTRANS.DWG DANNYM 7/17/12 4:41 pm



UTILITY NOTES

NO.	TYPE	COMMENT
1	SS	DIAMETER UNKNOWN. LOCATION IS APPROXIMATE. RECORD DRAWING NOT AVAILABLE.

SECTION 2J - VALENCIA AVE

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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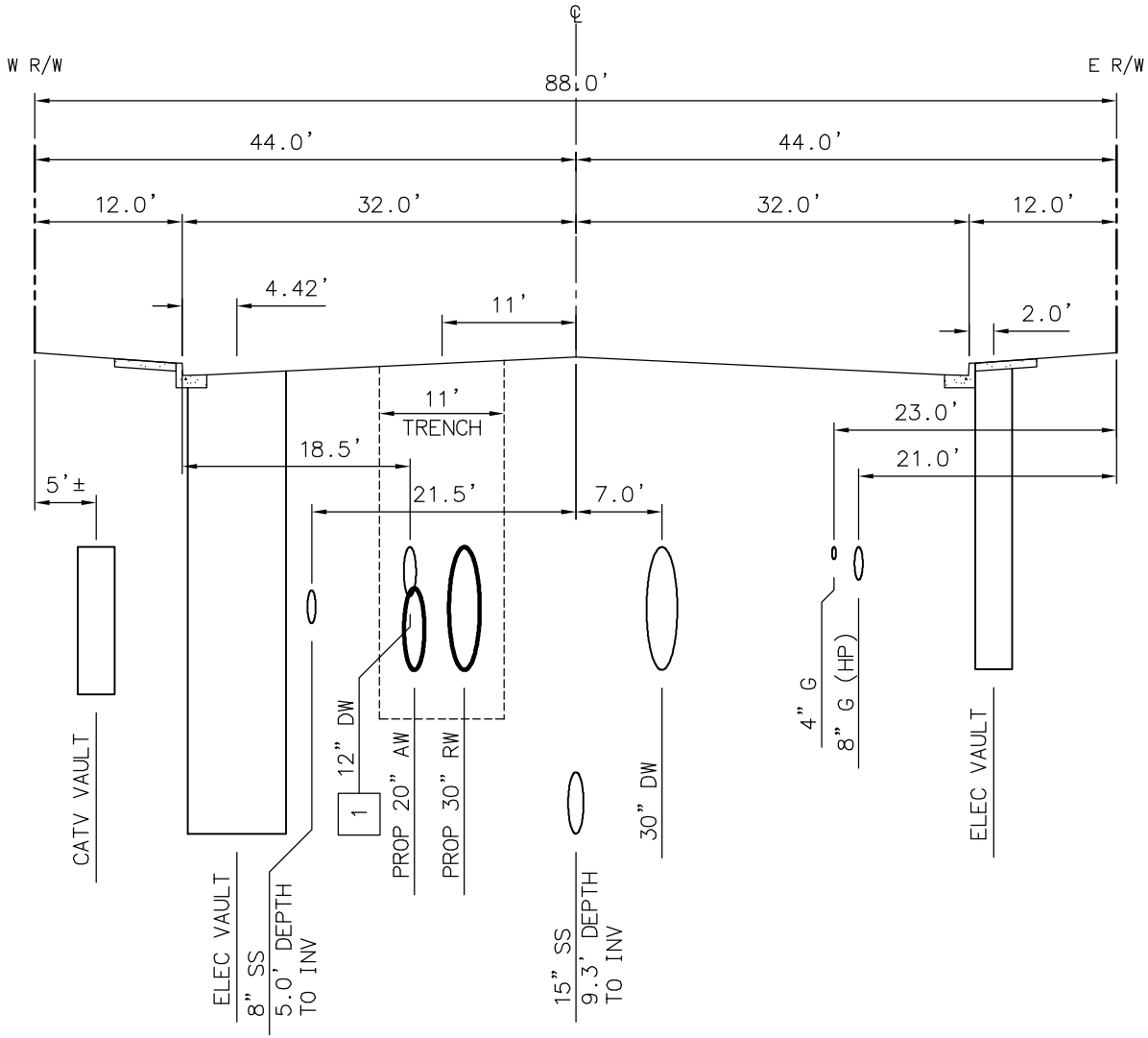
SECTION 2J - VALENCIA AVE BETWEEN AVERY ST AND 39TH ST

FIGURE
8-30

UTILITY NOTES		
NO.	TYPE	COMMENT
1	12" DW	RELOCATION REQUIRED



SECTION 3G - WATERMAN AVE

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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SECTION 3G - WATERMAN AVE BETWEEN GILBERT ST AND WABASH ST

FIGURE
8-31

60 30 0 60 120 180

SCALE: 1"=60'

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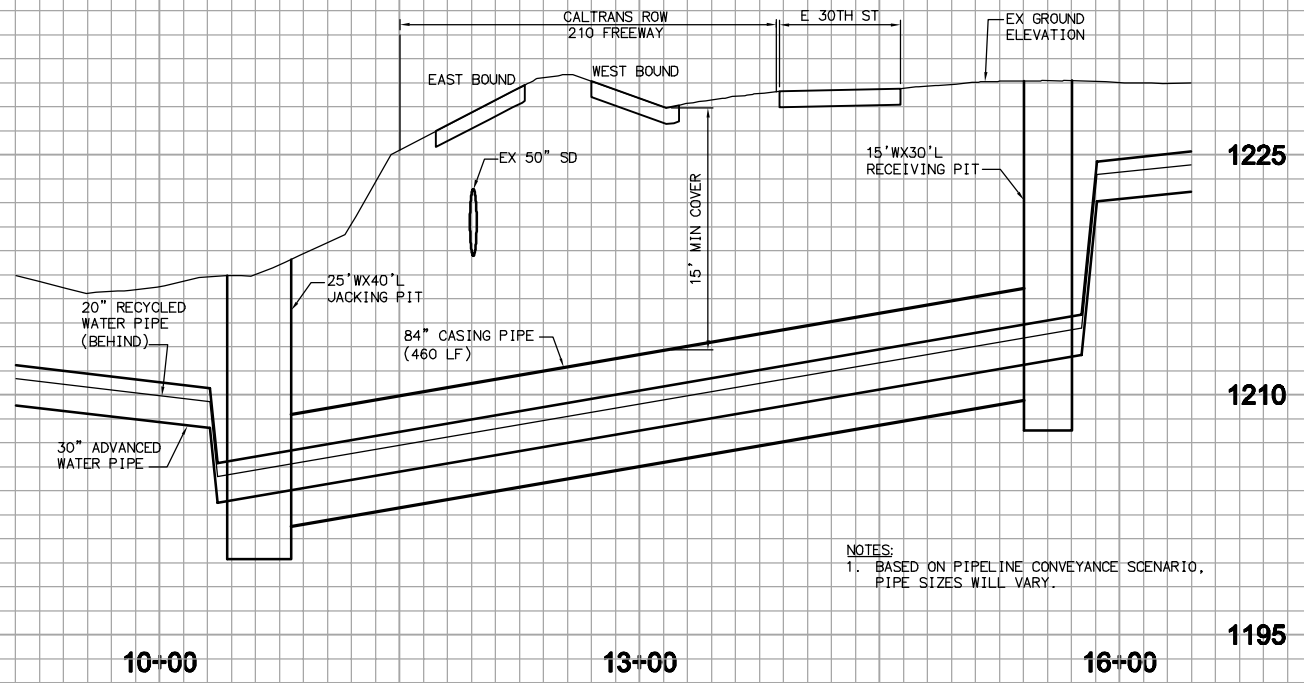
CALTRANS CROOSING 3H

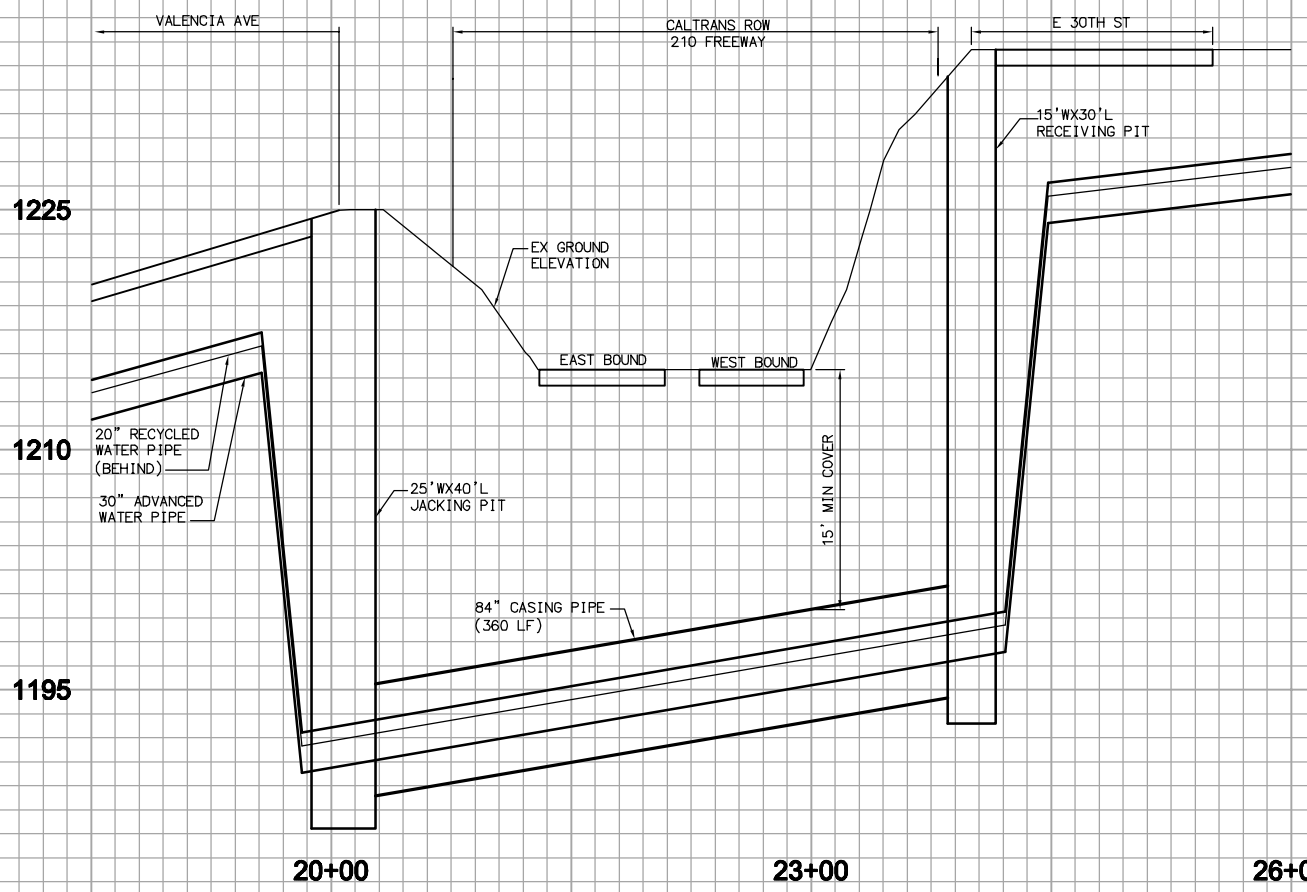
FIGURE
8-32

H:\PDATA\65100826\CADD\WATER\EXHIBITS\CALTRANS-CROSSING\0826-SEC3H-CALTRANS.DWG DANNYM 7/17/12 4:42 pm



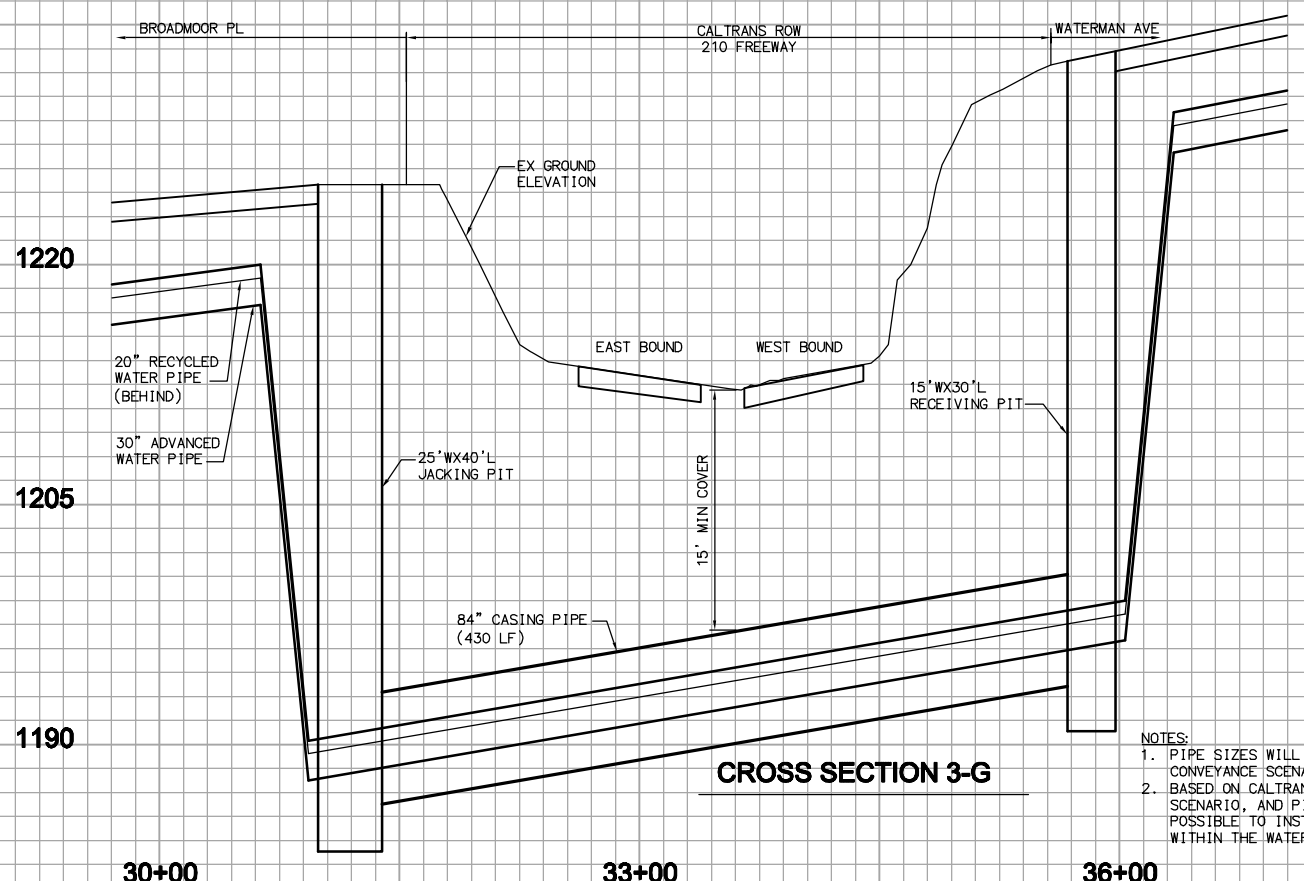
NOTES:
1. BASED ON PIPELINE CONVEYANCE SCENARIO, PIPE SIZES WILL VARY.

CROSS SECTION 1-G



CROSS SECTION 2-G (ALT. 1)

NOTES:
1. PIPE SIZES WILL VARY BASED ON PIPELINE CONVEYANCE SCENARIO.
2. BASED ON CALTRANS APPROVAL, CONVEYANCE SCENARIO, AND PIPE SIZE, IT MAY BE POSSIBLE TO INSTALL ONE OR MORE PIPES WITHIN THE VALENCIA AVE BRIDGE.
3. PROFILE OF SECTION 2G ALT 2 IS SIMILAR.



CROSS SECTION 3-G

NOTES:
1. PIPE SIZES WILL VARY BASED ON PIPELINE CONVEYANCE SCENARIO.
2. BASED ON CALTRANS APPROVAL, CONVEYANCE SCENARIO, AND PIPE SIZE, IT MAY BE POSSIBLE TO INSTALL ONE OR MORE PIPES WITHIN THE WATERMAN AVE BRIDGE.

PROFILE SCALE
HORIZ: 1"=60'
VERT: 1"=6'

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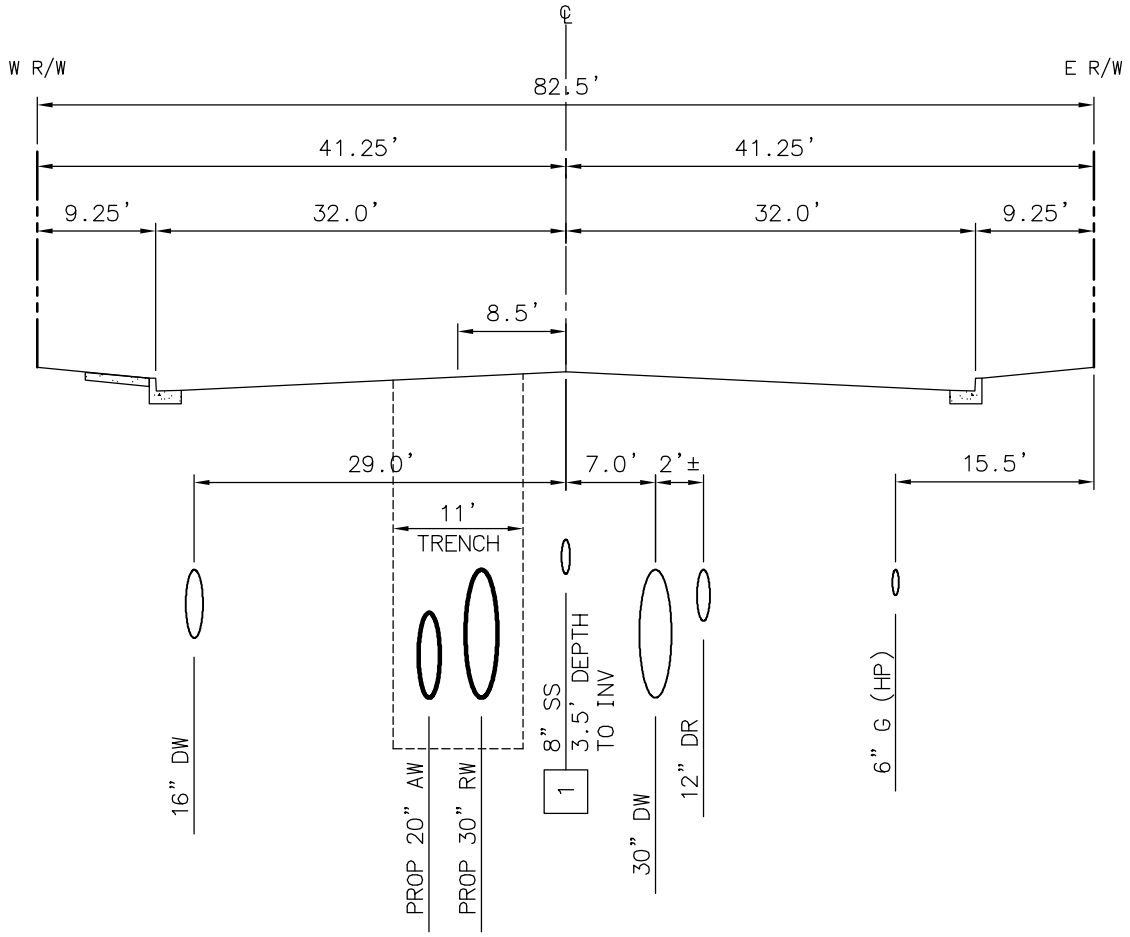
CALTRANS I-210 CROSSING
CROSS SECTIONS

FIGURE
8-33

UTILITY NOTES		
NO.	TYPE	COMMENT
1	8" SS	LOCATION IS APPROXIMATE RECORD DRAWING NOT AVAILABLE.



SECTION 3I - WATERMAN AVE

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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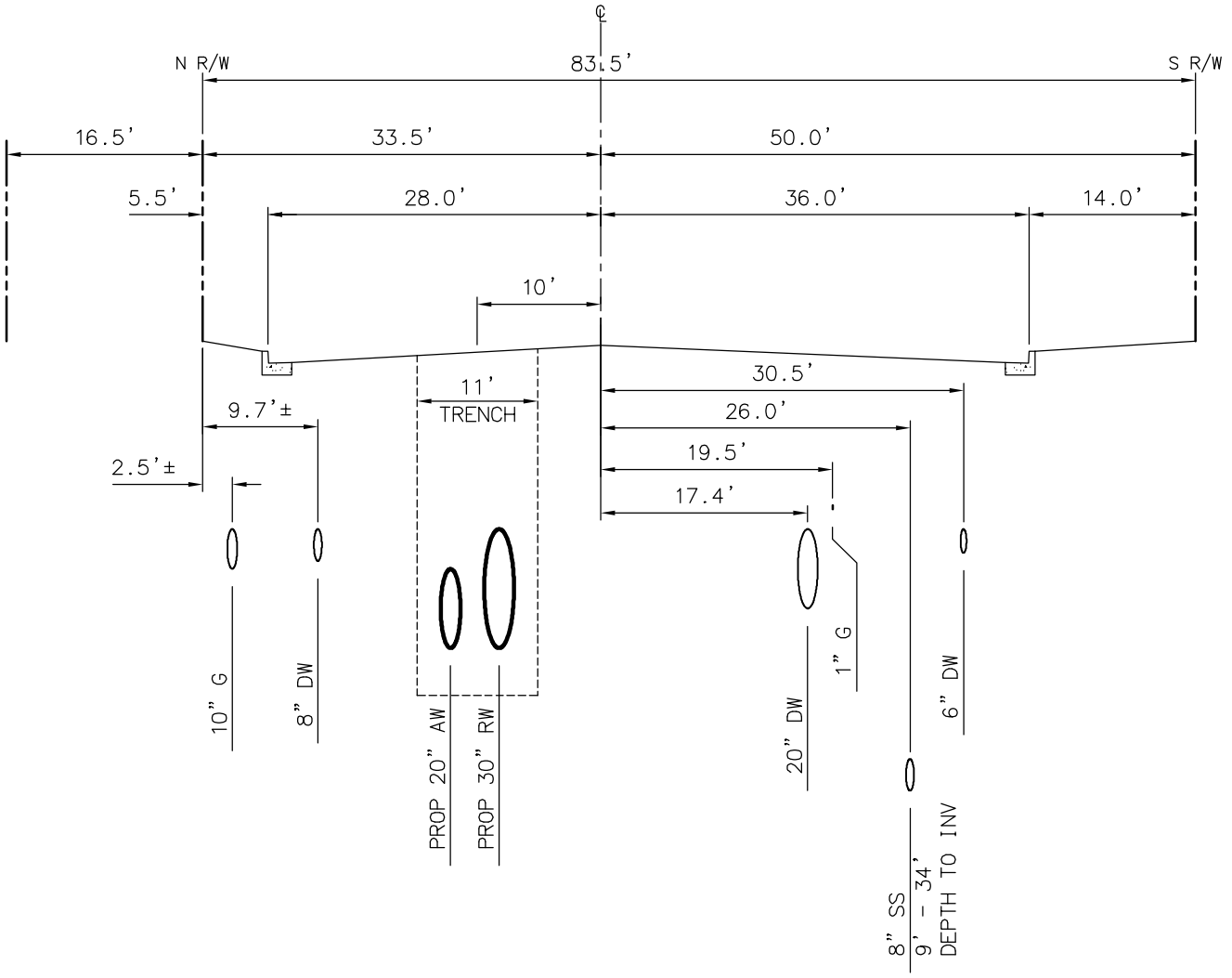
SECTION 3I - WATERMAN AVE BETWEEN 30TH ST AND MARSHALL BLVD

FIGURE
8-34



SECTION 3J - 40TH ST

HORZ SCALE: 1" = 15'
VERT SCALE: NONE

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SECTION 3J - 40TH ST BETWEEN WATERMAN AVE AND VALENCIA AVE

FIGURE
8-35

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9.0 PUMP STATION/STORAGE RESERVOIR ANALYSIS

An analysis was conducted to evaluate potential Pump Station/Storage Reservoir Sites within the Conveyance Facility Corridor. Seven preferred Pump Station/Storage Reservoir Sites were identified for the various Conveyance Scenarios. Typical site requirements were identified and layouts were developed for each potential site. Facility power requirements were determined and connections to existing power lines were identified. An evaluation of the preferred Pump Station/Storage Reservoir Sites was conducted considering evaluation factors and rating each site.

9.1 TYPICAL SITE REQUIREMENTS

Typical facility site requirements were identified in Section 7 for a typical storage reservoir site, pumping station site, and combined storage reservoir/pumping station site. These facility requirements were utilized to develop specific site layouts for each of the seven preferred Pump Station/Storage Reservoir Sites (see Figures 9-1 to 9-7).

9.2 ALTERNATIVE SITES

There are two potential areas for Pump Station/Storage Reservoir Sites – at an intermediate location or at a northern location depending on the conveyance scenario selected. Different site options were identified for each location. Three intermediate locations (Sites A, B, and C) were identified at a point approximately half way from the SBWRP to the Recharge Basins with an elevation approximately half way between the SBWRP elevation (Elevation 1,000 feet, amsl) and the Recharge Basins elevation (Elevation 1,470 feet, amsl). Four northern locations were identified near the Recharge Basins (Sites D, E, F, and G). The potential sites were also located on open private property or within a City park to minimize impacts to existing structures, homes, and commercial businesses. Storage reservoirs could be above-grade, welded steel; or above-grade, partially buried, or buried prestressed concrete. Specific site options are described below:

<u>Intermediate Location</u>

1. Pump Station/Storage Reservoir Site Option A – This site is located at a vacant lot at the corner of East 23rd Street and Leroy Street. It is anticipated that the tank would be above-grade welded steel or prestressed concrete.
2. Pump Station/Storage Reservoir Site Option B – This site is located in Perris Hill Park on the northwest corner of the park at the corner of East Highland Avenue and Valencia Avenue. It is anticipated that the tank would be partially buried or buried prestressed concrete due to its location within Perris Hill Park at the entrance to the park.

3. Pump Station/Storage Reservoir Site Option C - This site is located in Perris Hill Park at the corner where East Highland Avenue and East Twin Creek Channel meet and west of East Twin Creek Channel. It is anticipated that the tank would be above-grade welded steel or prestressed concrete since it is located at the edge of the park near East Twin Creek Channel.

Northern Location

1. Pump Station/Storage Reservoir Site Option D – This site is located in Wildwood Park along the west of the park where it borders Waterman Avenue. It is anticipated that the tank would be partially buried or buried prestressed concrete due to its location within Wildwood Park.

2. Pump Station/Storage Reservoir Site Option E – This site is located in Wildwood Park at the southeast corner where it borders East 40th Street. It is anticipated that the tank would be partially buried or buried prestressed concrete due to its location within Wildwood Park.

3. Pump Station/Storage Reservoir Site Option F – This site is located adjacent to East Twin Creek Spreading Grounds at the corner where East 40th Street and East Twin Creek Channel intersect and west of the East Twin Creek Spreading Basins within SBCFCD property. It is anticipated that the tank would be above-grade welded steel or prestressed concrete.

4. Pump Station/Storage Reservoir Site Option G – This site is located north of the Waterman Basins at the terminus of the pipeline alignments. It is anticipated that the tank would be above-grade welded steel or prestressed concrete.

9.3 PUMP STATION/STORAGE RESERVOIR EVALUATION CRITERIA

Critical evaluation factors relative to the construction and operation of the Pump Station/Storage Reservoir Sites were developed to evaluate the advantages and disadvantages of each site option. Each factor was evaluated and rated using an established rating system. Pump Station/Storage Reservoir Site Options with advantages were rated higher and those with disadvantages were rated lower. Eleven critical evaluation factors were developed for the Pump Station/Storage Reservoir Site Options: property, agency coordination/permitting, flexibility for future expansion, community/visual impacts, access, utilities, power supply, constructability, land development, construction costs, and O&M costs.

9.3.1 Property

The available property is important for construction and maintenance of the Pump Station/Storage Reservoir Sites. For combined pump station/storage reservoir locations, estimated required property dimensions were determined as follows:

- Intermediate Pump Station/Storage Reservoir Site: 190 feet by 265 feet
- Northern Pump Station/Storage Reservoir Site: 220 feet by 290 feet

For some of the selected sites, the property is slightly smaller than these dimensions, the property is shaped differently, or existing facilities on-site would need to be relocated. All of these factors were included in the evaluation of this criterion.

9.3.2 Agency Coordination/Permitting

The location of the Pump Station/Storage Reservoir Site may require coordination with other agencies for property acquisition (i.e. purchase of a privately owned lot or a license agreement with the SBCFCD). The location of the Pump Station/Storage Reservoir Site may require other special coordination such as locations within existing parks. Pump Station/Storage Reservoir Site Options without significant agency coordination and permitting requirement were rated higher than those with significant requirements.

9.3.3 Flexibility for Future Expansion

This criterion was used to evaluate the ability for future expansion with space available for construction of future facilities within or adjacent to the Pump Station/Storage Reservoir Site. Pump Station/Storage Reservoir Sites with space for future expansion were rated higher than those sites without additional space.

9.3.4 Community/Visual Impacts

This criterion was used to evaluate potential impacts to the community considering residential, commercial, parks, schools, churches, and other land uses in relation to the location of the Pump Station/Storage Reservoir Site. The estimated duration of construction was considered for the impacts to community uses such as parks and businesses. Pump Station/Storage Reservoir Site Options with fewer community impacts and visual impacts were rated higher than those with more community impacts and visual impacts.

9.3.5 Access

The ability to access the Pump Station/Storage Reservoir Site was evaluated. Potential impacts to traffic were considered for access to the Pump Station/Storage Reservoir Site.

9.3.6 Utilities

Existing utilities were identified to exist in the Pump Station/Storage Reservoir Sites including overhead utilities (power, phone, and cable), storm drains, water lines, sewer lines, underground electrical lines, high pressure gas lines, and buried communication lines. The utility information was obtained through utility research and investigation by contacting multiple agencies and visual observance. The number, location, size, and type of crossing or parallel utility impacts the construction and maintenance of the proposed Pump Station/Storage Reservoir Site. Most of the utility on sites were considered to be minor and not expected to result in difficult construction or relocation of the utility. If utilities would require relocation, the site was assigned a lower rating.

9.3.7 Power Supply

The availability of power was evaluated for each Pump Station/Storage Reservoir Site. Sites could be supplied with power from existing overhead or underground power. If no adjacent power service is available, an extension of the power service would be required to the Pump Station/Storage Reservoir Site.

9.3.8 Constructability

The overall constructability of the Pump Station/Storage Reservoir Site was evaluated considering access for equipment, staging areas, material storage, slope of construction, and cross slopes. The type of construction was also evaluated (i.e. circular versus rectangular and above ground versus buried).

9.3.9 Land Condition

This factor represents the type of use of land and developments on the land in the location of the Pump Station/Storage Reservoir Site. Land condition include open grade (dirt or grass surface) or vegetated, and may include asphalt paved roads or parking lots, recreational facilities (park, baseball field, etc.), and buildings/structures. Each Pump Station/Storage Reservoir Site Option was evaluated based on the land condition with a higher rating for sites with open country and lower rating for impacts to existing facilities.

9.3.10 Construction Costs

The estimated construction cost of Pump Station/Storage Reservoir was evaluated. Pump Station/Storage Reservoir Sites were rated based on their relative estimated construction costs.

9.3.11 Operation and Maintenance Costs

The estimated O&M cost of Pump Station/Storage Reservoirs was evaluated. Pump Station/Storage Reservoir Sites were rated based on their relative estimated construction costs.

9.4 PUMP STATION/STORAGE RESERVOIR SITE RANKING

Similar to the pipeline alignment evaluation and ranking, *Criterium Decision Plus,* was utilized for Pump Station/Storage Reservoir Site ranking (see Section 8.10). The same rating and weighting definitions were used. Each site option are rated based upon its ability to satisfy the project objectives. The alternatives were rated using a scale of 1 to 5 as shown in Table 9-1 with a higher rating indicating a more favorable scenario or option.

Table 9-1
Definition of Rating System

Definition	Rating
Satisfies project objectives with significant noted advantages	5
Satisfies project objectives with noted advantages	4
Satisfies project objectives	3
Satisfies project objectives with noted disadvantages	2
Satisfies project objectives with significant noted disadvantages	1

Each evaluation criteria was then assigned a weight representing the importance of the criteria on a scale of 1 to 5. A higher weight represents more important criteria as shown in Table 9-2.

Table 9-2
Definition of Weighting System

Definition	Rating
Critical Importance	5
Significant Importance	4
Important	3
Low Importance	2
Least Importance	1

Evaluation criteria weightings for Pump Station/Storage Reservoir Site Options are shown in Table 9-3.

Table 9-3
Pump Station/Storage Reservoir Site Options Criteria Weighting

Evaluation Criteria	Weight
Property	4
Agency Coordination/Permitting	3
Flexibility for Future Expansion	2
Community/Visual Impacts	4
Access	1
Utilities	1
Power Supply	3
Constructability	4
Land Condition	3
Construction Costs	5
O&M Costs	5

A score for each evaluation criteria was calculated by multiplying the rating and the weight. A higher score indicated a more favorable site option. The overall scores were compared for each site option. The overall score is a good indication as to which site options are the best match for meeting the project objectives.

Since the overall score may not add up to 100, a weighted score was calculated for each site option. The overall scores were converted to percentages; therefore the ideal score would have value of 100 percent. The higher the weighted score of the option, the closer that option would come to meeting all the project objectives considering the criteria impacting the decision.

Utilizing *Criterium Decision Plus*, a decision score was calculated with an ideal score of 1.00. The higher the decision score of the option, the closer that option would come to meeting all the project objectives considering the criteria impacting the decision. Weighted scores and decision scores were similar, but since *Criterium Decision Plus* utilizes a more complex integrated rating and ranking system, the decision score was considered in evaluating the rank.

The highest decision score is considered the highest ranked or preferred site option. Ranks were then assigned to the remaining site options in the order of highest score to lowest score.

The ranking of Pump Station/Storage Reservoir Site Options is shown in Table 9-4 and depicted graphically on Figure 9-8.

Table 9-4
Pump Station/Storage Reservoir Site Options Evaluation and Ranking

Evaluation Factor	Site A	Site B	Site C	Site D	Site E	Site F	Site G
Property Weight = 4	Private Property Rating = 1	Perris Hill Park, entrance Rating = 4	Perris Hill Park, edge Rating = 5	Wildwood Park, edge Rating = 4	Wildwood Park, edge Rating = 4	East Twin Creek, SBCFCD owned Rating = 2	Waterman Basin, SBCFCD owned Rating = 2
	Score = 4	Score = 16	Score = 20	Score = 16	Score = 16	Score = 8	Score = 8
Agency Coordination/ Permitting Weight = 3	Commercial Business Zone Rating = 4	Coordinate with Park (buried) Rating = 3	Coordinate with Park (above-ground) Rating = 3	Coordinate with Park (buried) Rating = 3	Coordinate with Park (buried) Rating = 3	Coordinate with SBCFCD Rating = 2	Coordinate with SBCFCD Rating = 1
	Score = 12	Score = 9	Score = 9	Score = 9	Score = 9	Score = 6	Score = 3
Flexibility for Future Expansion Weight = 2	Site fills lot Rating = 1	Expansion within Park Rating = 4	Expansion within Park Rating = 4	Expansion within Park Rating = 4	Expansion within Park, within corner Rating = 3	Limited by Slope/SBCFCD Rating = 3	Limited by Slope/SBCFCD Rating = 3
	Score = 2	Score = 8	Score = 8	Score = 8	Score = 6	Score = 6	Score = 6
Community/Visual Impacts Weight = 4	Above-ground within Commercial Zone Rating = 3	Buried within Park Rating = 4	Above-ground within Park Rating = 2	Buried within Park Rating = 3	Buried within Park; Impacts Ball Field Rating = 2	Above-ground near Residential Rating = 3	Above-ground near Waterman Basin Rating = 4
	Score = 12	Score = 16	Score = 8	Score = 12	Score = 8	Score = 12	Score = 16
Access Weight = 1	Access from E. 23rd Street Rating = 5	Access from E. Highland Ave. Rating = 4	Access from E. Highland Ave. Rating = 4	Access from N. Waterman Ave. (busy) Rating = 4	Access from E. 40th Str. Rating = 5	Access from E. 40th Str. Rating = 5	Access through SBCFCD Property Rating = 2
	Score = 5	Score = 4	Score = 4	Score = 4	Score = 5	Score = 5	Score = 2
Utilities Weight = 1	No Utilities on Site Rating = 5	Irrigation Utilities on Site Rating = 4	Irrigation Utilities on Site Rating = 4	Irrigation Utilities on Site Rating = 4	Irrigation/Ball Field Utilities On Site Rating = 3	No Utilities on Site Rating = 5	No Utilities on Site Rating = 5
	Score = 5	Score = 4	Score = 4	Score = 4	Score = 3	Score = 5	Score = 5
Power Supply Weight = 3	Power Available, overhead on E. 23rd Str. Rating = 5	Power Available, overhead on E. Highland Rating = 5	Power Available, overhead on E. Highland Rating = 5	Power Available, overhead on N. Waterman Rating = 5	Power Available, overhead on E. 40th Str. Rating = 5	Power Available, overhead on E. 40th Str. Rating = 5	Power facilities needed to site (3,300 feet) Rating = 1
	Score = 15	Score = 15	Score = 15	Score = 15	Score = 15	Score = 15	Score = 5
Constructability Weight = 4	Limited Space; above-ground; flat Rating = 4	Space available; Buried; flat Rating = 3	Space available; above-ground; flat Rating = 5	Space available; Buried; flat Rating = 3	Space available; buried; flat Rating = 3	Limited Space; above-ground; sloped Rating = 3	Limited Space; above-ground; sloped Rating = 2
	Score = 16	Score = 12	Score =20	Score =12	Score = 12	Score = 12	Score = 8
Land Condition Weight = 3	Open Land, dirt Rating = 5	Park, grass Rating = 4	Park, grass Rating = 4	Park, grass Rating = 4	Park, ball field Rating = 3	Edge of Channel; dirt Rating = 4	Vegetation Rating = 2
	Score = 15	Score = 12	Score = 12	Score = 12	Score = 9	Score = 12	Score = 6
Construction Costs* Weight = 5	$ 26.6 M Rating = 3	$ 29.5 M Rating = 2	$ 26.0 M Rating = 4	$ 23.8 M Rating = 2	$ 24.2 M Rating = 2	$19.1 M Rating = 5	$20.8 M Rating = 2
	Score = 15	Score = 10	Score = 20	Score = 10	Score = 10	Score = 25	Score = 10
Operation & Maintenance Costs* Weight = 5	$ 0.83 M/yr Rating = 3	$ 0.86 M/yr Rating = 3	$ 0.82 M/yr Rating = 3	$ 0.34 M/yr Rating = 4	$ 0.35 M/yr Rating = 4	$ 0.29 M/yr Rating = 4	$ 0.32 M/yr Rating = 4
	Score = 15	Score = 15	Score = 15	Score = 20	Score = 20	Score = 20	Score = 20
TOTAL (Weight = 35)	Overall Score 116	Overall Score 121	Overall Score 135	Overall Score 122	Overall Score 113	Overall Score 126	Overall Score 87
Weighted SCORE	66%	69%	77%	70%	65%	72%	50%
DECISION SCORE	0.713	0.734	0.773	0.722	0.662	0.742	0.500
RANK	**3rd**	**2nd**	**1st**	**2nd**	**3rd**	**1s**	**4th**

* Construction and O&M costs are based on Conveyance Scenario 2 for Sites A/B/C and based on Conveyance Scenario 3 or 4 for Sites D/E/F/G

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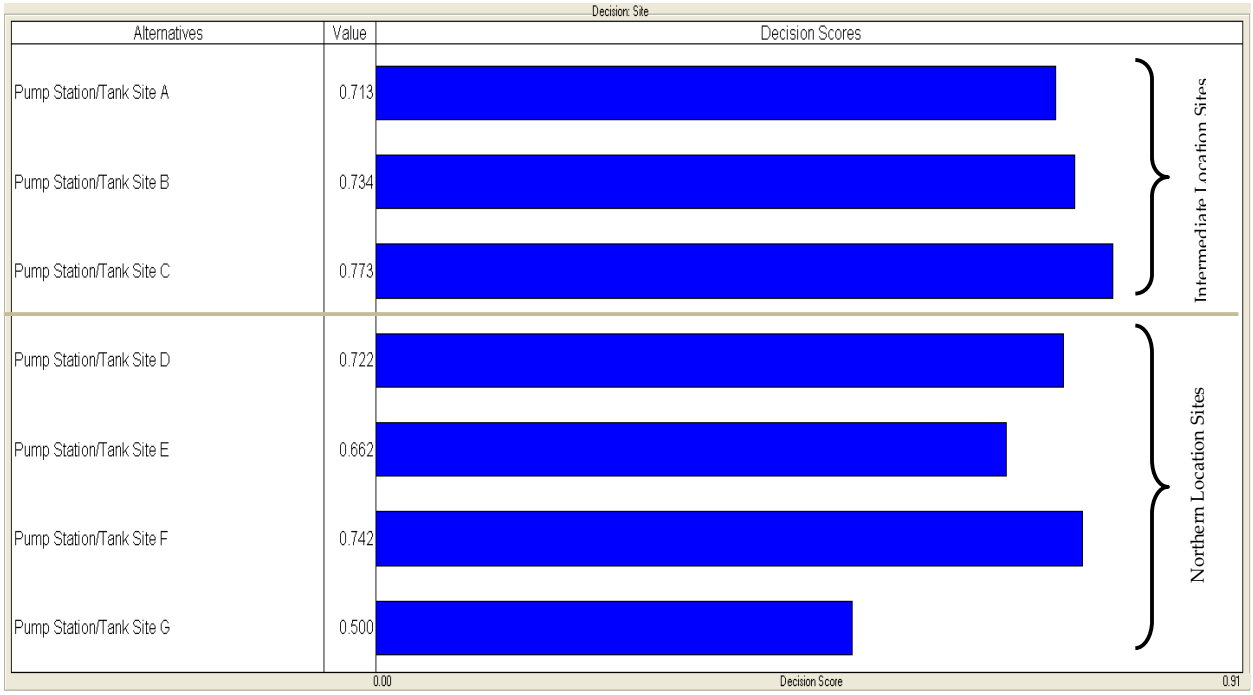
Figure 9-8
Pump Station/Storage Reservoir Site Options Evaluation



9.4.1 Pump Station/Storage Reservoir Site A

This site had the lowest ranking of the three intermediate location sites. Primary factors for the evaluation and ranking of Site A were the private ownership of the lot in a commercial area with limited space for future expansion.

9.4.2 Pump Station/Storage Reservoir Site B

This site ranked second of the three intermediate location sites. Primary factors for the evaluation and ranking of Site B were the location within Perris Hill Park near the entrance to the park would likely require the storage reservoir to be buried, with increased costs and difficulty of construction.

9.4.3 Pump Station/Storage Reservoir Site C

This site ranked first of the three intermediate location sites. Primary factors for the evaluation and ranking of Site C were the location within Perris Hill Park near East Twin Creek Channel, which would likely allow the storage reservoir to be constructed above-grade, reducing costs and decreasing difficulty of construction. The location of Site C was considered the most compatible location within Perris Hill Park since it is adjacent to an existing structure (the YMCA building), and is at an edge of the park near East Twin Creek Channel.

9.4.4 Pump Station/Storage Reservoir Site D

This site ranked second of the four northern location sites. Primary factors for the evaluation and ranking of Site C were the location within Perris Hill Park in an area without existing facilities and reduced visual impact with the storage reservoir likely buried. This option did have higher costs and difficulty of construction.

9.4.5 Pump Station/Storage Reservoir Site E

This site ranked third of the four northern location sites. Primary factors for the evaluation and ranking of Site E were the location within Perris Hill Park in an area with existing ball park facilities and reduced visual impact with the storage reservoir likely buried. This option did have higher costs and difficulty of construction.

9.4.6 Pump Station/Storage Reservoir Site F

This site ranked first of the four northern location sites. Primary factors for the evaluation and ranking of Site F were the location near the edge of East Twin Creek Channel with the storage reservoir above-grade, which reduced costs and decreased difficulty of construction. This option would require more grading and coordination with the SBCFCD including property acquisition or a license agreement.

9.4.7 Pump Station/Storage Reservoir Site G

This site had the lowest ranking of the four northern location sites. Primary factors for the evaluation and ranking of Site G were the location within SBCFCD property within a vegetated area that required extension of power facilities. This option has several disadvantages, but was considered as an option that would allow the storage reservoir to be terminal storage without a separate pump station for flow to the Recharge Basins.

9.5 SUMMARY

Based on the evaluation, any of the seven sites are feasible for the CWF Project. There are noted advantages for Pump Station/Storage Reservoir Site Option C for the intermediate location and Site Option F for the northern site location, which both ranked the highest in the evaluation. Coordination with the City's Parks and Recreation Department will be imperative in further development and selection of Site Option C as the preferred intermediate site. Coordination with the SBCFCD is recommended in further development and selection of Site Option F as the preferred northern site.

9.6 FACILITY POWER REQUIREMENTS

A preliminary investigation was conducted to identify power requirements for the preferred Pump Station/Storage Reservoir Sites. First, power requirements were developed for each Pump Station/Storage Reservoir Site configuration for each conveyance scenario. Then each site was evaluated to determine the power available at or near each site. Pump Station/Storage Reservoir Sites A, B, C, D, E, and F all have existing available power from Southern California Edison (SCE)'s exiting overhead power grid. A service connection, transformer, and meter would be required to bring 480 volt/3 phase power to the site. Pump Station/Storage Reservoir Site G is located north of Waterman Basin and does not have existing available power on site. However, an approximate 3,300 foot long extension of SCE's overhead power grid from E. 40th Street to the site could provide power to the site.

Estimated energy use for various Pump Station/Storage Reservoir Site configurations for each conveyance alternative were developed and are included in the cost data in Appendix D-4.

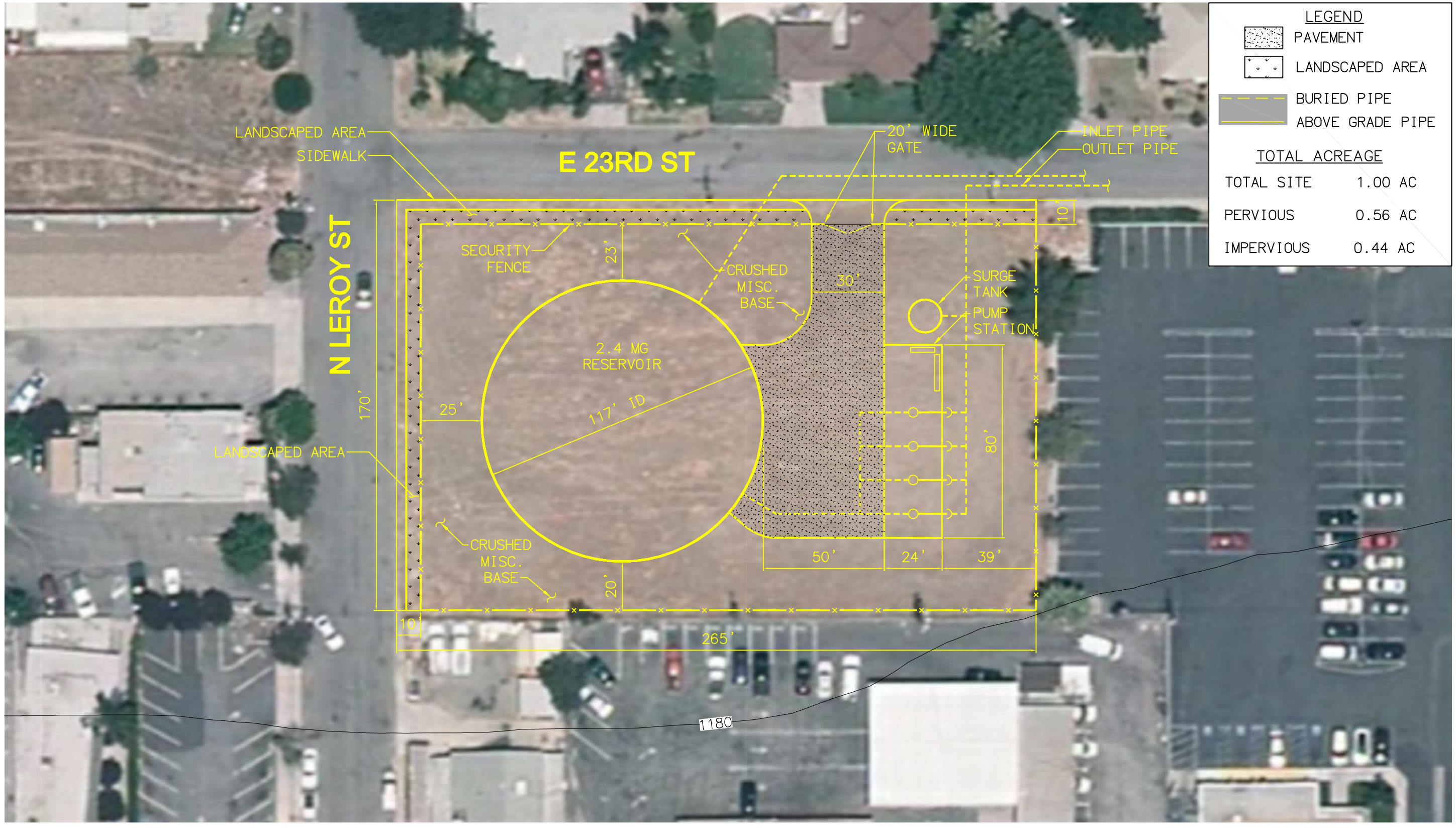
9.7 COST ESTIMATES

Feasibility-level cost estimates were prepared for the seven preferred Pump Station/Storage Reservoir Site Options based on feasibility-level planning data collected and developed as part of this analysis. Due to the preliminary status of the project, the current unpredictable bidding climate, and estimated project schedule, opinions of probable costs should be updated regularly as the project is better defined. A contingency of 30 percent was applied to the estimated construction costs to account for the preliminary nature of the project. An additional allocation of 30 percent was made for administrative, legal, design, and construction management costs in order to define overall project costs. Utilizing a Class 4 Estimate for feasibility-level estimates as defined by the AACEI, an estimated range of -15 percent to +30 percent can be expected and an additional contingency of 15 percent was applied to the overall project costs. Finally, with the estimated mid-point of construction in three years (March 2015), an escalation cost due to projected inflation at an annual rate of 4 percent was applied (total inflation for three years equal to 12.5 percent).

Based on the current understanding of the project's criteria and general assumptions made regarding facility locations and configurations, this opinion is intended to provide a feasibility-level overall cost. Unit costs for pump stations and storage reservoirs were based on historical cost data compiled from multiple similar projects and the experience of RBF and Black & Veatch. This estimate was compiled in March 2012 with an ENR – CCI (Los Angeles) of 10,283.55. Therefore, the costs can be updated once the schedule has been further defined. Table 9-5 summarizes the feasibility-level costs for each preferred Pump Station/Storage Reservoir Site Option. More detailed cost information for each preferred Pump Station/Storage Reservoir Site is included in Appendix D-2.

Table 9-5
Pump Station/Storage Reservoir Site Feasibility-Level Cost Estimate

Conveyance Scenario	Site A	Site B	Site C	Site D	Site E	Site F	Site G
1	$3.2 M	$3.7 M	$2.5 M	N/A	N/A	N/A	N/A
2	$26.6 M	$29.5 M	$26.0 M	N/A	N/A	N/A	N/A
3	N/A	N/A	N/A	$23.8 M	$24.2 M	$19.1 M	$20.8 M
4	$19.6 M	$19.3 M	$19.0 M	$23.8 M	$24.2 M	$19.1 M	$20.8 M
5	$3.2 M	$3.7 M	$2.5 M	N/A	N/A	N/A	N/A
6	$30.6 M	$33.6 M	$30.0 M	N/A	N/A	N/A	N/A



20 10 0 20 40 60
SCALE: 1"=20'

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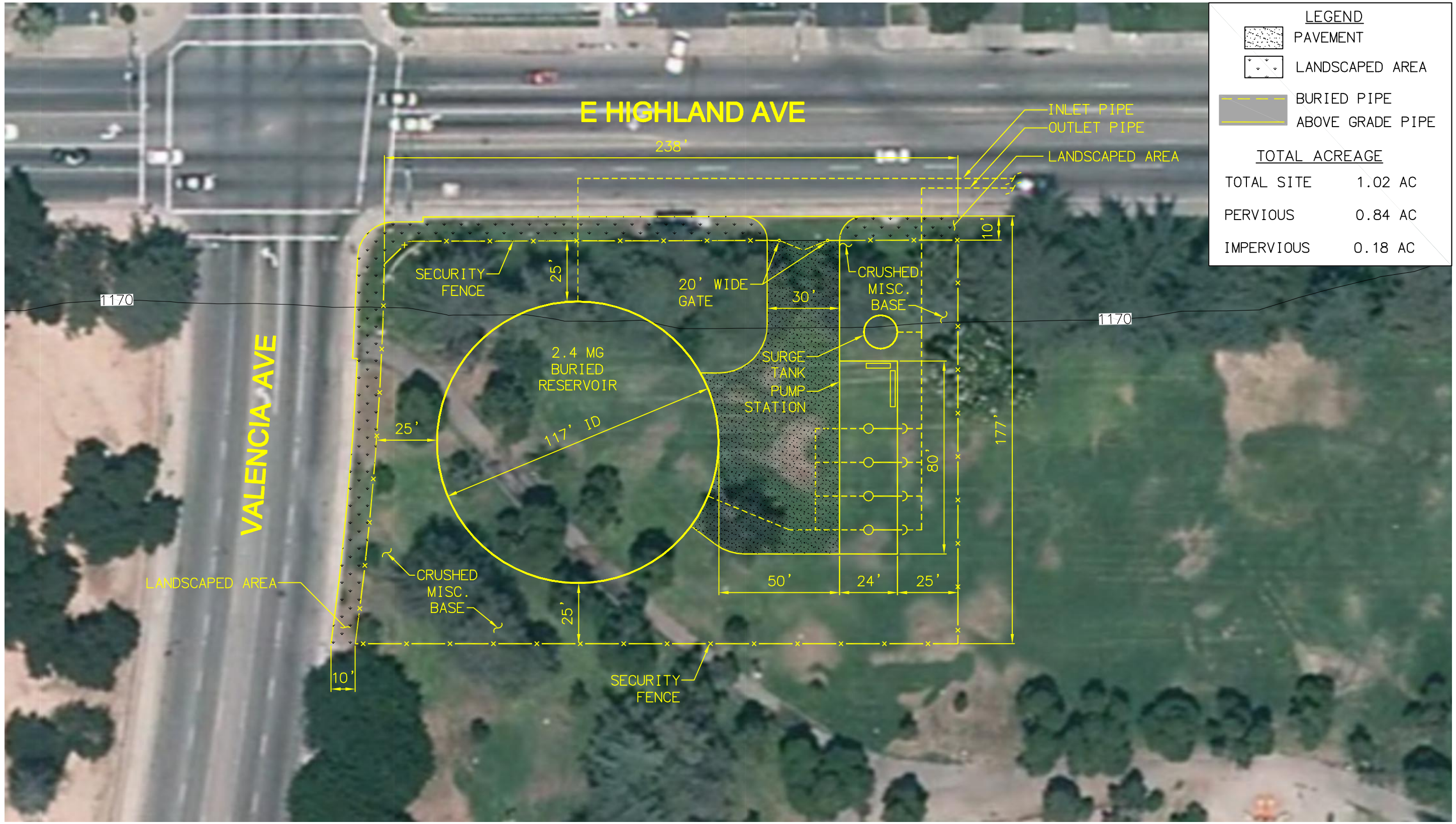
INTERMEDIATE PUMP STATION AND RESERVOIR SITE – OPTION A

FIGURE
9-1

H:\PDATA\65100826\CADD\WATER\EXHIBITS\FACILITYLAYOUTS\0826-OPTIONA.DWG JABDI 4/2/12 8:53 am



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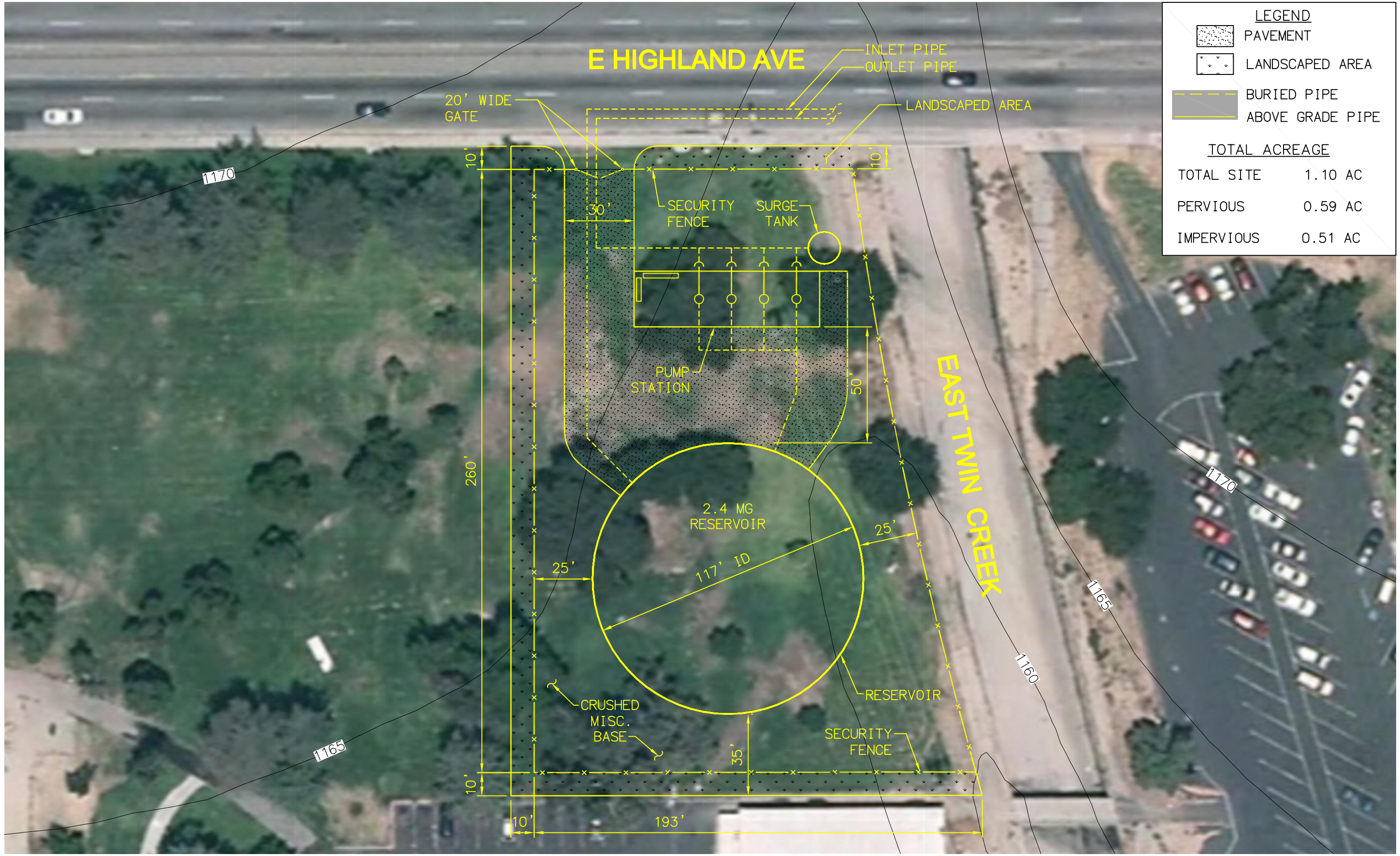
INTERMEDIATE PUMP STATION AND RESERVOIR SITE – OPTION B

FIGURE
9-2

H:\PDATA\65100826\CADD\WATER\EXHIBITS\FACILITYLAYOUTS\0826-OPTIONB.DWG JABDI 4/2/12 8:55 am



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SCALE: 1"=20'

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INTERMEDIATE PUMP STATION AND RESERVOIR SITE – OPTION C

FIGURE 9-3

H:\PDATA\65100826\CADD\WATER\EXHIBITS\FACILITYLAYOUTS\0826-OPTIONC.DWG JABDI 4/2/12 8:56 am

20 10 0 20 40 60
SCALE: 1"=20'

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INTERMEDIATE PUMP STATION AND RESERVOIR SITE – OPTION D

FIGURE 9-4

H:\PDATA\65100826\CADD\WATER\EXHIBITS\FACILITYLAYOUTS\0826-OPTIOND.DWG JABDI 4/2/12 8:57 am

20 10 0 20 40 60

SCALE: 1"=20'

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INTERMEDIATE PUMP STATION AND RESERVOIR SITE – OPTION E

FIGURE 9-5

H:\PDATA\65100826\CADD\WATER\EXHIBITS\FACILITYLAYOUTS\0826-OPTIONE.DWG JABDI 4/2/12 8:58 am

20 10 0 20 40 60
SCALE: 1"=20'

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INTERMEDIATE PUMP STATION AND RESERVOIR SITE – OPTION F

FIGURE 9-6

H:\PDATA\65100826\CADD\WATER\EXHIBITS\FACILITYLAYOUTS\0826-OPTIONF.DWG JABDI 4/2/12 8:59 am

LEGEND

PAVEMENT

LANDSCAPED AREA

BURIED PIPE

ABOVE GRADE PIPE

TOTAL ACREAGE

TOTAL SITE	1.12 AC
PERVIOUS	0.59 AC
IMPERVIOUS	0.53 AC

20 10 0 20 40 60

SCALE: 1"=20'

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INTERMEDIATE PUMP STATION AND RESERVOIR SITE – OPTION G

FIGURE 9-7

H:\PDATA\65100826\CADD\WATER\EXHIBITS\FACILITYLAYOUTS\0826-OPTIONG.DWG JABDI 4/3/12 1:18 pm

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10.0 CONVEYANCE SYSTEM SCENARIOS

An analysis was conducted to evaluate potential Conveyance Scenarios with various configurations of pipelines and Pump Station/Storage Reservoir Sites within a Conveyance Facility Corridor between the SBWRP and the Recharge Basins. Six potential Conveyance Scenarios were identified. An evaluation of the Conveyance Scenarios was conducted considering evaluation factors and rating each scenario.

10.1 OVERVIEW

The six Conveyance Scenarios represent possible overall configuration of the conveyance system to deliver recycled water to direct use customers and to the Recharge Basins and deliver advanced water to the Recharge Basins. Each conveyance scenario could utilize different Pipeline Alignment Options and Pump Station/Storage Reservoir Site Options. In fact, there are 100 possible combinations of Conveyance Scenarios with various Pipeline Alignment Options and Pump Station/Storage Reservoir Site configurations. In order to conduct a comparative analysis of the Conveyance Scenarios, the highest ranked preferred pipeline alignment option was selected (Pipeline Alignment Option 1) and used to compare the various Conveyance Scenarios. Likewise, the highest ranked preferred Pump Station/Storage Reservoir Site Option was selected (Site Option C for the intermediate location, or Site Option F for the northern location). The ranking for Pipeline Alignment Options was presented in Section 8 and for Pump Station/Storage Reservoir Site Options in Section 9.

10.2 SCENARIOS

There are six potential Conveyance Scenarios. Each of the Conveyance Scenarios was evaluated, rated, and ranked. The ranking of Conveyance Scenarios is shown on Table 10-1

10.2.1 Conveyance Scenario 1

Conveyance Scenario 1 would consist of a single conveyance system with one lift to deliver advanced treated water to direct use northern customers and the Recharge Basins. A separate recycled water system would serve direct use customers near SBWRP. For comparison purposes, this scenario utilized Pipeline Alignment Option 1 and Pump Station/Storage Reservoir Site Option C.

10.2.2 Conveyance Scenario 2

Conveyance Scenario 2 would consist of a single conveyance system with two lifts to deliver advanced treated water to direct use northern customers and the Recharge Basins. A separate recycled water system would serve direct use customers near SBWRP. For comparison purposes, this scenario utilized Pipeline Alignment Option 1 and Pump Station/Storage Reservoir Site Option C.

10.2.3 Conveyance Scenario 3

Conveyance Scenarios 3 would consist of dual conveyance systems with one recycled water pipeline serving direct use northern customers and one advanced water pipeline with one lift to the Recharge Basins. A separate recycled water system would serve direct use customers near SBWRP. For comparison purposes, this scenario utilized Pipeline Alignment Option 1 and Pump Station/Storage Reservoir Site Option F (for the recycled water pipeline).

10.2.4 Conveyance Scenario 4

Conveyance Scenario 4 would consist of dual conveyance systems with one recycled water pipeline serving direct use northern customers and one advanced water pipeline with two lifts to the Recharge Basins. A separate recycled water system would serve direct use customers near SBWRP. For comparison purposes, this scenario utilized Pipeline Alignment Option 1 and Pump Station/Storage Reservoir Site Option C (for the recycled water pipeline) and Pump Station/Storage Reservoir Site Option F (for the advanced water pipeline).

10.2.5 Conveyance Scenario 5

Conveyance Scenario 5 would consist of a single conveyance system with one lift to deliver recycled water to both direct use northern customers and to an advanced water treatment plant located at the Recharge Basins. For comparison purposes, this scenario utilized Pipeline Alignment Option 1 and Pump Station/Storage Reservoir Site Option C.

10.2.6 Conveyance Scenario 6

Conveyance Scenario 6 would consist of a single conveyance system with two lifts to deliver recycled water to both direct use northern customers and to an advanced water treatment plant located at the Recharge Basins. For comparison purposes, this scenario utilized Pipeline Alignment Option 1 and Pump Station/Storage Reservoir Site Option C.

10.3 EVALUATION CRITERIA

Critical evaluation factors relative to the construction and operation of the Conveyance Scenarios were developed to evaluate the advantages and disadvantages of each conveyance scenario. Each factor was evaluated and rated using an established rating system. Conveyance Scenarios with advantages were rated higher and those with disadvantages were rated lower. Six critical evaluation factors were developed for the Conveyance Scenarios: water supply, operation, treatment facilities location, flexibility for future expansion, construction costs, and O&M costs.

10.3.1. Water Supply

The ability to supply recycled water and advanced treated water to direct use customers and for groundwater recharge was evaluated. Delivery of advanced treated water to direct use customers is a disadvantage because the water is treated to level higher than necessary. Scenarios that utilize recycled water for direct use customers were rated higher than those that use advanced treated water for direct use customers. Use of the IEBL at the SBWRP for disposal of brine was rated higher than scenarios that would require a new brine pipeline.

10.3.2. Operation

The ease of operation of conveyance alternatives was evaluated. System operation was considered for direct use customers with operation of pump station and tank system to provide service and handle seasonal and diurnal demands including peak month, peak day, and peak hour demands. System operation was considered for advanced treated water recharge of groundwater considering pump station and tank system operation. Use of storage tanks to supply direct use customers were rated higher than those with a closed loop system or direct supply by pumping. System pressures were also evaluated with lower pressure systems rated higher than systems with higher pressures.

10.3.3. Treatment Facilities Location

The location of treatment facilities was evaluated whether at the SBWRP or at the Recharge Basins. A new treatment plant at the Recharge Basins has several disadvantages including: operation remote from the existing SBWRP, additional staffing, new property requirements, no method of diverting flow if there are treatment issues, and permitting a new plant. Scenarios that have treatment facilities at the SBWRP were rated higher than those that have the treatment plant at the Recharge Basins.

10.3.4. Flexibility for Future Expansion

This criterion is used to evaluate the ability for future expansion of conveyance facilities to connect to potential future direct use customers. Conveyance Scenarios with advanced treated water delivery to recycled customers were rated lower than those that provide recycled water to direct use customers due to advanced treatment limitations (maximum 14.2 mgd limited by IEBL contractual capacity of 2.5 mgd). Expansion flexibility of treatment facilities was also evaluated with treatment facilities at the SBWRP ranking higher than treatment facilities at the Recharge Basins due to land availability.

10.3.5. Construction Costs

The estimated construction cost of conveyance alternatives was evaluated. Conveyance Scenarios were rated based on their relative estimated construction costs.

10.3.6. Operation and Maintenance Costs

The estimated O&M cost of conveyance alternatives were evaluated. Conveyance Scenarios were rated based on their relative estimated construction costs.

10.4 CONVEYANCE SCENARIO RANKINGS

Similar to the pipeline alignment and Pump Station/Storage Reservoir Site evaluation and ranking, *Criterium Decision Plus*, was utilized for conveyance scenarios (see Section 8.10). The same rating and weighting definitions were used. Each scenario was rated based upon its ability to satisfy the project objectives. The alternatives were rated using a scale of 1 to 5 as shown in Table 10-1 with a higher rating indicating a more favorable scenario or option.

Table 10-1
Definition of Rating System

Definition	Rating
Satisfies project objectives with significant noted advantages	5
Satisfies project objectives with noted advantages	4
Satisfies project objectives	3
Satisfies project objectives with noted disadvantages	2
Satisfies project objectives with significant noted disadvantages	1

Each evaluation criterion was then assigned a weight representing the importance of the criteria on a scale of 1 to 5. A higher weight represents a more important criteria as shown in Table 10-2.

Table 10-2
Definition of Weighting System

Definition	Rating
Critical Importance	5
Significant Importance	4
Important	3
Low Importance	2
Least Importance	1

Evaluation criteria weightings for Conveyance Scenarios are shown in Table 10-3.

Table 10-3
Conveyance Scenario Criteria Weighting

Evaluation Criteria	Weight
Water Supply	3
Operation	4
Treatment Facilities Location	2
Flexibility for Future Expansion	2
Construction Costs	5
Operations and Maintenance Costs	5

A score for each evaluation criterion was calculated by multiplying the rating and the weight. A higher score indicated a more favorable conveyance scenario.

The overall scores were compared for each scenario. The overall score is a good indication as to which Conveyance Scenarios are the best match for meeting the project objectives.

Since the overall score may not add up to 100, a decision score was calculated for each scenario. The overall scores were converted to percentages; therefore the ideal score would have value of 100 percent. The higher the decision score of the alternative, the closer that alternative would come to meeting all the project objectives considering the criteria impacting the decision.

Utilizing *Criterium Decision Plus*, a decision score was calculated with an ideal score of 1.00. The higher the decision score of the option, the closer that option would come to meeting all the project objectives considering the criteria impacting the decision. Weighted scores and decision scores were similar, but since *Criterium Decision Plus* utilizes a more complex integrated rating and ranking system, the decision score was considered in evaluating the rank.

The highest score is considered the highest ranked or preferred scenario. Ranks were then assigned to the remaining scenarios in the order of highest score to lowest score.

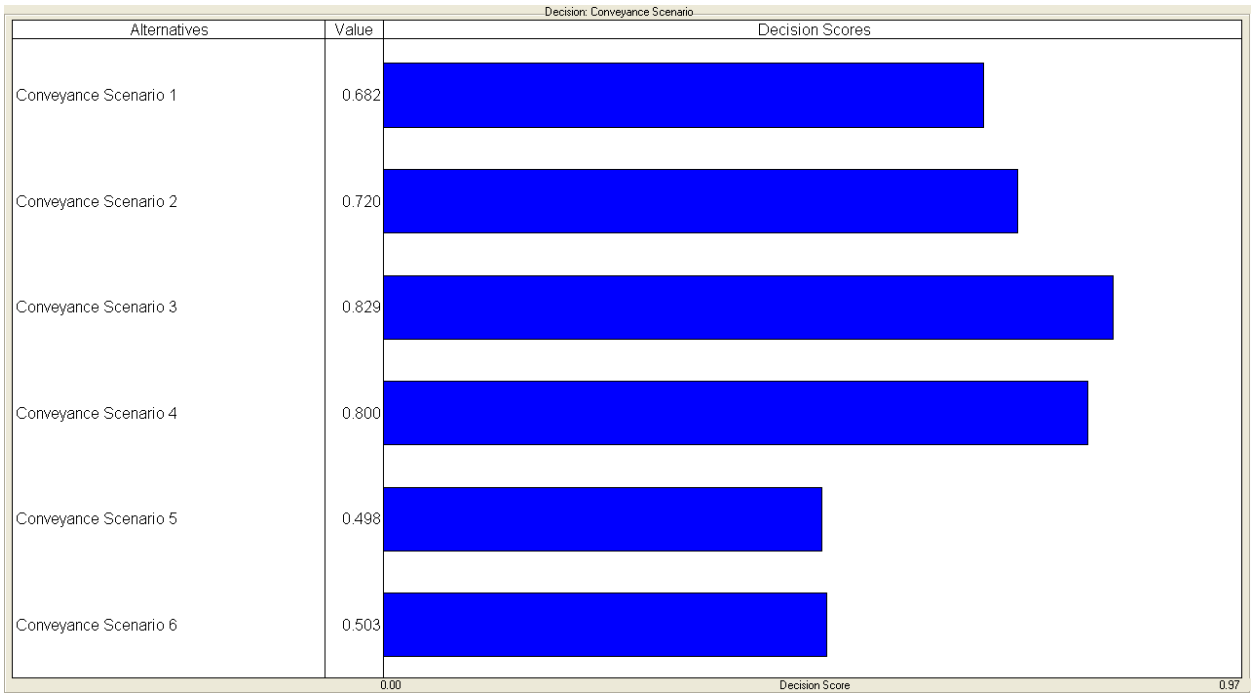
The ranking of Conveyance Scenarios is shown in Table 10-4 and depicted graphically on Figure 10-1.

Table 10-4
Conveyance Scenarios Evaluation and Ranking

Evaluation Factor	Conveyance Scenario 1	Conveyance Scenario 2	Conveyance Scenario 3	Conveyance Scenario 4	Conveyance Scenario 5	Conveyance Scenario 6
Water Supply Weight = 3	Advanced Water to Direct Use Customers; Brine at SBWRP Rating = 2	Advanced Water to Direct Use Customers; Brine at SBWRP Rating = 2	Recycled Water to Direct Use Customers; Brine at SBWRP Rating = 5	Recycled Water to Direct Use Customers; Brine at SBWRP Rating = 5	Recycled Water to Direct Use Customers; Needs Brine Pipeline Rating = 2	Recycled Water to Direct Use Customers; Needs Brine Pipeline Rating = 2
	Score = 6	Score = 6	Score = 15	Score = 15	Score = 6	Score = 6
Operation Weight = 4	Difficult Seasonal Operation; Partial System Float on Tank; 250 psi Pressure Rating = 1	Difficult Seasonal Operation; Partial System Float on Tank; 150 psi Pressure Rating = 2	Flexible Seasonal Operation; System Floats on Tank; 250 psi Pressure Rating = 4	Flexible Seasonal Operation; System Floats on Tank; 150 psi Pressure Rating = 5	Flexible Seasonal Operation; Partial System Float on Tank; 250 psi Pressure Rating = 3	Flexible Seasonal Operation; Partial System Float on Tank; 150 psi Pressure Rating = 4
	Score = 4	Score = 8	Score = 16	Score =20	Score = 12	Score = 16
Treatment Plant Location Weight = 3	Treatment at SBWRP Rating = 5	Treatment at SBWRP Rating = 5	Treatment at SBWRP Rating = 5	Treatment at SBWRP Rating = 5	Treatment at Rechg. Basins Rating = 1	Treatment at Rechg. Basins Rating = 1
	Score = 15	Score = 15	Score =15	Score = 15	Score = 3	Score = 3
Flexibility for Future Expansion Weight = 2	Advanced Water to Direct Use Customers; Treatment at SBWRP Rating = 2	Advanced Water to Direct Use Customers; Treatment at SBWRP Rating = 2	Recycled Water to Direct Use Customers; Treatment at SBWRP Rating = 5	Recycled Water to Direct Use Customers; Treatment at SBWRP Rating = 5	Recycled Water to Direct Use Customers; Treatment at Rechg. Basins Rating = 2	Recycled Water to Direct Use Customers; Treatment at Rechg. Basins Rating = 2
	Score = 4	Score = 4	Score =10	Score =10	Score = 4	Score =4
Construction Costs Weight = 5	$ 132 M Rating = 5	$ 139 M Rating = 5	$ 177 M Rating = 2	$ 185 M Rating = 1	$ 155 M Rating = 4	$ 167 M Rating = 3
	Score = 25	Score = 25	Score = 10	Score = 5	Score = 20	Score = 15
O&M Costs Weight = 5	$ 2.5 M/yr Rating = 5	$ 2.6 M/yr Rating = 5	$ 3.1 M/yr Rating = 4	$ 3.6 M/yr Rating = 3	$ 3.5 M/yr Rating = 3	$ 3.6 M/yr. Rating =3
	Score = 25	Score = 25	Score = 20	Score = 15	Score = 15	Score = 15
TOTAL (Weight = 22)	Overall Score 79	Overall Score 83	Overall Score 86	Overall Score 80	Overall Score 60	Overall Score 59
Weighted SCORE	72%	76%	78%	73%	55%	54%
DECISION SCORE	0.682	0.720	0.829	0.800	0.498	0.503
RANK	**4th**	**3rd**	**1st**	**2nd**	**6th**	**5th**

* Construction and O&M costs are based on Pipeline Alignment Option 1 and Pump Station/Storage Reservoir Site Option C and/or F

Figure 10-1
Conveyance Scenarios Evaluation



The cost of each scenario in Table 10-4 considers the construction and O&M costs independent of the amount of water produced. A parallel evaluation was developed for each conveyance scenario to analyze the cost per acre foot of water produced, and the results are shown in Table 10-5. A combined weight of 10 was assigned for the combined cost per acre-foot. Capital and O&M costs for treatment and the recharge basins were developed from data in the Recycled Water Report. The cost per acre-foot does not include IEBL charges.

The per acre-foot costs include consideration of reduced costs from reduced secondary treated effluent flows to the RIX facility and subsequent reduced tertiary treatment costs at the RIX facility. Estimated costs were developed in coordination with SBMWD for reduced treatment at the RIX Facility considering reduced use of sand filters and continued use of percolation/extraction treatment. The unit cost of treatment at the RIX facility drops to approximately $43,000 per mgd if RIX is operating at or below 22 mgd as originally designed with percolation and extraction only. Current and reduced flows to the RIX facility and corresponding reduced per acre-foot costs are shown in Table 10-6. These reduced per acre-foot cost have already been incorporated in to the per-acre foot costs in Table 10-5.

Table 10-5
Conveyance Scenarios Evaluation and Ranking (per Acre-Foot)

Evaluation Factor	Conveyance Scenario 1	Conveyance Scenario 2	Conveyance Scenario 3	Conveyance Scenario 4	Conveyance Scenario 5	Conveyance Scenario 6
Water Supply Weight = 3	Advanced Water to Direct Use Customers; Brine at SBWRP Rating = 2	Advanced Water to Direct Use Customers; Brine at SBWRP Rating = 2	Recycled Water to Direct Use Customers; Brine at SBWRP Rating = 5	Recycled Water to Direct Use Customers; Brine at SBWRP Rating = 5	Recycled Water to Direct Use Customers; Needs Brine Pipeline Rating = 2	Recycled Water to Direct Use Customers; Needs Brine Pipeline Rating = 2
	Score = 6	Score = 6	Score = 15	Score = 15	Score = 6	Score = 6
Operation Weight = 4	Difficult Seasonal Operation; Partial System Float on Tank; 250 psi Pressure Rating = 1	Difficult Seasonal Operation; Partial System Float on Tank; 150 psi Pressure Rating = 2	Flexible Seasonal Operation; System Floats on Tank; 250 psi Pressure Rating = 4	Flexible Seasonal Operation; System Floats on Tank; 150 psi Pressure Rating = 5	Flexible Seasonal Operation; Partial System Float on Tank; 250 psi Pressure Rating = 3	Flexible Seasonal Operation; Partial System Float on Tank; 150 psi Pressure Rating = 4
	Score = 4	Score = 8	Score = 16	Score =20	Score = 12	Score = 16
Treatment Plant Location Weight = 3	Treatment at SBWRP Rating = 5	Treatment at SBWRP Rating = 5	Treatment at SBWRP Rating = 5	Treatment at SBWRP Rating = 5	Treatment at Recharge Basins Rating = 1	Treatment at Recharge Basins Rating = 1
	Score = 15	Score = 15	Score =15	Score = 15	Score = 3	Score = 3
Flexibility for Future Expansion Weight = 2	Advanced Water to Direct Use Customers; Treatment at SBWRP Rating = 2	Advanced Water to Direct Use Customers; Treatment at SBWRP Rating = 2	Recycled Water to Direct Use Customers; Treatment at SBWRP Rating = 5	Recycled Water to Direct Use Customers; Treatment at SBWRP Rating = 5	Recycled Water to Direct Use Customers; Treatment at Recharge Basins Rating = 2	Recycled Water to Direct Use Customers; Treatment at Recharge Basins Rating = 2
	Score = 4	Score = 4	Score =10	Score =10	Score = 4	Score =4
Cost per Acre-Foot Weight = 10	$ 1,414/AF Rating = 2	$ 1,435/AF Rating = 2	$ 1,173/AF Rating = 5	$ 1,213/AF Rating = 5	$ 1,318/AF Rating = 3	$ 1,351/AF Rating = 3
	Score = 20	Score = 20	Score = 50	Score = 50	Score = 30	Score = 30
TOTAL (Weight = 22)	Overall Score 49	Overall Score 53	Overall Score 106	Overall Score 110	Overall Score 55	Overall Score 59
Weighted SCORE	45%	48%	96%	100%	50%	54%
DECISION SCORE	0.482	0.520	0.962	1.000	0.465	0.503
RANK	**5th**	**3rd**	**2nd**	**1st**	**6th**	**4th**

* Cost per Acre-Foot are based on Pipeline Alignment Option 1 and Pump Station/Storage Reservoir Site Option C and/or F

Table 10-6
Reduced RIX Facility Treatment Costs

Scenario	Flow to RIX from SBWRP	Reduced flow to RIX	Reduced Cost per Year	Reduced Cost per Acre-Foot
Current Condition	22 mgd	0 mgd	$0	$0
Scenario 1 or 2	14.2 mgd	7.8 mgd	$842,000	$46
Scenario 3 or 4	7.2 mgd	14.8 mgd	$1,278,000	$49
Scenario 5 or 6	5.7 mgd	16.8 mgd	$1,344,000	$52

10.4.1 Conveyance Scenario 1

This scenario ranked fourth in the original analysis and ranked fifth in the cost per acre-foot analysis. Primary factors for the evaluation and ranking of Conveyance Scenario 1 were the delivery of advanced treated water to direct use customers (excess treatment), difficulty of operation during seasonal fluctuations and only part of the system operates by floating off an intermediate storage reservoir, higher pipeline pressure (250 psi), and limited flexibility for expansion for additional direct use customers in the future (advanced treated water is limited to 14.2 mgd by SBMWD's contractual discharge capacity in the IEBL). This scenario does have lower construction and O&M costs, but considering the capacity of this scenario, it had a high overall cost per acre foot of water.

10.4.2 Conveyance Scenario 2

This scenario ranked third in the original analysis and ranked third in the cost per acre-foot analysis. Primary factors for the evaluation and ranking of Conveyance Scenario 1 were the delivery of advanced treated water to direct use customers (excess treatment), difficulty of operation during seasonal fluctuations and only part of the system operates by floating off an intermediate storage reservoir, lower pipeline pressure (150 psi), and limited flexibility for expansion for additional direct use customers in the future (advanced treated water is limited to 14.2 mgd by SBMWD's contractual discharge capacity in the IEBL). This scenario does have lower construction and O&M costs, but considering the capacity of this scenario, it had a high overall cost per acre foot of water.

10.4.3 Conveyance Scenario 3

This scenario ranked first in the original analysis and ranked second in the cost per acre-foot analysis. Primary factors for the evaluation and ranking of Conveyance Scenario 3 were use of separate pipelines to deliver the type of water needed (recycled or advanced treated water), flexible seasonal operation and ease of operating the recycled water system by floating off a northern storage reservoir, and the ability to expand the recycled water system in the future. This scenario does operate on a higher pipeline pressure (250 psi), but this is addressed with use

of ductile iron pipe. This scenario does have higher construction and O&M costs, but considering the additional capacity of this scenario, it had a low overall cost per acre foot of water.

10.4.4 Conveyance Scenario 4

This scenario ranked second in the original analysis and ranked first in the cost per acre-foot analysis. Primary factors for the evaluation and ranking of Conveyance Scenario 4 were use of separate pipelines to deliver the type of water needed (recycled or advanced treated water), flexible seasonal operation and ease of operating the recycled water system by floating off a northern storage reservoir, lower pipeline pressure (150 psi), and the ability to expand the recycled water system in the future. This scenario does have higher construction and O&M costs, but considering the additional capacity and this scenario, it had a low overall cost per acre foot of water.

10.4.5 Conveyance Scenario 5

This scenario ranked last in the original analysis and ranked last in the cost per acre-foot analysis. Primary factors for the evaluation and ranking of Conveyance Scenario 5 were the need for a separate brine line from the Recharge Basins to the SBWRP, flexible seasonal operation but only part of the system operates by floating off an intermediate storage reservoir, higher pipeline pressure (250 psi), location of the treatment plant at the Recharge Basins, and limited ability for expansion of treatment facilities at the Recharge Basins. This scenario had higher construction and O&M costs, and even considering the additional capacity and this scenario, it had a high overall cost per acre foot of water.

10.4.6 Conveyance Scenario 6

This scenario ranked fifth in the original analysis and ranked fourth in the cost per acre-foot analysis. Primary factors for the evaluation and ranking of Conveyance Scenario 6 were the need for a separate brine line from the Recharge Basins to the SBWRP, flexible seasonal operation but only part of the system operates by floating off an intermediate storage reservoir, lower pipeline pressure (150 psi), location of the treatment plant at the Recharge Basins, and limited ability for expansion of treatment facilities at the Recharge Basins. This scenario had higher construction and O&M costs, and even considering the additional capacity and this scenario, it had a high overall cost per acre foot of water.

10.5 SUMMARY

Based on the evaluation, any of the six Conveyance Scenarios would be feasible for the CWF Project. There are noted advantages for Conveyance Scenarios 3 and 4, which ranked the highest in the evaluation. Consideration of overall project objectives and cost per acre foot of water make Conveyance Scenarios 3 and 4 attractive even though initial construction costs are

higher than Conveyance Scenarios 1 and 2. There are significant disadvantages for Conveyance Scenarios 5 and 6, and eliminating these scenarios should be considered by SBMWD particularly in the ongoing environmental documentation process.

10.6 COST ESTIMATES

Feasibility-level cost estimates were prepared for the six Conveyance Scenarios based on feasibility-level planning data collected and developed as part of this analysis. Due to the preliminary status of the project, the current unpredictable bidding climate, and estimated project schedule, opinions of probable costs should be updated regularly as the project is better defined. A contingency of 30 percent was applied to the estimated construction costs to account for the preliminary nature of the project. An additional allocation of 30 percent was made for administrative, legal, design, and construction management costs in order to define overall project costs. Utilizing a Class 4 Estimate for feasibility-level estimates as defined by the Association for the AACEI, a estimated range of -15 percent to +30 percent can be expected and an additional contingency of 15 percent was applied to the overall project costs. Finally, with the estimated mid-point of construction in three years (March 2015), an escalation cost due to projected inflation at an annual rate of 4 percent was applied (total inflation for three years equal to 12.5 percent).

Based on the current understanding of the project's criteria and general assumptions made regarding facility locations and configurations, this opinion is intended to provide a feasibility-level overall cost. Costs for Conveyance Scenarios were developed using the sum of costs determined for the highest ranked pipeline alignment option (Pipeline Alignment Option 1), cost determined for the highest ranked pump station/storage reservoir site option (Pump Station/Storage Reservoir Site Option C for the intermediate location and/or Site Option F for the northern location), and cost determined for pump station and storage tank facilities at the SBWRP. Unit costs for pump stations and storage reservoirs were based on historical cost data compiled from multiple similar projects and the experience of RBF and Black & Veatch. This estimate was compiled in March 2012 with an ENR – CCI (Los Angeles) of 10,283.55. Therefore, the costs can be updated once the schedule has been further defined. Table 10-7 summarizes the feasibility-level costs for each conveyance scenario. More detailed cost information for each conveyance scenario is included in Appendix D-3.

Table 10-7
Conveyance Scenario Site Feasibility-Level Cost Estimate

Facility	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Pipeline(s) (Option 1)	$68.1 M	$68.1 M	$94.3 M	$94.3 M	$91.2 M	$91.2 M
Pump Station/ Storage Reservoir (Site Option C/F)	$2.5 M	$26.0 M	$19.1 M	$38.1 M	$2.5 M	$30.0 M
Pump Station/ Storage Reservoir (at SBWRP)	$61.2 M	$44.5 M	$64.1 M	$53.0 M	$61.5 M	$45.4 M
TOTAL	**$131.8 M**	**$138.6 M**	**$177.5 M**	**$185.4 M**	**$155.2 M**	**$166.6 M**

11.0 CONCLUSION

A comprehensive feasibility-level analysis of conveyance facilities associated with the CWF Project was conducted and is presented in this document. The data herein will be used in the development of the CWF Project EIR/EIS. Multiple conveyance facility options were evaluated including four Pipeline Alignment Options, seven Pump Station/Storage Reservoir Site Options, and six Conveyance Scenarios. Evaluation criteria were developed and scenarios and options were evaluated, weighted, rated, and ranked. The following conclusions were developed:

- Based on the evaluation, any of the four Pipeline Alignment Options would be feasible for the CWF Project. There are noted advantages for Alignment Option 1, which ranked the highest in the evaluation. Concurrence with the SBCFCD and compliance with their requirements will be imperative in further development and selection of Alignment Option 1 as the preferred alignment. Preliminary meetings with SBCFCD have indicated that pipeline(s) aligned within the SBCFCD Twin Creek Flood Channel would be compatible under a license agreement.

- Based on the evaluation, any of the three intermediate sites and any of the four northern sites would be feasible for the CWF Project. There are noted advantages for Pump Station/Storage Reservoir Site Option C for the intermediate location and Site Option F for the northern site location, which both ranked the highest in the evaluation. Coordination with the City's Parks and Recreation Department will be imperative in further development and selection of Site Option C as the preferred intermediate site. Coordination with the SBCFCD is recommended in further development and selection of Site Option F as the preferred northern site.

- Based on the evaluation, any of the six Conveyance Scenarios would be feasible for the CWF Project. There are noted advantages for Conveyance Scenarios 3 and 4, which ranked the highest in the evaluation. Consideration of overall project objectives and cost per acre foot of water make Conveyance Scenarios 3 and 4 attractive even though initial construction costs would be higher than Conveyance Scenarios 1 and 2. There are significant disadvantages for Conveyance Scenarios 5 and 6, and eliminating these scenarios should be considered by SBMWD particularly in the ongoing environmental documentation process.

APPENDIX A

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TABLE A-1
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

SUMMARY OF POTENTIAL DIRECT USE AREAS

Item No.	ID No.	Area Name	Land Use Type	Groundwater Well Present (Yes/No)	Gross Area (ac)	ADD Water Demand Factor (AFY/ac)	Est. ADD (AFY)	Est. ADD (gpm)	Est. MMD (AFY)	Est. MMD (gpm)	Est. MDD (AFY)	Est. MDD (gpm)	Est. PHD (AFY)	Est. PHD (gpm)
Areas Previously Identified in the Wildermuth Report														
1	PB-1	San Bernardino Water Reclamation Plant	Public	No	49	40.51	1,998.0	1,239	2,597.4	1,610	3,996.0	2,477	11,988.0	7,432
2	GC-1	San Bernardino Public Golf Course	Golf Course	No	93	2.25	209.1	130	271.8	169	418.2	259	1,254.6	778
3	CT-1	CalTrans (I-215)	Cal-Trans	No	15	6.89	100.2	62	130.3	81	200.4	124	601.2	373
4	GC-2	Arrowhead Country Club	Golf Course	Yes	110	2.25	247.2	153	321.4	199	494.4	306	1,483.2	919
5	PK-1	Mill Community Park	Park	No	14	1.81	25.3	16	32.9	20	50.6	31	151.8	94
6	PK-3	Meadowbrook Recreation Park	Park	No	14	1.81	25.4	16	33.0	20	50.8	31	152.4	94
7	PK-4	Meadowbrook Park	Park	No	7	1.80	12.6	8	16.4	10	25.2	16	75.6	47
8	PK-5	Secombe Lake State Recreation Area[4]	Park	No	31	1.81	56.0	35	72.8	45	112.0	69	336.0	208
9	PK-9	Perris Hill Park	Park	No	32	1.80	57.7	36	75.0	47	115.4	72	346.2	215
10	PK-17	Horine Park	Park	No	6	1.70	10.2	6	13.3	8	20.4	13	61.2	38
11	PK-15	Wildwood Park	Park	Yes	24	1.82	43.6	27	56.7	35	87.2	54	261.6	162
12	PK-6	Palm Field Park	Park	No	5	1.78	8.9	6	11.6	7	17.8	11	53.4	33
13	N-2	Community Gardens	Nursery	No	15	1.80	27.0	17	35.1	22	54.0	33	162.0	100
14	C-1	Pioneer Memorial Cemetery	Cemetary	No	20	1.84	36.7	23	47.7	30	73.4	46	220.2	137
15	C-2	Mountain View Cemetery	Cemetery	No	58	1.80	104.6	65	136.0	84	209.2	130	627.6	389
16	SC-22	Golden Valley Middle School	School	No	16	1.02	16.4	10	21.4	13	32.9	20	98.6	61
17	SC-21	Parkside Elementary School	School	No	5	3.00	16.4	10	21.4	13	32.9	20	98.6	61
18	SC-20	Wilson Elementary School	School	No	6	2.78	16.4	10	21.4	13	32.9	20	98.6	61
19	SC-9	Sierra High School	School	No	14	5.89	81.2	50	105.6	65	162.5	101	487.4	302
		Subtotals			***534***		***3,093***	***1,917***	***4,021***	***2,493***	***6,186***	***3,835***	***18,558***	***11,505***
Additional Areas Identified														
20	CT-2	Caltrans (I-210)	Cal-Trans	No	22	2	43.2	27	56.2	35	86.4	54	259.3	161
21	N-1	Leland Nursery & Patio Supply	Nursery	No	6	2	11.9	7	15.5	10	23.8	15	71.4	44
22	N-3	Lorton's Fresh Squeezed Juices	Nursery	No	5	2	9.1	6	11.9	7	18.3	11	54.9	34
23	PB-2	San Benardino County Gov Center	Public	No	9	3	28.2	17	36.6	23	56.3	35	168.9	105
24	PB-3	Law Library for San Bernardino	Public	No	7	3	22.1	14	28.7	18	44.1	27	132.3	82
25	PB-4	California Theater	Public	No	4	3	13.0	8	17.0	11	26.1	16	78.3	49
26	PB-5	Norman F Feldheym Public Library	Public	No	5	3	14.5	9	18.8	12	29.0	18	86.9	54
27	PB-6	San Bernardino County Medical Center Heliport	Public	No	12	3	36.0	22	46.8	29	71.9	45	215.8	134
28	PB-7	Mountain View Avenue Median (South of I-210)	Park	No	4	2	7.2	4	9.3	6	14.3	9	42.9	27
29	PB-8	Mountain View Avenue Median (North of I-210)	Park	No	6	2	11.9	7	15.5	10	23.8	15	71.5	44
30	PK-2	Municipal Baseball Park	Park	No	10	2	20.4	13	26.6	16	40.9	25	122.6	76
31	PK-7	Residential Community	Park	No	36	2	72.6	45	94.3	58	145.1	90	435.4	270
32	PK-8	Fiscalini Field	Park	No	12	2	23.1	14	30.0	19	46.1	29	138.4	86
33	PK-10	Community Park	Park	No	1	2	2.6	2	3.4	2	5.2	3	15.6	10
34	PK-11	St Sierra Park	Park	No	1	2	2.3	1	2.9	2	4.5	3	13.5	8
35	PK-12	Harper Field	Park	No	6	2	11.3	7	14.7	9	22.5	14	67.6	42
36	PK-13	Harrison Canyon Park	Park	No	6	2	11.5	7	15.0	9	23.0	14	69.1	43
37	PK-14	Hampshire Floodway Park	Park	No	4	2	8.3	5	10.8	7	16.6	10	49.8	31
38	PK-16	Community Park	Park	No	1	2	2.6	2	3.3	2	5.1	3	15.4	10

TABLE A-1
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

SUMMARY OF POTENTIAL DIRECT USE AREAS

Item No.	ID No.	Area Name	Land Use Type	Groundwater Well Present (Yes/No)	Gross Area (ac)	ADD Water Demand Factor (AFY/ac)	Est. ADD (AFY)	Est. ADD (gpm)	Est. MMD (AFY)	Est. MMD (gpm)	Est. MDD (AFY)	Est. MDD (gpm)	Est. PHD (AFY)	Est. PHD (gpm)
Additional Areas Identified														
39	SC-1	Norton Space Academy	School	No	4	4	15.8	10	20.6	13	31.7	20	95.0	59
40	SC-2	Burbank Elementary	School	No	8	4	31.1	19	40.4	25	62.1	39	186.4	116
41	SC-3	Residential	School	No	3	4	11.3	7	14.6	9	22.5	14	67.6	42
42	SC-4	Conrand MS and Harding School	School	No	4	4	16.3	10	21.2	13	32.7	20	98.0	61
43	SC-5	Juanita Blakely Jones Elementary	School	No	18	4	73.3	45	95.3	59	146.6	91	439.8	273
44	SC-6	Anderson Elementary	School	No	4	4	17.9	11	23.2	14	35.8	22	107.3	66
45	SC-7	Center for Individual Development	School	No	7	4	26.6	17	34.6	21	53.3	33	159.9	99
46	SC-8	Monterey Elementary	School	No	6	4	25.4	16	33.0	20	50.7	31	152.2	94
47	SC-10	E Neal Roberts Elementary	School	No	6	4	25.4	16	33.0	20	50.8	31	152.4	94
48	SC-11	School	School	No	17	4	68.6	43	89.2	55	137.2	85	411.7	255
49	SC-12	Curtis Middle School	School	No	27	4	108.6	67	141.2	88	217.3	135	651.8	404
50	SC-13	Bradley Elementary	School	No	10	4	39.5	24	51.3	32	79.0	49	237.0	147
51	SC-14	Lincoln School	School	No	9	4	35.6	22	46.3	29	71.2	44	213.7	132
52	SC-15	Riley School	School	No	8	4	32.7	20	42.5	26	65.4	41	196.3	122
53	SC-16	Pacific High School	School	No	49	4	197.8	123	257.1	159	395.6	245	1,186.7	736
54	SC-17	San Bernardino High School	School	No	36	4	144.8	90	188.2	117	289.6	180	868.7	539
55	SC-18	Arrowview Middle School	School	No	18	4	71.2	44	92.6	57	142.4	88	427.2	265
56	SC-19	School	School	No	7	4	28.5	18	37.0	23	56.9	35	170.8	106
57	SC-23	Arrowhead Elementary	School	No	5	4	19.6	12	25.4	16	39.1	24	117.4	73
58	SC-24	Hillside Elementary	School	No	8	4	33.5	21	43.6	27	67.0	42	201.0	125
59	SC-25	Our Lady of the Assumption Catholic School	School	No	5	4	20.9	13	27.2	17	41.9	26	125.7	78
60	SC-26	North Park Elementary	School	No	9	4	36.7	23	47.7	30	73.5	46	220.4	137
		Subtotals			***427***		***1,433***	***888***	***1,863***	***1,155***	***2,866***	***1,776***	***8,597***	***5,329***
		Grand Totals			**961**		**4,526**	**2,806**	**5,884**	**3,647**	**9,052**	**5,611**	**27,155**	**16,834**

1: Max Month Demand = Average Day Demand x 1.3
2: Max Day Demand = Average Day Demand x 2.0
3: Peak Hour Demand = Max Day Demand x 3.0 (8-hour Irrigation Period)
4: May not include lake make-up water.

Table A-2
City of San Bernardino MWD
Clean Water Factory Project
Recycled/Advanced Water Conveyance System Engineering Analsyis

Conveyance Scenario Pipeline Length Summary

				Alignment Option			
Conveyance Scenario	**Pipeline Segment**	**Description**	**Type**	**1**	**2**	**3**	**4**
1	Pipeline 1-1	SBWRP to Recharge Basins	Advanced	**39,280**	**42,900**	**42,740**	**82,180**
2	Pipeline 2-1	SBWRP to Intermediate Tank/Pump Station	Advanced	24,700	28,200	26,100	52,900
	Pipeline 2-2	Intermediate Tank/Pump Station to Recharge Basins	Advanced	14,600	14,700	16,600	29,300
				39,300	**42,900**	**42,700**	**82,200**
3	Pipeline 3-1	SBWRP to Intermediate Tank/Pump Station	Recycled	36,000	38,800	36,700	38,800
	Pipeline 3-2	Intermediate Tank/Pump Station to Recharge Basins	Recycled	3,300	4,200	6,000	4,200
	Pipeline 3-3	SBWRP to Recharge Basins	Advanced	39,280	42,900	42,740	39,280
				78,580	**85,900**	**85,440**	**82,280**
4	Pipeline 4-1	SBWRP to Intermediate Tank/Pump Station	Recycled	36,000	38,800	36,700	38,800
	Pipeline 4-2	Intermediate Tank/Pump Station to Recharge Basins	Recycled	3,300	4,200	6,000	4,200
	Pipeline 4-3	SBWRP to Intermediate Tank/Pump Station	Advanced	24,700	28,200	26,100	24,700
	Pipeline 4-4	Intermediate Tank/Pump Station to Recharge Basins	Advanced	14,600	14,700	16,600	14,600
				78,600	**85,900**	**85,400**	**82,300**
5	Pipeline 5-1	SBWRP to Recharge Basins	Recycled	39,280	42,900	42,740	N/A
	Pipeline 5-2	Recharge Basins to SBWRP	Brine	39,280	42,900	42,740	N/A
				78,560	**85,800**	**85,480**	N/A
6	Pipeline 6-1	SBWRP to Intermediate Tank/Pump Station	Recycled	24,700	28,200	26,100	N/A
	Pipeline 6-2	Intermediate Tank/Pump Station to Recharge Basins	Recycled	14,600	14,700	16,600	N/A
	Pipeline 6-3	Recharge Basins to SBWRP	Brine	39,280	42,900	42,740	N/A
				78,580	**85,800**	**85,440**	

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APPENDIX B

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City of San Bernardino MWD
Recycled Water Conveyance System Alternatives
Engineering Study
Preliminary Hydraulic Analysis

	Hazen-Williams
Coefficient, C	130

ADVANCED WATER

Alternative	Alternative 1			Alternative 2			Alternative 3			Alternative 4		
Alignment	1	2	3	1	2	3	1	2	3	1	2	3
Flow, Q (mgd)	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
Pipe Diameter, D (in)	30	30	30	30	30	30	30	30	30	30	30	30
Pipe Length, L (ft)												
Segment 1	39,280	42,900	42,740	24,730	28,170	26,130	38,500	42,900	42,740	24,730	28,170	26,130
Segment 2	0	0	0	14,550	14,730	16,610	0	0	0	14,550	14,730	16,610
Velocity, V (fps)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Area, A (sf)	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91	4.91
Wetted Perimeter, (ft)	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85	7.85
Hydraulic Radius, (ft)	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Friction Headloss (ft)												
Segment 1 (ft)	79.92	87.29	86.96	50.32	57.32	53.17	78.34	87.29	86.96	50.32	57.32	53.17
Segment 2 (ft)	0.00	0.00	0.00	29.61	29.97	33.80	0.00	0.00	0.00	29.61	29.97	33.80
Minor Headloss (ft)												
Segment 1 (ft)	10.00	10.00	10.00	6.00	6.00	6.00	10.00	10.00	10.00	6.00	6.00	6.00
Segment 2 (ft)	0.00	0.00	0.00	4.00	4.00	4.00	0.00	0.00	0.00	4.00	4.00	4.00
Total Headloss (ft)	89.92	97.29	96.96	89.92	97.29	96.96	88.34	97.29	96.96	89.92	97.29	96.96
SBWRF Elev (ft)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Intermediate PS/Tank Elev (ft)	--	--	--	1165	1165	1165	--	--	--	1165	1165	1165
Recharge Basin Elev (ft)	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470
Max. HGL												
Segment 1 (ft)	559.92	567.29	566.96	221.32	228.32	224.17	558.34	567.29	566.96	221.32	228.32	224.17
Segment 1 (psi)	242.39	245.58	245.44	95.81	98.84	97.04	241.70	245.58	245.44	95.81	98.84	97.04
Segment 2 (ft)				338.61	338.97	342.80				338.61	338.97	342.80
Segment 2 (psi)				146.58	146.74	148.40				146.58	146.74	148.40

City of San Bernardino MWD
Recycled Water Conveyance System Alternatives
Engineering Study
Preliminary Hydraulic Analysis

	Hazen-Williams
Coefficient, C	130

RECYCLED WATER

Alternative	Alternative 3			Alternative 4			Alternative 5			Alternative 6		
Alignment	1	2	3	1	2	3	1	2	3	1	2	3
Flow, Q (mgd)												
Segment 1	7.0	7.0	7.0	7.0	7.0	7.0	25.2	25.2	25.2	25.2	25.2	25.2
Segment 2	5.0	5.0	5.0	5.0	5.0	5.0				25.2	25.2	25.2
Pipe Diameter, D (in)												
Segment 1	20	20	20	20	20	20	36	36	36	36	36	36
Segment 2	16	16	16	16	16	16				36	36	36
Pipe Length, L (ft)												
Segment 1	36,020	38,750	36,700	36,020	38,750	36,700	39,280	42,900	42,740	24,730	28,170	26,130
Segment 2	3,260	4,150	6,040	3,260	4,150	6,040	0	0	0	14,550	14,730	16,610
Velocity, V (fps)												
Segment 1	5.0	5.0	5.0	5.0	5.0	5.0	5.5	5.5	5.5	5.5	5.5	5.5
Segment 2	5.5	5.5	5.5	5.5	5.5	5.5				5.5	5.5	5.5
Area, A (sf)												
Segment 1	2.18	2.18	2.18	2.18	2.18	2.18	7.07	7.07	7.07	7.07	7.07	7.07
Segment 2	1.40	1.40	1.40	1.40	1.40	1.40				7.07	7.07	7.07
Wetted Perimeter, (ft)												
Segment 1	5.24	5.24	5.24	5.24	5.24	5.24	9.42	9.42	9.42	9.42	9.42	9.42
Segment 2	4.19	4.19	4.19	4.19	4.19	4.19				9.42	9.42	9.42
Hydraulic Radius, (ft)												
Segment 1	0.42	0.42	0.42	0.42	0.42	0.42	0.75	0.75	0.75	0.75	0.75	0.75
Segment 2	0.33	0.33	0.33	0.33	0.33	0.33				0.75	0.75	0.75
Friction Headloss (ft)												
Segment 1	142.66	153.48	145.36	142.66	153.48	145.36	95.04	103.80	103.42	59.84	68.16	63.23
Segment 2	20.54	26.15	38.06	20.54	26.15	38.06				35.21	35.64	40.19
Minor Headloss (ft)												
Segment 1	9.00	9.00	9.00	9.00	9.00	9.00	10.00	10.00	10.00	6.00	6.00	6.00
Segment 2	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	4.00	4.00	4.00
Total Headloss (ft)	173.20	189.62	193.41	173.20	189.62	193.41	105.04	113.80	113.42	105.04	113.80	113.42
SBWRF Elev (ft)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Intermediate PS/Tank Elev (ft)	1350	1350	1350	1350	1350	1350	--	--	--	1165	1165	1165
Recharge Basin Elev (ft)	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470	1470
Max. HGL												
Segment 1 (ft)	501.66	512.48	504.36	501.66	512.48	504.36	575.04	583.80	583.42	230.84	239.16	234.23
Segment 1 (psi)	217.17	221.85	218.34	217.17	221.85	218.34	248.94	252.73	252.56	99.93	103.53	101.40
Segment 2 (ft)	141.54	147.15	159.06	141.54	147.15	159.06				344.21	344.64	349.19
Segment 2 (psi)	61.27	63.70	68.86	61.27	63.70	68.86				149.01	149.20	151.16

City of San Bernardino MWD
Recycled Water Conveyance System Alternatives
Engineering Study
Preliminary Hydraulic Analysis

	Hazen-Williams
Coefficient, C	130

BRINE

Alternative	Alternative 5			Alternative 6		
Alignment	1	2	3	1	2	3
Flow, Q (mgd)	2.5	2.5	2.5	2.5	2.5	2.5
Pipe Diameter, D (in)	12	12	12	12	12	12
Pipe Length, L (ft)						
Segment 1	39,280	42,900	42,740	39,280	42,900	42,740
Segment 2	0	0	0	0	0	0
Velocity, V (fps)	4.9	4.9	4.9	4.9	4.9	4.9
Area, A (sf)	0.79	0.79	0.79	0.79	0.79	0.79
Wetted Perimeter, (ft)	3.14	3.14	3.14	3.14	3.14	3.14
Hydraulic Radius, (ft)	0.25	0.25	0.25	0.25	0.25	0.25
Friction Headloss (ft)						
Segment 1 (ft)	278.68	304.36	303.23	278.68	304.36	303.23
Segment 2 (ft)	0.00	0.00	0.00	0.00	0.00	0.00
Minor Headloss (ft)						
Segment 1 (ft)	10.00	10.00	10.00	10.00	10.00	10.00
Segment 2 (ft)	0.00	0.00	0.00	0.00	0.00	0.00
Total Headloss (ft)	288.68	314.36	313.23	288.68	314.36	313.23
SBWRF Elev (ft)	1000	1000	1000	1000	1000	1000
Intermediate PS/Tank Elev (ft)	--	--	--	--	--	--
Recharge Basin Elev (ft)	1470	1470	1470	1470	1470	1470
Max. HGL (Gravity Line)						
Segment 1 (ft) (Available)	181.32	155.64	156.77	181.32	155.64	156.77
Segment 1 (psi) (Available)	78.49	67.38	67.87	78.49	67.38	67.87
Segment 2 (ft)						
Segment 2 (psi)						

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APPENDIX C

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Table C-1
City of San Bernardino MWD
Clean Water Factory Project
Recycled/Advanced Water Conveyance System Engineering Study

SUMMARY OF RESERVOIR SITE LAND ACQUISITION REQUIRMENTS

Reservoir				Reservoir Site Criteria			Minimum Reservoir (only) Site Dimensions		
Item	No.	Operation	Location	Volume (MG)	Height [1] (ft)	Diameter, D (ft)	D + 90 (ft)	D + 70 (ft)	(Ac)
1	1-1	Recycled - Dist./Forebay	SBWRP	4.2	30	155	245	225	1.3
2	1-2	Advanced - Forebay	SBWRP	3.2	30	135	225	205	1.1
3	1-3	Advanced - Distribution	Intermediate Site	0.8	20	83	173	153	0.6
4	2-1	Recycled - Dist./Forebay	SBWRP	4.2	30	155	245	225	1.3
5	2-2	Advanced - Forebay	SBWRP	1.6	20	117	207	187	0.9
6	2-3	Advanced - Dist./Forebay	Intermediate Site	2.4	30	117	207	187	0.9
7	3-1	Recycled - Dist./Forebay	SBWRP	4.3	30	157	247	227	1.3
8	3-2	Advanced - Forebay	SBWRP	0.2	10	59	149	129	0.4
9	3-3	Recycled - Dist./Forebay	Northern Site	4.0	30	151	241	221	1.2
10	4-1	Recycled - Dist./Forebay	SBWRP	4.3	30	157	247	227	1.3
11	4-2	Advanced - Forebay	SBWRP	0.2	10	59	149	129	0.4
12	4-3	Recycled - Dist./Forebay	Northern Site	4.0	30	151	241	221	1.2
13	4-4	Advanced - Forebay	Intermediate Site	0.2	10	59	149	129	0.4
14	5-1	Recycled - Dist./Forebay	SBWRP	7.4	40	178	268	248	1.5
15	5-2	Recycled - Distribution	Intermediate Site	0.8	20	83	173	153	0.6
16	6-1	Recycled - Dist./Forebay	SBWRP	5.8	40	158	248	228	1.3
17	6-2	Recycled - Dist./Forebay	Intermediate Site	2.4	30	117	207	187	0.9

= Intermediate/Northern Sites

[1] Height = height of water column. Freeboard is excluded.

	Height	Size
SmallReservoir Water Column (ft) =	10	0 to 0.2 MG
Medium Reservoir Water Column (ft) =	20	0.3 to 2.0 MG

Table C-2
City of San Bernardino MWD
Clean Water Factory Project
Recycled/Advanced Water Conveyance System Engineering Study

SUMMARY OF PUMP STATION SITE LAND ACQUISITION REQUIRMENTS

Pump Station				Pump Station Site Criteria					Minimum Pump Station (only) Site Dimensions		
					Pumps				L + 95	W + 95	
Item	No.	Operation	Location	Number	Size (gpm)	Size (HP)	Length (ft) [1]	Width (ft) [1]	(ft)	(ft)	(Ac)
1	1-1	Recycled - Distribution	SBWRP	3	4,400	250	55	20	150	115	0.4
2	1-2	Advanced - Transmission	SBWRP	4	3,300	600	95	28	190	123	0.5
3	2-1	Recycled - Distribution	SBWRP	3	4,400	250	55	20	150	115	0.4
4	2-2	Advanced - Transmission	SBWRP	4	3,300	250	65	20	160	115	0.4
5	2-3	Advanced - Transmission	Intermediate Site	4	3,300	400	80	24	175	119	0.5
6	3-1	Recycled - Dist./Trans.	SBWRP	3 + 3 *	4,400 + 2,500	250 + 450	68	44	163	139	0.5
7	3-2	Advanced - Transmission	SBWRP	4	3,300	600	95	28	190	123	0.5
8	3-3	Recycled - Dist./Trans.	Northern Site	3	1,750	100	42	16	137	111	0.3
9	4-1	Recycled - Dist./Forebay	SBWRP	3 + 3 *	4,400 + 2,500	250 + 450	68	44	163	139	0.5
10	4-2	Advanced - Transmission	SBWRP	4	3,300	250	65	20	160	115	0.4
11	4-3	Recycled - Dist./Trans.	Northern Site	3	1,750	100	42	16	137	111	0.3
12	4-4	Advanced - Transmission	Intermediate Site	4	3,300	400	80	24	175	119	0.5
13	5-1	Recycled - Dist./Trans.	SBWRP	3 + 4 *	4,400 + 5,830	250 + 1000	95	48	190	143	0.6
14	6-1	Recycled - Dist./Trans.	SBWRP	3 + 4 *	4,400 + 5,830	250 + 450	80	44	175	139	0.6
15	6-2	Recycled - Dist./Trans.	Intermediate Site	4	5,830	600	95	28	190	123	0.5

= Intermediate/Northern Sites

[1] Length and width determined by size and number pumps	Spacing	Size	Equip Space Add to Length
Small Pump Station (ft) =	8	0 to 100 HP	10
Medium Pump Station (ft) =	10	150 to 250 HP	15
Large Pump Station (ft) =	12	300 to 550 HP	20
Very Large Pump Station (ft) =	14	600 to 1000 HP	25

*For combined pumps, use larger size and total number of pumps for length sizing criteria and add width.

Table C-3
City of San Bernardino MWD
Clean Water Factory Project
Recycled/Advanced Water Conveyance System Engineering Study

SUMMARY OF COMBINED PUMP STATION + RESERVOIR SITE LAND ACQUISITION REQUIRMENTS

Pump Station & Reservoir					Reservoir Site Criteria			Pump Station Site Criteria					Minimum Combined Site (Alt. A) Dimensions			Minimum Combined Site (Alt. B) Dimensions				
Item	Reservoir No.	Pump Station No.	Operation	Location	Volume (MG)	Height [1] (ft)	Diameter, D (ft)	Pumps Number	Size (gpm)	Size (HP)	Length (ft) [2]	Width (ft) [2]	Dia+L+110 L (ft)	Dia + 70 W (ft)	(Ac)	Dia+W+120 L (ft)	Dia +70 W (ft)	(Ac)	Multiple Combined	Note
1	1-1	1-1	Recycled - Distribution	SBWRP	4.2	30	155	3	4,400	250	55	20	320	225	1.7	295	225	1.5	No	
2	1-2	1-2	Advanced - Transmission	SBWRP	3.2	30	135	4	3,300	600	95	28	340	205	1.6	283	205	1.3	No	
3	2-1	2-1	Recycled - Distribution	SBWRP	4.2	30	155	3	4,400	250	55	20	320	225	1.7	295	225	1.5	No	
4	2-2	2-2	Advanced - Transmission	SBWRP	1.6	20	117	4	3,300	250	65	20	292	187	1.3	257	187	1.1	No	
5	2-3	2-3	Advanced - Transmission	Intermediate Site	2.4	30	117	4	3,300	400	80	24	307	187	1.3	261	187	1.1	No	
6	3-1	3-1	Recycled - Dist./Trans.	SBWRP	4.3	30	157	3 + 3 *	4,400 + 2,500	250 + 450	68	44	335	227	1.7	321	227	1.7	No	
7	3-2	3-2	Advanced - Transmission	SBWRP	0.2	10	59	4	3,300	600	95	28	264	129	0.8	207	154	0.7	No	For W, use PS L +95
8	3-3	3-3	Recycled - Dist./Trans.	Northern Site	4.0	30	151	3	1,750	100	42	16	303	221	1.5	287	221	1.5	No	
9	4-1	4-1	Recycled - Dist./Forebay	SBWRP	4.3	30	157	3 + 3 *	4,400 + 2,500	250 + 450	68	44	335	227	1.7	321	227	1.7	No	
10	4-2	4-2	Advanced - Transmission	SBWRP	0.2	10	59	4	3,300	250	65	20	234	129	0.7	199	154	0.7	No	For W, use PS L +95
11	4-3	4-3	Recycled - Dist./Trans.	Northern Site	4.0	30	151	3	1,750	100	42	16	303	221	1.5	287	221	1.5	No	
12	4-4	4-4	Advanced - Transmission	Intermediate Site	0.2	10	59	4	3,300	400	80	24	249	129	0.7	203	154	0.7	No	For W, use PS L +95
13	5-1	5-1	Recycled - Dist./Trans.	SBWRP	7.4	40	178	3 + 4 *	4,400 + 5,830	250 + 1000	95	48	383	248	2.2	346	248	2.0	No	
14	6-1	6-1	Recycled - Dist./Trans.	SBWRP	5.8	40	158	3 + 4 *	4,400 + 5,830	250 + 450	80	44	348	228	1.8	322	228	1.7	No	
15	6-2	6-2	Recycled - Dist./Trans.	Intermediate Site	2.4	30	117	4	5,830	600	95	28	322	187	1.4	265	187	1.1	No	

= Intermediate/Northern Sites

[1] Height = height of water column. Freeboard is excluded.

	Height	Size
SmallReservoir Water Column (ft) =	10	0 to 0.2 MG
Medium Reservoir Water Column (ft) =	20	0.3 to 2.0 MG
Large Reservoir Water Column (ft) =	30	2.1 to 4.5 MG
Very Large Reservoir Water Column (ft) =	40	4.6 to 8.0 MG

[2] Sizing

	Spacing	Size	Elect Space Add to Length
Small PS (ft) =	8	0 to 100 HP	10
Medium PS (ft) =	10	150 to 250 HP	15
Large PS (ft) =	12	300 to 550 HP	20
Very Large PS (ft) =	14	600 to 1000 HP	25

*For combined pumps, use larger size and total number of pumps for length sizing criteria and add width.

ACTUAL COMBINED SITES COMBINATIONS - INTERMEDIATE
Location of Intermediate Sites = approximately at Highland Ave

Pump Station & Reservoir				Minimum Reservoir (only) Site Dimensions			Minimum Combined Site (Alt. A) Dimensions			Minimum Combined Site (Alt. B) Dimensions			Screen Out	
Item	Reservoir No.	Pump Station No.	Operation	D + 90 (ft)	D + 70 (ft)	(Ac)	Dia+L+110 L (ft)	Dia + 70 W (ft)	(Ac)	Dia+W+120 L (ft)	Dia +70 W (ft)	(Ac)		
1	1-3 or 5-3		Advanced - Distribution	173	153	0.61							X	
2	2-3	2-3	Advanced - Transmission				307	187	1.3	261	187	1.1	X	
3	4-4	4-4	Advanced - Transmission				249	129	0.7	203	154	0.7	X	Most Likely
4	6-6	6-2	Recycled - Dist./Trans.				322	187	1.4	265	187	1.1	X	Largest

ACTUAL COMBINED SITES COMBINATIONS - NORTHERN
Location of Intermediate Sites = approximately at 40th Street

Pump Station & Reservoir				Minimum Combined Site (Alt. A) Dimensions			Minimum Combined Site (Alt. B) Dimensions			Screen Out	
Item	Reservoir No.	Pump Station No.	Operation	Dia+L+110 L (ft)	Dia + 70 W (ft)	(Ac)	Dia+W+120 L (ft)	Dia +70 W (ft)	(Ac)		
1	3-3 or 4-3	3-3 or 4-3	Recycled - Dist./Trans.	303	221	1.5	287	221	1.5		Most Likely, Largest

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APPENDIX D

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Table D-1
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Pipeline Alignment Costs

Option 1.1 / 1.2	**Qty.**	**Unit**	**Unit Cost**	**Total**
30" Advanced Pipeline (open)	38,635	LF	$450	$17,385,750
8" Distribution Pipeline (paved)	93,400	LF	$120	$11,208,000
10" Distribution Pipeline (paved)	14,300	LF	$150	$2,145,000
Bore & Jack Tunnel (54")	645	LF	$2,160	$1,393,200
Construction Contingency (30%)				$9,639,585
Construction Subtotal				$41,771,535
Admin, Design, CM, Legal (30%)				$12,531,461
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$6,265,730
Project Subtotal				$60,568,726
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$7,571,091
ESCALATED PROJECT COST TOTAL				**$68,139,816**

Option 1.3 / 1.4	**Qty.**	**Unit**	**Unit Cost**	**Total**
30" Advanced Pipeline (open)	38,635	LF	$450	$17,385,750
20" Recycled Pipeline (open)	38,570	LF	$300	$11,571,000
8" Distribution Pipeline (paved)	93,400	LF	$120	$11,208,000
10" Distribution Pipeline (paved)	14,300	LF	$150	$2,145,000
Bore & Jack Tunnel (84")	645	LF	$3,360	$2,167,200
Construction Contingency (30%)				$13,343,085
Construction Subtotal				$57,820,035
Admin, Design, CM, Legal (30%)				$17,346,011
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$8,673,005
Project Subtotal				$83,839,051
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$10,479,881
ESCALATED PROJECT COST TOTAL				**$94,318,932**

Option 1.5 / 1.6	**Qty.**	**Unit**	**Unit Cost**	**Total**
36" Advanced Pipeline (open)	38,635	LF	$540	$20,862,900
12" Brine Pipeline (open)	38,570	LF	$180	$6,942,600
8" Distribution Pipeline (paved)	93,400	LF	$120	$11,208,000
10" Distribution Pipeline (paved)	14,300	LF	$150	$2,145,000
Bore & Jack Tunnel (72")	645	LF	$2,880	$1,857,600
Construction Contingency (30%)				$12,904,830
Construction Subtotal				$55,920,930
Admin, Design, CM, Legal (30%)				$16,776,279
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$8,388,140
Project Subtotal				$81,085,349
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$10,135,669
ESCALATED PROJECT COST TOTAL				**$91,221,017**

Table D-1
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Pipeline Alignment Costs

Option 2.1 / 2.2	**Qty.**	**Unit**	**Unit Cost**	**Total**
30" Advanced Pipeline (paved)	42,400	LF	$600	$25,440,000
8" Distribution Pipeline (paved)	80,400	LF	$120	$9,648,000
10" Distribution Pipeline (paved)	9,500	LF	$150	$1,425,000
Bore & Jack Tunnel (54")	500	LF	$2,160	$1,080,000
Construction Contingency (30%)				$11,277,900
Construction Subtotal				$48,870,900
Admin, Design, CM, Legal (30%)				$14,661,270
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$7,330,635
Project Subtotal				$70,862,805
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$8,857,851
ESCALATED PROJECT COST TOTAL				**$79,720,656**

Option 2.3 / 2.4	**Qty.**	**Unit**	**Unit Cost**	**Total**
30" Advanced Pipeline (paved)	42,400	LF	$600	$25,440,000
20" Recycled Pipeline (paved)	42,400	LF	$400	$16,960,000
8" Distribution Pipeline (paved)	80,400	LF	$120	$9,648,000
10" Distribution Pipeline (paved)	9,500	LF	$150	$1,425,000
Bore & Jack Tunnel (84")	500	LF	$3,360	$1,680,000
Construction Contingency (30%)				$16,545,900
Construction Subtotal				$71,698,900
Admin, Design, CM, Legal (30%)				$21,509,670
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$10,754,835
Project Subtotal				$103,963,405
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$12,995,426
ESCALATED PROJECT COST TOTAL				**$116,958,831**

Option 2.5 / 2.6	**Qty.**	**Unit**	**Unit Cost**	**Total**
36" Advanced Pipeline (paved)	42,400	LF	$720	$30,528,000
12" Brine Pipeline (paved)	42,400	LF	$240	$10,176,000
8" Distribution Pipeline (paved)	80,400	LF	$120	$9,648,000
10" Distribution Pipeline (paved)	9,500	LF	$150	$1,425,000
Bore & Jack Tunnel (72")	500	LF	$2,880	$1,440,000
Construction Contingency (30%)				$15,965,100
Construction Subtotal				$69,182,100
Admin, Design, CM, Legal (30%)				$20,754,630
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$10,377,315
Project Subtotal				$100,314,045
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$12,539,256
ESCALATED PROJECT COST TOTAL				**$112,853,301**

Table D-1
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Pipeline Alignment Costs

Option 3.1 / 3.2	**Qty.**	**Unit**	**Unit Cost**	**Total**
30" Advanced Pipeline (paved)	42,170	LF	$600	$25,302,000
8" Distribution Pipeline (paved)	74,000	LF	$120	$8,880,000
10" Distribution Pipeline (paved)	11,100	LF	$150	$1,665,000
Bore & Jack Tunnel (54")	570	LF	$2,160	$1,231,200
Construction Contingency (30%)				$11,123,460
Construction Subtotal				$48,201,660
Admin, Design, CM, Legal (30%)				$14,460,498
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$7,230,249
Project Subtotal				$69,892,407
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$8,736,551
ESCALATED PROJECT COST TOTAL				**$78,628,958**

Option 3.3 / 3.4	**Qty.**	**Unit**	**Unit Cost**	**Total**
30" Advanced Pipeline (paved)	42,170	LF	$600	$25,302,000
20" Recycled Pipeline (paved)	42,170	LF	$400	$16,868,000
8" Distribution Pipeline (paved)	74,000	LF	$120	$8,880,000
10" Distribution Pipeline (paved)	11,100	LF	$150	$1,665,000
Bore & Jack Tunnel (84")	570	LF	$3,360	$1,915,200
Construction Contingency (30%)				$16,389,060
Construction Subtotal				$71,019,260
Admin, Design, CM, Legal (30%)				$21,305,778
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$10,652,889
Project Subtotal				$102,977,927
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$12,872,241
ESCALATED PROJECT COST TOTAL				**$115,850,168**

Option 3.5 / 3.6	**Qty.**	**Unit**	**Unit Cost**	**Total**
36" Advanced Pipeline (paved)	42,170	LF	$720	$30,362,400
12" Brine Pipeline (paved)	42,170	LF	$240	$10,120,800
8" Distribution Pipeline (paved)	74,000	LF	$120	$8,880,000
10" Distribution Pipeline (paved)	11,100	LF	$150	$1,665,000
Bore & Jack Tunnel (60")	570	LF	$2,400	$1,368,000
Construction Contingency (30%)				$15,718,860
Construction Subtotal				$68,115,060
Admin, Design, CM, Legal (30%)				$20,434,518
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$10,217,259
Project Subtotal				$98,766,837
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$12,345,855
ESCALATED PROJECT COST TOTAL				**$111,112,692**

Table D-1
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Pipeline Alignment Costs

Option 4.3 / 4.4	**Qty.**	**Unit**	**Unit Cost**	**Total**
30" Advanced Pipeline (open)	38,570	LF	$450	$17,356,500
20" Recycled Pipeline (paved)	42,170	LF	$400	$16,868,000
8" Distribution Pipeline (paved)	74,000	LF	$120	$8,880,000
10" Distribution Pipeline (paved)	11,100	LF	$150	$1,665,000
Bore & Jack Tunnel (54")	710	LF	$2,160	$1,533,600
Bore & Jack Tunnel (48")	570	LF	$1,920	$1,094,400
Construction Contingency (30%)				$14,219,250
Construction Subtotal				$61,616,750
Admin, Design, CM, Legal (30%)				$18,485,025
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$9,242,513
Project Subtotal				$89,344,288
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$11,168,036
ESCALATED PROJECT COST TOTAL				**$100,512,323**

Unit Cost Parameters

	Unit Cost	**Unit**
Pipeline (open)	$15	$/inch-dia/LF
Pipeline (paved)	$20	$/inch-dia/LF
Bore & Jack Tunnel	$40	$/inch-dia/LF

	Dia. (inch)	**Open**	**Paved**
Pipeline	4	$60	$80
Pipeline	6	$90	$120
Pipeline	8	$120	$160
Pipeline	10	$150	$200
Pipeline	12	$180	$240
Pipeline	20	$300	$400
Pipeline	30	$450	$600
Pipeline	36	$540	$720
Bore & Jack	48	$1,920	
Bore & Jack	54	$2,160	
Bore & Jack	60	$2,400	
Bore & Jack	72	$2,880	
Bore & Jack	84	$3,360	

Pipeline O&M Costs 1% of Capital Costs

Table D-2
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Pump Station/Tank Costs

Pump Station / Tank Site A

Option A.1 / A.5 (Reservoir No. 1-3 or 5-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
0.8 MG Reservoir (D = 83', Ht = 20'), above ground	0.8	MG	$1,500,000	$1,200,000
Construction Contingency (30%)				$360,000
Construction Subtotal				$1,560,000
Property Acquisition	1.1	AC	$500,000	$550,000
Admin, Design, CM, Legal (30%)				$468,000
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$234,000
Project Subtotal				$2,812,000
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$351,500
ESCALATED PROJECT COST TOTAL				**$3,163,500**

Option A.2 (Reservoir No. 2-3 and Pump Station 2-3)	**Qty.**	**Unit**	**Unit Cost**	**Total**
2.4 MG Reservoir (D = 117', Ht = 30'), above ground	2.4	MG	$1,500,000	$3,600,000
Pump Station (4 Pumps, 3300 gpm each, 400 HP each)	1,600	HP	$5,400	$8,640,000
Construction Contingency (30%)				$3,672,000
Construction Subtotal				$15,912,000
Property Acquisition	1.1	AC	$500,000	$550,000
Admin, Design, CM, Legal (30%)				$4,773,600
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$2,386,800
Project Subtotal				$23,622,400
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$2,952,800
ESCALATED PROJECT COST TOTAL				**$26,575,200**

Option A.4 (Reservoir No. 4-4 and Pump Station 4-4)	**Qty.**	**Unit**	**Unit Cost**	**Total**
0.2 MG Reservoir (D = 59', Ht = 10'), above ground	0.2	MG	$1,500,000	$300,000
Pump Station (4 Pumps, 3300 gpm each, 400 HP each)	1,600	HP	$5,400	$8,640,000
Construction Contingency (30%)				$2,682,000
Construction Subtotal				$11,622,000
Property Acquisition	1.1	AC	$500,000	$550,000
Admin, Design, CM, Legal (30%)				$3,486,600
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$1,743,300
Project Subtotal				$17,401,900
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$2,175,238
ESCALATED PROJECT COST TOTAL				**$19,577,138**

Option A.6 (Reservoir No. 6-2 and Pump Station 6-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
2.4 MG Reservoir (D = 117', Ht = 30'), above ground	2.4	MG	$1,500,000	$3,600,000
Pump Station (4 Pumps, 5830 gpm each, 600 HP each)	2,400	HP	$4,400	$10,560,000
Construction Contingency (30%)				$4,248,000
Construction Subtotal				$18,408,000
Property Acquisition	1.1	AC	$500,000	$550,000
Admin, Design, CM, Legal (30%)				$5,522,400
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$2,761,200
Project Subtotal				$27,241,600
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$3,405,200
ESCALATED PROJECT COST TOTAL				**$30,646,800**

Table D-2
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Pump Station/Tank Costs

Pump Station / Tank Site B

Option B.1 / B.5 (Reservoir No. 1-3 or 5-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
0.8 MG Reservoir (D = 83', Ht = 20'), below ground	0.8	MG	$2,200,000	$1,760,000
Construction Contingency (30%)				$528,000
Construction Subtotal				$2,288,000
Admin, Design, CM, Legal (30%)				$686,400
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$343,200
Project Subtotal				$3,317,600
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$414,700
ESCALATED PROJECT COST TOTAL				**$3,732,300**

Option B.2 (Reservoir No. 2-3 and Pump Station 2-3)	**Qty.**	**Unit**	**Unit Cost**	**Total**
2.4 MG Reservoir (D = 117', Ht = 30'), below ground	2.4	MG	$2,200,000	$5,280,000
Pump Station (4 Pumps, 3300 gpm each, 400 HP each)	1,600	HP	$5,400	$8,640,000
Construction Contingency (30%)				$4,176,000
Construction Subtotal				$18,096,000
Admin, Design, CM, Legal (30%)				$5,428,800
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$2,714,400
Project Subtotal				$26,239,200
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$3,279,900
ESCALATED PROJECT COST TOTAL				**$29,519,100**

Option B.4 (Reservoir No. 4-4 and Pump Station 4-4)	**Qty.**	**Unit**	**Unit Cost**	**Total**
0.2 MG Reservoir (D = 59', Ht = 10'), below ground	0.2	MG	$2,200,000	$440,000
Pump Station (4 Pumps, 3300 gpm each, 400 HP each)	1,600	HP	$5,400	$8,640,000
Construction Contingency (30%)				$2,724,000
Construction Subtotal				$11,804,000
Admin, Design, CM, Legal (30%)				$3,541,200
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$1,770,600
Project Subtotal				$17,115,800
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$2,139,475
ESCALATED PROJECT COST TOTAL				**$19,255,275**

Option B.6 (Reservoir No. 6-2 and Pump Station 6-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
2.4 MG Reservoir (D = 117', Ht = 30'), below ground	2.4	MG	$2,200,000	$5,280,000
Pump Station (4 Pumps, 5830 gpm each, 600 HP each)	2,400	HP	$4,400	$10,560,000
Construction Contingency (30%)				$4,752,000
Construction Subtotal				$20,592,000
Admin, Design, CM, Legal (30%)				$6,177,600
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$3,088,800
Project Subtotal				$29,858,400
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$3,732,300
ESCALATED PROJECT COST TOTAL				**$33,590,700**

Table D-2
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Pump Station/Tank Costs

Pump Station / Tank Site C

Option C.1 / C.5 (Reservoir No. 1-3 or 5-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
0.8 MG Reservoir (D = 83', Ht = 20'), above ground	0.8	MG	$1,500,000	$1,200,000
Construction Contingency (30%)				$360,000
Construction Subtotal				$1,560,000
Admin, Design, CM, Legal (30%)				$468,000
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$234,000
Project Subtotal				$2,262,000
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$282,750
ESCALATED PROJECT COST TOTAL				**$2,544,750**

Option C.2 (Reservoir No. 2-3 and Pump Station 2-3)	**Qty.**	**Unit**	**Unit Cost**	**Total**
2.4 MG Reservoir (D = 117', Ht = 30'), above ground	2.4	MG	$1,500,000	$3,600,000
Pump Station (4 Pumps, 3300 gpm each, 400 HP each)	1,600	HP	$5,400	$8,640,000
Construction Contingency (30%)				$3,672,000
Construction Subtotal				$15,912,000
Admin, Design, CM, Legal (30%)				$4,773,600
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$2,386,800
Project Subtotal				$23,072,400
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$2,884,050
ESCALATED PROJECT COST TOTAL				**$25,956,450**

Option C.4 (Reservoir No. 4-4 and Pump Station 4-4)	**Qty.**	**Unit**	**Unit Cost**	**Total**
0.2 MG Reservoir (D = 59', Ht = 10'), above ground	0.2	MG	$1,500,000	$300,000
Pump Station (4 Pumps, 3300 gpm each, 400 HP each)	1,600	HP	$5,400	$8,640,000
Construction Contingency (30%)				$2,682,000
Construction Subtotal				$11,622,000
Admin, Design, CM, Legal (30%)				$3,486,600
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$1,743,300
Project Subtotal				$16,851,900
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$2,106,488
ESCALATED PROJECT COST TOTAL				**$18,958,388**

Option C.6 (Reservoir No. 6-2 and Pump Station 6-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
2.4 MG Reservoir (D = 117', Ht = 30'), above ground	2.4	MG	$1,500,000	$3,600,000
Pump Station (4 Pumps, 5830 gpm each, 600 HP each)	2,400	HP	$4,400	$10,560,000
Construction Contingency (30%)				$4,248,000
Construction Subtotal				$18,408,000
Admin, Design, CM, Legal (30%)				$5,522,400
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$2,761,200
Project Subtotal				$26,691,600
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$3,336,450
ESCALATED PROJECT COST TOTAL				**$30,028,050**

Table D-2
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Pump Station/Tank Costs

Pump Station / Tank Site D

Option D.3 / D.4 (Reservoir No. 3-3 or 4-3 and Pump Station 3-3 or 4-3)	**Qty.**	**Unit**	**Unit Cost**	**Total**
4.0 MG Reservoir (D = 151', Ht = 30'), below ground	4.0	MG	$2,200,000	$8,800,000
Pump Station (3 Pumps, 1750 gpm each, 100 HP each)	300	HP	$8,000	$2,400,000
Construction Contingency (30%)				$3,360,000
Construction Subtotal				$14,560,000
Admin, Design, CM, Legal (30%)				$4,368,000
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$2,184,000
Project Subtotal				$21,112,000
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$2,639,000
ESCALATED PROJECT COST TOTAL				**$23,751,000**

Pump Station / Tank Site E

Option E.3 / E.4 (Reservoir No. 3-3 or 4-3 and Pump Station 3-3 or 4-3)	**Qty.**	**Unit**	**Unit Cost**	**Total**
4.0 MG Reservoir (D = 151', Ht = 30'), below ground	4.0	MG	$2,200,000	$8,800,000
Pump Station (3 Pumps, 1750 gpm each, 100 HP each)	300	HP	$8,000	$2,400,000
Relocate Park Facilities	1	LS	$200,000	$200,000
Construction Contingency (30%)				$3,420,000
Construction Subtotal				$14,820,000
Admin, Design, CM, Legal (30%)				$4,446,000
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$2,223,000
Project Subtotal				$21,489,000
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$2,686,125
ESCALATED PROJECT COST TOTAL				**$24,175,125**

Pump Station / Tank Site F

Option F.3 / F.4 (Reservoir No. 3-3 or 4-3 and Pump Station 3-3 or 4-3)	**Qty.**	**Unit**	**Unit Cost**	**Total**
4.0 MG Reservoir (D = 151', Ht = 30'), above ground	4.0	MG	$1,500,000	$6,000,000
Pump Station (3 Pumps, 1750 gpm each, 100 HP each)	300	HP	$8,000	$2,400,000
Extra Grading	1	LS	$300,000	$300,000
Construction Contingency (30%)				$2,610,000
Construction Subtotal				$11,310,000
Property Acquisition	1.1	AC	$500,000	$550,000
Admin, Design, CM, Legal (30%)				$3,393,000
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$1,696,500
Project Subtotal				$16,949,500
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$2,118,688
ESCALATED PROJECT COST TOTAL				**$19,068,188**

Pump Station / Tank Site G

Option G.3 / G.4 (Reservoir No. 3-3 or 4-3 and Pump Station 3-3 or 4-3)	**Qty.**	**Unit**	**Unit Cost**	**Total**
4.0 MG Reservoir (D = 151', Ht = 30'), above ground	4.0	MG	$1,500,000	$6,000,000
No Pump Station (but add 300 HP to Pump Station at SBWRP)	300	HP	$8,000	$2,400,000
Electrical Power Line	3,300	LF	$250	$825,000
Extra Grading	1	LS	$300,000	$300,000
Construction Contingency (30%)				$2,857,500
Construction Subtotal				$12,382,500
Property Acquisition	1.1	AC	$500,000	$550,000
Admin, Design, CM, Legal (30%)				$3,714,750
Class 4 Estimate Contingency (-15% / +30%; use +15%)				$1,857,375
Project Subtotal				$18,504,625
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$2,313,078
ESCALATED PROJECT COST TOTAL				**$20,817,703**

Table D-2
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Pump Station/Tank Costs

Unit Cost Parameters

	Unit Cost	Unit
Pump Station, 300 HP	$8,000	$/HP
Pump Station, 1600 HP	$5,400	$/HP
Pump Station, 2400 HP	$4,400	$/HP

	HP	Cost
Pump Station, 300 HP	300	$2,400,000
Pump Station, 1600 HP	1,600	$8,640,000
Pump Station, 2400 HP	2,400	$10,560,000

	Unit Cost	Unit
Reservoir, above ground (0.8 to 4.0 MG)	$1,500,000	MG
Reservoir, below ground (0.8 to 4.0 MG)	$2,200,000	MG
Property	$500,000	Acre
Relocate Park Facilities	$200,000	LS
Extra Grading	$300,000	LS
Electrical Power Line	$250	LF

Pump Station O&M Costs	1% of Capital Costs
Pump Station Energy Cost	see separate sheet

Table D-3a
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Conveyance Scenario Facilities

CS1 (Reservoir 1-1 & 1-2 and Pump Station 1-1 & 1-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
4.2 MG Recycled Reservoir (D=155', Ht=30'), above ground	4.2	MG	$1,500,000	$6,300,000
Recycled Pump Station (3 pumps - 4,400 gpm / 250 HP each)	750	HP	$6,000	$4,500,000
3.2 MG Advanced Reservoir (D=135', Ht=30'), above ground	3.2	MG	$1,500,000	$4,800,000
Advanced Pump Station (4 pumps - 3,300 gpm / 600 HP each)	2,400	HP	$4,400	$10,560,000
Construction Contingency (30%)				$7,848,000
Construction Subtotal				$34,008,000
Admin, Design, CM, Legal (30%)				$10,202,400
Class 5 Estimate Contingency (-20% / +30%; use +30%)				$10,202,400
Project Subtotal				$54,412,800
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$6,801,600
ESCALATED PROJECT COST TOTAL				**$61,214,400**

CS2 (Reservoir 2-1 & 2-2 and Pump Station 2-1 & 2-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
4.2 MG Recycled Reservoir (D=155', Ht=30'), above ground	4.2	MG	$1,500,000	$6,300,000
Recycled Pump Station (3 pumps - 4,400 gpm / 250 HP each)	750	HP	$6,000	$4,500,000
1.6 MG Advanced Reservoir (D=117', Ht=20'), above ground	1.6	MG	$1,500,000	$2,400,000
Advanced Pump Station (4 pumps - 3,300 gpm / 250 HP each)	1,000	HP	$5,800	$5,800,000
Construction Contingency (30%)				$5,700,000
Construction Subtotal				$24,700,000
Admin, Design, CM, Legal (30%)				$7,410,000
Class 5 Estimate Contingency (-20% / +30%; use +30%)				$7,410,000
Project Subtotal				$39,520,000
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$4,940,000
ESCALATED PROJECT COST TOTAL				**$44,460,000**

CS3 (Reservoir 3-1 & 3-2 and Pump Station 3-1 & 3-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
4.3 MG Recycled Reservoir (D=157', Ht=30'), above ground	4.3	MG	$1,500,000	$6,450,000
Recycled Pump Station (3 pumps - 4,400 gpm / 250 HP each + 3 pumps - 2,500 gpm / 450 HP each)	2,100	HP	$4,800	$10,080,000
0.2 MG Advanced Reservoir (D=59', Ht=10'), above ground	0.2	MG	$1,500,000	$300,000
Advanced Pump Station (4 pumps - 3,300 gpm / 600 HP each)	2,400	HP	$4,400	$10,560,000
Construction Contingency (30%)				$8,217,000
Construction Subtotal				$35,607,000
Admin, Design, CM, Legal (30%)				$10,682,100
Class 5 Estimate Contingency (-20% / +30%; use +30%)				$10,682,100
Project Subtotal				$56,971,200
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$7,121,400
ESCALATED PROJECT COST TOTAL				**$64,092,600**

City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Conveyance Scenario Facilities

CS4 (Reservoir 4-1 & 4-2 and Pump Station 4-1 & 4-2)	**Qty.**	**Unit**	**Unit Cost**	**Total**
4.3 MG Recycled Reservoir (D=157', Ht=30'), above ground	4.3	MG	$1,500,000	$6,450,000
Recycled Pump Station (3 pumps - 4,400 gpm / 250 HP each + 3 pumps - 2,500 gpm / 450 HP each)	2,100	HP	$4,800	$10,080,000
0.2 MG Advanced Reservoir (D=59', Ht=10'), above ground	0.2	MG	$1,500,000	$300,000
Advanced Pump Station (4 pumps - 4,400 gpm / 250 HP each)	1,000	HP	$5,800	$5,800,000
Construction Contingency (30%)				$6,789,000
Construction Subtotal				$29,419,000
Admin, Design, CM, Legal (30%)				$8,825,700
Class 5 Estimate Contingency (-20% / +30%; use +30%)				$8,825,700
Project Subtotal				$47,070,400
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$5,883,800
ESCALATED PROJECT COST TOTAL				**$52,954,200**

CS5 (Reservoir 5-1 and Pump Station 5-1)	**Qty.**	**Unit**	**Unit Cost**	**Total**
7.4 MG Recycled Reservoir (D=178', Ht=40'), above ground	7.4	MG	$1,500,000	$11,100,000
Recycled Pump Station (3 pumps - 4,400 gpm / 250 HP each + 4 pumps - 5,830 gpm / 1,000 HP)	4,750	HP	$3,200	$15,200,000
Construction Contingency (30%)				$7,890,000
Construction Subtotal				$34,190,000
Admin, Design, CM, Legal (30%)				$10,257,000
Class 5 Estimate Contingency (-20% / +30%; use +30%)				$10,257,000
Project Subtotal				$54,704,000
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$6,838,000
ESCALATED PROJECT COST TOTAL				**$61,542,000**

CS6 (Reservoir 6-1 and Pump Station 6-1)	**Qty.**	**Unit**	**Unit Cost**	**Total**
5.8 MG Recycled Reservoir (D=158', Ht=40'), above ground	5.8	MG	$1,500,000	$8,700,000
Recycled Pump Station (3 pumps - 4,400 gpm / 250 HP each + 4 pumps - 5,830 gpm / 450 HP each)	2,550	HP	$4,200	$10,710,000
Construction Contingency (30%)				$5,823,000
Construction Subtotal				$25,233,000
Admin, Design, CM, Legal (30%)				$7,569,900
Class 5 Estimate Contingency (-20% / +30%; use +30%)				$7,569,900
Project Subtotal				$40,372,800
Escalation to Midpoint Constuction (March 2015 - 3 years at 4% per year = 12.5%)				$5,046,600
ESCALATED PROJECT COST TOTAL				**$45,419,400**

Unit Cost Parameters

	Unit Cost	**Unit**
Pump Station, 750 HP	$6,000	$/HP
Pump Station, 1000 HP	$5,800	$/HP
Pump Station, 2100 HP	$4,800	$/HP
Pump Station, 2400 HP	$4,400	$/HP
Pump Station, 2550 HP	$4,200	$/HP
Pump Station, 4750 HP	$3,200	$/HP

	HP	**Cost**
Pump Station, 750 HP	750	$4,500,000
Pump Station, 1000 HP	1,000	$5,800,000
Pump Station, 2100 HP	2,100	$10,080,000
Pump Station, 2400 HP	2,400	$10,560,000
Pump Station, 2550 HP	2,550	$10,710,000
Pump Station, 4750 HP	4,750	$15,200,000

	Unit Cost	**Unit**
Reservoir, above ground (0.2 to 7.5 MG)	$1,500,000	MG
Reservoir, below ground (0.2 to 7.5 MG)	$2,200,000	MG

Pump Station O&M Costs	1% of Capital Costs
Pump Station Energy Cost	see separate sheet

Table D-3b
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Conveyance Scenario Costs

Cost Scenario	**Total Cost**
Conveyance Scenario 1 *CS1 Facilities, Pipeline Alignment Option 1.1, PS/Tank Site C.1*	$131,898,966
Conveyance Scenario 2 *CS2 Facilities, Pipeline Alignment Option 1.2, PS/Tank Site C.2*	$138,556,266
Conveyance Scenario 3 *CS3 Facilities, Pipeline Alignment Option 1.3, PS/Tank Site F.3*	$177,479,720
Conveyance Scenario 4 *CS4 Facilities, Pipeline Alignment Option 1.4, PS/Tank Site F.4 + C.4*	$185,299,707
Conveyance Scenario 5 *CS5 Facilities, Pipeline Alignment Option 1.5, PS/Tank Site C.5*	$155,307,767
Conveyance Scenario 6 *CS6 Facilities, Pipeline Alignment Option 1.6, PS/Tank Site C.6*	$166,668,467

Table D-3c
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

Operation & Maintenance Costs

Cost Scenario	**Total Cost**
Conveyance Scenario 1	
CS1 Facilities, Pipeline Alignment Option 1.1, PS/Tank Site C.1	
Energy Costs	$1,207,120
O&M Costs	$1,318,990
Total	$2,526,110
Conveyance Scenario 2	
CS2 Facilities, Pipeline Alignment Option 1.2, PS/Tank Site C.2	
Energy Costs	$1,208,596
O&M Costs	$1,385,563
Total	$2,594,159
Conveyance Scenario 3	
CS3 Facilities, Pipeline Alignment Option 1.3, PS/Tank Site F.3	
Energy Costs	$1,314,155
O&M Costs	$1,774,797
Total	$3,088,952
Conveyance Scenario 4	
CS4 Facilities, Pipeline Alignment Option 1.4, PS/Tank Site F.4 + C.4	
Energy Costs	$1,779,368
O&M Costs	$1,852,997
Total	$3,632,365
Conveyance Scenario 5	
CS5 Facilities, Pipeline Alignment Option 1.5, PS/Tank Site C.5	
Energy Costs	$1,932,401
O&M Costs	$1,553,078
Total	$3,485,479
Conveyance Scenario 6	
CS6 Facilities, Pipeline Alignment Option 1.6, PS/Tank Site C.6	
Energy Costs	$1,933,877
O&M Costs	$1,666,685
Total	$3,600,562

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Table D-3d
City of San Bernardino MWD
Recycled/Advanced Water Conveyance System Alternatives
Engineering Study

OVERALL CONVEYANCE SCENARIO COSTS

	CAPITAL COSTS				O&M COSTS				COST PER ACRE-FOOT		
Conveyance Scenario 1	Quantity	Unit	$/Unit	Total Cost	Quantity	Unit	$/Unit	Total Cost	Present Worth (20 year, 6% =)		11.47
Tertiary Treatment	2.1	mgd	$ 3,000,000	$ 6,300,000	2.1	mgd	$ 66,000	$ 138,600	Capital	$ 246,098,966	
Advanced Treatment	14.2	mgd	$ 7,000,000	$ 99,400,000	14.2	mgd	$ 530,000	$ 7,526,000	O&M	$ 9,825,579	
Pipelines - Alignment Option 1	1	LS	$ 68,139,816	$ 68,139,816	1	LS	$ 681,398	$ 681,398	Present Worth O&M	$ 112,699,395	
PS/Tank Site Option C	1	LS	$ 2,544,750	$ 2,544,750	1	LS	$ 25,448	$ 25,448	Total Present Worth	$ 358,798,361	
PS/Tank at SBWRP	1	LS	$ 61,214,400	$ 61,214,400	1	LS	$ 612,144	$ 612,144	Total Flow (mgd)	16.3	18256 AF/yr
Recharge Basins/Convert Recycle Sites	1	LS	$ 8,500,000	$ 8,500,000	1	LS	$ 365,000	$ 365,000	**Cost per Acre-foot**	**$ 1,414**	
Energy Costs (Pump Station/Tanks - O&M)					1	LS	$ 1,318,990	$ 1,318,990			
Reduced RIX Cost (O&M)					1	LS	$ (842,000)	$ (842,000)			
TOTAL				$ 246,098,966				$ 9,825,579			

	CAPITAL COSTS				O&M COSTS				COST PER ACRE-FOOT		
Conveyance Scenario 2	Quantity	Unit	$/Unit	Total Cost	Quantity	Unit	$/Unit	Total Cost	Present Worth (20 year, 6% =)		11.47
Tertiary Treatment	2.1	mgd	$ 3,000,000	$ 6,300,000	2.1	mgd	$ 66,000	$ 138,600	Capital	$ 252,756,266	
Advanced Treatment	14.2	mgd	$ 7,000,000	$ 99,400,000	14.2	mgd	$ 530,000	$ 7,526,000	O&M	$ 9,781,759	
Pipelines - Alignment Option 1	1	LS	$ 68,139,816	$ 68,139,816	1	LS	$ 681,398	$ 681,398	Present Worth O&M	$ 112,196,772	
PS/Tank Site Option C	1	LS	$ 25,956,450	$ 25,956,450	1	LS	$ 259,565	$ 259,565	Total Present Worth	$ 364,953,038	
PS/Tank at SBWRP	1	LS	$ 44,460,000	$ 44,460,000	1	LS	$ 444,600	$ 444,600	Total Flow (mgd)	16.3	18256 AF/yr
Recharge Basins/Convert Recycle Sites	1	LS	$ 8,500,000	$ 8,500,000	1	LS	$ 365,000	$ 365,000	**Cost per Acre-foot**	**$ 1,435**	
Energy Costs (Pump Station/Tanks - O&M)					1	LS	$ 1,208,596	$ 1,208,596			
Reduced RIX Cost (O&M)					1	LS	$ (842,000)	$ (842,000)			
TOTAL				$ 252,756,266				$ 9,781,759			

	CAPITAL COSTS				O&M COSTS				COST PER ACRE-FOOT		
Conveyance Scenario 3	Quantity	Unit	$/Unit	Total Cost	Quantity	Unit	$/Unit	Total Cost	Present Worth (20 year, 6% =)		11.47
Tertiary Treatment	9.1	mgd	$ 3,000,000	$ 27,300,000	9.1	mgd	$ 66,000	$ 600,600	Capital	$ 312,679,720	
Advanced Treatment	14.2	mgd	$ 7,000,000	$ 99,400,000	14.2	mgd	$ 530,000	$ 7,526,000	O&M	$ 10,302,552	
Pipelines - Alignment Option 1	1	LS	$ 94,318,932	$ 94,318,932	1	LS	$ 943,189	$ 943,189	Present Worth O&M	$ 118,170,274	
PS/Tank Site Option F	1	LS	$ 19,068,188	$ 19,068,188	1	LS	$ 190,682	$ 190,682	Total Present Worth	$ 430,849,993	
PS/Tank at SBWRP	1	LS	$ 64,092,600	$ 64,092,600	1	LS	$ 640,926	$ 640,926	Total Flow (mgd)	23.3	26096 AF/yr
Recharge Basins/Convert Recycle Sites	1	LS	$ 8,500,000	$ 8,500,000	1	LS	$ 365,000	$ 365,000	**Cost per Acre-foot**	**$ 1,173**	
Energy Costs (Pump Station/Tanks - O&M)					1	LS	$ 1,314,155	$ 1,314,155			
Reduced RIX Cost (O&M)					1	LS	$ (1,278,000)	$ (1,278,000)			
TOTAL				$ 312,679,720				$ 10,302,552			

	CAPITAL COSTS				O&M COSTS				COST PER ACRE-FOOT		
Conveyance Scenario 4	Quantity	Unit	$/Unit	Total Cost	Quantity	Unit	$/Unit	Total Cost	Present Worth (20 year, 6% =)		11.47
Tertiary Treatment	9.1	mgd	$ 3,000,000	$ 27,300,000	9.1	mgd	$ 66,000	$ 600,600	Capital	$ 320,499,707	
Advanced Treatment	14.2	mgd	$ 7,000,000	$ 99,400,000	14.2	mgd	$ 530,000	$ 7,526,000	O&M	$ 10,845,965	
Pipelines - Alignment Option 1	1	LS	$ 94,318,932	$ 94,318,932	1	LS	$ 943,189	$ 943,189	Present Worth O&M	$ 124,403,219	
PS/Tank Site Option C + F	1	LS	$ 38,026,575	$ 38,026,575	1	LS	$ 380,266	$ 380,266	Total Present Worth	$ 444,902,926	
PS/Tank at SBWRP	1	LS	$ 52,954,200	$ 52,954,200	1	LS	$ 529,542	$ 529,542	Total Flow (mgd)	23.3	26096 AF/yr
Recharge Basins/Convert Recycle Sites	1	LS	$ 8,500,000	$ 8,500,000	1	LS	$ 365,000	$ 365,000	**Cost per Acre-foot**	**$ 1,213**	
Energy Costs (Pump Station/Tanks - O&M)					1	LS	$ 1,779,368	$ 1,779,368			
Reduced RIX Cost (O&M)					1	LS	$ (1,278,000)	$ (1,278,000)			
TOTAL				$ 320,499,707				$ 10,845,965			

	CAPITAL COSTS				O&M COSTS				COST PER ACRE-FOOT		
Conveyance Scenario 5	Quantity	Unit	$/Unit	Total Cost	Quantity	Unit	$/Unit	Total Cost	Present Worth (20 year, 6% =)		11.47
Tertiary Treatment (Remote Site + 30%)	9.1	mgd	$ 3,900,000	$ 35,490,000	9.1	mgd	$ 85,800	$ 780,780	Capital	$ 328,517,767	
Advanced Treatment (Remote Site +30%)	14.2	mgd	$ 9,100,000	$ 129,220,000	14.2	mgd	$ 689,000	$ 9,783,800	O&M	$ 13,071,059	
Pipelines - Alignment Option 1	1	LS	$ 91,221,017	$ 91,221,017	1	LS	$ 912,210	$ 912,210	Present Worth O&M	$ 149,925,043	
PS/Tank Site Option C	1	LS	$ 2,544,750	$ 2,544,750	1	LS	$ 25,448	$ 25,448	Total Present Worth	$ 478,442,810	
PS/Tank at SBWRP	1	LS	$ 61,542,000	$ 61,542,000	1	LS	$ 615,420	$ 615,420	Total Flow (mgd)	23.3	26096 AF/yr
Recharge Basins/Convert Recycle Sites	1	LS	$ 8,500,000	$ 8,500,000	1	LS	$ 365,000	$ 365,000	**Cost per Acre-foot**	**$ 1,318**	
Energy Costs (Pump Station/Tanks - O&M)					1	LS	$ 1,932,401	$ 1,932,401			
Reduced RIX Cost (O&M)					1	LS	$ (1,344,000)	$ (1,344,000)			
TOTAL				$ 328,517,767				$ 13,071,059			

	CAPITAL COSTS				O&M COSTS				COST PER ACRE-FOOT		
Conveyance Scenario 6	Quantity	Unit	$/Unit	Total Cost	Quantity	Unit	$/Unit	Total Cost	Present Worth (20 year, 6% =)		11.47
Tertiary Treatment (Remote Site +30%)	9.1	mgd	$ 3,900,000	$ 35,490,000	9.1	mgd	$ 85,800	$ 780,780	Capital	$ 339,878,467	
Advanced Treatment (Remote Site +30%)	14.2	mgd	$ 9,100,000	$ 129,220,000	14.2	mgd	$ 689,000	$ 9,783,800	O&M	$ 13,186,142	
Pipelines - Alignment Option 1	1	LS	$ 91,221,017	$ 91,221,017	1	LS	$ 912,210	$ 912,210	Present Worth O&M	$ 151,245,045	
PS/Tank Site Option C	1	LS	$ 30,028,050	$ 30,028,050	1	LS	$ 300,281	$ 300,281	Total Present Worth	$ 491,123,512	
PS/Tank at SBWRP	1	LS	$ 45,419,400	$ 45,419,400	1	LS	$ 454,194	$ 454,194	Total Flow (mgd)	23.3	26096 AF/yr
Recharge Basins/Convert Recycle Sites	1	LS	$ 8,500,000	$ 8,500,000	1	LS	$ 365,000	$ 365,000	**Cost per Acre-foot**	**$ 1,351**	
Energy Costs (Pump Station/Tanks - O&M)					1	LS	$ 1,933,877	$ 1,933,877			
Reduced RIX Cost (O&M)					1	LS	$ (1,344,000)	$ (1,344,000)			
TOTAL				$ 339,878,467				$ 13,186,142			

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City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

CONVEYANCE SCENARIO 1 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pipeline 1-1					
Capacity:	14.2	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	30	inch			
Length (min):	39,280	feet			
Length (max):	42,900	feet			
Pressure (min):	15	psi			
Pressure (min):	250	psi			
Pump Station 1-1					
Capacity:	12.6	mgd	Energy Demand Charges =	$3,429.30	$/mo
Pressure:	80	psi	Yearly Energy Demand Charges =	$41,151.60	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	3,335,553	kWh/yr
HP =	510		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$226,333.45	$/yr
			Yearly Energy Cost =	$267,485	$/yr
Pump Station 1-2					
Capacity:	14.2	mgd	Energy Demand Charges =	$11,767.36	$/mo
Pressure:	250	psi	Yearly Energy Demand Charges =	$141,208.35	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	11,747,234	kWh/yr
HP =	1798		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$797,106.90	$/yr
			Yearly Energy Cost =	$938,315	$/yr
Storage Tank 1-1:					
Capacity:	4.2	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 1-2:					
Capacity:	3.2	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 1-3:					
Capacity:	0.8	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Total Yearly Energy Costs for Conveyane Scenario 1:				**$1,207,120**	

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City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

CONVEYANCE SCENARIO 2 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pipeline 2-1					
Capacity:	14.2	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	30	inch			
Length (min):	24,730	feet			
Length (max):	28,170	feet			
Pressure (min):	30	psi			
Pressure (min):	100	psi			
Pipeline 2-2					
Capacity:	14.2	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	30	inch			
Length (min):	14,550	feet			
Length (max):	16,610	feet			
Pressure (min):	15	psi			
Pressure (min):	150	psi			
Pump Station 2-1					
Capacity:	12.6	mgd	Energy Demand Charges =	$3,429.30	$/mo
Pressure:	80	psi	Yearly Energy Demand Charges =	$41,151.60	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	3,335,553	kWh/yr
HP =	510		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$226,333.45	$/yr
			Yearly Energy Cost =	$267,485	$/yr
Pump Station 2-2					
Capacity:	14.2	mgd	Energy Demand Charges =	$4,780.71	$/mo
Pressure:	100	psi	Yearly Energy Demand Charges =	$57,368.51	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	4,698,893	kWh/yr
HP =	719		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$318,842.76	$/yr
			Yearly Energy Cost =	$376,211	$/yr

City of San Bernardino Municipal Water Department
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CONVEYANCE SCENARIO 2 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pump Station 2-3					
Capacity:	14.2	mgd	Energy Demand Charges =	$7,109.59	$/mo
Pressure:	150	psi	Yearly Energy Demand Charges =	$85,315.12	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	7,048,340	kWh/yr
HP =	1079		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$478,264.14	$/yr
			Yearly Energy Cost =	$563,579	$/yr
Storage Tank 2-1:					
Capacity:	4.2	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 2-2:					
Capacity:	1.6	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 2-3:					
Capacity:	2.4	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Total Yearly Energy Costs for Conveyane Scenario 2:				**$1,208,596**	

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City of San Bernardino Municipal Water Department
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Engineering Analysis

CONVEYANCE SCENARIO 3 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pipeline 3-1					
Capacity:	7.0	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	20	inch			
Length (min):	36,020	feet			
Length (max):	38,750	feet			
Pressure (min):	30	psi			
Pressure (min):	250	psi			
Pipeline 3-2					
Capacity:	5.0	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	16	inch			
Length (min):	3,260	feet			
Length (max):	6,040	feet			
Pressure (min):	15	psi			
Pressure (min):	80	psi			
Pipeline 3-3					
Capacity:	14.2	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	30	inch			
Length (min):	39,280	feet			
Length (max):	42,900	feet			
Pressure (min):	15	psi			
Pressure (min):	250	psi			
Pump Station 3-1					
Capacity:	12.6	mgd	Energy Demand Charges =	$3,429.30	$/mo
Pressure:	80	psi	Yearly Energy Demand Charges =	$41,151.60	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	3,335,553	kWh/yr
HP =	510		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$226,333.45	$/yr
			Yearly Energy Cost =	$267,485	$/yr

City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

CONVEYANCE SCENARIO 3 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pump Station 3-2					
Capacity:	14.2	mgd	Energy Demand Charges =	$11,767.36	$/mo
Pressure:	250	psi	Yearly Energy Demand Charges =	$141,208.35	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	11,747,234	kWh/yr
HP =	1798		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$797,106.90	$/yr
			Yearly Energy Cost =	$938,315	$/yr
Pump Station 3-3					
Capacity:	5.0	mgd	Energy Demand Charges =	$1,434.99	$/mo
Pressure:	80	psi	Yearly Energy Demand Charges =	$17,219.85	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	1,323,632	kWh/yr
HP =	203		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$89,814.86	$/yr
			Yearly Energy Cost =	$107,035	$/yr
Storage Tank 3-1:					
Capacity:	4.3	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 3-2:					
Capacity:	0.2	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 3-3:					
Capacity:	4.0	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Total Yearly Energy Costs for Conveyane Scenario 3:				**$1,314,155**	

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Engineering Analysis

CONVEYANCE SCENARIO 4 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pipeline 4-1					
Capacity:	7.0	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	20	inch			
Length (min):	36,020	feet			
Length (max):	38,750	feet			
Pressure (min):	30	psi			
Pressure (min):	250	psi			
Pipeline 4-2					
Capacity:	5.0	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	16	inch			
Length (min):	3,260	feet			
Length (max):	6,040	feet			
Pressure (min):	15	psi			
Pressure (min):	80	psi			
Pipeline 4-3					
Capacity:	14.2	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	30	inch			
Length (min):	24,730	feet			
Length (max):	28,170	feet			
Pressure (min):	30	psi			
Pressure (min):	100	psi			
Pipeline 4-4					
Capacity:	14.2	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	30	inch			
Length (min):	14,550	feet			
Length (max):	16,610	feet			
Pressure (min):	15	psi			
Pressure (min):	150	psi			

City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

CONVEYANCE SCENARIO 4 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pump Station 4-1A					
Capacity:	12.6	mgd	Energy Demand Charges =	$3,429.30	$/mo
Pressure:	80	psi	Yearly Energy Demand Charges =	$41,151.60	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	3,335,553	kWh/yr
HP =	510		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$226,333.45	$/yr
			Yearly Energy Cost =	$267,485	$/yr
Pump Station 4-1B					
Capacity:	7.0	mgd	Energy Demand Charges =	$5,863.15	$/mo
Pressure:	250	psi	Yearly Energy Demand Charges =	$70,357.78	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	5,790,890	kWh/yr
HP =	886		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$392,940.02	$/yr
			Yearly Energy Cost =	$463,298	$/yr
Pump Station 4-2					
Capacity:	14.2	mgd	Energy Demand Charges =	$4,780.71	$/mo
Pressure:	100	psi	Yearly Energy Demand Charges =	$57,368.51	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	4,698,893	kWh/yr
HP =	719		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$318,842.76	$/yr
			Yearly Energy Cost =	$376,211	$/yr
Pump Station 4-3					
Capacity:	5.0	mgd	Energy Demand Charges =	$1,434.99	$/mo
Pressure:	80	psi	Yearly Energy Demand Charges =	$17,219.85	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	1,323,632	kWh/yr
HP =	203		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$89,814.86	$/yr
			Yearly Energy Cost =	$107,035	$/yr

City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

CONVEYANCE SCENARIO 4 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pump Station 4-4					
Capacity:	14.2	mgd	Energy Demand Charges =	$7,109.59	$/mo
Pressure:	150	psi	Yearly Energy Demand Charges =	$85,315.12	$/yr
Efficiency:	80%				
HP =	Q (gpm) x TDH (ft) / 3960 x Eff (%)		Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	7,048,340	kWh/yr
HP =	1079		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$478,264.14	$/yr
			Yearly Energy Cost =	$563,579	$/yr
Storage Tank 4-1:					
Capacity:	4.3	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 4-2:					
Capacity:	0.2	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 4-3:					
Capacity:	4.0	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 4-4:					
Capacity:	0.2	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Total Yearly Energy Costs for Conveyane Scenario 4:				**$1,779,368**	

Table D-4
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

CONVEYANCE SCENARIO 5 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pipeline 5-1					
Capacity:	25.2	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	36	inch			
Length (min):	39,280	feet			
Length (max):	42,900	feet			
Pressure (min):	15	psi			
Pressure (min):	250	psi			
Pipeline 5-2					
Capacity:	2.5	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	12	inch			
Length (min):	39,280	feet			
Length (max):	42,900	feet			
Pressure (min):	5	psi			
Pressure (min):	15	psi			
Pump Station 5-1A					
Capacity:	12.6	mgd	Energy Demand Charges =	$3,429.30	$/mo
Pressure:	80	psi	Yearly Energy Demand Charges =	$41,151.60	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
HP =	510		Energy TOU =	3,335,553	kWh/yr
			Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$226,333.45	$/yr
			Yearly Energy Cost =	$267,485	$/yr
Pump Station 5-1B					
Capacity:	25.2	mgd	Energy Demand Charges =	$20,787.69	$/mo
Pressure:	250	psi	Yearly Energy Demand Charges =	$249,452.29	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
HP =	3190		Energy TOU =	20,847,203	kWh/yr
			Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$1,414,584.07	$/yr
			Yearly Energy Cost =	$1,664,036	$/yr
Storage Tank 5-1:					
Capacity:	7.4	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr

City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

CONVEYANCE SCENARIO 5 - ENERGY COSTS

FACILITY		ENERGY USE / COSTS		
Storage Tank 5-2:				
Capacity:	0.8 MG	Energy TOU =	2,000	kWh/yr
		Average Energy TOU Cost =	0.22000	$/kWh
		Yearly TOU Energy Cost =	$440	$/yr
Total Yearly Energy Costs for Conveyane Scenario 5:		**$1,932,401**		

Table D-4
City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

CONVEYANCE SCENARIO 6 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pipeline 6-1					
Capacity:	25.2	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	36	inch			
Length (min):	24,730	feet			
Length (max):	28,170	feet			
Pressure (min):	30	psi			
Pressure (min):	100	psi			
Pipeline 6-2					
Capacity:	25.2	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	36	inch			
Length (min):	14,550	feet			
Length (max):	16,610	feet			
Pressure (min):	15	psi			
Pressure (min):	150	psi			
Pipeline 6-3					
Capacity:	2.5	mgd	Energy Use =	None	
Velocity:	6	fps	Total Energy Cost =	$0	$/yr
Diameter:	12	inch			
Length (min):	39,280	feet			
Length (max):	42,900	feet			
Pressure (min):	5	psi			
Pressure (min):	15	psi			
Pump Station 6-1A					
Capacity:	12.6	mgd	Energy Demand Charges =	$3,429.30	$/mo
Pressure:	80	psi	Yearly Energy Demand Charges =	$41,151.60	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	3,335,553	kWh/yr
HP =	510		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$226,333.45	$/yr
			Yearly Energy Cost =	$267,485	$/yr

City of San Bernardino Municipal Water Department
Clean Water Factory Project
Recycled/Advanced Water Conveyance System
Engineering Analysis

CONVEYANCE SCENARIO 6 - ENERGY COSTS

FACILITY			ENERGY USE / COSTS		
Pump Station 6-1B					
Capacity:	25.2	mgd	Energy Demand Charges =	$8,388.84	$/mo
Pressure:	100	psi	Yearly Energy Demand Charges =	$100,666.08	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	8,338,881	kWh/yr
HP =	1276		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$565,833.63	$/yr
			Yearly Energy Cost =	$666,500	$/yr
Pump Station 6-2					
Capacity:	25.2	mgd	Energy Demand Charges =	$12,521.79	$/mo
Pressure:	150	psi	Yearly Energy Demand Charges =	$150,261.48	$/yr
Efficiency:	80%				
HP = Q (gpm) x TDH (ft) / 3960 x Eff (%)			Energy TOU =	HP x 0.746 x 24 hrs/day x 365 days/year	
			Energy TOU =	12,508,322	kWh/yr
HP =	1914		Average Energy TOU Cost =	0.06785	$/kWh
			Yearly TOU Energy Cost =	$848,750.44	$/yr
			Yearly Energy Cost =	$999,012	$/yr
Storage Tank 6-1:					
Capacity:	5.8	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Storage Tank 6-2:					
Capacity:	2.4	MG	Energy TOU =	2,000	kWh/yr
			Average Energy TOU Cost =	0.22000	$/kWh
			Yearly TOU Energy Cost =	$440	$/yr
Total Yearly Energy Costs for Conveyane Scenario 6:				**$1,933,877**	

APPENDIX E

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TABLE E-1
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 1 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
1-1	Orange Show Rd	CT-1	CalTrans (I-215)	373	0.830	6.0	5.0	6	2,598
2-1	Orange Show Rd	GC-1	San Bernardino Public Golf Course	778	1.733	--	--	--	
		N-1	Leland Nursery & Patio Supply	44	0.099	--	--	--	
		SC-1	Norton Space Academy	59	0.131	--	--	--	
		PK-1	Mill Community Park	94	0.210	--	--	--	
			SUBTOTAL	**975**	**2.173**	**6.0**	**8.1**	**10**	374
2-2	Orange Show Rd	GC-1	San Bernardino Public Golf Course	778	1.733	6.0	7.3	8	2,269
2-3	Orange Show Rd	N-1	Leland Nursery & Patio Supply	44	0.099	--	--	--	
	Waterman Ave	SC-1	Norton Space Academy	59	0.131	--	--	--	
	Central Ave	PK-1	Mill Community Park	94	0.210	--	--	--	
			SUBTOTAL	**197**	**0.440**	**6.0**	**3.7**	**8**	5,726
3-1	5th St	C-1	Pioneer Memorial Cemetery	137	0.304	--	--	--	
		PB-2	San Benardino County Gov Center	105	0.233	--	--	--	
		PB-3	Law Library for San Bernardino	82	0.183	--	--	--	
		PB-4	California Theater	49	0.108	--	--	--	
		PB-5	Norman F Feldheym Public Library	54	0.120	--	--	--	
		PK-2	Municipal Baseball Park	76	0.169	--	--	--	
		PK-3	Meadowbrook Recreation Park	94	0.211	--	--	--	
		PK-4	Meadowbrook Park	47	0.104	--	--	--	
		PK-5	Secombe Lake State Recreation Area4	208	0.464	--	--	--	
		SC-2	Burbank Elementary	116	0.257				
		SC-3	Residential	42	0.093	--	--	--	
		SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**1,342**	**2.990**	**6.0**	**9.6**	**10**	3,342
3-2	Sierra Way	C-1	Pioneer Memorial Cemetery	137	0.304	--	--	--	
		PK-5	Secombe Lake State Recreation Area4	208	0.464	--	--	--	
			SUBTOTAL	**345**	**0.768**	**6.0**	**4.8**	**8**	1,024
3-3	Sierra Way	PB-2	San Benardino County Gov Center	105	0.233	--	--	--	
		PK-3	Meadowbrook Recreation Park	94	0.211	--	--	--	
		PK-4	Meadowbrook Park	47	0.104	--	--	--	
		SC-2	Burbank Elementary	116	0.257				
			SUBTOTAL	**362**	**0.806**	**6.0**	**5.0**	**8**	1,368

TABLE E-1
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 1 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
3-4	3rd St	PB-2	San Benardino County Gov Center	105	0.233	6.0	2.7	8	1,042
3-5	Sierra Way	PK-3	Meadowbrook Recreation Park	94	0.211	--	--	--	
		SC-2	Burbank Elementary	116	0.257	--	--	--	
				210	**0.468**	**6.0**	**3.8**	**8**	1,361
3-6	Rialto Ave	PK-3	Meadowbrook Recreation Park	94	0.211	6.0	2.5	8	688
3-7	Sierra Way	SC-2	Burbank Elementary	116	0.257	6.0	2.8	8	2,774
3-8	5th St	PB-3	Law Library for San Bernardino	82	0.183	--	--	--	
		PB-4	California Theater	49	0.108	--	--	--	
		PB-5	Norman F Feldheym Public Library	54	0.120	--	--	--	
		PK-2	Municipal Baseball Park	76	0.169	--	--	--	
		SC-3	Residential	42	0.093	--	--	--	
		SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**636**	**1.416**	**6.0**	**6.6**	**8**	2,726
3-9	E St	PK-2	Municipal Baseball Park	76	0.169	6.0	2.3	8	4,052
3-10	5th St	PB-5	Norman F Feldheym Public Library	54	0.120	--	--	--	
		SC-3	Residential	42	0.093	--	--	--	
		SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**429**	**0.956**	**6.0**	**5.4**	**8**	681
3-11	F St	SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**333**	**0.743**	**6.0**	**4.8**	**8**	1,382
3-12	H St	SC-3	Residential	42	0.093	6.0	1.7	8	1,852
4-1	5th St	SC-6	Anderson Elementary	66	0.148	--	--	--	
	Pedley Rd	SC-7	Center for Individual Development	99	0.221	--	--	--	
		SC-8	Monterey Elementary	94	0.210	--	--	--	
		PK-6	Palm Field Park	33	0.074	--	--	--	
		N-2	Community Gardens	100	0.224	--	--	--	
		SC-11	School	255	0.569	--	--	--	
		SC-12	Curtis Middle School	404	0.900	--	--	--	

TABLE E-1
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 1 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
			SUBTOTAL	**1,053**	**2.346**	**6.0**	**8.5**	**10**	2,889
4-2	6th St	PK-6	Palm Field Park	33	0.074	--	--	--	
		N-2	Community Gardens	100	0.224	--	--	--	
			SUBTOTAL	**134**	**0.298**	**6.0**	**3.0**	**8**	851
4-3	6th St	SC-11	School	255	0.569	--	--	--	
	Pedley Rd	SC-12	Curtis Middle School	404	0.900	--	--	--	
	9th St		**SUBTOTAL**	**659**	**1.469**	**6.0**	**6.7**	**8**	6,146
5-1	Baseline St	N-3	Lorton's Fresh Squeezed Juices	34	0.076	--	--	--	
		PK-7	Residential Community	270	0.601	--	--	--	
		SC-10	E Neal Roberts Elementary	94	0.210	--	--	--	
		SC-13	Bradley Elementary	147	0.327	--	--	--	
		SC-14	Lincoln School	132	0.295	--	--	--	
		SC-15	Riley School	122	0.271	--	--	--	
		SC-9	Sierra High School	302	0.673	--	--	--	
			SUBTOTAL	**1,102**	**2.454**	**6.0**	**8.7**	**10**	2,118
5-2	La Junita St	N-3	Lorton's Fresh Squeezed Juices	34	0.076	--	--	--	
		SC-10	E Neal Roberts Elementary	94	0.210	--	--	--	
		SC-9	Sierra High School	302	0.673	--	--	--	
			SUBTOTAL	**431**	**0.959**	**6.0**	**5.4**	**8**	1,010
5-3	Olive St	SC-10	E Neal Roberts Elementary	94	0.210	--	--	--	
		SC-9	Sierra High School	302	0.673	--	--	--	
			SUBTOTAL	**397**	**0.884**	**6.0**	**5.2**	**8**	831
5-4	Crestview Ave	PK-7	Residential Community	270	0.601	--	--	--	
		SC-13	Bradley Elementary	147	0.327	--	--	--	
		SC-14	Lincoln School	132	0.295	--	--	--	
		SC-15	Riley School	122	0.271	--	--	--	
			SUBTOTAL	**671**	**1.495**	**6.0**	**6.8**	**8**	278
5-5	Baseline St	SC-13	Bradley Elementary	147	0.327	6.0	3.2	8	719
5-6	Baseline St	SC-14	Lincoln School	132	0.295	--	--	--	
		SC-15	Riley School	122	0.271	--	--	--	
			SUBTOTAL	**254**	**0.566**	**6.0**	**4.2**	**8**	8,007

TABLE E-1
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 1 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
6-1	Highland Ave	C-2	Mountain View Cemetery	389	0.867	--	--	--	
		CT-2	Caltrans (I-210)	80	0.179	--	--	--	
		PB-7	Mountain View Avenue Median (South of I-210)	27	0.059	--	--	--	
		SC-17	San Bernardino High School	539	1.200	--	--	--	
		SC-18	Arrowview Middle School	265	0.590	--	--	--	
		SC-19	School	106	0.236	--	--	--	
		SC-20	Wilson Elementary School	61	0.136	--	--	--	
			SUBTOTAL	**1,466**	**3.267**	**6.0**	**10.0**	**10**	2,671
6-2	Waterman Ave	CT-2	Caltrans (I-210)	80	0.179	--	--	--	
		SC-20	Wilson Elementary School	61	0.136	--	--	--	
			SUBTOTAL	**142**	**0.315**	**6.0**	**3.1**	**8**	2,344
6-3	28th St	SC-20	Wilson Elementary School	61	0.136	6.0	2.0	8	635
6-4	Waterman Ave	CT-2	Caltrans (I-210)	80	0.179	6.0	2.3	8	788
6-5	Highland Ave	PB-7	Mountain View Avenue Median (South of I-210)	27	0.059	--	--	--	
		SC-17	San Bernardino High School	539	1.200	--	--	--	
		SC-18	Arrowview Middle School	265	0.590	--	--	--	
		SC-19	School	106	0.236	--	--	--	
			SUBTOTAL	**936**	**2.085**	**6.0**	**8.0**	**8**	3,977
6-6	D St	SC-19	School	106	0.236	6.0	2.7	8	1,607
6-7	Highland Ave	SC-18	Arrowview Middle School	265	0.590	--	--	--	
	G St	SC-19	School	106	0.236	--	--	--	
			SUBTOTAL	**371**	**0.826**	**6.0**	**5.0**	**8**	3,695
7-1	Highland Ave	PK-8	Fiscalini Field	86	0.191	--	--	--	
		SC-16	Pacific High School	736	1.639	--	--	--	
			SUBTOTAL	**1,192**	**2.656**	**6.0**	**9.0**	**10**	120
7-2	Perris Hill Park Rd	SC-16	Pacific High School	736	1.639	6.0	7.1	8	2,378
7-3	Highland Ave	PK-8	Fiscalini Field	86	0.191	6.0	2.4	8	1,943

TABLE E-1
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 1 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
8-1	Parkdale Dr	CT-2	Caltrans (I-210)	80	0.179	--	--	--	
		GC-2	Arrowhead Country Club	919	2.049	--	--	--	
		PB-8	Mountain View Avenue Median (North of I-210)	44	0.099	--	--	--	
		PK-11	St Sierra Park	8	0.019	--	--	--	
		PK-12	Harper Field	42	0.093	--	--	--	
		PK-17	Horine Park	38	0.085	--	--	--	
		SC-21	Parkside Elementary School	61	0.136	--	--	--	
		SC-22	Golden Valley Middle School	61	0.136	--	--	--	
		SC-23	Arrowhead Elementary	73	0.162	--	--	--	
			SUBTOTAL	**1,328**	**2.958**	**6.0**	**9.5**	**10**	2,793
8-2	Waterman Ave	CT-2	Caltrans (I-210)	80	0.179	--	--	--	
		PK-17	Horine Park	38	0.085	--	--	--	
			SUBTOTAL	**118**	**0.264**	**6.0**	**2.8**	**8**	3,919
8-3	Waterman Ave	CT-2	Caltrans (I-210)	80	0.179	6.0	2.3	8	695
8-4	Parkdale Dr	PK-11	St Sierra Park	8	0.019	--	--	--	
		PK-12	Harper Field	42	0.093	--	--	--	
		SC-23	Arrowhead Elementary	73	0.162	--	--	--	
			SUBTOTAL	**123**	**0.274**	**6.0**	**2.9**	**8**	3,813
9-1	40th St	PK-15	Wildwood Park	162	0.361	--	--	--	
		PK-16	Community Park	10	0.021	--	--	--	
		SC-24	Hillside Elementary	125	0.278	--	--	--	
		SC-25	Our Lady of the Assumption Catholic School	78	0.174	--	--	--	
		SC-26	North Park Elementary	137	0.304	--	--	--	
			SUBTOTAL	**511**	**1.138**	**6.0**	**5.9**	**8**	3,012
9-2	40th St	PK-16	Community Park	10	0.021	--	--	--	
	Eletric Ave	SC-24	Hillside Elementary	125	0.278	--	--	--	
		SC-25	Our Lady of the Assumption Catholic School	78	0.174	--	--	--	
		SC-26	North Park Elementary	137	0.304	--	--	--	
			SUBTOTAL	**349**	**0.777**	**6.0**	**4.9**	**8**	5,704
9-3	48th St	SC-25	Our Lady of the Assumption Catholic School	78	0.174	6.0	2.3	8	3,037

TABLE E-1
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 1 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
9-4	Eletric Ave	SC-24	Hillside Elementary	125	0.278	--	--	--	
	Northpark Blvd	SC-26	North Park Elementary	137	0.304	--	--	--	
			SUBTOTAL	**261**	**0.582**	**6.0**	**4.2**	**8**	5,205
10-1	40th St	PK-13	Harrison Canyon Park	43	0.095	--	--	--	
	Harrison St	PK-14	Hampshire Floodway Park	31	0.069	--	--	--	
	39th St		**SUBTOTAL**	**74**	**0.164**	**6.0**	**2.2**	**8**	3,236

TABLE E-2
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTIONS 2 AND 4 - DISTRIBUTION PIPELNES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
1-1	Orange Show Rd	CT-1	CalTrans (I-215)	373	0.830	6.0	5.0	8	1,647
2-1	Orange Show Rd	GC-1	San Bernardino Public Golf Course	778	1.733	--	--	--	
		N-1	Leland Nursery & Patio Supply	44	0.099	--	--	--	
		SC-1	Norton Space Academy	59	0.131	--	--	--	
		PK-1	Mill Community Park	94	0.210	--	--	--	
			SUBTOTAL	**975**	**2.173**	**6.0**	**8.1**	**10**	374
2-2	Orange Show Rd	GC-1	San Bernardino Public Golf Course	778	1.733	6.0	7.3	8	2,269
2-3	Orange Show Rd	N-1	Leland Nursery & Patio Supply	44	0.099	--	--	--	
	Waterman Ave	SC-1	Norton Space Academy	59	0.131	--	--	--	
	Central Ave	PK-1	Mill Community Park	94	0.210	--	--	--	
			SUBTOTAL	**197**	**0.440**	**6.0**	**3.7**	**8**	5,726
3-1	Mill St	SC-2	Burbank Elementary	116	0.257	6.0	2.8	8	988
4-1	Athol St	PK-2	Municipal Baseball Park	76	0.169	6.0	2.3	8	1,397
5-1	Rialto Ave	PK-3	Meadowbrook Recreation Park	94	0.211	6.0	2.5	8	763
6-1	5th St	PB-2	San Benardino County Gov Center	105	0.233	--	--	--	
		PB-3	Law Library for San Bernardino	82	0.183	--	--	--	
		PB-4	California Theater	49	0.108	--	--	--	
		PB-5	Norman F Feldheym Public Library	54	0.120	--	--	--	
		SC-3	Residential	42	0.093	--	--	--	
		SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**664**	**1.480**	**6.0**	**6.7**	**8**	683
6-2	Mountain View Ave	PB-2	San Benardino County Gov Center	105	0.233	6.0	2.7	8	1,022
6-3	5th St	PB-3	Law Library for San Bernardino	82	0.183	--	--	--	
		PB-4	California Theater	49	0.108	--	--	--	
		PB-5	Norman F Feldheym Public Library	54	0.120	--	--	--	
		SC-3	Residential	42	0.093	--	--	--	
		SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**560**	**1.247**	**6.0**	**6.2**	**8**	2,722

TABLE E-2
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTIONS 2 AND 4 - DISTRIBUTION PIPELNES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
6-4	F St	PB-5	Norman F Feldheym Public Library	54	0.120	--	--	--	
		SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**387**	**0.863**	**6.0**	**5.1**	**8**	1,360
6-5	5th St	SC-3	Residential	42	0.093	6.0	1.7	8	1,700
	H St								
7-1	5th St	N-2	Community Gardens	100	0.224	--	--	--	
	Pedley Rd	PK-6	Palm Field Park	33	0.074	--	--	--	
		SC-11	School	255	0.569	--	--	--	
		SC-12	Curtis Middle School	404	0.900	--	--	--	
		SC-6	Anderson Elementary	66	0.148	--	--	--	
		SC-7	Center for Individual Development	99	0.221	--	--	--	
		SC-8	Monterey Elementary	94	0.210	--	--	--	
			SUBTOTAL	**1,053**	**2.346**	**6.0**	**8.5**	**10**	6,231
7-2	6th St	N-2	Community Gardens	100	0.224	--	--	--	
		PK-6	Palm Field Park	33	0.074	--	--	--	
			SUBTOTAL	**134**	**0.298**	**6.0**	**3.0**	**8**	851
7-3	6th St	SC-11	School	255	0.569	--	--	--	
	Pedley Rd	SC-12	Curtis Middle School	404	0.900	--	--	--	
	9th St		**SUBTOTAL**	**659**	**1.469**	**6.0**	**6.7**	**8**	6,146
8-1	Baseline St	SC-14	Lincoln School	132	0.295	--	--	--	
		SC-15	Riley School	122	0.271	--	--	--	
			SUBTOTAL	**254**	**0.566**	**6.0**	**4.2**	**8**	4,488
9-1	La Junita St	N-3	Lorton's Fresh Squeezed Juices	34	0.076	--	--	--	
		PK-7	Residential Community	270	0.601	--	--	--	
		SC-10	E Neal Roberts Elementary	94	0.210	--	--	--	
		SC-9	Sierra High School	302	0.673	--	--	--	
			SUBTOTAL	**701**	**1.561**	**6.0**	**6.9**	**8**	1,288
9-2	Olive St	SC-10	E Neal Roberts Elementary	94	0.210	--	--	--	
		SC-9	Sierra High School	302	0.673	--	--	--	
			SUBTOTAL	**397**	**0.884**	**6.0**	**5.2**	**8**	831

TABLE E-2
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTIONS 2 AND 4 - DISTRIBUTION PIPELNES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
10-1	Gilbert St	PB-6	San Bernardino County Medical Center Heliport	134	0.298	6.0	3.0	8	1,830
11-1	Highland Ave	C-2	Mountain View Cemetery	389	0.867	--	--	--	
		CT-2	Caltrans (I-210)	80	0.179	--	--	--	
		PB-7	Mountain View Avenue Median (South of I-210)	27	0.059	--	--	--	
		SC-17	San Bernardino High School	539	1.200	--	--	--	
		SC-18	Arrowview Middle School	265	0.590	--	--	--	
		SC-19	School	106	0.236	--	--	--	
		SC-20	Wilson Elementary School	61	0.136	--	--	--	
			SUBTOTAL	**1,466**	**3.267**	**6.0**	**10.0**	**10**	1,888
11-2	Waternman Ave	CT-2	Caltrans (I-210)	80	0.179	--	--	--	
		SC-20	Wilson Elementary School	61	0.136	--	--	--	
			SUBTOTAL	**142**	**0.315**	**6.0**	**3.1**	**8**	2,351
11-3	28th St	SC-20	Wilson Elementary School	61	0.136	6.0	2.0	8	658
11-4	Waternman Ave	CT-2	Caltrans (I-210)	80	0.179	6.0	2.3	8	788
11-5	Highland Ave	PB-7	Mountain View Avenue Median (South of I-210)	27	0.059	--	--	--	
		SC-17	San Bernardino High School	539	1.200	--	--	--	
		SC-18	Arrowview Middle School	265	0.590	--	--	--	
		SC-19	School	106	0.236	--	--	--	
			SUBTOTAL	**936**	**2.085**	**6.0**	**8.0**	**8**	3,982
11-6	D St	SC-19	School	106	0.236	6.0	2.7	8	1,607
11-7	Highland Ave	SC-18	Arrowview Middle School	265	0.590	--	--	--	
	G St	SC-19	School	106	0.236	--	--	--	
			SUBTOTAL	**371**	**0.826**	**6.0**	**5.0**	**8**	3,722
T	Highland Ave	PK-8	Fiscalini Field	86	0.191	--	--	--	
		PK-9	Perris Hill Park	215	0.478	--	--	--	
		SC-16	Pacific High School	736	1.639	--	--	--	
			SUBTOTAL	**1,036**	**2.308**	**6.0**	**8.4**	**10**	1,028
12-2	Perris Hill Park Rd	SC-16	Pacific High School	736	1.639	6.0	7.1	8	2,349
12-3	Highland Ave	PK-8	Fiscalini Field	86	0.191	6.0	2.4	8	1,810

TABLE E-2
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTIONS 2 AND 4 - DISTRIBUTION PIPELNES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
13-1	30th St	CT-2	Caltrans (I-210)	80	0.179	--	--	--	
		PK-17	Horine Park	38	0.085	--	--	--	
			SUBTOTAL	**118**	**0.264**	**6.0**	**2.8**	**8**	1,882
13-2	Waterman Ave	PK-17	Horine Park	38	0.085	6.0	1.6	8	778
14-1	Parkdale Dr	PK-11	St Sierra Park	8	0.019	--	--	--	
		PK-12	Harper Field	42	0.093	--	--	--	
		SC-21	Parkside Elementary School	61	0.136	--	--	--	
		SC-22	Golden Valley Middle School	61	0.136	--	--	--	
		SC-23	Arrowhead Elementary	73	0.162	--	--	--	
			SUBTOTAL	**245**	**0.547**	**6.0**	**4.1**	**8**	1,867
14-2	Parkdale Dr	PK-11	St Sierra Park	8	0.019	--	--	--	
	Mountain View Ave, Electric Ave	PK-12	Harper Field	42	0.093	--	--	--	
	Edgerton	SC-23	Arrowhead Elementary	73	0.162	--	--	--	
	Pershing Ave		**SUBTOTAL**	**123**	**0.274**	**6.0**	**2.9**	**8**	3,803
15-1	40th St	PK-15	Wildwood Park	162	0.361	--	--	--	
		PK-16	Community Park	10	0.021	--	--	--	
		SC-24	Hillside Elementary	125	0.278	--	--	--	
		SC-25	Our Lady of the Assumption Catholic School	78	0.174	--	--	--	
		SC-26	North Park Elementary	137	0.304	--	--	--	
			SUBTOTAL	**511**	**1.138**	**6.0**	**5.9**	**8**	1,884
15-2	40th St	PK-16	Community Park	10	0.021	--	--	--	
	Electric Ave	SC-24	Hillside Elementary	125	0.278	--	--	--	
		SC-25	Our Lady of the Assumption Catholic School	78	0.174	--	--	--	
		SC-26	North Park Elementary	137	0.304	--	--	--	
			SUBTOTAL	**349**	**0.777**	**6.0**	**4.9**	**8**	5,714
15-3	48th St	SC-25	Our Lady of the Assumption Catholic School	78	0.174	6.0	2.3	8	3,037
15-4	Electric Ave	SC-24	Hillside Elementary	125	0.278	--	--	--	
	Northpark Blvd	SC-26	North Park Elementary	137	0.304	--	--	--	
			SUBTOTAL	**261**	**0.582**	**6.0**	**4.2**	**8**	5,215
16-1	40th St	PK-13	Harrison Canyon Park	43	0.095	--	--	--	
	Harrison St	PK-14	Hampshire Floodway Park	31	0.069	--	--	--	
	39th St		**SUBTOTAL**	**74**	**0.164**	**6.0**	**2.2**	**8**	3,184

TABLE E-3
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 3 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
1-1	Orange Show Rd	CT-1	CalTrans (I-215)	373	0.830	6.0	5.0	8	1,647
2-1	Orange Show Rd	GC-1	San Bernardino Public Golf Course	778	1.733	--	--	--	
		N-1	Leland Nursery & Patio Supply	44	0.099	--	--	--	
		SC-1	Norton Space Academy	59	0.131	--	--	--	
		PK-1	Mill Community Park	94	0.210	--	--	--	
			SUBTOTAL	**975**	**2.173**	**6.0**	**8.1**	**10**	374
2-2	Orange Show Rd	GC-1	San Bernardino Public Golf Course	778	1.733	6.0	7.3	8	2,269
2-3	Orange Show Rd	N-1	Leland Nursery & Patio Supply	44	0.099	--	--	--	
	Waterman Ave	SC-1	Norton Space Academy	59	0.131	--	--	--	
	Central Ave	PK-1	Mill Community Park	94	0.210	--	--	--	
			SUBTOTAL	**197**	**0.440**	**6.0**	**3.7**	**8**	5,726
3-1	Mill St	SC-2	Burbank Elementary	116	0.257	6.0	2.8	8	988
4-1	Athol St	PK-2	Municipal Baseball Park	76	0.169	6.0	2.3	8	1,397
5-1	Rialto Ave	PK-3	Meadowbrook Recreation Park	94	0.211	6.0	2.5	8	763
6-1	5th St	PB-2	San Benardino County Gov Center	105	0.233	--	--	--	
		PB-3	Law Library for San Bernardino	82	0.183	--	--	--	
		PB-4	California Theater	49	0.108	--	--	--	
		PB-5	Norman F Feldheym Public Library	54	0.120	--	--	--	
		SC-3	Residential	42	0.093	--	--	--	
		SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**664**	**1.480**	**6.0**	**6.7**	**8**	683
6-2	Mountain View Ave	PB-2	San Benardino County Gov Center	105	0.233	6.0	2.7	8	1,022
6-3	5th St	PB-3	Law Library for San Bernardino	82	0.183	--	--	--	
		PB-4	California Theater	49	0.108	--	--	--	
		PB-5	Norman F Feldheym Public Library	54	0.120	--	--	--	
		SC-3	Residential	42	0.093	--	--	--	
		SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**560**	**1.247**	**6.0**	**6.2**	**8**	2,722

TABLE E-3
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 3 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
6-4	F St	PB-5	Norman F Feldheym Public Library	54	0.120	--	--	--	
		SC-4	Conrand MS and Harding School	61	0.135	--	--	--	
		SC-5	Juanita Blakely Jones Elementary	273	0.607	--	--	--	
			SUBTOTAL	**387**	**0.863**	**6.0**	**5.1**	**8**	1,360
6-5	5th St	SC-3	Residential	42	0.093	6.0	1.7	8	1,700
	H St								
7-1	5th St	N-2	Community Gardens	100	0.224	--	--	--	
	Pedley Rd	PK-6	Palm Field Park	33	0.074	--	--	--	
		SC-11	School	255	0.569	--	--	--	
		SC-12	Curtis Middle School	404	0.900	--	--	--	
		SC-6	Anderson Elementary	66	0.148	--	--	--	
		SC-7	Center for Individual Development	99	0.221	--	--	--	
		SC-8	Monterey Elementary	94	0.210	--	--	--	
			SUBTOTAL	**1,053**	**2.346**	**6.0**	**8.5**	**10**	6,231
7-2	6th St	N-2	Community Gardens	100	0.224	--	--	--	
		PK-6	Palm Field Park	33	0.074	--	--	--	
			SUBTOTAL	**134**	**0.298**	**6.0**	**3.0**	**8**	851
7-3	6th St	SC-11	School	255	0.569	--	--	--	
	Pedley Rd	SC-12	Curtis Middle School	404	0.900	--	--	--	
	9th St		**SUBTOTAL**	**659**	**1.469**	**6.0**	**6.7**	**8**	6,146
8-1	Baseline St	SC-14	Lincoln School	132	0.295	--	--	--	
		SC-15	Riley School	122	0.271	--	--	--	
			SUBTOTAL	**254**	**0.566**	**6.0**	**4.2**	**8**	4,488
9-1	La Junita St	N-3	Lorton's Fresh Squeezed Juices	34	0.076	--	--	--	
	Gilbert St	PB-6	San Bernardino County Medical Center Heliport	134	0.298	--	--	--	
		PK-7	Residential Community	270	0.601	--	--	--	
		SC-10	E Neal Roberts Elementary	94	0.210	--	--	--	
		SC-13	Bradley Elementary	147	0.327	--	--	--	
		SC-9	Sierra High School	302	0.673	--	--	--	
			SUBTOTAL	**981**	**2.186**	**6.0**	**8.2**	**10**	1,592
9-2	Crestview Ave	PB-6	San Bernardino County Medical Center Heliport	134	0.298	--	--	--	
		SC-13	Bradley Elementary	147	0.327	--	--	--	
			SUBTOTAL	**281**	**0.625**	**6.0**	**4.4**	**8**	705

TABLE E-3
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 3 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
9-3	Gilbert St	PB-6	San Bernardino County Medical Center Heliport	134	0.298	6.0	3.0	8	3,126
9-4	La Junita St	N-3	Lorton's Fresh Squeezed Juices	34	0.076	--	--	--	
		SC-10	E Neal Roberts Elementary	94	0.210	--	--	--	
		SC-9	Sierra High School	302	0.673	--	--	--	
			SUBTOTAL	**431**	**0.959**	**6.0**	**5.4**	**8**	1,288
9-5	Olive St	SC-10	E Neal Roberts Elementary	94	0.210	--	--	--	
		SC-9	Sierra High School	302	0.673	--	--	--	
			SUBTOTAL	**397**	**0.884**	**6.0**	**5.2**	**8**	831
10-1	Highland Ave	PB-7	Mountain View Avenue Median (South of I-210)	27	0.059	--	--	--	
		SC-17	San Bernardino High School	539	1.200	--	--	--	
		SC-18	Arrowview Middle School	265	0.590	--	--	--	
		SC-19	School	106	0.236	--	--	--	
			SUBTOTAL	**936**	**2.085**	**6.0**	**8.0**	**8**	3,982
10-2	D St	SC-19	School	106	0.236	6.0	2.7	8	1,607
10-3	Highland Ave	SC-18	Arrowview Middle School	265	0.590	--	--	--	
	G St	SC-19	School	106	0.236	--	--	--	
			SUBTOTAL	**371**	**0.826**	**6.0**	**5.0**	**8**	3,722
11-1	Highland Ave	PK-8	Fiscalini Field	86	0.191	--	--	--	
		PK-9	Perris Hill Park	215	0.478	--	--	--	
		SC-16	Pacific High School	736	1.639	--	--	--	
			SUBTOTAL	**1,036**	**2.308**	**6.0**	**8.4**	**10**	2,916
11-2	Perris Hill Park Rd	SC-16	Pacific High School	736	1.639	6.0	7.1	8	2,349
11-3	Highland Ave	PK-8	Fiscalini Field	86	0.191	6.0	2.4	8	1,810
12-1	28th St	SC-20	Wilson Elementary School	61	0.136	6.0	2.0	8	658
13-1	Parkdale Dr	PK-11	St Sierra Park	8	0.019	--	--	--	
		PK-12	Harper Field	42	0.093	--	--	--	
		SC-23	Arrowhead Elementary	73	0.162	--	--	--	
			SUBTOTAL	**123**	**0.274**	**6.0**	**2.9**	**8**	3,803

TABLE E-3
SAN BERNARDINO MUNICIPAL WATER DEPARTMENT
CLEAN WATER FACTORY PROJECT
RECYCLED/ADVANCED CONVEYANCE SYSTEM ENGINEERING ANALYSIS

ALIGNMENT OPTION 3 - DISTRIBUTION PIPELINES

Distribution Segment Number	Street(s)	Potential Direct Use Customer(s) ID No.	Potential Direct Use Customer(s) Name	Peak Hour Dmd (gpm)	Peak Hour Dmd (cfs)	Max Allowable Velocity (ft/s)	Min Diam Req'd (in)	Diam Actual (in)	Length (ft)
14-1	Parkdale Dr	GC-2	Arrowhead Country Club	919	2.049	6.0	7.9	8	1,189
15-1	40th St	PK-16	Community Park	10	0.021	--	--	--	
		SC-24	Hillside Elementary	125	0.278	--	--	--	
		SC-25	Our Lady of the Assumption Catholic School	78	0.174	--	--	--	
		SC-26	North Park Elementary	137	0.304	--	--	--	
			SUBTOTAL	**349**	**0.777**	**6.0**	**4.9**	**8**	5,714
15-2	48th St	SC-25	Our Lady of the Assumption Catholic School	78	0.174	6.0	2.3	8	3,037
15-3	Electric Ave	SC-24	Hillside Elementary	125	0.278	--	--	--	
	Northpark Blvd	SC-26	North Park Elementary	137	0.304	--	--	--	
			SUBTOTAL	**261**	**0.582**	**6.0**	**4.2**	**8**	5,215
16-1	40th St	PK-13	Harrison Canyon Park	43	0.095	--	--	--	
	Harrison St	PK-14	Hampshire Floodway Park	31	0.069	--	--	--	
	39th St		**SUBTOTAL**	**74**	**0.164**	**6.0**	**2.2**	**8**	3,184

APPENDIX F

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BASIC SEPARATION STANDARDS

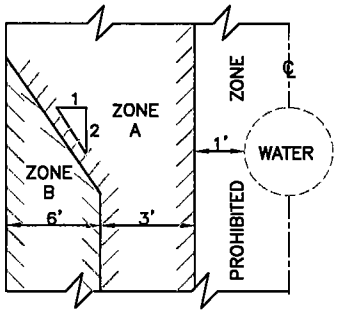
1. PARALLEL CONSTRUCTION: THE HORIZONTAL DISTANCE BETWEEN DOMESTIC WATER AND RECLAIMED WATER LINES AND SEWER LINES SHALL BE AT LEAST 10 FEET, OUTSIDE OF PIPE TO OUTSIDE OF PIPE.
2. PERPENDICULAR CONSTRUCTION (CROSSING): WATER LINES SHALL BE AT LEAST ONE FOOT ABOVE SEWER AND RECLAIMED WATER LINES WHERE THESE LINES MUST CROSS.
3. SPECIAL PROVISIONS: WHERE THE BASIC SEPARATION STANDARDS CANNOT BE ATTAINED ALTERNATIVE CONSTRUCTION CRITERIA ARE SHOWN BELOW:

GENERAL NOTES:

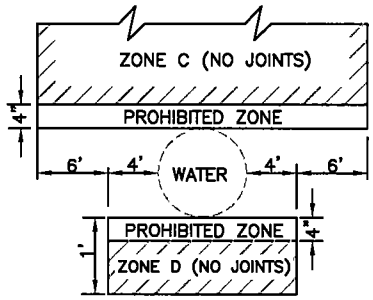
1. NO PIPE JOINTS SHALL BE PERMITTED WITHIN ZONE D AND ZONE C. IF THAT CANNOT BE ACCOMPLISHED, THE NEW LINE SHALL BE ENCASED FOR THE FULL LENGTH OF THE RESPECTIVE ZONE.
2. NEW SEWER FORCE MAINS SHALL NOT BE PERMITTED IN ZONES A THROUGH D.
3. THE MATERIALS OF NEW LINES AT CROSSINGS SHALL BE CONSISTENT WITH OTHER NEW MATERIALS I.E., STEEL ON A STEEL LINE.
4. THESE CONSTRUCTION CRITERIA APPLY TO HOUSE SEWER LATERALS THAT CROSS ABOVE A WATER MAIN, BUT NOT TO THOSE THAT CROSS BELOW A WATER LINE.
5. WHEN INSTALLING NEW DOMESTIC WATER D.I.P. BELOW AN EXISTING HOUSE SEWER LATERAL, THE REQUIRED ZONE C LENGTH CAN BE THAT OF A TYPICAL 18–FOOT STICK.

SITUATION:

LOCATION OF NEW SEWER & RECLAIMED WATER LINES TO EXISTING DOMESTIC WATER LINE.



PARALLEL CONSTRUCTION



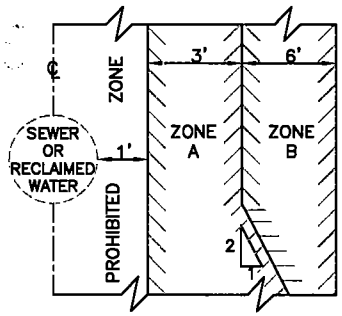
PERPENDICULAR CROSSING

IF ANY SEWER OR RECLAIMED WATER PIPELINES ARE TO BE CONSTRUCTED WITHIN ANY OF THE ABOVE INDICATED ZONES, SPECIAL CONSTRUCTION SHALL BE REQUIRED AS DESCRIBED BELOW.

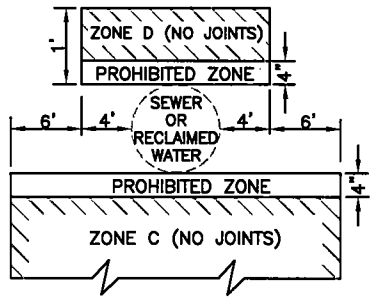
ZONE	SEWER	RECLAIMED WATER
A.	DO NOT LOCATE ANY PARALLEL SEWER OR RECLAIMED WATER LINES IN THIS AREA WITHOUT A STATE AND LOCAL HEALTH DEPARTMENT APPROVAL.	
B.	USE V.C.P., CLASS 200 PVC, OR D.I.P. WITH COMPRESSION JOINTS.	USE D.I.P., WELDED CML & C STEEL, OR CLASS 200 P.V.C. – AWWA C900
C.	USE D.I.P. WITH MECHANICAL JOINTS OR CLASS 200 P.V.C. – AWWA C900	USE D.I.P., WELDED CML & C STEEL, OR CLASS 200 P.V.C. – AWWA C900
D.	USE D.I.P. OR CLASS 200 P.V.C. – AWWA C900	USE D.I.P., WELDED CML & C STEEL, OR CLASS 200 P.V.C. – AWWA C900

SITUATION:

LOCATION OF NEW DOMESTIC TO EXISTING SEWER & RECLAIMED WATER LINES.



PARALLEL CONSTRUCTION



PERPENDICULAR CROSSING

IF ANY WATER LINE IS TO BE CONSTRUCTED WITHIN ANY OF THE ABOVE INDICATED ZONES, SPECIAL CONSTRUCTION SHALL BE REQUIRED AS DESCRIBED BELOW.

ZONE	DOMESTIC WATER (SEE GENERAL NOTE 3)
A.	DO NOT LOCATE ANY PARALLEL DOMESTIC WATER LINE IN THIS AREA A WITHOUT STATE AND LOCAL HEALTH DEPARTMENT APPROVAL.
B.	USE D.I.P., WELDED CML & C STEEL, OR CLASS 200 P.V.C. – AWWA C900.
C.	USE D.I.P., WELDED CML & C STEEL, OR CLASS 200 P.V.C. – AWWA C900.
D.	USE D.I.P., WELDED CML & C STEEL, OR CLASS 200 P.V.C. – AWWA C900.

REVISION DATE: 2/2/2012

D.D.M.	JAN. 12
REVISION	DATE
SCALE:	NONE

WATER AND SEWER SEPARATION STANDARDS

APPROVED _____ DATE 2-7-12

MATTHEW H. LITCHFIELD, P.E. RCE 58079

DRAWING NUMBER

SBMWD · W6.14

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